Green ICT Technologies for Smart Cities

Pr. Mohamed Cheriet, P.Eng, Ph.D
Canada Research Chair on Sustainsble Smart Eco-Cloud

École de technologie supérieure, Montréal, Québec

Laboratory for Multimedia Communication in Telepresence
Sustainable Smart Cities as Innovation & Prosperity Enabler

- “A smart sustainable city is an innovative city that uses ICT and other means to improve quality of life, efficiency of urban operation and services, and competitiveness” – ITU Definition

- Steps to build a smart city
  - Establishment of smart infrastructure: living labs, innovation networks
  - Clear skills gap: education programs, industrial partnerships
  - Well developed business models: monetize data, financing models
  - Governance: optimized governance models
  - Making smart city inclusive: multidisciplinary, gender sensitive
Design principles:

- People-Centered and Inclusive Infrastructure
- Resilience and Sustainability
- Interoperability and Flexibility
- Managing Risks and Ensuring Safety
ICT Enabling Technologies for Sustainable Smart Cities

- **Technology 1: Smart Sensing**
  - Capture: movement, environmental quality, force, acceleration, flow, position, light etc

- **Technology 2: City-wide communications**
  - Both fixed and mobile; licensed and unlicensed cellular networks; low power communications (LoRa, NB-IoT, LTE-M).

- **Technology 3: Cloud computing**
  - Storage, analytics, economic scalability, access anywhere, anytime, high performance, reliability

- **Technology 4: Big data**
  - IoT is King, Big data is Queen and Cloud is Palace

- **Technology 5: Artificial Intelligence (AI)**
  - Automate the management of city and make it more efficient

- **Technology 6: Security & Privacy**
  - Communication encryption, authentication & key, role-based authorization, blockchain
QI - Smart City Framework
Opensky Intelligent Life Lab

ÉTS
Le génie pour l’industrie
ERICSSON
VIDEOTRON
QUARTIER DE L’INNOVATION
Big Picture

Data extraction
Visualization
Modelling
Optimization

Application providers
TCSEP Platform
Green Cloud

ENDUSERS

AppIoT Platform

Bus station
Lachine Canal
Student rooms
Public space

LoRa
X-TELIA
VIDÉOTRON

VIDÉOTRON
WIFI SON + Internet GIGA

Smart Grid
ETS

Smart Water

Smart Air

Smart Heating

Smart Assistant

Statistics
Control
Monitor
Innovate
Big Picture
University as a Hub model

- Pub
- 100 genies
- Synchromedia Lab
- Résidence de l’ÉTS
- Habitat Évolutif
- Toronto (SAVI)
- Videotron/Quebecor
- Ericsson/Vaudreuil-Dorion
- Quartier de l’Innovation
Platform 1: Open Sensing Data Network

- Enabling R&D for a variety of applications
  - Smart utility: through temperature, humidity and user behavior analytics, develop new algorithms to save energy consumption (e.g., garage door control of buildings)
  - Environmental health: analyzing the impacts of environmental indicators on human health (e.g., stress, productivity, behaviors)
  - Positioning and localization: spotting lost objects, directions, etc.
Platform 2: Open next-generation communication network

- WiFi SON (Videotron/ETS)
  - Self-Configuration (plug and play)
  - Self-Optimization (auto-tune)
  - Self-Healing (auto-repair)

- Picocell (Ericsson/Videotron)
  - Increase coverage
  - Increase bandwidth
  - Lower latency

- Public LoRa network (ÉTS)
  - Low-power, long distance
  - Publicly accessible to all IoT objects
  - Additional service: localization, spotting

- LiFi (Videotron/GlobalLiFi)
  - Internet access via visible light
  - Ultrahigh security and speed
  - Low-power consumption
**Platform 3: Open cloud infrastructure**

- **Synchromedia cloud (ÉTS)**
  - Based on Green Sustainable Telco Cloud & GreenStar Network & SAVI
  - Featuring software-defined networking (SDN) and network function virtualization (NFV)
  - Green and awareness

- **Ericsson AppIoT**
  - The Application Platform for Internet of Things
  - Calculations based on device sensors
  - Acting on data
  - Analyzing the data
Platform 4: Big data analytics

- New data analytics techniques
  - Reconstruction of incomplete data
  - Complex event processing (CEP)
  - Fuzzy clustering and real-time classification
Platform 5: Artificial intelligence

- Various models developed by many partners
  - Ericsson: B2B AI model
  - Synchromedia: AI platform for cloud and IoT network management
  - NyX-R: Environmental pollution learning
  - Evey: User experience learning and adaptation
  - etc.
Platform 6: Smart City Security & Privacy

- **Ericsson Data-Centric Security**
  - Blockchain Trust-as-a-Service
  - Sign and verify documents & IoT data
  - Protect devices and softwares

- **Synchromedia SDN security**
  - Protect cloud and networks
  - Optimize firewall placement
  - Real-time access control
Though…. Fundamental key success

Networked Smart Infrastructure for Smart Cities

- **Networked infrastructure for innovations**
  - Looking beyond the Internet
  - Multiple, federated sites
  - Share experiences, data, technologies
  - Identify exciting, challenging research Problems

- Bridging successful cyberinfrastructures:
  - CANARIE, GENI, Internet2, etc…
THE UPCOMING Quebec-Windsor Corridor (ENCQOR)

- Virtual mobile test corridor following the Quebec to Windsor route
  - Utilize available test frequencies
- Connect and extend university test beds such as Aurora, SAVI and GreenStar Networks
- Utilize key technologies developed in Canada
  - Cloud, LTE, Small Cells, WME, CCIC, Broadband, etc.
Thank you!