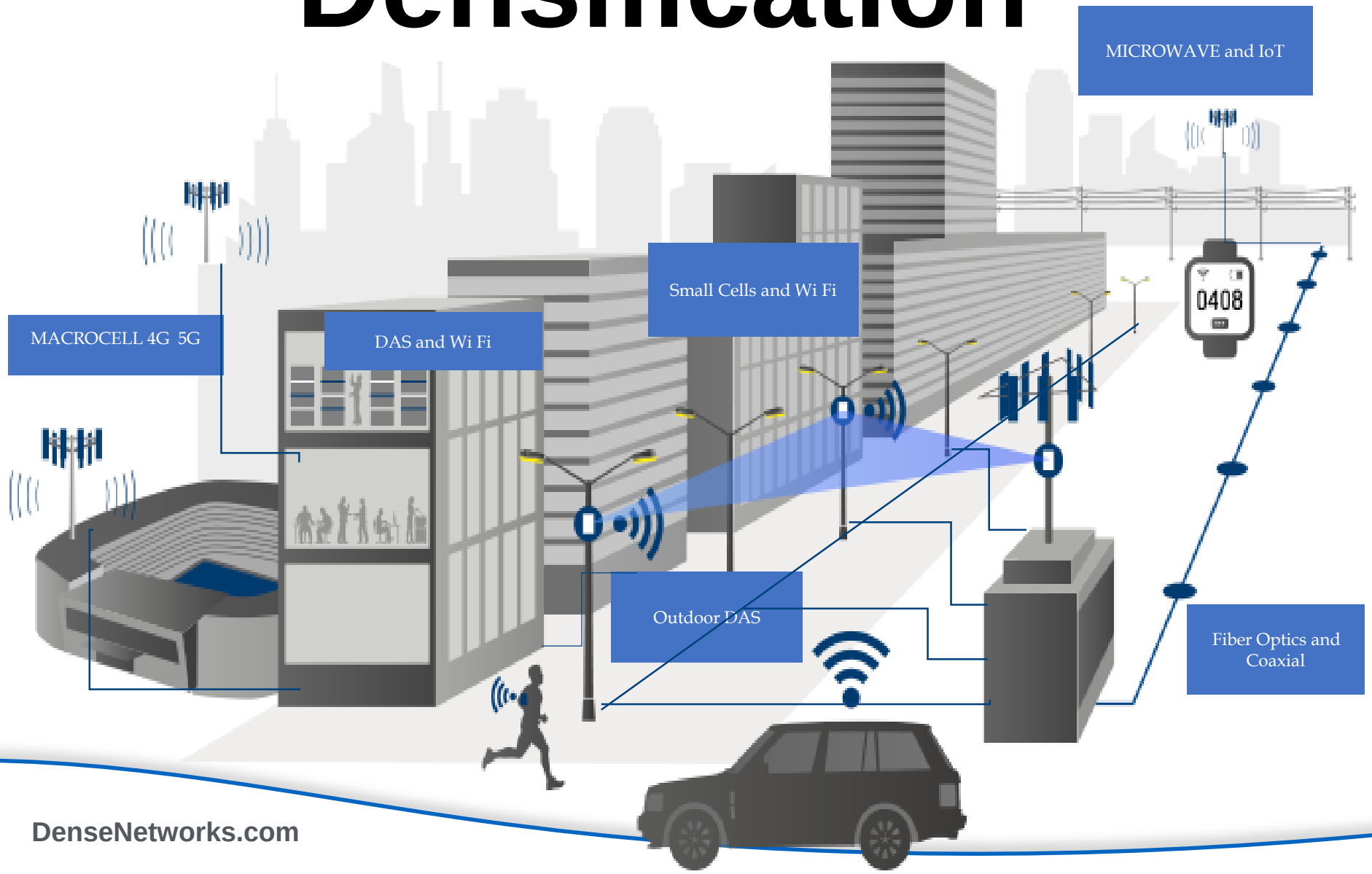
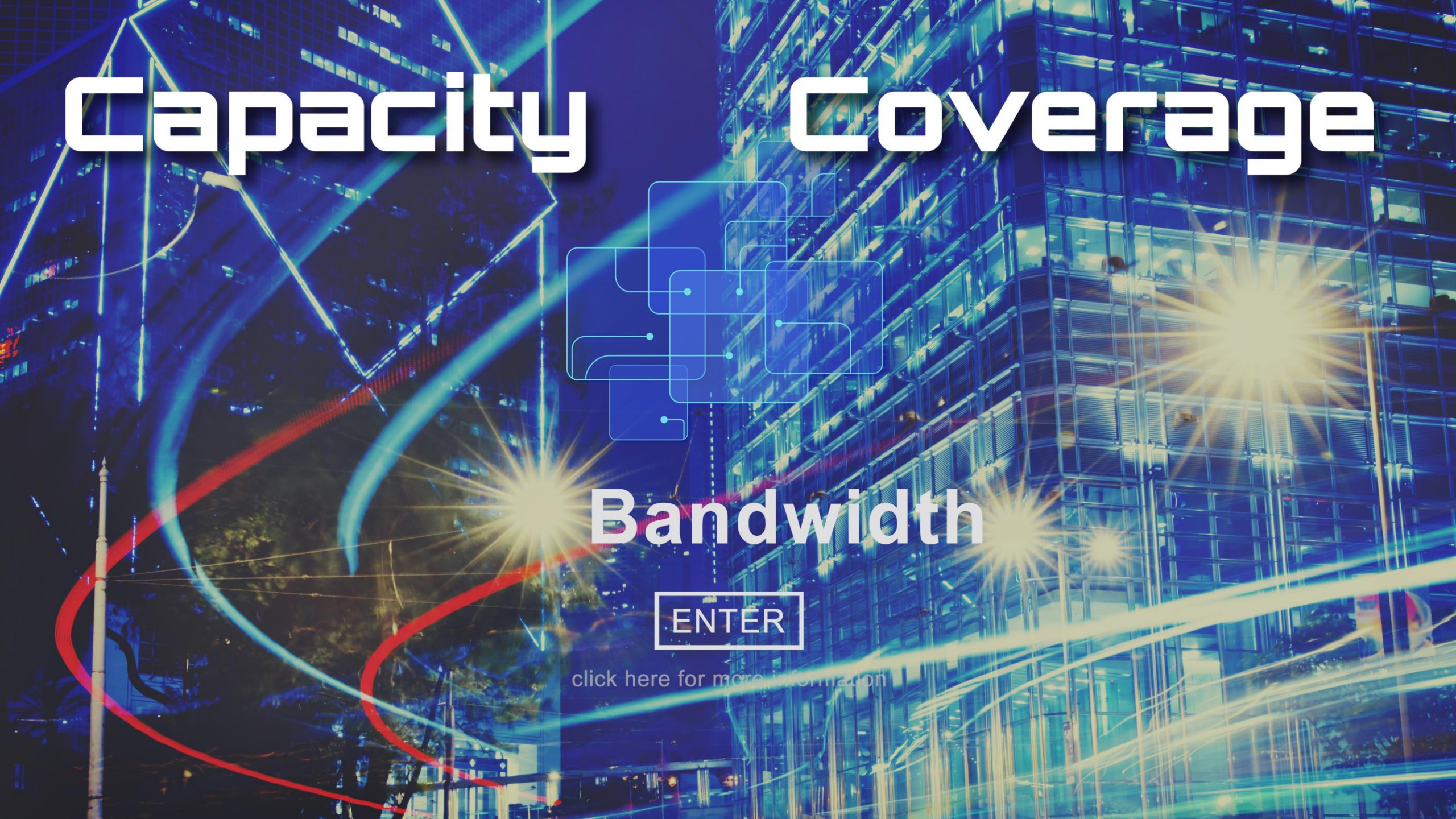
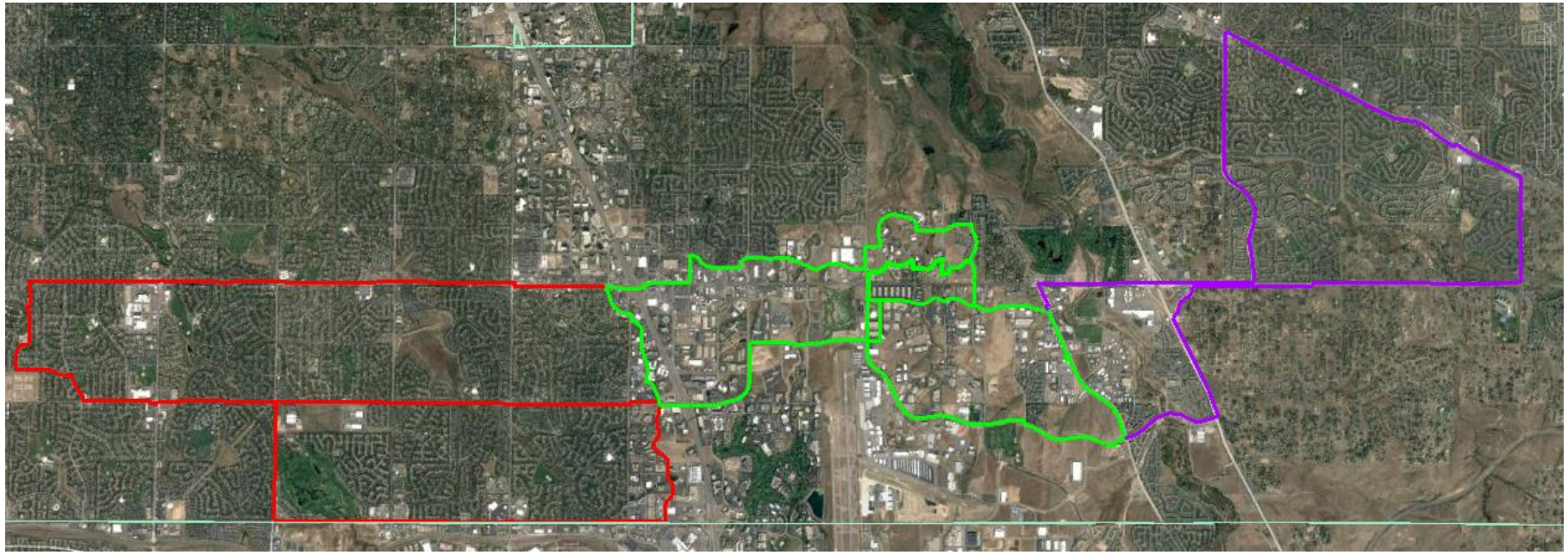
# Densification




