

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington DC 20554

In the Matter of	)	
	)	
Spectrum for Broadband	)	GN Docket No. 09-47
NBP Public Notice #6	)	GN Docket No. 09-51
	)	GN Docket No. 09-137
A National Broadband Plan for Our Future	)	

**COMMENTS OF MOTOROLA, INC.**

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## SUMMARY

Motorola supports the proposition that significant amounts of additional spectrum are needed to accommodate broadband applications in both the near-term and long-term. In considering new spectrum allocations, the Commission must recognize that carrier-based systems may not be able to meet all broadband requirements for public safety and other specialized markets such as education, health care, utilities and enterprise.

While it is difficult to predict with great precision future bandwidth and spectrum requirements, Motorola believes that the analysis and methodology submitted by CTIA that is used to predict a shortfall of nearly 800 MHz of spectrum for broadband services is fundamentally sound and provides a suitable target for Commission action. At the same time, Motorola believes that the CTIA study does not adequately consider the broadband spectrum requirements for public safety, utilities, and enterprise users that have specialized applications that are not adequately addressed by commercial networks. Therefore, spectrum for those uses will need to be added to the CTIA estimate.

Today's OFDM-based technology platforms are approaching the theoretical limits on bandwidth utilization and the Commission cannot expect to address the shortfall of broadband spectrum allocations through efficiency standards. Carriers are already pushing the envelope on cell splitting and are increasingly constrained by tower siting, environmental and zoning requirements. Finding additional suitable sites is becoming much more challenging due to zoning delays and restrictions for number of antennas, size of antennas, aesthetics, FAA restrictions, and power access, especially sites that can support critical and increasing backup power requirements. While technology and deployment methods will undoubtedly continue to advance and allow even greater efficiency to be squeezed from the limited spectrum resource, these advances will not keep pace with the growing capacity requirements.

Unlicensed devices are being used to provide wireless broadband services to end users or as a complement to broadband services provided over licensed spectrum. At this time, the most tangible action that the Commission can now take to encourage greater use of unlicensed devices for such applications is to complete its proceedings on the use of the TV white space spectrum.

CTIA has recommended that Federal policymakers work to make the 1755-1780 MHz and 2155-2180 MHz bands available in the near term for mobile broadband use. Motorola concedes that use of these bands offers the quickest path to getting usable spectrum that is compatible with off-the-shelf technologies, but also recognizes the challenges with finding alternative spectrum and/or communications solutions for incumbent Federal government users. Motorola also reiterates its recommendation that the Commission work with Congress to reallocate the Upper 700 MHz D block in order to provide public safety with 10+10 MHz of broadband spectrum.

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**COMMENTS OF MOTOROLA, INC.**

Motorola, Inc. (“Motorola”) respectfully submits these comments in response to the Commission’s above-captioned Public Notice that seeks comments on the sufficiency and adequacy of current spectrum allocations to support both near-term and longer-term demands of wireless broadband services.<sup>1</sup> These comments add to information filed previously by Motorola in response to other phases of the Commission’s broadband proceedings and should be considered in conjunction with those earlier filings.<sup>2</sup>

The Spectrum Public Notice raises a series of questions regarding spectrum for broadband that fall into five main categories: 1) the ability of current spectrum allocations to support next-generation build-outs and the anticipated surge in demand and throughput requirements; 2) spectrum bands best positioned to support mobile wireless broadband; 3) spectrum bands best positioned to support fixed wireless broadband; 4) key issues in moving spectrum allocations toward their highest and best use; and 5) the ability of current spectrum allocations to support both the fixed and mobile wireless backhaul

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<sup>1</sup> Comment Sought on Spectrum for Broadband, Public Notice, DA 09-2100, released September 23, 2009 (“Spectrum Public Notice”).

<sup>2</sup> See e.g., Comments of Motorola, GN Docket No. 09-51, submitted June 8, 2009 (“Motorola’s Broadband Plan Comments”). See also, Comments of Motorola, GN Docket No. 09-47, GN Docket No. 09-137, submitted October 2, 2009 (“Motorola’s Smart Grid Comments) and Comments of Motorola, GN Docket No. 09-157, GN Docket No. 09-51, submitted September 30, 2009 (“Motorola’s Innovation Comments).

market. Motorola has attempted to keep its comments consistent with the format of the Spectrum Public Notice. Where appropriate, questions raising similar issues are grouped and addressed with a singular response.

