



BUILDING BLOCKS OF A SMART CITY

Beijing Jiao Tong Univ., 19 Oct 2018

Invited Talk

Professor Saifur Rahman

Director, Virginia Tech Advanced Research Inst., USA

President, IEEE Power & Energy Society

Virginia Tech Research Center
Arlington, Virginia, USA



PPT slides will be available at

www.saifurrahman.org

www.saifurrahman.org
Use the Presentations tab



Keynote Speech
IEEE Smart Cities
Helping to Make Smarter Cities a Reality
Saifur Rahman
IEEE President
Smart Cities Conference (SCC)
Phoenix City, AZ
17 September 2018



**Critical Infrastructure Protection:
Addressing the Underlying Interdependencies**
IEEE PES Invited Lecture
06 September 2018
Columbus, Ohio
Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President-elect, IEEE Power & Energy Society



**IoT Sensor Integration in Smart
BUILDINGS FOR MONITORING & CONTROL**
Invited Lecture
Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President, IEEE Power & Energy Society
ENIT, Tunis, Tunisia, 04 September 2018



**IoT Sensor Integration in Smart
BUILDINGS FOR MONITORING & CONTROL**
Invited Lecture
Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President, IEEE Power & Energy Society
National University of Singapore, Singapore, 22 May 2018



**Smart Buildings & A Smart City
CONNECTED COMMUNITY**
Invited Lecture
Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President-elect, IEEE Power & Energy Society
AIT Bangkok, 25 May 2018



**Smart Buildings & A Smart City
CONNECTED COMMUNITY**
Keynote Speech
Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President-elect, IEEE Power & Energy Society
ISGT Singapore 23 May 2018




3


www.saifurrahman.org
Use the Presentations tab

What are Smart Cities

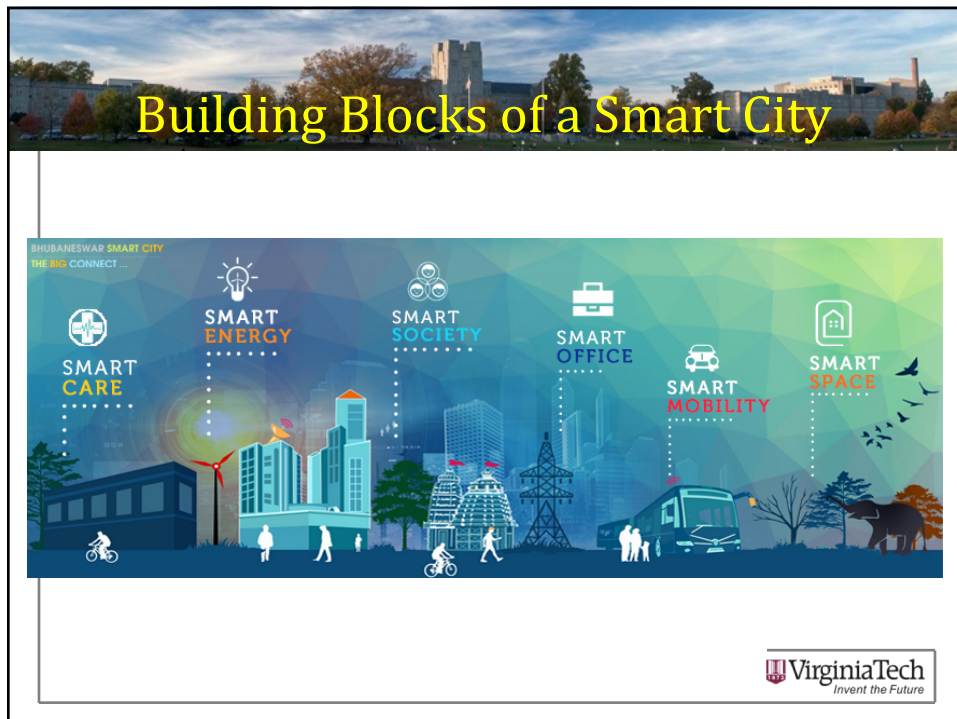
- There is **no** single consensus definition of a smart city, but there is some agreement that a smart city is one in which information and communication technology (ICT) facilitates improved insight into and control over the various systems that affect the lives of residents.



Picture from: <http://politic365.com/2017/09/01/smart-cities-require-smart-planning-policy-to-benefit-communities/>



Invent the Future





The Connected City

A connected city is one where all relevant city systems—transportation, utilities, employment, health care, public safety, education, and others—are capable of communicating with each other to allow coordination and reduce waste.



Smart City


A **smart city** is an urban development **vision** to integrate information and communication technology (ICT) and Internet of things (IoT) technology in a **secure** fashion to manage a city's assets.


To be fully “smart,” a city must be “connected.”



