Policy Development for Big Data at the ITS JPO

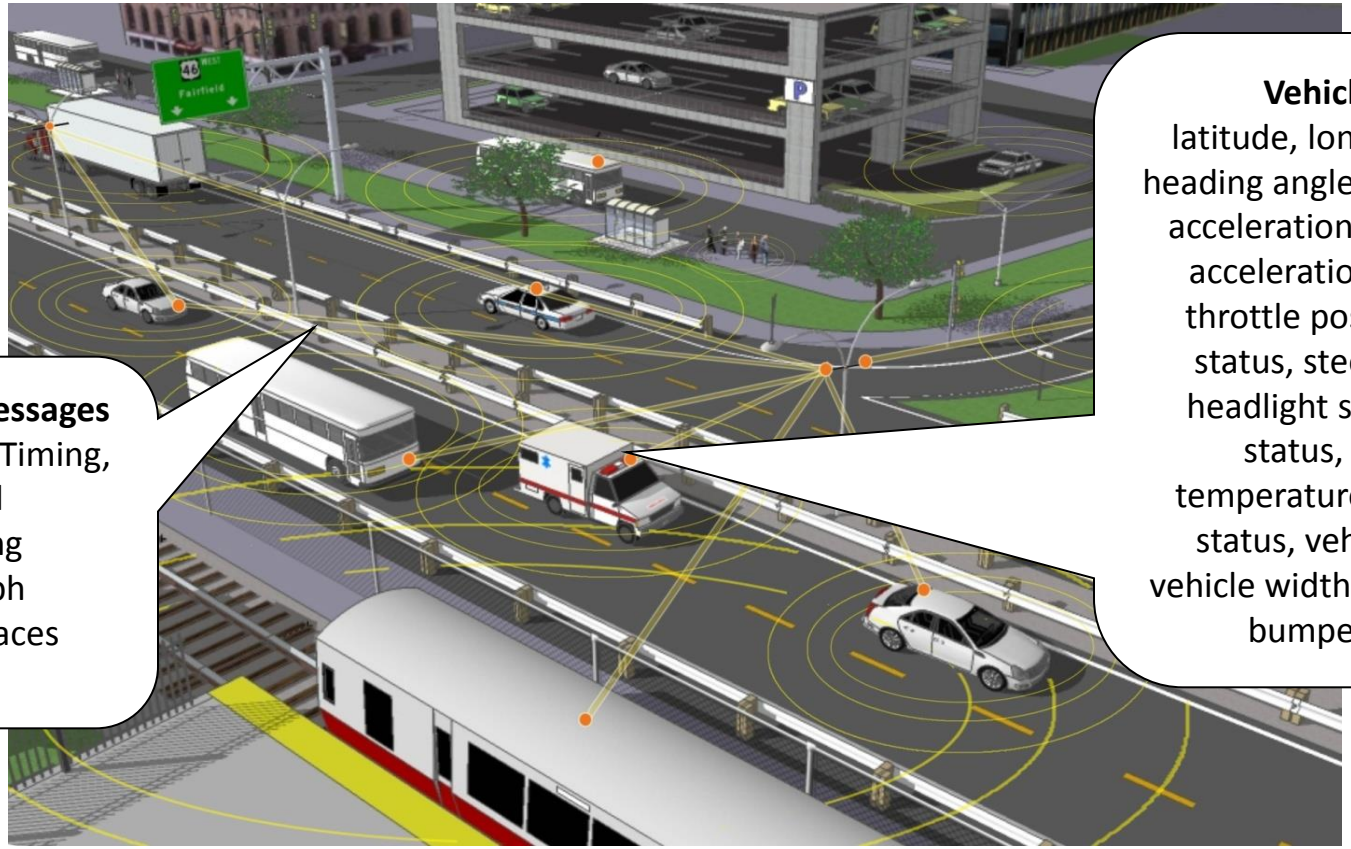
June 17, 2015

Dale Thompson
Office of the Secretary of Transportation – Research and Technology
Intelligent Transportation Systems Joint Program Office