Capacity
Coverage
Bandwidth
ENTER
click here for more information

# Fiber Backbone Construction Status
# April - 2018



CENTENNIAL FiberWorks

**Fiber Backbone – Rings and Status**

- Central Ring – Constructed
- East Ring – Under Construction
- West Ring – Under Construction

Centennial

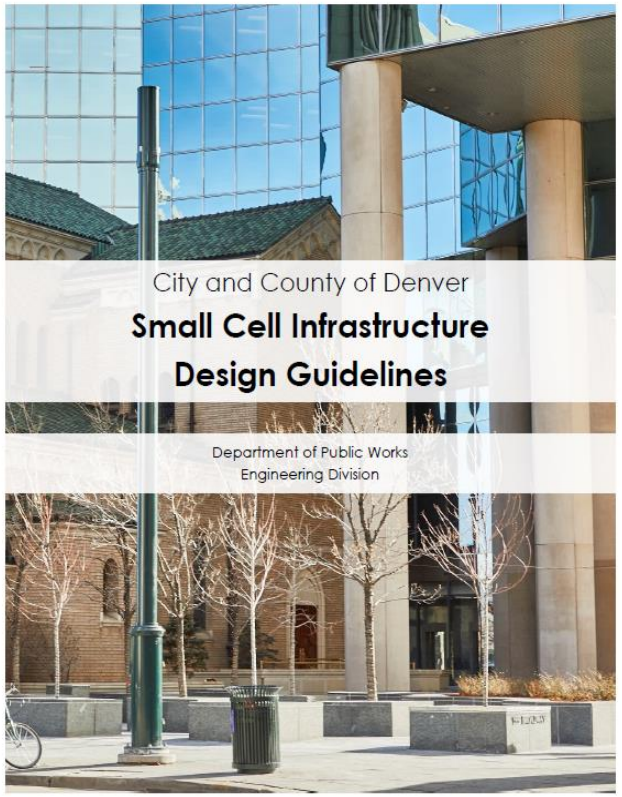
# About Landmark Dividend

LANDMARK DIVIDEND

Landmark Dividend LLC is a real estate and infrastructure investment firm specializing in the telecom and renewable energy industries. Our key areas of focus for acquisition and development include:

- Telecommunications (4G/5G Tower & Concealment Solutions)
- Data Centers
- Fiber Optic Infrastructure
- Smart Cities
- Renewable Power Generation and Energy Storage (Microgrids including EV charging)
- Outdoor Digital Media & Advertising

# Public Works has created Design Guidelines and a custom Permit process to address:




- Public-facing review process including Districts, City Departments, Neighborhood Orgs
- Policy for co-location first
- Notification of adjacent property owner
- Restricting new pole density through min 250’ spacing
- Restricting placement (along parks, historic & residential frontages)
- Restricting placement in front of residential & valuable sight lines
- Requiring camouflage and concealment
- Limiting height and equipment size
- Opportunity to coordinate fiber conduit

DENVER THE MILE HIGH CITY

**The City and County of Denver**
**Public Works Department**
Jon Reynolds, Engineering Supervisor

JACOBS

**Jacobs Engineering Group**
Mike Butters, Project Manger

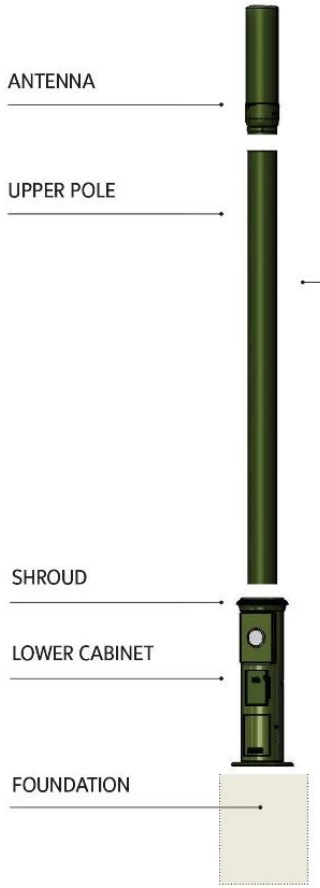
CLANTON & ASSOCIATES
LIGHTING DESIGN AND ENGINEERING

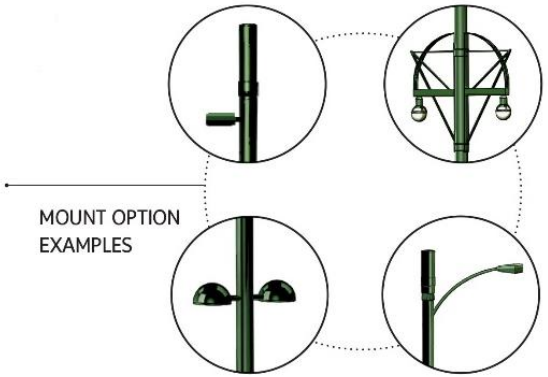
**Clanton & Associates:**
Nancy Clanton, CEO
Dane Sanders, Principal
Annie Kuczkowski, Engineer II - Lighting

Aero *Wireless Group*

**Aero Wireless Group:**
Jim Lockwood, CEO
Mike Hoganson, Chief Operating Officer

**The modular CityPole system** provides a “starting point” for assuring the local conditions and technology can work together seamlessly




CityPole core design is comprised of modular components.

