US Bank Stadium
August 16, 2018 at 9am to 2:00pm
Keynote Speaker: Otto Doll, CIO, City of Minneapolis

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

Minneapolis hosted this year’s Super Bowl. The City had to prepare for a doubling of its population for a week. Learn how both the Public and Private Sector leveraged existing resources and supplemented it with network and power technologies. CIO, Otto Doll will review the City’s overall vision for technology and then we will do a deep dive on the Super Bowl.

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

GraybaR · bandwidthlogic · Montage Diversity · JMA Wireless · City Networks Task Force · Dense Networks · SmartCitiesCouncil · extenet Systems · WIA Wireless Infrastructure Association · Safer Buildings Coalition

www.densenetworks.com

Mortons | 735 S Figueroa St.
September 12, 2018 at 9am to 2:00pm
Keynote Speaker: Jonathan Adelstein, CEO, Wireless Infrastructure Association

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 is a cute marketing term but few understand how to apply a Heterogeneous Network.
- Video is driving bandwidth demand. What is the right architecture to keep up?
- DAS Networks are essential for In Building Public Safety and Wireless Communications. Will Beacons and Location Based Services become the norm?
- Fiber Optics are essential to enable the bandwidth demand. Should cities own, lease or partner?
- WiFi is ubiquitous but is it viable for voice and IoT? LTE catch all?

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

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Agenda-Getting to Smart-Minneapolis

9:00 Scott Jackson, Graybar: Welcome

9:15 Peter Murray, Executive Director, Dense Networks: Smart City Networks

9:30 Otto Doll, CIO, Minneapolis: Minneapolis Smart City and Tech

9:50 Panel: Smart City Networks

- Sabrina Gosnell, VP CTC Communications & Energy
- Kurt Jacobs, Director, JMA Wireless
- Otto Doll, CIO, Minneapolis
- Scott Jackson, Smart City Program, Graybar

10:45 Break

11:00 Jeff Peskuski, Graybar, US Communities: Program for Cities, Counties, and Higher Education

11:15 Network Infrastructure Panel: Synergies of Electrical & Communications Infrastructure

-Parsons Team

4 Disciplines:

- Mobile Solutions: DAS/Public Safety
- Security:
- Audio Visual: Controls/Displays/Broadcast
- Construction: Tying it all together for a successful networ

12:15-2:00 Lunch and Networking
2pm – 3pm Tour of Stadium

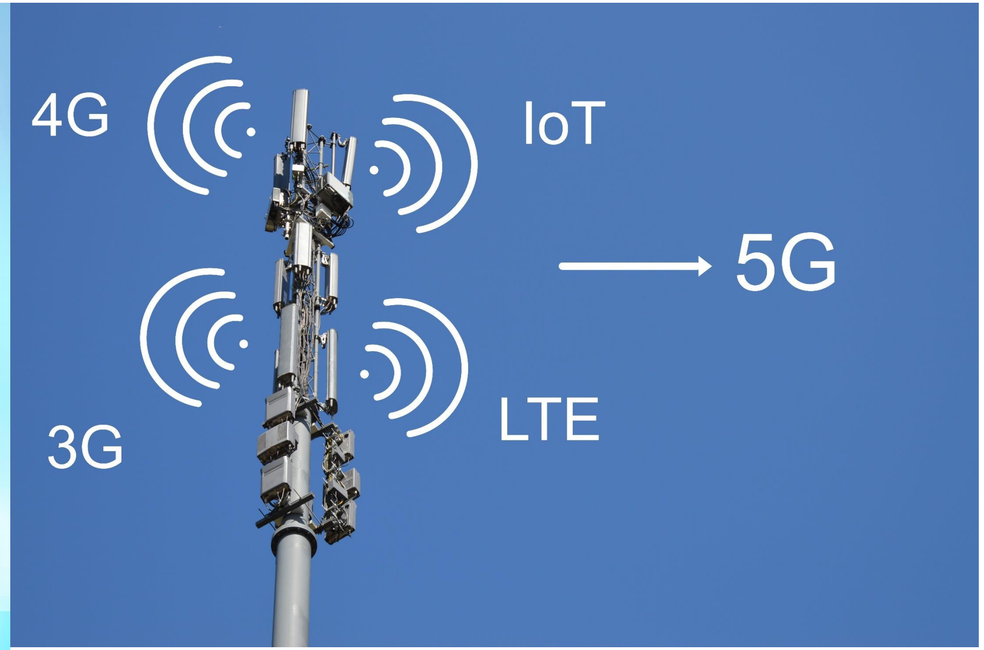

ALWAYS ON

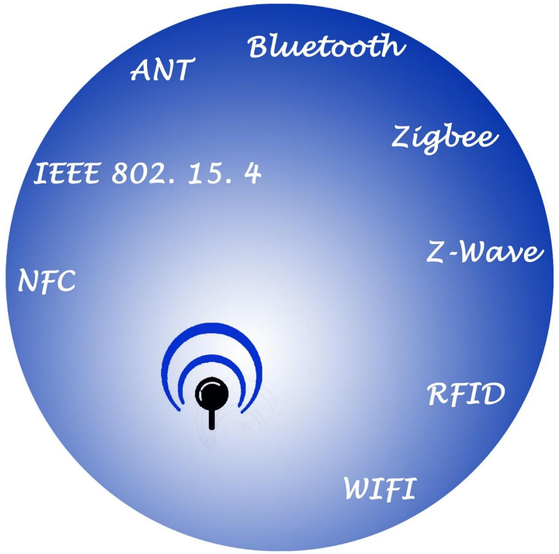

The UN predicts Global Population Growth
Greater than 30% by 2050
The Majority will be in Cities

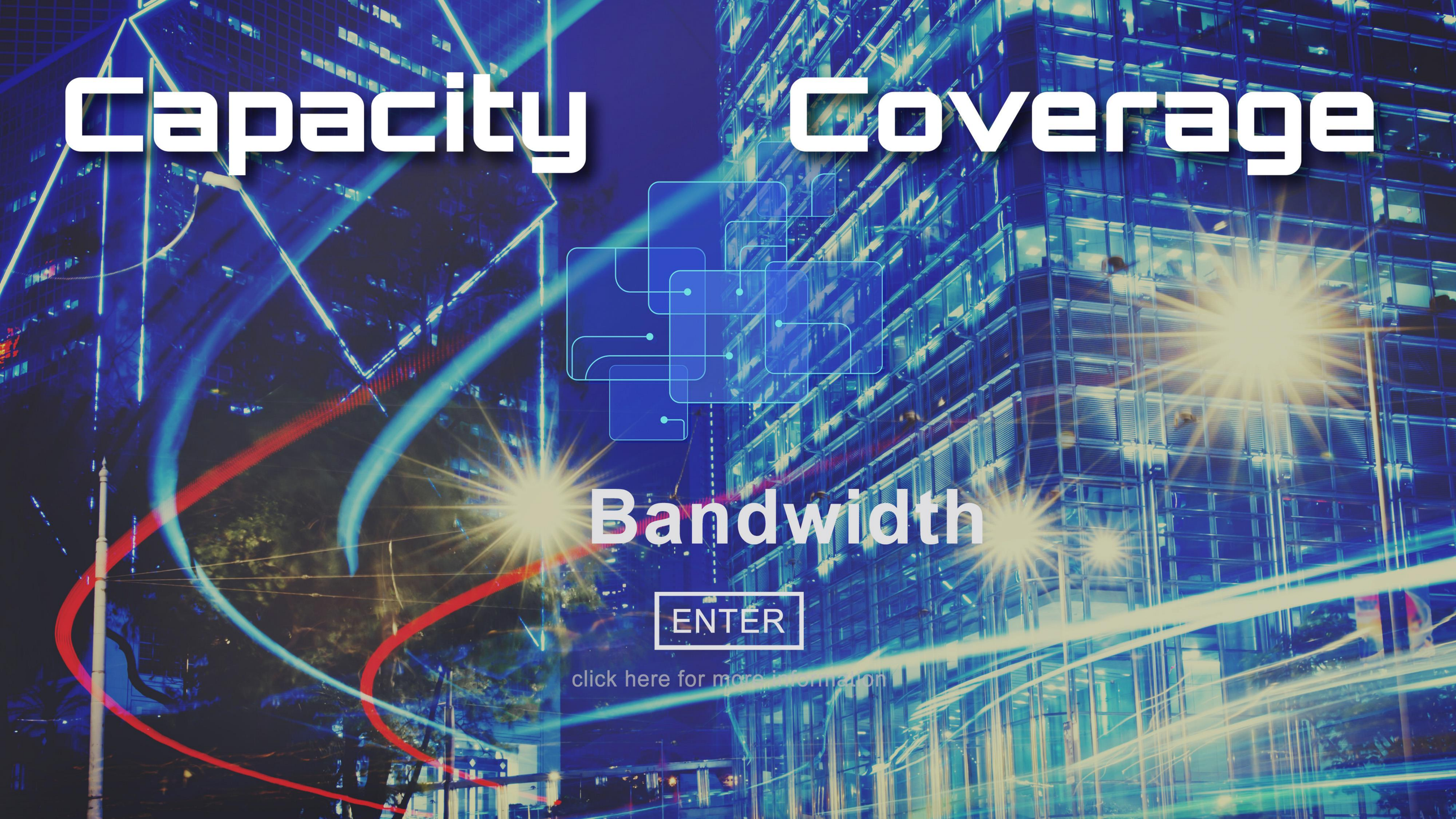

Connected City
Smart City

How Many Networks?

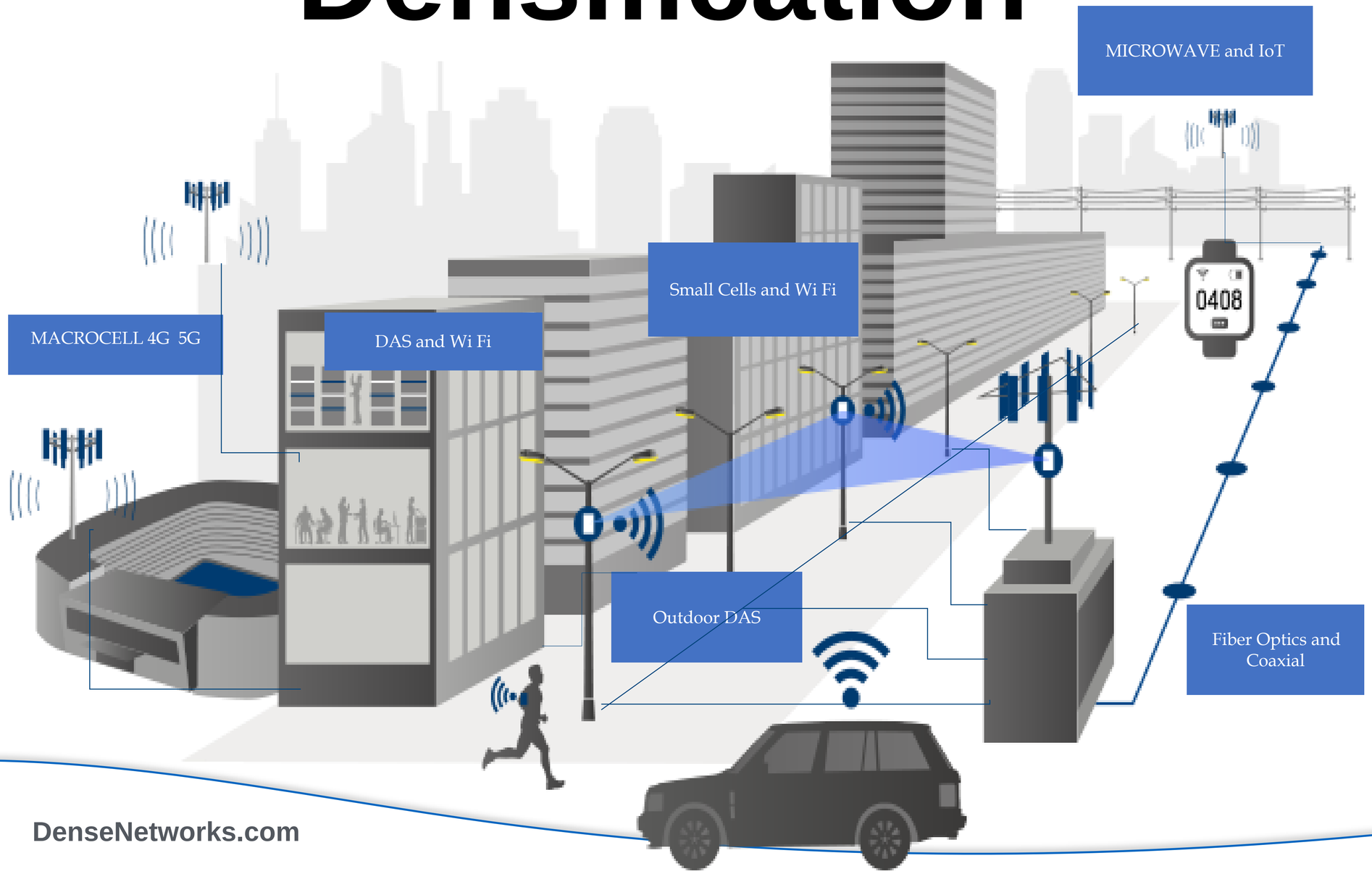
Capacity, Coverage, Compliance



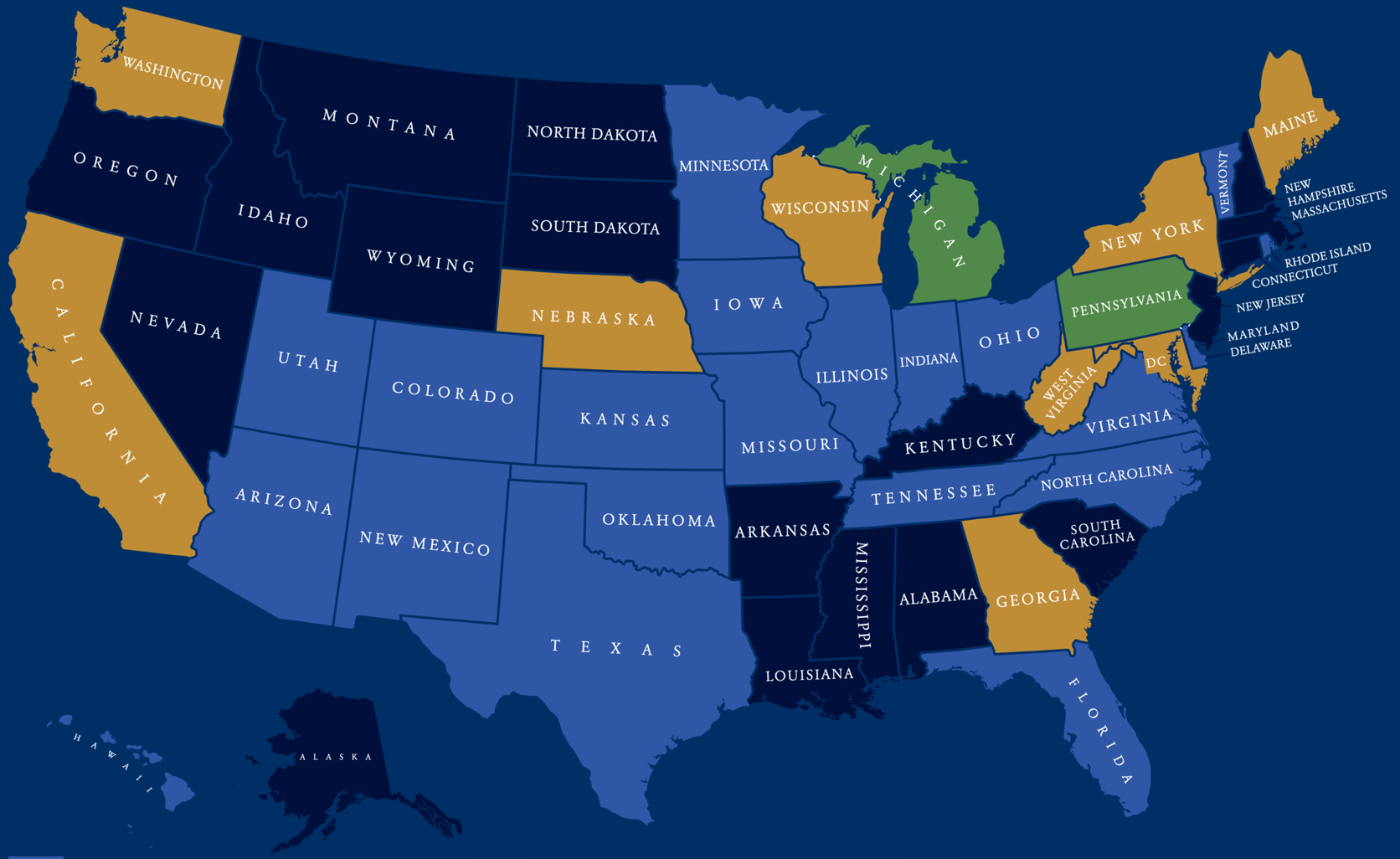



Capacity
Coverage
Bandwidth
ENTER
click here for more information

Densification



Working in States



- 21 State Bills
- Michigan and Pennsylvania active
- States where bills failed continue to have local discussions in anticipation of the next legislative session
- Notables:
  - California
  - Georgia
  - New York
  - Washington

