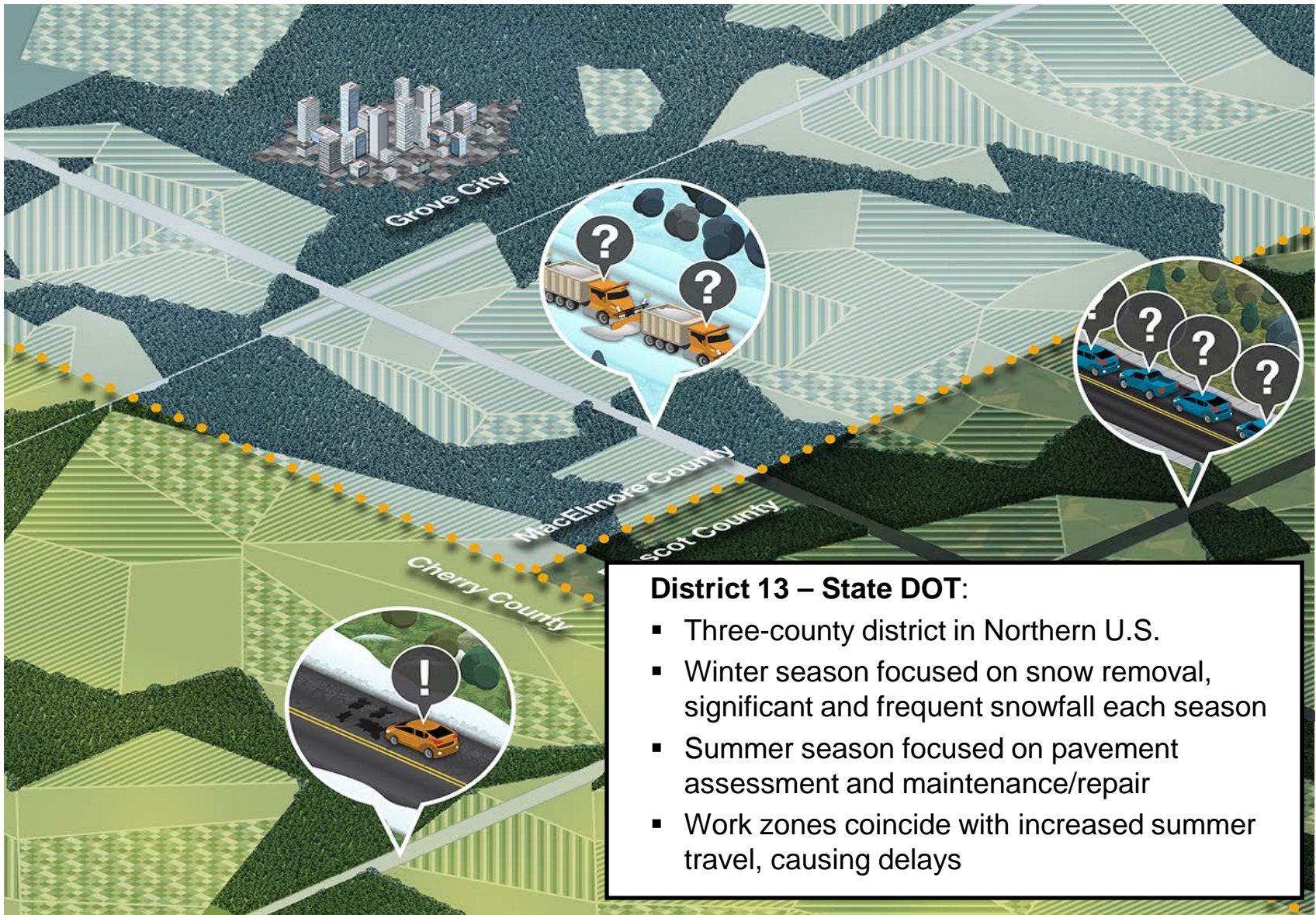




Example CV Pilot Deployment Concepts: District 13 Operations

Gabe Guevara (FHWA)

District 13 Operations



District 13 – State DOT:

- Three-county district in Northern U.S.
- Winter season focused on snow removal, significant and frequent snowfall each season
- Summer season focused on pavement assessment and maintenance/repair
- Work zones coincide with increased summer travel, causing delays