Agenda

- Overview of the Connected Vehicle Program
- Challenges and Opportunities of Big Data
- Critical Technical and Policy Research Questions and Projects

Connected Vehicle Environment

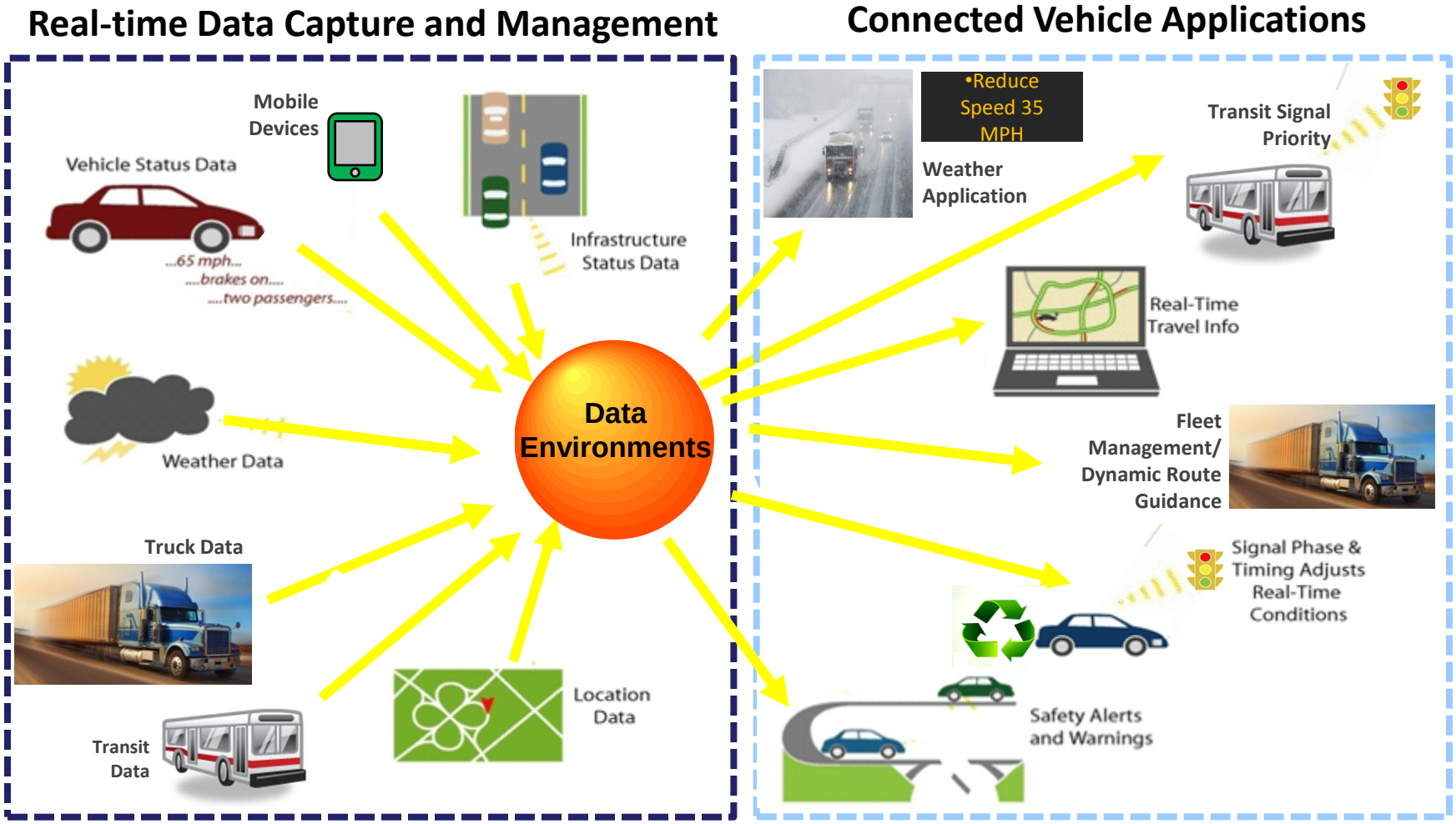


Infrastructure Messages
Signal Phase and Timing,
Fog Ahead
Train Coming
Drive 35 mph
50 Parking Spaces
Available