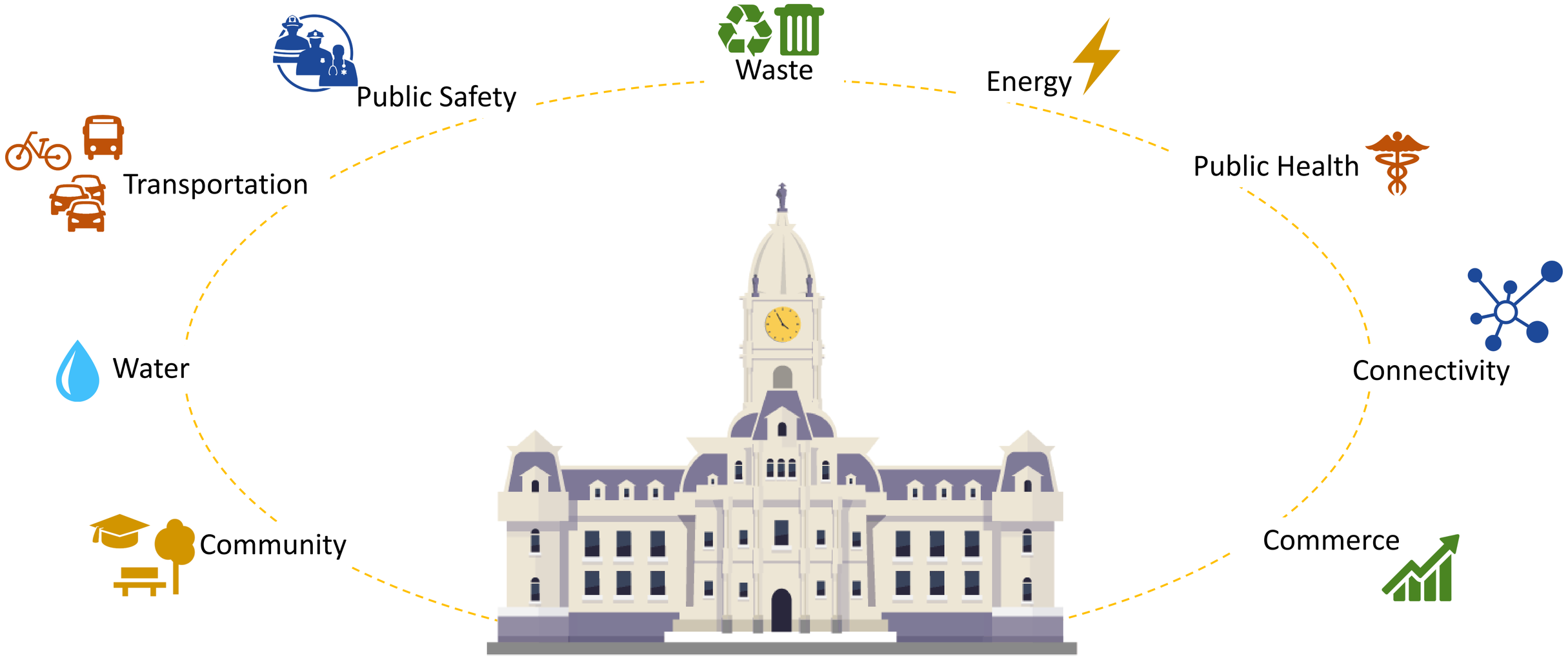
Small Cell Bills Enacted

Current Active States

2018 Bill Failed; ongoing discussions to prepare for 2019 session

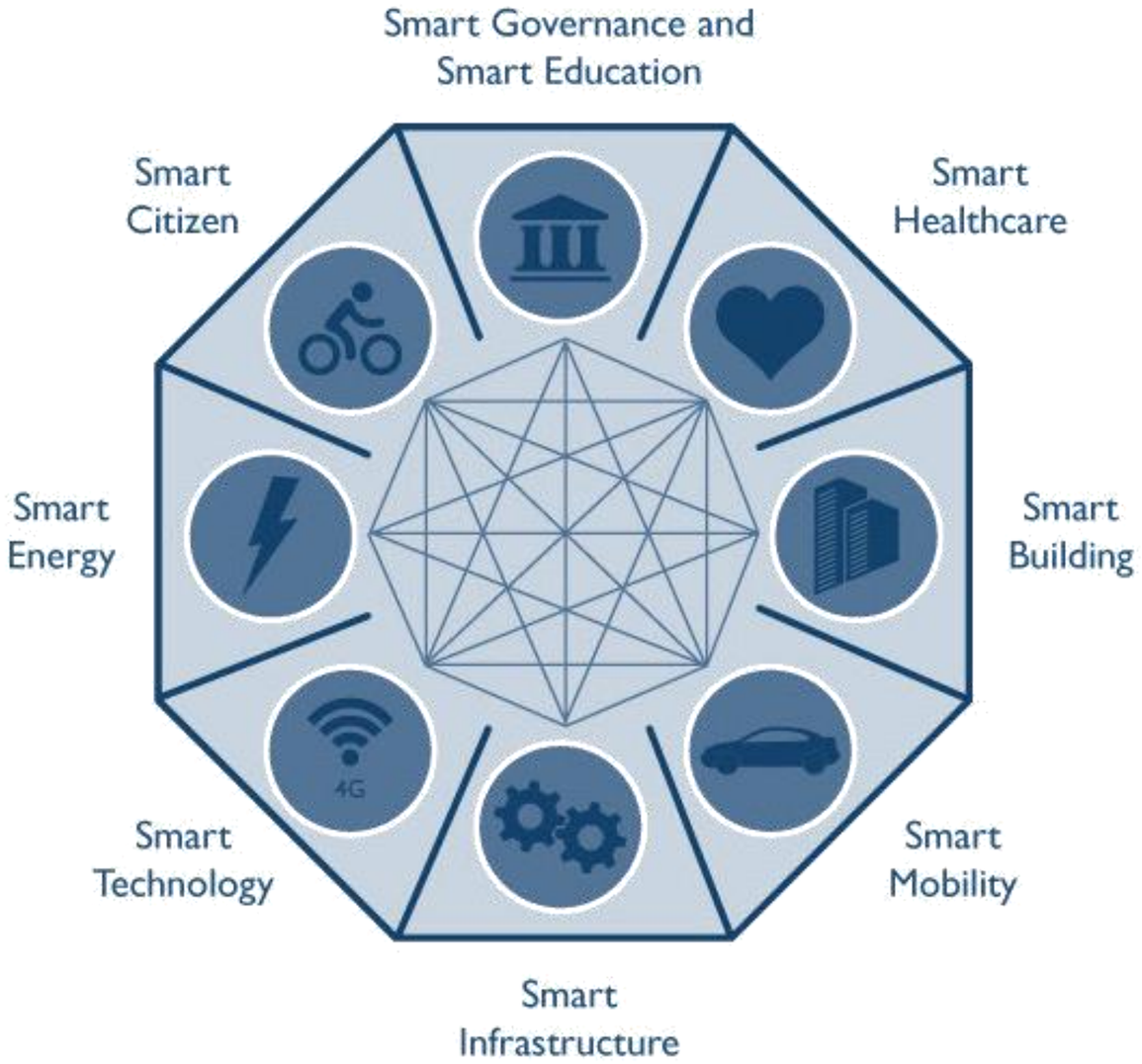
The Big Picture

Smart Collaboration > Improved Efficiency > Faster Response > Better Service



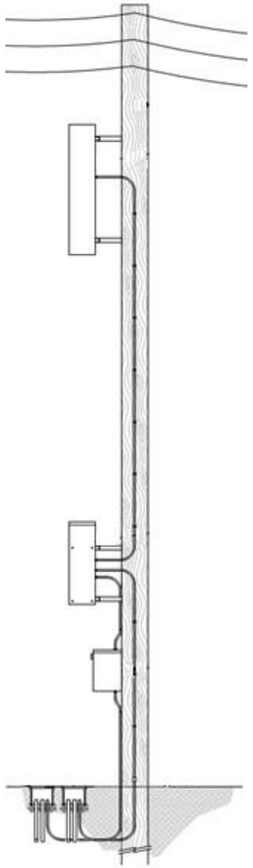
How Does Orlando Define Smart City?

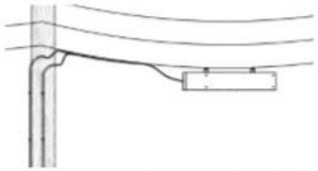
Using *technologies* to enhance the **livability**, **workability** and **sustainability** of Orlando.



Small Cellular Deployment Types in Denver ROW

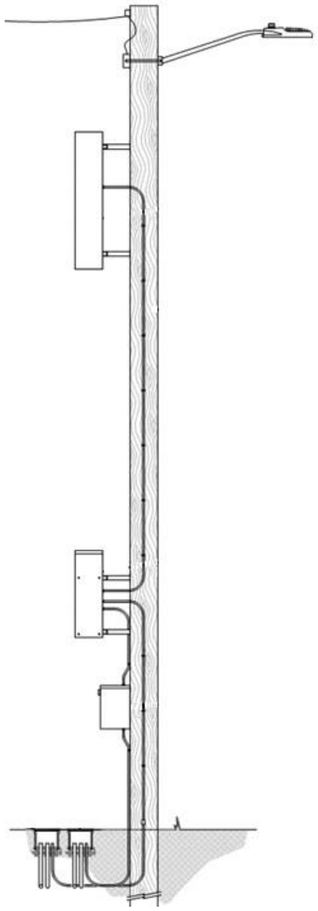
1





Onto or between
Xcel Utility Poles

2



Onto Xcel Wood
Street Lights

3

Remove & replace
Xcel Street Lights
with Hybrid

4

(Private)
Permitted
Freestanding
Antenna

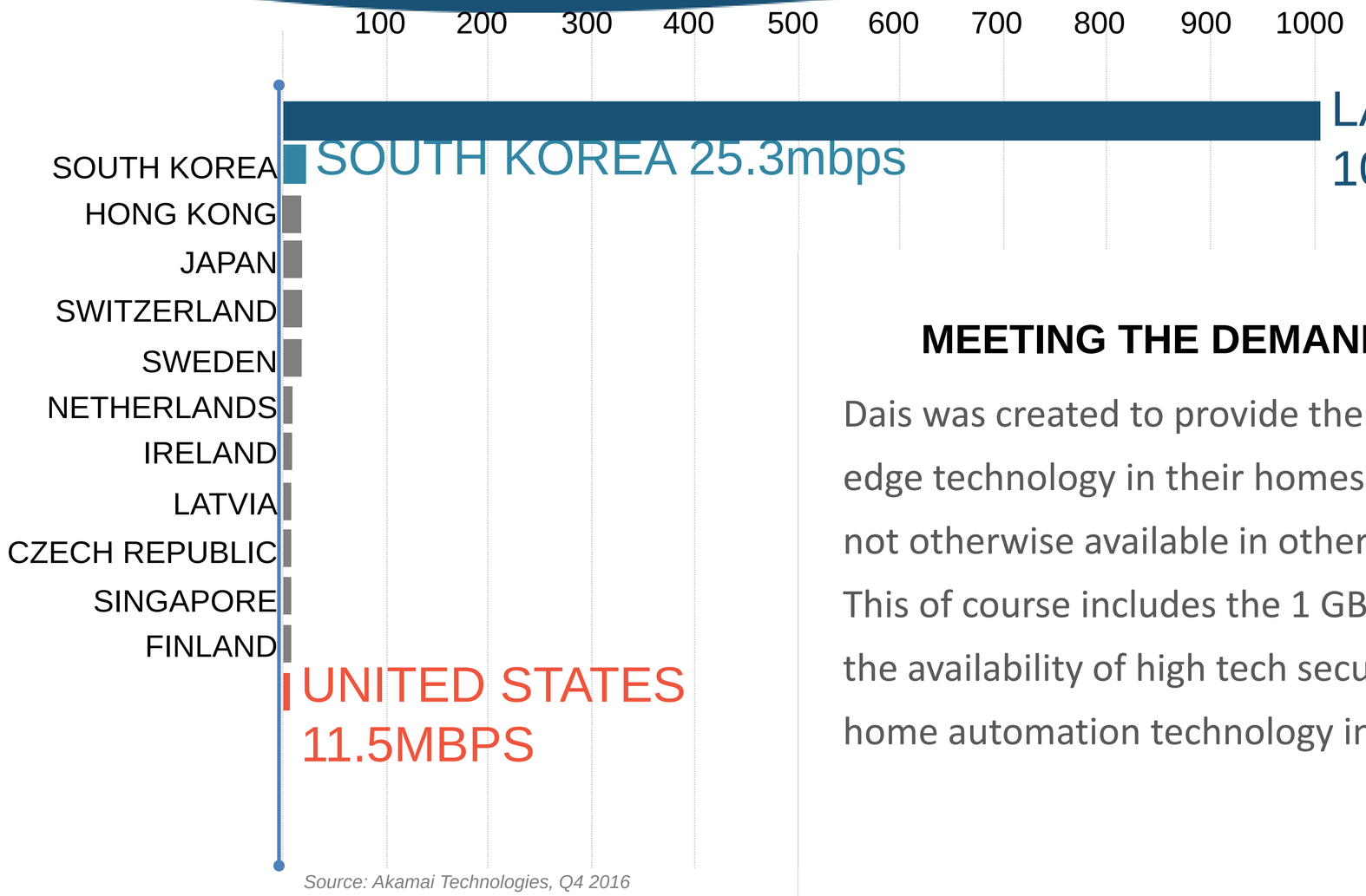
WELCOME TO LAKE NONA

LAKE NONA®

“Lake Nona: How to Build a Great American City.”

FORTUNE

TECHNOLOGICAL INFRASTRUCTURE



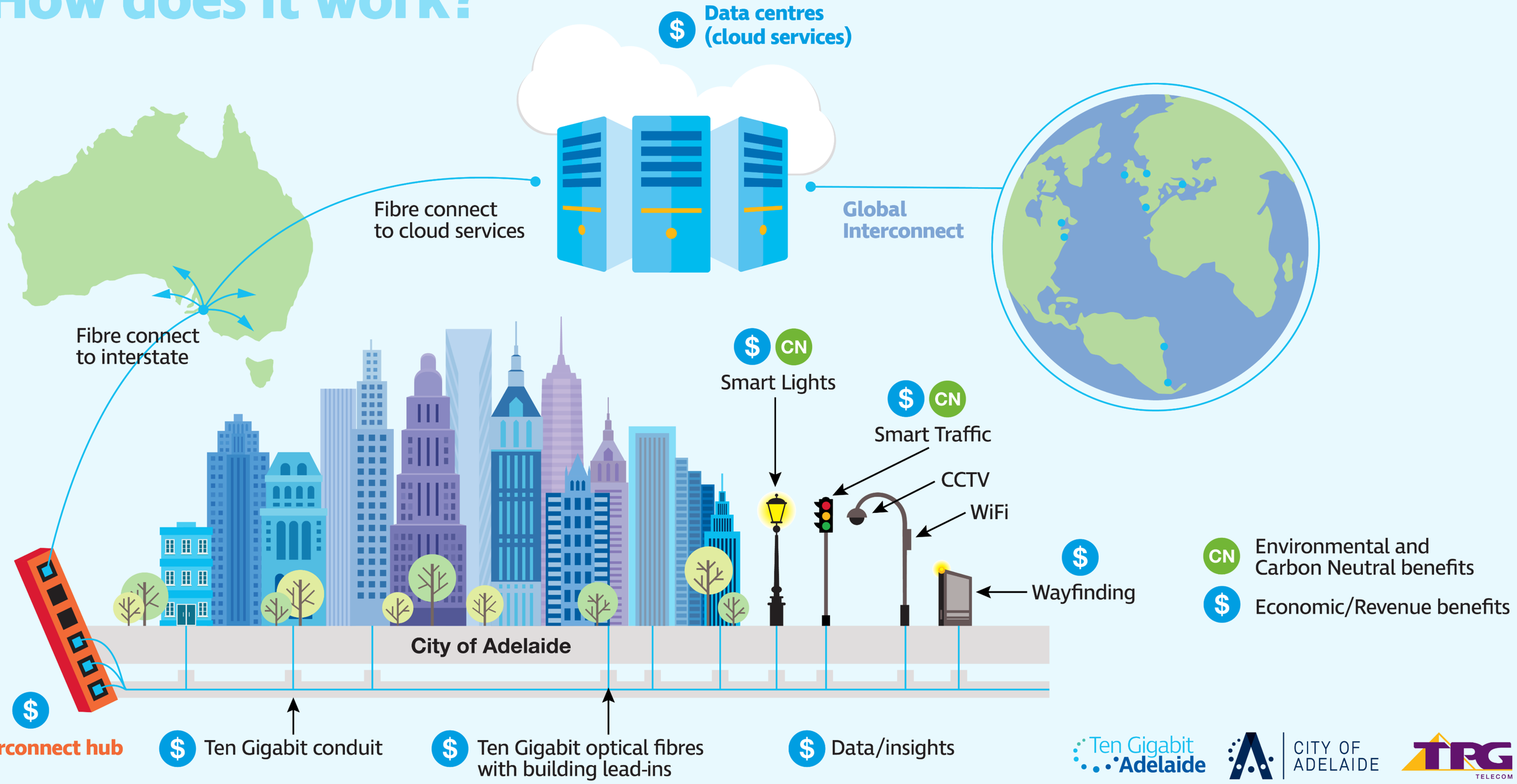
Source: Akamai Technologies, Q4 2016

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. “

dais

How does it work?



