# SMART COMMUNITIES INC.

## Connected Cities Tour "Getting to Smart"

**CONNECTED CITIES TOUR 2022**

**Dense NETWORKS**
The Social Think Tank™

**Presenting Sponsor: GraybaR**

**2022**

The Tour returns in 2022 with a focus on how Network Technology and the Cloud are enabling innovative new capabilities and services.

We will look at successful Use Cases, Technology Architectures, Business Models and Funding mechanisms for Cities, Schools, Building Owners, Utilities and Transportation.

For More Information Contact:
PeterMurray@DenseNetworks.com
☎ 267-237-5907

| Month | Day | City | Event |
|---|---|---|---|
| April | 07 | Scottsdale | Broadband Summit West |
| April | 14 | Orlando | Smart Hospitals |
| April | 28 | Peachtree Corners | Connected Cities Tour |
| May | 12 | Charleston | Broadband Summit East |
| May | 24 | Denver | Smart Cities Week |
| June | 16 | NYC | Smart Buildings |
| August | 11 | Aurora | Connected Cities Tour |
| September | 22 | Philadelphia | Connected Cities Tour |
| October | 26 | Los Angeles | Connected Cities Tour |

**Dense NETWORKS**

**DenseNetworks.com**

**Connected City**
**Smart City**

# Peter Murray, Executive Director
## Dense Networks, Smart Communities Inc.

- 30 + years Telecom
  - MCI, Verizon, Level 3
  - PECO/Adelphia Partnership

- Professor, Temple University

- US Department of Commerce
  NTIA Broadband Funding Judge

- Consultant to Orange and Lee Counties

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NETWORKS
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# Agenda

| 9:05 | Introduction | Peter Murray, Executive Director, Dense Networks |
|------|--------------|---------------------------------------------------|
| 9:15 | Broadband, Digital Equity and Maricopa County | |

Moderator:     Dominic Papa, Director, AWS

Bill Gates, Chairman, Board of Supervisors, Maricopa County

Erin Carr-Jordan, Head of Social Impact, Arizona State University

Justin Fair, CIO, City of Goodyear

| 10:00 | Federal Broadband Funding, Andy Lipman, Attorney, Morgan Lewis |
|-------|----------------------------------------------------------------|
| 10:20 | Smart City Technology Innovations |

Moderator, Peter Murray, Executive Director, Dense Networks

Bianca Lochner, CIO, City of Scottsdale

Scott Jackson, National Market Manager, Broadband, Graybar

Tim Scott, Network Manager, City of Boulder

Greg Spraetz, Chief Revenue Officer, Network Connex

Angela Quinn, VP, Signify

| 11:10 | Break |
|-------|-------|

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# Agenda

| | |
|---|---|
| 11:30 | **Smart City Innovation Award-Collin Boyce, CIO, Tucson** |
| 11:35 | Keynote: Collin Boyce, Past CIO, Tucson, Innovation |
| 11:50 | Private Networks-5G, LTE, IoT |
| | Moderator, Peter Murray, Executive Director, Dense Networks |
| | Collin Boyce, Past CIO, City of Tucson |
| | Rob Silverberg, Chief Strategy and Innovation Officer, State & Local Government, Dell Technologies |
| | Lauren Go, Director, SBA Communications |
| | James Jacobellis, VP, OnGo Alliance |
| 12:45 Lunch | |
| 1:45 | Roundtable Group |
| 2:30 | Adjourn |

# Thank You!!



Graybar

Signify

OnGo alliance

NETWORK CONNEX

DELL Technologies

SBA

Smart Cities Council | Infrastructure Innovation Forum

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# Densification

Private Wireless,
Microwave and IoT

Small Cells and Wi Fi

MACROCELL 4G 5G

DAS and Wi Fi

0408

Outdoor DAS

Fiber Optics and
Coaxial

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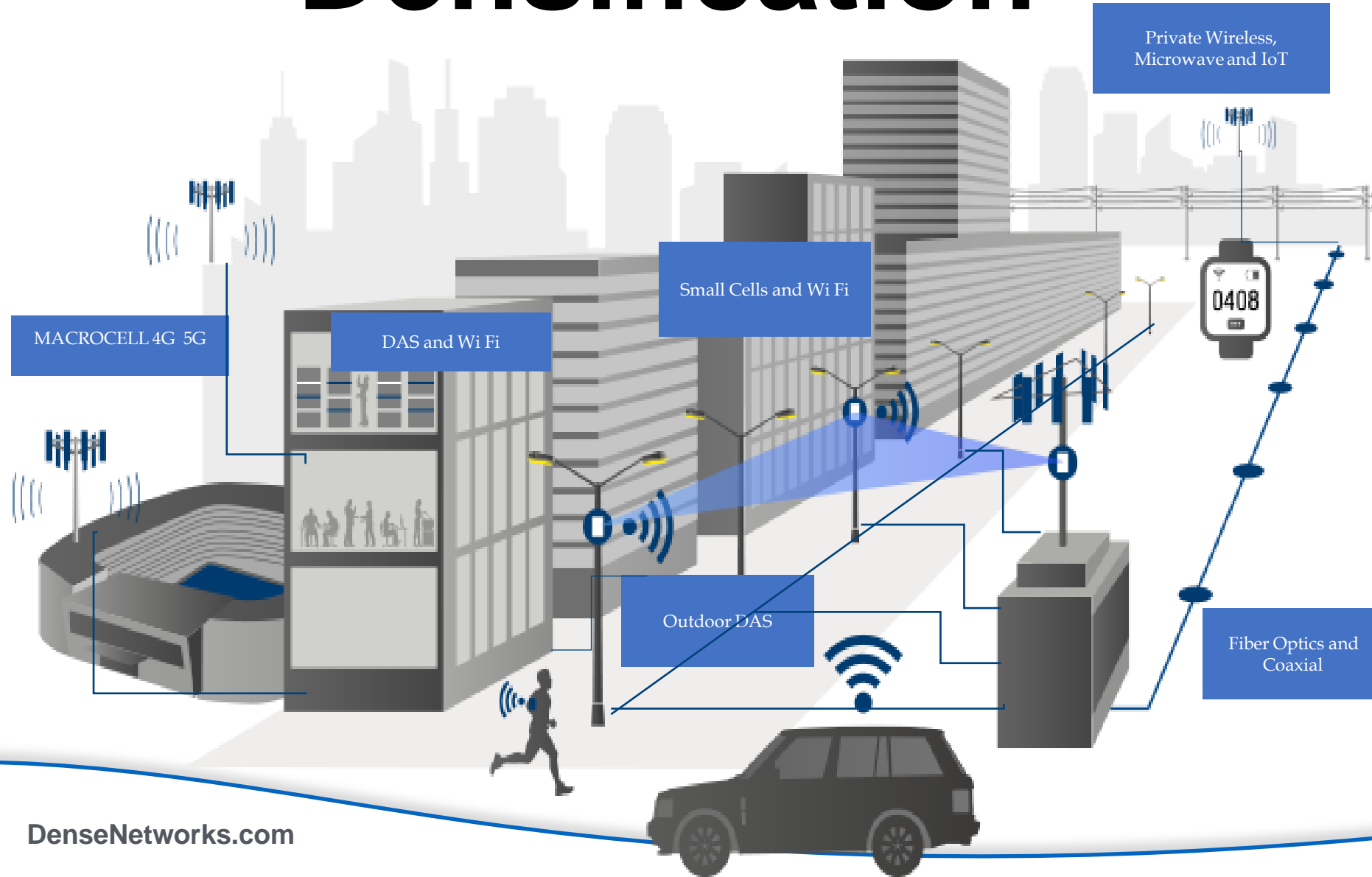
# Digital Infrastructure

## Scalable/Success Based

**Valuation 3 to 5 X vs. Network Providers
Digital Colony/SBA/Crown (REIT) vs. AT&T, Comcast**

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



Cameras

NB-IoT

LTE

Lighting +

Kiosks

LoRa

OnGo alliance
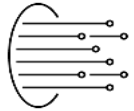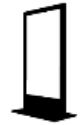
Computers/Tablets

Sensors

Dense
NETWORKS

# Broadband Strategy San Jose

## 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*
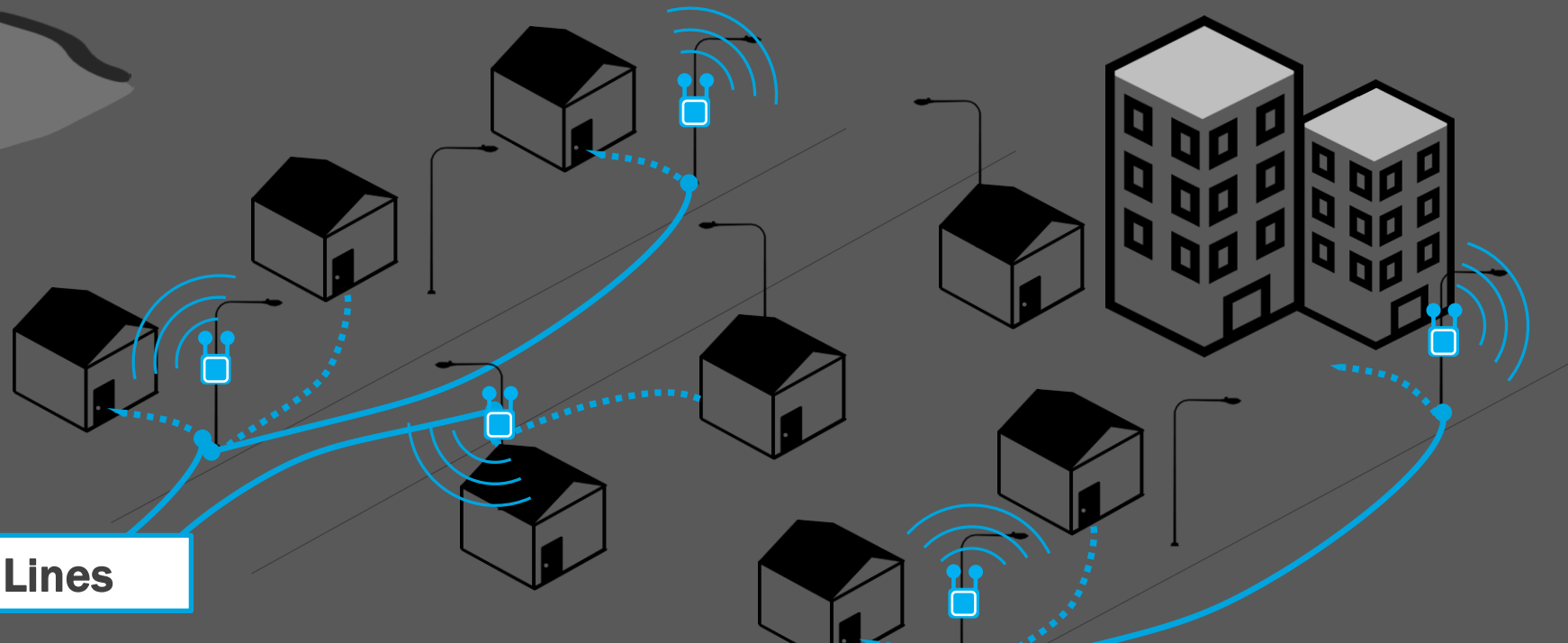
# Broadband Strategy San Jose

## STREETLIGHT
### Light/Safety

**Properties**
- Height
- Power
- Light Sensor
- Lumens
- Density
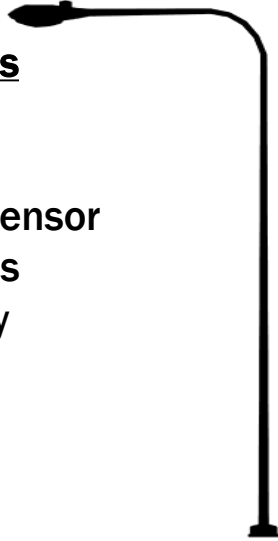
## SMALL CELLs
### Broadband Digital Infrastructure

**Properties**
- Height
- Power
- Light Sensor
- Lumens
- Density
- Data Backhaul (Fiber, COAX, Radio mesh)
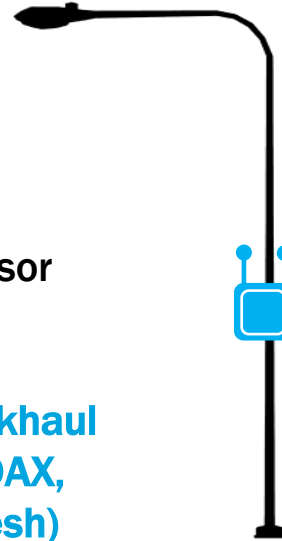
## INTERNET OF THINGS
### Smart Cities