In summary, these comments support the proposition that significant amounts of additional spectrum are needed to accommodate broadband applications in both the near-term and long-term. Spectrum will be needed for a multiplicity of broadband applications and user requirements for both consumer and specialized markets in addition to commercial needs. In considering new spectrum allocations, the Commission must recognize that carrier-based systems may not be able to meet all broadband requirements for public safety and other specialized markets such as education, health care, utilities and enterprise. Consideration must be given to providing spectrum for internal use networks having different operational requirements for reliability, coverage, and security than what is typically offered by commercial systems.

***Question 1: The Ability of Existing Spectrum Allocations to Support Next-Generation Deployment and the Anticipated Surge in Demand and Throughput Requirements.***

The first set of questions in the Spectrum Public Notice focus on the ability of existing allocations to support next-generation systems while recognizing the surge in demand and throughput that increased utilization of such advanced networks may have on broadband spectrum allocations.<sup>3</sup> At the outset, the Commission simply asks if there is enough spectrum to support announced and future network deployments.<sup>4</sup>

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<sup>3</sup> Spectrum Public Notice at 4.

<sup>4</sup> *Id.*

There is no doubt that additional significant quantities of spectrum will be needed to meet the predicted capacity requirements resulting from the surging demand for both consumer and specialized wireless broadband applications. Recently, the Cellular Telecommunications and Internet Association (“CTIA”) recommended that the Commission begin the process to identify and allocate at least 800 MHz of additional spectrum for mobile broadband services to meet anticipated demand in the year 2015.<sup>5</sup> CTIA’s conclusion is based in part on ITU-R recommendations prepared in 2006 that countries should have 1300 MHz of spectrum allocated for cellular mobile systems and advanced mobile broadband systems by the year 2015.<sup>6</sup> CTIA supports its recommendation for significant allocations by providing data and analysis of the “rapid mass market adoption” of mobile broadband services that is being driven by the “surging use of smartphones” which results in a “dramatic increase” in mobile broadband traffic for individual users.<sup>7</sup> To this end, CTIA provides data originally contained in a spectrum policy report prepared this year by 3G Americas showing that the average amount of data used in a month by subscribers has increased from 30 megabytes in 2005 to more than 1 gigabyte in 2009 and is predicted to exceed 14 gigabytes per user by 2015.<sup>8</sup>

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<sup>5</sup> Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs, CTIA, to Chairman Julius Genachowski, *et al*, Federal Communications Commission, GN Docket No. 09-51, September 29, 2009 (“CTIA Spectrum Needs”).

<sup>6</sup> See CTIA Spectrum Needs, Attachment (The Wireless Crisis Foretold: The Gathering Spectrum Storm...and Looming Spectrum Drought) at 18. See also, Estimated Bandwidth Requirements for the Future Development of IMT-2000 and IMT-Advanced, International Telecommunications Union, Report ITU-R, M.2079 (2006).

<sup>7</sup> See *e.g.*, CTIA Spectrum Needs, Attachment (The Wireless Crisis Foretold: The Gathering Spectrum Storm...and Looming Spectrum Drought) at 6-8, 13.

<sup>8</sup> CTIA Spectrum Needs at 14. See also, 3G Technology Approaches for Maximizing Fragmented Spectrum Allocations, 3G Americas, July 2009 at 19.

It is difficult to predict with great precision future bandwidth and spectrum requirements. Nonetheless, Motorola believes that the analysis and methodology submitted by CTIA is fundamentally sound and provides a suitable target for Commission action. At the same time, Motorola believes that the CTIA study and analysis do not adequately consider the broadband spectrum requirements for public safety, enterprise and other specialized applications that may not be adequately addressed by commercial networks.

In 1996, the Public Safety Wireless Advisory Committee (“PSWAC”) performed a rigorous analysis of future needs by public safety and concluded that there was an immediate need for 25 MHz and a longer term need of 95 MHz by 2010.<sup>9</sup> These estimates assumed increased spectrum efficiency over the technology available at that time and, also, factored in that some portion of public safety needs would be served by commercial carriers.<sup>10</sup> Since the PSWAC report was published, the Commission has responded by allocating a total of 24 MHz to public safety in the 700 MHz band capable of supporting wide area operations and 50 MHz of spectrum at 4.9 GHz, which is practical for hot spot and on-scene use, but not wide area operations. Even if the 800 MHz rebanding process also provides public safety with additional narrowband spectrum, the Commission’s actions will still leave public safety significantly short of PSWAC’s

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<sup>9</sup> Final Report Of The Public Safety Wireless Advisory Committee To The Federal Communications Commission And The National Telecommunications And Information Administration, September 11, 1996, at 3, *available at* [http://www.ntia.doc.gov/osmhome/pswac\\_al.pdf](http://www.ntia.doc.gov/osmhome/pswac_al.pdf) (“PSWAC Final Report”).

