Smart Cities and Communities Federal Strategic Plan: Exploring Innovation Together

National Science and Technology Council

Networking and Information Technology Research and Development Subcommittee

Smart Cities and Communities Task Force

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About this Document

The Smart Cities and Communities Task Force developed this report. The Task Force reports to the Subcommittee on Networking and Information Technology Research and Development (NITRD). This draft report is being released for public comment and will be revised in response to those comments.

About the Subcommittee on Networking and Information Technology Research and Development

NITRD is a body under the Committee on Technology (CoT) of the National Science and Technology Council (NSTC). The NITRD Subcommittee coordinates multiagency research and development (R&D) programs to help assure continued U.S. leadership in networking and information technology, satisfy the needs of the Federal Government for advanced networking and information technology, and accelerate development and deployment of advanced networking and information technology. It also implements relevant provisions of the High-Performance Computing Act of 1991 (P.L. 102-194), as amended by the Next Generation Internet Research Act of 1998 (P.L. 105-305), and the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science (COMPETES) Act of 2007 (P.L. 110-69). For more information, see www.nitrd.gov.

About the NITRD Smart Cities and Communities Task Force

The Smart Cities and Communities Task Force is a body under the NITRD Cyber-Physical Systems (CPS) Interagency Working Group (IWG). The CPS IWG's purpose is to coordinate programs, budgets, and policy recommendations for CPS R&D across the Federal government. This includes identifying and integrating requirements, facilitating joint program planning, and developing joint strategies for the CPS R&D programs conducted by agency members of the NITRD Subcommittee and CPS IWG. Specifically, the Smart Cities and Communities Task Force was chartered to coordinate Federal action and partnerships with academia, industry, local cities and communities, and other government entities to enable cities/communities of all types in accessing networking and information technologies and services. This access is intended to support cities/communities in developing smart solutions that enhance sustainability and quality of life, improve health and safety, and further economic prosperity.

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Smart Cities and Communities Task Force

Ken Calvert, Co-Chair, NSF   Chris Greer, Co-Chair, NIST   Ken Leonard, Co-Chair, DOT

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Executive Summary

Motivated by a vision of ubiquitous, smart infrastructure, systems, and services, many cities and communities view advances in networking and information technology as a way to increase efficiency, reduce costs, and improve quality of life for their residents. They seek to become "smart cities" and "smart communities" by embedding new digital technologies into their infrastructure, systems, and services to enhance existing, and develop new, city/community resources. Smart city/community solutions are intended to enable new capabilities and opportunities—all in the face of limited budgets. The possible applications are numerous: citizen services, smart grids, intelligent transportation systems, and remote healthcare, to name a few.

Although information technology promises enormous public benefits, it also introduces new challenges. These challenges range from technical to ethical, legal, and social, including cybersecurity, data sharing and analysis, privacy, public health and well-being, workforce and education needs, and cultural and socioeconomic considerations. Addressing these challenges requires new forms of cross-sector and cross-government collaboration, experimentation, knowledge sharing, and alignment.

This strategic plan offers a high-level framework to guide and coordinate smart city/community-related Federal initiatives, with an emphasis on local government and stakeholder engagement. Coordinating efforts across Federal agencies should help accelerate the development of smart city/community solutions that maximize the value of investments and optimize benefits to residents.

The Central Goals that motivate this strategy are to:
- Understand local needs and local goals;
- Accelerate smart city/community innovation and infrastructure improvement;
- Facilitate cross-sector collaboration and bridge existing silos;
- Boost exports and promote U.S. global leadership; and
- Focus on people-centered solutions that support job growth and economic competitiveness.

A key objective of this plan is to identify priorities for Federally funded research and development (R&D) as well as capacity-building to help transform our cities and communities and improve our standards of living. To do so, the Strategic Priorities identified herein are to:
- Accelerate fundamental R&D for smart cities/communities;
- Facilitate secure and resilient infrastructure, systems, and services for smart cities/communities;
- Foster smart cities/communities through data and knowledge sharing, best practices, and collaboration; and
- Enable evaluation of progress and long-term growth of smart cities/communities.

This plan envisions Federal agencies working together and engaging with local leaders, academia, industry, civil society, and other key stakeholders. The aim is to accelerate the development and implementation of new discoveries and innovations that in turn enable cities and communities to achieve local goals and address their most important challenges. Therefore, the Next Steps recommended in this strategic plan include, through the Smart Cities and Communities Task Force, promoting interagency coordination and collaboration; engaging cities/communities to collect feedback on and enable continued refinement of this strategic plan and future efforts; and developing a roadmap for specific Federal actions to execute the Strategic Priorities presented here.

1. Introduction

Recent advances in information and communications technologies (ICT) hold the potential for transformational change for cities and communities across the Nation and globally. By utilizing these technologies to improve existing infrastructure and enable new systems and services, cities and communities aim to improve efficiency and reduce costs, create new economic opportunities, enhance sustainability, improve quality of life, and meet other needs for their residents and businesses.[1,2,3]

Many have called for close cooperation and collaboration between Federal agencies, state and local governments, smart city/community stakeholders, and international partners in promoting progress toward such smart city and community goals.[2,3] This Smart Cities and Communities Strategic Plan sets out Central Goals, Strategic Priorities, and Next Steps for the Federal government in fulfill its role in the transition to next-generation cities and communities (see Figure 1).

Central Goals
Local Needs & Goals – Innovation – Collaboration – Global Leadership – People-Centered Solutions

Federal Strategic Priorities
Fundamental R&D – Secure & Resilient Infrastructure – Sharing & Best Practices – Evaluation & Long-Term Growth

Next Steps
NITRD Smart Cities and Communities Task Force Actions

Figure 1: Visual representation of this Smart Cities and Communities Federal Strategic Plan. Section 1 offers Smart City/Community Challenges and Central Goals toward addressing these challenges. Federal Strategic Priorities outline priority areas and actions for Federal agencies in realizing these goals, and the embedded Case Studies offer examples of current Federal activities aligned with the priorities (see Section 2). Next steps for pursuing the Federal Strategic Priorities are described in Section 3.

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[1] "Getting Smarter About Smart Cities," last modified April 23, 2014, https://www.brookings.edu/research/getting-smarter-about-smart-cities/.
[2] "Smart Cities, Regions, and Communities Export Opportunities," last modified 2016, http://www.trade.gov/markets/smartcities.pdf.
[3] "President's Council of Advisors on Science and Technology Report to the President: Technology and the Future of Cities," last modified February 2016, https://www.whitehouse.gov/sites/default/files/microsites/ostp/PCAST/pcast_cities_report_final_3_2016.pdf.

1.1 Smart City/Community Challenges and the Role of Digital Technology

Cities and communities across the Nation are today facing complex and persistent challenges stemming from changing populations and aging infrastructure. In particular, demands on city/community infrastructure, systems, and services are growing and changing, prompting important new needs, such as more effective use of limited space, greater walkability, and ways to support residents across all socioeconomic statuses. In addition, the need for improved resilience in the face of natural and man-made disasters adds to the challenges that cities and communities are facing. These challenges directly manifest for city/community residents as well.

