



VASEM

VIRGINIA ACADEMY *of* SCIENCE, ENGINEERING, AND MEDICINE

Smart Communities

2023 Summit Report



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Virginia Academy of Science, Engineering, and Medicine

The Virginia Academy of Science, Engineering, and Medicine is a nonprofit organization consisting of members of the National Academies of Science, Engineering, and Medicine who reside or work in Virginia as well as Virginians who are leaders in these fields. Through its nonpartisan network of experts, the Virginia Academy provides rigorous analytical, technical, and scientific support to inform policy on issues critical to the Commonwealth.

The Virginia Academy also promotes research, fosters interchange among individuals and organizations, and recognizes and honors Virginians who have made major contributions to science, engineering, and medicine.

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Senator Mark Warner

TEN YEARS AGO, I convened a meeting of National Academy members from Virginia and presidents of the

Commonwealth’s premier research institutions. Our purpose was to address the need for an independent body of experts to provide nonpartisan technical insight for state policymakers on complicated policy issues. I am proud that those early conversations led to the formation of the Virginia Academy of Science, Engineering, and Medicine.

Since that first meeting, the Virginia Academy has hosted a series of summits on emerging challenges and opportunities for the Commonwealth. This year, the Virginia Academy turned its attention to smart communities. Smart communities—which combine advances in such technologies as telecommunications, sensors, analytics and artificial intelligence—have great potential for improving the lives of our citizens.

The future of smart communities rests in large measure on innovative technology pioneered by our nation’s small businesses. That’s why I applaud the Virginia Academy for partnering with the Virginia Innovation Partnership Corporation to present this year’s summit. VIPC has an outstanding record of accelerating commercialization for entrepreneurs and startups.

I look forward to seeing where the conversations and ideas from this year’s summit go, and, as always, I look forward to continuing to support the efforts of the Virginia Academy.

Mark R. Warner
United States Senator



Joe Benevento

ONE OF THE key pillars of Governor Glenn Youngkin’s Compete to Win plan for economic growth in the Commonwealth of Virginia is innovation. Innovation can create quality opportunities for all Virginians, position Virginia at the forefront of emerging growth sectors, and create a more resilient Virginia economy.

The key to unlocking our full potential is enhancing collaboration across government, universities, businesses, and investors and developing clear stakeholder alignment around specific goals, objectives, and measurable outcomes.

Both the Virginia Academy of Science, Engineering, and Medicine and the Virginia Innovation Partnership Corporation are promoting that culture of collaboration throughout the Commonwealth. The 2023 VASEM Summit, which focused on smart communities, shone a light on collaboration and partnerships as well as the greater good that innovation can create for society and communities.

I appreciate the summit bringing together a wide range of stakeholders to celebrate VASEM’s past 10 years of engagement as well as to identify new ways to work together and impact the future.

Joe Benevento
President and CEO
Virginia Innovation Partnership Corporation



James Aylor

SINCE ITS INCEPTION 10 years ago, the Virginia Academy of Science, Engineering, and Medicine has sponsored a series of annual summits designed to highlight issues critical to the future of the Commonwealth. Examples include our 2017 summit on infectious diseases featuring keynote speaker Anthony Fauci and our climate change summit the following year, which led the General Assembly to fund an in-depth study of sea level rise.

This year's topic—smart communities—is equally important. By leveraging technologies such as high-speed networks, the Internet of Things, and data analytics, we help smart communities—be they rural, suburban, or urban—become safer, more resilient, and more equitable.

We were extremely fortunate to be able to team up with the Virginia Innovation Partnership Corporation to share with our audience some of the exciting smart city and smart community initiatives that are underway across Virginia.

James Aylor
President
Virginia Academy of Science, Engineering,
and Medicine



David Ihrle

FOR THE PAST five years, the Virginia Innovation Partnership Corporation has made it a priority to promote smart community initiatives and nurture a robust ecosystem of smart innovation for the Commonwealth. Because of such activities as our testbed in Stafford and our support for entrepreneurs, we have moved Virginia to the forefront of smart community innovation in the nation.

The Virginia Academy of Science, Engineering, and Medicine is also celebrating an anniversary this year. Over the past 10 years, it has provided authoritative, nonpartisan analysis of topics of pressing concern to the General Assembly, Virginia's executive branch, and the public through its many summits, in-depth studies, and key strategy documents.

We convened this summit, however, not simply to celebrate the accomplishments of the past five or 10 years but to look forward. As you will read in this report, the summit was an occasion to understand what smart community innovation looks like, gain a better understanding of the emerging technologies shaping the field, and identify opportunities awaiting us as we look forward to a smarter future.

David Ihrle
Chief Technology Officer, Vice President-
Strategic Initiatives
Virginia Innovation Partnership Corporation

Celebrating VASEM's

James Aylor, president of the Virginia Academy of Science, Engineering, and Medicine (VASEM), welcomed attendees to the summit and thanked them for sharing in the organization's 10th anniversary celebration. To provide a sense of VASEM's accomplishments over the past decade, he reflected on the organization's origins and growing range of activities. "Initiating any endeavor, be it a company or a new organization, can be a challenge," he said. "No matter how promising, there is no guarantee of success. We are gratified, therefore, to have met many of our original goals."

FINDING A CHAMPION WHO VALUES NONPARTISAN EXPERTISE

Aylor noted that the idea of creating a state-level version of the National Academies first surfaced in 2008. During his tenure as dean of engineering at UVA, he joined Bill Wulf, former president of the National Academy of Engineering (NAE) and a member UVA's Department of Computer Science, and Paul Torgersen, former president of Virginia Tech and an NAE member, in writing to Aneesh Chopra, Virginia's first secretary of technology, requesting start-up funds for a Virginia Academy of Science, Engineering, and Medicine. "Although he was enthusiastic, the funds never materialized," Aylor recalled. "The idea was put on the shelf."

In 2013, Sen. Mark Warner learned about an organization called the Texas Academy of Medicine, Engineering, Science, and Technology (TAMEST) that his colleague, Senator Kay Bailey Hutchison, created to advise policymakers in Texas. "Senator

"At the end of the next 10 years, we intend to be recognized across state government as the premier convener of science, engineering, and healthcare expertise in the Commonwealth."

Distinguished History of Service

Warner decided that Virginia would benefit from having a similar organization,” Aylor said.

Warner began by convening a select group of individuals from across the state that included members of the National Academies, the presidents of UVA and Virginia Tech, and other key technical leaders. With Warner’s blessing, they created VASEM as an independent, nonprofit organization to provide authoritative, nonpartisan guidance and information to Virginia’s legislature and its executive branch. It was also conceived to benefit the Commonwealth’s universities and industry, elevate its membership, and promote economic development.