Stakeholders Convene and Identify Key Transportation Challenges

- **Improve Efficiency of Snow and Ice Operations**
 - Frequent snow falls during winter season increasingly costly while maintenance budgets continue to shrink
 - Optimize the use of materials and resources
 - Improve LOS Improve “Regain-time”
 - Improve safety and mobility (WRTM)
 - Conduct winter maintenance operations in a sustainable fashion
 - Reduce fuel costs of plowing operations

- **Improve Pavement Maintenance**
 - Leverage technology to identify and classify pavement issues before they become critical without significant increases in operating costs

- **Improve Work Zone Planning and Management**
 - Unpredictable congestion during summer months due to concurrent roadwork and tourism
 - Plan work zones better to reduce delays
 - Improve traveler information on congestion resulting from work zones
 - Improve work zone safety of workers and travelers



Stakeholder Set Three Key Improvement Targets

Goal	Performance Measure	Performance Target
Increase snow removal efficiency	Snow removal time and plowing operations costs	Reduce snow removal time by 10% while lowering plowing operations costs 10% (fuel, materials, labor, etc.)
Improve ridability experience	Number of customer calls regarding dangerous pot holes on roads	Reduce number of customer calls regarding dangerous pot holes on roads by 25%
Reduce work zone delay	Number of work zone crashes and delay during summer season	Cut work zone crashes and delay by 80% and 30% respectively during summer season



Applications Considered for Improving Snow Removal



V2I Safety

Red Light Violation Warning
 Curve Speed Warning
 Stop Sign Gap Assist
 Spot Weather Impact Warning
 Reduced Speed/Work Zone Warning
 Pedestrian in Signalized Crosswalk Warning (Transit)

V2V Safety

Emergency Electronic Brake Lights (EEBL)
 Forward Collision Warning (FCW)
 Intersection Movement Assist (IMA)
 Left Turn Assist (LTA)
 Blind Spot/Lane Change Warning (BSW/LCW)
 Do Not Pass Warning (DNPW)
 Vehicle Turning Right in Front of Bus Warning (Transit)

Road Weather

Motorist Advisories and Warnings (MAW)
Enhanced MDSS
 Vehicle Data Translator (VDT)
 Weather Response Traffic Information (WxTINFO)

Environment

Eco-Approach and Departure at Signalized Intersections
 Eco-Traffic Signal Timing
 Eco-Traffic Signal Priority
 Connected Eco-Driving
 Wireless Inductive/Resonance Charging
 Eco-Lanes Management
 Eco-Smart Parking
 Eco-Traveler Information Control
 Eco-Ramp Metering
 Low Emissions Zone Management
 AFV Charging / Fueling Information
 Eco-Smart Parking
 Dynamic Eco-Routing (light vehicle, transit, freight)
 Eco-ICM Decision Support System

Agency Data

Probe-based Pavement Maintenance
 Probe-enabled Traffic Monitoring
 Vehicle Classification-based Traffic Studies
 CV-enabled Turning Movement & Intersection Analysis
 CV-enabled Origin-Destination Studies
 Work Zone Traveler Information

Mobility

Advanced Traveler Information System
 Intelligent Traffic Signal System (I-SIG)
 Signal Priority (transit, freight)
 Mobile Accessible Pedestrian Signal System (PED-SIG)
 Emergency Vehicle Preemption (PREEMPT)
 Dynamic Speed Harmonization (SPD-HARM)
 Queue Warning (Q-WARN)
 Cooperative Adaptive Cruise Control (CACC)
 Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG)
 Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
 Emergency Communications and Evacuation (EVAC)
 Connection Protection (T-CONNECT)
 Dynamic Transit Operations (T-DISP)
 Dynamic Ridesharing (D-RIDE)
 Freight-Specific Dynamic Travel Planning and Performance
 Drayage Optimization

Smart Roadside

Wireless Inspection
 Smart Truck Parking

Snow Removal



Applications Considered for Improving Pavement Maintenance



V2I Safety

Red Light Violation Warning
 Curve Speed Warning
 Stop Sign Gap Assist
 Spot Weather Impact Warning
 Reduced Speed/Work Zone Warning
 Pedestrian Warning

