



Connected City
Smart City

- 9:05 Welcome Peter Murray, Executive Director, Dense Networks
- 9:15 Keynote-Innovation Andrew Buss, Deputy CIO, Innovation, City of Philadelphia
- 9:35 Smart City Innovations-Smart Block and Infrastructure-Sensors, Poles, Network
 - Jake Purcell, Director, Smart Solutions, Comcast
 - Akshay Malik, Director, City of Philadelphia
 - Malik Ishak, Director, Signify
 - Greg Spraetz, CRO, Network Connex
- 10:20 Broadband Funding Andy Lipman, Lead Attorney, Morgan Lewis
- 10:45 Break
- 11:00 Broadband and Digital Equity
 - Juliet Fink Yates, Digital Inclusion Manager, City of Philadelphia
 - Brandon Carson, Director, PA. Broadband Development Authority
 - Christina Wiskowski, Senior Director, Digital Equity, Comcast
 - Nicole Ugarte, Federal Program Manager, NTIA
- 11:50 Panel-Connected Cities Innovations
 - David Eckell, National Market Manager, Graybar
 - Brendan Delaney, Director, ANS
 - Jack Hanley, VP, ALEF
- 12:30 Lunch and Networking
- 2:00 Adjourn

Thank You!!



DenseNetworks.com

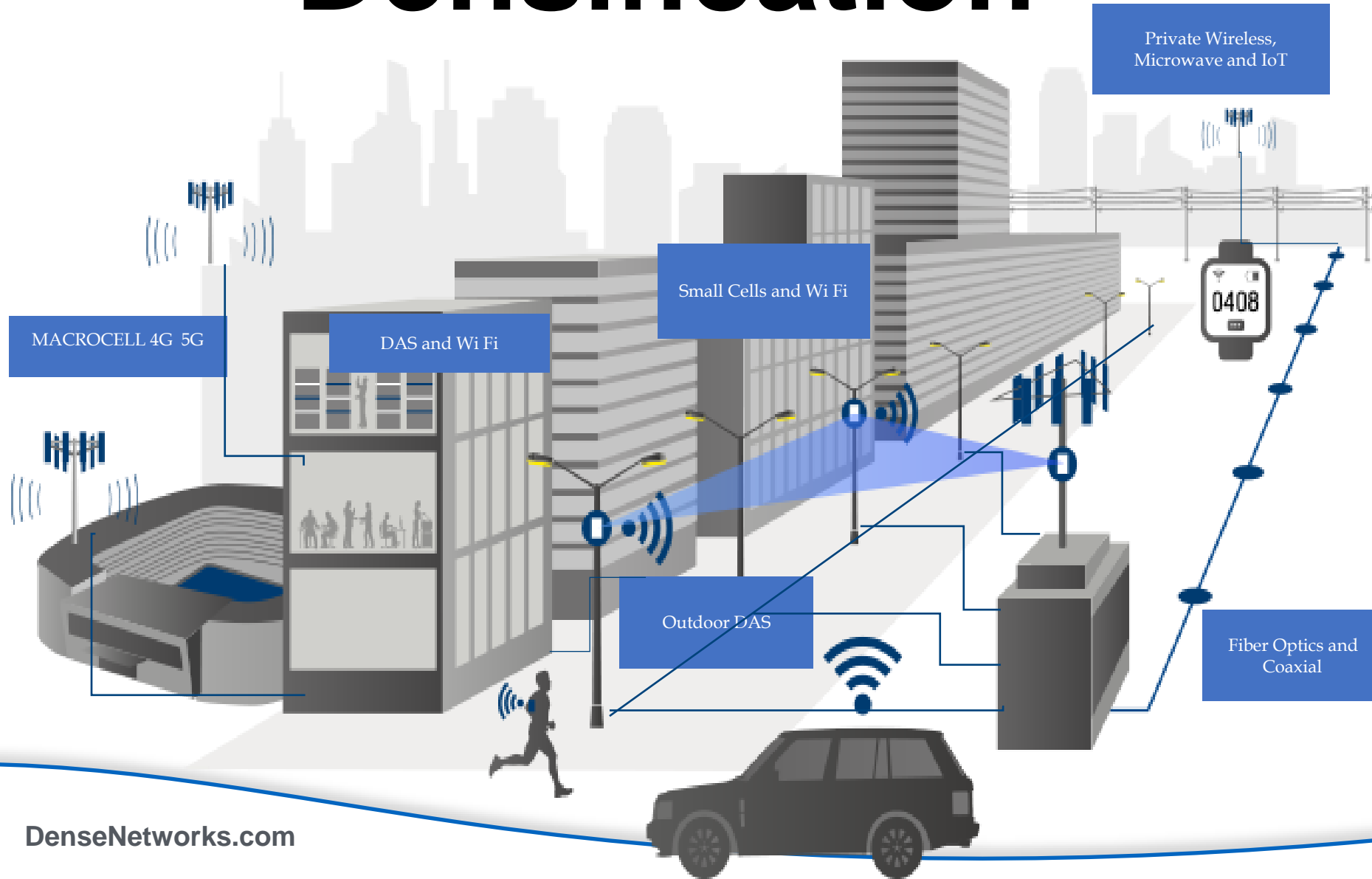


DenseNetworks.com



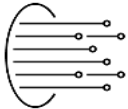
DenseNetworks.com

Densification



Digital Infrastructure

Fiber IoT Cell-Macro, Small & DAS Wi Fi Private LTE & 5G Smart Poles Devices



Cameras



Kiosks

LoRa®



Lighting +



Computers/Tablets



Sensors



DenseNetworks.com

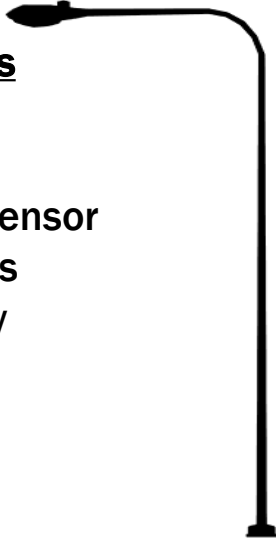
Broadband Strategy San Jose

STREETLIGHT

Light/Safety

Properties

- Height
- Power
- Light Sensor
- Lumens
- Density

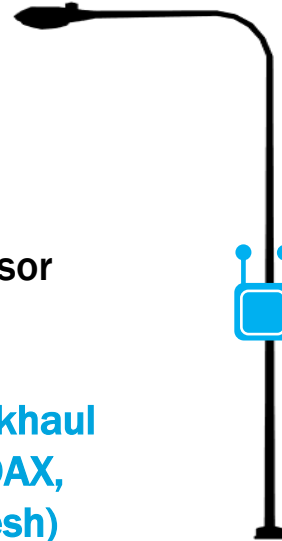


SMALL CELLS

Broadband Digital Infrastructure

Properties

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

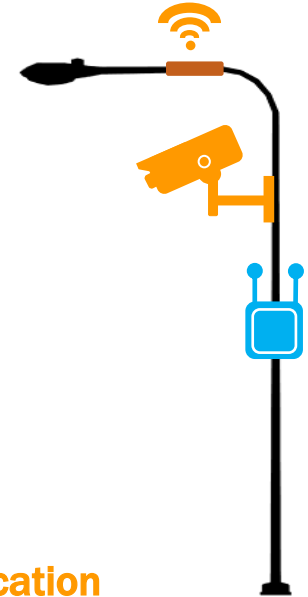


INTERNET OF THINGS

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

FCC Internet Benchmarks

Qualifies for Federal & State Investment

Date Adopted	Minimum Download	Minimum Upload	FCC Commissioner
2015	25 Mbps	3 Mbps	Tom Wheeler, D
2010	4 Mbps	1 Mbps	Julius Genachowski, D
1996	200 Kbps	200 Kbps	William Kennard, D

