U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology

Piloting Connected Vehicle Technology

George Washington University

Wednesday, July 27, 2016

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ITS Joint Program Office, OST-R
U.S. Department of Transportation

Presentation Overview

- Our Transportation Challenges
- Intelligent Solutions
- The ITS Strategic Plan
  - Connected Vehicles
  - Safety Pilot
  - Connected Vehicle Pilots
  - Lessons Learned
- Getting Smarter

Today's Transportation Challenges

Safety

- 35,200 highway deaths in 2015
- 6.1 million crashes in 2014
- Leading cause of death for ages 11, 16-24

Mobility

- 6.9 billion hours of travel delay
- $160 billion cost of urban congestion

Environment

- 3.1 billion gallons of wasted fuel
- 56 billion lbs of additional CO_2

Data Sources:

Early Estimate of Motor Vehicle Traffic Fatalities in 2015, National Highway Traffic Safety Administration (July 2016); Quick Facts: 2014 Data, National Highway Traffic Safety Administration (January 2016); 2015 Annual Urban Mobility Report, Texas Transportation Institute (Aug 2015); Centers for Disease Control

USDOT Modal Collaboration and Partnership

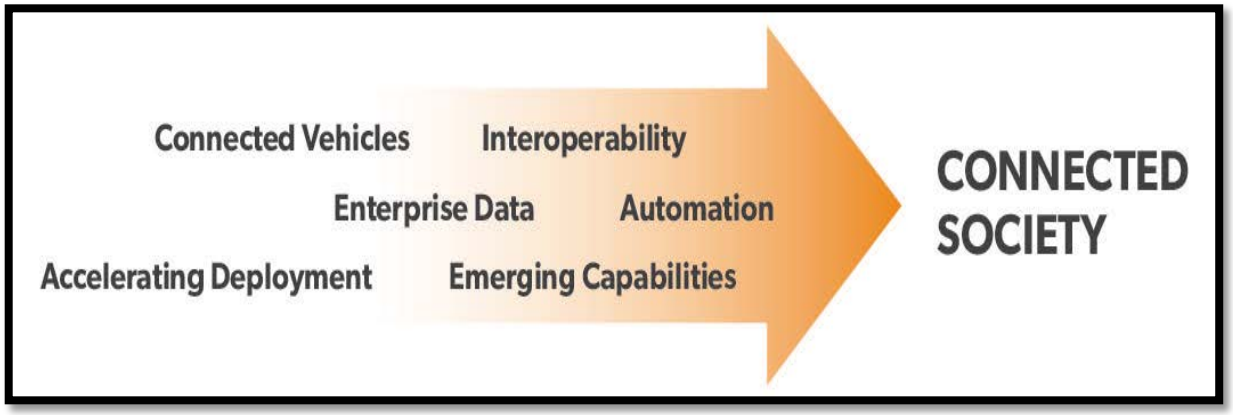
ITS Strategic Plan 2015-2019

http://its.dot.gov/strategicplan/index.html

Vision and Mission

VISION

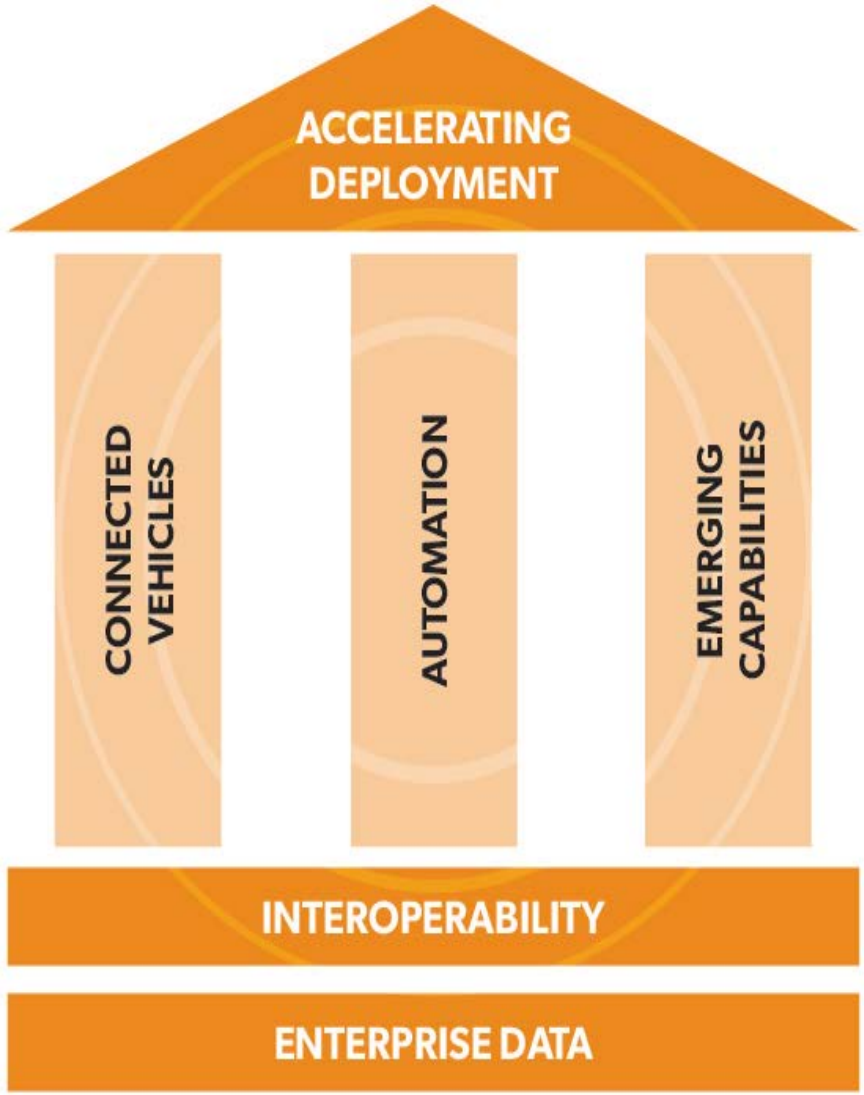
Transform the Way Society Moves



Conduct research, development, and education activities to facilitate the adoption of information and communication technology to enable society to move more safely and efficiently.

