Making Smart City Automation and City Infrastructure More Intelligent One Smart Technology at a Time

Glenn Buck, RCDD
Agenda

- Smart city and smart building technology
- Components and implementation
- Industry grids included in the integration
- Service provider benefits to the consumer
- Summary
US Smart City Global Market

$ 5.71B in 2016
$31.74B by 2022

70% of World Population Living in Urban Environments by 2050
(With a population growth of 7.6B to nearly 10B)

Source: UN DESA, UN World Urbanization Prospects

The smart city industry is projected to be a $400 billion market by 2020, with 600 cities worldwide...

https://www.researchgate.net/publication/305183838_Smart_cities_and_the_Internet_of_Things
Smart City Technology

- A smart city uses IoT sensors, actuators and technology to connect and power components across the city
- It impacts every layer of a city, from underneath the streets, to the air that citizens breath
- Data from all segments are analyzed and patterns are derived from the collected data
Smart City Driving Forces

- Sensor technology – tiny, low quality, variety
- Low quality miniature computers
- Low power connectivity
- Power-over-Ethernet (PoE)
- Mobile devices
- Power of the cloud

In many Internet of Things (IoT) applications, minimizing power consumption is a key design requirement. IoT capability involves adding sensors and connectivity to a valve or similar device in a location that may not already have power available.
IoT Sensors and Actuators
Smart City Ecosystem

- Smart Manufacturing
- Smart Government
- Smart Health
- Smart Energy/Utilities

- Mobility/Wi-Fi
- Smart Citizen
- Smart Building
- Smart Transportation
Smart City Lamp Post of the Future

- Wireless Dual Band Mesh Transceiver
- App Based Wireless control
- RGBA Notification (Indicator lights)
- Digital street sign *
- Façade lighting * (Color-Changing)
- Environmental CARSIC Sensors * Seismic Sensors
- Water Detection *
- “Smart Grid” Street Light
- Photocell control
- E-logic dimming
- On-demand light levels
- Concealed Placement Speaker (CPS) in:
  - Music
  - Announcements
  - Alerts
- Image Sensor *
- Proximity sensors
- Pedestrian counter
- Digital Signage *
  - Way finding
  - Traffic direction
  - Alert notification
  - Civic information
  - Revenue generation via advertising
- Push to Talk system “Blue emergency light” *

* Optional Features

Styles from traditional to contemporary available
Government of Canada Kicks Off the Smart Cities Challenge

In November 2017, the Government of Canada challenged communities across the country to develop bold and ambitious ideas to improve the lives of their residents using data and connected technology.

Over 200 communities from across Canada submitted their innovative ideas. An independent panel of 13 jury members evaluated these submissions based on the criteria set out in the Applicant Guide. On June 1, 2018, twenty finalists were announced to go on to the next step of the Challenge. Each finalist community receives a $250,000 grant to help it develop its final proposal.

Throughout October 2018 to February 2019, the Smart Cities Challenge team visited each finalist community.

**Feel safe and secure**
The neighbourhood in our community with the highest crime rate will become safer than the national average.

**Earn a good living**
After years of decline, our community will transform a former industrial neighbourhood into one of the top locations in Canada for economic growth.

**Enjoy a healthy environment**
Our community will implement preventative measures to reduce flood damage risk by 40 percent and provide every resident of at-risk areas with access to these measures.

**Be empowered and included in society**
Our community will ensure that every person without a home has access to nightly shelter, and will connect 100 percent of vulnerable residents with the services, activities and programs that are known to reduce the risk of homelessness.
Through the Smart Cities Challenge we hope to:

- **REALIZE OUTCOMES FOR RESIDENTS**
  Because the Smart Cities Challenge is all about achieving outcomes, it will be vital for communities to measure where they are starting from, when they are making progress, and when they have achieved success. Establishing a baseline and measuring results will be central to doing this.

- **EMPOWER COMMUNITIES TO INNOVATE**
  Communities should take risks and think big, identity significant, pressing, and perceived “un-solvable” problems, and achieve outcomes through data and connected technology.

- **FORGE NEW PARTNERSHIPS AND NETWORKS**
  Communities will need to undertake meaningful engagement with residents and forge relationships with new and non-traditional partners.