<sup>10</sup> *Id.* at 18-20.

recommendations for 2010.<sup>11</sup> Further, while PSWAC anticipated public safety having increased need for video and data applications, the report assumed wideband, rather than broadband, data speeds.<sup>12</sup> Broadband data speeds significantly expand the potential to provide real time video and to transfer large data and video files beyond what was originally contemplated. Such consideration would likely have increased PSWAC's recommendation for additional spectrum.

In comments recently filed with the Commission addressing the pending waiver requests filed by multiple public safety agencies to build regional 700 MHz broadband networks, Motorola reiterated its recommendation that the Commission make the 700 MHz public safety broadband spectrum available to early deployers without delay and to work with Congress to reallocate the D block in order to provide public safety with 10+10 MHz of broadband spectrum.<sup>13</sup> In addition, the Commission should encourage the public safety community to update its spectrum requirements. As evidenced by the process at 700 MHz, there is a long lead time between identifying requirements and actually having the spectrum available for use. Therefore, it is not too early to start the process of identifying additional requirements. The National Public Safety Telecommunications Council (NPSTC) would be a logical choice to lead such work as it represents the full range of public safety entities.<sup>14</sup>

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<sup>11</sup> See Improving Public Safety Communications in the 800 MHz Band, WT Docket No. 02-55, Report And Order, Fifth Report And Order, Fourth Memorandum Opinion And Order, And Order, 19 FCC Rcd 14969 (2004) at ¶ 11.

<sup>12</sup> PSWAC Final Report at 55.

<sup>13</sup> Comment of Motorola, Inc., PS Docket No. 06-229, submitted Oct. 16, 2009.

<sup>14</sup> NPSTC's governing board consists of fifteen voting and two non-voting organizations. The list of participating organizations can be found at <http://www.npstc.org/npstcintro.jsp>.

The shortage of public safety broadband spectrum must be considered in addition to the CTIA study. Other industry sectors have identified a shortage of spectrum for broadband uses as well. The Utilities Telecommunications Council (UTC) estimates that an additional 30 MHz of spectrum is required for new data applications such as Smart Grid, as well as for expanded critical mobile voice operations for utilities.<sup>15</sup> UTC indicates that two-thirds of this estimate (*i.e.*, 20 MHz) is needed for high speed data to support advanced meter infrastructure (“AMI”), Smart Grid implementation and security and vehicular data.<sup>16</sup> This need must also be considered in addition to the CTIA recommendations.

Other enterprise businesses also need operational control of their communications systems to effectively, efficiently and safely conduct business and provide goods and services to the public. Examples include ground support services for airlines, surface transportation systems, manufacturing and petrochemical facilities, large construction projects and package delivery hubs, just to name a few. While there is no spectrum estimate yet for these additional types of enterprise businesses, it is clear that as

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<sup>15</sup> The Utility Spectrum Crisis: A Critical Need to Enable Smart Grids, Utilities Telecommunications Council, January 2009, at Section V.

<sup>16</sup> AMI and other smart grid applications continue to advance. As announced this week, Motorola will provide the world's first WiMAX-based smart metering applications. Motorola will provide an Australian utility with a wireless end-to-end infrastructure for its smart metering program, that will help monitor and reduce electricity usage for more than 680,000 customers. Operating at 2.3GHz, the system is based on a flat, all-IP architecture that enables high-speed machine-to-machine (M2M) communications and will facilitate communication with smart meters embedded with WiMAX chipsets, collecting measurements and sending instructions in real time, supporting the analysis of usage patterns and power generation needs. *See* Motorola Powers World’s First WiMAX-based Electric Utility Smart Metering for SP AusNet, Press Release, Oct. 22, 2008, *available at* <http://mediacenter.motorola.com/content/detail.aspx?ReleaseID=12022&NewsAreaID=2#>.

broadband technology becomes more available, their operations will also benefit from broadband systems and spectrum in which they have operational control.

The Spectrum Public Notice asks about the “tradeoff” between providing more spectrum and encouraging greater investment in network infrastructure as means of adding network capacity.<sup>17</sup> Simply put, today’s OFDM-based technology platforms are approaching the theoretical limits on bandwidth utilization and the Commission cannot expect to address the shortfall of broadband spectrum allocations through efficiency standards.<sup>18</sup> Furthermore, carriers are already pushing the envelope on cell splitting and are increasingly constrained by tower siting, environmental and zoning requirements. Many existing sites are already at capacity due to the high demand. Finding additional suitable sites is becoming much more challenging due to zoning delays and restrictions for number of antennas, size of antennas, aesthetics, FAA restrictions, and power access, especially sites that can support critical and increasing backup power requirements. The problem is especially acute for sites that can support critical and increasing backup power requirements. While technology and deployment methods will undoubtedly continue to advance and allow even greater efficiency to be squeezed from the limited spectrum resource, these advances will not keep pace with the growing capacity requirements.

