

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

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In the Matter Of	)	
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Fostering Innovation and Investment in the	)	GN Docket No. 09-157
Wireless Communications Market	)	
	)	
A National Broadband Plan for Our Future	)	GN Docket No. 09-51
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**COMMENTS OF QUALCOMM INCORPORATED**

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

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## SUMMARY

Qualcomm is pleased to respond to the Notice of Inquiry to discuss the factors that encourage innovation and investment in wireless communications and to identify concrete steps the Commission can take to support and encourage further innovation and investment. No topic is more important to Qualcomm's very existence than innovation.

Qualcomm spends billions of dollars annually to develop innovations extending to every aspect of wireless communications. The innovations include inventing: upgrades to existing air interfaces and new air interfaces for deployment on licensed spectrum to provide ubiquitous, high quality mobile broadband service; network capacity enhancements to ensure that carriers can use their valuable licensed spectrum as efficiently as possible; new chipsets with integrated support for an ever-increasing number of technologies (licensed for wide areas and unlicensed for local areas) and operating systems; chipsets which incorporate a new low power processor creating whole new categories of mobile broadband devices, spurring exponential growth in the use of today's mobile broadband networks; support for all forms of machine to machine communications also on a ubiquitous basis, which deliver socially beneficial applications and will drive further demand for mobile broadband networks using licensed spectrum; and the technology which powers the world's largest mobile television network, which provides up to 20 channels of video content in the same 6 MHz licensed channel previously used by a single TV station, thereby offloading traffic that could otherwise clog up the mobile broadband networks.

Beyond Qualcomm's massive R & D expenditures and its work with its manufacturer and carrier partners, these innovations all require another ingredient before they can be brought to market: they need licensed spectrum with liberal property rights, flexible use rights, a technology neutral regulatory regime, full protection from interference, and free of

encumbrances. The single most important step that the Commission can take to spur greater innovation in wireless is to allocate and auction a steady stream of unencumbered licensed spectrum, certainly hundreds of MHz, for mobile broadband in bands below 3 GHz on a technology neutral, flexible use basis with liberal property rights and full protection from interference. The Notice of Inquiry highlights policies which has lead to the emergence of Wi-Fi and Bluetooth as well as “smart handheld devices,” but in fact, the main Commission policy which has driven tremendous economic growth and created a vibrant US wireless market in which over 95% of all Americans have ubiquitous access to at least one mobile broadband network is the Commission’s licensed spectrum auction program.

The need for additional licensed spectrum for mobile broadband becomes apparent when considering that Qualcomm’s innovations, indeed those of the entire wireless value chain, touch on virtually every facet of American life: health care, education, the smart grid, public safety, and the economy at large. Even taking into account capacity expansion techniques and new deployment scenarios (pico and femto cells) described herein, upgraded and new mobile broadband air interfaces and the new mobile broadband applications, services, and devices have created an enormous need for far more licensed spectrum now, and this need will continue to grow exponentially well into the future.

Consumers themselves, not just the carriers and not just vendors, need access to more licensed spectrum for mobile broadband. Indeed, in bringing innovative technologies to market for consumers, Qualcomm does not work by itself, but rather partners with carriers, manufacturers, software developers, and others in the US and around the world. Qualcomm’s expenditures on research and development are the linchpin of a virtuous cycle, whereby Qualcomm’s research and development teams develop innovations; Qualcomm then patents and

broadly licenses the innovations to device and infrastructure manufacturers; Qualcomm's manufacturer partners, through Qualcomm's carrier partners, sell products and services based upon the innovations; and, those sales produce royalty income for Qualcomm, which funds additional research and development. Putting aside factors which are outside of the Commission's jurisdiction, notably the continued operation of the American patent system, the single most important step that the Commission can take to spur further innovation and investment in wireless would be to identify, clear, and auction far more licensed spectrum.

Just as important as the steps that the Commission should take to spur innovation are the steps that the Commission should not take in the name of innovation. The Notice of Inquiry asks about sharing of spectrum by licensed and unlicensed uses via so-called underlays or overlays—which hinge on the unsupported notion that unlicensed devices can co-exist with licensed devices on an involuntary basis within a given band. Notice of Inquiry at para. 26. Underlays and overlays do not work as a matter of technology because licensed uses require full protection from interference. Underlays and overlays also discourage investment in licensed spectrum and will chill innovation. No one is going to spend billions of dollars on licensed spectrum and deploying networks on such spectrum if unlicensed devices can gain free access to the very same spectrum and interfere with licensed operations. The FCC should not resurrect this concept, which was discarded years ago in the interference temperature proceeding, among others.

Likewise, in seeking comment on how to promote further innovation in unlicensed spectrum, the Notice of Inquiry refers to the Commission's ruling on the TV White Space, but that ruling confused the proper role for licensed versus unlicensed spectrum. Unlicensed spectrum is well suited to low power, local area service, for which detailed interference protection rules are not necessary because the communications are confined to a short range and

are typically under the control of a single user. By contrast, licensed spectrum is necessary for high power, wide area service because the communications must cover wide distances and on a ubiquitous basis, and interference protection is necessary to ensure that the communications can take place over wide areas and among many users. It is uneconomic to cover wide areas with unlicensed transmitters that cannot operate successfully at the higher power levels used by licensed transmitters. The Commission should not allocate unlicensed spectrum in the name of spurring innovation in mobile broadband—such innovation will not happen.

