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2019 Global City Teams Challenge: Smart and Secure Cities and Communities Challenge Expo

Sokwoo Rhee

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C Y B E R - P H Y S I C A L S Y S T E M S

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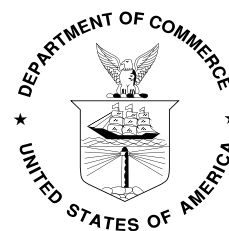
2019 Global City Teams Challenge: Smart and Secure Cities and Communities Challenge Expo

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Engineering Laboratory*

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U.S. Department of Commerce
Wilbur L. Ross, Jr., Secretary

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Executive Summary

The National Institute of Standards and Technology (NIST) Global City Teams Challenge (GCTC) promotes public-private collaboration in contributing to the standardization and interoperability of Cyber-Physical Systems (CPS) and Internet of Things (IoT) for use in our nation's communities. The GCTC program has evolved to become a collaborative platform to support information sharing and development of smart cities and communities. The program provides an environment in which communities can benefit from working with others to improve efficiency and lower costs.

In 2018-2019, NIST and the U.S. Department of Homeland Security, Science and Technology Directorate (DHS S&T) co-hosted the fourth round of the GCTC, called the Smart and Secure Cities and Communities Challenge (SC3). The objective was to encourage participating teams to include cybersecurity and privacy as integral project elements in addition to existing GCTC goals such as replicability, scalability and sustainability of technology and systems.

This report highlights the GCTC/SC3 Expo event held on July 11-12, 2019 to foster discussion of and collaboration to address the cybersecurity and privacy challenges faced by cities as they implement smart technologies. Over 1000 representatives from cities, industry, government, private institutions and academia with an interest in smart cities attended the event. The event included a series of plenary and panel sessions, interactive technical breakout sessions and open forums related to the GCTC domains. The February 2018 GCTC/SC3 Kickoff in Washington DC and June 2018 Global Tech Jam in Portland, Oregon, USA, contributed to the success of this event.

Highlights of the 2019 GCTC/SC3 Expo

- Over 1000 attendees
- Over 80 cities, communities, states and countries represented
- Seven Federal agencies represented
- Many experts from the cybersecurity and privacy communities of interest
- Nine SuperClusters represented
- Over 95 exhibits demonstrating smart city projects and related technologies

Technical breakout sessions covered nine SuperCluster domains and multiple special topics, integrated with cybersecurity/privacy (Figure E-1).

- | | |
|--|---------------------------------|
| • Agriculture and Rural Communities SuperCluster | • Knowledge Technology Platform |
| • Cybersecurity and Privacy Advisory Committee | • Public Safety SuperCluster |
| • Data SuperCluster | • Smart Buildings SuperCluster |
| • Education SuperCluster | • Smart States |
| • Fifth-Generation Wireless (5G) Reality Check: Deployment, Safety, Security | • Smart Regions Collaborative |
| • Healthcare | • Transportation SuperCluster |
| • Inclusivity and Privacy | • Utility SuperCluster |
| | • Wireless SuperCluster |

Figure E-1 GCTC/SC3 Breakout Session Topics

1 Introduction

1.1 Background

Smart cities are enabled by cyber-physical systems (CPS) and Internet of Things (IoT), which include interconnecting smart devices and systems in fundamentally new ways. CPS comprise interacting digital, analog, physical, and human components engineered for function through integrated physics and logic.¹ When applied to diverse sectors such as transportation, energy, public safety and healthcare, these technologies will enable cities and communities to improve services, promote economic growth and enhance quality of life.

In mid-2014, the National Institute of Standards and Technology (NIST) established the CPS Public Working Group (CPS PWG) to bring together CPS experts in an open public forum to help define and shape key characteristics of CPS, and to better manage development and implementation within and across multiple “smart” application domains. The CPS PWG developed a shared understanding of CPS and IoT, and its foundational concepts and unique dimensions, now described in the CPS Framework, Release 1.0, which is available to the public.^{2,3,4} The Framework presents a methodology centered on the concepts of CPS domains, facets and aspects, and supports understanding and development of new and existing CPS, including those designed to interact and function in multiple interconnected environments. A companion framework series for smart cities is also in development, including the work by the International Technical Working Group on IoT-Enabled Smart City Framework (IES-City Framework).⁵

Cities and communities across the globe are increasingly seeking smart and connected solutions to meet the needs of their residents. CPS and IoT play a key role in these solutions. In the past, hundreds of cities and dozens of technology providers were working independently on innovative, smart cyber-physical systems across a broad range of services and markets. This was leading to a proliferation of customized solutions as well as many different proposed standards and protocols. As part of its CPS activities, the NIST Global City Teams Challenge (GCTC) promotes a culture of collaboration and convergence around replicable and scalable solutions and contributes to the standardization and interoperability of CPS and IoT emerging for use in our nation’s and global communities.

¹ <https://www.nist.gov/publications/framework-cyber-physical-systems-volume-1-overview>. Accessed on December 6, 2019.

² NIST Special Publication 1500-201. Framework for Cyber-Physical Systems: Volume 1, Overview, Version 1.0. June 2017. <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-201.pdf>.

³ NIST Special Publication 1500-202. Framework for Cyber-Physical Systems: Volume 2, Working Group Reports, Version 1.0, June 2017. <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-202.pdf>

⁴ NIST Special Publication 1500-203. Framework for Cyber-Physical Systems: Volume 3, Timing Annex, Version 1.0, September, 2017. <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-203.pdf>

⁵ IES-City Framework. <https://www.nist.gov/el/cyber-physical-systems/ies-cities-architecture>. Accessed on December 6, 2019.

1.2 History of the GCTC Program

NIST launched the GCTC program to encourage collaboration and industry's leadership for the development of voluntary, consensus standards in technical areas related to cyber-physical systems. The program has been in place since 2013; a short history of the program and its impacts are found in NIST Special Publication 1900-01.⁶

The GCTC program has evolved as a collaborative platform to support information sharing and development of smart cities and communities. The program strives to create an environment where communities can benefit from working with others to improve efficiency and lower costs. The GCTC is led by NIST, a bureau within the U.S. Department of Commerce, in partnership with other U.S. federal agencies including the U.S. Department of Homeland Security, Science and Technology Directorate (DHS S&T), and the National Telecommunications and Information Administration (NTIA), as well as other organizations from the public and private sectors. New partners are continuously emerging and committing to involvement with the GCTC. The GCTC website maintains a listing of current GCTC partners.⁷

The GCTC encourages local governments, nonprofit organizations, academic institutions, technologists and corporations from all over the world to form project teams – “Action Clusters” and “SuperClusters” – to work on groundbreaking IoT and CPS applications within the city and community environment. Action Clusters are partnerships between cities/communities and innovators working together around a specific issue or problem to jointly identify and develop solutions that are scalable and replicable. Action Clusters sometimes include multiple cities/communities and as many as 10-15 partners. SuperClusters are a coalition of multiple Action Clusters, typically involving multiple cities/communities, and as many as 50 partners working on specific, shared themes such as transportation, public safety, data and agriculture and rural applications. Descriptions of the existing SuperClusters and Action Clusters are available on the GCTC website.⁵

Addressing the challenges of cybersecurity and privacy is the overall theme of the 2018-2019 round of the Global City Team Challenge – titled the *Smart and Secure Cities and Communities Challenge (SC3)*. The 2018 GCTC/SC3 Kickoff event, held in February 2018, fostered early discussion and collaboration on the cybersecurity and privacy challenges that face cities as they implement smart technologies. The event was attended by nearly 500 representatives from cities, industry, government, private institutions and academia. The objective was to build new teams, foster existing teams and encourage the inclusion of cybersecurity and privacy as integral project elements in addition to existing GCTC goals. A summary report of this event is available for more information.⁸

Long Term Goals for GCTC

To establish and demonstrate ways to incubate and deploy smart, secure, standards-based technology solutions that take advantage of the Internet of Things (IoT), advanced computing and connected devices to provide measurable benefits in cities and communities.

⁶ NIST Special Publication 1900-01. Global City Teams Challenge 2016. June 2017.

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1900-01.pdf>

⁷ <https://pages.nist.gov/GCTC/>. Accessed on December 6, 2019.

⁸ NIST Special Publication 1900-201. Global City Teams Challenge 2018 Kickoff and IES-City Framework Workshop: Smart and Secure Cities and Communities Challenge, October 2018.

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1900-201.pdf>

Following the Kickoff, the GCTC/SC3 Global Tech Jam was held in Portland, Oregon in June 2018, attracting more than 250 attendees. Over a dozen cities participated in the event, including Tel Aviv, Los Angeles, Portland, Austin, Vancouver, Surrey (Canada), Hong Kong, Seoul, Suwon (South Korea), Saitama (Japan) and Galway (Ireland). Appendix A provides a summary of this mid-course event.

Project development has been actively progressing during the months since the Kickoff and Tech Jam events. These activities culminated in many smart technology demonstrations during the final phase of Round 4 - the *2019 Smart and Secure Cities and Communities Challenge Expo* (2019 GCTC/SC3 Expo).



Dr. Sokwoo Rhee, NIST addresses participants during the 2018 GCTC/SC3 Kickoff event. Photo used with permission from Energetics.



Portland Mayor Ted Wheeler gives an opening keynote at the Portland GCTC/SC3 Global Tech Jam. Photo by NIST.

