

2 June 2016

Via email to: iotrfe2016@ntia.doc.gov
National Telecommunications and Information Administration,
U.S. Department of Commerce,
1401 Constitution Avenue N.W.,
Room 4725, Attn: IOT RFC 2016,
Washington, DC 20230

Re: InterDigital Response to NTIA Request for Comment on the Benefits, Challenges, and Potential Roles for Government in Fostering the Advancement of the Internet of Things

Dear Sir/Madam,

InterDigital, Inc. ("**InterDigital**") respectfully provides its comments to the NTIA's *Request for Comments on the Internet of Things*, dated April 1, 2016.

The Internet of Things (IoT) will have a significant impact on the world economy. By extending connectivity to machines and low-cost sensors, it will transform businesses and consumer lives as profoundly as the Internet did 20 years ago.

Several leading industrial nations are investing strategically in national initiatives to position their economies and industrial sectors to capitalize on the IoT opportunity. InterDigital believes that the NTIA's RFC process is a timely opportunity for the U.S. Department of Commerce to draw best-practice lessons from the international market in shaping its IoT strategy. There remains considerable opportunity for the U.S. Department of Commerce to promote long-term investments, strategic innovation and international trade activities in support of US businesses.

InterDigital is at the leading edge of IoT innovation with significant involvement in domestic as well as several international markets. Our response to the NTIA's IoT RFC aims to share our market knowledge and to offer guidance on the emerging and next-generation technologies which should be the strategic focus for the U.S. Department of Commerce's future role and resources.

1. Introduction

A. Background

InterDigital designs and develops advanced technologies that enable and enhance wireless communications and capabilities. Since our founding in 1972, our engineers have designed and developed a wide range of innovations that are used in digital cellular and wireless

products and networks, including 2G, 3G, 4G and IEEE 802-related products and networks. We are a leading contributor of intellectual property to the wireless communications industry and in 2015 the company's total revenues were \$441.4 million. InterDigital employs nearly 200 engineers at its facilities in the United States, Canada, South Korea and the United Kingdom.

B. InterDigital's participation in standardization

InterDigital's engineers look at the challenges of current technology to identify future issues which will require solutions. Standards Development Organizations (SDOs) have historically begun developing standardized technologies roughly 7 to 8 years prior to market adoption, but InterDigital often begins its research several years before SDO work begins.

InterDigital has been involved in mobile standardization since the formation of 3GPP, the mobile industry's central forum, in 1998. InterDigital is also involved in several other SDOs, including ITU, IEEE, TIA, IETF, OMA and oneM2M™.

Today, InterDigital is actively working on innovations relevant to 5G and other key technologies, such as bandwidth management and the Internet of Things. These technologies lead towards the development of dynamic networks which intelligently manage spectrum resource, achieving efficiencies that will greatly increase system capacity and flexibility, enabling networks to accommodate the rapidly growing demand for wireless services.

2. General Feedback on the NTIA RFC

The range of topics listed in the NTIA's request for comments touch on the most proximate technical, implementation and policy challenges associated with the emerging IoT market. These are entirely the correct topics to establish a baseline to derive future policy actions.

InterDigital's areas of expertise tend to align more closely with future/next-generation issues than those presented. This is due to a contrast between current and next-generation IoT applications whereby the former address data and device connectivity challenges in narrow industry verticals and silo architectures whereas next generation IoT applications will involve data sharing and cross-silo interoperability within clusters of applications. In the context of a smart city, for example, a silo application might track the location of a city's buses to provide arrival-time information. An interoperable application would combine bus, train, car-park and weather information to support a multi-modal journey-planning application.

InterDigital can best add value to the NTIA's RFC process by addressing the next-generation issues and challenges that this type of operating scenario will raise for businesses, consumers and policy makers.

3. Global, Public- and Private-sector Mobilization Around the IoT

Many governments and companies have launched strategic initiatives to capitalize on new IoT opportunities. In 2013, a German-government, high-technology project¹ adopted the term “Industrie4.0” to refer to the “fourth industrial revolution,” linking machines, data and services.

In 2014, AT&T, Cisco, GE, IBM and Intel established the Industrial Internet Consortium (IIC) to drive adoption of IoT technologies in industrial settings. The IIC is now working closely with Germany’s Industrie4.0 to explore collaborative efforts for the industrial sector.

China too recognizes many of the same issues in the industrial sector and has launched its “Made in China 2025” initiative² to comprehensively upgrade the Chinese industrial sector.

