Ofcom consultation on: "Promoting investment and innovation in the internet of things"

Qualcomm response
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INTRODUCTION

Qualcomm welcomes the opportunity to share its views with Ofcom on the Internet of Things, its applications, services and technologies, with the aim to foster its rapid take-up and to help unlock new business models and industry partnerships to deliver significant benefits for consumers.

Wireless connectivity is becoming integrated into everything from cars, smart meters and watches to medical devices. In fact, the current forecasts are that there will be more than 25 billion connected devices by 2020[1]. With so many connected devices reaching so many facets of life, you can see why Qualcomm envisions the Internet of Everything (IoE). At Qualcomm, we are continuously innovating and investing in R&D to invent technologies that enable all these devices to have ubiquitous connectivity, while meeting essential requirements for operators and consumers such as reliability, interoperability, security and quality of service. The innovation and investments of Qualcomm and our many partners are crucial to the development and proliferation of the IoE.

The IoE will be heterogeneous: indoors and outdoors, short and long range, mains and battery powered, low and high data rates, encompassing devices ranging from smart computing products to more basic machines with communication capabilities, which all have in common the ability to connect with each other and/or with the network, enabling many new verticals ranging from healthcare, smart grid, smart transportation to the connected home. As a result, the IoE requires interoperable and scalable ecosystems that will considerably drive demand for more spectrum. A holistic spectrum regulatory approach, encompassing licensed, unlicensed and licensed shared access (LSA) regimes, will therefore be needed to meet the variety of demand and the diversity of requirements to maximize the societal and economic benefits.

[1] Machina Research, September 2013, White Paper - M2M platforms are re-cast for the age of the 'Internet of Things'

THE SPECTRUM DIMENSION OF THE INTERNET OF EVERYTHING

The total number of mobile connections is today estimated at over 6.6 Billion. Mobile connectivity creates a platform for innovation that has reach like no other technology. Mobile will therefore be at the core of the IoE. Mobile data traffic has been growing exponentially and now the industry is preparing for an astounding 1000x increase. Qualcomm is leading the charge through its technologies, path breaking innovations, and market leading products in preparing the industry to meet this demand. The availability of additional harmonized spectrum and innovation in spectrum management are key cornerstones. We believe in a strong cooperation with regulators and the whole industry to achieve this objective.

IoE requirements in terms of data security, resilience of networks, continuity of service, penetration and power consumption will vary significantly per application and devices. It will require different radio links and spectrum approaches, corresponding to those diverse operational requirements (uninterrupted vs. intermittent use; real time vs. delayed communication; command/control vs. collection of information; cloud based vs. network edge processing and storage), bandwidth usage (high vs. low data rates; high vs. low density), Quality of Service (security, resilience and robustness vs. best effort), coverage (wide area vs. short range; deep indoor vs. outdoor) and finally enabling ultralow power consumption and very high battery life (10 years plus for certain devices).

From a spectrum management perspective, the challenge remains to make additional spectrum available to meet this IoE demand and there are three ways to achieve this: the traditional licensed approach for exclusive use, through auctions of cleared spectrum, which remains the industry's top priority; the unlicensed approach, in which spectrum is shared among users without anyone having priority, such as 5 GHz; and, finally, a new approach called LSA (Licensed Shared Access) which unlocks spectrum that cannot be cleared nationwide, 24/7, but is not used at given times and/or at given locations, allowing users to obtain licensed rights to access the spectrum when and where it is unused and to deliver a predictable quality of service. LSA, as defined by the Radio Spectrum Policy Group (RSPG),[2] will help address some IoE use cases, particularly when it comes to quality of service and cost aspects.

1. Licensed spectrum

3G/4G is the main driver for the growth and scalability of the IoE. LTE-Advanced is the next major milestone in the evolution of 4G, incorporating several enhancements, all of which will be beneficial for the roll-out of M2M applications and products. Leveraging carrier aggregation and hyper-dense HetNets to increase network capacities and data rates are one aspect. Leveraging the potential benefits of the use of part of the harmonized 700MHz band at European level for M2M applications is another core one.

[2] Radio Spectrum Policy Group: Opinion on Licensed Shared Access, RSPG 13-538, November 12th, 2013.

