U.S. Department of Transportation

CONNECTED VEHICLES DATA EXCHANGE PROJECT WEBINAR

Ariel Gold
Data Program Manager, ITS Joint Program Office
U.S. Department of Transportation

Riyadh Mahmood
The Aerospace Corporation

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AGENDA

- ITS JPO Data Program Overview
- Connected Vehicle Data Exchange Project Overview
- Technical Architecture
- Lessons Learned
- Q&A

ITS JPO DATA PROGRAM OVERVIEW

ABOUT THE ITS JPO DATA PROGRAM

The ITS JPO Data Program is a multimodal effort to enhance how data is managed, **accessed**, and **used** throughout the transportation ecosystem to support the next generation of ITS technologies.

We aim to establish a foundation for agility, data sharing, and privacy protection in the future transportation system – including connected, automated, and shared vehicles and smart communities – to maximize the societal benefits of these technologies.

https://www.its.dot.gov/factsheets/pdf/FactSheet_EnterpriseData.pdf

PROGRAM STRATEGY
PROBLEM SOLVING APPROACH – LEARN BY DOING

- Bring a system-wide/multimodal perspective to data availability and use
- Default to agile and open (data, code, docs) and other digital best practices[1]
- Pilot new approaches with the coalition of the willing to solve real problems
- Where successful, add new tools to our collective toolbox

[1]US Digital Services playbook available at: https://playbook.cio.gov/
Example of project developed iteratively in the open: https://github.com/usdot-jpo-ode/

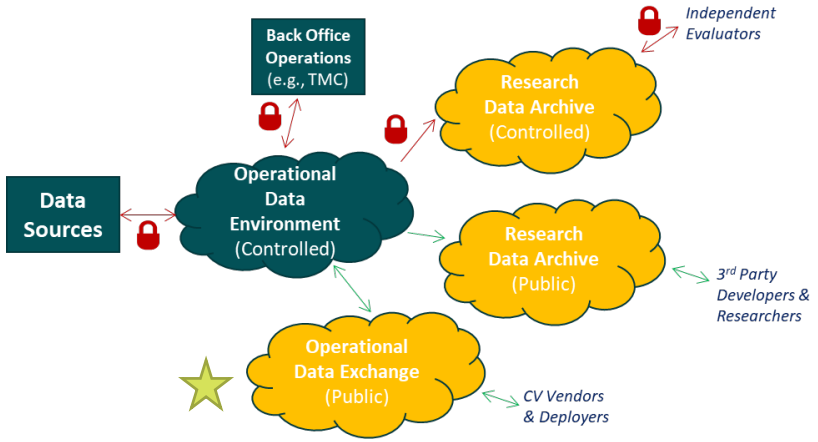
PROGRAM RESOURCES

- Public and controlled-access ITS research data sets
  - https://www.its.dot.gov/data/
  - https://its.dot.gov/data/secure/
- Open source ITS software
  - https://its.dot.gov/code/
- ITS data exchange enablement
  - https://www.transportation.gov/av/data
  - https://www.transportation.gov/av/data/wzdx
  - https://github.com/usdot-jpo-sdcsdw

CONNECTED VEHICLE DATA EXCHANGE PROJECT OVERVIEW

CONNECTED VEHICLE DATA EXCHANGE
PROJECT OBJECTIVES & BACKGROUND

- Support the national deployment of interoperable connected vehicle (CV) technologies
- Collect, fuse, and repackage operational data from disparate deployments and sources for dissemination at a national level to support a range of use cases
- Establish the technical capability as a proof-of-concept
- Evaluate the potential approaches, costs, and benefits of scaling these systems to support large-scale, national CV deployment



CONNECTED VEHICLE DATA EXCHANGE
PROOF-OF-CONCEPT SYSTEMS

Phase 1: Southeast Michigan Testbed

- The **Situation Data Clearinghouse** provided data collection and repacking functions, but only for data relevant in the immediate future. Data deposited at the Clearinghouse was immediately delivered via a 'push' mechanism to all registered and available delivery locations.
- The **Situation Data Warehouse** provided data collection, fusing, and repacking functionalities. Data deposited at the Warehouse was retained for a variable amount of time, based on the time context of the data) and was available for ad hoc queries through a 'pull' mechanism.

