U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology

Unified Implementation of the CVRIA – Regional Scale

Implementing the Department's ITS Strategic Plan – Interoperability "Opportunity for a Common Experience"

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Common transportation user experience through unified fundamental data definition and movement – from mobile elements, to roadside, to centers.

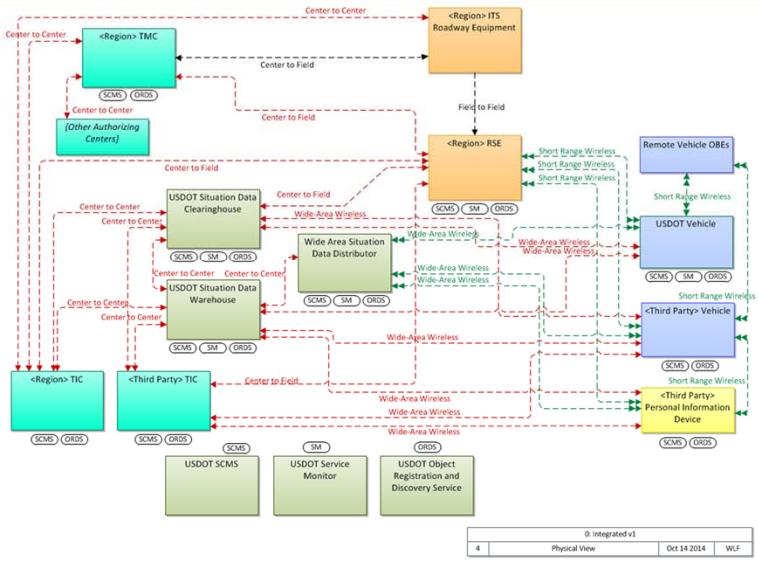
Strategic Priorities

- Two Strategic Priorities reflect a sense of where the bulk of transportation research and innovation is heading. These priorities are not exclusive of other technologies or research areas.

  - ***Realizing Connected Vehicle Implementation***
    - builds on the substantial progress made in recent years around design, testing, and planning for connected vehicles to be deployed across the nation.
  - ***Advancing Automation***
    - shapes the ITS Program around research, development, and adoption of automation related technologies as they emerge.

Connected Vehicle Vision

- **Complete System**
- **Comprehensive Communication Security**
  - Common Cryptographic processes
- **Data Flow and Evolution**
  - Data from all, to all
  - Private data



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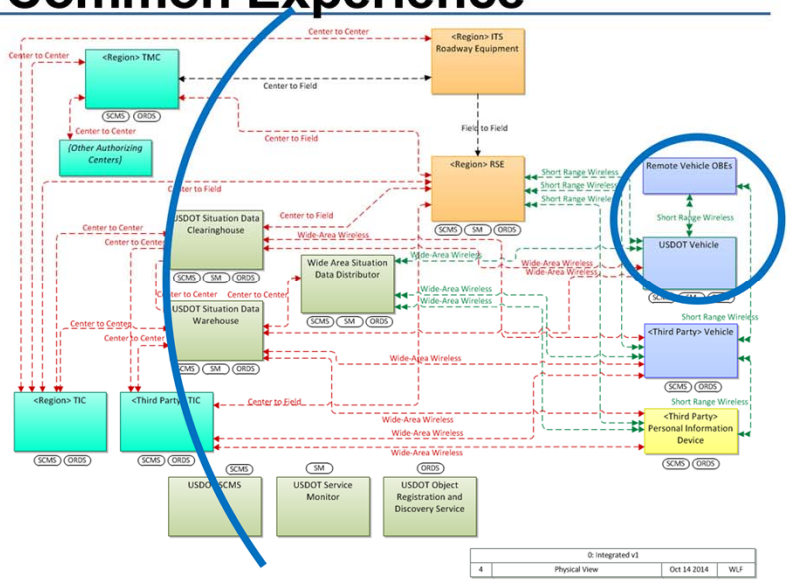
The concept is to organize installations in a large region so that all parties have a common experience. We expect a number of site operators, the USDOT Test Bed, and a number of independent content providers and vehicle and other mobile device operators. This expectation of common experience goes a number of ways. Vehicle operators expect consistent data from infrastructure devices and center-based content providers. Center-based data analysts expect consistent data from vehicles and infrastructure.

