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)
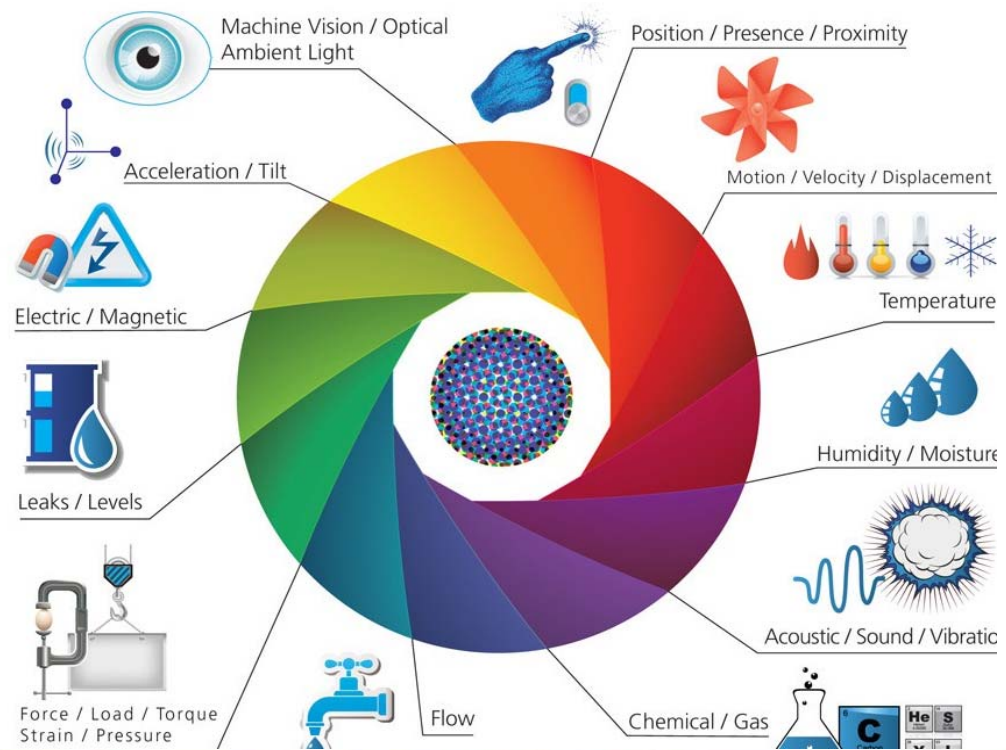- Mobile devices
- Power of the cloud