Ten Gigabit Adelaide

CITY OF ADELAIDE

TPG TELECOM
OFFICIAL NETWORK PROVIDER

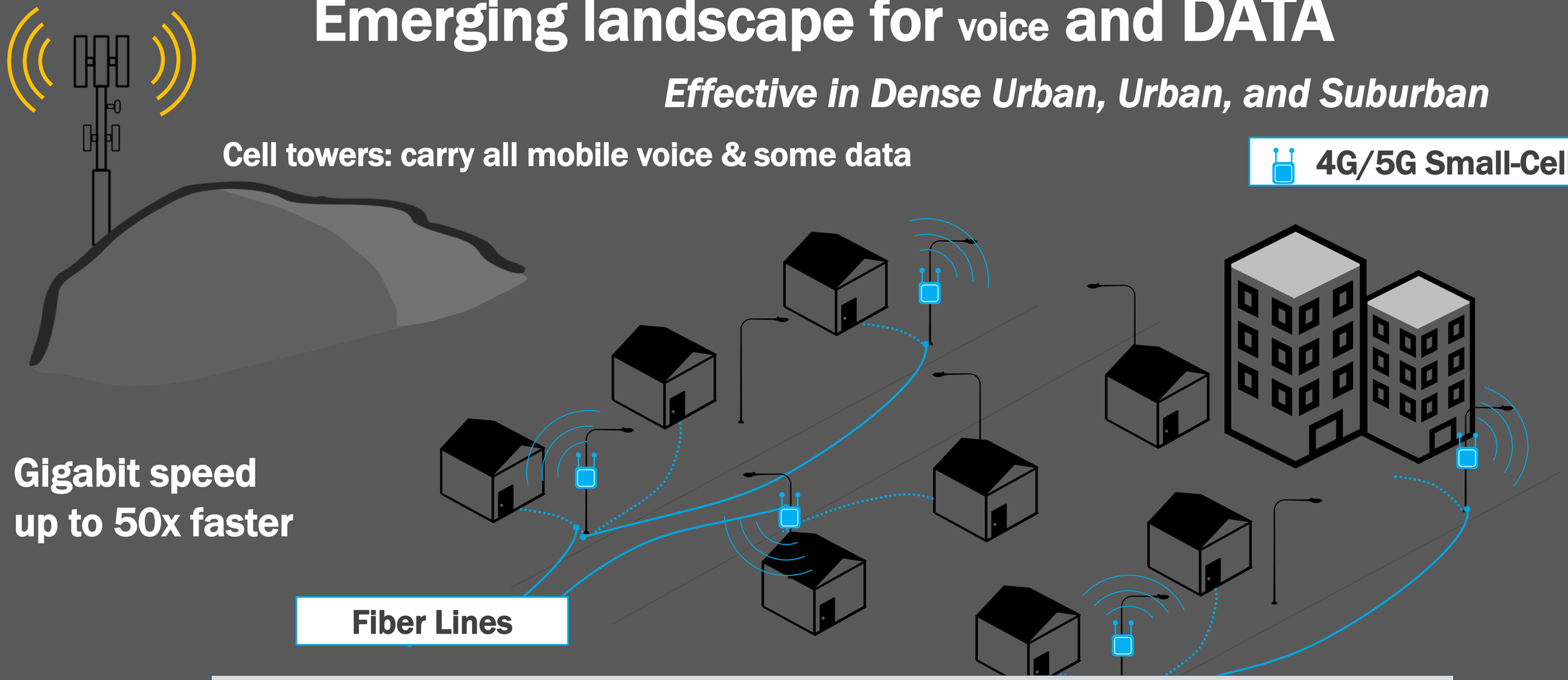
Broadband Strategy

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



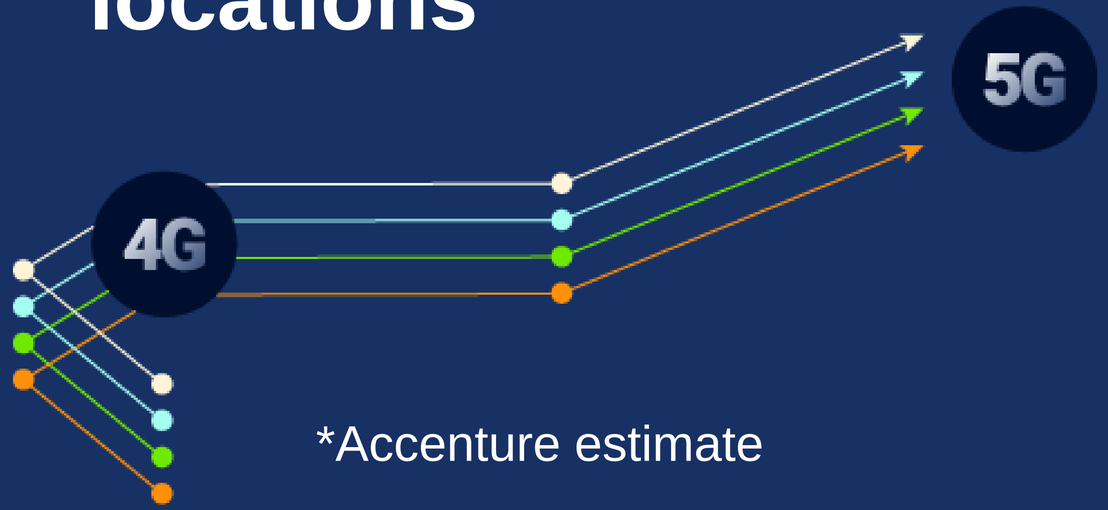
Gigabit speed
up to 50x faster

Fiber Lines

Light pole is most valuable asset for broadband

5G Momentum

- **$275 billion** opportunity*
- **3 million** new jobs
- **$500 billion** boost to GDP
- **100 x more** antenna locations

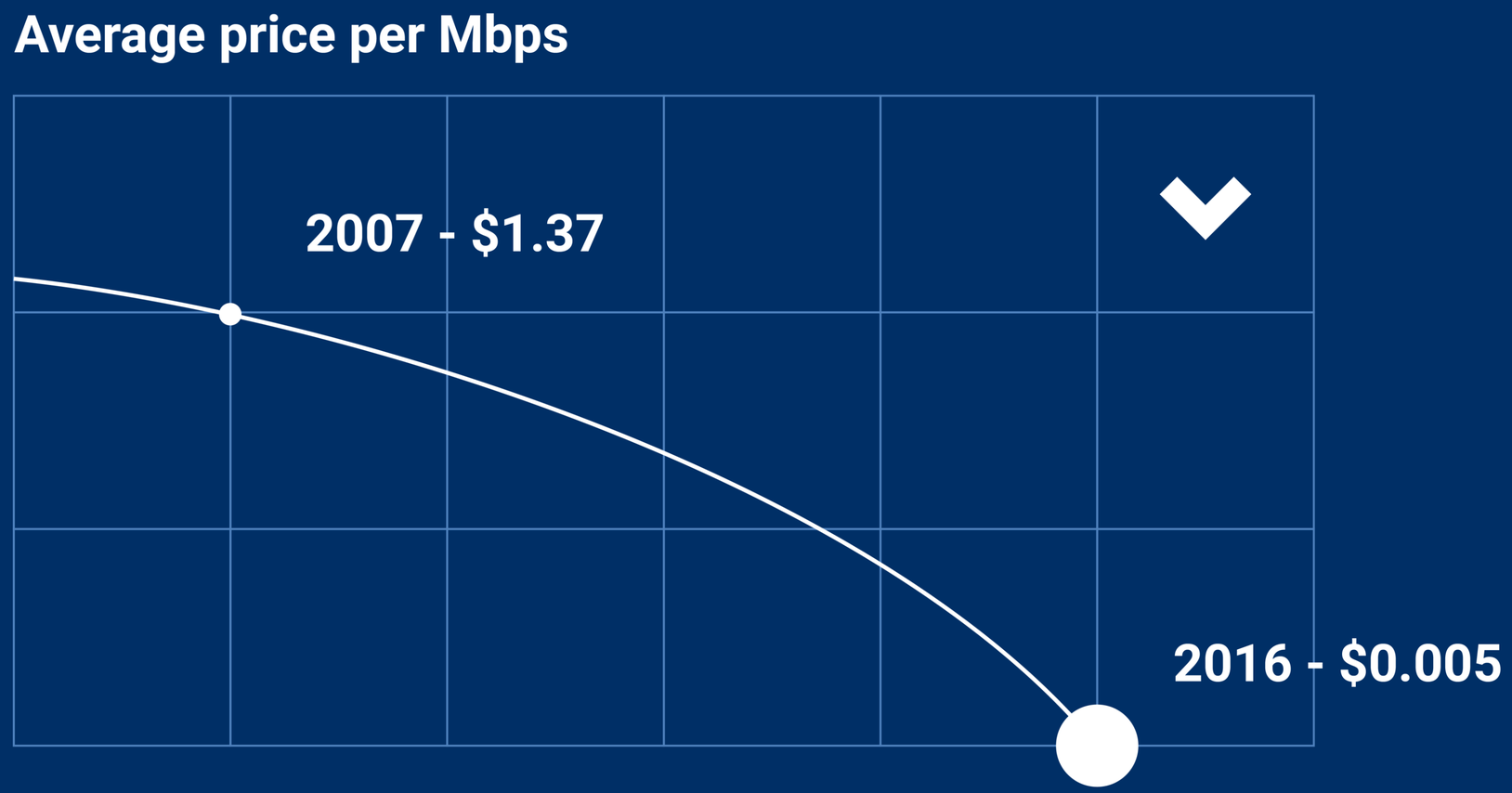


*Accenture estimate

Mobile Industry Trends - US

Data Source: GSMA 2017

How Low Can It Go?



Source: FCC’s “Twentieth Wireless Competition Report”


Connectedness

History of Innovation
- >70 Years Experience
- 600 Patents

Strong Operations
- Profitable High Growth Tech Company
- Privately Owned (non-VC)

Quality Supplier
- ISO 9001:2015 Certified
- Full Manufacturing Operations

Global Presence
- Sales & Deployment in over 40 countries
- US & EU Based Manufacturing

Rich Partner Network
- Over 200 deployment partners
- Over 20,000 Certified Experts

Customer Experience
- > 100K Venue Cells, 20M RF Connectors
- > 4000 Sites, >1000 Customers,

Strategic Technology Portfolio

Transmission Line RF Systems
- Antenna Systems
- RF Filtering
- Power Optimization
- RF Connectors

Heterogeneous Wireless Networking
- DAS RF Distribution
- Digital Electricity
- HetNet Solutions
- Public Safety

New 5G Virtualized Access Network
- Virtualized Edge RAN
- Mobile Edge Computing
- Mobile Broadband
- IoT Enablement

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

*Dates are subject to change.

Minneapolis being Smarter

Accelerate technology-enabled outcomes along City criteria

Criteria	Technology-enabled Outcomes
Buildings	Automated HVAC/lighting/mechanical/plumbing; Energy-efficient; LEED certified; Livable housing
Citizens	Business Prospers; Creative/Entrepreneurial Activity; Educational attainment; Disparities eliminated; Community engaged; Residents prosper
Data	Data analysis; Data integrity; Data sharing; Generic analytics
Energy	Affordable, efficient, reliable, renewable, and sustainable distribution
Government	Accountable; Better decision making; Connects to the community; Efficient provision of services; Equitable service delivery; Fair taxation; Regulate institutions/people; Transparent
Great Places	Attract visitors; Environment protected; Natural/Built spaces work together; Provide shade
Healthcare	Clean water available; Collaborative medical environment; Healthy food available
Infrastructure	Efficient bridges, Charging stations; Roads; Sidewalks; Waste management; Water distribution
Living Well	Active; Connected; Cyber-secure; Livable space; Privacy maintained; Safe
Mobility	Autonomous vehicles; Broadband fiber and wireless; Hybrid/Electric Vehicles; Increased public transport use; Less street parking; Reduced congestion
Resilience	Quick disaster recovery

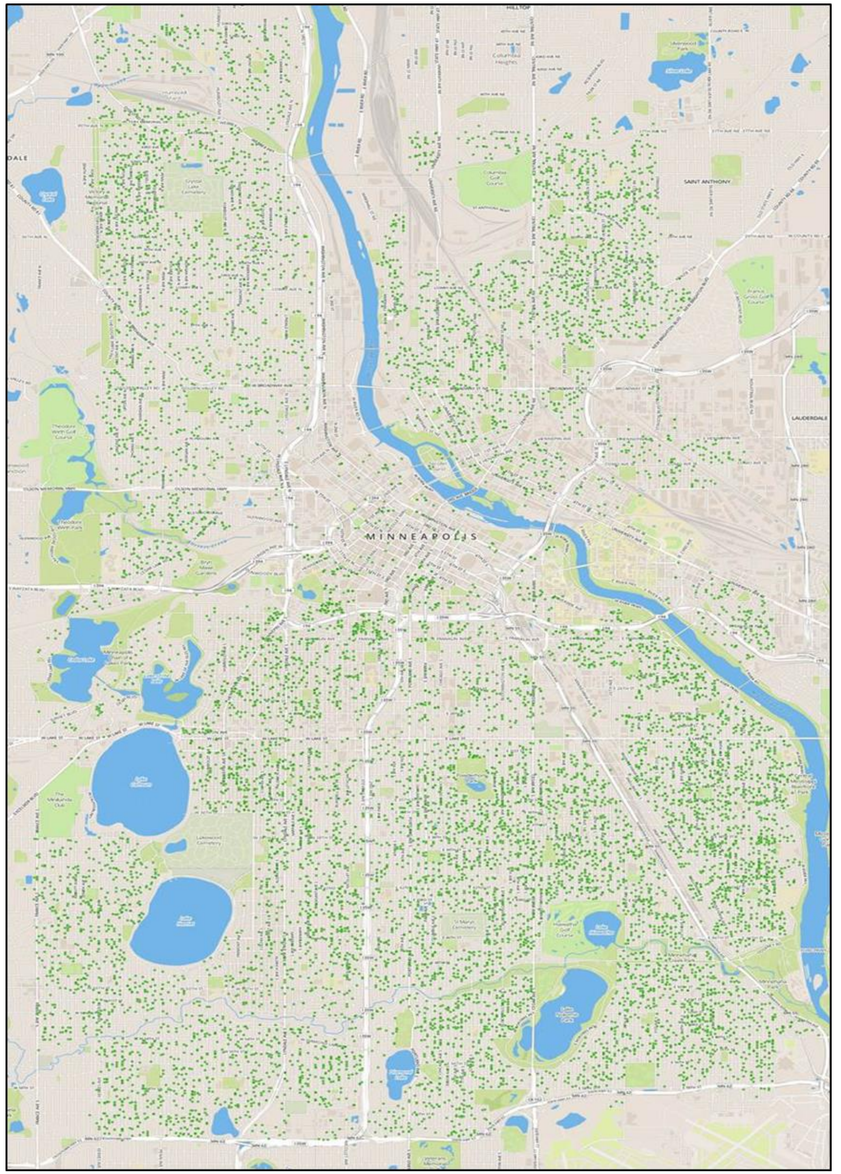
Ookla: Minneapolis has the fastest mobile internet among US cities

If you live in or often visit Minneapolis, Ookla has good news for you: the company says that locale tops the list of US cities with the fastest mobile internet, with a mean download speed of 44.92 Mbps. Ookla, which analyzed data from its Speedtest app from the first half of the year, said Minneapolis' Twin Cities brethren Saint Paul was in second place, followed by Fort Wayne, Indiana; San Francisco; and Irvine, California. Atlanta and Pittsburgh followed those cities, while Minnesota was also the fastest state.

Wireless Minneapolis - USI Wireless and Community Benefits

The City of Minneapolis has a unique public-private partnership for an outdoor wireless network that covers nearly 100% of our City.

