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BY ELECTRONIC MAIL

National Telecommunications and Information Administration

U.S. Department of Commerce

325 Broadway,

Boulder, CO 80305

Re: Docket 210105-0001

NEC Corporation of America is pleased to submit comments regarding the 5G Challenge Notice of Inquiry. Given NEC's experience developing 5G solutions that have advanced open and interoperable interfaces and our commitment to continuing to develop such capabilities, we are encouraged by this initiative and welcome the opportunity to share perspectives on developing, deploying, and managing secure and reliable 5G communications infrastructure.

1. Introduction

NEC Corporation, a global technology firm with $28 billion in annual revenue, a presence in over 160 countries and regions, and more than 110,000 employees worldwide, is recognized as a Top 100 Global Innovator and included as a Fortune Global 500 technology leader. One of the world's top patent-producing companies, NEC combines advanced technologies, services, knowledge, and its 120 years of operating expertise to help ensure safety, security, efficiency, and equality in modern society. Since the founding of the company in 1899, NEC's technologies and solutions have helped telecommunications and mobile infrastructure evolve from twentieth century switching systems, to the first generation of analog systems, and now towards 5G. NEC also provides a wide range of other technological capabilities, including underwater sea cables, space satellites, advanced unified telecommunications, and biometric solutions, to customers across the United States and around the globe. NEC has had a presence in the United States since 1963, and our North American headquarters is in Irving, Texas. Our major U.S. offices span 16 states. NEC Corporation of America implements, deploys, and supports large-scale information technology and communications solution integrations throughout the United States that perform mission-critical services for national security and law enforcement agencies, other government customers, and commercial businesses. NEC, a member of both the IT and Communications Sector Coordinating

Councils, is committed to providing reliable and secure solutions for our U.S. critical infrastructure customers. NEC's business is focused on public safety, social infrastructure, and network solutions toward 5G, and the United States is a strategically important market for us in all three of these areas.

We welcome this opportunity to provide comments for a 5G Challenge, which we view as a valuable opportunity for NTIA and DOD to work with trusted partners to lead the development, deployment, and management of secure and reliable 5G communications infrastructure and help the United States maintain its global leadership in communications technology. Our comments cover (1) NEC capabilities that may be relevant to the goal of spurring 5G innovation and (2) specific recommendations for the 5G challenge.

2. NEC Capabilities

NEC works to continually improve our network solution technologies in order to provide the most innovative capabilities to the U.S. government and the U.S. communications infrastructure industry and to mitigate new risks and vulnerabilities that advancing 5G may pose. Below, we describe our partnerships and technologies that help enhance national security, diversify supply chains, and improve network performance. By explaining how NEC has approached developing technologies to support 5G, we hope to help you consider which innovations a 5G Challenge could help support and incentivize.

Open-RAN: NEC has promoted open architecture approaches and has developed radio units for 5G base stations that comply with O-RAN fronthaul specifications that the O-RAN Alliance established. We have supported NTT DOCOMO, which has already realized interoperability between base station equipment from NEC and other vendors with O-RAN Alliance-compliant fronthaul and X2 interfaces in their 5G commercial service. Further, NEC is mass-producing O-RAN compliant radios for Rakuten Mobile, which is now building the world's first fully virtual, multi-vendor 5G radio access network conforming to O-RAN specifications across Japan. These are just a couple of examples of technology development for initial deployments. Additional research and development can realize the full potential of these architectures.

Open RAN Systems Integration (SI): With the opportunities created by open standards and disaggregation of monolithic stacks also come the challenges of integrating best-of-breed solutions.   This is also true for Open RAN. NEC is at the forefront of providing SI services to service providers around the world to help them gain the benefits of Open RAN without having to manage the complexity of integrating and managing these multi-vendor solutions. To this extent, NEC is making significant investments in establishing global centers of excellence and interoperability testing to provide pre-tested, integrated Open RAN solutions to carriers.

Next G innovation: NEC continues to invest in next-G innovation to build on the promise of 5G and address additional opportunities that ultra-low latency and other unique attributes that 5G networks have created. NEC is collaborating with trusted U.S. and Japanese companies to create open standards and accelerate 6G network innovation.
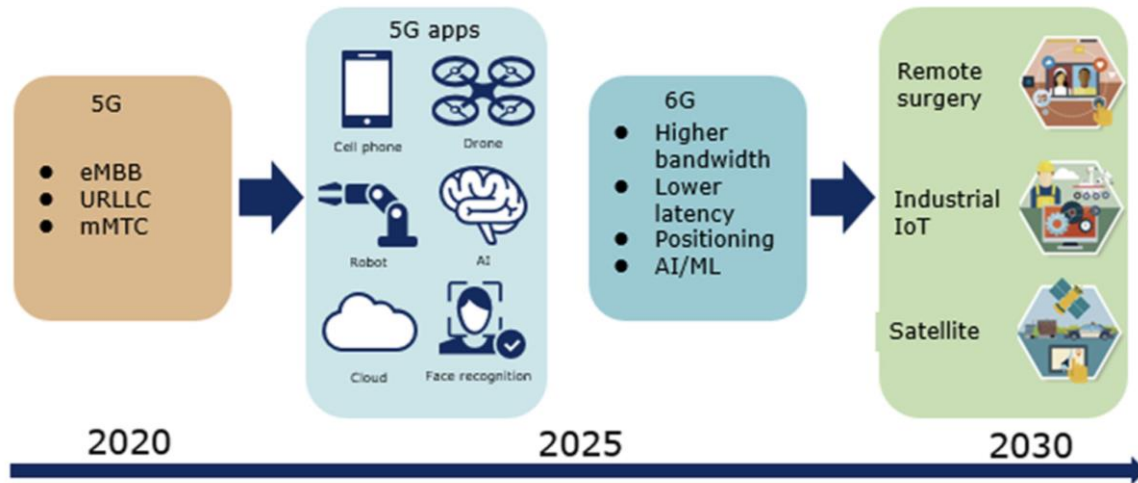
5G and 6G-enabled Applications