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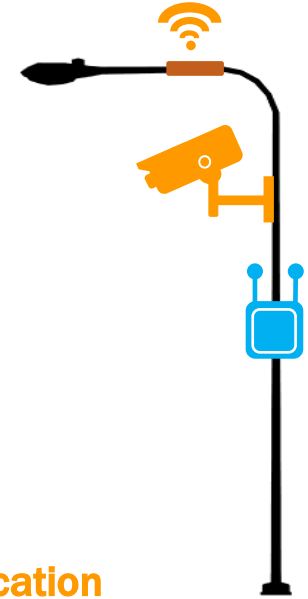
**Maturity:**

Mature | Emerging | Extremely Immature

**Possible Action:**

Proceed w/ LED Light Replacement Only | Re-examine in Broadband Strategy | Seek to Understand with Knight IoT Grant

# Broadband and Digital Equity
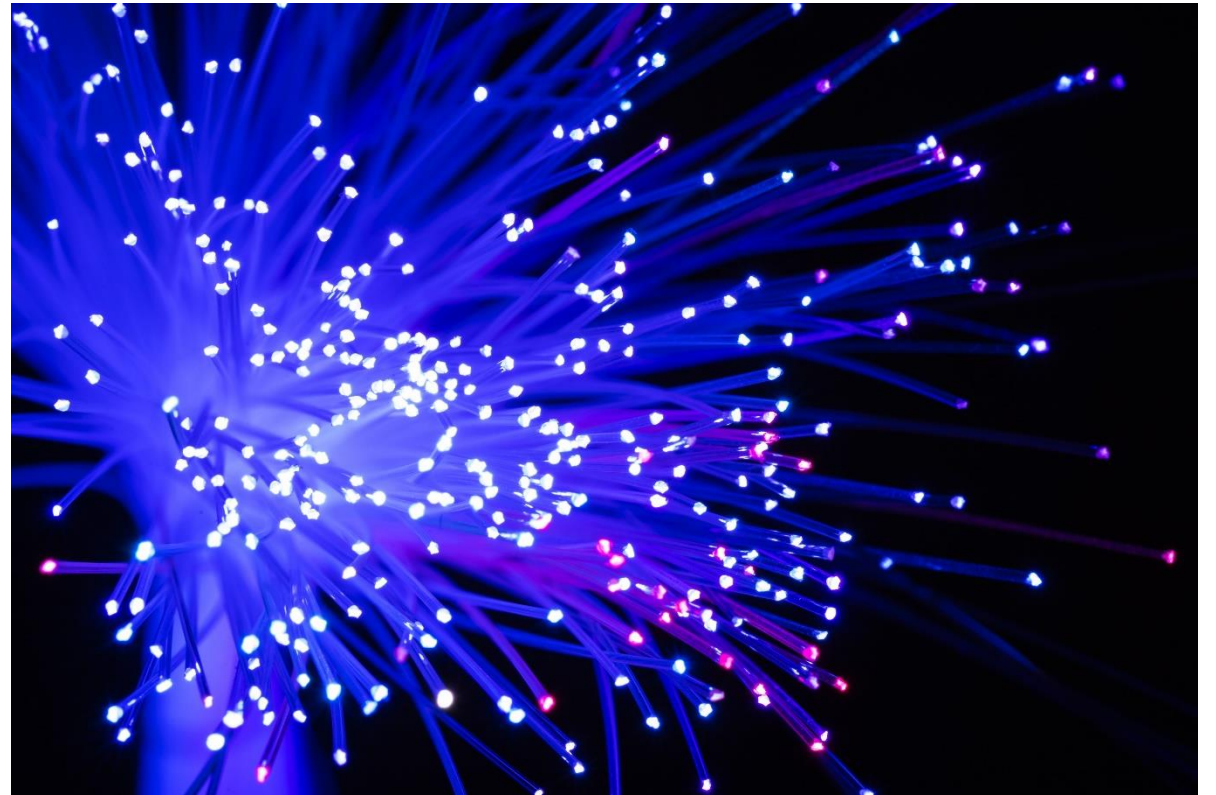
# South Carolina
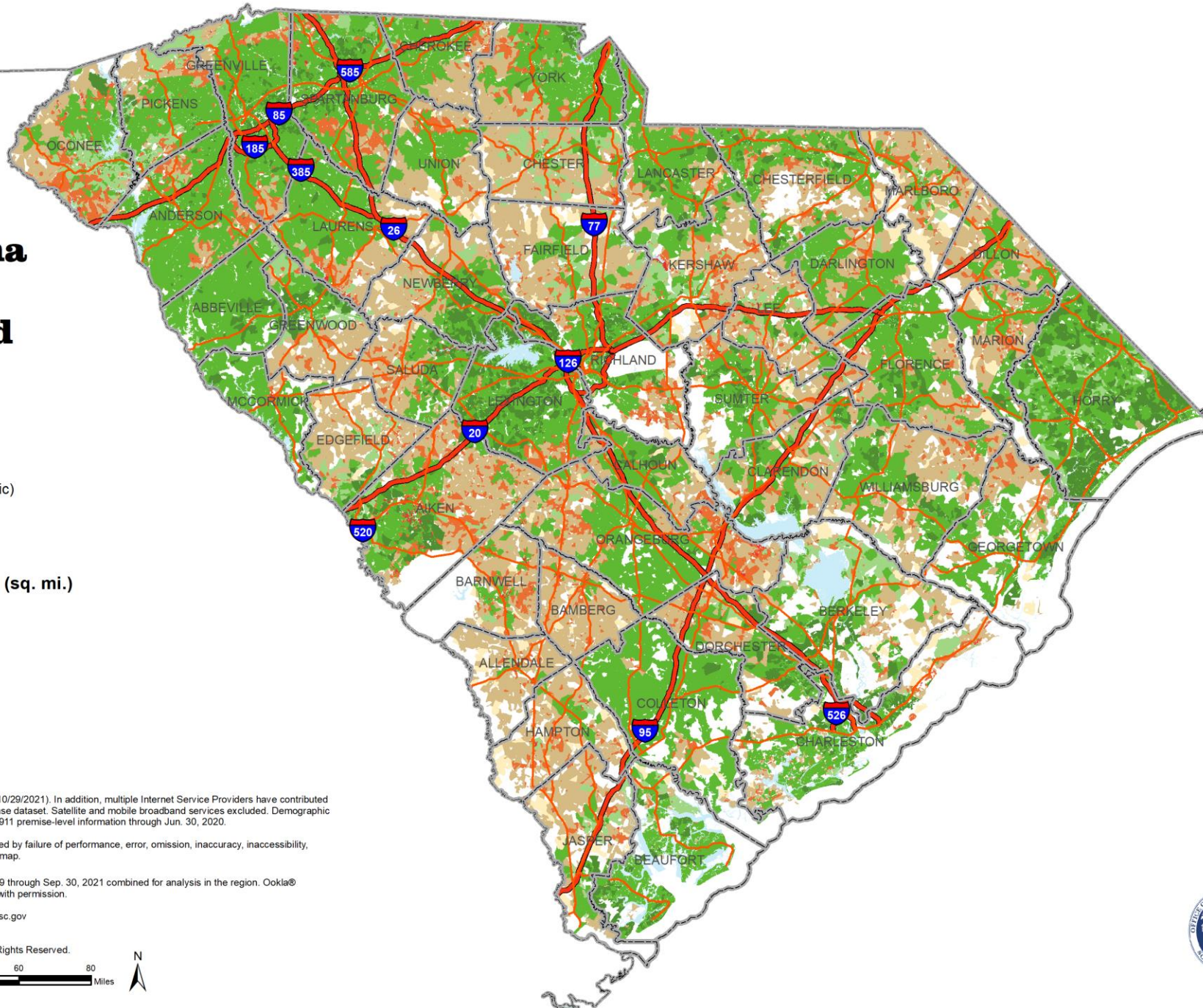
# Areas of Need
*September 30, 2021*

**Speed Tiers (download / upload)**

- >= 100 Mbps / 100 Mbps (symmetric)
- >= 100 Mbps / 20 Mbps
- >= 25 Mbps / 3 Mbps

**Density of Unserved Households (sq. mi.)**

- 200 or More
- 25 - 199
- 1 - 24
- > 0 and < 1
- Zero Households

Data: Based on ORS analysis of FCC Form 477, Dec. 31, 2020 (pub. 10/29/2021). In addition, multiple Internet Service Providers have contributed their FCC Form 477, Jun. 30, 2021 data to augment and update the base dataset. Satellite and mobile broadband services excluded. Demographic data based on US Census 2020 information that was enhanced with E911 premise-level information through Jun. 30, 2020.

The ORS is neither responsible nor liable for damages or injuries caused by failure of performance, error, omission, inaccuracy, inaccessibility, incompleteness or any other errors in information or formatting on this map.

OOKLA

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Submit comments or questions to maps@ors.sc.gov

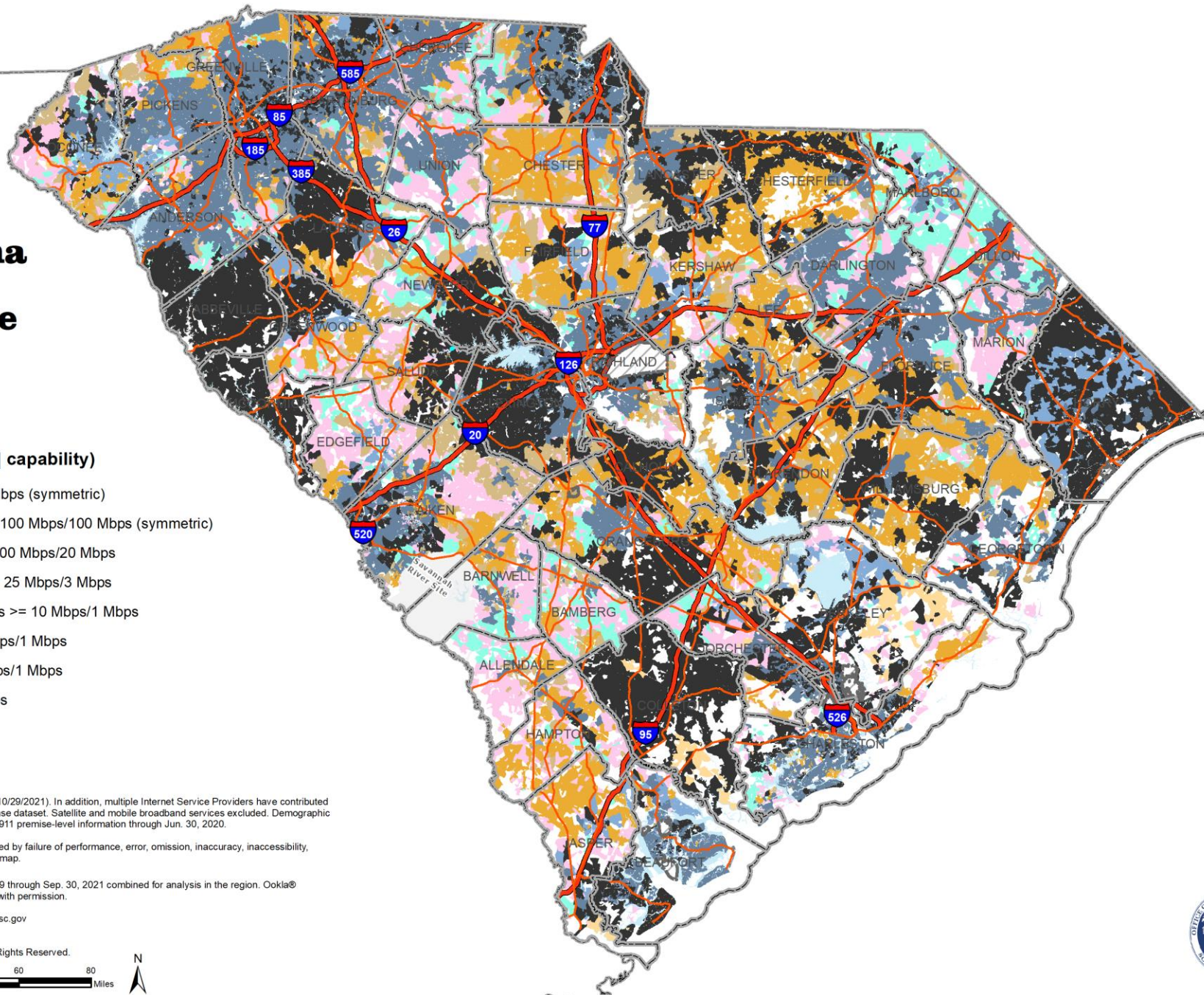0  10  20      40      60      80
Miles

N

**BROADBAND OFFICE**

# South Carolina

## Best Available Technology

*September 30, 2021*

### Best Available Technology (type | capability)

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

Data: Based on ORS analysis of FCC Form 477, Dec. 31, 2020 (pub. 10/29/2021). In addition, multiple Internet Service Providers have contributed their FCC Form 477, Jun. 30, 2021 data to augment and update the base dataset. Satellite and mobile broadband services excluded. Demographic data based on US Census 2020 information that was enhanced with E911 premise-level information through Jun. 30, 2020.