Qualcomm supports the harmonization of 2X3 MHz in that band, namely 733 – 736MHz and 788-791MHz, for M2M applications. The latter would then benefit from the considerable economies of scale driven by commercial mobile broadband LTE services to be deployed in the adjacent spectrum (703-733 MHz and 758-788 MHz). This option is currently under study in CEPT and the ECC should take a decision on such harmonization by end 2015. We invite Ofcom to continue supporting this harmonization at CEPT and EU levels. A 2x3 MHz in the 700 MHz band for M2M would offer a 24/7, national and European wide ubiquitous coverage; controlled QoS; high reliability (redundant network design) and strong penetration; a robust security (built-in security features used in government and financial sectors); extremely low power consumption; and finally scalability, as the lower total cost of ownership due to a large established ecosystem, leveraging existing mobile infrastructure and global standards enables seamless interoperability.

From a technology angle, LTE eMTC (evolved Machine Type Communication) will address the requirements of many M2M applications. LTE eMTC is part of the LTE Advanced evolution and is planned to be part of 3GPP Release 13. An important dimension of LTE eMTC is that it allows the coexistence between M2M applications and adjacent mobile services in the same band, leading to considerable economies of scale. This is to be combined with enhanced security elements, extended coverage and up to ten years battery power. LTE eMTC could be an ideal candidate for enabling M2M applications in the 2x3MHz of the 700MHz band.

As recently highlighted by the EC High Level Group report presented by Pascal Lamy, the 700MHz band provides the best opportunities for harmonized wireless applications across Europe. As the 700 MHz band becomes available across Europe, making available 2x3 MHz for M2M applications would appear to be the most cost-effective solution supported by industry. Given the requirements mentioned above, it would strongly benefit in particular the Smart Energy and the Smart Transportation sectors.

2. LSA spectrum

In complement to the traditional licensed approached, LSA will play key role for enabling the IoE. LSA applies to underutilized spectrum that some users, especially government users such as the Ministry of Defense, do not use nationwide every hour of every day, but cannot vacate because they still need it from time to time or in specific locations or situations.

With LSA this spectrum can be shared, on an exclusive basis, with a commercial operator in time or location or both. This exclusive, licensed shared access means that the existing user and the new commercial user never interfere with each other and can leverage the very best performance of their equipment, which ensures reliability and quality of service. An operator would aggregate its LSA spectrum with its licensed spectrum, using LTE-Advanced carrier-aggregation features, to significantly augment its network capacity, data rates and performance. LSA is ideally suited for higher frequency bands like the 2.3 GHz and 3.6 GHz bands and would optimally benefit from heterogeneous network architecture with small cells. Higher frequency bands and low power small cells allows to efficiently share the spectrum between the commercial operator and the incumbent by minimizing the risk of interference. In addition, LSA spectrum cost will be lower than licensed spectrum due its shared nature and the limitations in geographical coverage and time availability. The low spectrum cost would help making new harmonized spectrum available for innovative

services that can be scalable and growing while maintaining predictable QoS, unlike the cases when using unlicensed spectrum.

LSA can address those IoE use cases and applications where predictable QoS, short range and low cost for access are key requirements. It can therefore be particularly attractive for health monitoring and control, as well as for home and enterprise security applications.

3. Unlicensed spectrum

Unlicensed spectrum optimally addresses best effort service use cases and applications where predictable QoS and security are not key requirements. There is no spectrum access cost and thus market entry barriers are low. It enables to introduce new services quickly.

There are four unlicensed bands of relevance to the IoE: 2.4 GHz, 5 GHz, 60 GHz and 900 MHz/SRD. Qualcomm connectivity solutions currently integrate 802.11 ac, which operates in the 5 GHz band, 802.11 b/g/n, in the 2.4 GHz and 802.11 ad, in the 60 GHz. Those tri-band Wi-Fi solutions allow up to gigabit performance and are particularly suited to enable the connected home with kids on tablets, adults on computers, everybody with smartphones and non-stop gaming, music, movies and surfing. Today's average home has five or more connected devices. In the future, that number might be closer to 50.

