



Smart Connected Cities

Smart Cities need smart infrastructure



Smart
Grid

Energy Efficiency

EPB in Chattanooga built out a fiber network to reliably manage its energy and electrical systems



Smart
Health

Healthier Cities

Hiawatha Broadband in Minnesota piloting project to use its fiber as a platform for home monitoring of patients with dementia



Sensor
Network

Civic IoT

US Ignite and cities around the U.S. (and the world) are developing a smart city app store predicated on big bandwidth



Smart
Mobility

Safer Streets

Verizon and the City of Boston are using sensors and advanced traffic signal controls to measure traffic, improve safety



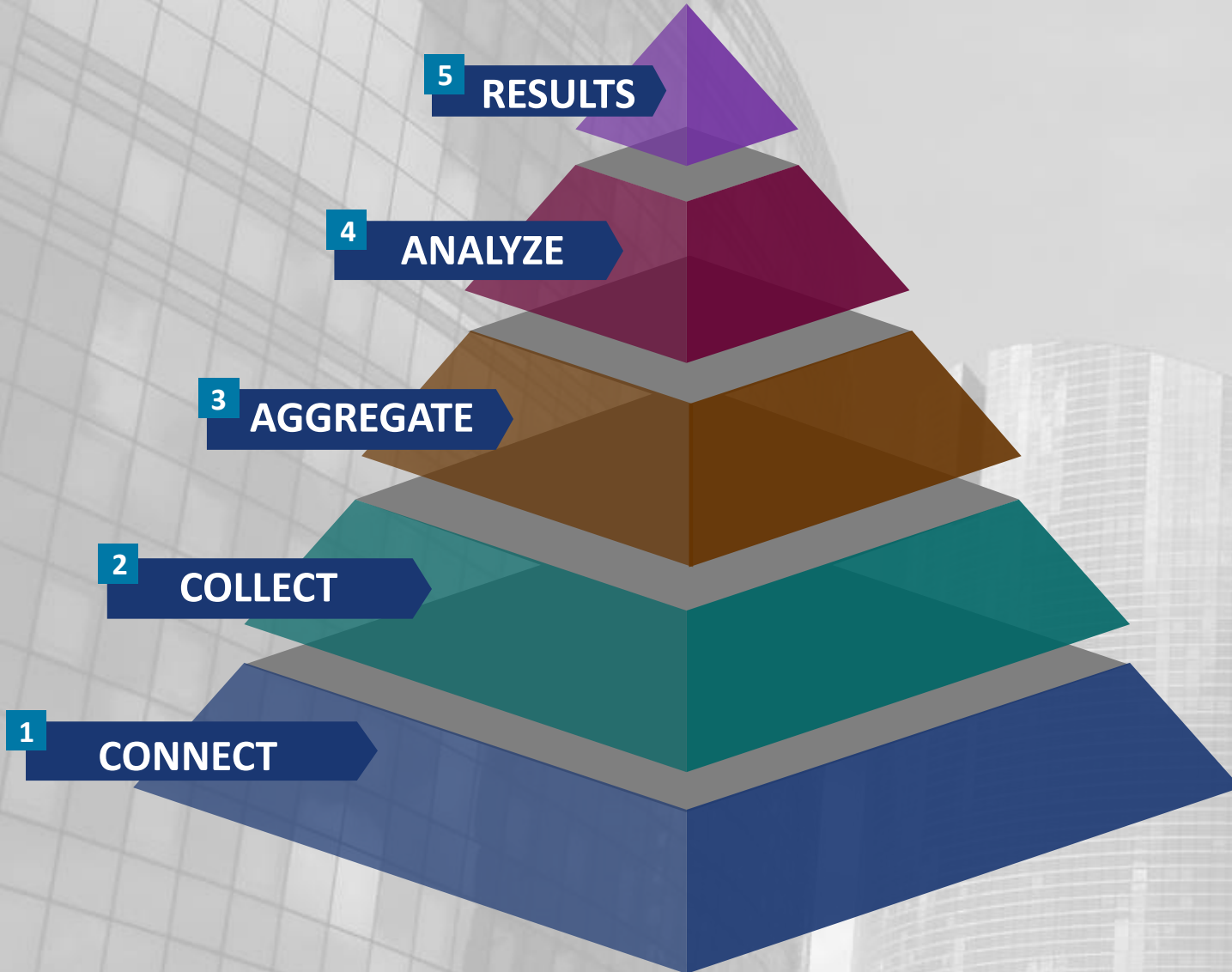
City
Wi-Fi

Connected Community

Santa Monica City Net provides fiber-supported Wi-Fi to its residents in public places



Building Smart City Infrastructure



USERS & CONSUMERS



Transform user and customer experience with engaging, enhanced and autonomous services

ANALYTICS & INTELLIGENCE



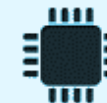
Transform data into insight, action and knowledge. Integrate into business and operational processes.

DATA FLOW & DEVICE CONTROL



Collect data and manage devices on the network. Use edge computing and gateways prior to sending to the cloud.

DEVICES & SENSORS



Deploy devices and sensors to measure existing and new data sets. Inventory assets that are not measured today.

CONNECTIVITY & ACCESS



Build a network foundation for connectivity and access for more bandwidth, device types & mobility.

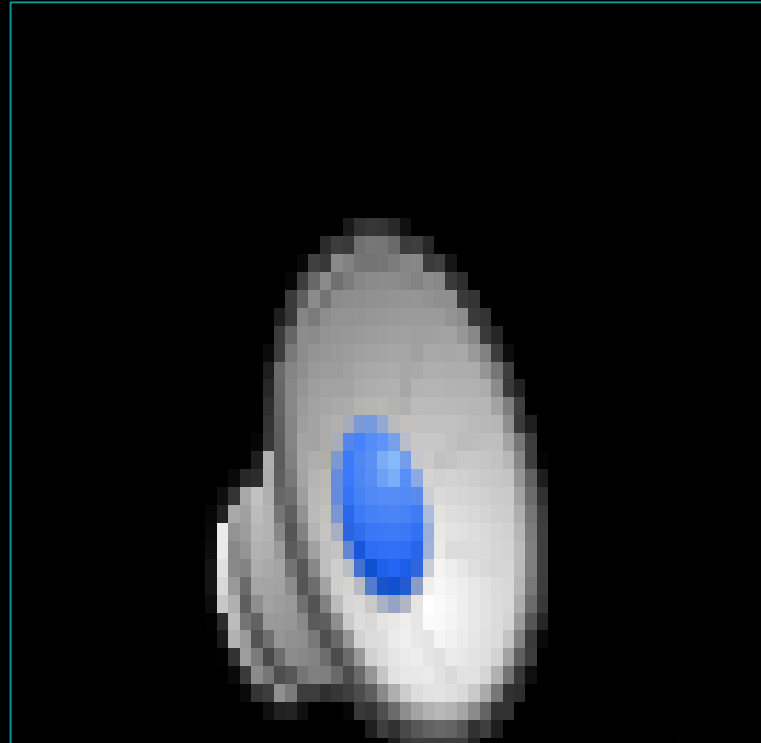
Video + AI = Rich Insights and Alerts Operations, Business and Safety Intelligence

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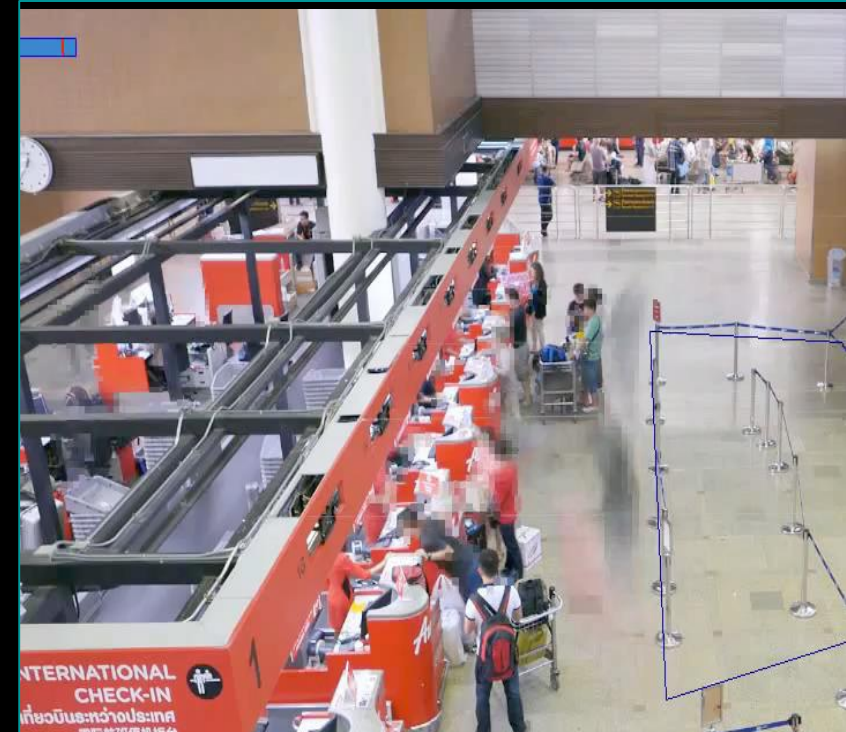
Traffic Analysis