2 2019 GCTC Expo: Smart and Secure Cities and Communities

2.1 Importance and Role of Security

Smart technology offers cities many opportunities to improve economies and quality of life, but also presents new challenges for cybersecurity and privacy. Taking advantage of the IoT and interconnected devices exposes cities to a greater array of cybersecurity threats. Recent reports note that misuse or attack on a single smart city vulnerability could potentially create risk for an entire city,⁹ and that increased digitization has forced smart cities to deal with more sophisticated cybersecurity threats.¹⁰ Preparing for and recovering from such attacks requires reliable digital forensic data – which means data from smart city systems must be available and secure.

Ensuring the cybersecurity of systems as well as data privacy is an integrated challenge. Systems that trigger emergency response, for example, must also protect privacy while being secure. Citizens are becoming digitized, offering a growing array of instrumented data available about their location, preferences, activities and other personal factors. This interaction between people, networks, systems and devices creates enormous privacy challenges that go hand in hand with addressing concerns for security.¹¹



*Roundabout illuminated by LED lights at twilight.
Courtesy IStock 475034487*

⁹ R. Khatoun, S. Zeadally. Smart cities: concepts, architectures, research opportunities. Communications of the ACM, 59 (8) (2016), pp. 46-57

¹⁰ Smart City Cyber Security. ABI Research, 2019. <https://www.abiresearch.com/market-research/product/1030850-smart-city-cyber-security/>

¹¹ Adel S.Elmaghraby Michael M.Losavio. Cyber security challenges in Smart Cities: Safety, security and privacy. <https://doi.org/10.1016/j.jare.2014.02.006>
<https://www.sciencedirect.com/science/article/pii/S2090123214000290>

2.2 Smart and Secure Cities and Communities Expo Overview

The GCTC SC3 Expo brought together public and private stakeholders from many sectors to share information, demonstrate new technologies and projects currently ongoing in cities and communities around the world and discuss important issues.

Plenary sessions included talks from federal, international and state leaders, industrial partners and technology experts, providing critical insights on cybersecurity and privacy issues.

Technical breakout sessions fostered networking and collaboration among SuperClusters and Action Clusters, as well as the many participants new to GCTC and interested in getting involved.

Open forums and special panels took place to encourage collaboration and allow participants to share information about their experiences and ideas. These were complemented by various ‘Birds of a Feather’ meetings taking place in the Exhibit Hall. The Exhibit Hall itself was populated by 95 booths demonstrating a wide spectrum of smart technologies and projects from around the world. Appendix D provides a complete list of exhibitors.

The following sections describe the plenaries, technical breakouts, special topic sessions and panels and exhibits.

Highlights of the 2019 GCTC Kickoff

- Over 1000 attendees
- Over 80 cities, communities, states and countries represented
- Seven Federal agencies in attendance
- Many experts from the cybersecurity and privacy communities
- Nine SuperClusters represented
- Over 95 exhibits demonstrating - SuperClusters, Action Clusters, and related smart city technologies



Full house in the plenary session on day 1 of the GCTC/SC3 Expo. Photo by NIST.

2.3 Plenary and Keynotes

A series of plenaries and panels were conducted throughout the event to provide federal, state and regional perspectives and inform participants about the key trends in cybersecurity and privacy that are affecting cities and communities across the globe. Table 2-1 shows the complete list of speakers for each session.

Table 2-1 Plenary and Panel Speakers

Track	Speakers
Welcome and Keynotes	<ul style="list-style-type: none"> • Chris Greer, Director, Smart Grid and Cyber-Physical Systems Program Office, National Institute of Standards and Technology (NIST) • Christos Papadopoulos, Program Manager, Science and Technology Directorate, U.S. Department of Homeland Security (DHS S&T) • Diane Rinaldo, Assistant Secretary, National Telecommunications and Information Administration (NTIA), U.S. Department of Commerce (Acting) • André Hentz, Deputy Under Secretary, DHS S&T (Acting)
Special Remarks	<ul style="list-style-type: none"> • Brendan Boyle, Congressman (PA-02), U.S. House of Representatives • Paul Tonko, Congressman (NY-20), U.S. House of Representatives (Introduced by Gary McCarthy, Mayor, City of Schenectady, New York, USA)
Smart and Local Government	<p>Smart Regions Panel</p> <ul style="list-style-type: none"> • Leslie Wollack, Executive Director, National Association of Regional Councils (NARC) • Jack McDougle, President and CEO, Greater Washington Board of Trade • Zack Huhn, Chairman, Smart Regions Initiatives (Moderator) <p>Smart States Overview</p> <ul style="list-style-type: none"> • Daniel Lauf, National Governors Association (NGA)
International	<ul style="list-style-type: none"> • Cheng Wen-Tsan, Mayor, City of Taoyuan, Taiwan • Bernard Dy, Mayor, City of Cauayan, Philippines • Ulrich Ahle, CEO, FIWARE Foundation
Mayors Keynote Panel	<ul style="list-style-type: none"> • Pauline Cutter, Mayor, City of San Leandro, California, USA • Gary McCarthy, Mayor, City of Schenectady, New York, USA • Joel Robideaux, Mayor-President, City of Lafayette, Louisiana, USA • Ben Walsh, Mayor, City of Syracuse, New York, USA • Jean Rice, Senior Broadband Specialist, NTIA (Moderator)
Cybersecurity and Privacy Panel	<ul style="list-style-type: none"> • Rhonda Binda, Co-Founder and COO, Venture Smarter; Executive Director, Smart Regions Initiative (Moderator) • André Hentz, Deputy Under Secretary, DHS S&T (Acting) • Eugene Grant, Mayor, City of Seat Pleasant, Maryland, USA • Matthew James Bailey, Global Leader in Smart Cities / President, Powering IoT

2.4 Technical Sessions

During technical breakout sessions, speakers provided information on the progress and scope of existing and new SuperClusters as well as many other topic areas of interest to participants. Sessions included a mix of representatives from cities, states and counties, SuperClusters, Action Clusters, Federal agencies and many other public and private organizations interested in fostering smart, secure communities.

Breakouts were organized primarily around SuperClusters, and included the topics shown in Table 2-2. The following sections provide a list of participating speakers and short description of each session. The focus of this year's Expo was on both smart and secure technologies; important themes that emerged in cybersecurity and privacy are highlighted where appropriate for each topic area.

Table 2-2 GCTC/SC3 Breakout Session Topics

- | | |
|--|---------------------------------|
| • Agriculture and Rural Communities SuperCluster | • Inclusivity and Privacy |
| • Cybersecurity and Privacy Advisory Committee | • Knowledge Technology Platform |
| • Data SuperCluster | • Public Safety SuperCluster |
| • Education SuperCluster | • Smart Buildings SuperCluster |
| • Fifth-Generation Wireless (5G) Reality Check: Deployment, Safety, Security | • Smart States |
| • Healthcare | • Smart Regions Collaborative |
| | • Transportation SuperCluster |
| | • Utility SuperCluster |
| | • Wireless SuperCluster |



GCTC/SC3 Exhibit Hall getting ready for visitors. Photo by NIST

2.4.1 Agriculture and Rural Communities SuperCluster

This newly formed Agriculture and Rural SuperCluster covered a broad range of topics, including technologies for increasing the productivity and quality of life for rural communities and agriculturists. Speakers from government, non-profits, academia and universities (Figure 2-1) provided perspectives on recent developments in smart technology; a panel of experts gave their insights on some of the innovations that are changing the way agriculture conducts both business and operations.

AGRICULTURE AND RURAL COMMUNITIES BREAKOUT

Chairs: Josh Seidemann, NTCA-The Rural Broadband Association; Mo Shakouri, Joint Venture Silicon Valley; Dennis Buckmaster, Purdue University

Panel: Innovation in the Smart Rural Ecosystem

Moderator: Mo Shakouri, Director, Community Broadband Initiative, Joint Venture Silicon Valley

Josh Seideman, Vice President of Policy, NTCA–The Rural Broadband Association

Hongwei Zhang, Associate Professor of Electrical and Computer Engineering, Iowa State University

Bill Pugh, CTO, LocalX Network

Charilaos Mousoulis, Senior Research Scientist at the School of Electrical Engineering at Purdue University

Scott J. Sheely, Special Assistant, PA Department of Agriculture

Debra Lam, Managing Director, Smart Cities and Inclusive Innovation, Georgia Tech

Margie Zuk, Senior Principal Cybersecurity Engineer, MITRE Corporation

Virtual Care Delivery Model to Sustainably Expand Capacity & Reach of Health Systems to Deliver High-Quality Care in Rural Communities: *Sarah B. Tyree, Vice President, Policy and Public Affairs, CoBank; Anshu Vaish, President & CEO, Perry Health*

Wireless Living Lab for Smart Agriculture and Rural Communities: *Hongwei Zhang, Associate Professor of Electrical and Computer Engineering, Iowa State University*

“575-HOPE” – A Technology Solution to Address Preparedness, Response and Recovery from Opioid and all Types of Addiction: *John Putnam, Smart Cities Program Manager, Cincinnati Bell*

Farm to Fork Crop Tracking: *Wilfred Pinfold, Urban Systems*

Device Identity and Device Integrity: Embedded Security Extending PKI: *Jason Soroko, CTO IoT, Sectigo*

Figure 2-1 Speakers and Topics in the Agriculture/Rural Communities Session

Key themes that emerged from presentations in this session included the following:

- Better access and quality of broadband in rural communities. It can take 40 times longer to download data than collect it. Companies are building smart apps with the expectation that the required connectivity will be available.
- Improved workforce capabilities; farmers using IoT to track data are delayed in building new facilities because of a lack of workforce skills.
- Opportunities for wireless connectivity applications in rural communities, from health to farm productivity.