Unlicensed technologies are playing an an important role in providing new low power, short range applications. Qualcomm is among the many companies involved in developing such technologies in standalone chips and in chips also containing cellular technologies to provide both wide area cellular and local area unlicensed connectivity. Furthermore, available data show that the existing unlicensed bands are not congested and that there is ample spectrum within these bands for new unlicensed devices and applications based on such devices.<sup>1</sup>

Finally, in addition to urging the Commission to adopt sound spectrum policy, Qualcomm proposes herein a series of actions the Commission could take to encourage innovation in wireless in a host of areas, including mobile education, mobile health care, universal service reform, tower siting policy, and experimental licensing.

Qualcomm applauds the Commission for focusing on innovation in wireless and looks forward to working with the Commission in these proceedings. The balance of this filing provides detailed information on Qualcomm’s innovations in virtually every facet of wireless communications and amplifies Qualcomm’s positions on the public policy issues raised in the Notice of Inquiry.

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<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.

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**COMMENTS OF QUALCOMM INCORPORATED**

QUALCOMM Incorporated (“Qualcomm”), by its attorneys, hereby submits these Comments in response to the Commission’s Notice of Inquiry, FCC 09-66, released August 27, 2009. In the Notice of Inquiry, the Commission seeks comment on the factors that encourage innovation and investment in wireless communications and to identify concrete steps the Commission can take to support and encourage further innovation and investment. Notice of Inquiry at para. 1.

In these Comments, Qualcomm provides the Commission with detailed information on many exciting innovations which Qualcomm and its partners are developing—innovations which extend to virtually every aspect of wireless and most all aspects of American life. These innovations will drive exponential growth in the demand for mobile broadband networks, services, and devices, which in turn will inexorably drive greater and greater need for additional licensed spectrum, certainly hundreds of 200 MHz. Since it takes many years to allocate and auction such spectrum, the Commission should begin the process now of identifying new, unencumbered spectrum bands and allocate such bands with flexible use rights, liberal property rights, a technology neutral regulatory regime, and full protection from interference. For both

technical and economic reasons, unlicensed spectrum is no substitute for licensed spectrum and can never be used to provide wide area, high power, ubiquitous mobile broadband service.

## **I. Qualcomm's Innovations in Wireless**

### **A. Background**

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 make many inventions. 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 technology it developed for orthogonal frequency division multiple access (“OFDMA”), 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 devices, mobile broadband-embedded laptops and netbooks, and a wide variety of pocketable computing devices with mobile broadband capability. These types of mobile broadband devices are already used today by millions of Americans, and they provide low-cost, mobile Internet access and broadband applications.

Other divisions and subsidiaries of Qualcomm develop innovations in other aspects of wireless. FLO TV, Incorporated, a wholly-owned 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. Qualcomm MediaFLO Technologies is bringing this same mobile TV technology to market with partners based around the world. Qualcomm MEMS Technologies, Inc. (“QMT”), also a wholly-owned subsidiary, 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. Qualcomm Ventures makes strategic investments in early stage, high technology companies which span the gamut of the wireless industry.

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.

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, 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 sheer number and wide variety of these devices is increasing every day.

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<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.”

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. That competition 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 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.

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

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

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. Innovation in Mobile Broadband Air Interfaces**

As operators began deploying EV-DO and HSPA in its initial forms—EV-DO Release 0 and HSDPA—the ecosystem of vendors who develop and support these technologies was simultaneously working on upgrades to these mobile broadband technologies, and there is a constant and never-ending drive to enhance these technologies which continues to the present and shows no sign of slowing down into the future. The networks rapidly migrated to the first

upgrade—EV-DO Revision A and HSUPA, which is widely deployed today throughout the United States.

Today, as noted supra, 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 working on the upgrade of its HSPA network to support peak speeds of 7.2 Mbps. This upgrade will begin later this year. AT&T also announced that they are adding additional capacity to thousands of cell sites to support higher mobile broadband speeds. Likewise, T-Mobile USA is moving forward rapidly with its HSPA deployment on the AWS-1 spectrum.

All of the mobile broadband technologies described above are available today. But, the EV-DO and HSPA technologies are not standing still. Both EV-DO and HSPA technology are being enhanced substantially, and these enhancements will all be backwards compatible—carriers who use EV-DO and HSPA do not require new spectrum to upgrade their networks to the next version of these technologies.

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 are all backwards compatible, meaning that they 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. This technology is under very active development. It does require new spectrum, but by auctioning the 700 MHz spectrum last year, the Commission has filled that need. Both Verizon and AT&T have publicly stated their intention to deploy LTE.

These mobile broadband technologies are 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 addition, Qualcomm will support the L and S-band mobile satellite frequencies in select RF processors.

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 interference issues within the aircraft.

