

Smart City Technologies: Driving Economic Growth and Community Resilience

Nick Maynard

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Summary

Today, cities across the United States face significant challenges. The future of economic growth is uncertain. Community leaders struggle to make overburdened transportation and energy systems more resilient to climate change, while workers grapple with the impacts of automation on jobs. First responders are stretched too thin as they react quickly to public-safety needs such as natural disasters.

An emerging set of smart-city technologies from industry and university labs offer communities tools to help address these challenges. Smart-city programs deploy sensors, networks, and data analysis to expand economic opportunities for citizens and make communities more resilient. While smart-city technologies are not panaceas for urban challenges, they can enable communities to move more quickly and cost-effectively in addressing some of their most difficult obstacles.

But smart-city technologies are not yet being used to their full advantage. In particular, small-and medium-sized cities lack the resources, networks, and investor appeal that has enabled larger cities to race ahead in implementing and scaling such technologies. Federal support is needed now to help advance smart-city technologies in underserved communities, helping all Americans to succeed and thrive.

To achieve this goal, federal policymakers should convene representatives of cities, industries, universities, and federal agencies to identify obstacles to adopting smart-city technologies and to identify gaps where the federal government can provide additional support. This group should be tasked with developing a National Smart Community Strategy to be carried out through a coordinated interagency effort. The Strategy should include a mix of short-, medium-, and long-term goals and actions, such as:

- **Short-term:** Authorize and provide funding for a Smart Community Prize Competition, similar to the Department of Transportation's (DOT) 2015 Smart City Challenge.¹ Expand funding opportunities for research into smart-city technologies and for deployment of smart-city technologies into underserved communities.
- **Mid-term:** Develop new city services that enable more resilient and responsive local governments, while driving economic opportunities for U.S. communities of all sizes.
- **Long-term:** Ensure U.S. leadership in smart city technologies by funding expanded federal research and development (R&D) for transportation, energy, public safety, healthcare, and other areas.

¹ U.S. Department of Transportation (USDOT), "Smart City Challenge," June 29, 2017, <https://www.transportation.gov/smartcity>.

1. Challenge and opportunity

1.1 Potential of smart-city initiatives

Over the past five years, the Internet of Things (IoT)² has enabled communities to evolve into “smart cities”—cities that leverage sensors, networks, and data analysis to address challenges in healthcare, energy, the workforce, and other sectors. IoT networks include a range of technologies that connect everyday objects like cars, pacemakers, and thermostats to the internet to drive cost savings and improve safety. Examples of smart-city applications include:

- **Transportation:** Autonomous vehicles can use sensors and networks to safely navigate city streets for shuttle and delivery services. Internet-connected traffic signals can communicate with cars to reduce traffic congestion and accidents. Other sensors can help city planners prioritize streets and intersections for pedestrian-safety upgrades.
- **Public safety:** Internet-connected sensors help first responders determine where to prioritize efforts during emergencies.³ Sensors can also be used to monitor flooding or wildfires, helping make cities more resilient. Working with the City of Nashville, Vanderbilt University teams created a dashboard tool that allows first responders to analyze and manage crime and traffic accidents in real time. The tool predicts the likely impact of storms or flooding on accidents and crime, streamlining city decision making.⁴
- **Communications:** 5G wireless networks are the next generation of connectivity for mobile phones and other devices. These new networks offer the promise of high-capacity, low-latency connections to sensors for data and video.
- **Energy:** Smart grids and smart lighting can closely monitor power consumption, enabling municipalities to better match energy supply to energy demand. This in turn can save cities and/or utilities millions of dollars per year.

San Diego, California and Chattanooga, Tennessee provide examples of smart-city initiatives in action in the United States. San Diego spent more than \$30 million to install 4,200 LED smart lights, traffic sensors, and pedestrian and public-safety monitors. Converting to LED lights saved the city approximately \$3 million a year in power costs, which covered the additional cost of the smart sensors. The success of the upgrades

² I.e., the “connection of devices (other than typical fare such as computers and smartphones) to the Internet.” Source: Andrew Meola, “What is the Internet of Things? What IoT means and how it works,” *Business Insider*, May 10, 2018, <https://www.businessinsider.com/internet-of-things-definition>.