Smart/Connected City

- A smart/connected city is a system of interconnected systems including:
 - Employment
 - Health care
 - Retail/entertainment
 - Public services
 - Residences
 - Energy distribution
 - Transportation
- The system of systems is tied together by information and communications technologies (ICT) that transmit and process data about all sorts of activities within the city.






 Invent the Future

Smart/Connected City, contd.

- Smart/connected cities contain and use “intelligent infrastructure”
 - Devices and equipment that can sense the environment and/or their own status, send data, and often, receive commands.
- Smart/connected cities use new analytical processes that have been facilitated by ICT advances
 - Big data analysis
 - Crowdsourcing to gather data and solve problems
 - Gamification to incentivize behaviors
 - Engage the connected citizen



 Invent the Future

Smart City Platform for City Info and Services



Source: Howard Bandler, IEEE Electrification, March 2016

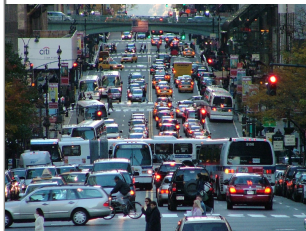


Connected Transportation

- Connected vehicles and travelers will be able to share data with all sorts of equipment, not only transportation-related devices and infrastructure, as they become integrated into the Internet of Things
- Travelers will increasingly be able to procure mobility as a service, rather than purchase vehicles or make other long-term commitments to particular modes of travel (eg, self-driven cars)



Elements of a Smart City



A neighborhood in a smart city:

- A smart traffic crossing sensitive to traffic volume
- Synchronized traffic lights for smooth flow
- Emergency vehicle priority access



Optical based traffic signal preemption system for emergency and transit vehicles

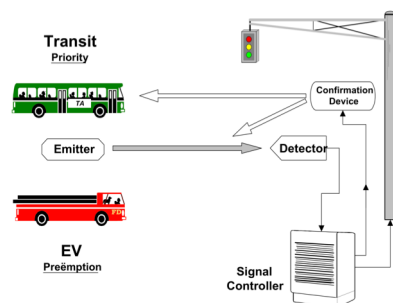
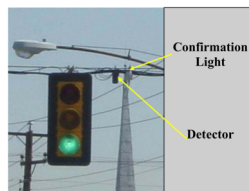


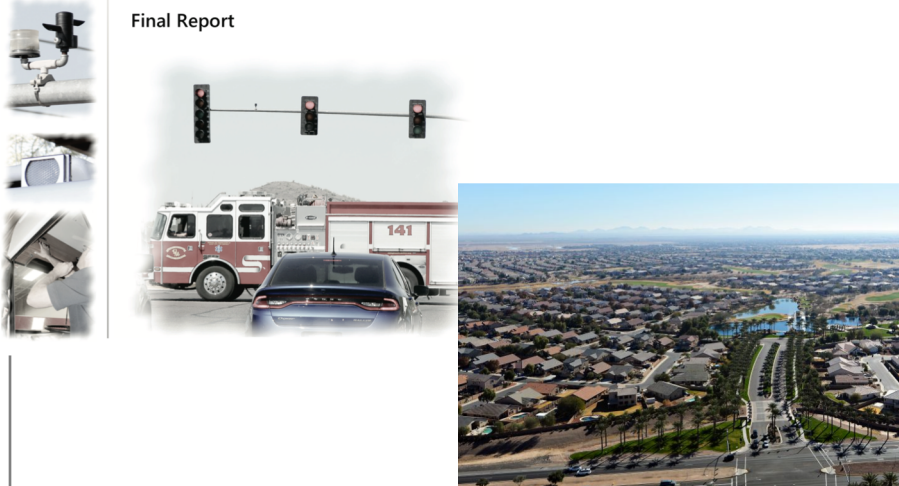
Figure 12 : System Architecture for 3M Optical Emitter Detection System



15

Example in Arizona, USA

Final Report




VirginiaTech
Invent the Future


Optical based traffic signal preemption system

Detector for Traffic Signal Pre-emption on a road intersection in Virginia, USA.

