Smart City and IoT

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IoT in Smart City

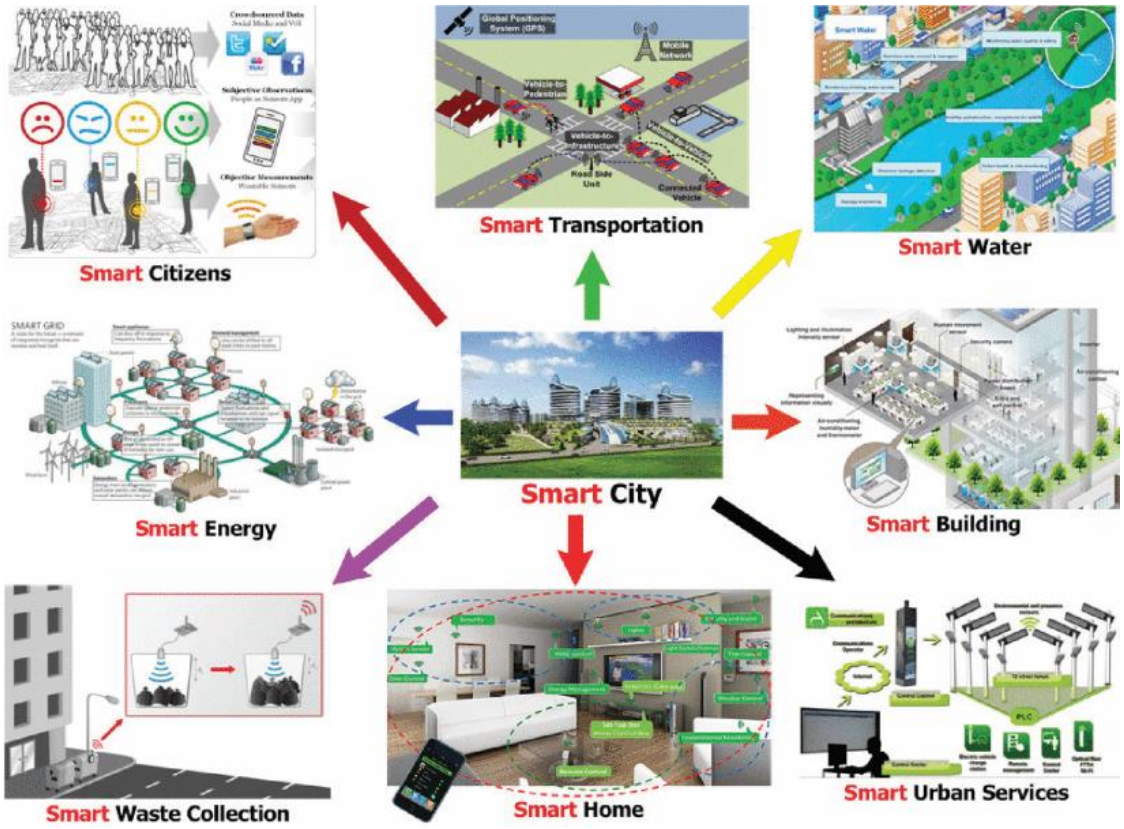


Fig: Various smart city applications

Smart Transportation: Smart Vehicle, Sask transit, City services, In a smart city, optimization of schedule for public transport can be done with IoT.

Smart Energy: Smart grid applications, energy data pertaining to the grid, commercial buildings, and residential premises.

Smart Building: Educational Institutions, Office space, parking, apartments, building security.

Smart Home: Optimized Indoor heating, ventilation and air conditioning (HVAC) system, remote appliances control, managed electricity reduction.
(https://www.forbes.com/sites/forbestechcouncil/2017/08/31/the-future-is-now-five-smart-building-features-transforming-todays-workplace/#33d27b332235)

W. Li, H. Song and F. Zeng, "Policy-Based Secure and Trustworthy Sensing for Internet of Things in Smart Cities," in IEEE Internet of Things Journal, vol. 5, no. 2, pp. 716-723, April 2018