CONVENING STAKEHOLDERS

Over the years, the Virginia Academy introduced a set of programs that reflect this mission. One of its first acts was to organize a summit. Since 2013, VASEM has convened nine annual summits identifying challenges facing the Commonwealth and highlighting the role of Virginia’s scientists, engineers, and healthcare professionals in addressing them. “Our goal is to put the spotlight on issues that we think are pressing,” he said. “Our 2017 summit on emerging infectious diseases, featuring keynote speaker Anthony Fauci, turned out to have been remarkably prescient, and our coastal resilience summit the following year attracted a standing-room-only audience.”

MOBILIZING EXPERTISE

To further its core mission of advising the Commonwealth, VASEM established a relationship with members of the Virginia General Assembly’s Joint Commission on Technology and

Science (JCOTS), which authorized VASEM to produce two in-depth studies for the legislature. For each report, academy leaders recruited a panel of experts. The first report was on prospects for the commercial space and unmanned aerial vehicle (UAV) industries in Virginia. “As you will see from later sessions today, the use of UAVs for infrastructure monitoring and emergency services is part of the vision for smart communities,” he said. The second, a follow-up to the coastal resilience summit, was on the impact of climate change on Virginia’s coastal areas. Several of the recommendations from these studies have been enacted.

In 2021, VASEM struck out on its own. “Previously, the Virginia Academy had limited itself to projects proposed by other sources,” Aylor said. “That year, we decided to take the initiative, developing what we called a key strategy document. We drew attention to five promising areas, such as sustainable energy production and semiconductors, in which the Commonwealth has the fundamental resources and expertise to achieve national prominence.” Aylor noted that VASEM is currently in the process of issuing a second, updated edition of the report.

PROMOTING INFORMED GOVERNANCE

Aylor observed that the challenges leaders face today—in such areas as health, climate, and security—are unprecedented in their scope, complexity, and urgency. All too often, he continued, decision-makers lack the scientific, medical, and technological background needed to act decisively and wisely. They would benefit, the VASEM board decided, from having policy

advisors who have been trained as scientists, engineers, and healthcare professionals.

In response, VASEM created the Commonwealth of Virginia Engineering and Science (COVES) Policy Fellowship program. Although many young scientists and engineers are eager to take an active role in policymaking, the opportunities to gain the skills and experience to make meaningful contributions are limited during their graduate careers. “Thanks to the fellowship, which provides support for them during the summer, they can now have those opportunities,” Aylor said.

As part of the COVES program, graduate researchers from state universities spend 12 weeks serving as technology advisors in legislative offices and executive agencies as well as in prominent Virginia companies and nonprofits. Some 45 graduate students have participated in the program over the past four years, and a significant number of them have altered their career plans to focus on the public sector.

LOOKING AHEAD

Aylor concluded by noting that the successes the Virginia Academy has achieved over the last decade have served to enlarge its aspirations. It is currently reflecting on these successes and, with membership input, has developed an ambitious strategic plan. “At the end of the next 10 years, we plan to be recognized across state government as the premier convener of science, engineering, and healthcare expertise in the Commonwealth,” Aylor said. “Our intention is to be seen as an indispensable source of information, analysis, and insight required for more effective public policy.”

KEYNOTE

Virginia's Energy Future

As directed by the Virginia General Assembly, the Department of Energy develops a comprehensive Virginia Energy Plan every four years. In October 2022, Gov. Glenn Youngkin delivered his vision of how the Commonwealth can meet the power demands of a growing economy and ensure that Virginia has a reliable, affordable, clean, and growing supply of power.

Abundant power provides the foundation of any smart community initiative. Accordingly, the Virginia Academy of Science, Engineering, and Medicine and the Virginia Innovation Partnership Corporation invited **Glenn Davis**, director of the Department of Energy, to address the summit and provide an overview of Youngkin's plan.

electric cars, building owners electrify their HVAC systems, and Virginia's economy continues to expand in energy-intensive sectors. "We can expect a 5 percent increase in energy consumption each year for the next 20 years," Davis said. "This is the most of any state in the nation."

In response, Youngkin proposed an all-of-the-above approach that harnesses natural gas, nuclear, and renewables while encouraging exploration of emerging sources to satisfy the increasing energy needs of the Commonwealth.

Davis explained the rationale for this broad-brush approach, starting by enumerating Virginia's current power sources. According to the latest U.S. Energy Information

to substantially raising costs. As a result, in this administration, we believe natural gas is here to stay." Hence the rationale for the Governor's all-of-the-above plan.

FOCUSING ON INNOVATION

Davis noted that Youngkin's plan was based on five important pillars: reliability, affordability, innovation, environment stewardship, and competition. Because the summit's topic was smart communities, Davis elected to focus on innovation. The plan advocates for investment in new clean-energy technologies that can support baseload generation as well as solar and wind.

One area in which Virginia already has an innovation

advantage, Davis said, is in nuclear power. Virginia is home to two of the world's largest nuclear companies, BWX Technologies (BWXT) and Framatome, and is a leader in the development of small modular reactors (SMR). SMRs can be built

in a factory and erected on smaller sites than those required by a traditional nuclear plant. Advocates maintain that their design makes them inherently safer. Davis noted that the Nuclear Regulatory Commission has begun to amend rules to make it easier to deploy SMRs and that BWXT has already been providing engineering support for several SMR prototypes.

Davis also highlighted Virginia's leadership in offshore wind power production. The Coastal Virginia Offshore Wind (CVOW) project has recently been approved by the federal government and is on track to begin construction in 2024. CVOW will consist of 176 wind turbines with a nameplate capacity of 2.6 gigawatts and will produce

"The key to maximizing the potential of renewables is battery storage. Batteries will enable us to capture power from these sources and use it when the wind isn't blowing or the sun shining."

AN ALL-OF-THE-ABOVE APPROACH

Davis set the stage by describing the unanticipated surge in energy demand that has occurred over the past few years. He recalled that when the Virginia Clean Economy Act was passed in 2020, the projection for Virginia's future year-over-year energy growth was 1 percent to 2 percent. "That estimate completely missed the mark," he said. One reason for this is Virginia's growing dominance in energy-intensive fields like data center operations and advanced computing. "A typical AI training run consumes as much energy as 120 homes over the course of a year," he said.

Demand for energy will only rise further as Virginians purchase

Administration reports, natural gas accounted for 54 percent of Virginia's net in-state electricity generation, nuclear power supplied 31 percent, renewables—solar energy, biomass, and hydroelectric—provided 11 percent, and coal fueled less than 4 percent.

These fuels have different capacity factors. This measurement is the percentage of time on average that an energy generation system is producing energy. In the United States, nuclear has a capacity factor of 92 percent, natural gas 54 percent, coal 49 percent, wind 35 percent, and solar photovoltaic 25 percent. "When you replace natural gas generation with solar," he said, "you reduce reliability—in addition



power at a 42 percent capacity factor, serving the equivalent of up to 660,000 homes. Davis said that Dominion Energy, the company behind CVOW, had avoided the financial issues that have caused other East Coast wind projects to become stalled or be scrapped.

