PROPOSALS FOR BUILDING OUR NATION’S BROADBAND FUTURE
EXECUTIVE SUMMARY

The research and education ("R&E") community has amassed decades of experience in the creation and development of the internet and, working hand in hand with the private sector, it continues to propel the evolution of this vital technology today. As the country’s premier national R&E network, Internet2, and the larger R&E community, stands ready to help deploy and upgrade truly world-class broadband infrastructure nationwide, and not just in select pockets of the country. By adopting the recommendations that follow, Internet2 is confident that the Administration will empower new economic opportunities throughout the United States that will serve as the foundation of economic development for years to come.

To address the pending broadband challenges facing our nation, Internet2 has identified four essential proposals for the Administration to consider as it develops and refines its national infrastructure and broadband strategy.

1. The Administration should support the construction of more broadband networks as part of any infrastructure program. The benefits are concrete. More and faster broadband networks will:
   - Promote economic development
   - Ensure that anchor institutions have the necessary "roads" connected to the rest of the nation
   - Support research activities in the US
   - Better prepare students and adult learners for the information economy

2. The Administration should use public-private partnerships to help support broadband construction.

3. The Administration should provide strategic leadership in supporting a rationally engineered global broadband infrastructure in order to secure America’s economic and technological leadership position.

4. The Administration should promote trust and identity access management frameworks to better safeguard critical research and development activities from cyber attacks.
INTRODUCTION

Internet2 presents this policy paper to help the Administration evaluate the challenges and opportunities related to broadband deployment and adoption in the U.S. The R&E networking community, which includes Internet2 and 43 state and regional networking partners, played a seminal role in the creation of the internet—and the services and applications that have made it the most transformative technology of the last hundred years. These networks are operated by non-profit organizations that provide high-capacity, advanced networking services, internet access, and related services to the R&E community.

R&E networks are purpose built and dedicated to meeting the specific needs of the R&E community located within their respective footprints, including experimental networks that foster networking and application research between R&E centers. These networks support higher education, federal and state government agencies, anchor institutions, and others. They offer the most advanced infrastructure, trusted network-to-network collaboration, and resource sharing throughout the community.

In 1996, key members of the R&E community joined together to form Internet2 and build the Internet2 Network, which is the nation’s premier national research and education network (“NREN”). Much of the cutting-edge research that is taking place at and between our country’s research universities and private laboratories is powered by the Internet2 Network. Just as broadband revolutionized and largely replaced dial-up internet connections, the Internet2 Network is removing the boundaries of today’s internet by enabling highly advanced research and experimentation using 100 Gigabit services, with examples already in place offering 200 and 400 Gigabit optical services. Internet2’s current 17.6 Terabit capacity national network positions the Internet2 Network as one of the most advanced networks in the world. Internet2 also helps the R&E community select, develop, and deliver its own cloud and trust solutions with commercial cloud service providers, maximizing the benefits of collaborative cloud environments and scale for academic institutions.

While the Internet2 Network primarily serves the higher education community, it also is utilized by industry, government agencies, and other entities. The network also serves as the backbone for the state and regional R&E networks that interconnect more than 94,000 schools, libraries, community colleges, and other anchor institutions throughout the country. Therefore, millions of K-12 students, college students, and adult learners rely on the broadband services provided over R&E networks, revolutionizing how the U.S. prepares its students today for the challenges of tomorrow.

The R&E networking community plays a truly unique part in how Americans’ lives are being transformed for the better by the internet. But much more needs to be done if we are to continue expanding access to future-proof broadband. Abundant bandwidth must continue to be available and keep pace with new applications and services demanded by end-users. Below are several recommendations for accomplishing these goals.
The Administration Should Support Construction of More Broadband Networks as Part of Any Infrastructure Program

CHALLENGE: Tens of millions of Americans simply lack access to broadband networks that are state of the art with abundant and symmetrical bandwidth. Yet a single fiber drop to an anchor institution can connect hundreds or thousands of people in a community to advanced broadband, thereby enhancing economic, educational, and social well-being throughout the area.

