

**Before The  
Federal Communications Commission  
Washington DC 20554**

---

In the Matter Of	)	
	)	
A National Broadband Plan for Our Future	)	GN Docket No. 09-51
	)	
Inquiry Concerning the Deployment of Advanced	)	
Telecommunications Capability to All Americans	)	
In a Reasonable and Timely Fashion, and Possible	)	GN Docket No. 09-137
Steps to Accelerate Such Deployment Pursuant to	)	
Section 706 of the Telecommunications Act of	)	
1996, As Amended	)	
	)	
International Comparison and Survey Requirements	)	GN Docket No. 09-47
In the Broadband Data Improvement Act	)	

---

**COMMENTS OF QUALCOMM INCORPORATED  
ON SPECTRUM FOR BROADBAND  
IN RESPONSE TO NBP PUBLIC NOTICE #6**

Dean R. Brenner  
Vice President, Government Affairs  
QUALCOMM Incorporated  
1730 Pennsylvania Ave., N.W.  
Suite 850  
Washington, D.C. 20006  
(202) 263-0020

Dated: October 23, 2009

## **SUMMARY**

Qualcomm is pleased to respond to NBP Public Notice #6, which seeks comment on the sufficiency of current spectrum allocations in bands including, but not limited to, the prime spectrum bands below 3.7 GHz, for purposes of the Commission's development of the National Broadband Plan pursuant to the American Recovery and Reinvestment Act of 2009 (the "ARRA") and for related purposes. Licensed spectrum is, to use Chairman Genachowski's phrase, "the oxygen" of mobile broadband networks. There is a clear consensus among all stakeholders that much more licensed spectrum, many hundreds of MHz, must be made available to meet the exponential growth in demand for mobile broadband services and applications. The need for more spectrum for mobile broadband becomes apparent when considering the wide variety of mobile broadband services and applications available today, which extend to virtually every facet of American life—ranging from health care, education, the smart grid, public safety, and the economy at large.

In the near term, technologies to upgrade 3G networks within existing spectrum and to roll out LTE in new spectrum are being developed and deployed simultaneously, depending on the spectrum holdings and plans of individual operators. As compared to the 3G technologies, CDMA2000 and HSPA, LTE is optimized for wider bandwidths—a minimum of 20 MHz of paired spectrum, and ideally at least 40 MHz of paired spectrum per operator, for initial deployments. And, as LTE is rolled out, and demands for bandwidth continue growing exponentially, even with implementation of technologies to expand network capacity and more densely deployed network topologies, there is no question but that far more licensed spectrum, many hundreds of MHz overall, is necessary for mobile broadband to expand and flourish. The American public cannot reap the full benefits of mobile broadband without far more spectrum.

Identifying, allocating, and auctioning more licensed spectrum, standing alone, is not sufficient, however. As the Public Notice itself implies, the additional spectrum needs to come from bands below 3 GHz. Otherwise, the business case for using the newly allocated spectrum for mobile broadband will be poor. There is no viable business case for the use of spectrum above 3 GHz for mobile broadband because a network on such spectrum would require far too many base stations. As the Commission's successful AWS-1 and 700 MHz auctions vividly demonstrated, licensed spectrum bands below 3 GHz are highly valued precisely because they are the only viable bands for mobile broadband. Thus, Qualcomm respectfully submits that the National Broadband Plan should focus on identifying, allocating, and auctioning licensed spectrum below 3 GHz to ensure that mobile broadband in the United States continues to expand and flourish to meet the demands of all Americans. No licensed band below 3 GHz should be ruled out. Certainly, the Commission should work with all affected agencies and stakeholders to find more licensed bands. Qualcomm supports expansion of the AWS-1 band by 50 MHz by allocating 1755-1780/2155-2180 MHz, and also reallocating spectrum in the 450 MHz band, where the business case will be especially strong since far fewer base stations would be required than in any existing band due to the favorable propagation at such a low frequency.

Furthermore, beyond just identifying, allocating, and auctioning a substantial amount of licensed spectrum below 3 GHz for mobile broadband, for mobile broadband to expand and flourish, it is critically important that the spectrum be auctioned free of encumbrances and with flexible use rights, liberal property rights, a technology neutral regulatory regime, and full protection from interference. Auctioning spectrum with encumbrances, such as allowing incumbents to remain on the auctioned spectrum, simply prevents the spectrum from being put to

full use until the encumbrances are removed. It is no solution to the current “spectrum crunch” to auction spectrum which cannot be fully used.

Likewise, it is vital that the Commission auction spectrum with flexible use rights, liberal property rights, and a technology neutral regulatory regime. Indeed, the Commission’s auction program has raised more than \$100 billion, and mobile broadband networks now cover over 95% of the US population, because the FCC has applied these market-based policies. Today, with a US mobile broadband market that is literally expanding every single day as new devices, applications, services, and technologies are rolled out, the government must avoid imposing or maintaining any constraints on the use of the spectrum. Finally, mobile broadband networks must be accorded full protection from interference. These networks cannot deliver the service that Americans demand without such protection.

Although NBP Public Notice #6 itself does not propose unlicensed allocations for mobile broadband or allowing unlicensed devices to operate within licensed bands via involuntary overlays or underlays, NBP Public Notice #6 references Commission’s recent Notice of Inquiry on innovation in wireless, which sought comment on these ideas, and Qualcomm restates herein its views that unlicensed devices cannot reliably support wide area mobile broadband service, and such overlays and underlays will not work for the many technical and economic reasons set forth in the record of the FCC’s innovation proceeding. Unlicensed spectrum is well suited to local area service, for which detailed interference protection rules are not necessary because the communications are confined to a small area and are typically under the control of a single user. By contrast, licensed spectrum is necessary for wide area service because the communications must ubiquitously cover wide distances, and interference protection is necessary to ensure that the network operator can support such communications from many

users simultaneously. It is not economically or technically feasible to allow multiple uncoordinated and high-powered unlicensed devices spread over large areas to transmit at will.

Nevertheless, Qualcomm recognizes that unlicensed technologies play an important role in providing many short range applications and offloading traffic from the wide area mobile broadband networks operating in licensed bands. In contrast to the current usage and expected growth in demand, which is causing a pressing need for more licensed spectrum below 3 GHz, available data show that the existing unlicensed bands are not congested and that there remains ample spectrum for unlicensed devices and applications based on such devices.<sup>1</sup> In short, there is no documented need to allocate additional unlicensed spectrum.

Moreover, allowing unlicensed underlays or overlays within licensed bands will discourage investment in licensed spectrum, chill innovation, and cause harmful interference. No sound business plan will support spending billions of dollars on licensed spectrum and deploying networks on such spectrum if unlicensed devices are permitted free access to the very same spectrum and thereby to interfere with licensed operations. The FCC should not resurrect this concept, which was discarded years ago in the interference temperature proceeding, among others.

In sum, Qualcomm looks forward to working with the Commission and all affected stakeholders throughout the process of identifying, allocating, and auctioning additional licensed spectrum for mobile broadband.

---

<sup>1</sup> Charles L. Jackson, Dorothy Robyn, and Coleman Bazelon, “Unlicensed Use of the TV White Space: Wasteful and Harmful,” (filed Aug. 20, 2008 in 04-186 & 02-380) at 4-13.