Youngkin's plan also includes solar. Davis cited such initiatives as a plan to develop solar facilities next to data centers at a brownfield site in Wise County as instances of innovative applications of solar power.

"The key to maximizing the potential of renewables is battery storage," Davis said. "Batteries

will enable us to capture power from these sources and use it when the wind isn't blowing or the sun shining." He told the audience that Dominion Energy has proposed a pilot project to test two innovative alternatives to current battery technology. Both technologies promise enhanced safety and significantly longer discharge time than lithium-ion batteries.

A ROLE FOR THE PRIVATE SECTOR

Davis concluded his keynote speech by highlighting the role that private industry could play in fostering innovation. He pointed out that

the organization he directs—the Department of Energy—changed its name in 2021 from the Department of Mines, Minerals, and Energy. "Only recently has energy become our primary focus," he said.

Accordingly, his department relies on subject matter experts from outside government to collaborate with it on strengthening the state's energy sector and ensuring that Virginia continues to be a place where people want to live, work, and grow businesses. "We need industry to come forward to help us decide where we should concentrate and where the opportunities lie," he said, "We welcome their input."

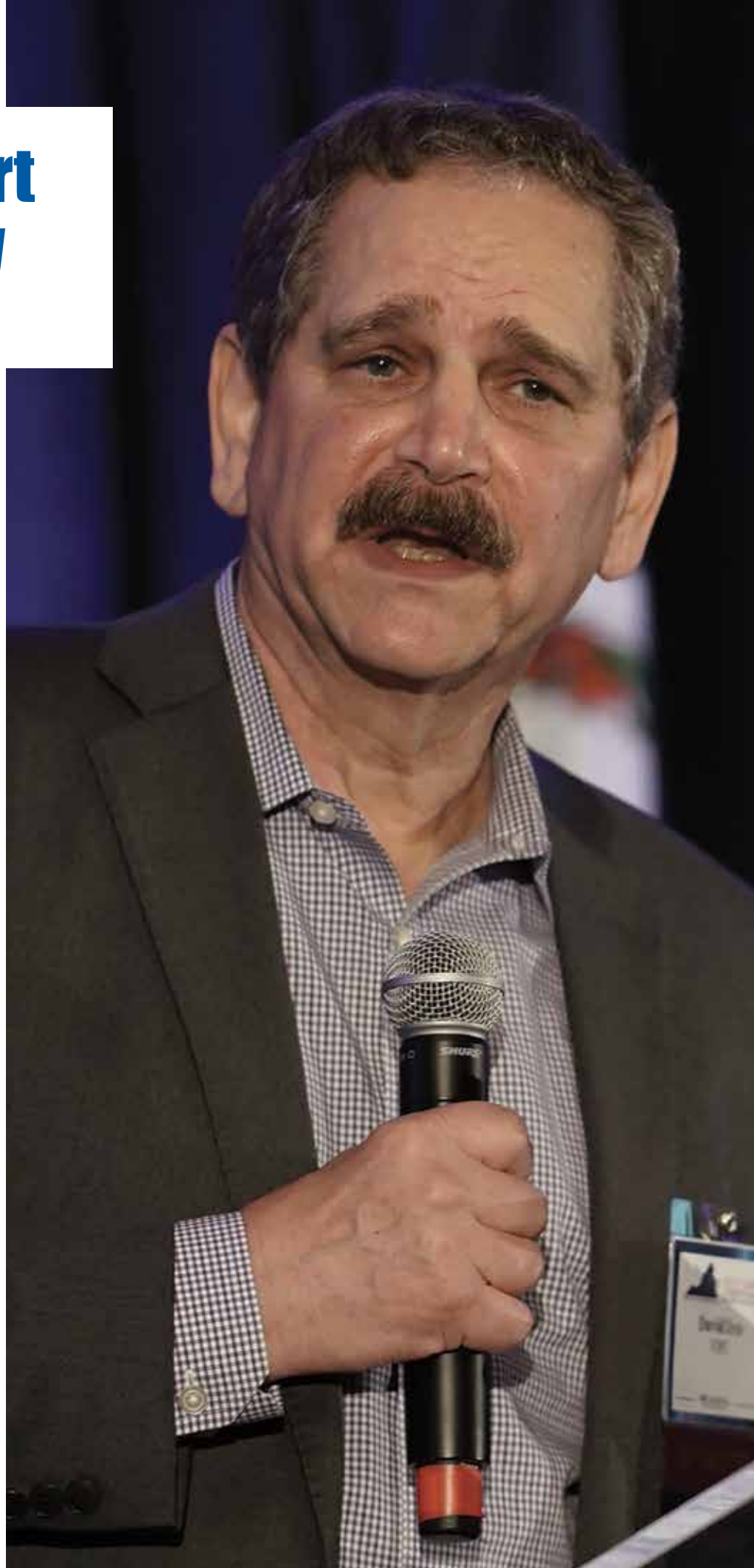
VIPC's Smart Community Journey

David Ihrle, chief technology officer and vice president—strategic initiatives at the Virginia Innovation Partnership Corporation (VIPC), framed his presentation by remarking that the purpose of the summit was to think about the future, about the role of smart communities in addressing not only the challenges we face today but also those our children will inherit. Progress will depend, he said, on capitalizing on the lessons learned along the way.

He didn't always think so. Ihrle recalled the readiness workshop five years ago that launched VIPC's smart communities portfolio. "I remember that many speakers said we were embarking on a journey, a notion that puzzled me," Ihrle said. "We had the sensors, the plans, and interest from many communities. As far as I was concerned, we were ready to go. But as it turned out, we were indeed embarking on a journey of incremental discovery."

THE IMPORTANCE OF PARTNERSHIPS

Perhaps the most crucial lesson learned, Ihrle said, was the importance of partnerships. For VIPC, a key partner has been the Science and Technology Directorate of the Department of Homeland Security (DHS). By joining together, they not only had the resources necessary to field prototypes of early warning systems for flooding and wildfires, but they also were better able to refine and improve upon these efforts.



Ihrle and his DHS colleagues quickly realized that developing technology was just the first of the challenges facing them. They had to find a way to take potentially valuable technology, often created at universities or federal labs, and make it operational in specific real-world contexts. “Together with DHS, we pioneered a new approach that we call ‘commercial-first innovation,’” he said. “Any new smart technology must have the capacity to scale if it is to meet the expectations of its venture investors and the marketplace.”

“As far as I was concerned, we were ready to go. But as it turned out, we were indeed embarking on a journey of incremental discovery.”

