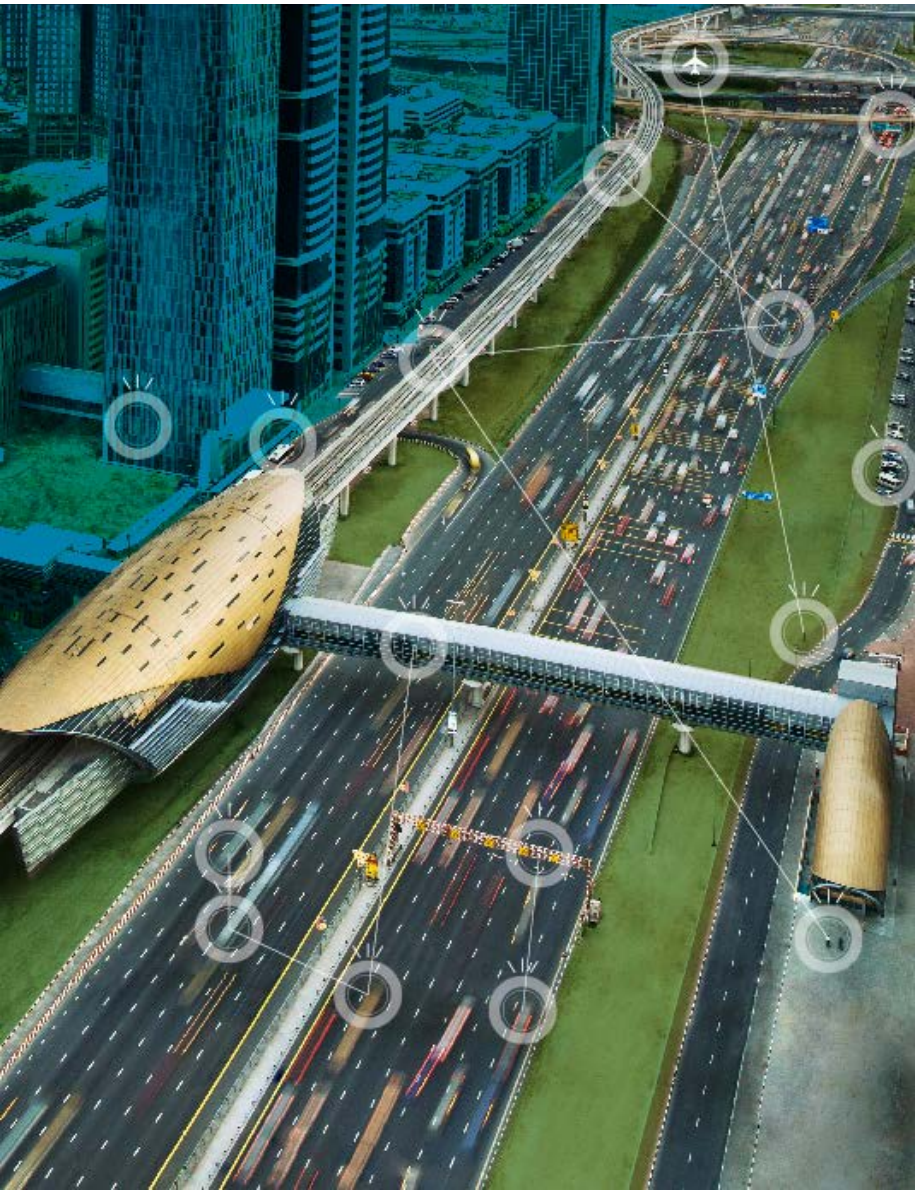


Statewide Connectivity

NE ITS

April 25, 2019

Robert James

Chief Engineer Emerging Mobility

HNTB Corporation

HNTB

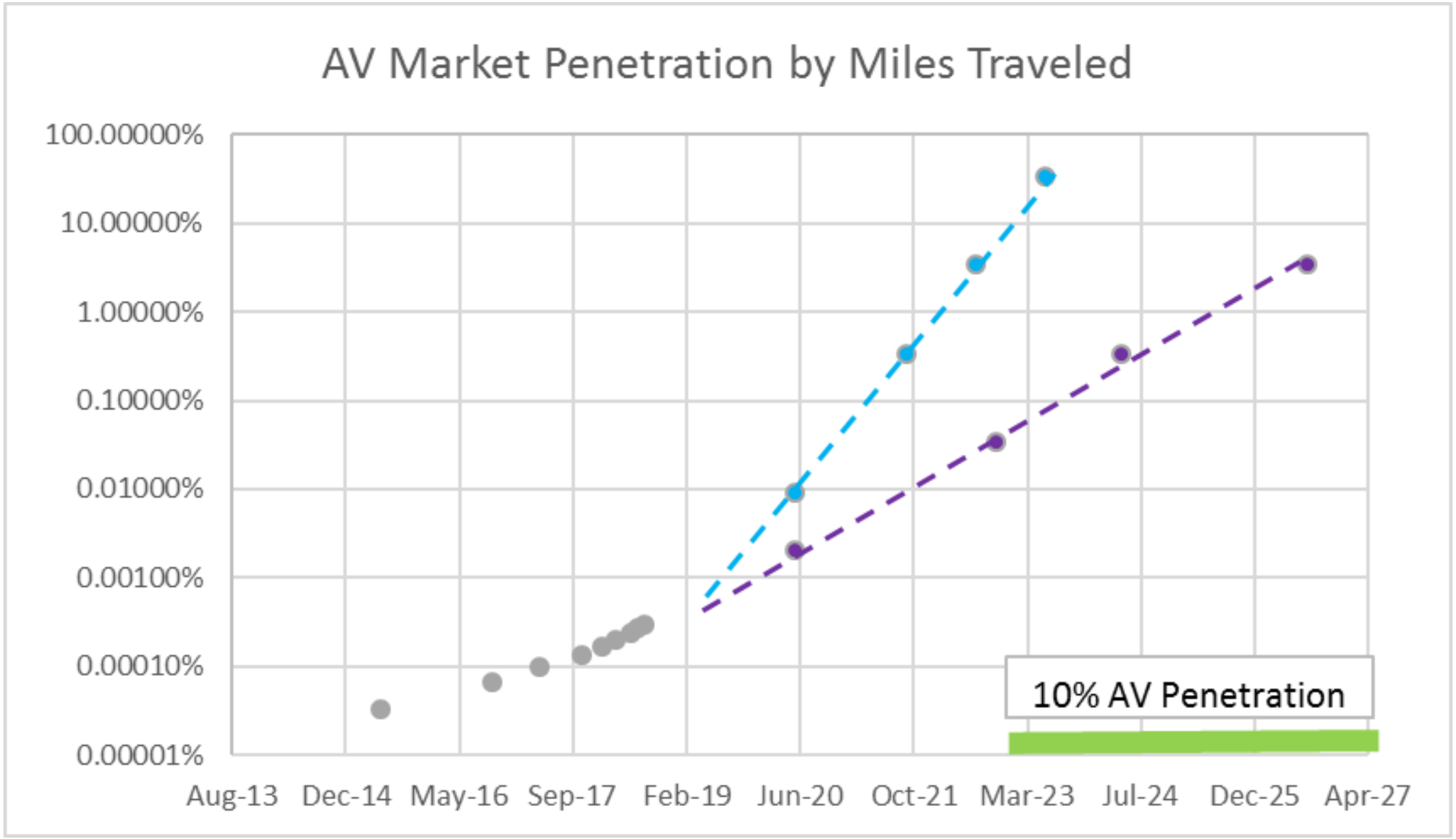
DISRUPTIVE FORCES AT WORK

We’re on the cusp of a transformation in transportation, driven by advances in vehicle **A**utomation, **C**onnectivity, **E**lectrification and **S**haring. The changes will be disruptive.

HNTB

Waymo Miles Traveled Exponential Trend

Projected AV Market Penetration Based on VMT Trends



AUTOMATED VEHICLE BUSINESS CASES

- Urban applications – ride-hailing services and fleets of shared use vehicles
- First and last mile mobility opportunities
- Residential and campus circulation
- Highway maintenance operations
- Truck automation and platooning
- Dedicated automated guideways

HNTB

CAV Impacts