It is important to note that data rates, by themselves, only deal with one aspect of user experience. Latency is another important factor in any broadband network, including mobile broadband networks. Indeed, consistently low latency is also critically important to user experience, especially for applications such as web browsing or others which involve a high degree of interactivity. Rate and latency are effectively a unified concept in broadband networks.

Stated differently, whether a network appears slow while web browsing because the underlying data rate is slow or because of a latency issue is irrelevant to a broadband user. Driving network upgrades to achieve the fastest possible data rates in mobile broadband networks is a worthwhile goal, but increases in data rates alone, especially those which might only occur in a small percentage of a given network’s coverage and/or traffic, do not dramatically improve user experience unless latency is also improved.<sup>6</sup> As a result, improving latency is another important aspect of Qualcomm’s research and development efforts.

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<sup>6</sup> The importance of low latency was demonstrated perhaps most vividly (and most humorously) in the experiment conducted in 2004 by Yossi Vardi, when he attached a number of memory cards to homing pigeons and then calculated the bandwidth associated with the birds flying from one point to another, and he compared the pigeons “data rate” to that of ADSL. The pigeons achieved fast data rates, but latency was bad.

#### **D. Innovations to Expand the Capacity of Mobile Broadband Networks**

Along with developing faster mobile broadband air interface technology, Qualcomm and its partners have also developed several technologies to expand the capacity of mobile broadband networks. These technologies are no substitute for new spectrum, but they may serve as stop gap measures to ease the crunch while the carriers wait for the Commission to allocate and auction new spectrum.

Qualcomm has developed a technique known as interference cancellation (“IC”), which can be incorporated in all 3G-based networks to significantly improve the voice and data capacity without requiring new spectrum or a new network. IC can be applied to both downlink (forward link) and uplink (reverse link). The downlink IC is standard independent and implemented in the handset (user device) and uplink IC is implemented in the base station. For 3G CDMA based technologies, such as HSPA and EV-DO, interference at the receiver limits the system capacity where each user represents interference to other users. Interference cancellation is a mechanism to cancel this interference from other users, thereby increasing the capacity. As Qualcomm explained in July of this year, a UMTS-based network’s data throughput and capacity can be increased by 60 percent, voice capacity by 45 percent, and a user experience can be provided that is similar to LTE when a similar channel bandwidth is used.<sup>7</sup> Similar gains in capacity, throughput, and user experience can be attained by using uplink interference cancellation in EV-DO-based networks.

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<sup>7</sup> See “ZTE and Qualcomm Collaborate to Boost UMTS System Performance,” [http://www.qualcomm.com/news/releases/2009/090705\\_ZTE\\_Qualcomm\\_Collaborate.html](http://www.qualcomm.com/news/releases/2009/090705_ZTE_Qualcomm_Collaborate.html). See also the prior announcement on this same topic from Qualcomm and Huawei—“Qualcomm and Huawei to Cooperate on Advanced UMTS Node B Receiver Technology,” Feb. 4, 2008, [http://www.qualcomm.com/news/releases/2008/080204\\_Qualcomm\\_and\\_Huawei\\_to\\_Cooperate.html](http://www.qualcomm.com/news/releases/2008/080204_Qualcomm_and_Huawei_to_Cooperate.html).

Using interference cancellation, the air link of a CDMA system can reach the theoretical limit. In fact, air links of all wireless technologies are approaching the theoretical limit, and IC is one of the major enhancements that bridge the performance gap between CDMA and OFDMA based technologies. As an example, an HSPA+ network with advanced receivers, IC and handset equalizer, provides similar spectral efficiency as LTE in the same amount of spectrum and for the same number of antennas. Significant future improvements to wireless networks (CDMA or OFDMA) will therefore come from optimizing the networks and the topology—such as adding femtocells—and not from the air interface technology. User data rates and system capacity can be increased significantly by bringing the transmitter closer to the users, e.g., adding picocells and femtocells. As an example, introducing femtocells with proper interference management can increase user data rates more than 10 times—significantly more than air link improvements can provide since the air link is approaching the theoretical limit.

For this reason, Qualcomm has developed femtocell technology. Femtocells are cellular access points that use DSL, fiber, or cable broadband connections to extend the reach of 3G mobile broadband service within a small area, such as within a home or office. Operators can use femtocells to enhance the overall capacity and coverage of their mobile broadband networks. Qualcomm will offer 3G mobile broadband chipsets for femtocell incorporating innovative technology to mitigate any interference that would otherwise occur between femtocells and the macro cellular network. See “Qualcomm Adds Femtocell Chipsets to Technology Portfolio,” [http://www.qualcomm.com/news/releases/2009/090216\\_Qualcomm\\_Adds\\_Femtocell\\_Chipsets\\_to\\_Technology\\_Portfolio.h](http://www.qualcomm.com/news/releases/2009/090216_Qualcomm_Adds_Femtocell_Chipsets_to_Technology_Portfolio.h) (Feb. 16, 2009). Qualcomm has also licensed femtocell manufacturerers. See “Qualcomm and Global Wireless Sign 3G Femtocell License Agreement,”

[http://www.qualcomm.com/news/releases/2009/090910\\_Qualcomm\\_and\\_GlobalWireless\\_Sign.html](http://www.qualcomm.com/news/releases/2009/090910_Qualcomm_and_GlobalWireless_Sign.html) ( Sept. 10, 2009).