Unlicensed devices are being used to provide wireless broadband services to end users or as a complement to broadband services provided over licensed spectrum.<sup>19</sup> For

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<sup>17</sup> Spectrum Public Notice at 5.

<sup>18</sup> See e.g., EDGE, HSPA, LTE: Broadband Innovation, Rysavy Research, Sept. 2008, at 13, 14, available at [http://www.3gamericas.org/documents/EDGE\\_HSPA\\_and\\_LTE\\_Broadband\\_Innovation\\_Rysavy\\_Sept\\_2008.pdf](http://www.3gamericas.org/documents/EDGE_HSPA_and_LTE_Broadband_Innovation_Rysavy_Sept_2008.pdf).

<sup>19</sup> Spectrum Public Notice at 5.

example, today's high-performance 802.11n wireless LAN and wireless broadband networks are used by educational institutions to allow the delivery of reliable high-speed wireless voice, video and data inside buildings as well as throughout the campus grounds. Similarly, the health care industry uses mobile computing devices capable of bedside bar coding as well as displaying electronic health records. Also, Wireless Internet Service Providers (WISPs) currently supply fixed wireless Internet services to more than 2,000,000 consumers and businesses using unlicensed spectrum, many of these subscribers live in underserved areas of the nation.<sup>20</sup> For these reasons, Motorola supports Commission actions that promote the use of unlicensed devices.

At this time, the most tangible action that the Commission can now take to encourage greater use of unlicensed devices for such applications is to complete its proceedings on the use of the TV white space ("TVWS") spectrum. The large amount of spectrum potentially available on an unlicensed basis will facilitate the deployment of a wide variety of cost-effective broadband solutions to provide new opportunities to connect the unconnected and create jobs. For that reason, unlicensed white space devices offer remarkable promise for helping this nation provide wireless broadband service to underserved and rural communities. The Commission should quickly resolve the pending petitions for reconsideration and move forward with authorizing database providers so that the devices can begin accessing this valuable asset.

The Spectrum Public Notice asks how the Commission can further characterize the impact of a shortage of spectrum available for fixed and mobile wireless services in

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<sup>20</sup> Comments of the Wireless Internet Service Providers Association, GN Docket No. 09-51, submitted June 8, 2009.

terms of costs, coverage, quality of service, innovation, and other implications.<sup>21</sup>

Migrating to more advanced broadband networks will allow carriers to meet the surging demand for personal, mobile video and streaming broadband data demanded by consumers. At the same time, the technologies are evolving to provide operators with increased efficiencies and savings in network management.

Operators must significantly increase wireless bandwidth to effectively push mobile broadband to consumers, but there are challenges associated with offering advanced services in a cost effective manner. The use of flat, all-IP networks is reducing the costs associated with the core network over 2G and 3G circuit-switched core networks but the operating expenses are increasing significantly to handle the huge increase in traffic load and an increase in the number of sites required to meet the demand. In a concerted effort to decrease OPEX costs, operators and vendors have made a significant push within the standards bodies defining LTE specifications to change the operations and maintenance paradigm. The Next Generation Mobile Networks (NGMN) Alliance and the Third Generation Partnership Project (3GPP) have specified a set of capabilities known as Self-Organizing Networks (SON). These self-configuring, self-operating and self-optimizing capabilities will improve the level of automation in operations and maintenance thereby helping to decrease associated OPEX. As such, operators have the luxury of automating previously manual steps throughout the lifecycle of a network — from planning and deployment to optimization and operations — and therefore lowering the need for new operation and management resources that would be

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<sup>21</sup> *Id.*

required to manage LTE on top of the 2G and 3G networks. Such advances in network management will be stifled without additional spectrum allocations.

In determining whether commercial bands are better suited for mobile or fixed or both broadband services, Motorola believes that mobile operations are best suited in bands below 4 GHz, but the Commission should not limit such use to mobile only services as the lines between fixed and mobile services are blurring. When possible, harmonization with global allocations should be a goal to drive equipment costs downward and to facilitate roaming on a regional and global basis. Harmonization will help drive investment in technologies and services and will result in lower costs due to economies of scale in the global market. Of course, harmonization must be taken into consideration with other factors, as spectrum needs and requirements can vary from country to country or region to region.