- Setting Safety and Interoperability Standards
- High Accuracy position location for Smart Cities
  - Street Lights, Traffic Lights and other common support structures for communications
  - Communication Standards (DSRC, 5G, UWB)
  - Producing high accuracy GIS Roadway and Intersection Maps
- Dedicated AV lane shared use requirements
- Repurposing Rail and APM for AVs

DISRUPTION CREATES OPPORTUNITY

HNTB

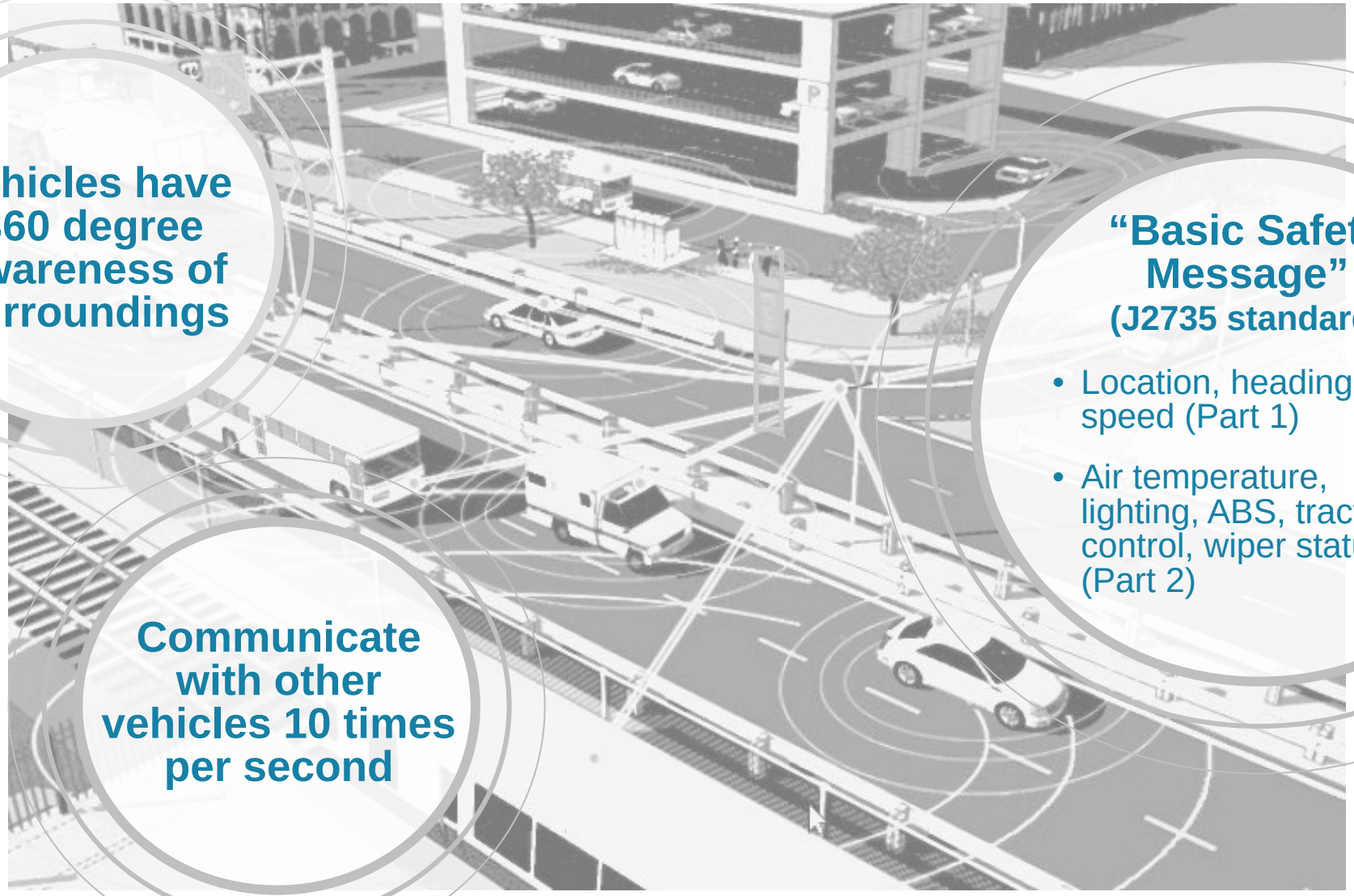
CONNECTED VEHICLES

Source: Florida DOT

- Notice of Proposed Rulemaking on December 12, 2016
- Final rule on V2V pending
  - Current federal position
  - Spectrum challenge
  - Privacy and security challenges
  - Progress on 5G M2M and C-V2X solutions
- Auto industry response
- Government stimulus for V2I
  - Connected Vehicle Pilot Program
  - Smart City Challenge
  - SPaT Challenge