A common understanding of how fundamental data units are defined and moved will be needed to meet those expectations. Overall, there are three fundamental data flows – vehicle situation data, intersections situation data, and traveler situation data. We will use a unified approach to communication security and advocate the use of common message sequences for all other peer-to-peer data exchanges.

Opportunity for a Common Experience

- **Started with crash avoidance**
- **Extending to interaction with field devices and data to/from back offices**



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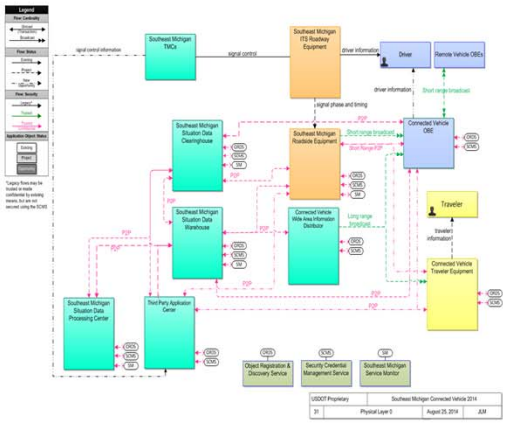
The common experience started with the vehicle-to-vehicle information flow - circled in blue. That had to be interoperable.

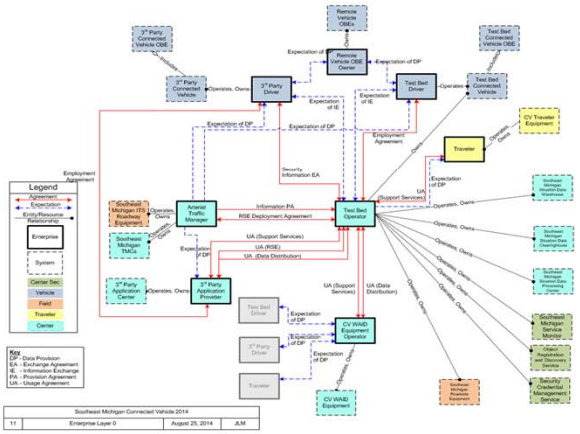
We are now working out from there.

Common Architecture, Graphical Language

Things



People



The Stop Sign metaphor

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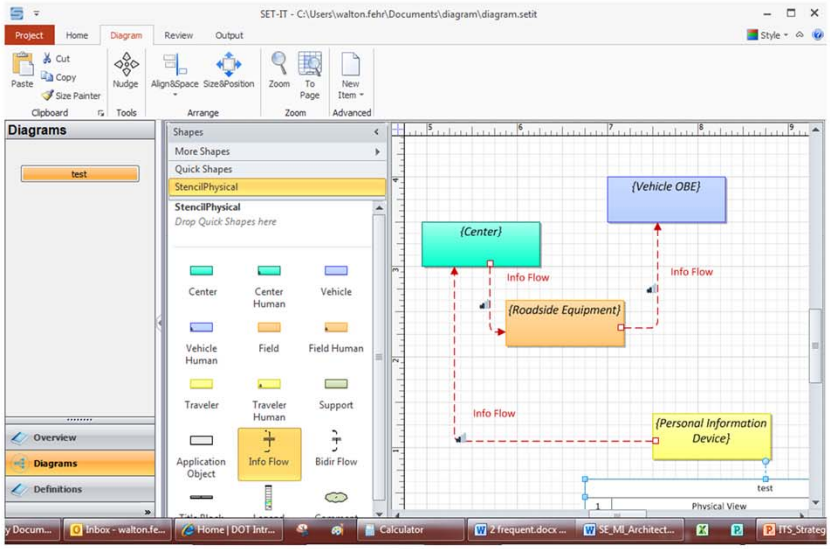
Need to understand things and people

Common Parts, Common Tools

- Architecture
- Concept of Operation
- Design Elements
  - Objects
  - Information Flows



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http://www.iteris.com/cvria/html/resources/tools.html

http://www.iteris.com/cvria/html/forms/setitform.php

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Unified Implementation of CVRIA - Regional

- **Architecture**
  - Based on Southeast Michigan 2014 Project Architecture which built upon the Connected Vehicle Reference Implementation Architecture, Safety Pilot Model Deployment and Proof-of-Concept experiences.
- **Concept of Operation** – *Preserving privacy by design*
- **Design Elements** – Agreement on standards usage, common communication security practice
  - **Vehicle Situation Data, Field Situation Data**
    - Broadcast and bundle-based
    - Intersections and other roadside infrastructure installations
  - **Traveler Situation Data**
    - Multiple delivery media
  - ***Peer-to-Peer Data Exchanges***
    - Maintenance, Management, Enforcement, Commercial

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The main emphasis will be on the agreement of standards usage for the creation and movement of fundamental data.

