



Digital Infrastructure for the Next Generation

INTEGRATED ROADWAYS, LLC

**INTEGRATED
ROADWAYS**

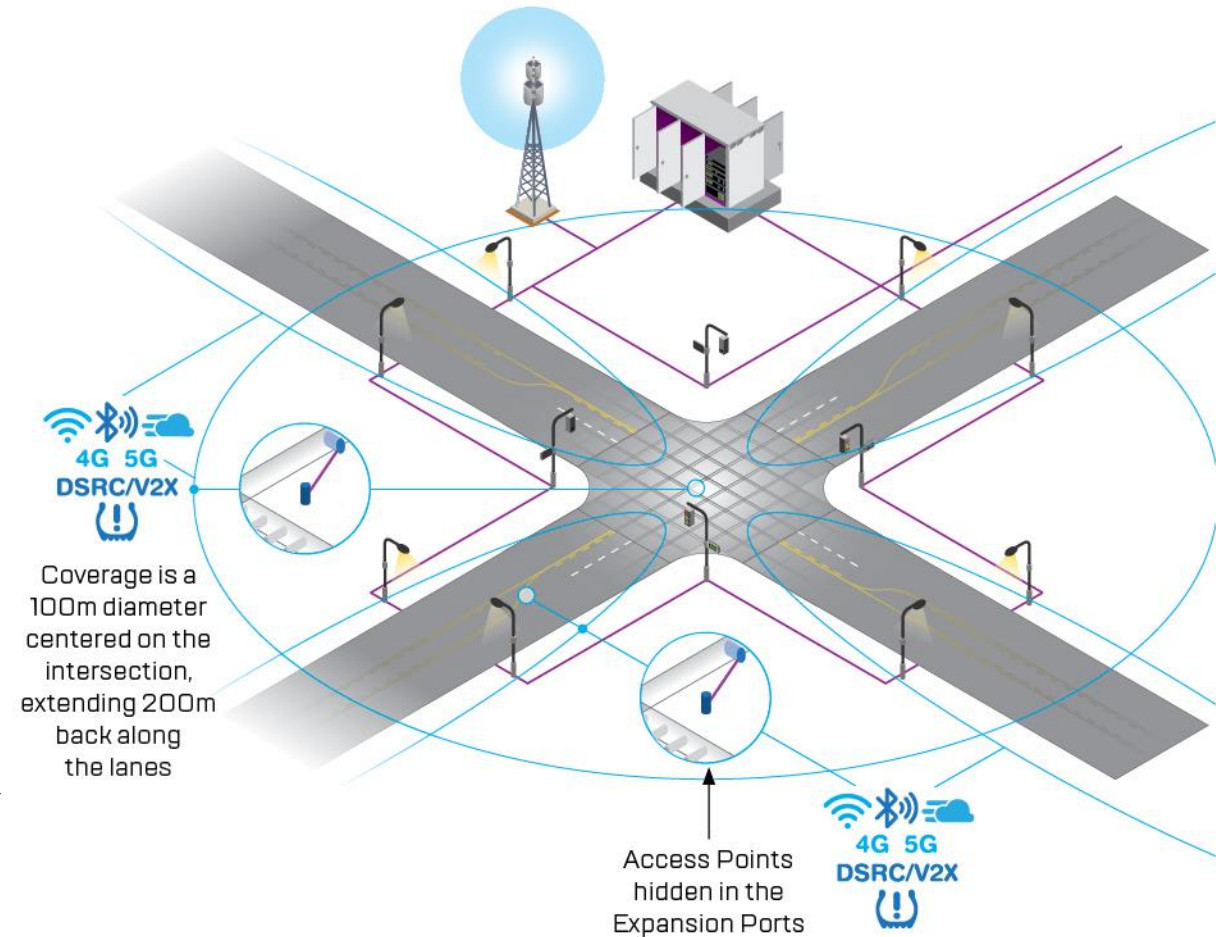
5G Standalone Network Deployment Challenges

Technical & Logistical	Political & Economic
Antenna ubiquity – every 100 meters	Cities hate antennas & they're expensive
Edge ubiquity – every antenna needs ULL Edge	Cities don't benefit from giving up ROW for Edge
Multicell coverage for handoff prediction	Small cell deployment costs are massive per Sq M
Multiple tenants on each antenna	If one antenna is hard to get, how about thousands?
Multiple protocols on each antenna	\$10k+ per antenna permits, \$25k to \$250k leases
Software defined ultrawideband antennas	Who's funding all the intermediate infrastructure?
Cost, difficulty, speed, scalability – 5G architecture & deployment mismatch vs 1G to 4G macrocell	