IoT in Smart City – Use Case

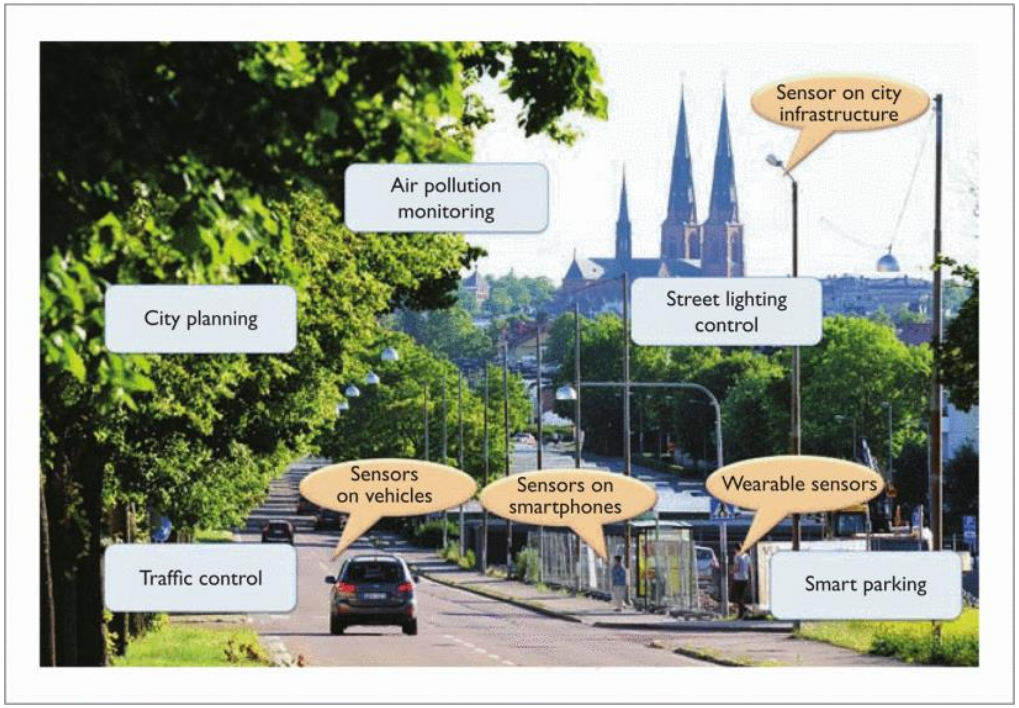


Fig: An IoT system that includes heterogeneous sensors to collect data for smart city development. (Photo provided courtesy of Bengt Ahlgren.)

- Using smartphones and smart meters to regulate energy consumption in the Hyllie smart networks of Malmö, Sweden. The system enables people to measure, monitor, control, and influence their own energy consumption, and be able to independently produce renewable energy (for example, by using solar panels). One way to optimize the use of renewable energy and reduce costs is to decide how and when you want to charge your electric car. Consumers are informed of the supply of renewable energy in the system and how much electricity costs via smartphones or tablets. (*Climate-Smart Hyllie - Testing the Sustainable Solutions of the Future*, 2013, [online] Available: http://malmo.se/download/18.760b3241144f4d60d3b69cd/1397120343885/Hyllie+klimatkontrakt_broschyr_EN_2013.pdf)
- In Amsterdam, a network-enabled LED street-lighting system has been developed to reduce the city's energy consumption and costs. ("Connected Lighting System", 2014, [online] Available: www.newscenter.philips.com/main/standard/news/press/2014/20140327-philips-gives-workers-smartphone-control-of-office-lighting-with-groundbreaking-connected-lighting-system.wpd#.VL46kS5rNow.)
- In the US, Cisco and a wide range of public and private stakeholders in Chicago have been driving smart community initiatives to improve neighboring services and the quality of life.(https://www.chicago.gov/city/en/progs/env/smart-grid-for-a-smart-chicago.html)

B. Ahlgren, M. Hidell and E. C. -. Ngai, "Internet of Things for Smart Cities: Interoperability and Open Data," in IEEE Internet Computing, vol. 20, no. 6, pp. 52-56, Nov.-Dec. 2016.