³ Fangzhou Sun, et al., “Real-time ad Predictive Analytics for Smart Public Transportation Decision Support System”, 2016 *IEEE International Conference on Smart Computing*, St. Louis, MO (May 2016).

⁴ Geoffrey Pettet, et al., “Incident management and analysis dashboard for fire departments: ICCPS demo”, *ICCPS '19: Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems* (April 2019): 336–337.

motivated city leadership to recently add an additional 1,000 smart lights and sensors.⁵ Chattanooga was an early adopter of high-speed fiber-optic internet networks and smart-grid applications. One study found that from 2011 to 2016, Chattanooga's investment in these and related technologies helped to create 3,950 jobs.⁶

Yet San Diego and Chattanooga are the exception rather than the rule. In general, the potential of smart-city technologies is going under-realized in the United States. We as a nation are failing to deploy, test, and scale what works. Successful technology development must be supported by experimentation, yet U.S. investment in testing the next generation of wireless networks, sensors, and data analytics has slipped behind the likes of China, East Asia, and Europe. This has left many American cities reliant on global industry partners to implement smart-city strategies.

1.2 *Obstacles facing smart-city initiatives*

Deploying and scaling smart-city initiatives has proven to be technically and financially prohibitive, especially for small- to medium-sized rural and urban communities. San Diego, Chattanooga, and other larger U.S. cities possess the right mix of investment, political will, and cross-sector collaboration to realize the full benefits of smart technologies. But smaller cities lack these vital capacities, making it difficult to invest in smart-city technologies and/or to move beyond the pilot stage of smart-city strategies. Specific obstacles include the following:

- **Pilot smart-city efforts tend to be championed by an individual**—a mayor or Chief Information Officer (CIO). These efforts often lose momentum to expand after an administration changes. Ensuring continuity when a change in administration occurs requires ensuring that city departments and external stakeholders see the value of smart-city technologies and are committed to furthering technology deployment.
- Most city CIOs (and the IT departments they oversee) **lack discretionary funds sufficient to make upfront, multi-year investments in smart-city projects**. As a result, smart-city pilot projects are often funded from whatever untapped pool of money happens to be available: typically around \$50,000 to \$250,000 per year. Funding at this level and in this way allows a community to trial multiple approaches to a particular problem and to demonstrate proof of concept. But without larger and/or more consistent investments, pilots are unable to grow.

⁵ "San Diego Debuts New Smart City Apps & Intelligent Lighting Controls from Current by GE," *BusinessWire*, November 13, 2018, <https://www.businesswire.com/news/home/20181113005384/en/San-Diego-Debuts-New-Smart-City-Apps>.

⁶ Bento J. Lobo, Md. Rafayet Alam, and Brian E. Whitacre, "Broadband Speed and Unemployment Rates: Data and Measurement Issues", *Telecommunications Policy* (June 2019).

- City leaders frequently **struggle to coordinate with all relevant city departments on smart-city projects**. Failing to include key departments in planning and pilot stages can create implementation challenges later on, especially when a particular department has the authority and budget needed to scale.
- Communities like Kansas City, MO have **relied on donated equipment and services** from industry partners in order to deploy smart-city pilot projects⁷. As successful demonstrations of smart-city solutions have created markets for smart-city technologies in large cities, industry partners have become less likely to provide small- or mid-sized cities with smart-city technologies and services for free.
- **American investment in R&D related to smart-city technologies is lagging**. Other countries are leading the way on developing the next generation of 5G wireless networks, IoT sensors, connected and autonomous vehicles, and similar technologies. Investment is particularly lacking in the underserved areas that could most benefit from it.

The upshot is that the United States has much ground to make up when it comes to building the next generation of smart cities. Federal agencies can play an important role in laying the foundation for a new set of smart-city services and ensuring global competitiveness in urban and economic development. Federal agencies will also be key in ensuring that smart-city technologies benefit all Americans, not just those in high-income and urban settings.

2. Proposed action

The federal government should launch a concerted national effort to expand the reach, readiness, and capacity of smart-city technologies, especially in smaller and underserved communities. This effort should be guided by the following fundamental principles:

- **Every community is at a different stage in its smart-city development**. Some are still working on their visions and strategies, others have completed small pilots, and still others have expanded their efforts citywide. The federal government must provide strong leadership when it comes to smart cities, while retaining flexibility to tailor specific projects and initiatives to individual communities. The federal government must offer communities (and their partners) a range of support options that vary by scope, technological maturity, and priority area. Small businesses, university researchers, and industry partners require R&D grants for a range of technology-readiness levels, including applied research, prototyping, demonstration projects, and real-world testing and evaluation.

