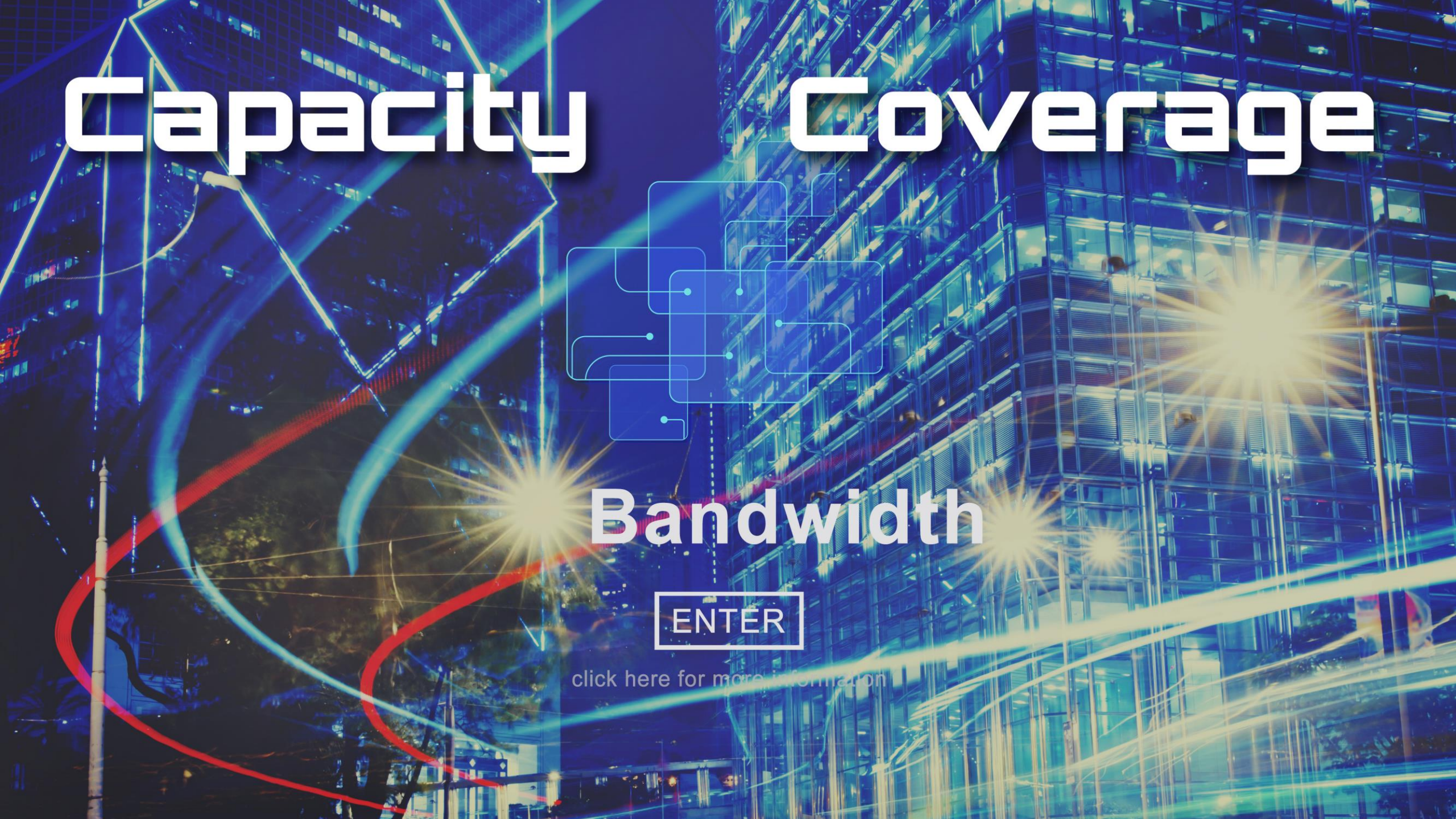
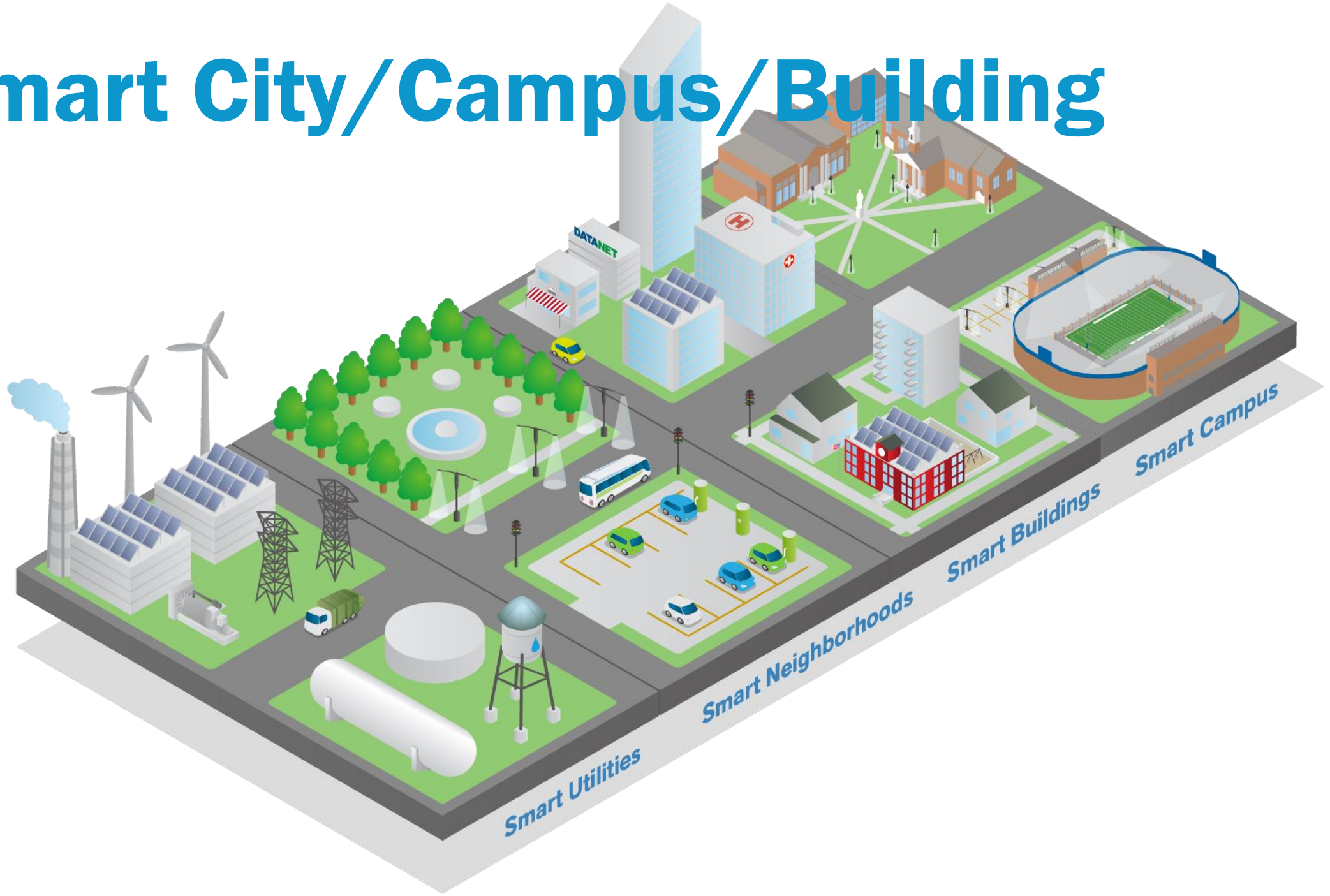