Includes a platform of standardized components along with a variety of customizable options.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# Background - Small Cell Dual Use Street Light Deployment

- Decision made in late 2016 / early 2017 to allow cell attachments to street lights
- Standard “Dual Use” Street Light Poles Developed
- Pole Suppliers Identified and agreements in place
- Attachment Agreements Developed and Executed with Carriers

# Permitting


- Coordinate ahead - Cell AND Fiber AND Power are linked!
- Require and perform "Pre-Review" before any application
- Bundle to reduce volume - Denver allows 10 poles per application
- Bundle Fiber optic submissions
- Work together on GIS data that works for City
- Leverage Xcel to ensure Co-location is a timely option
- Strategize with Xcel on grouping installations

Xcel ENERGY

# Adjacent Owner Notification

- No matter how good your guidelines, & procedures are, owners of adjacent property WILL RARELY be pleased with proposed antenna and construction
- Create notification form letter template
- Notify HOAs, Special Districts, Council, City depts with opportunity to participate in plan review!
- Have simple appeal process

# Installation – Designed to Reduce Time in Right of Way

The CityPole® is designed and fabricated to reduce the installation time required on site. Total installation time for a CityPole® (excluding excavation) can be achieved in less than one hour. All remote radio heads, power meter, ventilation system and antennas are pre-installed. The 3-step installation process is straightforward with safety as the priority.

### 3-Step Installation Process

Step 1: Place pre-cast foundation and grounding into excavation in the right-of-way. (Caisson optional.)

Step 2: Install base cabinet of the CityPole® onto the foundation and secure

Step 3: Install top section with antenna onto base section with architectural shrouds.

Aero Wir

CityPole

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# Small Cell Dual Use Street Light Processes

- Site Request
- Design
  1. Small Cell Dual Use Street Light - Metal
  2. Small Cell Dual Use Street Light - Wood
- Power Design
- Construction
  - Coordination
  - Material
- Communication

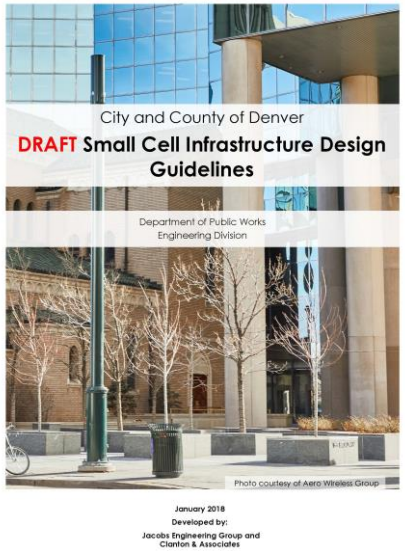
# Challenges using Wood Street Lighting

- Wood Street light poles present a substantial coordination issue with Utility
- Many existing wood poles are not structurally capable for co-locating
- Therefore, most would require replacement anyway
- City of Denver requires replacement to metal pole unless issues, such as
  - Overhead Conductors that are difficult to underground (to rear of lots)
  - Not enough space for metal pole foundation
  - Too close to trees where foundations can damage
  - Time for Xcel permitting and construction not compatible

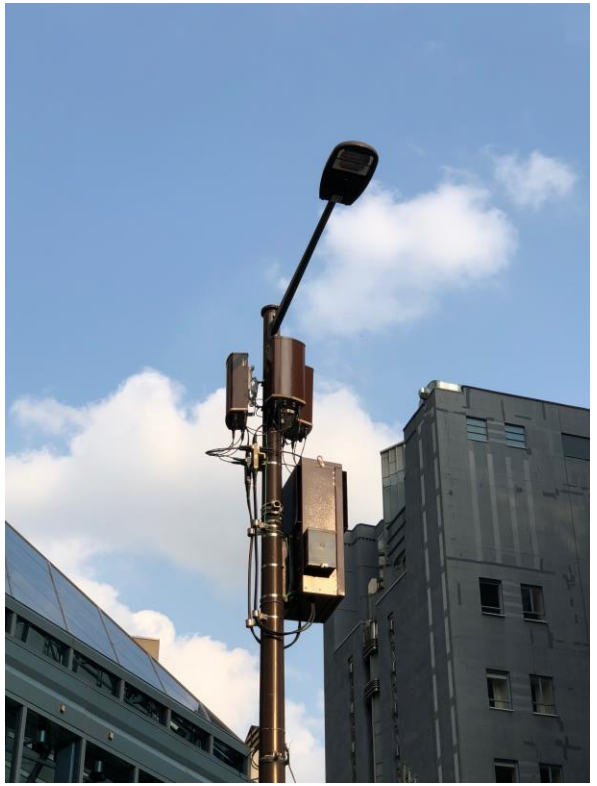
- Solutions:
  - Create rapid City “pre-review” process; Work diligently with Xcel on locations
  - City can offer 1% undergrounding fund to offset Xcel underground cost
  - Allow wood poles to be located on temporarily until Xcel can construct metal poles