HNTB

CONNECTED VEHICLES



Vehicles have 360 degree awareness of surroundings

Communicate with other vehicles 10 times per second

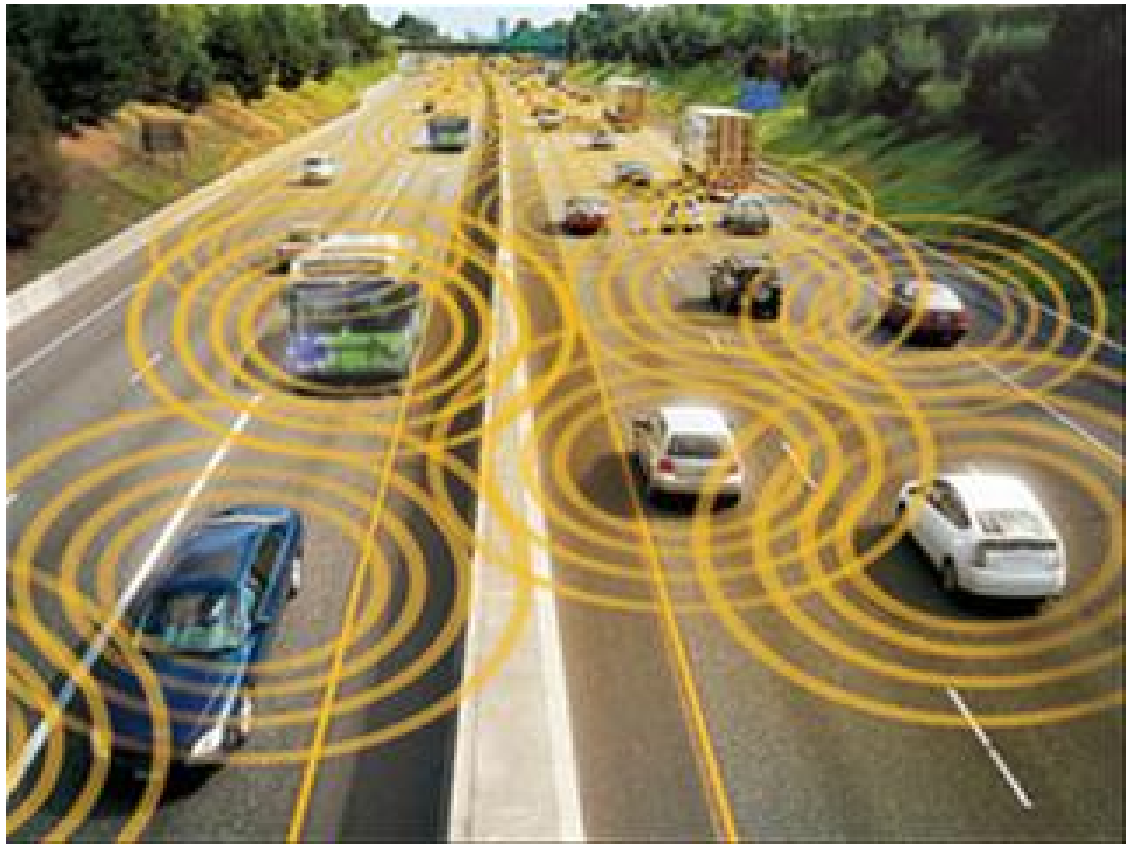
“Basic Safety Message”
(J2735 standard)

- Location, heading, speed (Part 1)
- Air temperature, lighting, ABS, traction control, wiper status (Part 2)

HNTB

OPPORTUNITIES FOR CONNECTIVITY

- Signal Phase and Timing
  - Eco-Driving
  - Transit Signal Priority
- Safety Applications
  - Intersection Collision Avoidance
  - Queue Warnings
  - Pavement Condition Warnings
  - Work Zone Applications
  - Incident Warnings
- Congestion Reduction
  - Traveler Information
  - Routing and Navigation
  - Location Services



DSRC vs 5G – Not mutually exclusive

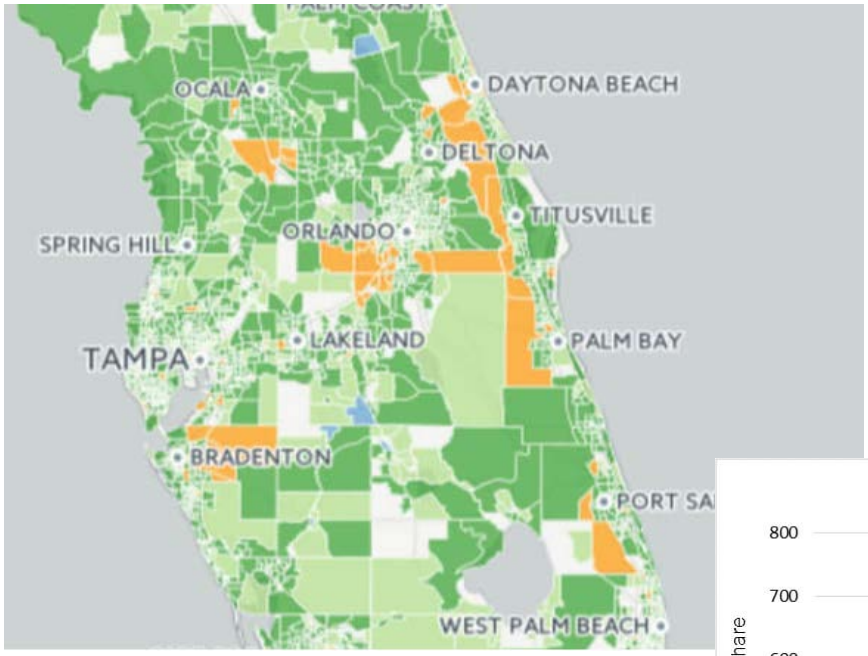
- Both are needed
- DSRC Radios already have 4G/LTE capability.
- Firmware upgrades can be made when 5G is available
- Always want to keep signals connections firewalled from cellular for security
- DSRC has longer range (300-1000m) vs 5G (100-150m)