Capacity
Coverage
Bandwidth
ENTER
click here for more information

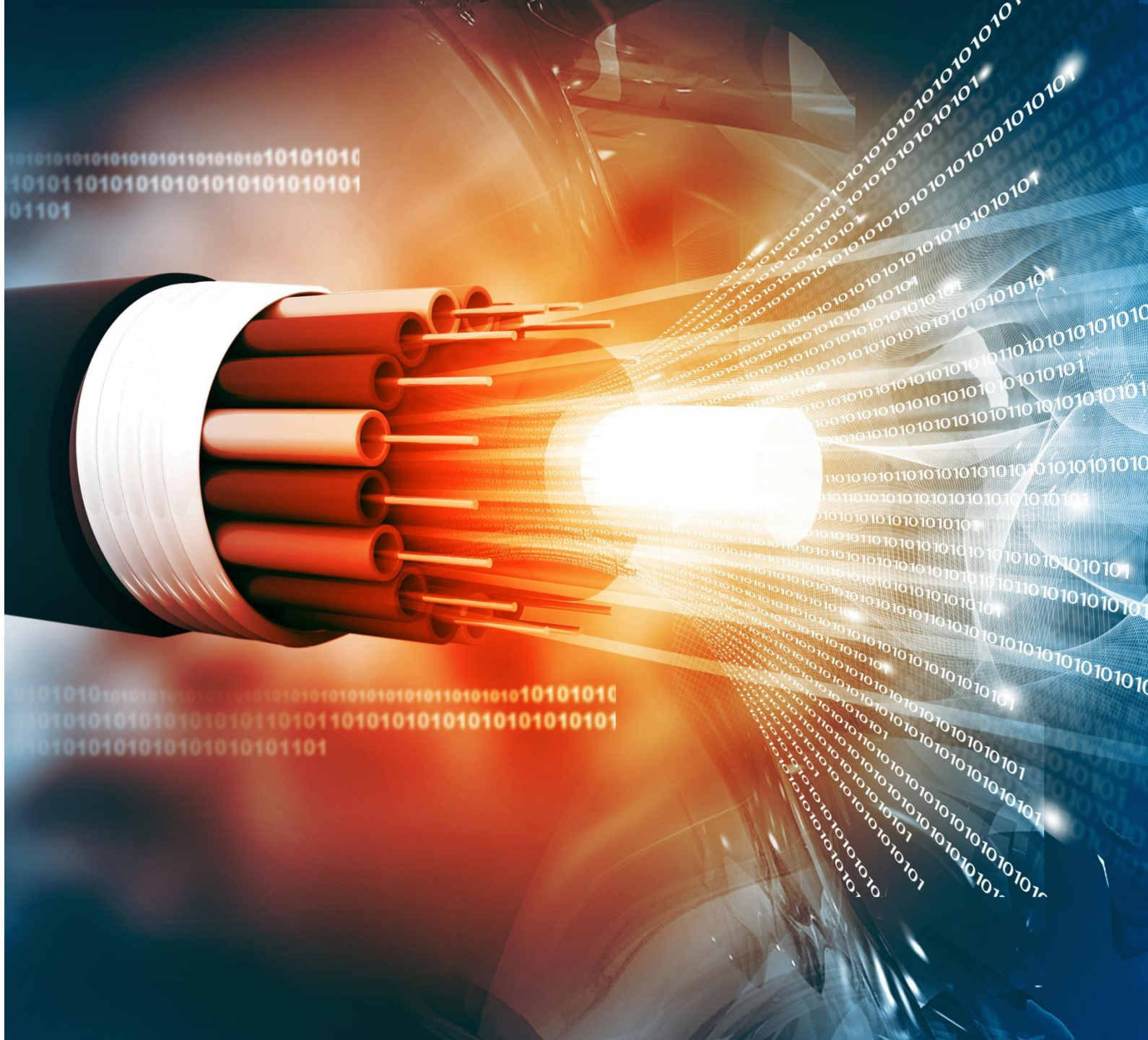
Smart City/Campus/Building



- IoT Sensors & Controls
- Security
- Access Controls
- IPTV
- Lighting Controls
- Building Automation
- Passive Optical Network
- WiFi
- Distributed Antenna Systems – cell, public safety, private radio, paging
- Voice
- Telemetry
- Any IP-based System

Fiber Optics

- Fiber Optic Links
  - greater bandwidth,
  - longer distance
  - more signal immunity
- Resistance
  - temperature fluctuations,
  - severe weather conditions
  - moisture
- Lifespan Over 100 Years
- Replace Outdated Solutions
  - Copper and twisted pair transmission
  - Traffic signal loop sensors
- 5G/ Small Cell