Smart tractor exhibit draws lots of visitors. Photo used with permission from Energetics

2.4.2 Cybersecurity and Privacy Advisory Committee

The Cybersecurity and Privacy Advisory Committee (CPAC) session included expert speakers and panelists covering some of the challenges cities are dealing with, as well as ongoing smart initiatives and technologies (Figure 2-2). Highlights of discussions are outlined below.

CYBERSECURITY AND PRIVACY COMMITTEE BREAKOUT

Chairs/Moderators: Lan Jenson, Adaptable Security; Christos Papadopoulos, U.S. Department of Homeland Security; Scott Tousley, Splunk, Inc.; Maryam Rahmani, Maryam Rahmani, LLC

A GCTC Executives Discussion

Maryam Rahmani, Cybersecurity and Privacy Advisory Committee; Principal, Maryam Rahmani LLC

Christos Papadopoulos, Department of Homeland Security S&T

Scott Tousley, Cybersecurity and Privacy Advisory Committee; Senior Cybersecurity Executive, Splunk

Jacob Margolis, Chief Information Security Officer, Metropolitan Water District of Southern California

Richard Tracy, Senior VP and Chief Security Officer, Telos

From Desire to Actionable Plan: A Cybersecurity Model for Smart Secure Cities Initiatives: *Benny Lee, Cybersecurity and Privacy Advisory Committee; Public Wi-Fi Program Director, San Mateo County, USA; Carmen Marsh, Cybersecurity and Privacy Advisory Committee; CEO, Intelligencia Inc.; Michael Kaiser, Board of Directors, Adaptable Security*

Towards A Cloud Privacy Security Rights Inclusive Architecture: Introducing the SC3-cpSria Secure Cloud Architecture Action Cluster and the Syracuse SURGE: *Sam Edelstein, Chief Data Officer, City of Syracuse; Yusuf Saadiq Abdul Qadir, Director, New York Civil Liberties Union; Lee W. McKnight, Associate Professor, School of Information Studies, Syracuse University*

Building Human Centered Smart City: *Yi-Chen Chu, CEO, BiiLabs*

Equity in Cybersecurity Training: A New Collaborative Pilot in Chicago: *Frank Downs, Director/SME Cybersecurity Practices, ISACA; Meera Raja, Manager of Solution Design & Program Development, City Tech Collaborative; Natasha Green, Global Community Manager, AnitaB.org*

Figure 2-2 Speakers and Topics in the CPAC Session

During the Executives discussion, panelists provided high-level guidance on securing smart cities, how to do a better job securing supply chains and risk-based approaches to security. Key themes highlighted by speakers included the following:

- Challenges include understanding data, including when/how to use it, securing it keeping it private, and anonymizing data where appropriate – to avoid data misuse.
- Risk assessments are more complex (and important) when many devices and connections are in play; each device represents additional attack vectors. Risk-based approaches to asset/infrastructure security are vital – understanding the goal and the acceptable security threshold; the risk of not securing the asset; and what can be done to protect/recover.
- Public trust in the security of infrastructure is critical (e.g., safe drinking water, reliable energy, etc.) but difficult to maintain; minor intrusions heavily impact public opinion. Securing operations for resilience is a primary requirement and managing the devices and identity of people connected to these assets.
- Securing assets/organizations is multi-faceted, requiring understanding of business processes, resources, capabilities, IoT-related risk, technical objectives and controls. One strategy that was described is to secure what you have control over and minimize attack surfaces; conducting

holistic cybersecurity checks for new systems; communicating risk within the organization; and raising the level of assurance.

- Major challenges arise in meeting expectations of multiple stakeholders (cities, consumers, technology vendors, service providers, etc.) when it comes to security; in smart cities/communities there are unique leadership, management and local challenges to address. Agile approaches are vital but difficult to explain to non-experts. Successful approaches find security priorities in daily operations, work across silos and stay ahead of problems.

Key cybersecurity and privacy themes from speakers representing cities in the United States and abroad included the following:

- Computers and connected devices are not used in isolation, which broadens and raises the level of the threat landscape. A playbook for how to secure smart cities is one focus of the CPAC; it includes success measures for a risk-based operational plan (risk posture, visibility, and confidence), cost benefit implementation guidance and how to move from risks to opportunities.
- Cloud-native approaches to security can be beneficial; a cloud privacy and security rights inclusive architecture is under development by multiple partners in New York. The architecture codes data according to shareability (i.e., open shareable data, cautionary data with some restrictive conditions, high security data, etc.), which helps in prioritizing security requirements.
- Blockchain is increasingly discussed as a security strategy. Companies working in Taipei, Taiwan developed a new Platform as a Service (PaaS) cloud computing model based on blockchain (IOTA – a distributed ledger for IoT). It supports a human-centered smart city to establish ownership and protection of data, incorporating a public ledger to help manage all digital assets.
- Cybersecurity skills and workforce are in short supply in many cities; many cannot afford to maintain expertise on staff. In Chicago, collaborators are working to develop training programs for women and under-represented groups as a pathway into cybersecurity fields to grow the workforce and provide people with employable cyber skills.



Mobile automated security and surveillance van reduces need for physical security guards. Photo by NIST.

2.4.3 Data SuperCluster

The Data SuperCluster session incorporated a broad perspective on how cities are optimizing data collection, utilization and interpretation. Speakers from the public and private sectors (Figure 2-3) provided perspectives on security and privacy issues and solutions, in the context of the collection and use of data as well as governance and exchange of data from the IoT. Use cases were presented on how cities today are using data to their advantage to inform city services and management.

DATA BREAKOUT

Chairs/Moderators: Alex Huppenthal, Aspenworks, Ltd.; Jason Whittet, 100 Resilient Cities; Scott Tousley, Splunk, Inc.; Aaron Deacon, KC Digital Drive

Project GRACE (Graceful Remediation with Authenticated Certificateless Encryption) – Towards a Secure Internet: Kang-Wei Woo, Executive Director, QuantumCIEL, Singapore

Japan's Smart Cities Efforts and Saitama Smart Town: Tomohiro Ushiyama, Deputy Director-General for International Economic Affairs, Global Strategy Bureau, Ministry of Internal Affairs and Communications, Japan; Hiroaki Nishi, Professor and Chairperson, Keio University / Misono Town Management Association, Inc.

Coral Gables Smart City Hub Public Platform: Eduardo "Ed" Santamaria, Assistant City Manager, City of Coral Gables, FL, USA; Raimundo Rodulfo, Director of Information Technology, City of Coral Gables, FL, USA

I3 Consortium: Jerry Power, Executive Director CTM and Founding Member of I3 Consortium, USC

Cybersecurity Use Case Analysis: Aaron F. Snyder, Director of Grid Technology, Enernex; Frances Cleveland, Xanthus Consulting

Implementation of Moving Target Data Protection to Secure Smart Lights and Sensors: Nick Shook, Software Engineer, CryptoMove

LotaData CityDash / CityGraph Data Analytics Platform: Apu Kumar, Co-Founder and CEO, LotaData

Presentation of Rural IoT Solution from Rural Ag: Mo Shakouri, Director, Community Broadband Initiative, Joint Venture Silicon Valley (JVS)

Using Smart City Data to Drive Economic Development: Nick Maynard, PhD, Chief Strategy Officer, US-Ignite

FIWARE Open Data Platform / Partner Overview: Juanjo Hierro, CTO, FIWARE

Q&A DSC Resources; Wrap up and Q&A: Moderators Scott Tousley, Aaron Deacon, Alex Huppenthal

Figure 2-3 Speakers and Topics in the Data Session

Key themes from speakers in this session included the following:

- Securing data remains a major consideration for smart cities; many types of methods are emerging, such as certificateless encryption, certified information banks, ways to distribute trust across different locations/layers, etc. to help keep data secure. Coordinating many types of data with different levels of security requirements is challenging (e.g., mobile data, open data, camera data, data from disasters, buses, etc.).
- With the influx of large amounts and types of data, traditional security methods may not work as well; storing data in millions of locations, data that is constantly moving, etc. requires addition of layers to ensure security. Data security must be future-proofed, i.e., consider the changes in technology and data exchange that may occur in the future.

- Real-time data collection creates a unique set of challenges for security and data management: how many devices are used for data collection, how many people are using the data; is the data aggregated; how often is it aggregated; what is the source of data; is it Global Positioning System (GPS)-dependent; is it video, audio or text; must it coordinate with other systems; must it have privacy controls; etc.
- Secure, effective and interpretable data analytics for cities are at the core of the Data SuperCluster; cities are increasingly using the IoT and incoming data to create better dashboards and analytics to guide city services and management, as well as support economic development. Data is coming from an increasing array of sources, from streetlights to citizen mobile devices, and traffic signals. The Coral Gables Smart City Hub Platform is one model example of a smart city ecosystem successfully using open source platforms to collect and exchange data from sensors and other sources. To be successful, trusted data exchange is critical among people, business, organizations and devices.



CityDash.ai provides a real-world knowledge graph for cities. Photo used with permission from Energetics

2.4.4 Education SuperCluster

The Education SuperCluster session took a themed approach, covering the key elements important to delivering quality education to communities (Figure 2-4). Concepts were presented for all levels of education from K12 to universities, as well as educating communities about the benefits of smart cities as well as neighborhoods. What smart education could do to improve your community was a key theme throughout.

