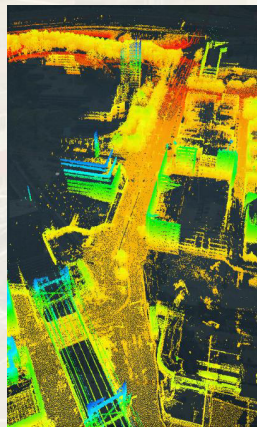# RUTGERS

School of Engineering

Region 2 University Transportation Center Consortium led by Rutgers Center for Advanced Infrastructure and Transportation (CAIT)

New Brunswick Innovation Hub

(Smart Mobility Testing Ground)

October 29, 2020

DEPARTMENT OF TRANSPORTATION · THE STATE OF NEW JERSEY

MIDDLESEX
COUNTY · NJ

THE CITY OF
NEW BRUNSWICK

Vehicle-to-Network (V2N)

Communications with backend systems establish automotive specific services like precise navigation maps and software updates, offer access to almost unlimited internet based applications.

Global Navigation Satellite System (GNSS)

High accuracy positioning is essential for almost all V2X services.

Vehicle-to-Infrastructure (V2I)

Road infrastructure e.g. traffic lights, road signs provides information for traffic and speed management. Specific infrastructure offers additional services like parking management and road toll collection.

Vehicle-to-Pedestrian (V2P)

Message exchange between vehicles and vulnerable road users encompassing e.g. pedestrian, cyclist etc. holds the promise of reduced road fatalities and serious injuries.

Vehicle-to-Vehicle (V2V)

Vehicles exchange messages to achieve cooperative awareness, to warn about road hazardous conditions and to improve driver assistance systems.

RUTGERS
Center for Advanced Infrastructure and Transportation

The Future of Transportation

Source: Rohde&Schwarz, 2018

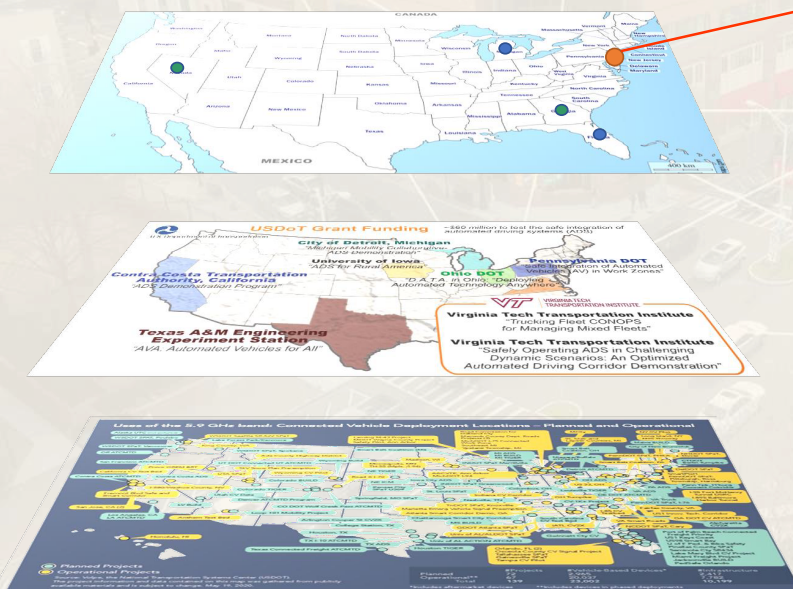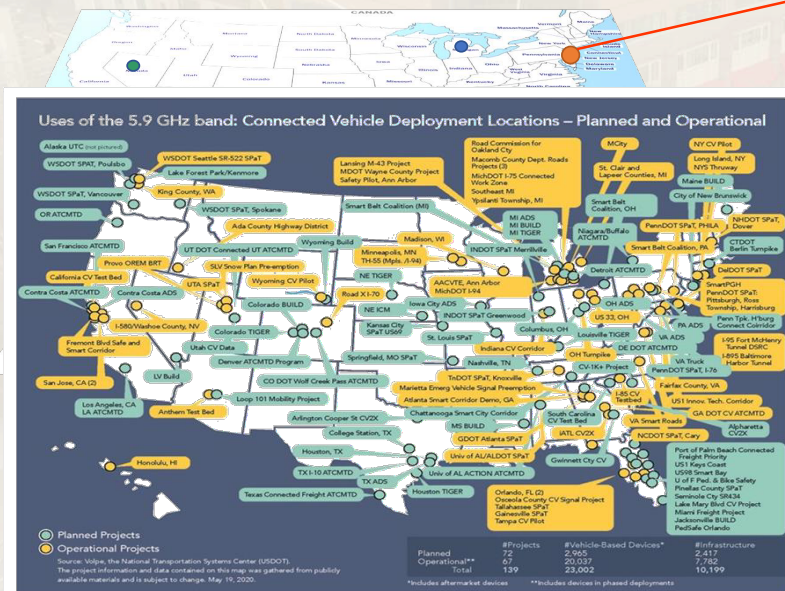# Connected and Automated Vehicle Technology Development in the US