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
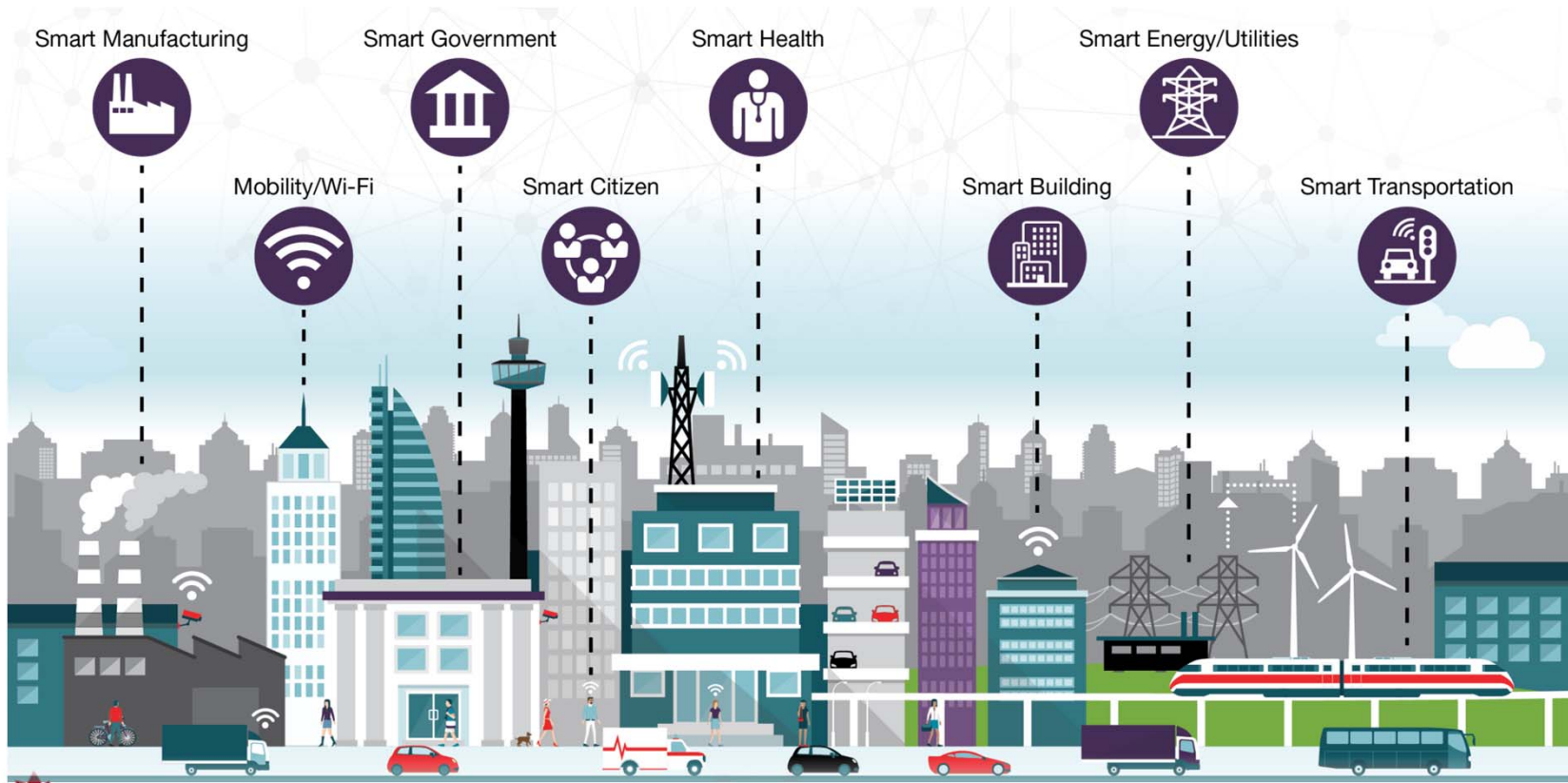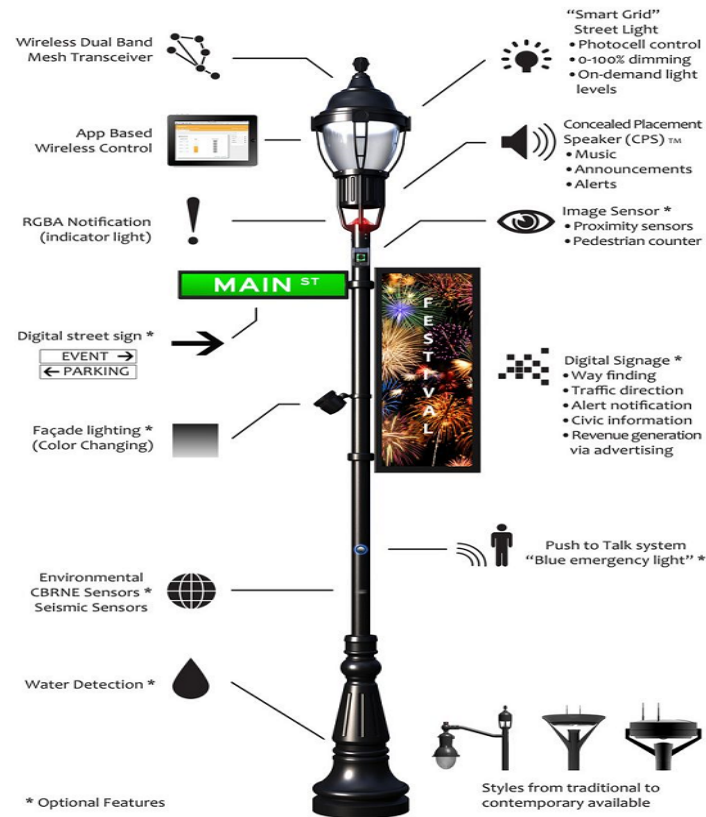
IoT Sensors and Actuators

Image from IoT Infographic

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

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, identify 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.

$5M Prize Category	$10M Prize Category		$50M Prize Category
Biigtigong Nishnaabeg (Pic River First Nation), Ontario	Town of The Pas, Opaskwayak Cree Nation, Rural Municipality of Kelsey, Manitoba	City of Airdrie and Area, Alberta	Waterloo Region, Ontario
Cree Nation of Eastmain, Quebec	City of Côte Saint-Luc, Quebec	City of Richmond, British Columbia	Quebec City, Quebec
Town of Bridgewater, Nova Scotia	Nunavut Communities, Nunavut	City of Guelph and Wellington County, Ontario	City of Edmonton, Alberta
Mohawk Council of Akwesasne, Quebec	Saint Mary's First Nation and City of Fredericton, New Brunswick	City of Saskatoon, Saskatchewan	City of Surrey and City of Vancouver, British Columbia
City of Yellowknife, Northwest Territories	Parkland, Brazeau, Lac Ste Anne and Yellowhead Counties, Alberta	Greater Victoria, British Columbia	Montréal, Quebec

Smart Buildings

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

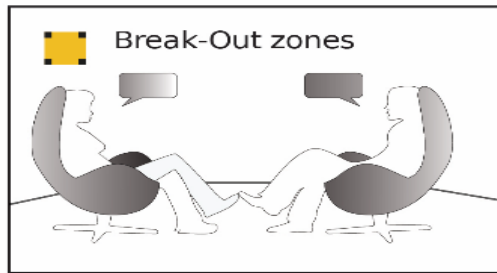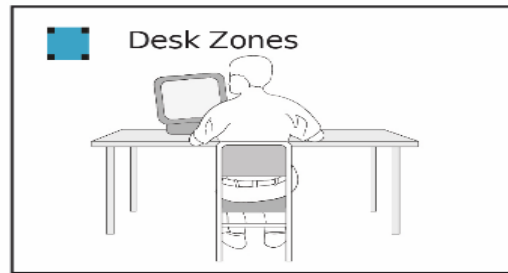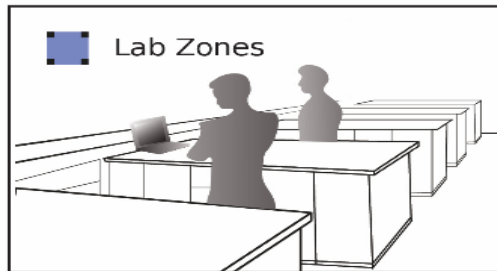**Environmental Sensor**   **Controller Sensor**   **Motion Sensor**   **IR/Occupancy Sensor**   **Smoke/CO Sensor**