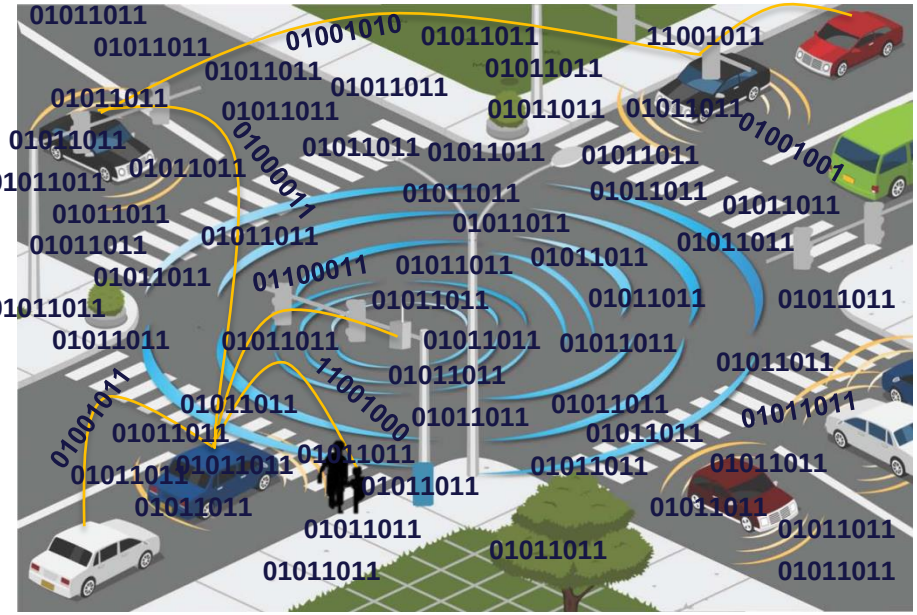
Vehicle Data
latitude, longitude, time, heading angle, speed, lateral acceleration, longitudinal acceleration, yaw rate, throttle position, brake status, steering angle, headlight status, wiper status, external temperature, turn signal status, vehicle length, vehicle width, vehicle mass, bumper height

Image Source: Thinkstock/USDOT

Real-time Data Capture and Management



Potential Data Explosion With Connected Vehicle Deployment



- Safety Pilot Model Deployment, Ann Arbor, MI
  - 2836 vehicles generating Basic Safety Messages on 73 miles of freeways and arterials (approx. 2% of vehicles)

Data Statistics	October 2012	April 2013
Number of Unique Vehicle IDs	1626	2069
Number of BSMs generated	1.3 Billion	2.7 Billion
BSM Storage Space	96 GB	197 GB

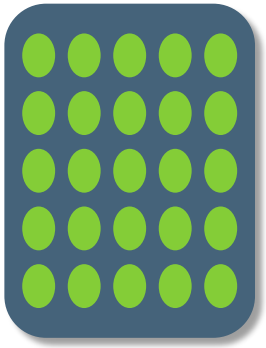
Challenges

- Data explosion imminent as connected vehicle research evolves to deployment phase
  - Significant challenges to data management and data analytics
- Will data communications swamp available channels?

Opportunities

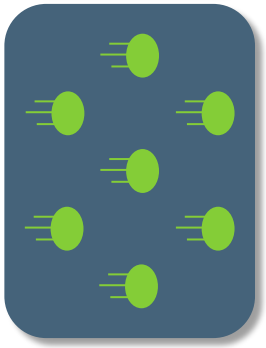
- Use large amount of data collected from connected vehicles for better traffic management through enhanced situational awareness and prediction
  - Improve accuracy and speed of decision-making, thereby facilitating proactive management
  - Affords capability to determine causality of transportation problems, such as crashes, bottlenecks, delays, etc.
  - Provides comprehensive and accurate view of transportation systems

What is Big Data?