IoT in Smart City – Use Case

Watch the video parking system:
https://www.cleverciti.com/en/verticals/city
https://vimeo.com/359783234?from=outro-embed
https://www.nominet.uk/creating-a-smart-parking-system-using-our-iot-tools/
https://www.nwave.io/japa-parking-smud-project-using-nwave-technology/

Simpler Parking examples:
https://www.parkhelp.com/parkhelp-installs-ultrasonic-system-at-localiza-headquarters-in-brazil/
https://www.parkhelp.com/parkhelps-ultrasonic-pgs-becomes-part-of-piramide-shopping-center/
https://www.parkhelp.com/

Investment on smart parking Canada:
https://www.cbc.ca/news/canada/london/world-s-first-automatic-electric-vehicle-parking-system-london-ontario-1.5247537
https://www.traffictechnologytoday.com/news/funding/canadian-funds-worlds-first-fully-automated-pick-up-parking-system.html

Sensors:
https://canada.newark.com/smart-parking-solutions-the-iot-sensors-space-race

Smart traffic management system:
https://www.digi.com/blog/post/smart-traffic-management-optimizing-spend

IoT in Smart City – Use Case

Smart traffic control:
https://ouster.com/industry/smart-infrastructure/

Saskatoon Based company developing traffic management system:
https://www.irdinc.com/

City in Germany uses camera for traffic management:
https://www.youtube.com/watch?v=j79offP5evc

Useful example of Intelligence Traffic System (ITS):
https://www.youtube.com/watch?v=dS4pWnNlxfA

Some smart city components:
https://www.trafficsafetystore.com/blog/how-iot-technology-is-creating-the-future-smart-cities/

IEEE Standards Impact Smart City Technology

IEEE Standards Help Enable Smart City Technologies for Humanity

Smart Grid
IEEE 1547™ Series DER
IEEE 1815™ Distributed Network Protocol
IEEE 2030™ Series Interoperability
IEEE C37™ Series Grid Critical Infrastructure

Intelligent Transportation
IEEE 1609™ Series Wireless Access Vehicle Environment
IEEE 1901™ Series Power Line Communications (PLC)
IEEE 802.15.4p™ WPAN Rail Communications and Control
IEEE 1512™ Emergency Management System

eHealth
IEEE 11073™ Series Medical Devices
IEEE 139™ RF Emission from ISM Equipment
IEEE 602™ Healthcare Facilities
IEEE 1363™ Series Encryption

Energy Efficiency
IEEE 1801™ Low Power, Energy Aware Electronic Systems
IEEE P1889™ Electrical Performance of Energy Saving Devices
IEEE P1823™ Universal Power Adapter for Mobile Devices
IEEE P1922.1™-IEEE P1929.1™ Series for Energy Efficient Systems

Internet of Things (IoT)
IEEE P2413™ IoT Architecture
IEEE 1588™ Precision Time Stamp
IEEE 1451™ Series Sensor Networks
IEEE P1451-99™ Harmonization of IoT Devices and Systems

5G
IEEE P1914.1™ Fronthaul
IEEE P1918.1™ Tactile Internet
IEEE 802® LAN/MAN
IEEE P1915™-IEEE P1921.1™ Series Software Defined Networks

Cyber Security
IEEE P802E™ ePrivacy
IEEE 1363™ Series Encryption
IEEE 1402™ Physical Security
IEEE 1686™ Intelligent Electronic Devices (IEDs)