Being able to address these challenges is in and of itself difficult. Ongoing city/community operations are often dependent upon the very infrastructure, services, and systems that could benefit from innovation—and finding the time, energy, and resources to improve city/community capabilities without adversely affecting these ongoing operations is not trivial.[1,2,3] Consider, for example, routine roadway construction projects; cities and communities must often conduct these projects during limited nighttime and weekend hours, so as to minimize disruptions for residents who rely upon the roadways to commute to and from work.

At the same time, advances in networking and information technology over the last several decades have transformed individuals' lives, rapidly altering how we live, work, and communicate. Integrating these digital technologies with physical infrastructure at the city/community level similarly enables innovative opportunities and solutions to the challenges cities/communities are facing. By working closely with cities/communities to support this integration in ways described in this strategic plan, Federal agencies can help facilitate solutions to city/community challenges and catalyze the smart cities and smart communities of the future.

1.2 Central Goals Aligned with Smart City/Community Challenges

Smart city/community projects are inherently undertaken at the local and state levels. To be an effective partner in these efforts, Federal efforts must therefore be well aligned with state and local needs. Considering the types of challenges facing cities/communities described in Section 1.1 above, as well as a range of ongoing smart city/community activities, the Smart Cities and Communities Task Force identified a set of five high-level challenge areas to inform this Federal strategy. These challenge areas and associated Central Goals are described below.

Like cities and communities today, no two smart cities/communities are exactly the same. Local cities/communities with varying needs and resources are embracing the smart city/community concept, but are pursuing goals that reflect different

circumstances, needs, and aspirations. This lack of uniformity makes it difficult to agree on what makes a city or community "smart."[4] However, there is a consistent vision across cities and communities—rural, urban, and tribal alike—that the leadership challenge lies with the local government to engage residents in identifying city/community goals, setting priorities, evaluating technical options, and managing implementation, operations, and assessment. Recognizing this challenge, the first Federal goal is:

(1) <u>Understand Local Needs and Local Goals</u>.
Federal smart city/community activities need to be informed by cities and communities and reflect the diverse challenges faced by cities/communities of all types (e.g., rural, suburban, urban, small and large). The focus should be on long-term sustainability of solutions, with consideration of privacy and security as well as social, behavioral, and economic factors in each city/community.

Current smart cities/communities initiatives are fueled by recent advances in information and communications technologies (ICT) combined with the declining price of such technologies. However, cities/communities are challenged to meet not only today's needs, but also those of tomorrow with changing populations, new economic pressures, and increased expectations of residents and businesses for continuing improvements in infrastructures, systems, and services. Meeting tomorrow's needs will require continuing advances in ICT and their adoption in the smart city/community marketplace. The second goal recognizes the important role of Federal agencies in promoting R&D and transition to practice of innovative new smart city/community technologies.

(2) <u>Accelerate Smart Cities/Communities Innovation and Infrastructure Improvement.</u>
Smart city/community innovation may be enabled by accelerating the entire pipeline, from fundamental R&D to testbeds for transitioning research to practice, as well as capacity-building to improve existing and new infrastructure, systems, and services. Design considerations include promoting interoperability and integration across sectors, and enabling improved security and privacy.

The goals of smart city/community projects typically focus on social (e.g., quality of life) or economic benefits and may not necessarily correspond to technological, geographical, organizational, or disciplinary boundaries. For example, making a city/community more livable and workable crosses sectors from transportation to health care and public safety; requires cooperation between the public and private sectors; involves technologies from distributed sensor networks to real-time data

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[4] For example, ITU's Telecommunication Standardization Sector (ITU-T) has provided an analysis of 116 definitions for "<u>a smart sustainable city</u>."

analytics and control and automation; draws from disciplines spanning engineering, computer and information science, the social, behavioral, and economic sciences, and beyond; and in many cases requires transitioning research to practice through testing at scale. Similarly, resilience to large-scale disasters or progress in broad transportation, energy, or other large-scale infrastructure projects may not be achieved by a city/community working alone, but may require a regional effort that brings together a diversity of authorities, entities, and interests.

The challenge for cities and communities here lies in bridging these divisions and silos. Thus, the third goal focuses on interagency coordination and use of the convening power of Federal agencies to enhance cooperation and facilitate new partnerships across agencies, sectors, and stakeholders. Figure 2 provides examples of Federal programs that bridge sectors and technology readiness levels, and Section 3 describes a convening role for the Federal government in bringing together representatives from cities and communities along with innovators from academia and industry to develop replicable solutions that are portable across cities/communities, interoperable across technologies and sectors, extensible, and cost-effective.

(3) Facilitate Cross-Sector Collaboration and Bridge Existing Silos.
Increasing efficiency and maximizing resources calls for collaboration across domains (e.g., integrating innovations at the nexus of food, energy, and water systems), organizational sectors (e.g., public-private partnerships that bring together government, academe, industry, and non-profit organizations), and geographic boundaries (e.g., cities/communities, states, and nations).
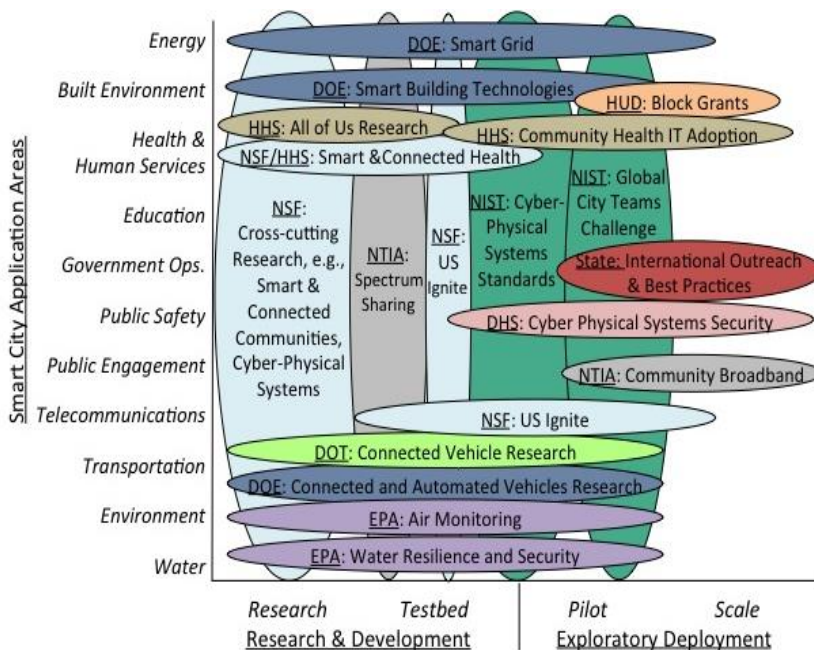
Figure 2: Examples of Federal smart city/community bridging programs. The image depicts examples of smart city/community bridging programs supported by the Federal government by application area (vertical axis) and technology readiness level, from research to exploratory deployment (horizontal axis). Bridging programs are those that cross multiple application areas (vertically-elongated ovals) or span multiple technology readiness levels (horizontally-elongated ovals).

