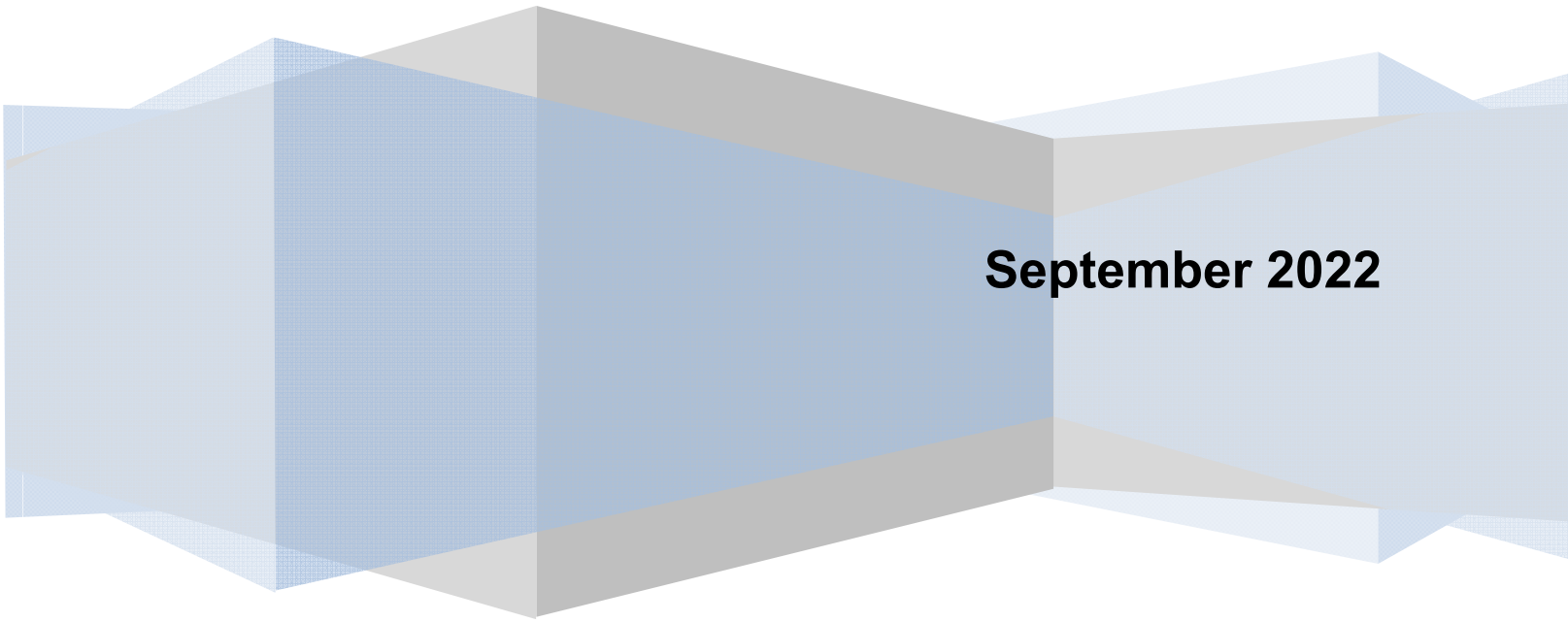
Miami Valley
Regional ITS Architecture
Reference Document



September 2022

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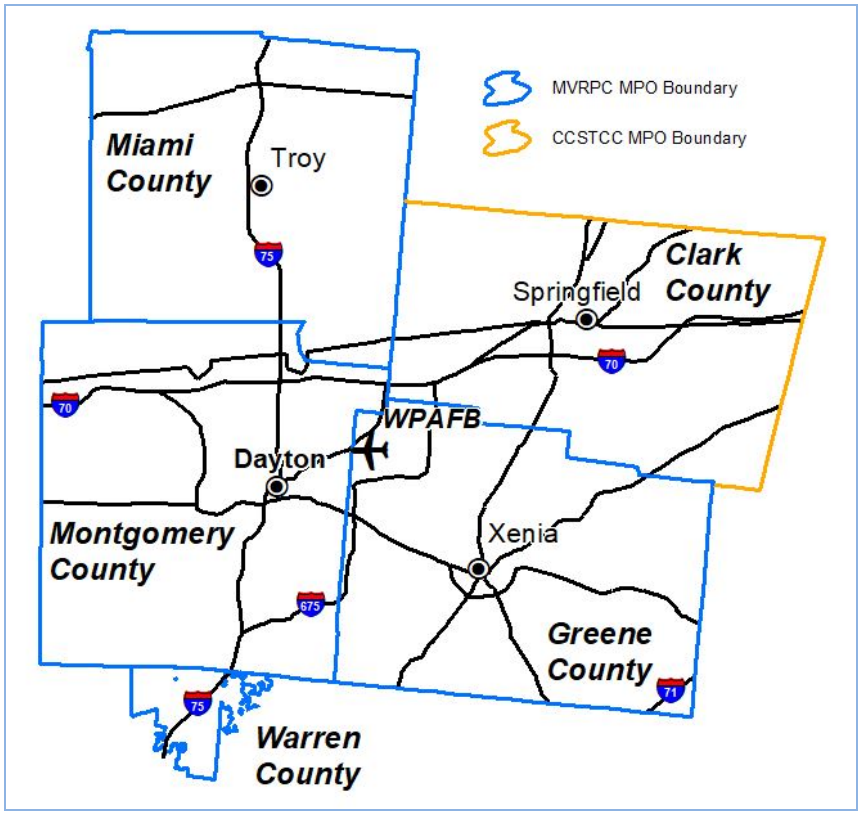
1 Introduction

