

"Getting to Smart" Connected Cities Tour

Connectivity and Bandwidth are the oil of the Gig Economy.

Network Technologies such as: 4G/5G, IoT, Fiber, Small Cell and Wi Fi are Transforming How Society Operates.

These sessions bring together thought leaders from Government, Enterprise, Academia and the Tech Community to look at the Business Models, Technology Architectures and action plans that City and Community ecosystems are using to build Dense Broadband Infrastructure.

Be part of the Solution



www.densenetworks.com

2019 Event Schedule

January 30	Miami
February 21	Tampa
March 14	Denver
May 22	Orlando
June 13	Las Vegas
September 10	Seattle
September 18	St. Louis
October 24	Los Angeles
October 29	San Diego
November 14	New York

Connected Cities Tour "Getting to Smart" 5G, IoT, Fiber Optics, Wi Fi

Tampa Museum of Art
February 21, 2019 at 9 am to 3 pm



Jean Duncan
Director of Transportation,
City of Tampa

Presenting Sponsor: **GraybaR.**

"Getting to Smart" is a quick dose of knowledge to help you navigate in our increasingly mobile, always-on, information intensive, and SMART Society

Smart Cities and Smart Buildings will explore the technologies that are enabling digital transformation.

- 5G, IoT, DSRC, Small Cells, DAS and Wi Fi are transforming how Cities and Society Operate.
- During this one day program, we will explore how network technology is impacting Transportation, Public Safety and Real Estate.
- Tampa is one of only 3 cities approved by USDOT to conduct public Connected Vehicle trials. Learn how the pilot is progressing.
- Other panels will explore the growing need for network densification both in buildings and in public areas.

Join Industry Thought Leaders and explore Business Models, Technology Architectures and First Hand Use Cases that are driving Innovation and Disruptive Solutions.



COMCAST BUSINESS Inspire the Next WIRELESS . . . T . . . Mobile . Hotwire COMMUNICATIONS



www.densenetworks.com



**The UN predicts Global Population Growth
Greater than 30% by 2050**



The Majority will be in Cities

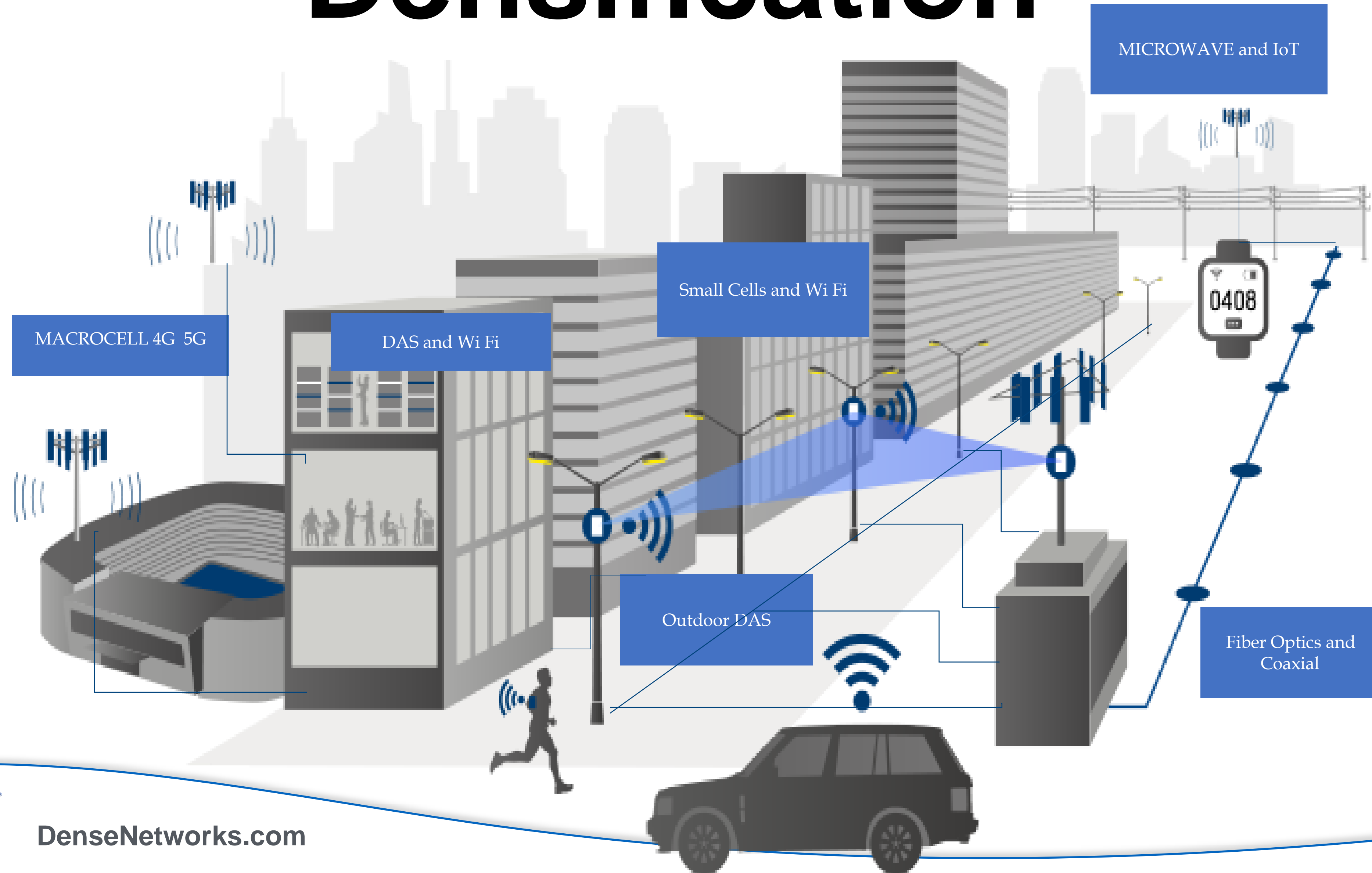


ALWAYS ON



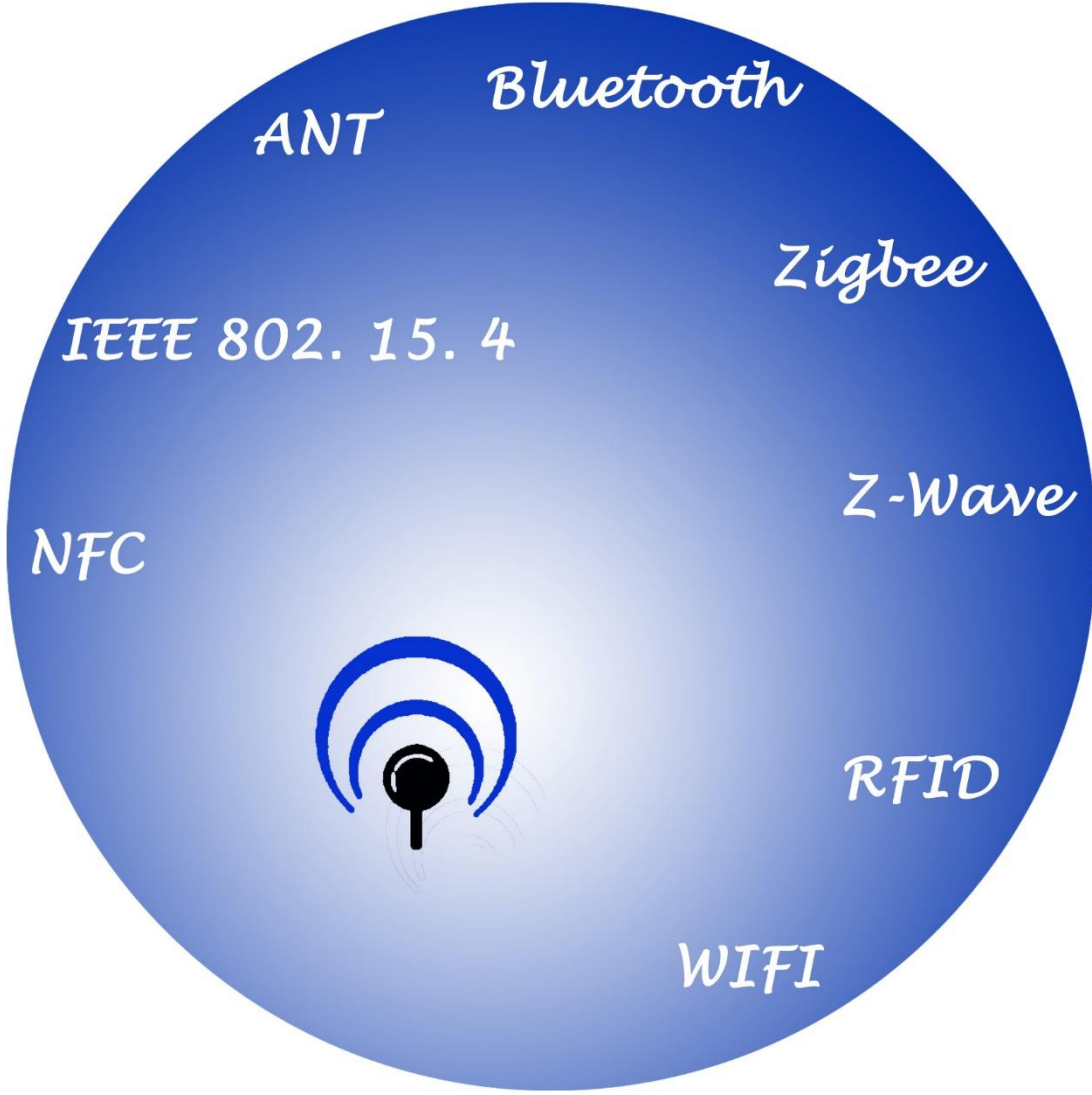
Connected City
Smart City

Densification



How Many Networks?

Capacity, Coverage, Compliance

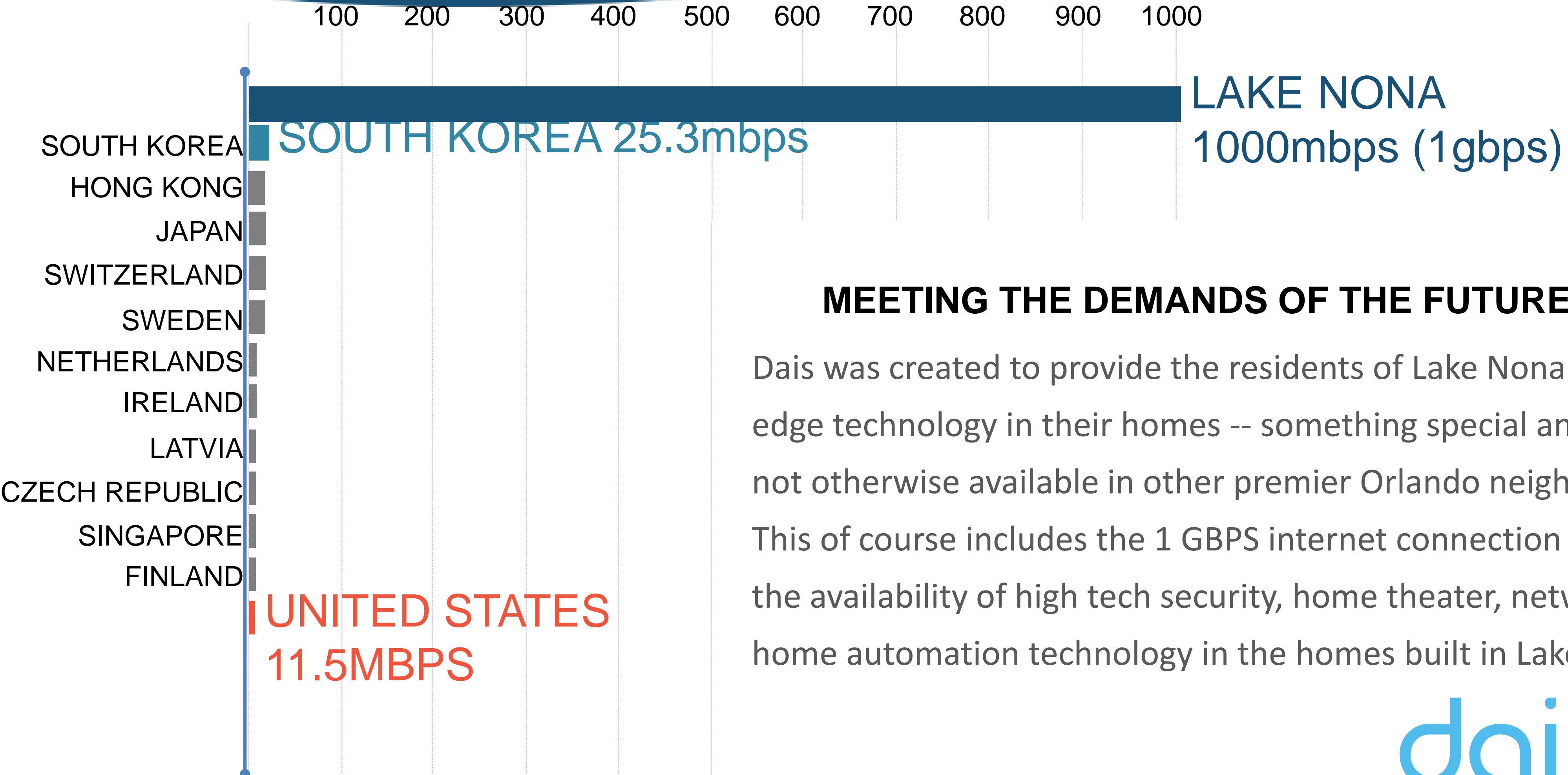


A Tidal Wave of Antennas



Significant opportunity exists to evolve to a *shared* infrastructure model in urban centers