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Submit comments or questions to maps@ors.sc.gov

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South Carolina Office of Regulatory Staff. All Rights Reserved.

0  10  20    40    60    80
Miles

N

**BROADBAND OFFICE**

**Dominic Papa**
**Director, AWS**

**Bill Gates**
**Chairman, Board of Supervisors**
**Maricopa County**

**Erin Carr-Jordan**
**Head of Social Impact**
**Digital Equity Institute, ASU**

**Justin Fair**
**CIO, City of Goodyear**

**DenseNetworks.com**

# Andy Lipman
## Telecommunications Practice Lead Attorney, Morgan Lewis

**Bianca Lochner**
CIO, City of Scottsdale

**Greg Spraetz**
CRO, Network Connex

**Angela Quinn**
VP, Signify

**Scott Jackson**
National Market Manager

**Tim Scott**
Consultant
Smart Communities,Inc.
City of Boulder

**DenseNetworks.com**

# Smarter City and Community Features


Secure


Connected


Mobile


Sustainable


Water


Energy


Resilient

# Strategies MUST Align With Community Priorities

➢Community Needs

➢Goals and KPIs

➢Smart Outcomes

# Scottsdale Smart City Roadmap

# A Balanced Approach

| Design Thinking | Engineering |
|---|---|
| Speed | Reliability |
| Pilots | Scalability |
| Open Data | Information Security |

# Densification

Private Wireless, Microwave and IoT

MACROCELL 4G 5G

DAS and Wi Fi

Small Cells and Wi Fi

Outdoor DAS

Fiber Optics and Coaxial

0408

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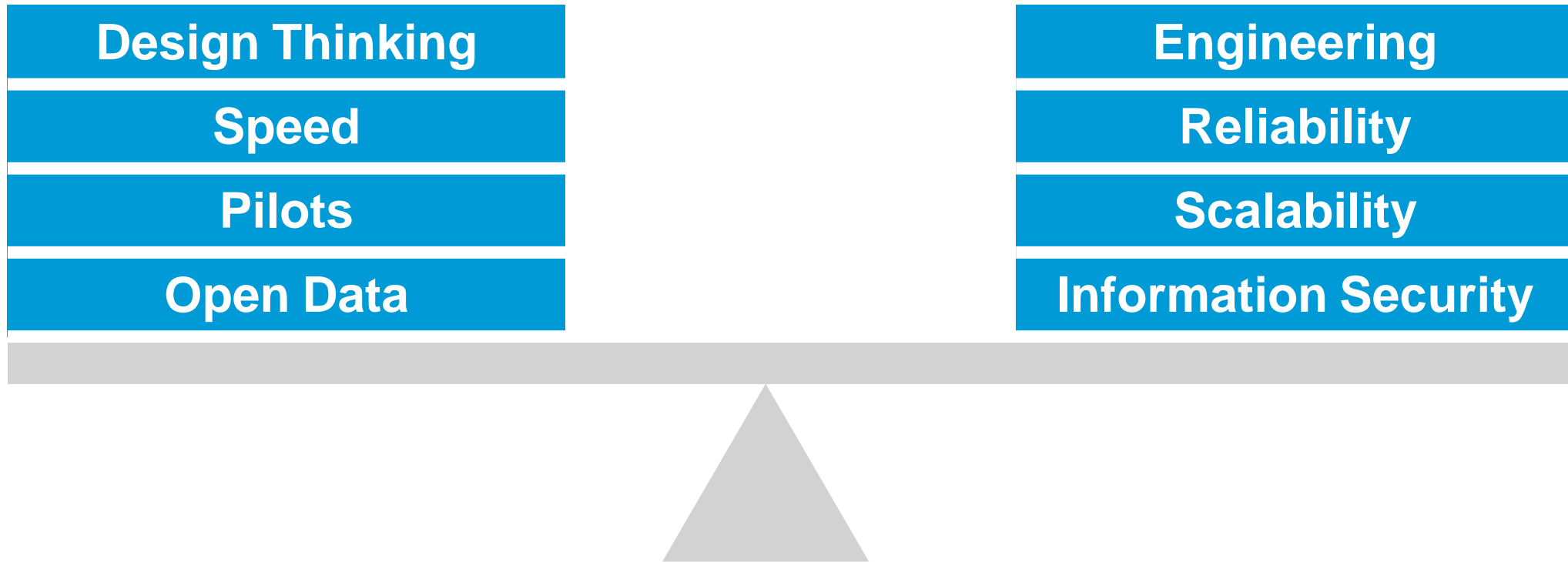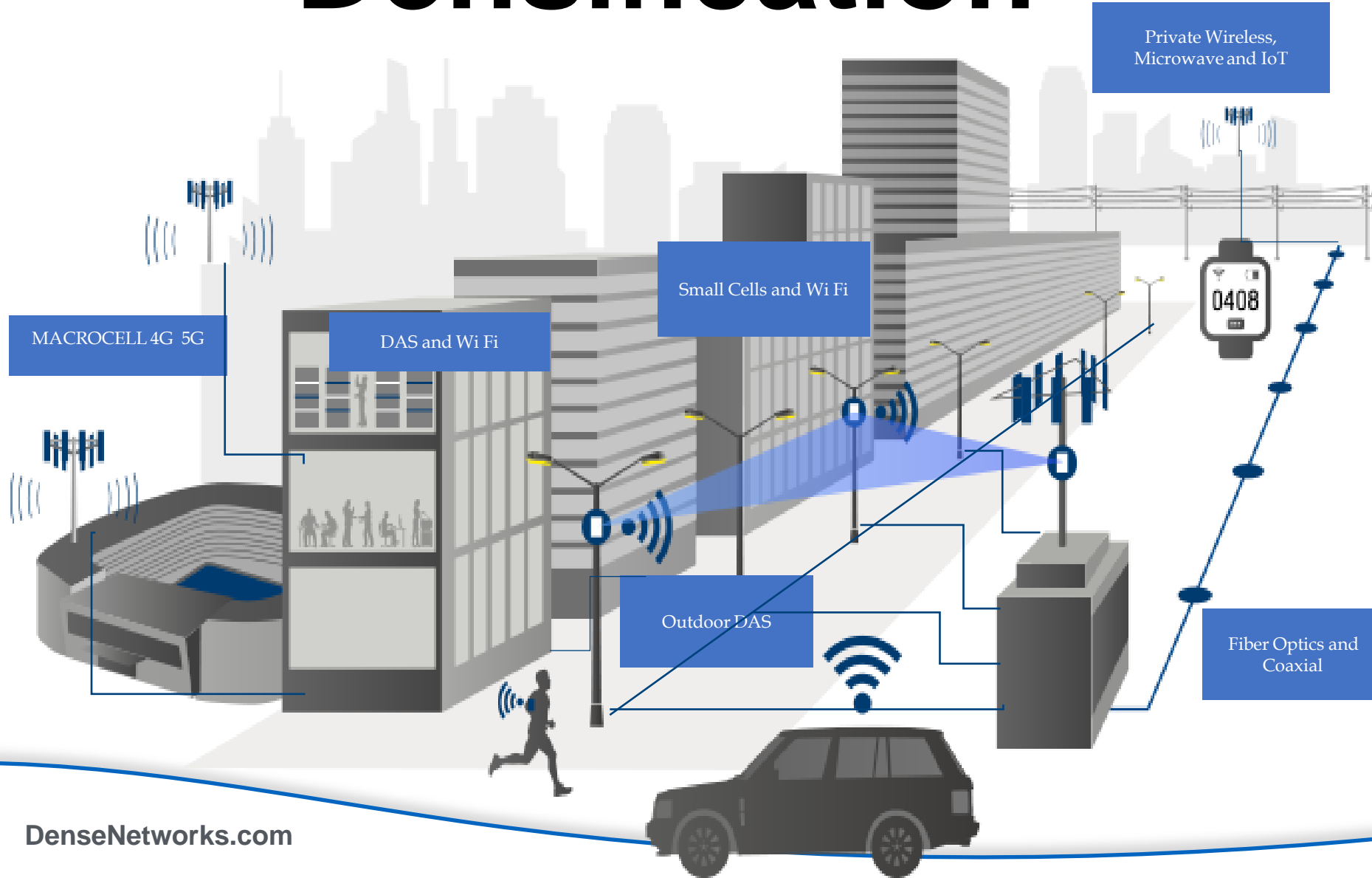
# Fiber, Power & Poles are the Foundation for a Smart City

DIGITAL EQUITY

AWARE

INTELLIGENT LIGHTING

5G OR WI-FI

PUBLIC SAFETY

PUBLIC SAFETY

ENVIRONMENTAL MONITORING

FLEXIBLE

SPEAKER

CONNECTED

INTERACTIVE

DIGITAL SIGNAGE

CITY HALL

EV CHARGING

TELEHEALTH CLINIC

FIBER BROADBAND

POWER DISTRIBUTION

POWER
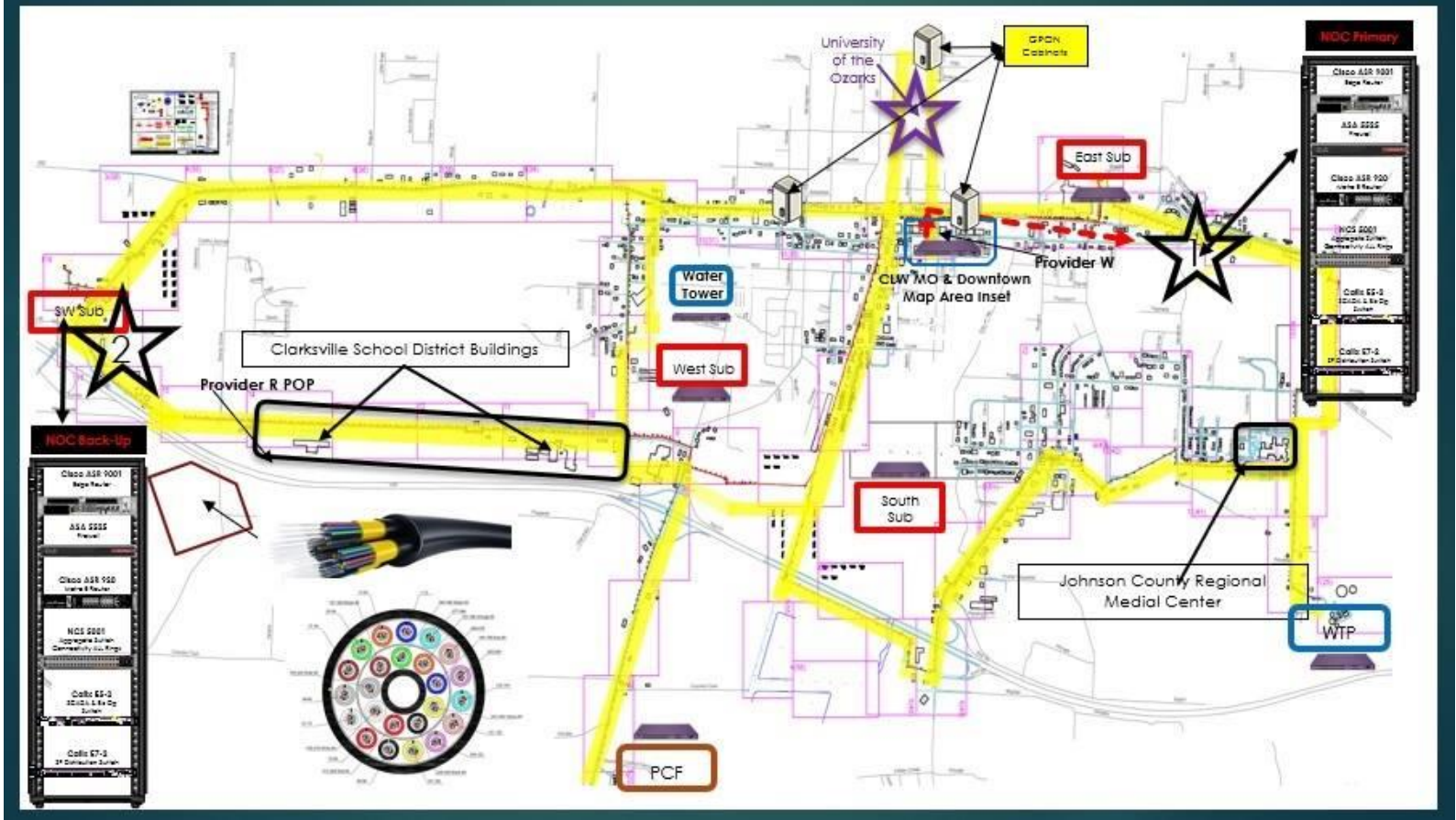
FIBER

# The Utilities' Leverage

- Use of assets
  - Street Lighting poles – allowing small cell growth in territory
  - Data access and availability
- Expansion of our fiber network
  - Pilot opportunities
- Facilitating Conversations
  - Utility is a common stakeholder in all smart city verticals