DENVER
THE MILE HIGH CITY

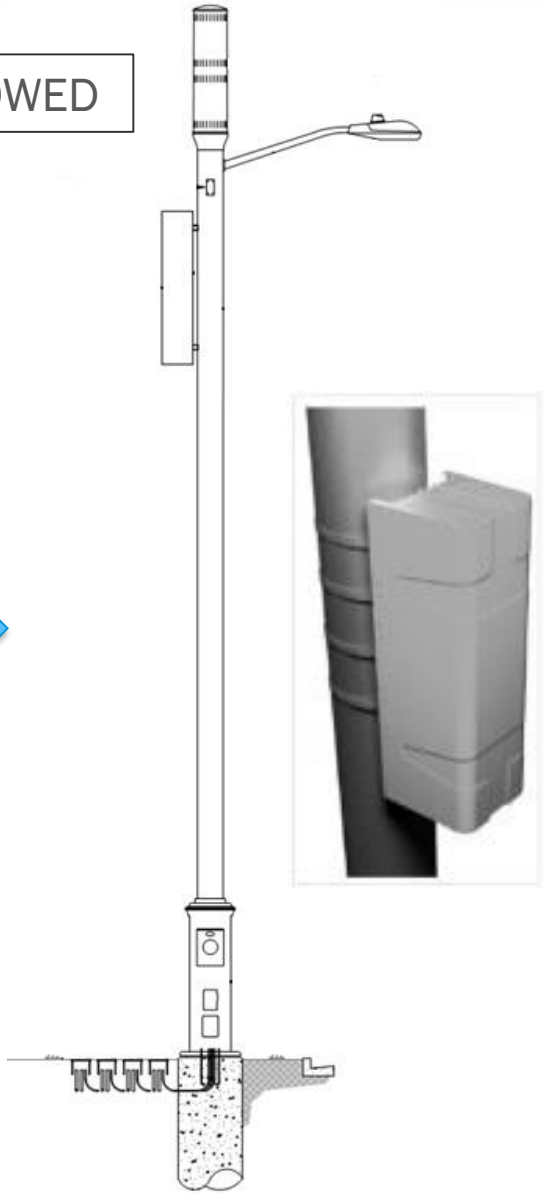
# Small Cell Guidelines




UNDESIRABLE

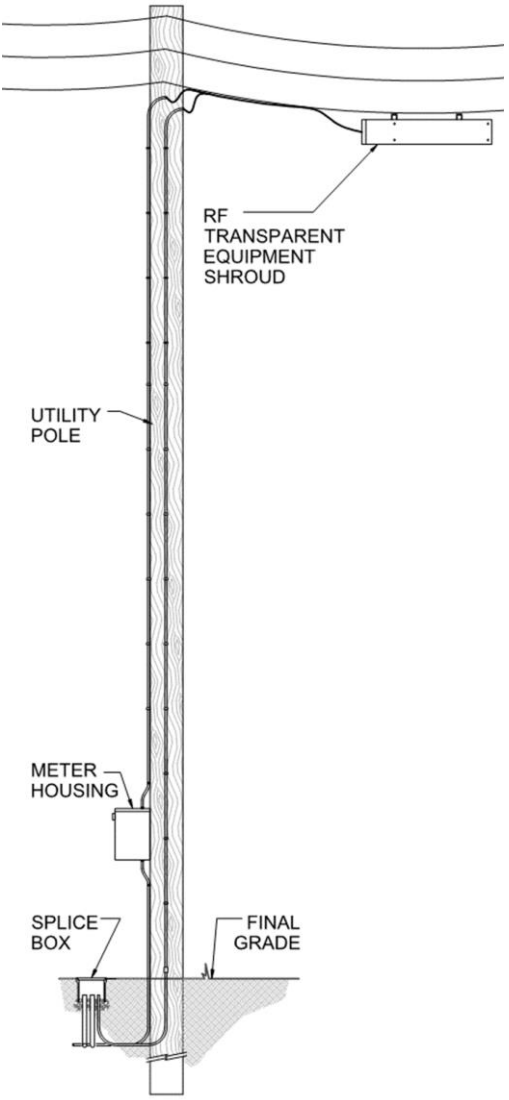


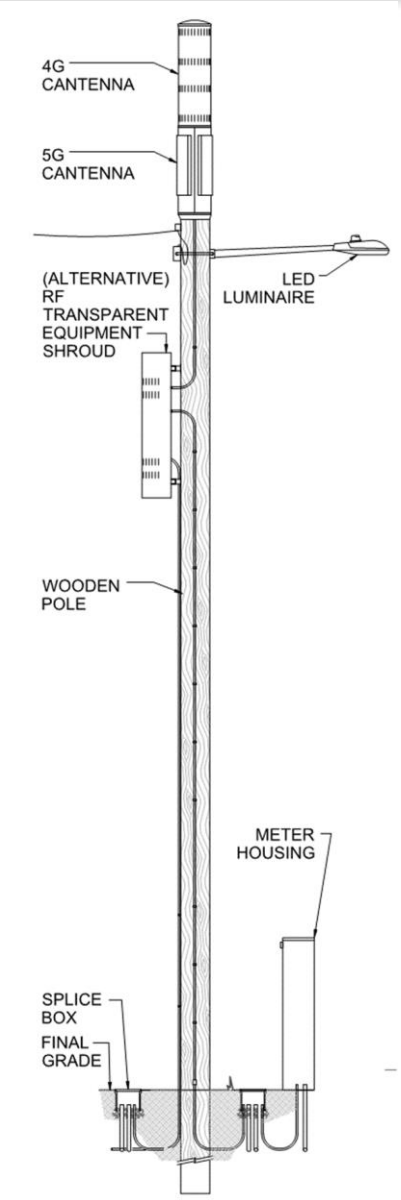
ALLOWED

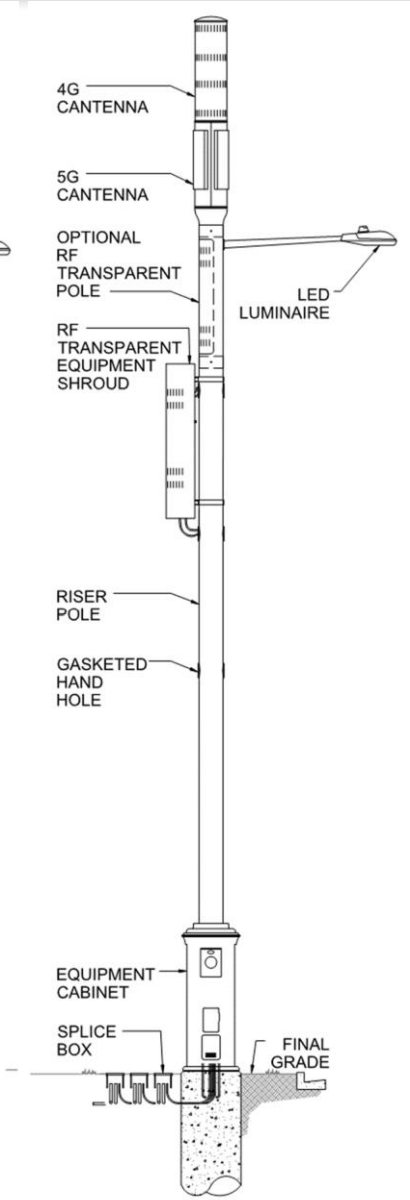


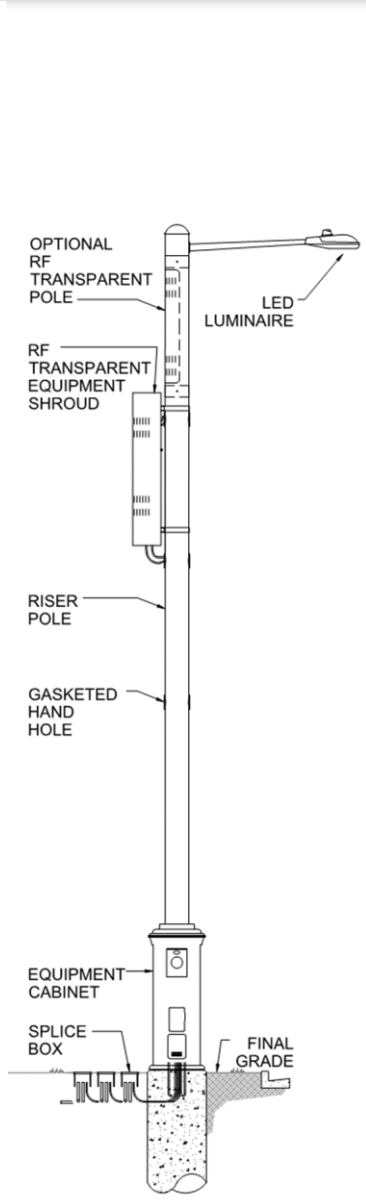
DENVER
THE MILE HIGH CITY

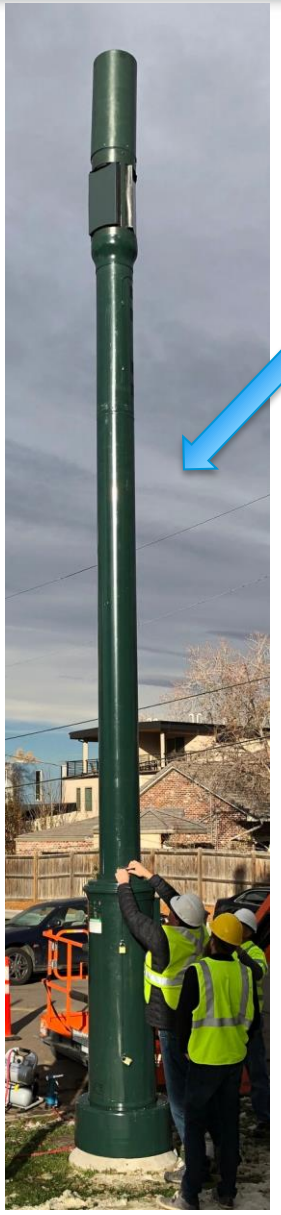
# Stand Up Options!



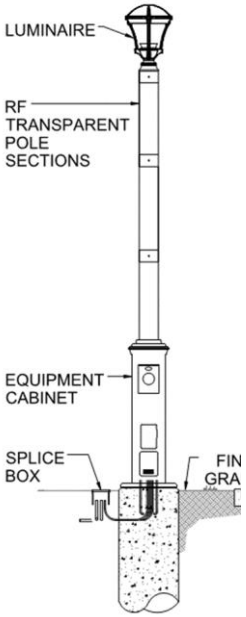



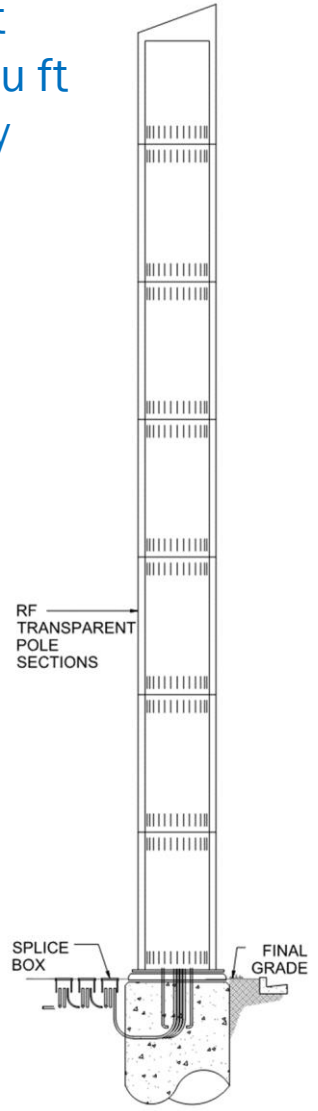



Colorado: 17 cu ft
FCC: 31 cu ft
Denver: 37 cu ft
pole capacity



## CityPole is a Technology Center

- Upper 4G Antenna or 5G Radio/Antenna
- Upper Pole Equipment Bays (4G)
- Lighting and IoT Systems
- Lower Pole Assembly
- Base cabinet – Radios and Power metering. Secured separations
- Foundation