Three main information flows to support common experience –

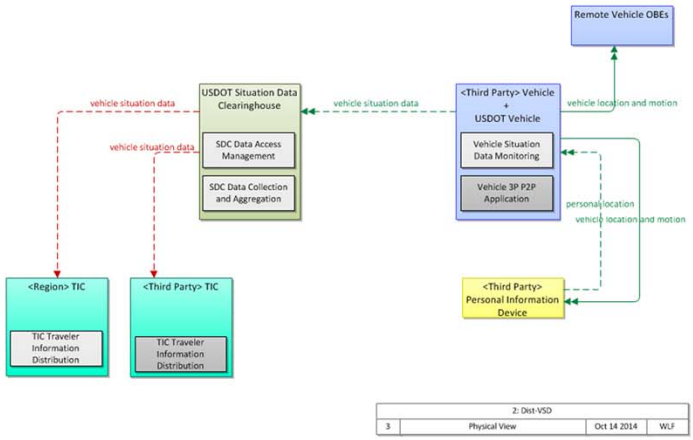
- Flows from vehicles and other mobile elements
- Flows from field devices like traffic signal controllers
- Flows toward vehicles and other mobile elements

The pattern for peer-to-peer data exchanges will be applied where needed for maintenance and management purposes – security credential management and object registration and discovery.

The main objective will be to see if individual installations can be unified as they would eventually need to be in a continent-wide deployment. Strategies and resources will be developed that can be applied to the planned Connected Vehicle pilots.

Vehicle Situation Data

- **All mobile devices will have a location service that meets J2945.1 performance requirements**
- Pooled signing certificates will be available
- USDOT will provide the clearinghouse
- As many vehicles as possible will transmit BSM's
- As many vehicles as possible will make Vehicle Situation Data deposits.
- USDOT vehicles will provide weather, environment, and electric vehicle data items



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a. All in-vehicle devices will have a location awareness service that meets the performance requirements given in J2945.1 for BSM

Need: copy of latest version of J2945.1 for BSM

b. As many as possible in-vehicle devices will transmit Basic Safety Messages defined by J2735 and J2945.1

Need: version of both J2735 and J2945.1

c. As many as possible in-vehicle devices will generate Enhanced Vehicle Situation Data deposits.

Have: Southeast Michigan 2014 definition

d. All USDOT in-vehicle devices will generate the Weather and Environment versions of the Enhanced Vehicle Situation Safety Data deposits.

Have: Southeast Michigan 2014 definition

e. Application objects in in-vehicle devices and roadside devices will implement privacy protection measures.

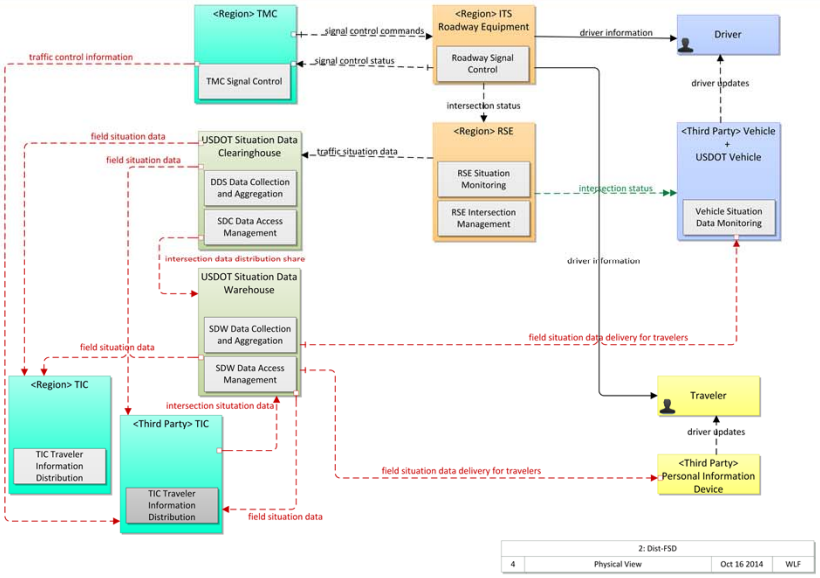
Need: Updated to Southeast Michigan design document

f. The USDOT will operate a regional Situation Data Clearinghouse.

