Probe Technology Update – U.S.

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SIS35: Transformation of road transport through the use of probe data

Probe Data & Application Areas

1. Connected Data Systems
2. Research Data Exchange
3. Intelligent Network Flow Optimization
   ➢ Freeway-Based Dynamic Speed Harmonization
4. Road Weather Management
   ➢ Enhanced Maintenance Decision Support
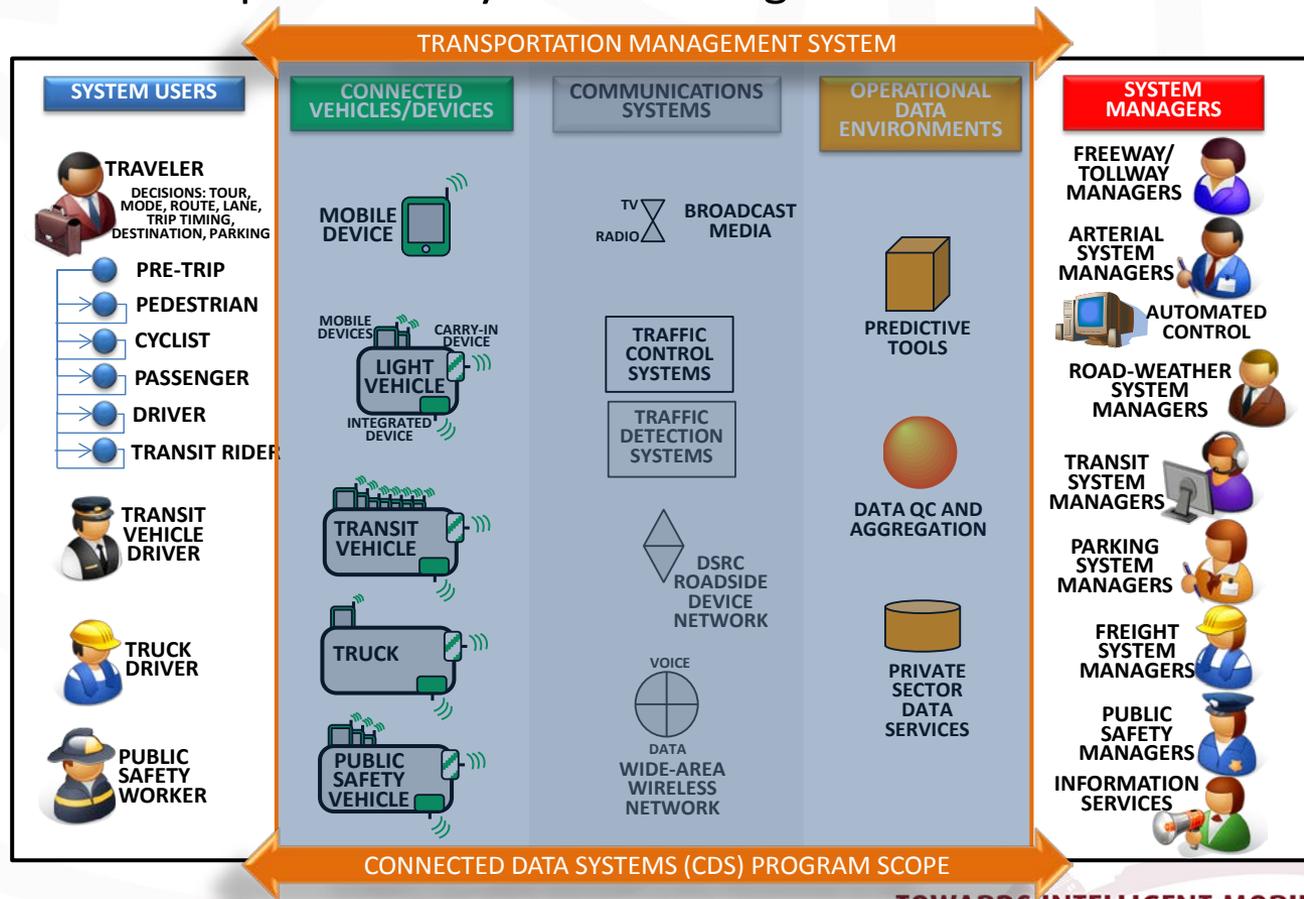5. Connected Vehicle Pilots
6. Trilateral Probe Data Research