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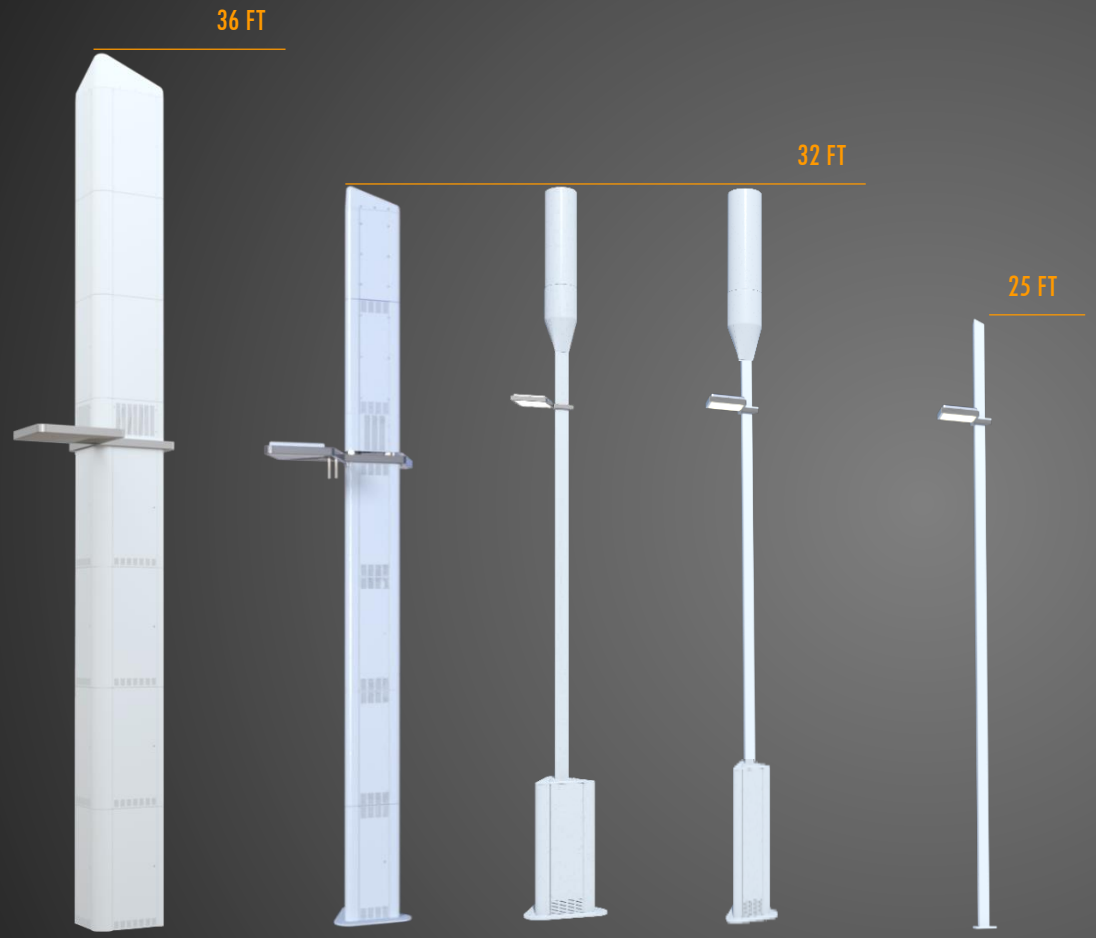
# Our Portfolio of Telecommunication Infrastructure




**Vertex 1**
High Power

**Vertex 2**
Low Power

**Vertex 3**
Mixed Class

**Vertex $0^T$**
Low Power

**Vertex $0^L$**
Light Only

## INTEGRATED POLE SPECIFICATIONS

- ❑ Radio Vendor Neutral
- ❑ ASHTO Light Standard Compliant ASCE 7-93
- ❑ GR487, NEMA and TIA-222 Compliant
- ❑ UL/ULC Approved Portfolio
- ❑ Vendor approved operating environment (preserving radio warranties)
- ❑ Universal foundation allowing for rapid site development/changes
- ❑ Stainless steel construction offering the longest life expectancy
- ❑ Engineered for coastal zone hurricane force winds and seismic zone 4
- ❑ Unmatched radio density across all classes of infrastructure

Back | Offset | Front

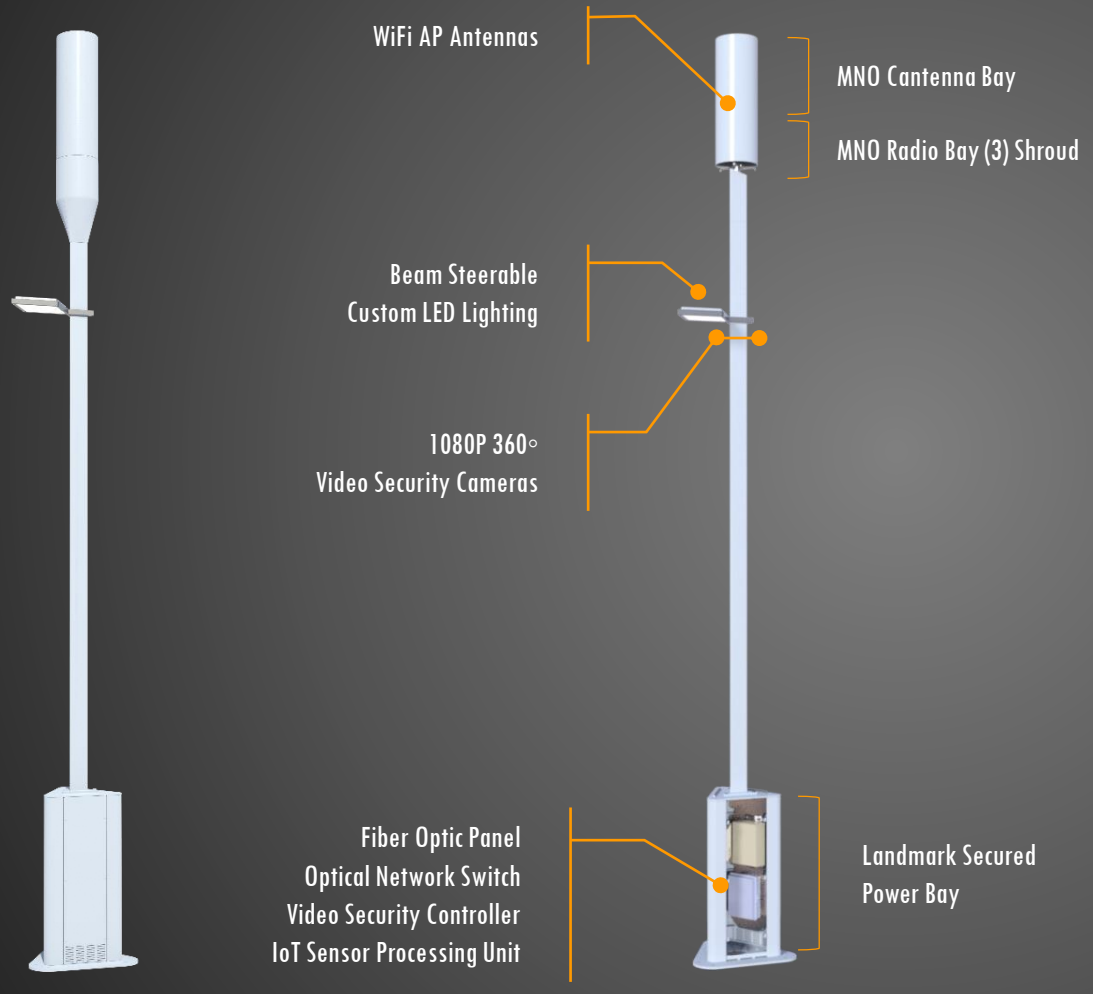
FDC – Configurable Site Cabinet

## Vertex Integrated Pole Portfolio for 4G/5G

# Smart Street lighting

- **GOAL: 100% LED streetlight by 2020**
- OUC working to retrofit 20,000+ streetlights to LED
  - 12,480 currently retrofitted
- Exploring test of new “Smart Streetlights” in Downtown
  - LED technology
  - Video surveillance
  - Environmental monitoring
  - Traffic analytics
  - Wi-fi / DAS systems
  - Gun shot detection