**Situational Awareness/
 Enhanced Ride
 Experience**

Emergency Electronic Brake Lights (EEBL)
 Forward Collision Warning (FCW)
 Intersection Movement Assist (IMA)
 Left Turn Assist (LTA)
 Blind Spot/Lane Change Warning (BSW/LCW)
 Do Not Pass Warning (DNPW)
 Vehicle Turning Right in Front of Bus Warning (Transit)

Road Weather

Motorist Advisories and Warnings (MAW)
 Enhanced MDSS
 Vehicle Data Translator (VDT)
 Weather Response Traffic Information (WxTINFO)

Environment

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 Eco-Traffic Signal Timing
 Eco-Traffic Signal Priority
 Connected Eco-Driving
 Wireless Inductive/Resonance Charging
 Eco-Lanes Management
 Eco-Speed Harmonization
 Eco-Cooperative Adaptive Cruise Control
 Eco-Traveler Information
 Eco-Ramp Metering
 Low Emissions Zone Management
 AFV Charging / Fueling Information
 Eco-Smart Parking
 Dynamic Eco-Routing (light vehicle, transit, freight)
 Eco-ICM Decision Support System

Agency Data

Probe-based Pavement Maintenance

Probe-enabled Traffic Monitoring
 Vehicle Classification-based Traffic Studies
 CV-enabled Turning Movement & Intersection Analysis
 CV-enabled Origin-Destination Studies
 Work Zone Traveler Information

Mobility

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 Dynamic Ridesharing (D-RIDE)
 Freight-Specific Dynamic Travel Planning and Performance
 Drayage Optimization

Smart Roadside

Wireless Inspection
 Smart Truck Parking



Applications Considered for Improving Work Zones



V2I Safety

Red Light Violation Warning
 Curve Speed Warning
 Stop Sign Gap Assist
 Spot Weather Impact Warning
 Reduced Speed/Work Zone Warning
 Pedestrian in Signalized Crosswalk Warning (Transit)

V2V Safety

Emergency Electronic Brake Lights (EEBL)
 Forward Collision Warning (FCW)
 In-Car Lane Change Warning (ICLCW)
 Left Turn Lane Change Warning (LLCW)
 Blind Spot/Lane Change Warning (BSW/LCW)
 Do Not Pass Warning (DNPW)
 Vehicle Turning Right in Front of Bus Warning (Transit)

Manage Work Zones

Road Weather

Motorist Advisories and Warnings (MAW)
 Enhanced MDSS
 Vehicle Data Translator (VDT)
 Weather Response Traffic Information (WxTINFO)

Environment

Eco-Approach and Departure at Signalized Intersections
 Eco-Traffic Signal Timing
 Eco-Traffic Signal Priority
 Connected Eco-Driving
 Wireless Inductive/Resonance Charging
 Eco-Lanes Management
 Eco-Speed Harmonization
 Eco-Cooperative Adaptive Cruise Control
 Eco-Traveler Information
 Eco-Ramp Metering
 Low Emissions Zone Management
 AFV Charging / Fueling Information
 Eco-Smart Parking
 Dynamic Eco-Routing (light vehicle, transit, freight)
 Eco-ICM Decision Support System

Agency Data

Probe-based Pavement Maintenance
 Probe-enabled Traffic Monitoring
 Vehicle Classification-based Traffic Studies
 CV-enabled Turning Movement & Intersection Analysis
 CV-enabled Origin-Destination Studies

Work Zone Traveler Information

Mobility

Advanced Traveler Information System
 Intelligent Traffic Signal System (I-SIG)
 Signal Priority (transit, freight)
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Smart Roadside