- Serving Residents, Businesses and Visitors since 2009
- City of Minneapolis government: anchor customer using the network for City services, emergency response, mobile workforce.
- Being upgraded to 100 Mbps



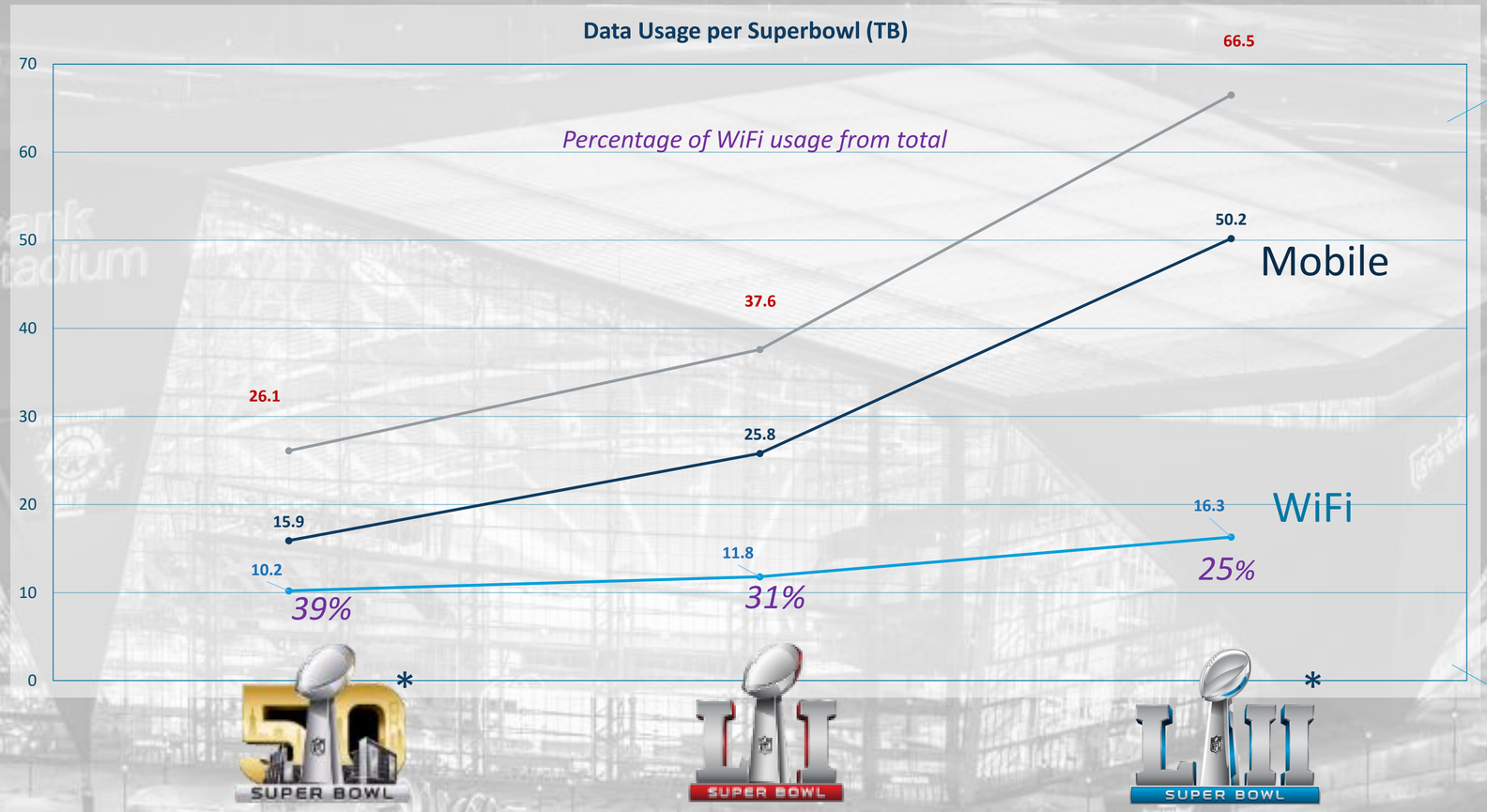
Community Benefits Agreement

- 117 Free Hot Spots
- Trial Account Vouchers
- The Civic Garden, Neighborhood Portals
- Digital Inclusion Fund
- Free Community Accounts
- Caps Residential Price

Low Cost Internet Access

USI Wireless offers multiple service packages for home, business and roaming service.

Mobile/Wireless Bandwidth Demand



x17

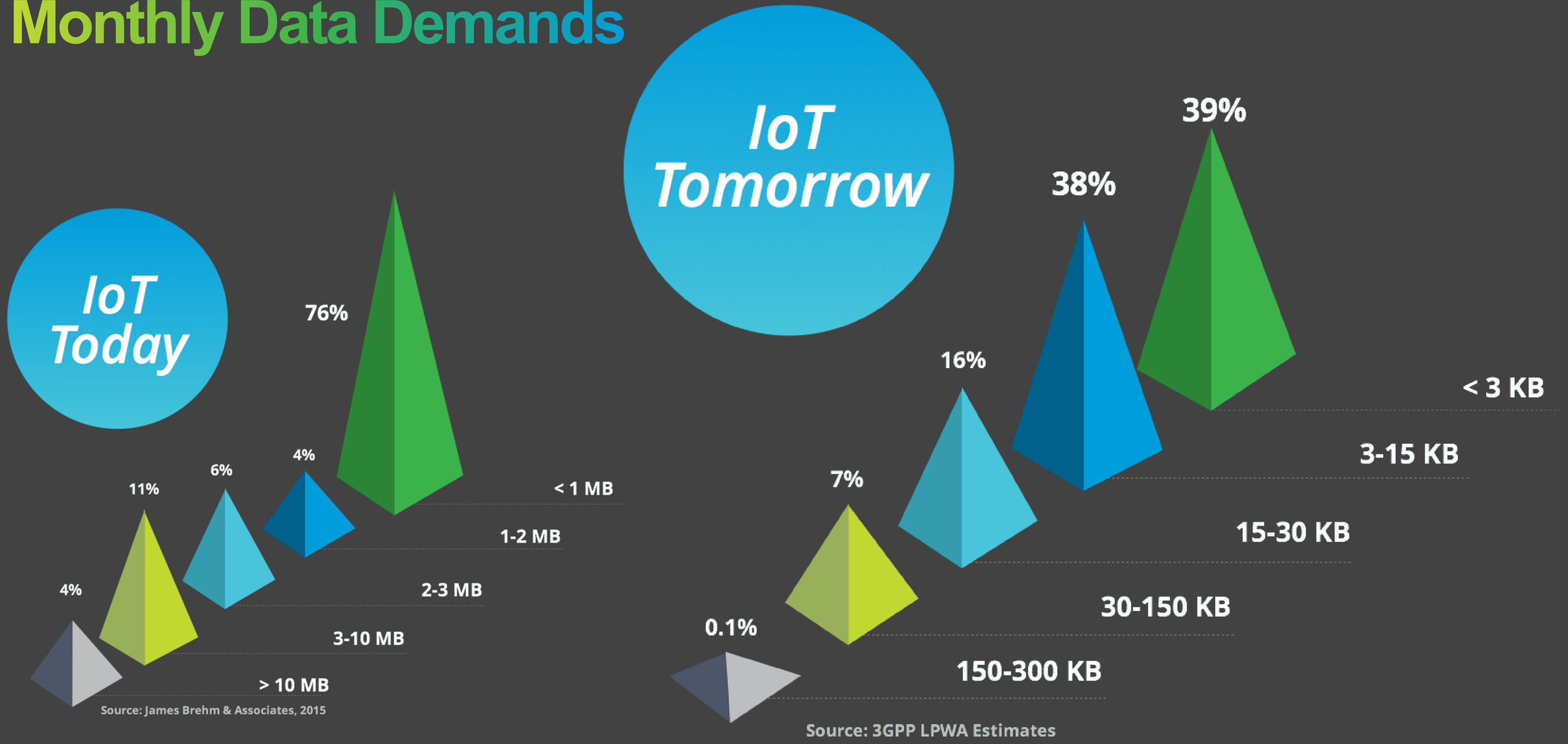
** JMA Wireless in-building solutions used for mobile traffic*

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/

RPMA

Monthly Data Demands



ingenu
simply genius

Mobile Connectivity Enabling More Than Phones

Heterogeneous Mobile Network Connectivity

Macro Micro Campus Venue Building

- 4K Video
- Augmented Reality
- Virtual Reality
- Gaming
- Loyalty Applications
- Wayfinding

- Point of Sale
- Kiosks
- Access Control
- Location
- Advertising
- Patron Services
- Wearables

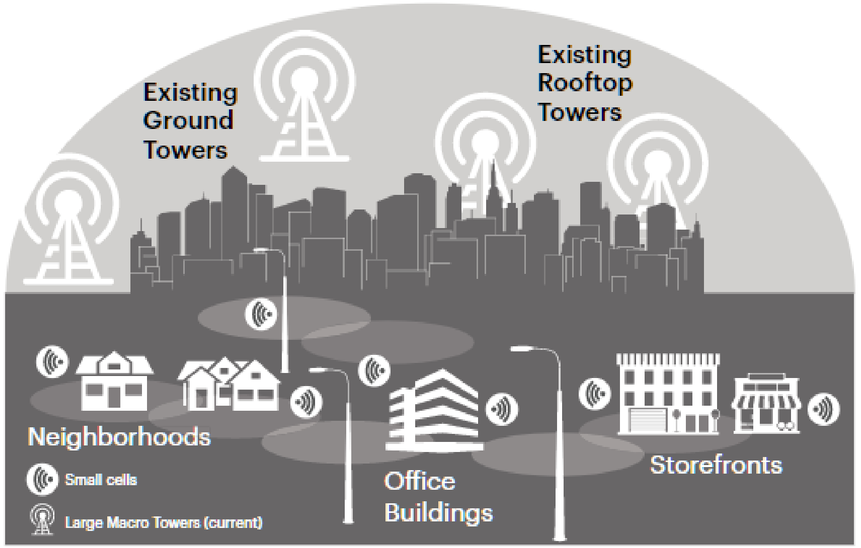
- IoT Gateway
- Smart Room
- Failover-Fallback
- Remote Monitoring
- Building Controls
- Security Systems

- Autonomous Cars
- Smart Machines
- Fleet Tracking
- Smart Parking
- Infotainment
- Navigation

- Environmental
- Noise Detection
- Smart Parking
- Utility Monitoring
- Asset Tracking
- Landscaping
- Waste Control

Growth of the Smart City Market

- The global Smart Cities market size is expected to grow from $424.68 Billion in 2017 to $1.20 Trillion by 2022, at a CAGR of 23.1%, mainly due to rapid connectivity and fast telecommunication provisioning; and growing demography and hyper-urbanization.

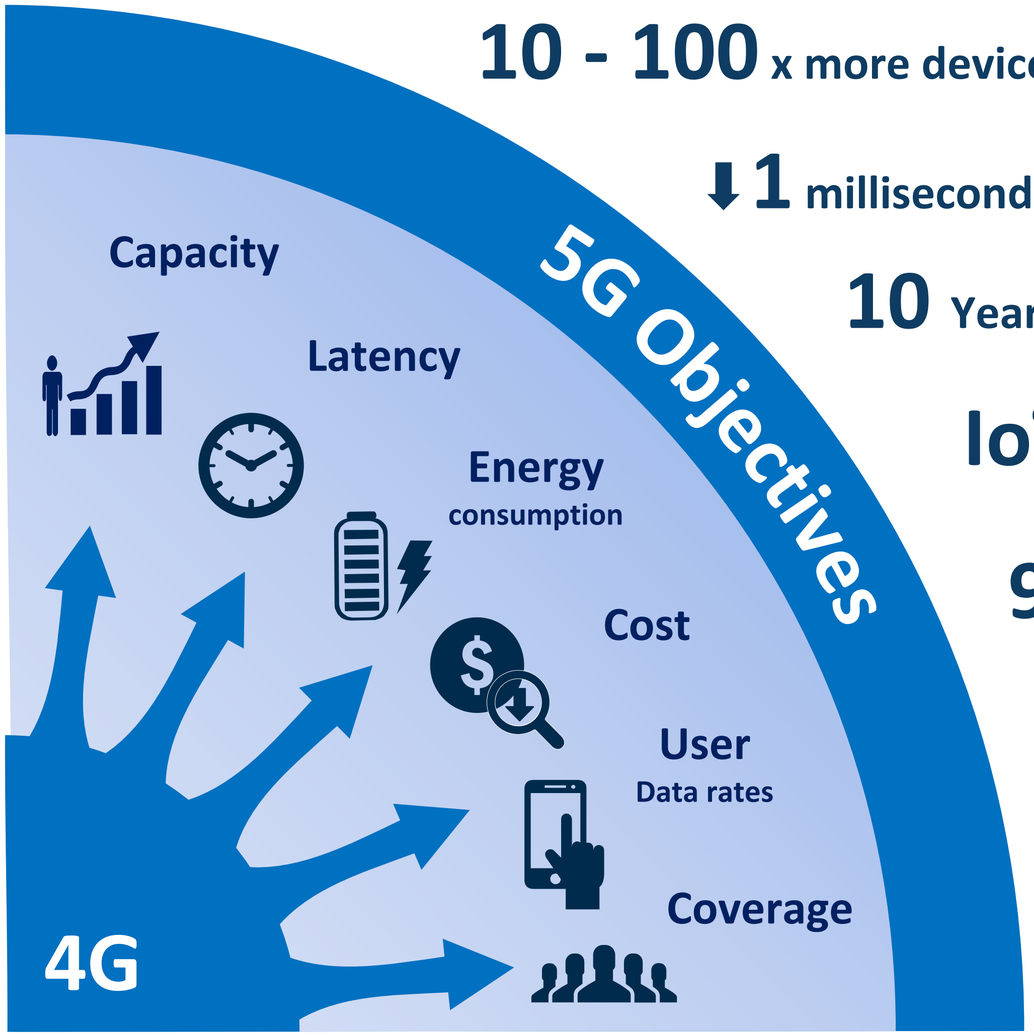


Wireless carriers need to add 10 to 100 times more antenna locations in connected cities to expand and densify their networks for 5G.

Access to hundreds of thousands of sites across the U.S. will speed deployment and enable plug-and-play installations.

Source: Accenture Strategy – Smart Cities, How 5G Can Help Municipalities Become Vibrant Smart Cities 2017