Strategic Plan
Program Categories

- **Connected Vehicles:** Focuses on adoption and deployment
- **Automation:** Focuses on automated road-vehicle systems that transfer some vehicle control from the driver to the vehicle
- **Emerging Capabilities:** Focuses on future generations of transportation systems
- **Enterprise Data:** Focuses on operational data capture from sensors, mobile devices, and vehicles, and applying data across all modes of transport
- **Interoperability:** Emphasizes effective connectivity among devices and systems
- **Accelerating Deployment:** Advances ITS work from adoption to wider scale deployment in coordination with multiple disciplines and stakeholders



Connected Vehicles


Imagine a Transportation System in which
VEHICLES CAN SENSE & COMMUNICATE
Things That You Can't.

How Connected Vehicles Work

1. A wireless device in a car sends basic safety messages 10 times per second
2. Other nearby cars and roadside equipment receive the messages
3. Drivers get a warning of a potential crash

*Connected vehicles have the potential to reduce non-impaired crash scenarios by **80%****

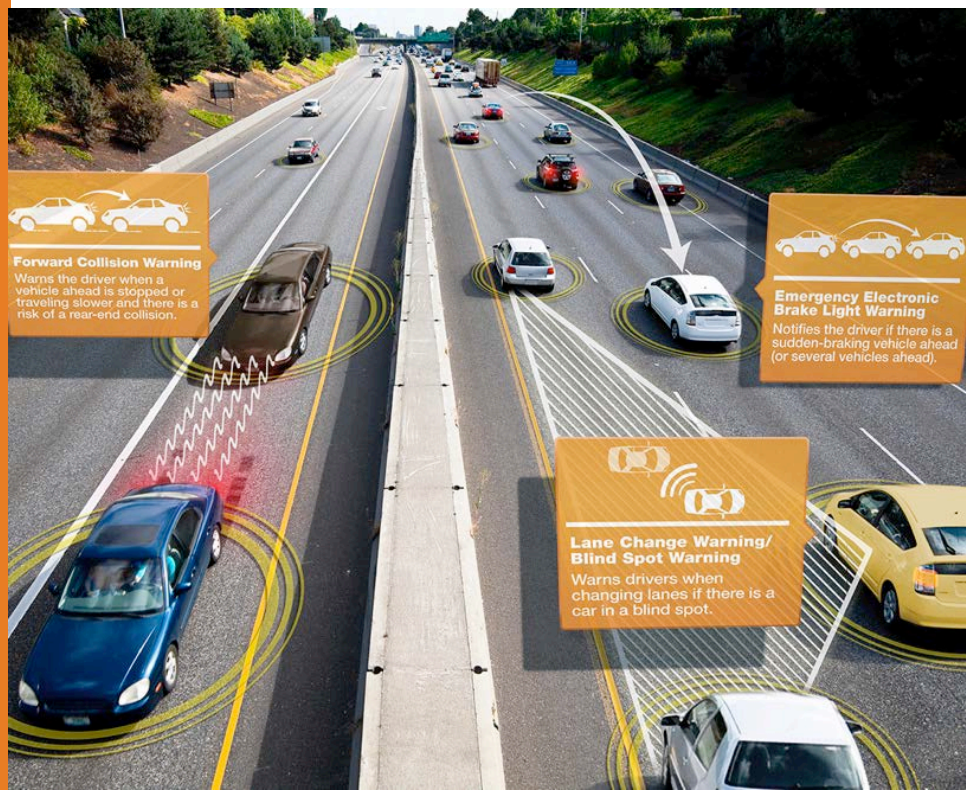
*Source: NHTSA

Connected Vehicles

What are they?

Connected Vehicles
What can they do?

- Save lives by significantly reducing traffic accidents
- Make travel easier, more efficient, and more enjoyable
- Help curb pollution



Connected Vehicle Safety Pilot

A major road test and real-world implementation involving:

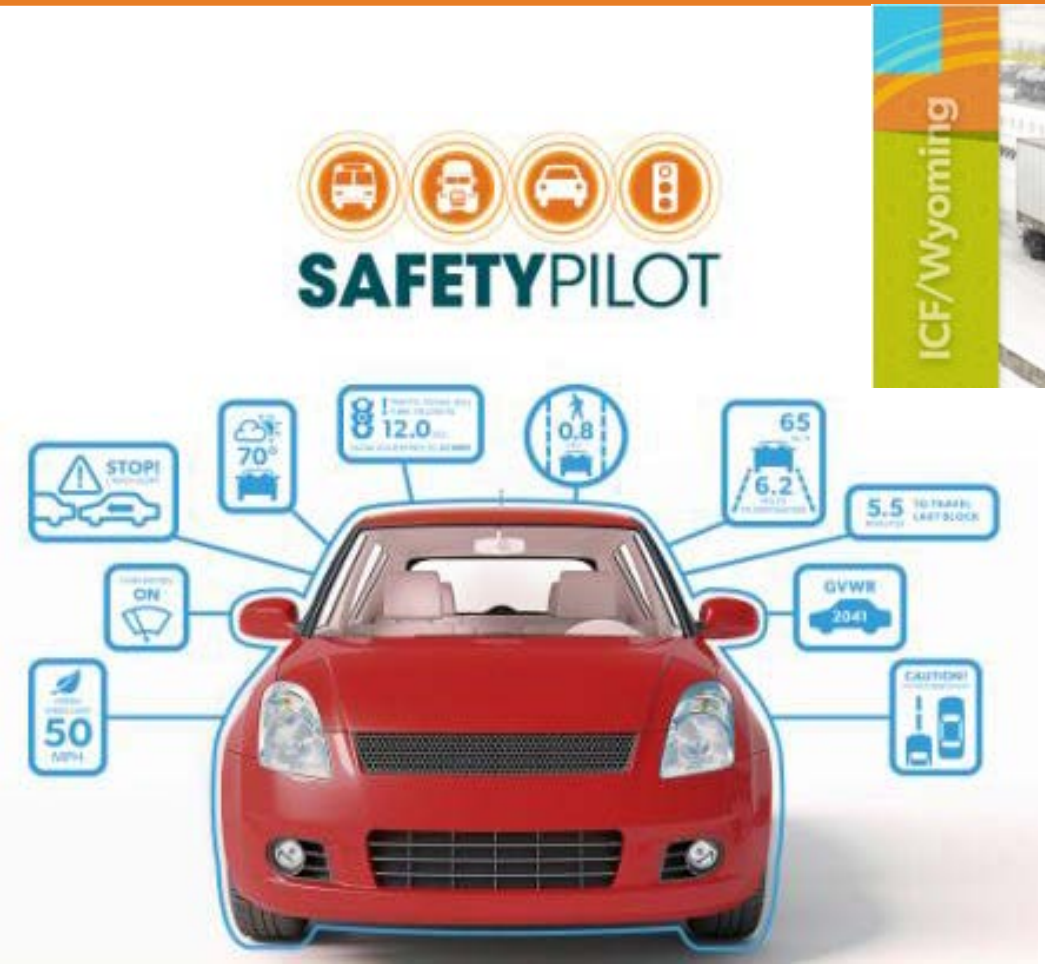
- 73 miles of instrumented roadway with 27 roadside units in Ann Arbor, MI
- Over 2,800 vehicles equipped with a variety of device types
- Various V2V and V2I applications
- Testing of prototype security mechanisms and device certification processes
- 1 year of data collection to support 2013 NHTSA decision