RECOMMENDATION: The Administration should support extending broadband access, particularly to more anchor institutions, in order to (1) promote economic development; (2) ensure that anchor institutions are connected to the necessary broadband highways to allow more people to access broadband services; (3) support research in the U.S.; and (4) better prepare students and adult learners for the information economy.

DISCUSSION: Some parts of the country remain broadband deserts with little or no access to broadband, or where the available broadband coverage is inadequate to meet the needs of the surrounding community. To remain competitive, the U.S. must ensure that all Americans have access to quality broadband connections. This will benefit consumers everywhere, including anchor institutions, households, and especially rural and tribal areas. For example, broadband speeds of at least 25 Mbps (download) are not available to 39 percent of rural households and 41 percent of people living on tribal lands. However, 96 percent of urban households have access to broadband at those speeds.1

Making matters worse, high-speed broadband access often is not available for residents even at their local schools or other anchor institutions.2 In short, the technologies and applications enabled by broadband that many of us take for granted cannot be accessed by tens of millions of Americans simply because of where they live. As detailed below, however, broadband infrastructure has a multiplier effect on the economy at large, reinvigorates local economies that so far have been passed by, and gives students and adult learners the tools necessary to compete in the information economy.

A. Broadband Deployment Leads to Increased Economic and Job Growth

The economic benefits of broadband infrastructure are well documented. Studies establish that a 10 percent increase in broadband penetration can lead to a 1.5 percent increase in economic growth, as measured by gross domestic product (“GDP”).3 Similarly, the Public Policy Institute of California found that broadband expansion is associated with employment growth, and that an analysis of the data actually demonstrates a causal relationship between the two—that is, broadband expansion leads to an increase in employment growth.4 In fact, the Brookings Institution estimated that a one percentage point increase in broadband penetration would lead to “an increase of about 300,000 jobs” for the U.S. economy as a whole.5

Moreover, a study by the White House Council of Economic Advisors concluded that broadband access correlates to higher employment rates, especially in rural communities, and that job seekers who can search for jobs online were re-employed 25 percent faster.6 This study also found that 30 million Americans used library internet access to conduct job searches, submit job applications, and engage in job-related training.7

Relatedly, there is abundant evidence demonstrating that broadband penetration enhances economic development generally. In fact, the Federal Communications Commission (“FCC”) recently concluded that broadband internet access service functions as a “driver of economic growth” and “an engine of the virtuous cycle of broadband deployment, innovation, and consumer demand.”8 The FCC also noted that
broadband access helps: (1) small businesses start, expand, and improve more quickly and efficiently; (2) individuals gain new skills and access new opportunities; and (3) local communities attract new investment, industries, and workers.

Further, based on Bureau of Labor Statistics data, the FCC has estimated that “jobs depending on broadband and information and communication technologies—such as computer systems analysts, database administrators, and media and communications workers—will grow by 25 percent from 2008–2018, 2.5 times faster than the average across all occupations and industries.” In short, investments in broadband are self-sustaining because they have a well-established multiplier effect on economic growth and job creation.

B. All Anchor Institutions Need to be Connected to Broadband Infrastructure

Anchor institutions, including universities, schools, libraries, museums, healthcare organizations, and other not-for-profit community organizations that provide support and services to citizens, increasingly are being recognized as critical indicators and influencers of a community’s socioeconomic well-being. Over the past 10 years, anchor institutions also have emerged as vital organizations for promoting digital literacy, broadband adoption, and related applications. Further, given the central role an anchor institution has and the number of citizens it impacts through one broadband connection, its broadband access has a social, educational, and economic multiplier impact.

Providing robust broadband connectivity to one anchor institution also can have “network effects” in terms of broadband deployment, availability, adoption, and use. One fiber drop to a university, a community college, a high school, or a library can impact hundreds, if not thousands of citizens versus a single fiber drop to a residential home. Deploying robust broadband connections is analogous to building roads: you need to first build the highways to connect the towns and their core institutions to the broader world and then invest in the diffusion of the connections within the community. Focusing broadband deployment on these core, public-serving anchor institutions can positively affect the broader public in multiple ways while allowing these institutions to better fulfill their missions. The Administration therefore should focus on ensuring that all anchor institutions in the country are connected as soon as possible to the nation’s advanced fiber networks.

