# Appendix C: Toledo Regional ITS Architecture 2021 Update

## Background and Purpose

An update to the Toledo Regional ITS Architecture was performed in 2021. The purpose of this appendix is to summarize the changes made to the Architecture and inform the ITS stakeholders in the region about the changes. The update effort in 2021 included three focuses: (1) to reflect the ITS deployments in the region since 2016; (2) to assist in ITS planning and recommend ITS projects to the region; and (3) to incorporate the DriveOhio's Connected Vehicle / Automated Vehicle (CV/AV) Roadmap into the Architecture.

The State of Ohio initiated a Systems Engineering Analysis (SEA) in 2018 to create a statewide framework to guide CV/AV technology deployments across the state. This framework is intended to promote consistency and interoperability amongst the CV/AV technologies and supporting systems implemented through various ongoing, planned, and future projects by a wide range of stakeholders. It also offers users a significant head start in performing systems engineering analyses for individual projects, when needed, along with helpful tools for planning and implementation.

A statewide CV/AV architecture was developed as the first step in the SEA. The Ohio Statewide CV/AV Architecture is a roadmap for the deployment and integration of CV/AV and ITS technologies throughout the state of Ohio for the next fifteen years. It helps guide the planning, implementation, and integration of ITS and CV/AV technologies deployed and managed by various agencies that provide transportation services in Ohio.

This 2021 update incorporated the Statewide CV/AV Architecture into the Toledo Regional ITS Architecture. The development of the Statewide CV/AV Architecture was a DriveOhio/Ohio DOT-led effort to streamline project planning and development for CV/AV technology in Ohio.

## Summary of Changes

Multiple changes were made to the Toledo Regional ITS Architecture, including information on stakeholders, ITS/CV/AV elements, service packages, functional requirements, interfaces and applicable standards. The updated architecture is documented and stored in the electronic RAD-IT database and on the architecture website. Key changes to the architecture are summarized below.

### ARC-IT Version
The Regional ITS Architecture was updated using ARC-IT version 9.0 and RAD-IT version 9.0.

### Subsystems and Interconnections
The graphic on the next page illustrates the updated architecture subsystems and primary types of interconnections (or communications) between these subsystems. The shaded areas indicate the functions and services do not currently exist or have not been planned in the region.

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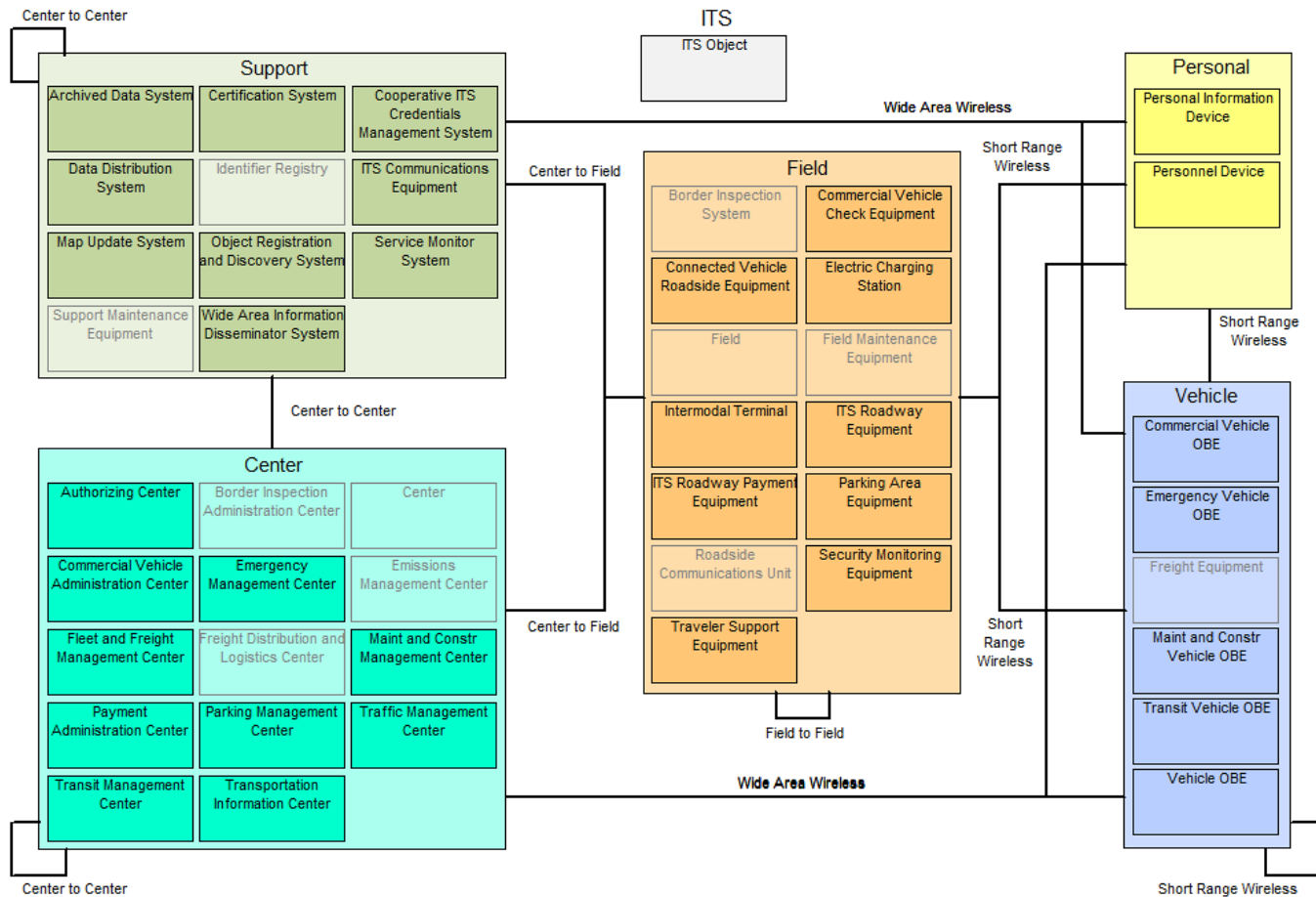
**Figure C.1. Updated Toledo Regional ITS Architecture Physical Object Interconnect Diagram**

