



Connected Vehicle
PlugFest

Southeast Michigan Project Architecture

Southeast Michigan Connected Vehicle Test Bed Project 2014



Other Engineering Disciplines Have Graphical Tools

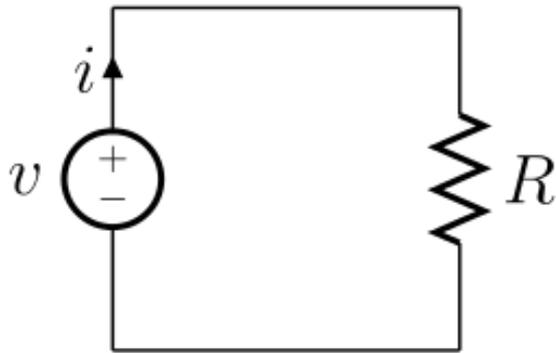


Image Source: Wikipedia

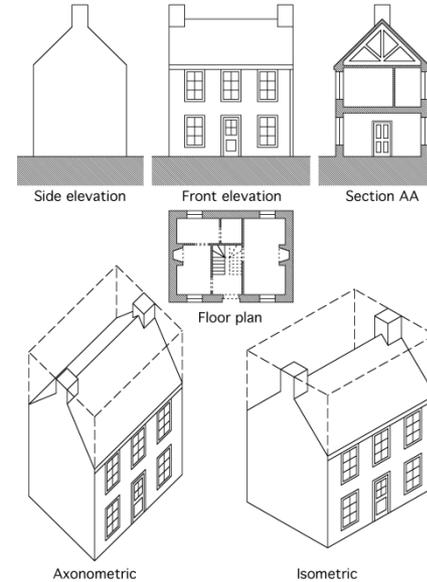


Image Source: Wikipedia

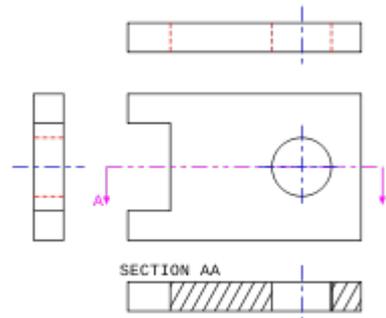


Image Source: Wikipedia



ITS National Architecture

- <http://www.its.dot.gov/arch/index.htm>

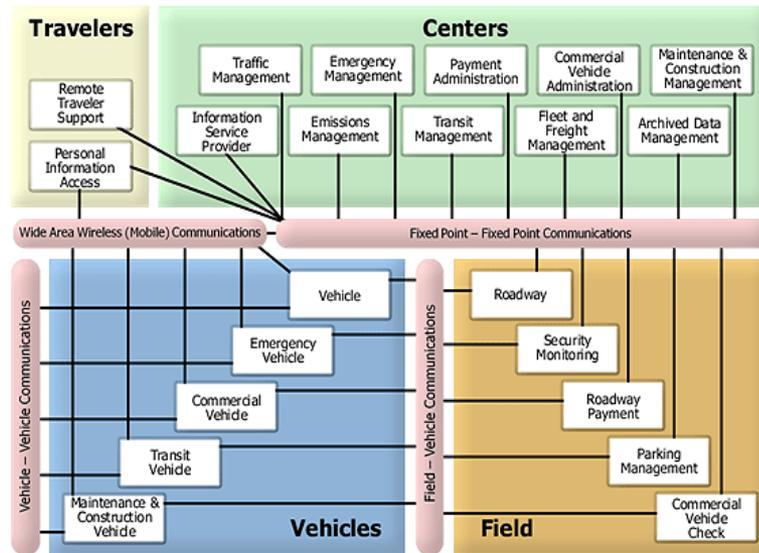


Image Source: USDOT

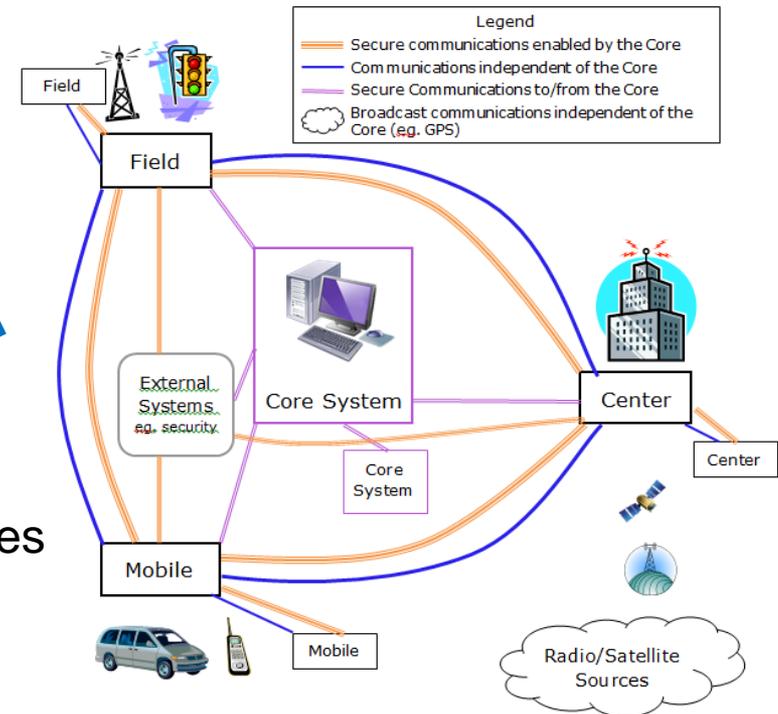


Image Source: USDOT

- Broadcast and Peer-to-Peer data exchanges
- Enable Big Data
- Multiple wireless communication media



Southeast Michigan Connected Vehicle 2014 Project Architecture

Complete Architecture shown in a set of views

- Physical view [**THINGS**] – overviews and specifics of objects and the information that flows between them, hierarchically arranged to show varying levels of detail.