All bands should have flexibility to offer both fixed and mobile services but it is imperative that the rules for use are clearly set in advance of any new spectrum allocation. The Commission should be very clear about the appropriate uses for new allocations, the responsibilities of primary and secondary users, as well as acceptable levels of interference - which will influence system design, deployment and equipment performance. It is a disruptive and expensive practice to clarify or reverse course after solutions are already deployed. Further, the Commission must remain cognizant about allowing services with very different technical characteristics to operate in co-channels or adjacent channels. This includes segregating: 1) Time Division Duplex (“TDD”) and Frequency Division Duplex (“FDD”) technologies; 2) high power and low power architecture systems including avoiding mixing interference limited systems with noise

limited systems; and, 3) segregating very different services, such as satellite downlink and terrestrial uplink services, unless the services are under the control of the same network operator or clear sharing rules are developed beforehand. These policies are consistent with the findings of the Commission's Spectrum Policy Task Force.<sup>22</sup>

The Commission concludes this first section by asking about the potential impact of more spectrum on increasing competition, the pace and extent of deployment of different services and technologies, and the overall business case.<sup>23</sup>

Technology is progressing to use spectrum in more efficient ways (via advanced antennas, MIMO, cell splitting and Femto Cell deployment) to deliver larger pipes to users, but even with these advances the industry continues to forecast a shortfall of spectrum. For example IMT-Advanced systems are looking to utilize scalable bandwidths of 40-100 MHz with downlink spectral efficiencies of 15 bit/s/Hz and 6.75 bit/s/Hz in the uplink. For a 100 MHz channel the theoretical downlink peak rates would be 1,500 Mbit/s and 675 Mbit/s in the uplink.<sup>24</sup> Without adequate allocations to support these channel sizes, such advancements cannot be realized.

The degree of commercial operator competition is driven by multiple factors and not, primarily, by the availability of spectrum. However, the amount of spectrum a given operator can obtain, the cost of obtaining that spectrum and its related regulatory provisions, directly affects the services that can be provided and the cost of those

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<sup>22</sup> Spectrum Policy Task Force Report, ET Docket No. 02-135, November 2002, at 4, available at [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/DOC-228542A1.doc](http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.doc).

<sup>23</sup> Spectrum Public Notice at 5.

<sup>24</sup> Requirements Related to Technical Performance for IMT-Advanced Radio Interface(s), International Telecommunications Union, Report ITU-R, M.2134 (2008).

services. The introduction of wireless broadband operators into a service area increases consumers' access alternatives and enables more competitive pricing.

Motorola notes that for enterprise users which need spectrum to support their own internal communications, there is no competitive option or alternative to address cases where commercial networks do not provide the requisite coverage, reliability, or features demanded by the private user. As recognized by the Enterprise Wireless Alliance (“EWA”), spectrum is essential for private internal communications systems used by enterprise businesses and that only 30 MHz of licensed spectrum is available to support networks operated by their membership which employs nearly 68 million Americans.<sup>25</sup> EWA further notes that an internal system is needed when operational requirements demand a guaranteed level of reliability, security or coverage beyond that provided by a carrier, the ability to customize the communications system or the flexibility to prioritize system utilization among work groups.

The secondary markets process has provided few utilities or other large enterprise users the opportunity to acquire spectrum sufficient to deploy wide area broadband networks. In the absence of allocations for these users, they will be forced to purchase service from a commercial operator that may be inadequate for certain critical internal operations that require broadband capacity. In essence, enterprise users would be unable to address real and unique requirements that do not align with a mass market consumer oriented service. Because the services and functions provided by these enterprise and critical infrastructure users provides fundamental economic growth for the country, it is

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<sup>25</sup> Comments of Comments of the Enterprise Wireless Alliance, GN Docket No. 09-51, submitted June 8, 2009.

imperative that the Commission ensure that their requirements are adequately met rather than merely trust that the market will somehow meet their unique needs.

***Question 2: What spectrum bands are best positioned to support mobile wireless broadband?***

The second series of questions concerns the amount of spectrum available for mobile wireless broadband as distinguished from fixed wireless broadband allocations.<sup>26</sup> The Commission seeks input on the current stock of spectrum available to support mobile wireless broadband and asks commenters to identify other spectrum bands that might be appropriate to repurpose to support for mobile wireless broadband.<sup>27</sup> The Commission then asks commenters to address how different frequency bands may affect the business cases to deploy mobile broadband and whether there are geographic distinctions to be made between the frequency bands that are most suitable to serve urban or rural areas.<sup>28</sup> The Commission asks whether there are specific bands usable for mobile wireless broadband in other countries that might also be used in the United States and, finally, how much spectrum is required to allow mobile wireless access to compete with fixed and/or wired access for large portions of the US population.<sup>29</sup>

The following frequency bands are home to existing commercial mobile services: 698 – 806 MHz (“700 MHz”); 824 – 849/869 – 894 MHz (“800 MHz Cellular”); 1850 – 2000 MHz (“Broadband PCS”); 1710 – 1755/2110 – 2155 (“AWS-1”), and 2500 – 2690 MHz (“BRS” & “EBS”). In addition, the following frequency bands have pending

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<sup>26</sup> Spectrum Public Notice at 5.