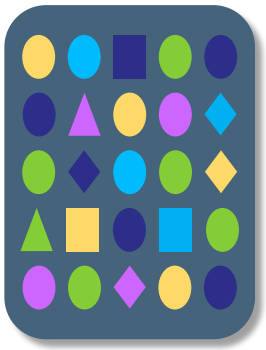
Volume

Use greater amounts of data



Velocity

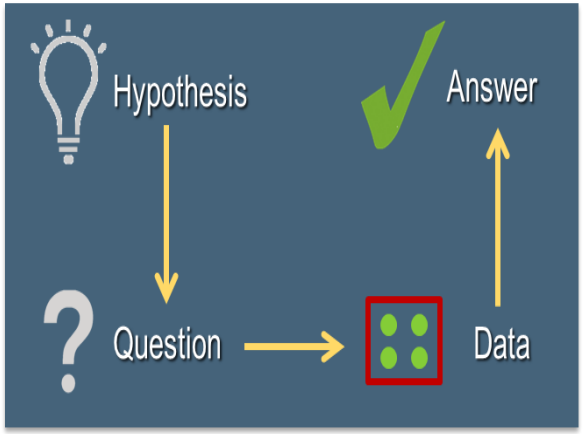
Use data more quickly



Variety

Use more types of data

Traditional Approach

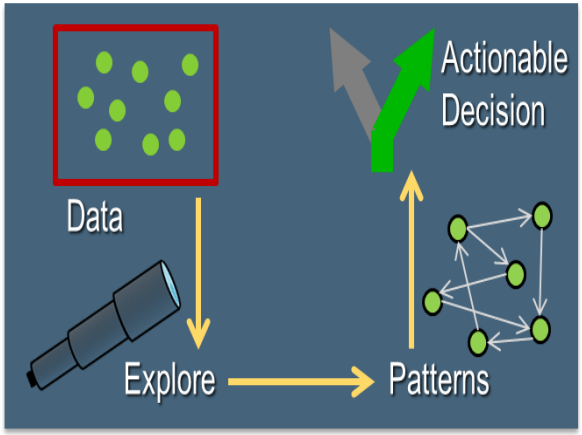


Hypothesize –

test against subset of data that has been cleansed

Big Data Approach:

