Before the
DEPARTMENT OF ENERGY
Washington, DC 20585

In the Matter of National Broadband Plan (NBP) RFI: Communications Requirements

COMMENTS OF QUALCOMM INCORPORATED

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SUMMARY

Qualcomm is pleased to provide these detailed comments to the Department of Energy ("DOE" or "Department") on how current and future wireless broadband communications capabilities can support the energy management needs of electric utilities, businesses, and consumers, which include requirements for the evolving and growing Smart Grid. The DOE should be applauded for timely following-up on the recommendations in the Federal Communications Commission's National Broadband Plan ("NBP") that focus on how broadband communications systems can achieve the critically important U.S. goals of energy independence and enhanced energy efficiency. *See* FCC NBP at 247. In this regard, Qualcomm explains how commercial wireless technologies can be used to satisfy the varied and increasing communications needs of electric utilities. Qualcomm looks forward to continuing a dialogue with the DOE and its industry partners on these important issues as Smart Grid technologies are further integrated into our electrical networks.

For more than two decades, Qualcomm has enabled the introduction of countless wireless technologies and products that are used by many utilities to support the smart delivery and consumption of energy. Qualcomm believes that these technologies also will enable the swift, broad, and cost-effective implementation of the Smart Grid. Indeed, as the DOE appreciates, Smart Grid communications must benefit businesses, consumers, and utilities alike by transporting the information required to wisely manage energy use. Commercial cellular technologies, which currently provide mobile broadband service to approximately 98% of all Americans, must play a key role in the continued development of the Smart Grid to fully realize the goals of the FCC's NBP – which are appropriately echoed in the DOE's RFI – namely (i) improved reliability and power quality; (ii) reduction in peak demand and in transmission

congestion costs; (iii) increased energy efficiency; (iv) greater environmental benefits through increased asset utilization; (v) increased security; (vi) greater ability to accommodate more renewable energy, and (vii) increased durability and ease of repair in response to attacks and natural disasters. *See* 75 Fed. Reg 26206, 26207.

Qualcomm explains in these Comments the vital role that existing commercial cellular technologies, and the enhancements to these technologies that are being rapidly developed and deployed, can play in supporting the communications requirements of the Smart Grid. Many key Smart Grid applications can take full advantage today of the enormous sunk and ongoing investments in commercial cellular technology: from automated meter reading to demand response (*i.e.*, the ability of the customer to alter energy usage through remote control of customer equipment based on, for example, time of use and critical peak pricing) to remote connects and disconnects of electric power to remote fault detection and isolation to net metering (*i.e.*, the means of monitoring energy from a customer's solar panel system or wind farm back to the utility grid).

To launch the Smart Grid broadly and rapidly, it will be far more cost-effective to take advantage of the substantial economies of scale and other benefits of cellular technology already in heavy use throughout America. There is no other available broadband communications technology that can meet the unique combination of requirements for the Smart Grid, including reliability, security, full coverage, and global harmonization and interoperability, other than today's cellular technology. Cellular technology offers highly attractive economies of scale as the underlying equipment is available from a wide array of vendors at very low costs.

Cellular technology can be used to meet the broadband needs of Smart Grid applications in two ways. *First*, existing commercial cellular networks can be used, thereby taking advantage

of the massive investments the wireless carriers have made and will continue to make. These virtually ubiquitous networks deliver high speed, low latency mobile broadband service where the overwhelming majority of Americans live, work, and travel, and these networks are constantly being expanded and upgraded. *Second*, if a particular utility determines that, notwithstanding the tremendous past, present, and future network investments by commercial cellular carriers, those networks will not meet their own requirements for reliability, coverage, performance, and security, they can acquire spectrum rights and build their own cellular wireless networks.

In fact, commercial cellular carriers are expanding their coverage every day. Also, to reach areas that would be unduly expensive to cover with terrestrial mobile broadband, Qualcomm has developed satellite-based mobile broadband technology, which will be integrated into the same wireless chipsets that support terrestrial mobile broadband. Mass-market, hybrid satellite-terrestrial devices using these chipsets will enable access to mobile broadband anywhere within the U.S. This satellite-based mobile broadband technology can be used to fill coverage holes in terrestrial mobile broadband networks. The result will be truly ubiquitous high speed wireless broadband coverage across the U.S., which may be necessary to cover the countless devices that are expected to access the Smart Grid, including those that will support the increased need for renewable energy and storage.