Connected Data Systems - Program Overview

Develop, test, and make available methods to capture, manage, and exploit multi-source data to enhance current operational practices and transform future surface transportation systems management.
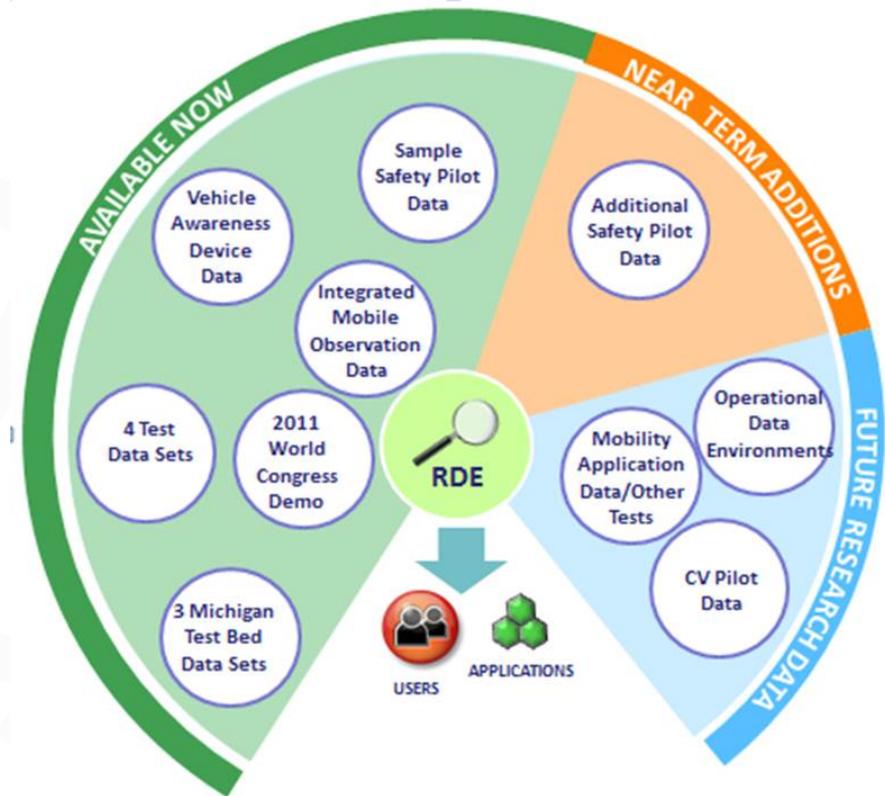

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Connected Data Systems - Program Goals

- Identify emerging data use cases to enhance surface transportation systems management
- Develop and test new capabilities to optimize data generation and transmission both from mobile data sources and roadside devices
- Identify opportunities to incorporate next-generation analytics and high-performance computing into transportation systems management
- Develop a prototype next-generation operational data environment
- Facilitate the transition from legacy systems to next generation transportation management systems that incorporate emerging data
- Share CDS products to encourage complementary research and facilitate deployment

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Research Data Exchange (RDE)

- Web-based resource that collects, manages, and provides access to multi-source and multi-modal transportation data

- Quality-checked, well-documented, and freely available to the public

- Currently has ITS and connected vehicle data from 13 locations

- More data environments are constantly being added, including data from several Dynamic Mobility Application (DMA) prototypes.