C. Broadband Infrastructure Should be Deployed in a Manner that Supports Research in the United States.

Research institutions rely on high-capacity broadband networks to support their bandwidth-intensive research and education activities. As an added benefit, these institutions can leverage broadband deployment within the surrounding community, often allowing the network to support other socioeconomic institutions. However, the rapid growth of scientific data and the international scope of research universities require significant increases in broadband network capacity and a new approach to network architecture and deployment. Genomic sequencers, new telescopes, and sensor networks, for example, all place demands on the existing infrastructure. High-performance networks, such as the Internet2 Network, allow scientific endeavors to flourish across multiple fields and accelerate research discovery. But the network infrastructure continually needs to be upgraded to keep pace with the demands that scientists and researchers will increasingly place on their networks.

As the Administration develops strategies for supporting broadband infrastructure, it should consider proposals that are better tailored toward rationally engineered, comprehensive infrastructure solutions to promote the types of data-intensive global scientific collaborations that are needed now and in the future. The Administration should also explore the best practices adopted by R&E network operators in using network infrastructure that can increase meaningful access to the highest-tier computing systems. The challenges of providing innovative networking solutions to common technology problems faced by the R&E networking community will be similar to those that may confront the Administration in developing advanced computing infrastructure that will satisfy data-intensive needs. Rapid advancements in both computing and networking technologies and the applications that run over such infrastructure quickly can and do make what would appear to be high-capacity infrastructure today less than adequate in the near future. Through these efforts, the Administration can ensure the efficiency of new infrastructure, the sustainability of global collaborative efforts, and continued support for network research activities.
D. Broadband Infrastructure is Essential for Preparing Students and Adult Learners for the Information Economy

In addition to serving as a social and economic lifeline for the surrounding area, anchor institutions play an important role in the lives of many students, helping to close the “homework gap” and promoting digital equality. Many low-income and rural students do not have internet access at home. And even many who do have access lack connections that are fast enough to allow them to take advantage of many of the educational experiences that are commonly available online today. By promoting more and better connections to anchor institutions, the Administration will support the millions of Americans who rely on these services every day, including the estimated 21 million children whose schools currently lack adequate bandwidth for digital learning. This is particularly important because higher education is a critical mechanism for both individual socioeconomic advancement and the future competitiveness of the U.S. economy. Yet entire segments of the K-12 population are unprepared or at a distinct disadvantage upon entering college because of the uneven distribution and access to high-capacity broadband at home and in schools.

To remedy this, the Administration should leverage the R&E community’s experience in broadband networking to extend advanced, high-capacity, future-proof broadband connections to our country’s schools to provide the intellectual foundation for the next generation of the U.S. workforce. The Administration’s broadband strategy would be incomplete if it does not focus on our education system. The success of both the U.S. economy and students seeking a college or graduate degree are inextricably interlinked. As the U.S. Chamber of Commerce concluded in a study analyzing the impact of broadband on education, less than half of all U.S. high school graduates are adequately prepared for college or for the workforce, and “[s]chools are generally failing to instill 21st century skills in students.” As the Chamber noted, the FCC recently has recognized that “digital literacy is a necessary life skill, much like the ability to read and write.” This is why it is essential for unserved or underserved areas to be connected to R&E backbone facilities, like the Internet2 Network, as soon as possible so that students in these areas can compete on a level playing field.

As the Department of the Treasury and the Department of Education recently concluded in a joint report regarding the “complex public-private market” for secondary education, “[h]igher education is a critical mechanism for socioeconomic advancement among aspiring individuals and an important driver of economic mobility in our society.” The report determined that students who completed two to four years of college received $2.4 trillion more in additional earnings in 2011 than they would have if they had just completed high school. This represented 16 percent of the $15 trillion total GDP for that year. In 2013, young adults with a bachelor’s degree on average earned 62 percent more than their counterparts who only had a high school diploma ($48,000 vs. $30,000), and those with an associate’s degree made 25 percent more ($37,500 vs. $30,000).