Qualcomm's DO-Advanced technology optimizes the performance of a CDMA2000 network by software upgrades used in concert with picocells, femtocells, macrocells, and advanced devices, which, taken together, significantly improve the overall capacity and coverage of the network. In addition, Qualcomm has developed technologies to expand the voice capacity of 3G networks. The 1X Advanced technology increases the voice capacity of a CDMA2000 network by up to four times. This technology requires new handsets and channel cards in network base stations.

Finally, Qualcomm is conducting research into peer to peer communications in non-cellular networks which would use licensed spectrum to enable device to device discovery and communications within a range of approximately one mile. These networks will also require licensed spectrum because device-to-device discovery and communications over such a wide area requires the absence of interference. Such networks would potentially enable a wide variety of new applications based on this new form of proximate communications.

#### **E. Innovations in Chipsets for Mobile Broadband Devices**

As noted, 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 innovations to expand the scope and use of mobile broadband devices.

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>8</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 "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 that 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

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<sup>8</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.

browser, and access via the browser to 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 by using a standardized web browser running at desktop resolutions and mobile broadband networks which employ 3G wireless broadband technology, 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. Notebooks containing Gobi 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 offering mobile broadband capability 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>9</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 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. At less than 1,000 mm<sup>2</sup> in area, the inGeo module is one of the industry’s smallest

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<sup>9</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=>.

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.

#### **F. Innovations to Improve the Wireless 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 also developing technologies to improve the mobile broadband user experience in several ways. These innovations range from improving the displays used on wireless devices so they consume less power and can be viewed in broad daylight; enabling the wireless charging of multiple devices simultaneously, which will eliminate the need for chargers and connectors for each and every wireless device and, therefore, ease the problem of where to dispose of chargers once discarded; 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 shimmer. 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 will 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 experience, which will drive even further growth in the use of mobile broadband networks.

### **G. Innovations in Wireless Services**

Qualcomm’s innovations extend beyond just the technology used in wireless networks, wireless chips, and wireless devices. Qualcomm has invented a host of wireless services. These services relate to many important aspects of American life—health, education, finance, and entertainment, and the services will also drive further use of mobile broadband networks and spectrum.

**1. Innovative 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. Two weeks ago, FLO TV made a joint announcement with Audiovox Corporation of plans to offer in-vehicle TV, 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, and 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.

**2. Innovative 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, which 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>10</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 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. Innovations in 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.

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<sup>10</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).

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>11</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.

**4. Innovations in Mobile Healthcare.** The Notice of Inquiry seeks information on the use of wireless technology for healthcare. Notice of Inquiry at para. 16. Wireless healthcare is a field of great interest to Qualcomm. Today, Qualcomm provides services to CardioNet, a company which uses 3G connectivity for cardiac monitoring. 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.

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<sup>11</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).

**5. Innovations in Mobile Education.** The Notice of Inquiry seeks comment on wireless applications for education, and in this area also, Qualcomm has been at the forefront of innovation. Notice of Inquiry at para. 18. 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 not participating in Project K-Nect, but taught by the same teacher.

Earlier this month, 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>12</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

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<sup>12</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).

station modems to enable the wireless downloading of books, have tremendous potential to 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.

#### **H. Innovation in Machine to Machine Communications, Including Smart Grid**

As mentioned in the Notice of Inquiry, in late 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>13</sup> Notice of Inquiry at para. 60, n.75. An example of a smart service is the smart grid—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 aims to deliver seamless, fully integrated M2M communication of this type with global connectivity.

With respect to the smart grid in particular, a topic on which comment is sought in the Notice of Inquiry, earlier this month, the joint venture, now named nPhase, 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>14</sup> Notice of Inquiry at para. 17. nPhase is providing real time wireless network connectivity and services together with technology from ABB. The

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<sup>13</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>14</sup> See “nPhase Powers ABB’s Asset Monitoring Solution,” (released Sept. 1, 2009); <http://www.reuters.com/article/pressRelease/idUS188177+01-Sep-2009+GNW20090901>.

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. The ABB solution, known as Circuit Breaker Sentinel, gathers critical information from the utility asset to determine the health of the electricity transmission equipment. nPhase extracts crucial data via a secure cellular network and forwards the data to ABB's Asset Insight hosted web platform. This combination of sophisticated monitoring technology, smart services connectivity, and complex analytics will together drive the smart grid.

M2M communications offers tremendous potential for the nation with respect to the smart grid and many other areas. The Notice of Inquiry asks about the policy implications of the emerging area of M2M communications. Notice of Inquiry at para. 55. 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. See also September 29, 2009 Presentation to FCC Open Meeting, 141 Days Until Plan Is Due at Slide 71 ("Record is clear: More Spectrum Needed.").