TECHNOLOGICAL INFRASTRUCTURE



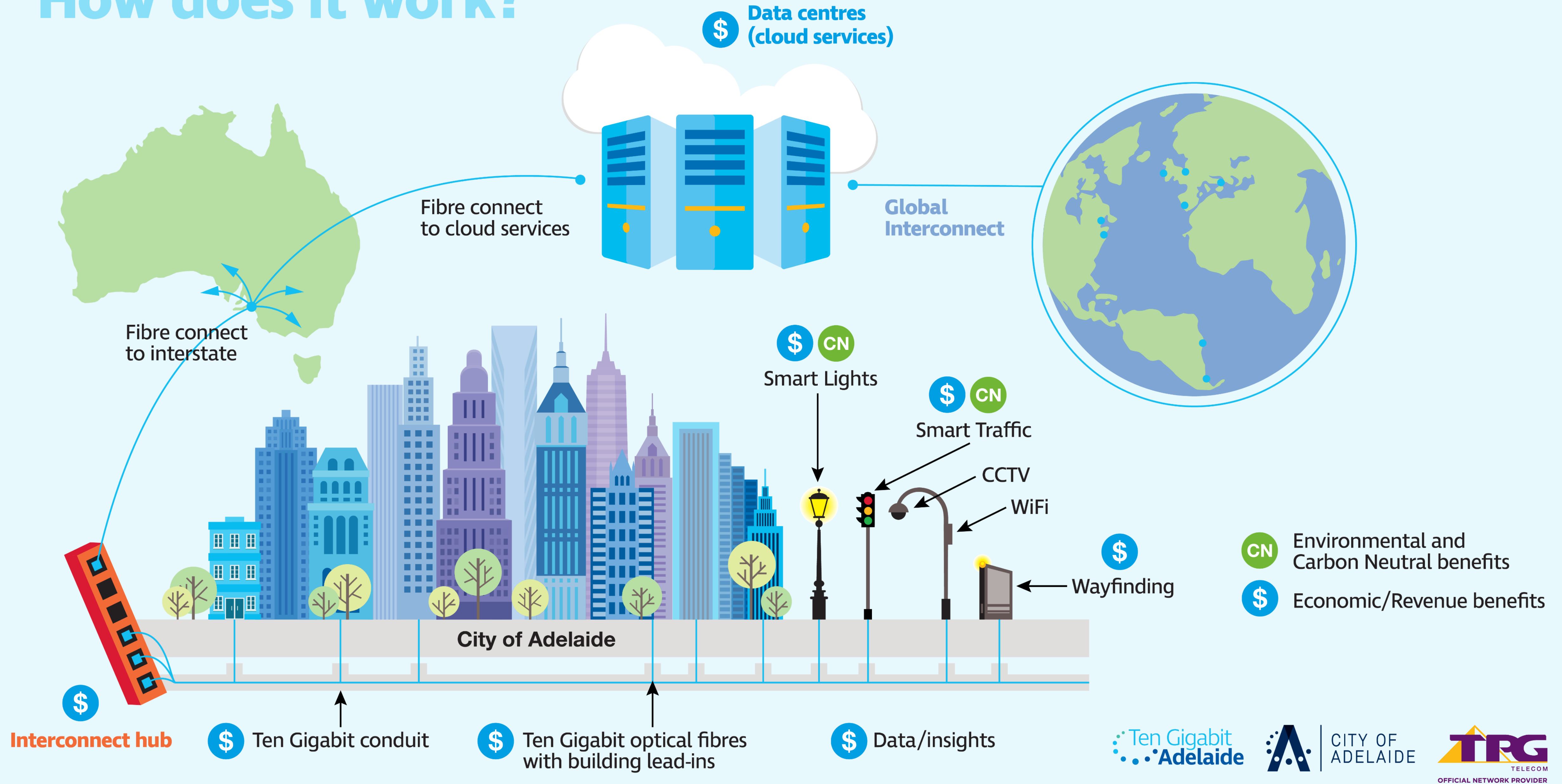
Source: Akamai Technologies, Q4 2016

MEETING THE DEMANDS OF THE FUTURE - TODAY

Dais was created to provide the residents of Lake Nona with cutting-edge technology in their homes -- something special and exciting, and not otherwise available in other premier Orlando neighborhoods. This of course includes the 1 GBPS internet connection. It also includes the availability of high tech security, home theater, networking and home automation technology in the homes built in Lake Nona. “



How does it work?





SAN FRANCISCO
DEPARTMENT OF
TECHNOLOGY

Fiber for San Francisco Internet for All

Date RFQ Issued:	January 31, 2018
Pre-Submittal Conference:	February 12, 2018 (10:00 a.m. PST) View livestream: http://sfgovtv.org/youtube_live
Deadline for Respondent Team Written Questions or Requests for Clarification:	March 2, 2018
Respondent Team Submittals Due:	March 26, 2018
Issue Notice of Shortlist of Respondent Teams Selected for Oral Interviews:	April 9, 2018
Oral Interview with Selected Respondent Teams:	Week of April 16, 2018
Issue Notice of Qualified Bidders:	April 30, 2018

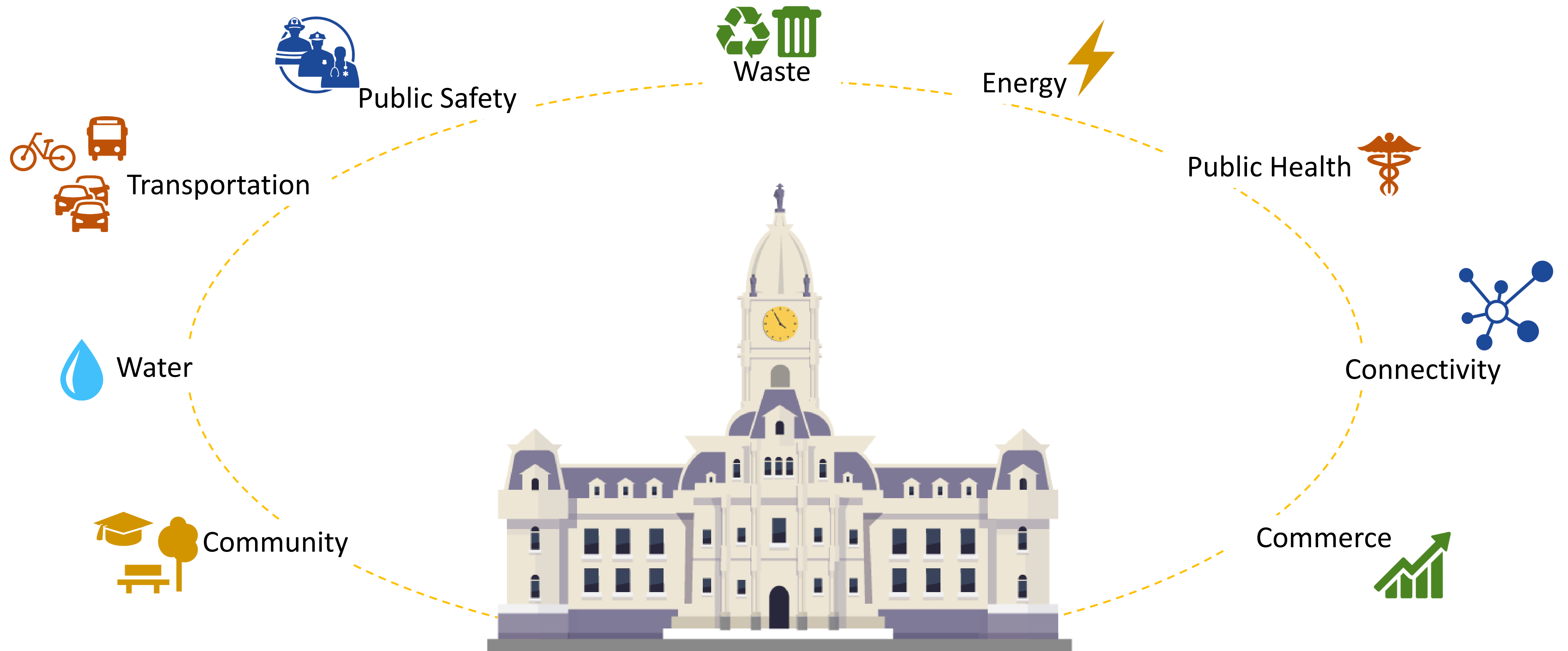


DenseNetworks.com

*Dates are subject to change.

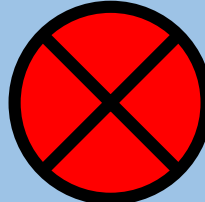

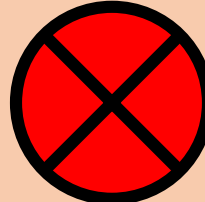
The Big Picture

Smart Collaboration > Improved Efficiency > Faster Response > Better Service



Broadband Strategy

Hybrid Approach – 80% results for 20% effort

	Government-led	Hybrid model <u>(Recommended)</u>	Market-led
Summary	<p>Cities building full fiber networks is expensive, complex, and risky</p> <p></p> <p>Too Risky</p>	<p>Cities that welcome private investment with appropriate guidance are most successful</p> <p></p> <p>Just Right</p>	<p>Cities with laissez faire broadband stagnate as cable-telecom duopolies</p> <p></p> <p>Too Ineffective</p>
Key Takeaways	<ul style="list-style-type: none"> • Seattle, Palo Alto and others have determined that city-led full fiber build-outs are not practical, after detailed assessments • Chattanooga’s unique buildout included control by the utility and federal funds 	<ul style="list-style-type: none"> • Seattle leveraged streamlined policies to drive competition and massive fiber buildout • NYC used franchise agreements to drive fiber build-out 	<ul style="list-style-type: none"> • Broadband speed and price cluster to the bottom of the peer set • No substantial competition in any market-led city
Potential costs	<p>Very high. City-owned fiber-to-the-premise would cost \$800M+.</p>	<p>Moderate. Working with carriers could cost \$50-250M based on build types.</p>	<p>Very low or none. City relies on private sector investment.</p>
Results	<p>Peers show 90%+ fiber build-out.</p>	<p>Peers show 55-70% fiber build-out.</p>	<p>Peers show 0-5% fiber build-out.</p>

Broadband Strategy

Emerging landscape for voice and DATA

Effective in Dense Urban, Urban, and Suburban

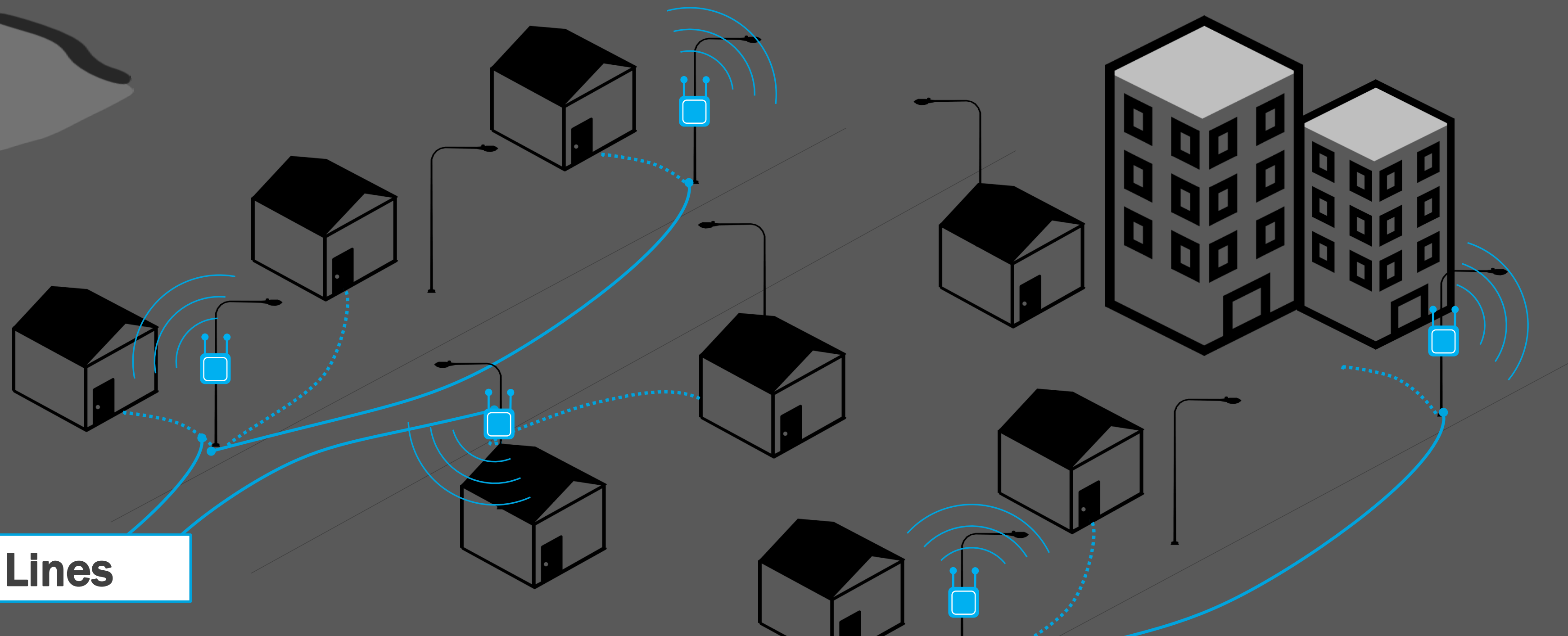
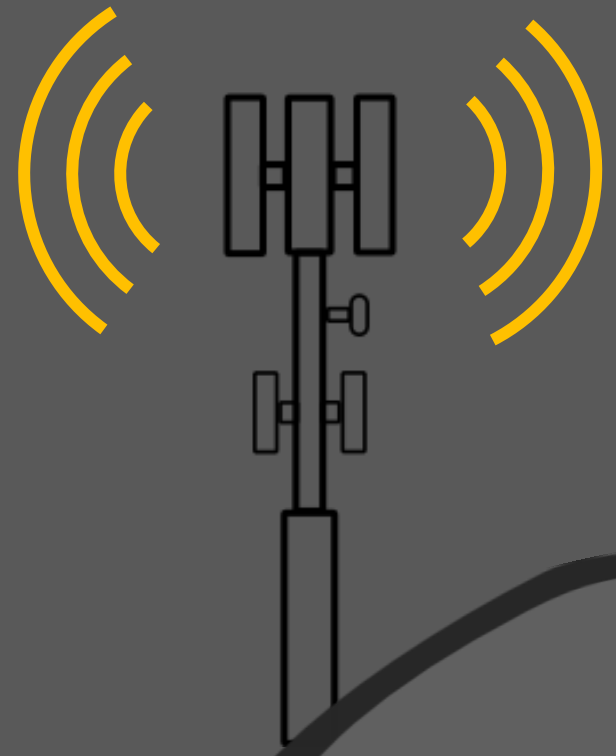
Cell towers: carry all mobile voice & some data

 **4G/5G Small-Cells**

Gigabit speed
up to 50x faster

Fiber Lines

Light pole is most valuable asset for broadband



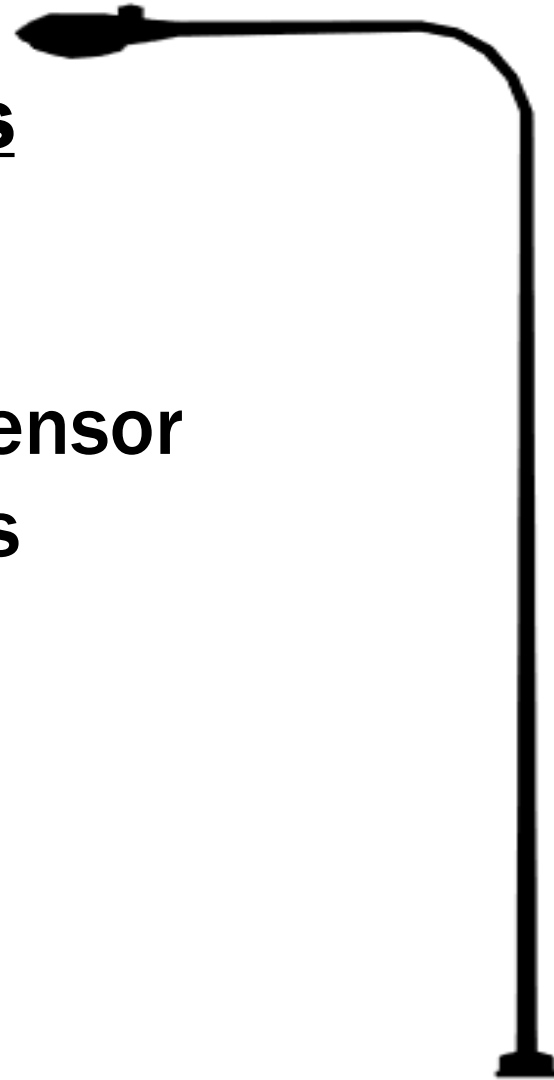
Broadband Strategy

STREETLIGHT

Light/Safety

Properties

- Height
- Power
- Light Sensor
- Lumens
- Density

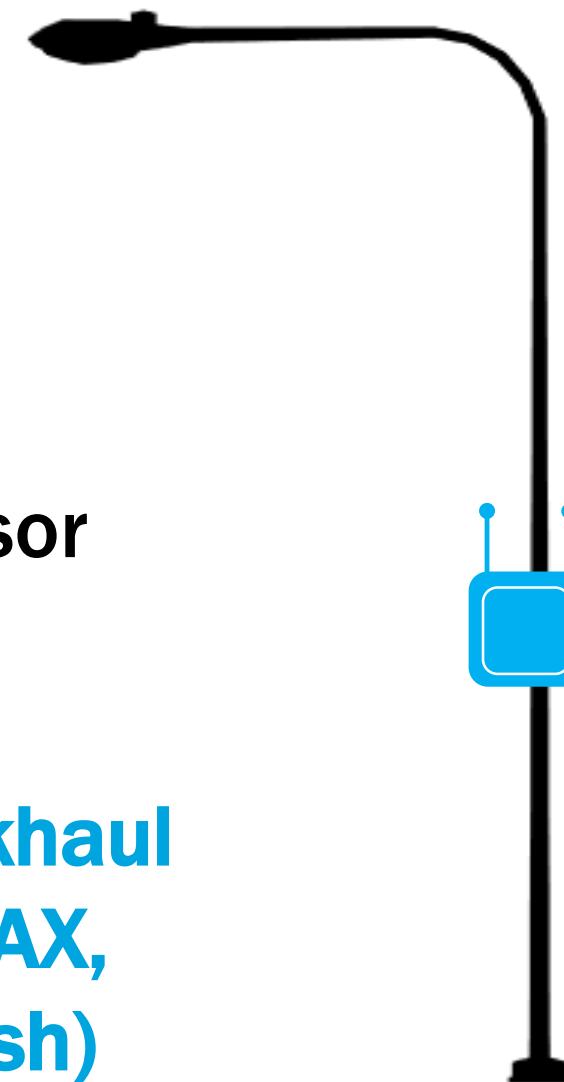


SMALL CELLS

Broadband Digital Infrastructure

Properties

- Height
- Power
- Light Sensor
- Lumens
- Density
- **Data Backhaul (Fiber, COAX, Radio mesh)**