Sprint 5G Curiosity IoT Including Ultrawideband

Connectivity Approaches

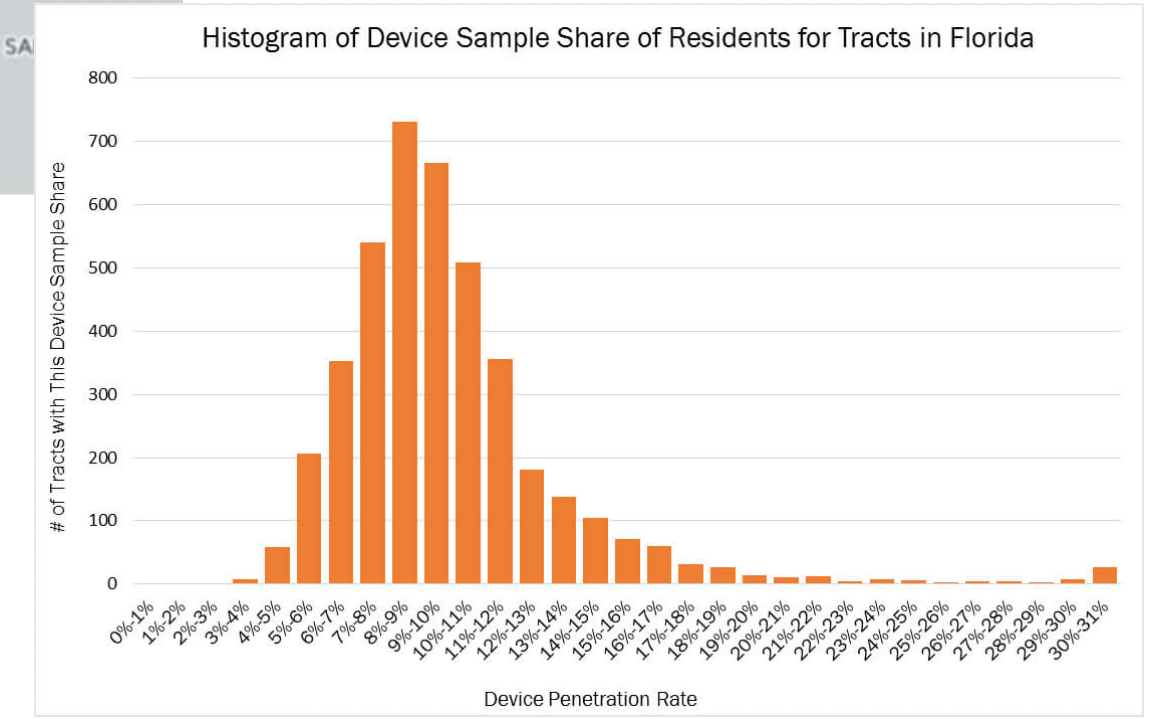
- Big Data
- ATMS Cloud Connectivity
- Direct Signal Cloud Connectivity
- DSRC & Cloud

Big Data Device Penetration



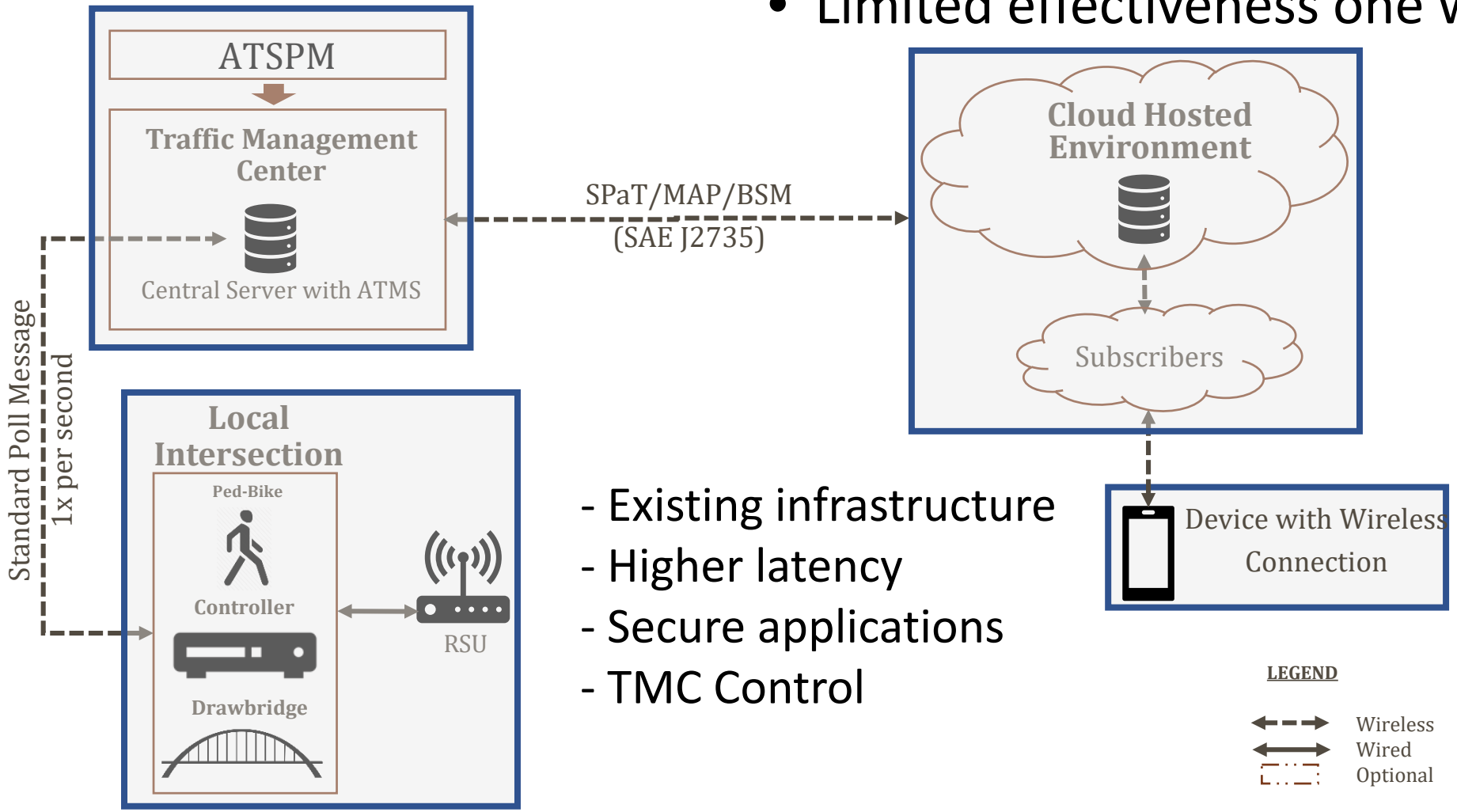
Source: StreetLights

- Uses existing data application to provide large amounts of probe vehicle data
- Extensive traffic management analysis opportunities