**TABLE OF CONTENTS**

**Summary . . . . . i**

**I. The Demand for Additional Licensed Spectrum for Mobile Broadband. . . . . 2**

**A. Qualcomm’s Pioneering Work on New Mobile Broadband Technologies, Applications, & Services . . . . . 2**

**B. The Proliferation of Innovative Mobile Broadband Networks & Devices. . . 5**

**C. Upgraded 3G Technologies and LTE Technology. . . . . 8**

**D. New Categories of Mobile Broadband Devices . . . . . 10**

**E. Improvements to the Mobile Broadband User Experience. . . . . 14**

**F. New Mobile Services and Applications . . . . . 16**

**1. Mobile TV Service . . . . . 16**

**2. Mobile Internet Services . . . . . 17**

**3. Mobile Banking & Commerce . . . . . 18**

**4. Mobile Healthcare . . . . . 19**

**5. Mobile Education . . . . . 20**

**6. Non-Terrestrial Mobile Broadband. . . . . 21**

**G. Machine to Machine to Communications, Including Smart Grid . . . . . 21**

**II. The Commission Should Identify, Allocate, and Auction Significantly, More Licensed Spectrum for Mobile Broadband with Flexible Use Rights, Liberal Property Rights, a Technology Neutral Regulatory Regime, Full Protection from Interference, and Free of Encumbrances . . . . . 23**

**A. Spectrum Should Be Auctioned Free of Encumbrances . . . . . 25**

**B. Spectrum Should Be Auctioned with Flexible Use Rights and Liberal Property Rights . . . . . 27**

**C. Spectrum Should Be Auctioned & Regulated on a Technology Neutral Basis . . . . . 29**

**D. Spectrum Should Be Auctioned with Full Interference Protection for the Winning Bidders. . . . . 30**

**III. The Commission Should Not Allocate Unlicensed Spectrum for Mobile Broadband—There Is Ample Unlicensed Spectrum for Short Range Services . . . . . 32**

**IV. The Commission Should Not Compel Spectrum Underlays or Overlays Because They Are Not Technically Feasible, They Discourage Investment in Licensed Networks and Services, and They Devalue Licensed Spectrum . . . . . 34**

**V. Conclusion. . . . . 37**

**Before The  
Federal Communications Commission  
Washington DC 20554**

---

In the Matter Of	)	
	)	
A National Broadband Plan for Our Future	)	GN Docket No. 09-51
	)	
Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans In a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, As Amended	)	GN Docket No. 09-137
	)	
International Comparison and Survey Requirements In the Broadband Data Improvement Act	)	GN Docket No. 09-47
	)	

---

**COMMENTS OF QUALCOMM INCORPORATED**

QUALCOMM Incorporated (“Qualcomm”), by its attorneys, hereby submits these Comments in response to the Commission’s NBP Public Notice #6, DA 09-2100, released September 23, 2009, in which the Commission sought comment on the sufficiency of current spectrum allocations, including but not limited to prime spectrum below 3.7 GHz, for purposes of the development of the National Broadband Plan and for related purposes.

In these Comments, Qualcomm provides the Commission with detailed information on some of the types of devices, applications and services which are driving the exponential growth in the demand for mobile broadband, which in turn is driving the need for additional licensed spectrum. Qualcomm then turns to spectrum policy and explains the myriad of reasons why additional cleared spectrum should be auctioned with flexible use rights, liberal property rights, a technology neutral regulatory regime, and full protection from interference. Finally, Qualcomm discusses why unlicensed spectrum is not suitable, technically or economically, for wide area

mobile broadband service and why the Commission should not impose overlays or underlays in licensed bands.

**I. The Demand for Additional Licensed Spectrum for Mobile Broadband**

**A. Qualcomm's Pioneering Work on New Mobile Broadband Technologies, Applications, & Services**

Qualcomm is a world leader in developing innovative digital wireless communications technologies and enabling products and services based on the digital wireless communications technologies that it develops. Qualcomm is the pioneer of code division multiple access ("CDMA") technology, which is utilized in the 3G CDMA family of wireless technologies. These technologies include CDMA2000 and HSPA/WCDMA, which are used in today's 3G wireless networks and devices to enable tens of millions of Americans, in rural, suburban, and urban areas alike, to enjoy advanced, high speed, and ubiquitous mobile broadband services.

In fiscal 2008 alone, Qualcomm spent \$2.28 billion, or approximately 20% of its revenues on research and development. Since Qualcomm's inception in 1985, it has invested a total of approximately \$12.2 billion in R & D. These enormous expenditures enabled Qualcomm to invent many of the technologies that are fueling the mobile broadband boom. Today, Qualcomm holds or has applied for approximately 11,000 US patents (3,200 issued and 7,800 pending) and 50,800 foreign patents (17,100 issued and 33,700 pending). Every division and subsidiary of Qualcomm has multiple research and development teams working on projects which will hopefully lead to patentable inventions. This work occurs in many offices and labs around the US and the world. In addition, Qualcomm has a Corporate Research and Development group, which has its own Research Center in San Diego and other offices and labs in the US and abroad.

Qualcomm broadly licenses its technology to over 165 handset and infrastructure manufacturers around the world, who make infrastructure equipment, handsets and other consumer devices, and develop applications, all based on the CDMA2000 and/or HSPA air interfaces. Qualcomm also licenses its orthogonal frequency division multiple access (“OFDMA”) technology, which will be used in wireless networks based on the so-called Long Term Evolution (“LTE”) air interface.

Qualcomm CDMA Technologies (“QCT”), a division of Qualcomm, is the world’s largest provider of wireless chipset technology. QCT’s chipsets provide a high degree of integration and support all the major frequency bands, the full gamut of wide area cellular technologies, Assisted GPS, Bluetooth, Wi-Fi, and many different operating systems, including Android, Windows Mobile, Symbian, and Qualcomm’s Brew Mobile Platform.

Moreover, QCT has helped lead the diversification of mobile broadband into many new types of mobile broadband-enabled devices, ranging from smartphones, mobile broadband PC cards and USB dongles, Mi-Fi devices which provide a 3G mobile broadband connection to up to five Wi-Fi enabled devices, mobile broadband-embedded laptops and netbooks, and a wide variety of pocketable computing devices with mobile broadband capability. These mobile broadband devices are used today by millions of Americans, and they provide low-cost, mobile Internet access and broadband applications.

Qualcomm Internet Services offers software platforms which aim to bring any application to any wireless device on any network in any location. These platforms began with BREW, a thin software layer which was the first platform to enable the downloading of applications into wireless phones. More recently, Qualcomm Internet Services began offering Plaza Mobile Internet, a platform which allows mobile devices to access widgets, thereby

bringing the features and interactivity of Web 2.0 applications to mobile devices, and Plaza Retail, which provides support for multiple app stores, which give wireless subscribers a uniform and easy shopping experience on a wide variety of wireless devices.

Other wholly-owned subsidiaries of Qualcomm are working on other technologies and services which will encourage the rapid proliferation of mobile broadband. Qualcomm MEMS Technologies, Inc. has developed the world's first MEMS display for mobile devices—a new display technology which offers dramatically lower power consumption and superb viewing quality in a wide range of environmental conditions, including bright sunlight. This display technology is well suited for a new generation of mobile broadband devices which will have far longer battery lives than today's devices. Qualcomm's FLO TV, Incorporated subsidiary operates the world's largest mobile TV network, which currently delivers 15 channels of high quality video content to AT&T and Verizon Wireless subscribers on Channel 55 spectrum licensed to Qualcomm. FLO TV recently announced the expansion of its mobile TV service onto several new platforms, including in-car entertainment systems and consumer electronics devices.

Finally, Qualcomm recently formed a joint venture with Verizon Wireless by the name of nPhase. The joint venture will provide machine to machine communications and smart service offerings across a wide variety of market segments including healthcare, manufacturing, utilities, distribution, and consumer products over 3G mobile broadband networks. Before discussing these and other innovative applications delivered over these 3G mobile broadband networks, Qualcomm presents the Commission with data on such networks themselves and devices used on such networks.

## **B. The Proliferation of Innovative Mobile Broadband Networks & Devices**

In the United States, as the Commission itself has found in May of this year, 95.6% of the US population is covered by a mobile broadband network (defined as a network based on EV-DO or WCDMA/HSPA), and 99% of the non-rural US population and 82.8% of the rural US population is so covered.<sup>2</sup> Worldwide, there are 578 wireless carriers in 157 countries that have deployed one of the 3G CDMA technologies. Of those 578 carriers around the world, 108 have deployed EV-DO, 70 of whom have deployed EV-DO Revision A. Another 274 of the 578 carriers have deployed HSDPA, 87 of whom have deployed HSUPA. These broad deployments create enormous demand for EV-DO Revision A and HSDPA equipment, thereby creating economies of scale which bring down prices for carriers and ultimately consumers.