Closed Testbeds • Living Labs • Urban Living Lab

New Brunswick Innovation Hub Smart Mobility Testing Ground (SMTG)

Connected and Automated Vehicle Testbeds (5 Sites)

Automated Vehicle Demonstration (10-15 Sites)

Connected Vehicle Deployment (139 Sites)

Source: U.S.DOT, 2020

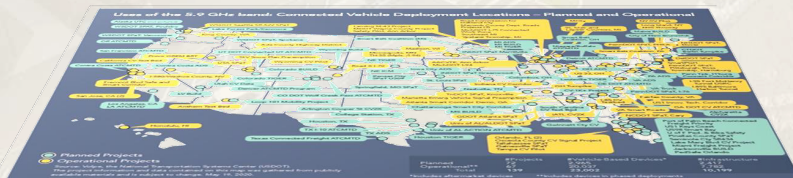# Connected and Automated Vehicle Technology Development in the US

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- Living Labs
- Urban Living Lab

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Connected and Automated Vehicle Technology Development in the US

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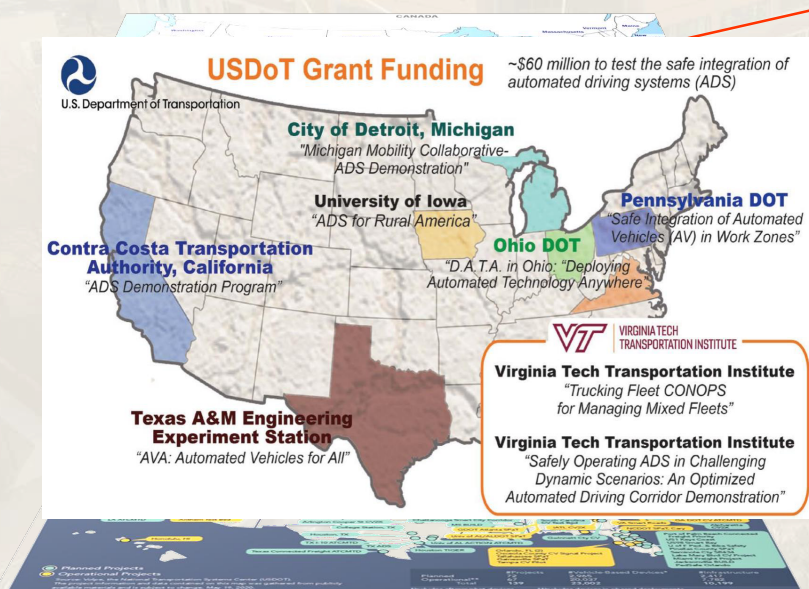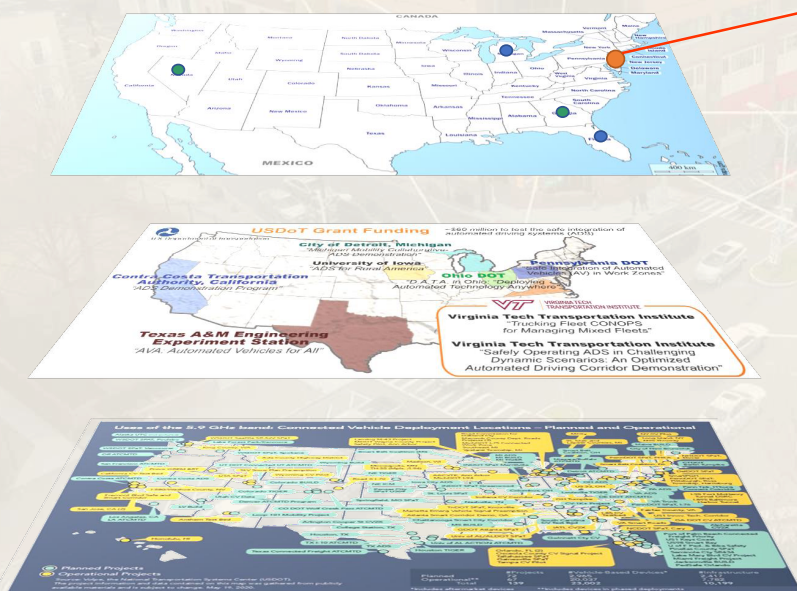# Connected and Automated Vehicle Technology Development in the US