Common Interests

City of Orlando

Developer 1

Developer 2

Focusing Attention and Effort

OUC
The *Reliable* One®
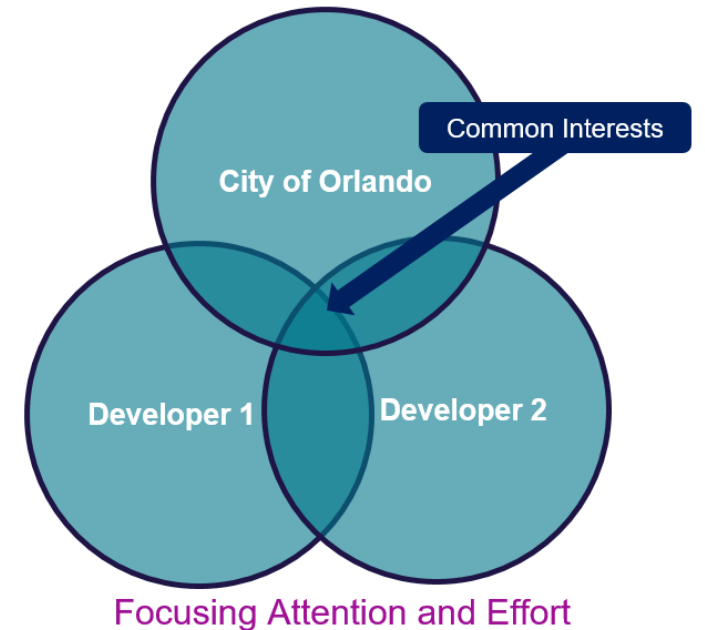
17+ Miles Fiber Optic Network, Already Installed
Yellow Highlight Indicates the Exist "Core" Route around Clarksville

CLARKSVILLE
CONNECTED UTILITIES
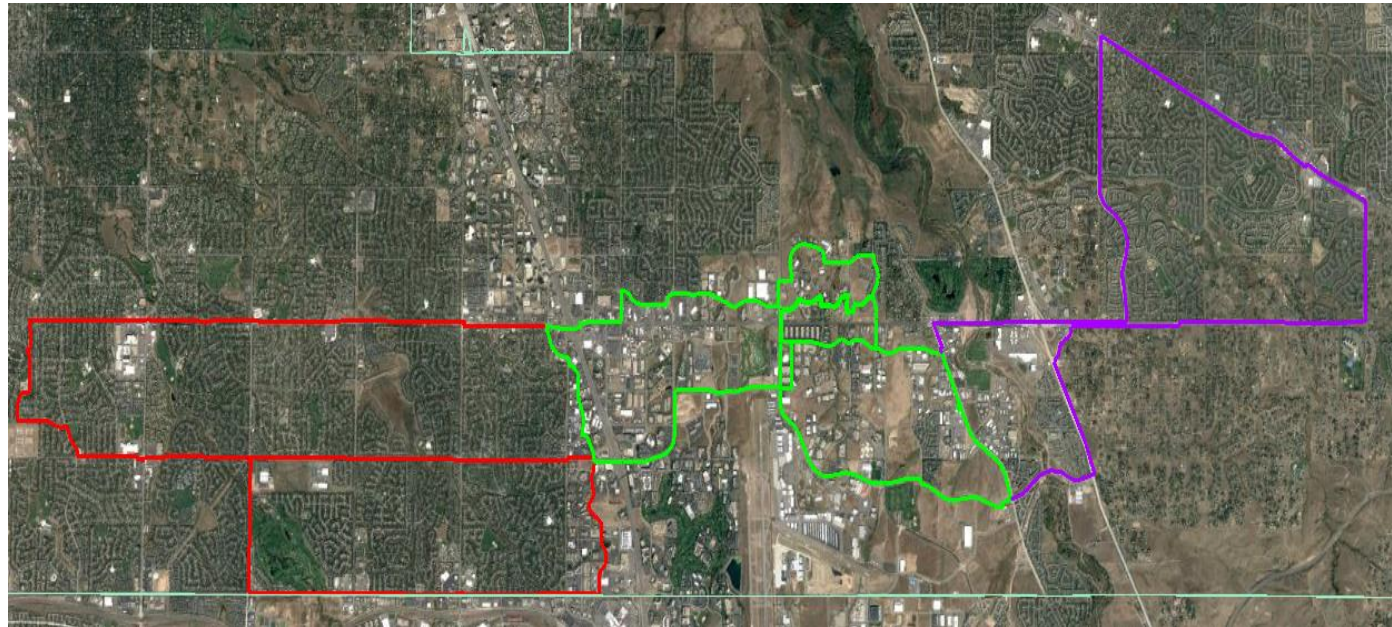
# Fiber Backbone-Open Access Model



**Fiber Backbone – Rings and Status**

| | |
|---|---|
| 🟩 | Central Ring – Constructed |
| 🟪 | East Ring – Under Construction |
| 🟧 | West Ring – Constructed |

# Broadband and Digital Equity
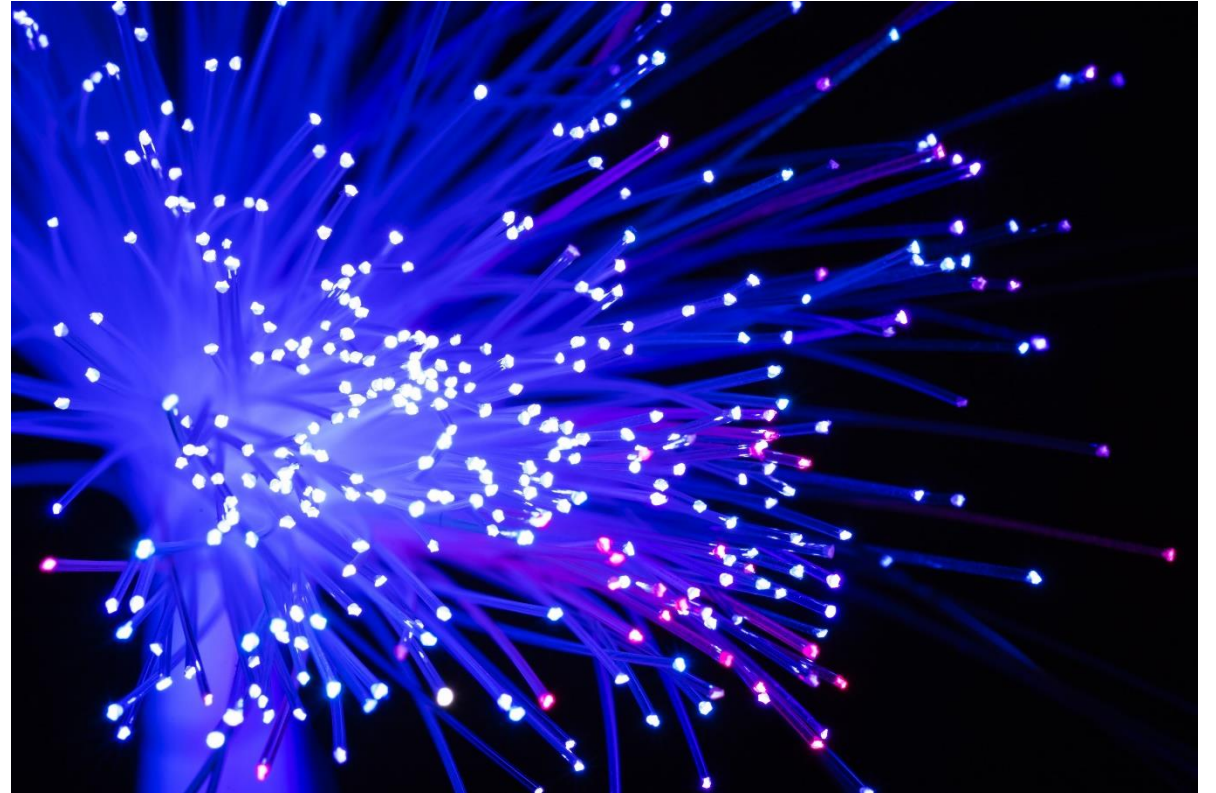
# FCC Internet Benchmarks

**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)**

Question 5: What type of technology do you believe would make internet more accessible in your community?
Answered: 2,764 Skipped: 14

# Residential Broadband Technology

## Best Available Technology Class

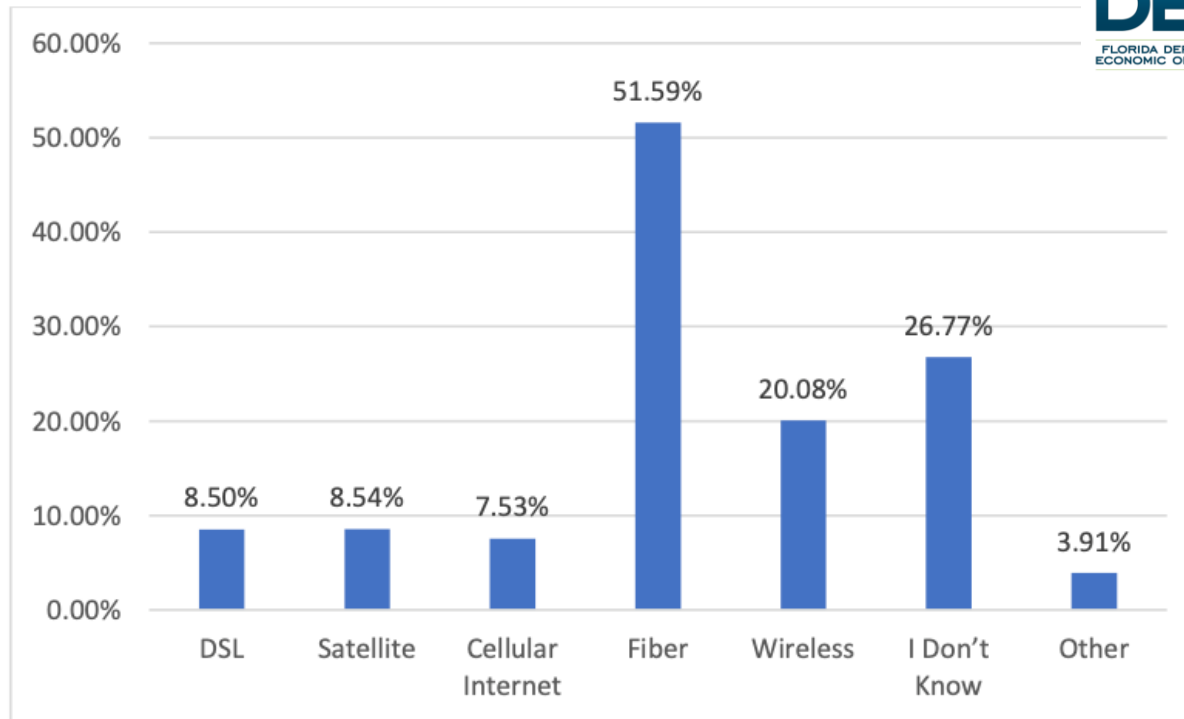■ Fiber | Speeds >= 100 Mbps/100 Mbps (symmetric)

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■ ADSL2, ADSL2+ | Speeds >= 6 Mbps/1 Mbps

■ Fixed Wireless | Speeds >= 10 Mbps/1 Mbps

■ ADSL | Speeds >= 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.