Currently, approximately 830 million people around the world use a 3G device. By 2013, the number of 3G subscribers is projected to reach approximately 2.4 billion, and at that time, most 3G subscribers will be using an EV-DO or HSPA-based device.<sup>3</sup> This strong demand creates an ever-expanding market for 3G-based devices, including 3G phones, smartphones,

---

<sup>2</sup> See Bringing Broadband to Rural America, Report on a Rural Broadband Strategy, released May 22, 2009, at Pgs. 12-13. In making that finding, the Commission defined networks based on EV-DO and WCDMA/HSPA as constituting mobile broadband. The Commission used the same definition of mobile broadband in its annual reports on the state of competition in the US wireless market in 2009, 2008, and 2007. See Thirteenth Report, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, WT Docket No. 08-27, DA 09-54, released January 16, 2009 at Pgs. 69, 73-74; Twelfth Report, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, WT Docket No, 07-71, released Feb. 4, 2008, at Pgs. 8, 68-69; Eleventh Report, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, WT Docket No, 06-17, released Sept. 29, 2006, at Pg. 54

<sup>3</sup> The source of the data on subscribers is Wireless Intelligence, a database which collects such information. Wireless Intelligence defines a subscriber (actually a “connections” as a “unique SIM, or where SIM cards do not exist, a unique telephone number, which has access to the network for any purpose (including data-only usage), but excluding telemetric applications.”

PDAs, consumer electronics devices, and laptops. These devices include more than 646 EV-DO-based devices (118 of which incorporate EV-DO Revision A) and more than 1,910 HSDPA-based devices (305 of which incorporate HSUPA). The number and variety of these devices is increasing every day.

As noted above, Qualcomm licenses its technology to over 165 companies, who manufacture infrastructure and subscriber devices (including phones, smartphones, smartbooks, consumer electronic devices, and the like). These companies span the entire wireless industry. In particular, the number of companies manufacturing devices based on mobile broadband technologies, such as CDMA2000 and HSPA, continues to increase, along with the different types of devices themselves. At last count, 111 companies have manufactured at least one CDMA2000 device, and more than 169 companies have manufactured at least one WCDMA or HSPA device. These devices span all price points—from low end 3G phones to very high end smartphones and other consumer electronics devices.

In particular, eighteen laptop manufacturers now offer at least one laptop model with a form of embedded mobile broadband technology, and more than 400 such laptop models have been brought to market. It is becoming increasingly common for Americans, in urban, suburban, or rural areas, to access the Internet and a plethora of mobile broadband services through these mobile broadband-embedded laptops or by using a PC card or USB device with 3G mobile broadband connectivity.

There is fierce competition in the US among the wireless carriers in the provision of mobile broadband services, which has brought substantial benefits to consumers and has spurred the rapid deployment and expansion of these mobile broadband networks across the country. Indeed, American consumers in urban, suburban, and rural areas are enjoying mobile broadband

service at ever-increasing penetration rates and data speeds. Moreover, as the Commission found in its annual reports on the US wireless market, carriers have deployed competing mobile broadband technologies, which has only intensified the competition as the carriers seek to differentiate their networks by providing what each claims to be the best and most advanced high speed mobile broadband network and by offering the most robust and compelling mobile broadband services to consumers.<sup>4</sup>

Accordingly, Verizon Wireless, Sprint, US Cellular, Leap Wireless, and Cellular South, among other carriers, have deployed the CDMA2000 (EV-DO) mobile broadband technology, and their deployments are expanding every day. Overall, according to the Commission's latest report, EV-DO is available in over 1.5 million square miles across the country.<sup>5</sup>

On the other hand, AT&T has deployed the alternative WCDMA/HSDPA technology, and it is expanding the footprint of its WCDMA/HSDPA network at a very rapid rate. AT&T provides mobile broadband across much of the United States. Initially, AT&T deployed HSDPA, and subsequently, AT&T completed deploying HSUPA, thereby supporting higher speed uploads and downloads. For its part, T-Mobile USA has also launched HSPA on its AWS-1 spectrum in major markets around the country and now provides this mobile broadband service to an ever-increasing footprint. Thus, the mobile broadband networks based on HSPA/WCDMA technology are also expanding rapidly.

Mobile broadband networks based on these technologies are also operated by many smaller carriers. For example, Stelera Wireless provides mobile broadband service via HSPA to rural areas in Texas. Prior to Stelera's launch, these areas either had no broadband service of any kind or very limited service. Earlier this year, Cellular South announced a major expansion of its

---

<sup>4</sup> See Thirteenth Report at Pg. 66.

<sup>5</sup> Id. at Pg. 73.

mobile broadband service, provided via EV-DO, in Mississippi to cover the Mississippi Delta region and as well as counties in Southwest and Eastern Mississippi. Mobile broadband deployment is especially critical in Mississippi, which has the lowest overall broadband penetration among the 50 states.

All told, in January 2009, the Commission found in the Thirteenth Report that approximately 263 million Americans live within a census block in which one carrier provides mobile broadband service, as defined by the FCC to include EV-DO or WCDMA/HSPA; 207 million Americans live in a census block in which two or more carriers provide such mobile broadband; and, 145 million Americans live within a block in which three or more carriers offer mobile broadband. Thirteenth Report at Pg.73. The Commission's May 2009 Rural Broadband Report included a more recent statistic—now, over 95.6% of all Americans, i.e., approximately 272.55 million Americans, now live within a census block in which one carrier provides mobile broadband service as defined by the FCC to include EV-DO or WCDMA/HSPA. These numbers are increasing every day as the carriers constantly expand and enhance their mobile broadband networks.

In addition, the number and variety of devices, including handsets, PDAs, smartphones, and other consumer electronic devices, which incorporate EV-DO or HSPA is also growing by leaps and bounds every single day. As already noted, these technologies are now embedded in numerous laptop models sold by the major laptop vendors offering consumers another way to access mobile broadband services.

### **C. Upgraded 3G Technologies and LTE Technology**

As operators began deploying the first mobile broadband technologies, EV-DO and

HSPA in their initial forms—EV-DO Release 0 and HSDPA—the ecosystem of vendors that develop and support these technologies were simultaneously working on upgrades to the technologies for deployment in existing spectrum, and the new LTE mobile broadband technology, which was designed for deployment in new spectrum and which was optimized for wider bandwidths than the 3G technologies.

Today, as noted supra and as the FCC recently found, Verizon Wireless, Sprint, Leap Wireless and others provide mobile broadband service to areas in which over 95% of Americans live via EV-DO Revision A, which supports peak data speeds of 3.1 Mbps on the downlink and 1.8 Mbps on the uplink. Likewise, AT&T is concluding its network upgrade to HSUPA, which will support peak data speeds of up to 1.8 Mbps to 5.6 Mbps on the uplink, and is already in the midst of upgrading its HSPA network to support peak speeds of 7.2 Mbps. Likewise, T-Mobile USA is moving forward rapidly with its HSPA deployment and will migrate to HSPA+ on its AWS-1 spectrum.

The EV-DO and HSPA technologies are not standing still. Both are being enhanced substantially, and these enhancements will all be backwards compatible. The next upgrades to EV-DO and HSPA will result in dramatically faster data rates. EV-DO Revision B enables the aggregation of three EV-DO carriers in one 5 MHz channel. In its Phase I, EV-DO Rev. B will support downloads at a peak rate of 9.3 Mbps and eventually, in Phase II, at 14.7 Mbps, while supporting uploads at up to 5.4 Mbps. This technology will undergo an additional upgrade, now known as EV-DO Advanced, which, if implemented with four carriers, will support downloads of up to 34.4 Mbps and uploads of 12.4 Mbps. These upgrades will not require any new infrastructure. The net result of these upgrades to CDMA2000 will be wireless broadband

service with data rates that are ten times faster than even today's fastest EV-DO-based networks achieve.

Likewise, there are substantial upgrades for HSPA technology on its roadmap. The initial version of the technology known as HSPA + (also called HSPA Evolved—HSPA Release 7) will support peak downloads of 28 Mbps and uploads of 11 Mbps. Future releases of HSPA, Releases 8 and 9, will increase the peak downlink speeds, first to 42 Mbps and then to 84 Mbps.

Moreover, Qualcomm and many other vendors around the world are working on LTE, an OFDM-based technology, which achieves higher data rates and is optimized for wider bandwidths— a minimum of 20 MHz of paired spectrum, and ideally at least 40 MHz of paired spectrum per operator, for initial deployments. But, over the longer term, as data traffic moves to LTE and as mobile broadband use continues to explode, far more licensed spectrum, hundreds of MHz, needs to be identified, allocated, and auctioned for mobile broadband.