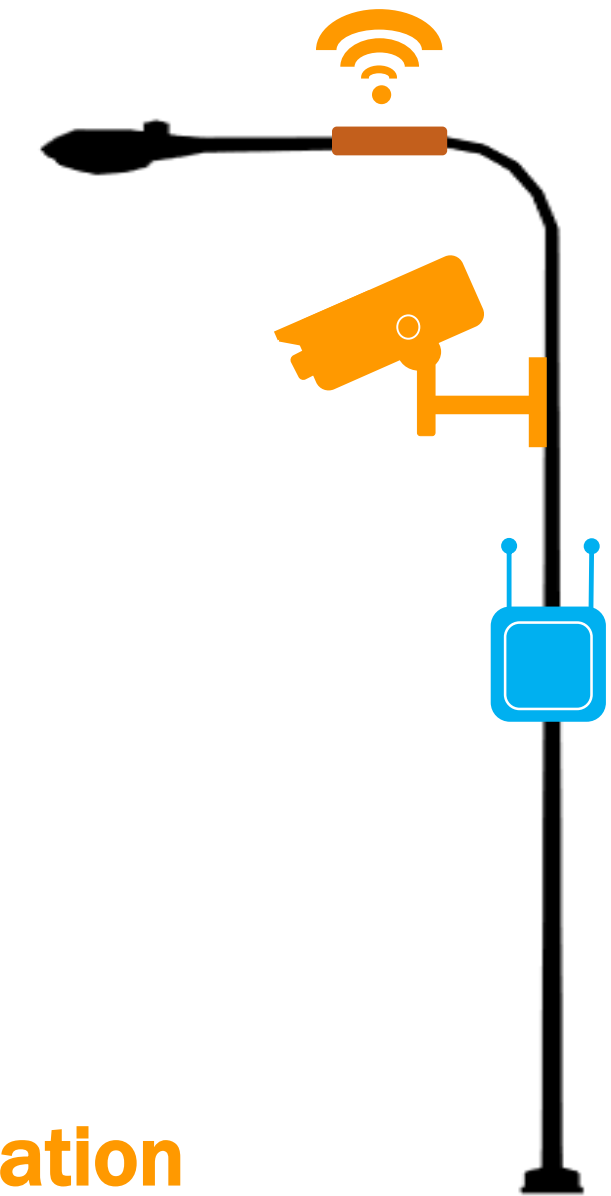


INTERNET OF THINGS

Smart Cities

Properties

- Height
- Power
- Light Sensor
- Lumens
- Density
- **Data Backhaul**
- **Sensors**
- **Cameras**
- **2-way Communication**
- **Banner Advertising**



Maturity:

Mature

Emerging

Extremely Immature

Possible Action:

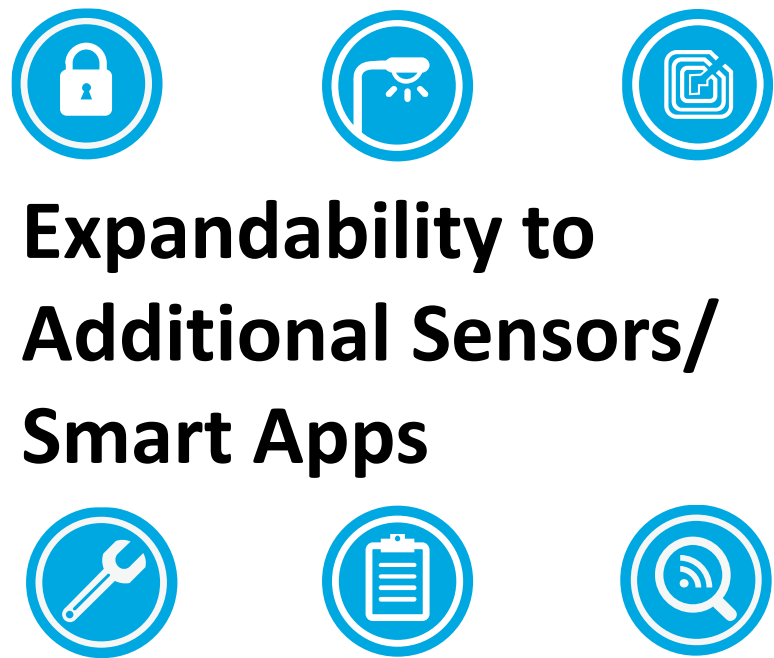
Proceed w/ LED Light Replacement Only

Re-examine in Broadband Strategy

Seek to Understand with Knight IoT Grant

Light Pole as Smart Venue Information Hub

Smart Lighting



Expandability to Additional Sensors/ Smart Apps

Wi-Fi Connectivity



Smart Parking



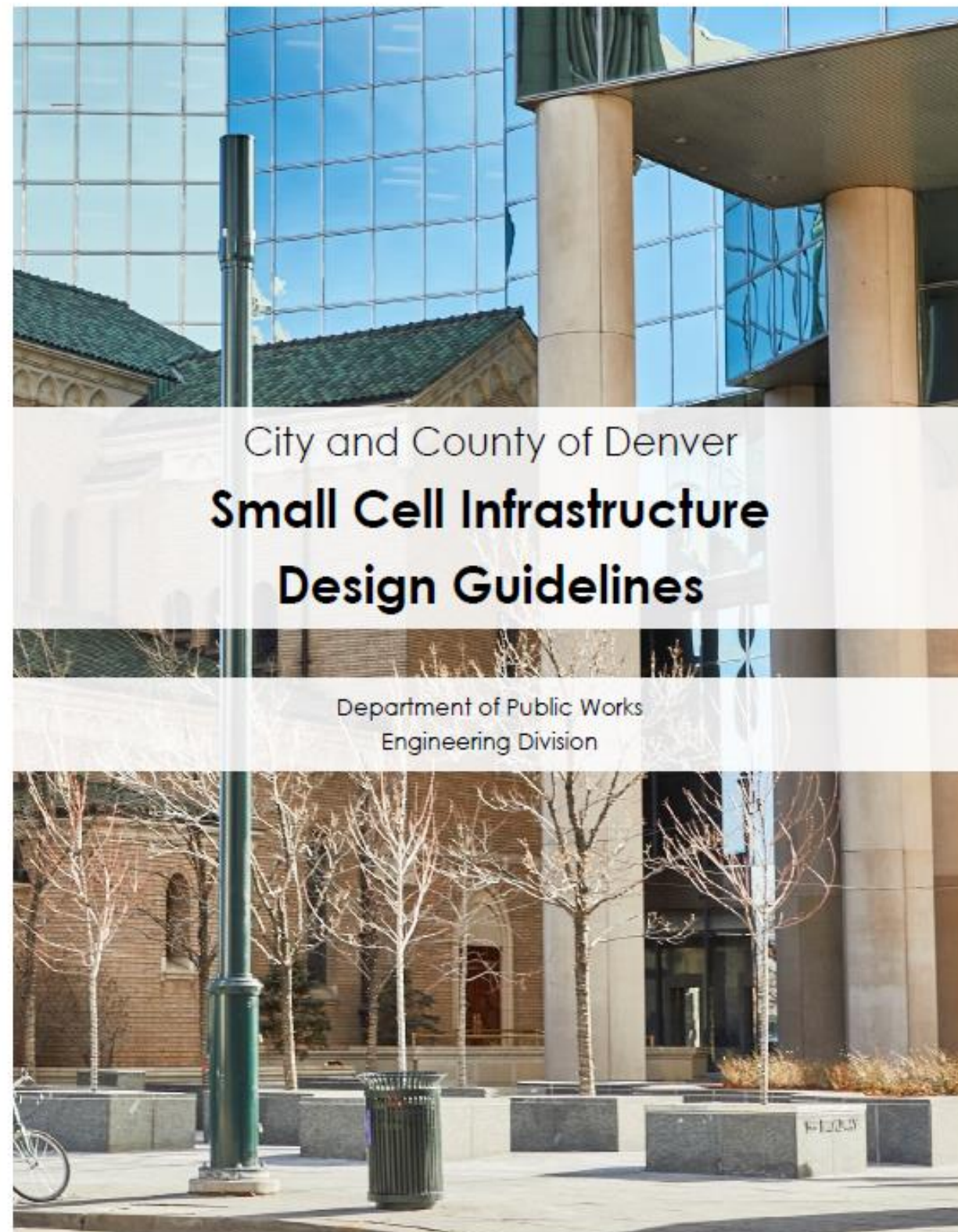
Smart Traffic



Video Surveillance



Public Works has created Design Guidelines and a custom Permit process to address:



April 2018

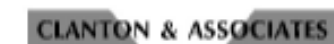
- Public-facing review process including Districts, City Departments, Neighborhood Orgs
- Policy for co-location first
- Notification of adjacent property owner
- Restricting new pole density through min **250'** spacing
- Restricting placement (along parks, historic & residential frontages)
- Restricting placement in front of residential & valuable sight lines
- Requiring camouflage and concealment
- Limiting height and equipment size
- Opportunity to coordinate fiber conduit



The City and County of Denver
Public Works Department
Jon Reynolds, Engineering Supervisor



Jacobs Engineering Group
Mike Butters, Project Manger



LIGHTING DESIGN AND ENGINEERING

Clanton & Associates:
Nancy Clanton, CEO
Dane Sanders, Principal
Arnie Kuczkowski, Engineer II - Lighting



Aero Wireless Group:
Jim Lockwood, CEO
Mike Hoganson, Chief Operating Officer

CITY GOALS

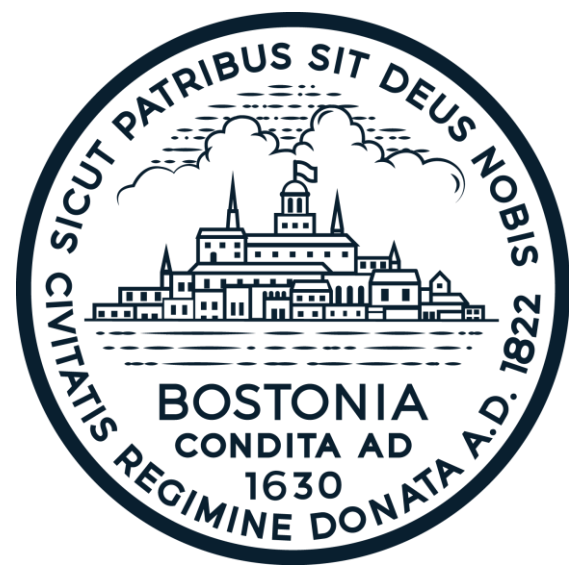
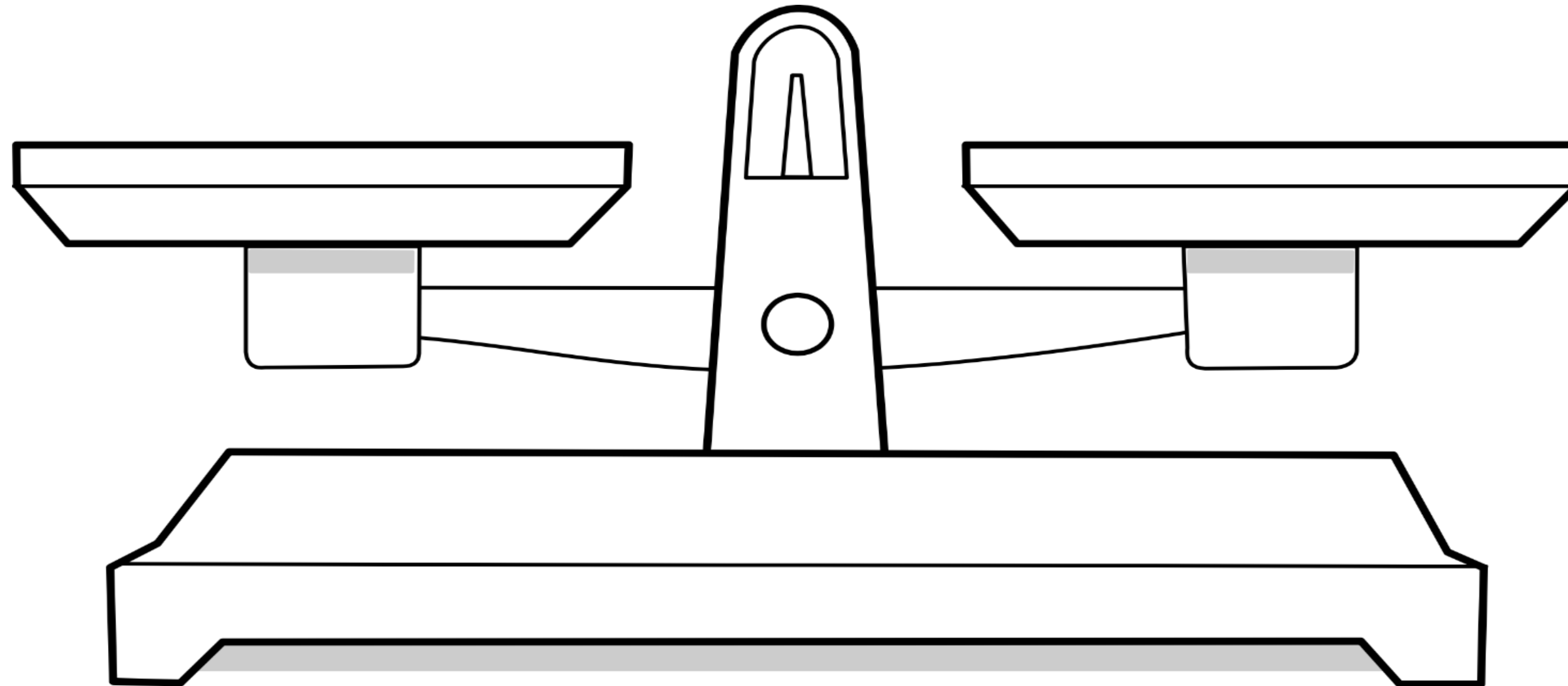
- *Minimize aesthetic impacts*
- *Encourage competition in wireless market*
- *Community awareness / comfort*
- *Fair compensation for use of public asset*