Data Leads the Way



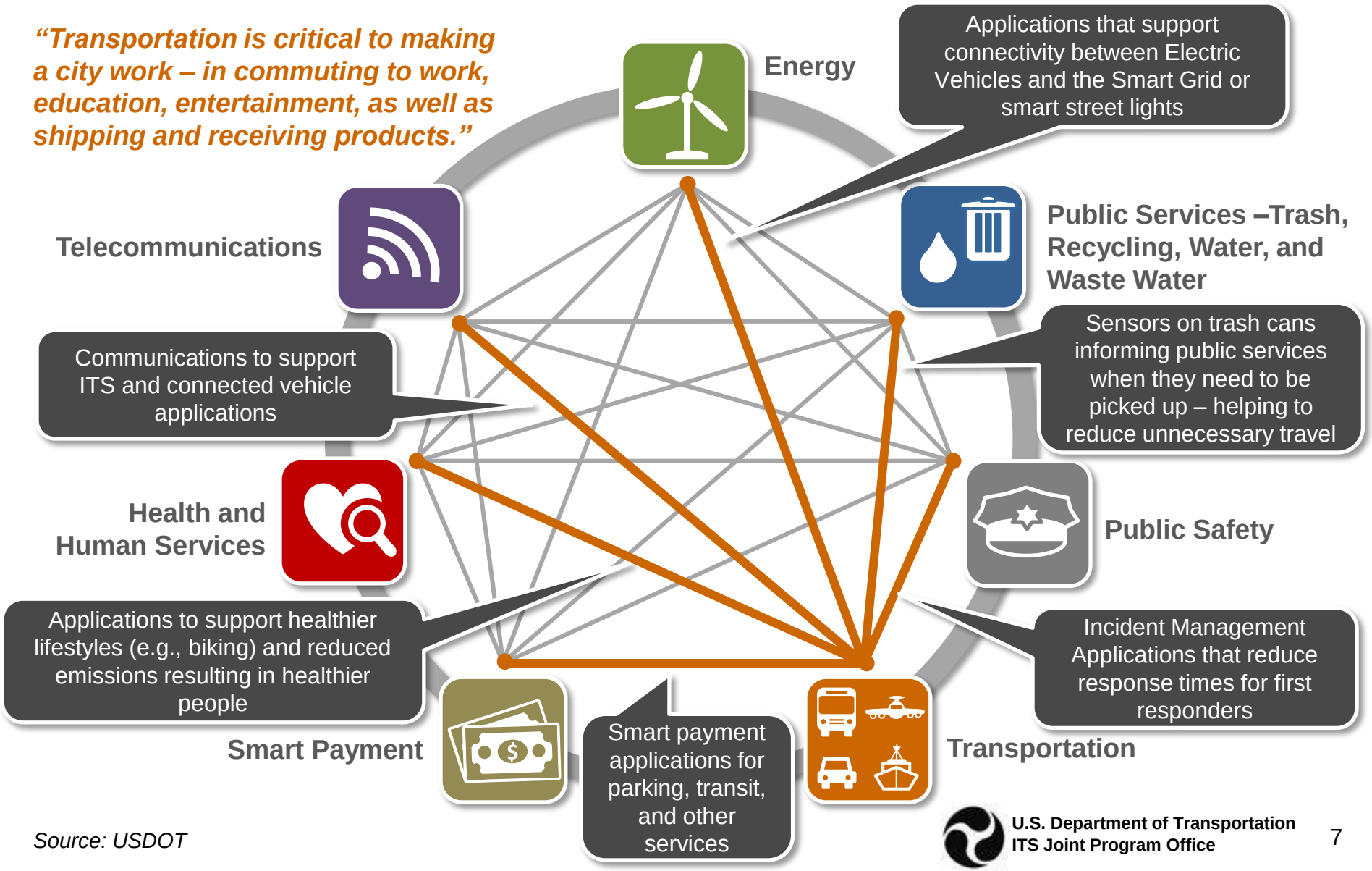
Explore all data as is –

identify patterns – take action

- **Exceeds capabilities of conventional tools**
- **Requires alternative or new solutions**
- **Requires high performance computing and advanced analytics**

Components of the Smart / Connected City

"Transportation is critical to making a city work – in commuting to work, education, entertainment, as well as shipping and receiving products."



Source: USDOT

USDOT Big Data Research is Addressing Specific Questions and Challenges

Example Big Data Research (by Category)	Example Questions Addressed
Big Data Capture and Management	
Research Data Exchange (RDE)	How can very large connected vehicle data sets be stored and made accessible to many researchers and developers?
Operational Data Environment (ODE)	How can connected vehicle data be integrated and aggregated in a real-world, operational connected vehicle environment and be provided to all applications and users?
Dynamic Interrogative Data Capture (DIDC)	How can the volume of connected vehicle data be reduced to manageable levels without comprising functionality?
Crowdsourcing Research	How can travelers and citizens serve as potential data and information sources?
Big Data Analytics	
Graph Analytics for Connected Vehicles – Bottleneck Prediction	How can big data analytics, such as graphic network techniques, be applied to predict traffic congestion?
Using Big Data for Transportation Operations	
Big Data for Next Generation Integrated Corridor Management (ICM)	How can big data tools and techniques be applied within a real-world transportation system management strategy?
Agency Readiness for Big Data – Transitioning to a Data Culture	How must transportation agencies change in order to effectively incorporate big data strategies?
Connected Cities Research	How will connected and automated vehicles and other aspects of a dynamic, multi-modal and integrated transportation system link with the other elements of a Connected City?