Have: Southeast Michigan 2014 clearinghouse

Field Situation Data

- **Common style for creating and grouping MAP and SPaT data elements, new version of J2735**
- USDOT will provide the clearing house and warehouse
- USDOT will provide a tool for creating MAP and SPaT groupings



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a. All devices creating Field Situation Data at intersections will use a common MAP and SPaT format based on the new version of J2735

Need: version of J2735, update to Southeast Michigan 2014 design version

b. Intersections will include driving lanes and as many cross walks as possible.

Have: current Southeast Michigan 2014 example

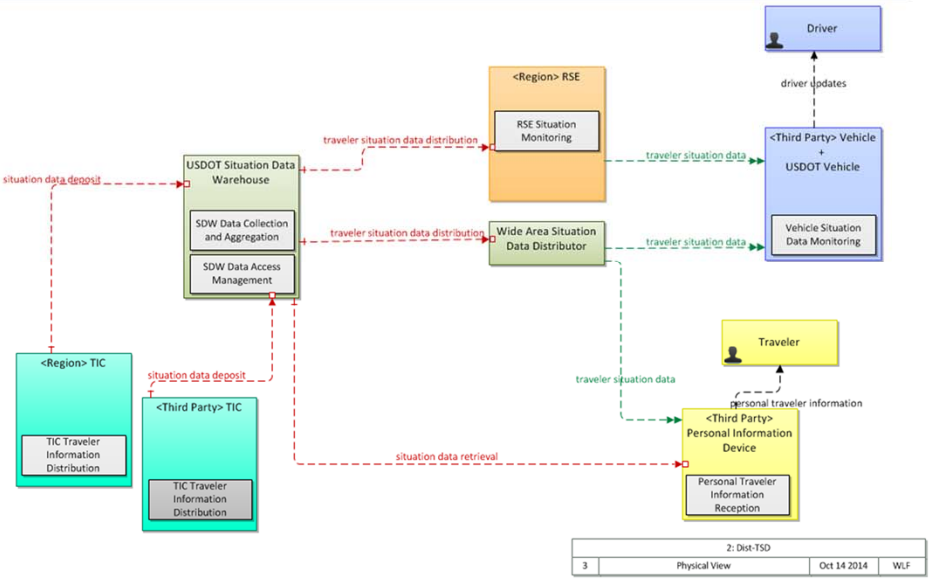
c. As many intersections will be described in Intersection Situation Data deposits.

Need: intersection definitions in areas of interest

Have: Southeast Michigan 2014 bundle definition

Traveler Situation Data

- **Everyone will use the warehouse for data delivery**
- USDOT will provide a tool for creating Traveler Situation Data deposits



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a. All Traveler Situation Data will pass through the Southeast Michigan Situation Data Warehouse.

Have: Southeast Michigan 2014 warehouse

b. All Traveler Situation Data will be generated by one of the USDOT tools, or follow an established pattern.

Need: J2735 Traveler Information Message

Have: pattern for electric vehicle charging station location, type, availability

Have: …yellow diamond signs

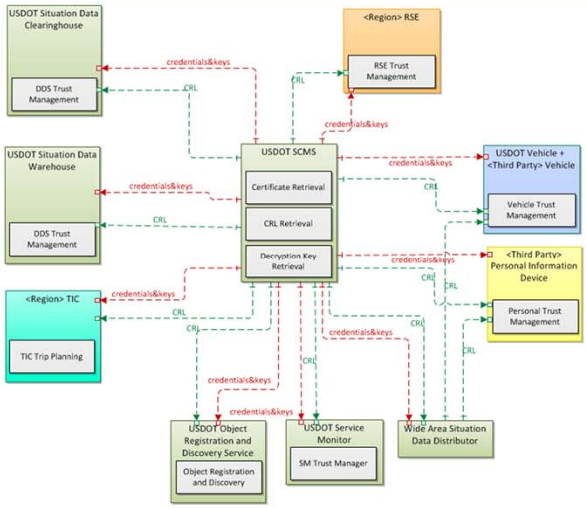
Have: …work zones

Have: …school zones

Have: …speed limits

Communication Security

- **Common communication security approach**
- 1609.2 will be used between mobile objects and field and center objects
- USDOT will provide the Security Credential Management System



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a. All messages originating from mobile objects will be signed using 1609.2 processes.