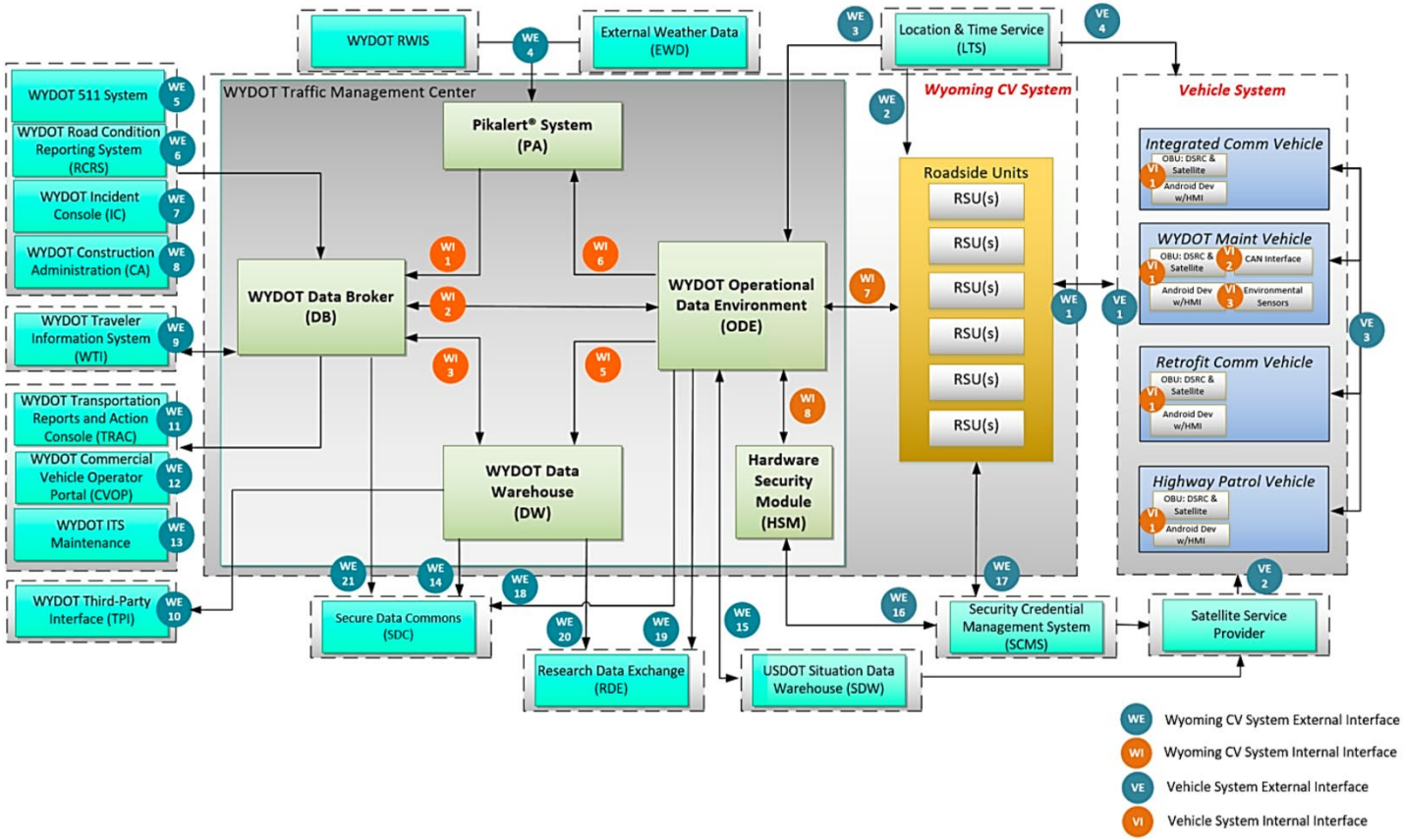
Phase 2: CV Pilot Proof-of-Concept

- The upgraded **Situation Data Warehouse** was developed in the open in collaboration with the Wyoming CV pilot and their data exchange partners. The updated system architecture enhanced scalability and extensibility using cloud technologies and modular design with provided data collection, fusing, and repacking functionalities.