USDOT Big Data Research is Addressing Specific Questions and Challenges

Big Data Issues	CV Projects Addressing the Issues
Big Data Capture and Management	
Data Distribution Rights and methods	The Research Data Exchange (RDE) is making large sets of connected vehicle data accessible to many researchers and developers, and is moving toward cloud storage for massive data sets.
Vehicle data Integration and aggregation	Operational Data Environments (ODEs) in Northern Virginia and Southeast Michigan are collecting, integrating, and aggregating real-time connected vehicle data and supplying the data to connected vehicle applications.
"Right-sizing" the amount of data generated, transmitted, and stored	The Dynamic Interrogative Data Capture (DIDC) project is developing techniques for reducing the volume of connected vehicle data to manageable levels without comprising functionality.
Using travelers and citizens as potential data and information sources	A new Connected Data System project will examine ways that emerging data sources including "crowd-sourcing" can be used to transform surface transportation management.
Big Data Analytics	
Using big data analytics such as graphic network techniques to predict traffic congestion	The CDS Program is sponsoring a project using Graph Analytics to detect and predict bottlenecks and congestion using large volumes of connected vehicle data Future projects are focused on high-performance computing approaches.
Using Big Data for Transportation Operations	
Using big data tools and techniques within a real-world transportation system management strategy	The Integrated Corridor Management (ICM) project is building big data into the Next Generation of multi-modal traffic management strategies

Agency Readiness for Big Data: Transitioning to a Data Culture

- How is big data different from current approaches?
- What new tools and workforce capabilities may be needed?
- How much will be contracted from the private sector?
- How to link to broader trends transforming transportation agencies?
- Are new relationships with Information Technology (IT) departments needed?