- **SPREAD THE BENEFIT TO ALL CANADIANS**
  Smart cities approaches should not only benefit a single community; they should be scalable and replicable across Canada.
<table>
<thead>
<tr>
<th>$5M Prize Category</th>
<th>$10M Prize Category</th>
<th>$50M Prize Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Wig Neg'haa-beg (Pic River First Nation), Ontario</td>
<td>Town of The Pas, Opaskwayak Cree Nation, Rural Municipality of Kelsey, Manitoba</td>
<td>Waterloo Region, Ontario</td>
</tr>
<tr>
<td>Cree Nation of Eastmain, Quebec</td>
<td>City of Côte Saint-Luc, Quebec</td>
<td>Quebec City, Quebec</td>
</tr>
<tr>
<td>Town of Bridgewater, Nova Scotia</td>
<td>Nunavut Communities, Nunavut</td>
<td>City of Guelph and Wellington County, Ontario</td>
</tr>
<tr>
<td>Mohawk Council of Akwesasne, Quebec</td>
<td>Saint Mary’s First Nation and City of Fredericton, New Brunswick</td>
<td>City of Edmonton, Alberta</td>
</tr>
<tr>
<td>City of Yellowknife, Northwest Territories</td>
<td>Parkland, Brazeau, Lac Ste Anne and Yellowhead Counties, Alberta</td>
<td>City of Saskatoon, Saskatchewan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>City of Surrey and City of Vancouver, British Columbia</td>
</tr>
</tbody>
</table>
Smart Buildings

- Smart Buildings are a Microcosm of Smart Cities
- Smart Campus
- Smart Neighborhood
- Smart City
Smart City/Building Technology
Smart Building Technology

PoE++ LED Lighting  Video Phones  Thermostats  Door Access

Digital Signage  Thin Clients  IP Combo Security Cameras  Monitor Displays

Power and Data over the Same Infrastructure
Smart Building Technology

Environmental Sensor  Controller Sensor  Motion Sensor  IR/Occupancy Sensor  Smoke/CO Sensor

Meeting  Lab Zones  Break-Out zones

Desk Zones

Building Layer

Exits  Kitchen
WC  WC’s
Corridors
Lifts  Lobby
Accent  Stairs

ICT CANADA PRESENTED BY BICSI
What is Power-over-Ethernet?
Traditional Way
What is Power-over-Ethernet? Using PoE
# PoE Hierarchy

<table>
<thead>
<tr>
<th>IEEE 802.3af PoE Type 1 Work Group</th>
<th>IEEE 802.3bt PoE Type 3 Work Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 15W at PSE</td>
<td>• 60W at PSE</td>
</tr>
<tr>
<td>• Cabling Cat3 and Cat5</td>
<td>• Doubling IEEE 802.3at</td>
</tr>
<tr>
<td>• Utilizing 4 pairs, data/power</td>
<td>• Utilizing all 4 wire pairs</td>
</tr>
<tr>
<td>• Ratification in 2003</td>
<td>• Ratification September 2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IEEE 802.3at PoE Type 2 Work Group</th>
<th>IEEE 802.3bt PoE Type 4 Work Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 30W PoE at PSE</td>
<td>• 100W PoE at PSE</td>
</tr>
<tr>
<td>• Cabling Cat5 and Cat6</td>
<td>• Utilizing all 4 wire pairs</td>
</tr>
<tr>
<td>• Utilizing 4 pairs, data/power</td>
<td>• 1 AMP on each of four pairs</td>
</tr>
<tr>
<td>• Ratification in 2009</td>
<td>• Ratification September 2018</td>
</tr>
</tbody>
</table>
## PoE and Networks

<table>
<thead>
<tr>
<th>Standard</th>
<th>IEEE 802.3af</th>
<th>IEEE 802.3at</th>
<th>IEEE 802.3bt</th>
<th>HDBaseT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>PoE</td>
<td>PoE+</td>
<td>PoE++</td>
<td>4PPoE</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>2003</td>
<td>2009</td>
<td>2003</td>
<td>N/A</td>
</tr>
<tr>
<td>Publish Date: 12/26/2018</td>
<td>Exists today</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum number of energized pairs</strong></td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Maximum DC current per pair</strong></td>
<td>350 mA</td>
<td>600 mA</td>
<td>600 mA</td>
<td>960 mA</td>
</tr>
<tr>
<td><strong>Maximum power delivered by the Power Sourcing Equipment (PSE)</strong></td>
<td>15.4 Watts</td>
<td>30.0 Watts</td>
<td>60.0 Watts</td>
<td>90.0 Watts</td>
</tr>
<tr>
<td><strong>Minimum required power at the Powered Device (PD)</strong></td>
<td>12.95 Watt</td>
<td>25.5 Watt</td>
<td>51.0 Watt</td>
<td>71.0 Watt</td>
</tr>
<tr>
<td><strong>Maximum Data Rate</strong></td>
<td>1000BASE-T</td>
<td>1000BASE-T</td>
<td>10GBASE-T</td>
<td>Varies</td>
</tr>
</tbody>
</table>
PoE Applications