Collaboration has also been useful in helping them establish what that market should be. VIPC distributed over 100 sensors developed by DHS around Virginia. “We soon found that there were a number of groups besides emergency managers that cared about flood information,” Ihrle said. “For instance, we discovered that flooding was a concern of drone operators.” Such realizations when prototyping a new technology put innovators in the position of deciding whether they wish to accommodate any additional use cases they encounter. These deliberations might involve the placement of the sensors, which in turn must be balanced against such practical concerns as providing a source of power.

And finally, there is the issue of getting pertinent information generated by these systems into the hands of the intended audience in a form that is easy to digest. Here again, partnerships were useful. To convey wildfire alerts to the public,

VIPC and DHS, coordinating with the Federal Emergency Management Agency and N5 Sensors, devised a method to push sensor feeds through the Integrated Public Alert and Warning System to WAZE, the traffic app, and reach travelers.

THE VIRGINIA SMART COMMUNITY TESTBED

As part of its journey, VIPC realized that a powerful way to accelerate the development of smart community technologies and generate knowledge about deploying them would be to create a testbed. Such a testbed would enable entrepreneurs and other partners to evaluate and refine new systems under controlled circumstances. In 2021, VIPC, in conjunction with Stafford County, launched

the Virginia Smart Community Testbed (VSCT). It was the first smart city testbed in the country with an Internet of Things platform fully integrated with 5G and other new and emerging technologies. VSCT is a true public-private partnership involving multiple industry partners that focuses on relevant and practical use cases that could help Virginia localities better serve their citizens. The testbed is also the home of the Virginia RIoT Accelerator Program and has been selected by Verizon as one of its 5G Innovation Hubs.

The vision for the testbed was to make the Commonwealth a global leader in smart community implementation—and this goal is being realized. “Several international companies have moved to Stafford County to be close to the testbed,” Ihrle said. “We have welcomed a number of visitors including the chief science advisor from the United Kingdom and representatives from the Australian Ministry of Defense.”

The testbed complements living labs, which are collaborative exercises dedicated to testing prototype smart technologies rather than an established platform grounded in a locality. An example of a living lab exercise was the use of the Virginia Flight Information Exchange (VA-FIX) in conjunction with surveillance drone flights over the 2023 Shenandoah Apple Blossom Festival in Winchester. The drone pilots relied on VA-FIX, a digital data-sharing platform, for critical information about infrastructure and activities on the ground that might affect their flight path as well as the real-time positions of other drones in the area. The drone pilots successfully used this system to help manage traffic, support a missing person search, and identify a vehicle of interest for law enforcement personnel.

PLUG-AND-PLAY SMART COMMUNITIES

Looking back, Ihrle said, building a smart community ecosystem in Virginia and working with public and private partners across the nation has indeed been a journey. Now that so much preliminary work has been done, Ihrle believes that it is time to start thinking about the appropriate role for the state in developing a mix-and-match offering for cities and counties looking to tap the benefits of smart community platforms.

“We have now piloted almost every aspect of the architecture. It would be great to say to a jurisdiction, here is the core infrastructure you need, here are sensors you can install, and here are a series of applications you can use to analyze data and disseminate information,” Ihrle said. “It could choose among these elements according to its needs.”



Moderator Uma Marques.

PANEL

Testbeds and Living Laboratories

It is one thing to develop a new technology. It is quite a different thing to determine how it might be used in the market. Testbeds and living laboratories developed by nonprofit and government-sponsored organizations help address this issue. They provide a real-world environment for entrepreneurs to determine whether their technology is appropriate for a specific market and, if so, how to refine and optimize it to meet its needs.

The Virginia Innovation Partnership Corporation (VIPC) has made Virginia the go-to state for testing technology in smart community applications by sponsoring the Virginia Smart Community Testbed (VSCT) in Stafford, Virginia, and by promoting living laboratories. In addition to helping businesses commercialize their technology, these initiatives place local cities, counties, and government agencies at ground zero for innovations that can help them provide more responsive and effective service to their citizens.

As **Uma Marques**, formerly director of the VSCT and now director of information

technology for Roanoke County, aptly described the model of co-innovation these experiential spaces promote: “By implementing pilots in partnership with local governments, testbeds and living laboratories have opened doors for innovative companies to explore potential markets. This collaborative approach benefits the public as well as these organizations, as it encourages the creation of relevant technology that can improve the quality of life.”

As panel moderator, Marques brought together government and business panelists with experience in innovative tech and testbeds to discuss the benefits of participating in these programs and describe the lessons they have learned. They were **Nick Sabo**, executive director of Winchester Regional Airport Authority; **Andrew Spence**, chief information services director for Stafford County; **Greg Welch**, Verizon’s distinguished architect for 5G and Edge Strategic Partnerships; and **Sridhar Katragadda**, lead data scientist with the City of Virginia Beach’s Department of Information Technology.

PREPARING FOR ADVANCED AIR MOBILITY

Each panelist had a different motivation for staying at the cutting edge of smart community innovation and a slightly different relationship to the VIPC and its living laboratories. For Sabo, the impetus was the realization that advanced air mobility (AAM) could be a game-changer for regional airports like his. AAM refers to next-generation aviation systems that combine various technologies, including automated flight, electric propulsion, and advanced traffic management systems. AAM applications include everything from passenger flight to infrastructure inspection to package delivery. For Sabo, getting on the AAM bandwagon is imperative for his airport authority. “If we don’t get out in front of the requirements of AAM, our airport could be left behind, and the local economy might suffer,” he said.

Among other activities, the Winchester Airport Authority is collaborating with VIPC to develop a corridor connecting Warrenton-Fauquier Airport and Stafford Regional Airport for beyond-visual-line-of-site drone testing. “This living laboratory can help provide the data needed to make the case to the Federal Aviation Administration that we can successfully and safely incorporate these technologies in our communities,” Sabo said.

Panelists Nick Sabo, Andrew Spence, Greg Welch, and Sridhar Katragadda.



REALIZING THE BENEFITS OF HOSTING A TESTBED

Stafford County has a record of deploying smart community technology to better serve its citizens. In 2023, for instance, the county placed first nationally in the Center for Digital Government's Government Experience Award.

As Stafford County's information services chief director, Spence is in a perfect position to grasp the value of its decision to support a testbed. Spence noted that the county would have had difficulty establishing the partnerships with vendors that the testbed made possible. So far, the testbed has enabled the county to use advanced technology to better manage flood risks and prevent cyberattacks, among other tasks. "We're trying to create a template for technological innovation that other counties can adopt while providing a vehicle for companies to learn how to work with governments," Spence said.

Marques followed up by noting that "hosting a testbed gives local governments an opportunity to test innovation through a 'try before you buy' model, thereby minimizing risk and enhancing the value to citizens from investing taxpayer dollars."

Spence stressed that the relationships fostered by the VSCT are also beneficial for vendors. The testbed serves as a proving ground for entrepreneurs, giving them

first-hand insight into how their technology meets or fails to meet customer needs.