Beyond developing technology for universal mobile broadband coverage, Qualcomm is working to enable the use of mobile broadband for the Smart Grid in other ways. For example, several companies produce 3G-based modules using chips supplied by Qualcomm CDMA Technologies ("QCT"), the world's largest supplier of chips for wireless devices. These modules are very small in size and are embedded in computers, into dongles attached to

computers and other consumer devices, and a variety of machines and equipment to provide high speed wireless broadband connectivity for Smart Grid applications, among other uses.

In addition, QCT's Gobi module provides multi-mode mobile broadband connectivity so it can be used on *any* commercial 3G mobile broadband network. In this way, Gobi would permit a utility to use multiple 3G network technologies for Smart Grid applications and allow the provider to choose the most cost-effective 3G network in any given area. Gobi is particularly well-suited for several highly prevalent Smart Grid applications: (i) automated meter reading, particularly at the "concentrator" level, where the data aggregated from hundreds of homes are collected and transmitted to the utility; (ii) demand response systems, and (iii) remote fault detection and isolation.

Another QCT module, known as inGeo, uses Assisted GPS and wireless connectivity to report position location data from a very small, extremely low-power device. inGeo also allows for the simple integration of sensors that, for example, can measure pressure and temperature and report those readings back to a utility's network control center in near real time. This capability is perfect for remote monitoring, sensing, and control systems that support Smart Grid reliability improvements and limit the need for expensive site visits to remote sites.

Qualcomm hopes that the DOE will find this submission helpful as it reviews the current and projected communications requirements for sustaining and modernizing our power grid. As summarized above and as detailed herein, cellular technology should continue to serve an essential role in supporting the communications needs of our nation's 21st century power grid.

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In the Matter of National Broadband Plan (NBP) RFI: Communications Requirements

COMMENTS OF QUALCOMM INCORPORATED

Qualcomm Incorporated ("Qualcomm" or "Company") is pleased to provide these comments in response to the Request for Information ("RFI")[1] of the Department of Energy ("DOE" or "Department") associated with the energy and environmental recommendations in the Federal Communications Commission's National Broadband Plan ("NBP").[2] The RFI specifically seeks information relating to the communications needs of the electric utilities, including, but not limited to, the requirements associated with Smart Grid implementation.

As the DOE well knows, what makes the power grid smart is its ability to manage the bidirectional and end-to-end delivery of energy and information. Indeed, the impetus behind the Smart Grid is the need to improve power generation reliability and quality, enhance transmission efficiency, expand the use of renewable energy sources, and implement new load shifting and energy efficiencies on a customer by customer basis while increasing customer choice and overall awareness of electricity needs and consumption. Communications among a whole host

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1 *See* Department Of Energy, Implementing the National Broadband Plan by Studying the Communications Requirements of Electric Utilities To Inform Federal Smart Grid Policy: Request for information (RFI), 75 Fed. Reg. 26206 (May 11, 2010).

2 *See* FCC *Connecting America: The National Broadband Plan* (rel. Mar. 16, 2010) (hereinafter "FCC NBP") at 245-59.

of machines, equipment, devices, systems, and people will be needed to realize these goals.

In these Comments, Qualcomm explains the vital role that commercial cellular networks and the underlying communications technologies used on such networks can serve to achieve the rapid, wide scale, and cost-effective implementation of the Smart Grid. Cellular technology is uniquely well-positioned to satisfy the varied needs of electric utilities, for, as the DOE RFI acknowledges, there is no "one size fits all" solution for our nation's electric utilities.[3] As described herein, there are a number of interesting cellular-based and other communications products and technologies that can support successfully a broad collection of Smart Grid applications and uses today and well into the future.

I. Cellular Communications Technology And Networks Are Essential To The Successful Deployment Of The Smart Grid

Cellular communications technology and networks already are supporting vital components of the Smart Grid architecture. Because cellular technology is scalable and flexible, Qualcomm expects that the technology will continue to support the growth and evolution of the Smart Grid.