INDUSTRY GOALS

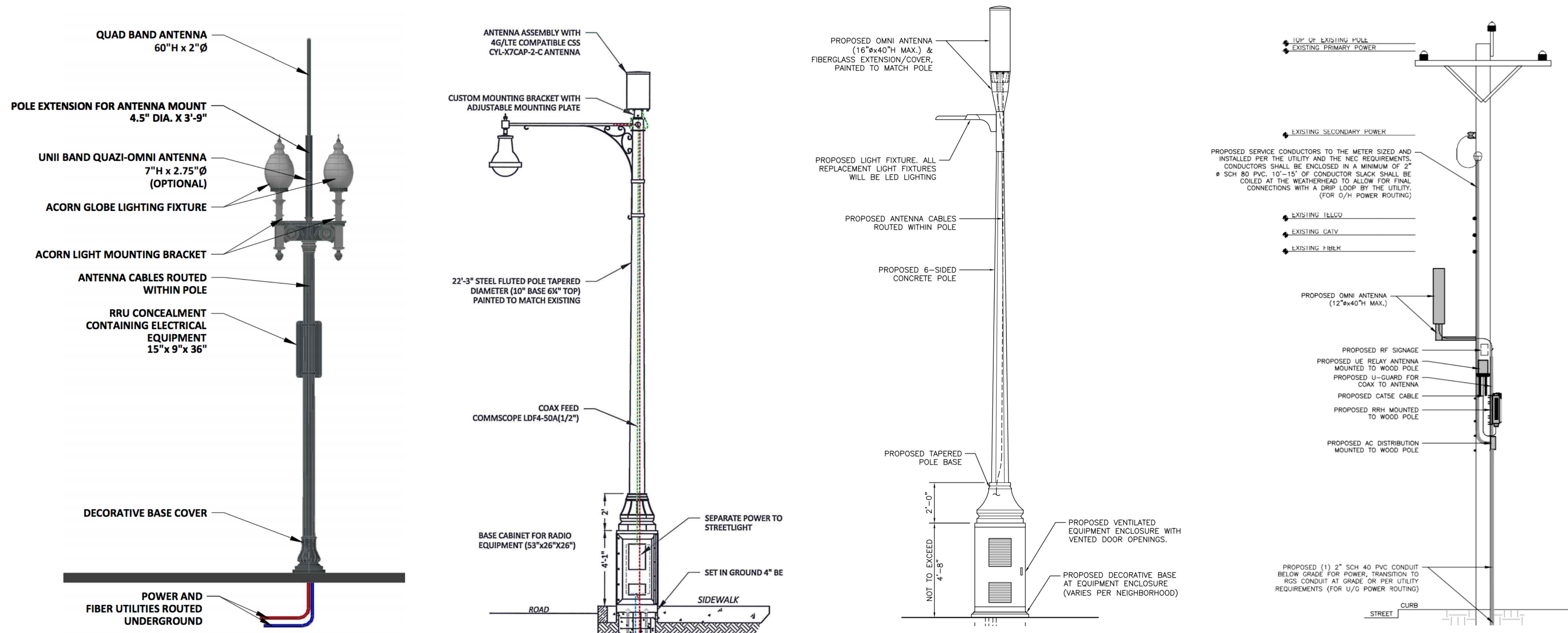
- *Fast and predictable approvals*
- *Large volume of installations*
- *Manageable community process*
- *Appropriate pricing models for carriers and neutral hosts*

SHARED GOALS

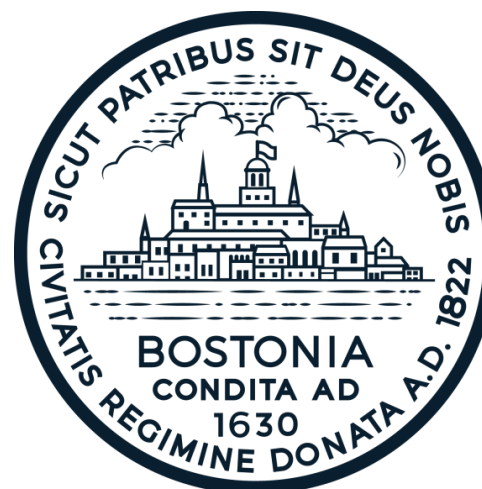
- *Great wireless service in every neighborhood*
- *Avoid community concerns with deployment*



COOPERATIVE DESIGN PROCESS

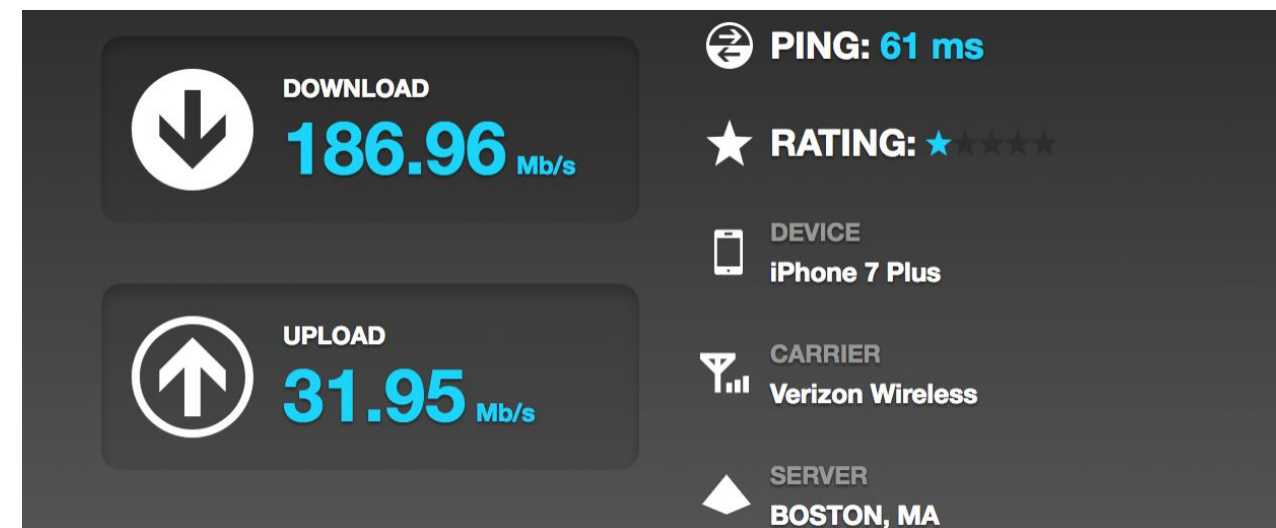


- *City and Licensees develop designs for replacement lights together*
- *Heavy focus on aesthetics, concealment, and historic character*
- *Once approved, design can be used by any licensee*



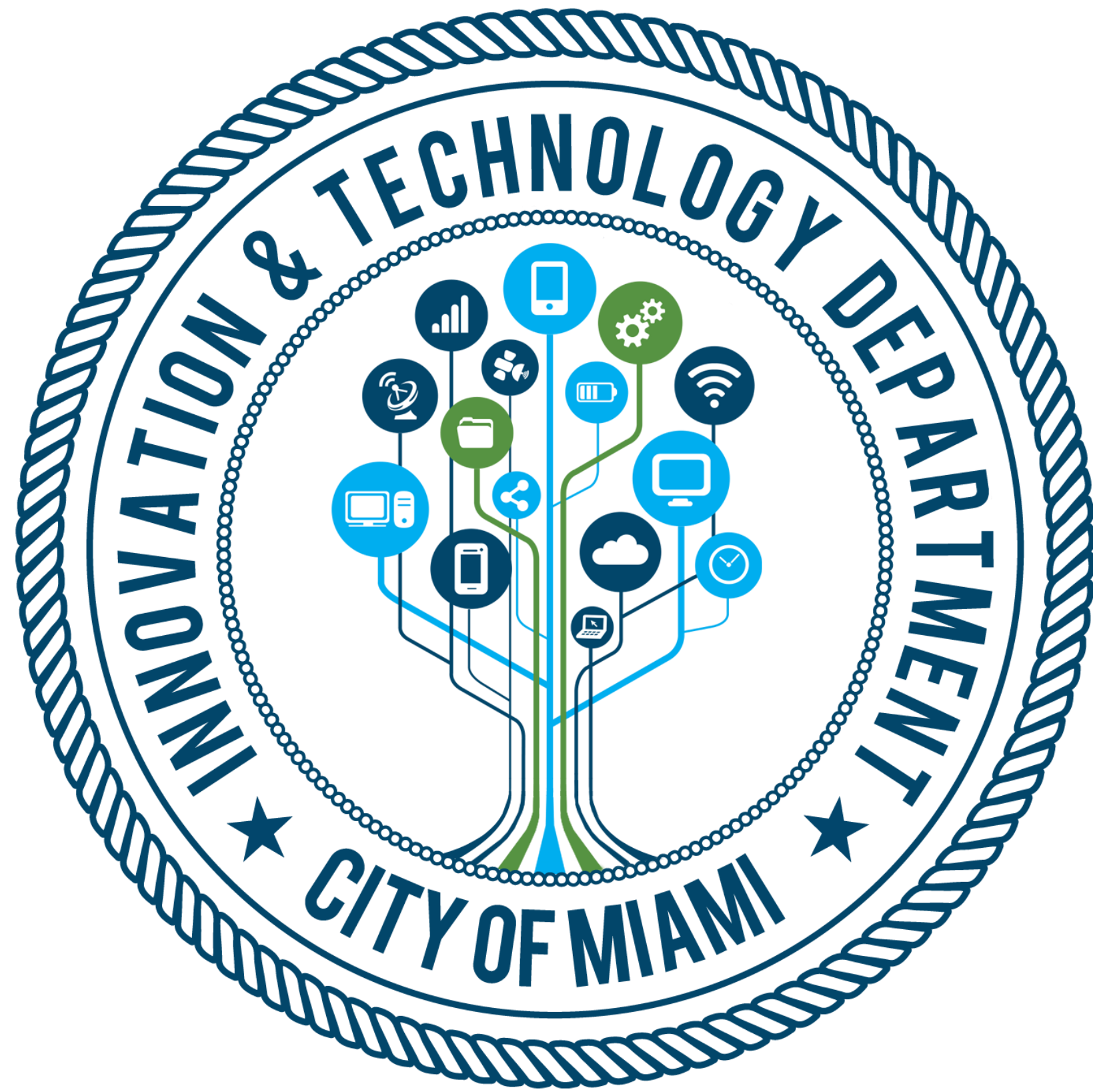
RESULTS (OCTOBER 2017)

- *>800 approved or installed, 314 in process*
- *90% approved within 10 business days, 100% within 28 business days*
- *Improved wireless service*



- *Funding for digital equity programs and hotspot lending*
- *Positive relationship between City and licensees*

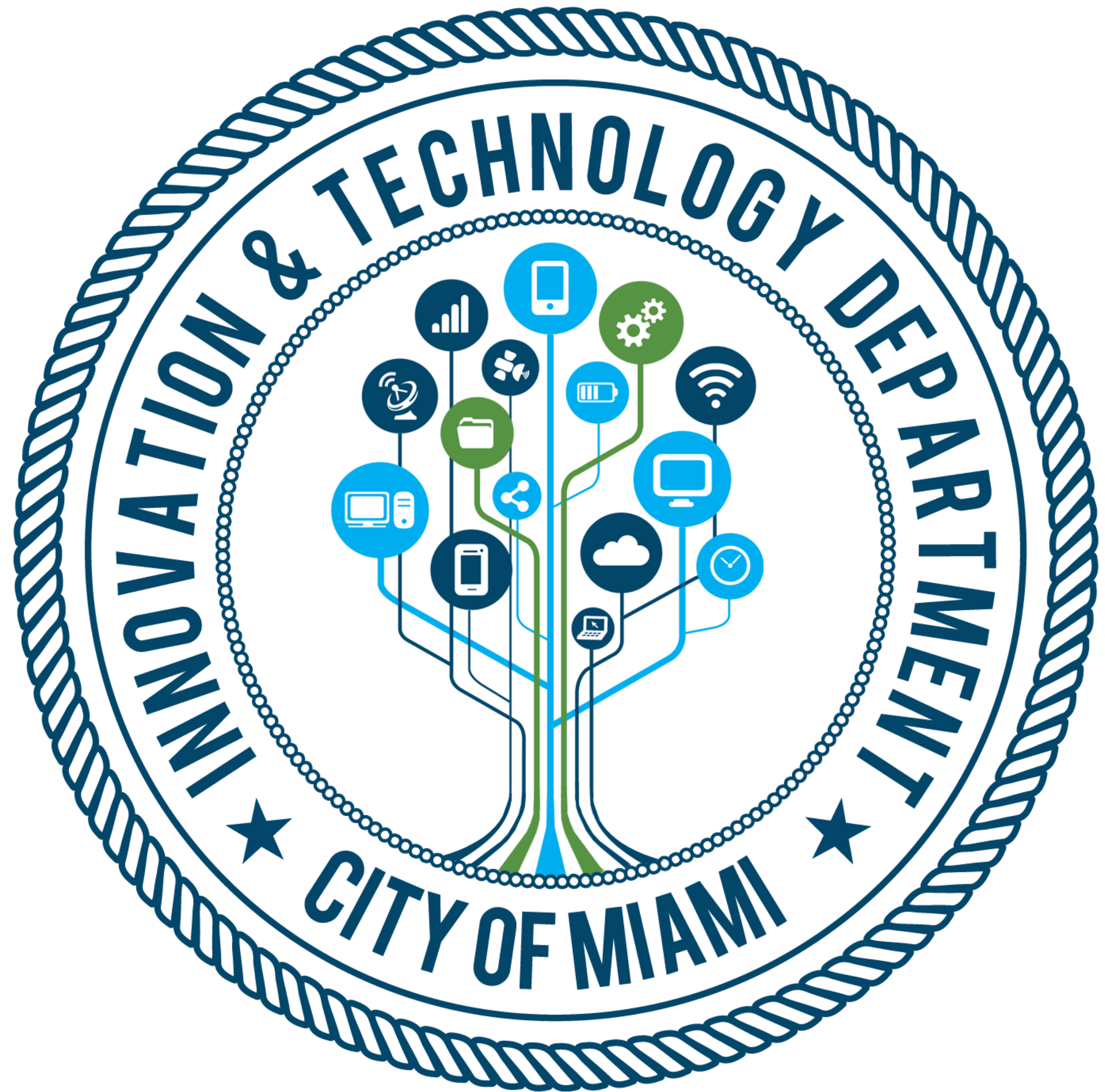




What does
“Smart” Mean for
the City of Miami?