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USDoT Grant Funding

U.S. Department of Transportation

~$60 million to test the safe integration of automated driving systems (ADS)

City of Detroit, Michigan
"Michigan Mobility Collaborative-ADS Demonstration"

University of Iowa
"ADS for Rural America"

Pennsylvania DOT
"Safe Integration of Automated Vehicles (AV) in Work Zones"

Ohio DOT
"D.A.T.A. in Ohio: "Deploying Automated Technology Anywhere"

Contra Costa Transportation Authority, California
"ADS Demonstration Program"

VIRGINIA TECH TRANSPORTATION INSTITUTE

Virginia Tech Transportation Institute
"Trucking Fleet CONOPS for Managing Mixed Fleets"

Virginia Tech Transportation Institute
"Safely Operating ADS in Challenging Dynamic Scenarios: An Optimized Automated Driving Corridor Demonstration"

Texas A&M Engineering Experiment Station
"AVA: Automated Vehicles for All"

Source: U.S.DOT, 2020

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Connected and Automated Vehicle Technology Development in the US

● Closed Testbeds ● Living Labs ● Urban Living Lab

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Connected and Automated Vehicle Testbeds (5 Sites)

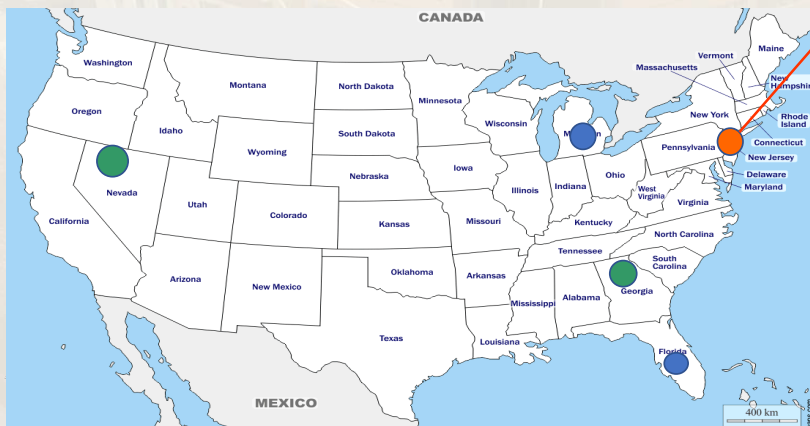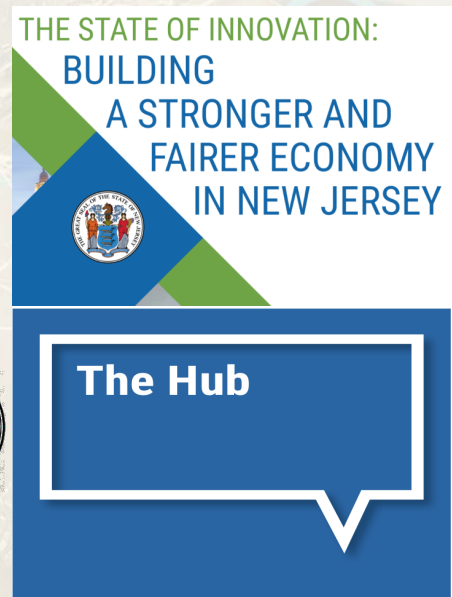**Automated Vehicle** Demonstration (10-15 Sites)

Connected Vehicle Deployment (139 Sites)

Source: U.S.DOT, 2020

Connected and Automated Vehicle Technology Development in the US

● Closed Testbeds   ● Living Labs   ● Urban Living Lab

New Brunswick Innovation Hub Smart Mobility Testing Ground (SMTG)