ATMS CENTRALIZED TRAFFIC SIGNAL CLOUD

- Uses existing ATMS to provide data to the cloud
- Limited effectiveness one way data

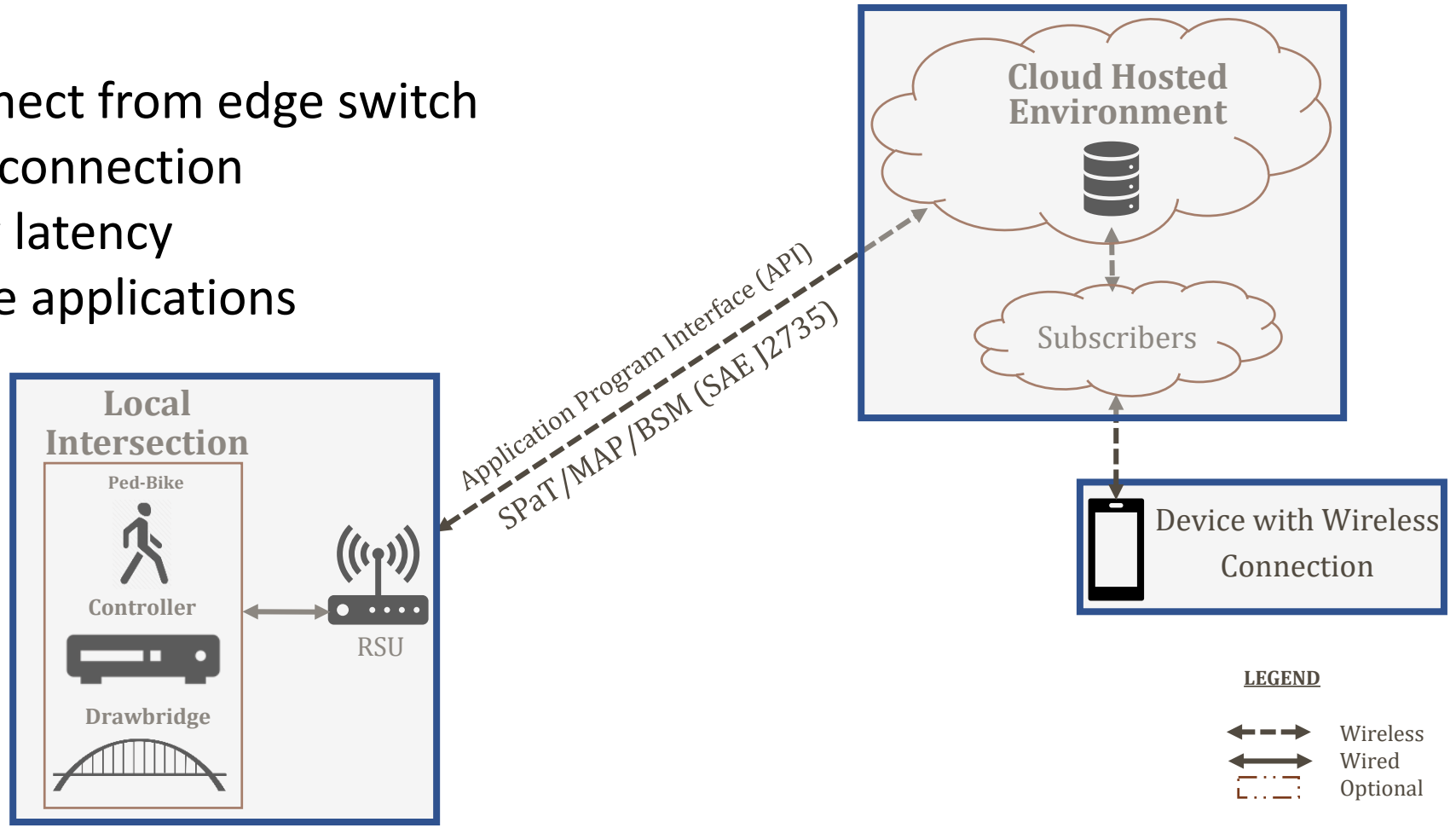


- Existing infrastructure
- Higher latency
- Secure applications
- TMC Control

DIRECT TRAFFIC SIGNAL CLOUD CONNECTION

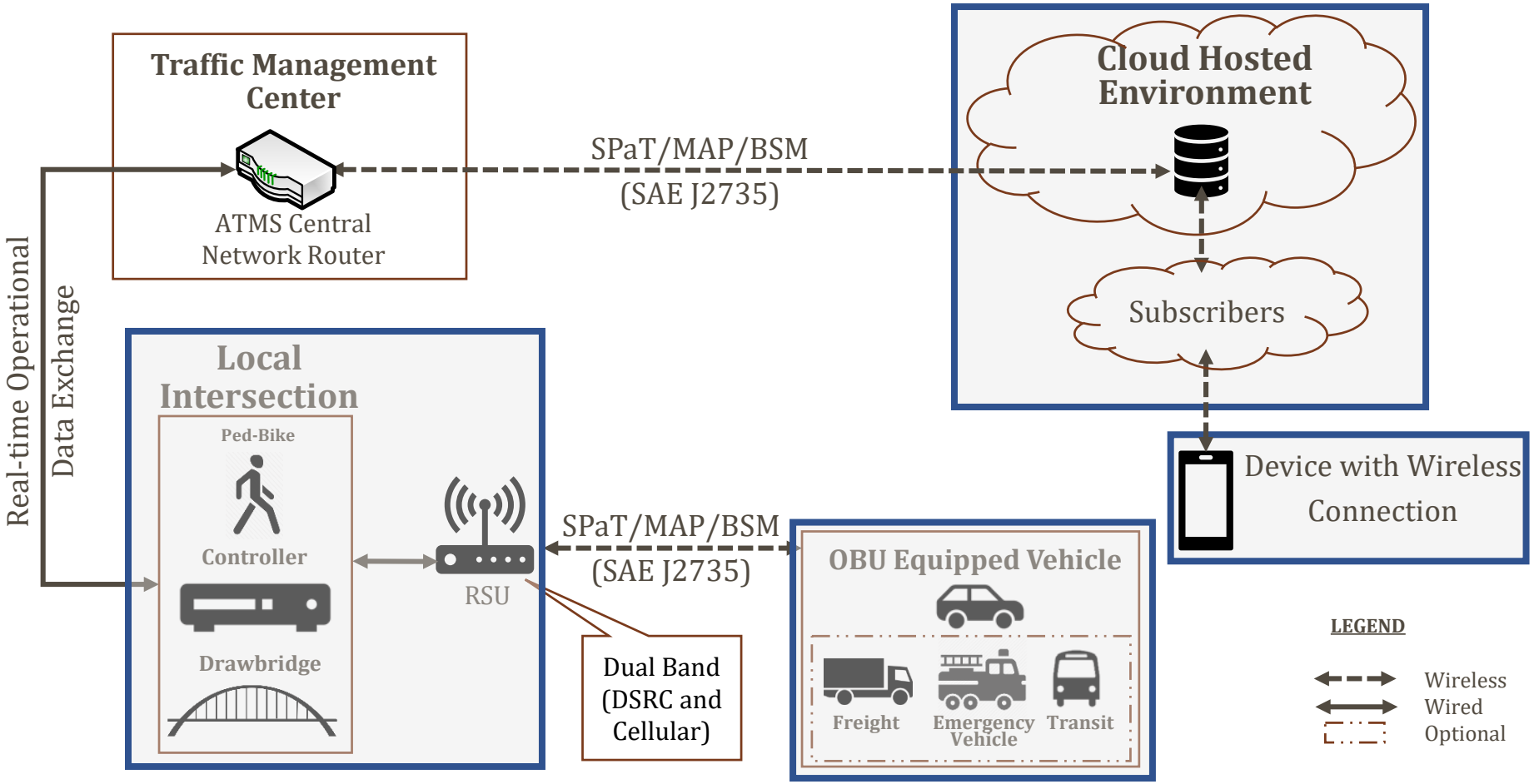
- Streams traffic signal data to the cloud for use by the public and other traffic signals
- Low cost quick deployments with good analytic tools

- Direct connect from edge switch or cellular connection
- Mid to low latency