Phase 3: National Operational System(s)

TECHNICAL ARCHITECTURE

WYDOT CV PILOT SYSTEM ARCHITECTURE



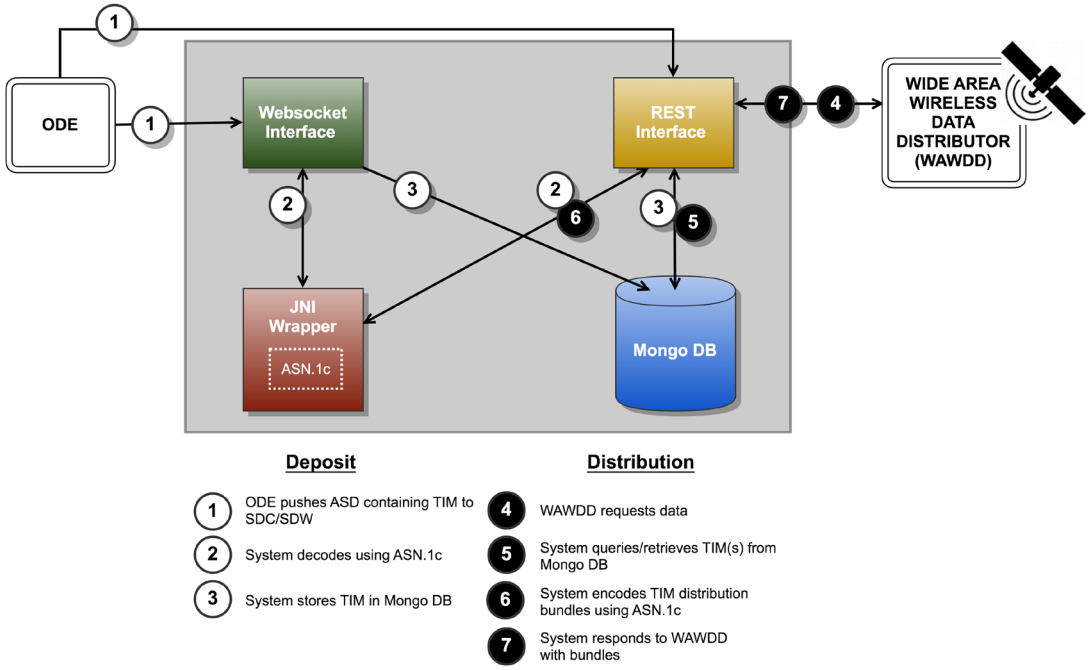
NOTE: The Wyoming CV System Interface WI4 (PA→DW) was not implemented in the final system design.

Figure 2-2. Physical View of WYDOT CV Pilot System Architecture with Numbered Interfaces. (Source: WYDOT)