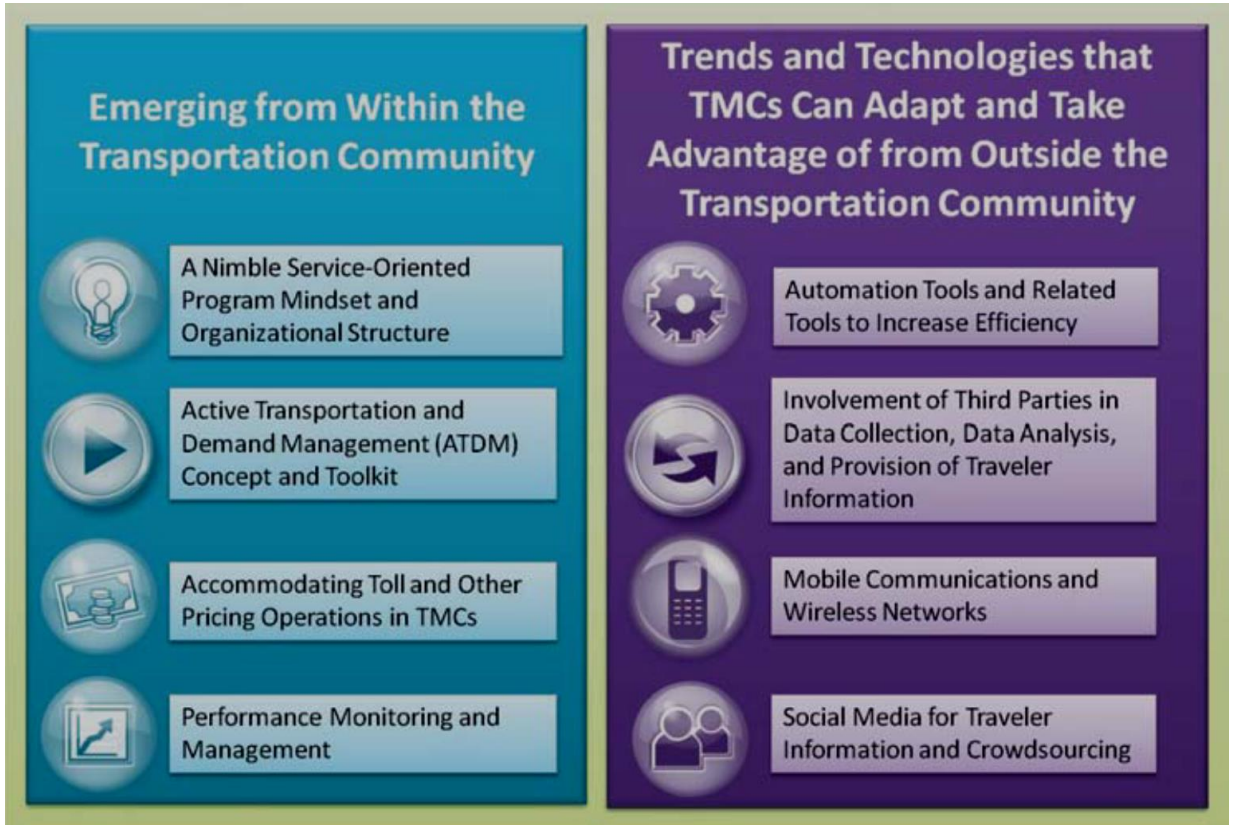
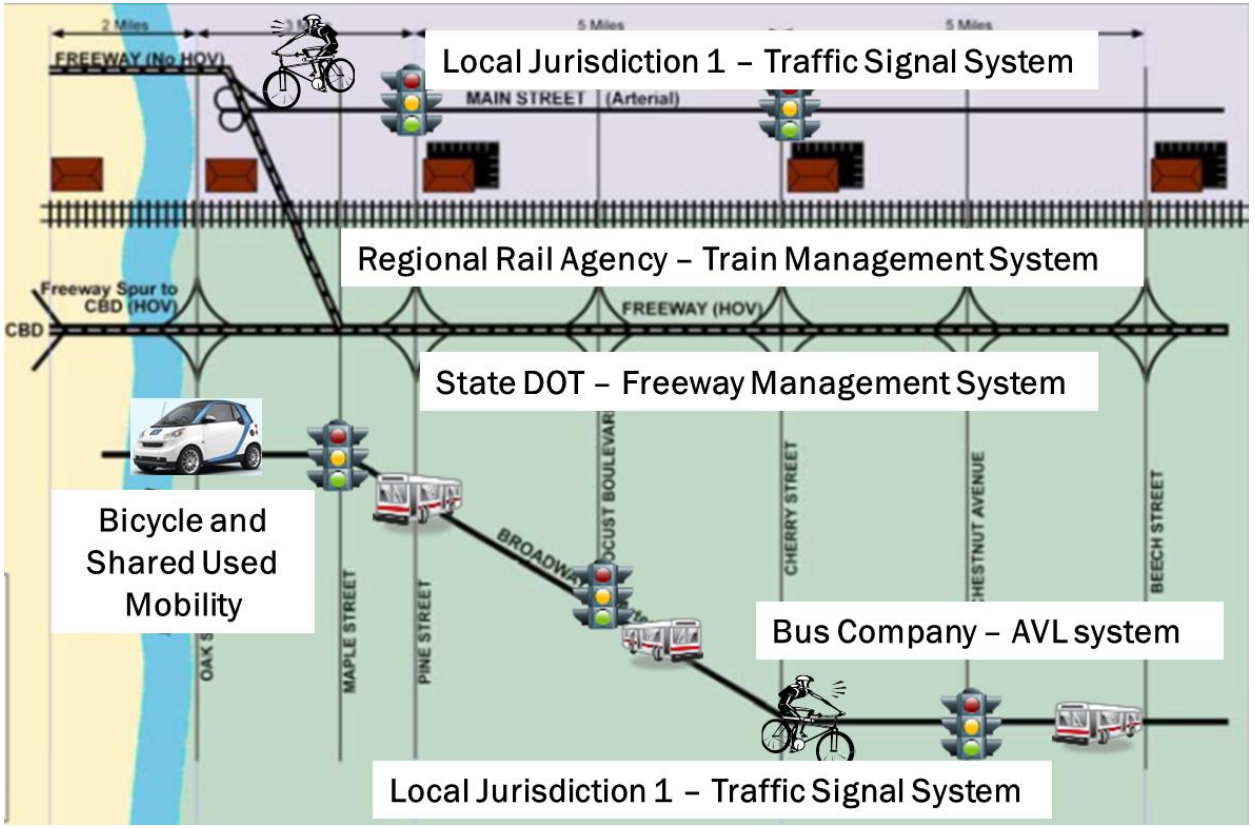