- Non-secure applications



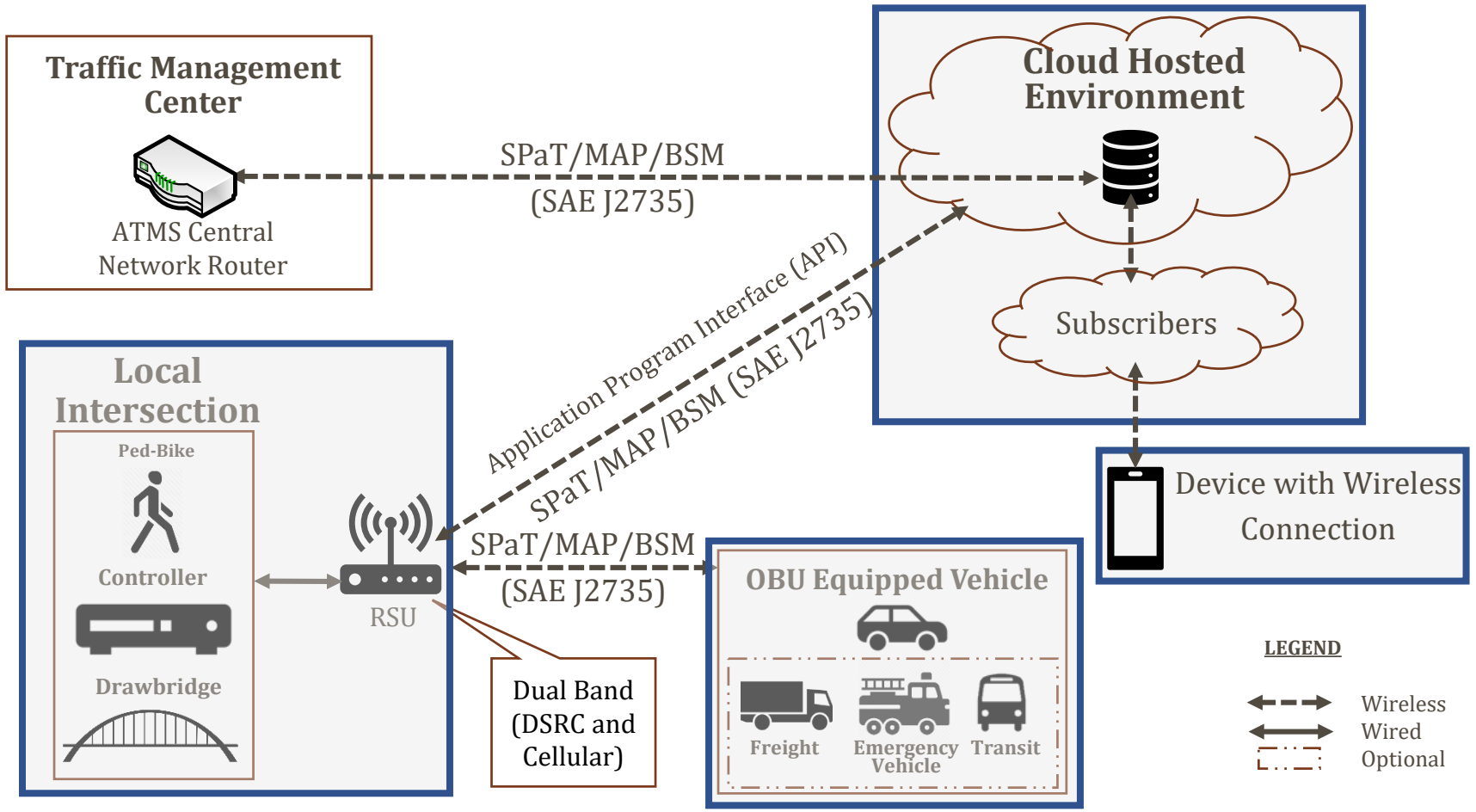
DSRC & CLOUD VIA TMC TRAFFIC SIGNAL COMMUNICATION

- Modified infrastructure
- Very low latency
- Secure applications
- TMC Control



HYBRID DSRC & CLOUD TRAFFIC SIGNAL COMMUNICATION

- Provides direct CV applications to fleet vehicles and offers public access over cellular
- Provides advantages for fleet and larger data sources



SPaT Challenge

SPaT deployment underway

SPaT deployment operational

26

States Committed

Number of states committed to respond to SPaT Challenge.

