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FOSTERING THE ADVANCEMENT OF INTERNET OF THINGS

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Abstract: This paper begins with an overview of IoT, including definitional issues, the benefits of IoT, the possible role of government in fostering the IoT environment, and some of the international considerations that, due to the global nature of the Internet and connected technologies, are inherent in the issues discussed in the rest of the paper. The next section lays out an approach for Departmental action organized around four engagement areas. The section thereafter provides a review and analysis of the comments, current Department initiatives, and next steps for each engagement area. Consistent with the established U.S. Government policy approach to emerging technology, this approach proposes the following. The Department will lead efforts to ensure the IoT environment is inclusive and widely ϖ accessible to consumers, workers, and businesses; The Department will recommend policy and take action to support a stable, secure, and ϖ trustworthy IoT environment; The Department will advocate for and defend a globally connected, open, and ϖ interoperable IoT environment built upon industry-driven, consensus-based standards; and The Department will encourage IoT growth and innovation by encouraging expanding ϖ markets and reducing barriers to entry, and by convening stakeholders to address public policy challenges.

I. The Internet of Things (IoT) Landscape

A. Unique Opportunities and Challenges

The Request for Comment's initial question – and likely the most important one – was whether IoT is different from technological issues that we as a society have already faced, or at least different enough to merit specific attention and/or different policy responses. Based on the collective comments, the responses at the workshop, and our conversations with stakeholders we have concluded that IoT *is* different in important aspects:

1) **Scope**: IoT is connecting a wider range of systems and devices than ever before, enabling greater integration of previously distinct industries, sectors, and activities. This will require new forms of cross-sector and cross-government collaboration, knowledge sharing, and alignment.

2) **Scale**: The number of connected devices coming online is growing rapidly. Cisco estimates that, between the years of 2015 and 2020, the number of connected devices in the United States will nearly double from 2.3 billion to 4.1 billion; globally connected devices will increase from 16 billion to 26 billion over the same period.[4] McKinsey Global Institute has projected that, by 2025, the overall impact of these devices on the global economy will be between $4 trillion and $11 trillion.[5] This rapidly changing environment will have broad implications

3) **Stakes**: While many commenters argued that IoT is an evolution rather than a revolution in information and communications technologies,[6] the increased scale and scope produces a qualitative change in the stakes involved in connectivity. A major Internet outage or a cyberattack would never have been without consequence, but IoT raises the stakes significantly, as such events can now affect medical devices, supply chain reliability, and cars driving down the highway, raising the real possibility of physical harm.

II. Benefits of IoT

From baby monitors to automatic climate control, IoT technologies promise a wide array of safety and efficiency benefits for consumers and businesses alike. While consumer-facing devices – such as exercise trackers, health monitors, and home safety systems – have drawn much of the media attention, Ligado Networks suggested that the most significant value for the U.S. economy is likely to result from enterprise IoT applications, particularly those that focus on industries such as manufacturing, agriculture, and infrastructure.[29] Broken down by industry, the manufacturing sector appears to have the most to gain from the adoption of IoT, with connected factories increasing productivity, optimizing inventory planning, reducing waste, and saving on energy costs and equipment maintenance. Industry is already exploring how connected devices can improve the safety and reliability of complex processes, and can achieve greater energy and operational efficiencies.

III. An Approach for Departmental Action to Advance the Internet of Things

Given the great economic and social potential of IoT, as well as the qualitatively different challenges raised by its development, it is important for the Department to engage proactively yet selectively on issues described in this paper. The Department has a longstanding approach to encouraging innovation in new technologies, while taking steps to address policy matters in a proactive, multistakeholder manner. We have approached emerging market trends and technologies with restraint and an eye toward allowing new entrants room to experiment and mature before they encounter significant government intervention. These guiding principles worked well as the Internet developed, and – as gleaned from our commenters – are appropriate to apply in the IoT sphere as well. Coupled with close partnership and collaboration with stakeholders, including our government and international partners, a cautious but thoughtful approach will map well to an emerging landscape where existing and new policy and technology norms and standards are starting to coalesce or collide. The overarching goal will remain the same: to foster the benefits of IoT while meeting its challenges.

Figure 1. The Department of Commerce will work across multiple stakeholder communities to foster IoT advancement.

Several principles – derived from stakeholder input – will guide the Department's intended ongoing engagement with all stakeholders at the local, tribal, state, federal, and international levels across the evolving IoT landscape.

 The Department will lead efforts to ensure the IoT environment **is inclusive and widely accessible** to consumers, workers, and businesses;

 The Department will recommend policy and take action to support a **stable, secure, and trustworthy** IoT environment;

 The Department will advocate for and defend a **globally connected, open, and interoperable** IoT environment built upon industry-driven, consensus-based standards; and

 The Department will encourage IoT **growth and innovation** by encouraging expanding markets and reducing barriers to entry, and by convening stakeholders to address public policy challenges.

IV. Technical Limitations

One comment highlighted the technical limitations of many IoT devices as a particular hurdle for implementing known good security practices.[147] These limitations include computationally weak hardware, minimal operating systems, and/or limited memory, commented Krawetz et al. They added that limited resources make connected devices more vulnerable to denial of service and stacksmashing attacks (causing a stack in a computer application or operating system to overflow, which may subvert or crash the stack); the IoT world has not yet developed common mitigation techniques.[148] Even when adequate technology exists, devices may lack the metrics or interfaces for security awareness. CTIA commented that a breach could exist for an extended period of time before being noticed, and once noticed, correction or mitigation may not be possible or practical.[149] Alternative solutions may require greater coordination across different parts of the IoT environment.

Promoting Standards and Technology Advancement

 Monitor IoT-related technology developments and applications and contribute to research and development involving those technologies.

 Advocate for industry-led, consensus-based, international standards for IoT technologies and applications in its bilateral and multilateral engagements.

 Actively participate in, and contribute to, the development of technical standards for IoT.

Encouraging Markets

 Continue to work toward fulfilling the missions of its various bureaus with greater impact and efficiency by leveraging emerging technologies such as IoT.

 Inform and influence government practices (purchasing and otherwise) in the use of emerging technologies such as IoT in a way that maximizes efficiency and the public good while protecting the security and privacy of individuals, which will help promote a market for devices that are consistent with these practices.

 Leverage its role as an IoT consumer to promote a market for secure IoT technologies and the supply chains supporting those technologies.

 Play an active role in 21st century skills development by inserting the business perspective into federal workforce policy making to support creation of quality career paths for workers, particularly in areas of emerging technologies such as IoT, to meet employer demand.