⁷ Josh Taylor, "Kansas City partners with Cisco and Sprint for smart city, Wi-Fi," ZDNet, June 8, 2015, <https://www.zdnet.com/article/kansas-city-partners-with-cisco-sprint-for-smart-city/>.

- **Intersectoral partnerships are essential to successful smart-city strategies.** Federal support for smart-city initiatives should encourage collaborative partnerships among local governments, researchers, small businesses, and industry leaders.
- **Smart-city investment should be targeted towards the places where it will do the most good.** Today, larger cities and higher-income communities are reaping a disproportionate share of the benefits of smart-city technologies. The federal government should give priority to smaller, more rural, and underserved communities when it comes to allocating grants for smart-city planning, funding for smart-city pilot project, and support for scale-up efforts.

To begin, federal policymakers should convene representatives of cities, industries, universities, and federal agencies to identify obstacles to adopting smart-city technologies and to identify gaps where the federal government can provide additional support. This group should be tasked with developing a National Smart Community Strategy to be carried out through a coordinated interagency effort. An interagency working group should then be established to (1) oversee Strategy implementation, (2) identify additional options for expansion of federally funded smart-city R&D, and (3) identify barriers to use of federal community funds for smart-city initiatives.

The Strategy should include a mix of short-, medium-, and long-term goals and actions. Short-term goals (*i.e.*, over the next 2–3 years) should include creating new funding and support options for researchers and communities, especially in cities underserved by existing industry and federal investments. Medium-term goals should include developing a new set of expanded city services that enable more responsive governments and new economic opportunities for U.S. cities large and small. Long-term goals include making the United States a global leader in developing and deploying smart-city technology.

Below, we propose specific policy actions designed to achieve these goals. These actions are intended to span a range of national priorities—including transportation, energy, and public safety—and to build on existing federal, state, and local smart-city programs.

2.1 *Launch a smart city prize competition*

The federal government has, to date, completed over 1,000 prize competitions across 100 agencies through its Challenge.gov platform. One of these, DOT's Smart City Challenge,⁸ specifically involved deployment of smart-city technologies to improve

⁸ USDOT, "Smart City Highlights," December 19, 2018, <https://www.transportation.gov/policy-initiatives/smartcity/smart-city-highlights>.
<https://www.transportation.gov/policy-initiatives/smartcity/smart-city-highlights>.

urban transportation. This approach could be easily extended to other smart-city domains, accelerating adoption of smart-city technologies nationwide and offering startups, students, researchers, application developers, and others a valuable opportunity to work with local communities on new solutions. We recommend that a national smart city prize competition (1) reward smart-city proposals that deliver clear benefits for underserved communities and (2) require communities to scale their smart city pilots to citywide services and secure industry and local matching funds. If federal agencies offered \$250 million annually in total support across a range of sectors, competing communities could raise several times that from state, local, industry, and foundation partners. Support bundled together could easily top \$1 billion in federal, local, and partner funding for smart cities.

2.2 Expand existing community development programs

The Department of Housing and Urban Development's (HUD) ConnectHome pilot program⁹ allows HUD funding to be used to provide digital-literacy training for and distribute internet-connected devices to public-housing residents, and to install broadband networks in public housing units. Creating similar smart-city programs at HUD or other agencies would allow local public-housing authorities to leverage HUD funding for smart-city deployments and workforce training for residents. Since some HUD programs have a match requirement, these programs could also create even larger impacts by driving community reinvestment into smart-city efforts at the local level.

2.3 Award planning grants targeted at underserved communities

Before communities can take advantage of the opportunities afforded by smart-city technologies, they have to understand just what those opportunities are—and how their cities or regions could benefit. Small planning grants, such as those awarded by the Economic Development Administration's (EDA) Economic Development Planning Assistance Program,¹⁰ could support dozens of cities with \$50,000 to \$100,000 each to take this first step.

2.4 Expand support for regional innovation ecosystems

EDA provides communities with funding for smart-city startup accelerators, workforce training, IoT networks, and planning.¹¹ This funding could be increased to provide

⁹ U.S. Department of Housing and Urban Development, "ConnectHome is Internet Access, Training, and Devices," n.d., <https://connecthome.hud.gov/>.