- Will receive data from CV Pilots and Operational Data Environments

https://www.its-rde.net/

Example Probe Data-Enabled Applications

Intelligent Network Flow Optimization (INFLO):
- Freeway-Based Dynamic Speed Harmonization (SPD-HARM)
  - Harmonizes speeds within and across lanes to maximize roadway throughput, reduce crashes, and reduce fuel consumption
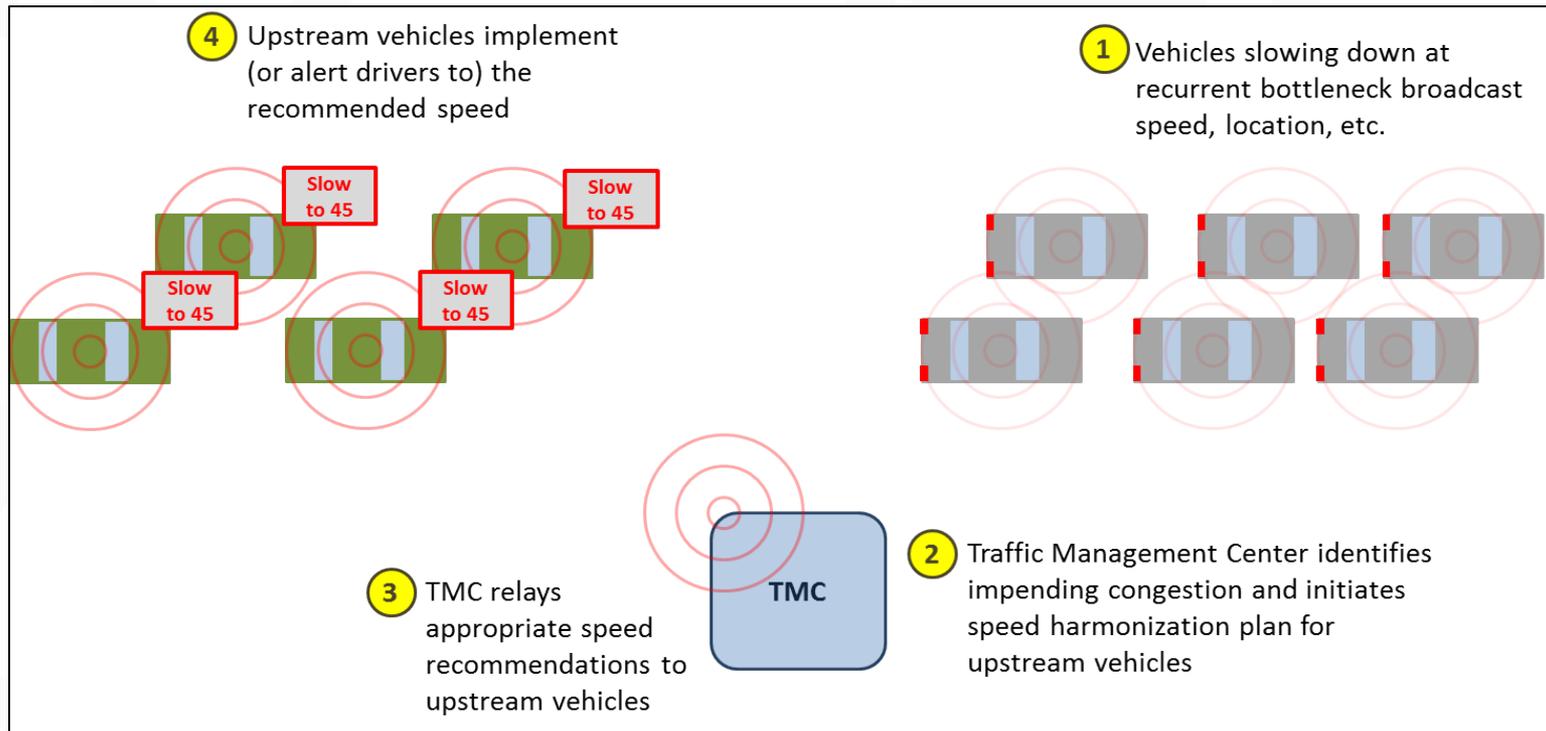
Road Weather Management Program (RWM):
- Enhanced Maintenance Decision Support System (EMDSS)
  - Generates and sends improved road-surface treatment plans to snow plow operators and drivers of maintenance vehicles by using road-weather data from maintenance and other probe vehicles

Road Agency Operations:
- Traffic Management Measures Estimation Applications
  - Estimates key traffic measures (such as travel times, speeds, flows, queues, etc.) to provide comprehensive, accurate, and precise information rapidly for improving decision-making

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Intelligent Network Flow Optimization (INFLO)

- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)