https://www.its.dot.gov/pilots/pilots_wydot.htm

OVERALL ARCHITECTURE

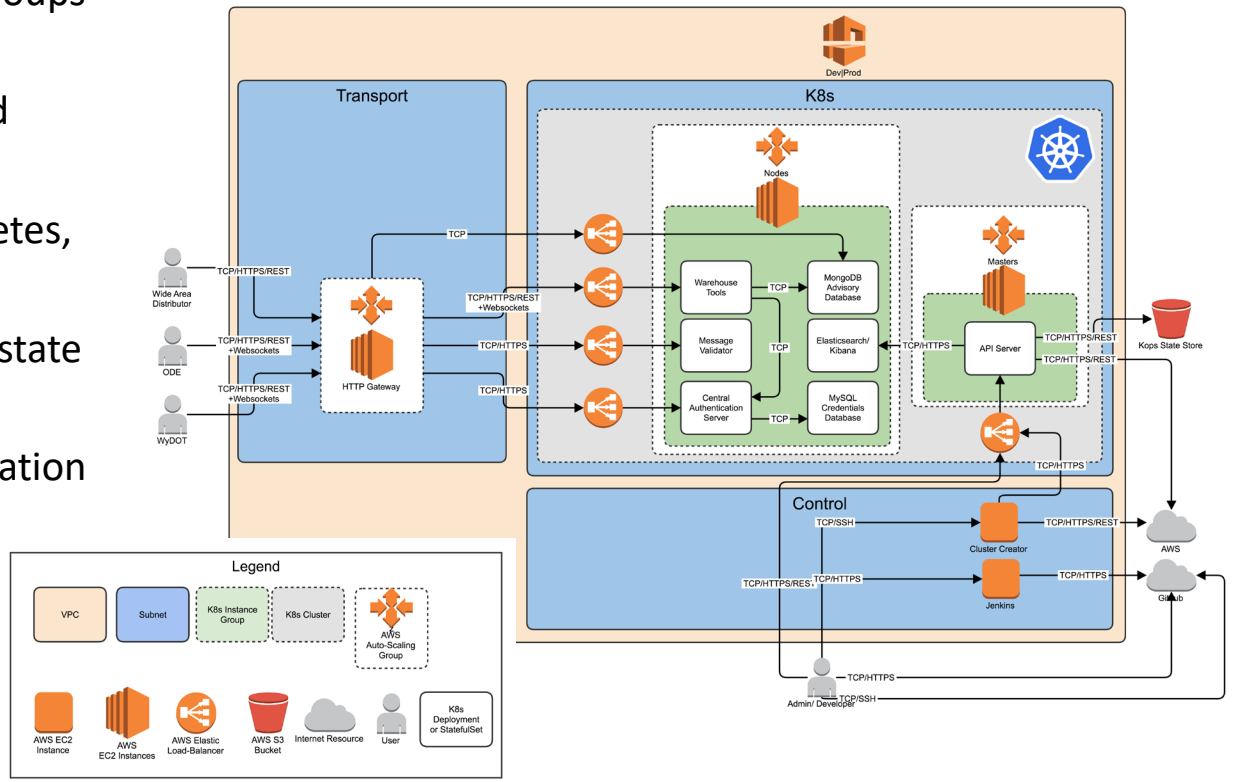
- SDW provides two external interfaces (WebSocket, REST)
- Operational Data Exchange (ODE)* is able to send data over WebSocket and REST interfaces
- A test and validation web GUI (shown later) communicates over the WebSocket interface
- Wide area data distributors query the data over the REST interface
- All REST interfaces are described using the OpenAPI specification