People Counting



Operations and Privacy



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

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Evaluating Public Private Network Projects

Governments seek the optimal balance between three interwoven issues

- Risk
- Benefit
- Control

Governments prefer to focus on the “middle mile”

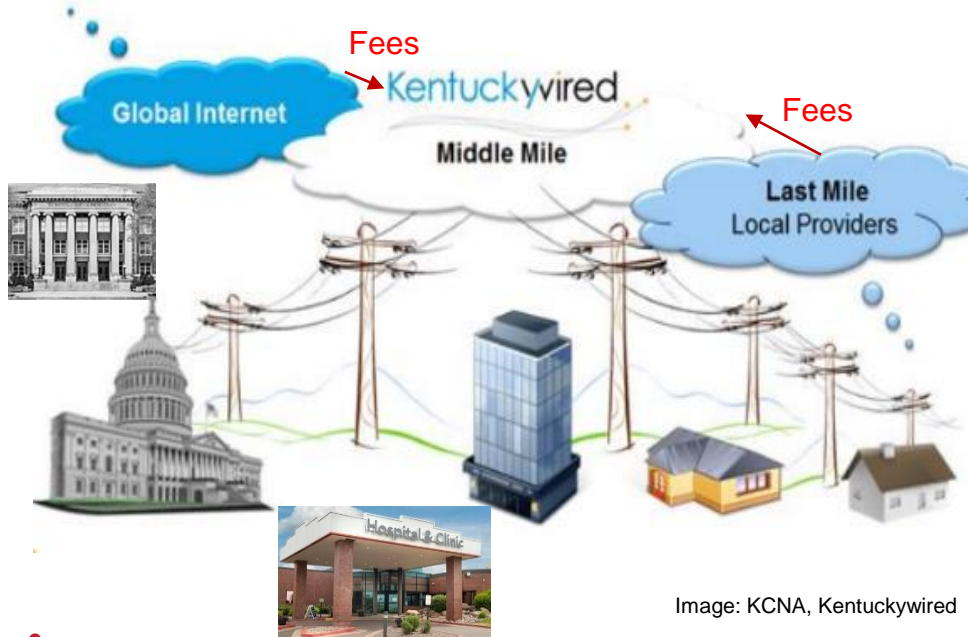


Image: KCNA, Kentuckywired

“Traditional”

“Emerging”

Governance Entity	Definition
Municipal Department	A local government creates a town or county department for the purpose of offering broadband.
Regional Authority	An independent entity jointly owned by several local governments for purpose of offering a shared service.
Private Coop	A private sector coop owned by the customers receiving services.
Non-profit	A 501(c)3 private corporation formed for a specific charitable purpose.
LLC/LLC	A general purpose private sector corporation owned by the participating partners.
Public/Private Partnership	A private company working in close cooperation with participating local governments.
Ad Hoc	An informal committee formed for a specific purpose.
Economic Development Corporation (EDC)	A public or private corporation formed to promote economic development in a geographic region.

Source: Roanoke Valley Broadband Authority, Fiber Infrastructure for the 21st Century

Smart Cities invest in smart infrastructure like fiber



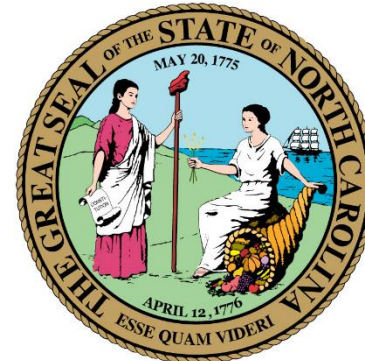
According to 2018 research from RVA, LLC:

Fiber Cities are more likely to be Smart Cities

- Cities with fiber have, on average, **37% more deployed small cells** and just **over 35% more smart city applications**
- **33% of cities without fiber** report small cell activity, versus **60% of cities with fiber** to the residence.

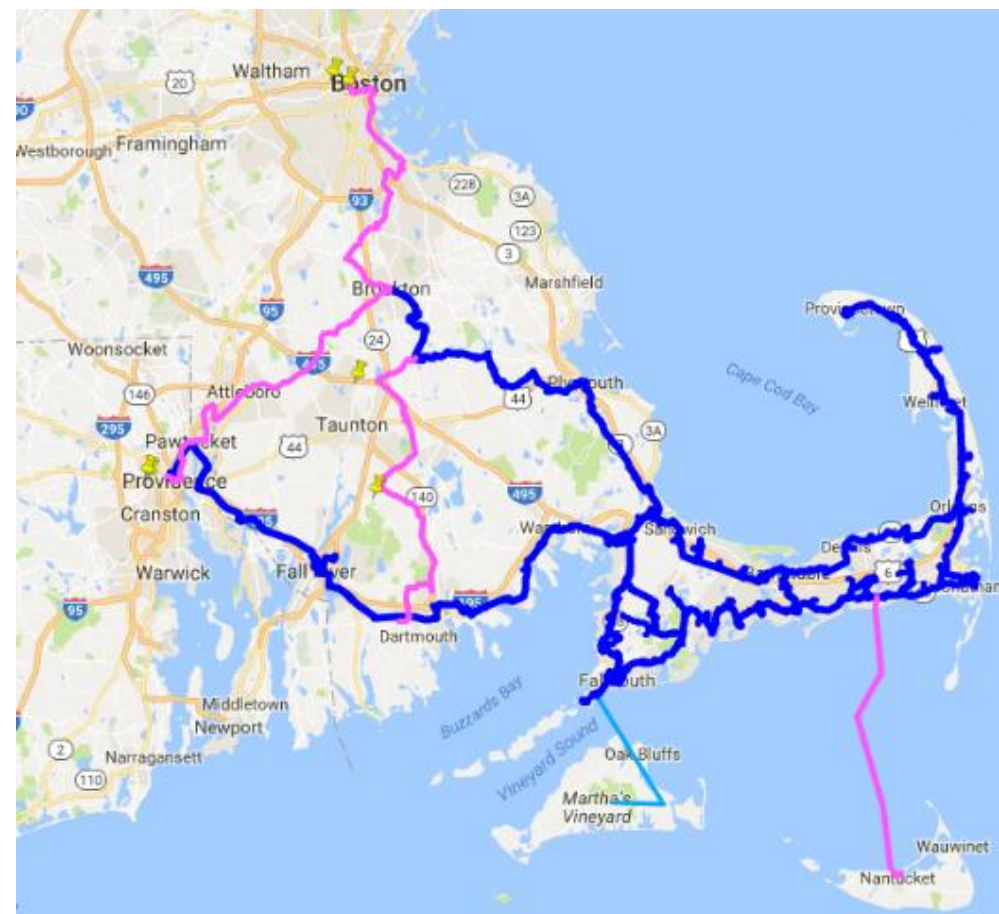


Examples of Ciena public network projects – hybrid open access



Open Cape Regional Broadband Network –475 mile fiber network across SE Massachusetts