216

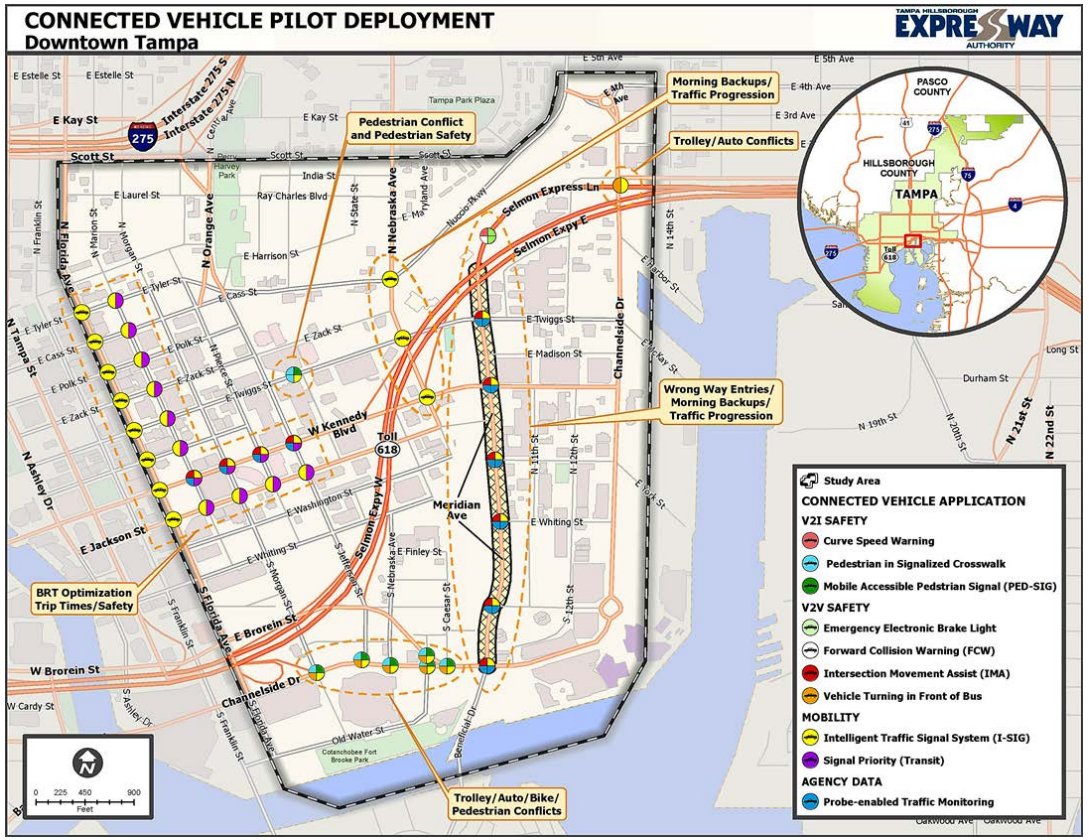
Signals Operating

Current number of operating signals.

2,121

Signals Planned

Number of signals planned for 2018, 2019, and 2020+



Tampa Connected Vehicle Pilot

- Multi-modal suite of applications collocated at intersections
- Bus, streetcar, vehicle, pedestrians and bikes
- Expressway and arterial streets

HNTB

NYC CV Pilot

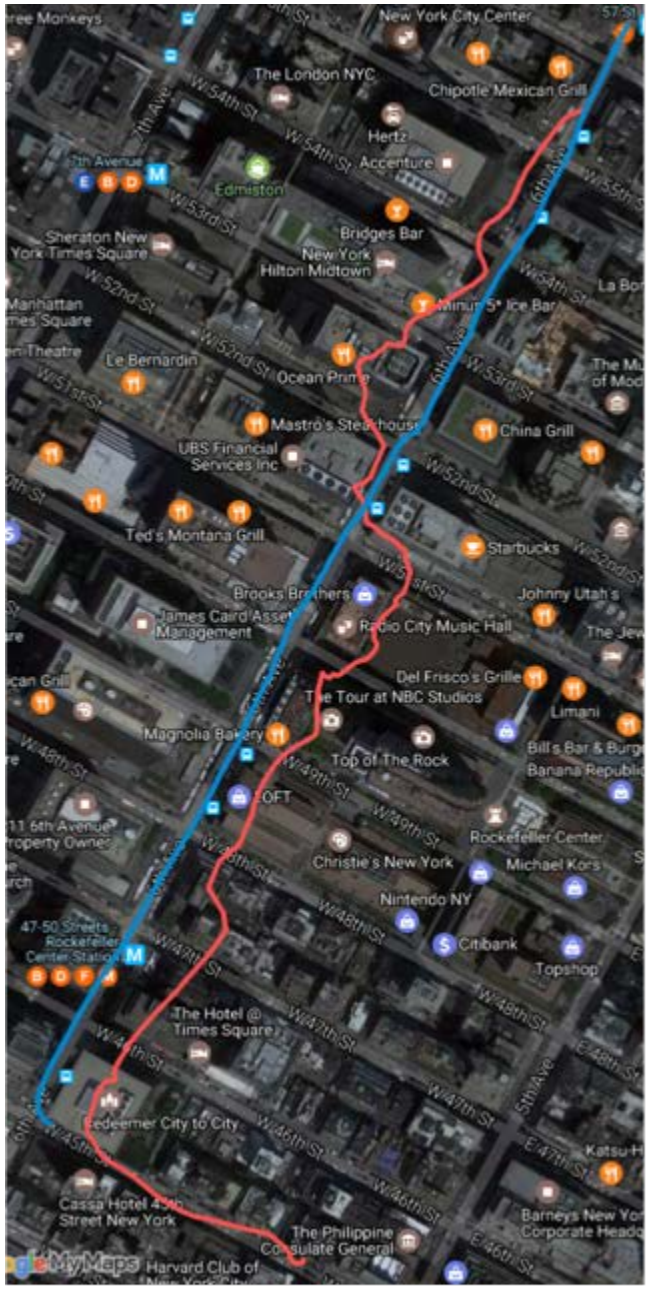
Three corridors

- Manhattan Grid
- Manhattan FDR Dr.
- Brooklyn Flatbush Ave.