5G Objectives



10000 x more traffic

10 - 100 x more devices

⬇ **1** millisecond latency

10 Years M2M battery life

IoT ultra low cost

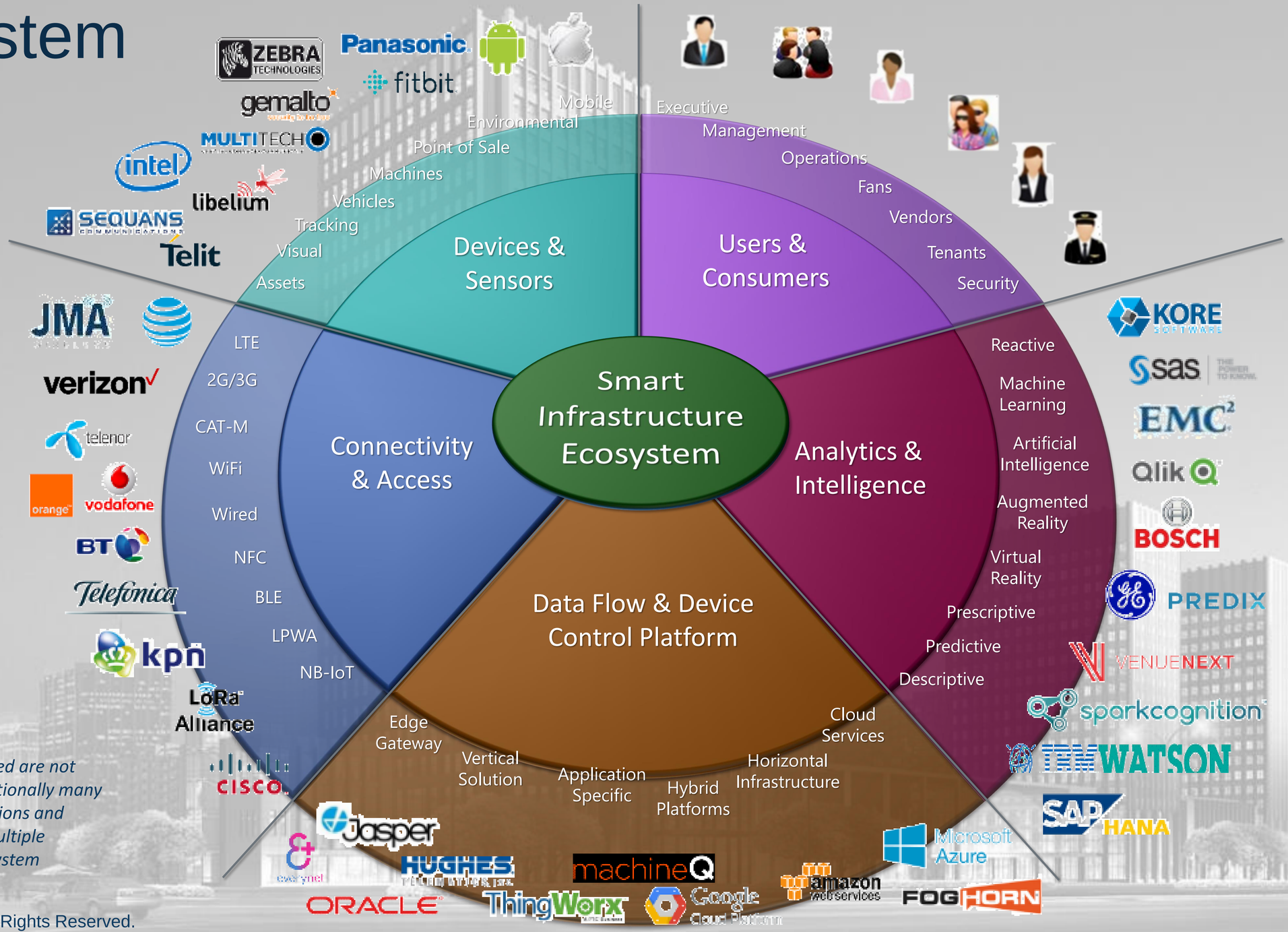
90% less network energy usage

⬆ **10** Gbit/s peak data rates

100 Mbit/s wherever needed

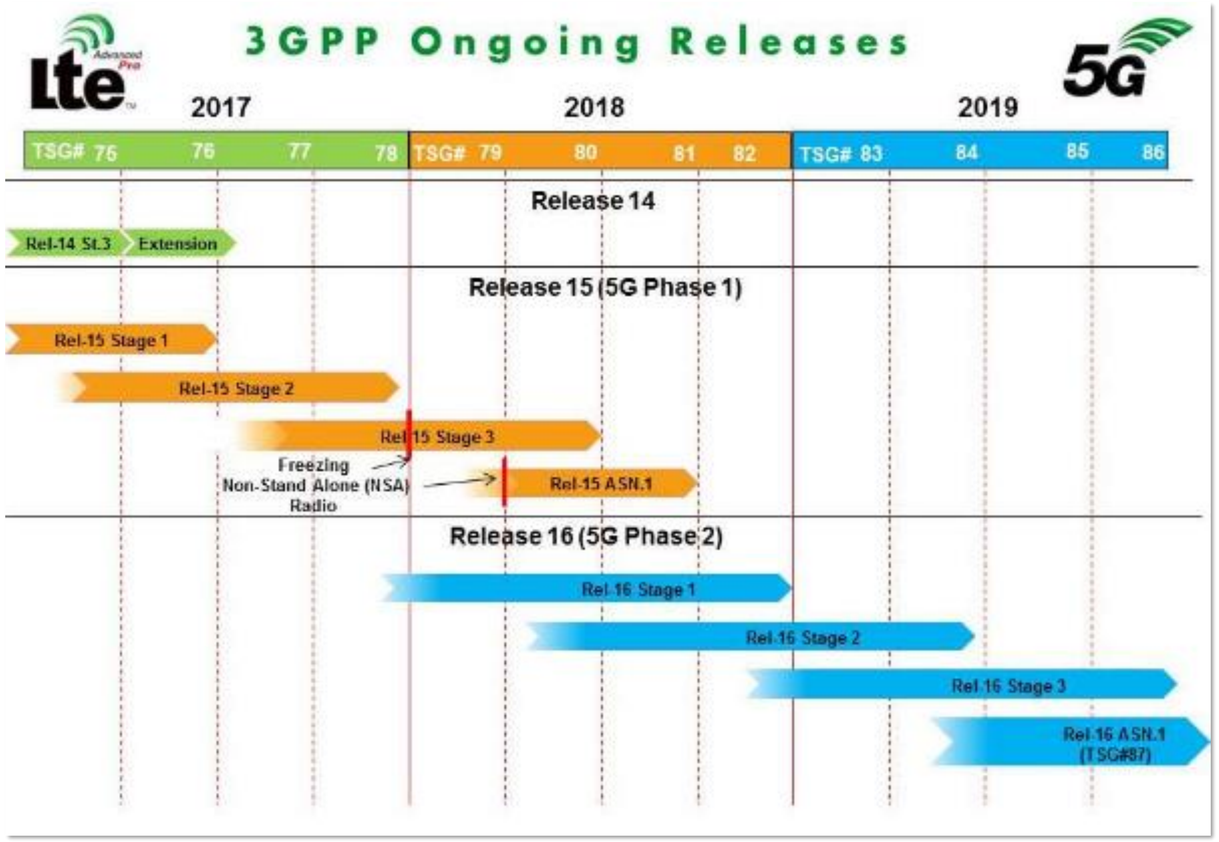
5-9s availability/reliability

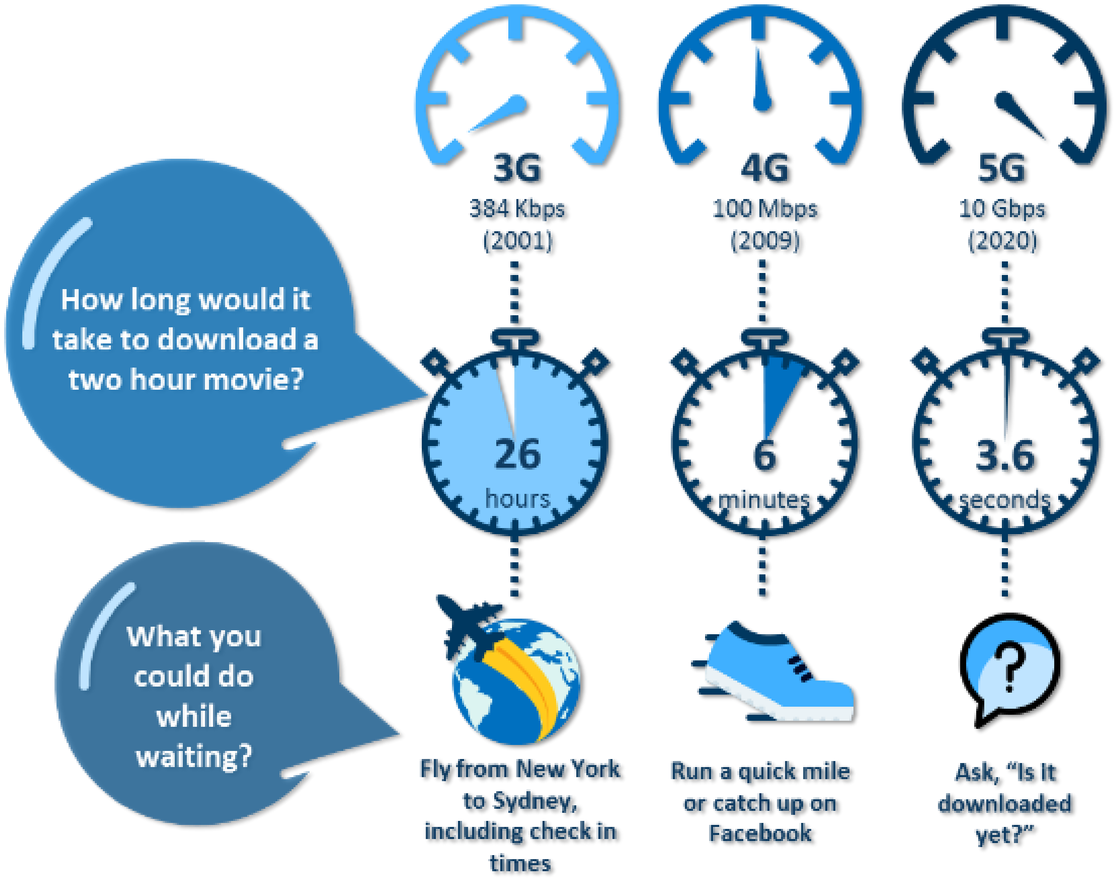
Ecosystem



NOTE: Companies listed are not comprehensive. Additionally many companies have solutions and products that span multiple segments of the ecosystem

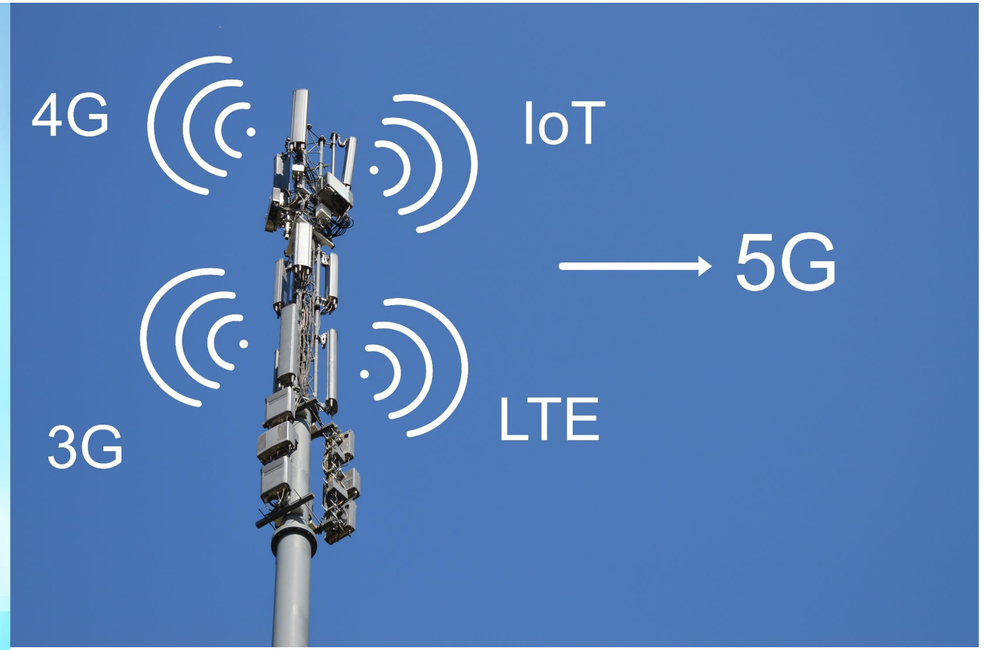
5G Timeline

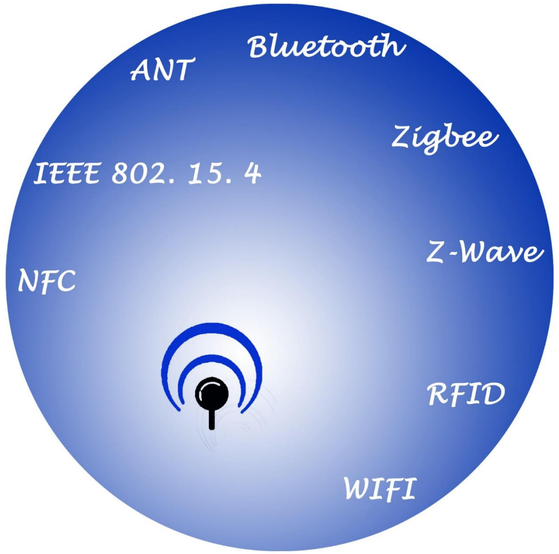

3GPP Ongoing Releases
2017
2018
2019
TSG# 76
76
77
78
TSG# 79
80
81
82
TSG# 83
84
85
86
Release 14
Rel-14 St.3
Extension
Release 15 (5G Phase 1)
Rel-15 Stage 1
Rel-15 Stage 2
Rel-15 Stage 3
Freezing
Non-Stand Alone (NSA)
Radio
Rel-15 ASN.1
Release 16 (5G Phase 2)
Rel-16 Stage 1
Rel-16 Stage 2
Rel-16 Stage 3
Rel-16 ASN.1
(TSG#87)


How long would it take to download a two hour movie?
What you could do while waiting?
3G
384 Kbps
(2001)
4G
100 Mbps
(2009)
5G
10 Gbps
(2020)
26
hours
6
minutes
3.6
seconds
Fly from New York to Sydney, including check in times
Run a quick mile or catch up on Facebook
Ask, "Is It downloaded yet?"

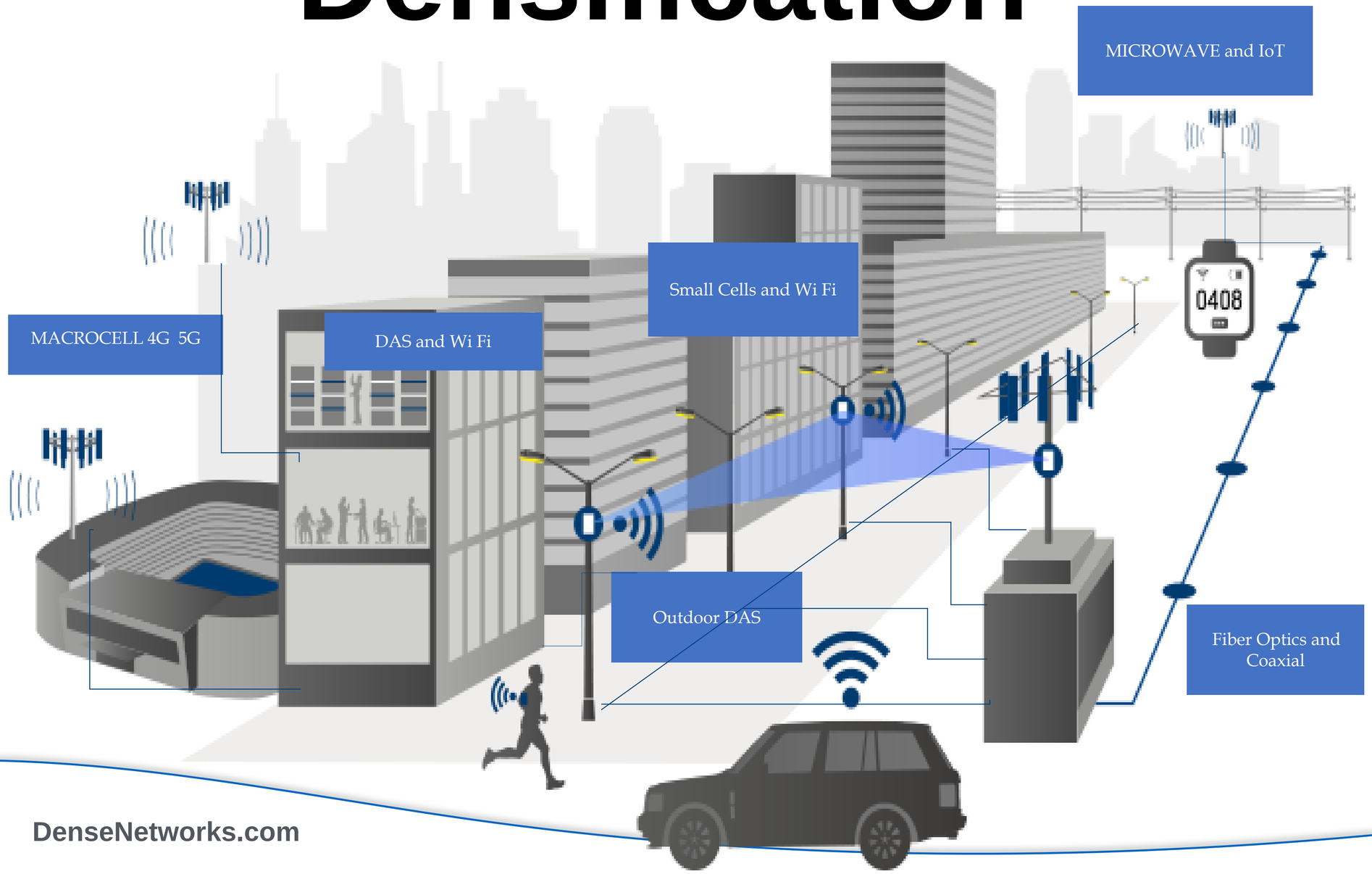
How Many Networks?

Capacity, Coverage, Compliance

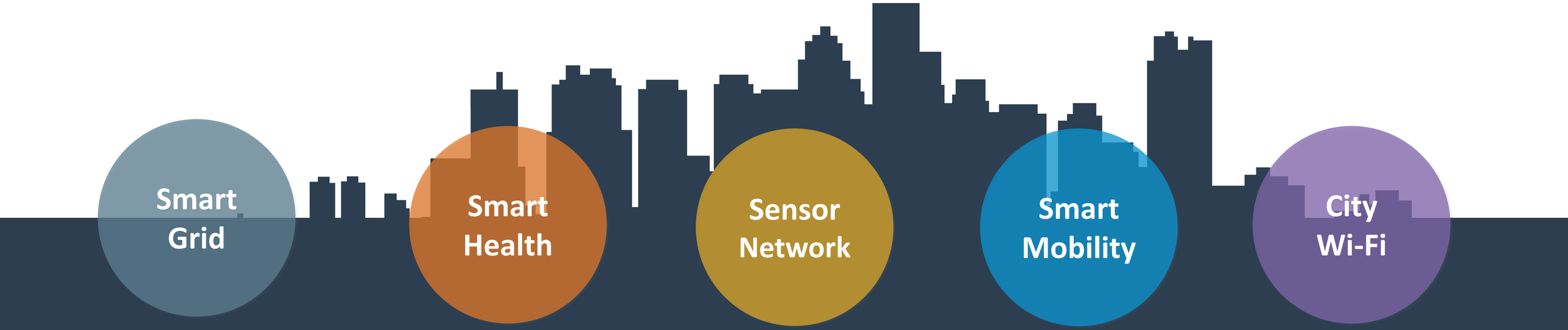




Densification



Smart Cities need smart infrastructure



Smart Grid

Smart Health

Sensor Network

Smart Mobility

City Wi-Fi

Energy Efficiency

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

Healthier Cities

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

Civic IoT

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

Safer Streets

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

Connected Community

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

Metro Area Neutral Host

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.