Need: Agreement on version of 1609.2 – pooled certificates

b. Messages from mobile elements needing encryption will use 1609.2 processes.

Need: Agreement on version of 1609.2

c. The Safety Pilot Model Deployment root will be used.

Have: root value

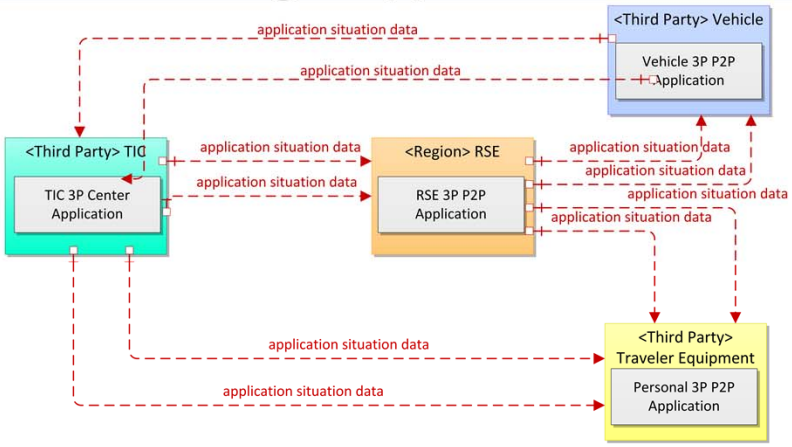
d. The Test Bed SCMS will provide the material.

Have: test bed installation

e. Collective management oversight

Peer-to-Peer Date Exchange Applications

- **Common message sequence**
- 5.9GHz DSRC roadside equipment needs to have adequate backhaul for Internet Protocol transport activities
- Used for maintenance, management, enforcement, commercial types purposes



2: Third P2P			
3	Physical View	Oct 16 2014	WLF

a. All roadside equipment will support peer-to-peer data transport.

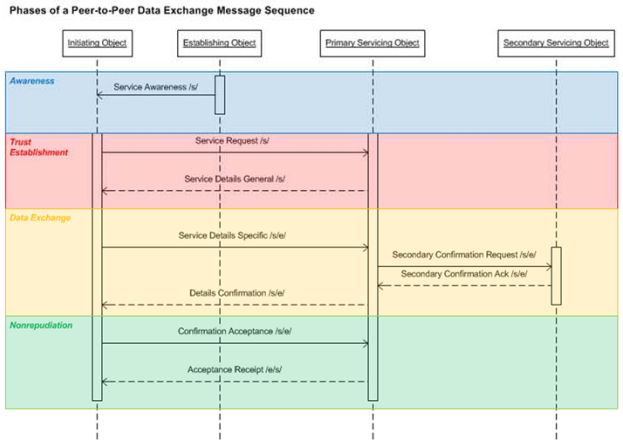
b. All roadside equipment will be updated to the latest version of 1609.n