The 802.11ah standard is currently under development and being designed to address wideband SRDs with advanced spectrum sharing capability in the 870-876 MHz and 915-921 MHz frequency bands. A system reference document has been developed in ETSI and the 870-876 MHz and 915-921 MHz bands are considered for harmonization such use in CEPT countries. We believe that this will enable to useful for specific IoE use cases, in particular wearable devices and similar SRD-oriented applications, e.g. home automation or low-power sensors with higher achievable data rates and improved propagation and penetration of 900MHz radio waves through walls and obstructions. With 802.11ah, Wi-Fi coverage improves in previously hard to reach places such as garages, back yards, attics, buildings, factories, malls.

LTE features, such as carrier aggregation have made it possible to operate LTE in unlicensed bands as well – in bandwidth-rich spectrum in the 5 GHz band that can be used to augment capacity. The insatiable thirst for capacity indoors is what is creating a huge opportunity for operators to use small cells that deploy LTE in unlicensed spectrum indoors – concurrently with Wi-Fi as both can coexist harmoniously – utilizing all their spectrum assets and leveraging their existing core network. Carrier aggregation between the licensed and unlicensed bands will create faster speeds and higher capacity, with an anchor in the highly reliable licensed spectrum – by which the add-on capacity of the unlicensed band is managed. Commercial deployments of LTE-U in Europe will be possible after changes in the LTE air interface in order to support LBT (Listen-Before-Talk) at milliseconds scale, which is planned in 3GPP Release 13.

INNOVATIVE IOE TECHNOLOGIES, APPLICATIONS AND SERVICES, ENABLING NEW ECO-SYSTEMS

The Connected Home: entertainment, consumer electronics, home security

In terms of radio access connectivity, Wi-Fi has been largely prevalent in the home environment. While this best effort connectivity would be suitable for some of use IoE use cases scenarios, other would require a higher level of QoS and security such as health remote monitoring for chronicle disease between the home patient and the care givers, home safety cameras or gateways to other mission critical applications.

Allseen Alliance & Alljoyn

To fully understand the challenges of the home cloud, we need look at the connectivity requirements: there are several important trends there. The increasing number of devices and applications on the home network stretches the connectivity requirements. It is hard to keep track of all the devices but they can be broadly categorized in four buckets: 1) media & broadband mostly driven by high bandwidth, low latency requirements, 2) home management mostly driven by reach & power efficiency, 3) mobile apps & services mostly driven by high bandwidth & mobility, and 4) life management mostly driven by power efficiency and mobility. It is important to consider the different performance requirements in such cases.

The industry and consumers need a solution that enables a healthy ecosystem for products/services, which means interoperable communications protocols for connectivity to devices in proximity such that mobile devices can easily connect to speakers, TVs, thermostat, alarm system, even your car independently of the manufacturer, brand or the OS platform.

AllJoyn is an open, secure software framework, fully radio interface agnostic striving for verticals to intersect in new and useful ways. Qualcomm designed AllJoyn as a fast track to the IoE – to significantly reduce the time, effort, and cost of adding advanced peer-to-peer features to apps and to ensure interoperability across device types and operating systems. It provides tools to address discovery, connectivity and security among nearby devices in ad-hoc proximal networks that meet consumers needs (creating personal cloud of “things near me”). Consumers love simplicity of access and of use of devices and even more when internetworking between devices functions well thank to a SW like AllJoyn.

Alljoyn was initially developed by Qualcomm Innovation Center, Inc. The development of AllJoyn and related services is now in the hands of the AllSeen Alliance, a cross-industry consortium of companies focused on advancement and innovation in the “Internet of Everything.” It is a nonprofit consortium, dedicated to enabling the widespread adoption of products, systems and services that support the Internet of Everything through an open environment, vibrant ecosystem and thriving technical community. The Alliance hosts and advances an industry-supported software and services framework initially based on the AllJoyn™ open source project.

Smart City: energy, transport, building, retail, water management

There are tremendous opportunities to leverage technology to make cities smarter. 70% of the world's population is expected to live in urban environments in 2050 (up from ~50% today). Cities are facing huge challenges to modernize infrastructure. Qualcomm strongly sees 3G/4G cellular connectivity over licensed spectrum as the solution of choice by meeting many of the utilities' requirement in terms of high reliability and controlled QoS, scalability, durability, security, low power consumption, harmonization across regions and interoperability. In particular the 700MHz band, as discussed above would be an ideal candidate to achieve these objectives.