Until more spectrum is made available, technologies can be deployed to increase the capacity of existing networks, such as interference cancellation. In addition, operators can use femtocells to enhance the overall capacity and coverage of their networks. Finally, networks which use the 3G technologies or LTE can all be deployed in a more dense topology to increase frequency reuse and achieve greater capacity. All of these techniques are important and very helpful, but they are not substitutes for more licensed spectrum. At the end of the day, in order for the American public to enjoy the full range of benefits from mobile broadband, substantially more licensed spectrum must be identified, allocated, and auctioned.

#### **D. New Categories of Mobile Broadband Devices**

As noted supra, QCT is the world's largest provider of chipsets for mobile broadband devices. QCT constantly develops new chipsets incorporating more functionality and lower

power to drive mobile broadband into an ever increasing variety of devices at all price points. In particular, QCT is in the midst of four important initiatives to expand the scope and use of mobile broadband devices by creating new categories of mobile broadband devices. These new categories of devices are another important factor causing the need for additional licensed spectrum for mobile broadband.

QCT's first mobile broadband initiative is a platform by the name of Snapdragon. Snapdragon, which consists of a single chip with integrated wireless modem, applications processor, multimedia, GPS and other features, enables a new generation of mobile computing devices with embedded support for mobile broadband. These new mobile broadband computing devices, known as smartbooks, are much smaller, thinner, and less expensive than traditional notebook and mini-notebook PCs and with longer battery life that provides day-long availability.<sup>6</sup> Smartbooks feature always-on mobile broadband connections similar to mobile phones with everyday computing functionality in sub-compact, ultra-thin, and highly portable devices. (For more information on smartbooks, see [www.hellosmartbook.com](http://www.hellosmartbook.com).)

At present, 15 major manufacturers are developing more than 30 Snapdragon-based mobile broadband devices. The first Snapdragon-based mobile broadband smartphone was introduced in February 2009 by Toshiba, and other Snapdragon-based devices for mobile broadband computing will be introduced throughout this year.

A second QCT mobile broadband initiative involves another new category of low-cost, low power devices that use mobile broadband networks for wireless internet access and support e-mail, social networking, e-commerce, and distance learning applications. Late last year, Qualcomm formally announced the introduction of a new low cost PC alternative by the name of

---

<sup>6</sup> In the territory of the Federal Republic of Germany, the use of the term "smartbook" in connection with portable computers is reserved exclusively to Smartbook AG, Germany.

“Kayak.” See [www.qualcomm.com/news/releases/2008/081112\\_qct\\_kayak.html](http://www.qualcomm.com/news/releases/2008/081112_qct_kayak.html). Kayak consists of a reference design and recommended software specifications that device manufacturers are using to bring to market a variety of innovative wireless devices.

These Kayak-based devices use mobile broadband technology to fill the niche between desktop computers, which typically require wireline or cable connections for internet access, which is often unavailable in rural areas, and internet-capable mobile broadband-enabled smartphones. Kayak-based devices include embedded mobile broadband capability, a full featured Web 2.0 browser, and support Web 2.0 productivity and other broadband applications. In addition, Kayak supports both television sets and computer monitors for displays and/or built-in displays. Kayak-based devices are compatible with a standard keyboard and a mouse for input and will include a music player and/or 3D gaming console functionality.

The Kayak reference design uses a Qualcomm Mobile Station Modem, which enables the user to access the internet via standardized web browser offering desktop resolutions and supported by 3G mobile broadband networks employing either EV-DO Revision A or HSPA. Thus, Kayak-based devices use built-in cellular connectivity and an inherently low-cost platform based on high-volume wireless chipsets. Kayak-based devices enable affordable mobile broadband Internet access and will be introduced commercially later this year.

QCT’s third mobile broadband initiative consists of a global mobile broadband and GPS embedded solution for notebook computers and other wireless devices. This solution is called Gobi. Gobi-enabled notebooks can operate on mobile broadband networks in the United States and around the world. The original Gobi solution included a Qualcomm chipset, associated software and API, and a reference design for a data module supporting both the EV-DO Revision A and HSPA mobile broadband air interfaces as well as GPS. This solution allowed notebook

manufacturers to deliver products that provide mobile broadband connectivity wherever the user may happen to be. Earlier this year, Qualcomm announced its second generation embedded Gobi module. This module, which will launch commercially this year, provides a wide range of enhancements, including support for additional frequencies, increased data speeds, enhanced GPS functionality, and additional operating systems, such as Windows 7 and Linux.

While Gobi was initially deployed in notebooks, it is now being embedded into other devices to provide worldwide mobile broadband connectivity. Just last week, IREX Technologies (“IREX”) announced a new Gobi-embedded touch-screen e-Reader, the IREX DR800SG. This innovative device will enable the wireless downloading of books, newspapers, and magazines around the world via the embedded 3G multi-mode capability provided by the Gobi module. This device is the first eReader to leverage Qualcomm’s technology to support global connectivity. IREX is teaming with Barnes & Noble’s eBookstore, which gives users access to more than 750,000 titles, as well as with Verizon Wireless, Best Buy and Qualcomm. This device will launch in the United States in October and in Europe in the first half of next year.<sup>7</sup> This device, and others like it, will be key growth drivers for the mobile broadband ecosystem and will be another important factor in the exponential growth in the usage of mobile broadband networks, which creates the need for substantially more licensed spectrum.

QCT’s fourth mobile initiative is a platform by the name of inGeo. The inGeo platform provides a complete end-to-end solution for personal location devices and services. It currently uses CDMA2000 and Assisted GPS and is optimized for extremely small form factors and long

---

<sup>7</sup> For more information, see “IREX Technologies Turns the Page on eReaders with New 8.1-Inch Consumer Device,” released September 23, 2009, and available at <http://news.prnewswire.com/DisplayReleaseContent.aspx?ACCT=104&STORY=/www/story/09-23-2009/0005099605&EDATE=>.

battery life using Qualcomm's low duty cycle technology. (A next generation inGeo could be based on WCDMA.) The inGeo solution and associated server control technology provide accurate near real time location data that can be used for wireless tracking, safety and monitoring applications, including many Smart Grid-related applications. At less than 1,000 mm<sup>2</sup> in area, the inGeo module offers one of the industry's smallest form factors, and it incorporates a 2.4 GHz ZigBee transceiver and a Bosch SMB380 3-axis accelerometer to limit power consumption and provide short range connectivity.

#### **E. Improvements to the Mobile Broadband User Experience**

In addition to developing new technology to enable faster mobile broadband networks and new chips to power new categories of mobile broadband devices, Qualcomm is developing technologies to improve the mobile broadband user experience in several ways, which will also drive far greater mobile broadband use and create additional demand for mobile broadband spectrum. These new technologies range from: improving the displays used on wireless devices so they consume less power and they can be viewed in broad daylight; enabling the wireless charging of multiple devices simultaneously, which will eliminate the need for separate chargers and connectors for every wireless device and, therefore, are much more environmentally friendly than today's wired chargers; and, improving the voice reception of mobile broadband devices so that calls can be heard even in noisy environments.

The Wall Street Journal recently gave Qualcomm's wireless display technology, known as mirasol, its award for 2009 Technology Innovation in Semiconductors. See Michael Totty, "The Wall Street Journal 2009 Technology Innovation Awards," Wall Street Journal, Sept. 14, 2009. This innovative MEMS (micro-electrical-mechanical systems)-based technology reflects light so that specific wavelengths interfere with each other to create color, the same phenomenon

which makes a butterfly's wings shutter. Displays based on mirasol increase the capabilities of the device because the device can be seen in full sunlight, while dramatically reducing the power consumed by the display. Devices using mirasol will have a much improved user experience since they can be used in any environment and need to be charged less often.

In addition, the Wall Street Journal recognized another innovative Qualcomm technology which will revolutionize wireless charging. See "The Wall Street Journal 2009 Technology Innovation Awards," supra. This technology, known as eZone, provides a universal charging platform that can charge multiple devices simultaneously and wirelessly. eZone eliminates the need for each device to have its own battery charger and its own connector. Users will benefit because they will not need to carry a charger for each device, and the user experience will be far more convenient than today because they will be able to charge any number of devices easily.

Finally, Qualcomm has developed technology to improve vastly the quality of reception in wireless devices. Qualcomm's technology, known as Fluence, uses dual microphone noise cancellation in a handset, which provides higher noise suppression of approximately 25 to 30 dB. Fluence allows a user to hear the other end of a call with great clarity even in the most noisy of environments. In addition, Fluence can be used in conjunction with a new wideband vocoder to provide true high definition voice with unprecedented mobile voice quality.