Federal Construction Requirements

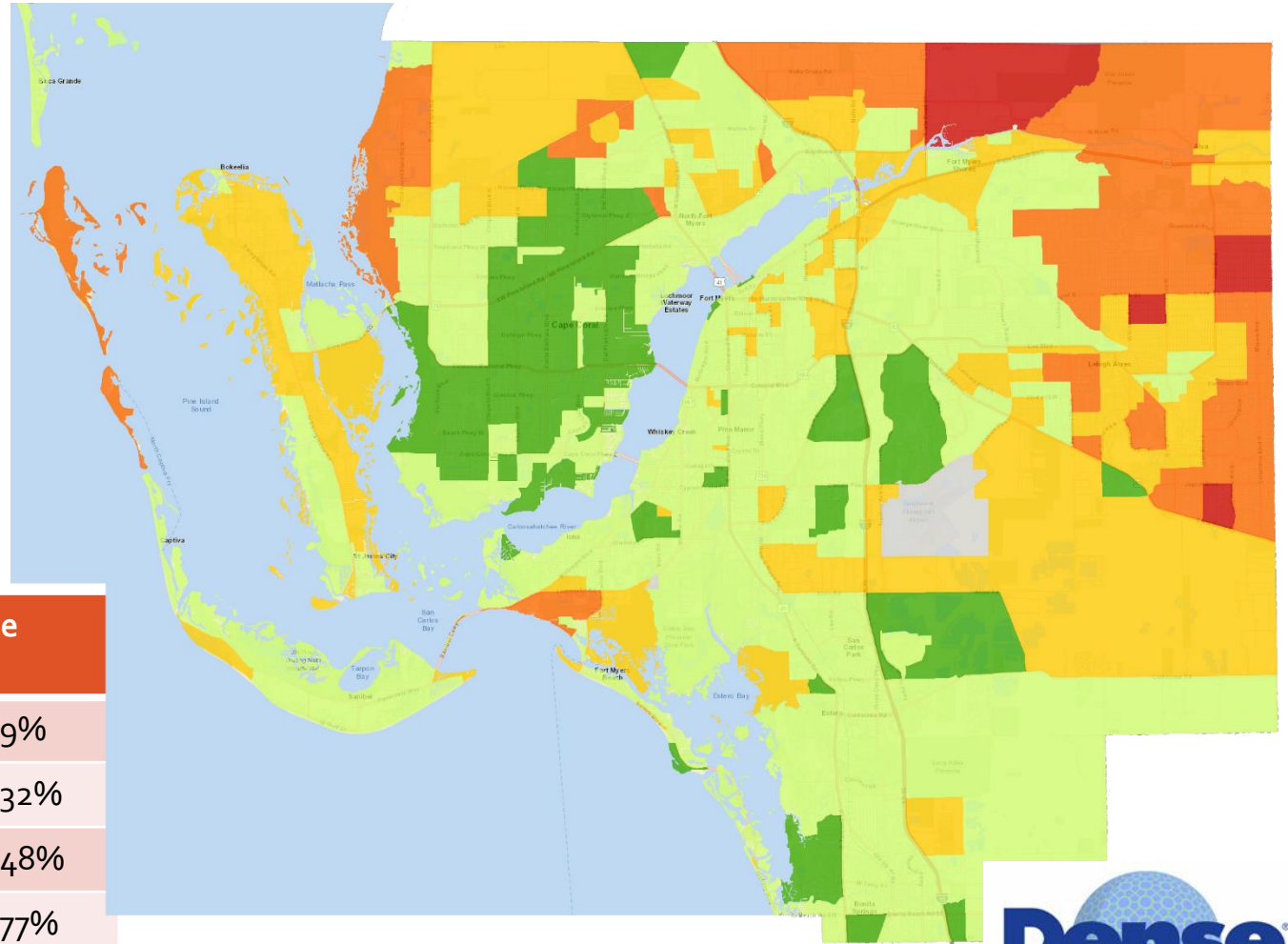
Reliable 100/20 Mbps scalable to 100/100 Mbps (symmetric)



Broadband Availability Fixed-East, North and NW Unserved

72% of households and 77% of populated square miles are **underserved** according to IIA standard.

7% of households and 32% of populated square miles are **unserved** according to FCC standard.



		Speed rating	Households	Square miles		
unserved	{	Below 10/1	5,681	2%	58	9%
		Below 25/3	24,437	7%	214	32%
		Below 50/10	89,808	24%	317	48%
underserved	{	Below 100/20	266,634	72%	511	77%
		Above 100/20	104,465	28%	154	23%

Residential Broadband Technology

Best Available Technology Class

- Fiber | Speeds \geq 100 Mbps/100 Mbps (symmetric)
- Cable (DOCSIS 3.1+) | Speeds \geq 100 Mbps/100 Mbps (symmetric)
- Cable (DOCSIS 3.0) | Speeds \geq 100 Mbps/20 Mbps
- Cable (DOCSIS $<$ 2.0) | Speeds \geq 25 Mbps/3 Mbps
- VDSL (Fiber-To-The-Curb) | Speeds \geq 10 Mbps/1 Mbps
- ADSL2, ADSL2+ | Speeds \geq 6 Mbps/1 Mbps
- Fixed Wireless | Speeds \geq 10 Mbps/1 Mbps
- ADSL | Speeds \geq 3 Mbps/768 kbps
- No Internet Service Available
- Zero Households



Copper & Fixed Wireless

Copper technology (xDSL) cannot deliver reliable 25/3. End of useful life.

Fixed Wireless requires optimum conditions to exceed 25/3; however, it delivers *Speed to Access* meaning that high need areas have the potential to get coverage fast while physical connections to each house are built.



No Internet Options Exist

This has nothing to do with affordability!
Customers in these areas cannot receive service at their physical address.

SLG Private LTE / 5G Wireless Concept

PRIVATE WIRELESS NETWORK SOURCE

A private 5G network is placed on or near the building to create a new network that connects to the city's existing network.

CITY HALL



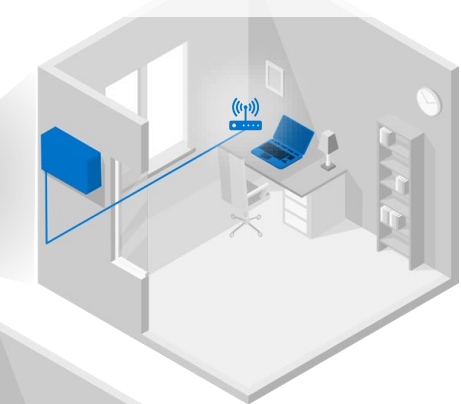
PRIVATE 5G OR LTE ENABLED PUBLIC TRANSIT



SECURE NETWORK
Monitors the city's wireless network, all connected gateways and private 5G network enabled devices. Data stays local to the city's network to ensure control.