## ITS Inventory Elements

The 2021 Update introduced several new ITS elements to the region. The new elements are mainly related to technology and systems that enable or support the operation of CV/AV technologies.

**Table C.1. ITS Elements Added to the Toledo Regional ITS Architecture**

| Stakeholder | New ITS Element |
| --- | --- |
| Counties and Cities | • County and City CV Authorizing Center<br>• County and City Equipment and Fleet Service Facilities<br>• County and City CV Service Monitoring Systems<br>• County and City Parking Management Systems |
| County and City Public Works Departments | • County and City Connected Vehicles Roadside Equipment<br>• County and City Traffic Data Archives |
| DriveOhio | • Ohio Certification System<br>• Ohio Connected Vehicles Roadside Equipment<br>• Ohio Cooperative ITS Credentials Management System<br>• Ohio CV Authorizing Center<br>• Ohio CV Service Monitor System<br>• Ohio Event Streaming Platform<br>• Ohio Object Registration and Discovery System<br>• Ohio Smart Mobility Program |

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| Stakeholder | New ITS Element |
|---|---|
| Driver | • Basic Vehicles<br>• Drivers |
| General Public (Stakeholder Group) | • Cyclists<br>• Pedestrians<br>• Traveler |
| ODOT | • ODOT District 2 Automated Gate Closure Systems<br>• ODOT District 2 Automated Roadway Treatment Systems<br>• ODOT District 2 Lane Control Devices<br>• ODOT District 2 Maintenance and Construction Center Personnel<br>• ODOT District 2 Ramp Meters<br>• ODOT District 2 Speed Monitoring Roadside Equipment<br>• ODOT District 2 Variable Speed Limit Signs<br>• ODOT Traffic Signal Control System<br>• ODOT Wide Area Information Disseminator System |
| Ohio Department of Public Safety | • Ohio Emergency Alert System |
| Ohio State Highway Patrol (OSHP) | • OSHP Weigh-in-Motion Stations |
| Ohio State University | • OSU Center of Automotive Research |
| Ohio Turnpike and Infrastructure Commission (OTIC) | • OTIC Connected Vehicles Roadside Equipment<br>• OTIC CV Authorizing Center<br>• OTIC CV Service Monitoring System<br>• OTIC Equipment and Fleet Service Facilities<br>• OTIC Maintenance and Construction Vehicles<br>• OTIC Maintenance Dispatch Offices<br>• OTIC Public Service Vehicles<br>• OTIC Service Plaza Truck Parking Management System<br>• OTIC Website |
| Private Companies | • Private EV Charging Stations |
| Private Map Data Providers | • Private Map Update Systems |
| Public Agencies (Stakeholder Group, including DriveOhio) | • ITS Communications Equipment<br>• Public Agency EV Charging Stations |
| Public Utilities Commission of Ohio (PUCO) | • PUCO Commercial Vehicle Registration System |
| Research Institutes | • Transportation Research Centers |
| Toledo Area Regional Transit Authority (TARTA) | • TARTA Transit Data Archive<br>• TARTA Transit Information Kiosks |
| Toledo-Lucas County Port Authority | • Toledo-Lucas County Port Authority<br>• Toledo-Lucas County Port Authority Connected Vehicle Roadside Equipment<br>• Toledo-Lucas County Port Authority CV Authorizing Center<br>• Toledo-Lucas County Port Authority CV Service Monitoring System<br>• Toledo-Lucas County Port Authority Parking Management System |