Smart cities and communities benefit from a robust technology marketplace that provides for healthy competition and economies of scale that help keep prices low, and offers a range of choices and options enabled by interoperability and replicability domestically and globally. The challenge for cities and communities is that individually they may have only limited influence on the marketplace. Recent reports have noted that nations around the world are racing to transform their cities and communities and reap the economic and social benefits that smart cities/communities promise, including skilled jobs creation, new products and services, and global trade and investment opportunities.[2,3] The fourth goal, therefore, recognizes an important Federal role and interest in the global smart city/community technology marketplace.

(4) <u>Boost Exports and Promote U.S. Global Leadership.</u>
The Federal government may foster industry-driven standards, sharing of best practices domestically and internationally, and interoperable and replicable solutions to increase global trade, investments, and export opportunities, and global leadership for smart cities/communities.

To be successful, a smart city/community project must provide tangible benefits to residents. Moreover, for a given smart citiy/community innovation to be sustainable, the city/community needs to attract and retain talented individuals and provide education and training to help residents understand how to utilize and build on the technological innovations and new jobs and business opportunities that are being created. The challenges of ensuring that smart city/community efforts create measurable benefits for residents and provide for appropriate education and training are best met by a broad, cooperative effort. The fifth goal recognizes the Federal government can play an important role in facilitating progress on these design, measurement, and workforce (including education and training) challenges.

(5) <u>Focus on People-Centered Solutions that Support Job Growth and Economic Competitiveness.</u>
Smart city and community projects should improve quality of life for all residents, advance education and workforce development initiatives that build the capacity for equal opportunity, and enable inclusive and sustainable smart cities and communities of the future.

Section 2 below delineates Strategic Priorities, together with case studies of current activities led by Federal agencies, for achieving these goals.

2. Strategic Priorities

The following Strategic Priorities provide a vision and structure for agency activities in the future; the case studies presented provide current and past examples for illustration. Future agency activities may contribute to a single priority or multiple

priorities. For greatest success, Federal agencies' activities, in sum, should address all Strategic Priorities outlined below.

2.1 Accelerate Fundamental R&D for Smart Cities/Communities

Fundamental scientific and engineering research in the fields of computing, engineering, social sciences, ethics, education, and policy over the last several decades has enabled today's smart city/community innovations. Investments by Federal agencies should transcend science and engineering disciplines, cross a broad range of application areas, and be conducted in close engagement with cities/communities. The following list exemplifies some research areas that provide the foundation of knowledge for smart city/community solutions (note that this list is not intended to be exhaustive):

- Create next-generation capabilities leveraging big data techniques and technologies, real-time analytics, decision-making, adaptation, and automation of systems and infrastructure to address local needs;
- Investigate cybersecurity and privacy scientific and engineering foundations and risk management strategies in order to achieve secure, privacy-sensitive, and resilient smart systems and infrastructure;
- Bolster the Nation's broadband and wireless network ecosystem and opportunities by exploring new wireless devices, communication techniques, networks, systems, and services to enhance high-speed, software-defined connectivity and leverage the emerging Internet of Things (IoT);
- Understand and integrate the role of humans in smart systems, including social, behavioral, economic, cultural, legal, and ethical drivers, incentives, and intended and unintended consequences;
- Advance the theories of science, technology, engineering, and mathematics, including computing (STEM) learning and education that are enabled by technology innovations and simultaneously enable future technology advances to achieve sustainable solutions for local challenges; and
- Develop real-time models of human behavior, disease occurrence and transmission, and disasters to optimize healthcare and first-responder resources in dynamic situations.

Fundamental research provides a foundation for subsequent applied research as well as activities that support transition of research innovations into city/community settings, including at-scale testing.

2.1.1 Facilitate city/community engagement in an iterative research cycle

Collaboration with city/community stakeholders represents a key element in advancing smart city/community innovation and implementation. Research should include close engagement, well-developed partnerships, and iteration with city/community stakeholders—citizens, entrepreneurs, civic leaders, and policy makers—in ways that accelerate innovation, increase value of investments, and facilitate adoption of smart solutions. This engagement includes working closely with cities and communities to

unearth the challenges that they are facing; to inspire research questions based on these challenges; and to take the innovations that result from the associated research advances and pilot them in the very same cities and communities to evaluate the solutions, and continue the iterative cycle of innovation.

NSF Smart and Connected Communities Program

NSF has long supported the basic science and engineering research that lays the foundation of knowledge for smart cities and communities. Investment areas include, but are not limited to, Big Data, Cyber-Physical Systems, Critical Resilient Infrastructure Systems and Processes, Secure and Trustworthy Cyberspace, and Smart and Connected Health. In FY 2017, NSF will invest $18.5M in a focused Smart and Connected Communities (S&CC) program solicitation. This program uniquely engages communities to help inform research questions and pilot solutions to local challenges— for example, in the event of a natural disaster, using drones to provide wireless communications for emergency response teams. The S&CC program is highly interdisciplinary, spanning NSF's directorates for Computer and Information Science and Engineering; Education and Human Resources; Engineering; Geosciences; and Social, Behavioral, and Economic Sciences. The program will support use-inspired fundamental science research demonstrating three critical components: multidisciplinary integrative research, meaningful community engagement, and research capacity building.

2.1.2 Support research transition to practice in cities/communities

The transition of research innovations to practice is critical to ensure that smart city/community innovations benefit cities/communities and their residents, and yield the greatest return on investment for the Federal government. The chasm between fundamental science and engineering research and full production is often referred to as the "Valley of Death." To bridge this divide, the Federal government should work synergistically with industry, non-governmental organizations, and other stakeholders to shepherd innovations using transition-to-practice programs to move research to adoption and fully realize their value. To do so, the Federal government should foster at-scale research platforms to test and evaluate innovations while mitigating risk— especially early in the business cycle. Moreover, commercialization programs like the Small Business Innovation Research (SBIR) and Innovation Corps™ (I-Corps™)[5] programs should continue to receive support from multiple Federal agencies. Such programs provide a mechanism for the Federal government to foster strong, high-value partnerships with industry and create workforce training and recruiting opportunities, particularly with innovation and entrepreneurship as a focus.

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[5] For additional information, see I-Corps at NSF and I-Corps at NIH.

