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Dear Ms. Chia:

Qualcomm Incorporated appreciates the opportunity to provide comments on Infocomm Development Authority of Singapore's (IDA) Consultation Paper on Net Neutrality ("Consultation Paper").

Qualcomm is a world leader in developing innovative digital wireless communications technologies and enabling products and services based on the technologies that it develops. It is one of the leading enablers of 3G wireless as well as other wireless solutions and services, including those based on Code Division Multiple Access (CDMA) and Orthogonal Frequency Division Multiplexing (OFDM). The 3G CDMA family of wireless technologies, which includes CDMA2000/EV-DO and Wideband CDMA/High Speed Packet Access (HSPA), currently enables over one billion subscribers around the world to enjoy advanced, high speed, and ubiquitous voice and mobile broadband data services.¹ Qualcomm is also a leading contributor to LTE technology and standards development. Qualcomm broadly licenses its technology to over 180 manufacturers around the world that make infrastructure equipment, handsets and other consumer devices and develop applications based on the 3G CDMA and HSPA air interfaces.

Qualcomm CDMA Technologies (QCT), a division of Qualcomm, is the world's largest supplier of wireless chipsets.² QCT has helped lead the diversification of mobile broadband into many new types of mobile broadband enabled devices, ranging from smartphones, PC cards and USB dongles to embedded laptops, netbooks, tablets, gaming devices and a wide variety of pocketable computing devices with mobile broadband capability. Many of these devices are ultra-portable, personalized, easy-to-use, and powered all day on a single battery charge delivering a unique mobile broadband experience different from other types of devices on the market today. These types of devices are already used today by millions of wireless users and provide low-cost, mobile access to the Internet and to broadband applications.

Other divisions and subsidiaries of Qualcomm develop innovations in other aspects of wireless. Qualcomm MEMS Technologies, Inc., a wholly-owned subsidiary, has developed the world's first MEMS

¹ Wireless Intelligence for the quarter ending June 30, 2010.

² http://www.qualcomm.com/who_we_are/businesses/index.html.

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 Internet Services offers software platforms which aim to bring any application to any device on any network in any location. These platforms began with BREW, a thin software layer which was the first platform that enabled the downloading of applications into wireless phones. More recently, Qualcomm Internet Services began offering Plaza Mobile Internet, a platform that 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, giving wireless subscribers a uniform and easy shopping experience on a wide variety of wireless devices. Finally, Qualcomm has formed a joint venture with Verizon Wireless by the name of nPhase. The joint venture will provide machine to machine communications (M2M) and smart service offerings across a wide variety of market segments including healthcare, manufacturing, utilities, distribution, and consumer products over 3G mobile broadband networks. Large scale M2M deployments are much more complex than what is commonly understood and nPhase removes these complexities through a simple, secure, reliable M2M cloud computing platform that proves secure bi-directional communications across 3G networks and is agnostic to devices and applications. The joint venture was announced in July 2009 and is aimed at accelerating the adoption of global M2M deployments.

General Policy Approach

Qualcomm appreciates the IDA's efforts to gather information and refine its approach to network neutrality. We agree that the policies and regulations put in place by IDA have worked well to promote Internet development and increased access by consumers. IDA's "three-pronged approach" has been successful in balancing the needs of consumers with the flexibility businesses seek to develop innovative business models and manage their traffic to reduce congestion and preserve appropriate levels of service.

As an initial matter, Qualcomm believes that IDA has adopted the right general approach to net neutrality by focusing on improving competition and access, and taking a light regulatory approach to net neutrality. Competitive pressures in Singapore provide the necessary market discipline to generally prevent access providers from engaging in "non-neutral" behavior. And IDA is correct to point out that even if a provider does engage in some discriminatory or anti-competitive practices, the level of competition provides consumers a way to punish those providers by switching to a carrier that better meets their needs.³

Going forward, Qualcomm sees no need for major changes to IDA's approach. As the Consultation Paper notes, the policies and regulations governing Internet access and net neutrality must balance consumer and industry needs. For consumers, this means protecting and advancing user access to the lawful content of their choice and making sure that consumers have appropriate information on which to base purchasing decisions, including clear explanations of pricing, network management policies and the speeds that can be expected. For Internet access and content providers, this means having the ability to develop innovative business models and the flexibility to manage network resources in order to ensure that all customers get the best possible Internet experience, given the constraints imposed by network traffic patterns and system architectures. In this context, given the dynamic and rapidly changing nature of the Internet (the incredible rise of video streaming services) and the lack of any real net neutrality "problem," Qualcomm believes that IDA should seek to continue

³ Consultation Paper at 9.

policies that reward innovation and place as few constraints as possible on providers seeking to meet market demands.