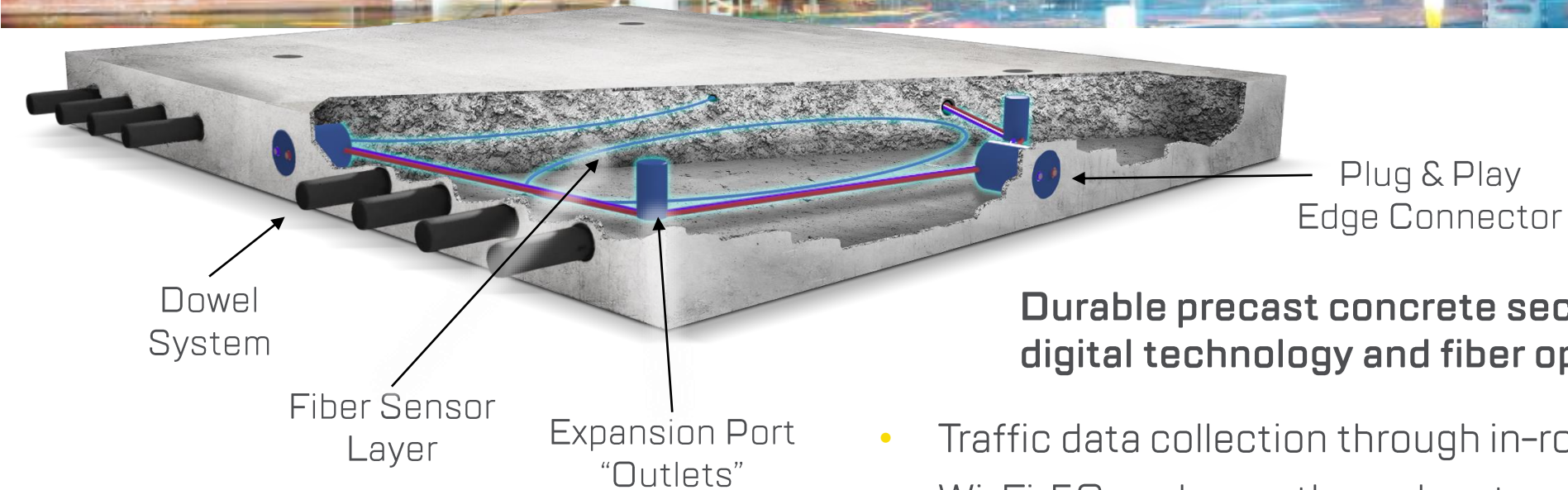
Smart Pavement Small Cell Deployment

5 APs per intersection:

- One providing 100m radial coverage
- Four directional 200m coverage
- Coverage can overlap significantly
- Matches City grid
- Matches radio horizon for key frequencies
- Geometry is essentially the same for antennas at 8' - 16' overhead
- Similar LOS issues for vehicle interference
- Devices can connect to multiple antennas & choose path based on strength
- Device vector is discoverable



What is a Smart Pavement System?



Durable precast concrete sections embedded with digital technology and fiber optic connectivity for:

- Traffic data collection through in-road sensors.
- Wi-Fi, 5G, and more through antennas in the Expansion Ports.
- Edge services and cloud access .
- Wireless EV charging and assisted autonomy.