NSF Advanced Wireless Research Testbed Programs

Beginning in FY 2017, NSF, together with a consortium of industry partners, plans to fund development of a set of Platforms for Advanced Wireless Research (PAWR). This NSF-led public-private partnership aims to advance the development of next-generation wireless technologies and services. In partnership with over 20 companies and industry associations, NSF will invest $50 million over 7 years, combined with an additional $50 million committed by industry, to design, develop, deploy, and operate four city-scale wireless research platforms. Each platform will deploy an infrastructure focused on one or more aspects of wireless services (e.g., dynamic spectrum access, mobility at scale, measurement), allowing academic researchers, entrepreneurs, and wireless companies to test, prove, and refine advanced technologies and algorithms in real-world settings. The innovations that result from PAWR may have the potential to impact future generations of wireless networks and communication.

NTIA Institute for Telecommunications Sciences Research Testbed

NTIA Institute for Telecommunications Sciences (ITS) is developing a spectrum testbed in collaboration with the University of Colorado-Boulder to span the Federal research laboratory and university campus. The testbed will facilitate research to explore campus-scale wireless networking, spectrum sharing, and mobile applications, and enable collaborations between NTIA, the University of Colorado-Boulder, and the City of Boulder.

2.1.3 Accelerate local solutions using community-centric programs

The Federal government has a role in shaping pilot projects, challenges/prize competitions, and other programs in cities and communities to leverage new technology to address local priorities. Such programs can broaden the impacts of innovations, and help integrate technologies across application areas relevant to the cities and communities.

DOT Smart City Challenge

DOT issued the Smart City Challenge to encourage cities to propose holistic approaches to improving surface transportation performance within a city and integrate transportation with other smart city application areas such as public safety, public services, and energy. Seventy-eight cities/communities responded with their vision for using emerging data, technologies, and applications to address daunting transportation challenges and demonstrate how their smart city/community will reduce congestion, keep travelers safe, protect the environment, connect underserved communities, and support economic vitality. Their responses blended 12 vision elements that addressed technologies, people, and data. Smart technologies such as connected and automated vehicles and sensor-based infrastructure connected citizens to opportunities and focused on mobility services and choices. The DOT's $40 million challenge generated public and private partners, leveraging an additional $500 million in resources to support the seven finalist cities.

> DOE Better Communities Alliance
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> The Better Community Alliance (BCA) is a new DOE-led network of 70 cities, counties, non-profits, philanthropies, and companies with the goal of creating cleaner, smarter, and more prosperous communities for all Americans. Through the BCA, which is part of the Better Buildings Initiative, DOE is creating a one-stop shop for cities and counties to plug into DOE resources to support them in tackling energy and environmental challenges. As part of the BCA, DOE will gather key stakeholders to promote knowledge exchange and collaboration, while streamlining access to community-focused DOE resources and funding through coordinated assistance across programs and a common digital portal.

2.2 Facilitate Secure and Resilient Infrastructure, Systems, and Services for Smart Cities/Communities

As connectivity and interdependencies of smart city/community solutions increase, cities/communities should manage risk by increasing the security, resiliency, and extensibility of critical infrastructure, systems, and services for long-term value. These efforts are important to reduce the cost of hazards and malfunctions, in terms of lives, livelihood, and quality of life.

2.2.1 Enable cities/communities to assess, leverage, and enhance existing infrastructure, systems, and services

Cities and communities have already invested substantially in their current infrastructure. It is therefore important for cities and communities to find ways to leverage existing infrastructure, systems, and services to increase efficiency, security, reliability, and resiliency. For example, the City of Boston has been able to leverage data from its 630,000 residents using the Waze application to rethink its traffic planning,[6] with the goal of producing time and fuel savings, without adding new infrastructure or changing the behavior of its residents. Similarly, researchers at Vanderbilt University are partnering with the Nashville Metro Police Department and Nashville Fire Department to develop tools to improve upon existing emergency response infrastructure and services.[7,8] With funding from NSF, the team is developing a Smart City Emergency Response Hub, a next-generation system that anticipates incidents and allocates resources efficiently, securely, and reliably. It is leveraging current infrastructure and services together with innovations in sensing, wireless communication, predictive analytics, and human decision-making and behavior.

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[6] Waze (/weɪz/) is a GPS-based geographical navigation application program that was first developed and popularized by Waze Mobile. It works on smartphones and tablets with GPS support and provides turn-by-turn information and user-submitted travel times and route details including traffic and incidents. "Waze," *Wikipedia*, last modified December 7, 2016, https://en.wikipedia.org/wiki/Waze.

[7] "CPS EAGER: Experiments with Smart City Hubs: Integration Platform for Human Cyber-Physical Systems In Smart Cities," https://www.nsf.gov/awardsearch/showAward?AWD_ID=1528799&HistoricalAwards.

[8] "Integrated Safety Incident Forecasting and Analysis," https://www.nsf.gov/awardsearch/showAward?AWD_ID=1640624&HistoricalAwards.

The Array of Things, A Partnership among Argonne National Laboratory, the University of Chicago, and City of Chicago[9]

As cities explore smart solutions as part of urban modernization, assessing and leveraging existing expertise, resources, and infrastructure, they may be able to identify emerging challenges and adopt smart city/community innovations. Led by DOE's Argonne National Laboratory, the University of Chicago, and the City of Chicago, and funded by NSF, the Array of Things exemplifies a successful ongoing and expanding partnership. Innovations are being deployed to improve public health and welfare, and city operations. Researchers are leveraging city resources, and researchers and city representatives are continually learning from one another. The Array of Things is a network of interactive, modular sensor boxes being deployed. A key element of the system is modularity so that new sensors can be added as needed. Currently, sensors evaluate metrics like temperature, light, carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, sound, particulate matter, and pedestrian and vehicle traffic to better understand their links to health outcomes, transportation safety, and crime. These real-time, location-based data are provided to researchers, policymakers, developers and residents, who are working together to make Chicago healthier and more livable. Chicago anticipates operating more efficiently and realizing cost savings by proactively addressing challenges such as urban flooding and traffic safety. In addition, residents should be able to track their personal exposure to air contaminants, enabling them to consider factors such as urban heat islands, air quality, or excessive noise and congestion, when navigating the city.

DOE Pacific Northwest National Laboratory Wide Area Resiliency & Recovery Program

Pacific Northwest National Laboratory (PNNL), led by DOE, Wide Area Recovery & Resiliency Program (WARRP) created a framework for urban areas, critical infrastructures, and military installations to enhance wide-area recovery efforts in response to chemical, biological, radiological, or nuclear (CBRN) events, to enable a timely return of basic services and social and economic order. PNNL's efforts included work with DHS, the State of Colorado, and the City of Denver to explore and develop an all-hazards regional recovery framework to enable critical recovery decisions at a regional level, and provide context to local jurisdictions to develop their own operational recovery plans. Additionally, with FEMA, an urban area recovery planning aid was developed as a guide to inform the development of recovery plans and strategies in response to CBRN events. In addition to DOE, DHS, and FEMA, CDC, EPA, HHS, and DOD were also were involved in the work, along with local and state authorities; the resources have been made available to other cities as well.