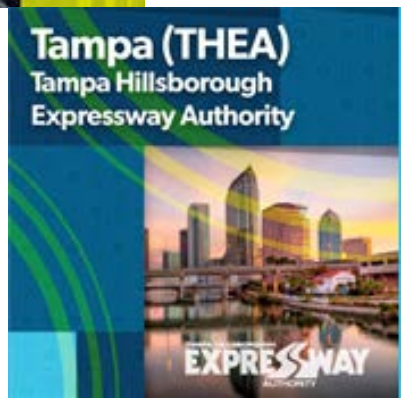
Successfully Piloting Connected Vehicles

- Data collection exceeded expectations
- Regular drivers experienced proven technology
- Connectivity was achieved across various types and modes
- Reduced risks

Photo Source: US DOT

Safety Pilot Lessons Learned





Participant Recruitment

- **Light Vehicle Drivers**
  - Understand what motivational factors are important to the community and utilize them in the recruitment process.
  - Recruit participants iteratively to align with the planned device deployment schedule.
- **Transit Vehicle Drivers**
  - Understand the number of drivers that a transit operator uses in its operations and plan for that when selecting a transit agency for deployment of applications for testing.
  - Consider the system that the transit operator uses for matching drivers to routes when choosing to deploy transit applications for testing.

Device Installation

- **In-Vehicle Device**
  - Develop an installation plan (including device mounting) for each vehicle type and evaluate designs for any potential common elements.
  - Include “end of the line” performance testing as part of the final close-out installation tests to determine if the installation is operating as intended.
- **Infrastructure-Level Device**
  - Establish strong partnerships with state and local agencies responsible for the operations and maintenance of roadways and related equipment.
  - Consider deploying RSUs at sites that already have existing ITS installations to minimize costs. Having a robust fiber optic network is key to managing the volume of data collected by RSUs.

Data Collection

- Assess the approach to data collection in the test in terms of volume and types of data that will be collected. Then, develop a plan for collecting and storing the data, including the sizing of servers and any necessary data management processes.
- Allow the opportunity for the evaluator to provide a more detailed data specification document to the data collection entities as a part of the process.
- Developing a standard database structure is more cost effective to manage and analyze the data separately.

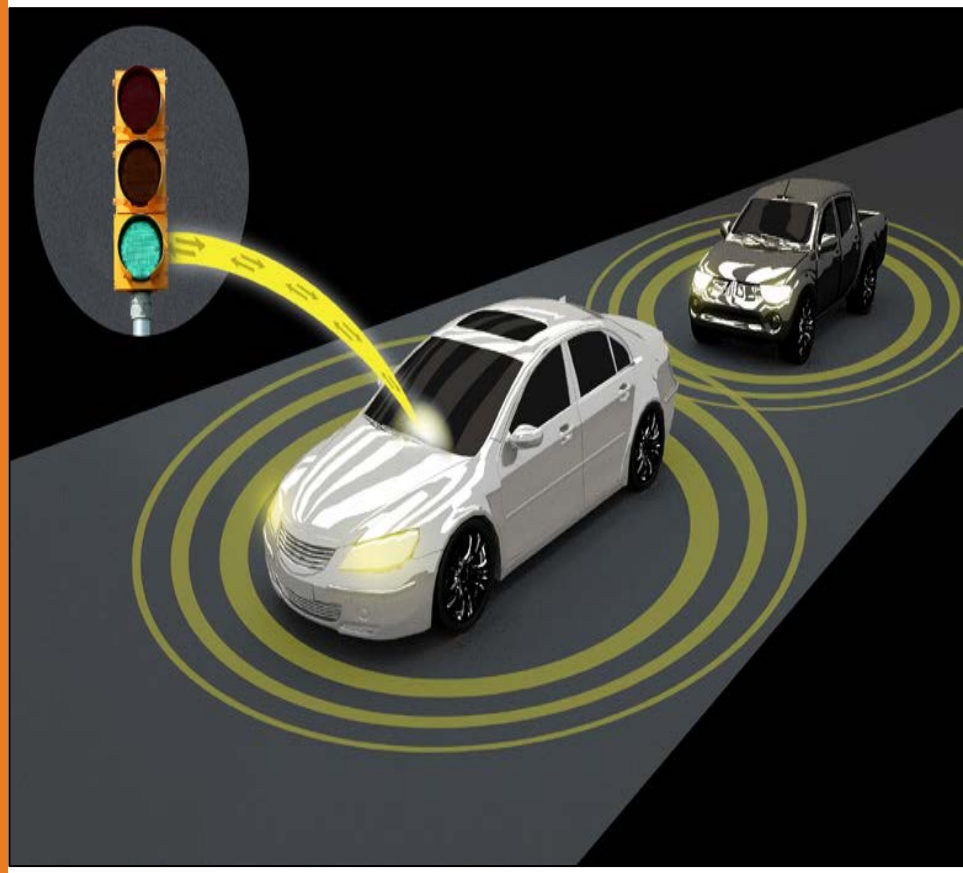
Outreach and Showcase

- **Outreach**
  - Determine in advance the role the USDOT and contractors will have when working with the media and incorporate language into the contracting agreements.
  - Develop a key message that is agreed upon by all parties at onset of project. Establish clear guidelines on what information can be shared.
- **Showcase**
  - Ensure capabilities are in place early in the deployment for stakeholders to be able to experience the environment via demonstrations and showcases of the technology.
  - Be prepared to maintain momentum throughout the project by establishing a plan to use a variety of tools to support the interests and needs of various stakeholders and audiences. Start with a prominent launch event, then follow-up with other high-visibility elements.