All three of these innovations—mirasol, eZone, and Fluence—will vastly improve the wireless user's experience and drive even further growth in the use of mobile broadband networks and concomitant need for additional licensed spectrum for such networks.

## **F. New Mobile Services and Applications**

New devices, new networks, new categories of devices, and new improvements to the user experience are all driving enormous growth in mobile broadband use, thereby creating the need for additional licensed spectrum. Qualcomm is also working on a variety of mobile applications and services. These applications and services relate to many important aspects of American life—health, education, finance, and entertainment. These applications and services will, likewise, drive additional growth in mobile broadband use, which will fuel greater need for additional licensed spectrum for mobile broadband.

**1. Mobile TV Service.** Of these services, the one perhaps most well known to the Commission is FLO TV (formerly called MediaFLO). In 2003 and 2004, Qualcomm acquired Lower 700 MHz licenses covering the entire nation on Channel 55 (716 to 722 MHz). Qualcomm's FLO TV subsidiary built and operates the world's largest dedicated mobile television network, which uses the FLO technology, an OFDM-based one-way multicast technology. The FLO TV network delivers fifteen channels of high quality video content from some of the nation's top video content brands on a one to many basis to subscribers using a variety of mobile phones sold by Verizon Wireless and AT&T. At present, the FLO TV network covers over 83 markets across the country, in which over 180 million Americans live. Now that the DTV transition is complete and Qualcomm's spectrum is entirely clear of TV stations, Qualcomm is rapidly expanding the FLO TV network. By the end of 2009, the FLO TV nationwide network will provide its robust mobile TV service to a footprint of over 200 million people.

FLO TV's mobile TV service is not limited to wireless phones. Recently, FLO TV announced the expansion of its service onto two new platforms. First, FLO TV and Audiovox

Corporation jointly announced plans to offer in-vehicle TV product and service, to be known as FLO TV Auto Entertainment, which will be offered through a national network of more than 12,000 car dealers. New car dealers will sell FLO TV Auto Entertainment with Audiovox's Advent brand, which is compatible with all vehicle makes and models and adds to any in-car overhead or head rest entertainment system with screen sizes of up to 10.5 inches. (There are also approximately 23 million vehicles in the US which can be retrofitted with the small, easy-to-install FLO TV Auto Entertainment system.) Second, FLO TV announced the launch of a personal television device—a handheld digital television. This announcement marked the first expansion of the FLO TV service into consumer electronics devices.

**2. Mobile Internet Services.** Another mobile broadband service initiative relates to the delivery of software applications to mobile phones, taking advantage of the tremendous capabilities of mobile phones and the ingenuity of software developers. Many years ago, Qualcomm invented BREW, a thin software middleware layer supported by an end-to-end system that allows the downloading of applications into mobile phones. More recently, Qualcomm introduced Plaza Mobile Internet, a platform which allows mobile devices to access widgets, thereby bringing the features and interactivity of Web 2.0 applications to mobile devices. Earlier this year, America Movil announced that they would deploy Plaza Mobile Internet across all of their 18 wireless carrier subsidiaries in Latin America.<sup>8</sup>

In addition, Qualcomm has announced Plaza Retail, which allows mobile operators to present subscribers with an easy and uniform app store experience on any mobile device; gives mobile publishers and developers the ability to make their content available to multiple retailers

---

<sup>8</sup> See “America Movil and Qualcomm Empower Users to Monetize Their Online Lives,” [http://www.qualcomm.com/news/releases/2009/090727\\_America\\_Movil\\_and\\_Qualcomm\\_Empower.html](http://www.qualcomm.com/news/releases/2009/090727_America_Movil_and_Qualcomm_Empower.html).

instantly, regardless of development platform; and, gives consumers access to the wide variety of applications being developed for mobile broadband devices, regardless of which device a consumer owns and which software platform the device uses. All of these initiatives should fuel substantial growth in mobile broadband adoption and use.

**3. Mobile Banking & Commerce.** Mobile banking and commerce are other key drivers of wireless industry growth and have been areas of tremendous innovation by Qualcomm. Qualcomm's Firethorn subsidiary offers mobile banking through many of the nation's top financial institutions to subscribers of several of the nation's top wireless carriers. As a pioneer in mobile banking, Firethorn is transforming the traditional wallet into a secure, streamlined, and efficient mobile revenue channel that will bridge the relationships among financial institutions, retailers, wireless carriers, and consumers. Firethorn's innovative technology creates easily accessible, branded, and personalized mobile commerce channels that will give consumers secure access to their accounts, various offers, and transactions on the go.

In June of this year, Firethorn announced enhancements to its mobile banking and payments application to adhere to the industry's most rigorous benchmark for secure credit card transactions—the Payment Card Industry Data Security Standard.<sup>9</sup> In doing so, Firethorn reinforced its commitment to security and providing additional protection for consumers' sensitive credit and debit card information.

Mobile banking and mobile commerce are the way of the future. These applications will continue to drive substantial growth in mobile broadband adoption and use.

---

<sup>9</sup> See "Firethorn Increases Mobile Banking Security with Full PCI Compliance," [http://www.qualcomm.com/news/releases/2009/090630\\_Firethorn\\_Increases\\_Mobile\\_Banking.html](http://www.qualcomm.com/news/releases/2009/090630_Firethorn_Increases_Mobile_Banking.html).

**4. Mobile Healthcare.** Wireless healthcare is another field of great emphasis for Qualcomm. Today, Qualcomm provides services to CardioNet, a company which uses 3G connectivity for cardiac monitoring. Another innovative mobile health care service involves Triage Wireless, a medical device company in which Qualcomm has invested. Triage has developed an innovative solution for the wireless monitoring of a patient's vital signs. Triage is developing a product to measure blood pressure and other vital signs on a continuous basis without a cuff using a "wireless band-aid," which consists of an arm-worn transceiver that sends data to a monitor via short range, unlicensed technology and then from the monitor to a hospital via a cellular module.

In addition, Qualcomm recently joined with the Gary and Mary West Foundation and Scripps Health to create the West Wireless Health Institute. The Institute is the one of the world's first medical research organizations dedicated to advancing health and well-being through the use of wireless technologies. The Institute is fostering an unprecedented convergence of science, medicine, engineering and technology to change the way healthcare is delivered. The Institute has teamed with Corventis to conduct its first clinical research of the benefits of wireless health—a multicenter, randomized trial to validate remote wireless monitoring technology in proactively managing heart failure patients and reducing hospital readmissions. Such clinical research is vitally important to establish the improved patient care and quantify the substantial cost savings from wireless health services.

It is clear that mobile health care will require reliable communications networks and lead to vastly increased growth mobile broadband use, thereby creating the need for additional unencumbered licensed spectrum.

**5. Mobile Education.** Another significant field for new mobile broadband services and applications is mobile education. Qualcomm's Wireless Reach Initiative, an initiative designed to promote the socially beneficial uses of mobile broadband technology, supports Project K-Nect, a project in rural North Carolina which uses smartphones operating on a mobile broadband network to teach math to at-risk high school students. The first phase of this project had dramatically positive results, with one participating class scoring 30 percent higher on their end of course exam than a class of their peers taught by the same teacher, but not participating in Project K-Nect.

In September, Sprint and GoKnow, a provider of educational software, announced the results of a similar trial project conducted in a school district in Michigan, the Inkster Public School District. In a summer session, students were given Sprint handsets loaded with GoKnow software, which was used for English Language Arts and Math. Prior to using the handsets, the students were performing below Michigan state standards in these subjects. After using the handsets and software during the summer session, the students improved their test scores by an average of 25 percent.<sup>10</sup> There is no question but that mobile broadband technology has the potential to improve education in countless ways and with extraordinary results as these two projects demonstrate.

Likewise, the Amazon Kindle and the recently announced IREX device, both of which are e-book readers with embedded mobile broadband connections powered by Qualcomm mobile station modems to enable the wireless downloading of books, have tremendous potential to

---

<sup>10</sup> See "Sprint and GoKnow Trial Delivers Higher Achievement Scores in English Language Arts and Math," released September 22, 2009 and available at [http://newsreleases.sprint.com/phoenix.zhtml?c=127149&p=irol-newsArticle\\_newsroom&ID=1334364](http://newsreleases.sprint.com/phoenix.zhtml?c=127149&p=irol-newsArticle_newsroom&ID=1334364).

improve education. Several major universities and textbook manufacturers are partnering with Amazon to make the Kindle DX model, which is optimized for textbook reading, available to college students, who will download and read their textbooks via the device.