PROVING OUT 5G USE CASES

Verizon is a platinum sponsor of VSCT, Welch explained, because the company has spent \$50 billion rolling out its 5G network and knows that it will not come close to securing its planned return on this investment by selling smartphones alone. It will succeed only if it can develop and demonstrate use cases that industry and enterprises can adopt. "My role and that of my group," Welch said, "is to help drive those use cases forward. Working with VIPC, Stafford County, and the VSCT is one way of testing these use cases."

The 5G standard was expressly designed with the Internet of Things in mind and can support up to a million devices per square kilometer. Getting those devices on the 5G network, therefore, is critical to its future. The VSCT allows Welch the opportunity to zero in on devices capable of enabling novel use cases and to persuade manufacturers to certify them for the 5G network. "The VSCT gives me the opportunity not only to learn about new devices but also to gain the vendors' perspective on our certification process so that we can adjust it to reflect their constraints as well as our requirements."

STAYING AHEAD OF THE WATER

One of Katragadda's main reasons for pursuing innovation is flood protection. With sea level rise, Virginia Beach is subject to flooding from hurricanes and high tides. The city has created a flooding monitoring system, StormSense, funded by the National Institute of Standards and Technology and the city's Capital Improvement Program in collaboration with the City of Newport News, Norfolk, and the Virginia Institute of Marine Science. It combines sensors, data analytics, machine learning, and cloud computing. The sensor data, once processed, sets the stage for city officials to respond to flooding by closing roadways and lowering reservoir levels.

There is, however, opportunity for further progress. For instance, there is the issue of getting complete coverage in areas where cellphone service is weak and ensuring that sensors have an adequate power source. There is also the challenge of combining feeds from different kinds of sensors and securing long-range drones that can stay aloft for hours at a time during King Tide. "The pursuit of innovation can seem endless—but the vision of a smart flood monitoring system serving our community is compelling and provides innovative solutions and data for long-term planning," Katragadda said.



PANEL

Emergency Management and the Cybersecurity Threat

Bob Greenberg, CEO of G&H International Services, Inc., set the stage for this panel discussion by describing the challenges facing the emergency services community. Greenberg should know. Over the past quarter century, G&H has worked with scores of federal, state, and local emergency services agencies around the country, providing them the tools they need to make smarter, more timely decisions. “Everything today comes at you very quickly,” he said. “It’s the new normal.”



Moderator Bob Greenberg.

But speed is just one of the challenges emergency managers face. They are also being asked to do more. Thanks to the changing climate, there has been a surge in the frequency and, most notably, the severity of natural disasters. The Canadian forest fires of 2023 were unprecedented in scope and duration, and the number of Category 5 hurricanes each year has tripled since the beginning of the 21st century. “The number of

billion-dollar events has increased exponentially and will continue to increase,” Greenberg said. At the same time, manmade disasters that emergency responders must address—for instance, mass shootings—have also been on the rise.

In other words, emergency managers in 2023 have much more responsibility than they did 20 years ago and are accountable for planning, preparedness, and prevention as well as response and recovery for events of unparalleled scale and complexity. And they are being asked to take on this challenge without a commensurate increase in resources. “Yes, there are billions of dollars available for disaster relief and resilience funding, but that doesn’t help emergency managers with their daily operations,” Greenberg said.

THE STAKES GET HIGHER

Despite these limitations, emergency managers are now being tasked with a major new challenge. Greenberg said that at the National Emergency Management Association Annual Forum, held just two weeks before the summit, FEMA administrator Deanne Criswell warned attendees of “the looming danger presented by nation-state threats to our homeland.” As an example, she cited misinformation and disinformation campaigns launched by pro-Russian

actors to spread anger and confusion during the East Palestine, Ohio, train derailment. She also talked about cyberattacks on our digital and physical infrastructure—our cloud computing services as well as our power grids.

“In effect, she was telling us that homeland security is international security—and that emergency managers must find ways to develop strategies to prepare for and mitigate these threats,” Greenberg said. “This will require new ways of thinking, new partnerships, and new approaches to information sharing.”

Greenberg asked Dale Sisson, the technical director for the Naval Surface Warfare Center, Dahlgren Division, and Luiz DaSilva, executive director of the Commonwealth Cyber Initiative (CCI) and Bradley Professor of Cybersecurity at Virginia Tech, to talk about their organizations’ efforts to combat these threats and support the emergency management community.

KEEPING TABS ON NAVAL INFRASTRUCTURE

The Naval Sea Systems Command operates eight naval surface warfare centers across the United States, which, in its own words, operate “the navy’s full spectrum research, development, test and evaluation, engineering, and fleet support centers for offensive and defensive systems associated with surface warfare and related areas of joint, homeland, and national defense systems from the sea.” While the Dahlgren Division focuses on developing and integrating warfare systems, critical infrastructure protection is also part of its portfolio, Sisson explained.



Panelist Dale Sisson.

The Dahlgren Division has a cyber-analysis and mission insurance group that helps determine the vulnerability of naval infrastructure to natural and manmade disaster. It has experts in all infrastructure areas, including telecommunications, cyber, electric power, fuels, transportation, chemical, and water systems. It can produce briefs on imminent or ongoing disasters or take deeper dives to help emergency responders on navy bases better understand the challenges they face. In addition, Dahlgren provides red teams that emulate adversarial tactics, techniques, and procedures to identify weaknesses in systems and networks fielded by the navy.

“We also participate in FEMA activities to make sure we understand the importance to us of components of civilian infrastructure like the power grid and the railroads,” Sisson said. “There are also a number of avenues through which we can share expertise and assist the civilian emergency management community.”

RAISING THE BAR ON CYBERSECURITY

DaSilva made the point that the CCI’s three interlocking missions—research, innovation, and workforce development—directly correlate with the resources the emergency management community requires to

counter cyberthreats. The CCI fosters a vast research enterprise. Researchers from the 43 colleges and universities in Virginia who are part of its network brought in \$75 million in new contracts from federal and private-sector sources in 2023 alone. The projects they are pursuing—such as an AI-driven framework for managing and

securing wastewater treatment plants and the use of 5G and NextG wireless networks to support a secure smart power grid—will eventually bolster the capacity of emergency managers to respond to attacks on critical infrastructure.

Partnerships with private-sector companies are essential if emergency managers are going to do more within the limits of their budgets. One way the CCI assists the emergency management community is supporting the creation of companies that commercialize university research. “This year, the CCI had its first four spin-offs,” DaSilva noted.

The CCI also supports existing startups by funding internships with

Panelist Luis DaSilva.



emerging cybersecurity companies. Not only does this program help get these companies off the ground, but it is also an important source of experiential learning. “We have about 60,000 open cybersecurity jobs in Virginia,” DaSilva observed. “If emergency managers are to successfully address cybersecurity challenges, they will need trained personnel.”