- Enterprise view [**PEOPLE**] – includes installation, operations, maintenance and certification diagrams for each physical diagram
- Communication views [**INFORMATION**] – one for each information flow



Southeast Michigan Project Architecture

■ Physical View

- Layer 0: The physical objects that participate, the interconnects between them
- Layer 1: The project-specific functions performed by each physical object, and the data exchanged between them
- Layer 2: Application-specific; shows only those objects that are part of the application, with more detail on the flow of data

■ Enterprise View

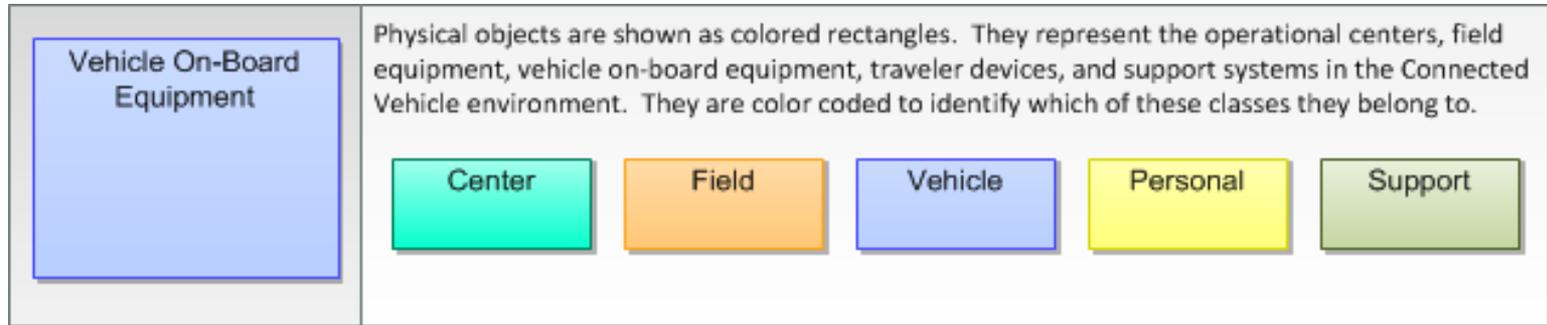
- Layer 0: The people and agencies that own and operate physical objects
- Layer 1: The people and agencies that own and operate physical objects and application objects