Wireless Inspection
 Smart Truck Parking



Connected Vehicle Applications Selected in Performance-Driven Approach

Improve Snow Removal

- Enhanced Maintenance Decision Support System

Improve Situational Awareness

- Probe-based Pavement Maintenance

Improve Management of Work Zones

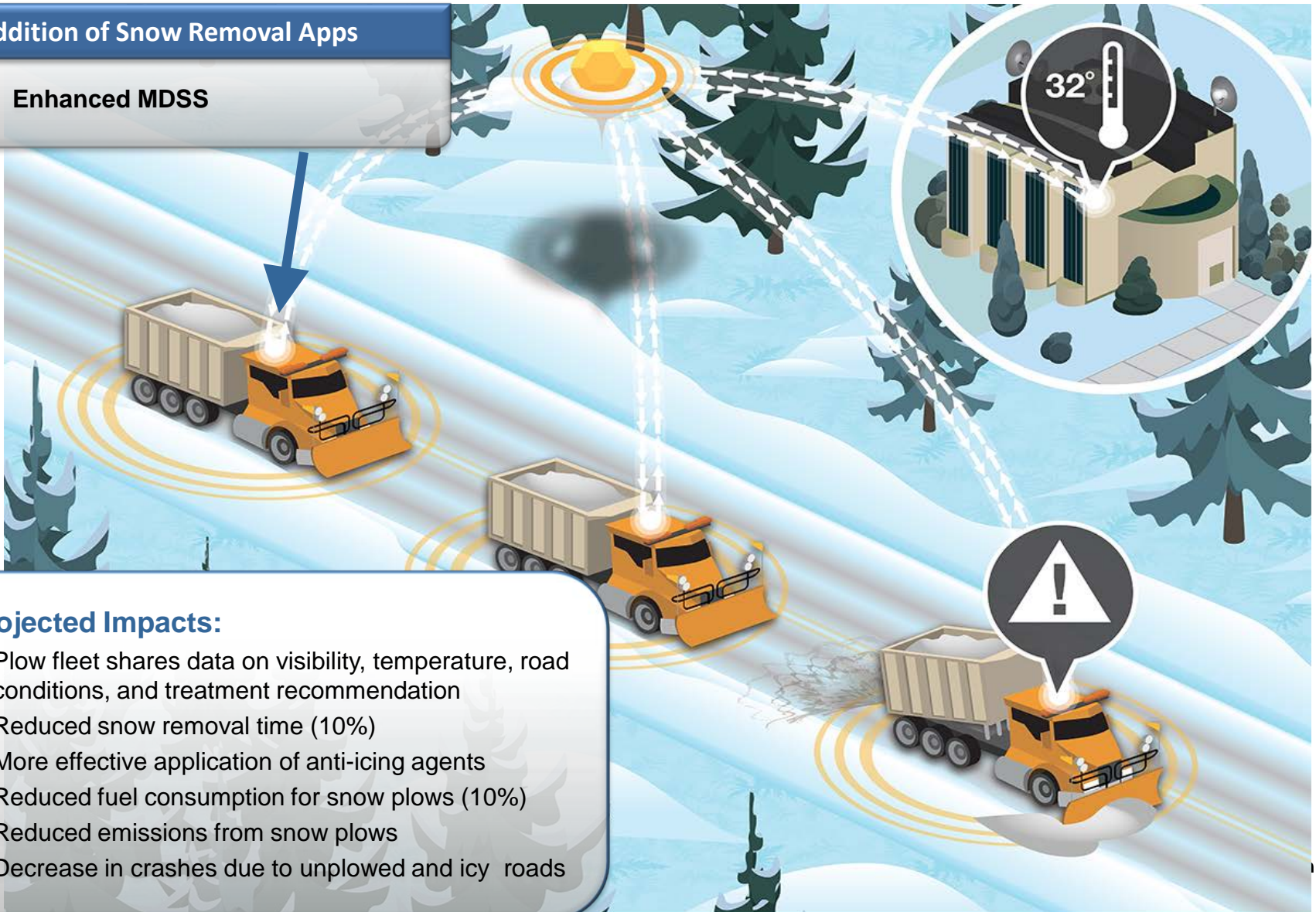
- Work Zone Traveler Information



Projected Synergies and Impacts from Snow Removal Applications in the Deployment Concept

Addition of Snow Removal Apps

- Enhanced MDSS



Projected Impacts:

- Plow fleet shares data on visibility, temperature, road conditions, and treatment recommendation
- Reduced snow removal time (10%)
- More effective application of anti-icing agents
- Reduced fuel consumption for snow plows (10%)
- Reduced emissions from snow plows
- Decrease in crashes due to unplowed and icy roads

Projected Synergies and Impacts from Pavement Management Applications in the Deployment Concept