**6. Non-Terrestrial Mobile Broadband.** Mobile broadband is not limited to terrestrial wireless networks. Last year, Qualcomm announced that it would develop a satellite-based variant of EV-DO Revision A, known as S-DO, which will be included in the firmware of select Qualcomm multi-mode chips, thereby integrating satellite and cellular technology for use pursuant to the Commission's ATC (ancillary terrestrial component) rules in the L and S bands. This S-DO technology will be incorporated in chips which also support terrestrial LTE, UMTS, and/or EV-DO. These chips will enable mass market hybrid terrestrial/satellite devices that will work even in areas where cellular coverage is spotty or non-existent. This technology adds yet another dimension to mobile broadband by enabling truly ubiquitous service across the entire United States.

In addition, Qualcomm mobile broadband technology is also used in the air-to-ground ("ATG") system operated by AirCell to provide wireless internet service for airplane passengers. AirCell's ATG system uses EV-DO Rev. A base stations and an IP switching platform manufactured by ZTE and aircraft-mounted modems from Qualcomm. While en route, subscriber Wi-Fi traffic within a plane is transmitted to the ground and vice versa via EV-DO Rev A, and the result is a compelling mobile broadband service without any on-board interference issues.

**G. Machine to Machine Communications, Including Smart Grid**

Another driver of substantial growth in mobile broadband, which will drive the need for substantially more licensed spectrum, is machine to machine communications. In July 2009,

Qualcomm and Verizon Wireless announced formation of a joint venture to provide machine to machine communications (“M2M”) and smart services offerings across a variety of market segments, including healthcare, manufacturing, utilities, distribution, and consumer products.<sup>11</sup> One important category of smart services are Smart Grid applications—technology which enables utilities to connect wirelessly to their grid assets, such as circuit breakers, transformers, and other sub-station equipment. Likewise, wireless remote monitoring will allow the deployment of interactive utility networks that are more intelligent, resilient, reliable, and self-balancing. The joint venture, named nPhase, aims to deliver seamless, fully integrated M2M communication of this type with global connectivity.

With respect to the Smart Grid in particular, nPhase has announced a series of ongoing pilot smart grid programs with ABB Inc., a leader in power and automation technologies, for ABB’s utility customers.<sup>12</sup> nPhase is providing real time wireless network connectivity and services together with technology from ABB. The pilot programs have already demonstrated positive results for some of the nation’s largest electric utilities, such as Con Edison of New York, by allowing them to improve their performance while minimizing their environmental impact. By using real-time wireless connectivity and services coupled with ABB’s asset monitoring solution for high voltage circuit breakers, utilities can improve grid reliability and

---

<sup>11</sup> See “Verizon Wireless and Qualcomm Announce Joint Venture to Provide Advanced M2M Solutions,” (released July 28, 2009); [www.qualcomm.com/news/releases/2009/090728\\_Verizon\\_Qualcomm\\_JV\\_M2M.html](http://www.qualcomm.com/news/releases/2009/090728_Verizon_Qualcomm_JV_M2M.html).

<sup>12</sup> See “nPhase Powers ABB’s Asset Monitoring Solution,” (released Sept. 1, 2009); <http://www.reuters.com/article/pressRelease/idUS188177+01-Sep-2009+GNW20090901>.

reduce operating costs. This solution can also prevent power outages and maintain environmental compliance.<sup>13</sup>

The ABB solution, known as Circuit Breaker Sentinel, gathers critical information from a utility asset to determine the health of the electrical transmission equipment; nPhase extracts crucial data via the secure cellular network and forwards the data to ABB's Asset Insight hosted web platform, which allows the data to be reviewed and acted upon. .

M2M offers tremendous potential for the nation with respect to the Smart Grid and many other areas. There is no question that M2M communications will drive exponential increases in the use of mobile broadband networks, and that is yet another reason why the Commission should allocate and auction considerably more spectrum for mobile broadband.

**II. The Commission Should Identify, Allocate, and Auction Significantly More Licensed Spectrum for Mobile Broadband with Flexible Use Rights, Liberal Property Rights, a Technology Neutral Regulatory Regime, Full Protection from Interference, and Free of Encumbrances**

As the Commission's staff recognized in its September 2009 presentation on the National Broadband Plan: "Record is clear: More spectrum is needed." See Presentation on the Status of the Commission's Processes for Development of a National Broadband Plan (Sept. 29, 2009) at Page 71. The consensus on this point goes further—more licensed spectrum is needed for mobile broadband. The entire wireless industry, which has internal disagreements on many public policy issues, is in complete agreement on this point. There is no substitute for more licensed spectrum. Without more licensed spectrum, the American public will be unable to enjoy all of the benefits of mobile broadband devices, applications, and services.

---

<sup>13</sup> See "nPhase Powers ABB's Asset Monitoring Solution," (released Sept. 1, 2009); <http://www.reuters.com/article/pressRelease/idUS188177+01-Sep-2009+GNW20090901>.

The additional licensed spectrum should be auctioned without strings attached. Let the high bidders win the spectrum and use it as they see fit. The Commission's auction program has raised upwards of \$100 billion for the American people and has succeeded in getting spectrum into the hands of those companies who value it most highly and, therefore, who will put it to its highest and best use as quickly as possible.

As has already been shown supra, the innovations that have already occurred and those in today's pipeline are driving the tremendous need for additional licensed spectrum for mobile broadband. These innovations all require highly reliable connections using wireless spectrum that is free of interference. They necessarily offer ubiquitous coverage, not just local service confined to a hot spot. For these reasons, additional licensed, not unlicensed, spectrum is essential for mobile broadband.

In terms of particular bands which should be targeted, Qualcomm believes that the Commission should work with all affected agencies and stakeholders to expand the identify new licensed bands. Qualcomm supports expansion of the AWS-1 band by 50 MHz by allocating 1755-1780/2155-2180 MHz, and also reallocating spectrum in the 450 MHz band, where the business case will be especially strong since far fewer base stations would be required due to the favorable propagation at such a low frequency.

It is not sufficient, however, for the Commission merely to auction more licensed spectrum. Unless the spectrum comes with clearly defined property rights, flexible use rights, a technology neutral regulatory regime, and full interference protection, and unless the spectrum is free of encumbrances, use of the spectrum for mobile broadband will be hampered, delayed or prevented outright. Qualcomm amplifies these points below.

### **A. Spectrum Should Be Auctioned Free of Encumbrances**

Encumbered spectrum is no solution for mobile broadband or for innovation. Until the encumbrances on spectrum are removed, the spectrum cannot be put to its highest and best use, and innovation must be delayed or cannot occur at all. Qualcomm's own experience with its 700 MHz spectrum makes this point in spades. Qualcomm purchased its spectrum in 2003 and 2004, but TV and DTV stations occupied the spectrum until June 12, 2009, when the DTV transition finally ended. It took passage of two laws by Congress before all of the stations vacated the spectrum so that Qualcomm could have full use of the spectrum. These delays hampered Qualcomm's ability to deploy its innovative mobile TV technology on a nationwide basis and denied the innovative service to consumers in many areas throughout the US.

Even worse, the original legislation, enacted in February 2006, set a February 17, 2009 so-called hard date for the end of the DTV transition, and Qualcomm, in reasonable reliance on the law, made plans to turn on transmitters all over the country immediately after February 17, 2009 on the spectrum stations were required to move off. As it happened, Congress passed the DTV Delay Act, which delayed the DTV transition date to June 12, 2009. This statute forced Qualcomm to bear the costs of the resultant delay in the deployment of its mobile TV network in certain markets, and the residents of those markets, having already been made to wait for several years, could not receive the innovative service for at least another four months. This unfortunate episode should not be repeated. The Commission should seek to identify spectrum which is free of encumbrances, particularly incumbents, and to the extent that the spectrum has an encumbrance, but a deadline is set for removal of the encumbrance, that deadline should remain firm. Innovators and their investors require certainty—the certainty that the innovation can be

deployed on a date certain and the certainty that a critical deadline for removal of an encumbrance will not be deferred.