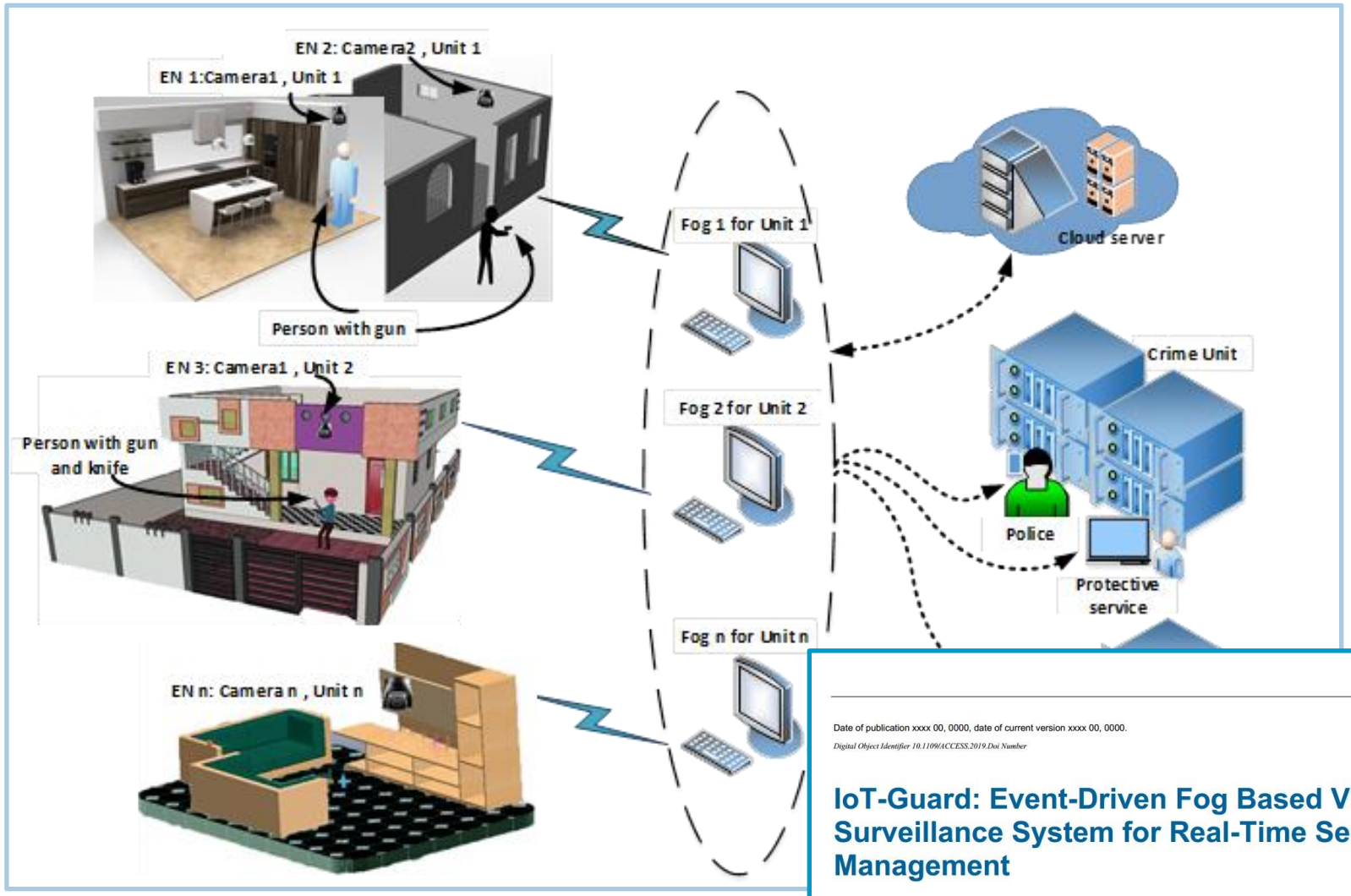
eGovernance
IEEE P7002™ Data Privacy Process
IEEE P7004™ Child and Student Data Governance
IEEE P7005™ Transparent Employer Data Governance
IEEE P7006™ Personal Data Artificial Intelligence (AI) Agent

Smart Home
IEEE 802® LAN/MAN
IEEE 1901™ Series PLC
IEEE 1905.1™ Home Network for Heterogeneous Technologies
IEEE 2030.5™ Smart Energy Profile

Learning Technologies
IEEE 1484™ Series eLearning Technologies
IEEE 1278™ Series Distributed Interactive Simulation
IEEE 1516™ Series Modeling and Simulation
IEEE 1730™ Series Distributed Simulation Engineering and Execution Process

IEEE-SA Internet of Things Standards & Certification - Sri Chandrasekaran, Senior Director – Standards & Technology

Smart City: IoT-Guard



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Date of publication xxxx 00, 0000, date of current version xxxx 00, 0000.