Image Source: USDOT-FHWA/Parsons Brinkerhoff. "Impacts of Technology Advancements on Transportation Management Centers." January 2013

Big Data for Next Generation Integrated Corridor Management (ICM)

- How can big data techniques support:
  - ***Integration* and *sharing*** of connected vehicle and traveler data?
  - Incorporation of additional ***operational objectives***, such as economic, freight, transit
  - ***Situational awareness*** (fusing data to assemble a comprehensive picture of real-time multi-modal system conditions)
  - ***Decision Support Systems***, including predicting conditions and recommending responses?



Integrated Corridor Management =
Actively managing a transportation corridor as an integrated, multi-modal system to spread demand over available capacity in time and space to enhance mobility

Image Source: USDOT

USDOT Big Data Research is Addressing Specific Policy Questions and Challenges

Example Policy Research (by Category)	Example Questions Addressed
Privacy/Confidentiality	
De-Identification Algorithm Development and Testing	How can individuals' locations be hidden in data containing GPS traces? How can we preserve the data's value at the same time?
Security	
Security Management Credential System Analysis and Testing	How can data transmitted by vehicles be protected from corruption while preserving driver anonymity?
Data Monetization	
Southeast Michigan CV Test Bed	How can private companies recover their costs from participating in an operational data environment?
Data Quality/Reliability	
Device/Application Certification	How can the data produced by a device or service be proven reliable?
Standards Harmonization	How can data-dependent functions operate reliably across international borders?

USDOT Big Data Research is Addressing Specific Policy Questions and Challenges

Policy Issues	CV Projects Addressing the Issues
Privacy/Confidentiality	
-Ensuring that released data does not contain information that could lead to: • Identification of the driver • Identification of the vehicle	The Oak Ridge Data De-Identification project; • Developed algorithms to remove locations that could lead to identification • Identified vehicle characteristics parameters that could lead to identification • Will identify driver behavior patterns that could lead to identification • Evaluates proposed “privacy by design” approaches • Without deleting so much data it is useless to researchers
Security	
Protecting data transmitted by vehicles from corruption while preserving driver anonymity	Security Credential Management System (SCMS) is being implemented and tested at the Southeast Michigan Testbed, and will be required for Connected Vehicle Pilot projects
Data Monetization	
Ensuring that private companies can recover their costs from participating in an operational data environment	The Data Business Plan project develops policies for government/private sector coordination. Public/private ventures are explored at the Southeast Michigan CV Test Bed
Data Quality/Reliability	
Ensuring that the data produced by a device or service can be proven reliable	The Device/Application Certification program is developing policies for certifying products for performance and interoperability.
Operating data-dependent functions reliably across international borders	The International Standards Harmonization committee works with European and Japanese counterparts to select the best parts of emerging standards to share across international boundaries.

Contact Information

For Additional Information

Dale Thompson
Office of the Secretary of Transportation – Research and Technology (OST-R)
Intelligent Transportation Systems Joint Program Office (ITS JPO)
Connected Vehicle Policy Program
202-493-0259
dale.thompson@dot.gov