Fortunately, for Qualcomm and its relatively high power FLO TV network, its 700 MHz spectrum is now free of encumbrances. But for the cellular carriers, their 700 MHz spectrum is still encumbered with wireless microphones. This situation is especially unfair since many of the wireless microphone use is unlawful. Moreover, even for the duly licensed wireless microphones, there is now no hard date by which they must vacate the 700 MHz band. This situation cries out for swift Commission action once and for all. Certainly, the failure to do so will delay full use of the auctioned 700 MHz spectrum and will defer the innovations that American consumers could enjoy if this spectrum was cleared. As for band sharing, in the first place, no one should have to share spectrum with unlawful users. Mobile broadband technologies require exclusive use of spectrum. They are not designed to share spectrum with other uses.

In a similar vein, the Commission's past efforts to reclaim TV Channels 52 to 69 from analog television and the reallocation of that spectrum for wireless as well as public safety will bring tremendous benefits to the American public, not to mention the over \$19 billion earned through the spectrum auctions. In the case of Qualcomm's mobile television service, fifteen video streams are now available to consumers in the same 6 MHz channel formerly used by one television station.

Also, the AWS-1 auction occurred in 2006, but portions of that band still have incumbents on it in various locations. The fact that this spectrum is still not clear three years after the auction is, of course, preventing the spectrum from being put to its highest and best use.

Repurposing of spectrum is of no use unless the spectrum is cleared of incumbents on a date certain and without any slippage in that date.

**B. Spectrum Should Be Auctioned with Flexible Use Rights and Liberal Property Rights**

Qualcomm wholeheartedly supports continuation of the FCC's flexible use policy in allocating new licensed spectrum. The Commission is just not in a position to pick and choose which uses of a given band should be permitted and which should be forbidden both because the Commission cannot foresee which uses are best suited for a given spectrum band when allocating the spectrum, years before the spectrum is actually used, and because the Commission should let the marketplace decide what use should be made of a given band. The auction program itself is based on the assumption that the auction winner values the spectrum most highly because it was willing to pay more than anyone else for the auctioned spectrum, and, therefore, the auction winner, not the Commission, should decide how to use the spectrum.

Once again, Qualcomm's mobile TV network is a case in point for the wisdom of flexible use rights. Qualcomm was able to acquire its 700 MHz spectrum with the flexibility to deploy any fixed or mobile system. If a use had been dictated by the Commission, that use would likely not have been mobile TV, a service which had not been deployed before in the US until Qualcomm did so and which was largely unknown at the time the 700 MHz rules were adopted. Flexible use rights allowed Qualcomm, as the party that bid the most for the spectrum in the auction, to decide how to use the spectrum and rightly so.

Moreover, the highest and best use of spectrum can change over time, and flexible use rights allow the licensee to adapt to changing marketplace conditions without unnecessary government intervention. Flexible spectrum allocations with flexible use rules are best because the government's objective should be to ensure that spectrum is put to its highest and best use,

not to require adherence to a particular use selected by the government which may no longer have a business case.

Just as important as flexible use rights are liberal property rights. The two go hand-in-hand. Flexible use rights are not rights at all unless they are well defined and have all the earmarks of property. To the greatest extent possible, in allocating spectrum, the Commission should strive to define the rights of the licensees and allow licensees to engage in private transactions whereby they sell, lease or trade rights.

Once again, Qualcomm's FLO experience is a case in point, both for the benefits of liberal property rights in spectrum and in the need for such rights to be defined as clearly as possible. Section 27.60 (b) (1) of the Commission's rules did not clearly define whether, prior to the DTV transition, Qualcomm could cause interference to co-channel and adjacent channel TV stations. As a result, Qualcomm filed a petition for declaratory ruling asking the Commission to set a de minimis interference standard just for the limited period of time before the DTV transition to enable Qualcomm to use its spectrum even before the transition was completed. Approximately, twenty months later, the Commission granted Qualcomm a waiver of its rules, establishing the de minimis standard. See In re Qualcomm Incorporated, 21 FCC Rcd 11683 (2006). A licensee's interference rights (and protections) should be fully defined when the spectrum is auctioned, rather than as the result of a twenty-month FCC proceeding. Qualcomm was unable to launch its FLO TV service until the FCC proceeding was completed.

However, even before Qualcomm's rights were well defined, Qualcomm was able to enter into transactions with some TV stations all over the country whereby such stations consented to receiving interference. Such transactions were expressly provided for in the Commission's rules. See 47 C.F.R. Sec. 27.60 (b) (1) (iv). One spectrum policy expert noted

that Qualcomm’s private transactions illustrated “some of the key efficiencies of private property rights.” See Hazlett, A Law and Economics Approach to Spectrum Property Rights: A Response to Weiser and Hatfield, 15 *George Mason Law Rev.* 975, 1004 (2008).

**C. Spectrum Should Be Auctioned & Regulated on a Technology Neutral Basis**

The Commission’s longstanding policy of technology neutrality in wireless has been a tremendous success. Rather than dictating a 2G, 3G ,or 4G technology, the US has let the licensees select the technology it wants to deploy, and the result has been a robustly competitive US wireless market with a plethora of competing devices, applications, and services for consumers. Once again, the Commission is in no position to dictate a technology both because the Commission is not in a position to decide which technology to mandate, and because the Commission should allow the market—carriers, vendors, and ultimately consumers—to decide which technologies will prevail.

As the Commission itself has noted in its most recent annual report on the state of competition in the US wireless market:

As a result of the Commission’s market-based approach, different U.S. providers have chosen to deploy a variety of different technologies with divergent technology migration paths. Competition among multiple incompatible standards has emerged as an important dimension of non-price rivalry in the US mobile telecommunications market and a distinctive feature of the US mobile industry model.

Thirteenth Report at para. 126.

The evidence is clear from the Commission’s own reports: technology neutrality has produced enormous benefits for the American public.

Moreover, technology neutrality is the official policy of the US government as reflected in a series of bilateral free trade agreements, including those between the United States and Chile, Singapore, Australia, Morocco, Peru, and Bahrain. A provision regarding technology neutrality is also included in the Central American Free Trade Agreement (“CAFTA”), as well as in other free trade agreements either not yet fully implemented (Peru and Oman) or not yet ratified by Congress (Panama, Colombia, and Korea). The United States government has been very successful in reaching agreements with foreign governments which, to varying degrees, strongly encourage or require technology neutrality.

**D. Spectrum Should Be Auctioned with Full Interference Protection for the Winning Bidders**

Mobile broadband systems require protection from interference. Indeed, more than 270 million US wireless subscribers have come to expect a very high degree of reliability—on a par with wireline service. Interference results in blocked calls, dropped calls, and poor service. New spectrum must be free of interference problems if innovative technologies and services of the type described herein are to be deployed successfully for the American public.

In particular, full interference protection should be assured for licensees who acquire spectrum from the Commission in an auction. No one is going to invest in spectrum and in a network to deploy on the spectrum without an assurance of full interference protection. As stated supra, regulatory certainty and stability is essential to facilitate innovation in wireless, and ensuring full interference protection is certainly one of the Commission’s core functions.

It is true that in making allocations, the Commission is often confronted with competing claims of interference and non-interference. Most recently, the proceedings involving the AWS-3 and PCS H blocks posed these issues. In these cases, in which the issue was whether interference would occur to spectrum for which licensees had paid the Commission billions of

dollars, fundamental fairness and longstanding FCC precedent requires that the burden should be placed squarely on the new entrant to prove the absence of interference. See, e.g., Midnight Sun Broadcasting Co., 11 F.C.C. 1119 (1947) (new entrant is required to resolve objectionable interference to existing FCC licensees). Placing the burden on an incumbent who purchased its spectrum license at auction to show non-interference would be illogical since only the new entrant knows what operations it intends to launch and would undermine the integrity of the Commission's auction program. The Commission should not auction spectrum and thereafter propose allowing interfering operations on the auctioned spectrum.