15.4W 2-Pair PoE
Thin Clients | Biometric Access Control | 802.11n

30W 2-Pair PoE+
RFID Readers | PTZ IP Cameras | Video IP Phones | Alarm Systems

60W 4-Pair UPoE (2011)
Laptops | PTZ IP Cameras with Heaters | Information Kiosks

60W 4-Pair PoE (2017)
Access Controls | Point of Sales | Nurse Call | 802.11ac

100W 4-Pair PoH (2011)
Computers | TV | Video Conferencing | High Power Wireless

100W 4-Pair PoE (2017)
Computers | Televisions | Video Conferencing | High Power Wireless
PoE Lighting is One of the Biggest Opportunities in the ICT Industry

- Connects via common category twisted-pair cabling
- Average number of devices per 10,000 sq. feet is 115
- Extra-low voltage (SELV) application; no safety risk
- Provides strategic placement for advanced sensor technologies and other devices (e.g. speakers)
- Supports future Li-Fi where wireless data is sent via light beams
- Receives centralized back-up power from the telecom room
- LED technology supports different colors to indicate different status for security purposes or aesthetics
Spectrum image looks distorted. Can we remove if not useful?
Stacy May, 3/20/2019
Digital Building: Power & Data

- Eliminated batteries in sensors, alarms and emergency exit signs for reduced TCO

Source: Legrand
Smart Energy Management

Energy Management Platform

• Enables tenants and property managers to control energy usage and costs
  o Wireless platform
    – WAP meshed network all floors
    – Wireless sensed occupancy HVAC thermostats
    – Sensor based lighting and occupancy
    – Energy savings automated blinds and door access
    – Cloud-based EMS portal (real-time/historical energy usage)
    – Allows tenant control to balance energy
    – Text/email alerts
• Becoming more common in hotels, universities, office buildings, MDU’s
Smart Energy Management

Smart Thermostats/Lighting

- Allow temperature to drift based on real-time occupancy
- The thermostat serves as a router, which sends and receives its own data to and from the server, and routes the data to and from other smart devices
- Processes data and forwards to an EMS platform
  - EMS analyzes the data and issues commands to the smart thermostat with the goals of saving energy, improving efficiency and elevating resident/guest experience
  - The thermostat then routes these commands to the HVAC unit and to other smart devices

EMS Data Accessible via Desktop, Tablet or Phone
PoE – Commercial Building Applications

PoE Infrastructure

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Lighting</td>
<td>389</td>
</tr>
<tr>
<td>Phone, Client, Monitor</td>
<td>192</td>
</tr>
<tr>
<td>Display</td>
<td>16</td>
</tr>
<tr>
<td>Occupancy Sensors</td>
<td>89</td>
</tr>
<tr>
<td>WAP</td>
<td>107</td>
</tr>
<tr>
<td>Shade Control</td>
<td>40</td>
</tr>
<tr>
<td>Security Camera</td>
<td>12</td>
</tr>
<tr>
<td>Access Controls</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>853</strong></td>
</tr>
</tbody>
</table>

25,000 SQ Feet

222'-10"

112'-9"
Data Analytics’ Future Unlocked

**Analyze, Predict, Optimize**

- Operations and management processes
  - Automation, security, standards, policies

- Connectivity and telecommunications
  - Fiber, WiFi, PoE, cellular, LPWAN, other

- Power and energy
  - Smart outlets, sensors, controls, metering

- Building infrastructure
  - Plumbing, ducting, cabling, sensors
Smart Public Safety
Smart Public Safety

- Thermal camera imaging
- Occupancy detection
- Pedestrian activity
- Crowd detection
- Traffic detection/mapping
- Sound and ballistic detection
  - Shouting within a crowd
- Data analytics
  - Vehicle behavior (e.g. Driving wrong side of road)
  - Pedestrian behavior
  - Suspicious activity
Smart Transportation
Smart City Intelligent Transportation Systems (ITS)