Digital Object Identifier 10.1109/ACCESS.2019.Doi Number

IoT-Guard: Event-Driven Fog Based Video Surveillance System for Real-Time Security Management

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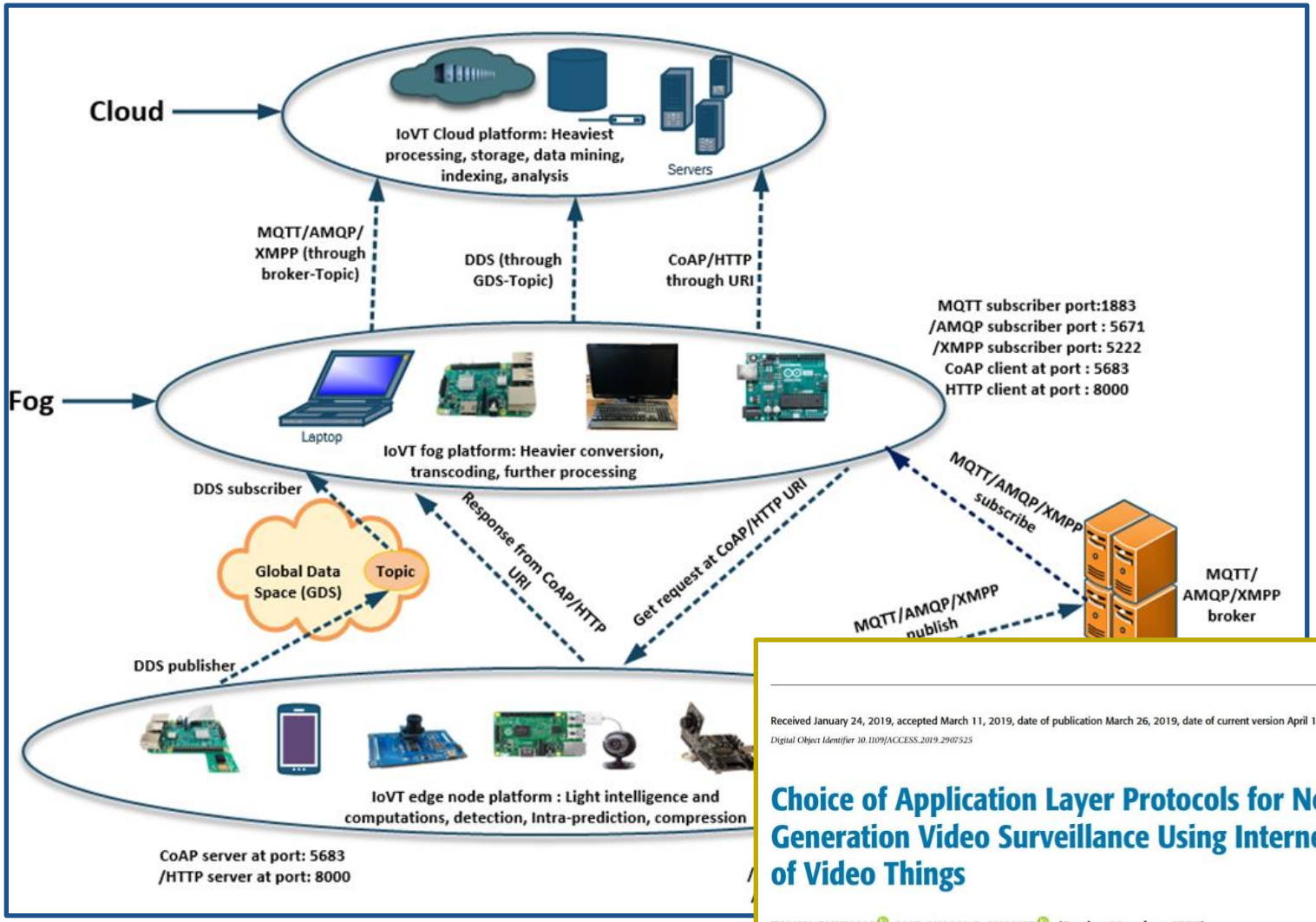
This work was supported in part by The Natural Sciences and Engineering Research Council of Canada (NSERC) and in part by The Canada First Research Excellence Fund (CFREF).

Smart City: Video Surveillance



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Received January 24, 2019, accepted March 11, 2019, date of publication March 26, 2019, date of current version April 12, 2019.