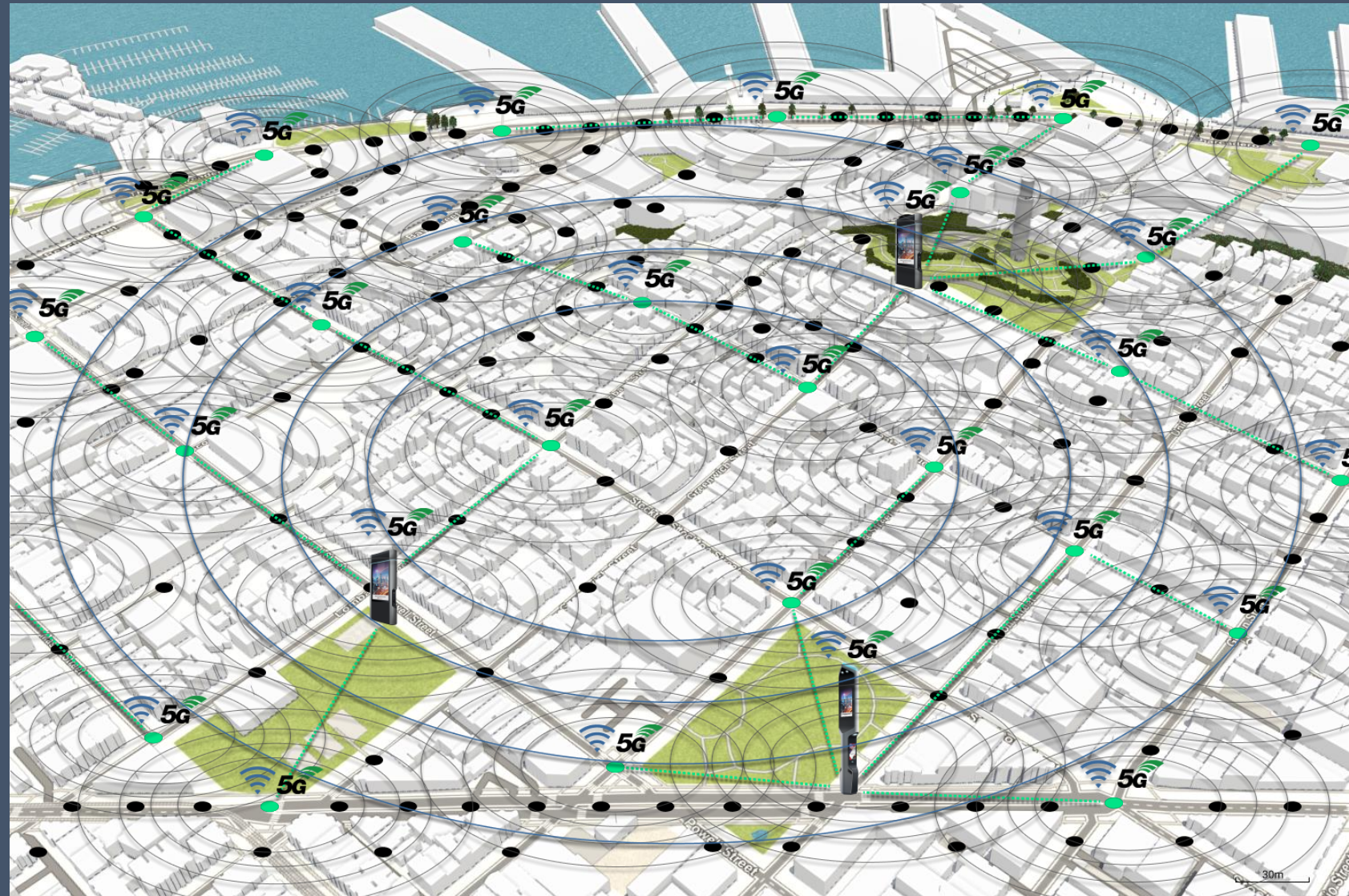**No Internet Options Exist**

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

**ORS.SC.GOV/Broadband**

# 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

The Grid of the Future - YouTube

# 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 mi. / 450 m Range

## Lighting

Energy efficiency connected luminaires

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

interact

Signify

OMNIA
PARTNERS
PUBLIC SECTOR
COOPERATIVE
PROGRAM

OMNIA
PARTNERS

POWER. ACCESS. TRUST.

Graybar

# OMNIA PARTNERS | Public Sector

- 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**

GraybaR

**Rob Silverberg**
CSIO, Dell Technologies

**Jim Jacobellis**
VP, OnGo Alliance

**Collin Boyce**
Consultant
Past CIO, City of Tucson

**Lauren Go**
Director, SBA Communications

# Broadband and Digital Equity
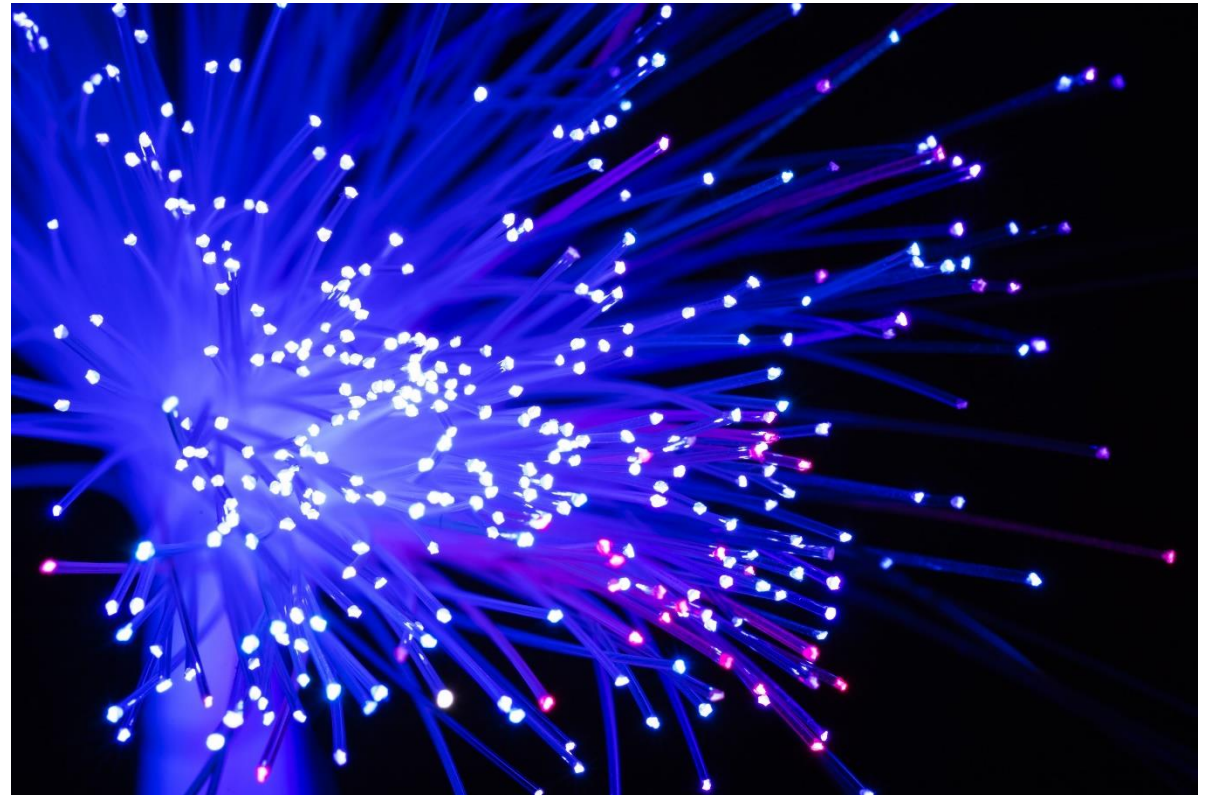
# COVID-19 will hit the poor hardest

## Poverty Rate (2018)



U.S. Census Bureau via MAP (mapazdashboard.arizona.edu)
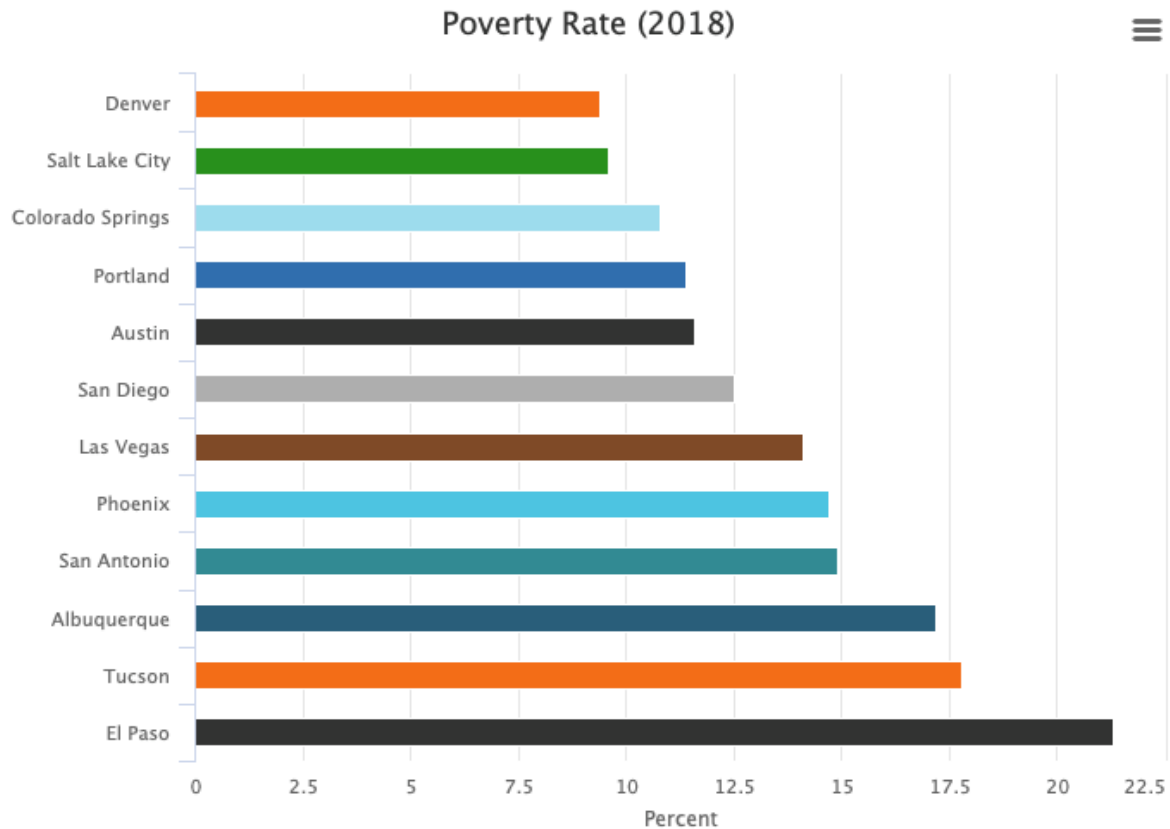
**Tucson, Arizona**
- **Change in per capita income:** $3,436
- **Change in median household income:** -$8,806
- **Change in population:** 276,283
- **Change in poverty rate:** 64.79%