The R&E community realizes that helping today’s students access broadband and training to exploit its potential will ensure that they come into the higher education system with a full complement of the skills necessary for success. The number of options available to schools and libraries through massive online open courses (“MOOCs”) and other online learning resources continues to grow daily. Students with sufficient broadband capability can now interact directly with teachers renowned in their fields, remotely access advanced scientific equipment located at research universities, or perform live with a symphony across the country in real time. The possibilities for educational collaboration are endless and will greatly lower the costs of learning by allowing these experiences to take place right inside of the classroom, sometimes for hundreds or thousands of students at a time. This technological and collaborative paradigm enables knowledge and expertise to flow seamlessly between higher education institutions and schools and libraries by providing limitless opportunities to expand and strengthen learning experiences for all researchers and students.

In short, the economic growth that broadband enables is tied tightly to our colleges and universities, and the Administration should leverage the R&E networking community’s broad resources and experience to drive broadband deployment, adoption, and innovative learning applications. R&E institutions are innovation incubators, where transformational technology companies are created, generating millions of jobs and billions of dollars in economic growth and helping America to remain the world leader in information technology that it is today. But for new waves of innovators to continue this cycle, the Administration must work to “reverse patterns of low achievement” in education by increasing access to high-capacity broadband at the earliest possible age for all students.
The Administration Should Use Public-Private Partnerships to Help Construct Broadband Infrastructure

**CHALLENGE:** Key stakeholders from the public and private sectors are not consistently involved in decisions regarding where and how to construct broadband infrastructure.

**RECOMMENDATION:** The Administration should support public-private partnerships that will expand broadband infrastructure throughout the country and continue to build on the successful partnership between the private sector and the R&E community in delivering advanced network applications and services.

**DISCUSSION:** Internet2 also recommends that the Administration focus on the success of public-private partnerships to help construct broadband infrastructure projects. For example, the Broadband Technology Opportunities Program (“BTOP”) leveraged public-private partnerships to help fund construction of broadband networks in unserved and underserved areas. BTOP, which oversaw the disbursement of approximately $4 billion in grants, required all recipients to provide matching funds toward the total cost of their broadband infrastructure, adoption, and training projects. BTOP funded more than a quarter of all infrastructure grants made either directly to a member of the R&E community or with an R&E network as a partner or sub-recipient. Funding to the R&E community amounted to more than $1.5 billion in federal awards. In addition, the BTOP program as a whole stimulated approximately $21 billion in economic activity.

In addition, the private sector has long partnered with the R&E community to deliver networking applications and cloud services to campuses nationwide through the Internet2 Network, as well as to address research, big data, and innovation challenges. For example, Level 3 Communications partnered with Internet2 to offer fiber and network support for the network upgrade that was partially funded by BTOP. Other partners, like Juniper Networks and Brocade, have provided equipment to support the Internet2 Network, such as by helping to create an Innovation Platform on the Internet2 Network that offers new capabilities for network and scientific researchers. In addition, partnerships between R&E networks and commercial telecommunications carriers and other industry representatives have allowed schools, libraries, and other anchor institutions to cost effectively access R&E networks’ shared infrastructure while increasing revenue and lowering administrative costs for those commercial partners.

The Administration Should Provide Strategic Leadership in Supporting a Rationally Engineered Global Broadband Infrastructure

**CHALLENGE:** In a truly interconnected world, the U.S. must continue to lead in broadband deployment and adoption globally to maintain and enhance its economic and technological position. European and Chinese governmental bodies have made significant investments in international networking capacity that bypass those of the U.S., increasing the need for a renewed national focus on broadband development.