# Vertex VO$^{T}$ — Micro Cell Concealment




## VERTEX INFRASTRUCTURE HIGHLIGHTS

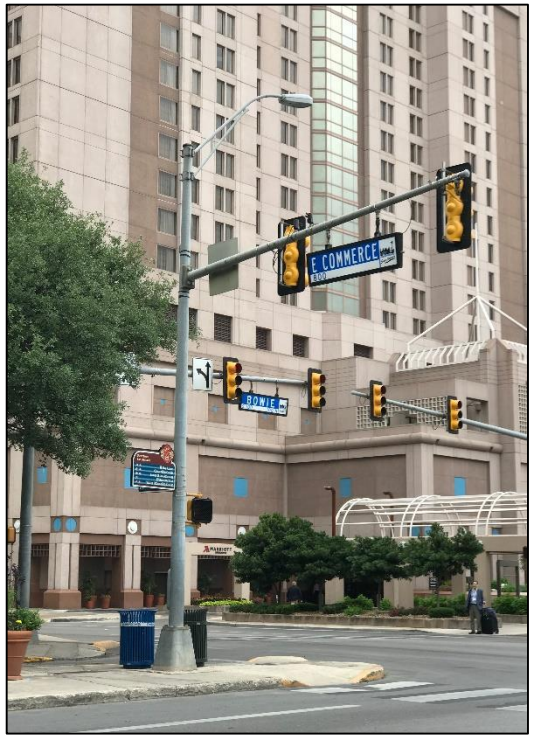
- ❑ Multi-Port 4G / 5G Cantenna Bay (LB + HB + AIR)
- ❑ Vendor Neutral Small Cell Low Power MMRUS Radio Mounting Bay - 3 MRRUS Radios supported
- ❑ 15,000 Cubic Inches of Colocation Space
- ❑ UL/ULC Certified
- ❑ GR487, NEMA, TIA-222 Compliant
- ❑ AC & DC Power Systems
- ❑ Custom Designed LED Luminaires
- ❑ Battery Backup Available

## SITE OFFER OPTIONS

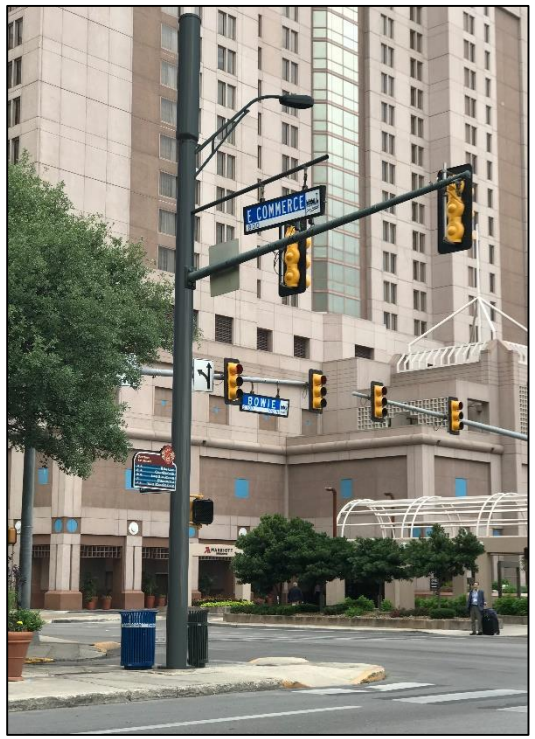
- ❑ WiFi Services
- ❑ Fiber Optic Backhaul/Fronthaul
- ❑ Internet Services
- ❑ Encryption
- ❑ Supports Sensor Nets
- ❑ Site Security/Monitoring
- ❑ Video Surveillance
- ❑ Rackspace / Padmount Colocation
- ❑ GPS / SAT Services
- ❑ Supports Special Radio Applications – Utility FAN, Meter Collection

# Vertex VO$^{T}$ — Integrated Micro Cell Single Tenant Light Standard

# Traffic Signal:  Before vs. After




Existing – Before




New – After

Aero Wireless Group

Comptek

CityPole by Comptek

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# Vertex V1 — Maximum Concealment

GPS Receiver
Weather Station
Smart Metering
Colocation

WiFi AP Antennas
Heat Exhaust Ventilation

Beam Steerable
Custom LED Lighting

1080P 360°
Video Security Cameras

Fiber Optic Panel
Optical Network Switch
Video Security Controller
IoT Sensor Processing Unit

MNO 1 Antenna Bay

MNO 2 Antenna Bay

MNO 3 Antenna Bay

MNO 1 Radio Bay

MNO 2 Radio Bay

MNO 3 Radio Bay

Landmark Secured
Power Bay

## VERTEX INFRASTRUCTURE HIGHLIGHTS

- ❑ Radio Vendor Neutral
- ❑ 4G / 5G — High Band & Low Band
- ❑ 80,000 Cubic Inches/Bay
- ❑ 12-18 RRUS & 5G AIR Full Concealment
- ❑ Baseband & CIPRI CRAN Hub Ready
- ❑ Radio / Antenna Vendor Neutral
- ❑ UL/ULC Certified
- ❑ GR487, NEMA, TIA-222 Compliant
- ❑ 240V AC
- ❑ AC & DC Power Systems
- ❑ Custom Designed LED Luminaires
- ❑ Battery Backup Available

## SITE OFFER OPTIONS

- ❑ WiFi Services
- ❑ Fiber Optic Backhaul/Fronthaul
- ❑ Internet Services
- ❑ Encryption
- ❑ Supports Sensor Nets
- ❑ Site Security/Monitoring
- ❑ Video Surveillance
- ❑ Rackspace / Padmount Colocation
- ❑ GPS / SAT Services
- ❑ Supports Special Radio Applications — Utility FAN, Meter Collection

## Vertex V1 — Integrated Mini-Macro Multi-Tenant Light Standard

# Example FlexGrid Deployment

FLEXGRID™

**1: Radio Colocation & Core Network**

Landmark deploys state-of-the-art stealth tower infrastructure that enables the deployment of 4G/5G in marquee locations typically resistant to traditional macro/micro cell towers. Landmark's offerings provide prospective tenants a neutral host solution for small cell connectivity and various smart city and IoT applications.

