

# Smarter cities, smarter living

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A home thermostat automatically establishes a comfortable environment for its occupants. A washing machine sends a text message when its cycle is complete. Lights throughout a house are controlled with a tap and swipe on a tablet, saving Dad a final trip down the stairs before bed.

In much the same way such smart technology has transformed the home, intelligent infrastructure technologies promise to revolutionize the way cities, towns and communities operate and change the way people interact with one other and society.

On January 30, 2018, Dan Lopresti, professor and chair of the department of computer science and engineering at Lehigh University, is moderating a briefing on intelligent infrastructure for the U.S. House of Representatives' Science, Space and Technology Committee in Washington, DC.

The event is being convened by the Computing Research Association (CRA), a partnership among industry, government and academia, and a leading voice in the computing research community. Honorary co-hosts of the event are Texas representative Lamar Smith, who chairs the Committee, and Rep. Eddie Bernice Johnson, also from Texas, who is a ranking member of the committee.

According to the CRA, intelligent infrastructure is defined as "the deep embedding of sensing, computing, and communications capabilities into traditional urban and rural physical infrastructures such as roads, buildings, and bridges for the purpose of increasing efficiency,

resiliency, and safety."

Lopresti, a widely respected researcher whose work in fundamental algorithmic and systems-related questions in pattern recognition, bioinformatics and computer security, also serves on the executive committee of the CRA's Computing Community Consortium. Since joining Lehigh's faculty in 2003, he has helped to launch and lead Lehigh's successful [DataX](#) program as well as its innovative [Mountaintop Initiative](#), and served as interim dean of Lehigh's [P.C. Rossin College of Engineering and Applied Science](#) in 2014-2015.

During the January 30 event, Lopresti will guide a panel of researchers from across academia and industry to discuss the role of intelligent infrastructure in addressing the nation's broader infrastructure needs, identify critical gaps and barriers to successful deployments and the importance of continued research in addressing the field. Panelists include Henning Schulzrinne, Columbia University, who will speak on the need for resiliency and adaptability; Matthew Wansley, general counsel of nuTonomy, who will address robustness and interoperability; Nadya Bliss, Arizona State University, who will discuss security and trustworthiness; and Elizabeth Mynatt, Georgia Tech, who will speak about accessibility and usability.

Lopresti's leadership on the panel is indicative of the Lehigh's emerging reputation in data and computational research, in particular through interdisciplinary team science in crucial application areas such as [smart infrastructure](#) and connected communities.

## **Empowering the smart city**

A 2014 United Nations report projected that the global urban population would rise from 54 percent in 2014 to 66 percent in 2050. Much of that growth will take place in disadvantaged areas ill-equipped to

accommodate the greater numbers and density of people. As urban populations rise, efficiencies will have to be identified in expanding the finite elements of urban infrastructure. There will be commensurately greater wear and tear on energy, communication and transportation systems. The vital mechanisms that make cities habitable are going to come under increasingly severe duress.

"We view smart cities as adaptive systems, where interaction between the city's infrastructure and humans is modeled as a continuous feedback loop and enabled by a supporting cyber-system," explains Hector Muñoz-Avila, professor of computer science and engineering. "The infrastructures are themselves connected sharing information, which derives from infrastructure interdependencies, enabling cities to adapt to changes to over time. This includes long-term changes such as population growth and short-term immediate responses such as severe weather events."

Muñoz-Avila, along with Lopresti, is part of a team of Lehigh researchers seeking solutions in what it calls "Smart Infrastructure for Connected Communities." And although the team's approach includes focused engineering needs in this space, it also addresses broader systemic and policy issues that can hinder these complex systems from running smoothly. It's a big picture approach that tackles overarching problems and creates solutions that can be transferred across particular applications.

Connected communities will herald new opportunities to increase public safety, clean the environment, enable urban farming and on-demand manufacturing, and create as yet unseen avenues to entrepreneurship that will further accelerate the cycle of change. During the minutes spent on the bus commuting to work, in interactions with civil government, inside within the four walls of their homes, city dwellers will see the shape of their lives shift. And as they interact with the city's mechanisms, use its

[infrastructure](#), and communicate with each other—via their actions, mobile and personal devices, and computers—citizens will provide information that will alter the systems of the city.

But the task of creating successful smart cities is gargantuan. Researchers will have to find a way to integrate information from power plants, bridges, tunnels, means of transport, home appliances and everything in between. The data from sensors and devices will have to be communicated reliably and securely to data centers, which will analyze the information. Necessary actions or notifications will have to be transmitted to traffic control devices, buses and trains, power grids, homes and health care facilities. To top it all off, none of these systems will work optimally until their elements are connected and interdependent.

According to Muñoz-Avila, the cross-disciplinary culture at Lehigh in particular makes it a fruitful place to develop answers for tomorrow's urban communities. "I have been at Lehigh for about 15 years, and one thing that always makes me feel great is the low barrier between the disciplines," he says. "I have the freedom to devote a lot of time to interdisciplinary work, and that is exactly what is needed to create smart cities—people from multiple disciplines working together."

Provided by Lehigh University

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