Signal Detector



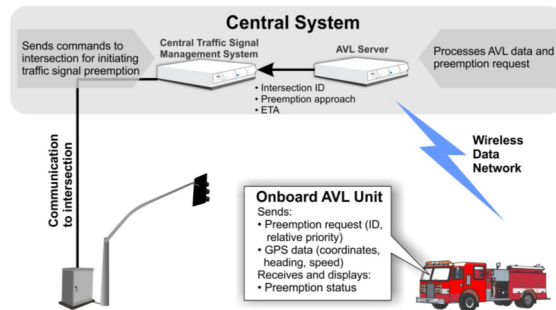
Typical Signal Detector



Source: Maricopa Association of Governments (MAG) Emergency Vehicle Preemption
[State of the Practice Study Final Report](#)

VirginiaTech
Invent the Future

Central/Automatic Vehicle Location based Traffic Signal Preemption

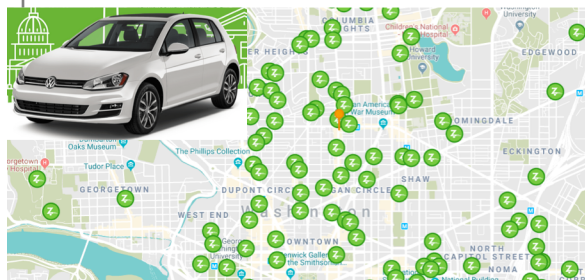


Source: Maricopa Association of Governments (MAG) Emergency Vehicle Preemption [State of the Practice Study Final Report](#)



Connected Transportation

- Connected vehicles and travelers will be able to share data with all sorts of equipment, and be able to procure mobility as a service, rather than purchase vehicles



Self-driven Vehicles



19

Source: Qualcomm

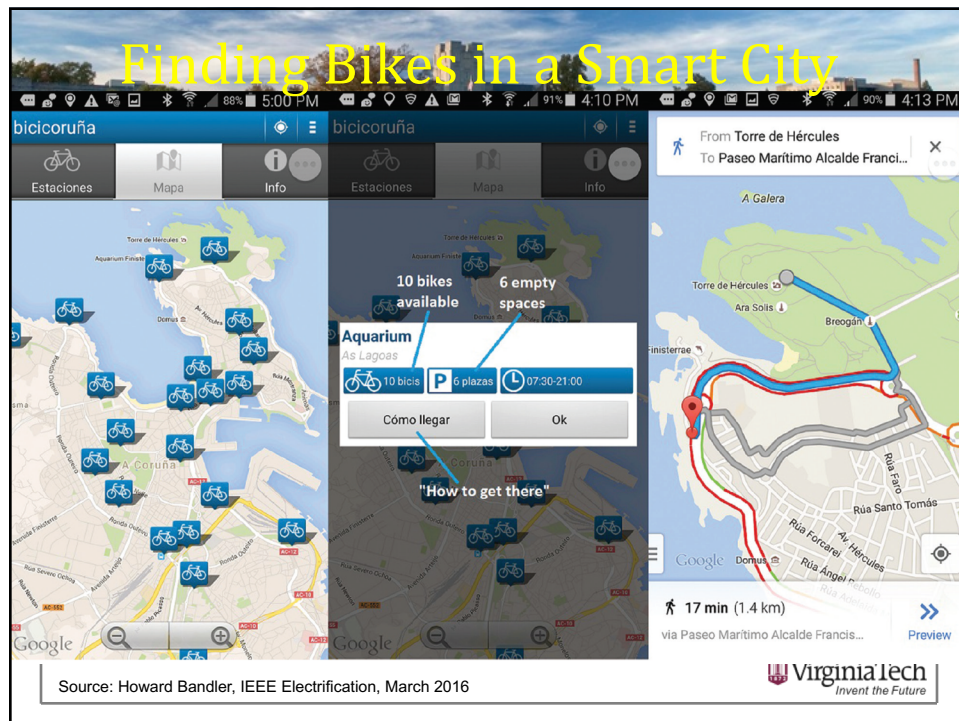
VirginiaTech
Invent the Future

Smart Trash Cans in Baltimore, USA



VirginiaTech
Invent the Future






Smart City Examples

Santander, Spain

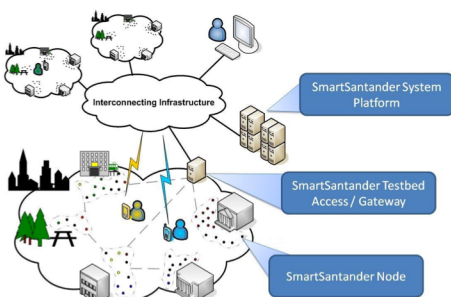

- Living experimental laboratory smart city
- 10,000 sensors located around downtown
 - Attached to street lamps, poles, building walls, beneath the asphalt of parking lots.
- Sensors data collection from:
 - Traffic, environment, weather, and people.
- Smart phone applications makes the data available to citizens
 - Real-time transit information, culture event schedules, tourist sightseeing information, and retail offers.









Santander, Spain

Pictures from:
<http://www.smartsantander.eu/>
<https://www.bloomberg.com/news/articles/2013-05-16/spains-santander-the-city-that-runs-on-sensors>

 **VirginiaTech**
Invent the Future



Thank You!



Professor Saifur Rahman
Director, Advanced Research Institute
www.saifurrahman.org