Multi-phase strategy, with public-private collaboration

Phase 1. City/county and other public sector facilities

Business case is internal savings, efficiencies, Smart City

Phase 2. Key economic development targets

Business case is economic development

Phase 3. Platform for last mile deployment

Business case is economic development, private sector opportunity, service improvement

Platform is public infrastructure, optimized to enable the Smart City, with private opportunity for commercial service

Phase 1: The basic financial business case

How to analyze the Phase 1 financial case for Smart City public fiber:

1. Scalability and hedging against cost increases over time
2. Internal operations and operational efficiencies
3. Emergency response and disaster recovery
4. Regional collaboration
5. Smart applications (current and future)
6. Smart community resilience

Phase 2: Route fiber to pass key economic development target areas

Deploy fiber strategically, with focus on key economic development targets

- Historic downtowns, rehab areas, business parks
- Connect to internet peering point (could be local meet point)

City to build and own the infrastructure, and work with a private partner who will serve customers and other ISPs

- Public-private collaboration enables pricing designed to support anchor entities and attract ISP customers

Phase 3: Private partner leases services to ISPs for expansion to homes and small businesses

Enormous capacity of fiber serves as platform for economic development, retail broadband opportunity

- Private partner serves as both wholesaler and retailer
- Serves key target customers itself, and
  - Also leases capacity to other ISPs that are focused on small business and residential opportunities
- Pricing designed to enable new opportunity
- Public-private collaboration designed to protect the public asset

Broadband Strategy

Hybrid Approach – 80% results for 20% effort

	Government-led	Hybrid model (Recommended)	Market-led
			
Summary	Cities building full fiber networks is expensive, complex, and risky **Too Risky**	Cities that welcome private investment with appropriate guidance are most successful **Just Right**	Cities with laissez faire broadband stagnate as cable-telecom duopolies **Too Ineffective**
Key Takeaways	• 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	• Seattle leveraged streamlined policies to drive competition and massive fiber buildout • NYC used franchise agreements to drive fiber build-out	• Broadband speed and price cluster to the bottom of the peer set • No substantial competition in any market-led city
Potential costs	**Very high.** City-owned fiber-to-the-premise would cost $800M+.	**Moderate.** Working with carriers could cost $50-250M based on build types.	**Very low or none.** City relies on private sector investment.
Results	Peers show **90%+ fiber build-out.**	Peers show **55-70% fiber build-out.**	Peers show **0-5% fiber build-out.**

Comprehensive Plan Values

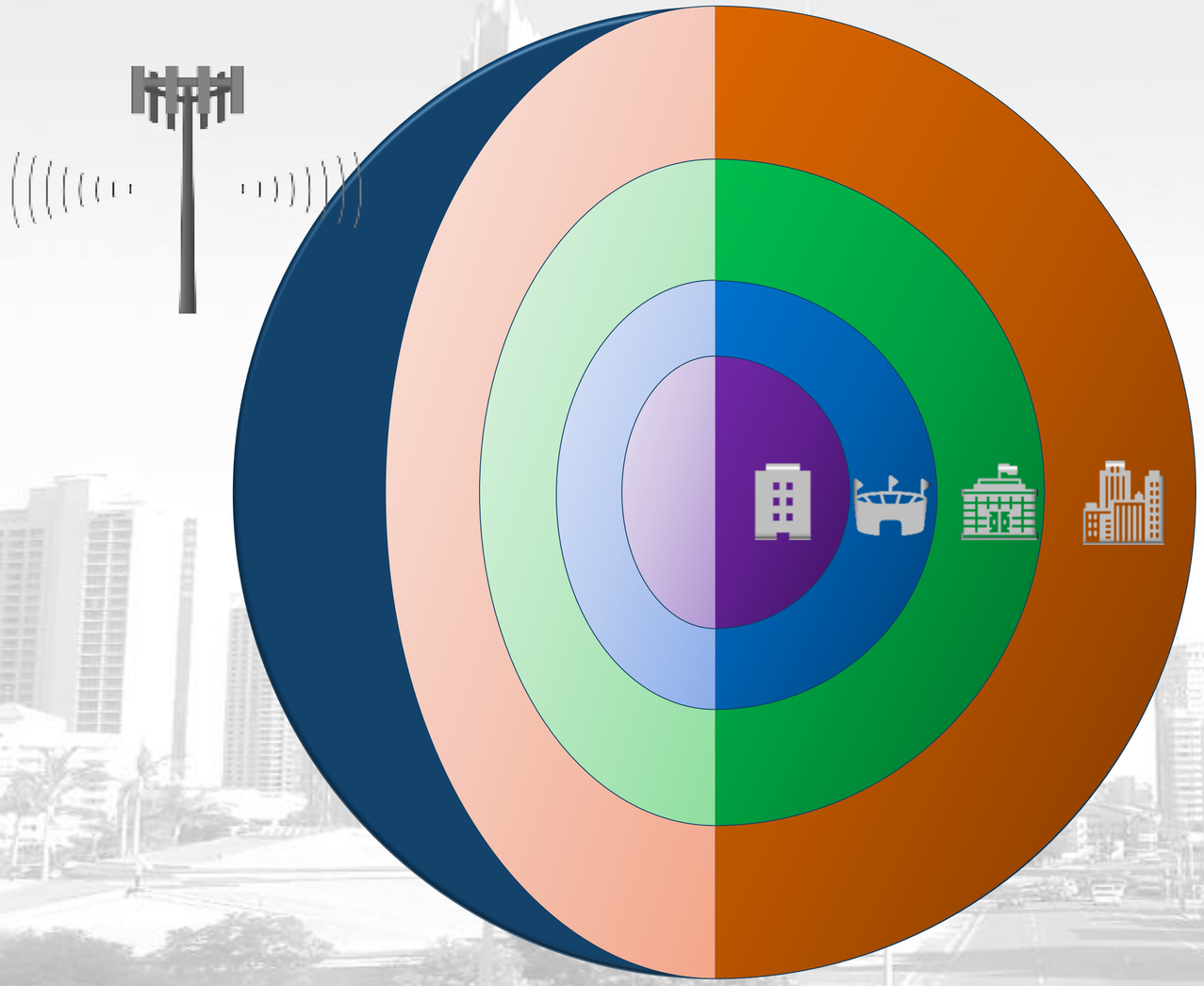
The update to the City's Comprehensive Plan will outline citywide policies and priorities, working toward a unified vision for Minneapolis in 2040. The plan will cover a wide range of topics related to investment in the built, natural, and economic environment. As we work together to shape the future of our city, we will do so in service to the six values illustrated below. These values are consistent with those established in the City Council's Vision, Values, Goals, and Strategic Directions, adopted in 2014. Click on the icons below to learn more.

Technology and Innovation 2040

DRAFT

- **Access to Technology**
  - Ensure residents have the technology and skills needed to fully participate in the economy and civic life.
- **Technology in the Economy**
  - Foster a growing technology sector with a vibrant ecosystem of companies, entrepreneurs, funders, mentors, and support organizations.
- **Technology in the City Enterprise**
  - Use technology to make City services accessible to all, make City information and decision-making processes transparent, and provide decision-makers with real-time and high integrity data on which to make decisions.
- **Data-Driven Decisions**
  - Use data and research to guide and evaluate housing priorities, policies, and programs.
- **Innovations in Transportation and Infrastructure**
  - Support the development and deployment of new transportation technologies that positions Minneapolis to benefit from these advancements.
- **Shared Mobility**
  - Position Minneapolis to benefit from upcoming changes to vehicle ownership models while supporting a shared use mobility network.

Mobile Convergence



CITY

Densification

CAMPUS

Coverage

VENUE

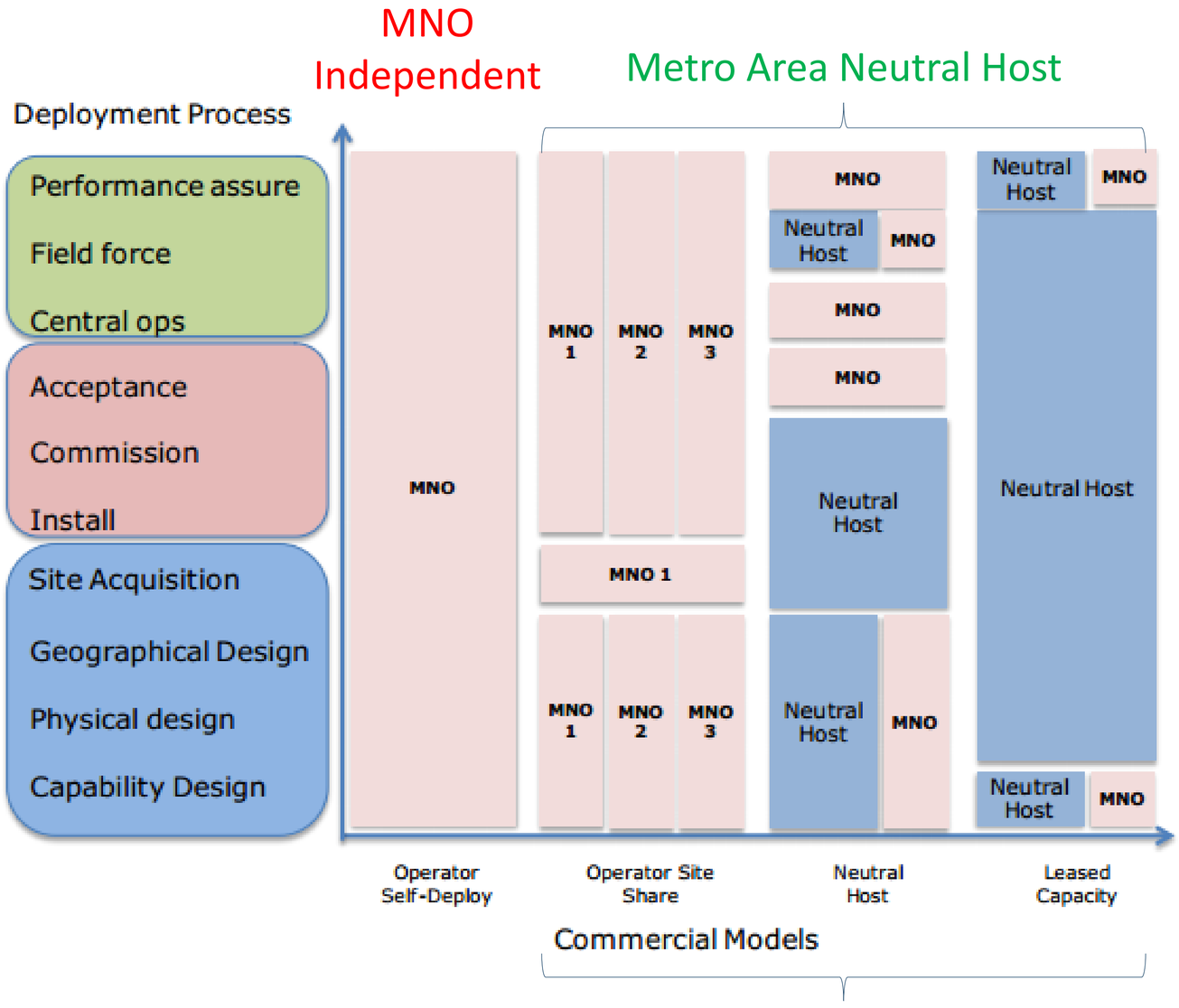
Capacity

BUILDING

All of the above

Business Models for Urban Deployments

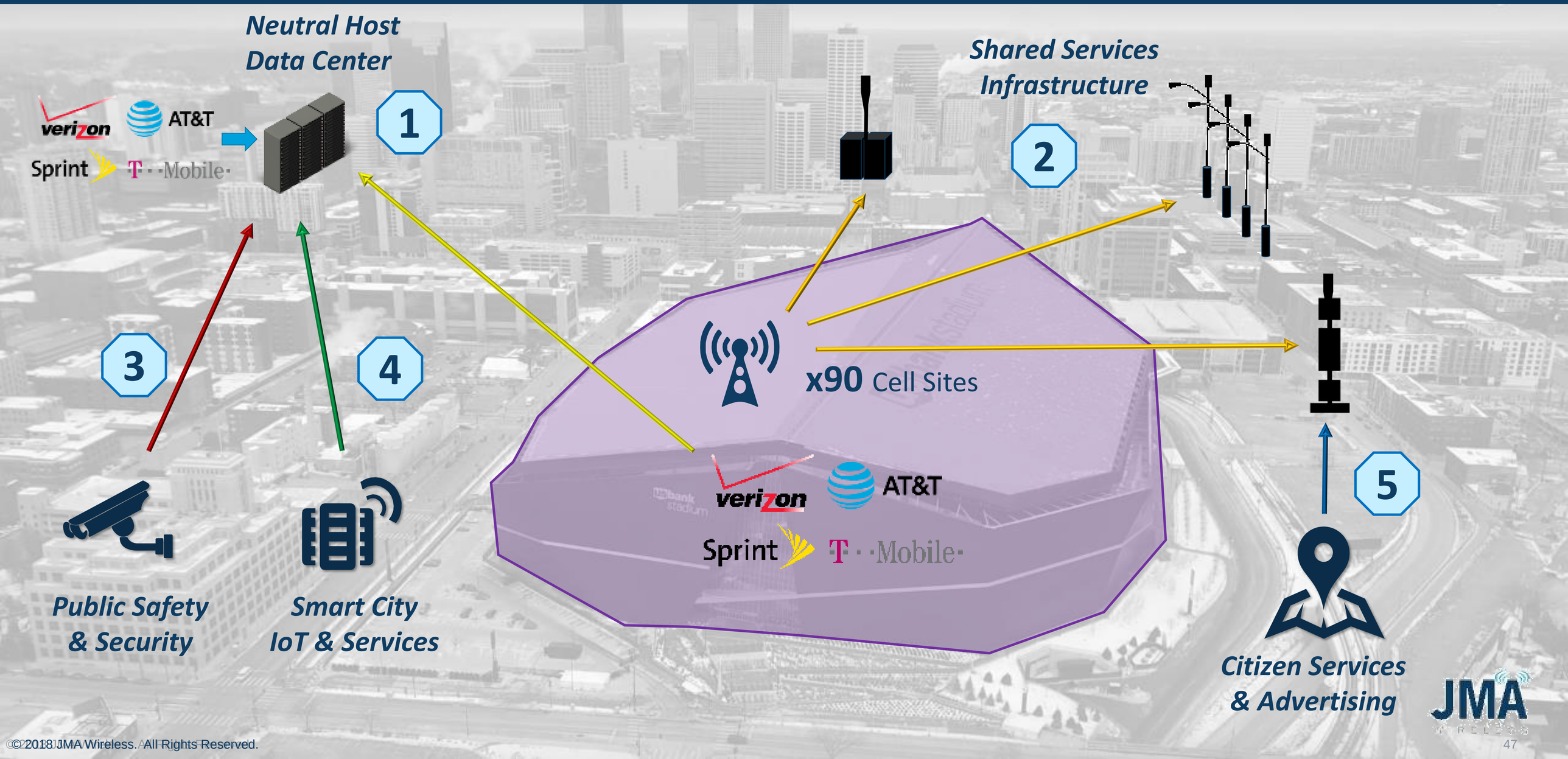
- Solutions and commercial models shifting towards multiple operator and neutral host
- Not just connectivity
  - Advertising & Display
  - Lighting
  - Waste management
  - Transit Services
  - IoT Solutions



Source: Smart City Council

Multiple Operator & Solutions

Metro Area Neutral Host



US Bank Mobile Wireless Solution

Neutral Host Headend

verizon AT&T Sprint T··Mobile·

92 Rack Units → 30

JMA TEKO

x90 Cell Sites

Edge

FUZE Venue Mounting Solutions

x2 Radios / Wall Space

No exposed wiring

“Pigeon-proof”