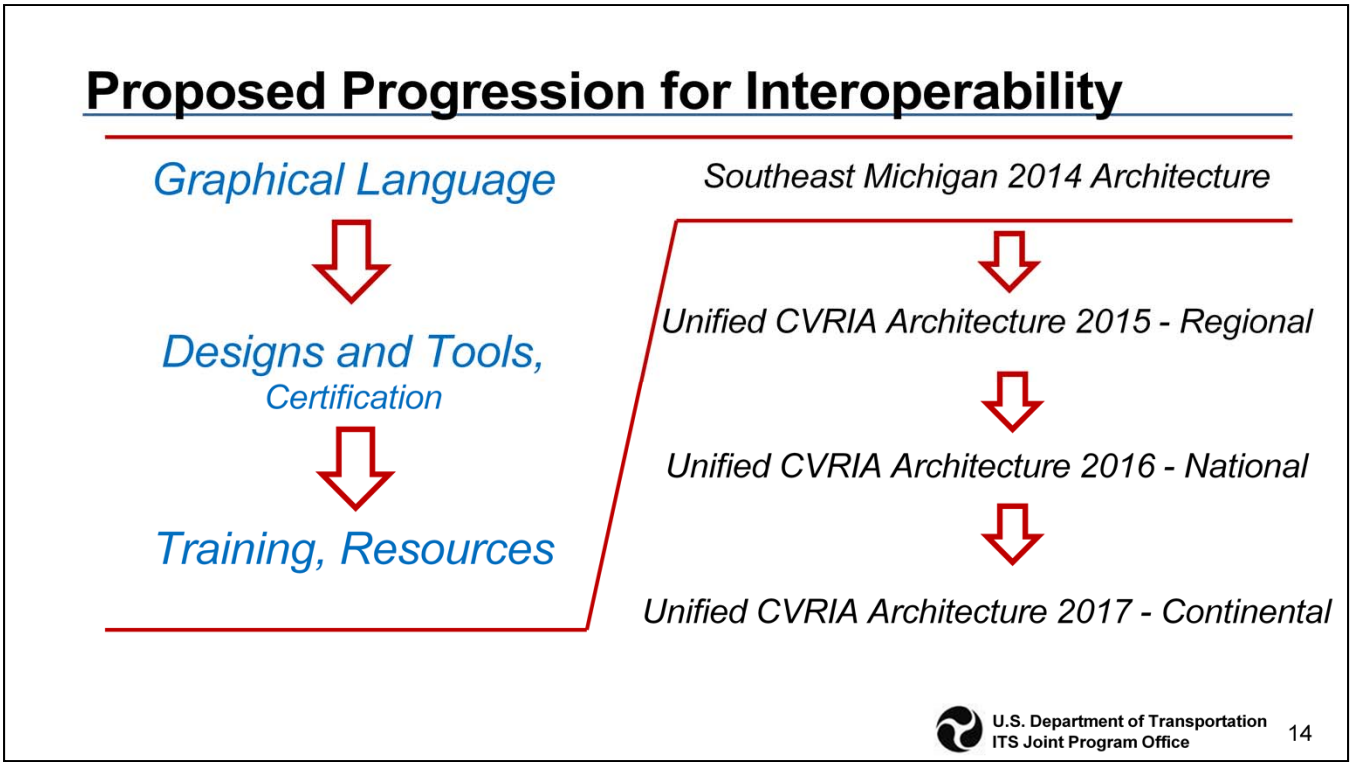
c. All roadside installation will have backhaul with capacity for Internet Protocol transport

Data Exchanges – *Preserving privacy by design*

- **Common Pattern** – based on the four phases of a peer-to-peer data exchange message sequence.
- **Common Communication Security** – build on crash avoidance experience.
- **Maintenance, Management, Enforcement, Commercial** – examples of all peer-to-peer data exchange activities.
- **Nonrepudiation** – accounting of contributions and uses.

The credit card metaphor



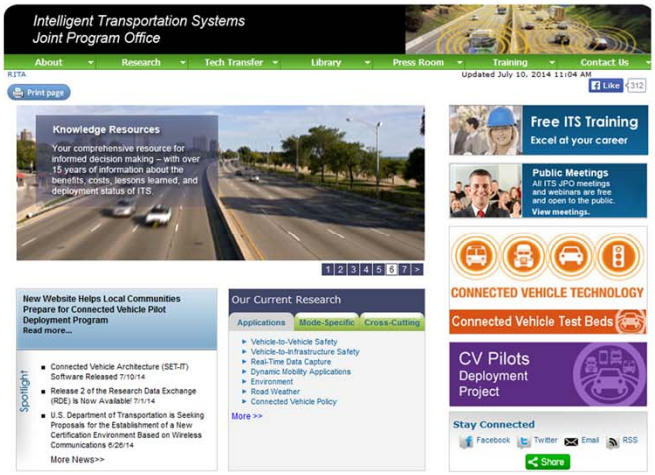


Logical progression.

Connected Vehicle Pilots

- Pilot deployments should **use USDOT-sponsored research**
- Well-defined, focused while part of the whole, with quantitative **performance measures**
- **Share data and lessons learned** while protecting privacy and intellectual property
- www.its.dot.gov/pilots

For More Information



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Virtual Plug Fests – October to December 2014

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