<sup>27</sup> *Id.*

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

rulemaking proceedings to adopt rules that would make them suitable to support mobile broadband services: 1915 – 1920/1995 – 1920 MHz (“AWS”); 2020 – 2025/2175 – 2180 MHz (“AWS”); 2155-2175 MHz (“AWS”); and 2305 – 2320/2345 – 2360 MHz (“WCS”).

Note that these bands are also used for other beneficial uses such as:

- The 700 MHz band has spectrum supporting guard bands necessary to prevent interference and for critical existing and planned narrowband and broadband public safety operations. Also, the lower 700 MHz band has commercial spectrum blocks that are unpaired, but adjacent to paired spectrum blocks, which impacts their potential use.
- The Broadband PCS band has a 15 MHz duplex gap currently allocated for unlicensed PCS devices.
- The BRS & EBS allocation designates spectrum for guard band purposes and mixes high powered fixed services with low power mobile broadband use.
- The unassigned AWS bands near 2.1 GHz are restricted to prevent interference to adjacent channel government and non-government operations.
- Mobile use of the 2.3 GHz WCS bands is restricted to prevent interference to adjacent band satellite downlink services.

These additional allocations and interference protection standards reduce the amount of spectrum available for mobile broadband services down to approximately 500 MHz.<sup>30</sup> While these requirements are often critically necessary to avoid excessive interference between systems and allow the spectrum to be used much more efficiently, they highlight the need for long range spectrum planning that optimizes allocation for both paired and unpaired use and limits the amount of spectrum used for guardbands.

Therefore, Motorola agrees with CTIA that significant additional allocations will be needed to meet near term future demands. CTIA has identified as an immediate target

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<sup>30</sup> This estimate assumes that the BRS and EBS allocations provide, on average, about 150 MHz of spectrum for wireless broadband uses.

the reallocation of the 1755 – 1780 MHz bands from Federal Government use to non-government mobile broadband.<sup>31</sup> CTIA notes that this band can be readily paired with existing, unassigned spectrum at 2155-2180 MHz and is well harmonized with IMT-2000 global allocations.<sup>32</sup>

To take full advantage of the 1755 – 1780 MHz band for mobile broadband, most Federal operations would need to be relocated but Motorola could envision some limited sharing scenarios with Federal satellite uplinks. While Motorola concedes that reallocation of this band may offer a reasonable path for making usable spectrum available that is consistent with off-the-shelf technologies, it also recognizes that there are challenges with finding alternative spectrum and/or communications solutions for incumbent users. Further, the Commission and the NTIA would need to establish similar compensation programs funded by auction proceeds for the reallocation of incumbent systems that have proven to be successful for AWS-1 licensees relocating Federal users from the 1710-1755 MHz adjacent band, which is still on-going.<sup>33</sup>

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<sup>31</sup> CTIA Spectrum Needs at 2.

<sup>32</sup> CTIA Spectrum Needs, Attachment (The Wireless Crisis Foretold: The Gathering Spectrum Storm...and Looming Spectrum Drought) at 20.

<sup>33</sup> NTIA is building a record to review methods of making the relocation process work more efficiently for both Federal and non-Federal licensees. These changes should include ensuring the impacted Federal agencies have faster access to sufficient funds to relocate and improve their communications networks. Relocation of Federal Systems in the 1710–1755 MHz Frequency Band: Review of the Initial Implementation of the Commercial Spectrum Enhancement Act, Notice of Inquiry, Docket No. 0906231085–91085–01, 74 Fed. Reg. 32131 (2009).