4 Upstream vehicles implement (or alert drivers to) the recommended speed

Slow to 45

Slow to 45

Slow to 45

Slow to 45

1 Vehicles slowing down at recurrent bottleneck broadcast speed, location, etc.

TMC

3 TMC relays appropriate speed recommendations to upstream vehicles

2 Traffic Management Center identifies impending congestion and initiates speed harmonization plan for upstream vehicles

INFLO Prototype Small Scale Demo

Freeway-based Highway Speed Harmonization

- Scripted driving scenario: I-5, Seattle, WA
  - 20 vehicles with naïve drivers
  - Processed infrastructure & vehicle data in real time – delivered Q-WARN and SPD-HARM messages to drivers
- Successfully demonstrated:
  - Formulation of speed harmonization recommendations
  - Communication of queue location and speed harmonization recommendations to drivers
  - Vehicle data capture and dissemination using both cellular communications and DSRC
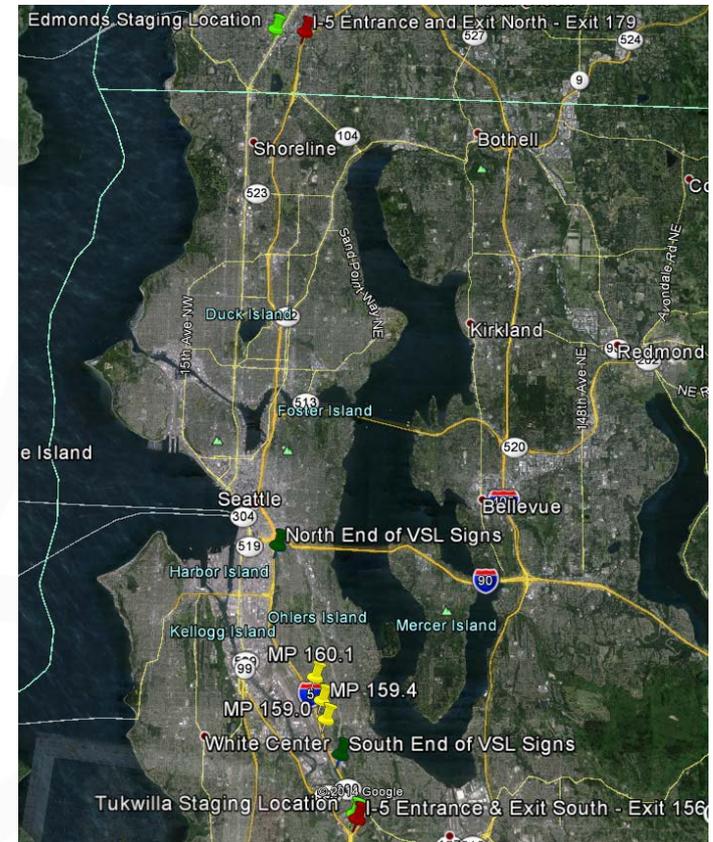
INFLO Impacts Assessment

Dynamic Speed Harmonization (SPD-HARM) & Queue Warning (Q-WARN) at various levels of potential future market acceptance

- Series of simulation experiments to estimate changes in Measures of Effectiveness (MOEs) under variety of operating conditions & response rates.
  - Reduced magnitudes of speed drops between vehicles (shockwaves), even at 10% market penetration level. Safety benefit considered through reduced probability of collisions where free-flowing traffic meets the back of a queue.
  - Trade-off was increased geographic impact of existing bottlenecks
  - Increased lane changing on the freeway
  - Rapidly increasing benefits in the first 20% of the fleet that is connected and complying
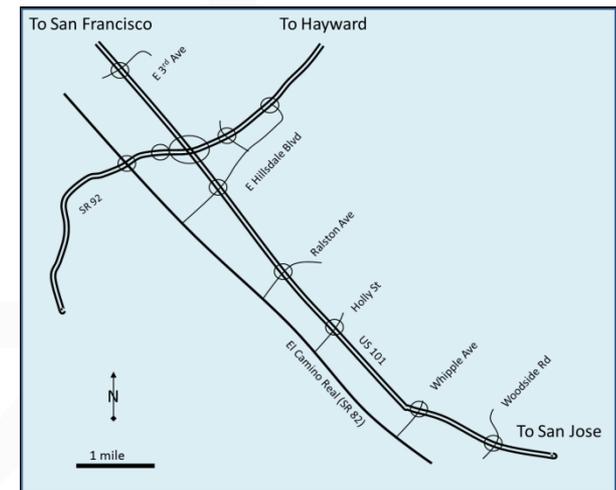
Road Weather Management (RWM) Program