- Meeting
- Lab Zones
- Desk Zones
- Break-Out zones

Building Layer

→	Exits	🍴	Kitchen
WC	WC's	⊠	Corridors
⬆	Lifts	👤	Lobby
▲	Accent	📶	Stairs
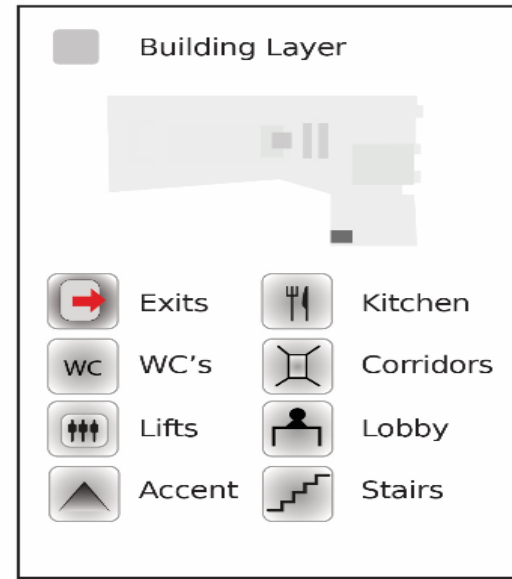
What is Power-over-Ethernet?
Traditional Way

What is Power-over-Ethernet?
Using PoE

PoE Hierarchy

IEEE 802.3af PoE Type 1 Work Group

- 15W at PSE
- Cabling Cat3 and Cat5
- Utilizing 4 pairs, data/power
- Ratification in 2003

IEEE 802.3at PoE Type 2 Work Group

- 30W PoE at PSE
- Cabling Cat5 and Cat6
- Utilizing 4 pairs, data/power
- Ratification in 2009

IEEE 802.3bt PoE Type 3 Work Group

- 60W at PSE
- Doubling IEEE 802.3at
- Utilizing all 4 wire pairs
- Ratification September 2018

IEEE 802.3bt PoE Type 4 Work Group

- 100W PoE at PSE
- Utilizing all 4 wire pairs
- 1 AMP on each of four pairs
- Ratification September 2018

PoE and Networks

Standard	IEEE 802.3af	IEEE 802.3at	IEEE 802.3bt		HDBaseT
	PoE	PoE+	PoE++	4PPoE	PoH
Type	1	2	3	4	N/A
Status	2003	2009	Publish Date: 12/26/2018		Exists today
Maximum number of energized pairs	2	2	4	4	4
Maximum DC current per pair	350 mA	600 mA	600 mA	960 mA	1000mA
Maximum power delivered by the Power Sourcing Equipment (PSE)	15.4 Watts	30.0 Watts	60.0 Watts	90.0 Watts	>100W
Minimum required power at the Powered Device (PD)	12.95 Watt	25.5 Watt	51.0 Watt	71.0 Watt	>100W
Maximum Data Rate	1000BASE-T	1000BASE-T	10GBASE-T		Varies

PoE Applications
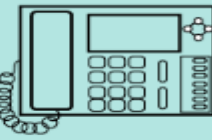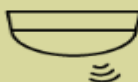
PoE Lighting is One of the Biggest Opportunities in the ICT Industry

- Connects via common category twisted-pair cabling

- Average number 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
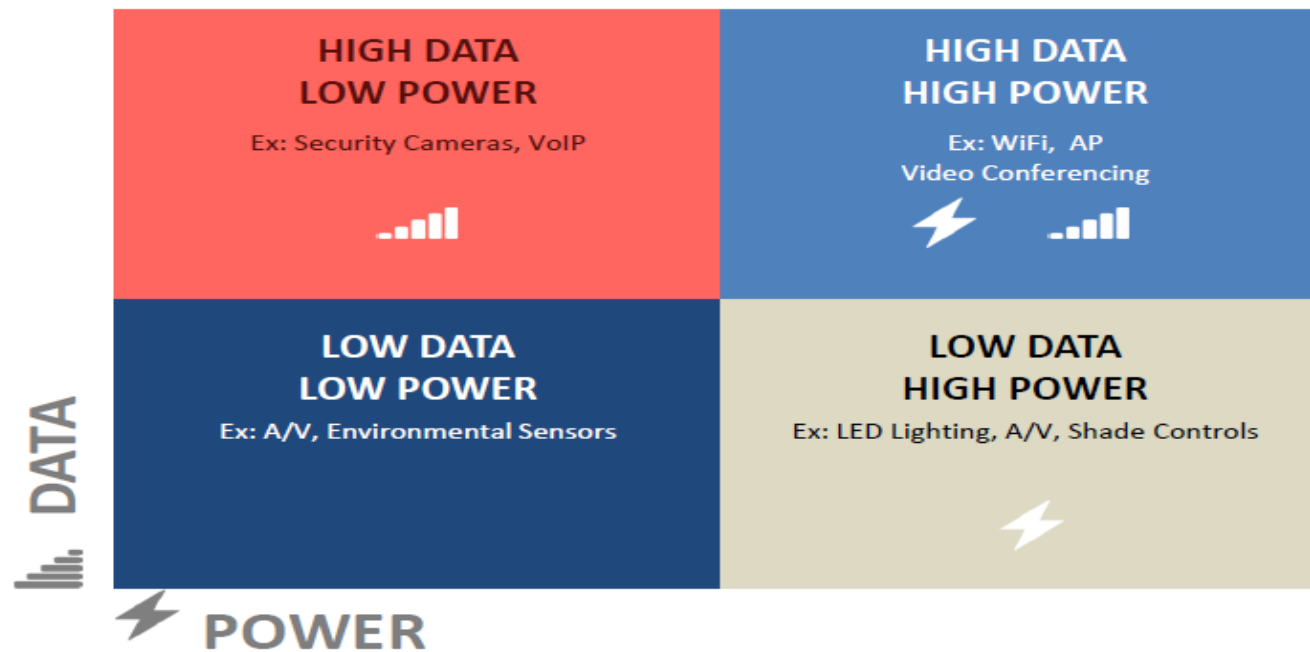
SM3