A Smart Miami is:

- *Connected*
- *Equitable*
- *Resilient*
- *Sustainable*
- *Transparent*
- *Self-Aware*



L A K E N O N A

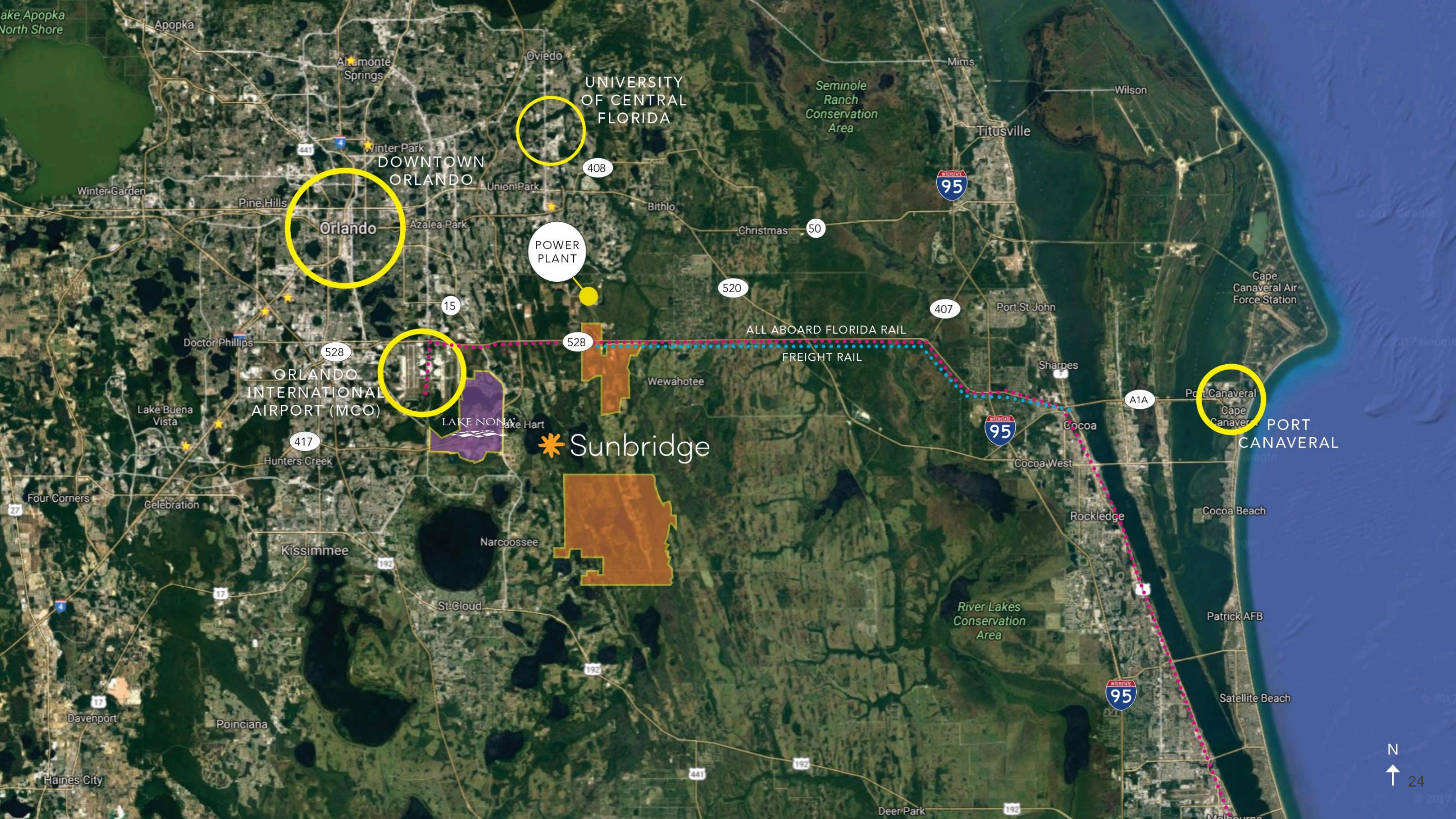
“HOW TO BUILD A GREAT AMERICAN CITY.”

– FORTUNE

LAKE NONA[®]



Spring 2018



UNIVERSITY OF CENTRAL FLORIDA

DOWNTOWN ORLANDO

Orlando

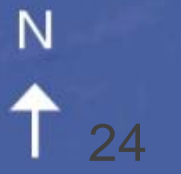
ORLANDO INTERNATIONAL AIRPORT (MCO)

Sunbridge

PORT CANAVERAL

POWER PLANT

ALL ABOARD FLORIDA RAIL
FREIGHT RAIL



LAKE NONA IS A SMART CITY



- **Clustering businesses to create moments of intersection** that spark breakthrough ideas
- **US. Home of Veteran's Affairs SimLearn Center**, their national simulation training center
- **Partnered with White House** for U.S. Ignite project to focus on possibilities of gigabit network
- Network of towers providing robust cellular coverage & operates a campus wide **Distributed Antenna System (Das)**
- **First Gigabit city** in Florida & 1st Cisco designated Smart + Connected City
- **Robust fiber network** across 17-square-mile community
- Designing **healthy homes** that enhance wellbeing
- **Partnering with GE** to build homes with a 20% reduction in energy emissions and water consumption
- **Lake Nona's definition of SMART extends far beyond our robust technology infrastructure...**



A Smart Miami is *Connected*

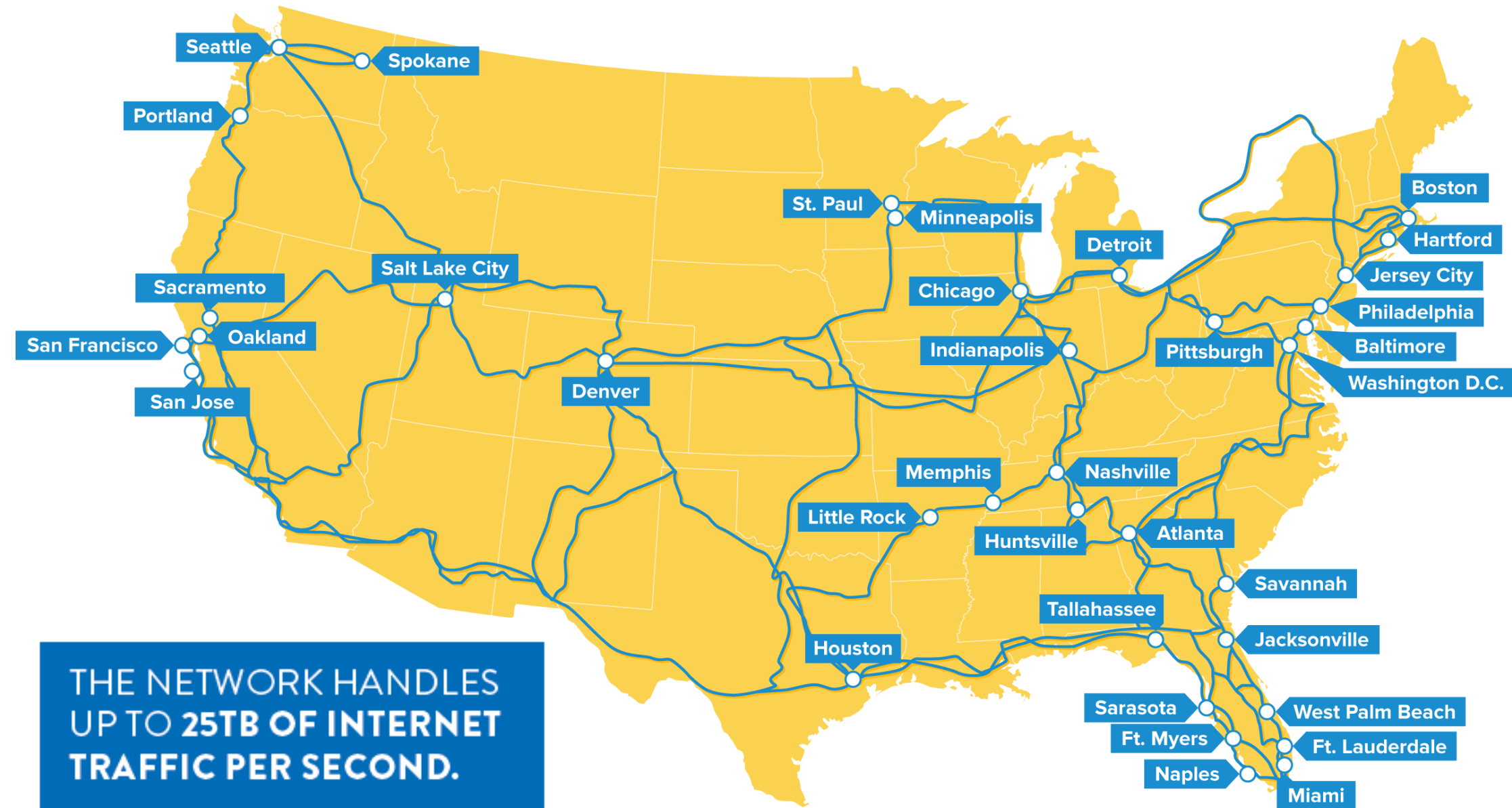
- We are working closely with industry to quickly and efficiently build-out a citywide 5G network.
- Build out a citywide network of sensors that relay critical information to control centers and data portals.
- Soon all services will be accessible online from a mobile device.



DIVERSE NETWORK

OUR NETWORK:

- **Physically diverse network** from telcos (routes, access points, building access, etc.)
- **Largest converged IP network in the country**
- Far-reaching **fiber and HFC infrastructure**
- **Network monitoring and management** in every market 24/7/365
- **Customer monitoring** from Redundant NOCs
- Metro Ethernet Forum's **2014 Service of the Year**



Over 1 million Ethernet enabled buildings



Capacity that scales up to 100Gbps



150k fiber route miles



600+ connected data centers



4th Largest voice provider in the nation

A Smart Miami is – *Self-Aware*

- Internal data catalog and review -
City data is highly siloed, hidden in
databases on networks and
spreadsheets on desktops. Sometimes
on paper in file cabinets.

*“We've figured out that 85 percent of
the data that you need to run a smart
city, you've probably already got. Any
city can be a smart city, or a smarter city,
just by getting better control of their
data and by understanding what it's
saying to them.” – Bob Bennett*

- Analytics - Combining pre-existing
internal data sources will allow for
detailed analysis and give us a view of
the City that is not currently possible,
looking back not only on historical data
but forward by using this data to build
predictive models



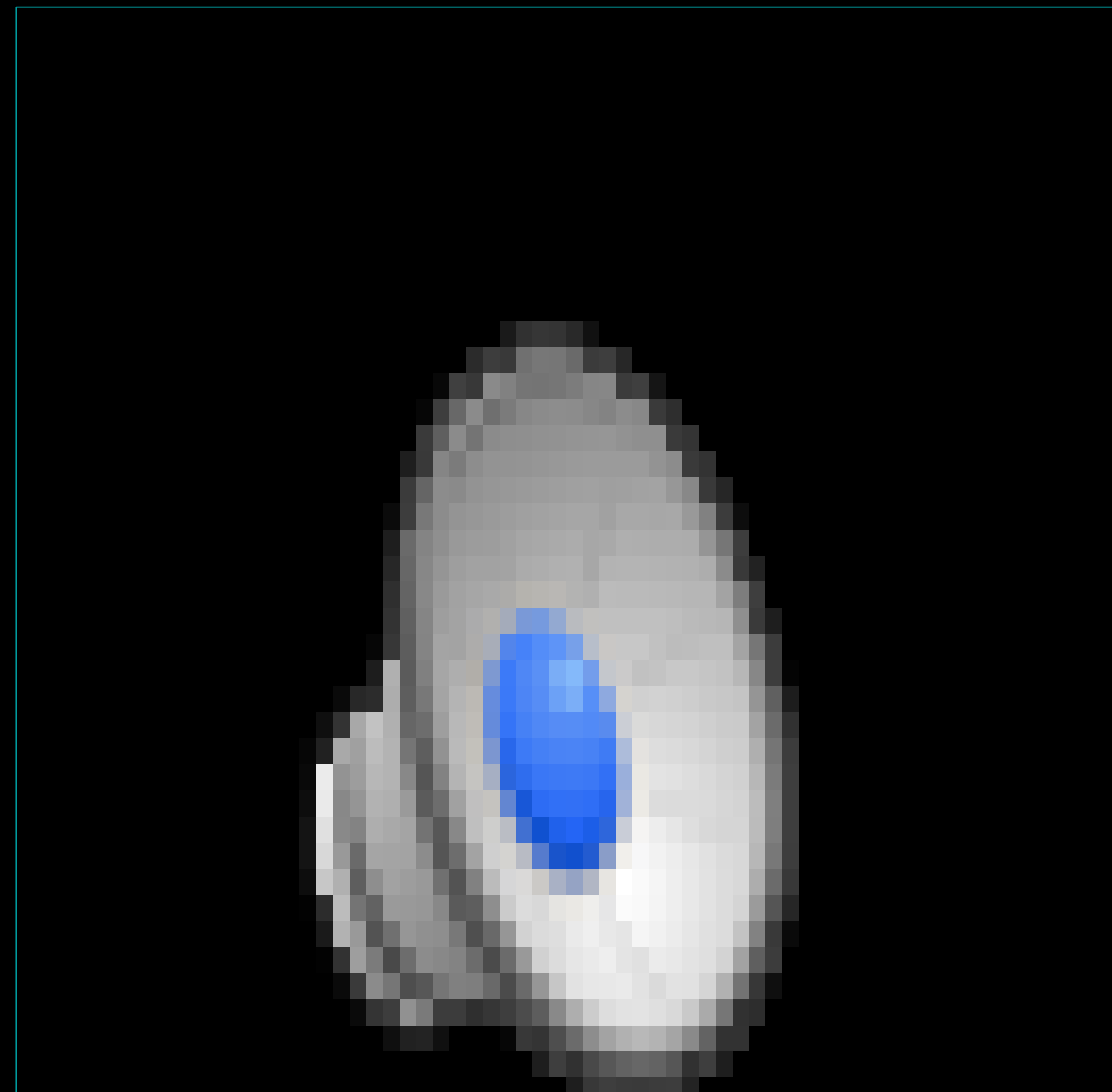
Video + AI = Rich Insights and Alerts Operations, Business and Safety Intelligence