*For more information on the ODE, visit https://github.com/usdot-jpo-ode/

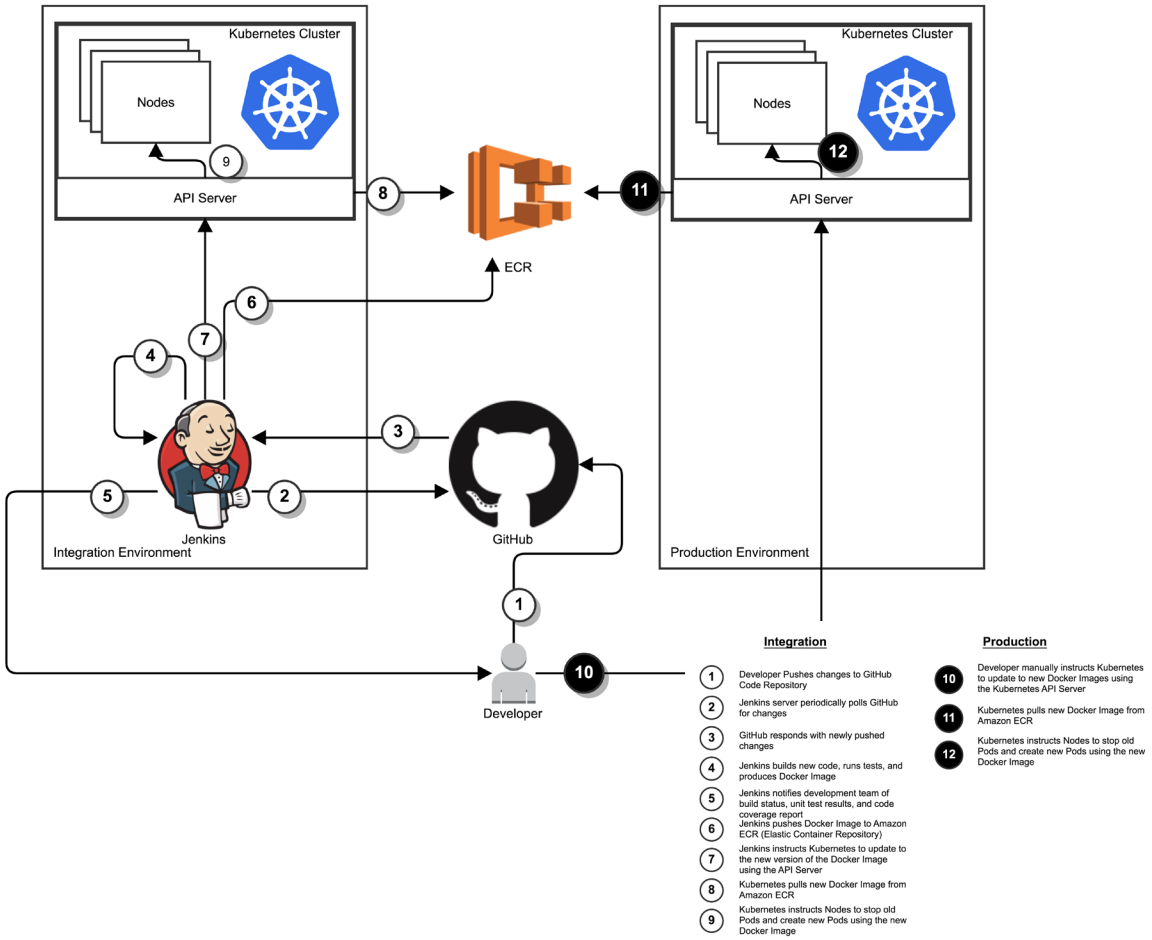
DEPLOYMENT ARCHITECTURE

- SDW deployed on the AWS EC2 instances with auto scaling groups and load balancers
- All components containerized using Docker
- All containers run on Kubernetes, enabling horizontal scaling
- Kubernetes backed by S3 for state storage
- Three subnets used for separation of concerns and security



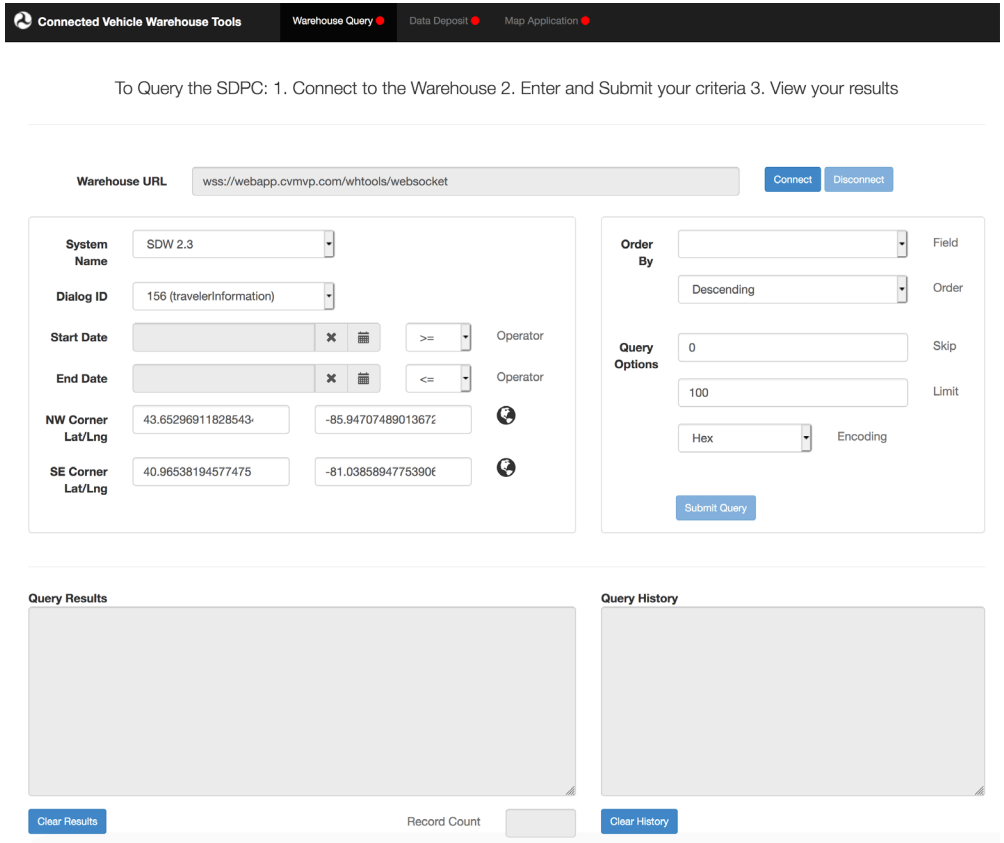
CONTINUOUS INTEGRATION, CONTINUOUS DELIVERY (CI/CD) PROCESS

- Git/GitHub is used as the source repository following coding standards and unit tests
- Identical integration and production environments
- Jenkins is used as the CI/CD tool to deploy code into integration
- All containers are stored in AWS Elastic Container Registry (ECR)
- Production deployments handled by engineering team upon concurrence from stakeholders