EDUCATION BREAKOUT

Chairs/Moderators: Derick Lee, Pilot City; Shannan Williams, NIST; Emy Tseng, NTIA

Session 1: Education and Workforce

Cincinnati-Dayton Cyber Corridor: *Stephanie Keinath, Director, Public Policy & Economic Development, Dayton Ohio Area Chamber of Commerce; Tom Skill, Associate Provost and Chief Information Officer, Professor, University of Dayton*

World Digital School: *David Sandel, Founder, iNeighborhoods*

South Bend's Technology Resource Center: A Collaboration Platform for a Responsive, Inclusive Beta City:

Brian Donoghue, Director of Civic Innovation, South Bend, Indiana

DC Asset Management Lab at the University of the District of Columbia – A Continuing Education Program for Professionals: *Michael Bordenaro, President, Asset Management Labs, LLC*

Session 2: Neighborhoods and Communities

Smart Neighborhoods: *Seth Hubbert, Executive Director, Tech Exchange*

Augmented Neighborhood Watch: *Stephanie Hayden, CEO & Founder, Metropolitan Intelligence*

Smart Work Learn Play: Participatory Smart City Innovation and Digital Inclusion in Public and Subsidized Housing: *Catherine Crago, Head of Strategic Initiatives, Housing Authority of City of Austin*

UPsouth – A Primer on How Cities Can Connect With Citizens to Build Resilient Communities and Strengthen Smart City Initiatives: *Priti Ambani, Chief Evangelist, UPsouth*

Connecting the Dots: Technology Enhanced Aging-in-Place for Residents of Waterfront Village, Washington, DC:

Marjorie Lightman, Partner, QED Associates llc, Senior Fellow, WREI

Session 3: Civic Engagement and Data

Data Equity for Main Street - Bring Open Data to Communities Through Public Libraries: *Anne Neville-Bonilla, Director, California Research Bureau, California State Library*

Smart City Diaries TV / Video Series: *Deborah Acosta, Smart City Diaries, Co-Host, Writer; Ann M. Marcus, Smart City Diaries Producer*

IoT-Enabled Smart City Workshop for City, Private and Public Communities: *Shivakumar Mathapathi, Faculty, Santa Clara University, CA; Vanessa Garrett, Deputy City Engineer, City of Rohnert Park, CA, USA*

CIVIC Data Platform: Data by the People, for the People: *Catherine Nikolovski, Executive Director, Civic Software Foundation; Michael Hanna, Multnomah County, OR*

Closing: SuperCluster Next Steps

Derick Lee, Pilot City, and Shannan Williams, NIST

Figure 2-4 Speakers and Topics in the Education Session

Key themes from speakers in this session included the following:

Neighborhoods and Communities

- People adopt technology from human connections; humans are catalysts for technology adoption. People/navigators commonly teach others about apps/technology.
- Trust and privacy are major issues for human adoption of technology. Trust can be the foundation to align technology.

- One-third or more of people may be without computers or the Internet; some are indigent, homeless or economically disadvantaged, others lack access. In California, there is an ongoing project to recycle computers and deliver them to poverty belt citizens. In New Zealand, a platform has been created to help reach youth and underserved groups in low economic areas.
- Our fastest growing population is over 65. This population is underserved and under-tapped for contributions to society. New programs are needed to bring technology to this group.

Civic Engagement

- Greater awareness of what ‘smart’ means to cities and citizens is needed; engaging students, millennials, etc. is one way to spread awareness. Making information available about open data and sources of data available to everyone is important.
- Privacy and security training and education are needed at many levels of city workers and stakeholders to help all to understand the full potential of smart technologies and their applications (e.g., streetlights, waste management, analytics, traffic and street use, etc.).
- Data sharing has many challenges, making it difficult for policy makers to make data-driven decisions. Libraries and educational institutions are growing resources as data repositories in the public domain.

Education and Workforce

- Demands for tech talents, especially in cybersecurity, are exploding across the country. Filling these positions is a continuing challenge.
- Workforce and retention of cybersecurity staff is a major issue for cities. Curricula and real-world training are needed, particularly in data visualization, forensics, data preservation, policies and communications. Effective approaches to recruitment and retention of cybersecurity professionals are needed.



Education SuperCluster leads cover concepts for smart, connected educators. Photo used with permission from Energetics

2.4.5 Fifth-Generation Wireless (5G) Reality Check

The 5G Reality Check session included a panel focusing on exploring the issues of deployment, safety and security (Figure 2-5). Under 5G, users are expected to be able to connect to just about anything reliably and 50 times faster than 4G technology. Deployment will be an evolution, rather than a revolution.

5G REALITY CHECK BREAKOUT

Chair/Moderator: Jeffrey Booth, U.S. Department of Homeland Security

Panel Session on 5G Deployment, Safety and Security

Keith Gremban, Director of the Institute for Telecommunication Sciences (ITS), NTIA

Jim Houchens, Chief Engineer, Intelligence Programs, MITRE Corporation

Nicholas Nilan, Director, Product Development, Public Sector, Verizon Business Group

Figure 2-5 Speakers and Topics for the 5G Reality Check Session

Key themes that emerged from presentations in this session included the following:

- Start preparing for 5G; cities can get ready for 5G by looking at infrastructure needs (wiring, modifications in buildings, etc.), and get workers aligned with the required changes and processes. Educate people now (city officials, service providers, end users) about characteristics of 5G, including high speed and low latency, to bring awareness about benefits and tradeoffs.
- 4G devices will still be operable for some time; operating characteristics of 5G will depend on how it is implemented on top of the existing 4G networks.
- Cities will need to identify new risks; security features will improve with 5G, but new concerns could emerge; more and more devices will be connected, with new attack surfaces that can't be imagined today.
- Individuals and their devices will be even more connected to networks; this raises additional needs for privacy protection as well as individual awareness of cybersecurity.
- 5G will not fill all gaps in wireless coverage; with higher operating frequency, more cells will be needed with shorter operating ranges.

2.4.6 Healthcare

The Healthcare session included a panel focused on improvements to rural health possible through interconnected devices and the IoT (Figure 2-6). Concepts ranged from telehealth to emergency response and improving health connections and access in the rural community.

HEALTHCARE BREAKOUT

Chair/Moderator: Matthew Quinn, Health Resources and Services Administration

Panel Session: The Promise of IoT for Rural Health (and Beyond)

Thomas Joseph Doherty, Psy.D, Licensed Psychologist, Sustainable Self, LLC

Sarah Tyree, Vice President, Policy and Public Affairs at CoBank

Brian Scarpelli, Senior Global Policy Counsel, Connected Health Initiative, ACT

John Putnam, Smart Cities Program Manager, Cincinnati Bell

Penny Chase, Senior Principal Scientist, Cybersecurity, MITRE

Figure 2-6 Speakers and Topics for the Healthcare Session

Key themes that emerged from speakers in this session included the following:

- Telehealth has many benefits for rural communities; it expands access, saves money and improves quality of care, replacing in-person services with virtual ones.
- Rural America is suffering from insufficient healthcare; severe lack of doctors; an older population with medical issues; opioid problems disproportionately affecting rural communities; rural hospitals closing and few with obstetrics facilities; and skyrocketing costs. Digital technology could be a life-saving solution.
- Multi-stakeholder advocacy groups such as the Connected Health Initiative aim to broadly advance the use of digital health innovations.
- Panelists called for a Healthcare SuperCluster to focus on how technology can help rural communities thrive and be healthy and connected.
- Short Message Service (SMS) text messaging can be lifesaving; text messaging is the number one communication method for people under 50 years old. SMS text messaging is being used to help move people at risk or suffering from opioid addiction into local treatment.

2.4.7 Inclusivity and Privacy

The Inclusivity and Privacy session panel focused on how to handle issues of privacy and trust within the context of smart city (Figure 2-7). Issues ranged from data protection to issues of trust and governance.

INCLUSIVITY AND PRIVACY

Chair/Moderator: Emy Tseng, Senior Program Specialist, BroadbandUSA, NTIA

Panel Session: The Smart and Respectful City: How to Handle Issues of Privacy and Trust

Travis R. Hall, Telecommunications Policy Specialist, NTIA

Kelsey Finch, Senior Policy Counsel, Future of Privacy Forum

Denise Linn Riedl, Chief Innovation Officer, Department of Innovation and Technology, South Bend, IN

Lee W. McKnight, Associate Professor in the iSchool (The School of Information Studies), Syracuse University

Erin Kenneally, Program Manager, the Cybersecurity Division for the Homeland Security Advanced Research Projects Agency at the DHS Science & Technology Directorate.

Figure 2-7 Speakers and Topics in the Inclusivity and Privacy Session

Panelists responded to questions about the most pressing issues, the digital divide and the role of governments in privacy. Key themes from the panel session included the following:

- Pressing issues for privacy centered around federal, state and municipal governments; main concerns are control and stewardship of data; tensions between stakeholders, companies and citizens protecting their interests; and instilling trust in citizen consumers. Many cities lack an infrastructure or platform for privacy, as well as lacking rules, resources and expertise.
- Policy and regulation are still unclear and market incentives for privacy are lacking; what needs to be regulated remains uncertain. Active discussions on privacy have been ongoing for two decades. At the state level, some regulation is being considered (e.g., California, Washington State).
- Data governance is a primary issue; who owns the data, how to share it, how to allow access and how to determine its value.
- Universal methods for protecting the privacy of city-related data don't exist, such as standard click and consent forms, ways to notify and give citizens choices, what types of meta data can be accessed, etc.
- The digital divide is bigger than assumed in terms of literacy and accessibility; many still don't have access to mobile and computing platforms. Inclusiveness does not happen by accident and requires good planning. As cities embrace new technologies, inclusivity should be part of the discussion.
- Artificial Intelligence (AI) and other tools used to enhance security are creating new challenges for privacy; data governance principles are needed to cover new concepts such as facial recognition, etc.