■ Communications View

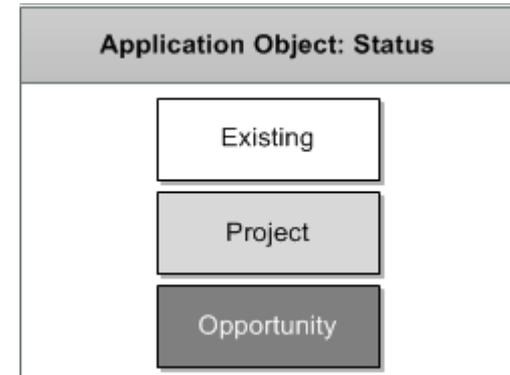
- For each information flow in the Physical View, the layered communications protocols necessary to implement the information flow



Physical View Architecture Constructs: Objects

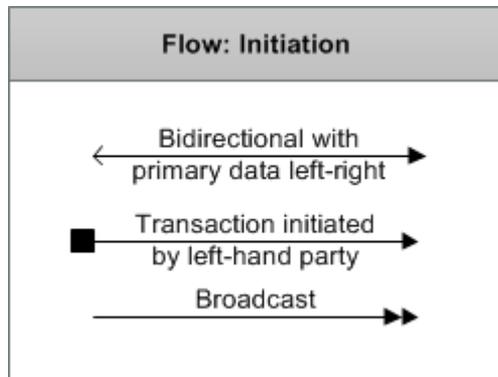


Application objects are also categorized according to their implementation within the project.

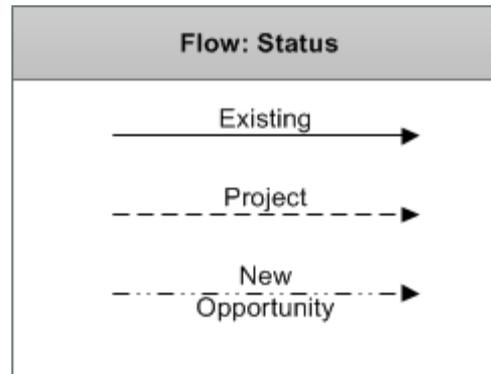


Physical View Architecture Constructs: Flows

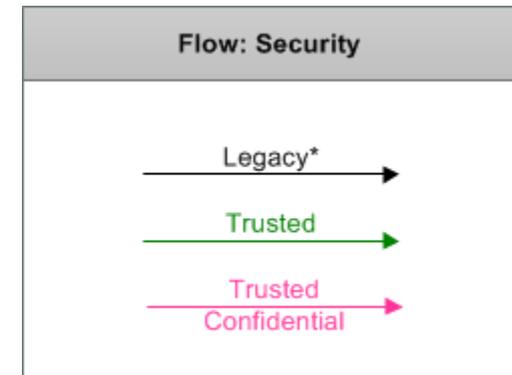
- Which device initiates the flow?
- What is the communication pattern?