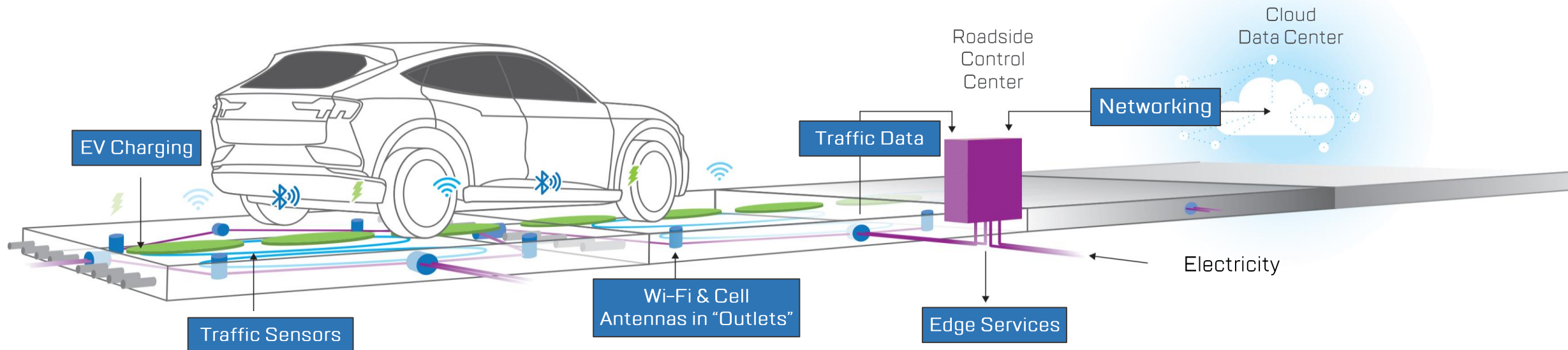
INTEGRATED ROADWAYS

Current Outdated Road Infrastructure

- 40% of roads in the U.S. need immediate improvement.
- Road construction practices and procurement have barely improved since the Federal Aid Highway Act of 1956.
- Cities are demanding new technologies for connected, electric, and autonomous vehicles.
- COVID and online retail have disrupted local economies and led to capital outflows from local communities to major tech hubs.

Smart Pavement **Managed Services Platform**

- Traffic Data:** Sensors collect anonymous vehicle, traffic, pavement condition, weather, and other data
- In-Road “Outlets”:** Leased to partners for wireless access points (Wifi, 5g, and 4G), new sensors, Smart Cities
- Edge Services:** High-demand on-prem service for cell carriers, content distribution networks, and more.
- Networking:** Fiber capacity available for lease to carriers & network operators
- Autonomy:** Sensors + Edge + Digital Twin + 5G + Wi-Fi etc. provides APNT for autonomy



Political & Economic Benefits

- Aligned value prop for municipal & DOT permitting
- Open access networks enable more competition
- Open access enables new service ideation, origination, implementation
- Deployment costs spread over numerous integrated service deliveries
- CapEx is dramatically reduced
- Telecom expenses shift to OpEx
- Updates, modification, densification, and replacement are cheap

Logistic & Technical Benefits

- Removes backhaul for local CEAV services
- Dramatic latency improvements
- Path selection enabled from overlapping cells
- Reliability from path selection
- MIMO maximization from overlapping cells
- High service predictability
- Significantly more scalable
- Enables mesh extension
- Ideal for next-gen mobility apps

INTEGRATED ROADWAYS

Smart Pavement in Denver, CO

Brighton Blvd. Proof of Capability

- Demonstrated tech & construction
- 4 Smart Pavement Slabs
- 32 Traffic Sensors
- 16 “Expansion Ports”
- Edge server with 60 rack units
- Ready to deliver in-road AP today



INTEGRATED ROADWAYS

Proposed Antenna Design

Proposed Design Parameters

- 4cm rad x 4cm height
- Software defined fractal antenna
- Multi-segment domed “buckyball”
- ~800 MHz to ~6 GHz
- Top edge at -0z to -2.5cm z
- Full network function virtualization
- Massively MIMO
- Supports most/all 4G, 5G, Wi-Fi bands
- Multi-protocol & multi-tenant
- Beamforming by attenuating segments



INTEGRATED ROADWAYS

Lenexa, KS

Showcase City Center

- 10-year, \$250m Smart Infrastructure Program Concession
- Deploy Digital Infrastructure over 10% to 20% of City
- City wants to demonstrate CEAV services
- In engineering now, groundbreaking soon
- Use as services development, testing, early deployment location for the next 10 years

[Learn more about Showcase City Center Here](#)

Digital Infrastructure: **Multifunctional, Hyperlocal, Hyperscale**

- Single-application networks are too costly & outdated architecture
- Next-gen+ requires distributed density + ubiquitous ULL Edge
- Digital infrastructure is sustainable, extensible, upgradeable framework
- Integrated approach enables 5G, Smart Cities, Fiber, CEAV Services
- Digital Infrastructure is our path to “a trillion connected devices.”

We believe integrated infrastructure for CEAVs represents the best compromise of outcomes, cost, and performance