Utilities & Smart Energy

Water, wastewater, irrigation, and natural gas systems are all adding communications and localized intelligence to their distribution grids. That technology improves efficiency via things like wireless metering. And it's contributing to public safety, by detecting leakage, monitoring system pressure, water contaminants, and hazardous chemicals. Solar panels are also becoming connected using real-time communications to act like a big renewable energy power plant.

Smart transportation

The connected car is becoming a reality with more and more connected cars using 3G/4G to provide connectivity and applications ranging from entertaining to safety and security applications. Intelligent Transport Systems initiatives are becoming prevalent in particular with the launch of Emergency Call in the path to be mandated across the EU. Many other use cases are being considered with the launch of infotainment services to. Applications include navigation, 3D maps, driver assistance, eCall, instrumentation, multimedia streaming, content sharing, etc. The integration of both 3G/4G modem along with Wi-Fi/Bluetooth modules will enable a variety of applications to make the road safer and enhance consumer experiences. In the future, the car will be connected more and more to infrastructure and even to pedestrian for more safety and innovative use cases such as smart parking meters and garages, wireless electric vehicle charging, smart traffic lights, demand/response, etc.

Smart buildings

As part of urban planning, cities are starting to deploy small cells to ensure that everyone has access to connectivity everywhere in places like taxis, light poles, and remote areas where reception may be spotty. Buildings are becoming platforms for smart apps and services, using geofencing, indoor navigation, & Bluetooth beacons to help consumers find their way and to find the products and services they want need. In addition, retail, manufacturing and commercial building operators are increasingly relying on local area sensor networks as well as wide area mobile communications to manage high value assets, inventory and energy usage.

Specific use cases: Mobile Healthcare

Qualcomm is strongly committed to Mobile Health in creating academic programs focused on wireless health, supporting global challenges to drive next generation health development, investing in innovative mHealth technologies and leading interoperability, standards and initiatives. Qualcomm Life's 2net hub and 2net Mobile platform enables seamless data capture aggregation and

transmission across multiple radios, devices and service platforms. We have announced 2net hub SW update to support BLE-enabled medical & fitness devices. Other applications and services are developing, thriving on national and European efforts to implement cost-effective healthcare and monitoring solutions to drive down costs across the region. Mobile devices become the center of the patient's life with the availability of electronic healthcare records and secure platforms and applications, interacting with the consumer's/patient are remote monitoring devices.

As such, high levels of security and protection of data are required, along with the availability of wireless connectivity anytime, anywhere, taking into account patient mobility. Again, LTE-Advanced in a harmonized 700MHz band across Europe would offer an enormous potential and the perfect characteristics for such sensitive services.

New business models and Sponsored Connectivity

Wireless business models are constantly evolving, and the wireless eco-system for wireless applications, services, and devices is highly dynamic. New models such as the Amazon Kindle model, family plans, pay-per-day plans for tablets, etc. Come to market all the time. Consumers reap so benefits from the new options, and the wide variety of choices, that are available. Sponsored connectivity, in which consumers would not pay for connectivity for particular services, applications, or content because the cost of connectivity would be covered by the content owner/application developer/service provider would offer yet additional choices for consumers. Governments should not regulate, limit, prohibit, or favor or disfavor any wireless business model. There is no reason to deny consumers any choice.

CONCLUSION

Qualcomm is committed to further work with industry partners and develop technologies that will foster the development of the IoE for the benefit of European consumers. We are also strongly committed to work with Ofcom and other regulatory agencies, to set the underlying policies that will ensure the success of IoE.

We therefore strongly encourage European regulators to:

- Support a standard competition based approach, allowing for industry-led innovation in harmonized spectrum and based on industry-driven, international standards meeting IoE's main requirements in terms of scalability and interoperability.
- Use the largest connectivity platform ever, which is mobile broadband, in order to cost-effectively connect the billions of objects with the networks and with each other;
- Develop and implement innovative radio spectrum management approaches based on licensed, unlicensed and LSA spectrum;
- Harmonize a 2x3 MHz in 700 MHz band at 733-736MHz and 788-791MHz for M2M/IoE applications in CEPT/EU;
- Envisage new platforms and business models as enablers for the IoE and move away from any heavy handed regulation which would limit their development.