- Congestion monitoring
  - People and vehicle counting
- Motion and speed detection
- Automatic license plate detection
- GPS mapping
- Traffic metrics
- Live video stream – camera/server/cloud
# Smart ITS Safety/Signal Automation

<table>
<thead>
<tr>
<th>LiDAR</th>
<th>Sensors used at intersections for signal automation. Real-time visualization for mapping objects (video/audio). Look and listen for anomalies/aggressive detection.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection</td>
<td>Detects the presence of one or more vehicles, bicycles, pedestrians.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Locates objects in a zone to determine distance from a sensor, vehicle height or length.</td>
</tr>
<tr>
<td>Profiling and</td>
<td>Enables vehicle classification through accurate cloud-point measurements based on dimensions and profile.</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
</tr>
<tr>
<td>Tracking and</td>
<td>Rapid measurement tracks the displacement of an object in the sensors field of view and estimates its speed.</td>
</tr>
<tr>
<td>Speed</td>
<td></td>
</tr>
</tbody>
</table>

*Heavy construction in major cities can result in commuters spending nearly 70 hours in gridlock*
Smart Traffic

• **Smart City Parking** – integrates sensor technology into parking lots as a way to save citizens time and manage space
  o Reduces commuter time
  o Better space management
  o Virtual payment methods

• **Smart Traffic Strategies** - cities and towns want to cut down on traffic by monitoring and controlling traffic lights and alerting drivers of traffic patterns

*Commuters looking for available parking in major cities contributes to 30% of traffic congestion in cities*
Smart Parking

Monument Sign
Located at entrance to show how many parking spaces are available on each level of parking garage
Smart Parking

**Sensors** – Cameras watch spaces and indicate all available/open spots

**Green** – open, **Red** – occupied, **Blue** – open handicap
Smart City Key Technologies

1. Smart Energy
   - **Smart Grids/Smart Meters (Water and Power)**
     - Automatically detect outages/leaks/real-time usage and reporting
   - **Smart Street Lights**
     - Embedded sensors that monitor and respond to traffic, parking, air quality, crowds and noise
     - Energy efficient LED Lighting
   - **Building Automation**
     - Energy management, HVAC, lighting controls, occupancy detection, door access
     - Real-time and historical data collection via energy management platforms and smart apps
Smart City Key Technologies

2. Smart Network Infrastructure

- Advanced WiFi and LTE service
- City-wide small cell and DAS
- Fiber connectivity
- Intelligent “smart managed” PoE++ network switches
- Network redundancy/high availability with failover mechanisms
Smart ITS Network

- **Near Field Communications (NFC)**
  - Simple switch configuration using mobile device; intuitive for all skill levels
  - Switch can be configured prior to job dispatch and prior to powering up and connecting cables
  - Configuration can be quickly duplicated across multiple units for deployments of more than one switch

- **Bluetooth Low Energy (BLE)**
  - Remote access to switch with no scissor lift/ladder or cables required
  - Monitoring, troubleshooting and changes can be made prior to leaving job site
Smart City Key Technologies

3. Smart Data
Analyze, Predict, Optimize

• Open data portals for cities to publish online; use of predictive analytics to assess future patterns
  o Well being
  o Kiosks
  o Accounting
  o User interaction
  o End user apps
  o Positioning
  o Energy metering

• The collection of smart city/smart building data must support:
  o IOS tablets
  o Smartphones
  o Sensors
  o Thin clients
  o Access control, IP cameras, intrusion detection
  o Lighting
Smart City Key Technologies

4. Smart IoT Devices

Whether we like it or not, sensors and actuators in our cities are here to stay. Fusing sensor information into our daily lives and integrating it all with third party social networks will knit the fabric of society closer together, while leaving city leaders to grapple with serious privacy and security challenges.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4%</td>
<td>Increase in average annual spend on IoT from 2017 to $4.6 million</td>
</tr>
<tr>
<td>86%</td>
<td>Expect that number to increase in the next 1-2 years</td>
</tr>
<tr>
<td>49%</td>
<td>Expect their IoT investment to increase by 11-20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>55%</td>
<td>Have an IoT vision and are currently executing their IoT plans</td>
</tr>
<tr>
<td>38%</td>
<td>Currently have company-wide deployments</td>
</tr>
<tr>
<td>30%</td>
<td>Of remaining companies plan to deploy IoT company-wide in the future</td>
</tr>
</tbody>
</table>

SOURCE: ZEBRA TECHNOLOGIES 2018 INTELLIGENT ENTERPRISE INDEX PUBLISHED OCTOBER 31, 2018
Internet of Things (IoT) Connected Devices Installed Base Worldwide from 2015 to 2025 (in billions)

This statistic shows the number of connected devices (Internet of Things: IoT) worldwide from 2015 to 2025. For 2020, the installed base of Internet of Things devices is forecast to grow to almost 31 billion worldwide. The overall Internet of Things market is projected to be worth more than one billion U.S. dollars annually from 2017 onwards.
Components and Implementation
The Future of Retail

IoT is transforming retail by enhancing the shopping experience and making retail more efficient.