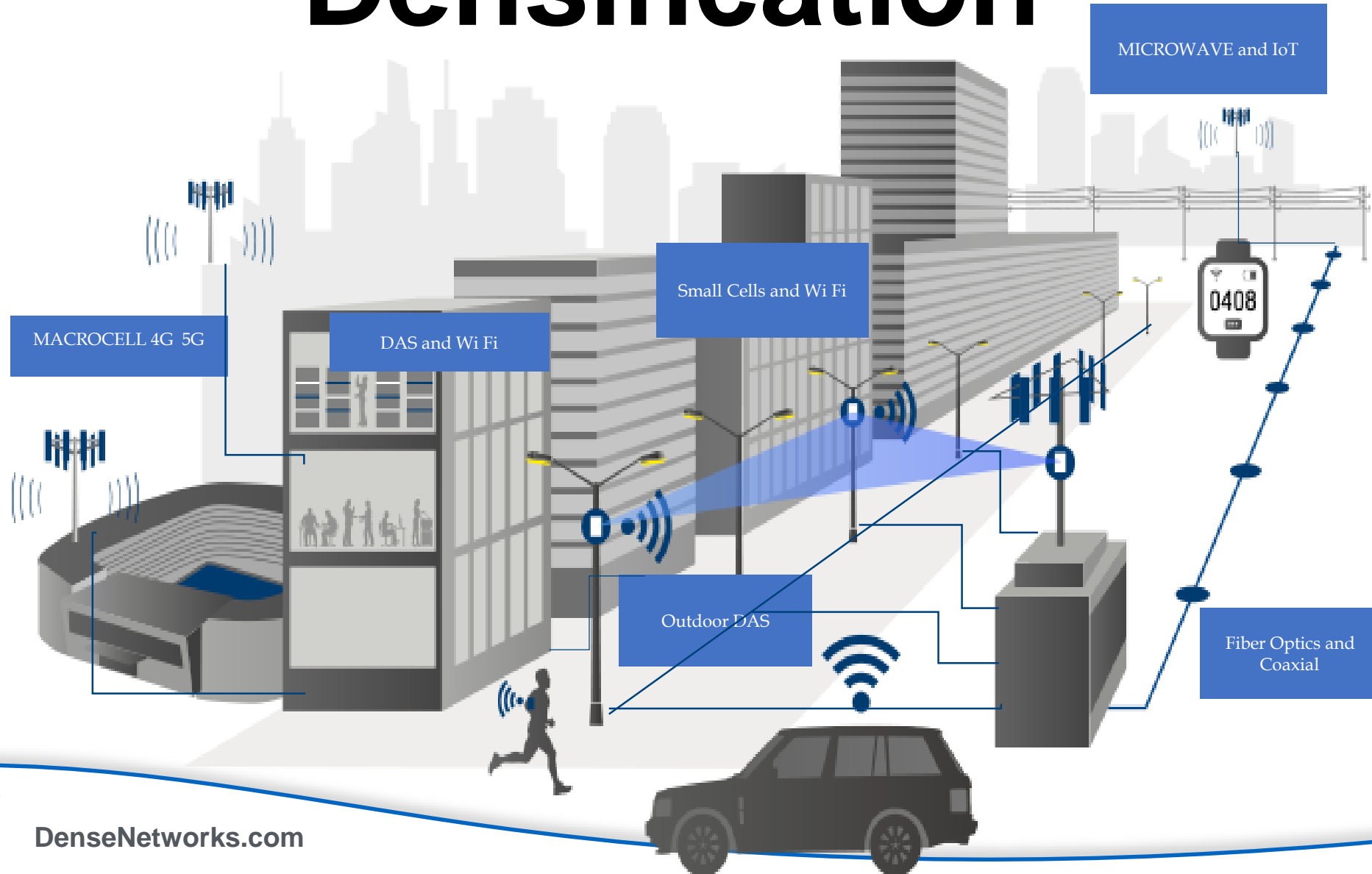
- 100G optical middle mile network using Ciena's 6500 packet-optical platform, with Carrier Ethernet aggregation and service delivery via the 5150 and 3916
- Connects approximately 70 anchor institutions, including 30 libraries, five colleges, 15 town network hubs, and six research institutions
- Throughout its entire footprint, offers further opportunities to hundreds of additional anchor institutions and nearly 62,000 businesses
- Open to all legitimate service providers that wish to use the network to offer FTTX services
- Community movements in towns across the footprint are paving the way for residential services.



Ciena has proven leadership in optical transport technology- enabling CapeNet to build an agile, scalable network architecture with the ability to increase capacity as needed.

- Shannon Silvus, CapeNet CTO

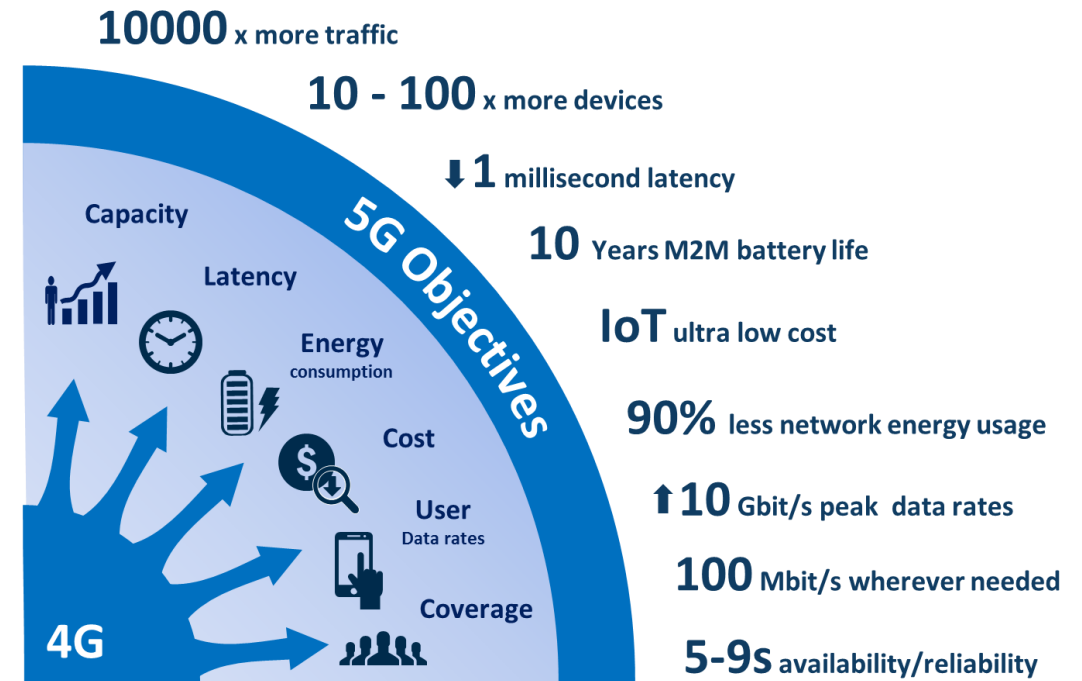
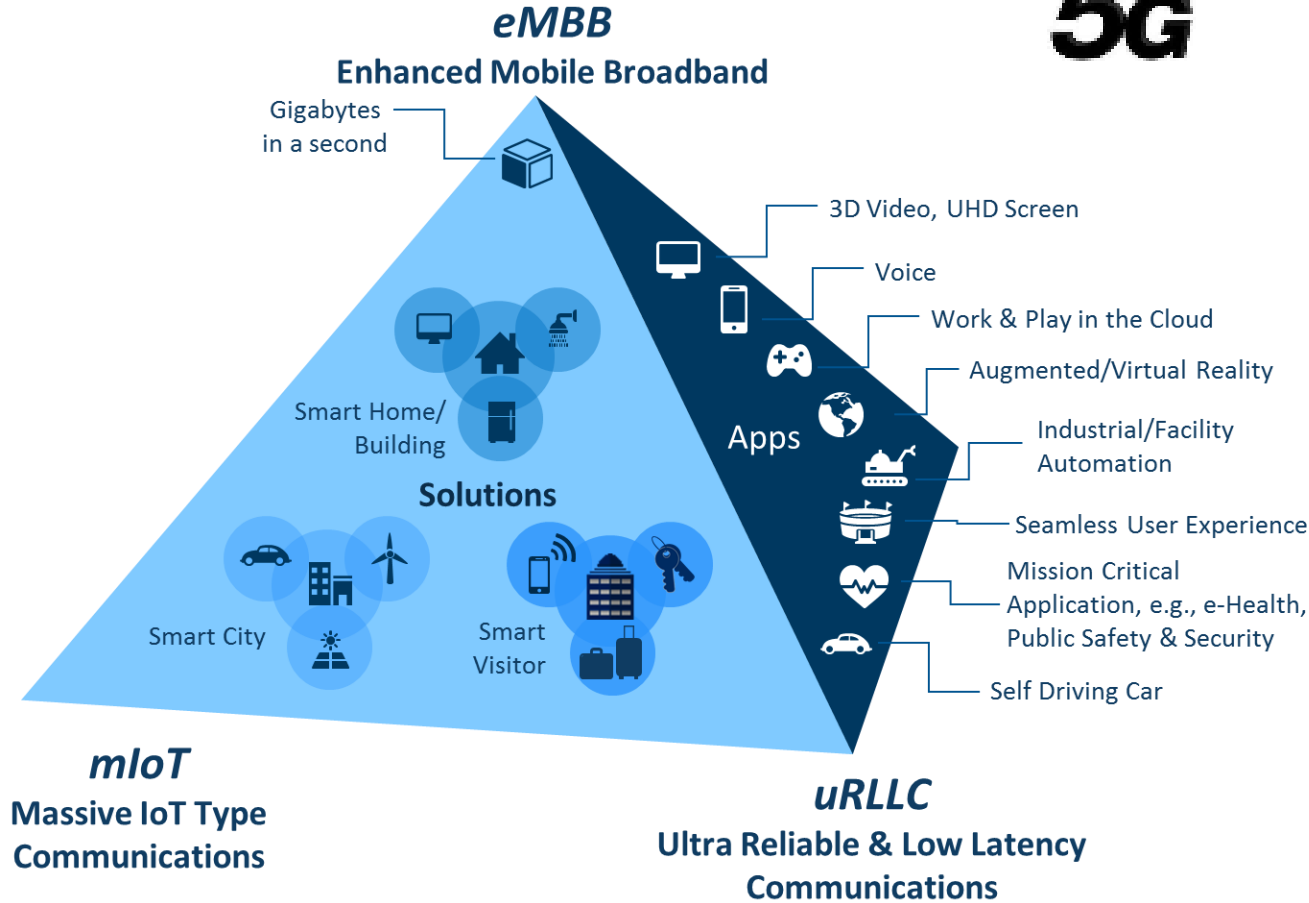
Densification