Source SIEMON

SM3

Spectrum image looks distorted. Can we remove if not useful?

Stacy May, 3/20/2019

Digital Building: Power & Data

| HIGH DATA LOW POWER Ex: Security Cameras, VoIP	HIGH DATA HIGH POWER Ex: WiFi, AP Video Conferencing
LOW DATA **LOW POWER** Ex: A/V, Environmental Sensors	**LOW DATA** **HIGH POWER** Ex: LED Lighting, A/V, Shade Controls

DATA

POWER

- 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
  - 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
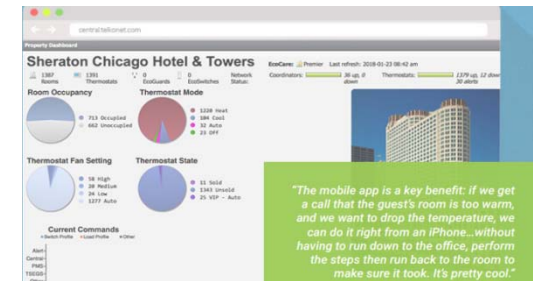
Smart Energy Management

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
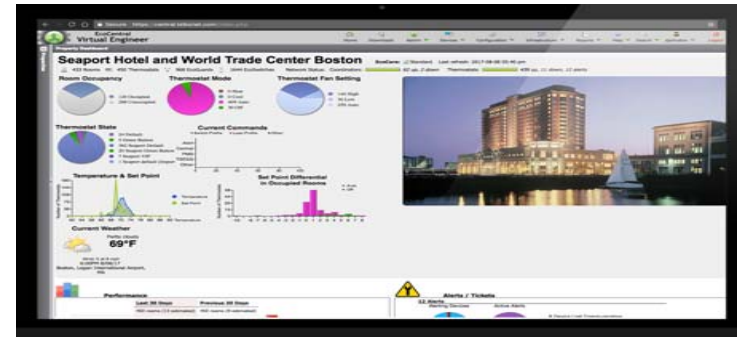
EMS Data Accessible via Desktop, Tablet or Phone

PoE – Commercial Building Applications

PoE Infrastructure

🟪	LED Lighting	389
🟩	Phone, Client, Monitor	192
🟧	Display	16
🟨	Occupancy Sensors	89
🟥	WAP	107
🟦	Shade Control	40
🟦	Security Camera	12
🟪	Access Controls	8
	Total	**853**

25,000 SQ Feet

112'-9"

222'-10"
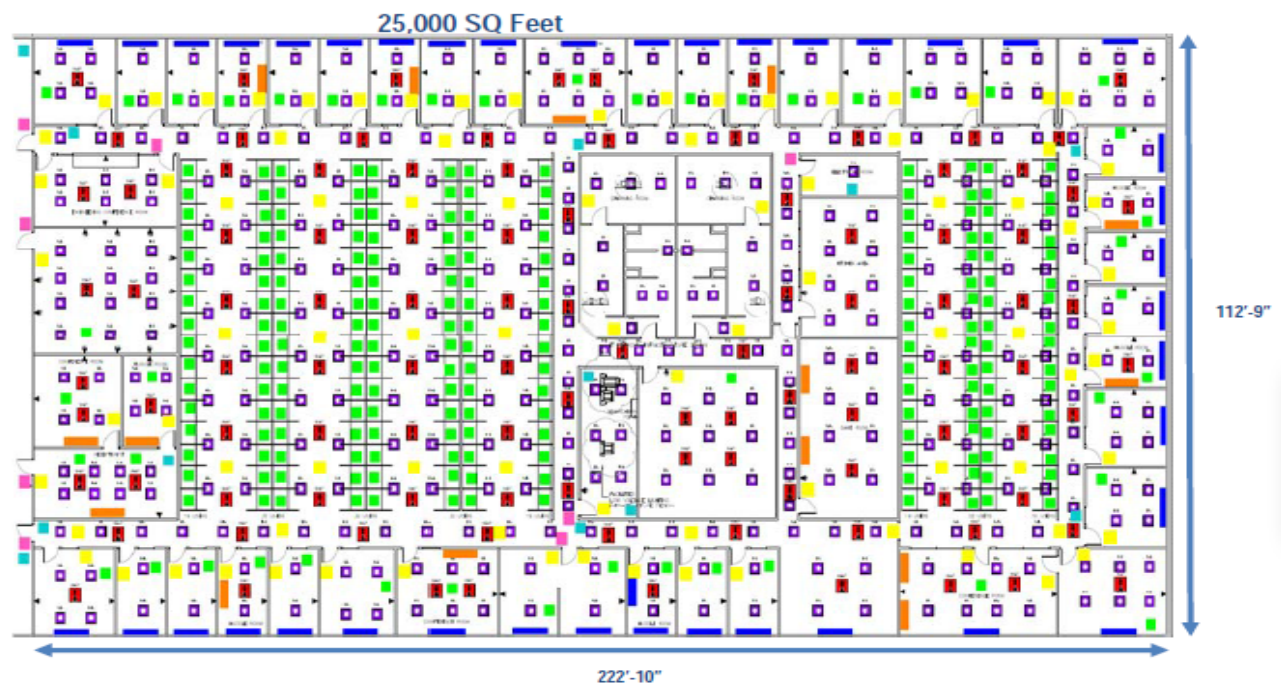
Data Analytics' Future Unlocked