TELUS Fleet Tracker

GEOTrac Fleet by TELUS

eCompliance - EHS Management Software for Compliance & Reporting

ProntoForms Mobile Forms Solution

Public Transportation Wi-Fi

Snowplow Fleet Management

Building HVAC Energy Management

Smart Security Solutions for Educational Institutions

Digi SafeTemps for Transportation

SafetyAware Lone Worker Safety Solution

ICT Canada Presented by Bicsi
Smart Building Integrated Ecosystem

Quality of Visitor/Tenant Experience
- Maintenance
- Janitorial
- Security
- Parking
- Lighting

Productivity and Efficiency
- Ridesharing, etc.
- Managed services
- EV charging
- Content

Economic Development
- Air quality
- Traffic Mgmt.
- Safety alerts
- Emergency Mgmt.

Visitor/Tenant Safety
- Microservices
- Personalized ergonomics
- Wayfinding

Sustainability

Mobility

Health

Innovation and Services Enablement
- Building Driven Services
- Externally Provided Services
- City/Community Created Services
- Tenant Created Services

Data, Analytics and Intelligence

Operations and Management processes
- (Application Development, Tools, Deployment)
- (Integration, automation, cybersecurity, standards, policies and support)
- (HVAC, AV, lighting, energy, security, safety, digital)
- (Fiber, Wi-Fi, Cellular, LPWAN, Others)

Building Subsystems
- (Distribution Smart “On/Off”, POE, USB-C DE, I/O, HVAC, Sensors, Controls)

Connectivity and Telecommunications – Internal/External
- (Plumbing, cabling, ducting, sensors, etc.)

Power & Energy - Distribution/Sensors/Controls

Source: TIA
Smart Building/City Activities

Smart Buildings Collaboration

Key 2018 Activities:
- Development of Reference Architecture, Assessment & Certification for Smart Buildings
- Movement towards training, auditing, and certification partnerships
- CABA, NAA, & Safer Buildings Coalition for cross-industry collaboration
- MOUs with other Alliances on shared technology
- GCTC Action Cluster Group
  - US Ignite, NIST, GSA on Smart Buildings to Smart Cities
- oneM2M – potential IoT & cybersecurity

Source: TIA
Challenges and Opportunities

• Multiple Technologies and Vendor Platforms
  o Integration is key to a useful and successful smart city/building platform
    – Physical infrastructure
    – Network systems
    – HVAC, AV, lighting
    – Security
    – Software apps
    – Operations and management processes

*Who’s responsible to lead, integrate and own the project(s)*
# Operating Model Employed for Cities for Smart City Solutions

<table>
<thead>
<tr>
<th></th>
<th>Build, Own, Operate (BOO)</th>
<th>Build, Operate, Transfer (BOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The smart city planner independently builds the city infrastructure and delivers smart city services. The operation and maintenance of the services is fully under the planner's control.</td>
<td>The smart city planner appoints a trusted partner to build the city infrastructure and provide smart city services for a particular area within a time period. After completion, the operation is handed over to the smart city planner.</td>
</tr>
<tr>
<td>2</td>
<td>The smart city planner appoints a trusted partner to develop the city infrastructure and services. The partner operates and manages the smart city services. The city planner has no role further. Most of the public-private partnerships are built on this model.</td>
<td>The city planner allows any qualified company or business organization to build city infrastructure and provide city services. The city planner, however, will impose some regulatory obligations.</td>
</tr>
<tr>
<td>3</td>
<td>Build, Own, Manage (BOM)</td>
<td>Open Business Model (OBM)</td>
</tr>
</tbody>
</table>
Take the Road And Drive

Who’s Ready to Drive and Lead?

- RCDD’s, RPTM’s, OSP designers
- Building owners or architects
- Engineering consultants/planners
- Telecom design engineers
- City/state government planners
- Service providers

The opportunity is available and NOW is the time!
Thank You!