**RECOMMENDATION:** The Administration should prioritize U.S. involvement in global networking initiatives and support public-private efforts to construct “wet optical fiber pairs” between continents in order to link NRENs in a more robust, cohesive, and future-proof manner. As part of sustained U.S. leadership in promoting a rationally architected global broadband infrastructure, the Administration also should support a coherent, open, global R&E broadband network. Such a network will enhance and safeguard the impact of the internet.

**DISCUSSION:** Broadband infrastructure can provide the foundation for overcoming many research, educational, political, and economic challenges. But like the domestic network, the global network is only as good as its last-mile connections. Expanding broadband access abroad not only serves U.S. interests, it also supports the capacity of the R&E community to tackle today’s most challenging research activities and support U.S. diplomatic efforts. What has been lacking to date, however, is sustained U.S. governmental leadership in supporting a rationally engineered global broadband infrastructure.

R&E networks create a networking environment that allows for big data endeavors to function seamlessly. Together, they also serve as an innovation platform for new technologies and allow academic and scientific leaders to work in a collaborative environment to develop common solutions to the world’s most pressing challenges. In fact, the G7 ICT Ministers recognized in a 2016 Joint Declaration the importance of the “development, interconnection, and utilization
of NRENs as providing an open infrastructure for education, research, and development purposes that also serve to enhance connectivity around the world.\textsuperscript{23}

Further, colleges and universities comprise a significant portion of the overall U.S. economy. Postsecondary institutions account for approximately $500 billion in revenue, representing about 4 percent of the GDP, and they employ 4 million workers, or about 3 percent of the country’s workforce.\textsuperscript{24} Moreover, U.S. universities took 16 of the top 20 spots in the most recent Academic Ranking of World Universities, and there is significant demand for American colleges and universities to educate abroad.\textsuperscript{25} For these reasons, prominent American universities are continuing to establish campuses in Europe, China, Qatar, the United Arab Emirates, and many other areas that are of geopolitical and economic interest to the U.S. A coordinated, global R&E network can support the rise of global education by ensuring that students, educators, and administrators throughout the world have access to open and reliable networking.

Therefore, the Administration should focus on the development of a global advanced networking infrastructure, which will have far-reaching impacts.\textsuperscript{26} In the short term, public-private efforts to construct wet optical fiber pairs between continents will be enough to connect NRENs more robustly. From a longer-term perspective, the Administration should consider the role it could play in developing a coordinated strategy for the acquisition and operation of global cyberinfrastructure. Relevant activities include establishing a global network backbone to meet aggregated demand; designing the architecture of “open exchange points” throughout the world; and establishing a governance model for building and supporting the global network of the future. Pursuing these efforts will allow a rationally architected network, services, and community of collaborators to grow and enhance the work of stakeholders in U.S.-funded activities.

European and Chinese governmental bodies have made significant investments in international networking capacity that bypass the U.S.\textsuperscript{27} In recent years, the European Commission has devoted significant funding to allow the pan-European networking organization Delivery of Advanced Network Technology to Europe (“DANTE”) to connect its network to South America, Africa, and Asia.\textsuperscript{28} China has made similar investments to connect its NREN to regional and global cyberinfrastructure.

Internet2 recommends that the Administration prioritize increasing U.S. involvement in global networking initiatives. NRENs can be valuable assets as “market makers” in their communities by spurring demand and adoption of advanced broadband connectivity, thereby promoting economic development.

NRENs, as well as U.S. federal agency partners, already are building collaborative relationships within international R&E communities that transcend cultures and survive political regimes. Internet2 has partnerships with more than 70 NRENs worldwide. Therefore, the U.S. R&E networking community is uniquely positioned to help broker U.S. involvement in key parts of the world, including South Asia, the Middle East and Gulf States, Latin America and the Caribbean, and Africa, where Internet2 has provided direct input into many emerging national networks.

The Administration Should Promote Trust and Identity Access Management Frameworks to Better Safeguard Critical Research from Cyber Attacks

**CHALLENGE:** Enhancing trust and identity access management is critical for academics and researchers to maintain the ability to securely create and collaborate on potentially sensitive projects, as well as maintain online privacy protections.