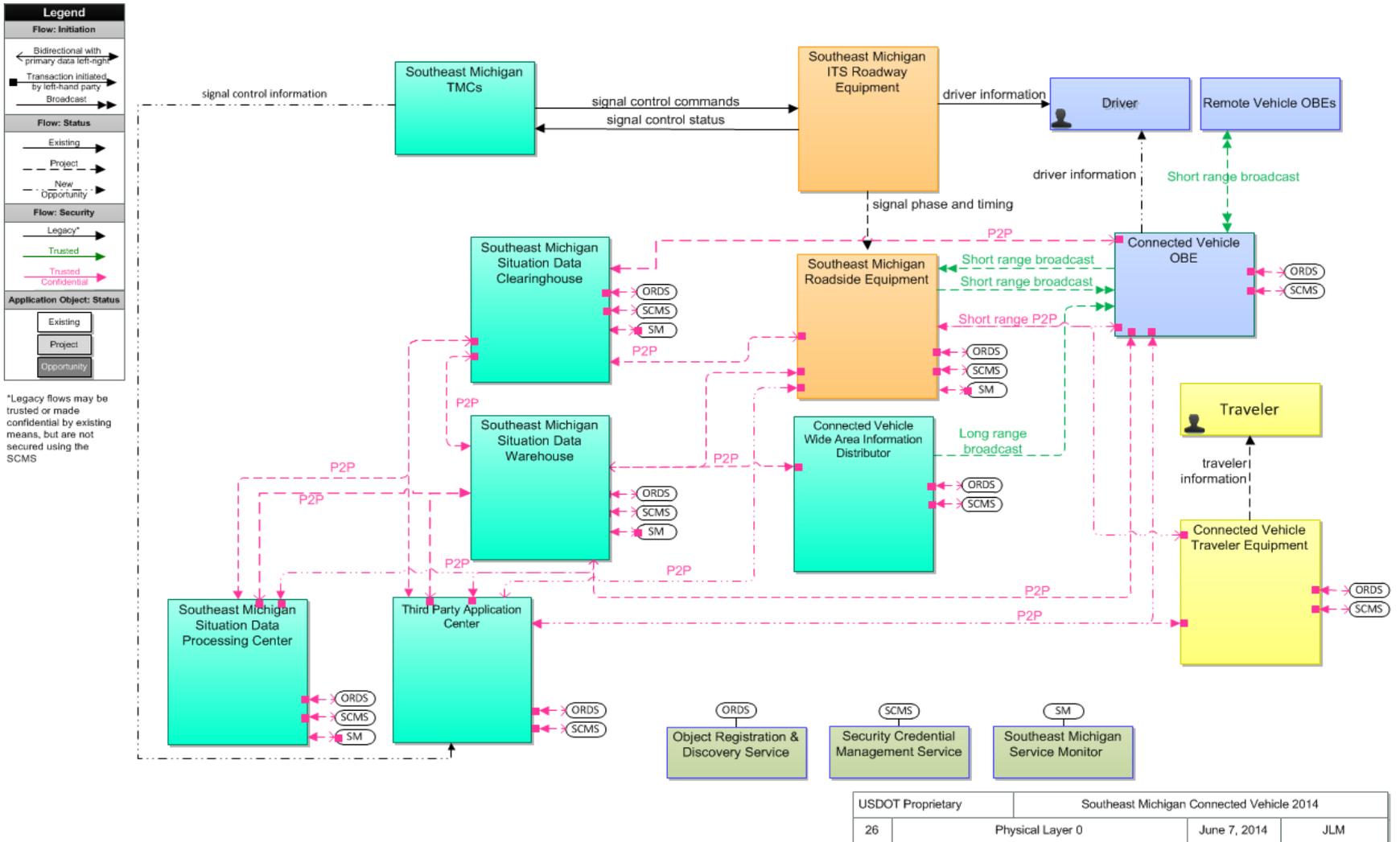
- Does the flow exist?



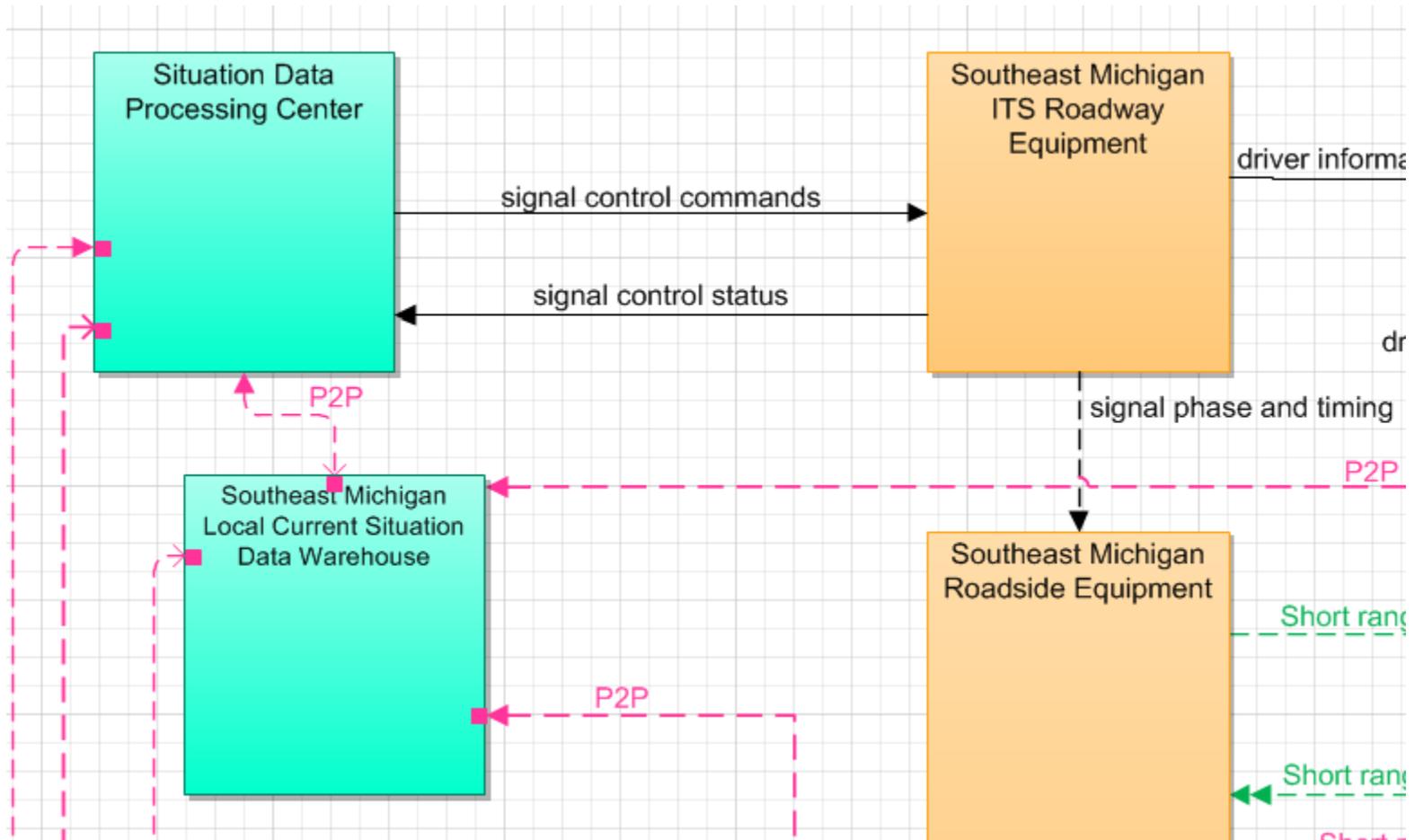
- What type of security does the flow require?