2.2.2 Support cities/communities in designing new secure and resilient infrastructure, systems, and services

In designing and building new infrastructure, systems, and services, security and resiliency should be key considerations. For example, cyber-physical systems (CPS) and

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[9] "MRI: Development of an Urban-Scale Instrument for Interdisciplinary Research," https://www.nsf.gov/awardsearch/showAward?AWD_ID=1532133&HistoricalAwards.

IoT[10] are playing increasingly important roles in cities/communities, from remote healthcare to transportation to the electric grid. At the same time, CPS and IoT are increasing cybersecurity risks through the introduction of new attack surfaces. These new vulnerabilities yield the need to build security and resiliency into new infrastructure and systems. Whether referencing the forward collision prevention capability of a car, a telehealth system's ability to adapt to circumstances in real-time, or the latest IoT innovation, these systems are a source of competitive advantage in today's innovation economy and provide vast opportunities for smart and connected cities/communities. However, the consequences of unintentional faults or malicious attacks in CPS and/or IoT could have severe impact on human lives and the environment, in urban and rural areas alike. The DHS Science and Technology Directorate's Cyber Physical Systems Security program is working to addresses such CPS and IoT concerns. Proactive and coordinated efforts are needed to strengthen security and reliability for CPS and IoT more broadly.

DOE and NIST Smart Grid R&D Programs

DOE's Smart Grid program is developing innovative technologies, tools, and techniques to move to a modern electric grid distribution delivery system. Smart Grid efforts are pursuing strategic investments to improve reliability, operational efficiency, resiliency, and faster outage recovery to meet the ever-changing capabilities necessary to meet our Nation's evolving electricity needs. These needs include accommodating the increasing customer-owned distributed power generation (such as solar photovoltaics); supporting the shift towards the electrification of transportation/electric vehicles; enabling greater customer choice and control over electricity consumption; being more resilient to extreme weather conditions; reducing the duration and number of outages; and, at the same time, maintaining affordability. Smart Grid investments are focused on Advanced Distribution Management Systems, Transactive Controls, Microgrids, and Resilient Electric Distribution.

NIST's Smart Grid program complements DOE's efforts with an emphasis on measurement methods, best practices, and guidelines for interoperable smart grid technologies that enhance safety, security, resilience, and reliability, and enable new architectures for the electric grid of the future that may support new energy resources, stakeholders, and market models.

2.2.3 Foster smart infrastructure, systems, and services with long-term capacity

Cities and communities often face tight budgets that can severely constrain future decisions on infrastructure. By making strategic forward-looking decisions now, cities

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[10] Automobiles, medical devices, building controls and the electric grid are all examples of CPS. Each includes smart networked systems with embedded sensors, processors, and actuators that sense and interact with the physical world and support real-time, guaranteed performance in safety-critical applications. This points to developing CPS with greater assurances of safety, security, scalability, reliability, interoperability, and verifiability. By contrast, the closely related area of IoT represents a broader ecosystem with the potential for connecting tens of billions of devices and integrating many CPS technologies. IoT continues to emerge and expand as costs drop and the confluence of sensors, platforms, and networks increases.

and communities can be better prepared for future growth and changes in technology. The Federal government can help cities and communities determine ways to build for future capacity and to collaborate across sectors to create more resilient, interoperable systems that provide key services in a cost-effective manner. For example, if a city or community is installing fiber optic communications, it may be cost-effective to install excess capacity to improve extensibility in anticipation of future demand. Likewise, spectrum sharing offers a mechanism to coordinate across application areas and increase the long-term capacity and scalability of the wireless infrastructure. In both cases, if additional projects are pending, anticipated, or projected, projects may be phased together to support a single digging operation, as well as a one-time allocation of resources. In addition, data from smart infrastructure can support decisions about infrastructure repair, retrofit, and redesign to improve long-term value. By taking an integrated approach, i.e., coordinating across multiple sectors, such as water, electricity, and telecommunications, cities and communities can develop intelligent, cost-effective solutions for satisfying user demand for services.

2.3 Foster Smart Cities/Communities through Data and Knowledge Sharing, Best Practices, and Collaboration

Knowledge sharing and collaboration could enable replication and scaling of smart city/community innovations across cities and communities both in the United States and globally. Data sharing and interoperability are critical, as data are the foundation of improved decision-making. The Federal government offers diverse tools and tactics, e.g., toolkits, convening workshops, and grant programs, to enable technology scaling across application areas and geographic boundaries. Toward increasing global competitiveness, the Federal government can cultivate best practices for sharing of data, innovations, and exports.

2.3.1 Advance secure, privacy-preserving data sharing and interoperability

By their very nature, smart city/community goals require the analysis of many different types of data from many different sources. For example, improving environmental quality and enhancing sustainability requires fusing data from air quality and traffic, energy usage, water quality, and other monitoring systems. Reducing traffic congestion requires integrating data from roadway infrastructures, vehicles, public transit, weather, and others. In the case of healthcare, improving the outcomes from a heart attack or stroke requires coordination of 911 operators, emergency vehicles, monitoring systems, and traffic management to get patients as quickly as possible to a treatment location. Therefore, incentivizing secure, privacy-preserving data sharing and promoting interoperability of that data offer two key opportunities for Federal support and engagement.

Efforts to achieve comprehensive secure, privacy-preserving shared data for use within and across smart city/community infrastructure systems and services are needed. Currently, common datasets are limited or restricted to comparatively few infrastructure providers or sectors. Additionally, the privacy and security of data yields

challenges. In the case of datasets to support health innovation in cities/communities across the United States, NIH launched the [Precision Medicine Initiative](#) (PMI) with an initial investment of $200 million in FY 2016.[11] PMI aims to gain better insights into the biological, environmental, and behavioral factors that drive disease. PMI tackles the aforementioned challenges, making data available to researchers across providers and sectors, and managing highly sensitive information. A cornerstone of this investment is storing, managing, and moving highly sensitive data from one million individuals, making them accessible to researchers. Innovations in data infrastructure (including software and hardware) are enabling this ambitious effort, addressing challenges in data management, movement, and analysis.

In addition to NIH's PMI, Federal agencies are generating extensive datasets on a wide variety of topics ranging from the environment and census to transportation, energy, and beyond. Through the Open Data Initiative, agencies have been working to make these datasets easier to find and use through resources like [Data.gov](#). Continued efforts to make relevant Federal agency datasets readily available to communities, entrepreneurs, innovators, and researchers will enable new analytics and capabilities that will in turn enhance understanding of cities/communities and their needs. Additionally, while there are clear opportunities for making existing data available, there are also compelling reasons for investing in the production of synthetic or simulated data to test and evaluate, for example, future or projected infrastructure solutions or disaster management strategies.