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
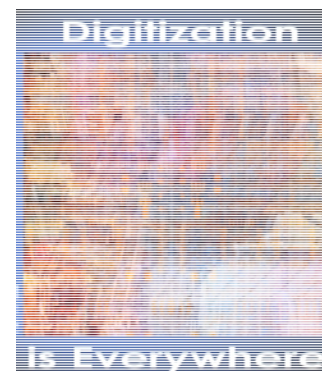
Smart Public Safety

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
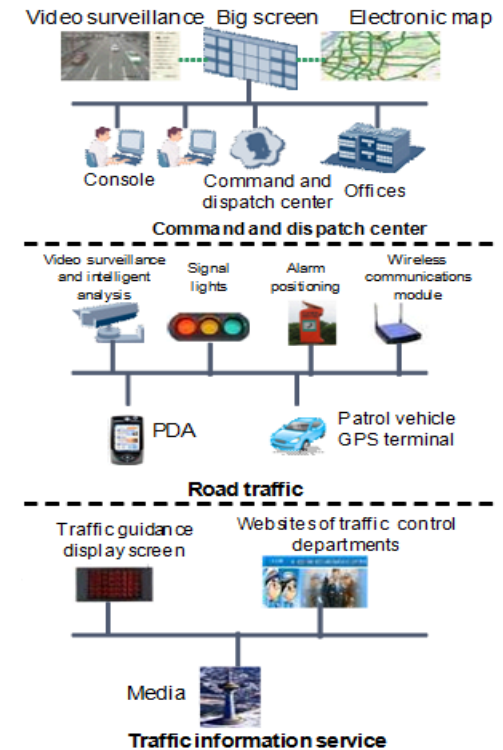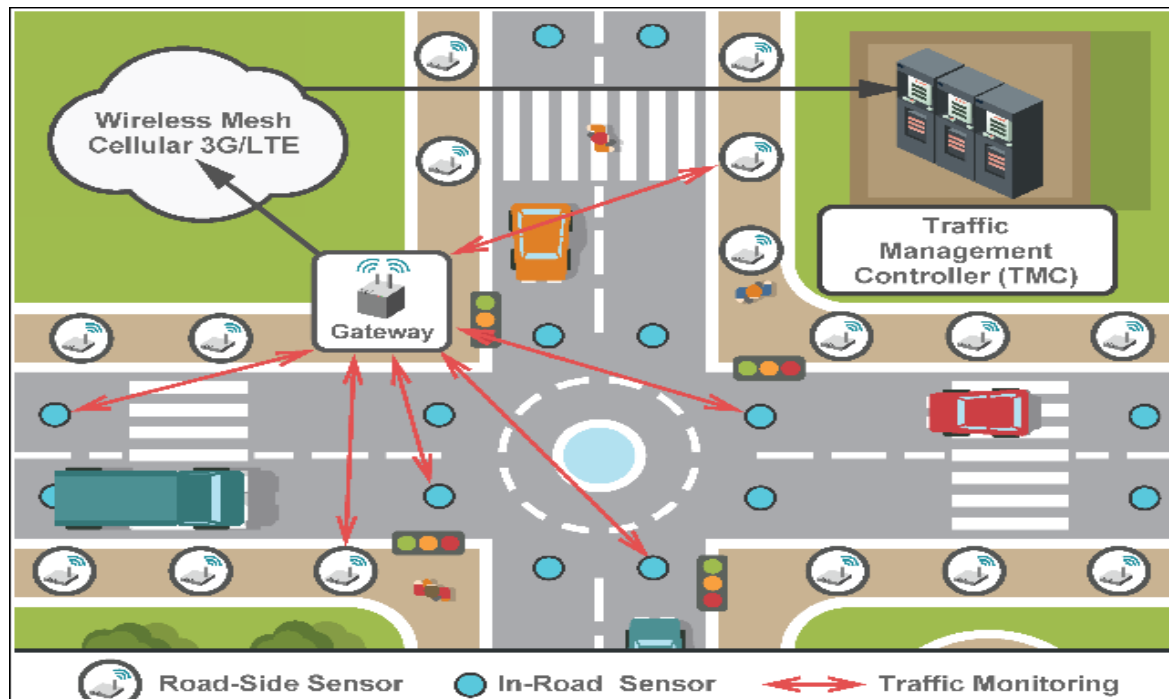
Smart City Intelligent Transportation Systems (ITS)