Mobile Broadband and Possible Future Net Neutrality Developments

In the comments below, Qualcomm focuses its attention on the issues associated with net neutrality in the wireless and mobile broadband context. Mobile broadband is growing incredibly quickly across the world, thanks in large part to the rapid spread of smartphones, netbooks, e-readers and now tablets. Given this rapid increase in demand, coupled with the unique characteristics of mobile broadband systems (including the spectrum constraints now faced by many operators), Qualcomm believes that it is particularly important to recognize and take into account the differences between wireline and wireless systems as IDA considers changes to its approach to net neutrality. Specifically, given the more challenging operating environment for mobile networks, and the corresponding need for more intensive network and traffic management, net neutrality rules that might be applicable in a wireline context could be extremely detrimental in a wireless and mobile context.

Growth of Mobile Broadband

Mobile telephony and mobile broadband demand and consumption have been growing at an unprecedented pace. Currently, 3G technologies are providing services to more than one billion subscribers worldwide and, by 2013, the number of 3G subscribers is projected to reach approximately 2.4 billion.⁴ IDA indicates that between April 2009 and April 2010, 3G subscriptions grew by about 25 percent while High Speed Packet Access (HSPA) subscriptions grew by 240 percent.⁵ ABI research estimates that worldwide wireless data traffic grew by 5,800 percent during the two year period from 2006 to 2008; and only slightly decreased growth rates of 4,500 percent are forecast over the next few years.⁶ On a worldwide basis, ABI Research now projects that monthly worldwide mobile data traffic in 2014 will exceed the total for all of 2008.⁷ With respect to individual carriers, AT&T in the United States reported in February 2010 that its mobile broadband traffic had grown more than 5,000 percent over the past three years.⁸ This strong demand creates an ever-expanding market for 3G-based devices, including 3G feature phones, smartphones, PDAs, tablets, e-readers, gaming devices, consumer electronics devices, and laptops.

Qualcomm licenses its technology to over 180 companies that manufacture infrastructure and subscriber devices (including phones, smartphones, smartbooks, consumer electronic devices, and the like) that provide connectivity to the internet. These companies span the entire wireless industry. The number of companies manufacturing devices based on mobile broadband technologies, such as HSPA and LTE, continues to increase, along with the different types of devices themselves. In particular, 18 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 consumers in urban, suburban, or rural areas and of all age groups, including both students and teachers, 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.

⁴ Wireless Intelligence estimates as of July 19, 2010 for the quarter ending June 30, 2010.

⁵ See IDA Statistics on Telecom Services and IDA 3G Consultation Paper at para 3.

⁶ <http://www.abiresearch.com/press/1466-In+2014+Monthly+Mobile+Data+Traffic+Will+Exceed+2008+Total>.

⁷ See "Report: 2014 Monthly Wireless Data Traffic to Exceed Total for 2008," Wireless Week, August 4, 2009.

⁸ <http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30536>.

Rapid growth can also be seen with respect to the usage of particular devices. For example, Amazon announced that last December 25th, more customers purchased Kindle books than physical books, and in the case of books offered on both the Kindle and on Amazon's website, Kindle sales are now 48% of the total, up from 35% in May, a much faster growth rate than Amazon expected.⁹

Finally, with respect to wireless applications, the rate of growth in usage is similarly impressive. As of October 2008, Facebook had just 6 million mobile users.¹⁰ By February 2009, that number had risen to 25 million mobile users. And as of October 2009, Facebook had 65 million mobile users.¹¹ Nielsen projected that the number of people who use social networks from smartphones grew in July 2009 was 187% more than those who did so in July 2008.¹² In June 2009, You Tube reported that uploads from mobile phones grew by 1700% during the first six months of the year.

Need for flexible network management practices

Against this background, carriers are doing their best to keep up with demand. However, wireless carriers face challenges that their wireline counterparts do not. In the first place, as IDA is well aware, wireless network operators face unique constraints on how much bandwidth they can supply. Unlike a fiber optic system, for example, where changing the electronics at the ends of the fiber can radically improve capacity, wireless operators cannot add bandwidth whenever they would like. Wireless networks operate on licensed frequency spectrum which is finite and limited. If a wireless network becomes congested in a given area, the operator may not own any more spectrum in the same area. And even if it does own spectrum in such area, the operator cannot just add capacity with the flick of a switch. Wireless operators worldwide invest billions of dollars each year in the costly, time consuming process of expanding wireless coverage and capacity where they do own spectrum. Notably, the Federal Communications Commission in the United States, in adopting on December 21st 2010 new rules for the Open Internet, recognized the important differences between mobile and fixed broadband; unique technical issues involving spectrum and mobile networks, the stage and rate of innovation in mobile broadband; and market structure.¹³

Originally, when wireless networks moved from analog to 2G digital air interfaces and then again from 2G to 3G, large gains in capacity (upwards of 20 to 30 times analog) were achieved. But, gains of those orders of magnitude are no longer technologically possible simply through deployment of a new air interface, i.e., moving to the newest enhanced 3G technologies, such as multi-carrier HSPA+ and LTE. The undeniable fact is that the speed of an individual wireless radio link is approaching the theoretical limit at the same time that usage of wireless networks is exploding. As a result, operators are essentially forced to provide more capacity and throughput with no increase in available resources. This fact makes it all the more important for operators to have the flexibility to manage their traffic—on a real-time basis—as they decide best meets the needs of their customers as a whole.