A. Overview of Qualcomm's Role In The Development Of Cellular Technology

Qualcomm is a world leader in developing the innovative cellular technology that is used for wireless broadband communications and to enable products and services based on that technology. Qualcomm is the pioneer of code division multiple access ("CDMA") technology, which powers the so-called 3G cellular networks operated by Verizon Wireless, Sprint, AT&T, T-Mobile, and other wireless carriers throughout the U.S. Today, these networks enable many millions of Americans, in rural, suburban, and urban areas alike, to enjoy advanced, high speed,

[3] *See* 75 Fed. Reg. 26206, 26207.

and ubiquitous mobile broadband services.

Indeed, Qualcomm broadly licenses its technology worldwide to over 180 handset and infrastructure manufacturers that make infrastructure equipment, handsets and other consumer devices, and develop applications for 3G cellular networks. Qualcomm also licenses technology that will be used in the next generation of cellular networks to be based on the so-called Long Term Evolution ("LTE") air interface.

Qualcomm's chip division, Qualcomm CDMA Technologies ("QCT"), is the world's largest provider of wireless chipset technology that is used in cell phones and consumer electronics devices. QCT's chipsets support all the major frequency bands, the full gamut of standardized, globally harmonized wide area mobile broadband and cellular technologies, Assisted GPS (*i.e.*, Global Positioning System), Bluetooth, Wi-Fi, and many operating systems, such as Android, Windows Mobile, Symbian, and Qualcomm's Brew Mobile Platform. QCT produces chips that the world's leading equipment manufacturers integrate into devices based on 3G technology. QCT also produces chips based on LTE that incorporate one or more 3G technologies to ensure the widest coverage for LTE/3G devices.

Of particular note for Smart Grid applications, several companies produce 3G-based modules using QCT's chips. These modules, which have a very small form factor, are embedded into: (i) computers and other consumer devices, (ii) dongles that can be attached to computers and other devices; and (iii) a variety of machines and other equipment to provide high speed wireless broadband connectivity. This third form of cellular communications, which is referred to as machine-to-machine ("M2M"), is a major focus of Qualcomm's and its communications partners' forward-looking communications network infrastructures, for, among other things, Smart Grid applications.

3G cellular networks today blanket most of the United States with wireless broadband service due to many billions of dollars in capital and operating expenditures. According to FCC's National Broadband Plan, approximately 98% of the US population is covered by at least one carrier's 3G wireless broadband network.[4]

Two different technologies are used in cellular networks to support mobile broadband service. *First*, Verizon Wireless, Sprint, and other carriers use a technology called EV-DO Revision A. That technology supports downloads of up to 3.1 megabits per second ("Mbps") and uploads of up to 1.8 Mbps. *Second*, AT&T, T-Mobile, and other carriers use a technology called HSPA (*i.e.*, "High Speed Packet Access"). The latest version of HSPA technology deployed in the U.S. enables downloads of 7.2 Mbps and uploads of 1.8 Mbps to 5.6 Mbps. To the extent that Smart Grid applications require real-time data transfer as well as large downloads or uploads, these currently deployed networks support such services over very wide coverage areas. If lower speeds are sufficient for certain applications, the networks also are well able to meet those needs.

Worldwide, 658 wireless carriers have deployed 3G technology. Such wide-scale deployments have created enormous demand for 3G equipment, both network infrastructure and consumer devices, thereby creating economies of scale that bring down prices for carriers and ultimately consumers. There are currently over 1 billion people in the world who use a 3G device. By 2014, the number of 3G subscribers is projected to reach approximately 2.7 billion, and, at that time, most 3G subscribers will be using an EV-DO or HSPA-based device.[5] This

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4 *See* FCC NBP at 22.

5 This data is from Wireless Intelligence, a database which defines a subscriber (or a "connection") 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."

strong demand creates an ever-expanding market for 3G-based devices, including 3G phones, smartphones, consumer electronics devices, and laptops. The sheer number and variety of these devices is increasing every day. Many consumer devices, including tablet computers and laptops, also contain embedded 3G capability that allow consumers to access Smart Grid applications.

The number of companies manufacturing devices based on 3G wireless broadband technology also continues to increase: 111 companies have manufactured at least one device based on an EV-DO technology, and more than 169 companies have manufactured at least one device based on HSPA or an earlier, compatible 3G technology. Thus, there is a wide-ranging eco-system of commercial mobile broadband equipment and device manufacturers ready to support the next generation of Smart Grid applications.