- 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

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

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
  - Reduces commuter time
  - Better space management
  - 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
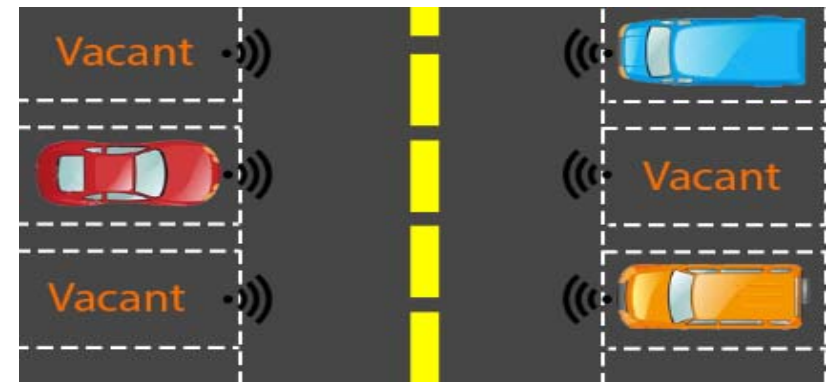
Commuters looking for available parking in major cities contributes to 30% of traffic congestion in cities
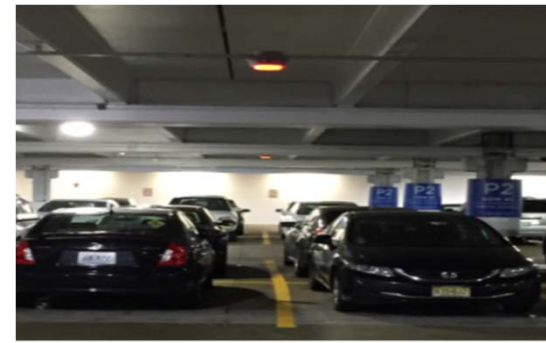
Smart Parking

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
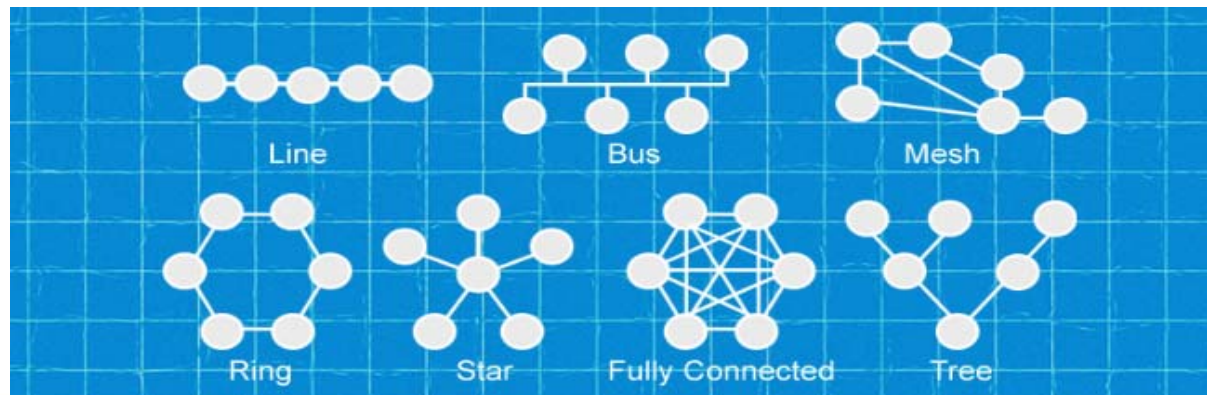
Smart ITS Network

- **Near Field Communications (NFC)**

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

- **Bluetooth Low Energy (BLE)**

  - o Remote access to switch with no scissor lift/ladder or cables required
  - o Monitoring, troubleshooting and changes can be made prior to leaving job site

Smart City Key Technologies
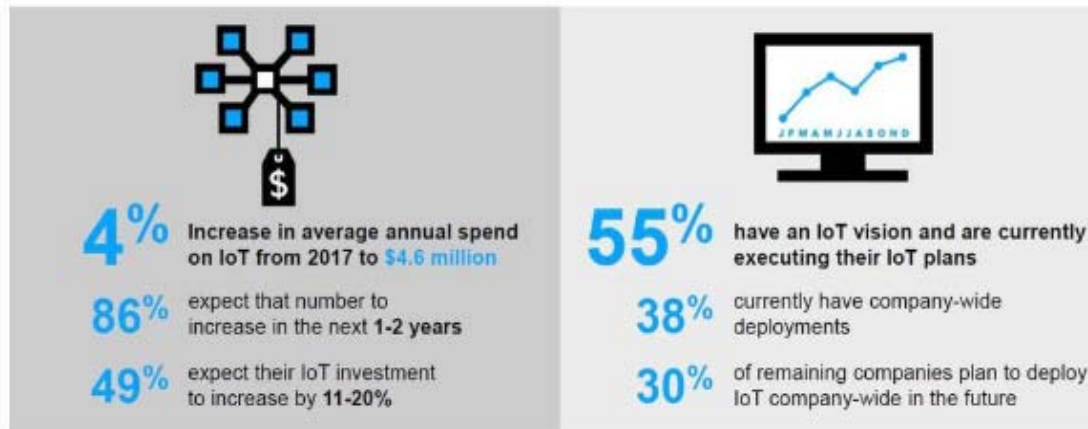
3. Smart Data