HNTB

V2X Accuracy Not Sufficient

Enhanced GPS vs UWB on 6th Ave



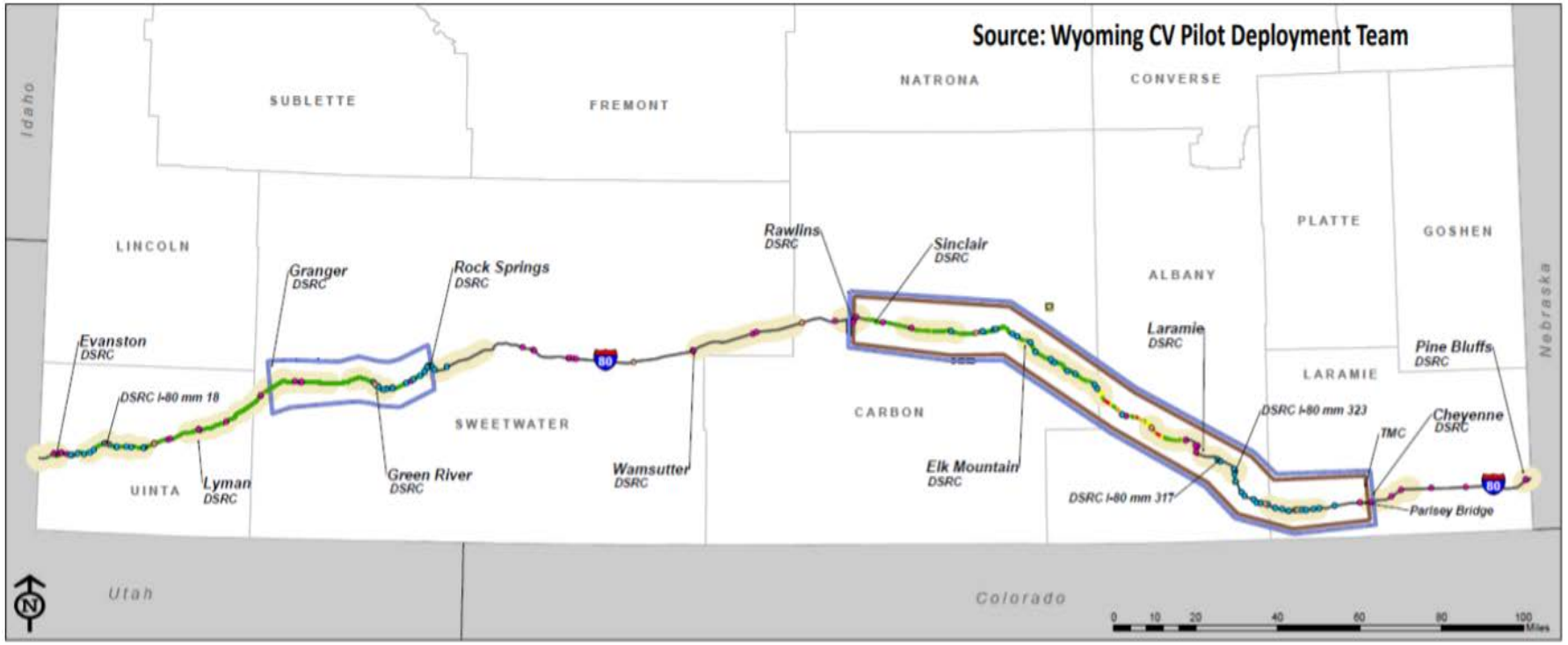
Enhanced GPS

Ultra-wideband

HNTB

Wyoming CV Pilot

Wyoming I-80 Corridor - Connected Vehicle Map



TRANSFORMATION REQUIRES PLANNING

HNTB

IMPLICATIONS FOR GOVERNMENT AGENCIES

- Near Term Implications
  - TSM&O is still a “Go”
    - Leverage current tools
    - Leverage partnerships
      - WAZE, INRIX
    - All modes, all roads
    - Regional managed lanes
    - ICM and ATM
    - Performance-driven processes
  - Plan for impacts of ACES on operations
- Prepare govt resources
  - Expand communications infrastructure and establish partnerships for 5G capabilities
  - Strengthen data management capabilities (collect, transmit, store, aggregate, analyze, disseminate, report)
  - Strengthen technical capabilities of staff

HNTB

FCC 5G Fast Plan (Effective March 27, 2019)

- Allows use of public structures 50ft or less
- Allows use of any public right of way
- All permits must be approved by shot clock
  - zoning permit,
  - building permit,
  - electrical permit,
  - road closure permit,
  - architectural or
  - engineering permit
- Shot Clock - New regulations that require state and local facilities to approve use
  - Existing utility poles within 60 days
  - New utility poles in 90 days
- Same time period applies if they submit a batch of sites at one time
- Define ROW restrictions and fair and reasonable use fees now!!
- If no published rates then
  - $100 per existing site
  - $1,000 for new site and
  - $270 per year

IMPLICATIONS FOR THE FUTURE

- Medium Term Implications
  - Identify pilot projects
  - Seek funding and investment
  - Leverage partnerships to support new mobility solutions
  - Deploy pilot projects
    - Leverage lessons from other programs
    - Engage partners
    - Create pilot concept
    - Implement
    - Evaluate

HNTB

IMPLICATIONS FOR THE FUTURE

- Long Term Implications
  - Implement emerging mobility solutions
    - Fewer crashes
    - Platooning operations and higher system capacity
    - Lower level of personal vehicle ownership
    - Reduced parking needs
- Automation of government functions
  - Video analytics
  - Artificial intelligence
  - Predictive analytics
- Greater privatization of government functions
  - Traveler information services
  - Data management

PLANNING TRANSFORMS OUR FUTURE

HNTB

INFRASTRUCTURE IMPACTS

- Traffic signalization impacts
- Signage
- Seamless travel between roads and modes
- If cars don’t crash

Source: University of Texas

HNTB

WHAT LIES AHEAD?

- Connectivity and automation solve a lot of problems
- Greater accessibility to opportunities
- More mobility choices
- Harmonized traffic flow
- Greater traffic safety