2.4.8 Knowledge and Technology Platform

The Knowledge and Technology Platform session focused on a variety of platforms for cities as well as citizens (Figure 2-8). Key themes from speakers in the session included the following:

- Transportation is one of the leading social problems that increased knowledge can improve. The WeGO organization supports activities to improve knowledge capture in the context of smart sustainable cities; concepts include, for example, using mobile data for monitoring transportation of people and goods and improving bike and car sharing. Other cities are working on solving the social problems of parking and autonomous vehicles through better knowledge capture. The Taipei government, for example, has conducted over 170 proof-of-concept projects for transport and infrastructure, some focused on electric vehicles, parking, bike and scooter transport and bridges.
- Organizations such as Leading Cities can promote collaboration to advance sustainability and resilient city strategies and technologies. They are developing a global ranking system to categorize cities, encourage participation and facilitate collaboration and change.
- Getting data and next generation tools out to the citizenry is a challenge; Hackathons and other challenge programs can help encourage community collaboration and reach underserved communities through partnerships with technology companies and local governments.
- Open source platforms such as FIWARE can help to access and manage heterogeneous context information through open Application Program Interfaces (APIs). The FIWARE Context Broker has been adopted as an API standard for smart cities by the European Commission.

KNOWLEDGE AND TECHNOLOGY PLATFORM

Chair/Moderator: Albert Graves, World Smart Sustainable Cities Organization (WeGO)

Taipei Smart City Program/GO SMART: Hsin-Lun Tsai, Research Fellow of Taipei Smart City Project Management Office

FIWARE: Ulrich Ahle, CEO, FIWARE Foundation

Leading Cities: Michael Lake, President & CEO, Leading Cities

GO-PS (Gyeonggi Open Platform for SmartCity): Tae-Kyung Kim, Research Fellow, Gyeonggi Research Institute (GRI), South Korea

WeGO: Albert Graves, Program Director, World Smart Sustainable Cities Organization

Breaking the Code: The UN-hackathon: Skip Newberry, President and CEO, Technology Associates of Oregon

Figure 2-8 Speakers and Topics in the Knowledge and Technology Platform Session

2.4.9 Public Safety SuperCluster

The Public Safety and Cybersecurity/ Privacy session covered technologies, processes and strategies to enhance public safety and resilience within smart connected communities; improved preparedness, response and recovery from hazards and risks that threaten local and regional stability; and the role of cybersecurity and privacy in safety. Speakers from the government, private sector and academia (Figure 2-9) provided their perspectives on innovations in cybersecurity for smart cities, as well as the challenges emerging from the increasing use of connected systems and IoT.

PUBLIC SAFETY BREAKOUT

Chairs/Moderators: W Michael Dunaway, U. of Louisiana, Lafayette; Dean Skidmore, IoT+LTE Consulting; Brenda Bannan, George Mason University

Smart City IoT Innovation (SCITI) Perspectives: David Ihrie, Center for Innovative Technology; David Heyman, Smart City Works; Brenda Bannan, George Mason University

DHS Perspective and Priorities for Action Clusters: Jeff Booth, DHS S&T Directorate

GCTC Perspectives from the Private Sector: Scott Tousley, Splunk, Inc.

Smart Wide Area Protection & Security for All from Concorde Security: Ben Ng, Head USA, Concorde USA

Technology for Safety and International Collaboration: Emika Hasegawa, Director for International Negotiations Management, Ministry of Land, Infrastructure, Transport and Tourism, Japan

The NTT Smart Vegas Cities Solution for the City of Las Vegas: Ashwini Chharia, Senior Director, NTT DATA, Inc.

StormSense: Kyle Spencer, Deputy Resilience Officer, City of Norfolk, VA, USA

Public Safety SuperCluster Blueprint Update: Dean Skidmore, PSSC CO-Chair, IoT+LTE Consulting Group, Inc.

Figure 2-9 Speakers and Topics in the Public Safety Session

Key themes from speakers in the session included the following:

- Emergency responders can benefit from digitally-mediated team learning; behavior during training can be captured via Internet-enabled devices in real time and mined to learn and shape team behavior in a beneficial way.
- Many new connected systems are coming online to aid in emergency response; some take advantage of multiple data streams such as social and web media, 911 calls, and sensors to process behavior (Multimodal stream analytics). Other approaches include sensors that alert agencies who might respond (e.g., smoke detectors, panic buttons).



NTT DATA's solution is designed to reduce response times for first responders during public safety incidents in Las Vegas. Photo by NIST.

- New public-private partnerships are needed to process and quickly utilize the vast amounts of data available for public safety; there are many opportunities to use data to benefit citizens, from crowd control to weather, traffic problems, floods, fires and other events.

2.4.10 Smart Buildings SuperCluster

The Smart Buildings SuperCluster session included a variety of speakers with perspectives on connectivity and how IoT technologies are contributing to better building systems management, improving building safety and contributing to more efficient services (Figure 2-10).

SMART BUILDINGS BREAKOUT

Chair/Moderator: Limor Schafman, Telecommunications Industry Association (TIA)

IoT & AI-based Smart Energy Management System for Smart City: Changsoo Park, General Manager, NTELS Co, Ltd

Point Cloud MAP901, Building Rich Interior Hazard Maps for First Responders: Mike Rodriguez CIO, City of Memphis, TN

Anatomy of a Smart City: Mayor Gary R. McCarthy, City of Schenectady, NY; John P. Coluccio, City of Schenectady, NY

Connectivity – Empower Your Smart Buildings: Ronna Davis, LEED Green Associate, Strategy and Technology, Enterprise Product Management, CommScope, Inc.

Smart Cities/Safer Buildings – Technologies that Save Money...and Lives: Jeffrey Booth, Director, Sensors and Platforms Technology Center, DHS S&T

Smart Buildings – Improving Organizational Productivity: Limor Schafman, Senior Director, Smart Buildings Program, TIA

Transportation: Yuri Gawdiak, Airspace Operations & Safety Program Associate Director, Aeronautics Research Mission Directorate, National Aeronautics and Space Administration (NASA)

City Services and Utilities: John P. Coluccio, Signal Superintendent, City of Schenectady, NY

Figure 2-10 Speakers and Topics in the Smart Buildings Session

2.4.11 Smart States

During the Smart States session, speakers presented on various initiatives occurring at the state level to encourage smart communities (Figure 2-11). Some of the key themes raised by speakers included the following:

- Smart communities can be empowered if they understand the advantage of technology change; one challenge is how to ensure the empowerment of small communities or underserved, poor communities.
- Some of the capabilities important to smart communities include how to drive economic development with smart technology; improving public safety via the IoT technology; improving the well-being of the community; and using data and technology to make intelligent decisions in policies and community management.
- Data analytics and data in general can be overwhelming for small communities; one approach is to collaborate with other communities; others include identifying and prioritizing datasets, using data judiciously and tackling data analytics in stages.
- Sharing data is critical but a universal challenge; people are reluctant to share data for privacy, security and other reasons; data governance isn't clear on data; and security of data isn't certain. Sharing with regions rather than state-owned data may be a first step.
- Small communities may lack data science capabilities; required skill sets can be accessed by collaborating with other communities and regions.
- States can play a role in community smart technology by providing cybersecurity and physical connectivity.

SMART STATES BREAKOUT

Chair/Moderator: Daniel Lauf, National Governors Association (NGA)

Debra Lam, Managing Director, Smart Cities and Inclusive Innovation, Georgia Tech

Mark Critz, Western Regional Director, Pennsylvania Department of Agriculture

Joe Zilka, Sr. Manager, Government Solutions Manager, SAS

David Ihrie, CTO at the Center for Innovative Technology, Commonwealth of Virginia

Figure 2-11 Speakers and Topics in the Smart States Breakout



*The TriState Food System Project is focusing on smart ways to supply food in PA, WV and OH.
Photo by NIST.*

2.4.12 Smart Regions Collaborative

The Smart Regions Collaborative session focused on a variety of regional projects to deploy a wide range of smart technologies in different domains (Figure 2-12). The Smart Regions Collaborative is conducting a survey outside of the GCTC to understand what regions are doing and gaps in resources. They will use this information to further develop GCTC regional SuperClusters. Presentations described projects across several regions in the U.S., and included smart technologies for agriculture, food processing, traffic management systems, 911 centers, clean energy and water.

On the technology side, supercomputing and AI are being explored for smart cities via the Innovation Corridor in Colorado, a large-scale collaboration platform which incorporates work from two national labs, Fortune 500 companies, and smart cities consortiums. The aim is to develop a framework to support global smart cities initiatives by getting technologies from the national labs connected to governments and industry.

The Greater Washington Smart Region movement aims to establish a regional digital framework for delivering smart technology solutions to scale and incorporates both hard (fiber optics) and soft (planning and policy) infrastructure. While industry drives to commercial solutions, this movement is aiming to drive to a better societal answer using the solutions.

In the Northwest, smart region initiatives are building digital testbeds to create the Cascadia Innovation Corridor which is green, socially aware and tech savvy. The initiative is testing multiple technologies together to see how they interface with the community.