Multiple operator

Tamperproof

x1200 Antennas

Power

FUZE Digital Electrcity Solutions

All Digital Electricity

Low voltage wire inside fiber conduit

~$700,000 savings in wiring cost

Centralized power and UPS

JMA

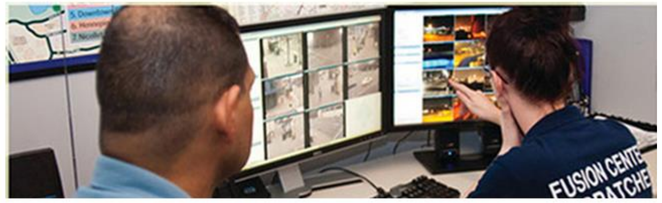
Capturing Video and Sounds

June 13, 2016 - The Sounds of Summer Meander Through the

HOME ENTERTAINMENT PUBLIC SAFETY WEATHER

MPD LEVERAGING BUSINESS CAMERAS FOR CRIME INVESTIGATION

OCTOBER 10, 2015 MINNYAPPLE BUSINESS, CRIME, GOVERNMENT, MINNEAPOLIS, PUBLIC SAFETY, TOP STORIES 0



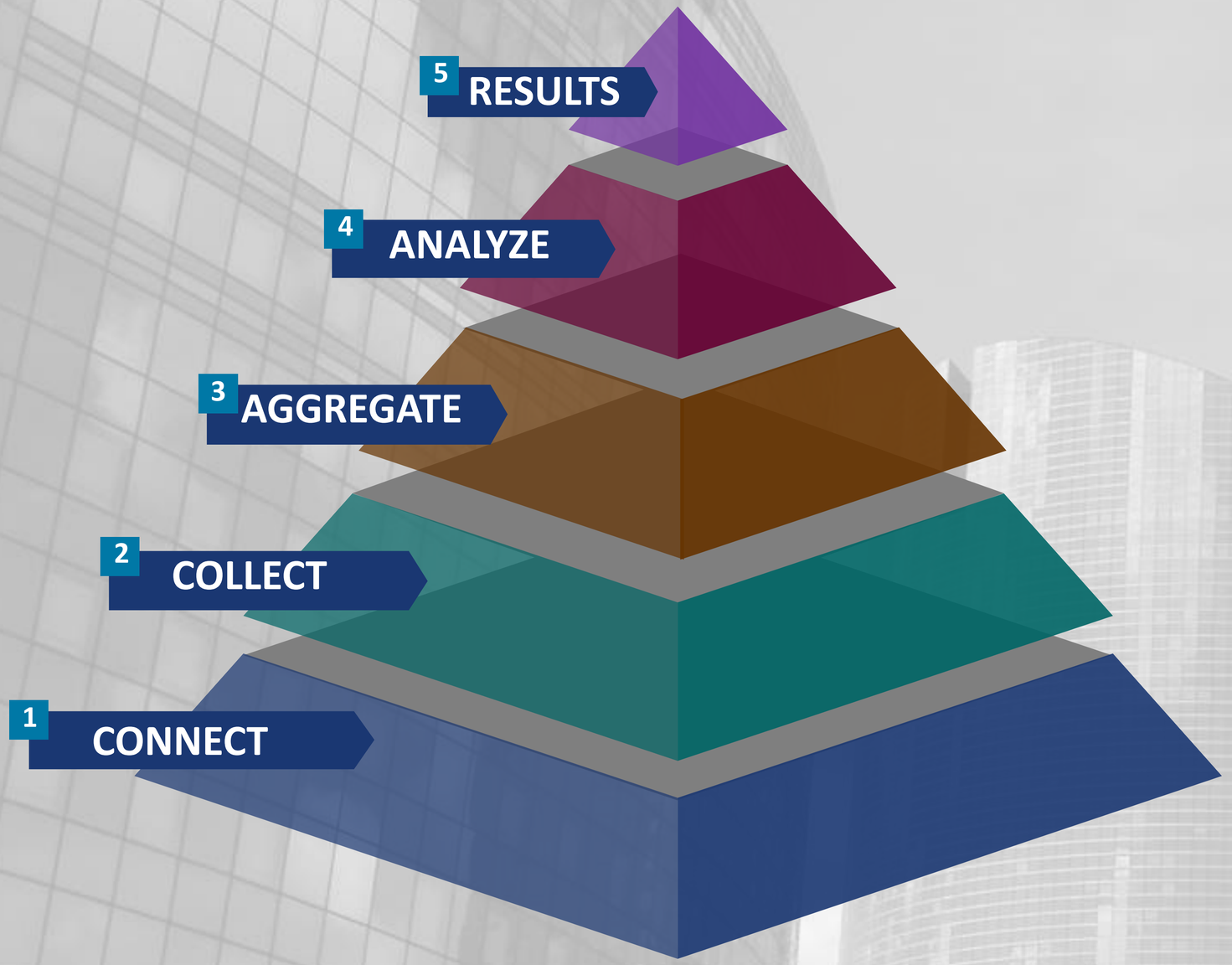
All businesses, schools, hospitals and housing facilities explored for registration

Common Operating Picture

COPApp and FieldWatch

- Mobile officer tracking
- Live streaming to command centers

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.

JMA WIRELESS

Evolution of the RAN towards an All Software EdgeRAN Solution

100% ALL Software RAN operating a LIVE Commercial LTE Network Service

TIM

Bologna, Italy City Center Area
Approximately 40 Acres in downtown area

- Standard Intel Xeon server
- JMA Wireless TEKO RF Distribution
- Supporting LTE Data, VoLTE, and IoT Services
- Multiple Bands, Multiple Sectors, MIMO
- More than 180K RRC Connected UEs & 40GB per day
- Handling more than 150K handovers per day

RAN Software by

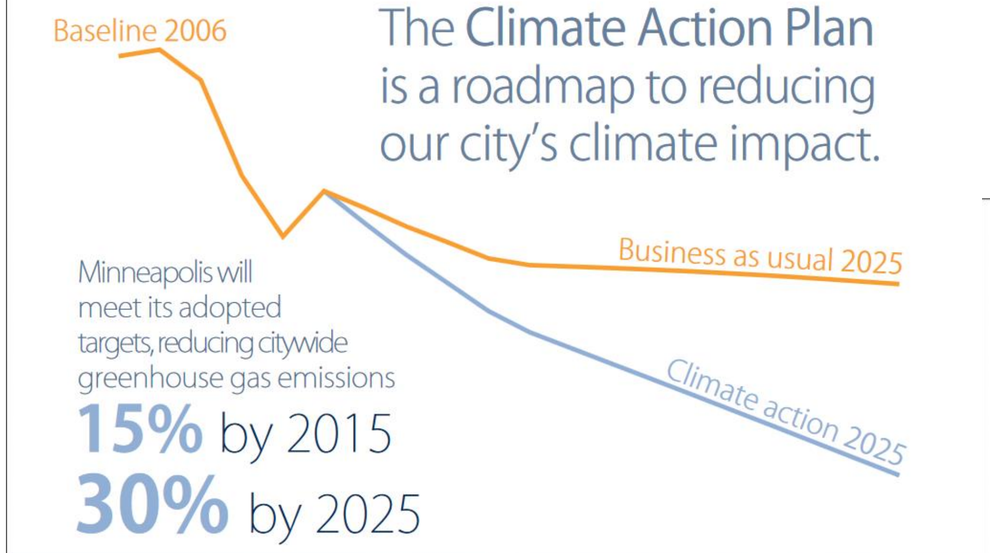
JMA WIRELESS | XRAN Adaptive Baseband

Running on

intel inside Xeon


Sustainability

Sustainability



The Climate Action Plan is a roadmap to reducing our city's climate impact.

Minneapolis will meet its adopted targets, reducing citywide greenhouse gas emissions

15% by 2015

30% by 2025

By **2025**, Minneapolis will

Reduce energy use by **17%**.

Generate **10% of our electricity** from local, renewable sources.

Construct **30 miles** of on-street, protected bicycle facilities and raise the bicycle commute mode share to **15%**.

Help **double** regional transit ridership and support safe, **walkable** neighborhoods.

Hold total waste generation **flat** and recycle **half** of all waste citywide.

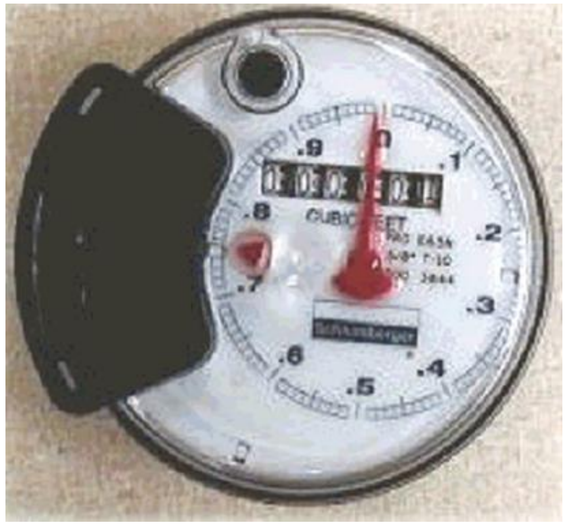
Reach a composting rate of **15%** of the entire waste stream.

Continue to **grow sustainably and equitably** with more residents, jobs, and opportunity across **all of Minneapolis**.

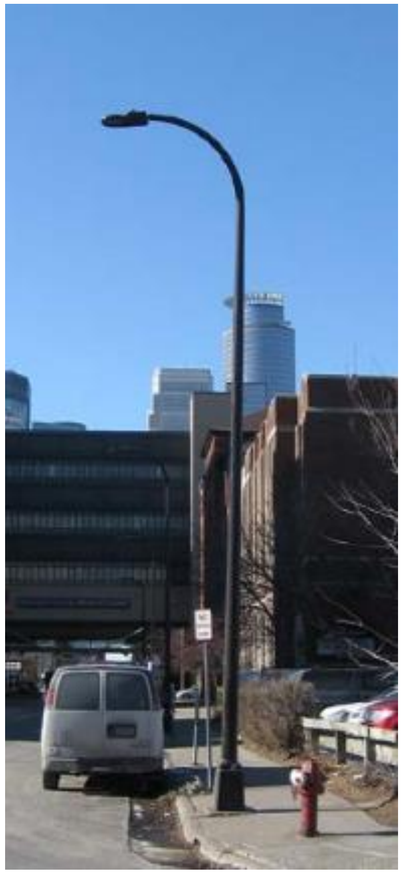
Replace All Water Meters

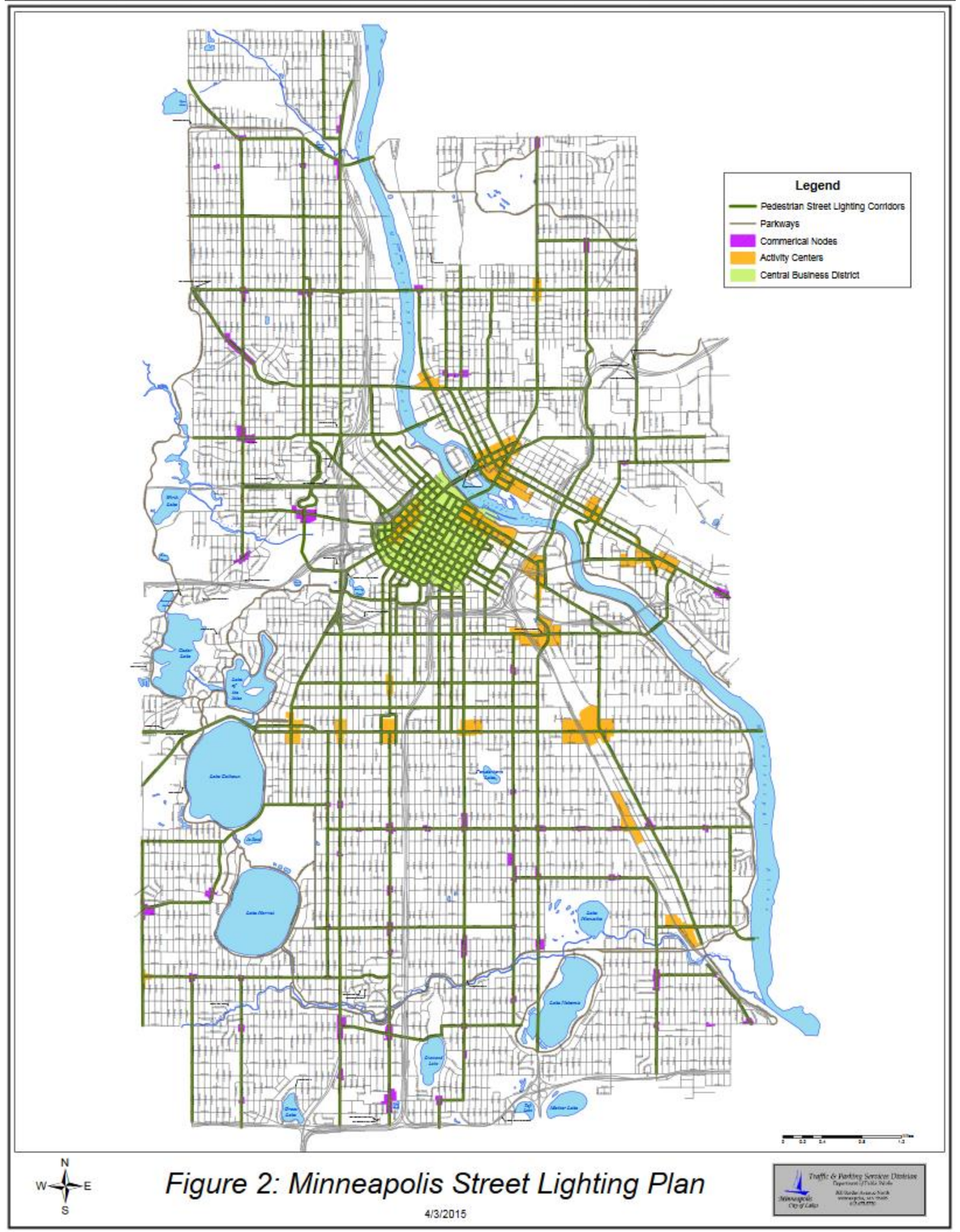
Wireless connected water meters

- Started as radio transmitters
- Going to be connected via WiFi

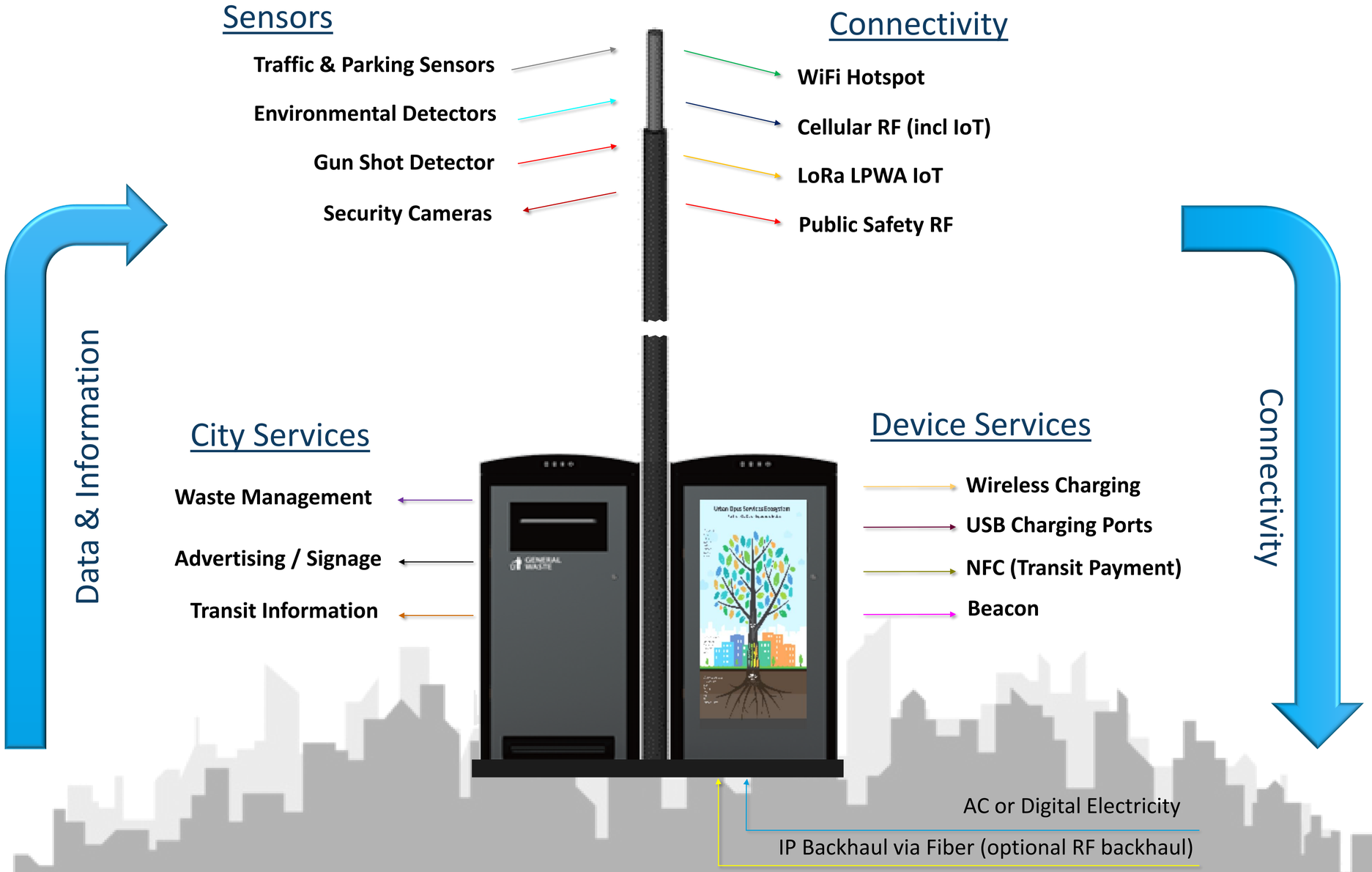


LED Lighting Plan





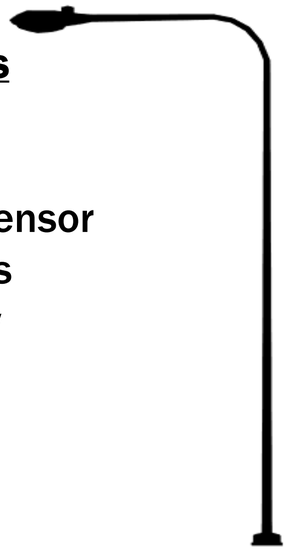
Edge of the Smart City



Broadband Strategy

STREETLIGHT

Light/Safety

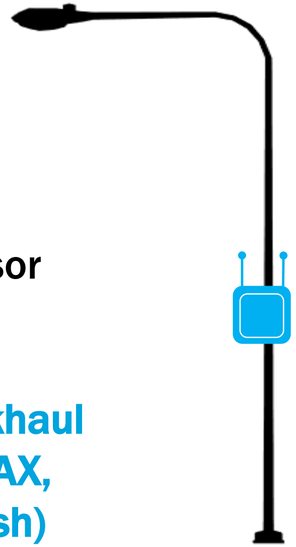


Properties

- Height
- Power
- Light Sensor
- Lumens
- Density

SMALL CELLs

Broadband Digital Infrastructure

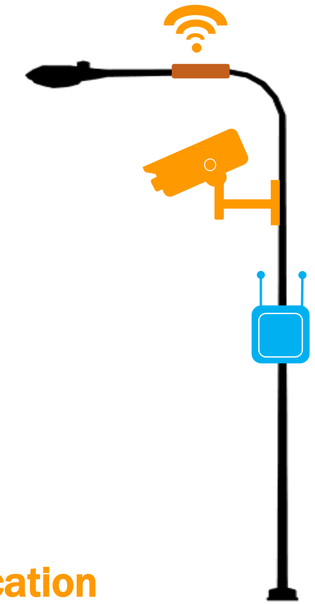


Properties

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

INTERNET OF THINGS

Smart Cities



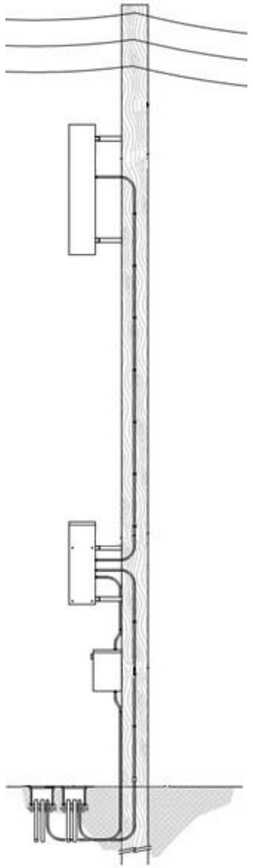
Properties

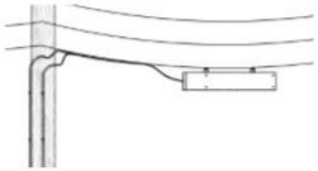
- Height
- Power
- Light Sensor
- Lumens
- Density
- Data Backhaul
- Sensors
- Cameras
- 2-way Communication
- Banner Advertising