Optical network solutions provide a future-ready platform at less cost

End-User Experience (Customers, Tenants, Guests, Fans)

Wi-Fi	POS	VoIP	IPTV	A/V	BMS
Mobile Devices	Internet of Things	Access Control	Smart Lighting	Surveillance	

Corning's In-Building Network Solutions

Cellular Solutions

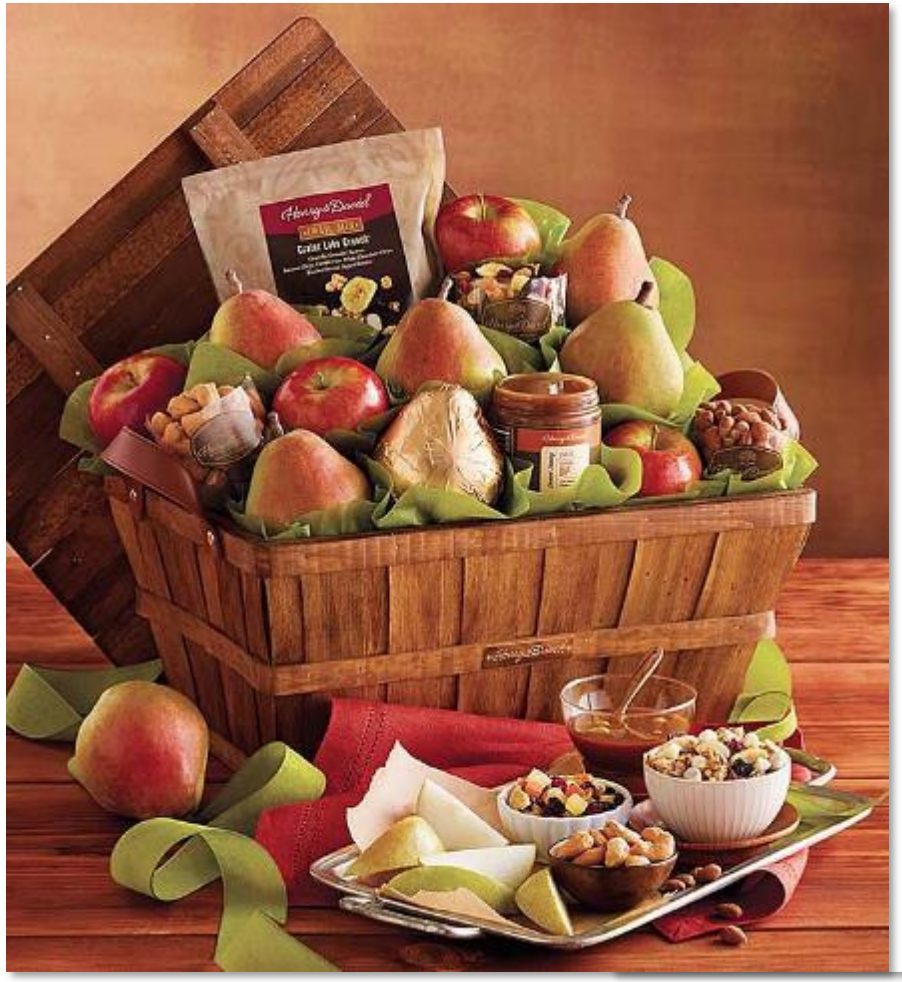
LAN Solutions

Powering Solutions

CORNING

5G Technology Basket

"Its all good but you don't have to eat everything!"



5G

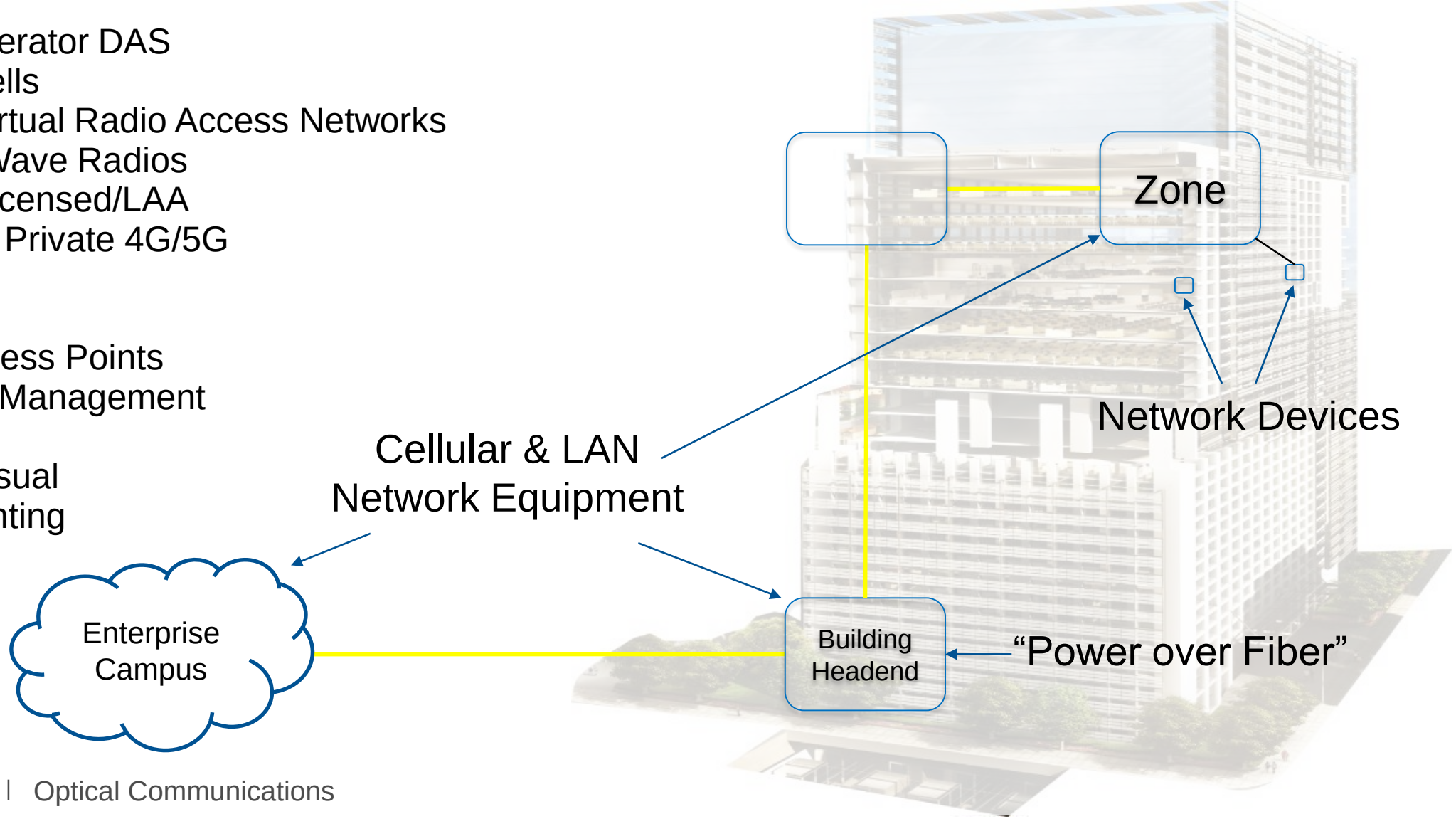
- **Spectrum:** Expanded, Shared, Dynamic, mmWave
- **Topology:** Distributed, User & Control Separation
- **Antennas:** Massive MIMO, Beam Forming
- **Edge Computing:** Applications, APIs
- **Security:** Authentication, Privacy
- **Radio:** New Radio (NR), Software, Micro Cells
- **IoT:** Low Power, Low Latency, NB-IoT, CAT-M
- **Network:** Slicing, Virtualization, SDN, SON, COTS
- **Interoperability:** Path from 4G (NSA), Coexist with 4G (SA)