Analyze, Predict, Optimize

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

- The collection of smart city/smart building data must support:
    - IOS tablets
    - Smartphones
    - Sensors
    - Thin clients
    - Access control, IP cameras, intrusion detection
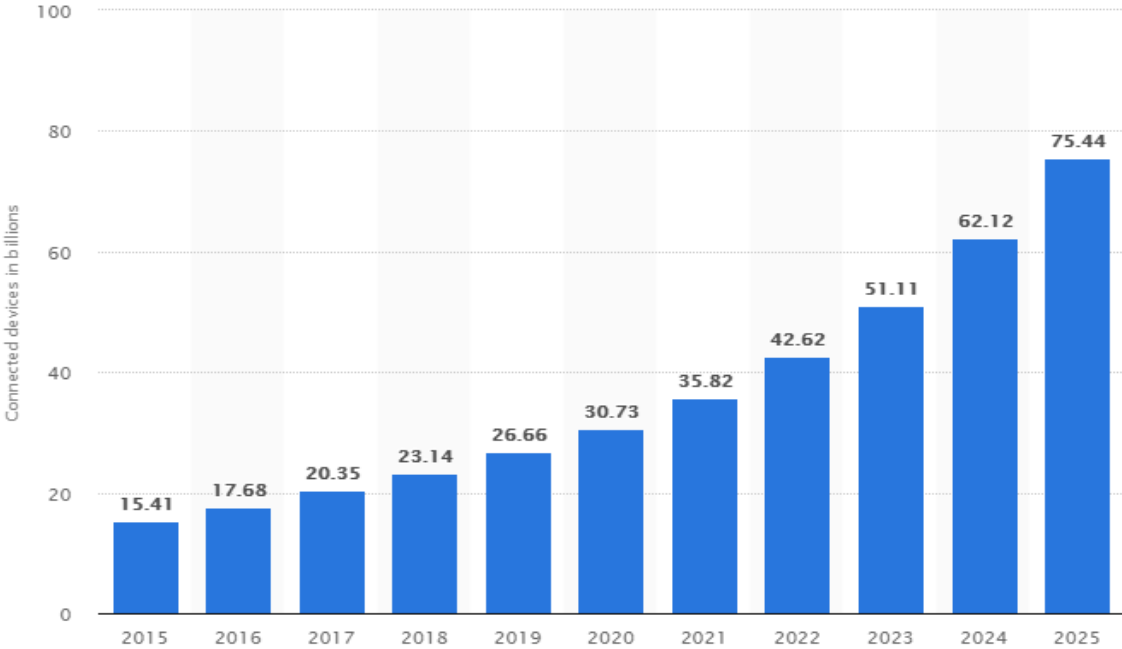   - Lighting

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.

4% Increase in average annual spend on IoT from 2017 to $4.6 million

86% expect that number to increase in the next 1-2 years

49% expect their IoT investment to increase by 11-20%

55% have an IoT vision and are currently executing their IoT plans

38% currently have company-wide deployments

30% of remaining companies plan to deploy IoT company-wide in the future

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)

Components and Implementation

TELUS IoT

The Future of Retail

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

VEHICLE STATUS ON DUTY ✓	TELUS Fleet Tracker	11 MINUTES TO LOCATION	GEOTrac Fleet by TELUS
	eCompliance - EHS Management Software for Compliance & Reporting	WORK ORDER #56 SENT TO HEAD OFFICE	ProntoForms Mobile Forms Solution
CITY LIMO WiFi STATUS ACTIVE	Public Transportation Wi-Fi	SPINNER SPEED: 100	Snowplow Fleet Management