In terms of interoperability, data are often produced in multiple formats that lack standard measures, definitions, and taxonomies, thus creating substantial barriers to rapid and effective data integration and fusing for analytics. In some cases, for example, in the private sector, customized and proprietary data systems are incompatible with one another. Federal agencies working together with academic and industry partners can facilitate the development and dissemination of best practices, guidelines, and standards for interoperability. For example, Federal agencies may promote best practices by sharing their data from smart city/community applications in standards-based, well-documented, interoperable forms. In addition, they may encourage public-private partnerships to help make data more interoperable and promote data sharing across sectors, technology platforms, and application areas. To advance this work, appropriate economic incentives and collaboration models that encourage sharing of interoperable data are needed. These models should take privacy and security issues into consideration.

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[11] "FACT SHEET: President Obama's Precision Medicine Initiative," last modified January 30, 2015 https://www.whitehouse.gov/the-press-office/2015/01/30/fact-sheet-president-obama-s-precision-medicine-initiative.

Ultimately, data-centric services, capabilities and resources are central to smart city/community solutions. Federal support for the development of secure, privacy-preserving data sharing and interoperability may accelerate the activities described in Sections 2.1 and 2.2 above. Their design and implementation also requires workforce development and training opportunities as detailed in Section 2.4.3.

DHS Science and Technology Directorate, Homeland Security Advanced Research Projects Agency, Data Analytics Engine

The Data Analytics Engine (DA-E) uses emerging storage, security, computation, and analytics technologies to rapidly leverage and convert data to decisions for Homeland Security systems, missions, and operations. Many IoT applications require real-time analytics to maintain situational awareness and make decisions for quick action. Additionally, most real-world IoT environments involve multi-latency networks due to heterogeneous network interconnections, and multi-party networks, as different IoT sub-networks may be deployed and/or owned by different entities. DAE is exploring how emerging technologies can be applied to reliably and securely collect, stream, and analyze large quantities of IoT data in real-time.

U.S. Census Bureau Open-Source City Software Development Kit

The U.S. Census Bureau's open-source CitySDK project makes valuable data and app development accessible by communities and civic innovators. To help incubate new apps that are based on open data, including smart cities/communities apps with broad civic benefits, the Census Bureau launched a pilot program of data innovation workshops, delivered in close collaboration with city experts, to help solve the most pressing local issues. The pilot program helps bridge the data production and management gap between Federal, state, and city data, and scales nationally through the Census's 50 State Data Centers Program. A key focus of the pilot is helping cities break down data silos to enable smarter disaster response.

DHS Science and Technology Directorate First Responders Group

DHS Science and Technology Directorate's First Responders Group is exploring the need for diverse types of geospatial data for emergency response in future cities and communities. The group is exploring how better access to a diversity of interoperable data sources and powerful analytics could inform and protect the safety of firefighters responding to an incident, enable next-generation, more intelligent firefighting systems, and allow safer and more efficient evacuation in the event of a disaster.

2.3.2 Facilitate replication and scaling through best practices

The Federal government has a role in helping cities identify best practices and boost replication and scaling across geographic boundaries by facilitating multi-city programs. Exemplary areas where best practices may improve scaling include intelligent transportation systems that cross geographic boundaries; remote healthcare systems that work in any city; and regional air quality improvements through coordinated local action. By bringing multiple Federal agencies together with local governments, academia, industry, and non-profit stakeholders to collaborate on shared solutions broadly adoptable to many cities, the cities can leverage each other's investments and reduce barriers to the adoption of such solutions. Through best practices and economies

of scale, more cities and communities of all types can leverage, scale, and replicate each other's successes.

NIST Global City Teams Challenge

NIST's Global City Teams Challenge (GCTC) is a collaborative platform to promote replicable, scalable and sustainable models for incubation and deployment of interoperable, standards-based IoT solutions and demonstrate their measurable benefits in smart cities and communities across the Nation and around the world. In its 2016 round, GCTC has recruited and incubated over 100 "Action Clusters," or teams of diverse stakeholders with a common objective, including participation from over 120 cities and 300 companies, universities, and other organizations worldwide. In the 2017 round, GCTC is establishing multi-team "SuperClusters," which bring together Action Clusters to take on grand challenges, such as the Transportation, Energy/Utility/Water, and Healthcare SuperClusters. This initiative brings together groups of communities formed around lead cities and private sector partners to work with NIST and its collaborators, including DOT, DHS, NSF, EPA, and NTIA, to develop "blueprints" for shared solutions that will be collaboratively implemented and replicated in multiple cities and communities.

2.3.3 Foster global collaboration to drive innovation

While cities and communities have unique characteristics, they face common challenges regionally and globally. Global issues affecting cities and communities include increased consumption of non-renewable energy, impacts associated with natural and man-made disasters, variability in climate and severe weather events, access to safe sanitation and potable water, and efficient distribution of food. By engaging internationally, e.g., through programs like NSF's S&CC program and NIST's GCTC, or in fundamental research that addresses such global problems, technologists and researchers are able to share innovations and new approaches to common problems. In one specific example, the Array of Things project (see case study in section 2.2.1) is expanding its reach to other parts of the world, to understand the impact of different physical environments on the reliability of its technology, and to create a network of users who can share data, information, and approaches.

2.3.4 Boost global technology trade and investments opportunities

Smart cities and communities across the United States should think beyond their geographic borders and consider global trade and investment opportunities. An effective strategy for creating such opportunities focuses on local needs, while also seeking solutions broadly and sharing successes internationally.

Global trade, investments, and export opportunities are enabled by sharing best practices and promoting interoperable technology. For example, the International Trade Administration and the U.S. Commercial Service's Smart Cities Task Force can foster deeper knowledge and opportunity sharing across the United States and globally. Specifically, their trade promotion activities support joint implementation of best practices across global borders; and their trade policy and sector work with foreign governments can assist U.S. companies with market access challenges (e.g., see the Smart Cities, Regions & Communities Export Opportunities Report).

Additionally, local leaders are challenged to ensure their cities and communities do well for residents of all races, ages, socioeconomic levels, and skill sets; and for those who have moved recently as well as those who have lived in a particular locale for generations. To meet these diverse requirements, city/community leaders can look to examples of successful solutions regionally, nationally, and then globally. One such example is developing and sharing best practices for context-aware technology designed for use by people with differing native languages, cultural references, disabilities, and cognitive abilities. Inclusive environments such as these should further support global opportunities, beyond the borders of the United States.

2.4 Enable Evaluation of Progress and Long-term Growth of Smart Cities/Communities

Long-term growth and sustainability of smart cities/communities initiaitives requires evaluating progress, demonstrating benefit, and investing in human capital. The Federal government, working with state, local, academic, and industry partners, can contribute to developing standards, metrics, and economic models for evaluation that can be easily adapted on the local level. In addition, the long-term sustainability depends on workforce training and communicating successes to all stakeholders, including the public.