South Korea is a global supplier for mobile communications, industrial machinery and consumer electronics whose actions are far-reaching the global economy. In 2014, its Ministry of Science, ICT and Future Planning, launched a national IoT Master Plan³ to grow a creative IoT service market, foster global-scale IoT- business capabilities, and establish infrastructure for the safe and dynamic development of the IoT.

Global mobilization at the national level is a very real feature of the emerging IoT landscape, notably in the industrial sector. These public-sector initiatives will undoubtedly shape the global competitive landscape and are not to be ignored. They offer an opportunity to learn and apply best practices. They also represent opportunities for US private-sector organizations to become involved on the national and international scenes.

4. Sustained investment action plan is necessary to capitalize on sizeable IoT Opportunities

The European Commission (EC) is another body that anticipates significant economic benefits from new technologies including the IoT. Its Horizon2020⁴ program is the biggest European Union (EU) Research and Innovation program ever with nearly EUR80 billion of funding available over a 7-year period. This amount does not include additional private-sector funding.

Horizon2020 is a financial instrument to implement Europe’s Innovation Union which aims to secure Europe’s’ global competitiveness. Approximately 23% of the budget targets activities aimed at industrial leadership. A further 40% targets societal challenges in areas such as: agriculture; clean energy; and, integrated transport. Each of these is a prime candidate for IoT technologies and services.

¹ Germany Trade & Invest – Industrie 4.0 - <http://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/industrie-4-0.html>

² ‘Made in China 2025’ plan issued - http://english.gov.cn/policies/latest_releases/2015/05/19/content_281475110703534.htm

³ Master Plan for Building the Internet of Things, retrieved from <http://www.iotweek.kr>

⁴ What is Horizon2020? - <http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>

The NTIA's IoT RFC highlights \$35 million in new grants and nearly \$70 million in new spending on Smart Cities on the part of the U.S. Government. These are quite small investments when set against the EC's multi-year, EUR80 billion program.

The EC's commitment, in the context of other global government initiatives provides a clear signal as to the magnitude of the IoT economic opportunity and the need to invest accordingly. They also highlight the value of a multi-year plan which the EC's Horizon2020 program considers necessary to take "great ideas from the lab to the market".

5. IoT's technology future depends on international collaborations in mobile and Internet arenas

The Internet transformed business and consumer lives, offering easy access to information, the convenience of eCommerce and new forms of self-expression through social media. The IoT extends similar principles to devices, machines and sensors.

However, while today's IoT focus is on technologies to connect devices and make sense of their data, tomorrow's market will be about an Internet-like fabric that enables connected devices to interoperate. In other words, today's hardware paradigm will rapidly give way to one defined by software-based, IoT platforms. These will build on two key foundations; the mobile and the Internet sectors.

Mobile is the largest and most ubiquitous distribution platform on the planet. Its continued development and evolution into the 5G arena will be vital for the success of the IoT. Equally important are the innovations, currently in the standardization pipeline⁵, to accommodate low-power and less "chatty" IoT devices.

The same is true of Internet and web-service technologies which are beginning to adapt⁶ to the far more granular scale and constrained functionality of IoT devices and sensors. This evolved Internet fabric, in a form that is better suited to the scale and the economics of IoT applications, will be critical in providing the platform for devices, applications and users to communicate.

The machinery for core-innovation and standardization in the mobile and Internet arenas exist in a few standardization development organizations (SDOs); 3GPP for the mobile industry and the IETF for the Internet sector, for example. Increasingly, a standard setting organization (SSO) known as the oneM2M Partnership Project is gaining standing in the IoT-platforms space that bridges the worlds of mobile and Internet communications. There is a stark difference between SDOs and SSOs. The former is where the technical development takes place behind the scenes that involves billions of dollars of investment. The latter involves picking from known technologies, usually on the basis of compatibility.

⁵ Mobile Industry Agreement on Technology Standards for Global Low Power Wide Area Market – <http://www.gsma.com/newsroom/press-release/gsma-welcomes-mobile-industry-agreement-on-technology-standards/>

⁶ RFC 7252 – Constrained Application Protocol specialized web transfer protocol in the Internet of Things – <http://coap.technology/>

All of these SDOs and SSOs are global institutions with membership and contributions from an international array of academic and business organizations. This further emphasizes the importance of shaping the US Department of Commerce's IoT strategy against an international backdrop.

6. The future success of the IoT depends equally on federated data, privacy and security principles

Protocols to manage data, privacy and security play an important and highly complementary role to technology advances in determining the success of the IoT. While there is considerable work underway in other fora to address privacy and security challenges, the topic of data management receives less attention. It encompasses issues such as the application of data ownership rights as well as the granting of permissions and access to data in ways that increase trust.