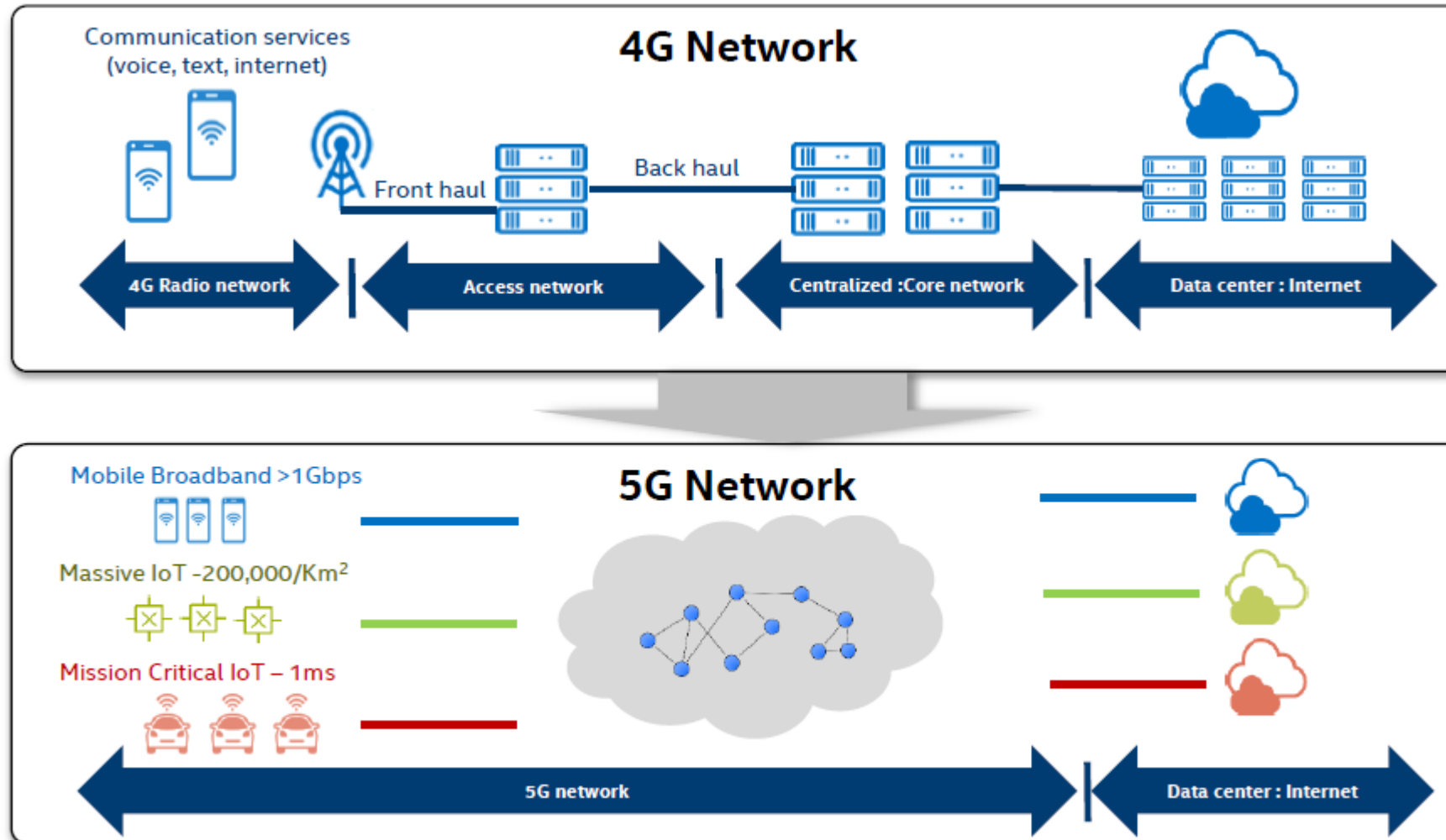


5G Goals and Objectives

International Mobile Technology 2020



Multiple Dimensions of 5G



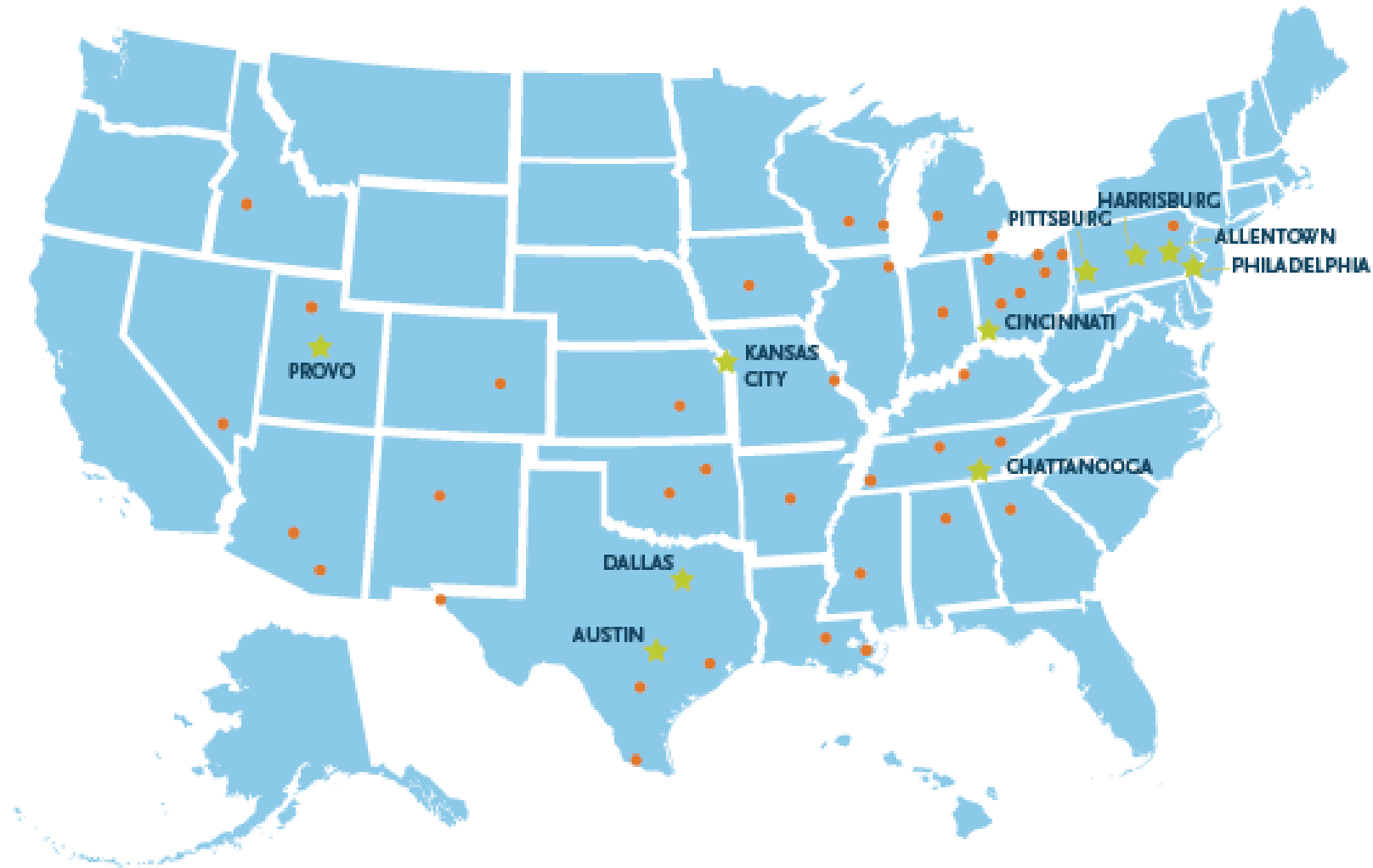
Source: Intel

Economic Development: Fiber's Killer App

Ten Year Gross Metropolitan Product:
64% Better For FTTH Cities

Ten Year Job Impact:
72% Better For FTTH Cities

Better Year New Business Formation:
46% Better For FTTH Cities

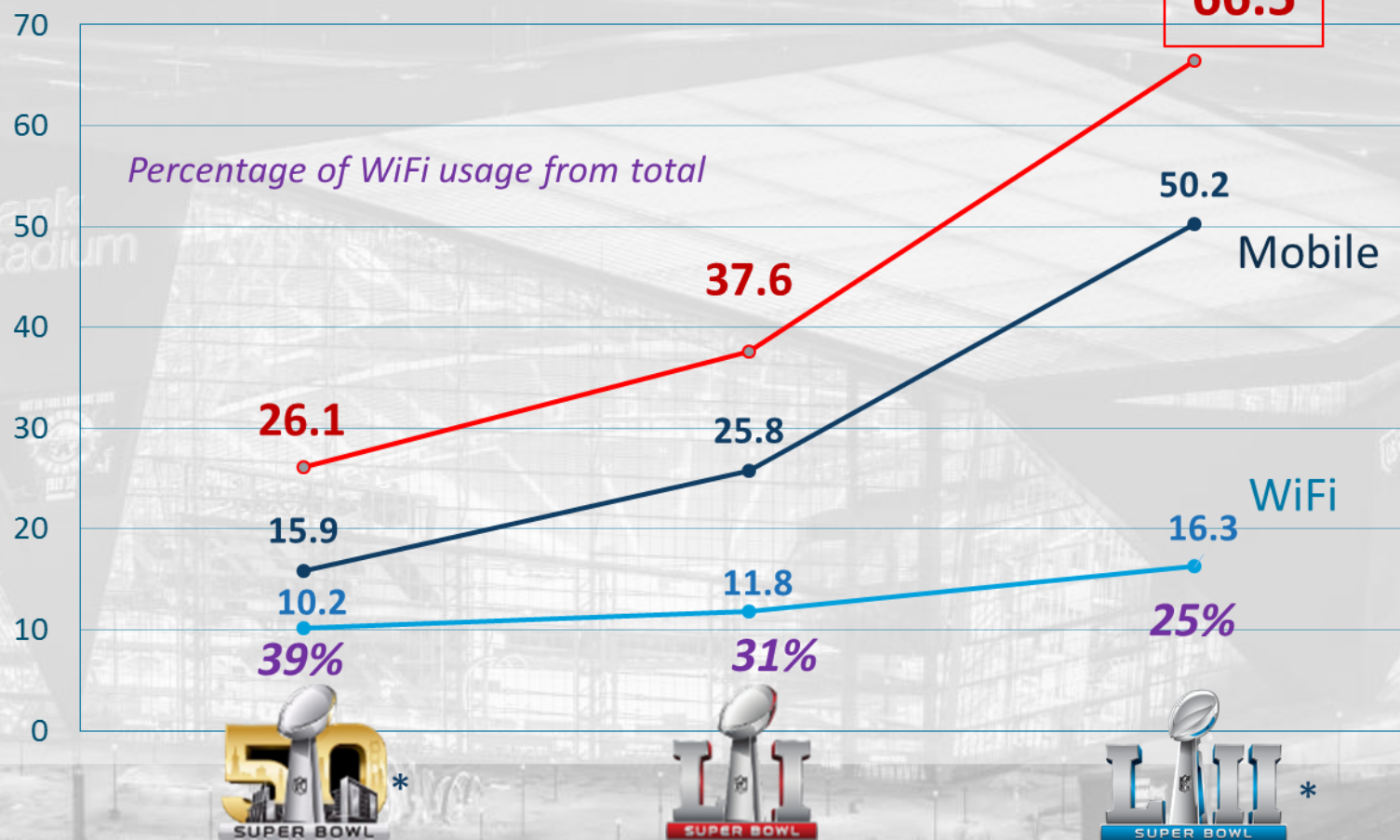


Mobile/Wireless Bandwidth Demand



US Bank Stadium
Minneapolis, MN

Data Usage per Superbowl (TB)



* JMA Wireless in-building solutions used for mobile traffic

SOURCES:

- Data usage at Super Bowl 52 grows 48% as social media use skyrockets <https://www.techrepublic.com/article/data-usage-at-super-bowl-52-grew-48-as-social-media-use-skyrockets/>
- Super Bowl 51 makes digital history with record-breaking data usage <https://www.techrepublic.com/article/super-bowl-51-makes-digital-history-with-record-breaking-data-usage/>
- AT&T, Verizon and Sprint see a combined 50.2 TB of cellular traffic for Super Bowl 52 <https://www.mobilesportsreport.com/2018/02/verizon-sees-18-8-tb-of-cellular-data-used-at-super-bowl-52/>
- Super Bowl fans use a record 10TB of data on Levi's Stadium WiFi network, up 63% from 2015 <https://www.geekwire.com/2016/super-bowl-data-usage/>