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## Service Packages

The table below shows the service packages that were added to the Regional ITS Architecture as a result of the update.

**Table C.2. Service Packages Added to the Toledo Regional ITS Architecture**

| Service Package | Service Package Name |
|---|---|
| CVO03 | Electronic Clearance |
| CVO05 | Commercial Vehicle Parking |
| CVO06 | Freight Signal Priority |
| CVO08 | Smart Roadside and Virtual WIM |
| CVO09 | Freight-Specific Dynamic Travel Planning |
| CVO10 | Road Weather Information for Freight Carriers |
| MC09 | Infrastructure Monitoring |
| PM01 | Parking Space Management |
| PM03 | Parking Electronic Payment |
| PM06 | Loading Zone Management |
| PS07 | Incident Scene Safety Monitoring |
| PS09 | Transportation Infrastructure Protection |
| PT11 | Transit Pedestrian Indication |
| PT12 | Transit Vehicle at Station/Stop Warnings |
| PT13 | Vehicle Turning Right in Front of a Transit Vehicle |
| PT16 | Route ID for the Visually Impaired |
| PT17 | Transit Connection Protection |
| ST05 | Electric Charging Stations Management |
| ST08 | Eco-Approach and Departure at Signalized Intersections |
| SU01 | Connected Vehicle System Monitoring and Management |
| SU02 | Core Authorization |
| SU03 | Data Distribution |
| SU04 | Map Management |
| SU05 | Location and Time |
| SU06 | Object Registration and Discovery |
| SU08 | Security and Credentials Management |
| SU09 | Device Certification and Enrollment |
| SU12 | Vehicle Maintenance |
| TI06 | Dynamic Ridesharing and Shared Use Transportation |
| TI07 | In-Vehicle Signage |
| TM04 | Connected Vehicle Traffic Signal System |
| TM10 | Electronic Toll Collection |
| TM19 | Roadway Closure Management |
| TM21 | Speed Harmonization |
| TM22 | Dynamic Lane Management and Shoulder Use |
| TM25 | Wrong Way Vehicle Detection and Warning |
| TM26 | Signal Enforcement |
| VS01 | Autonomous Vehicle Safety Systems |
| VS05 | Curve Speed Warning |
| VS06 | Stop Sign Gap Assist |
| VS07 | Road Weather Motorist Alert and Warning |
| VS08 | Queue Warning |
| VS09 | Reduced Speed Zone Warning / Lane Closure |
| VS12 | Pedestrian and Cyclist Safety |

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| Service Package | Service Package Name |
|---|---|
| VS14 | Cooperative Adaptive Cruise Control |
| VS15 | Infrastructure Enhanced Cooperative Adaptive Cruise Control |
| VS16 | Automated Vehicle Operations |
| WX03 | Spot Weather Impact Warning |

## Interfaces

Interfaces to support data exchange, particularly for CV/AV technologies and systems, were added to the Regional ITS Architecture. Details of the updated interfaces were documented in the RAD-IT database and the architecture website.

## Recommended ITS Projects

The list of recommended ITS projects from the 2016 Architecture was updated. Several projects were implemented over the past five years hence were removed from the list. Additional projects were identified and recommended to the region based on an analysis on stakeholder needs and current gaps. A total of 43 ITS projects were recommended for the region over the next 15 years. The recommended ITS projects and their details were documented in the RAD-IT database and the architecture website.

## Architecture Website

The Toledo Regional ITS Architecture website was updated to document and store the latest architecture for the region. The website continues to serve as a one-stop shop for stakeholders to obtain the latest information on the Regional ITS Architecture and the recommended ITS projects to support planning, development, deployment and integration of ITS and CV/AV technologies in the region.

With the inclusion of additional ITS projects and the CV/AV systems in the Regional ITS Architecture, ITS and CV/AV projects within the Toledo planning area may utilize the streamlined review and approval process developed by DriveOhio and ODOT.

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