JMA WIRELESS

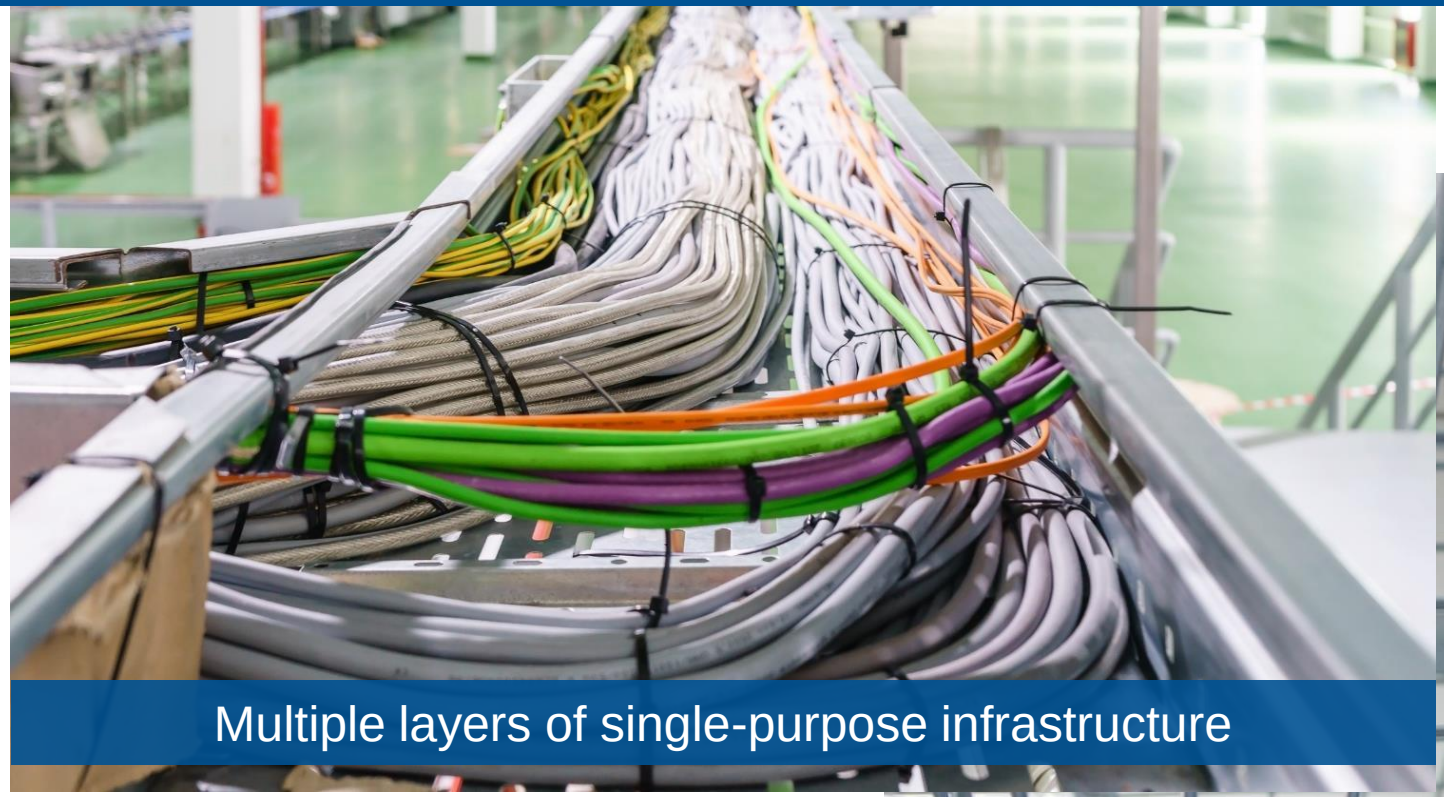
Corning ONE Fiber & Power Deep
ONE Infrastructure for All Networks & Applications

- Multi-Operator DAS
- Small Cells
- Cloud/Virtual Radio Access Networks
- 5G mmWave Radios
- LTE-Unlicensed/LAA
- CBRS & Private 4G/5G

- LAN
- WiFi Access Points
- Building Management
- Security
- Audio Visual
- LED Lighting
- Etc.