SMART REGIONS COLLABORATIVE BREAKOUT

Chair/Moderator: Jean Rice, NTIA

Smart Regions Collaborative Kickoff: Zack Huhn, Chairman, Smart Regions Initiative, and Jean Rice, NTIA

Tri-State Region (PA, WV, OH) Food System Project: Scott J. Sheely, Special Assistant, Pennsylvania Department of Agriculture; Mark Critz, Executive Director, PA Rural Development Council

Wabash Heartland Innovation Network (WHIN) – Advancing Agriculture and Manufacturing via IoT: Johnny Park, CEO, Wabash Heartland Innovation Network (WHIN)

Lake Tahoe Basin End Warning System and Bi-State Next Gen 911 Dispatch and Traffic Management Center: Danielle Hughes, Capital Program Manager, Tahoe Transportation District

The Great Lakes Smart and Sustainable Cities Cluster: Jeffrey Leonard, City Administrator, City of Defiance, OH; Mark Fisher, President and CEO, The Council of the Great Lakes Region

Supercomputer Modeling and Artificial Intelligence Cluster for Smart Cities and Regions: Eric Drummond, CEO and Founder, Innovation Corridor; Matthew James Bailey, Global Leader in Smart Cities / President, Powering IoT

Greater Washington Smart Region Movement: Karl Darin, VP & Program Lead, Greater Washington Board of Trade

Portland/Seattle/Vancouver Area Smart Region Initiative: Jonathan Fink, Professor, Director, Digital City Testbed Center, Portland State University

Smart Regions Initiative, Silicon Valley: Jeff Lewis, Director of Smart Regions, Joint Venture Silicon Valley

The Mid-Ohio Smart Region Task Force: Thea Walsh, Director, Director of Transportation & Infrastructure Development, MORPC

Figure 2-12 Speakers and Topics in the Smart Regions Collaborative Session

2.4.13 Transportation SuperCluster

This session covered transportation technologies including intelligent vehicles and transport systems; smart traffic technologies; big data analytics for transport; autonomous vehicles; disaster alert systems; and building smart communities around transfer points and mobility hubs. A variety of speakers (Figure 2-13) provided insights on smart transportation technologies currently used to help cities improve traffic, citizen and freight mobility and overall transportation safety and flow.

TRANSPORTATION BREAKOUT

Chairs/Moderators: Wilfred Pinfold, OpenCommons; Skip Newberry, Technology Associates of Oregon

Empowering Ruston City Services Using Wireless Sensor Networks for an Environmental and Transportation Monitoring System: *Benjamin Drozdenko, Assistant Professor of Cyber Engineering and Computer Science, Louisiana Tech University*

Empowering Walkable and Bikeable Communities Using Smart Decision Support System (DSS) Integrated with Vehicle-to-Everything (V2X) Communication: *Eugene W. Grant, Mayor, City of Seat Pleasant, Maryland, USA; Z. Jenipher Wang, CEO, Wiomax*

Wireless (LTE) Traffic Signal Control System Using IoT Technology for All Crossroads: *Min Kim, Traffic and ITS Engineer, Gunpo City, South Korea*

Big Data and Artificial Intelligence for Road Infrastructure Sustainability: *Nikhil Ranga, Director of Product & Customer Experience, Roadbotics; Robert Smith, Director of Engineering, City of Cumberland, MD*

Full Functioned Autonomous Driving Development Park in Taiwan: *Ying-Fan Lin, Associate Manager from Kingwaytek Technology Co., Ltd.*

Thriving Communities: Promoting Quality of Life for All Ages and the Role of Transportation: *Thomas Doherty, Clinical and Organizational Psychologist, Sustainable Self*

Public Private Partnerships to Support Transportation Infrastructure: *Hurst Renner - Manager, Public Policy & Smart City Partnerships, Rubicon*

Use of Transportation Data to Encourage More Trips on Transit, by Bike, on Foot: *Wilfred Pinfold - President, OpenCommons*

Figure 2-14 Speakers and Topics in the Transportation Session

Key themes that emerged from speakers in the session included the following:

- Autonomous Vehicles (AVs) are coming to roadways; cities are gearing up, studying the issues and creating test/training areas for AVs. Cybersecurity is one of the challenges to be addressed for AVs.
- Sensors can help to monitor and control traffic flow and improve pedestrian and biker safety in high traffic areas; cities are looking to improve walkability and bikeability.
- Smart transport systems can improve emergency response and save lives; flood detection and prediction and weather alert systems can inform local transport.
- Smart phones and AI technology are being combined to help evaluate road conditions; mobile data collection is a cost-effective alternative to rank road conditions and zero in on road repairs

that yield the highest return for citizens. Mobile data is also being used to improve trash removal, street sweeping and snow plowing – improving recycling and reducing landfill use.

- Smart transport has been shown to have positive impacts on overall health and well-being of citizens; surveys reveal smart transport provides equity of access to services and improves quality of life.



Transportation SuperCluster exhibit included a smart vehicle for public transit. Photo used with permission from Energetics

2.4.14 Utility SuperCluster

This session focused on topics related to municipal utilities, including smart, connected and innovative energy, water and waste management systems; virtual power systems; and new business models such as transactive energy and demand response. Speakers provided perspectives on advances in connected systems being used for utilities (Figure 2-14). Mobile, online and networked telecommunications are fueling innovations in how utilities are managed and operated.

The Utility SuperCluster discussed the key issues, which included good connectivity, and the ability to incorporate broadband in rural farming areas. Overall themes from the Utility session included the following:

- Waste management is an often overlooked area for smart city solutions but is gaining ground due to sustainability benefits.
- Smart cities must be resilient enough to evolve with technology as well as real situations that arise.
- Smart grid solutions are critical to incorporating many point sources of energy now possible through connected devices and systems, such as rooftop solutions, electric vehicles and other home energy systems. The virtual power plant would provide system balancing and synchronization to alleviate the issues with balancing many small distributed energy sources.

- Transactive energy is a newly emerging business model that allows consumers to have some control/awareness of power costs and transactions; this model relies on having an efficient smart grid which allows for harmonization of IoT devices and systems connected to the grid. Smart IoT connected devices and technologies are wide-ranging from metering and energy monitoring, to smart lighting and waste management.

UTILITY BREAKOUT

Chair/Moderator: Pete Tseronis, Dots and Bridges, LLC

Global, High Impact Energy Efficiency: Joe D'Agostino, President, Enterprise Infrastructure Partners

Smart Waste Management & Logistics: Paul Park, Global Business Development Manager, Ecube Labs

Gyeonggi Provincial Virtual Power Plant in GOPS (Gyeonggi Open Platform for SmartCity): Ilhan Ham, CEO & Founder, H Energy Co., Ltd.

Transactive Energy for Smart Cities: William J. Miller, MaCT USA

Chat with the Utility SuperCluster Task Force

Pete Tseronis, CEO, Dots and Bridges LLC

Ian Magazine, Strategy, Operations, and Finance Executive, Carnegie Mellon University

Kohlle Frantzen, Managing Partner, Helical Holdings

Jennifer Morrissey (invited), Manager, Smart and Sustainable Communities Think Tank, Dentons

Figure 2-15 Speakers and Topics in the Utility Session



The Fybr smart cities platform provides solutions for public safety, transportation, utilities and other city functions. Photo used with permission from Energetics

2.4.15 Wireless SuperCluster

The Wireless session focused on several examples of innovations in deployment of wireless systems in municipalities; and solving challenges in deploying/sustaining wireless systems. Speakers (Figure 2-15) gave perspectives on successful efforts that are currently ongoing in many cities, as well as new technologies. The SuperCluster representatives also provided an update on their blueprint for IoT deployment of wireless networks.

WIRELESS BREAKOUT

Chairs/Moderators: David Witkowski, Joint Venture Silicon Valley; Jon Walton, San Mateo County, CA; Tony Batalla, City of San Leandro, CA; Benny Lee, San Mateo County, CA

Wireless SuperCluster IoT Blueprint Presentation: *Tony Batalla, City of San Leandro, CA, USA*

East Palo Alto Neighborhood Innovation Zone: *Jon Walton, CIO, County of San Mateo, CA*

Galway Smart City: Light Pollution, Air Quality and Noise Monitoring Smart System - IoT Based:

Shivakumar Mathapathi, CTO, Dew Mobility / Faculty, Santa Clara University, CA

Palo Alto Networks Presentation: *Tom Williams, Palo Alto Networks*

Acoustic Monitoring at the Edge: *Tom Darbonne, Director of Applications Engineering, AudioT*

SmartWave Technologies: *Al Brown, CEO, SmartWave Technologies*

Edge Compute in the Era of 5G: *Leland Brown, Technology Development Manager / Advanced Wireless Solution Architect, Intel Federal*

Figure 2-16 Speakers and Topics in the Wireless Session

Key themes from speakers in this session included the following:

- Many options exist to bring IoT technologies to cities, but no one-size-fits-all solution; solutions need to be flexible, still be relevant in the future and fit unique city needs, use cases and services. Risk analysis and other technology considerations should be assessed (level of security/privacy, licensing, cost of ownership, skills, alignment with vision, etc.).
- Wi-Fi planning for large counties or regions is challenging due to scale; it may include multiple cities and a single solution may not be practical (range of income levels, digital divide, etc.). Providing citizens with tools to test public Wi-Fi pilots is one city's strategy and can provide excellent feedback to improve the system.
- Security is a significant issue for public Wi-Fi; one local government reported over 100 cybersecurity incidents in one year; across the U.S. in 2019, a ransomware incident was reported nearly every week. Main issues include:
 - Talent shortage exists in cybersecurity, especially for local/state governments.
 - Additional cybersecurity tools are needed.
 - Automated tools are lacking to combat automated adversaries, who are using AI and machine learning.
 - Securing the IoT requires securing multiple components: devices at the endpoint, gateway controllers, enterprise networks, service provider networks and platforms.