Paving the Way for the Connected Vehicle Ecosystem

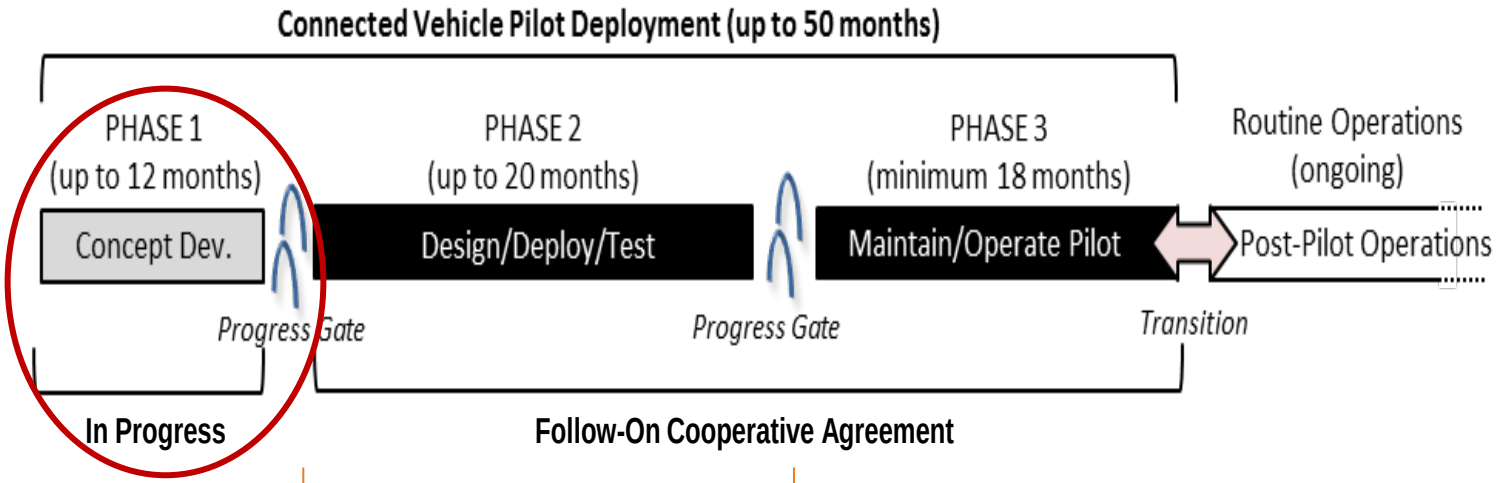
- Research & Demonstration
- NHTSA V2V Ruling
- FHWA V2I Guidance
- Facilitating Deployment

U.S. Department of Transportation
Federal Highway Administration



NHTSA
www.nhtsa.gov

Connected Vehicle Pilot Deployment Program



Sept. 2016 – Sept 2017

Sept. 2017 – May 2019

May 2019 – Nov. 2020

PILOT SITES

New York City

ICF/Wyoming

Tampa (THEA)

Connected Vehicle Pilot Deployment Sites

ICF/Wyoming

- Reduce the number and severity of adverse weather-related incidents in the I-80 corridor to improve safety and reduce incident-related delays.
- Focused on the needs of commercial vehicle operators in the State of Wyoming

New York City

- Improve safety and mobility of travelers in New York City through connected vehicle technologies.
- Vehicle-to-vehicle (V2V) technology installed in up to 10,000 vehicles in Midtown Manhattan, and vehicle-to-infrastructure (V2I) technology installed along high-accident rate arterials in Manhattan and Central Brooklyn.

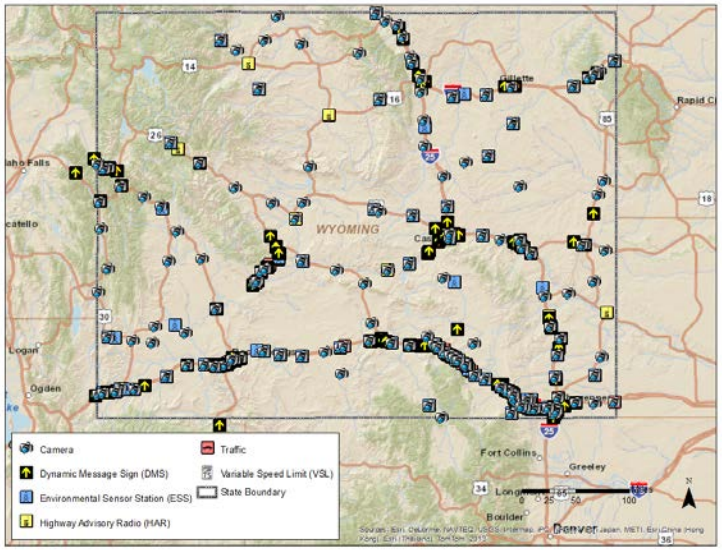
Tampa (THEA)

- Alleviate congestion and improve safety during morning commuting hours.
- Deploy a variety of connected vehicle technologies on and in the vicinity of reversible express lanes and three major arterials in downtown Tampa to solve the transportation challenges.