4 TB per car per day

x17





Office Buildings

Industrial

Suburbs

Public Areas

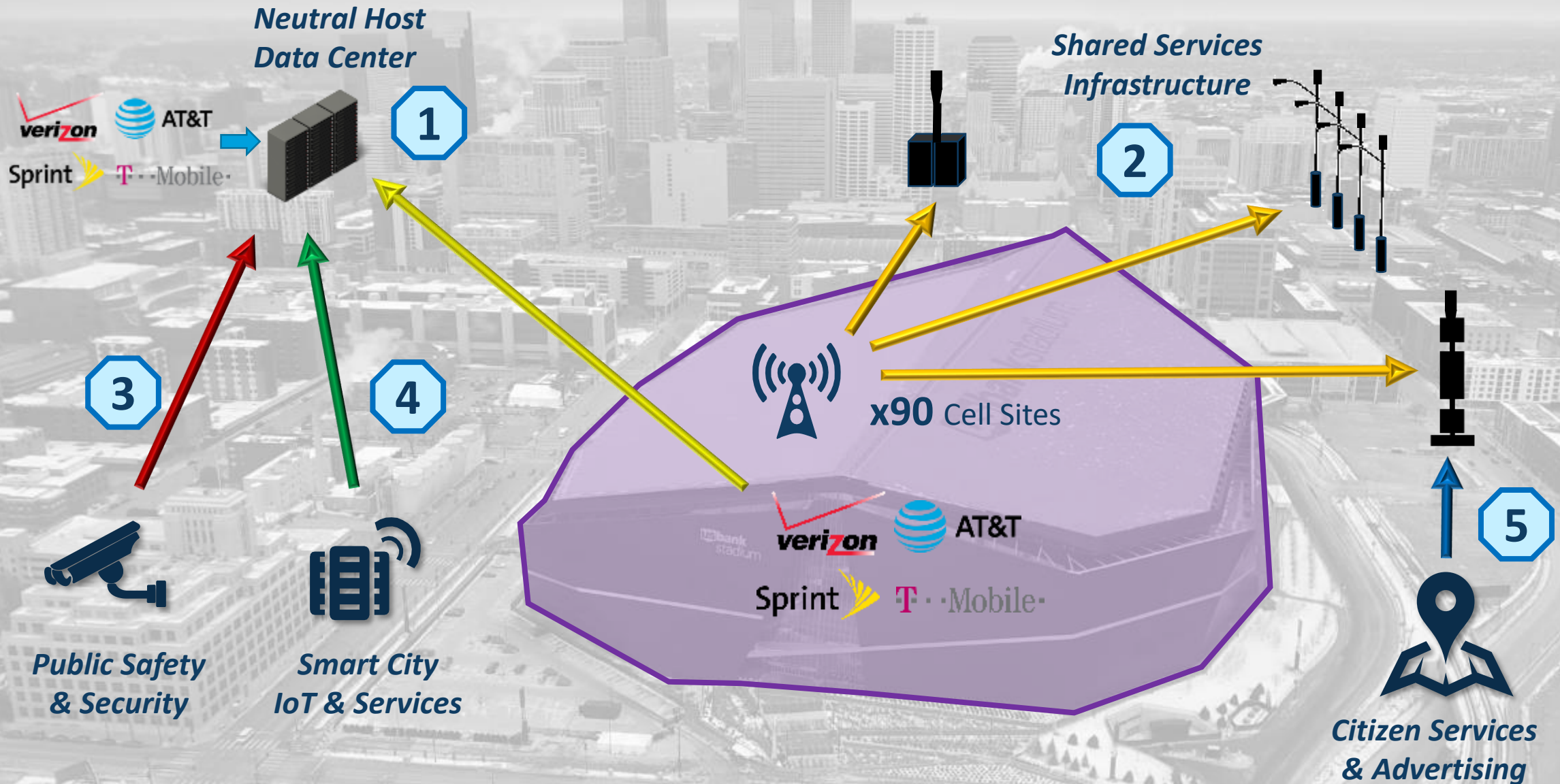
Major Venues

Transportation Systems

Private Campus

Metro Area Neutral Host

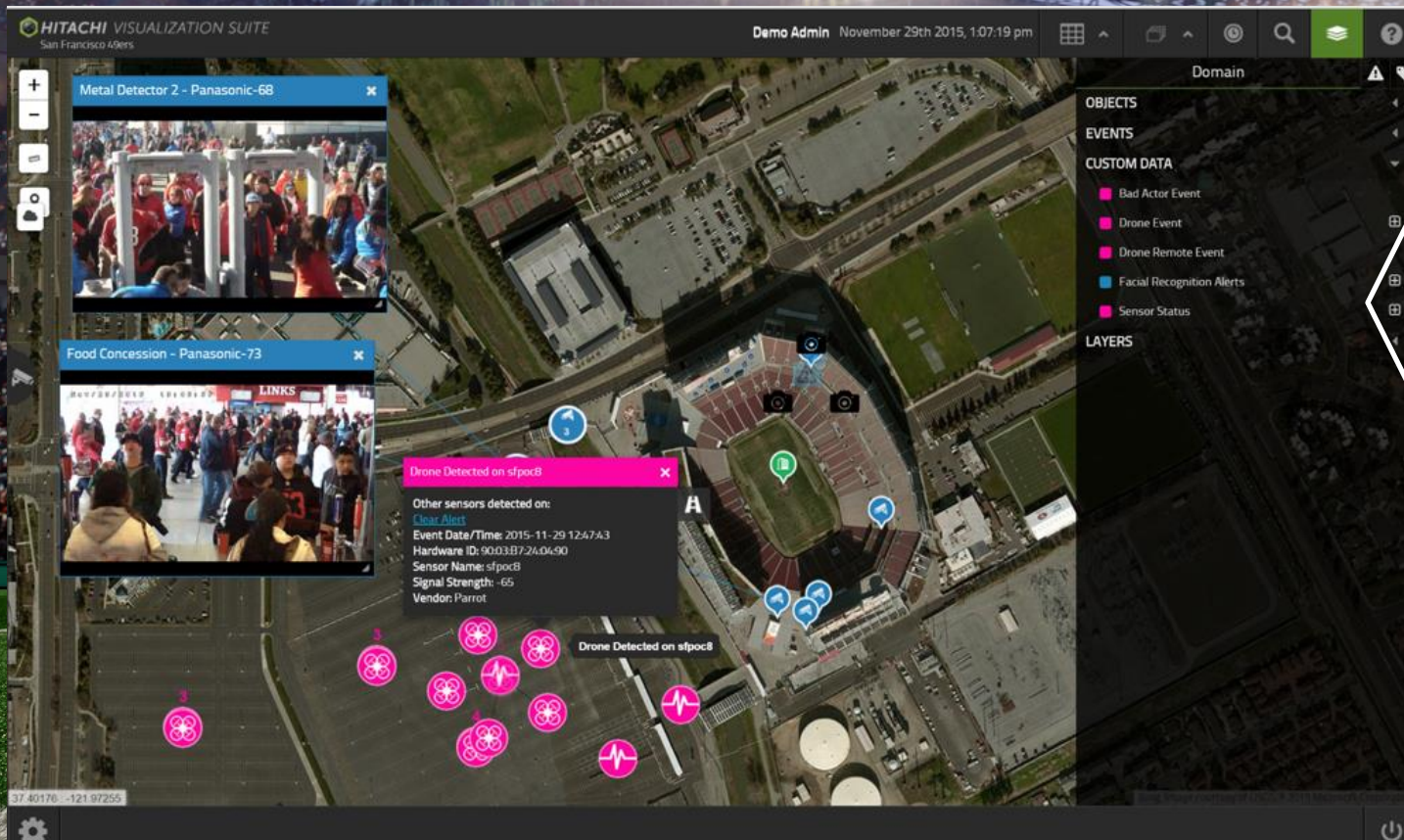
Metro Area Neutral Host



Smart and Safe Stadiums

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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

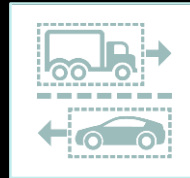
Hitachi Video Analytics Delivers Digital Insights

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Operational & Business Intelligence



People Counter



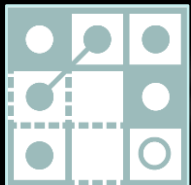
Traffic Analyzer



Queue Detector



License Plate Recognizer



Activity Visualizer



Parking Space Analyzer



Direction Controller



Camera Health Monitor

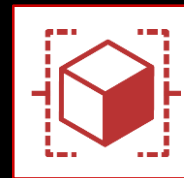
Security



Intrusion Detector



Facial Recognition



Object Detector



Video Enhancer

Privacy



Privacy Protector



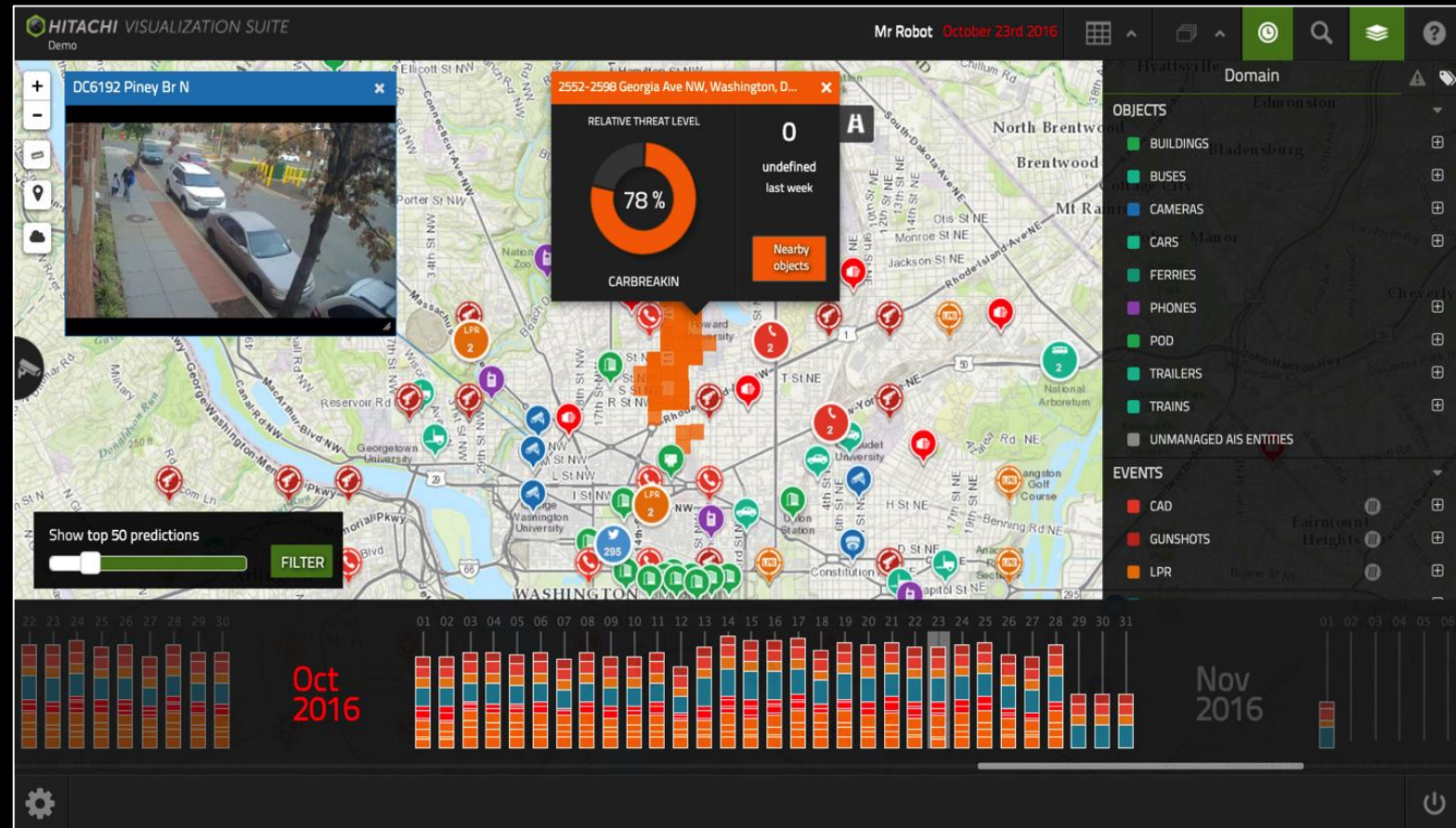
European Privacy Seal
EP-P-F9LDTM / Valid till 2017-10