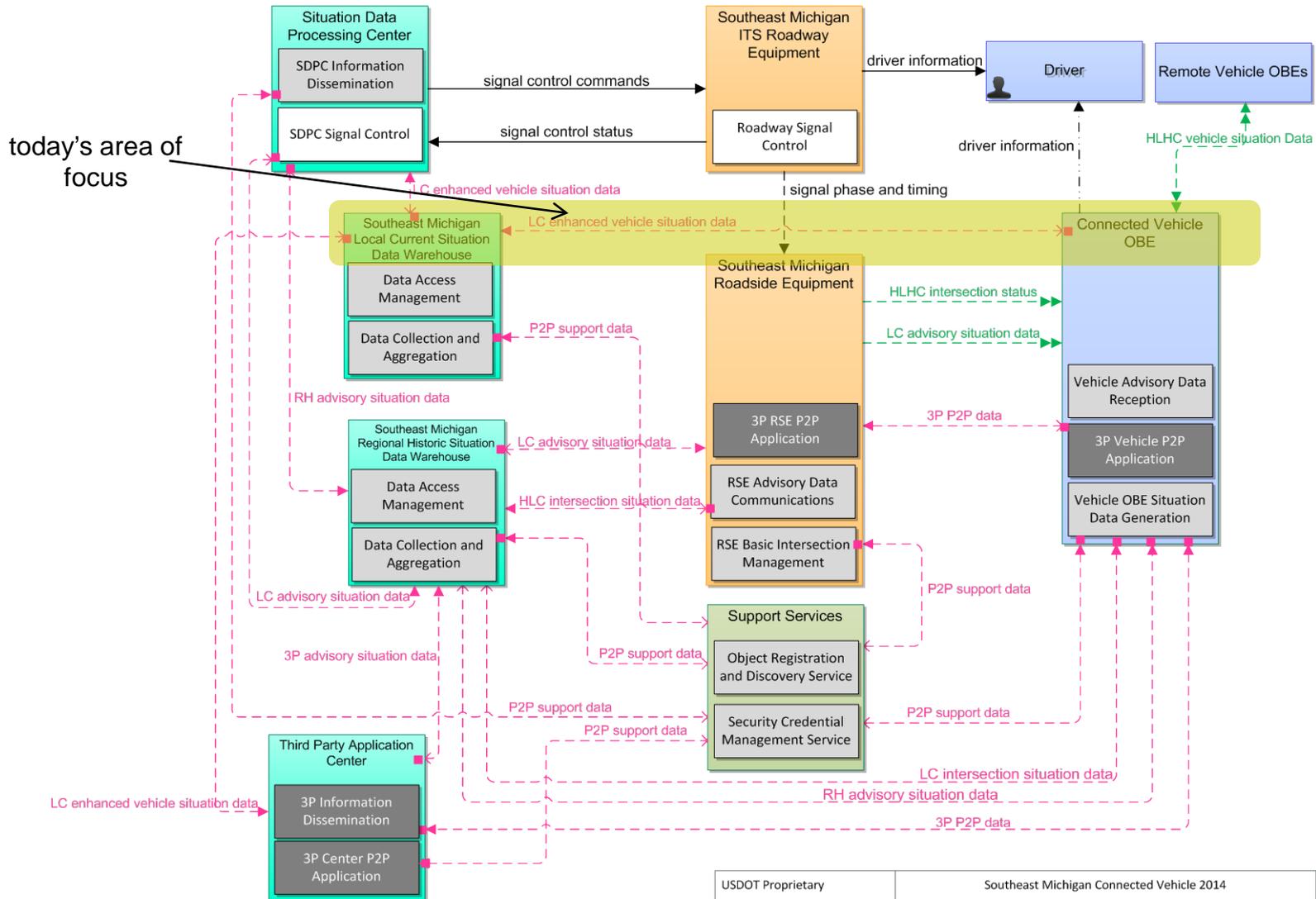
Physical View – Southeast Michigan 2014 Layer 0