Digital Object Identifier 10.1109/ACCESS.2019.2907525

Choice of Application Layer Protocols for Next Generation Video Surveillance Using Internet of Video Things

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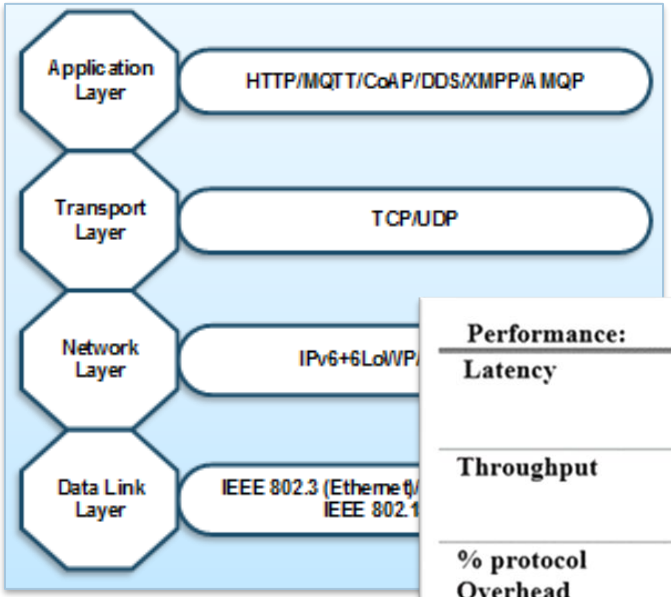
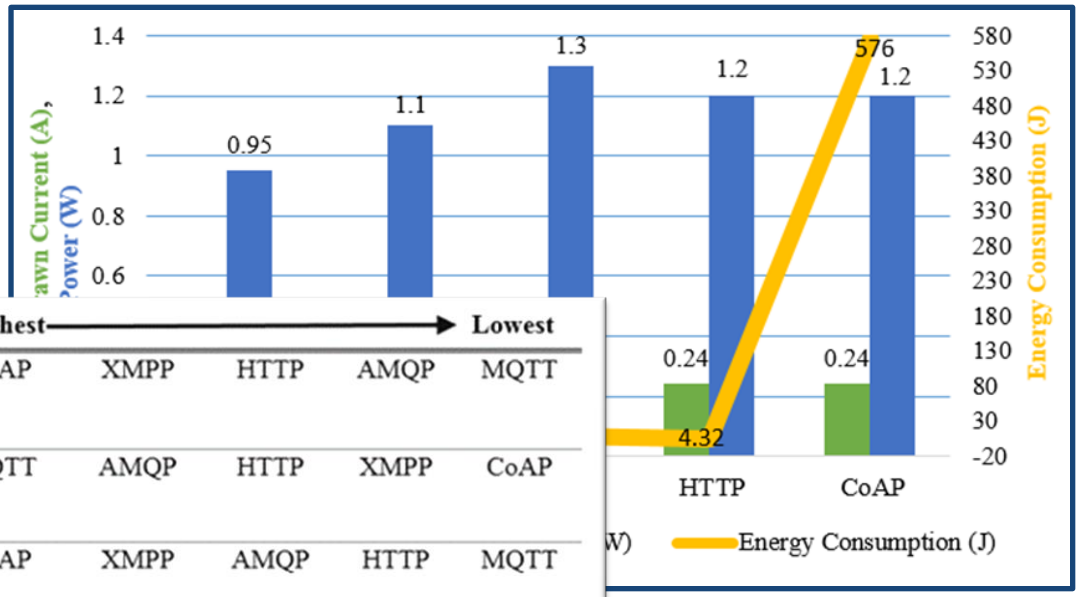
This work was supported in part by the Natural Sciences and Engineering Research Council of Canada (NSERC), and in part by the Canada First Research Excellence Fund (CFREF).

Smart City: Video Surveillance





Performance:	Highest → Lowest				
Latency	CoAP	XMPP	HTTP	AMQP	MQTT
Throughput	MQTT	AMQP	HTTP	XMPP	CoAP
% protocol Overhead	CoAP	XMPP	AMQP	HTTP	MQTT
%CPU usage	AMQP	CoAP	MQTT	HTTP	XMPP
%Memory usage	XMPP	AMQP	CoAP	MQTT/ HTTP	MQTT/ HTTP
BW (bits/s) consumption	HTTP	XMPP	AMQP	MQTT	CoAP
Energy consumption (J)	CoAP	XMPP	HTTP	AMQP	MQTT

Smart City: IoT-Guard

(a)

(b)

(c)