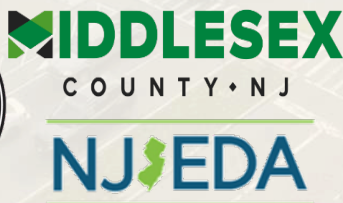**Connected and Automated Vehicle** Testbeds (5 Sites)

Automated Vehicle Demonstration (10-15 Sites)

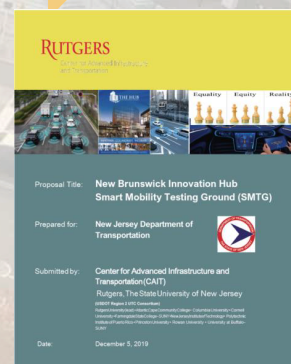**Connected Vehicle** Deployment (139 Sites)
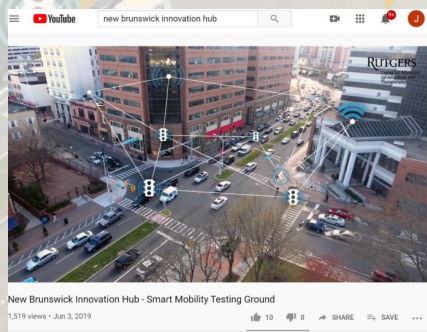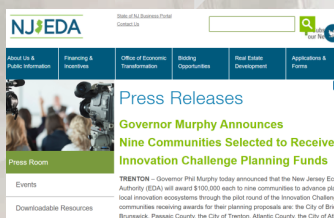
Source: U.S.DOT, 2020

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New Brunswick Innovation Hub
- Smart Mobility Testing Ground (*The Living Lab*)

Governor Murphy's vision on creating "**The Innovation Hub**" to transform New Brunswick to state's home for research and start-up incubation

THE STATE OF INNOVATION:
**BUILDING
A STRONGER AND
FAIRER ECONOMY
IN NEW JERSEY**

The Hub

New Brunswick Innovation Hub
Smart Mobility Testing Ground - Timeline

August 2019	NJEDA Innovation Challenge
November 2019	Proposal Discussion with NJDOT
December 2019	Innovation Hub Video and Pilot Testing
February-September 2020	Phase I Deployment Planning and Initiation
Spring 2021	Planning and Discussion on Phase II Deployment

Proposed Smart Mobility Testing Ground (SMTG)

Concepts:

- **Self-Driving-Grade Roadside** Sensing and Computing Infrastructure

- Industrial-Grade **Smart Mobility Data Hub**

- **Mobility Technology Breeding Ground** for State, Middlesex County, and the City of New Brunswick

- V2X Smartphone-based **Community Mobility Applications**

SMTG Roadside Unit Deployment and "**Living Lab**"

Technologies

SMTG **Living Lab**

- High-Resolution Sensing
- DSRC/5G Communication
- Edge/Cloud Computing
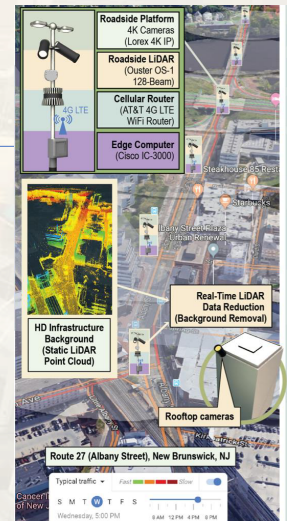- 3D Modeling and Digital Twin
- Smartphone and Apps.