**2: Connected Kiosk**

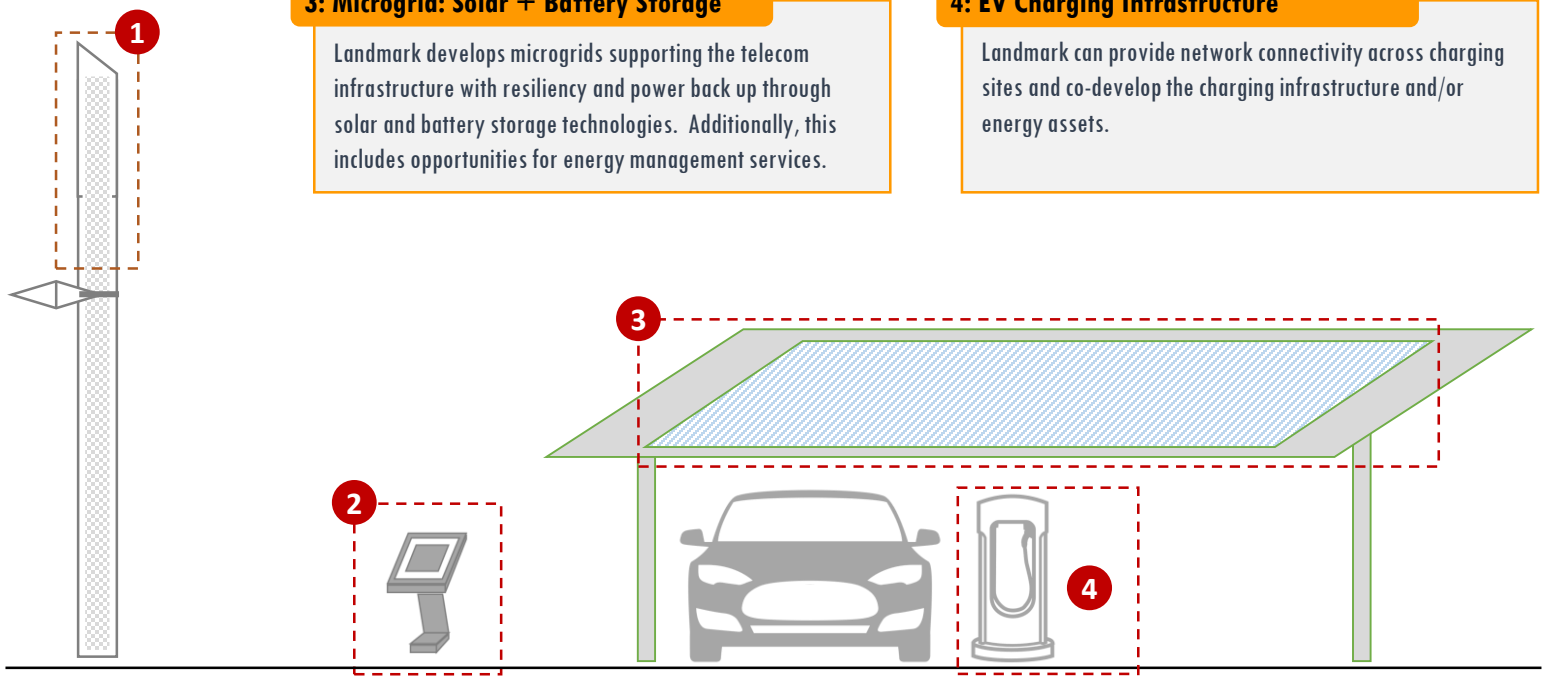
Landmark brings high-speed connectivity fostering a rich environment for out-of-home digital kiosk network operators. Kiosk networks can be leveraged for public safety announcements and advertising revenues.

**3: Microgrid: Solar + Battery Storage**

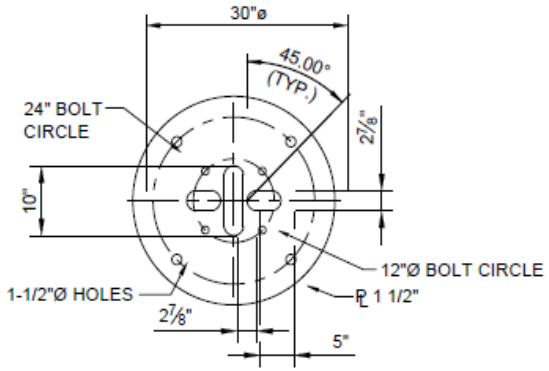
Landmark develops microgrids supporting the telecom infrastructure with resiliency and power back up through solar and battery storage technologies. Additionally, this includes opportunities for energy management services.

**4: EV Charging Infrastructure**

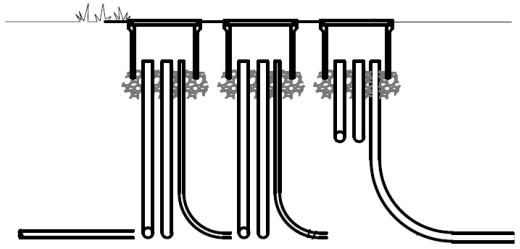
Landmark can provide network connectivity across charging sites and co-develop the charging infrastructure and/or energy assets.

