Globally, communities are facing unprecedented unemployment and struggling through stay-at-home orders resulting from the COVID-19 pandemic. Organizations across government sectors are working to maintain or increase their service outputs in a virtual landscape, the nonprofit sector is struggling to respond to the increase of clients in need of support with decreases in charitable donations, and the private sector is working rapidly to compete in new ways for fewer consumers.

In the US, the subsequent shifts in local economies will significantly affect the ability of city, county, and state agencies to generate an appropriate response. Widespread challenges are predicted with dramatic losses in tax revenue (income, sales, use, property), decreased municipal revenue (fees, permitting, and delayed tax filing), and increased demands for community-based services (medical care, unemployment support, workforce training).

Results from a recent US Conference of Mayors survey of 2,400 cities suggest that 88% of cities expect a budget shortfall due to the impact of the COVID-19 pandemic on their economies. For cities with populations of 50,000 to 500,000, 98% expect a budget shortfall.

These constraints will cause cities, counties, and states to reexamine the resources dedicated to smart city funding. The municipalities, grappling with hundreds of millions of dollars in budget shortfall will be making program decisions in the coming months and years based on the realities of these limited resources. Of course, not all cities and states will feel these impacts of COVID-19 equally. The economic downturn from unemployment driven by decreased consumption of goods and services will vary by region and population density, and other factors.

Complicating matters, the impact of this pandemic has not been distributed equally across the population, and federal policymakers are reluctant to implement system-wide regulation. Furthermore, there are large disparities across vulnerable populations, including young workers, ethnic minorities, seniors in social isolation, and living on a fixed income, low-income workers (adults and youth), and people with disabilities.

1 US Conference of Mayors and National League of Cities, April 14, 2020
Collectively, communities and their residents are looking to advanced technology solutions to provide rapid and efficient responses to COVID-19 challenges. Beginning with modifications to 2020 city budgets, municipal resources are likely to shift to reflect a reallocation of local tax revenue and economic activity, and municipalities are likely to explore alternative funding and financing models that decrease or eliminate up-front capital expenditures.

Communities will consider some of the following factors in determining priority initiatives (projects, applications, or services) to meet community needs:

- **Public Trust**: Will the solution reinforce public confidence that the municipality is aware of challenges and taking the correct steps to address them?
- **Technical Availability**: How immediately available is a technology solution, or how easily can it be made available to address the priority area?
- **Community Engagement**: What is the likelihood that the priority area has been recognized and well-publicized among residents as an area of concern?
- **Value of Contribution**: Is the impact of the solution measurable, and will it meet the stated need of the municipality with more value than the anticipated project cost?
- **Feasibility**: What is the degree to which internal and external forces will delay implementation and result in unanticipated cost overruns?
- **Equity**: Will the solution address systemic issues of inequity across the municipality?
- **Cost**: What are the budget implications for the municipal budget or the budgets of federal, nonprofit, or private sector partners?
- **Scale and Sustainability**: Will the solution provide a reliable outcome that the municipality can maintain with an independent and continuous operation and scalable to reach additional community residents?

While each community will differ in their approach, priority work will address the needs of residents and support locally operated businesses. For many, desired projects will support connections for vulnerable, isolated, and socially-distant populations, facilitate safe and healthy movement across public gatherings and transportation methods, reinforce high-quality and accessible education and workforce training, and improve the ability to govern virtually. We believe that smart and connected communities will focus efforts on the following areas.
Trends in Smart Communities: 2020
Community Priority Trends

As education systems have ceased on-campus learning, schools are seeing the need for stable high-speed broadband connections for students and workers now accessing the Internet from home. Communities have already invested significant energy and resources to close the broadband gap (Wi-Fi-enabled buses parked throughout underserved neighborhoods, routers/ dongles/hotspot donations). They will seek long-term sustainable solutions that address broadband gaps to the home for homebound students, workers, and seniors. Example projects might include efforts to:

- Utilize private sector partnerships or other business models to expand low-cost internet access to the home
- Build or expand public access points at anchor and partner institutions
- Develop enhanced services extending from public Wi-Fi networks (wireless distribution via pole top or kiosk)

In March 2020, Clayton Williams (pictured), the Founder and CEO of Silicon Harlem tapped into a community ecosystem of partners to close broadband gaps with a temporary CBRS and wireless mesh solution for students schooling-at-home without the internet. Learn more about a wide array of actionable community responses to COVID-19 here: [https://www.us-ignite.org/covid-19-resources/](https://www.us-ignite.org/covid-19-resources/)

Communities will explore systems that help manage additional outbreaks of the virus. Some communities may:

- Deploy contact tracing and mobile phone surveillance to monitor gathering and interaction with infected populations
- Support artificial intelligence and machine learning to identify and respond to newly infected populations
- Address and mitigate vulnerabilities in the delivery of healthcare to vulnerable people through expanded or non-traditional partnerships with community leaders and medical professionals
- Support rapid expansion of telemedicine systems to scale remote virus diagnosis and build stability for long-term services to support rural or hard-to-reach populations
- Explore secure, HIPAA-compliant collection, maintenance, and storage of health data