ICF/WYDOT Pilot Deployment Overview

Approach:

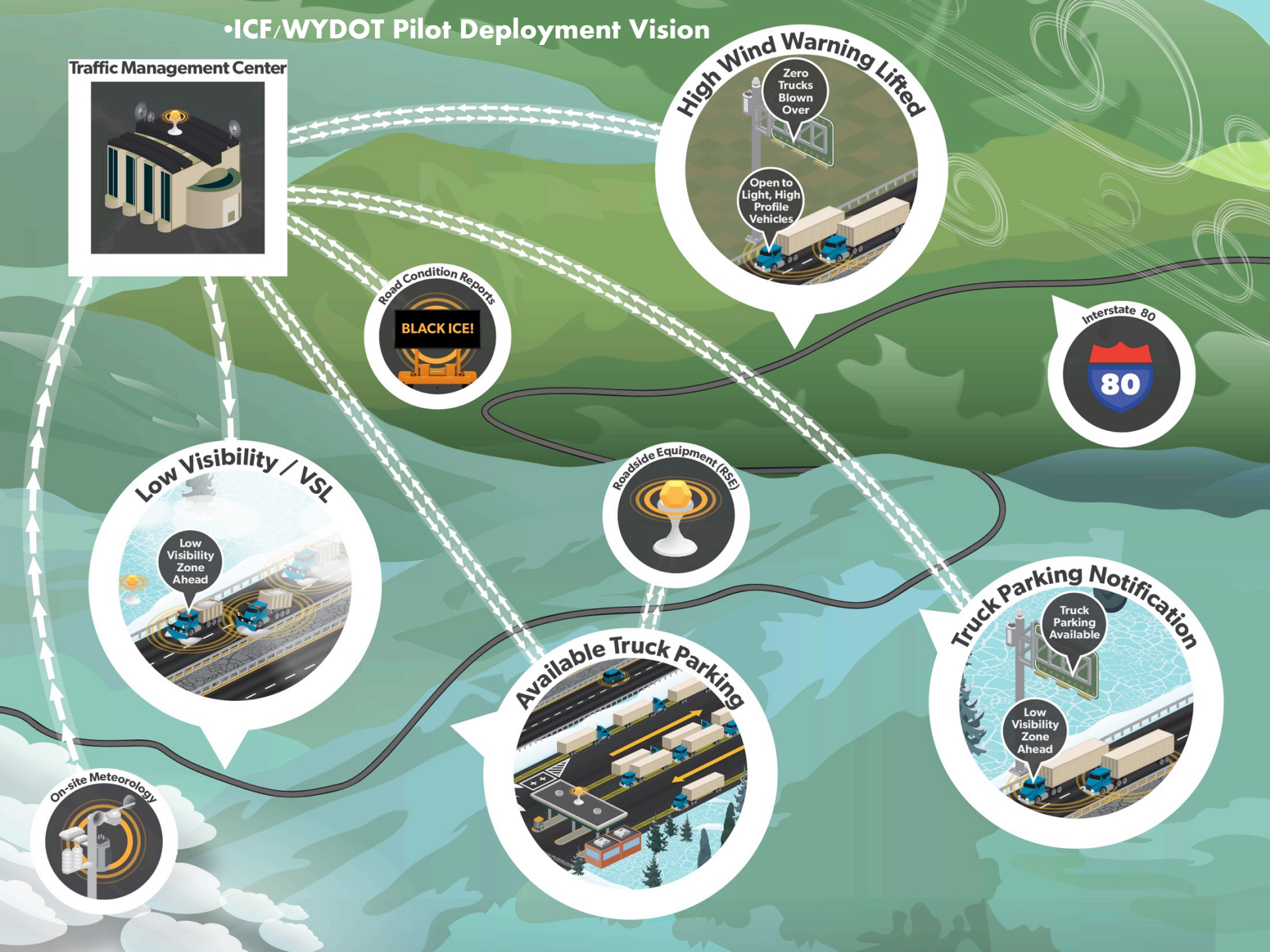
- Equip fleet vehicles (combination of snow plows, maintenance fleet vehicles, emergency vehicles, and private trucks) that frequently travel the I-80 corridor to transmit basic safety messages (BSMs), collect vehicle and road condition data and provide it remotely to the WYDOT TMCs
- Deploy DSRC roadside equipment (RSE) to supplement existing assets and initiatives
- Road weather data shared with freight carriers who will transmit to their trucks using exiting in-vehicle systems



•Source: Wyoming DOT

Deployment Team:

- Prime Consultant: ICF International; Partner State: Wyoming DOT
- Sub Consultants: Trihydro Corporation, National Center for Atmospheric Research, University of Wyoming, Catt Laboratory and McFarland Management


•ICF/WYDOT Pilot Deployment Vision
Traffic Management Center
High Wind Warning Lifted
Zero Trucks Blown Over
Open to Light, High Profile Vehicles
Road Condition Reports
BLACK ICE!
Interstate 80
80
Low Visibility / VSL
Low Visibility Zone Ahead
Roadside Equipment (RSE)
Truck Parking Notification
Truck Parking Available
Low Visibility Zone Ahead
Available Truck Parking
On-site Meteorology

NYCDOT Pilot Deployment Overview

Approach:

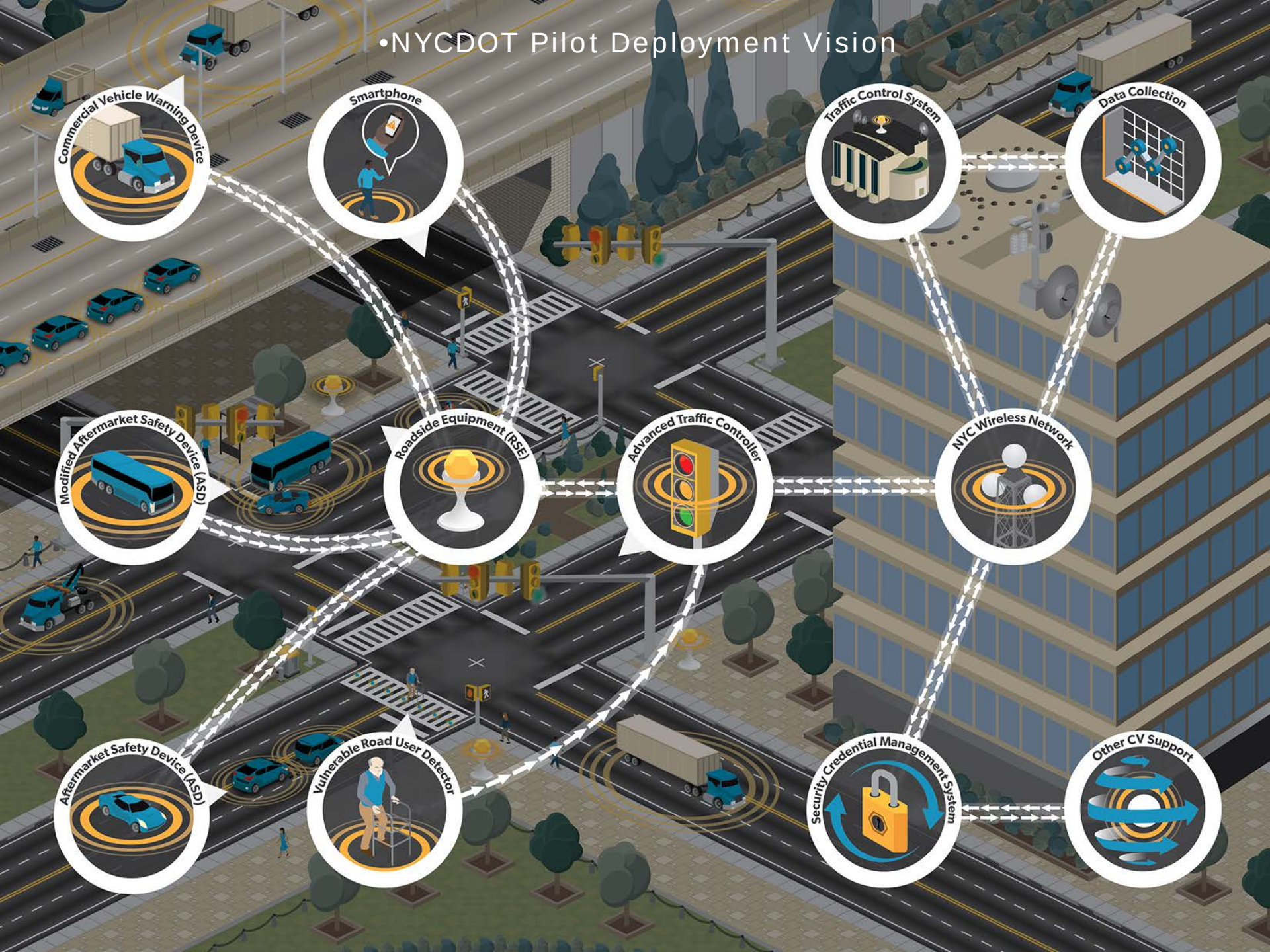
- Equip up to 10,000 vehicles (taxis, buses, commercial fleet delivery trucks, and City-owned vehicles) that frequently travel in Midtown Manhattan and Central Brooklyn to transmit and receive connected vehicle data
- Install V2I technology at high-accident rate arterials:
  - Upgrade 239 traffic signals along 1st, 2nd, 5th, and 6th Avenues in Manhattan and Flatbush Avenue in Central Brooklyn (emergency evacuation route)
  - Deploy RSE along FDR Drive

•*Source: NYC DOT*

Deployment Team:

- Prime Consultant: NYCDOT
- Sub Consultants: JHK Engineering, Battelle, Cambridge Systematics, KLD Engineering, Security Innovation and Region 2 University Transportation Research Center

•NYCDOT Pilot Deployment Vision



TAMPA (THEA) Pilot Deployment Overview

Approach:

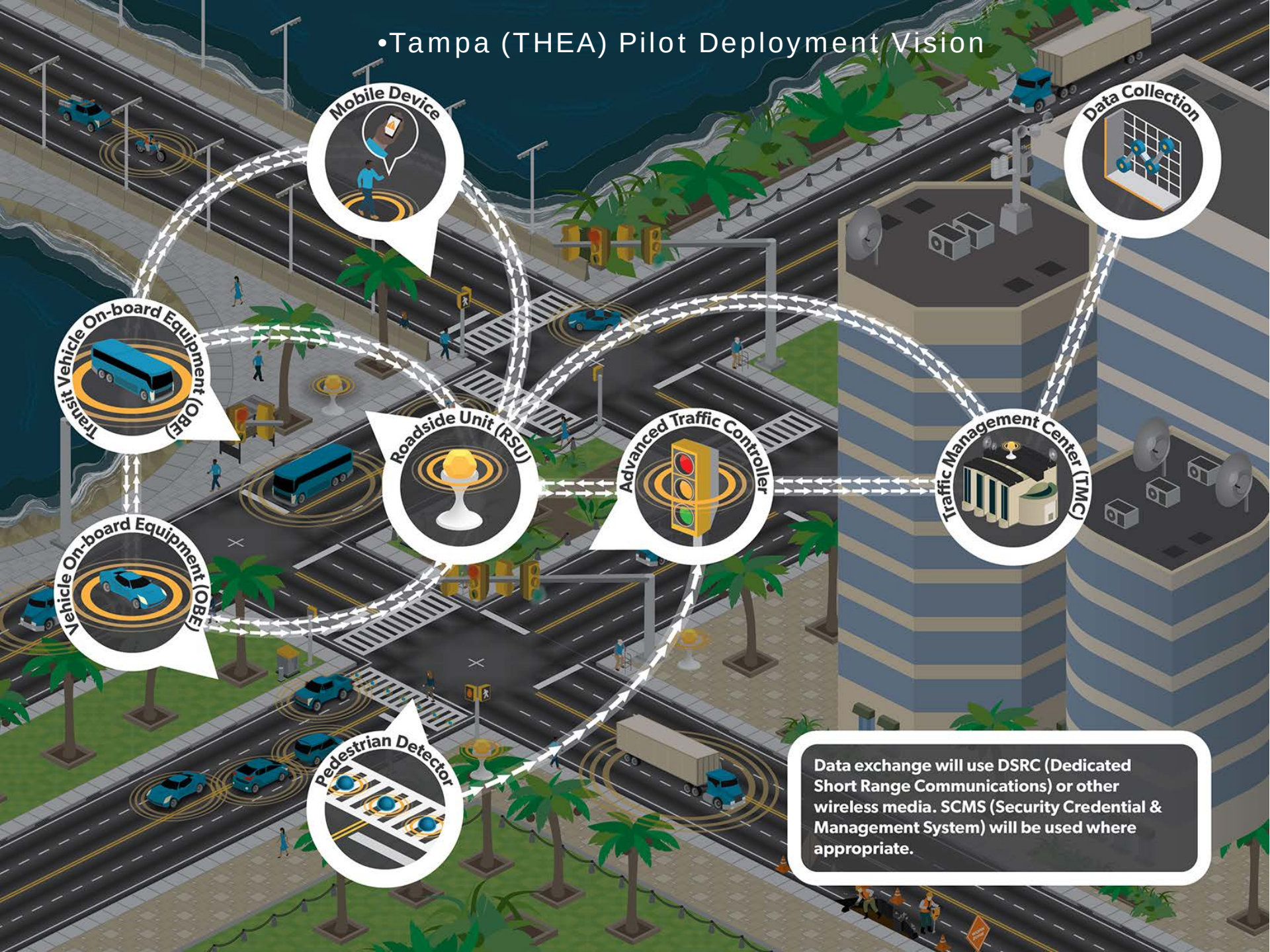
- Deploy a variety of connected vehicle technologies on and in the vicinity of reversible express lanes and three major arterials in downtown Tampa to solve the following transportation challenges:
- Morning peak hour queues, wrong-way entries, pedestrian safety, bus rapid transit (BRT) signal priority optimization, trip time and safety, streetcar trolley conflicts, and enhanced signal coordination and traffic progression.