uring-covid-19-who-has-access-who-doesnt

# 2020 CARES Act $ Paid for Network & Devices to support Homework Gap



CBRS Connected Wi-Fi Hotspot

Geoverse

# City of Tucson Use Case Examples:

Park Wi-Fi

City Smartphone Service

Analytics for City Pools

Mobile Data Terminal Service

City Mobile Tablet Service

Digital Divide Broadband

In-Building Neutral Host

City Transportation & Service Efficiency

Traffic Efficiency

39

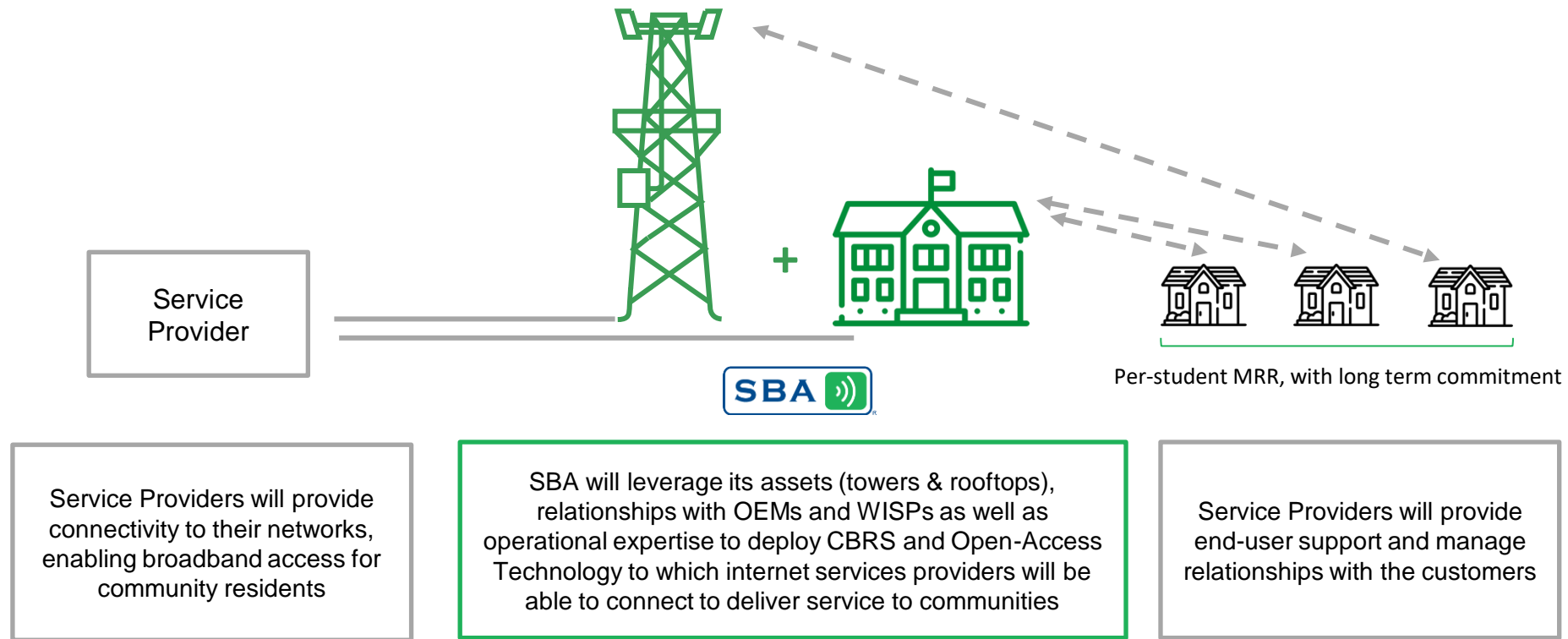# How the Open Access Model Works

With an ecosystem of partnerships, SBA is positioned to deliver a valuable solution to distributed connectivity needs; in the proposed model, SBA and Internet Service Providers will enter into a long-term agreement to provide broadband connectivity to local students using CBRS and Open-Access Technology



Service Provider

Per-student MRR, with long term commitment

Service Providers will provide connectivity to their networks, enabling broadband access for community residents

SBA will leverage its assets (towers & rooftops), relationships with OEMs and WISPs as well as operational expertise to deploy CBRS and Open-Access Technology to which internet services providers will be able to connect to deliver service to communities

Service Providers will provide end-user support and manage relationships with the customers

Base stations are deployed at the school or another central location; once a base station is deployed, homes can be served within a range of 0.4 – 3.75 miles, depending on their corresponding infrastructure



CBRS LTE to Outdoor
1.25 – 3.75 miles

CBRS Base Station

CBRS LTE to Indoor
0.4 – 0.6 miles

**Outdoor CPE**
- Professional install
- Connected to Wi-Fi router inside home

**Indoor CPE**
- Self install
- Same unit providing Wi-Fi coverage inside home
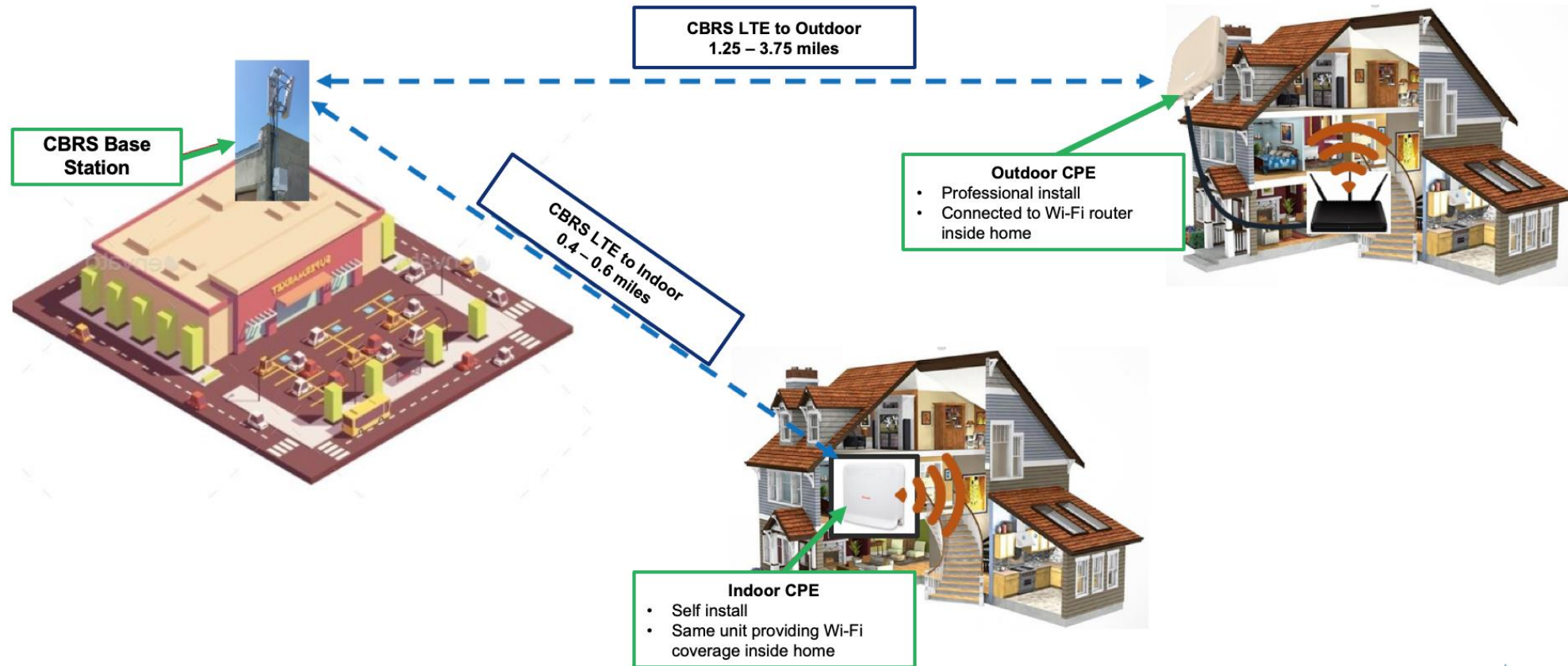
# Dell Technologies and JMA Wireless Help Solve the Digital Divide for Tucson, AZ



## OVERCOMING DIGITAL EQUITY CHALLENGES:

- How to provide internet access to disadvantaged neighborhoods
- A completely wireless solution was needed to accommodate all residents
- Impossible to deploy and maintain approx. **20,000 WiFi hotspots** over 70 miles
- In order to leverage CARES Act funding, needed a product solution vs. a service

## ADVANTAGES OF THE JOINT SOLUTION:

**With advanced 4G/5G hotspots from Dell and JMA Wireless, the city was able to:**

- Cover the same 70 mile area with only 80 hotspots
- Gain 50MB internet speeds within the extended 4G LTE range and up to 100MB connections for a smaller 5G circle
- Offer a more secure network to approved applicants with rugged 4G/5G to WiFi devices provisioned with city-supplied SIM cards
- Dramatically reduce deployment costs as each Dell server supports 4 hotspots

## WHAT'S NEXT FOR THE CITY OF TUCSON:

- The city is in the process of deploying 40 hotspots and will expand further in 2021
- Over 2000 applications received from families in need of internet connectivity
- Extend utility to other city services to further reduce spend on external carriers
- Connectivity is now in place to be able to deploy "smart" devices

**DELL**Technologies

# SLG Private LTE / 5G Wireless Concept

**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.

**CITY HALL**

**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.

**PRIVATE 5G OR LTE ENABLED PUBLIC TRANSIT**
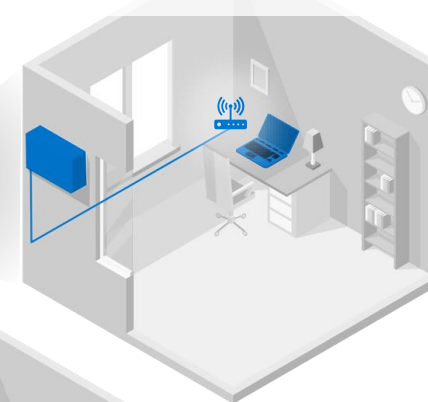
**STRONG SIGNAL WITH MOBILE ENVIRONMENT**

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.

**D&LL**Technologies

# The Spectrum Highway is Changing:

Enterprise 5G

**650 MHz**

**1850 MHz**

**3250 MHz**

44

## Current Licensed Spectrum

- Licensed 600 thru 2500 MHz
- AT&T: 150 MHz,  Verizon: 115 MHz,
  T-Mobile: 110 MHz,  Sprint: 200 MHz,
  Other: ~120 MHz

## + Mid-Band Spectrum

- **3550 to 3700 MHz (150 MHz) CBRS**
- **3700 to 4200 MHz  (500 MHz FCC) C Band**
- 5925 to 6425 MHz  (500 MHz FCC)
- 6425 to 7125 MHz  (700 MHz FCC)

## + mmWave Spectrum

- 27.5 – 28.35 GHz (2X425 MHz)
- 37.6 – 38.6 GHz (5X200 MHz)
- 38.6 – 40 GHz (7x200 MHz)

# What is Private Cellular/CBRS?

- It is a cellular network that leverages a private core element instead of connecting to AT&T/VZ/TMO Public Wireless Network.

- Provides connectivity for enterprise members and their applications using 150 MHz of spectrum in the 3.5GHz Range – "CBRS"

- CBRS = Citizens Broadband Radio Service or LTE Band 48: Up to 150 MHz Fully Dedicated to Single Venue, Enterprise, or Community

- LTE Based Technology, Full Compatibility with Global Mobile Networks

- 15 Channels up to 160 Mbps Each

- 5G Friendly

45
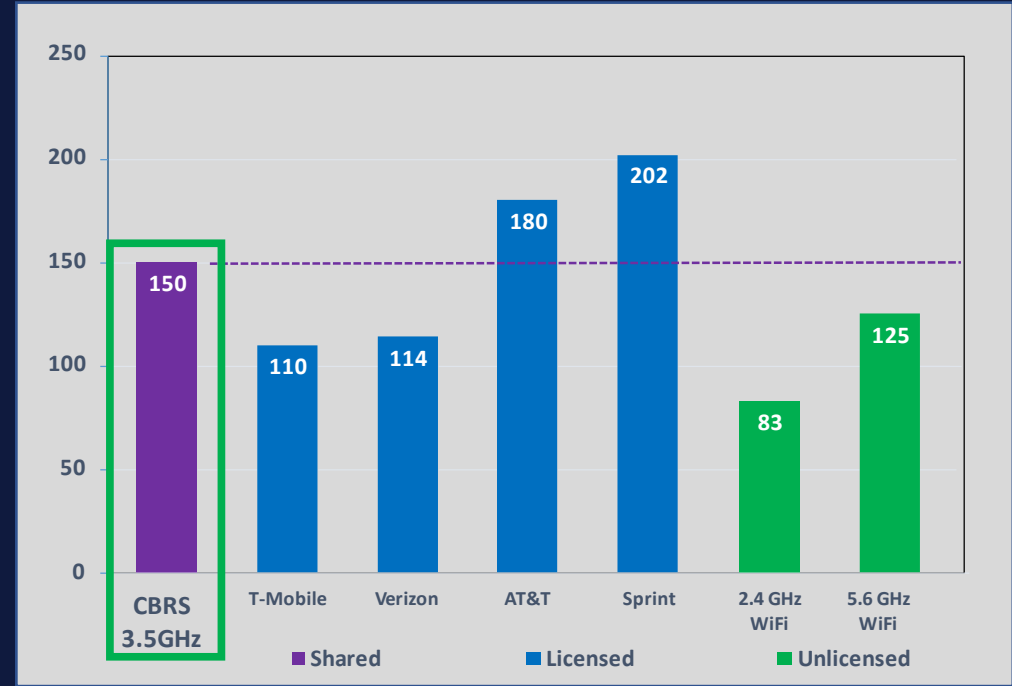
## Basic Use Cases

- Fiber Alternative for Backhaul and Transport, Wi-Fi Offload, Network Densification, Low Latency Performance, User Mobility, Voice Services