¹⁰ Economic Development Administration (EDA), "Planning Program," n.d., <https://www.eda.gov/pdf/about/Planning-Program-1-Page.pdf>.

¹¹ EDA, "2019 Regional Innovation Strategies Competition i6 Grantees Announced," July 23, 2019, <https://www.eda.gov/news/blogs/2019/07/23/ris-i6.htm>.

additional resources for smart-city startups or workforce training in underserved communities.

2.5 Expand R&D programs

Funding for R&D and pilot-project grants from agencies including DOT, the National Science Foundation (NSF), the Department of Energy (DOE), the Department of Homeland Security (DHS), and the Department of Defense (DOD) would accelerate domestic progress on technologies such as smart grids, autonomous vehicles, and remote healthcare. Funding should be used to enhance existing and effective programs (e.g., NSF's Smart and Connected Communities Program, DOE's Advanced Grid Research and Development Program¹²), as well as to expand funding for smart-city technologies to new agencies.

2.6 Use Presidential and Congressional authority

The next president should issue an Executive Order (EO) directing federal agencies to use existing programs to support smart-city R&D and to help expand access to smart-city technologies in underserved areas. In addition, if smart-city legislation (Section 4) does not pass in this Congressional session, the next president should support introduction of an updated and expanded smart-city bill in the next session. Such a bill should incorporate feedback from communities and other stakeholders as an important precursor to securing bipartisan support.

3. Historical precedents

There are almost 50 existing federal programs related to smart cities and broadband infrastructure that could support the goals outlined in this paper.¹³ These programs support every stage of the smart-city pipeline, from support for R&D to community support for implementation. Some are narrowly focused on "smart cities" specifically, while others have a broader scope that includes funding for smart-city technologies as a component. Detail on several of these programs is provided below.

3.1 Smart City Challenge (Department of Transportation)

The Smart City Challenge asked "mid-sized cities across America to develop ideas for...[a] smart transportation system that would use data, applications, and technology to help people and goods move more quickly, cheaply, and efficiently." DOT committed up to \$40 million to help the winning city implement its vision. The challenge drew applications from 78 cities, and elicited proposals developed by city leaders, universities,

¹² U.S. Department of Energy, "Advanced Grid Research and Development," n.d., <https://www.energy.gov/oe/mission/oe-divisions/advanced-grid-research-and-development>.

¹³ "Federal Funding Opportunities" US Ignite, n.d., <https://www.us-ignite.org/tools/fundings/>.

industry, and nonprofits working in collaboration. The challenge also led to over \$90 million in matched funding from local industry partners in the winning city of Columbus, Ohio, as well as \$10 million from Paul Allen's Vulcan Inc.¹⁴ The Columbus proposal focused on providing better access to underserved neighborhoods and motivated establishment of an autonomous vehicle pilot with May Mobility in Columbus's downtown.

Several cities, like Denver, that were selected as challenge finalists (but not winners) have followed through on ideas generated as part of the challenge process. Several of these cities have since received sizable grants from DOT (from \$5 to more than \$10 million) to implement projects and establish partnerships outlined in challenge proposals.

3.2 *i6 Challenge (Economic Development Administration)*

As part of the Department of Commerce, EDA is focused on job creation and economic development within low-income or high-unemployment areas across the country. The agency has traditionally provided communities with funding for projects ranging from training facilities to roads to networks of fiber-optic cables. The launch of EDA's i6 Challenge in 2010 was novel for the agency in two ways: first, by being a prize competition, and second, by focusing on supporting startup accelerators. The challenge offered \$12 million in funding for startup accelerators, with one prize for each of EDA's 6 national regions (giving the program its i6 name). The i6 Challenge expanded quickly. A second round of awards was made to help communities launch new seed funds, and the program budget has been doubled to almost \$24 million awarded to 44 organizations in 2019.¹⁵

3.3 *Smart and Connected Communities Program (National Science Foundation)*

Numerous federal programs support R&D projects narrowly targeted on one sector, such as healthcare, energy, or public safety. NSF's Smart and Connected Communities (S&CC) program is one of the few programs that targets smart-city R&D across each of these technology areas. This annual grant opportunity offers universities and their community partners funding to develop the next generation of smart-city technologies. The S&CC program's goal is to create "living labs" by supporting university research efforts within a partner community. Last year, NSF announced over \$22 million in awards across 13 communities and 35 universities nationwide.¹⁶

¹⁴ USDOT. "Smart City Highlights".