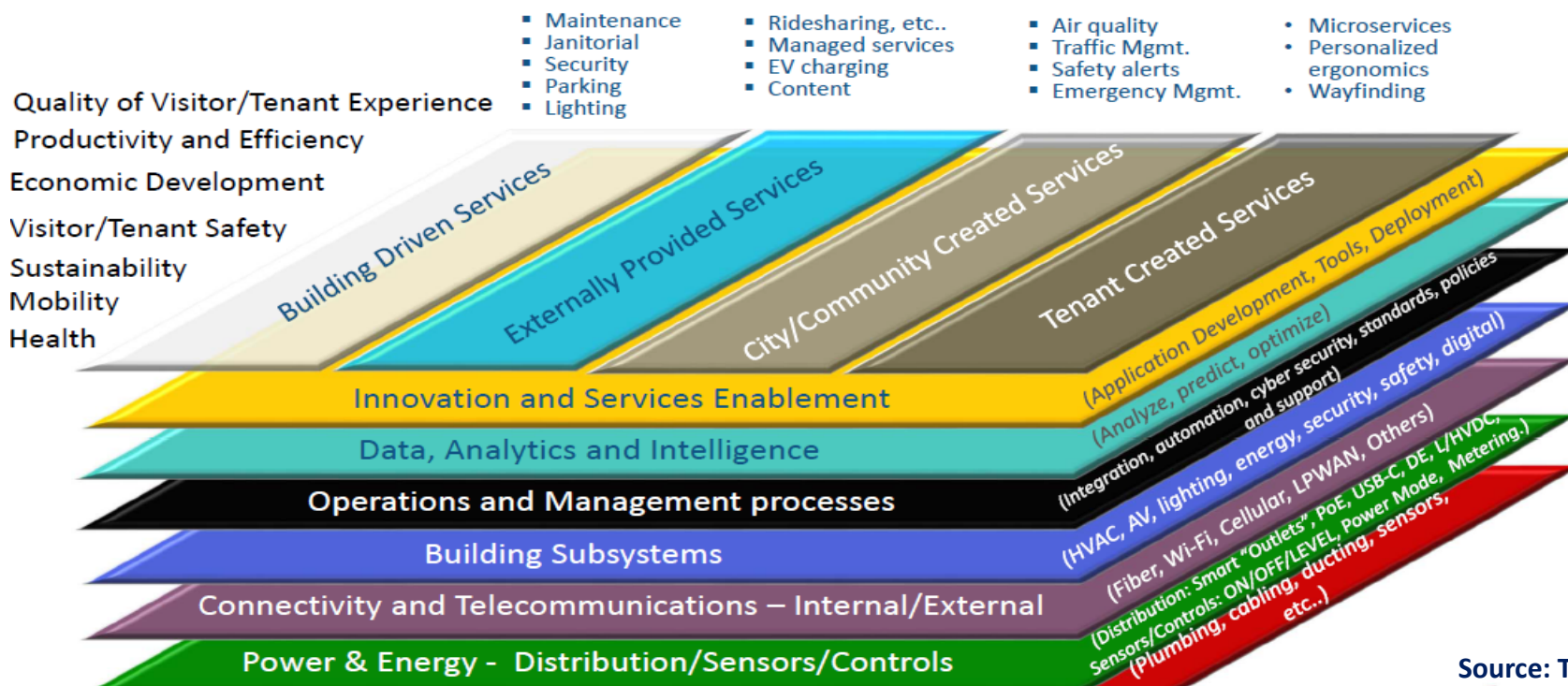|			
ALERT! OBSTRUCTED CONDENSER	Building HVAC Energy Management	STUDENT: SUSAN JONES BUILDING: HUMANITIES	Smart Security Solutions for Educational Institutions
FREEZER TEMP. -18°C	Digi SafeTemps for Transportation	EMPLOYEE STEVE BING ⚠ALERT SAFETY TIME ACTIVATED	SafetyAware Lone Worker Safety Solution
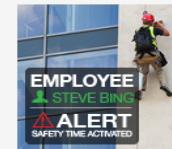
Smart Building Integrated Ecosystem

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
- Small Cell Forum joint Guide Document on Making Buildings Small Cell Ready
- 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**
    - 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

1 **Build, Own, Operate (BOO)**	**2** **Build, Operate, Transfer (BOT)**
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.	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.
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.	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.
3 **Build, Own, Manage (BOM)**	**4** **Open Business Model (OBM)**

Take the Road And Drive
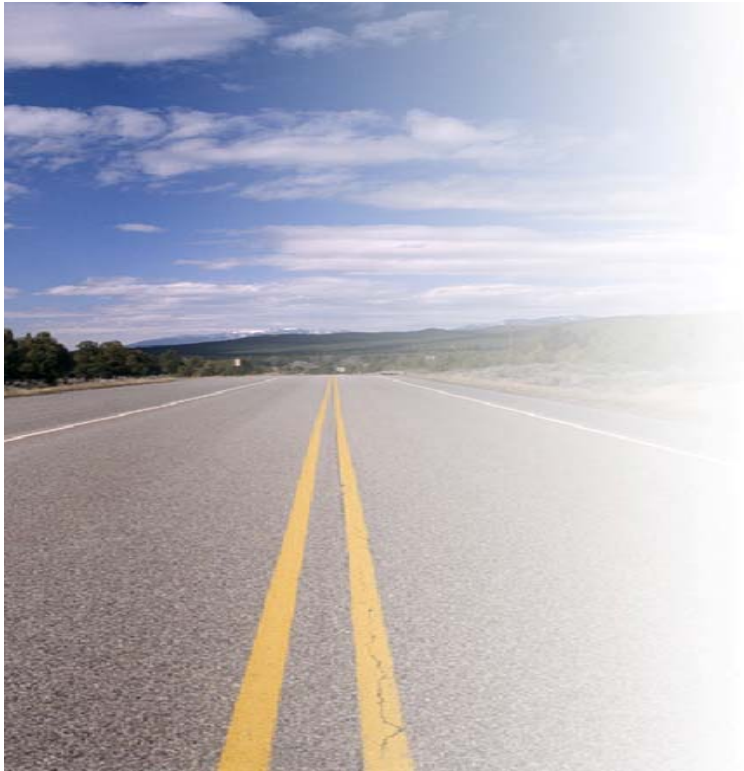
Who's Ready to Drive and Lead?

- 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!