Goals:

- Better understand impacts of weather on roadways and promote strategies and tools to mitigate those impacts

- Develop a system that provides "Anytime, Anywhere Road Weather Information" for road users and road operating agencies, as well as a robust, competitive market for road weather services

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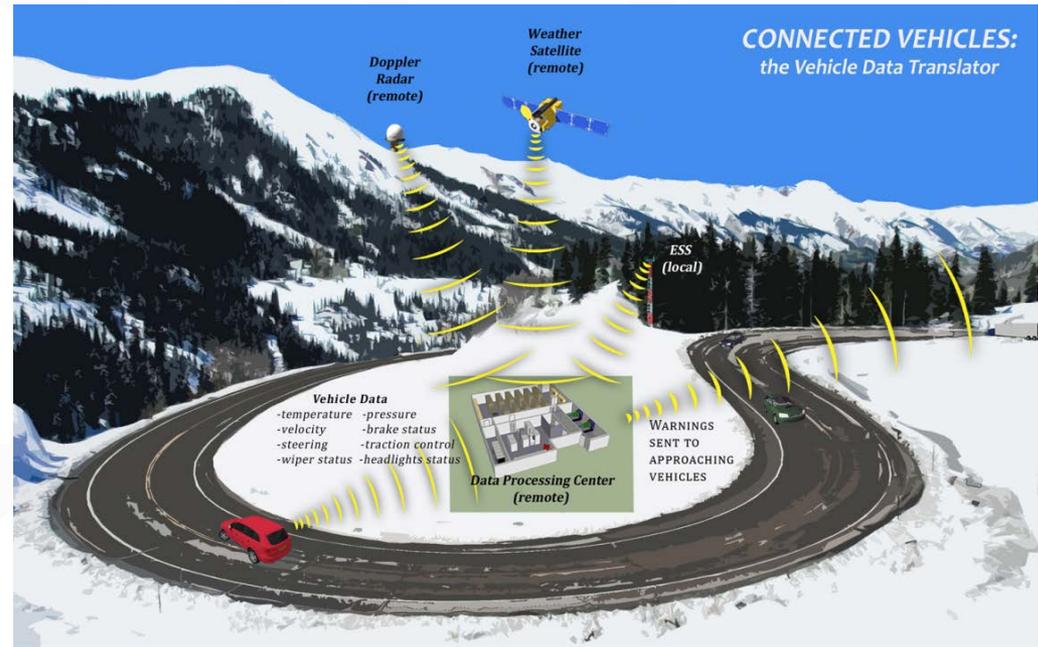
Enhanced Maintenance Decision Support System (EMDSS)

- Incorporates Connected Vehicle (CV) data, processes it through the VDT – outputs are used in road weather forecast and maintenance decision processes

- Vehicle data are from general public, commercial entities or specialty vehicles and public fleet vehicles

- Infrastructure data from fixed road side sensors – Environmental Sensor Station (ESS) sites and the National Weather Service

- Combined data sources insure information along entire corridor and not just at ESS sites

- Produces road weather forecasts and treatment recommendations to aid maintenance managers and other personnel in key decisions of treatment type, timing, rates, and locations

1 — Connected vehicles gather data on road-weather conditions and transmit to roadside equipment

2 — Roadside equipment sends connected vehicle road-weather data to VDT

3 — VDT ingests data, performs quality checks, applies other algorithms, and outputs advanced road segments data to Enhanced-MDDS

4 — Enhanced-MDSS ingests advanced roadway segment data from VDT, develops enhanced forecasts and road condition predictions, and provides enhanced recommendations and treatment plans

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EMDSS Estimated Impacts

- With improved VDT algorithms the expected benefits of EMDSS are:
  - Improved accuracy of short (12hrs), and medium to long (24 hrs to 48 hrs) high resolution forecasts
  - High accuracy of forecasts will help maintenance personnel draft efficient strategies to optimize labor, equipment and chemicals thereby reducing costs
  - Timely treatment recommendations to potentially improve safety and roadway levels of service during adverse weather