¹⁵ EDA, "2019 Regional Innovation Strategies."

¹⁶ National Science Foundation, "NSF announces \$24.2 million to support research fueling smart cities and communities," News Release 18-091, October 4, 2018, https://www.nsf.gov/news/news_summ.jsp?cntn_id=296755.

3.4 *ConnectHome (Department of Housing and Urban Development)*

Launched in 2015, HUD's ConnectHome pilot program allowed HUD funding to be used to provide free broadband services, digital training, and devices. The program targeted students (and their families) in public housing by leveraging newly adopted flexibility within existing HUD funding opportunities. ConnectHome started with 28 communities and quickly grew. The program reaches 56 communities and 52,000 students today, and has a goal of reaching more than 100 communities by 2021.¹⁷ While ConnectHome is not focused on smart-city technologies, this digital-inclusion initiative offers an approach for leveraging existing funding authorities and funding programs at HUD and other agencies to support smart-city technology deployment in underserved areas.

4. Stakeholder support

There is bipartisan support for smart-city funding and programs at all levels of government. In Congress, the Smart City Caucus is co-chaired by Reps. Yvette Clarke (D-NY) and Susan Brooks (R-IN). A smart-city bill has been introduced in multiple Congressional sessions, although none has yet passed. On May 9, 2019, three members of the Smart Cities Caucus reintroduced their Smart Cities and Communities Act, which would provide \$1.1 billion in agency funding over five years for smart-city initiatives.¹⁸

A large contingent of industry leaders and startups have entered the smart-city space to provide equipment, software, data analytics, and other smart-city services to cities. Stakeholders include large telecommunications providers, technology vendors, chip manufacturers, and cloud-service providers plus dozens of unique startups with their own market niche. No single company can supply a full range of smart-city services to a community, so many companies have begun forming partnerships to provide a "one-stop shop" for city leaders. These new partnerships can foster new applications of smart-city technologies and smart-city services.

Universities strongly support more R&D funding for foundational smart-city technologies, such as linking communications networks, IoT sensors, and data analytics. There is a particular need to fund real-world tests and evaluations of novel technologies emerging from university labs. Federal funding designated to support commercialization and deployment of new technologies would help researchers cross the "valley of death" that separates the lab from the marketplace.

¹⁷ HUD, "ConnectHomeUSA," n.d., <https://connecthomeusa.org/>.

¹⁸ Ryan Johnston, "Congress will reconsider \$1.1 billion 'Smart Cities and Communities Act,'" May 15, 2019, <https://statescoop.com/congress-will-reconsider-1-1-billion-smart-cities-and-communities-act/>.

Conclusion

Building resilient, equitable, and sustainable communities is difficult. Challenges in public safety, transportation, energy, healthcare, and other domains will only continue to grow in coming years. Smart-city technologies can help cities, small businesses, and local leaders address these challenges. The potential benefits are especially large for smaller, more rural, and lower-income communities. To help realize these benefits, the federal government should launch a national smart cities initiative with \$1 billion in support from federal and external sources targeting underserved communities to catch up with leading U.S. cities, and the United States as a whole to catch up with the world.

About the author

Nick Maynard is Chief Operating Officer of US Ignite, where he is responsible for designing and executing the organization's growth strategy. Prior to US Ignite, Nick was a Program Director at the National Science Foundation, where he launched a \$450 million initiative on advanced wireless research. He was also the Assistant Director at the White House Office of Science and Technology Policy, where he managed a federal IT R&D portfolio, launching both a \$610 million photonics foundry as well as the President's ConnectHome program to bring broadband to underserved students. Previously, Nick was a member of the National Broadband Taskforce at the FCC, where he created a public-private partnership to offer technology training to small businesses in low-income communities. Nick also spent six years in the telecom industry, consulting with leading global carriers and vendors on next-gen networks and services. Nick received his BA and MA from the University of Chicago and a Public Policy Ph.D. from the University of North Carolina at Chapel Hill. His dissertation research on national ICT adoption strategies was supported by a National Science Foundation grant.

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