2.4.1 Promote standards and metrics for evaluation

Key features of an effective smart city/community system are interoperability, replication and scalability, extensibility, and ability to update. Interoperability enables modular designs that allow cities/communities to build solutions in manageable budget increments and enable options and choices among competing solutions. Replication and scalability allows cities/communities of all sizes and types to adopt successful solutions deployed in other cities/communities. Extensibility allows cities/communities to plan for future growth and evolving needs. Updating capabilities ensure that smart infrastructure systems that may be deployed for decades can be updated as technology evolves. All of these features require an underlying foundation of voluntary, consensus-based standards and best practices developed through industry-led processes, along with a robust testing and certification capacity that supports these standards.

The Federal government can play an effective role in promoting the emergence of global smart cities/communities standards and best practices by providing relevant technical expertise and facilitating industry-led processes. This activity would seed private-sector testing and certification capacity for uniform smart city/community accreditation.

NIST Internet of Things-Enabled Smart City Framework

NIST and its collaborators have launched a new international coalition dedicated to developing an IoT-Enabled Smart City Framework, with an initial release planned for summer 2017. Through an open, technical working group studying real-world smart city applications and architectures, the coalition may identify pivotal points of interoperability, where emerging alignment on best practices and standards can enable a landscape of diverse but interoperable smart city solutions. Coalition members include the American National Standards Institute; the U.S. Green Building Council; the Telecommunications Industry Association (TIA); the Republic of Korea's Ministry of Science, Information and Communications Technologies, and Future Planning; the Italian National Agency for New Technologies, Energy, and Sustainable Economic Development; the European Telecommunications Standards Institute; and the FIWARE Foundation.

2.4.2 Support economic models for evaluation

With cities and communities now being analyzed and understood as complex systems of systems, city-/community-scale economic models are increasingly important. Such economic models offer a means to evaluate and demonstrate impact and return on investments for smart city/community initiatives, evaluate progress in real time and make as-needed adjustments, and plan investments in the future. Technical expertise within the Federal government may support cities and communities in developing economic models and evaluation methods. These capabilities require an underlying framework of metrics and measurement methods, including quantifiable key performance indicators, and Federal agencies can facilitate their development. In doing so, unique characteristics of cities and communities should be considered to ensure that models and methods are easily adaptable to the local level.

NTIA Broadband Technology Opportunities Program Evaluation Study

NTIA contracted ASR Analytics, LLC, to conduct an independent Broadband Technology Opportunities Program (BTOP) Evaluation Study of the long-term economic and social impacts of the $4 billion in American Reinvestment and Recovery Act grants awarded under BTOP. Examples of the analysis included evaluating the impacts of BTOP infrastructure spending on gross domestic product (GDP) in the areas served by the new broadband infrastructure. For the base case of a 2.0 percent increase in broadband availability, BTOP infrastructure spending could be expected to yield $5.7 billion in increased output annually, using Czernich et al. as a basis for extrapolation.[12] Kolko provide a basis for estimating the increase in employment due to broadband infrastructure spending.[13] Based on Kolko's estimates, the additional broadband infrastructure provided by BTOP could be expected to create more than 22,000 long-term jobs and generate more than $1 billion in additional household income each year.

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[12] Nina Czernich, Oliver Falck, Tobias Kretschmer, and Ludger Woessmann, "Broadband Infrastructure and Economic Growth," *The Economic Journal* 121 (2011): 505—532, doi:10.1111/j.1468-0297.2011.02420.x.
[13] Jed Kolko, "Broadband and Local Growth," (2010): http://ssrn.com/abstract=1680597.

2.4.3 Facilitate long-term sustainability by boosting human capital

The long-term sustainability of smart cities/communities requires creating and supporting a population and workforce that are both motivated to understand and tackle local challenges and are enabled to do so through education and workforce development.

The smart cities/communities arena offers a unique opportunity for the Federal government to engage with residents to spur interest in, and motivate students to, participate in their cities/communities in meaningful ways. In one such example, through the NSF-funded Water Awareness Research and Education (WARE) program at the University of South Florida,[14] K-12 teachers and students work alongside university faculty and students to install and retrofit smart infrastructure to alleviate flooding, improve nutrient management, and execute project-based learning activities for all involved.

In addition to engaging the community, Federal agencies can continue to invest in education and workforce development initiatives to provide the foundation of knowledge for smart city/community solutions. The foundation is in STEM education, which enables individuals to understand and apply the scientific method to solve pressing challenges. Additionally, computational thinking and data analytics are a cornerstone of smart city/community applications. Beyond fundamental STEM education, next-generation cities and communities require a trained workforce for cybersecurity, defense, agriculture, energy, health, environment, transportation, research, entrepreneurship, and beyond.

NIST National Initiative for Cybersecurity Education

The National Initiative for Cybersecurity Education (NICE), led by NIST, is a partnership between government, academia, and the private sector focused on cybersecurity education, training, and workforce development. The mission of NICE is to energize and promote a robust network and an ecosystem of cybersecurity education, training, and workforce development. NICE fulfills this mission by coordinating with government, academic, and industry partners to build on existing successful programs, facilitate change and innovation, and bring leadership and vision to increase the number of skilled cybersecurity professionals helping to keep our Nation secure.

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[14] "RET in Engineering and Computer Science Site: Water Awareness Research and Education," https://www.nsf.gov/awardsearch/showAward?AWD_ID=1200682.

NSF Cyberlearning and Future Learning Technologies (Cyberlearning) Program

NSF has supported interdisciplinary research on learning in many programs over many decades, especially in cross-directorate investments. In the Cyberlearning and Future Learning Technologies program, three NSF directorates (Computer and Information Science and Engineering; Education and Human Resources; and Engineering) fund projects that exploit emerging technologies to advance learning in multiple contexts. For example, a recent project will examine how medical and emergency response teams learn to coordinate their efforts using data from cyber-physical systems. The goal of that effort is to enhance the effectiveness of multi-team systems, particularly in the context of sociotechnical infrastructures that are driving smart and connected cities and communities.

2.4.4 Communicate successes and lessons learned through cross-sector platforms

It is critical to celebrate the successes and communicate the lessons learned of smart city/community innovations, especially in forums that reach broad stakeholder audiences and cross sectors. Key to these successes have been partnerships that bring cities and communities together with academia, industry, non-profit organizations, and others to work on innovative solutions that benefit residents. Each group of stakeholders offers unique values and perspectives for smart city/community innovation, and it is becoming increasingly critical to provide mechanisms for coordinating and sharing the cross-sector, cross-stakeholder innovation, and for building capacity to maximize the benefits of strong collaborative efforts.