Example of high resolution forecasts

Avg. Air Temp - 31°F
Dewpoint - 29°F
Pavement Temp – 29.6°F
Precip – Mixed
Condition – Slush
Visibility - LOW

A

Avg. Air Temp - 30°F
Dewpoint - 29°F
Pavement Temp – 27.3°F
Precip – Snow
Condition – ICE
Visibility - Moderate

B
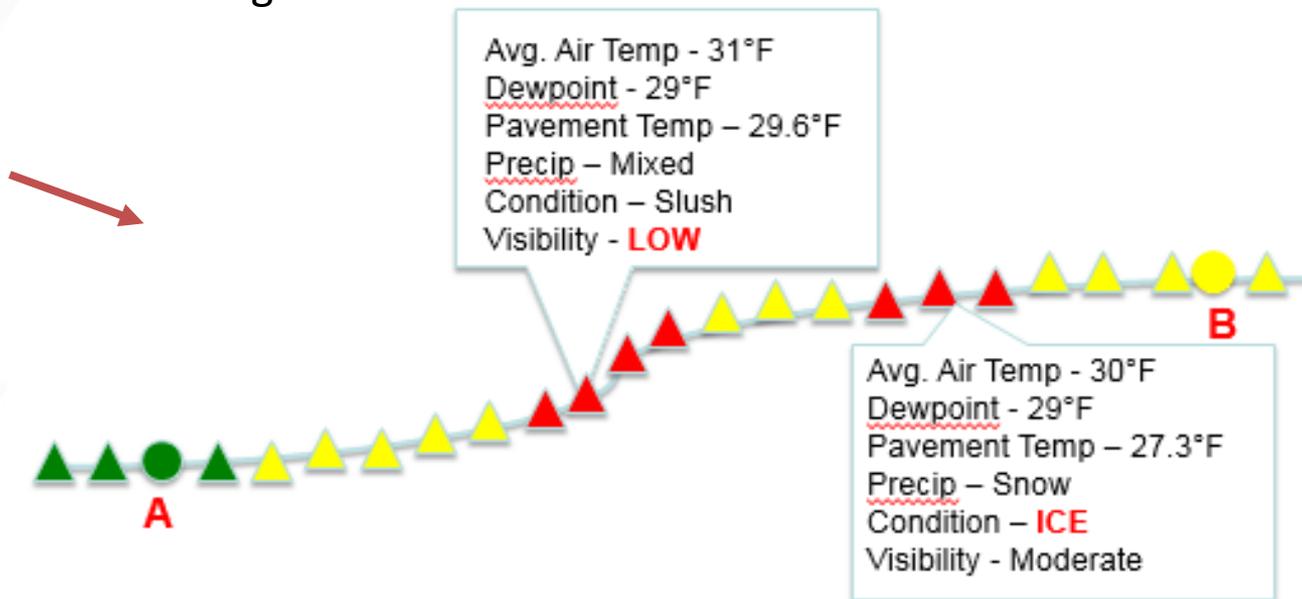
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Connected Vehicle Pilot Deployment Program
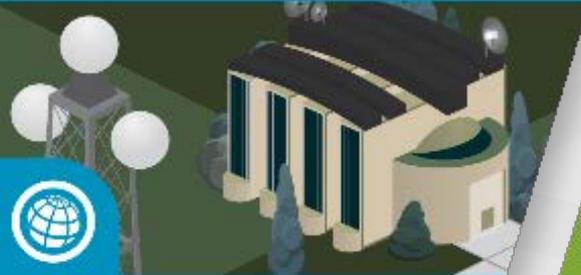
Trilateral Probe Data Research Objectives

- JOINTLY DEVELOP high-level definition of probe data (from light, transit, and freight vehicles) for purposes of this collaboration and IDENTIFY technologies and systems that deliver these data

- **SHARE data** and research findings, experiences, and lessons learned from development and deployment of probe-data enabled applications and probe data systems

- JOINTLY IDENTIFY **applications** that may be developed using probe data as defined by the Trilateral EU-US-JPN Probe Data WG

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For More Information – www.its.dot.gov