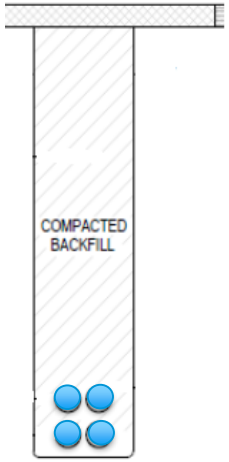


# “Make Ready” Infrastructure



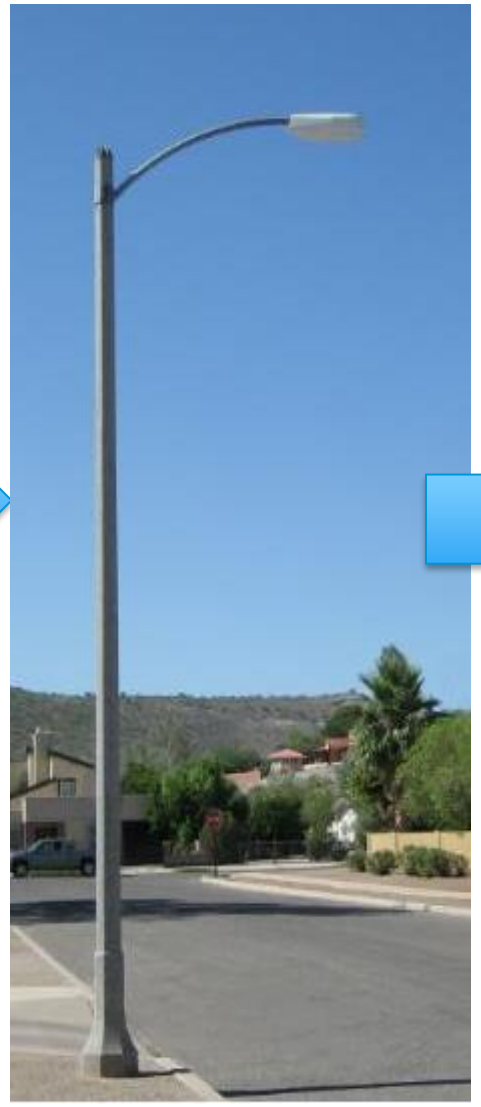

ADAPTER - PLATE PLAN





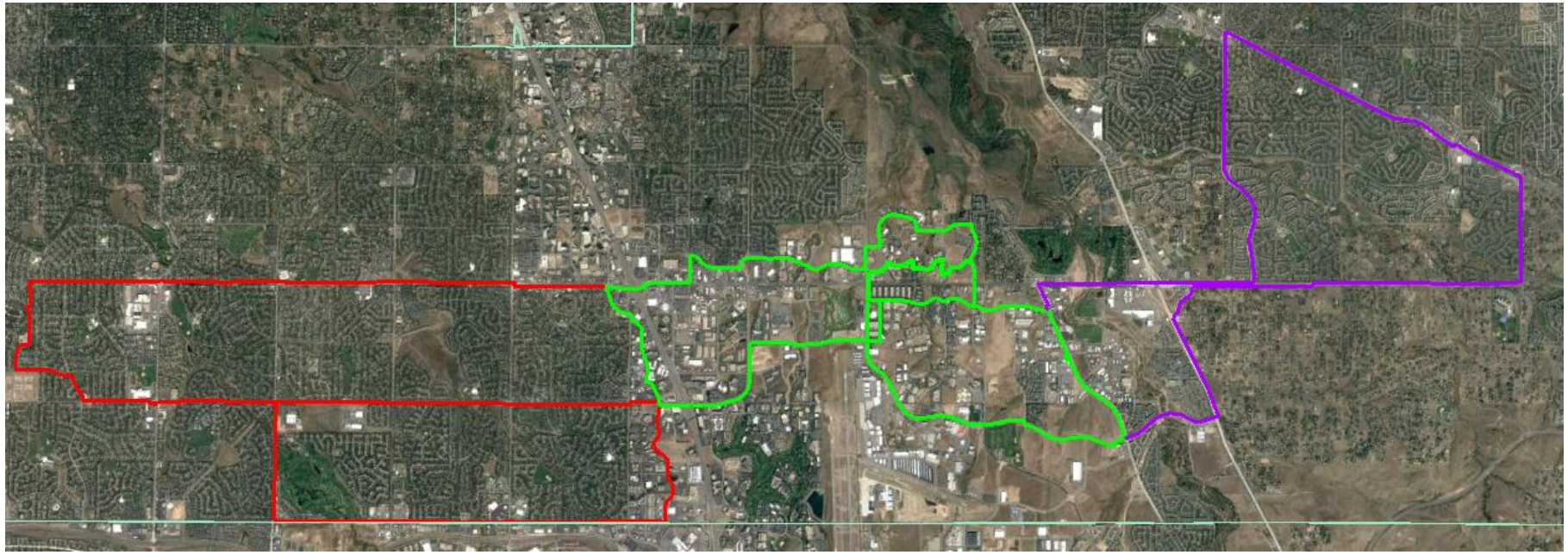

- ✓ Company Fiber
- ✓ Shared Fiber
- ✓ Power
- ✓ Street Light Power

Allows This



Or This

# Fiber Backbone Construction Status
# April - 2018



CENTENNIAL FiberWorks

**Fiber Backbone – Rings and Status**

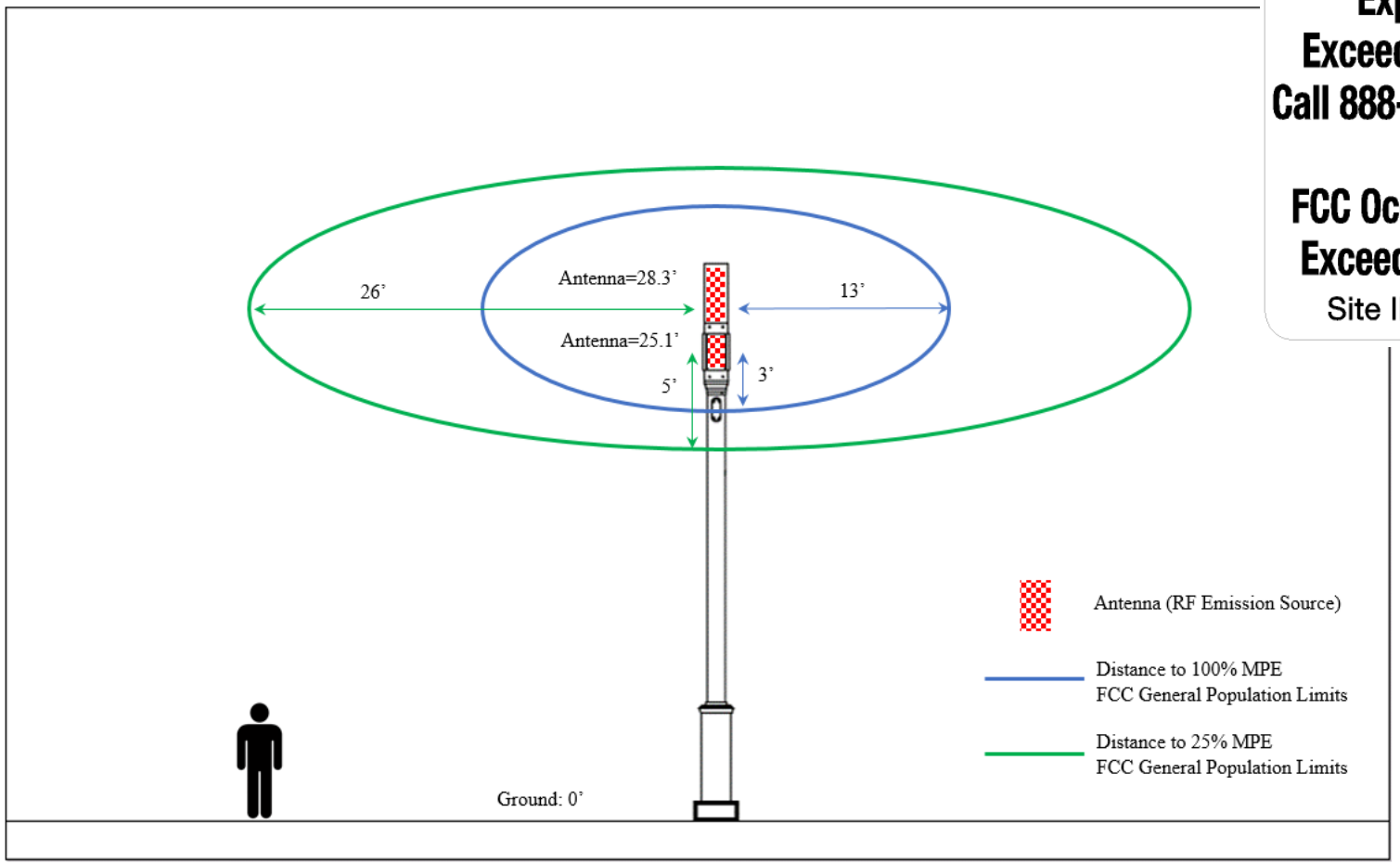
- Central Ring – Constructed
- East Ring – Under Construction
- West Ring – Under Construction

Centennial

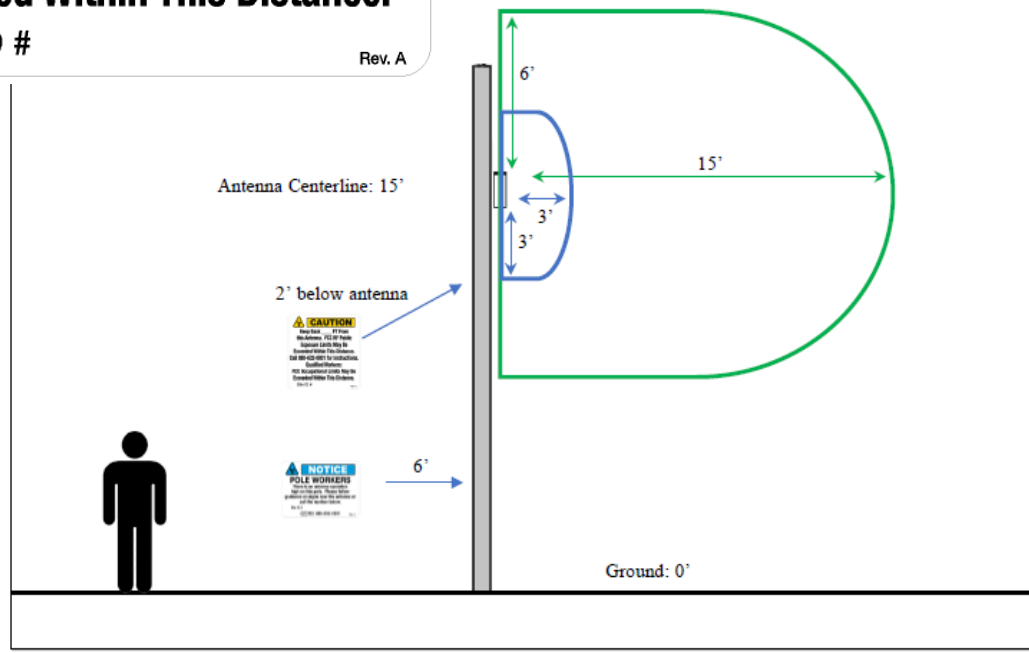
# Small Cell Dual Use Street Light Pole Deployment

## Small Cell Dual Use Sites

# RF Emissions Certificate







# LESSONS LEARNED

1. Development of a strategic plan
2. Processes in place and communicated
3. Meet with Carriers
   - Understand goals and expectations
4. Meet with Cities
   - Partnership
   - Collaborative
5. Establish rapport
   - Maintain relationship
6. Set Realistic Expectations
7. Communication
8. Utilities are different