# Building Blocks for Private Cellular Networks to Deliver True Mobility and Connectivity for All

Enterprise 5G

**Licensed or Shared (CBRS) Spectrum**

CBRS expansion of the cellular spectrum enables enterprises to launch wireless networks using cellular networking technologies

**LTE / CBRS Small Cells and CBSDs**

Low-cost cellular/CBRS small cells makes private Radio Access Networks (RANs) attractive

**Core**
Core powers your Private LTE/5G network and serves as a trusted party between enterprises and major *public* cellular carriers. Connect to Core, and your enterprise is **interconnected**

**Trade**
Trade is a service management platform that provides insights into user experience and in-building analytics
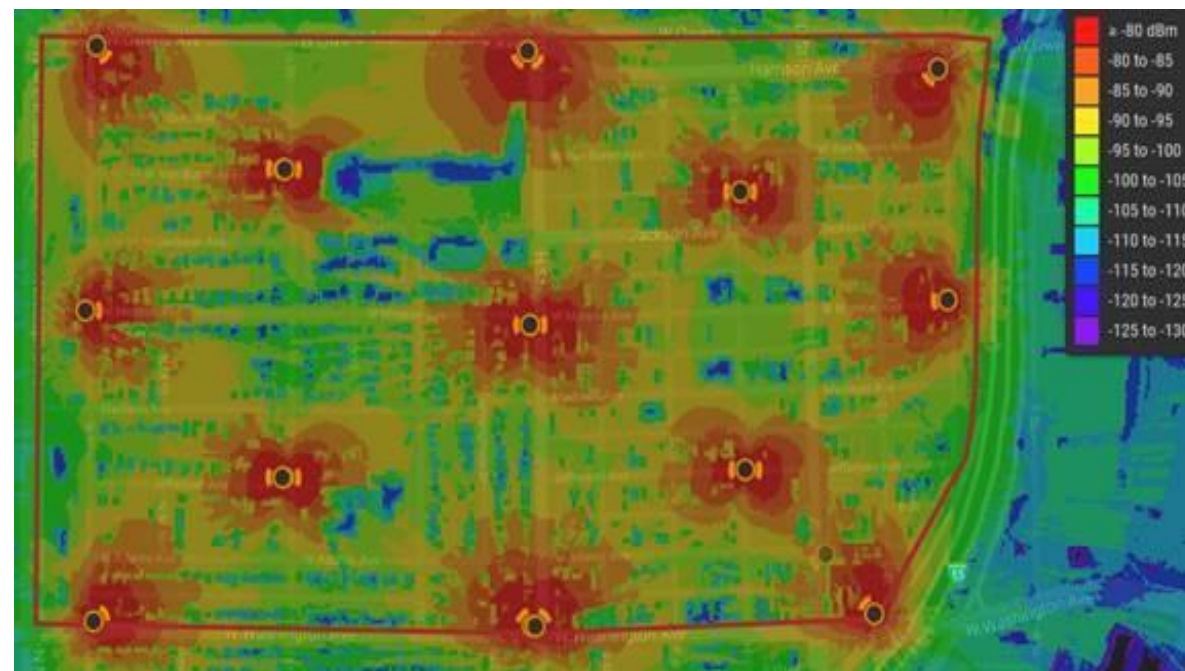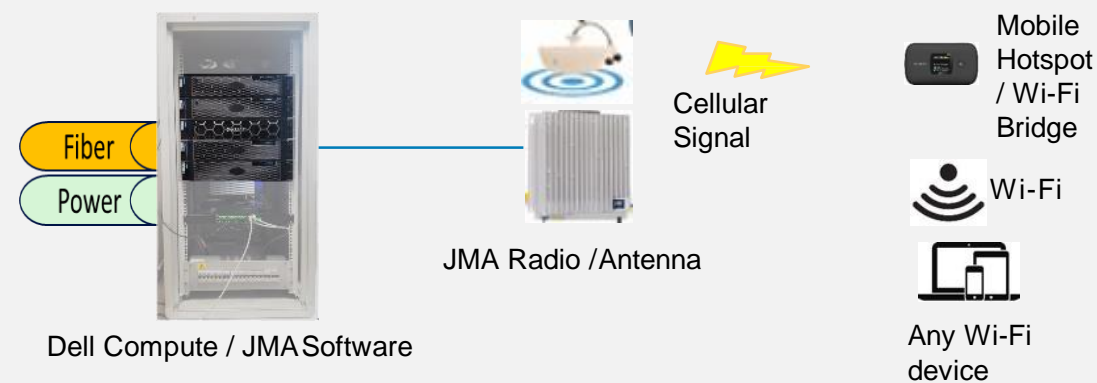
**SIM Cards –**

Core Connected Devices

**Interconnected Private Cellular & Neutral Host Network**

46
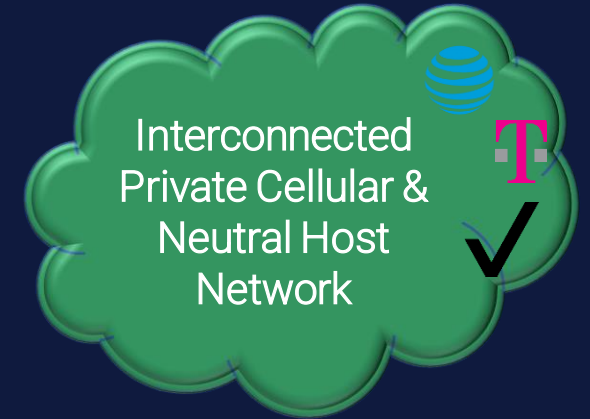
One private network, Two key benefits:

1) Secure, high-performance network tailored to enterprise venue and user community

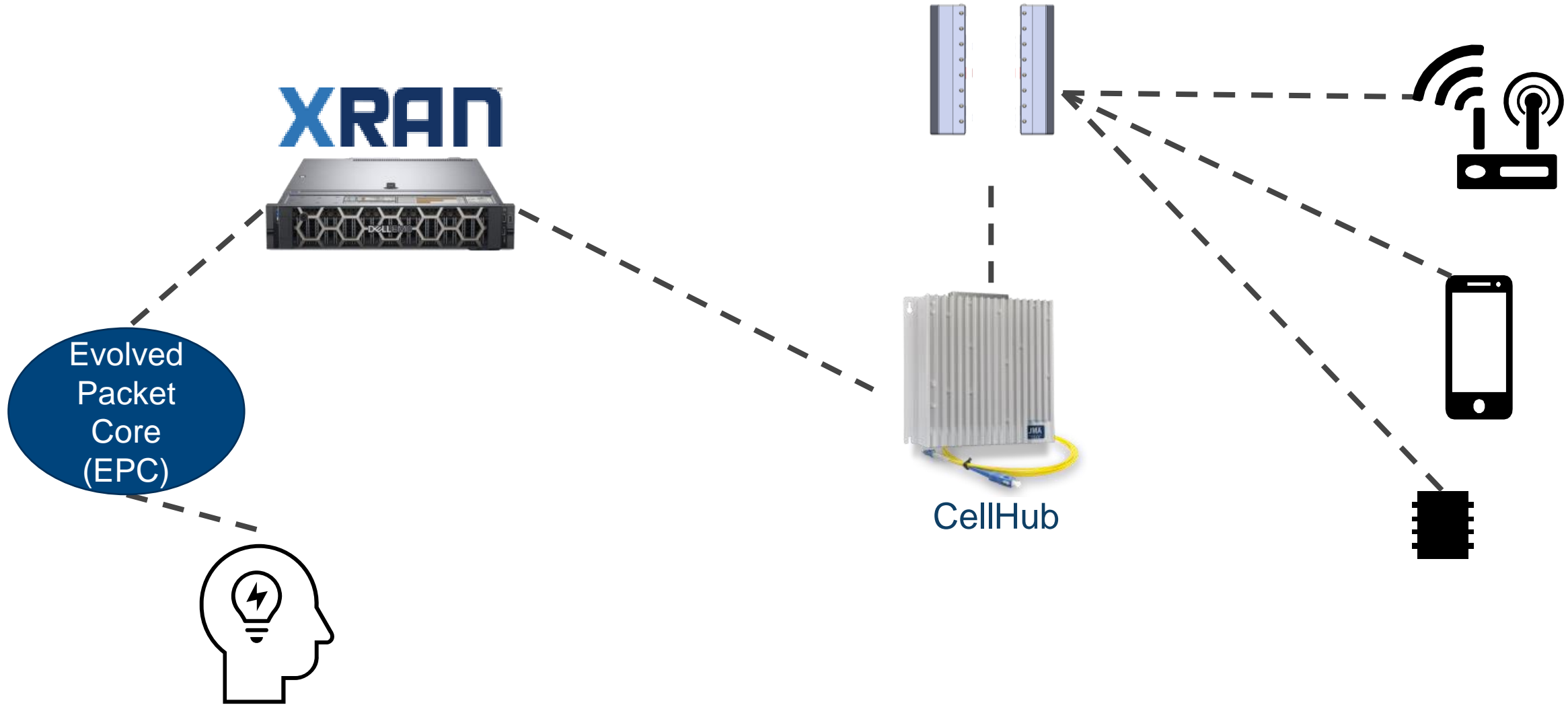2) Neutral Host multi-carrier subscriber support

# Digital Divide Example – Bringing Connectivity to Underserved Areas



- Customer Provided Indoor Rack Location
- City Provides Fiber, Power, Connection Locations
- JMA Private Wireless Software Running on Dell 740
- JMA Carrier Grade Radios ~12-15 radios covering 100 blocks



Fiber

Power

Dell Compute / JMA Software

JMA Radio / Antenna

Cellular Signal

Mobile Hotspot / Wi-Fi Bridge

Wi-Fi

Any Wi-Fi device

**DELL**Technologies

# Simple Deployment Architecture



CellHub

DELLTechnologies

# Speeds



| | | |
|---|---|---|
| **49.6** ⬇ 3☁ megabit/s | | |
| **2.97** ⬆ 3☁ megabit/s | | |