WEAK SIGNAL TO HOME

An outdoor receiver captures the signal from the city's network and sends it to an indoor gateway that converts it to Wi-Fi.



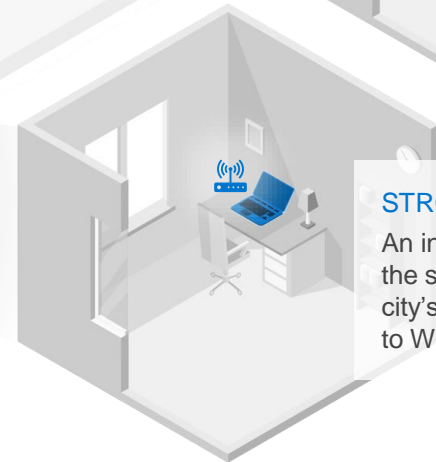
STRONG SIGNAL WITH MOBILE ENVIRONMENT

A private 5G enabled device receives the signal directly from the city's network and converts it to Wi-Fi. It can also wire directly to other applications (ie. security cameras).



STRONG SIGNAL TO HOME

An indoor gateway receives the signal directly from the city's network and converts it to Wi-Fi.



Broadband and Digital Equity Planning Matrix

Who	Healthcare	Child Teen Focused Housing	Child Teen Focused Support	Homeless and Shelter	Seniors	Disabled	Language
What							
Literacy	x	x	x	x	x	x	x
TeleHealth	x	x	x	x	x	x	x
Remote Work		x	x	x		x	x
Workforce Development		x	x	x		x	x
Engagement	x	x	x	x	x	x	x
Services (Pay bills, email, forms)		x	x	x	x	x	x

Why	Functional Locations	Devices	Networks	Literacy and Skills	Workforce	Health
Availability	Functional Locations	Devices	Networks	Literacy and Skills	Workforce	Health
Affordability	Functional Locations	Devices	Networks	Literacy and Skills	Workforce	Health
Ease of Use	Functional Locations	Devices	Networks	Literacy and Skills	Workforce	Health

How	Community Centers	Hospitals and Clinics	Libraries	Senior Centers	Parks	MDU
Functional Locations	Community Centers	Hospitals and Clinics	Libraries	Senior Centers	Parks	MDU
Devices	Computers	Tablets	Smart Phone	Mi Fi	Telehealth Booth	Digital Boards
Networks	Fiber	Fiber Service				
Programs	Government	Provider	Cellular	Wi Fi	Private	LAN
Funding	Literacy	Individual Package	MDU Infrastructure	Workforce and Skills	Health	Helpdesk
	State-BOP	Federal-State-CPF	Federal-State-BEAD	Federal-State-Digital Equity	Federal Digital Equity	E-Rate

Andrew Buss,
Director,
Innovation
City of
Philadelphia

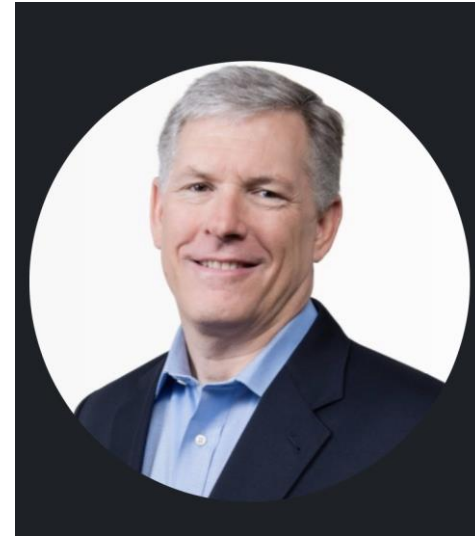




Akshay Malik
City of Philadelphia



Jake Purcell
Comcast

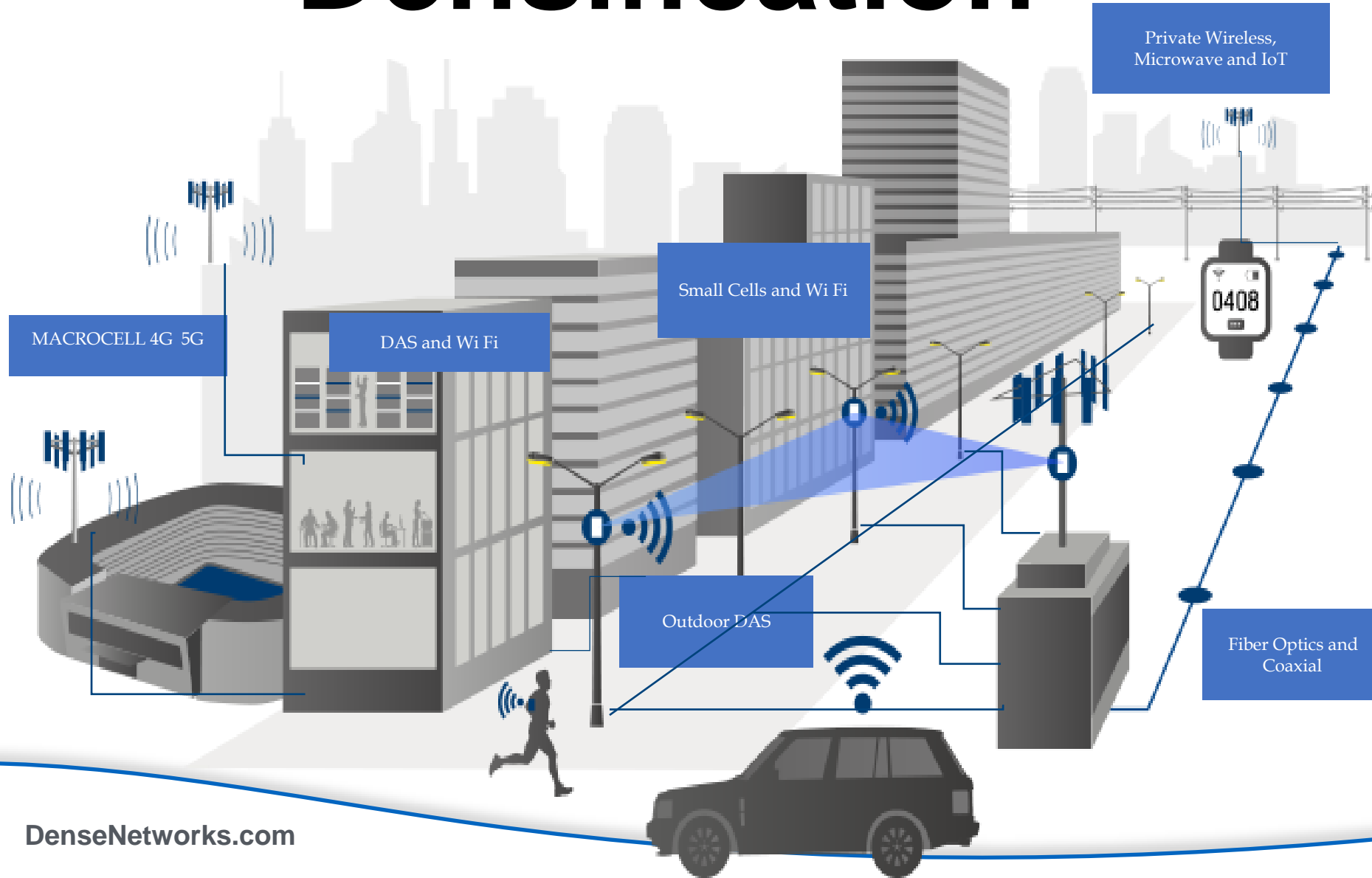


Greg Spruetz
Network Connex



Malik Ishman
Signify

Densification



Our Services by State

	Ala	Ariz	Ariz	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif	Calif
Construction Management		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Center Infrastructure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Ctr/MSO Headend Installations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fiber Placement, Splicing & Testing		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OSP Construction		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓	
OSP/ISP Design & Engineering		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Professional Engineering Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Real Estate & Site Acquisition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Turnkey Solutions		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wireless Tower Construction		✓					✓	✓	✓	✓	✓			✓	✓	✓		✓			✓	