⁹ See "Amazon Kindle Is the Most Gifted Item Ever on Amazon.com," December 26, 2009, at <http://phx.corporate-.net/phoenix.zhtml?c=176060&p=irolewsArticle&ID=1369429&highlight=>. "New Amazon Kindle to Download Books Beyond U.S.," October 7, 2009, New York Times, available at <http://www.nytimes.com/2009/10/07/technology/companies/07amazon.html>

¹⁰ See "Marketers Salivating Over Smartphone Potential," October 21, 2009, http://www.usatoday.com/tech/news/2009-10-20-social-network-smartphone_N.htm.

¹¹ Id.

¹² Id.

¹³ See Statement of FCC Chairman, Julius Genachowski, December 21st 2010.

Qualcomm has developed, or is developing, various techniques to increase the capacity of mobile broadband networks. For example, Qualcomm and its partners have developed interference cancellation techniques for both the downlink and uplink; software and hardware upgrades to increase voice capacity; and MIMO and other smart antenna technologies, which can also increase wireless capacity to some degree. Qualcomm and its partners are also working on facilitating the use of a denser wireless network topology based on the widespread deployment of femtocells and picocells to achieve greater frequency reuse. This technology will increase uplink capacity and performance.

Importantly, the move to a denser topology will require even more sophisticated network and traffic management systems and approaches to control the flow of traffic and maximize the efficiency of the networks. Without the flexibility to properly manage these new networks, operators would be constrained from getting the most out of them. In the end, advances in technology will solve only part of the capacity and throughput problem. Better management techniques will also be required to help manage the rapid growth in wireless broadband Singapore and world are now experiencing.

Although technology developments can help ease capacity constraints, rapidly increasing demand is making this much more difficult. Anticipating how future demand for mobile data traffic will impact existing wireless and mobile networks can be challenging. It is clear, however, that the phenomenal growth in traffic will put more pressure on current networks as more users adopt Internet-enabled wireless devices, increase their data consumption over each device and substitute wireline for wireless and mobile broadband. While new technologies provide for much greater spectral efficiency and throughput rates that will help to offset strains on existing networks, the rising demand for network capacity will outpace technological advances of currently deployed networks. The progression to LTE and LTE-Advanced networks will only intensify the demand for mobile broadband applications and services, as new applications and devices take advantage of these advanced networks.

The development of 'bandwidth efficient' applications and browsing services will also be important to sustain the explosive growth of mobile internet. Mobile applications can have largely different bandwidth consumption patterns even when offering similar services. Information regarding the average and instantaneous bandwidth consumption of applications is currently not transparent to internet users. Given that operators are now moving towards tiered mobile broadband offerings and data plans, the development of 'bandwidth efficient' applications will become increasingly more relevant to mobile internet users.

The IDA's current regulatory regime for mobile broadband has facilitated a wide range of business models and uses for mobile broadband-enabled devices. In order to offer increased choices to consumers, the IDA must continue to allow the scarce spectrum resources to be conserved via any reasonable economic and technical means.

In conclusion, Qualcomm believes that the IDA is already pursuing the right policies that address net neutrality concerns in a way that balances consumers' needs and industry's drive for innovation. Going forward, as it continues to monitor developments in Singapore and beyond, we urge IDA to be mindful of the unique constraints faced by wireless carriers as they confront an unprecedented rise in traffic on their networks, and to recognize that net neutrality rules that may or may not make sense for wireline carriers have the potential to undermine the efforts wireless broadband providers are making to manage traffic and keep quality levels high for all customers. The imposition of network neutrality regulations upon mobile broadband connectivity may stifle the future, successful growth of a critically important sector of Singapore's economy.

Should you have any questions or comments on this submission, please do not hesitate to contact me at +852 6348 6687 (mobile) or juliewelch@qualcomm.com.

Sincerely,

A handwritten signature in blue ink that reads "Julie Garcia Welch". The signature is written in a cursive, flowing style.

Julie Garcia Welch
Senior Director, Government Affairs
Southeast Asia & Pacific

cc: John Stefanac, Vice President & President, Southeast Asia & Pacific, Qualcomm International Inc.