Fig. IoT-guard detection accuracy on real-world CCTV footage/image

Smart City: COVID-SAFE

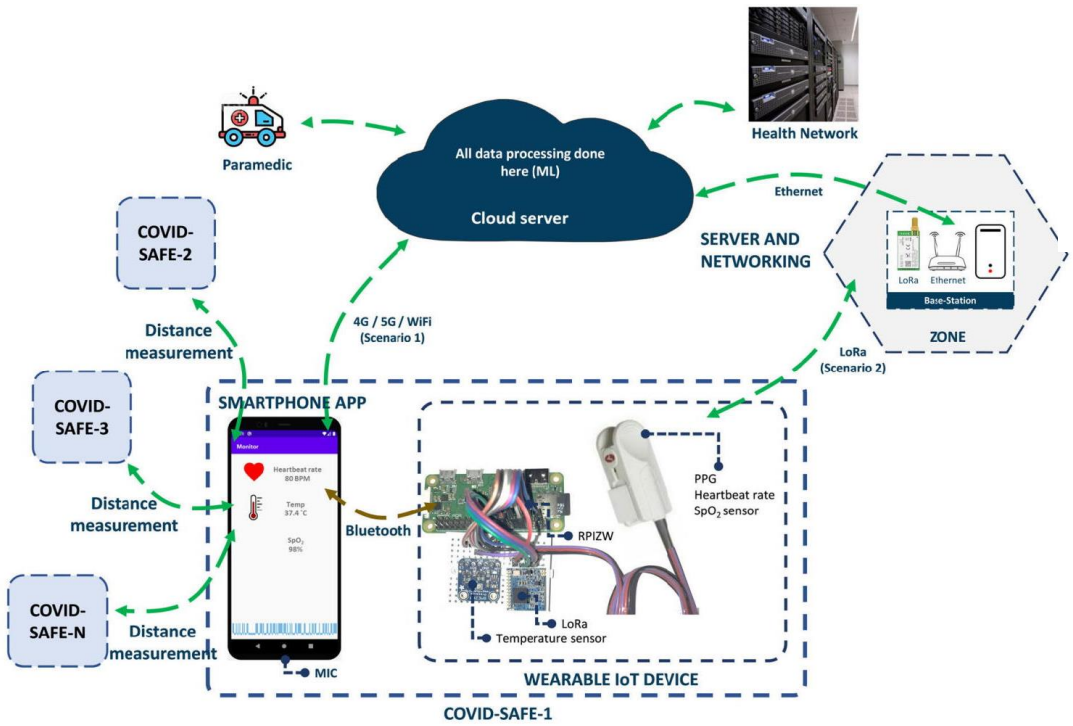


FIGURE 1. High-level architecture of COVID-SAFE framework, in which COVID-SAFE-1 is carried by the user and COVID-SAFE-2 - N belong to adjacent people.

FIGURE 2. COVID-SAFE application which is connected to fog server based on predefined API, a) login menu b) general information page c) radar dashboard d) health monitoring menu and e) individual risk factor.

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Received October 4, 2020, accepted October 6, 2020, date of publication October 12, 2020, date of current version October 27, 2020.

Digital Object Identifier 10.1109/ACCESS.2020.3030194

COVID-SAFE: An IoT-Based System for Automated Health Monitoring and Surveillance in Post-Pandemic Life