### **I. Innovation Through Partnering**

In addition to Qualcomm's organic innovations, it is a core value of Qualcomm to partner with other companies. In this regard, Qualcomm operates its own venture capital fund, known as Qualcomm Ventures, with the goal of accelerating the growth of wireless by investing in and partnering with start-ups and early stage companies. Through Qualcomm Ventures, Qualcomm makes strategic investments in four general areas across the wireless value chain: 1) applications, software, and services; 2) wireless components, and devices; 3) infrastructure; and,

4) enabling technologies. Qualcomm Ventures is a \$500 million evergreen fund currently with investments in 28 companies. Qualcomm partners with its portfolio companies by providing them with early access to Qualcomm research and development and with technical support from one or more Qualcomm business units.

A good example of the wireless innovation spurred through Qualcomm Ventures is Triage Wireless, a medical device company which 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.

Another example of innovation driven by a Qualcomm Ventures portfolio company is Novarra. It provides a server-based platform that takes entire web pages and automatically optimizes them for viewing on virtually any mobile device. Simply put, Novarra drives mobile internet usage.

A third example of such innovation is Obopay, which operates a mobile payment service that enables consumers, merchants, banks, and carriers to make, receive, and facilitate mobile payments. These companies and the others in the Qualcomm Ventures portfolio are important sources of innovation supported by Qualcomm.<sup>15</sup>

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<sup>15</sup> In an effort to reach out as broadly as possible in its search for enterprising wireless technology companies in need of early stage financing, Qualcomm Ventures is currently running an international business plan competition. Four semi finalists will each receive \$100,000 in convertible note funding, and the winner will receive another \$150,000 in convertible note funding. This competition may well have more prize money than any comparable early stage venture program in the high technology sector. For more information on this contest (known as the "QPrize Competition"), see <http://www.qualcomm.com/ventures/qprize>.

**II. Innovations in Wireless Require Significantly More Licensed Spectrum Auctioned with Flexible Use Rights, Liberal Property Rights, a Technology Neutral Regulatory Regime, Full Protection from Interference, and Free of Encumbrances**

In the very first paragraph of the Notice of Inquiry, the Commission asks what concrete steps it can take to support and encourage further innovation in wireless, and in one of the first paragraphs to follow, the Commission states that to the extent innovation is facilitated by Commission policies, it seeks comment on how best to expand the scope of successful policies. Notice of Inquiry at paras. 1, 5. In truth, the Commission's ability to cause innovation is limited both by the Commission's jurisdiction and by the fact that the research and development itself is conducted in the private sector. What the Commission has done with great success, and should continue to do, is auction licensed spectrum. 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 which have already occurred and which are in today's pipeline will drive tremendous need for additional spectrum for mobile broadband. These innovations all require highly reliable connections using wireless spectrum that is free of interference. They use relatively high power to minimize the number of base stations necessary to cover wide areas. They provide ubiquitous coverage, not just local service confined to a hot spot. For these reasons, they require licensed, not unlicensed, spectrum.

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. To Spur Innovation, 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 residents in many areas around 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 which the stations were going to be required to move off. As it happened, Congress passed the DTV Delay Act, which delayed the DTV transition date to June 12, 2009. As a result, Qualcomm had 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 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 not be delayed or pushed back. 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 incumbent wireless microphones are 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. In the Notice of Inquiry, the Commission asks for comment on band sharing. Notice of Inquiry at paras. 38 to 48. In the first place, no one should have to share spectrum with unlawful users. On that basis alone, the Commission should move forward with a solution to the wireless microphone encumbrance in the 700 MHz band. More fundamentally, mobile broadband technologies require exclusive use of spectrum. They are not designed to share spectrum with other uses.

In a similar vein, the Notice of Inquiry seeks comment on the repurposing of spectrum, asking if the Commission's past repurposing of spectrum has spurred innovation or resulted in innovation. Notice of Inquiry at para. 27. Certainly, the reclaiming of 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. However, 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. To Spur Innovation, Spectrum Should Be Auctioned with Flexible Use Rights and Liberal Property Rights**

The Notice of Inquiry itself notes that the Commission has “increasingly sought to encourage innovation by allocating spectrum flexibly so that it can be used in ways that best meet the needs of the market and the public.” Notice of Inquiry at para. 21. Qualcomm wholeheartedly supports this approach. 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, as the Commission itself notes in the Notice of Inquiry, the highest and best use of spectrum can change over time, and flexible use rights allow the licensee to adapt to

changing marketplace conditions. As the Notice of Inquiry put it, the Commission “can, for example, provide flexible spectrum allocations, with flexible rules regarding use of the spectrum, that give incumbents considerable discretion to continue operating existing services or to introduce new services to address changing needs.” Notice of Inquiry at para. 26. 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. The Notice of Inquiry does not expressly discuss property rights as such, but it does refer to “spectrum rights” and “spectrum usage rights in the context of its discussion of the secondary market. See Notice of Inquiry at para. 33. 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 and did establish 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 could not 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 (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. To Spur Innovation, Spectrum Should Be Auctioned and 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.