These functions will exist within IoT platforms. However, the interoperability aspect of IoT applications means that data management, along with privacy and security, policies will have to function in a federated rather than narrowly constrained operating environment.

7. Open standards⁷ will lower business risk and boost the size of the IoT opportunity

The topic of standardization has developed into a major activity within the IoT industry over the past few years. Many businesses and research initiatives see significant value in creating a unified architecture for IoT systems. Examples include the European AIOTI⁸ and, more recently, the IIC's Industrial Internet Reference Architecture⁹ (IIRA). Since then, several formal, standards setting organizations such as NGMN and ISO/IEC have launched similar IoT architecture programs.

One frequently cited criticism of standardization relates to the proliferation of standards. In the case of the IoT, this criticism applies to the numerous standards that have acquired the IoT label, largely driven by marketing purposes. For the most part, these are standards addressing specific elements of an end-to-end IoT application. Put differently, they contribute to an overall solution but are not the entire solution.

The reality of IoT applications is that they will employ a range of sensors and devices, each of which may rely on a mix of fixed-network, mobile-network, Wi-Fi, Bluetooth and other proprietary communications technologies. The applications that make use of connected-device and sensor data will also make use of a wide variety of software technologies. No single technology will dominate the hardware and application-software end-points of an IoT application.

⁷ "Open Standards" refers to a term to describe a collaborative, balanced and consensus-based approval process for the promulgation of domestic or international standards.

⁸ The Alliance for the Internet of Things Innovation (AIOTI) - <https://ec.europa.eu/digital-single-market/alliance-internet-things-innovation-aioti>

⁹ The Industrial Internet Reference Architecture Technical Report - <http://www.iiconsortium.org/IIRA.htm>

IoT platforms, which sit in between devices and applications, offer the best way of ensuring interoperability. Importantly, by adhering to an open standards solution, different IoT platforms will have the means to interoperate and support the vision of a cooperative, federated architecture that echoes the philosophy of the Internet. An open standard for IoT platforms ensures competitive choice to business users and mitigates the risk of vendor lock-in.

InterDigital's business model aligns strategically with global, open standards. We are a regular contributor to the oneM2M standardization partnership and its formal releases are reflected in our IoT platform development activities.

8. Recommendations for NTIA

In keeping with other international efforts, the U.S. Department of Commerce should formulate a strategy that reflects the sheer magnitude, economic reach and long-term potential of the IoT opportunity. Similar to the Internet and GPS technologies, this strategy needs to reflect the multi-year nature of the IoT market, backed by a suitable program of funding.

While recent Federal investment initiatives provide a starting point, the next step should focus on harnessing private-sector interest to amplify the overall investment impact through effective, public-private sector cooperation. This may take the form of a long-term, public/private working group or partnership to determine the best path forward for IoT, especially from a regulatory/non-regulatory framework. Such a framework will become increasingly relevant as future challenges transcend the boundaries of individual government entities as in the example of consumer and health IoT applications.

By their very nature, technology innovation and business experimentation will lead the IoT applications market. The U.S. Department of Commerce needs to look ahead to policy implications in areas of security, privacy and data ownership. Looking ahead involves anticipating the consequences of these developments in heterogeneous (interoperable) IoT application environments, i.e. where there will be 'trading' boundaries between IoT service delivery partners which operate under distinct business rules and possibly under different legal jurisdictions.

The U.S. Department of Commerce's future IoT strategy should also address the challenge of market education. This ranges from centralized information sharing about pre-commercial funding and innovation opportunities in U.S. and international markets to raising awareness about seminal international developments. Examples of the latter include the European Horizon2020 program and the oneM2M Partnership Project which brings together Chinese, European, Indian, Japanese, North American and S. Korean SDOs.

InterDigital has a multi-year history of innovation, market development and standardization in the IoT arena. We are active in US, Asia Pacific and European markets and would welcome the opportunity to share our experiences through a suitable public/private working group or partnership initiative. Ultimately, an initiative like this would help ensure that, a) the government is creating the proper framework for the private sector to innovate and b) that the government can regulate as lightly as possible and only in the areas where it should be regulating.

InterDigital appreciates the opportunity to comment on the NTIA's review. If there are any questions about these comments, please contact James Harlan, Director of Standards and Competition Policy, at Jim.Harlan@Interdigital.com.

Respectfully submitted,



James J. Nolan
Executive Vice President, IoT Solutions
InterDigital Communications, Inc.