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

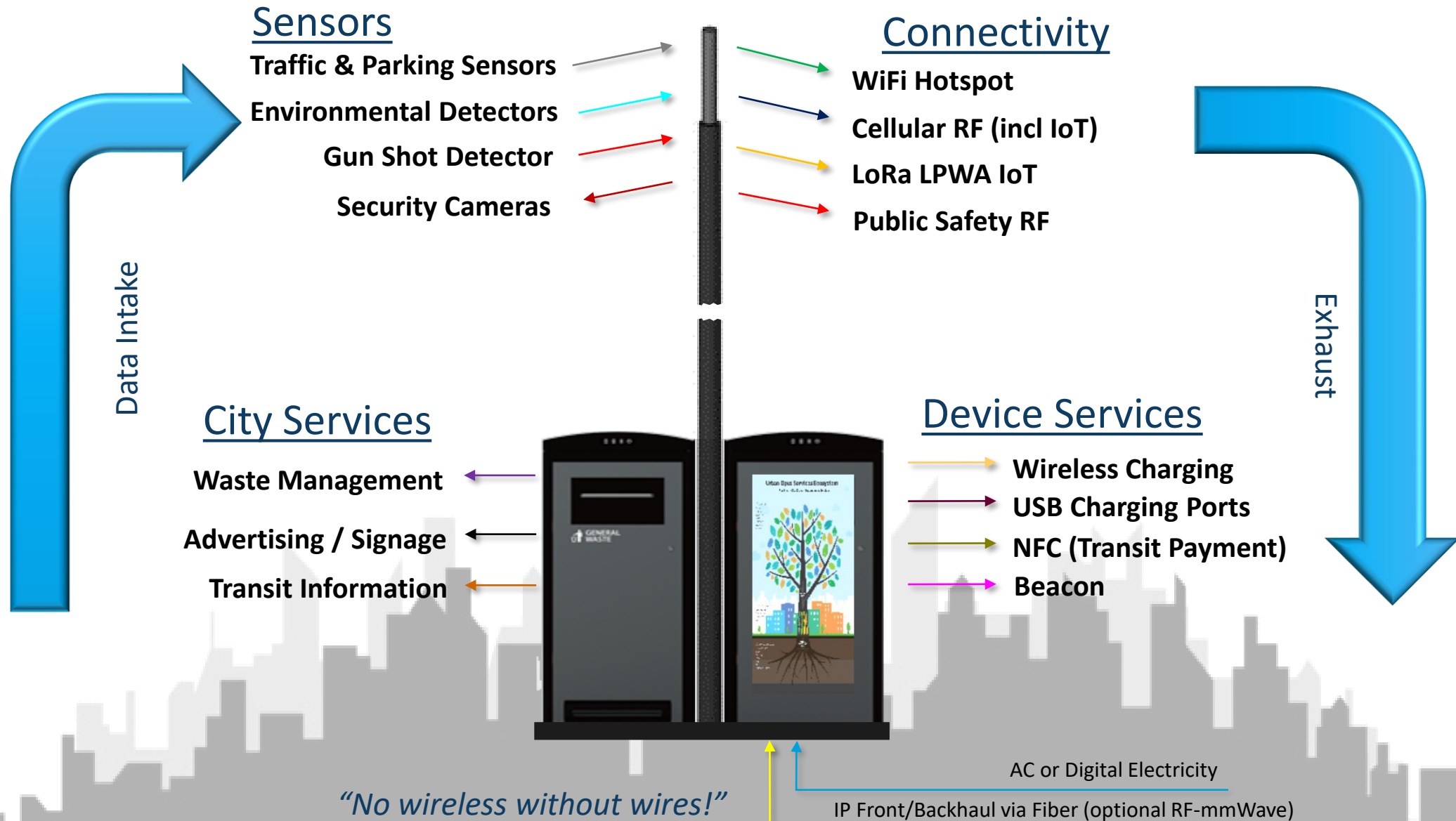
Situational Awareness Through Hitachi Visualization Suite

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- 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



Network Edge of the Smart City



Broadband Strategy

Emerging landscape for voice and DATA

Effective in Dense Urban, Urban, and Suburban

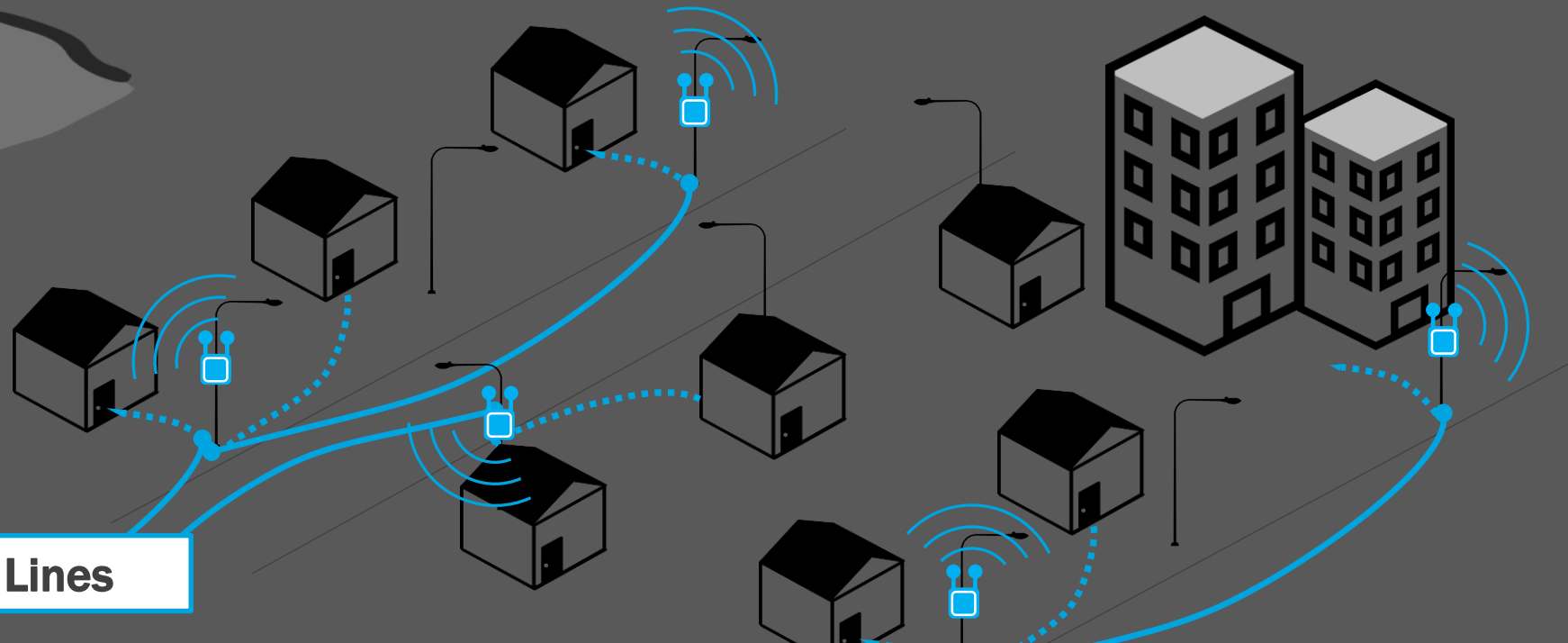
Cell towers: carry all mobile voice & some data

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

Gigabit speed
up to 50x faster

Fiber Lines

Light pole is most valuable asset for broadband



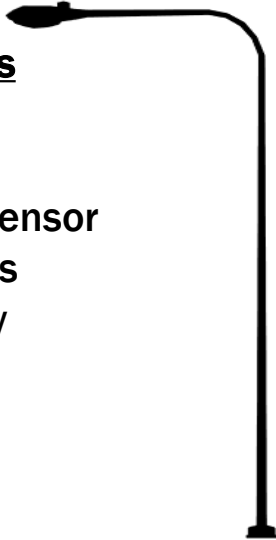
Broadband Strategy

STREETLIGHT

Light/Safety

Properties

- Height
- Power
- Light Sensor
- Lumens
- Density

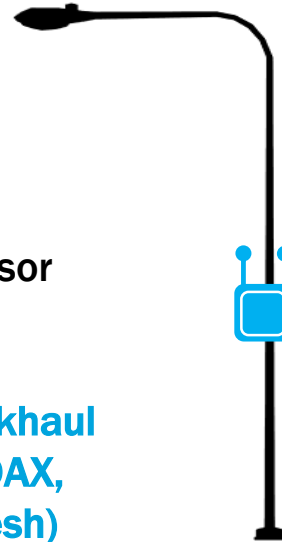


SMALL CELLS

Broadband Digital Infrastructure

Properties

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

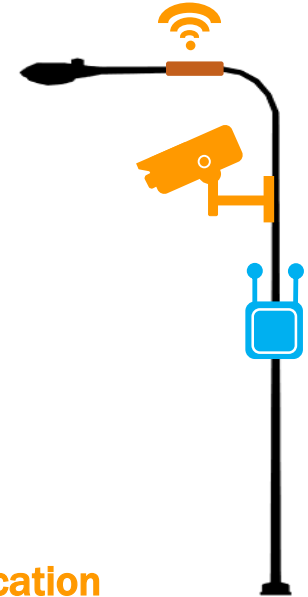


INTERNET OF THINGS

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



Governments have a range of potential Public Private Partnership (P3) models

Public Facilitation of Private Investment

- Partner owns and operates the network
- Governments “facilitates” build out
 - Tax benefits and incentives
 - “Dig Once” and “Make Ready” statutes
 - Access to Public Rights of Way, conduits and agency fiber
 - Streamlined permitting and approval processes
- Examples: Mesa, AZ, Holly Springs, NC