5G Solution + Fiber

- Critical to success
 - Zoning/Permitting
 - High volume of applications
 - Fiber availability
 - Supply chain challenges
 - Timely installation
 - Power availability
 - High volume of applications
 - Timely installations
 - Trained and trusted professional service providers to support
 - Design
 - A&E
 - Site Acquisition
 - Construction

Product Portfolio Overview



Smart poles

Everything needed for small cell tower and IoT

- Small cells (RRU for 4G LTE / 5G)
- Neutral host
- IoT applications



Pole attachments

Economic solution for retrofitting existing poles

- Full size radome: 5G mmWave, CBRS/LAA + universal antenna
- Compact radome: CBRS/LAA + universal antenna



Hub

Fiber hub with smart services for highly visible locations

- Neutral host for Telco and IoT devices
- Digital screens for advertising
- In kiosk or pole form factor



Gb Luminaire

Wireless mesh for last mile coverage

- Utilizing ubiquitous lighting grid
- Up to 16Gbps aggregated capacity
- ≤ 0.3 ml. / 450 m Range



Lighting

Energy efficiency connected luminaires

- Energy efficient Existing sensor based connected luminaires
- Offer narrow band IoT services through Interact



Comcast Smart Solutions in Partnership with Philadelphia

Connected Cities

September 2022



How Comcast & Philadelphia Smart City Partnership Began

USignite bought Philadelphia and Comcast together in January 2020. Philadelphia was interested in finding ways to use technology to address public challenges like illegal dumping. As a newcomer to this space, Comcast was interested in credentialing itself and strengthening its partnership with the city.

			
Contributes	<ul style="list-style-type: none"> • Connectivity resources and investment • In-kind contribution of time and start up resources • Smart city expertise and partner ecosystem 	<ul style="list-style-type: none"> • Technical assistance • Project management and organizational expertise • Bridging multiple constituencies and acts as a neutral “translator” to address community challenges 	<ul style="list-style-type: none"> • City expertise and support in articulating and defining challenges • Provide access to a living lab space and opportunity for real world deployment and testing • Streamlined approvals
Benefits	<ul style="list-style-type: none"> • Ability to have testing ground for new, smart city technology • Tangible environment to showcase solutions for customers in hometown 	<ul style="list-style-type: none"> • Showcase successful deployment • Accelerate smart city tech adoption 	<ul style="list-style-type: none"> • Smart streetlight pilot deployment • Continue to build city’s legacy of as a leader in technology innovation • Living lab • Test new solutions before larger deployments

SmartBlockPHL: Midtown Village

A collaborative effort among Comcast, US Ignite, and Philadelphia to deploy a multi-pronged solution designed to meet the needs of several stakeholders. The demonstration project entails retrofitting luminaires and sensors onto pre-existing streetlight poles. This project will deliver new insights to Philadelphia, its residents, and its partners in the business and the community.

Fast Facts:

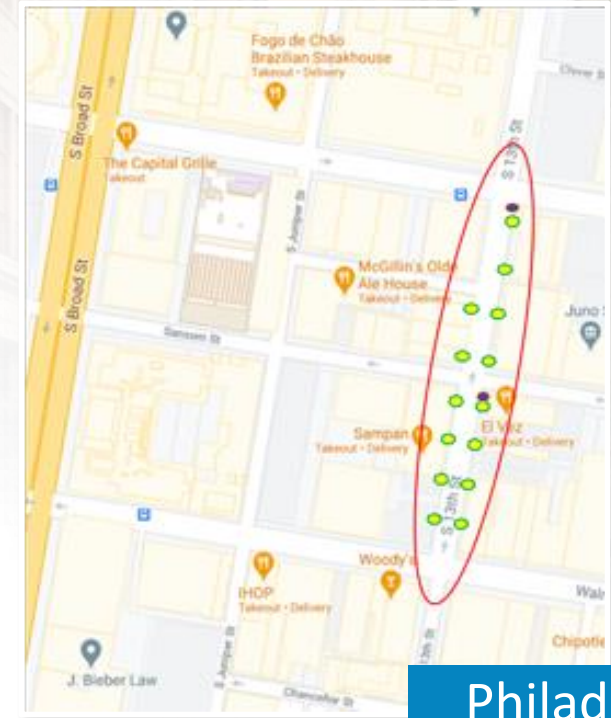
- 14 Smart Streetlights (Colonial Design) with sensors
- City owned and managed solution
- Collects meta-data about traffic, street activity and the environment
- No PPI is collected or stored
- PHL will not use data to enforce laws or issue tickets
- Uses the latest in EDGE processing
- Deliver new insights to Philadelphia, its residents, and its business partners

Use cases & Insights:

- Pedestrian occupancy
- Environment health
- Roadway Traffic
- Parking Utilization
- Managed WIFI

Technology:

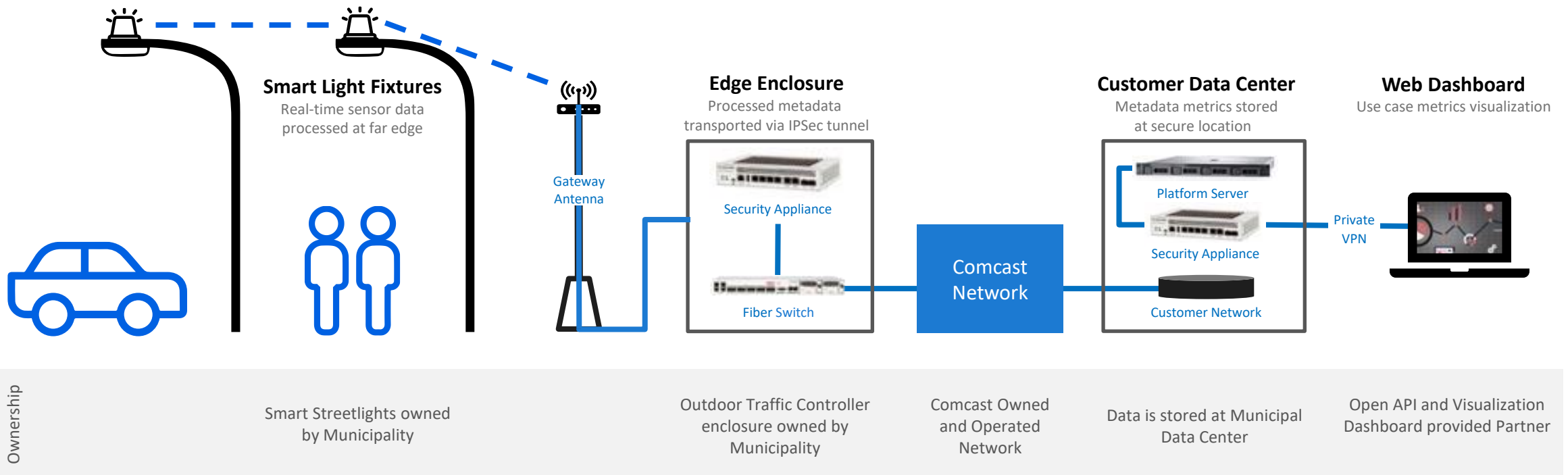
- Comcast 1Gbps EDI Circuit
- Retrofit streetlights with Partner's smart solution
- Partner's lighting management and Smart City Platform



Philadelphia, PA

High– Level Architecture Design

Comcast works with municipalities to install optical sensors in smart streetlights that can track specific, pre-programmed events or data. For example, a city may want to understand how many people are passing through a specific location over time. The optical sensors use AI to detect when a person crosses the location. Like a tally counter, the computer “counts” the people and sends this information back to the city.