Physical View Layer 0 Example

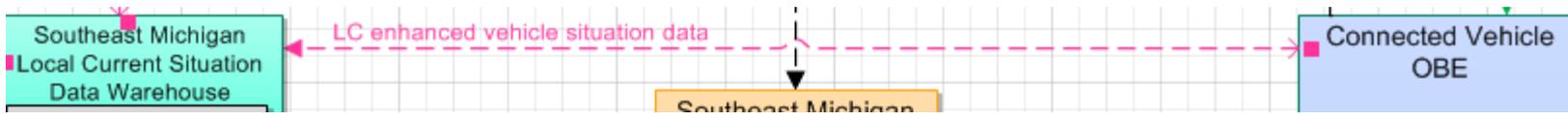


Physical View – Southeast Michigan 2014 Layer 1



| | | | |
|-------------------|----------------------------------|---|-----|
| USDOT Proprietary | | Southeast Michigan Connected Vehicle 2014 | |
| 19 | Physical Layer 1 - Comprehensive | Jan 28, 2014 | WLF |

Physical View – LC Enhanced Situation Data



From this snippet we can see that the LC enhanced vehicle situation data flow has the following characteristics:

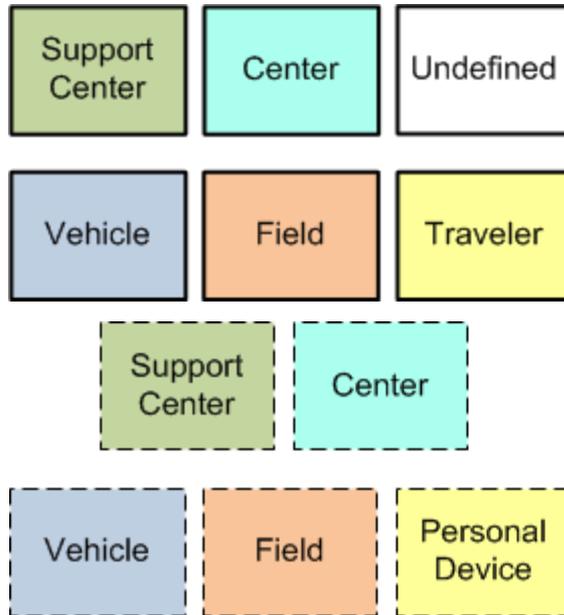
- The Connected Vehicle OBE initiates this data exchange
- This flow is encrypted and signed
- This flow is part of the testbed development