NSF-Supported US Ignite Application Summit

NSF launched US Ignite in 2012 as a public-private partnership seeking to connect "islands" of broadband across the Nation and demonstrate the potential of game-changing new applications, "apps," that take advantage of smart, ultra-high-speed connections. These apps are offering new ways for communities to adopt and deploy new networking technology, enabling them to become smart and connected, and to provide never-before-imagined services that are beginning to transform public safety, healthcare, education and learning, energy, transportation, manufacturing, and more. For example, in education and learning, an app developed jointly by researchers at USC and educators in Chattanooga, TN enables STEM students in Chattanooga to learn Biology in newly immersive ways by viewing Pacific Ocean microorganisms under a 4k microscope, remotely manipulating the microscope in near real-time, and simultaneously holding high-definition video conferences with world-class university researchers – all from 1,800 miles away via a low-latency, ultra-high-speed connection. To date, nearly 40 US Ignite cities and communities across the nation have deployed gigabit connections to homes and businesses–and over 100 app concepts or prototypes that leverage these advanced networks have emerged. Since inception, US Ignite has achieved 1:1 matching support from private sector and Federal sources, with significant commitments from corporate sponsors, local cities and communities, and foundations. Every summer, the US Ignite Application Summit has brought together over 300 computing researchers, software and application developers, entrepreneurs, innovators, investors, industry executives, and mayors and other civic leaders (the 2016 summit had over 1,200 participants) to showcase the emerging content-rich, high-bandwidth, dynamic, secure, and reliable apps; identify opportunities for cross-city/community expansion of emerging apps; and catalyze new collaborations and partnerships for furthering the US Ignite ecosystem.

NIST Global City Teams Challenge Expo

The annual [Expo for NIST's GCTC](#) is one of the largest convening opportunities in the United States for smart city/community stakeholders to celebrate progress and innovation. The 2016 GCTC Expo that took place June 13-14 in Austin, Texas, attracted nearly 2,000 attendees to see the latest developments in the rapidly expanding smart city/community sector. More than 110 cities from 11 countries gave on-stage presentations and hosted display booths at the Austin Convention Center and over 90 teams demonstrated the results of their smart city pilots and experiments.

In addition to communicating successes and lessons learned between smart city/community stakeholders in academia, industry, and government, the Federal government has a role to play in elevating smart city/community efforts for public awareness more broadly. Highlighting city/community challenges and smart city/community solutions to diverse audiences, including the public, promotes inclusive, equitable, and sustainable progress.

3. Summary and Next Steps

This plan offers a shared Federal strategy for smart cities/communities that is informed by and responsive to the needs of the full spectrum of stakeholders, spanning sectors (e.g., academia, government, industry), application areas (e.g., transportation, energy, networking, health), and geographic boundaries (i.e., cities and communities themselves). The Strategic Priorities are summarized below and next steps are recommended, emphasizing the continued need for coordinated efforts among Federal agencies and through close engagement with cities/communities.

3.1 Federal Strategic Priorities Summary

This section summarizes the Strategic Priorities presented in Section 2. The Strategic Priorities are anticipated to evolve over time, particularly with input from city/community stakeholders.

3.1.1 Accelerate fundamental R&D for smart cities/communities

Fundamental scientific and engineering R&D provides the foundation of knowledge for smart city/community solutions. Supporting fundamental research and transition-to-practice programs that engage city/community end-users and stakeholders helps accelerate innovation and improve the value-add to cities/communities. Promoting STEM research that spans multiple disciplines and application areas is necessary to maintain and enhance U.S. smart city/community leadership.

3.1.2 Facilitate secure and resilient infrastructure, systems, and services for smart cities/communities

With increasing connectivity and interdependencies of smart city/community solutions, existing infrastructure, systems, and services should be leveraged and updated, and new ones should be developed, with significant attention to security, resiliency, reliability,

interoperability, and scalability. Integrating these assurances into technology development should help to improve the long-term value and extensibility of smart city/community solutions.

3.1.3 Foster smart cities/communities through data and knowledge sharing, best practices, and collaboration

Data and knowledge sharing and interoperability across application areas, smart city/community stakeholders, and geographic boundaries promotes a robust domestic and international smart cities/communities ecosystem. Catalyzing such an ecosystem should include promoting secure, privacy-preserving data sharing and interoperability, and domestic and global best practices for technology development, distribution, replication, and scaling.

3.1.4 Enable evaluation of progress and long-term growth of smart cities/communities

Evaluation and decision-making for sustainable smart city/community solutions requires that cities/communities have the standards and tools needed to explore options and measure success; a workforce capable of analyzing and implementing complex systems; and examples of successful, smart city/community solutions that serve as guiding lights for emulation.

3.2 Next Steps

To enhance and support implementation of a coordinated Federal smart cities and communities strategy, the following next steps should be pursued.

3.2.1 Promoting interagency coordination

The Smart Cities and Communities Task Force should continue its mission to provide an ongoing forum for interagency coordination. The group should facilitate agencies' identification of shared interests and synergistic opportunities. The diverse capabilities and communities represented by Task Force member agencies could enable a range of coordination and collaboration mechanisms such as joint funding opportunities for multi-sector and multi-technology solutions that maximize synergies and reduce duplication; and coordination of multi-agency workshops and other meetings that bring together stakeholders to understand challenges, enable solutions, identify best practices, and grow and nurture the multi-faceted community, including by fostering new collaborations. As the first step in promoting interagency coordination, the Smart Cities and Communities Task Force should post and update regularly an online resource of Federal Smart Cities and Communities Programs, a preliminary version of which has been developed. This resource should be maintained on the NITRD website.

3.2.2 Engaging with city/community stakeholders

A key element of this strategy constitutes close engagement between Federal agencies and cities/communities, industry, academia, and other government entities to understand local needs and to enable and mobilize solutions. Specifically, the Task Force should:

1. Consult broadly with stakeholder organizations, such as the International City/County Management Association, National Association of Counties, National League of Cities, Smart Cities Council, Telecommunications Industry Association, U.S. Conference of Mayors, US Ignite, Inc., and others;
2. Participate in and convene public events, including conferences and workshops, to share the emerging concepts in the draft strategy; and
3. Use the full spectrum of input from comments, consultations, and public events to inform Federal activities, including those that support the Strategic Priorities in Section 3.1 and the interagency coordination described in Section 3.2.1.

As the first step in promoting this close engagement, the Smart Cities and Communities Task Force is releasing a draft of this strategic plan for public comment, ahead of publication of a final version. In particular, the Task Force is seeking input from the diverse range of smart city/community stakeholders, with the overall goal to establish and continually refine a shared Federal strategy for smart cities/communities that is informed by and responsive to the needs of the full spectrum of stakeholders, including those of the cities and communities themselves. This form of engagement may persist beyond the strategic plan itself to support the diverse range of Task Force activities recommended herein.

3.2.3 Developing a shared roadmap for progress

Following public comment and upon revision of the Smart Cities and Communities Federal Strategic Plan, the Smart Cities and Communities Task Force should develop a roadmap for Federal actions that implement this strategy going forward. Subject to revision, the Strategic Priorities summarized in Section 3 offer the foundation for the shared roadmap. This roadmap should encompass the elements of effective smart city/community efforts, ranging from research and planning to exploratory deployment, and including milestones and evaluation, as well as surfacing and promulgation of best practices.