In the Notice of Inquiry, the Commission notes that it has long supported flexibility in the standards-setting process, but, nevertheless, the Commission asks whether it should become involved in the standards-setting process in various ways. Notice of Inquiry at para. 60. The evidence is clear from the Commission's own reports: technology neutrality has produced enormous benefits for the American public, and there is no need for the Commission to become involved in wireless standard-setting.

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. To Spur Innovation, Spectrum Should Be Auctioned with  
Full Interference Protection for the Winning Bidders**

As the Notice of Inquiry states, "(s)pectrum allocations and access often hinge on controlling interference between new services and incumbent services, as do licensing and service rules to some extent." Notice of Inquiry at para. 34. Mobile broadband systems require protection from interference. The more than 270 million US wireless subscribers have come to

expect a high degree of reliability. 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 requires that the burden should be placed squarely on the new entrant to prove the absence of interference. 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.

In a similar vein, the Notice of Inquiry resurrects an idea that the Commission discarded many years ago, namely whether the Commission should adopt receiver standards since the Commission's rules regulate transmitter performance but not receiver performance. Notice of Inquiry at para. 36. The fact is that regulating transmitter performance—regulating the potential source of the interference—is, by far, the most effective and fairest way for the Commission to

prevent interference. Receiver performance is regulated in many cases through industry standards bodies, but the Commission should regulate the source of the interference, the offending transmitter, not the victim receiver. Likewise, the most effective way to regulate interference from transmitters is via the traditional limits on transmitted power.

In the Notice of Inquiry, the Commission seeks comment on whether to designate a panel of technical experts to advise it on spectrum sharing issues and disagreements about harmful interference; whether the Technological Advisory Council (the “TAC”) could be used for this process; and, whether the Commission could use alternative dispute resolution (“ADR”) for settling disagreements about interference which arise in the rule making process. Notice of Inquiry at para. 35. Qualcomm is always open to new ideas, and if there are good ways to use ADR to expedite the Commission’s processes while preserving the procedural rights of all parties, they merit further debate and discussion. Qualcomm does, however, believe that the TAC should play the role of an advisor on technology, not an adjudicator of specific disputes or even an advisor to the Commission on specific disputes. In Qualcomm’s experience, the TAC works best when academics and private sector expert members brief the Commission on technological developments of which the Commission and staff are either unaware or need further information. The TAC is not a policy body or a jury, and it should not serve as such.

Finally, the Commission asks for input on market-based ways to manage interference, such as a cap and trade system or spectrum usage rights. 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, Low Power, Local Area Service**

The Notice of Inquiry asks to what extent is spectrum use by unlicensed devices playing a role in encouraging or facilitating innovations in wireless devices or networks, and the Notice of Inquiry seeks information on unlicensed technologies under development. Notice of Inquiry at paras. 12, 45. However, the Notice of Inquiry does not propose, or seek comment on, any framework the Commission could apply in deciding whether a given spectrum band should be allocated for licensed versus unlicensed use. Qualcomm believes that the Commission should use such a framework in a systematic fashion, rather than deciding on an ad hoc basis whether a given band should be licensed or unlicensed. Qualcomm offers these comments as the developer and chip manufacturer of both licensed and unlicensed technologies. Qualcomm's mobile

broadband technologies and chipsets based on those technologies have been described supra, but QCT also offers chipsets for handsets and mobile devices based on 802.11n, the most advanced version of Wi-Fi, as well as Bluetooth solutions.

Technologies such as Wi-Fi provide short range, low power service within a small confined area—a local area. Transmitters based on these technologies use very low power levels because they are only attempting to 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, higher power service. Transmitters based on these technologies use relatively higher power since they 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. As noted, unlicensed technologies must operate at relatively low power levels. This means that 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 in wide areas.

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 De-Value Licensed Spectrum**

The Notice of Inquiry asks several times for comment on the usefulness of the Commission compelling spectrum overlays or underlays. See Notice of Inquiry at paras. 26, 41, 47, 55. 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.

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.<sup>16</sup> See Comments of Qualcomm Incorporated in ET Docket No. 03-237 (filed April 5, 2004).

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 would be lost if that network would be subject to interference from unlicensed devices operating on the same spectrum without having to pay anything for access.

The Commission's spectrum auction program has been a great success for the American people 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

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<sup>16</sup> The Notice of Inquiry speculates about a package of sensors and measurement systems which could supposedly be deployed throughout the country to collect data on spectrum usage. Notice of Inquiry at para. 47, n.50. Qualcomm does not believe that this idea, which was raised in the Commission's interference temperature proceeding earlier this decade, is practical or feasible, and in any event, it would not create a margin for an unlicensed overlay or underlay which does not exist.

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. In Addition to Auctioning More Spectrum, There Are Other Steps the Commission Should Take to Facilitate Innovation in Wireless**

As has already been demonstrated supra, the wide variety of innovation in wireless is generating a substantial need for the Commission to auction far more licensed spectrum to keep up with the exponential, never-ending growth in demand. In addition, there are other actions, some modest and some more extensive, that the Commission could take to support greater innovation in wireless.