NEXT
2018

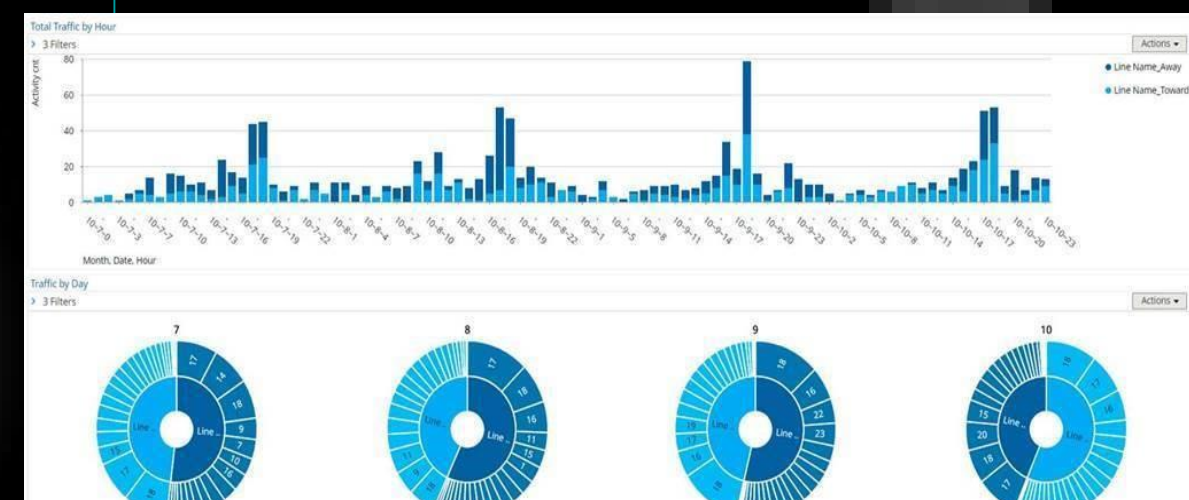
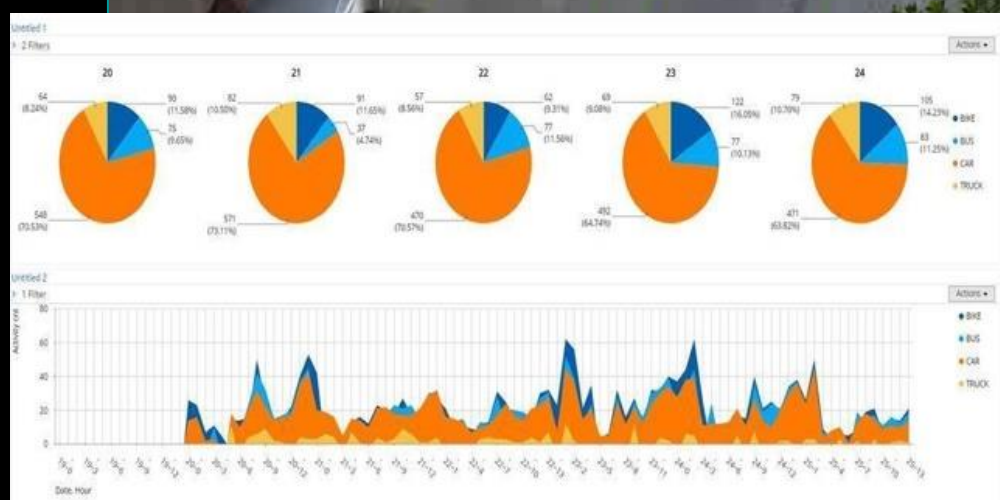
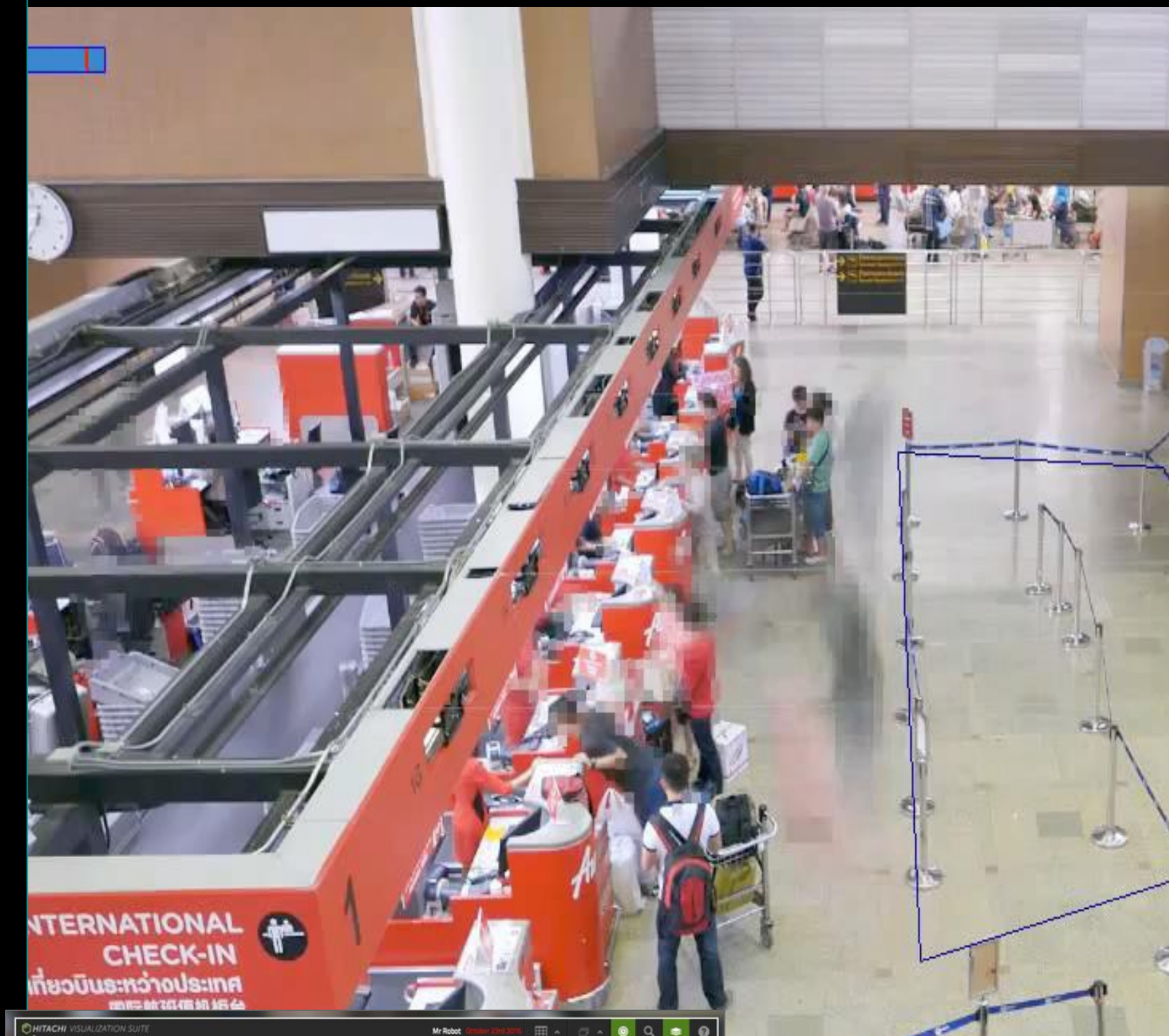
Traffic Analysis



People Counting



Operations and Privacy

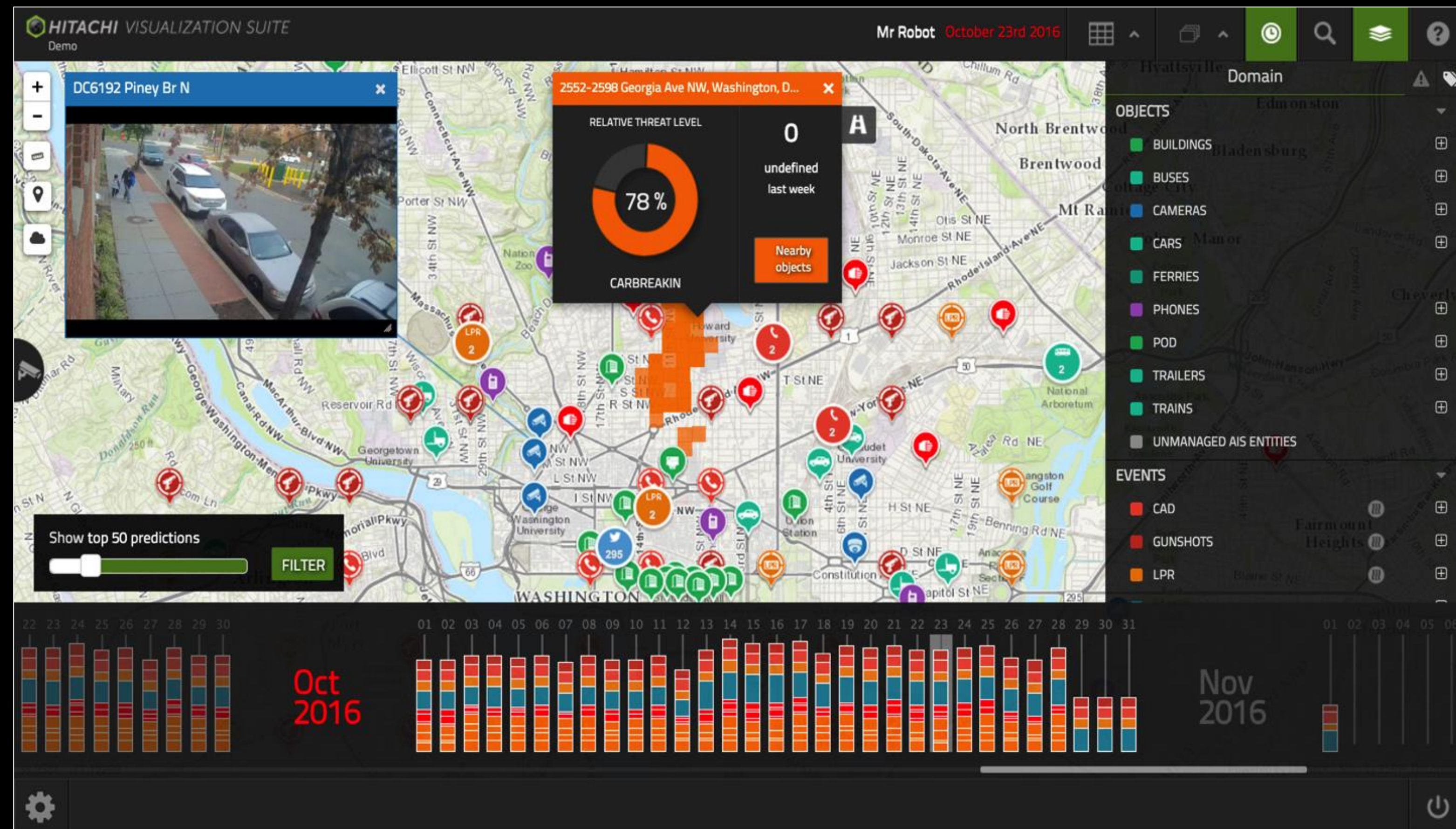


*VMP = Video Management Platform VSP = Virtual Storage Platform HCP = Hitachi Content Platform

Situational Awareness Through Hitachi Visualization Suite

NEXT
2018

- Real-time video and IoT data from facilities, vehicles, infrastructure, security, and shops
- Unlimited data layers on a single pane of glass
- Distributed intelligence for all staff with browser-based desktop or mobile capability
- Workflow automation for setting alerts for customer needs or security incidents



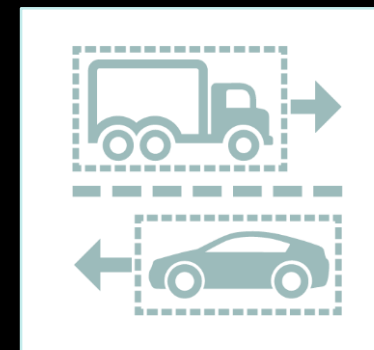
Hitachi Video Analytics Delivers Digital Insights

NEXT
2018

Operational & Business Intelligence



People Counter



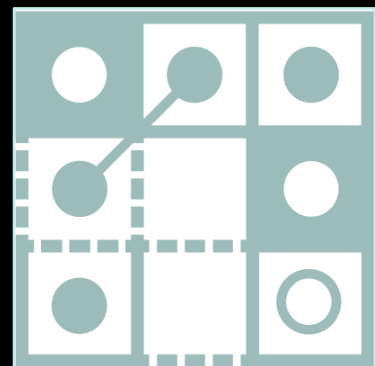
Traffic Analyzer



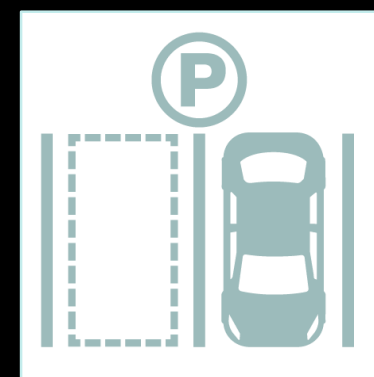
Queue Detector



License Plate Recognizer



Activity Visualizer



Parking Space Analyzer



Direction Controller



Camera Health Monitor

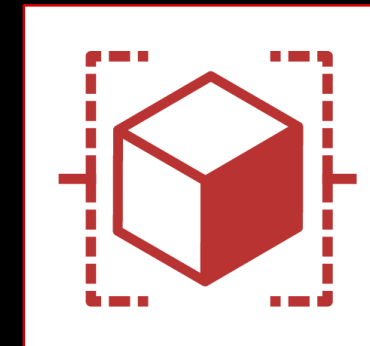
Security



Intrusion Detector



Facial Recognition

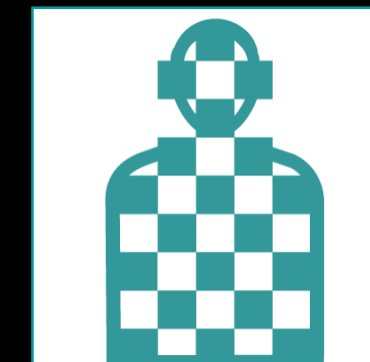


Object Detector



Video Enhancer

Privacy



Privacy Protector



European Privacy Seal
EP-P-F9LDTM / Valid till 2017-10

Police • Hospitals • Campuses • City Agencies • Retail • Financial Services • Transportation • Utilities



Comcast Business Smart Communities use innovative sensor and network technology to provide cost-effective, scalable solutions to the real-world issues impacting local communities.

MACHINEQ IOT NETWORK



- 1 Tower & building deployed-gateways provide broad coverage across
- 2 Cable strand deployed-gateways provide dense, indoor coverage
- 3 PiCO Celli placements for deep indoor coverage
- 4 Multitude of sensors and applications across numerous verticals

A WELLNESS HOME BUILT ON INNOVATION AND TECHNOLOGY

MeetWHIT.com



Constraints

- Funding: “Smart” can be expensive
- Risk Aversion: A city’s risk tolerance is much different than private sector
- Privacy!!!!!!!!!!!!!!