Earlier in these comments, Qualcomm explained a paradigmatic case of a market-based mechanism to manage interference involving Qualcomm's FLO TV network. In that case, Qualcomm was able to reach private agreements with TV stations around the country whereby the stations accepted a certain level of interference within a defined geographic area for a limited period of time. It was not easy or quick to reach these agreements, but the experience proves that the private market can work. It bears emphasis, however, that these agreements were voluntarily negotiated. The Commission did not force any licensee to enter into an agreement. And, the facts were unique-- the licensees were all broadcasting the same content on a second channel that would not suffer any interference, and the stations all knew that when the DTV transition occurred, they would be required to vacate the spectrum. The interference was only to one of each station's over the air streams, and the vast majority of Americans watch TV via cable or satellite, not over the air, and thus would not suffer any interference.

Accordingly, in this unique case and only in certain markets, the market provided a solution to an otherwise vexing interference problem. While market-based solutions should

never be compelled, allowing private parties to negotiate freely can provide successful results in certain circumstances, particularly where property rights are defined in advance.

**III. The Commission Should Not Allocate Unlicensed Spectrum for Mobile Broadband—There Is Ample Unlicensed Spectrum for Short Range, Local Area Service**

Mobile broadband requires licensed, not unlicensed, spectrum for wide area operations. Technologies such as Wi-Fi provide short range, local area service within a small confined area—a local area. Transmitters based on these technologies only cover a small area. These Part 15 devices may not cause interference to other devices and must accept interference “caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator.” 47 C.F.R. Sec. 15.5. Thus, unlicensed devices are less reliable than those that use licensed spectrum, and as unlicensed devices proliferate, their reliability is unlikely to improve.

On the other hand, mobile broadband technologies, including CDMA2000, WCDMA/HSPA, and LTE provide wide area service. Base stations based on these technologies provide coverage over a much wider area. These technologies require interference protection to ensure that the communications link across a wide area, from the base station to the phone or modem, is maintained.

These technical differences dictate vastly different business models for unlicensed versus licensed technologies. To cover a wide area, an unlicensed deployment would require far more transmitters than licensed deployment. For example, in the TV White Space proceeding, Qualcomm showed that a 700 MHz licensed transmitter could cover approximately twenty times the area of an unlicensed transmitter. See Charles L. Jackson, “Unlicensed TV White Space Wireless Cannot Provide Substantial Rural Broadband Access,” (October 22, 2008), attached to

Qualcomm Ex Parte Filing in Dockets 04-186 & 02-380. This disparity establishes that there is no business case for the deployment of unlicensed technology for wide area communications.

Based on the above, the Commission should not allocate unlicensed spectrum for the deployment of mobile broadband or, likewise, to improve broadband in rural areas. It is not technically or economically feasible to provide mobile broadband or rural broadband via unlicensed technology. When the Commission allocates spectrum to meet the burgeoning demands for mobile broadband, and rural broadband, the spectrum must be licensed.

Likewise, before the Commission allocates more spectrum for unlicensed devices, it should examine the use of the existing unlicensed bands. In truth, there is no evidence that the unlicensed bands are congested. To the contrary, the evidence from the FCC's own database of equipment authorizations is that manufacturers continue to make new equipment for all of the currently allocated unlicensed bands. If any unlicensed band was congested, new equipment authorizations for the band would decrease such equipment would be un-usable and would not sell. But, the data from the Commission's data base show that manufacturers continue to make equipment for all of the unlicensed bands. See Charles L. Jackson, Dorothy Robyn, and Coleman Bazelon, "Unlicensed Use of the TV White Space: Wasteful and Harmful," (filed in Dockets 04-186 & 02-380, Aug. 20, 2008) at Pgs. 4-13.

In sum, there is no documented need for the allocation of more unlicensed spectrum, and unlicensed technology should not be allocated in the name of either mobile broadband or rural broadband.

**IV. The Commission Should Not Compel Spectrum Underlays or Overlays Because They Are Not Technically Feasible, They Discourage Investment in Licensed Networks and Services, and They Devalue Licensed Spectrum**

In the Notice of Inquiry on innovation in wireless, which is referenced in the Notice of Inquiry, the Commission raises the topic of spectrum underlays or overlays—allowing unlicensed devices to operate in licensed bands. The Commission should not move forward with this idea both for technical and economic reasons.

Technically, spectrum overlays or underlays simply will not work and will cause interference. As shown herein, mobile broadband systems require full protection from interference. Mobile broadband technology is not designed to permit unlicensed devices to transmit “on top” or “underneath” the licensed transmitters, i.e., within the same spectrum band. Rather, mobile broadband systems enable communications over wide areas, and to maintain the link from a licensed device to its nearest base station requires the absence of any interference.

Mobile broadband systems already employ power control to optimize their spectral efficiency. For example, the power control inherent in CDMA-based networks and mobiles ensures that each mobile always transmits exactly enough power to provide decent call quality, but not more than enough. For example, on the return link, CDMA base stations constantly measure the error rate performance from each mobile transmitting a signal, and, depending on whether the error rate is trending above or below an adequate performance level, the power control circuit is told to ask for a higher or lower signal to noise ratio. A base station function measures the actual signal to noise ratio and compares it to the target, and if the actual ratio is too high or too low, an “up power” or “down power” command is sent to the mobile, which responds by increasing or decreasing its power by approximately 1 dB. All of this occurs approximately 1,000 times per second at each base station and for each operating mobile. The mobile

continuously measures the received signal level of the base station signal, averaged over a relatively long time interval, but with a very large dynamic range (about 80 dB). These measurements are used to set the mobile transmit power at approximately the optimal level over this very large dynamic range. The base station commands have a much smaller range, but are transmitted much faster.

In addition, CDMA-based mobiles also have variable rate vocoders that vary the data rate over an 8 to 1 range since lower power can be used for lower data rates. This permits the mobile to adjust the power on a frame by frame basis (20 milliseconds) based on the varying data rate.

For soft handoff between base stations, the relative strength of nearby base stations is continuously monitored. Although all base stations communicating with a mobile try to control its power, the mobile pays attention only to the one asking for the lowest power. CDMA uses powerful forward error correction coding and efficient modulation and implementation so that the signal to noise ratios are very low- approaching the Shannon limits. All these features ensure that CDMA-based networks and mobiles operate at the most efficient levels. OFDMA-based networks use similar techniques to achieve the same result.

Thus, these networks and devices use all of their spectrum as efficiently as possible and do not leave any margin within which unlicensed devices can operate. In other words, there is no unoccupied spectrum within which an overlay or an underlay of unlicensed devices can be placed without impairing the operation of licensed services. In its comments in the Commission's interference temperature proceeding, Qualcomm showed that a 1 dB increase in noise temperature in a licensed band would cause each CDMA-based cell to suffer a 10-15% decrease in coverage area, and, conversely, to maintain current coverage while compensating for a 1 dB increase in noise temperature, a licensee would have to increase the number of cell sites

by 12 to 17%, an impossible task given the limitations imposed by zoning regulations and other practical difficulties in identifying locations for new towers. Indeed, operators may not even know where to add the cell sites since unlicensed devices can be mobile, and so the interference can vary in location as the devices move around. In sum, mandating any unlicensed overlay or underlay in a licensed band will unquestionably cause interference and will degrade service for US wireless subscribers.

Mandating such an overlay or underlay will also have negative consequences from an economic point of view. Licensees will not spend billions of dollars for non-exclusive spectrum licenses, and the value of existing investments in spectrum licenses would be destroyed if anyone—a device manufacturer, a competing network operator, or others-- could gain access to the same spectrum for free. In the same vein, a carrier's incentive to invest in its existing network is lost if that network is subject to interference from unlicensed devices operating on the same spectrum on a secondary basis without having to pay anything for access.

The Commission's spectrum auction program has been a great success for the American public and is a model for the rest of the world because it awards the spectrum to the party that values it the most and, therefore, has the greatest incentive to deploy a network as broadly and as quickly as possible. The Commission should not undermine the powerful economic incentives which have made that success possible. For all of these reasons, the Commission should not move forward with any proposal to mandate an overlay or underlay in any licensed band.

**V. Conclusion**

Wherefore, Qualcomm requests that the Commission take actions in accordance with these Comments.

Respectfully submitted,

By: /s/Dean R. Brenner  
Dean R. Brenner  
Vice President, Government Affairs  
QUALCOMM Incorporated  
1730 Pennsylvania Ave., N.W.  
Suite 850  
Washington, D.C. 20006  
(202) 263-0020  
Attorney for QUALCOMM Incorporated

Dated: October 23, 2009