Corning ONE Fiber & Power Deep
ONE Infrastructure for All Networks & Applications



Multiple layers of single-purpose infrastructure

Reduce and eliminate single-purpose infrastructure

Low-e Glass

SAFER BUILDINGS COALITION
www.saferbuildings.org

6 mm Glass Pane = -0.8 dB @ 900 MHz

Double Glazing w/ 2 coated Glass Pane = -23 dB @ 900 MHz

	Material	Source	Shielding effect / dB 900 MHz	1800 MHz	3 GHz
Glazing	Glass pane 6 mm	[8]	-0.8	-1.3	-1.9
	Double glazing 4 mm/air 12 mm/5mm	[5]	-0.8	-1.1	-1.2
	Double glazing with commercial low-e 4 mm coated/air 12 mm/5mm	[5]	-30.6	-26.8	-27
	Double glazing with 2 coated glass	[2]	-23	-30	-36
Glazing with pattemed low-e	Double glazing with square pattern (4 %) low-e coating 4 mm coated/air 12 mm/5mm (measured)	[5]	-1.3	-1.3	-1.9
	Double glazing with triangle pattern (2 %) low-e coating 4 mm coated/air 12 mm/5mm (measured/*simulated*)	This work	*-2.0/-2.0*	*-2.3/-2.2*	*-4.0/-3.9*
	Double glazing with triangle pattern (2 %) low-e coating 4 mm coated/air 8 mm/5mm (*simulated*)	This work	*-2.1*	*-3.2*	*-1.5*
	Double glazing with triangle pattern (2 %) low-e coating 4 mm coated/air 16 mm/5mm (*simulated*)	This work	*-1.8*	*-1.4*	*-7.1*

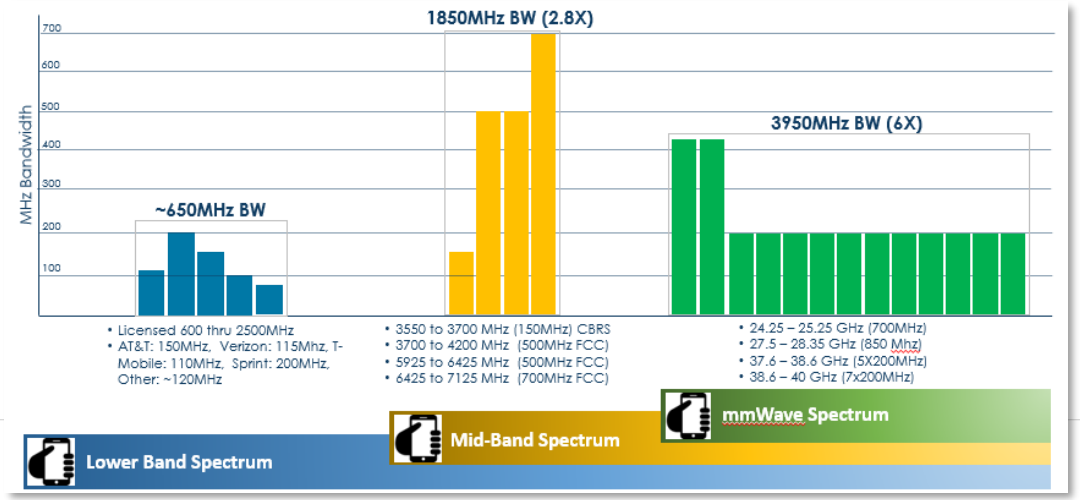
Source: Bouvard, Olivia & Lanini, Matteo & Burnier, Luc & Witte, Reiner & Cuttat, Bernard & Salvadè, Andrea & Schüler, Andreas. (2017). Mobile communication through insulating windows: a new type of low emissivity coating. Energy Procedia. 122. 781-786. 10.1016/j.egypro.2017.07.396.

Spectrum Utilization: Today to 5G

Source: Qualcomm

More Capacity
More Antennas
More Radios
Smaller Antennas

Less Penetration
Less Coverage
Less Latency



LIGHTS? WATER?
WIRELESS!

In office buildings and facilities across America, basic amenities like electrical, gas and plumbing are essential components that are planned and constructed.

The new amenity being planned or added by building owners, architects and operators?

Reliable, in-building wireless coverage.

T-Mobile®
PLAN • PROCURE • DEVELOP

T · ·Mobile·
BUILD YOUR OWN COVERAGE

Reliable Cell Coverage is Crucial in an Emergency

911

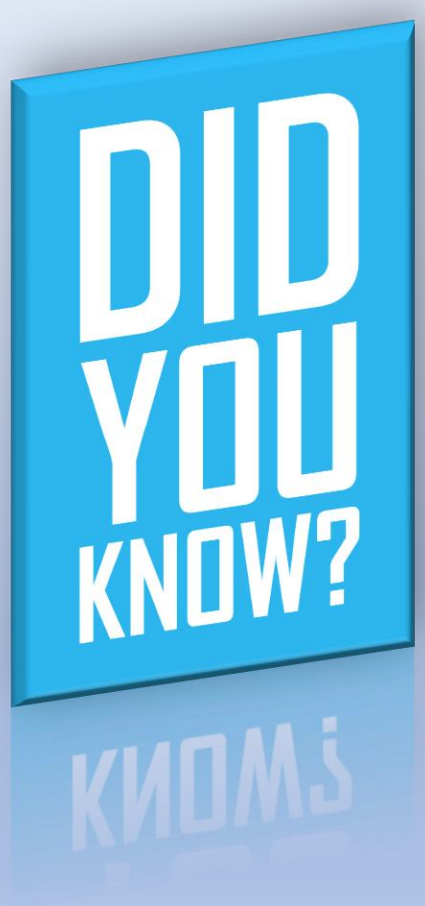
70% of wireless calls to 911 originate from inside houses, apartments and buildings.

ENHANCE PUBLIC SAFETY

With an indoor wireless network you can...