SMART COMMUNITY SOLUTIONS



Crime Prevention

Public Safety

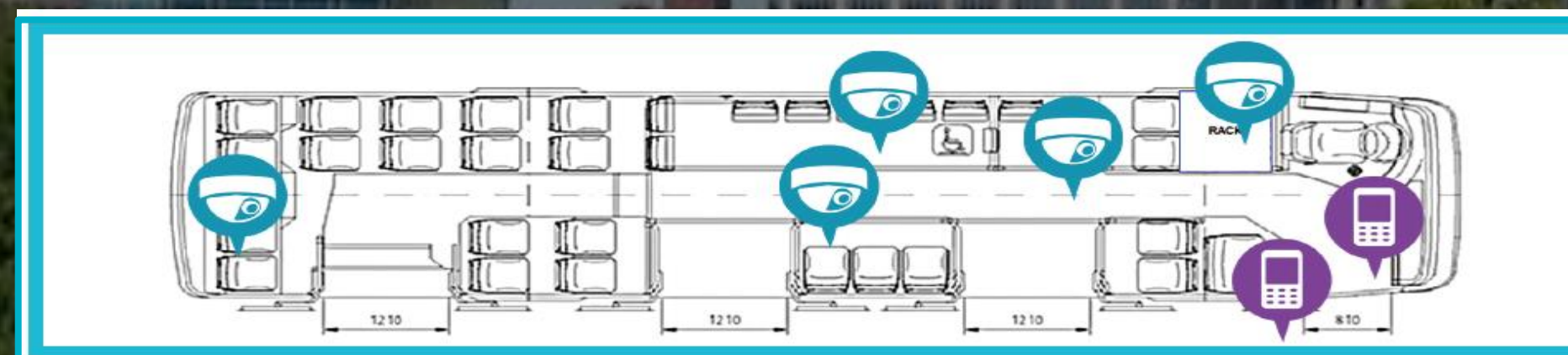
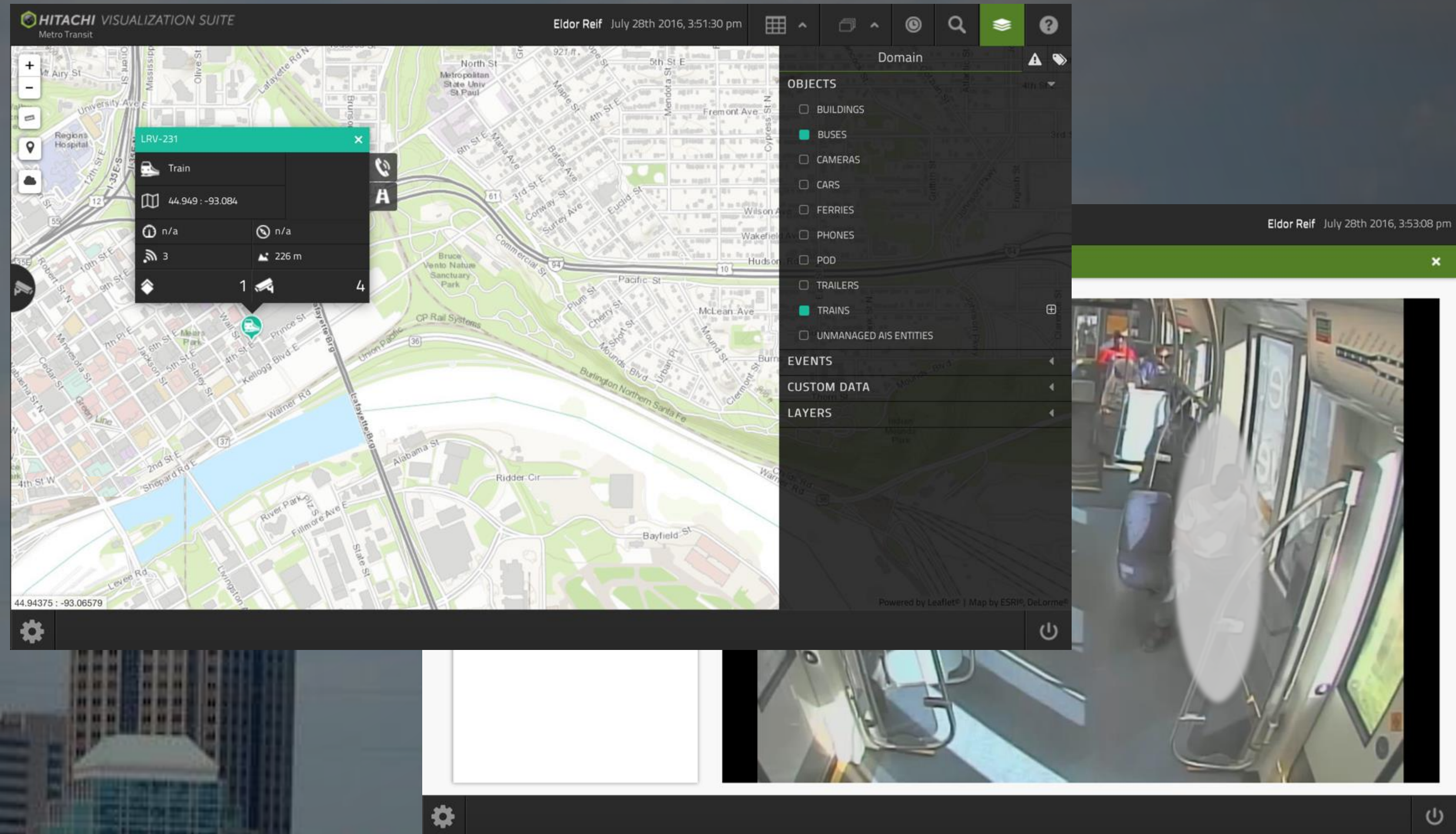
Sustainability Solutions

Remote Monitoring

Smart Transportation Use Case

NEXT
2018

- Ensure public safety with real time and recorded video
- Integrate Disparate Fixed and Mobile Video Systems
- Provide situational awareness for first responders
- Track vehicle locations
- Count and track people and crowds
- Find objects left behind
- Integrate traffic data and video
- View IoT data for trains, stations, and infrastructure



Vehicle schematics give real-time access to cameras and IoT data.

Smart and Safe Stadiums

NEXT
2018

Challenge: Emerging threats to stadiums and venues, need to improve operations and customer experience while ensuring safety.

TRANSFORMATION

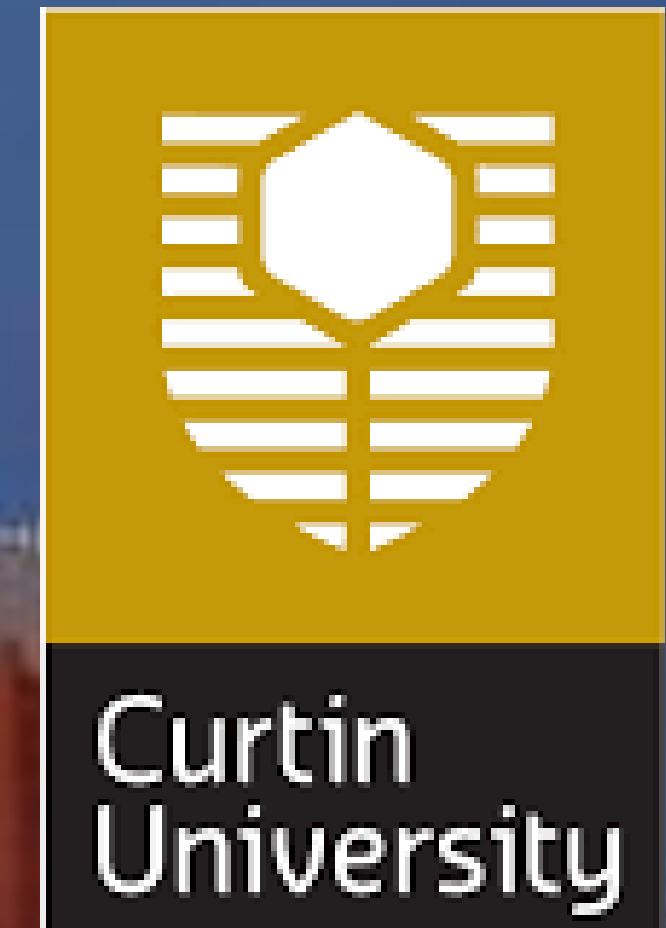
- Drone detection, facial recognition and fan experience
- Millions of fans, visitors and city residents kept safe

The screenshot displays the Hitachi Visualization Suite interface for the San Francisco 49ers stadium. The main view is an aerial map of the stadium area with several drone detection alerts marked by pink icons. A detailed alert for 'Drone Detected on sfpoc8' is shown, including sensor data such as Event Date/Time (2015-11-29 12:47:43), Hardware ID (9003:B7:26:04:90), Sensor Name (sfpoc8), Signal Strength (-65), and Vendor (Parrot). The interface also features a sidebar with video feeds from 'Metal Detector 2 - Panasonic-68' and 'Food Concession - Panasonic-73', and a right-hand panel with 'OBJECTS', 'EVENTS', 'CUSTOM DATA', and 'LAYERS' sections.

Smart Campus: University

NEXT
2018

- 60,000 students, 4,000 staff smart campus
- **Goal:** Better student experience, increased efficiency and safety
- **Hitachi Smart City Platform** collects, integrates, and analyzes data



Outcomes:

- Campus and facility utilization analysis for operations
- Activity analysis to understand and enhance student experience
- Environmental health and sustainability on campus
- Public safety and prevent testing fraud

"The smart campus is all about looking at what we do at Curtin, and doing it better."

Paul Nicholls, Director,
Strategic Projects (R&D),
Curtin University

A Smart Miami is *Equitable*

- Close the digital divide by ensuring universal internet access for our citizens.
- We will seek out and engage with the residents and stakeholders who represent our diverse community.
- Design technology for everyone.





SPOTLIGHT ON FLORIDA

\$22.4 B

2017 direct and indirect economic activity generated in Florida.

\$1.6 B

2017 investments in payroll, benefits and workforce training in Florida.

39.2 K

Employed in Florida; and more than 15,000 veterans, National Guard and Reserve members and military spouses hired across Comcast NBCUniversal since 2010. We invest more than \$1.6 billion annually in payroll, benefits, and training for our Florida workforce.

\$684.7 M

In direct taxes, fees and permits are paid annually by our company to Florida state and local governments (e.g., property tax, sales and use tax, and franchise fees).

> \$6.9 B

Invested in Florida technology and infrastructure from 2011 to 2017. Our nationwide network is enhanced with more than 150,000 miles of fiber.

\$42.7 M

Cash and in-kind contributions invested in Florida communities in 2017.

484 K

Low-income Florida residents connected to low-cost, high-speed Internet service through Internet EssentialsSM, the most successful and comprehensive broadband adoption program in the country.

75.9 K

Volunteer hours donated during Comcast Cares Day 2017 across 127 projects in Florida. Comcast Cares Day is an annual celebration of our year-round commitment to service.

A night cityscape with a network overlay of white arcs and Wi-Fi symbols. The word "Connectedness" is written in large white letters across the center of the image. The background shows a dense urban area with many lit-up buildings and streets, with a prominent highway interchange in the foreground. The network overlay consists of numerous white Wi-Fi symbols (three curved lines above a dot) connected by thin white arcs, creating a complex web of connections across the city.

Connectedness



Cooperative Program Overview

GOVERNMENT PURCHASING, COOPERATIVES, & U.S. COMMUNITIES

- Government requires Three Bid or Solicitation Process
 - Best Value
 - Equal Access
- Cooperative purchasing saves money & time
 - Satisfy the competitive solicitation requirement of public agencies
 - Invest less time and money in the procurement process
 - Leveraging the aggregate volume government agencies nationwide
 - Speeds up the process
 - Maintain quality business partners and practices
- U.S. Communities - A national cooperative purchasing alliance for local governments including States, Cities, Counties, Special Districts, Schools, Colleges and Universities & Non-profits.

Website: www.uscommunities.org

ADVANTAGES OF COOPERATIVE PROCUREMENT

- Agency, Consultant, Contractor / Integrator, Manufacturer, Supplier
 - Offer Total Solutions
 - Specify, Finance, Integration, Product
 - Product & Project Management
 - Flexible & Legal Contract Vehicle
 - Saves Overall Costs
- No Bid
 - Saves Money on Procurement Process
 - Speeds up Project Timelines
 - Eliminates the Unknown
- Partnerships
 - Brings Together the Necessary Partners

- Cooperative Contract Manager
- Lead Public Agency Managed Contracts
- Public Solicitation Process
- National Volume
- Nation's Largest Cooperative Program
- No Cost/ Non-Binding
- Best Overall Value
- Best in Class Vendors

ELIGIBLE AGENCIES

- Over 98,000 eligible agencies can participate
 - Registration & MICPA
 - Over 60,000 registered with US Communities
 - Over 17,000 using Graybar's contracts
- Eligible Agencies Include:
 - State Agencies, Counties, Cities, Towns and Villages
 - Specials Districts: Water, MUD's, Transportation, Airports
 - Public and Private Higher Education
 - Colleges, Universities, Technical Schools
 - K-12 School Districts, Charter Schools & Other
 - Non-Profits Churches, Education, Hospitals, YMCA & Other

GRAYBAR'S ROLE WITH U.S. COMMUNITIES

- One Combined Contract # EV2370
 - Valid date February 1, 2018
 - 5 year initial term (with “three” two year extension options)
 - Electrical, Lighting, Utility
 - Data/Communications, Networking, Wireless, Service Provider, Security
 - Comprehensive Service Offering
 - Other Related Products & Services
- Graybar has a 21 year history with USC
- City of Kansas City, Lead Public Agency
- Large Breadth of Product - Consistent and competitive pricing
- Project & Volume Discounts Available
- No contracts to sign, no spend limits, non-binding & best overall value

SERVICES OVERVIEW

- Key areas for services are but not limited to:
 - Lighting & LED, Power & Energy, Technology, Networking & Wireless, Security, Repair
- Services performed by approved contractors and integrators
 - Agency Preferred Companies
 - Graybar suppliers, contractors, integrators
 - Manufacturers Approved Integrators
- Pricing is based on a Not to Exceed Cost Plus basis.
- Graybar acts as G.C.
- Sub-Contract and Service Owner Documents recommended

GRAYBAR SUCCESS STORIES AND CASE STUDIES

Graybar Brings Great Lighting and Energy Savings to the Raleigh Convention Center



Graybar Helps Bring Intelligent Lighting to the City of Hudson



Graybar eBusiness with NC State Univ.
Through U.S. Communities





Open Discussion

Questions & Answers

Easter morning 1900: 5th Ave, New York City. Spot the automobile.

Disruption can happen very fast...



Source: US National Archives.

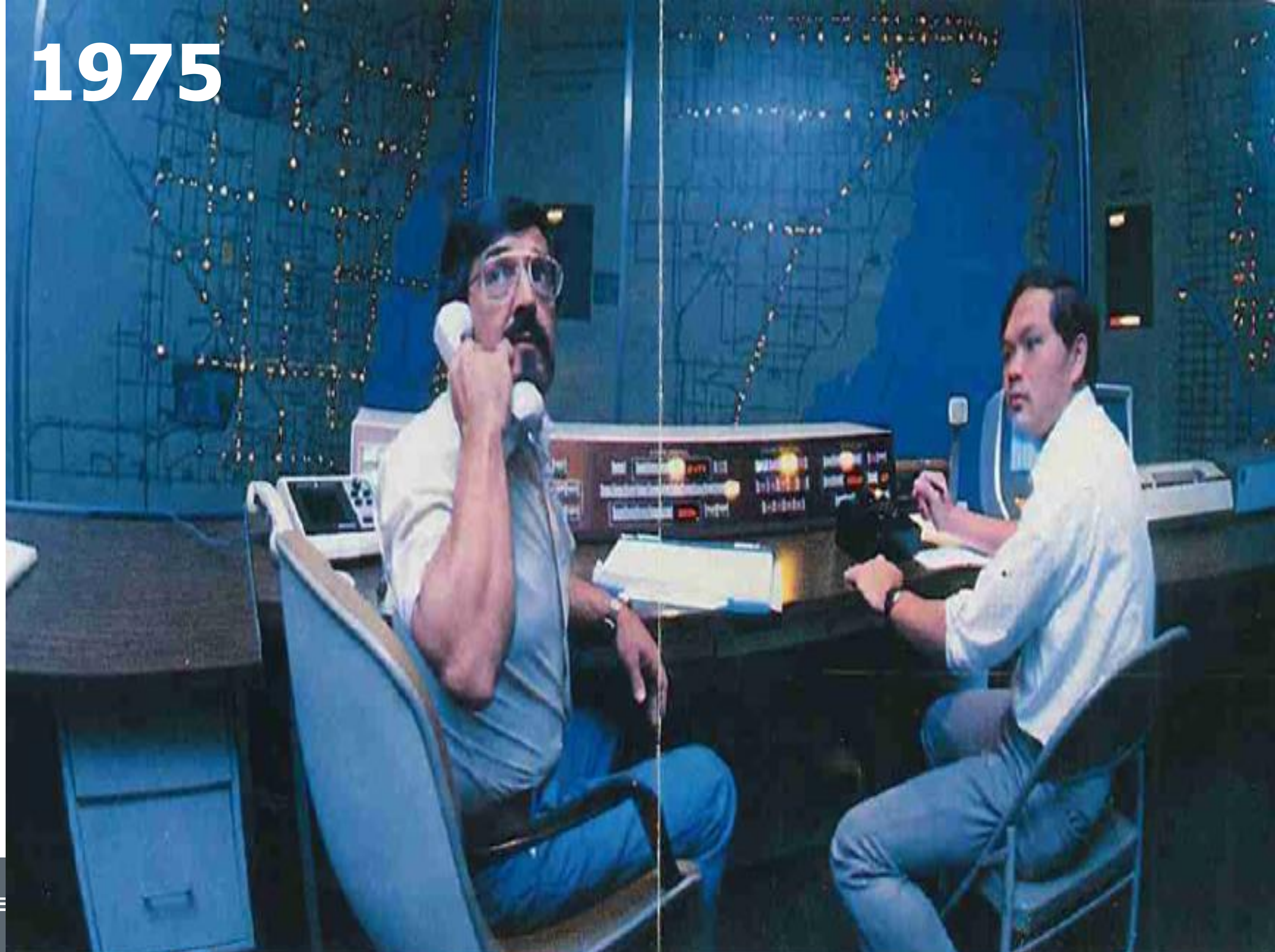
**Easter morning 1913: 5th Ave, New York City.
Spot the horse.**

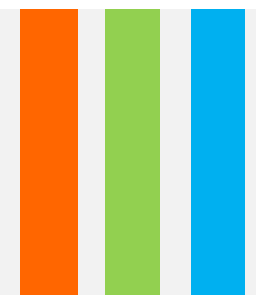
Disruption can happen very fast...