***Question 3: What spectrum bands are best positioned to support fixed wireless broadband?***

***and,***

***Question 5: What is the ability of current spectrum allocations to support both the fixed and mobile wireless backhaul market?***

The Spectrum Public Notice raises two series of questions, one on the spectrum requirements for fixed wireless broadband and another targeting spectrum for wireless backhaul purposes.<sup>34</sup> The Commission acknowledges that the two series of questions are related but states that a number of commenters have noted a pressing need for additional cost-effective backhaul capacity for both wired and wireless networks and therefore believes that the topic merits special focus.<sup>35</sup>

The Commission should distinguish between fixed wireless broadband delivered to customers and backhaul services. Fixed wireless broadband, such as that provided by WISPs, is often deployed in unlicensed bands (900 MHz, 2.4 GHz, and 5 GHz). There is also growing demand for fixed wireless broadband in the “licensed-lite” 3650 MHz band as evidenced by the fact that at least 20 applications for NTIA and RUS grant money proposing to use equipment designed to operate in the 3650 MHz band.<sup>36</sup> Thus, the 3650 MHz band is poised to play a significant role in advancing broadband deployment in

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<sup>34</sup> Spectrum Public Notice at 6, 7.

<sup>35</sup> *Id.* at 7.

<sup>36</sup> The Federal Government has established the deployment of advanced broadband networks as a major priority by making more than \$7 billion available in grants and loans for new deployments. American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115 (2009). During the first filing window that expired in August of 2009, more than 2200 applications were submitted. While public information on the content of these applications is limited, searching the on-line database of applications available at [www.broadbandusa.gov](http://www.broadbandusa.gov), shows that at least 20 applications describe projects that wish to use the 3650 MHz band.

unserved and underserved areas. The 2.5 GHz band also provides growth opportunities for licensed fixed services, as Clearwire's WiMAX based network provides opportunities to compete with wired broadband providers while also offering nomadic and mobile operations.<sup>37</sup>

The convergence of fixed, nomadic and mobile broadband services at 2.5 GHz is likely to occur in the other mobile broadband bands as carriers increase the capabilities of their networks and seek to leverage their investment. Carriers in adjacent bands and geographic areas will need to recognize that the bands may support various operating modes that require revised sharing considerations.

Both the mobile and fixed wireless broadband networks will need spectrum for wireless backhaul. To understand the demands of IMT-2000 networks, the ITU produced a report on fixed service use in the IMT-2000 transport network and spectrum choices.<sup>38</sup> This report indicated that a single IMT-2000 network may need multiple fixed backhaul links of data rates in the range of 4-34 Mbit/s from a number of bands in the 3-57 GHz range. Demand will only increase as the technology grows to meet the future needs as outlined for IMT-Advanced networks.

In the deployment of a pure fixed broadband network, systems can make use of higher frequencies, such as the unlicensed 5 GHz bands, to significantly extend coverage to rural and other underserved areas. However, because of the better propagation characteristics for lower frequency spectrum, TVWS will provide improved coverage per

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<sup>37</sup> See e.g., Sprint sees WiMAX as path back into fixed broadband, Feb. 2009, available at <http://telephonyonline.com/wireless/news/sprint-wimax-path-to-fixed-broadband-0209/>.

<sup>38</sup> See Fixed Service Use In The IMT-2000 Transport Network, International Telecommunications Union, Report ITU-R, F.2060 (2005).

site that also helps reduce costs of providing this point to multipoint fixed service. The UHF-TV band has great potential in extending cost-effective wireless broadband coverage because of the dramatically lower shadowing effects of foliage and topographical features compared to the 5 GHz band, due to the 8 to 10 times greater wavelength. Motorola's experience with fixed wireless broadband is consistent with the results of numerous reported propagation studies, in that 900 MHz systems achieve effective coverage over distances twice or three times greater than the 5 GHz installations, and with less coverage variability or coverage "holes," so that 10x estimate of the actually covered area is realistic. All other parameters being equal, the TVWS spectrum in the bands below 698 MHz would provide even more cost-effective coverage than that at 900 MHz.

Motorola also notes that these same characteristics that make the TVWS spectrum well suited to providing rural broadband services also make it less than ideal to be used for backhaul services. The longer wavelength in lower frequency bands would mean that significantly larger antenna would be needed to efficiently provide a point-to-point backhaul service. Even then, it is unlikely that the larger antennas would provide the desirable highly directional beams that allow more aggressive reuse of higher frequency bands that are better suited for backhaul services. Motorola therefore again reiterates its request that the Commission finalize its proceedings on TVWS so that the spectrum can be made available for productive fixed broadband uses.

Finally, the Commission should be attentive to rule changes that would make existing microwave bands more efficient for backhaul services. Currently, the Commission is considering a request from representatives of the fixed microwave

industry, including Motorola, to clarify its rules for fixed microwave links to explicitly permit the use of adaptive modulation technology.<sup>39</sup> Adaptive modulation provides many benefits for the both the wireless industry and regulators. The use of adaptive modulation allows fixed microwave links to reduce the modulation order and corresponding data rate, thereby avoiding service outages during atmospherically induced fading.<sup>40</sup> Maintaining the link during propagation fades also avoids the additional outage time required to resynchronize the network. The use of adaptive modulation reduces the additional power that has to be included in a link budget for a fixed link to counter a specified amount of atmospherically induced fading. By using more robust modulation and reducing the data rate, the link can be maintained with lower power levels than would otherwise be required during faded conditions. Thus the link's interference potential will be reduced.