**RECOMMENDATION:** The Administration should direct the Federal Government to support initiatives that promote a comprehensive trust and identity strategy for higher education in order to protect their research and development activities, which the U.S. depends on, using the best practices developed by the R&E networking community.

**DISCUSSION:** The higher education community has performed over half of all basic research and development in recent decades in the U.S.\textsuperscript{29} The Federal Government has moved away from federally funded, federally performed research, essentially outsourcing R&D activities to universities and colleges. As the trend toward networked innovation continues, network authentication and privacy issues will come to the forefront for the Administration as it seeks to ensure that federally funded projects remain secure.
Two significant developments in this area that the Administration will be faced with are the National Institute of Standards and Technology’s ("NIST") transformation of Special Publication 800-63, which provides the basis for how individuals authenticate their identity online to the government, and the implementation of the European Union’s ("EU") General Data Protection Regulation ("GDPR") in May 2018. The NIST framework allows an identity provider to tell a service provider how much trust to put into an authentication event. The changes NIST is proposing include decreasing the number of assurance levels, establishing stricter rules for knowledge-based verification, and offering guidance to strengthen passwords. These changes have the potential to better protect sensitive data while only requiring a full identity proofing process when necessary. The GDPR will make a variety of changes, including broadening the reach of European data privacy regulations to jurisdictions outside of the EU, and the Administration may have to address legislation that mirrors the GDPR. At the same time, the R&E networking community will have to be prepared to address these changes, both abroad and domestically.

The R&E community has developed two significant initiatives to provide a more secure networking environment: InCommon, the nation’s trust federation, and the Trust and Identity in Education and Research ("TIER") program, designed to create a coherent identity and access management toolkit for federation participants. InCommon has more than 900 participants, including over 500 university and college participants and over 200 commercial participants, ultimately providing a secure bridge to R&E resources and experiences to over eight million people. TIER aims to simplify campus processes and advance inter-institutional collaboration and research. Both programs are operated by Internet2. Through these programs, the R&E community is poised to offer tools to help individuals preserve privacy and create a scalable privacy infrastructure that can serve a broader community, thereby adding value to the nation’s identity ecosystem and enhancing cybersecurity.

Internet2 recommends that the Administration should build on these programs and provide further support with initiatives such as the National Strategy for Trusted Identities in Cyberspace ("NSTIC") that focus on trust and identity management issues. NSTIC was created to work collaboratively with the private sector, advocacy groups, public sector agencies, and other organizations to improve the privacy, security, and convenience of online transactions. In addition, cybersecurity concerns should be entrenched in the government’s overall broadband infrastructure plans. Building networks that are secure from the start will help deter attacks and protect these vital assets.