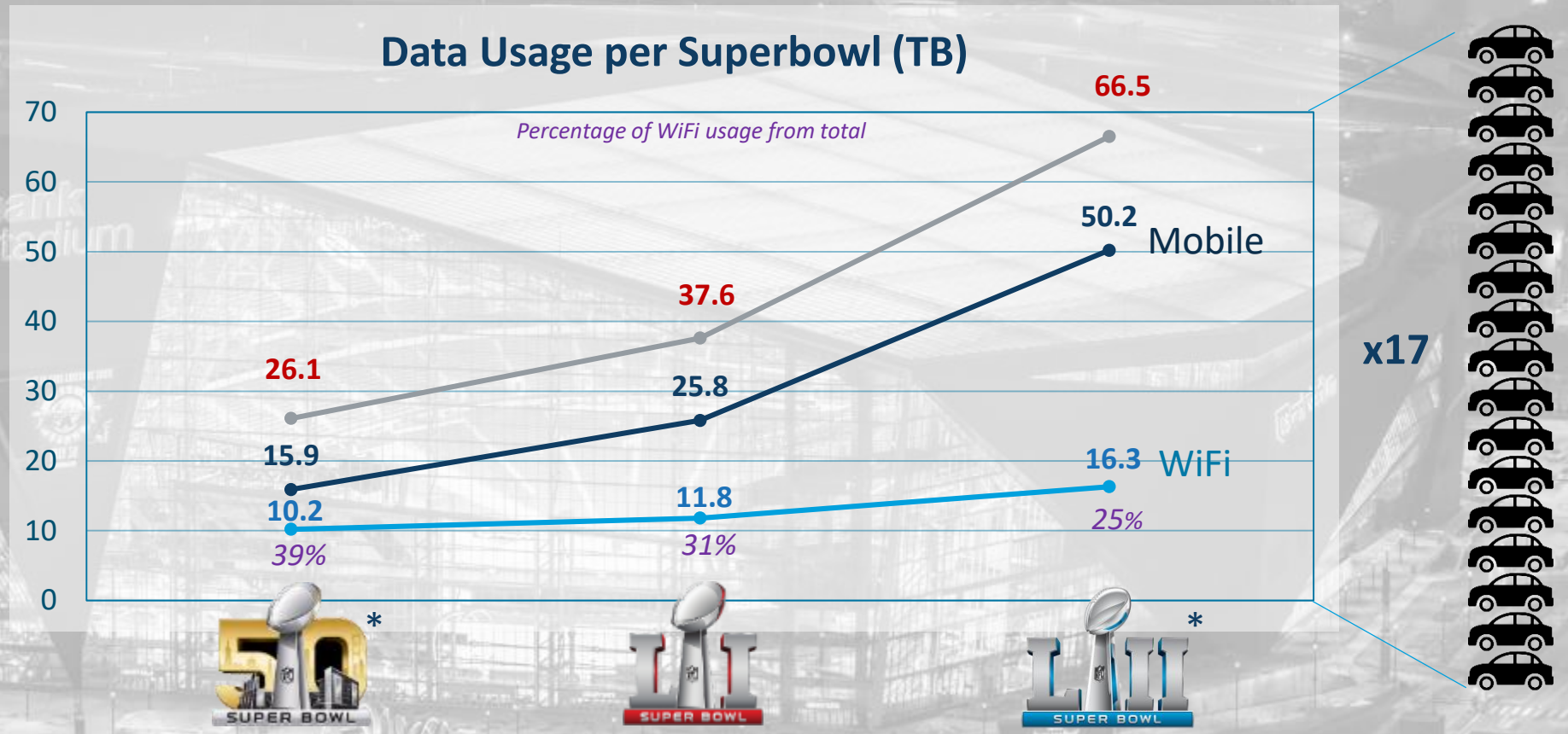
- Improve ability to call 911 throughout the building
- Help emergency personnel coordinate efforts
- Meet public safety codes and ordinances

Driver: NG911 Location Accuracy



"The FCC estimates that a one minute improvement in 9-1-1 dispatch time could save 10,000 lives each year"

Mobile/Wireless Bandwidth Demand



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

SOURCES:

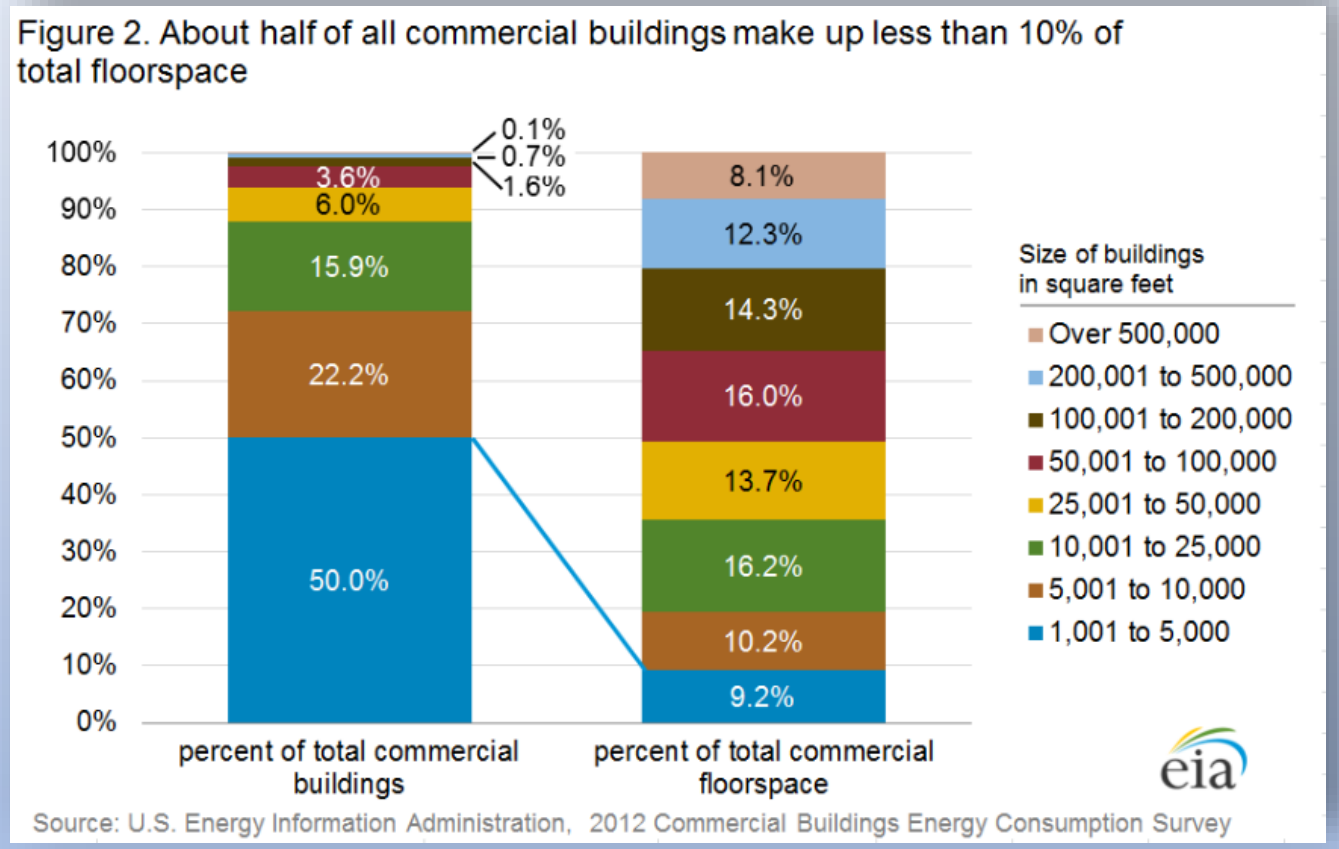
- Data usage at Super Bowl 52 grows 48% as social media use skyrockets https://www.techrepublic.com/article/data-usage-at-super-bowl-52-grew-48-as-social-media-use-skyrockets/
- Super Bowl 51 makes digital history with record-breaking data usage https://www.techrepublic.com/article/super-bowl-51-makes-digital-history-with-record-breaking-data-usage/
- 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/