As part of this effort, the CCI is making a push to move cybersecurity training beyond the computer

Emergency managers ... have much more responsibility than they did 20 years ago and are accountable for planning, preparedness, and prevention as well as response and recovery.

science and engineering programs where it has traditionally resided and incorporate it in other fields like civil engineering and the health sciences. “Cybersecurity is a multidomain, multidisciplinary issue, and we need to infuse expertise wherever it is needed,” DaSilva said.

Greenberg concluded that organizations such as the Dahlgren Division and the CCI will play a vital role in helping emergency managers face new and more complex threats. “It is extremely important that we not only address the cyberthreats we face today but also anticipate the threats that will emerge in the future,” he said. “This kind of ongoing partnership with the emergency management community will be essential to our ability to resist threats, global as well as local, well into the future.”

PANEL

The Role of Virginia's Universities in Fostering Climate-Resilient Communities

Many of the innovations that can make communities smarter have their origins in university labs. For this panel, **Hina Mehta**, director of the University Commercialization Program at the Virginia Innovation Partnership Corporation (VIPIC), included on her panel two faculty members who have developed technologies that can help communities address the impacts of climate change and aging infrastructure.



Moderator Hina Mehta.

Professor **Jon Goodall**, a water resources engineer and specialist in hydroinformatics at the University of Virginia (UVA), develops cyberphysical systems for real-time flood mitigation in coastal urban communities. His counterpart at George Mason University, Associate Professor **David Lattanzi**, combines data analytics, robotics, artificial intelligence, and structural engineering to produce safer and

more reliable lifecycle assessments of bridges and other structures.

To complement their perspectives, Mehta recruited **Troy Hartley**, director of Virginia Sea Grant (VASG), a multiuniversity coalition dedicated to bridging the gap between university research and the needs of coastal communities and businesses.

AN EVOLUTIONARY PROCESS

Mehta began the discussion by asking the panel to talk about the challenges of developing technologies to support smart communities. Goodall has been working with Norfolk and other cities whose stormwater management systems are threatened by sea level rise. “We have billions of dollars nationally invested in our stormwater infrastructure, which are passive systems that depend heavily on gravity to remove water,” he said. “But as sea level rises above a system’s outfalls, water backs up. It’s too expensive to rip everything out. Part of the answer is to make the system smarter and more adaptive.”

A critical enabling technology for smart stormwater systems is sensors, but, as Goodall noted, there are many barriers to deploying them widely including power, connectivity, security, and cost. “One of the benefits of working in the smart community context is that it effectively provides a blueprint for how the technology can be improved,” he said.

Lattanzi talked about both the technological and institutional challenges that must be met to

advance smart infrastructure monitoring. He noted that civil engineers spent the last half of the 20th century developing remarkable physics-based simulation tools, but around 2010, there was an emerging consensus that they were dealing with systems as well as individual structures—and that data-based AI models would be a better direction to pursue. “We now understand that we need both,” he said. “We are learning when we should use data-driven machine-learning approaches and when we should leverage our physical simulations in tandem.”

BUILDING BRIDGES TO BUSINESS

This larger systems-based approach, in Lattanzi’s mind, has required a change in engineering education. “There is a sea change underway,” he said. “Members of our community are rethinking what it means to be a civil engineer, the skill sets and technologies our students should master, and how we can better prepare them for a role in the ecosystem of innovation.”

Lattanzi also sees universities playing a greater role in this ecosystem. “Rather than pushing new technologies out for others to take, we must bring others in to help guide us in their development,” he said.

Virginia Sea Grant has a similarly inclusive mission, Hartley said. Thanks to its network of field stations, VASG researchers have seen firsthand the damage caused by sea level rise, from wells polluted by saltwater intrusion to septic

systems overwhelmed by flooding. The seven-university consortium has partnered with the private sector and nonprofits to explore immediate and long-term solutions to problems like these. “Because of the geology of coastal Virginia, we are seeing the highest level of relative sea level rise anywhere on the East Coast,” Hartley said. “The strategies we develop will be adopted by states around the country.”

We are learning when we should use data-driven machine-learning approaches and when we should leverage our physical simulations in tandem.

As an example of the kinds of collaborative initiatives VASG pursues, Hartley cited its partnership with the Middle Peninsula Chesapeake Bay Public Access Authority, Old Dominion University, and RISE, a nonprofit dedicated to helping communities adapt to climate change and sea level rise. Together, the group secured a \$2.9 million award from Go Virginia to launch a resilience innovation ecosystem, with a business entrepreneurship competition, collaborative R&D, and an emerging resilience and water adaptation industry cluster.

The group used part of its funding to strengthen businesses that are focusing on challenges caused by rural flooding. One company, Natrx, is prototyping the use of structures created with 3D printers from dredging materials to protect shorelines and increase their resilience over time. Another, Triangle Environmental, will pilot a compact, modular wastewater treatment system with potential for the nonpotable reuse of household greywater. “There will be an inevitable migration from the coast over the next 100 years,” Hartley said. “With a Triangle system, a house can be moved away from the coast and take its septic system with it.”

The panelists cited other instances of universities pursuing measures to bridge the gap with business. “University can seem opaque to companies,” Goodall observed. “Finding faculty with technology that can advance their goals can be baffling.” One of the purposes of UVA’s Link Lab, which Goodall directs, is to provide that access point. The Link Lab brings together more than 250 faculty and graduate students who develop cyberphysical systems for applications that include smart cities and connected health.

FINDING MIDDLE GROUND

Universities also have to build bridges to communities. “In the past, most universities took a top-down approach to addressing challenges facing local communities,” Lattanzi said. “Because they were missing that bottom-up component, their solutions often missed the mark.” A worthwhile role for universities, he suggested, is to serve not simply as a source of innovation but also as a trusted advisor, helping local communities evaluate their needs and evaluate technological solutions.

But that trust has to be earned. Goodall highlighted the National Science Foundation’s Coastlines and People (CoPe) program, which unites university faculty and local communities in an effort to develop the resources needed to make better decisions in response to flooding and sea level rise. Goodall is leading a \$5 million CoPe project currently bringing together researchers from UVA, Norfolk State University, and the Elizabeth River Project with leaders from Virginia’s Hampton Roads region. “These initiatives are about building trust as well as capacity,” Goodall said. “Ultimately, it’s about creating the long-term relationships needed to codesign a better future for our coastal communities.”

Panelists Jon Goodall, David Lattanzi, and Troy Hartley.



PANEL

The Entrepreneurial Experience

Smart communities are necessarily entrepreneurial communities, because entrepreneurs are vital to identifying and commercializing the innovations that make smart communities even smarter. The data that communities generate using these smart technologies point entrepreneurs in the direction of even more potent smart technologies. It's a virtuous circle.