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**

Small Cellular Deployment Types in Denver ROW

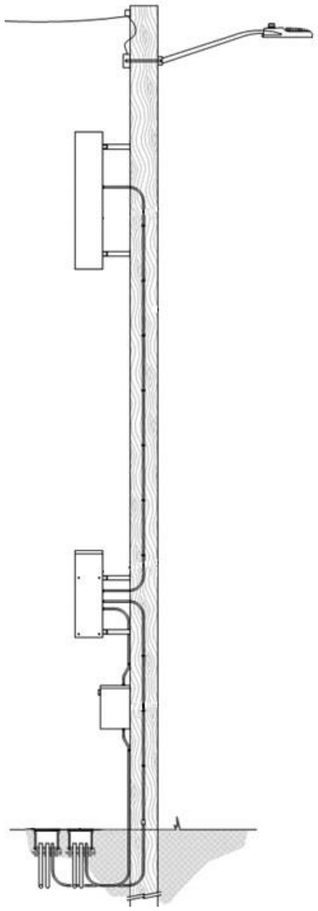
1





Onto or between
Xcel Utility Poles

2



Onto Xcel Wood
Street Lights

3

Remove & replace
Xcel Street Lights
with Hybrid

4

(Private)
Permitted
Freestanding
Antenna

City and County of Denver

DRAFT Small Cell Infrastructure Design Guidelines

Department of Public Works
Engineering Division

Photo courtesy of Aero Wireless Group

DenseNetworks.com

Making the Technology Disappear

10ft
Link NYC

14ft
Verizon LQD

14ft
Citi Bike

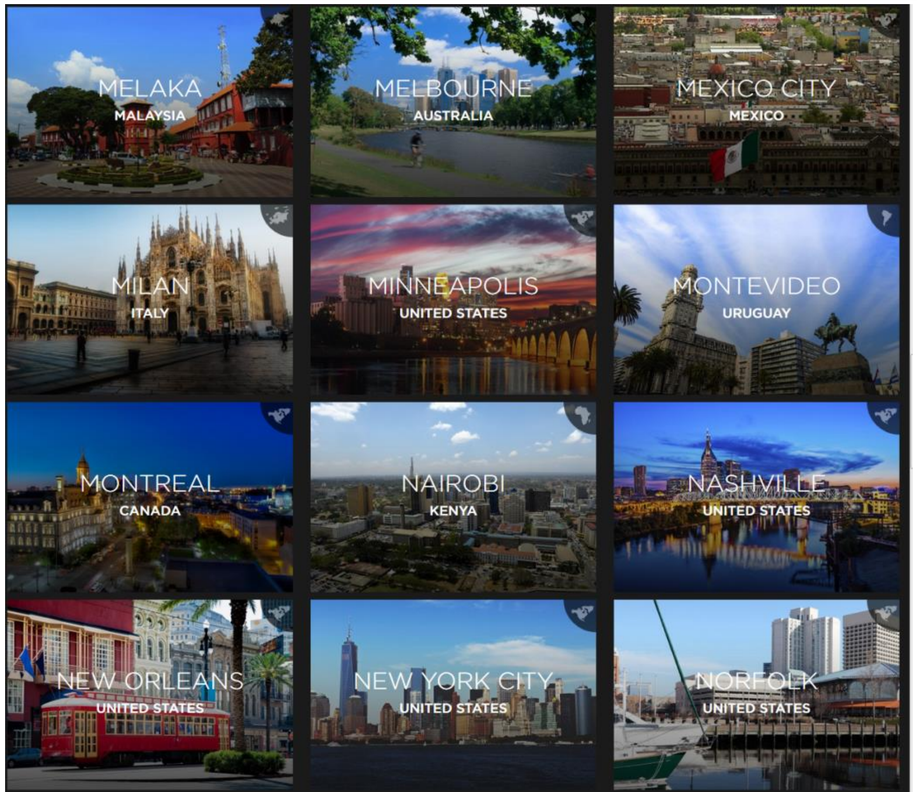
15ft Bus
Shelter

20.5ft
News Stand

30ft
Smart Pole

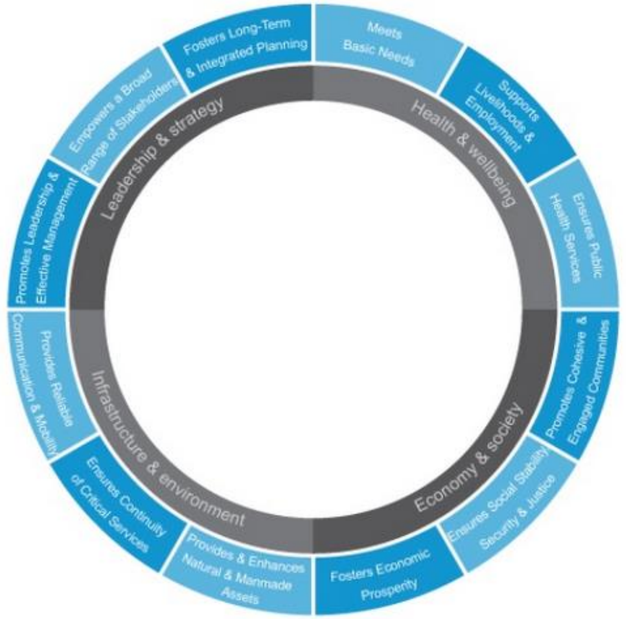
Working with Congress

- **STREAMLINE Small Cell Deployment Act**
  - Introduced by Sens. Thune and Schatz
  - Includes shot clocks for local approval of small cells and cost-based fees



THE CITY RESILIENCE FRAMEWORK (CRF)

The City Resilience Framework is a unique framework developed by Arup with support from the Rockefeller Foundation, based on extensive research in cities. It provides a lens to understand the complexity of cities and the drivers that contribute to their resilience. Looking at these drivers can help cities to assess the extent of their resilience, to identify critical areas of weakness, and to identify actions and programs to improve the city's resilience.

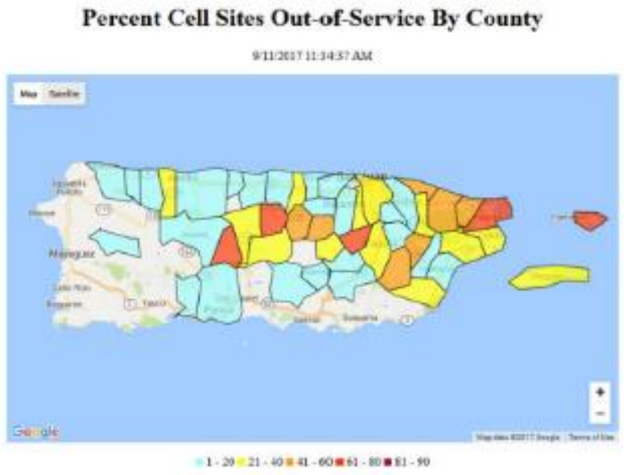


Hurricane IRMA – Early September 2017

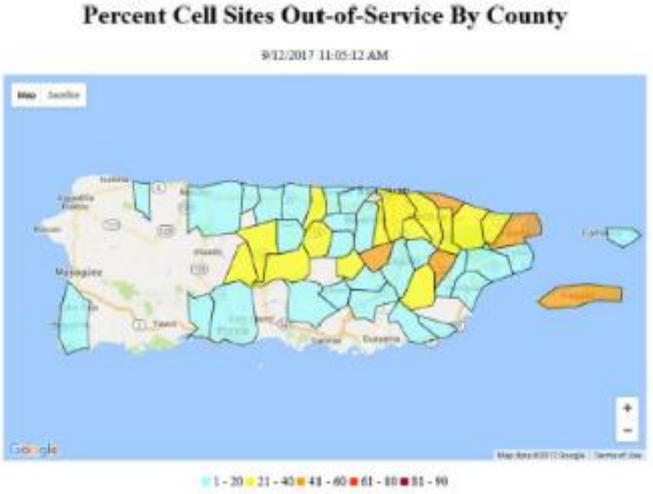
- In FL **3,973 of 14,730** out (27.4%) with 6 counties >50%, 2 counties >80%.
- In PR & USVI **497 of 1,850** (26.9%) out with
  - St Johns 9/10 out
  - St Thomas 44/57 out
  - St Croix 9/40 out

Florida:

Alabama, Florida, and Georgia:



Puerto Rico:



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:

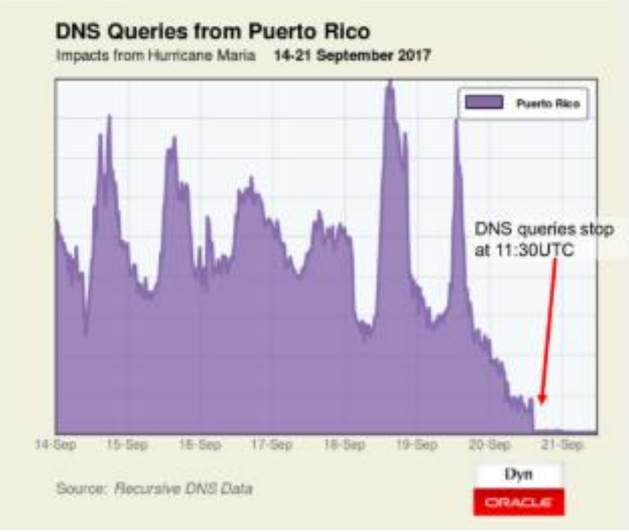
→ Preparation

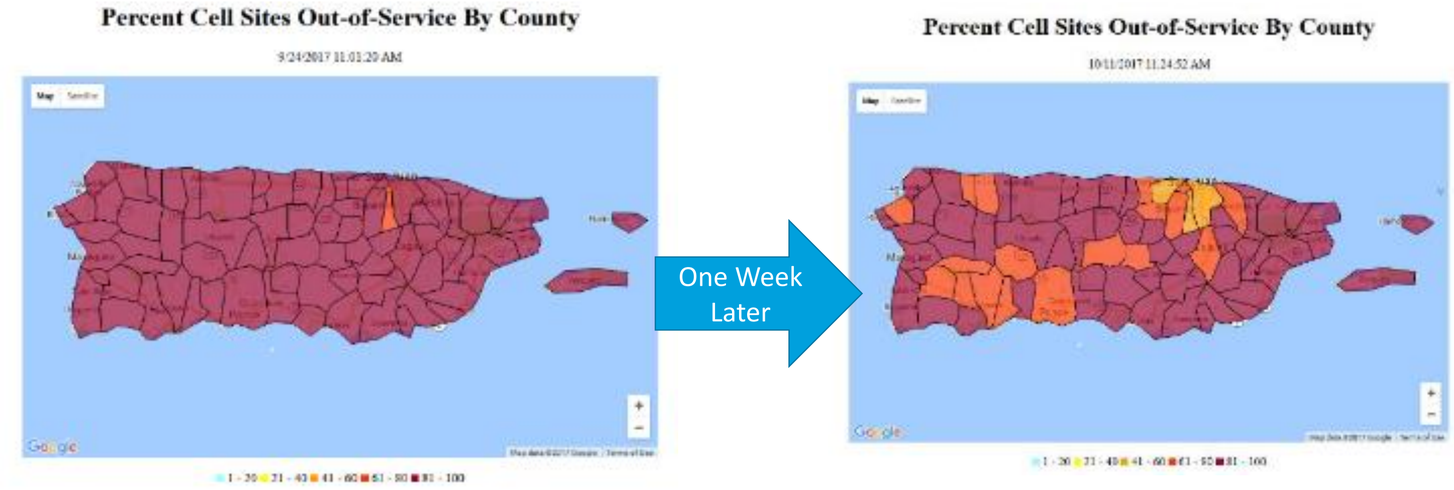
→ **Immediate Response**

→ **Response**

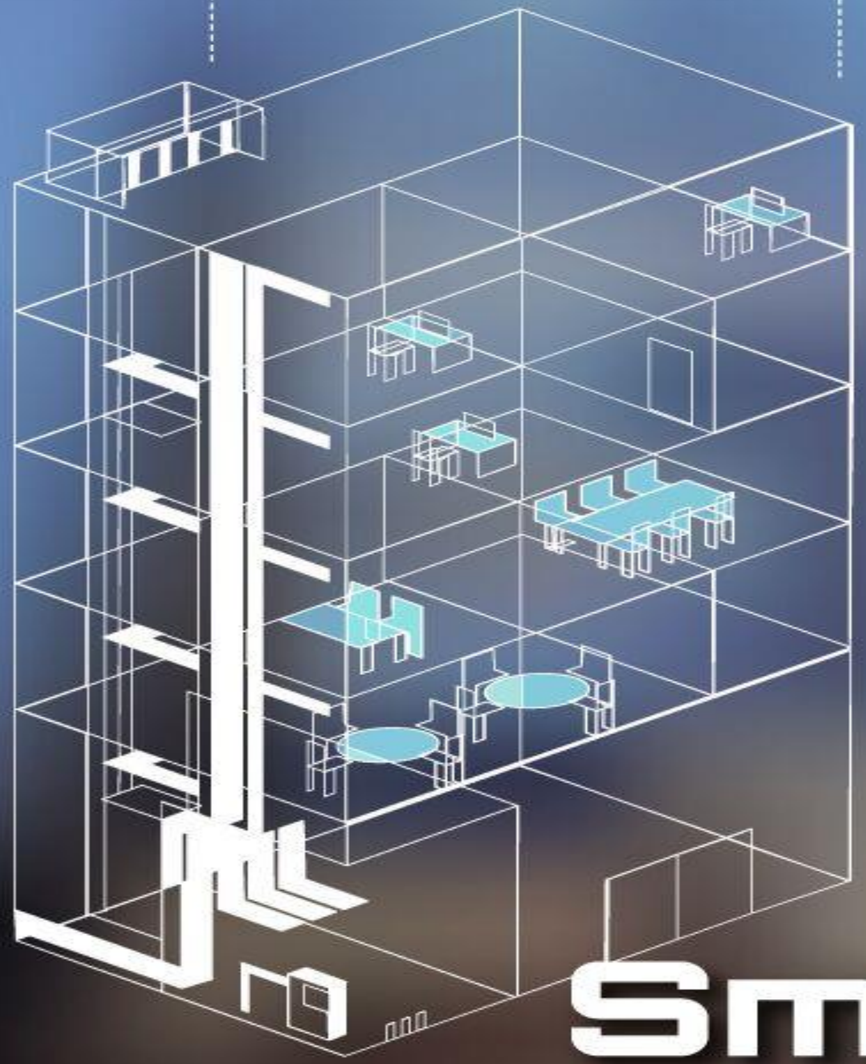
→ **Restoration**

→ Recovery





BUILDING MANAGEMENT SYSTEM



Smart Buildings