- Smart technologies are emerging that are more effective for wireless applications; examples include audio streaming to replace or enhance video in applications such as traffic or crime prevention; lower latency computing at the edge, 5G, etc.; large-scale wireless mesh networks for connecting large volumes of customers; and unique wireless locations (stadiums, streetlights, traffic signals, etc.).



This tractor incorporates precision agriculture systems which depend on reliable wireless access. Photo used with permission from Energetics.

2.5 Open Forums

Open forums and sidebar meetings served to both inform and allow for exchange of information across many specialized areas. These sessions explored topics such as funding and financing, open source platforms and tools and best practices for risk reduction in smart cities (Figure 2-16).

FIWARE Workshop

Hosted by FIWARE, this meeting provided information on how FIWARE is driving the de-facto standards needed for the creation of a sustainable global market for Smart Cities. The workshop highlighted the overall FIWARE vision and value proposition for Smart Cities, as well as collaboration activities with the World Economic Forum and TM Forum. In addition, information was provided about the FIWARE Smart Cities showcase program and how to join.

Funding and Financing

This panel covered the options and challenges of financing smart city projects. Speakers provided insights on grants, funding opportunities, private investment strategies and other financial aspects.

Moderator: Aimee Mecham, Chief, External Affairs, NTIA, BroadbandUSA

Meghan Houghton, Senior Advisor for Strategic Engagements, National Science Foundation

Jeanne Miliken Bonds, Senior Manager, Community Development, Federal Reserve Bank of Richmond

Oliver Kroner, City of Cincinnati OES

Eric Drummond, Chair, Colorado Venture Capital Authority, CEO Innovation Corridor

Ryeon Corsi, Management and Program Analyst, USDA, Rural Utilities Service Telecommunications Program

Innovative Business Modeling Panel

Panelists discussed innovative business models that have been successfully applied to support smart city projects, and lessons learned.

Moderator: Don Williams, Senior Program Specialist for Broadband Development, NTIA

Jon Walton, CIO of San Mateo County (confirmed);

Jay Nath, Co-Executive Director, City Innovate

Seema Alexander, Lexden Capital

Chris Rezendes, Chief Business Officer at Spherical Analytics

Smart and Safe: Risk Reduction in Tomorrow's Cities Panel and Reception

Hosted by the EastWest Institute, in partnership with Microsoft and Unisys, this panel brought together representatives from the private sector, non-profits and city leadership to discuss the challenges cities face when deploying technology and smart solutions in urban environments. Speakers shared views on recommendations and best practices to manage the risks and reap the full potential of Smart Cities across four main areas: cybersecurity, public safety, privacy and data protection and collaboration in governance. The discussion was based around a 2019 report from the EastWest Institute, Microsoft and Unisys.

Opening Remarks

Bruce W. McConnell, Executive Vice President, EastWest Institute

Panelists:

Mark Forman, Global Head, Public Sector, Unisys

Ben Walsh, Mayor, City of Syracuse, New York, USA

Lindsey Parker, Chief Technology Officer, Washington DC, USA

Kimberly Nelson, Executive Director State and Local Government Solutions, Microsoft

Figure 2-17 Summary of Open Forums

3 Next Steps

The 2019 GCTC/SC3 Expo was the culmination of collaboration team efforts over the last 18 months. The 2018-2019 GCTC round has successfully catalyzed formation of new teams from around the world including many Action Clusters and new SuperClusters.

Various activities continue to occur to build new teams and Action Cluster projects. SuperClusters continue to make progress by starting new pilot programs and creating smart city blueprints. Projects are diverse and cover the full spectrum of smart city solutions – with many now incorporating cybersecurity and privacy elements.

Over the past several years, GCTC has built up a vibrant community of multi-city teams and partnerships to deploy shared and replicable solutions in a collaborative manner and encouraged participants to set tangible and measurable goals to be accomplished by the teams. Since 2017, the GCTC initiative has supported the concept of multi-city, multi-team SuperClusters organized around common project objectives and shared solutions in sectors. GCTC has encouraged the community to share best practices in their deployment efforts and the measurement science and standards requirements through mechanisms such as technical publications and SuperCluster blueprints. During the process, GCTC collected many examples of best practices and approaches for smart cities and communities.

As the next step, NIST plans to work with stakeholders from industry, academia, and local, state and Federal government sectors in providing relevant technical analyses and publishing the collection of best practices for use by all stakeholders, including developing effective smart city frameworks, performance indicators and measurement approaches. NIST will work with the broader community to consolidate insights from the blueprints and guidebooks into publications along with additional technical analysis and requirements for standards, while continuing to build new teams and projects through GCTC Action Clusters and SuperClusters.

Acknowledgements

The 2019 Global City Teams Challenge (GCTC), Smart and Secure Cities and Communities Challenge (SC3) Expo was co-hosted by the National Institute of Standards and Technology (NIST), an agency of the U.S. Department of Commerce; the National Telecommunications and Information Administration (NTIA); and the U.S. Department of Homeland Security Science and Technology Directorate (DHS S&T).

Appreciation is extended to the GCTC/SC3 organizers, many speakers and panelists who provided their perspectives on current projects, future opportunities, needs and challenges for smart and secure cities and communities. The Energetics team is recognized for coordinating and managing the event.

GCTC/SC3 Organizers



Sokwoo Rhee, Associate Director, Cyber-Physical Systems Innovation, National Institute of Standards and Technology



Chris Greer, Senior Executive for Cyber-Physical Systems, National Institute of Standards and Technology



Christos Papadopoulos, Program Manager, Science & Technology Directorate, U.S. Department of Homeland Security (DHS S&T)



Jean Rice, Senior Broadband Program Specialist, National Telecommunications and Information Administration (NTIA)

Appendix A. 2018 Portland GCTC/SC3 Global Tech Jam Highlights

Over 250 attendees joined the GCTC/SC3 Tech Jam in Portland, Oregon, on June 20-22, 2018 with participation of over a dozen cities including Tel Aviv, Los Angeles, Portland, Austin, Vancouver, Surrey (Canada), Hong Kong, Seoul, Suwon (Korea), Saitama (Japan) and Galway (Ireland). Highlights of the event are summarized below.

Day 1

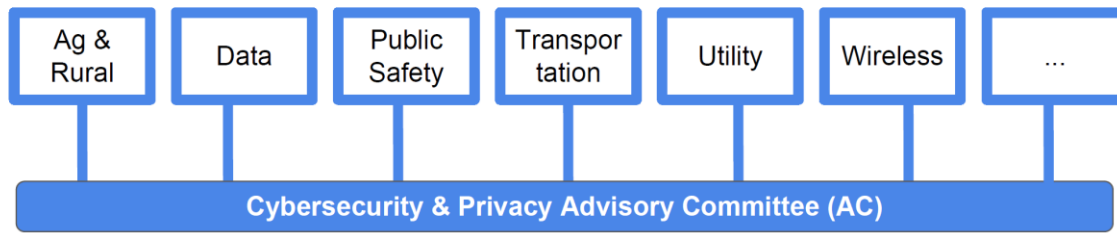
Keynotes: The first day began with a federal keynote by **Chris Greer (NIST)** and **Scott Tousley** on behalf of Doug Maughan (DHS S&T), followed by a panel of experts from industry and the city of Portland. Panelists included:

- Elizabeth Carter, Chief Security Officer, Armored Things
- Sara J. Lewis, Director – Legal, Sidewalk Labs (smart city division of Google/Alphabet)
- Joe Zehnder, Chief Planner, City of Portland

Lightning Talks: Eight SuperClusters participated in lightning talks: Transportation, Public Safety, Utility, Agriculture and Rural Development, Wireless, Data, Education and Smart Buildings.

Cybersecurity/Privacy Panel: Scott Tousley, Erin Kenneally (DHS S&T) and Lan Jenson (Adaptable Security) convened a cybersecurity and privacy panel, as described below.

- Scott Tousley and Lan Jenson presented a plan to create a “**Cybersecurity and Privacy Advisory Committee (CPAC)**” within the GCTC/SC3 with the following goals:
 - Identify and apply cybersecurity and privacy standards to ensure smart cities and communities are digitally resilient
 - Develop a supporting framework, leveraging continuous feedback and improvement
 - Support SuperCluster and Action Cluster development of domain/local solutions
- CPAC will be composed of the cybersecurity/privacy experts embedded in each SuperCluster and will coordinate the cybersecurity/privacy activities and blueprints of SuperClusters. CPAC will also build up capacity to help SuperClusters lacking expertise in cybersecurity and privacy. An overview schematic of the CPAC is shown in Figure A-1.
- Erin Kenneally provided an overview on security and privacy risk mitigation in terms of law, regulation, best practices and standards.