**A. Modernizing the E-rate Program**

As explained supra, mobile broadband devices, services, and applications have tremendous potential to improve education. The Commission should make modest changes in the E-rate program to modernize it and facilitate these important innovations. Mobile broadband devices, applications, and services should all be subsidized for educational use under a revamped E-rate program. These devices, applications, and services are critical tools for the improvement of American education in the 21<sup>st</sup> Century, and no school or student should be denied these tools due to lack of funding.

As Qualcomm, Sprint, Verizon, and Verizon Wireless have all explained in prior filings with the Commission, the 2010 E-rate Eligible Services List does not clearly provide that wireless internet equipment, such as 3G (EV-DO and WCDMA/HSPA) connection cards, My-Fi devices and other 3G routers, and USB modems are eligible for E-rate support. See Docket 02-6, Comments of Sprint Nextel and Verizon and Verizon Wireless (filed June 19, 2009); Reply Comments of Qualcomm (filed June 30, 2009). There is no functional difference between a wireless modem and a wired (cable or wireline) modem except that the wireless modem can be

used wherever the student is physically located. Similarly, the Eligible Services List provides support for “routers” without unequivocally providing that wireless routers are covered.

Wireless routers provide a broadband signal just like a wireline router except that the wireless router does not need a wireline connection and instead uses a mobile broadband connection for its backhaul. These wireless devices should all be covered by the E-rate program.

Likewise, as e-book readers, such as the Amazon Kindle and the IREX device, become more prevalent, they should also be eligible for federal subsidies. Students can use these devices to gain access to textbooks wherever they go. These devices will lower costs for schools and students, reduce adverse environmental impacts, and improve learning in a host of ways. There is no better use of federal funds than to subsidize these types of devices to make them available to all students. This funding should be made available under ARRA, various federal education programs, or a revamped E-rate program.

Moreover, the E-rate program should provide funding for wireless internet applications and services. These applications may or may not be used on school property, and that is their virtue. Students can use mobile broadband technology to learn before, during, and after school. The E-rate program should aim widely. It should fund these applications and services precisely because they can help students learn before or after school, when their teachers may not be physically available to them.

In the past, the E-rate program has focused largely on wiring schools. Today, the program should focus on mobile broadband devices, applications, and services, which have the potential to transform learning. The Commission should quickly transform the E-rate program so that it can bring all students the benefits of wireless learning.

## **B. Modernizing the Universal Service Program**

Perhaps a more gargantuan task is reform of the universal service program. That program, too, needs to be modernized and converted into a broadband program. In the 21<sup>st</sup> Century, every American needs access to mobile broadband so that they can enjoy the benefits of broadband wherever they work, live, or travel. Today, as noted supra, the Commission's most recent data show that over 95% of Americans have access to at least one mobile broadband network. Qualcomm believes that the Commission should revise the universal service program to set a national goal: every American should be covered by at least one mobile broadband network. That goal is attainable with sufficient funding. Universal service reform to reach that goal is essential.

One aspect of universal service reform could be put in place quickly. As Qualcomm and a host of other companies have argued, a pilot program could be put in place under Lifeline and LinkUp to provide subsidized 3G-based devices and 3G broadband service initially to at least one million participants all over the US. See Comments of Qualcomm Incorporated, Docket Nos. 01-92, 99-200, 99-68, 96-98, 96-45, 06-122, 05-337, 04-36, 03-109, 08-262 (filed Nov. 26, 2008). Such a pilot program should be fully funded and put in place quickly, and if the pilot is successful, as it should be, the program should become permanent. As the Commission itself found in the Order & Further Notice in the omnibus universal service proceeding, according to the Pew Internet & American Life Project, only 25 percent of households with incomes under \$25,000 have broadband service. See Order on Remand and Further Notice of Proposed Rulemaking, FCC 08-262, released November 5, 2008, A-35, C-34. It is essential that this problem be cured quickly. The Lifeline and LinkUp programs are well suited to do so.

Devices based on Qualcomm's Kayak (formerly named Candlebox), i.e., low-cost, low-power PC alternatives with embedded wireless broadband access, are well suited for such a program. See id. at A-35, n.187, C-34, n.179. Kayak-based devices will use built-in cellular connectivity and an inherently low cost platform based on high volume chipsets. These devices should enable affordable broadband Internet access in homes across the country for people who could not otherwise afford a computer or broadband service.

The Commission should convert the universal service program into a broadband program. That conversion will take time to complete. In the meantime, the Commission should authorize and fund a wireless broadband pilot program under the existing Lifeline and LinkUp programs.

### **C. Modernizing the Rural Health Pilot Program**

The Notice of Inquiry seeks comment on how to encourage growth in the use of wireless devices and services for health care. Notice of Inquiry at para. 16. As already shown supra, mobile broadband networks and devices offer tremendous potential to improve health care in this nation by enabling delivery of an improved quality of care at significantly reduced costs. Auctioning more spectrum and funding universal mobile broadband coverage will certainly go a long way toward facilitating the use of wireless devices and services for health care, but there is more that the Commission can do.