But getting that circle in motion takes a push. With that in mind, **Conaway Haskins**, vice president for entrepreneurial ecosystems at the Virginia Innovation Partnership Corporation (VIPC), assembled a panel that included entrepreneurs and representatives of organizations that support them. Together, they talked about the kinds of assistance that are most meaningful to entrepreneurs, that help them better understand their market and build momentum for their companies.

The entrepreneurs were **Cory Perdue**, **Jen Finn**, and **Matt Westergard**. Perdue is the founder and CEO of Datakwip, a company that helps building owners and engineers dramatically lower energy consumption by applying its advanced analytics platform to existing HVAC data. Jen Finn is cofounder of HIO, an easy-to-adopt service for landlords that uses large language models to answer resident questions. And Westergard is cofounder and COO of Secure Process Intelligence (SPI), which develops secure cloud-based remote monitoring and control solutions for the water and energy industries.

Tom Snyder and **Braden Croy** are members of organizations that help entrepreneurs succeed. Snyder is executive director of RIoT, which focuses on companies building

technology for the Internet of Things. It offers its six-week RIoT Foundations Program and 12-week Virginia RIoT Accelerator Program at the Virginia Smart Communities Testbed. Croy is program director for the Dominion Energy Innovation Center (DEIC), located in Ashland, Virginia. The center has worked to jumpstart a broad range of companies, from clean tech to food production.

PRIVATE-SECTOR PILOT PROGRAMS

Haskins asked the panelists to name the specific kinds of assistance that, in their view, are crucial in getting start-ups off the ground. The panelists all agreed that pilot programs and testbeds are essential. "Access to a built environment or working system is vital for a founder trying to deploy advanced technology," Finn said. She was able to install HIO's platform in one of her partner's buildings, helping her gain a better sense of its strengths and weakness.

With assistance from VIPC and the Department of Homeland



Moderator Conaway Haskins.

Security's Science and Technology Directorate, Datakwip was able to use the Capital One Arena in Washington, D.C., as well as government buildings in Stafford County as a testbed. Perdue reports that the experience was valuable to the company in a number of ways. "With the Capital One Arena project, we were able to take our existing facility analytics platform and expand its ability to ingest different types of building data," he said. "This can help us better contextualize data around such issues as indoor air quality, physical safety and security, and sustainability."

Panelists Cory Perdue, Jen Finn, Matt Westergard, Tom Snyder, and Braden Croy.





Another advantage of a testbed on a commercial property, especially one of this size, is that it gives a start-up a way to establish the value of its technology. Datakwip was able to identify and begin implementing strategies that will significantly lower Capital One Arena's energy bill, Perdue reports, and, in a combined platform operated by Smart City Works and other technology performers, demonstrated that the arena could modify its airflow to allow faster returns while complying with building codes.

Finally, a testbed at a commercial location gives the entrepreneur the opportunity to make a sale and establish a track record. "That endorsement is a critical milestone," Perdue said.

COMMUNITY TESTBEDS

RIoT's Snyder highlighted the value of government-sponsored testbeds such as the one hosted by Stafford County. "It's a great situation for start-ups to gain credibility," he said. "Governments can't hire you if they are not sure you will be in business in six months. By taking advantage of these shared resources, startups create credibility, connections, and solutions."

Snyder also emphasized the value jurisdictions gain from creating a smart community testbed. "Rural counties and cities that can't

afford a large IT budget can leverage cutting-edge technology by bringing startups into their ecosystem," he said. Braden agreed—and noted that small cities, despite the stereotype, are often open to innovation. He noted that Ashland recently implemented free town-wide Wi-Fi as a way to show it welcomes innovation. "The idea of smart cities, smart infrastructure, and smart agriculture has become a beacon for rural communities," he said.

PEOPLE POWER

In the final analysis, the panelists concluded it is people who breathe life into entrepreneurial ecosystems in the form of mentors, colleagues, or talented employees. The entrepreneurs said that they appreciated any assistance that helps them forge these relationships. DEIC's Braden concurred: "From our perspective," he said, "helping startups find appropriate partners and connecting them with appropriate stakeholders at each stage in their development is one of the most important things we do."

SPI's Westergard finds having access to experienced mentors is particularly helpful. "One of the scariest things about being an entrepreneur is that you don't know what you don't know—and that can be completely overwhelming," he said. Westergard credits insights

gained from RIoT for helping his company make better decisions.

The panelists also expressed gratitude for assistance building networks. Finn said that "having the opportunity to meet people in related fields who are passionate about their work was invaluable." But Snyder reminded entrepreneurs in the audience that it is up to them to take advantage of these opportunities, citing the summit itself as a great example. "I promise that every person in this room has at least one superpower and a unique perspective to share," he said. "I urge you to make the most of occasions like these to get to know each other and perhaps join forces."

Finally, the panelists maintained that access to qualified, ambitious young employees was indispensable to their growth. And while hands-on technical training is essential for students in community colleges as well as universities, they called on universities to ground students in the fundamentals of such nontechnical topics as organizational dynamics. As Perdue said, "Knowing how to participate in a team and understanding the basic components of human performance go hand in hand with expertise. When students join our organization, they have to have all the skills needed to move at our pace."





Moderator Dave Ihrle. Panelists J. J. Rusculla, Mike Keymer, Shawn Talmadge, Michael Clark, and Emily Saulsgiver.

PANEL

The Smart Community Future

The 2023 Summit concluded with a diverse panel of experts assembled to provide a well-rounded perspective on the future of smart communities. The panelists included representatives of two companies actively involved in creating technology that has been

The panel also included members of the federal government who are actively involved in bringing teams together to further smart community development. **Michael Clark** from the Naval Surface Warfare Center Dahlgren Division is the director of the

the implications of emerging technologies for smart communities and the conditions needed to realize their potential. He began by asking Rusculla and Clark to talk about the next stage in the adoption of their technologies. Rusculla explained that a number of

factors had come together that position VR for widespread adoption. From a technical standpoint, VR has reached the point of presence, where the brain no longer perceives it as a constructed reality.

In addition, the technology is now affordable to a mainstream audience. And, thanks to the pandemic, users are more amenable than ever to virtual learning and communication. Working against wider acceptance, however, is institutional inertia. “If governments and the private sector don’t take the reins and drive the technology forward, there is no guarantee that society will have the opportunity to reap its benefits,” he said.

Because there are many distinct approaches to quantum computing, describing its current state is more difficult. The various quantum technologies are at different readiness levels. The computers that Keymer’s company produces are based on photons, or light particles, rather than atoms. That gives

David Ihrle kicked off the discussion by focusing on the implications of emerging technologies for smart communities and the conditions needed to realize their potential.

integrated in smart community services. **J. J. Rusculla** is cofounder, executive vice president, and chief immersive officer of ACCESSVR, whose virtual reality (VR) platform is being used for public safety, first responder, and workforce development training as part of a number of smart community initiatives. **Mike Keymer** is vice president of quantum solutions at Quantum Computing, Inc., which has demonstrated that its computing systems can provide optimized flight paths for drone flights that minimize costs and in-flight risks.