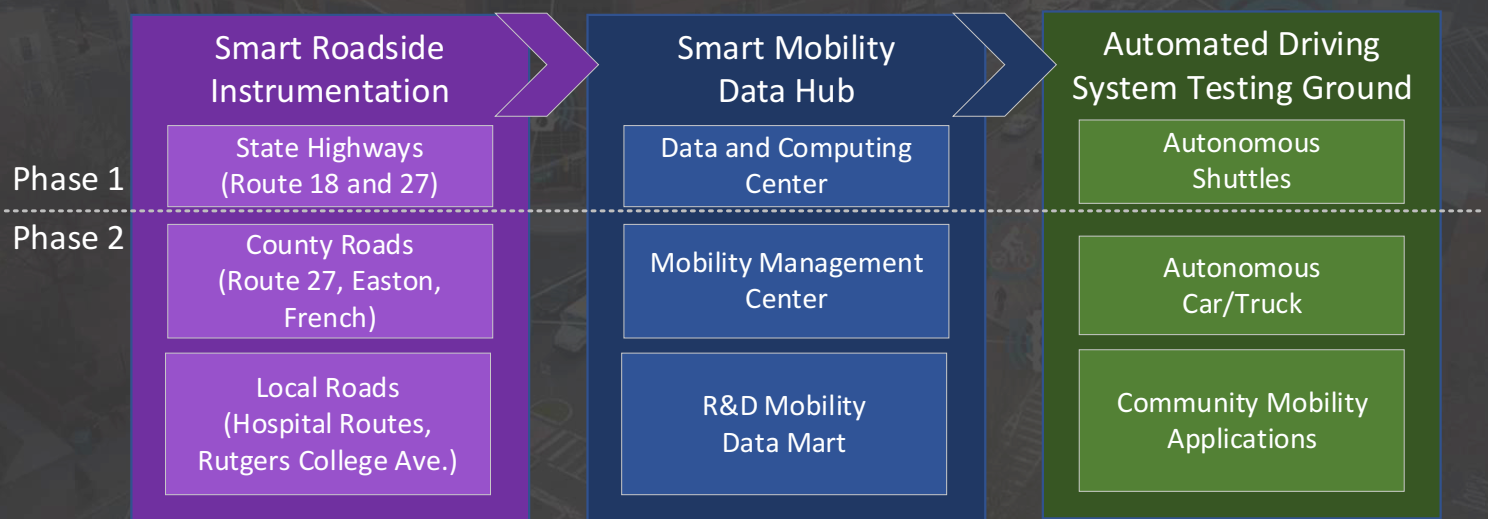Support **Self-Driving** and Smart Mobility Industry

Enable **Data sharing** among **all Road Users**
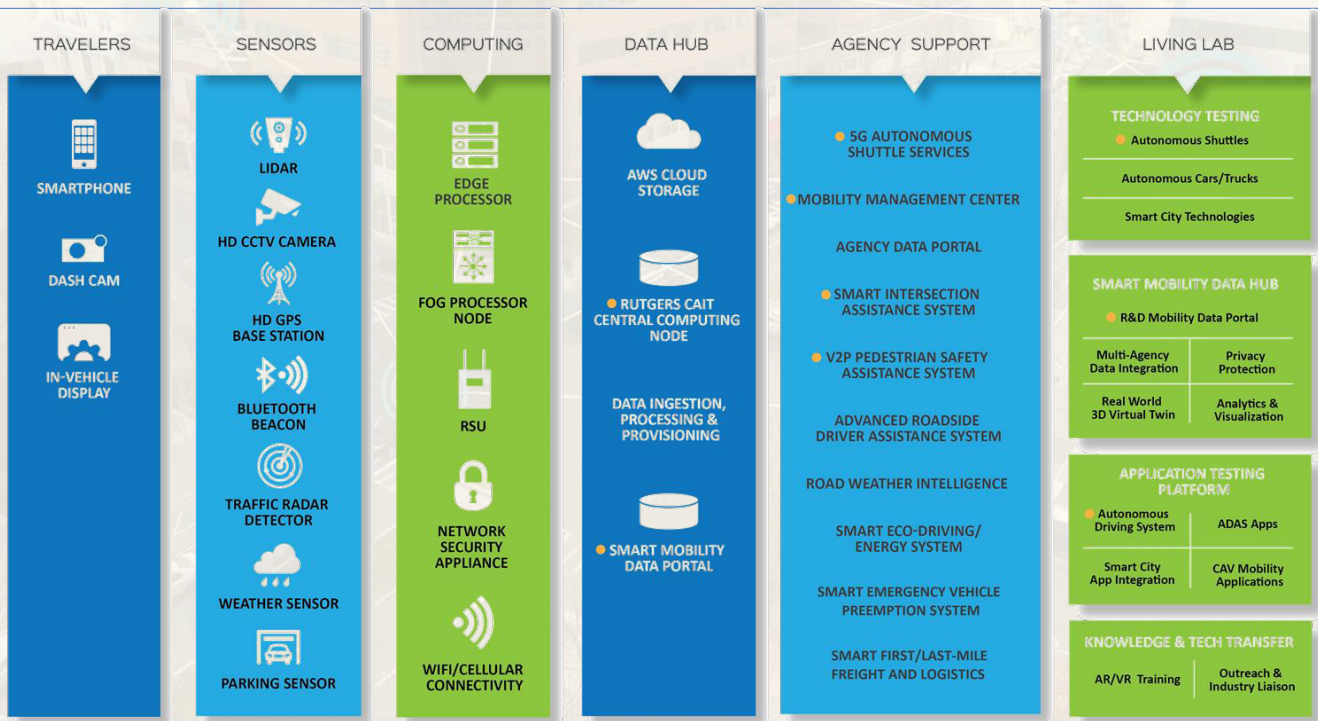
Create **Data Hub** for public, private, and academic R&D