Artificial Intelligence: NEC has been steadily developing AI technologies for years, and our goal has always been to create the highest-level artificial intelligence. For instance, we have been working on image recognition technology–a key constituent of AI–for a half century. Starting with character recognition, this technology has evolved into fingerprint identification and face and iris recognition. By refining and expanding this technology to enable understanding of human behavior and cognitive states, NEC is hoping to create intelligent systems capable of understanding and analyzing human actions and events in the real world in a manner that protects individual privacy and supports human rights. We are also involved in the development of data analysis technology, including deep learning systems, which currently provide the best automated solutions for image recognition, speech recognition, and natural language processing. The extremely high precision of deep learning, however, means that it cannot present the basis of its predictions in a manner that is comprehensible to humans, making it unsuitable for applications where critical judgment and thinking are required. To address these issues, NEC has developed Heterogeneous Mixture Learning Technologies that can analyze hidden patterns in data and explain the basis of its predictions. The aforementioned capabilities will form an increasingly important part of NEC 5G Solutions, and NEC looks forward to working with government and industry partners to explore additional potential collaboration opportunities.

Space, Terrestrial, and Sub-sea Communications: NEC is using its extensive experience in aerospace development and leveraging its AI and other advanced technologies to provide total support from the development, production, and launch of satellites, to the operation of data centers that process and analyze received image data. We also provide training for each process. In addition, NEC has been manufacturing and deploying submarine cables globally since 1935 and subsea housings since 1968. Decades of development experience continue to underpin our products and solutions today. These capabilities uniquely position NEC to partner with U.S. entities to evaluate and research potential for integrated communications across space, terrestrial, and subsea communications and defense mission coordination.

NEC believes that we are well positioned to assist in developing 5G networks in the United States with an open ecosystem approach. We also believe that building a strong, secure 5G network will require close collaboration between existing U.S. companies, new U.S.-based technology and manufacturing firms, and technology partners from allied nations. Together, and with support from U.S. and allied governments, such technology partnerships will facilitate effective deployment of 5G technology within the United States and the development of new technology capabilities domestically that will serve the U.S. and allies into the future.

3. 5G Challenge Considerations

In structuring a 5G Challenge, there are a number of considerations that may best incentivize participation from diverse contributors while advancing innovative solutions for government and private-sector applications.

To incentivize participation from diverse contributors while advancing innovative solutions for government and private-sector applications, the 5G Challenge should consider incorporating as many 5G-related, practical, real-world applications as is feasible across the capabilities 5G enables. Such capabilities include: a low latency application, a high reliability application, a high bandwidth application, and a large scale (number of devices) application. To do so, the Challenge could assess each entry along each dimension. In this scenario, each team would have to create a basic architecture that addresses all applications but could prioritize a few as part of the competition, and the competition could evaluate each team by application and across applications.

Due to the essential role that collaboration will play in the development and deployment of strong, secure 5G networks in the United States and around the world, we would recommend structuring the Challenge to encourage the greatest amount of collaboration possible. In particular, we would suggest creating a mechanism for multiple team collaboration, meaning an infrastructure and testbed that will

allow co-development between people in different organizations. Partnerships should require minimal or no contractual requirements and companies and contributors should be able to support multiple teams with varying elements of a 5G architecture. Subsequent to a primary challenge during which teams partner to create complete solutions, the program could have sub-challenges around critical software elements that are open to individuals and/or single companies. Additionally, the Challenge could provide funding for people and materials in a manner that helps to level the playing field for competing teams. We would also recommend structuring the Challenge in a manner that leverages the significant collaboration that already exists between U.S. industry and industry in allied nations working to develop 5G and Next G capabilities.

Finally, we believe that the Challenge should deploy applications on network slices and utilize to the greatest degree possible cloud and MEC computational resources. This capability would help ensure applications developed as part of the Challenge would be deployable on any network slice, on any network, by any provider. Further, the architectures should utilize available spectrum, and the solutions should be robust to interference in this spectrum.

4. Closing

Thank you for taking the time to consider these comments. The investments that NEC is making in developing open and interoperable 5G solutions have already begun providing secure, resilient, highly scalable networks around the world. We would be delighted to have the opportunity to support the United States government by working with fellow ecosystem partners based in the United States to drive faster adoption of 5G with our open architecture approach. We believe that strong support by the U.S. government for open and interoperable solutions now will help ensure the U.S. remains the world leader in communications technology for years to come.

Sincerely,

Shin Takahashi
Chairman and Head of Government Relations