A third panelist, **Shawn Talmadge**, represented users of smart community services. He is state coordinator for the Virginia Department of Emergency Management.

Potomac Tech Bridge. This is one of a series of 18 tech bridges established by NavalX to bring to bear the resources of Navy commands, government agencies, industry, and academia to accelerate the development of solutions for warfighters. **Emily Saulsgiver** is the director of the Asia Near East Portfolio for the International Cooperative Programs Office at the U.S. Department of Homeland Security (DHS) Science & Technology Directorate, where she works to bolster emergency response capabilities through international partnerships.

GETTING THE FUTURE DONE
VIPC’s **David Ihrle** kicked off the discussion by focusing on



them the advantage of being able to operate at room temperature. “I think this type of quantum analog computers will be ideal for many applications,” Keymer said. Right now, they are being demonstrated in such applications as aviation, financial services, and machine learning.

For Talmadge, innovations like these will transform emergency management at the state level, although it will require a series of partnerships with public institutions like the DHS Federal Emergency Management Agency (FEMA) and private companies to fully implement them. The net effect, he believes, is that the new technologies will “collapse the decision space.” For instance, drones flying over a disaster area could transmit data to a command center, where it could be combined with tax information and analyzed with a quantum computer to provide a damage assessment and calculate reimbursements. Such a system would be impossible without contributions from partners in various fields. “In the future, I will be able to start moving assets before people on the ground start calling for them,” he said. “That’s a game-changer for us.”

Clark also stressed the importance of creating a network of partnerships—essentially the role of Tech Bridges—in realizing the potential of smart technologies. “The perfect win for us would be when sailors or marines identify a problem, we come up with a solution by communicating that problem to the Tech Bridges network, which

then floats the request to their local ecosystems,” he said.

Also emphasizing collaboration, Saulsgiver cited the example of South Korea. She noted that South Korea has designated sections of the country to serve as testbeds for smart technology and works with local government to encourage tests on their systems. “Local government, entrepreneurs, startups, and universities all collaborate while giving themselves space to fail and learn,” she said. “We could gain a lot from working with our international partners.”

“WHAT KEEPS YOU UP AT NIGHT?”

Inevitably there will be bumps in the road in adopting any technology. Ihrle asked each of the panelists to name a challenge they think must be addressed as we move toward a smart community future. “What keeps you up at night?” he asked.

For Talmadge, the answer was straightforward. He noted that FEMA Administrator Deanne Criswell gave a recent speech in which she maintained that the United States should no longer consider itself free from concerted cyberattacks on critical infrastructure launched by nation/state actors. “As an emergency manager, my challenge is now to anticipate what those impacts might be on the local level,” Talmadge said. “That’s a tall order.”

Clark and Ruscella both pointed to systemic institutional issues. Clark observed that the federal acquisitions process, with its

We have to lean into the technology and become more agile.

labyrinthine rules, lags far behind the pace of technological change—and as a result, the United States runs the risk of being a step behind our enemies. “We have to lean into the technology and become more agile,” Clark said. Ruscella pointed to the decreasing number of small businesses in the United States. “Not enough companies are receiving the assistance they need as they try to scale up and commercialize their technologies,” he said. “As a result, all too many of them fail, and their technology is lost.”

By contrast, Keymer and Saulsgiver pointed to unresolved issues in how we approach technology. Keymer was worried that “we are working so fast to incorporate technologies like artificial intelligence in smart community platforms that we risk overlooking some of their downsides.” And Saulsgiver’s biggest concern was that “we don’t understand the context in which new technology would be used and the threats that it might introduce.”

One way to ensure that these issues are addressed, Ruscella argued, was not only to bring a variety of institutions together to work on smart community technology but also to enlist people from a variety of backgrounds. “We need artists as well as scientists to make smart communities work,” he said.

Facilitating the Exchange of Pertinent Information

MOVING BEYOND THE VISUAL LINE OF SIGHT

The applications of unmanned aerial systems (UAS) are virtually limitless. When used widely, they will enable dramatic advances in fields like infrastructure monitoring, emergency management, transit, and logistics. But this potential will not be realized until the Federal Aviation Administration (FAA) is certain that UAS can be operated safely beyond the visual line of sight (BVLOS) of their operators.

The Virginia Flight Information Exchange (VA-FIX) was built to demonstrate that it is possible to deliver the range of information needed for safe BVLOS flight. At the summit, Advanced Technology Application's (ATA's) **Scott Drew** highlighted the features of VA-FIX, which it developed in conjunction with the Department of Aviation, the Department of Transportation, the Department of Emergency Management, and the VIPC.

As Drew explained it, VA-FIX is a secure platform that enables stakeholders, public and private, to share information needed for UAS operators and service suppliers to plan and conduct safe operations. At the time of the summit, Drew reported that VA-FIX was drawing information from seven different agencies and had signed on almost 200 users and issued 35,000 advisories.

VA-FIX meets the FAA's standards for being a supplemental data service provider for the Commonwealth. It is the first of its kind in the nation, and ATA is rolling out similar platforms in the other states. "As these systems are tested, the data they're generating



Presenters Scott Drew and Erik Endrulat.

is making a clear case for relaxing BVLOS regulations," Drew said.

BREAKING DOWN INFORMATION SILOS

For emergency managers, accurate information flowing to the right place at the right time saves lives. To help address this need, G&H International Services, working with the Consortium for Emergency Services Technology, developed its P4 (Public-Private Partnership Platform) technology. **Erik Endrulat**, a solutions architect with G&H, called it a scalable collaborative information workspace that improves how government agencies and private entities operate together. "We want to encourage better coordination across various organizations, disciplines, and jurisdictions and promote shared situational awareness," he said.

G&H has tested P4, which is based on Microsoft Teams and incorporates ArcGIS, in a number of training exercises and has customized it for a number of different purposes. For instance, Endrulat reported that P4 served as the primary operational platform during the Cascadia Rising

2022 response exercise, which was predicated on a disastrous 9.0 magnitude earthquake along the Cascadia Subduction Zone. Used to coordinate steps needed to stabilize the food lifeline, it was accessed by 75 participants, including representatives from four state emergency management agencies, 20 businesses, two nonprofit organizations, and FEMA Region 10.

The nonprofits World Central Kitchen and Team Rubicon posted files listing the food they needed and where it was needed. These requests were automatically pushed out to private sector collaborators like Walmart and Albertsons, which could respond by specifying the materials they could supply along with contact and delivery information.

According to FEMA, this proof-of-concept was well received by the participants, who saw it as a simple, scalable, and useful solution for future collaborative efforts.

Among other use cases, Endrulat reported that G&H is working with the Virginia Innovation Partnership Corporation, the Virginia Department of Emergency Management, and York County to adapt P4 for UAS operations.





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