Communications View – LC Enhanced Situation Data

| Vehicle-Center (RSE) | | | | |
|---|--|------------------------------------|---------------------------|--|
| LC Enhanced Vehicle Situation Data -> | | | | |
| Southeast Michigan Connected Vehicle OBE Vehicle OBE Situation Data Generation | | Roadside Equipment | | Southeast Michigan Local Current Situation Data Warehouse Data Collection and Aggregation |
| SAE J2735 (2009) – Sequence Design | | | | SAE J2735 (2009) – Sequence Design |
| ASN.1 BER | | | | ASN.1 BER |
| (session layer unused) | | | | (session layer unused) |
| UDP | | | | UDP |
| IPv6 | | IPv6 | IPv6 | IPv6 |
| 1609.3, 802.2, 802.11p | | 1609.3, 802.2, 802.11p | IEEE 802.2 | IEEE 802.2 |
| 5.9 Ghz wireless (802.11p) / 1609.4 | | 5.9 GHz wireless (802.11p), 1609.4 | Backhaul PHY ² | Backhaul PHY ² |

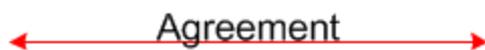
2: An Internet connection or private network connection that is routable between the RSE and the Southeast Michigan Local Current Situation Data Warehouse

Enterprise View Architecture Constructs



Enterprise objects (people, organizations) are shown as boxes with thick black borders, color coded by their relationship to the transportation environment

Physical objects are color coded the same as in physical view diagrams, but shown as rectangles with dashed lines.



Formal coordination between people and/or organizations, documented in some contract or other form of written agreement that both parties acknowledge.



Information coordination between people and/or organizations, usually undocumented.

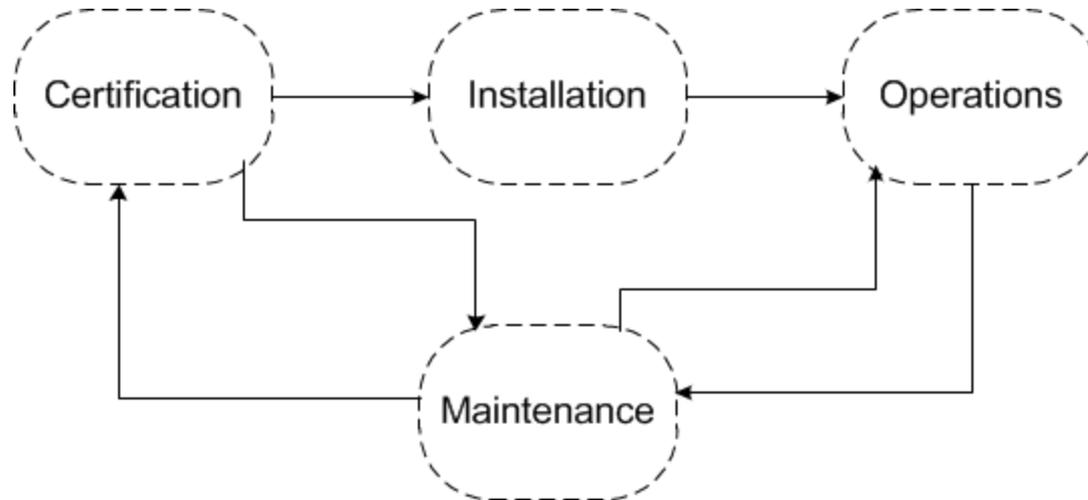


Relationship between people and/or organizations (e.g., member of) or between people/organizations and physical objects (owns, operates, maintains, installs, certifies etc.)



Relationship between physical objects that is relevant to people and/or organizations: includes, extends

Enterprise View – Life Cycle



- Certification Phase: application and device approval, adherence to standards
- Installation Phase: deployment of applications and devices
- Operations Phase: operation of applications to provide benefits to end users
- Maintenance Phase: maintenance of applications and devices, and feedback of performance

Project Architecture Tool Support

- All Southeast Michigan project architecture diagrams were drawn using the CVRIA Mini-Tool
- Short-term use method for drawing CVRIA-like diagrams, using the viewpoint specifications defined in the CVRIA
- Enables a common language
- Enables information exchange and re-use
- Provides a rich backdrop of work that has already been done to define the 85+ applications USDOT has already considered in some fashion



Architecture Tool



Contact Information

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- Project Architecture SET-IT Tool:
<http://www.iteris.com/cvria/html/resources/tools.html>
- CVRIA: <http://www.iteris.com/cvria>