Consumers and private businesses are not the only groups that rely heavily on 3G cellular technology. Public safety agencies, which previously used narrowband land mobile radio technology, now acknowledge the need for ubiquitous data connectivity supported by wireless broadband service and are turning to cellular technology. Indeed, the Public Safety Spectrum Trust currently is advocating for the creation of a nationwide wireless broadband network based on cellular technology.[6]

One other factor driving the increased reliance on cellular technology is the fact that commercial cellular networks are designed to be resilient so they continue to operate reliably during emergencies and surge scenarios. Wireless carriers invest billions of dollars each year to maintain and improve this resiliency and reliability, and Smart Grid applications can in many instances take advantage of this high level of service.

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[6] *See* http://www.psst.org/index.jsp.

Smart Grid applications will proliferate rapidly, broadly, and in a cost-effective manner if they take advantage of the economies of scale already attained by cellular technology. Indeed, the failure to do so could severely limit and delay the implementation of the Smart Grid and potentially drive up costs to uneconomic levels.

B. Cellular Technology Is Continually Being Upgraded to Deliver Faster Data Rates, Lower Latency, and Greater Capacity

Qualcomm and other companies are constantly working on upgrades and enhancements to the EV-DO and HSPA technologies that power today's cellular networks as well as new fourth generation ("4G") LTE technology. Smart Grid applications should take advantage of the continued innovations that will deliver mobile broadband at faster data rates and without undue latency and will expand the coverage and capacity of such mobile broadband networks.

1. Faster Data Rates

The next upgrades to the EV-DO and HSPA 3G technologies will result in dramatically faster wireless uploads and downloads. EV-DO Revision B will initially 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. Notably, this upgrade will not require any new infrastructure. Future upgrades will support even faster uploads and downloads. The net result of these upgrades will be wireless broadband service with data rates that are ten times faster than today's fastest EV-DO-based networks. The next upgrade to HSPA is called HSPA+ (also called HSPA Evolved – HSPA Release 7). This upgrade will support peak downloads of 28 Mbps and uploads of 11 Mbps. Future releases of HSPA will support even faster uploads and downloads.

In addition, Qualcomm and many other vendors around the world are actively working on LTE, the 4G technology. LTE, which will be deployed in the U.S. later this year, uses wider bandwidths than EV-DO or HSPA. QCT's chips will support both LTE and 3G so that devices

can use either technology to support a carrier's network build-out which typically occurs in stages over multiple years.

2. Wider Coverage

Wireless cellular carriers are constantly expanding their networks so that they cover greater geographical areas. In addition to those efforts, Qualcomm has developed technological solutions to fill coverage holes in mobile broadband networks to enable truly ubiquitous mobile broadband service across the entire United States.

Last year, Qualcomm announced that in conjunction with three licensees of mobile satellite systems, namely, Skyterra, ICO, and TerreStar, Qualcomm would develop chips to support hybrid satellite-terrestrial phones. These phones would use a terrestrial 3G or LTE network where service is available and would use a satellite network where a terrestrial network is not available.[7] Thus, these chips will enable cell phones, and perhaps Smart Grid devices embedded with these chips, to work in areas where cellular coverage is spotty or non-existent.

Smart Grid applications can begin now with the extensive coverage provided by commercial mobile broadband networks, which is expanding on a daily basis. Ultimately, however, if complete mobile broadband coverage across the entire nation is necessary for all Americans to enjoy the benefits from the Smart Grid and for the Smart Grid to flourish, Qualcomm offers a solution.

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[7] *See* "SkyTerra's Mobile Satellite Ventures, ICO Global Communications, and Qualcomm Sign Groundbreaking Technology Agreement Enabling First-Ever Integration of Satellite Communications into Mass Market Cellular Handsets and Devices," (Sept. 22, 2008) *and* "TerreStar Signs Technology Agreement with Qualcomm to Broaden Market Opportunity for Conventional-sized Integrated Satellite-Cellular Handsets and Devices," (Dec. 11, 2008), *available at* http://www.qualcomm.com/news/releases/2008/09/22/skyterra-s-mobile-satellite-ventures-ico-global-communications-and-qualcomm and http://www.businesswire.com/portal/site/home/permalink/?ndmViewId=news_view&newsId=20081211006242&newsLang=en.