CONCLUSION

Internet2 presents the preceding recommendations in order to help the Administration identify and address the challenges and opportunities applicable to broadband deployment and adoption in the U.S. Internet2, and the R&E networking community, looks forward to working with the Administration on ways to expand access to future-proof broadband to ensure that no American community is left behind and the global promise of the internet is realized.
2 Id. ¶ 2.
3 MARTIN CAVE, SPECTRUM AND THE WIDER ECONOMY 7 (2015) (collecting studies); see also Czernich et al., Broadband Infrastructure and Economic Growth 1 (CESifo Working Paper No. 2861, 2009) (testing the effect of broadband infrastructure on economic growth in Organization for Economic Co-operation and Development countries from 1996 to 2007 and finding “that a 10 percentage-point increase in the broadband penetration rate results in a 0.9-1.5 percentage-point increase in annual per-capita [economic] growth.”); Christine Zhen-Wei Qiang, et al., Economic Impacts of Broadband, in INFORMATION AND COMMUNICATIONS FOR DEVELOPMENT 2009 39, 44-45 (World Bank Group, 2009) (finding that “broadband connectivity had positive impacts on job creation, company and community retention, retail sales, and tax revenues.”).
4 JED KOLKO, PUBLIC POLICY INSTITUTE OF CALIFORNIA, DOES BROADBAND BOOST LOCAL ECONOMIC DEVELOPMENT 22-28 (2010).
7 Id.
11 Id.
12 For example, the University Community Next Generation Innovation Project, or Gig.U, is a group of dozens of leading U.S. research universities that seeks to accelerate the deployment of ultra high-speed networks to other universities and their surrounding communities. See http://www.gig-u.org/.
15 Id. at 24.
17 See id. at 13.
19 See The Economics of MOOCs at 5 (noting that MOOCs have an extremely low marginal cost of providing educational instruction to students), available at https://www.nea.org/assets/docs/HE/2014_Compilation-Saltzman.pdf.
20 Internet2 supports these efforts through its K20 Initiative, which develops programs and partnerships designed to leverage its advanced R&E networking infrastructure to deliver high-quality digital content and learning experiences to K-12 schools, public libraries, and other anchor institutions across the country. For example, the Presidential Primary Sources Project (“PPSP”) is a program series developed by Internet2 in partnership with the National Park Service, Library of Congress, and National Archives and Records Administration Office of Presidential Libraries. At one event, students from across the country were able to participate in a real-time video conference with former President Jimmy Carter to discuss his contributions to the National Park System and his decision to protect more than 100 million acres of federal lands in Alaska while he was president. See Nat’l Park Service Press Release, President Carter to Share History of Alaskan National Parks, available at http://www.nps.gov/news/release.htm?id=1539.
21 CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, FEDERAL COMMUNICATIONS COMMISSION at 226, 232 (2010). A comprehensive approach to broadband access should include investments in infrastructure in rural areas. Targeting rural areas not only will equalize educational opportunities but also help spur agricultural innovation (smart farming) and contribute to enhanced public safety, healthcare, and transportation systems throughout the country.
26 The Administration can and should build on initiatives such as the National Science Foundation’s International Research Network Connections program. This program provided approximately $50 million in support toward the high performance network connectivity required by international R&E collaborations involving the NSF research community. See https://www.nsf.gov/awardsearch/advancedSearchResult?WT.si_x=18&WT.si.cs=18&WT.z_pims_id=503382&ProgEleCode=7369&BoolAdvancedSearchResult=1&WT.sih=Any&Count=5&WT.sih=Any&Count=5&WT.element=Any&ActiveAwards=true#results.
27 For example, the European Commission has provided more than €300 million in grant funding to the Delivery of Advanced Network Technology to Europe (DANTE) organization, which built and operates the European NREN, GEANT. See http://www.dante.net/Research_Networking/European_Commission/Pages/Home.aspx. In addition, the Council of the European Union recently adopted a resolution recognizing the importance of high-performance computing (“HPC”) infrastructure for research and the need to develop the next generation of HPC technologies and calling for an exploration into mechanisms for better coordination of member states’ investment strategies in e-infrastructure. See Council Conclusions on Open, Data-Intensive and Network Research as a Driver for Faster and Wider Innovation, at 8, available at http://data.consilium.europa.eu/doc/document/ST-9360-2015-INIT/en/pdf.
28 The European Commission has provided millions in funding to support and connect NRENs across the globe with GEANT. In particular, the European Commission has provided €29 million to the Trans-Eurasia Information Network (TEIN4) in the Asia-Pacific region, €18 million to the RedCLARA network in Latin America, and €11.8 million to AfricaConnect in Southern and Eastern Africa. See https://
ec.europa.eu/europeaid/regions/asia/tein-3_en;


30 To strengthen global R&E collaborations, in February 2016, the InCommon trust federation also became a member of edugain, a global collection of 39 national research and education trust federations connected via interfederation.

31 Internet2 received a grant from NSTIC in 2012 and is using these funds to build a consistent and robust privacy infrastructure and encourage the use of multifactor authentication and other technologies. Internet2’s partners on this project include Carnegie Mellon University, Brown University, the University of Texas, the Massachusetts Institute of Technology, and the University of Utah.