Build the **Test Platforms** for new Smart Mobility Applications

Roadside Platform
4K Cameras
(Lorex 4K IP)

Roadside LiDAR
(Ouster OS-1
128-Beam)

Cellular Router
(AT&T 4G LTE
WiFi Router)

Edge Computer
(Cisco IC-3000)

HD Infrastructure
Background
(Static LiDAR
Point Cloud)

Real-Time LiDAR
Data Reduction
(Background Removal)

Rooftop cameras

Route 27 (Albany Street), New Brunswick, NJ

DRIVING
INTELLIGENT
MOBILITY

IM DATA HUB

PROVIDING UNIQUE DATA
AND EXPERT ANALYSIS TO
POWER YOUR TRANSPORT
INNOVATIONS

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SMTG Project Phases and Deliverables

	Smart Roadside Instrumentation	Smart Mobility Data Hub	Automated Driving System Testing Ground
Phase 1	State Highways (Route 18 and 27)	Data and Computing Center	Autonomous Shuttles
Phase 2	County Roads (Route 27, Easton, French)	Mobility Management Center	Autonomous Car/Truck
	Local Roads (Hospital Routes, Rutgers College Ave.)	R&D Mobility Data Mart	Community Mobility Applications

SMTG System Architecture

TRAVELERS	SENSORS	COMPUTING	DATA HUB	AGENCY SUPPORT	LIVING LAB
SMARTPHONE	LIDAR	EDGE PROCESSOR	AWS CLOUD STORAGE	• 5G AUTONOMOUS SHUTTLE SERVICES	**TECHNOLOGY TESTING**
DASH CAM	HD CCTV CAMERA	FOG PROCESSOR NODE		• MOBILITY MANAGEMENT CENTER	• Autonomous Shuttles
IN-VEHICLE DISPLAY	HD GPS BASE STATION	RSU	• RUTGERS CAIT CENTRAL COMPUTING NODE	AGENCY DATA PORTAL	Autonomous Cars/Trucks
	BLUETOOTH BEACON			• SMART INTERSECTION ASSISTANCE SYSTEM	Smart City Technologies
	TRAFFIC RADAR DETECTOR	NETWORK SECURITY APPLIANCE	DATA INGESTION, PROCESSING & PROVISIONING	• V2P PEDESTRIAN SAFETY ASSISTANCE SYSTEM	**SMART MOBILITY DATA HUB**
	WEATHER SENSOR			ADVANCED ROADSIDE DRIVER ASSISTANCE SYSTEM	• R&D Mobility Data Portal
	PARKING SENSOR	WIFI/CELLULAR CONNECTIVITY	• SMART MOBILITY DATA PORTAL	ROAD WEATHER INTELLIGENCE	Multi-Agency Data Integration / Privacy Protection
				SMART ECO-DRIVING/ ENERGY SYSTEM	Real World 3D Virtual Twin / Analytics & Visualization
				SMART EMERGENCY VEHICLE PREEMPTION SYSTEM	**APPLICATION TESTING PLATFORM**
				SMART FIRST/LAST-MILE FREIGHT AND LOGISTICS	• Autonomous Driving System / ADAS Apps
					Smart City App Integration / CAV Mobility Applications
					KNOWLEDGE & TECH TRANSFER
					AR/VR Training / Outreach & Industry Liaison

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SMTG Deployment and Phase Plan
- Total Mileage: 5 Miles

Phase 2: SMTG Automated Shuttles
Local Road RSU Deployment
AV Shuttle Services (Hospitals/University)
AV Car/Trucks Demonstration

Phase 1: SMTG East Wing
Route 27/18 Corridors (2.1 Miles)
State Route RSU Deployment
Smart Mobility Application Pilots
Computing and DataMart Center