3. Lower Latency

The data rate, by itself, only deals with one aspect of the user experience. Latency, which measures the time delay a user experiences in waiting to communicate via a network, or, in the case of a Smart Grid application, the time it takes to complete a machine-to-machine communication, is another important factor in a broadband communications network. Many Smart Grid applications, such as those that need real-time data communications, will need low latency, which is something cellular technology supports on a routine basis. Improving data rates and reducing latency are effectively a unified concept in broadband networks. As a result, continuing such improvement is another important aspect of Qualcomm's R & D efforts.

4. Expanded Capacity/Improved Performance

Smart Grid applications, if deployed broadly on existing commercial mobile broadband networks, may consume considerable network capacity. While allocating additional spectrum is, of course, a solution, new spectrum cannot be allocated and auctioned overnight. Because of this, Qualcomm has developed several technologies (*e.g.*, advanced interference cancellation techniques)[8] that expand the capacity of mobile broadband networks to ease the crunch that could occur with the rapid proliferation of Smart Grid and other broadband applications.

In addition, significant future improvements to wireless networks will come from optimizing the layout (or topology) of such networks. Wireless networks can deliver faster

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[8] The throughput and capacity of cellular networks can be increased substantially via interference cancellation. *See* "ZTE & Qualcomm Collaborate to Boost UMTS System Performance - Interference Cancellation Technology Increases Uplink Data Throughput and Capacity By Up To 60 Percent" (July 5, 2009) *available at* http://www.qualcomm.com/news/releases/2009/07/05/zte-and-qualcomm-collaborate-boost-umts-system-performance. *See* also "Qualcomm and Huawei to Cooperate on Advanced UMTS Node B Receiver Technology - Uplink Interference Cancellation to Significantly Increase Data and Voice Throughput," (Feb. 4, 2008) *available at* http://www.qualcomm.com/news/releases/2008/02/04/qualcomm-and-huawei-cooperate-advanced-umts-node-b-receiver-technology.

downloads and uploads for an increasing number of users by moving base station transmitters closer to the users. This not only means a greater number of cell sites, but also much smaller cells. In this regard, Qualcomm is developing so-called "femtocells" – mini-base stations that use a wireline connection to extend the reach of 3G mobile broadband service within a small area, such as within a home or office. Operators can use repeaters and femtocells to enhance the overall capacity and coverage of their mobile broadband networks.[9]

5. Support for Full Mobility

As noted above, the Smart Grid will support automated outage detection and isolation, and it also will enable proactive maintenance of utility assets. To obtain the maximum benefits from the availability of such information, the information must be readily available to a mobile workforce to facilitate efficient workforce management and rapid dispatch. Relatedly, for security reasons, certain sites may be equipped with cameras and intrusion detection capabilities that trigger remote alarms. Again, real-time communications is essential so this information is collected and delivered in a timely manner. Commercial mobile broadband networks already support full vehicular mobility and mobile workforces in many other industries.

6. Security & Reliability

Wireless cellular 3G technologies and LTE technology are highly secure and reliable. The fact that more than 20% of U.S. households now rely on wireless cellular service as their sole source of telephone service, something that was unthinkable only a few years ago, and that so many Americans rely upon 3G-based mobile broadband service, demonstrates the high degree of reliability and security that public cellular networks have achieved.

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[9] *See* "Qualcomm Adds Femtocell Chipsets to Technology Portfolio," http://www.qualcomm.com/news/releases/2009/090216_Qualcomm_Adds_Femtocell_Chipsets_to_Technology_Portfolio.h (Feb. 16, 2009).

C. Mobile Broadband Chipsets & Modules for Smart Grid Applications

Qualcomm offers several wireless broadband products that implement cellular technology with low latency, among the other benefits noted above, to produce some important benefits for Smart Grid applications. These products, which use standardized physical and electrical interfaces that are implemented today in mobile broadband data cards, give Smart Grid device developers a key starting block so they need not start from scratch in their development.