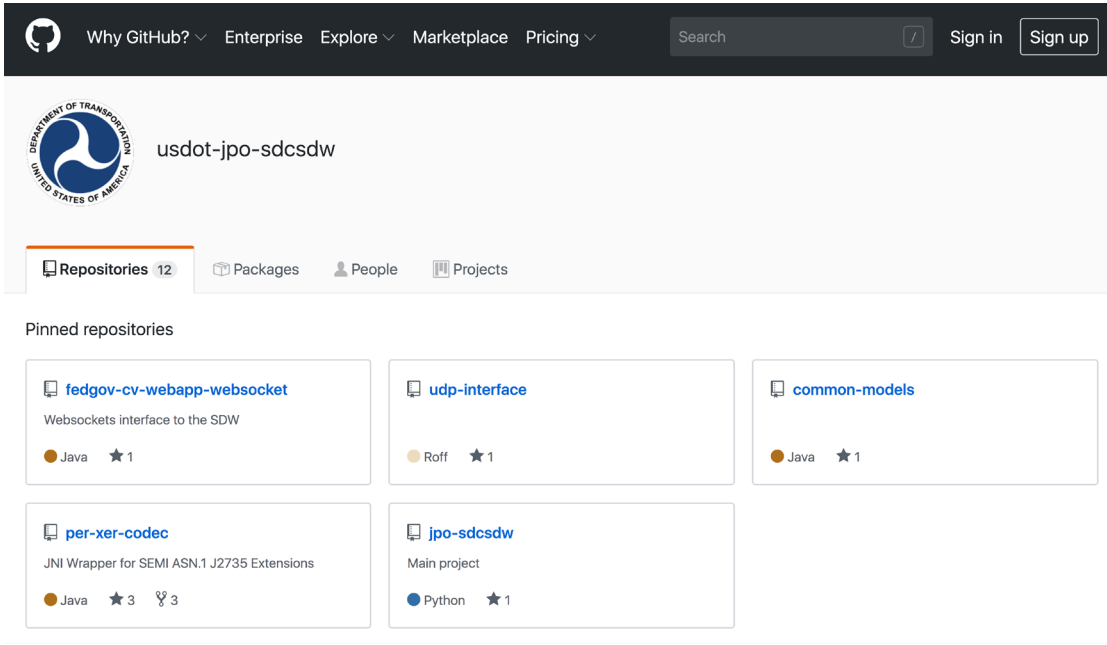
TEST / VALIDATION GRAPHICAL USER INTERFACE

- Test/validation web GUI interacts over the WebSocket interface
- Requires users to create username and password prior to accessing
- Allows to deposit, query, and view messages
- Useful when debugging test messages and during the integration phase
- Various filtering and data format options are available



FREE AND OPEN SOURCE SOFTWARE

- SDW developed as an open-source project
- All code, artifacts, and build instructions are available on GitHub
- Open-sourcing checklist is used to ensure coding and licensing standards are followed and sensitive information not leaked (e.g. passwords, configurations)
- The code and build instructions have been independently verified by an industry partner
- https://github.com/usdot-jpo-sdcsdw



LESSONS LEARNED

LESSONS LEARNED

- Development Approaches and Technologies
  - Validated agile and open source development, included across multiple projects
  - New technology advances justify “building from scratch” with modular architecture
  - Technology coordination (between public & private systems) and modern standards vital (e.g., RESTful API)
  - Public-private collaboration and user-centered design critical to transition into sustained operations

- Business Case
  - Clear business case for large-scale CV data warehouse capability
  - Less clear business case for large-scale CV data clearinghouse capability

- USDOT Role
  - Acted as incubator with foundational research
  - Supported CV Pilots for operational data exchange proof-of-concept
  - Enabled third-party development of commercial application

Questions?

Contact Us:

Ariel Gold
Data Program Manager
U.S. Department of Transportation
Intelligent Transportation Systems Joint Program Office
ariel.gold@dot.gov