DAS

Neutral Host

In-Building Public Safety – US Market Size

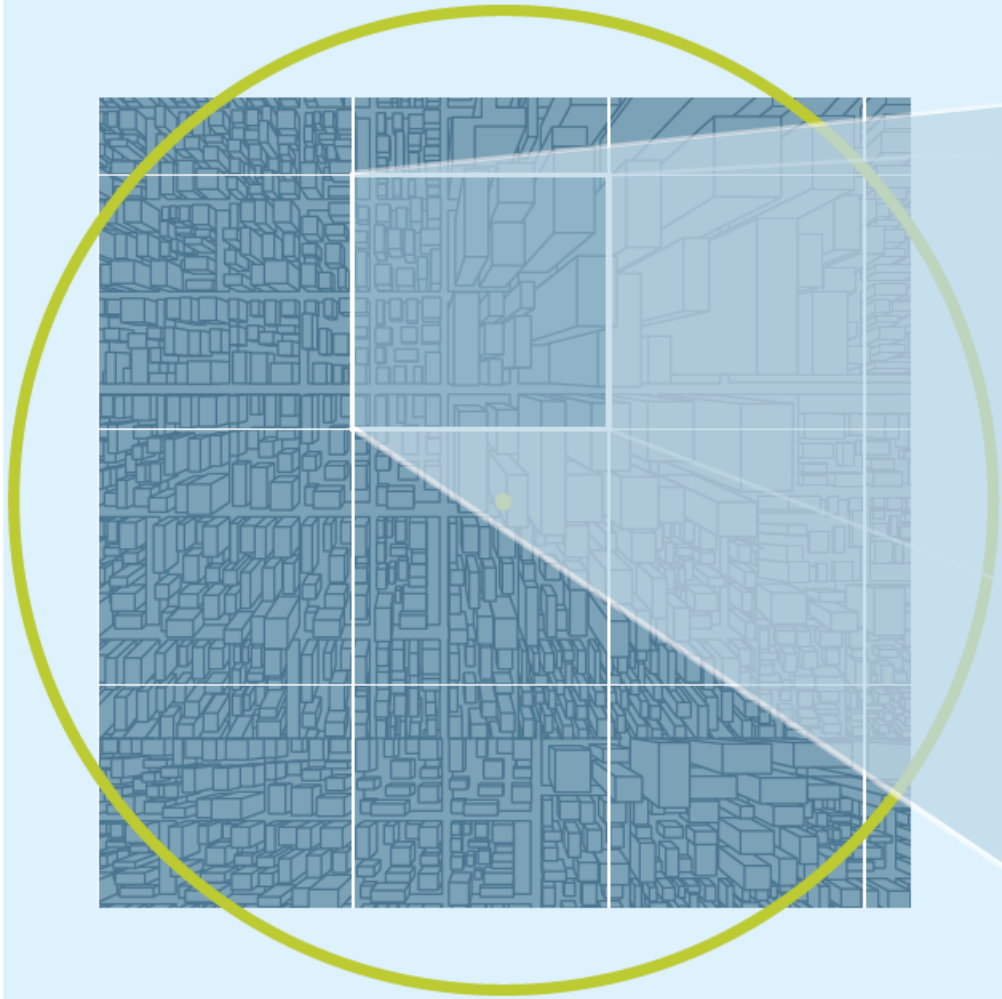
- 5.6 million commercial buildings in the United States in 2012
- 87 billion square feet of floorspace
- 14% increase in the number of buildings and a 21% increase in floorspace since 2003



Source:
Commercial Buildings Energy Consumption Survey (CBECS)