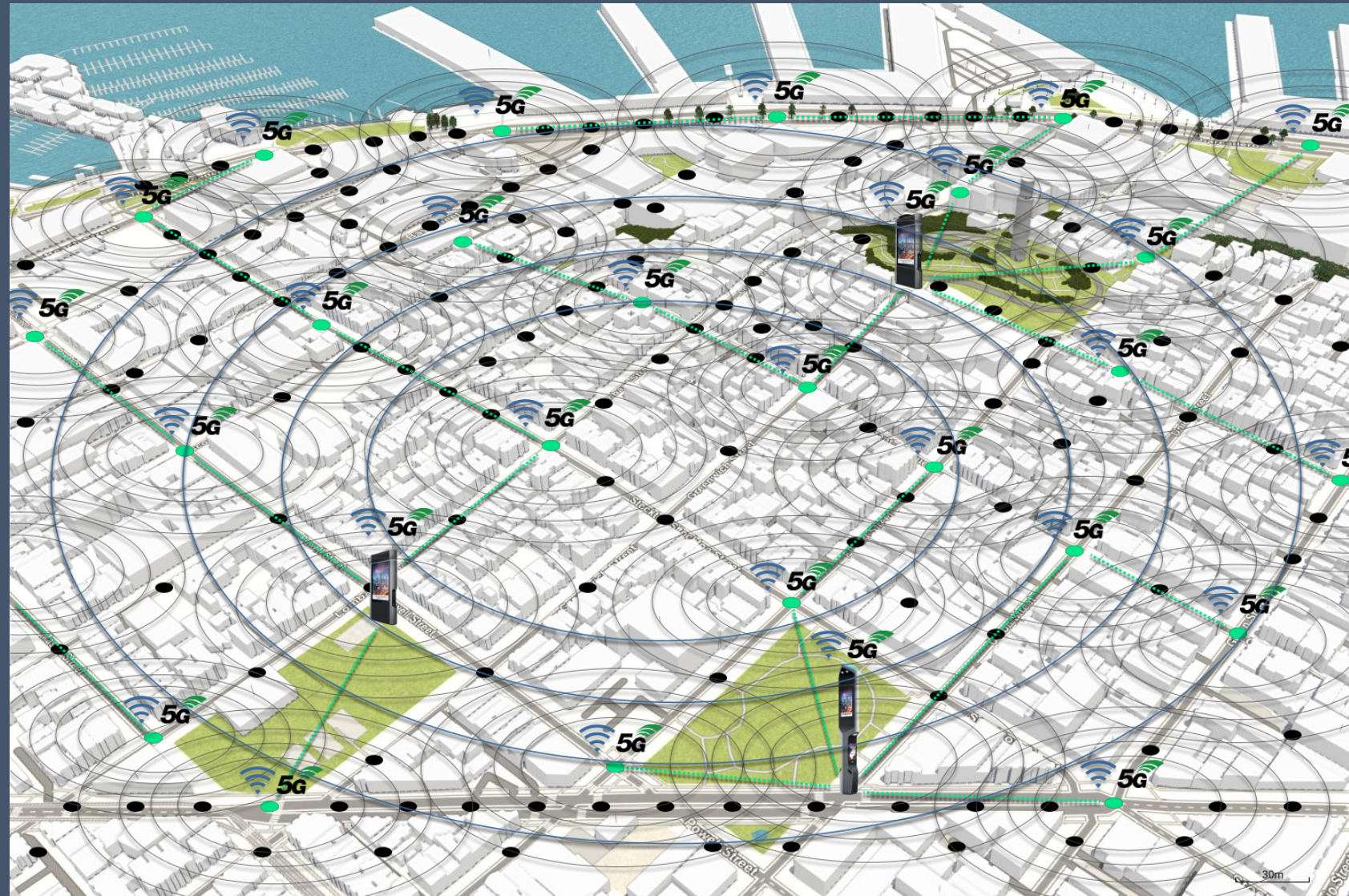
Laying the Groundwork for a Successful Smart City

Smart technology promises to help cities become more efficient, sustainable, and better places to live. But plenty of efforts have failed to scale. Before anything is installed, successful smart initiatives start with engaging local stakeholders and community members to build trust early and level set on priorities and policies.

	Data and Privacy Governance	Involve the Community Early and Often	Establish Creative Partnerships
	Set clear policies that determine what data is collected, who has access, and how long is it kept.	Develop processes for engaging citizens and stakeholder feedback and use to make consistent decisions about technology implementation.	PPP can balance risks, costs, and benefits between private and public partners, especially with such new technology.
Philadelphia's Approach	<ul style="list-style-type: none"> • Digital Standards • Data Requirement Standards • OIT's Project Intake Form • General Technology Standards • Legal Privacy Review Policy and Portal 	<ul style="list-style-type: none"> • SmartCityPHL task force includes eight diverse, independent subject matter experts who will review the city's data management practices while also advising throughout the project. • Local signage, communities meetings, FAQs 	<ul style="list-style-type: none"> • US Ignite Partnership • Openness to trying a new technology and sharing learnings together

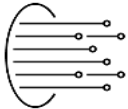
Lighting is the key enabler for the connectivity grid of the future

- 1 Light pole grid
- 2 Smart Hub
- 3 Upgrade pole
- 4 Activate pole
- 5 Meshed network