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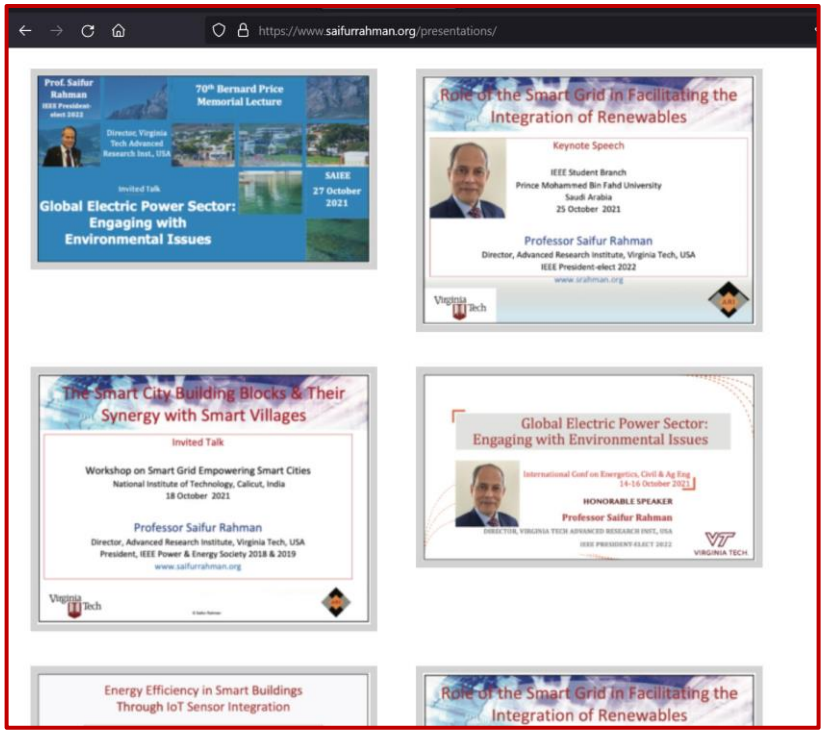
This work was supported by the Natural Sciences and Engineering Research Council of Canada (NSERC).

Smart City Resources

- Presentations by Prof. Saifur Rahman, 2022 IEEE President-Elect, Virginia Tech
  https://www.saifurrahman.org/presentations/



- IEEE Smart Cities
  - https://smartcities.ieee.org/

- Online course by MIT Media Lab
  Beyond Smart Cities: Emerging Design and Technology

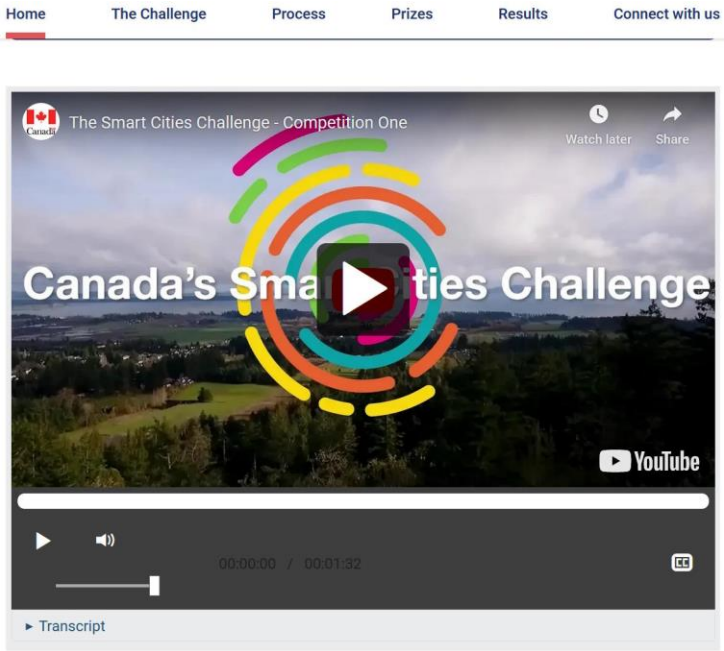
- AT&T Business:
  - Smart cities and communities

Infrastructure Canada: Smart Cities Challenge

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

- Meet the finalists:
- https://www.infrastructure.gc.ca/cities-villes/profiles-profils-eng.html

- The Economist: Transforming cities with technology
  - https://www.youtube.com/watch?v=hRY-ZUlJXY0



CME466 – Group Project Presentation (up to 20%)

- Students will form “Group of 3 or 4” – January 26, 2024
- Research Smart city initiatives and projects from posted materials and internet sites
- Propose one project that can be part of a smart city – (February 16, 2024)
  - Must include all main parts of an IoT system (edge sensors, wireless communication, server, user/public, ML/AI component)
  - Tell us using system level (and functional) block diagrams how the system works
    - Add some details on all parts (e.g., sensor/node type, availability and cost, type of communication, components/software/infrastructure needed, what are the best alternatives, etc.)
  - How the proposed system will solve current issues/problems in the city
  - Major roadblocks to implement the system
  - More to be added later as we progress…
  - You do not need to implement the system
- Make a final presentation to the class – TBD (likely towards end of term)

Acknowledgement

NSERC CRSNG

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Thank
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