download phase

upload phase

n Jose, USA — Los Angele 2, CA, USA

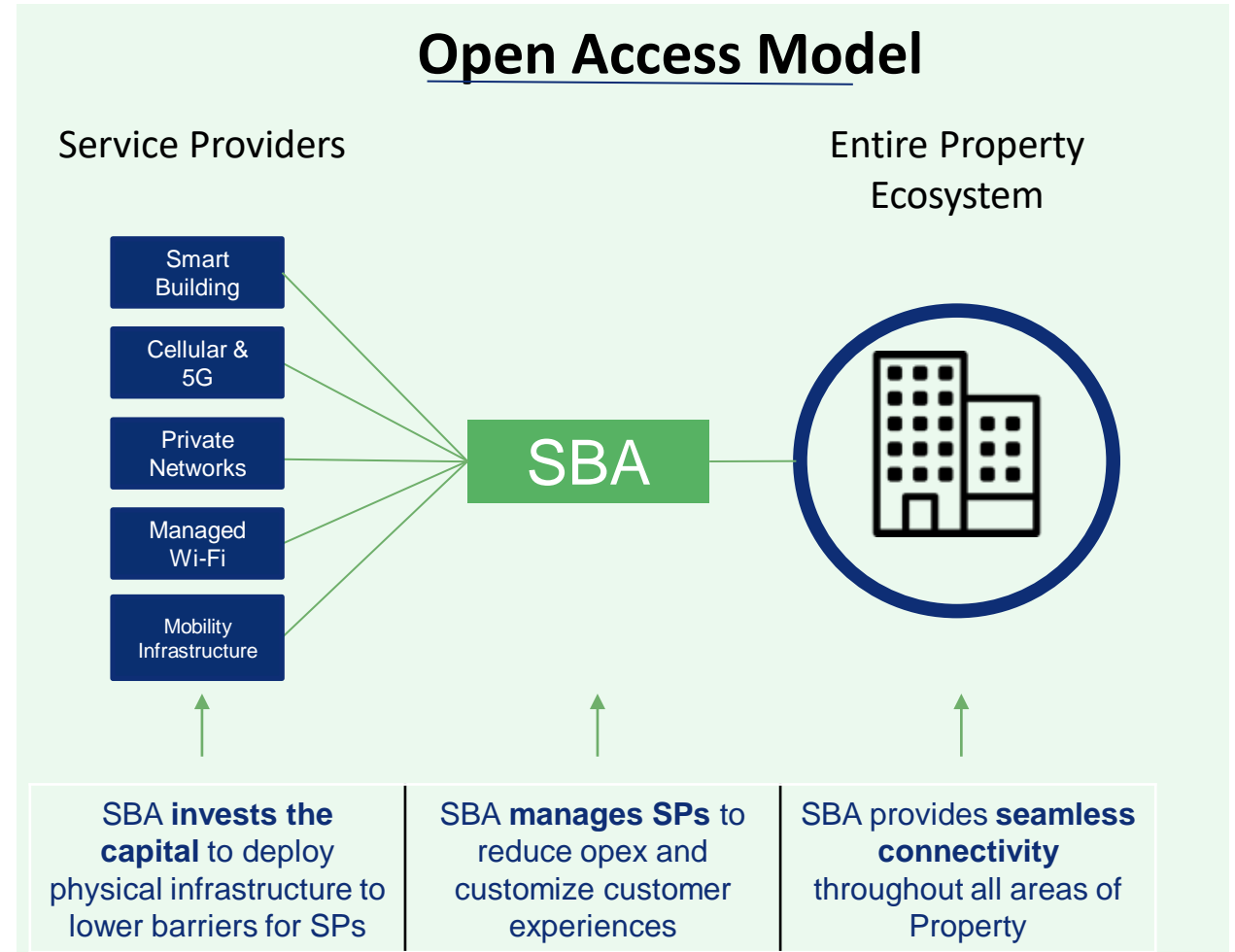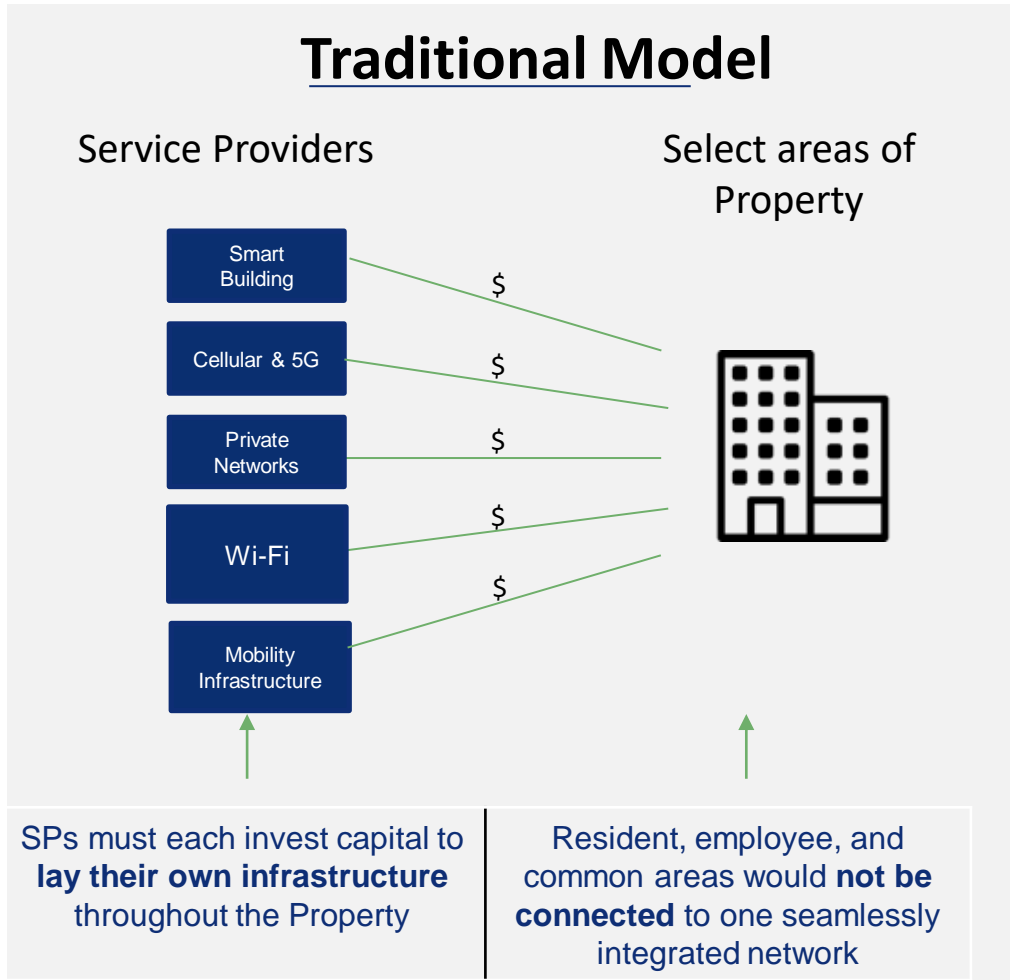Overall **B**   BufferBloat **-**   Quality **A**   Speed **C**

Results + Share

# The Open Access Model – How it Works

Traditional connectivity models require one or more carriers to invest in infrastructure; SBA's open access model provides the investment and leaves room for all types of service providers



## Traditional Model

**Service Providers**

- Smart Building
- Cellular & 5G
- Private Networks
- Wi-Fi
- Mobility Infrastructure

**Select areas of Property**

SPs must each invest capital to **lay their own infrastructure** throughout the Property

Resident, employee, and common areas would **not be connected** to one seamlessly integrated network

## Open Access Model

**Service Providers**

- Smart Building
- Cellular & 5G
- Private Networks
- Managed Wi-Fi
- Mobility Infrastructure

**SBA**

**Entire Property Ecosystem**

SBA **invests the capital** to deploy physical infrastructure to lower barriers for SPs

SBA **manages SPs** to reduce opex and customize customer experiences

SBA provides **seamless connectivity** throughout all areas of Property

SBA is also responsible for all infrastructure maintenance, replacement, and upgrades

By deploying Open-Access technology at multiple locations, the City or County can establish a wide-reaching coverage footprint

In the example pictured (right), three schools serve as base stations, each providing coverage to homes within a **radius of approximately 0.4-0.6 miles**.

With this deployment, **560 concurrent Zoom sessions can be served from each school location**, or 1,680 concurrent Zoom sessions across all three.
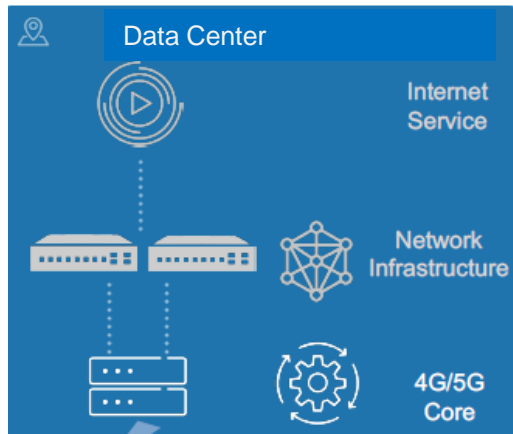
# Network Architecture
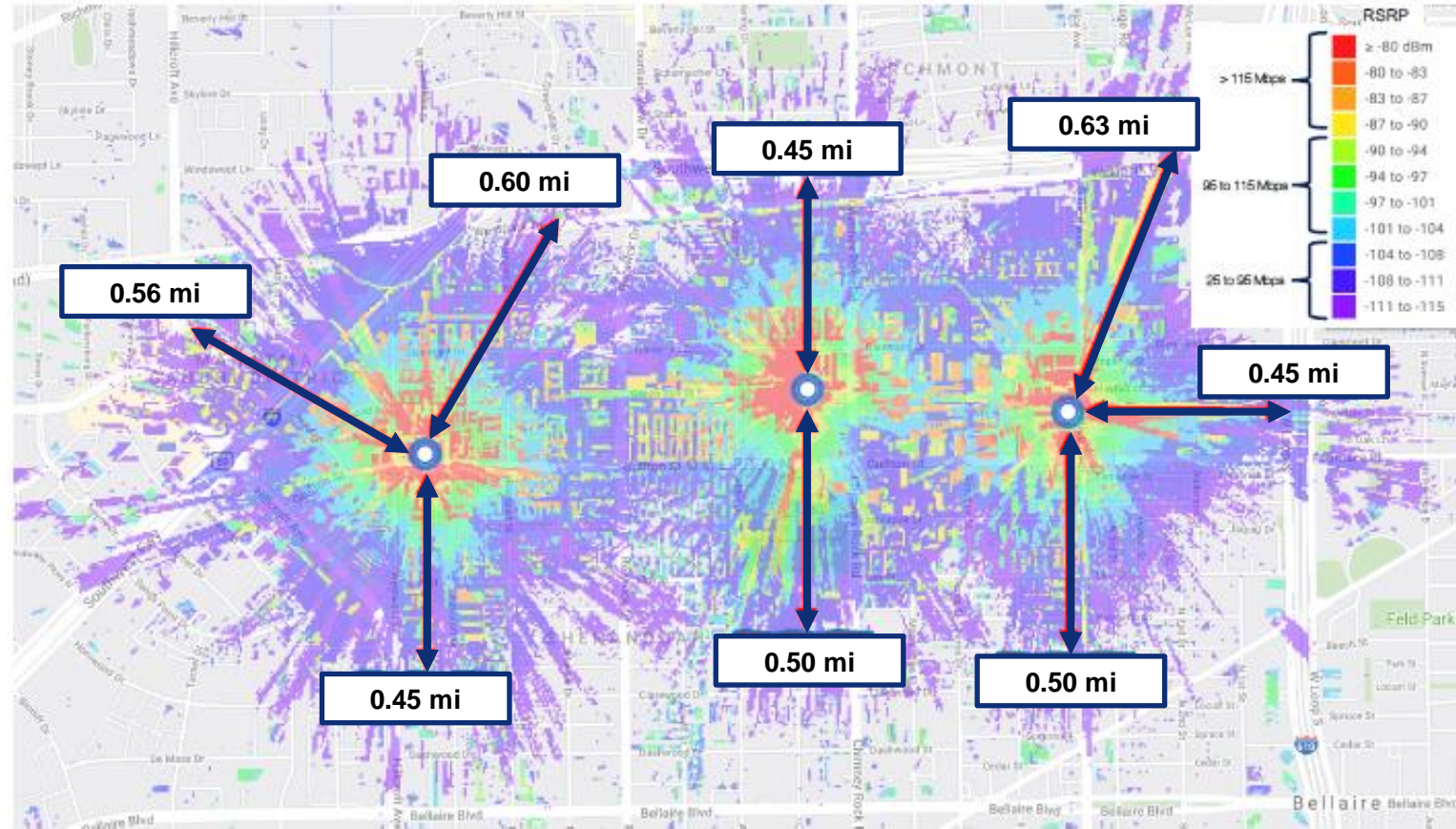


**Orchestrator**

**Capabilities**
Cloud Management
Policy Orchestration
Analytics & Reporting

**Data Center**
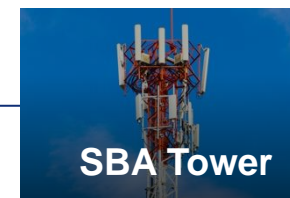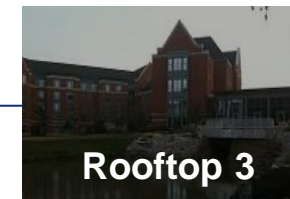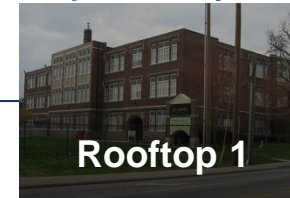
Internet Service

Network Infrastructure

4G/5G Core

**Technology**
Edge
Enterprise Packet Core
Spectrum Management
Software-Driven Solution

**Existing Dark Fiber**

**Private Network- Owned and Operated by SBA**

Rooftop 1

Rooftop 2

Rooftop 3

SBA Tower

**Home Communications Infrastructure**

Indoor Cellular CPE with Wi-Fi

Wi-Fi Clients

An Internet-connected data center like JAX NAP serves as the aggregation point and Internet gateway for network traffic on the SBA private network

Point-to-point dark fiber links the local data center to communications infrastructure at each school

CBRS Radios connected to Federated SAS provide broadband connectivity for E-Learning, Telehealth, and other applications

Wireless infrastructure on or within the home communicates with the base station at the nearby school