1. Gobi Solution for the Widest Possible Connectivity

The first such product addresses the need for Smart Grid applications to use devices that can access multiple wireless network technologies so that the applications can take advantage of the non-overlapping coverage of multiple wireless broadband networks, thereby enabling utilities to attain the widest possible wireless broadband coverage at the lowest possible cost. The product, which is called Gobi, is a global mobile broadband and GPS (Global Positioning System) embedded solution for wireless devices. A Gobi-based Smart Grid device can operate on mobile broadband networks throughout the world. The original Gobi solution included a Qualcomm chipset, GPS capability, associated software and API (application programming interface), and a reference design for a data module supporting both the EV-DO Revision A and HSPA mobile broadband air interfaces.

Several months ago Qualcomm announced its second generation embedded Gobi module, which will launch commercially later this year. This module 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 notebook computers, it is now being embedded into other devices, such as e-Readers, that support worldwide mobile broadband connectivity.

For Smart Grid uses to proliferate broadly, rapidly, and cost-effectively, devices will need to access multiple networks and multiple technologies on a globally harmonized, standardized basis. The Gobi platform is designed for such usage. Gobi is well suited to support AMI (or automated meter infrastructure), which needs to have broad coverage, and residential gateways, which provide connectivity to multiple devices within a home to enable load shedding at peak periods.

Gobi modules will provide important business benefits for utilities implementing Smart Grid applications by enabling utilities to select from competing networks no matter what technology the networks are based upon and thus obtain the best possible cellular service at the lowest possible cost. These modules offer economies of scale because they are standardized for use on a variety of networks and device types. For all of these reasons, Qualcomm's Gobi platform can help drive the rapid and broad proliferation of Smart Grid applications.

2. inGeo Solution for Wireless Monitoring & Tracking

inGeo is another wireless broadband product that leverages cellular technologies and networks for Smart Grid applications. The inGeo platform is a complete end-to-end solution for accurate, real time tracking and reporting of location and other data. It is designed for use in wireless monitoring, tracking, and safety applications. inGeo and its associated server control technology provide accurate near real time location data that can be used for wireless tracking, monitoring, and safety applications. At less than 1,000 mm^2 in area, the inGeo module is one of the industry's smallest form factors. It also incorporates a Bosch SMB380 3-axis accelerometer for positioning info and 2.4 GHz ZigBee transceiver to provide short range connectivity.

inGeo is extensible for both hardware and software. With relative ease, sensors can be integrated and drivers installed into a device containing InGeo. The platform even supports

updates of firmware over the air and a variety of standards. inGeo also supports the ability to customize the device by upgrading applications over the air using Qualcomm's BREW Application Distribution System. Not only does this ensure the longevity of a device that may be in the field for 20 years or longer, but BREW also has implemented strong security principles of authentication and authorization to ensure the continued robustness of the Smart Grid.

Critically important Smart Grid applications will certainly involve remote monitoring and tracking, and include control of electricity transmissions and distribution to address renewable intermittency, and increased customer participation in demand management activities. Having wireless connectivity integrated with sensors at remote locations also will ensure that the system is secure, supports end-to-end integration, and manages customer distributed energy resources.

D. Cellular Technology Is Being Used Today For Smart Grid Applications

Today, a number of Smart Grid applications are being successfully supported via commercial mobile broadband technology. One such example is nPhase, Qualcomm's joint venture with Verizon Wireless. nPhase is engaged in a series of ongoing Smart Grid pilot programs with ABB, a leader in power and automation technologies, involving ABB's utility customers like Con Edison of New York. By coupling real-time wireless connectivity with ABB's asset monitoring solution for high voltage circuit breakers, the Smart Grid program is showing that utilities can improve grid reliability by preventing outages and reduce operating costs by maintaining environmental compliance.[10]

An ABB solution, known as Circuit Breaker Sentinel, gathers critical information from a utility asset to determine the health of the electrical transmission equipment, while nPhase

[10] *See* "nPhase Powers ABB's Asset Monitoring Solution," (Sept. 1, 2009); http://www.reuters.com/article/pressRelease/idUS188177+01-Sep-2009+GNW20090901.

securely extracts crucial data via the cellular network and forwards the data to ABB's Asset Insight hosted web platform where the data is reviewed and acted upon as appropriate. This type of end-to-end solution would not be possible without a high speed, reliable, ubiquitous cellular connection. Qualcomm believes that such connectivity will drive the rapid proliferation of the Smart Grid.