[www.us-ignite.org](http://www.us-ignite.org)
Trends in Smart Communities: 2020
Community Priority Trends

Creating Healthy Public Spaces

Communities planning for public spaces that encourage social distancing, health and temperature screening, cleaning, and sanitation may pursue efforts to:

• Develop guidelines (with the help of medical professionals) for redesigning and retrofitting public assets (sidewalks, airports, transit hubs, convention centers, arenas, performing arts centers)
• Initiate the use of high-definition infrared cameras or temperature-sensing technology to identify infected populations in public spaces
• Engage citizens and public officials to develop community-driven responses (public awareness campaigns on health and safety, utilization of large-scale stimulus funds for retrofits and redesigns)
• Create procedures and physical spaces for remote workers that link them with community-wide efforts, support small business creation, and increase domestic production of goods and services

Reframing Education

When compared to more traditional university-led learning models, discovery and research may be accelerated by the increased velocity of collaboration. The use of smaller and more targeted meetings can easily leverage collaboration, including video conferencing and productivity tools. Education systems are likely to utilize digital learning tools and video meetings to:

• Support critical thinking and skills which require the use of student imagination and small group interactions
• Expand e-learning offerings for students (all ages) across school districts, blending lecturers from different institutions (accessed online), and in-class and out-of-class experiences
• Create opportunities for students not pursuing four-year schooling to enhance skills for trades in high demand

Research shows that an increase of 1 microgram per cubic meter of fine particulate matter (PM2.5) corresponded to a 15% increase in COVID-19 deaths. To create healthy spaces, the University of Utah (in Salt Lake) developed affordable sensors and are populating visualization tools that create real-time 2D and 3D maps of pollution microclimates.
Trends in Smart Communities: 2020
Community Priority Trends

**Enhancing Workforce Development**

Businesses are already experiencing revenue shortfalls as unemployment reaches record levels. As unemployment has affected communities of color disproportionately, many local, women- and minority-owned businesses in these neighborhoods risk complete failure, which will contribute to additional unemployment and a localized collapse of commercial real estate. To mitigate against further negative economic impacts, communities will launch programs that support efforts to:

- Enhance digital delivery to increase workforce development and job skills training (entrepreneurs, workers, and unemployed persons at home)
- Assist businesses as they reconfigure their services and operations to meet the needs of clients locally and online
- Expand coaching and counseling for startups to ensure specialized training, and extend legal, finance, IT, and human resource services to reach local and minority-owned businesses
- Expand diversity, equity, and inclusion efforts through working groups and steering committees to seek and incorporate community feedback into the design of funding initiatives, new programs, and support systems

**Increasing Resiliency**

For many communities, efficiency is the desired output of sensor deployments and increased networking functionality. We anticipate interest to grow in programs that:

- Support quicker response times and enhanced public safety for first responders (police, fire, and EMS)
- Increase asset tracking and vehicle location information (public works, municipal transportation, street, and highway management)
- Explore autonomous vehicle delivery for people, goods, and services
- Enhance asset management (video surveillance, storm systems, water management, building security and climate control, controls for testing sites, street parking, illegal dumping)
- Support scaled IT services and expansion of resilient e-Government directly to citizens
- Improve food supply chain management (precision agricultural technology, including robotics and agriculture sensors on farms, and during food storage and transportation to consumers)
- Explore AI for improved approval/request processing

This Joplin, MO mural re-imagines community resiliency through art. A new partnership seeks to help a utility partner recognize, adapt to, and absorb disturbances. This *cyber-physical resiliency* project will assist others preparing for prolonged outages caused by severe weather events while needing to maintain designated emergency safe zones.
Trends in Smart Communities: 2020
Examples of US Ignite supported initiatives

Through its NSF-funded Smart & Connected Communities project, US Ignite has helped develop over 153 applications or projects across 30 communities, 72 of which are in some stage of deployment. The following projects fall into the six categories identified above as community priority areas as we address COVID-19 challenges:

**Closing Broadband Gaps**

**Strategies for expanding Internet access** – As a civic tech collaboration, DigitalC provides strategies and programs to help communities navigate the pathway to 21st-century opportunities for all. DigitalC is developing a way to serve the third of Cleveland residents who have no access to the Internet. Architectural planning is underway to utilize existing fiber to 40 buildings across Cuyahoga County, allowing them to beam small-cell wireless Internet to groups of underserved homes. Once fully accessible and optimized with gigabit broadband available throughout the northeast Ohio region, there will be the foundation for a gigabit application ecosystem.

**Supporting Public Health**

**Remote physical therapy and rehabilitation** – The GonioSense platform consists of a mobile app and a web management portal. The mobile app leverages motion sensors embedded into wearable devices and edge computing resources to detect and monitor rehabilitation exercises and track progress. Clinicians can evaluate the rehabilitation status of each patient and can make changes to the protocols if necessary. Digital wristbands provide a more accurate and consistent measurement of joint movements than existing manual goniometers.