•Source: THEA

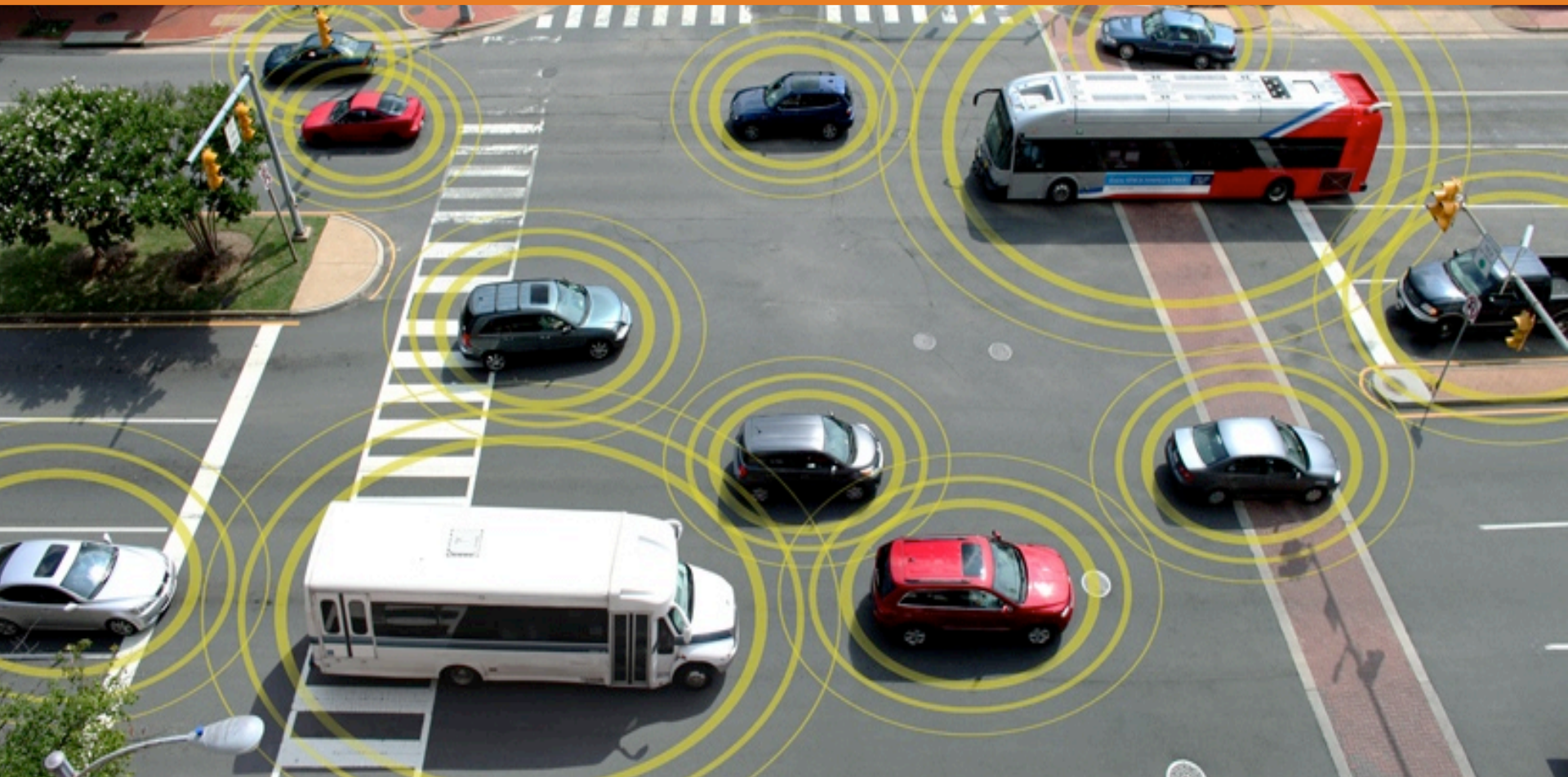
Deployment Team:

- Prime Consultant: Tampa Hillsborough Expressway Authority (THEA)
- Sub Consultants: HNTB Corporation, Siemens Industry, Inc., Booz Allen Hamilton, Center for Urban Transportation Research at University of South Florida, and Global-5 Communications

•Tampa (THEA) Pilot Deployment Vision



Lessons Learned during *Connected Vehicle Pilots* Concept Development Phase



Deployment Complexity

- **Sites are eager to consume USDOT technical assistance**
  - Deployments are complex, requiring a lot of diverse elements to come together in an integrated system (technical, security, privacy, performance measurement, institutional, financial, etc.)
- **Concept development takes some time to conduct – prior to procuring, designing, installing equipment**
  - Sites are willing to “do the hard work now” rather than later, which would be more challenging and expensive (e.g., participating in detailed SyRS walkthroughs, thinking through initial application development cost estimates)
  - Early discussions and information sharing regarding the Phase 2 and 3 NOFO allows agencies to investigate options for coming up with the required cost share

Collaboration

- **Stakeholder interaction and partnership are valuable**
  - Stakeholder interaction early and often leads to better concepts and more buy-in
  - Select complementary partners as subs to fill out the experience required for many different activities
- **Site-to-site coordination can be useful (since not competitive)**
  - Cooperation on security, vendor interaction, stakeholder coordination (UPS in WY and NYC) is useful
  - Participate in virtual roundtables
- **Site deliverables create examples for others to follow**
  - Meeting with others who have already implemented connected vehicle technology was an enormously helpful and successful activity (e.g., good lessons learned from the SPMD on installation planning/training)