Phase 2: SMTG West Wing
Easton/French Corridors (2.8 Miles)
SMTG RSU Deployment
Mobility Management Center

New Brunswick

Roadside Unit Design Concepts

- LiDAR/Video and Edge Computing Units

- Installation Scenarios/Designs

Proposed SMTG ADS Technology Demonstration Project

Key Service Locations:
1. Innovation Hub
2. RWJ Hospital
3. St. Peters Hospital
4. Rutgers University Campus

Autonomous Shuttle Service Testing

St. Peters Hospital

RWJ Hospital

Connected Automated Vehicles

RSU-Assisted CAV services
V2V, V2I, and V2P services

Internet
Cellular network
C-V2X Local platform

3G/4G/5G
V2V/V2I/V2P

eNB
RSU
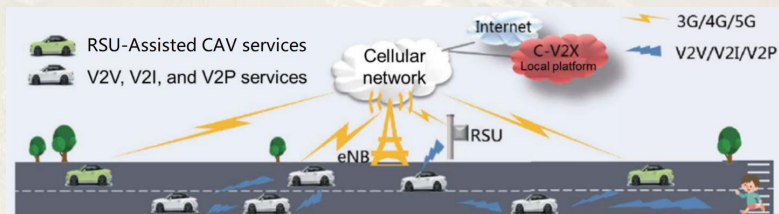
Mobility Data Hub and Digital Twin Model

SmartMobi Community Mobility Application
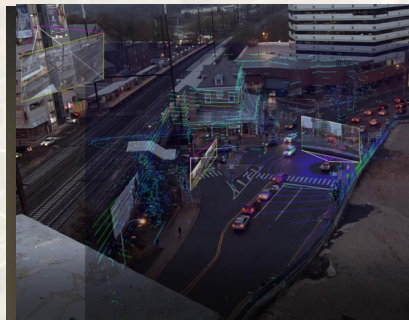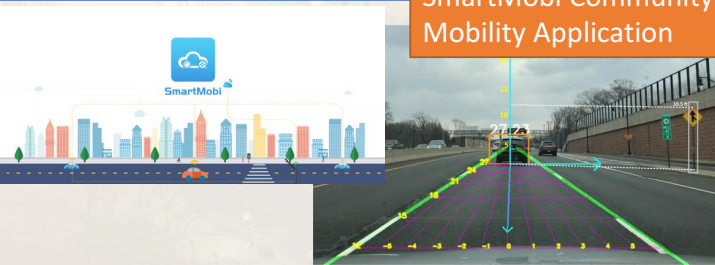
Full-Digital Sibling of the Corridor
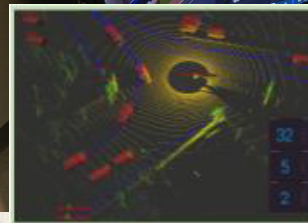
270-degree Visualization Lab

LiDAR Sensor Tests and Site Planning

Sensor Coverage Comparison

- Velodyne
  - VLP-32c:
    - 310 ft (Tracking*)
  - Alpha Prime (128):
    - 380ft (Reconstruction**)
    - 485-525ft (Tracking)

- Ouster
  - OS-1-64:
    - 120 ft (Reconstruction)
    - 285 ft (Tracking)
  - OS-2:
    - 150-230 ft (Reconstruction)
    - 225-290 ft (Tracking)

* Tracking: >1-2 scanning rings
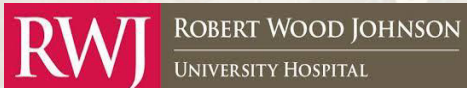** Reconstruction: >5 scanning rings