With increasing demands for new broadband services for consumers, the need for backhaul spectrum to support those wireless networks also increases. As new commercial wireless spectrum comes online, there is a need for either wireline or wireless backhaul to connect each base station to the overall network. Especially in rural areas, wireless backhaul may be the only means to connect remote base stations to the wireless network provider's network. Allowing the use of adaptive modulation will help ensure that the Commission's fixed microwave rules are well-positioned to support the

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<sup>39</sup> See Wireless Telecommunications Bureau Seeks Comment on Request of Alcatel-Lucent, et al. for Interpretation of 47 C.F.R. § 101.141(A)(3) To Permit the Use of Adaptive Modulation Systems, WT Docket No. 09-106, DA 09-1427, released June 25, 2009.

<sup>40</sup> See Letter from Alcatel-Lucent, Dragonwave Inc., Ericsson Inc., Exalt Communications, Fixed Wireless Communications Coalition, Harris Stratex Networks, and Motorola, Inc. to Ms. Marlene H. Dortch, Secretary, Federal Communications Commission, Request for Interpretation of Section 101.141(a)(3) of the Commission's Rules to Permit the Use of Adaptive Modulation Systems, filed May 9, 2009 ("Request").

increasing demand being placed on wireless backhaul to support the Nation's broadband goals. Accordingly, the Commission should move forward with a clarification that the use of adaptive modulation and average criteria is acceptable.

***4. What are the key issues in moving spectrum allocations toward their highest and best use in the public interest?***

The Spectrum Public Notice states that some commenters have noted the low average percentage of use of spectrum in some commonly used commercial bands, which may signify that such spectrum is not being put to its highest and best use in the public interest. The Commission therefore seeks public comment on the different types of incentives to licensees to ensure the spectrum allocated to them is used in ways that maximize its public value.

Motorola believes that the frequency bands available for mobile broadband services are used efficiently today. The 800 MHz and 1.8 GHz PCS bands are highly efficient from a user/MHz perspective while the 700 MHz, AWS-1 and 2.5 GHz allocations are in the process of being deployed. While Motorola agrees that promotion of efficient use of spectrum is a laudatory goal, efforts to impose or encourage efficiency must be taken in concert with users' operational requirements and the maturity of technology. It would be irresponsible to mandate that users deploy a certain level of efficiency before the technology required to do so is adequately tested and proven for the operational requirements applicable in a given market segment. Also, efficient spectrum use is a much broader and more complex issue than merely the amount of information that is transmitted over a finite amount of spectrum. Instead, efficiency should be measured by how well spectrum use meets the requirements of spectrum users, *i.e.*, economic efficiency, which is dependent upon operational efficiency as well as spectrum

efficiency.<sup>41</sup> Information must be distributed reliably throughout the area where it is needed without undue degradation. If not, communications must be repeated, leading to inefficient and possibly even unsafe situations. Achieving the highest spectrum efficiency does not necessarily result in the highest operational efficiency, or the maximum economic efficiency.

Motorola recommends that the Commission adopt incentives for efficient spectrum use, rather than mandate specific spectrum efficiency standards. While the specific incentives would need to vary by service to take account of operational requirements, geographic area, etc., the Commission should be consistent in applying efficiency incentives across all spectrum bands. For example, it would be unfair to apply incentives only to public safety and private radio bands but not to broadcast use.

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The availability of spectrum provides the foundation for expanding wireless network capacity which, in turn, provides the foundation for industry to develop new and innovative products and services for consumers and industry. Motorola strongly agrees that the lack of sufficient inventories of spectrum to meet surging demands threatens to choke innovation and potentially impact the competitive delivery of broadband services. Motorola therefore urges the Commission to begin an expedited process to identify and reallocate significant new quantities of spectrum for broadband services. In so doing, it is imperative that the Commission maximize the availability of spectrum for a variety of broadband applications and provide additional licensed and unlicensed spectrum under a

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<sup>41</sup> See Spectrum Policy Task Force Report at 21 (defining “economic efficiency” in similar terms, and distinguishing this concept from “spectrum efficiency” and “technical efficiency”).

variety of regulatory approaches compatible with the broadband needs of a multitude of providers and users, including enterprise businesses.

Respectfully Submitted,

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