Digital Infrastructure

Fiber IoT Cell-Macro, Small & DAS Wi Fi Private LTE & 5G Smart Poles Devices



Cameras



Kiosks



Computers/Tablets



Sensors

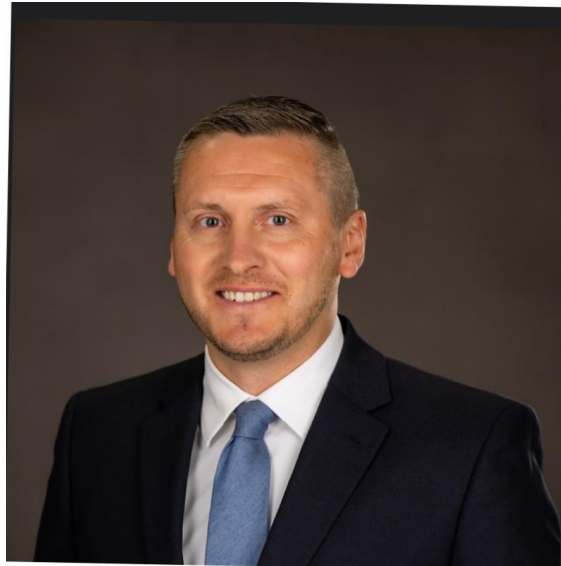
LoRa®



DenseNetworks.com



Juliet Fink-Yates
City of Philadelphia



Brandon Carson
Pennsylvania Broadband
Development Authority



Christina Wiskowski
Comcast



Nicole Ugarte
NTIA



Eric Toenjes
Graybar



Jack Hanley
Alef



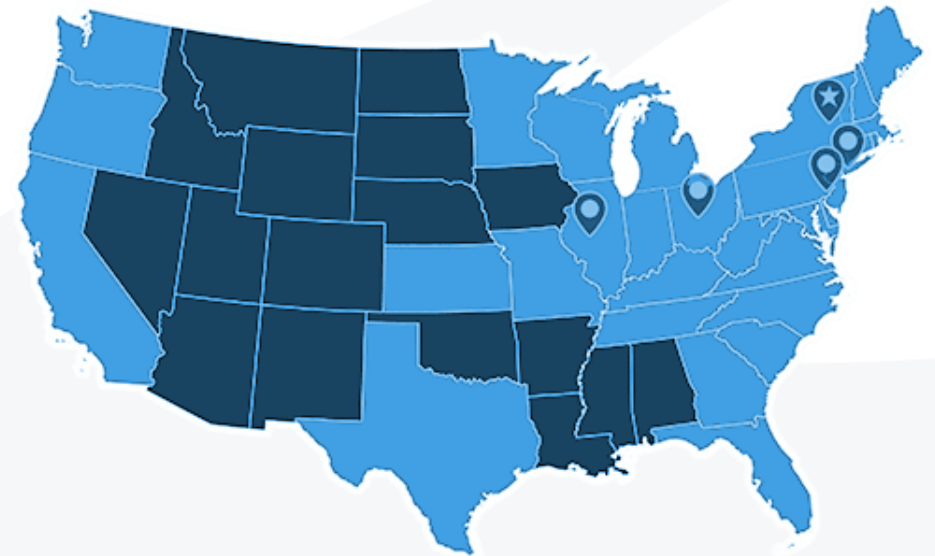
Brendan Delaney
ANS

ANS Advanced Network Services

Headquartered in **NY since 1991**

Regional operations centers –
Northeast, Midatlantic, Midwest

Suite of services include - In-Building Wireless, Tower Services, Network Infrastructure, DC Power Systems, AC Electrical, Monitoring & Maintenance and EV Charging Solutions



Fiber, Power & Poles are the Foundation for a Smart City



Bridge the Digital Divide & Extend the Smart City Foundation

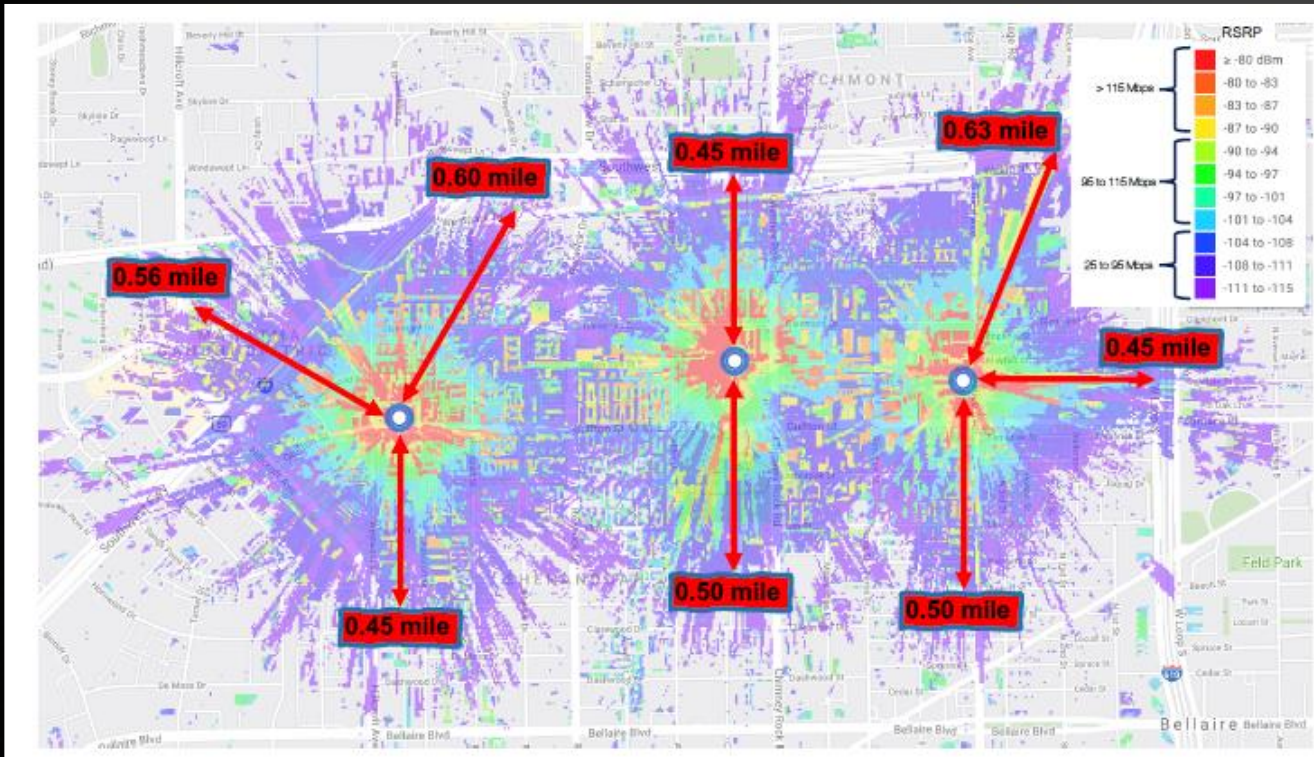
Build a private LTE/5G wireless network broadcast from city and school facilities

Secure Network

Monitors the wireless network, all connected gateways and private LTE enabled devices. Data stays local to the network to ensure control.



What is CBRS & How to Leverage for a Private Network?



- Allows Enterprise to use cellular technology (LTE or 5G) to enable a private network instead of connecting to AT&T/VZW/TMO