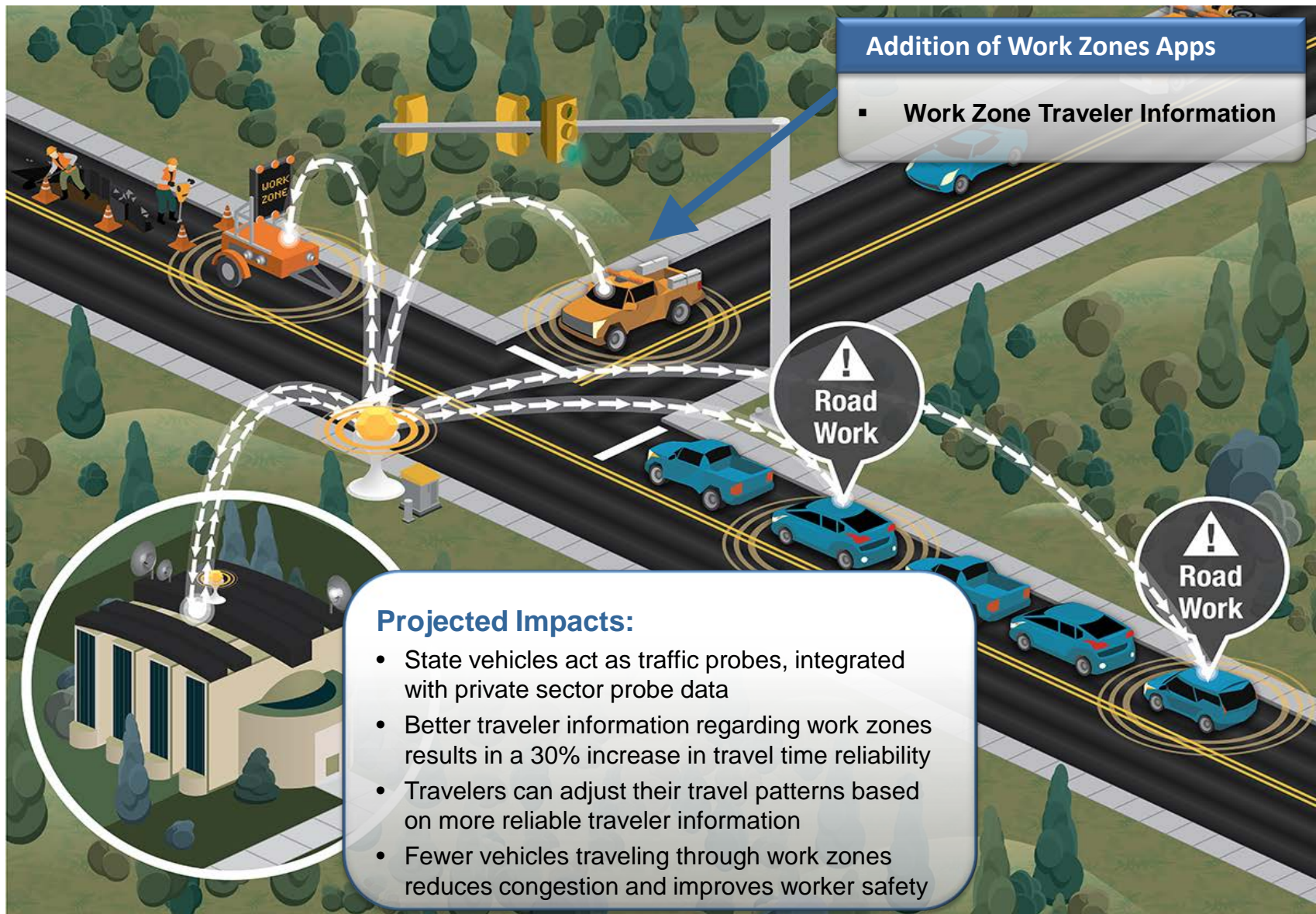
Projected Impacts:

- Automatic reporting of road maintenance needs decreases customer calls by 25%
- Decrease in crashes due to poor pavement conditions
- Better detection of pavement maintenance needs results in faster repairs and reduced lane closures
- Decreased time of lane closures, reduces congestion and worker safety concerns

Addition of Pavement Management Apps

- Probe-based Pavement Maintenance

Projected Synergies and Impacts from Work Zone Applications in the Deployment Concept



Integrated Concept for District 13 Operations