Continuous feedback and improvement:

1. AC provides input to SuperClusters (SC) by embedding 1-2 members in SC leadership team
2. In exchange, SC nominates at least 1 existing leadership team member to embed in AC
3. Embedded members report to both AC and their SC

Figure A-1 Overview of the Proposed CPAC

Federal Talks: Besides DHS, two GCTC federal partners provided a brief on their smart city activities, including:

- Jean Rice, NTIA
- Kellie Holloway Jarman, U.S. Commercial Service

Action Cluster Presentations: Twenty-five (25) action clusters presented in afternoon breakout sessions. Most of the presentations mentioned their activities on cybersecurity/privacy in their project. A few examples:

- Farm to Fork Crop tracking project for food quality and safety by the **City of Independence, Oregon**
- Smart Wide Area protection and security by **Singapore** and Concorde, a perimeter security company
- Flooding prediction project by **City of Dunedin, New Zealand** and Nokia
- A civic data platform by the city of Portland and a non-profit Civic Software Foundation (a.k.a. Hack Oregon)
- Utilizing low speed EVs to provide first mile/last mile solution by **St. Louis, MO**, and Electric Cab of North America

Day 2

Mayor's keynote: **Portland Mayor Ted Wheeler** gave an opening keynote. **Kevin Martin**, the city's innovation director, highlighted that Portland's smart city initiative first started with its participation in the GCTC 2015 round, which catalyzed a series of follow-up activities and wins including becoming one of the 7 finalists in the USDOT smart city challenge.

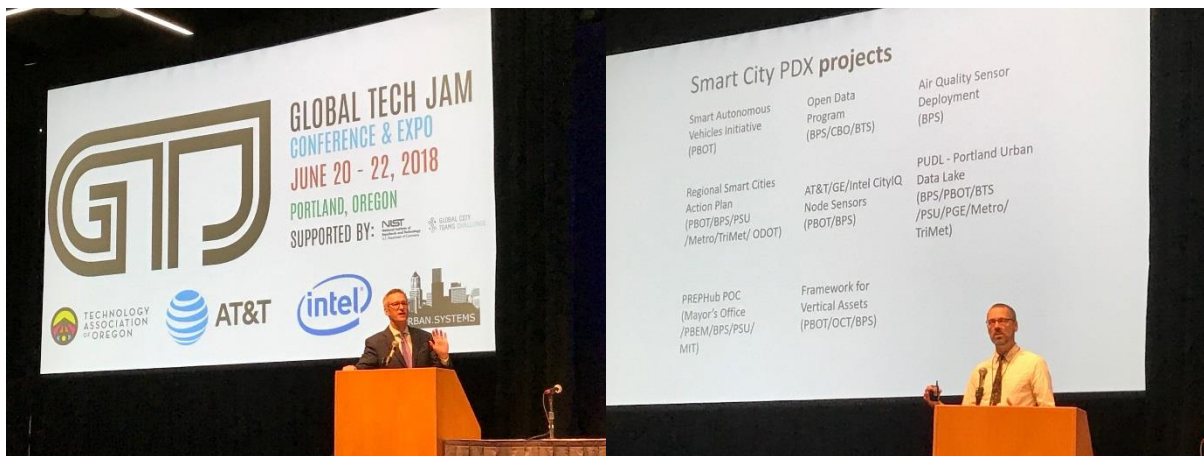


Photo by NIST

Photo by NIST

Canadian Smart City Challenge: Canada conducted a \$75M smart city challenge in 2019.^{12 13} Their program is similar to the USDOT challenge but with a broader scope than transportation and with a focus on identifying replicable examples. They will select multiple winners within three different categories based on population size. The finalists were announced on June 1. Multiple cities can join forces to create a team, mostly through regional partnerships.



Photo by NIST

Cybersecurity & Privacy Advisory Committee Meetup: The CPAC met for the first time and discussed next steps. Two action items were identified.

- The group will come up with a strawman document of the security and privacy guideline/framework that SuperClusters can use as a template for their blueprint.

¹² <http://www.infrastructure.gc.ca/cities-villes/index-eng.html>

¹³ <https://impact.canada.ca/en/challenges/smart-cities>

- CPAC will discuss with all SuperClusters to identify one or two cybersecurity/privacy leads. If the capacity doesn't exist in a SuperCluster, CPAC can dispatch its resources.

NASA Aerial Taxi Update: Yuri Gawdiak from NASA gave an update on the Urban Air Mobility (UAM). He presented the latest status of the landscape and discussed collaboration exploration objectives with the GCTC/SC3 Transportation SuperCluster. NASA plans to help private sector stakeholders start pilots in 2020.

Day 3

- **Association for Computing Machinery (ACM) Smart City Conference:** Seven peer-reviewed papers were presented including an application to use AI for traffic pattern identification.
- Scott Tousley and Sokwoo Rhee joined a "Vision" session on how cities can increase smart city citizen engagement.

Appendix B. Acronyms/Abbreviations

AC	Action Cluster
AI	Artificial Intelligence
API	Application Program Interface
AV	Autonomous Vehicle
CPAC	Cybersecurity and Privacy Advisory Committee
CPS	Cyber-Physical System
CS/P	Cybersecurity/Privacy
DHS	U.S. Department of Homeland Security
DHS S&T	DHS Science and Technology Directorate
DOC	U.S. Department of Commerce
EV	Electric Vehicle
GCTC	Global City Teams Challenge
GPS	Global Positioning System
ICT	Information and Communications Technology
IES	IoT-Enabled Smart City
IoT	Internet of Things
NIST	National Institute of Standards and Technology
NTIA	National Telecommunications and Information Administration
SBAC	Smart Building Action Cluster
SC	SuperCluster
SC3	Smart and Secure Cities and Communities Challenge

Appendix C. Useful Links

Global City Teams Challenge

<https://pages.nist.gov/GCTC/>

2019 GCTC/SC3 Expo

<https://pages.nist.gov/GCTC/event/>

2019 GCTC/SC3 Expo News Releases

<https://www.dhs.gov/science-and-technology/news/2019/06/20/news-release-global-city-teams-challenge-expo>

<https://www.nist.gov/news-events/news/2019/06/global-city-teams-challenge-smart-and-secure-city-expo-convenes-july-10-12>

<https://www.ntia.doc.gov/press-release/2019/global-city-teams-challenge-smart-and-secure-city-expo-convenes-july-10-12>

2018 GCTC Kickoff: Smart and Secure Cities and Communities

<https://pages.nist.gov/GCTC/event/gctc-kickoff-2018/>

Portland Global Tech Jam

<https://globaltechjam.com/>

International Technical Working Group on IoT-Enabled Smart City Framework (IES)

Website and Draft IES-City Framework

<https://pages.nist.gov/smartcitiesarchitecture/>

Cyber-Physical Systems Public Working Group (PWG)

Website

<https://pages.nist.gov/cpspwg/>

CPS Framework, Version 1.0

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-201.pdf>

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-202.pdf>

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-203.pdf>

Appendix D. Expo Exhibitors

List of GCTC/SC3 Exhibitors (alphabetical)		
13 Consortium	Education SuperCluster	Paradox Eng. – Minebea Mitsumi Group
360 Network Solutions	EnerNex	Paramount Planet Product
Advanced Flood Warning	Enterprise Infrastructure Partners	Project GRACE
Aging in Style, Southwest Neighborhood Assembly	Fend, Inc.	Public Safety SuperCluster
Agricultural and Rural SuperCluster	FIWARE	Shulman Rogers
AIG	Fybr	Skayl
Aimsun	Galway Smart City	Relax, Recharge, Retreat LLC
Anatomy of a Smart City (City of Schenectady)	Genetec	RoadBotics/City of Cumberland, MD
ASVDA Taiwan Smart Cities	Greater Washington Smart Region Movement	Rural Telehealth Initiative
Axis Communications	Gyeonggi Open Platform for Smart City	Saitama City Smart Community Project
BEM Controls, Inc.	IDC	Smart Building SuperCluster
CinDay (Cincinnati-Dayton) Cyber Corridor	Intel Federal LLC	Smart Regions Collaborative SuperCluster
City of Coral Gables	International Access Corporation	SmartWAVE Technologies
City Tech Collaborative	IoT Enabled Smart City Workshop for City	Soofa
Civic Software Foundation	Iowa State University	SPIN Global Presents ResponderCQ
CommScope	IPgallery	StormSense
Concorde Technologies Inc.	Jacobs	Syracuse U. Secure Cloud Architecture
Council of the Great Lakes Region	Juniper Networks	Tech Exchange
CryptoMove	Lafayette, Louisiana: Innovation with an Accent	Temboo
Cyber Resilience Planning (<i>formally Adaptable Security</i>)	LotaData	The Open Group
Cybersecurity and Privacy Advisory Committee (SuperCluster)	Louisiana Tech. Univ./City of Ruston	Transportation SuperCluster
Databuoy	Map901	Ubiquia
DC Asset Mgmt. Lab at the Univ. of the District of Columbia	National Institute of Information Communications (NICT), Japan	Underground Infrastructure Monitoring
DELI-i/Jeju Special Self-Governing Province/ Gunpo City	NIST GCTC Action Cluster Saudi Arabia	United States Postal Service
Dell Technologies	NTELS/Suwon City	Upsouth, Auckland Council, New Zealand
Deloitte Consulting	NTIA, BroadbandUSA	U.S. – ASEAN Smart Cities Partnership
DHS Science and Technology	NTT DATA	Vorbeck Materials
DLT Solutions	Open City Labs	Wabash Heartland Innovation Network and Purdue University
EastWest Institute	Otaris	Wiomax
Eaton Lighting	PA Department of Agriculture	Wireless SuperCluster
Ecube Labs	Palo Alto Networks	World Smart Sustainable Cities Organization (WeGO)