Source: George Grantham Bain Collection.

1975



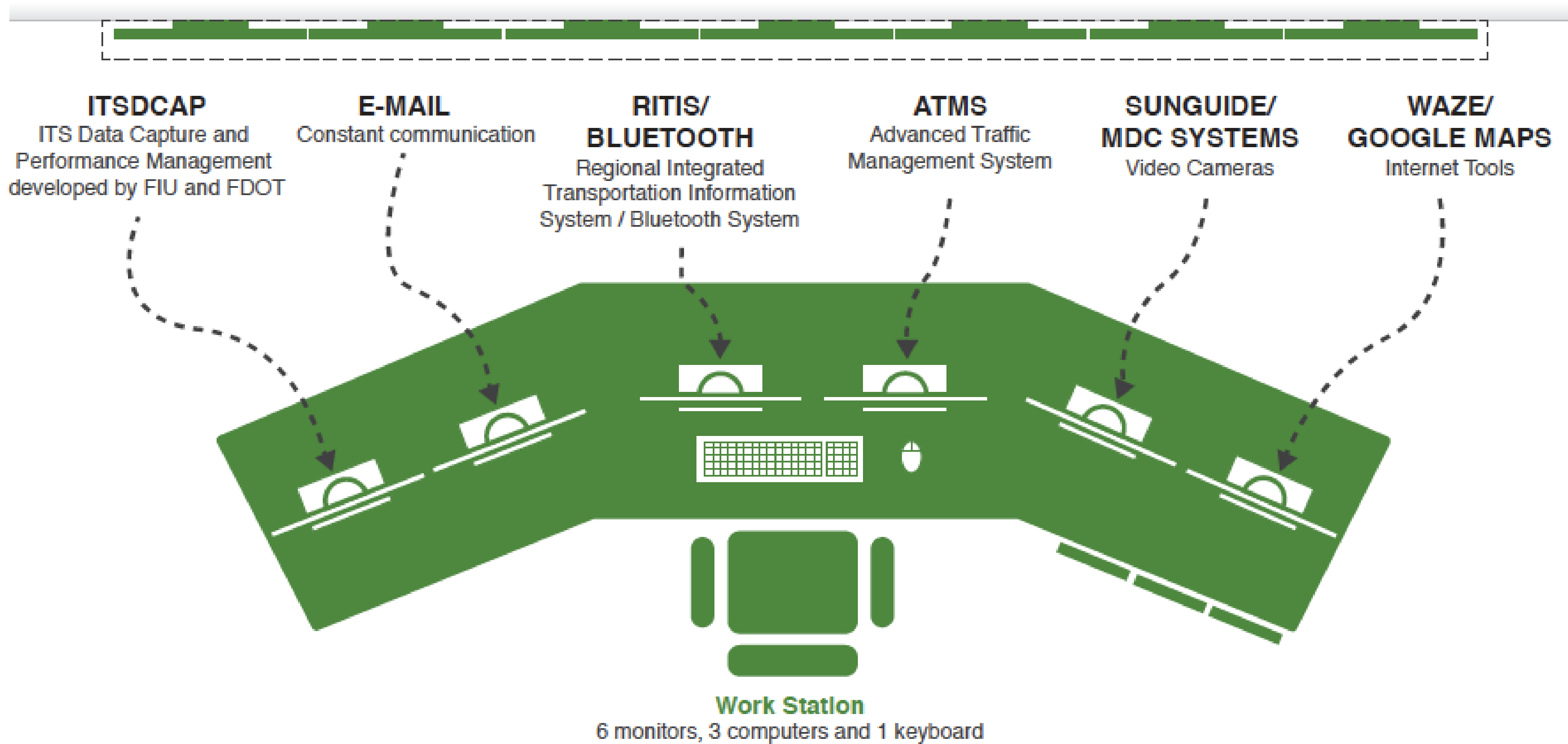




TOOLS & RESOURCES

VIDEO WALL

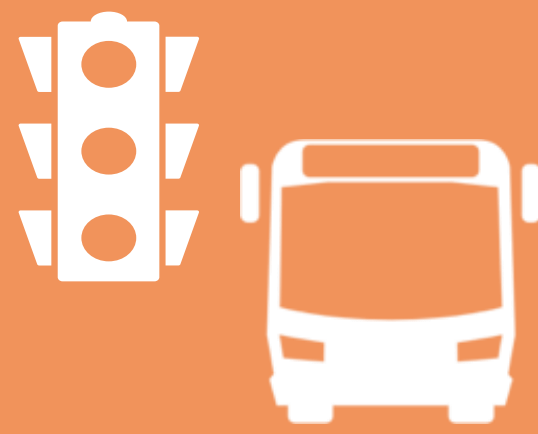
2 rows of 7 monitors (14 total) connected to the workstations





Adaptive and Connected

Upgrades to the traffic signal systems to fully adaptive signal controllers



Transit Signal Priority

Bringing Transit to the front line in traffic management techniques

SMART TECH



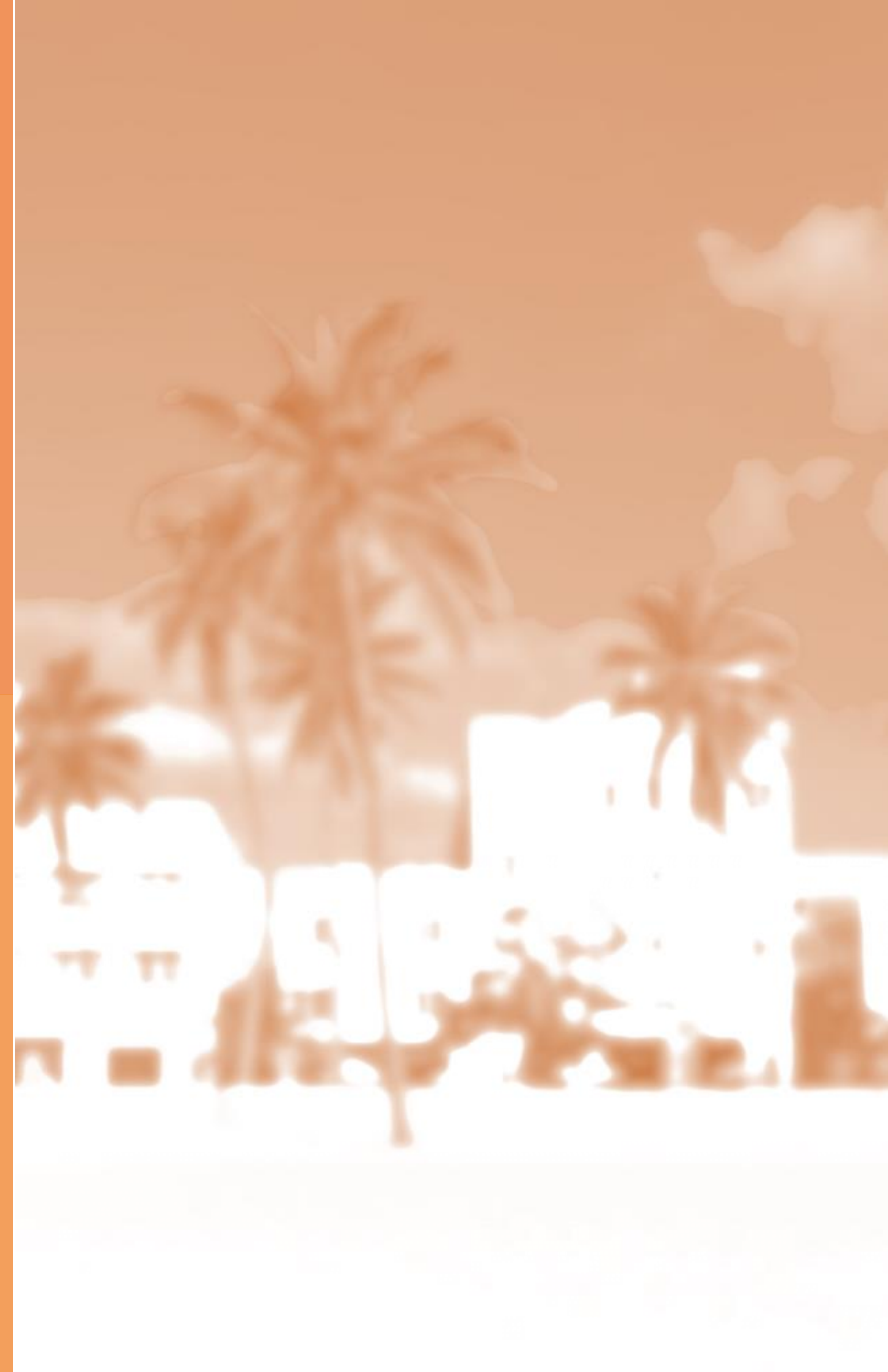
Communication Network

Taking advantage of streetlights to create a communication network for Smart Cities Solutions



Mobility Management

Using technology to manage demand in *Time, Space* and *Mode*



Capacity

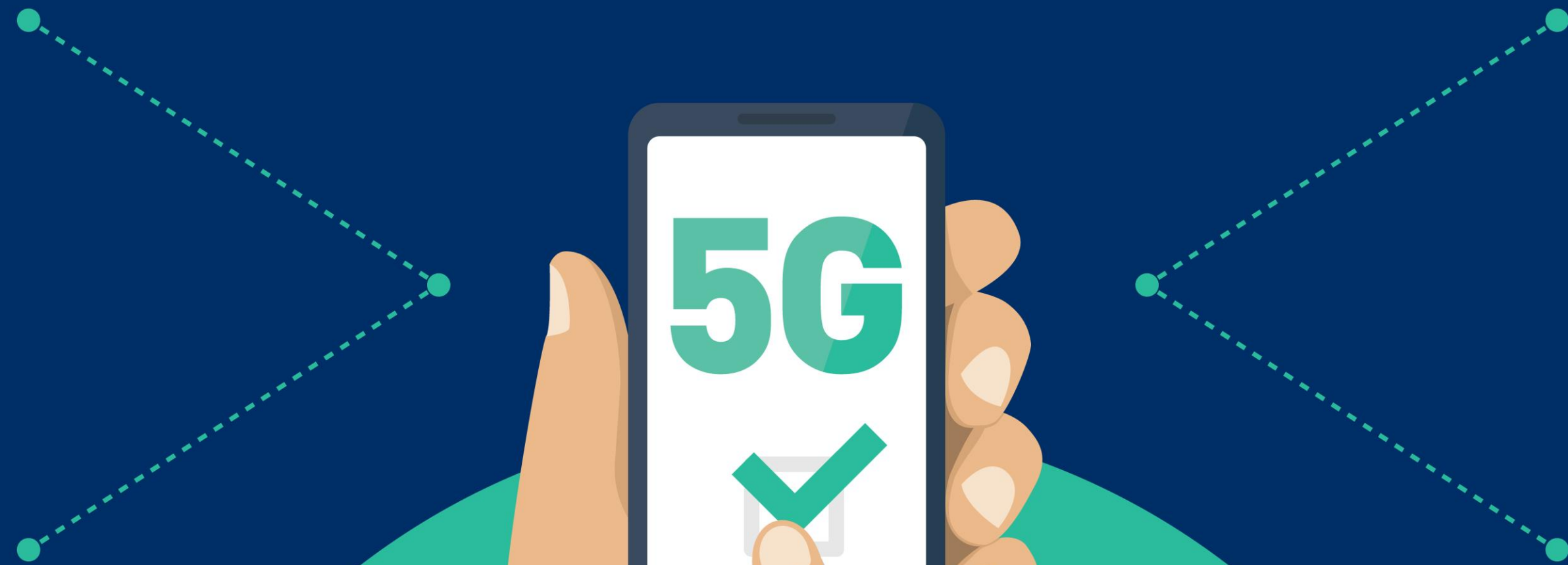
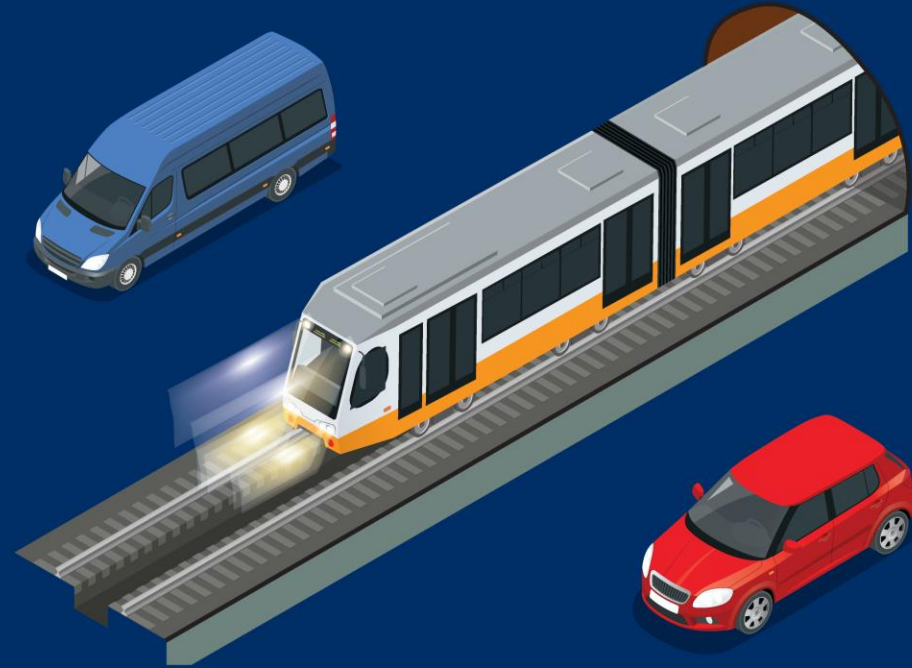
Coverage



Bandwidth

ENTER

[click here for more information](#)



New York Subway

- The largest in-building DAS network in the world covering all NYC underground stations with expansions into the tunnels.
- Serves 282 underground stations.
- Design, built, operate entire network from 5 base station hotels to 160 miles of carrier grade fiber optic cable.
- Integrated Access Points throughout each station.
- Privately funded with a license that extends to 2038 and covers all current & future commercial cellular wireless bands as well as unlicensed WiFi bands.
- Supports Transit Apps, Public Safety and Security requirements for Federal, State and City agencies.

Objectives

- Resilient, fault-tolerant
- Leverage fiber for future assets
 - Street infrastructure
 - Buildings
- Ubiquitous WiFi
 - APPs to promote transit
 - Ad-based
- Support NYC Transit Operations

Challenges

- Heat
- Equipment size and orientation
- A lot of RF
- 24x7 Rail Ops with Express Track (only system in the world)
 - 22 Lines
 - 5.7 million daily riders
- Multiple agencies involved
- Cost



Design

- Double Star Topology
 - Base Station Hotels to Stations
 - Primary Station Hub to multiple nodes in each station
- Fiber-To-The-Edge
 - (XG Ready)
 - Each station capable of well over 100Gbps
- Integration of CMRS, WiFi and PSR

Benefits

- Integrated solution a cost-effective means to solve multiple communications objectives
- Carrier Off-Loading due to network densification
- Happier customers - NYCT and CMRS
- Public Safety
 - See Something, Say Something
 - Wayside Blue Light System
- Improved communication with customers

Autonomous



Connected

4 Terabytes Per Vehicle