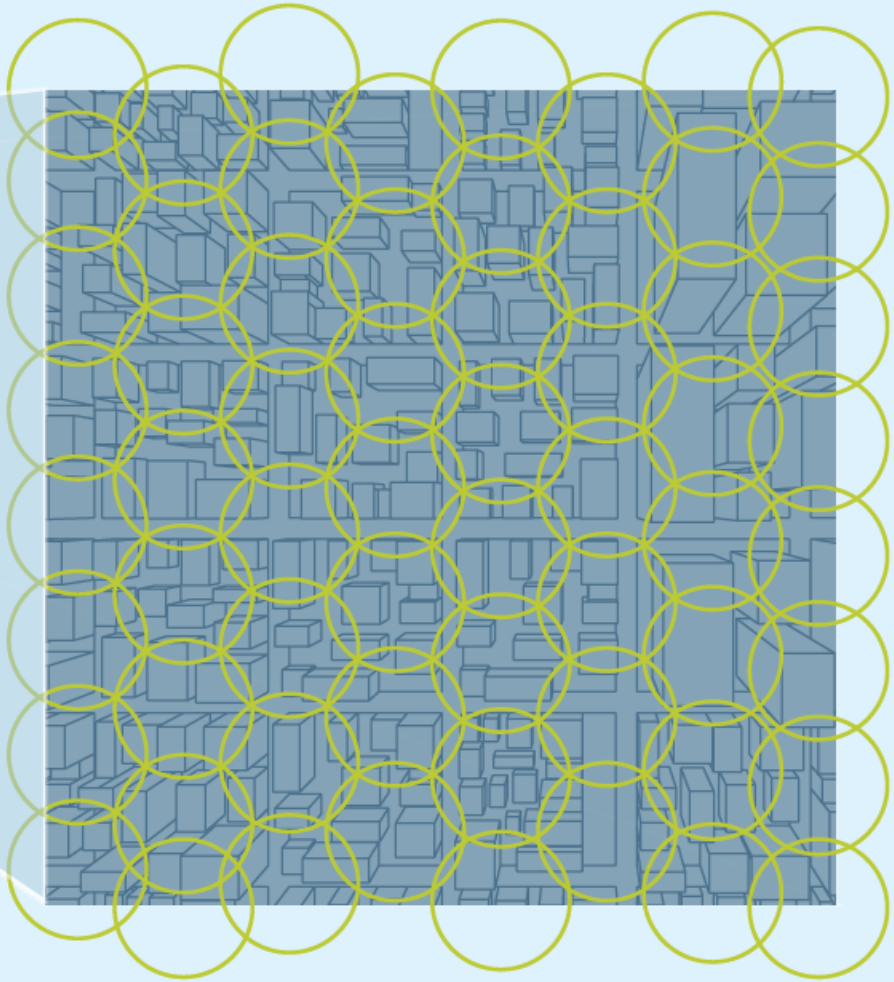
eia Independent Statistics & Analysis U.S. Energy Information Administration

Why 5G Differs From Existing Cellular Networks



TODAY'S 4G NETWORK

This sketch (which does not depict an actual city) shows the range of a single 4G macro cell at the center of the circle. Such a small cell, served by fiber, can potentially serve 10 square miles. The white square shows one square mile.



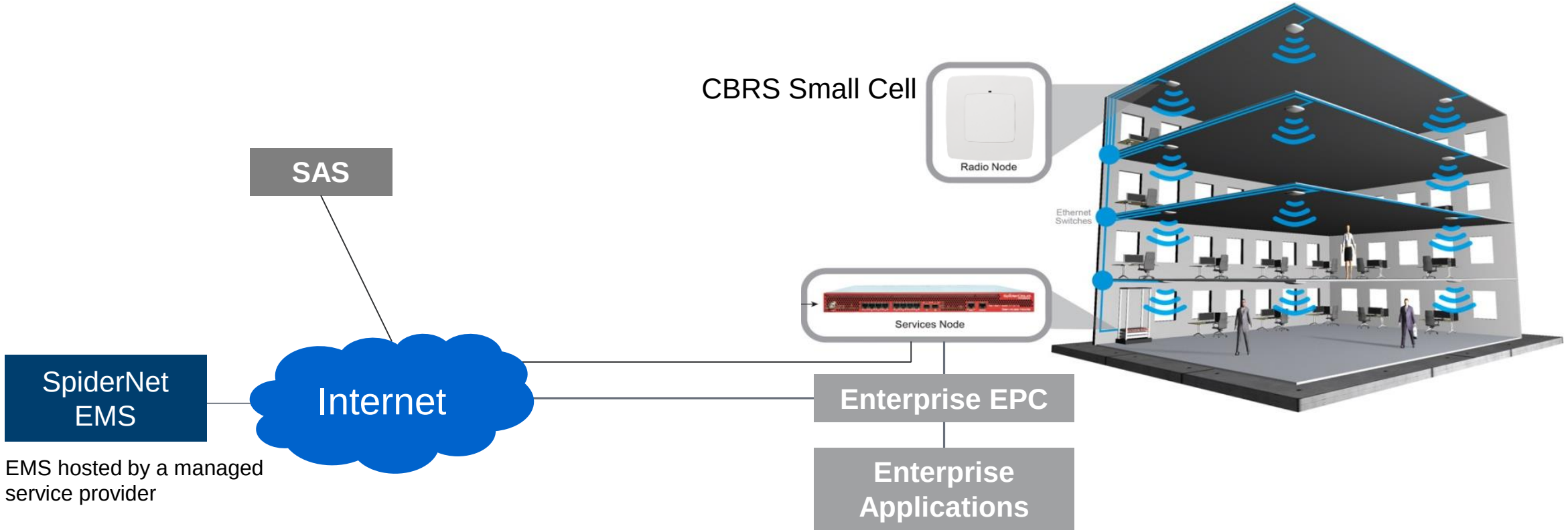
FUTURE 5G NETWORK

This sketch, showing one square mile, provides one estimate of how many 5G cells would be needed: 60, each covering a 750-foot diameter area. These small cells could require about eight miles of fiber.

The sketch is conceptual. Actual deployments would be customized for local conditions and demand, and might need additional or fewer 5G cells.[5]

SpiderCloud Wireless

CBRS Private LTE as Managed Service



SpiderCloud E-RAN can be deployed like Enterprise Wi-Fi in CBRS band with local EPC
Enterprise data stays local (local breakout). Easy to integrate with enterprise applications.

Business Model

01

Granite Approach

- Serve 98% users Day-1
- In-building wireless service provided by Granite to building owners and developers
- Project executed by Granite
- Granite retains control of in-building wireless service

Past Industry Approach

02

- In-building wireless system led by one operator and equipment vendor
- Project executed by system integrator or operator
- Operators retain effective control of the system
- Repeat for second, third and fourth operators