**Virtual real-time patient interaction** – The EVP System App from the Centre for Modelling and Simulation/Virtual Humans and Synthetic Societies Lab at The University of Texas at Dallas, allows professors to observe the student and virtual patient interaction via a Microsoft HoloLens headset in real-time. As the next step in the platform development, the Center has successfully developed real-time feedback functionality that enables the professor not only to observe but also communicate with students, using audio and text during the virtual patient scenario. The team is developing the EVP Real-Time Feedback Module in which a video framework specification creates the architecture and the components required to specify and potentially implement a real-time video feedback stream from the professor to the student during the virtual patient scenario.

**Remote therapy and client management** – This COVID-19 VR Healthcare Training project builds on a strong foundation of research-focused virtual reality training. It takes the novel step of using virtual reality to empower healthcare, childcare, and other frontline workers to make a significant change in how they receive critical up-to-date training and manage their workloads. The project builds on Shift, a proven platform that is prepared to deliver timely training that will save lives throughout the United States and beyond by providing Covid-19 symptom identification, patient/resident assessment, and administration of COVID-19 tests to accompany existing PPE and patient interaction training.
Trends in Smart Communities: 2020
Examples of US Ignite supported initiatives

Creating Healthy Public Spaces

AI-driven video analysis – iNotify by Plano Intelligence LLC is a versatile multipurpose cloud-based AI platform capable of real-time generation and delivery of intelligence from video, audio, and text that is coupled with an application for smart devices that notifies users of updates in real-time. iNotify AI technology eliminates the need for human video surveillance by enabling intelligence for video cameras; these cameras understand and convey essential aspects of what they see to people who may need it in real time. A potential application of iNotify is the analysis of InfraRed HD camera footage to identify at-risk individuals in mass gatherings.

Emergency response and management through drones – Unmanned Aircraft Systems (UAS), or drones, enable government agencies to reduce costs and time associated with emergency management and the daily operations of all manner of essential public services. These technologies are allowing communities to minimize response times in settings that may have power disruption or complete outage. One of the most promising areas for drone-supported communications applications is in the municipal public safety arena.

Reframing Education

Innovative educational experiences through IoT – Guardians of the Gulf is a collaboration among the University of South Florida College of Marine Science, the St. Pete Innovation District, and the Boys & Girls Clubs of the Suncoast. It leverages the power of technology to provide children with web-based educational experiences such as news-style broadcasts from researchers in the field, gamified learning, and real-time sensors, including underwater cameras and drones. It also gives underserved communities a voice in the dialogue surrounding escalating coastal threats. The program leverages technologies implemented by Spectrum, encompassing wireless point-to-point connectivity, Wi-Fi, underwater equipment (HD cameras and drones), and a wireless sensor network that will broadcast real-time marine life experiences back to the Boys & Girls Club in St Petersburg, FL (pictured).
Trends in Smart Communities: 2020
Examples of US Ignite supported initiatives

Enhancing Workforce Development

**Immersive STEM education enhanced by 4K Microscopy** – Research skills are climbing to new levels for K-12 students in Chattanooga, TN, with this 4K microscopes and remote instrumentation platform that can increase exposure and learning opportunities for entry-level lab technicians. The program uses a low-latency, gigabit network to enable near-real-time viewing of microorganisms in 4K, remote manipulation to enhance viewing, and high-quality conferencing with world-class biology professors.

Increasing Resiliency

**Underground infrastructure sensing and mapping for maintenance, sustainability, and resilience** – The team at the University of Vermont is using sensing and information technology to determine the state of underground infrastructure and deliver it in an appropriate, timely, and secure format to infrastructure managers, planners, and users. Using ground-penetrating radar, pipe robot telemetry, new construction observations, historical records, and a combination of construction pattern recognition and data fusion methods, the team is now building a map of underground utilities locally. Integrating this data with augmented reality headsets allows for "X-ray vision" through the ground enabling more accurate digging.

**Optimized environmental impact through in-project design** – PlanIT Impact is a web app allowing designers and developers to obtain and understand annual energy use for buildings quickly, as well as potential cost fluctuations by iterating different scenarios (e.g., building materials, insulation, windows). PlanIT Impact provides feedback throughout every step of the design process, providing clarity and direction when introducing new attributes. Additionally, there are collaboration capabilities that facilitate the Integrated Design Method, bringing more value to the client. The integration of big data from urban sciences helps users forecast environmental implications (e.g., on groundwater runoff, sun shadows) based on the building massing and architecture.

## Final Thoughts

In the short term, local governments will support public health, support economic development activity, and build the public’s trust in the plan for this new normal. Over time, communities will increase investments that enhance resident privacy, public safety, and develop resiliency for local businesses. Drawing on innovation, these smart and connected communities will be agile and focus on rapidly deployed demonstration projects. Building on years experience with public-private partnerships, these communities will create safer, leaner, inclusive, and collaborative places for working, learning, and living.
Launched as an initiative of the National Science Foundation in 2015, the US Ignite Smart Gigabit Communities (SGC) project is a network of 30 communities developing a catalog of applications and services to address smart city and IoT challenges with support from academic and industry partners. Members lead by example, solve challenges, and develop innovation ecosystems that benefit from advanced networking technologies and data-driven strategies.