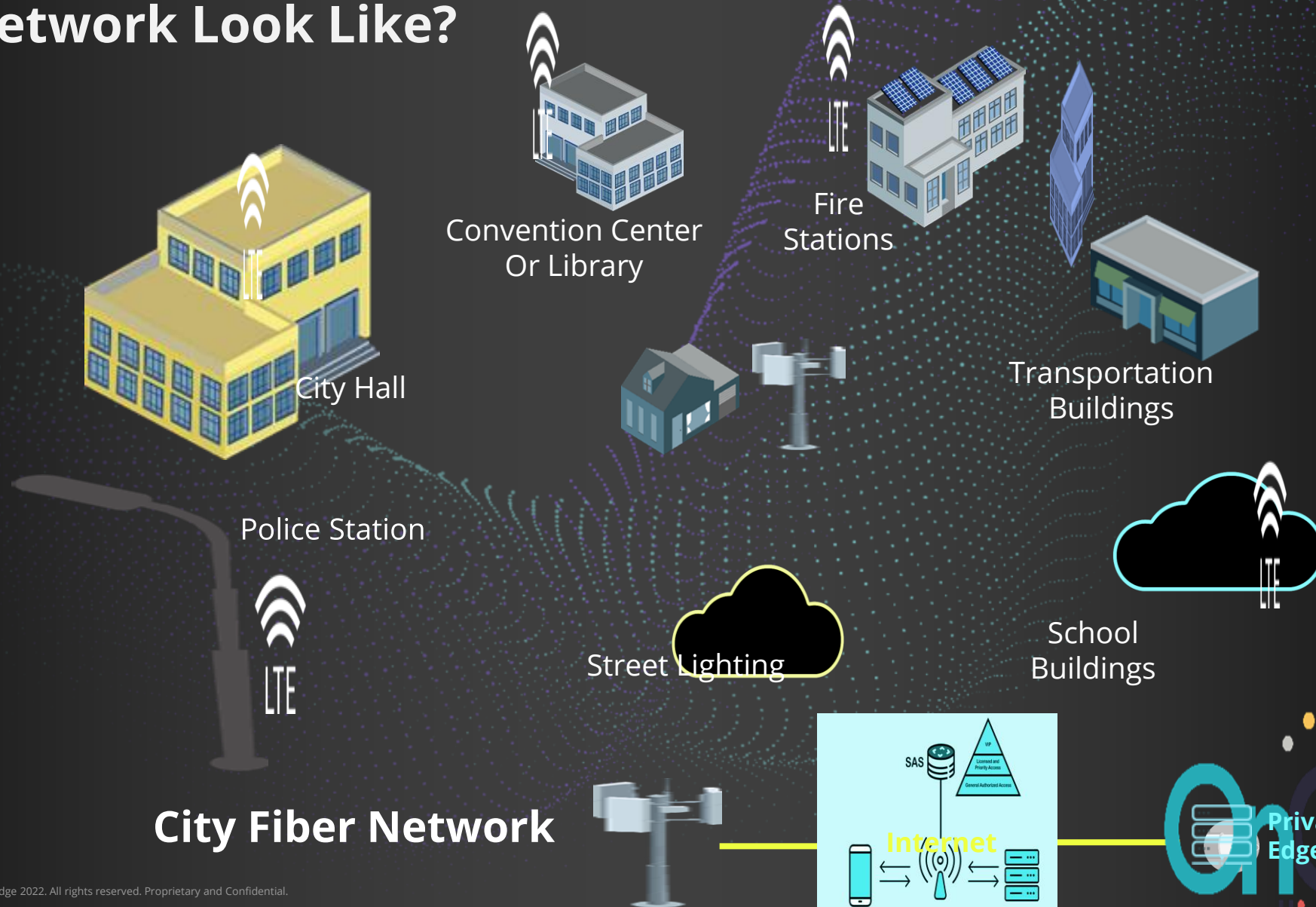
Provides connectivity for enterprise applications using 150 MHz of spectrum in the 3.5GHz range

SAS coordinates all frequencies to be used to ensure QOS

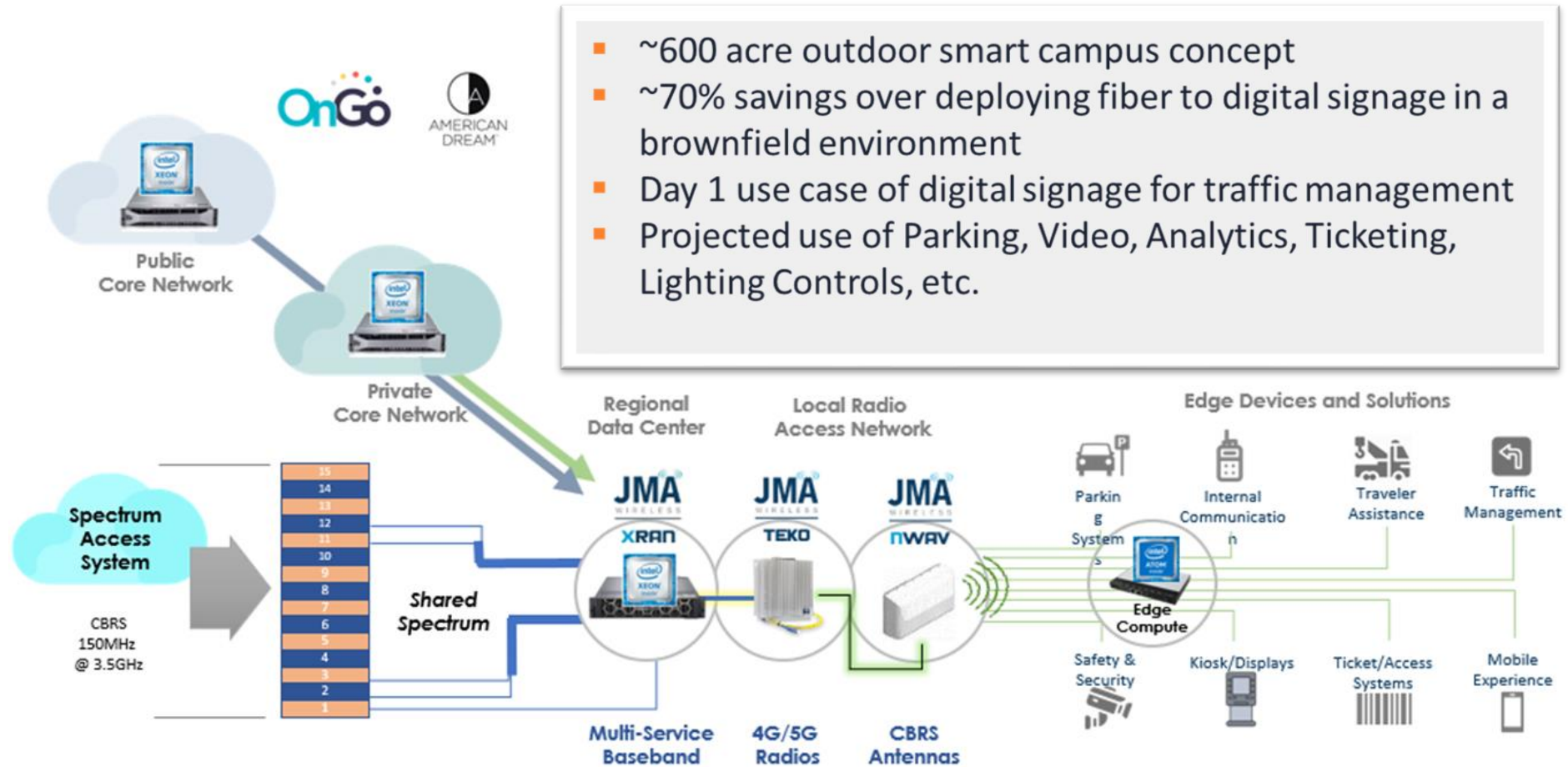
SIM/eSIM at device level required for network access

- EPC can have local break out to LAN and provide devices with private IP addresses

What does a CBRS Private Network Look Like?



American Dream Entertainment & Retail Experience



- ~600 acre outdoor smart campus concept
- ~70% savings over deploying fiber to digital signage in a brownfield environment
- Day 1 use case of digital signage for traffic management
- Projected use of Parking, Video, Analytics, Ticketing, Lighting Controls, etc.