Verizon Wireless also is working with Itron to use its 3G network for advanced metering and with Ambient Corporation to facilitate a number of Smart Grid applications.[11] Meanwhile, AT&T has teamed with SmartSynch, a leader in the development of Smart Grid applications using commercial wireless networks, to offer a suite of smart grid solutions supported by the AT&T wireless network.[12] These initiatives and others soon to be underway that take full advantage of wireless cellular connectivity show that commercial networks are well positioned to drive the rapid proliferation of Smart Grid applications.

E. Cellular Networks Can Support The Successful Rollout Of Electric Vehicles

As explained above, support for Electric Vehicles ("EVs") will certainly be an important part of the Smart Grid. The rapid proliferation of EVs is not likely to be achieved, however, without the close integration of mobile wireless connectivity into the Smart Grid. Motorists will need mobile connectivity to help them locate charging stations while travelling. Also, utilities will need such connectivity to coordinate the storage of intermittent energy generation for

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[11] *See* "Verizon Wireless and Ambient Corporation Join Forces to Offer Utilities Smart Grid Communications Solutions," (Mar. 4, 2009) *available at* http://www.reuters.com/article/pressRelease/idUS133942+04-Mar-2009+PRN20090304; Verizon Wireless and Itron Combine Forces to Harness the Power of Wireless Technology in Advanced Metering and Smart Grid Market," (Apr. 1, 2009) *available at* http://news.vzw.com/news/2009/04/pr2009-04-01a.html.

[12] See "AT&T to Offer Wireless Smart Grid Technology to Utility Companies," (Mar. 17, 2009) *available at* http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=26613.

batteries and to aggregate battery storage capacity. And, vehicle manufacturers will need wireless broadband to manage energy use in order to maximize the lifespan of the battery system. Charging stations, which may ultimately be located throughout the country, also will require wireless connectivity so that utilities can manage their power loads.[13]

Indeed, many cars on the roads in the U.S. today already have cellular connectivity embedded into them. OnStar provides telematics services, including roadside assistance, directions and the like, to cars by using the embedded cellular technology. Other telematics providers similarly use cellular connectivity. Earlier this year, Qualcomm announced that it is working with Audi to integrate QCT's 3G chips into 2010 Audi A8 vehicle models.[14] Leveraging similar types of mobile broadband connectivity for EVs and associated smart charging stations makes perfect sense.

F. Cellular Technology Also Can Reliably Support The Multiple Residential Consumer Gateways That Will Comprise The Smart Grid

Qualcomm believes that the Smart Grid will require a number of different residential gateways – each of which can be seamlessly supported via wireless cellular technology. For example, home energy management platforms will require ubiquitous, very low latency connectivity in order to interact with real time price information from utilities. Such platforms will be essential to improve energy efficiency, and they will require much higher bandwidth

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[13] It may even be possible to leverage the battery storage capabilities of EVs to help meet certain peak events. *See* Bob Heile, "Smart Grids for Green Communications, IEEE WIRELESS COMMUNICATIONS (June 2010) ("EVs can charge during low use periods, and then supply power to the grid during periods of high demand." It may assist in power management and be significantly more environmentally friendly for utilities, with the customer's okay, to "selectively target vehicles with sufficient spare power to cover a peak event.").

[14] *See* "Qualcomm and Audi to Make Connected Car a Reality in 2010," (Feb. 10, 2010), *available at* http://www.qualcomm.com/news/releases/2010/02/15/qualcomm-and-audi-make-connected-car-reality-2010.

communications than, for example, typical smart meters.

In addition, the technical requirements to support smart meters will be very different from those necessary to support EVs and charging stations. Smart meters in the residential setting will require much less bandwidth and operate at generally predictable hours. On the other hand, EVs and smart charging stations will require a low latency, relatively high bandwidth connection, accessible at all hours of the day and night. Because residential consumer gateways will need to support a wide range of functionality, they will be best supported via separate cellular connections to the mobile broadband network, which could be managed seamlessly by commercial mobile carriers.

CONCLUSION

The future Smart Grid requirements of consumers, businesses, and electric utilities can and should be successfully supported with cellular wireless broadband technologies. As explained herein, Qualcomm and its partners have designed wireless network equipment as well as M2M and consumer devices that can seamlessly serve the diverse needs of the Smart Grid.

Respectfully submitted,

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