The Commission has a rural health care pilot program designed "to provide funding to support the construction of state or regional broadband networks and services provided over the networks," and applicants can seek funding "to construct a dedicated broadband network that connects health care providers in a state or region." Order, 21 FCC Rcd 11111 (2006). Under the pilot program, wireless devices, telemedicine applications and software, and computers are all ineligible for funding. See <http://www.fcc.gov/cgb/rural/rhcp.html#orders>. Although there is

\$400 million per year in available funding, almost no funds have been paid out under the pilot program even though the program will soon expire.

This program, while well intentioned, is not funding the tools necessary to spur innovation in wireless health, and it should be converted into a mobile broadband program. Wireless health care will be provided over commercial mobile broadband technology, networks, devices, and applications. There is no need to spend hundreds of millions of dollars per year for single-purpose, dedicated wireline networks for hospitals. People need access to telemedicine wherever they live, work, and travel. Dedicated networks drive up costs and can never provide the ubiquitous service that both health care providers and patients require. As already noted, mobile broadband networks today reach 95% of all Americans. It will take decades if not longer before 95% of all Americans are covered by a dedicated health care broadband network. The Commission should provide funding for the use of commercially available mobile broadband networks and services for wireless health and telemedicine services.

Moreover, federal funding should be used to subsidize mobile broadband devices, mobile health devices, and telemedicine software and applications for health care professionals and patients. These are critical building blocks for wireless health. Federal funds under the ARRA, other health-related programs, or some other program should be made available to drive the rapid and broad proliferation of such devices, software, and applications.

#### **D. Modernizing Tower Siting Policy**

As the Notice of Inquiry states, “(t)owers are the backbone of our wireless infrastructure, supporting both commercial and private wireless services, in addition to critical public safety and home security wireless communications.” Notice of Inquiry at para. 52. Wireless carriers cannot deploy innovations and extend their networks unless they can add base station sites.

Innovative mobile broadband technology, devices, and applications require ubiquitous coverage, and ubiquitous coverage requires more towers. There is no way around that. Unfortunately, carriers face a host of obstacles in the state and local zoning process.

As a Commission licensee itself for the spectrum used by FLO TV, Qualcomm is well aware of the delays and impediments that the state and local zoning process can pose when a carrier simply wants to widen its coverage footprint so that more subscribers can enjoy the fruits of wireless technological innovation.

The Commission asks what it can do to promote innovation in tower siting and colocation. Notice of Inquiry at para. 52. To ease the undue delays experienced in the state and local zoning process and to aid the deployment of innovative wireless networks and technologies, the Commission should grant CTIA's petition for declaratory ruling to impose a shot clock of 45 days for proposed co-locations and 75 days for all other wireless facilities siting applications. See CTIA Petition for Declaratory Ruling to Clarify the Provisions of Section 332 (c) (7) (B) to Ensure Timely Siting Review and to Preempt Under Section 253 State and Local Ordinances That Classify All Wireless Siting Proposals as Requiring a Variance (filed July 11, 2008). For consumers to reap the benefits of wireless innovation, a reasonable time limit should apply to the state and local zoning process.

**E. Avoiding the Imposition of New Fees & Mandates**

The Notice of Inquiry asks whether the imposition of spectrum user fees would encourage more efficient spectrum use. Notice of Inquiry at para. 42. Nothing will chill innovation more than adding yet another financial burden to the carriers. The Commission already imposes annual regulatory fees on spectrum users and maintains build out requirements to ensure that spectrum is used. There is no need to impose any new fee on spectrum licensees.

What should be considered is how to incentivize federal users from giving up spectrum which they do not use. Imposition of a spectrum user fee on federal agencies would give the agencies a strong incentive to turn back spectrum they do not use. Qualcomm realizes that the imposition of such a fee would require Congressional action.

Similarly, although Qualcomm understands that the Commission plans to start a separate proceeding on network neutrality and Qualcomm awaits seeing the details of any Commission proposal to impose network neutrality requirements, Qualcomm can state now that such requirements, whatever they may be, should not be applied to wireless networks, which operate with limited capacity due to the limited bandwidth available to any wireless operator. Innovative devices, applications, and services get deployed on wireless networks every single day without such requirements.

**F. Encouraging Experimentation**

Finally, the Notice of Inquiry asks what the Commission can do “to affirmatively support experimentation in wireless technology and services” and whether the Commission should explore modifying its rules governing experimental licenses. Notice of Inquiry at para. 65. Qualcomm has obtained many experimental licenses to support its various research and development programs and is not aware of any rule changes that are necessary. The most important thing that the Commission can do to support experimentation is to continue the speedy processing of applications for experimental licenses. The Commission is to be commended for its efforts to process such applications quickly and to avoid the creation of any backlog.

In Qualcomm’s experience, the requirement to coordinate any experimental use in a given band at a given location with any incumbent licensee works well. No one should be

permitted to perform an experiment on anyone else's spectrum without obtaining the prior consent of the licensee.

**VI. 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  
2001 Pennsylvania Ave., N.W.  
Suite 350  
Washington, D.C. 20006  
(202) 263-0020  
Attorney for QUALCOMM Incorporated

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