Public Funding and Private Execution

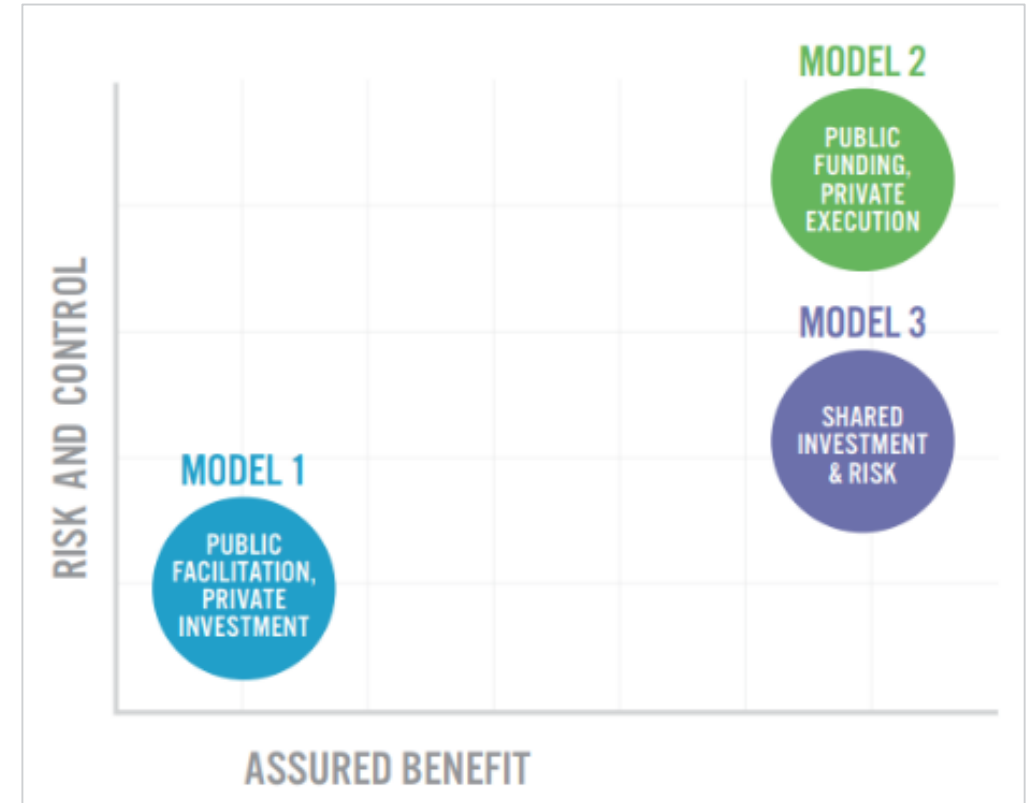
- Government provides funding and/or act as project “guarantor”
- Governments grants long-term “concession” to partner
- Partner provides design, construction, operations and maintenance
- Example: Kentuckywired, Huntsville

Shared Investment and Risk

- Government and Partner find hybrid ways to share risks, costs and benefits
- Allocate capital and operating risk, ideally targeted to their respective strengths
- Examples: Urbana/Champaign, IL, Lincoln, NE

Broadband Public-Private Partnership (P3) Models – Government Perspective

	MODEL 1 PUBLIC FACILITATION, PRIVATE INVESTMENT	MODEL 2 PUBLIC FUNDING, PRIVATE EXECUTION	MODEL 3 SHARED INVESTMENT & RISK
RISK	LOW	HIGH	MODERATE
BENEFIT	POTENTIAL BUT NOT ASSURED	HIGH	HIGH
CONTROL	NONE	MODERATE	MODERATE



Source: CLIC & Benton Foundation, The Emerging World of Broadband Public-Private Partnerships

Initiatives for Resiliency



- Broadband Deployment Advisory Committee (BDAC)
 - Disaster Response and Resiliency Working Group
 - Industry Standards and Infrastructure
 - Mutual Aid, Support and Reporting
 - Policy and Regulations
- Alliance for Telecommunications Industry Solutions (ATIS)
 - Network Reliability Steering Committee
 - Industry Best Practices and Checklists
 - Disaster Information Reporting System (DIRS) with FCC



- Many Others
 - FEMA ESF #2, FirstNet, CTIA, TIA, WIA, Safer Building Coalition....
 - 2016 Wireless Industry Cooperative Framework



Hurricane IRMA – Early September 2017

- In FL **3,973 of 14,730** out (27.4%) with 6 counties >50%, 2 counties >80%.
- In PR & USVI **497 of 1,850** (26.9%) out with
 - St Johns 9/10 out
 - St Thomas 44/57 out
 - St Croix 9/40 out



Florida:

Percent Cell Sites Out-of-Service By County



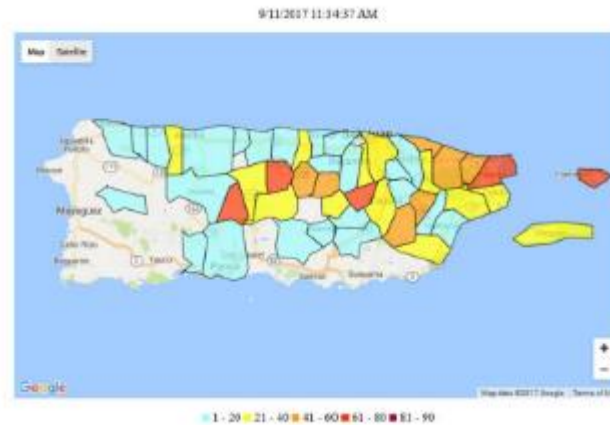
Alabama, Florida, and Georgia:

Percent Cell Sites Out-of-Service By County

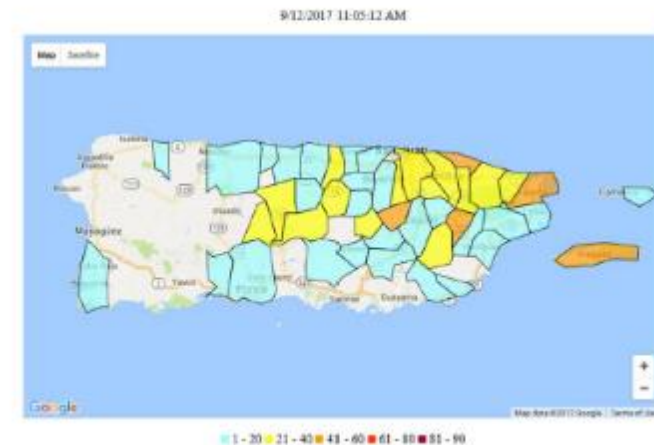


Puerto Rico:

Percent Cell Sites Out-of-Service By County



Percent Cell Sites Out-of-Service By County



Hurricane Maria – Late September 2017

- In PR **2,470 of 2,671** cell sites out (92.5%) with 100% in majority of counties/municipalities
- IN USVI
 - St John 6/9 (66.7%)
 - St Thomas 26/55 (47.3%)
 - St Croix 33/42 (78.6%)

In the fall of 2017:

- Over 5,700 cell sites impacting over 10 million people
- Plus the California wildfires (failures & responders)

Phases impacted across all hazards:

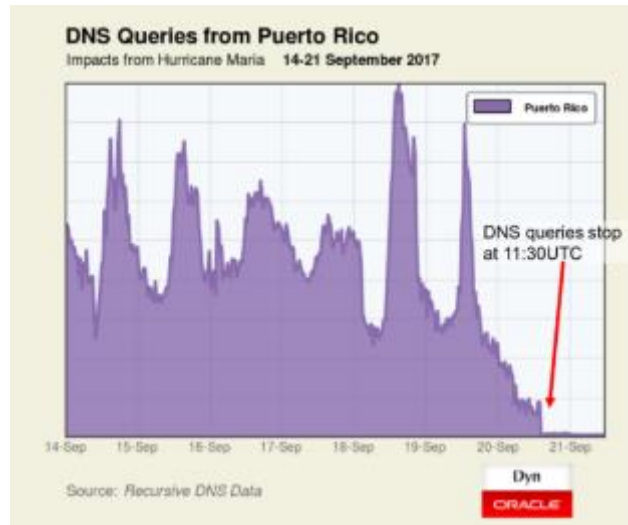
→ Preparation

→ **Immediate Response**

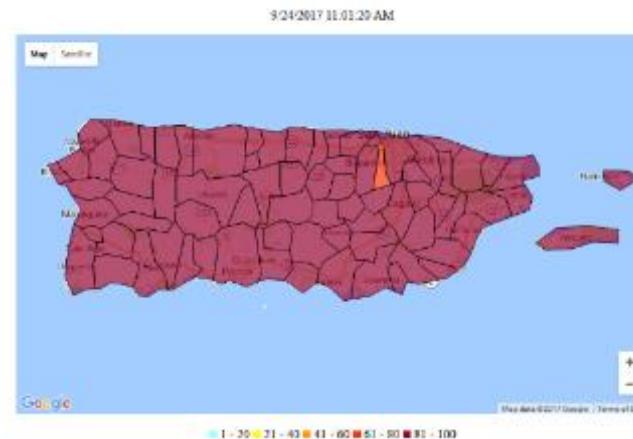
→ **Response**

→ **Restoration**

→ Recovery



Percent Cell Sites Out-of-Service By County



One Week Later

Percent Cell Sites Out-of-Service By County