Technical

- Building in performance measurement to a deployed system requires serious thinking in the concept development phase
- Using standards (intelligently) can help to advance sites' systems engineering
- Existing DMA applications made a great starting point for teams to build their ConOps around, but some will need tweaking before implementation
- Building agreements with equipment suppliers is a long and uncertain activity – it is best to start exploring many options as soon as possible
- Gaining an early understanding of Institutional Review Board (IRB) process and timeframes can help in planning and managing schedule risk (e.g., considering how frequently the IRB meets in planning the project schedule)

Building on Connected Vehicle Lessons Learned

USDOT Smart City Challenge

Vision Elements

TECHNOLOGY ELEMENTS

Vision Element #1
Urban Automation

Vision Element #2
Connected Vehicles

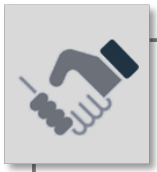
Vision Element #3
Intelligent, Sensor-Based Infrastructure

INNOVATIVE APPROACHES TO URBAN TRANSPORTATION ELEMENTS

Vision Element #4
User-Focused Mobility Services and Choices

Vision Element #5
Urban Analytics

Vision Element #6
Urban Delivery and Logistics

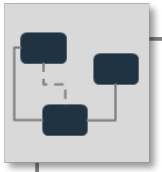


Vision Element #7
Strategic Business Models & Partnering

Vision Element #8
Smart Grid, Roadway Electrification, & EVs

Vision Element #9
Connected, Involved Citizens

SMART CITY ELEMENTS

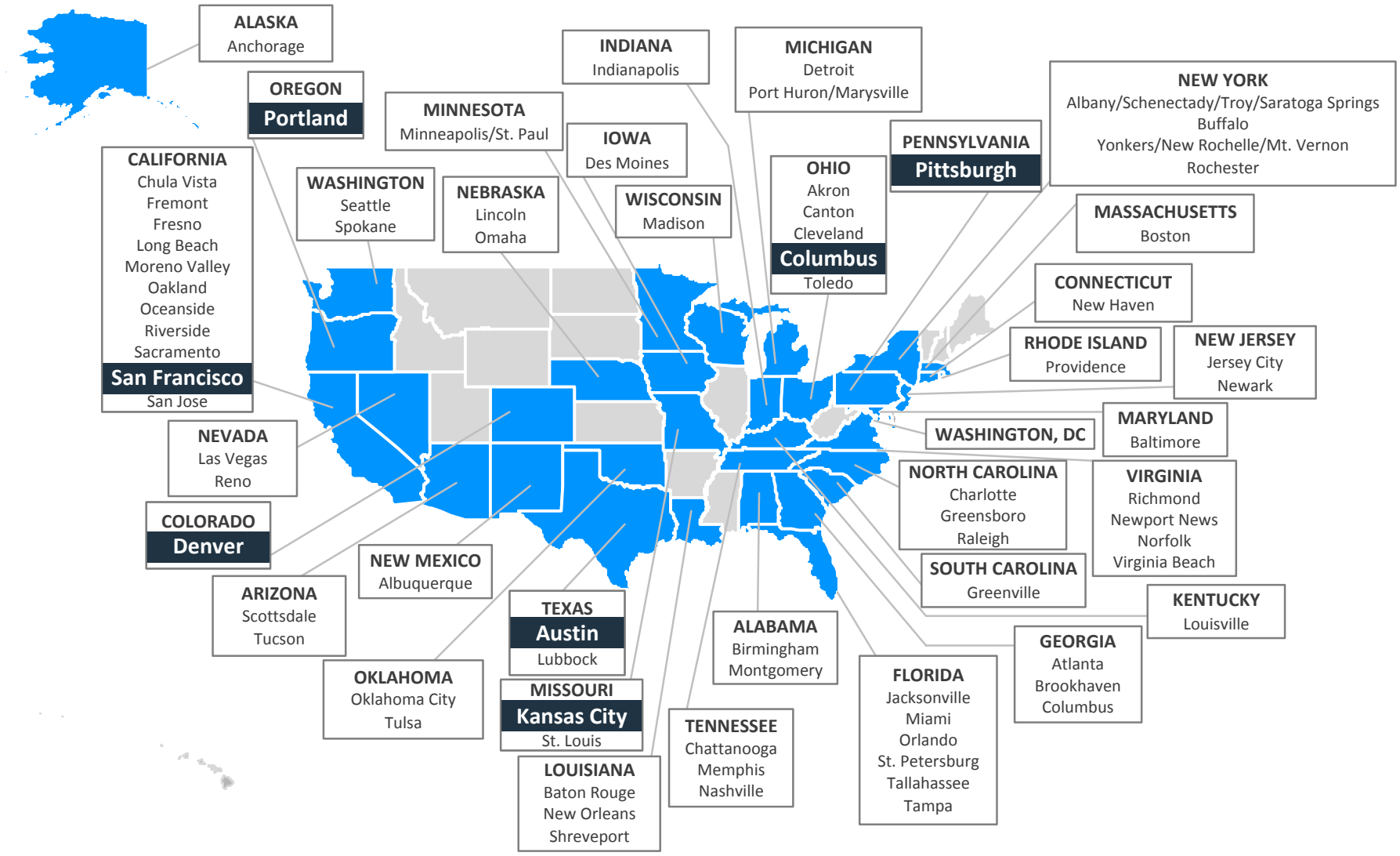


Vision Element #10
Architecture and Standards

Vision Element #11
Low-Cost, Efficient, Secure, & Resilient ICT

Vision Element #12
Smart Land Use

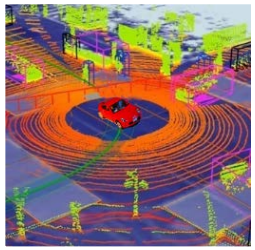
Smart City Challenge Finalists



Advanced Technologies and Smart Cities

Technology convergence will revolutionize transportation, dramatically improving safety and mobility, enhancing ladders of opportunity, and reducing environmental impacts

- Connected Vehicles
- Vehicle Automation



Connected-Automated Vehicles

- Internet of Things
- Machine Learning
- Big Data
- Sharing Economy

Smart Cities

Benefits

- Order of magnitude safety improvements
- Reduced congestion
- Reduced emissions and use of fossil fuels
- Improved access to jobs and services
- Reduced transportation costs for gov't and users
- Improved accessibility and mobility

For More Information

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