OS-2

Velodyne Lidar

Alpha Prime (128)
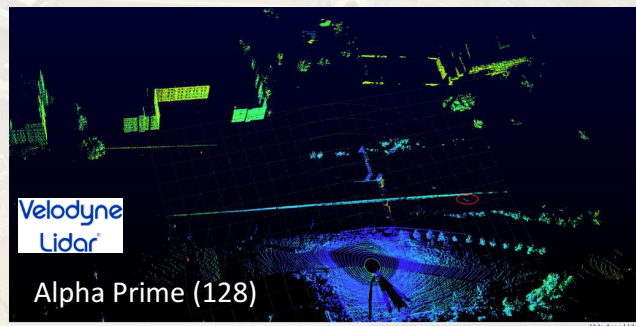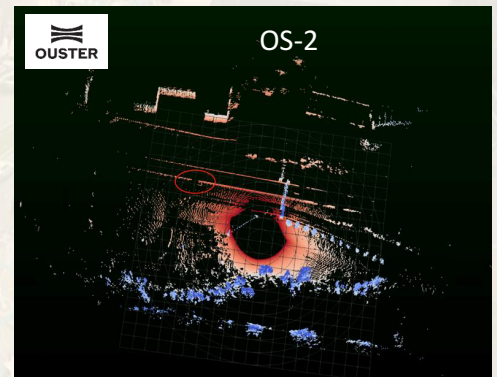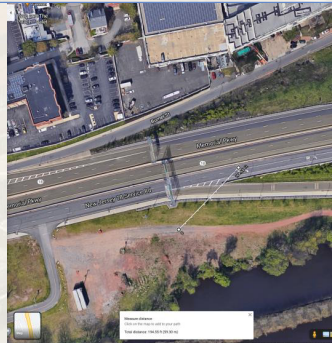
SMTG Project Team and Partnership

- **Public Sectors**


- **Private Sectors**

- **Academic/R&D Partners**

Engaging New Jersey Academic Communities

- Rutgers:
  - School of Engineering (CAIT)
    - **Peter Jin (PI), Ali Maher, Mohsen Jafari**
  - Voorhees Transportation Center –
    - **John Carnegie**
  - WINLAB
- ITS Resource Center at NJIT
- Steven Institute of Technology
- Rowan University
- The College of NJ (TCNJ)
- Princeton University
- Columbia University
- M-City: University of Michigan-Ann Arbor
- SunTrax: Florida International University
- Carnegie Mellon University
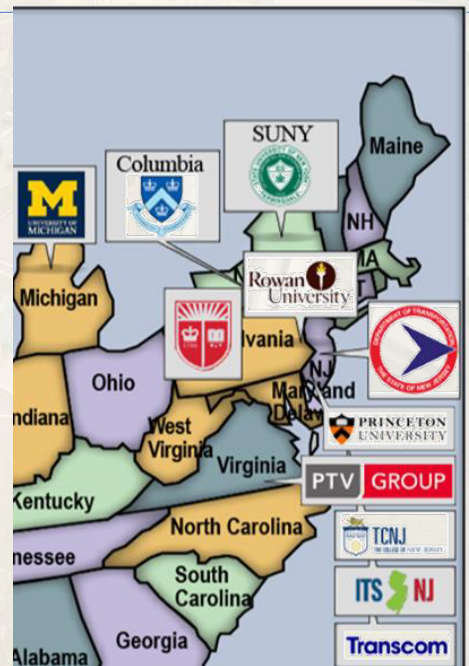
New Brunswick Innovation Hub Smart Mobility Testing Ground

Regional Impact

- **Position Middlesex County as a national leader** in ushering in the next generation of transportation

- Demonstrate leading edge technology applications to improve transportation **reliability and safety** and provide new **mobility** solutions

- Grow **jobs**, attract **investment** and build an **ecosystem of entrepreneurship** around advanced autonomous vehicles in the County

DESTINATION 2040
MIDDLESEX COUNTY ◆ NJ
STRATEGIC PLAN

New Brunswick Innovation Hub Smart Mobility Testing Ground

State Impact

- Economy: Governor Murphy's vision on creating the hub to promote innovative economy.

- Workforce Development: Attract and retain high-tech talents to build careers in NJ.

- Transportation: Breeding ground of transferrable smart mobility solutions to state and nation.

These earnings and activity will generate **significant local and state tax revenues.**

The Hub

THE STATE OF INNOVATION:
**BUILDING
A STRONGER AND
FAIRER ECONOMY
IN NEW JERSEY**

High Quality Jobs: Average annual pay for Middlesex County workers in scientific research and development services is $147,000, **more than 2x the average** private wage of $65,000. *- U.S. Bureau of Labor Statistics (2018)*

Spillover Effect: For every $1.00 of production in scientific research and development services in the county, **$1.90 of activity is generated** in the local economy.
- IMPLAN (2015)

New Brunswick, Middlesex County and New Jersey will also benefit from innovative technologies that increase efficiency and productivity and reduce costs.

Thank you!