CBRS versus Wi-Fi

	CBRS	Wi-Fi
Devices	Handles many	System performance unpredictable as devices added
Inference	Greatly reduces	Prone to interference from signals in most unlicensed bands
Authentication & Encryption	End-to-end SIM based	Requires proprietary / conflicting coordination
Security	Channel monitoring and coordination of spectrum	Poorer security vs LTE/5G
Handover	Controlled between devices managed by standards	Proprietary best effort for roaming
Latency	Consistently Lower	Unpredictable
Radio	Works well in complex environments with many wireless clients/devices	Works well in simple environments with a moderate number of devices

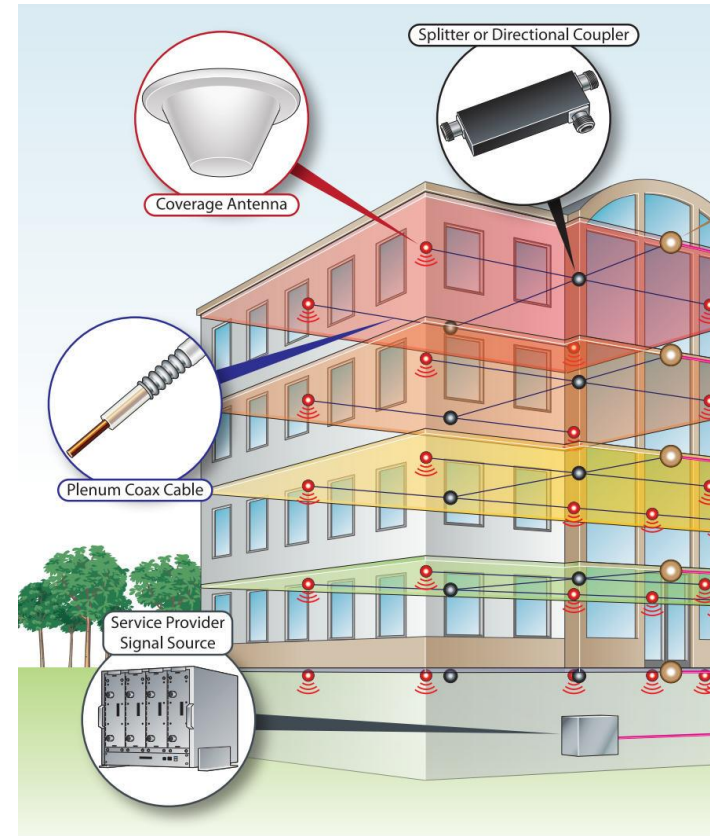
Smart Building Private 4G and 5G Networks

- ❑ CBRS based private 4G LTE and 5G networks
- ❑ Fiber-like connectivity and quality of service with the ability to deploy flexibly
- ❑ Network segmentation to support
 - ❑ Security for heating, lighting, sensors, building automation
 - ❑ Video and communications
 - ❑ Point of sale and tenant services
 - ❑ Path to carrier roaming



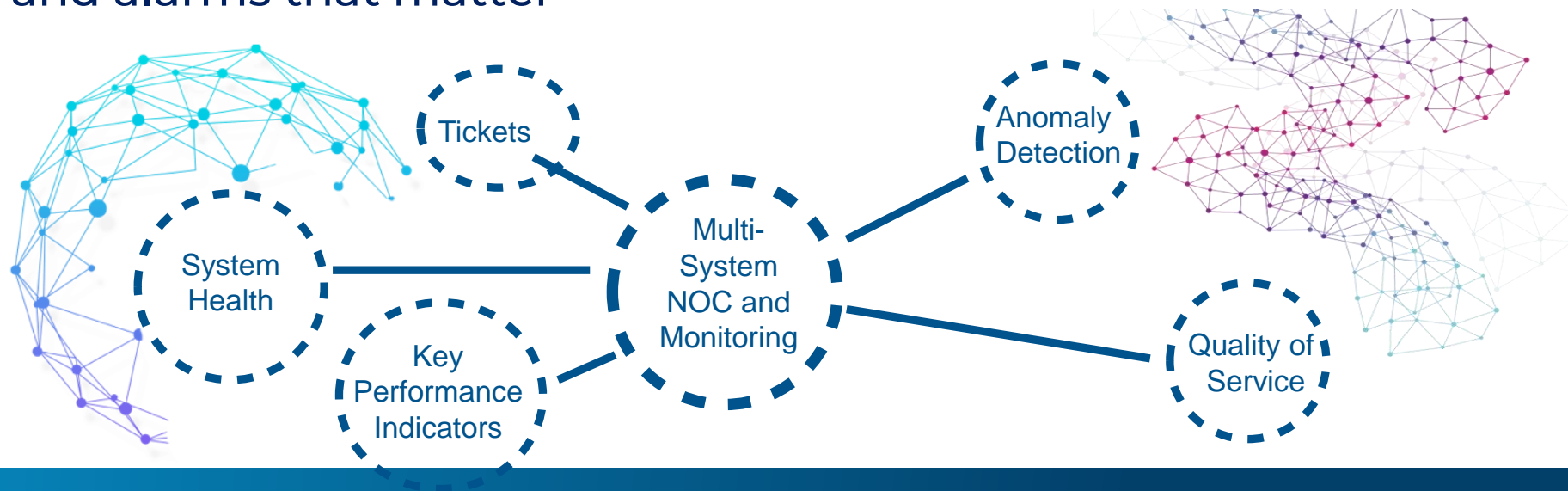
A Smart Building is a Connected Building

- Voice and data services for tenants via DAS and small cell networks
 - Convenience and business continuity
 - Ability to call 911 in case of emergency
- Emergency Responder Radio Communication System (ERRCS)
 - Ensures 2-way radio communications for first responders in case of emergency
 - Increasingly required by code
 - Responsible thing to do if not code required



Systems Monitoring and Visibility

- ❑ System agnostic monitoring and maintenance to ensure uptime and business continuity across platforms in the smart building
- ❑ Knowledgeable NOC with tight processes and a flexible monitoring platform
- ❑ Proactively identify issues before customer complaints
- ❑ Single-pane of glass for multiple systems with the key performance indicators, tickets, and alarms that matter



OMNIA

PARTNERS

POWER. ACCESS. TRUST.

**OMNIA
PARTNERS
PUBLIC SECTOR
COOPERATIVE
PROGRAM**



- Competed Contract satisfies Public Solicitation Process
- Kansas City – Lead public agency
- Products & Services eligible
- National Volume
- 23 years and 20,000 cities / agencies
- No Cost / Non-Binding
- Best in Class Vendors
- Best Overall Value

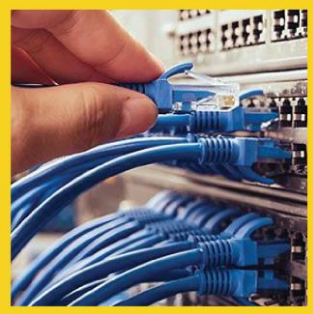
Key Benefits:

- **No RFP or Solicitation required**
- **Flexibility to choose suppliers and installation partners**
- **Shorten timeframes from concept to completion**
- **Great pricing resulting from competed contract**

TYPES OF PRODUCTS



Electrical



DataComm



Lighting & Controls



Power Distribution



Industrial Control
& Automation



Conduit, Raceway
& Cable Support



Wire, Cable &
Wiring Devices



Power Protection &
Maintenance Supply