The Miami Valley Regional Planning Commission (MVRPC), in coordination with the Clark County Springfield Transportation Coordinating Committee (CCSTCC) and the Ohio Department of Transportation (ODOT), has completed a comprehensive update to the Miami Valley Regional Intelligent Transportation System (ITS) Architecture, the original architecture was completed in 2005 and updated in 2008 with minor updates completed in 2013 and 2018 as a result of stakeholder requests.. The Miami Valley Regional ITS Architecture effort, with its 20 year planning horizon, is built on a strong ITS interest in the region and some signature ITS projects which have brought the need for a Regional ITS Architecture to the forefront. A regional architecture is required by both the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) to qualify ITS projects for federal funding after April 2005.

The Miami Valley Regional ITS Architecture covers the Dayton/Springfield area. MVRPC is the Metropolitan Planning Organization (MPO) for the counties of Greene, Miami, and Montgomery as well as the Cities of Franklin, Carlisle, and Springboro, and Franklin Township in northern Warren County and the CCSTCC is the MPO for Clark County as illustrated in the Figure below.

Miami Valley Regional ITS Architecture Geographic Scope



Progress has been made since the original architecture was developed in 2003, in addition to many signal coordination systems implemented throughout the years, the Freeway Management System was completed in 2012 and provides timely and accurate traveler information to motorists that can be accessed through www.ohgo.com or mobile applications.

Update Overview:

MVRPC has updated the regional architecture to be consistent with the recently released National Reference ITS Architecture, ARC-IT, version 9.0. Similarly ODOT/DriveOhio has completed a systems engineering analysis to develop a statewide framework for Connected and Automated Vehicles (CV/AV) technology deployments. This comprehensive framework promotes consistency and interoperability as various projects are implemented at varying scales by a wide range of stakeholders and has been incorporated in full into the Miami Valley Regional ITS Architecture. Key points of the architecture update are summarized below.

- Comprehensive update to stakeholders, elements, and services to better reflect the services that are currently in use or planned/possible in the near future.
- Addition of functional requirements for the major ITS elements in the region.
- Addition of potential communication solutions based on nationally recognized standards.
- Addition of RAD-IT database to MVRPC website, available to download for project implementation.
- Integration of Statewide CV/AV architecture into Regional ITS architecture.

2 Architecture Scope

The Miami Valley Regional ITS Architecture is a roadmap for transportation systems integration. The architecture was developed through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. It represents a shared vision of how each agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region.

The architecture provides an overarching framework that spans all of the region's transportation organizations and individual transportation projects. Using the architecture, each transportation project can be viewed as an element of the overall transportation system, providing visibility into the relationship between individual transportation projects and ways to cost-effectively build an integrated transportation system over time. This chapter establishes the scope of the architecture in terms of its geographic breadth, the scope of services that are covered, and the time horizon that is addressed.

Description:

A regional ITS architecture for the Miami Valley in southwest Ohio. This is a joint effort by the Miami Valley Regional Planning Commission (MVRPC), MPO for Dayton, OH; and the Clark County-Springfield Transportation Coordination Committee (CCSTCC), the MPO for Springfield, OH.

Timeframe: 20 years

Geographic Scope:

Four counties in Southwest Ohio in the Dayton/Springfield Metropolitan Area - Clark, Greene, Miami, Montgomery, and northern Warren Counties.

Developer/Maintainer: MVRPC

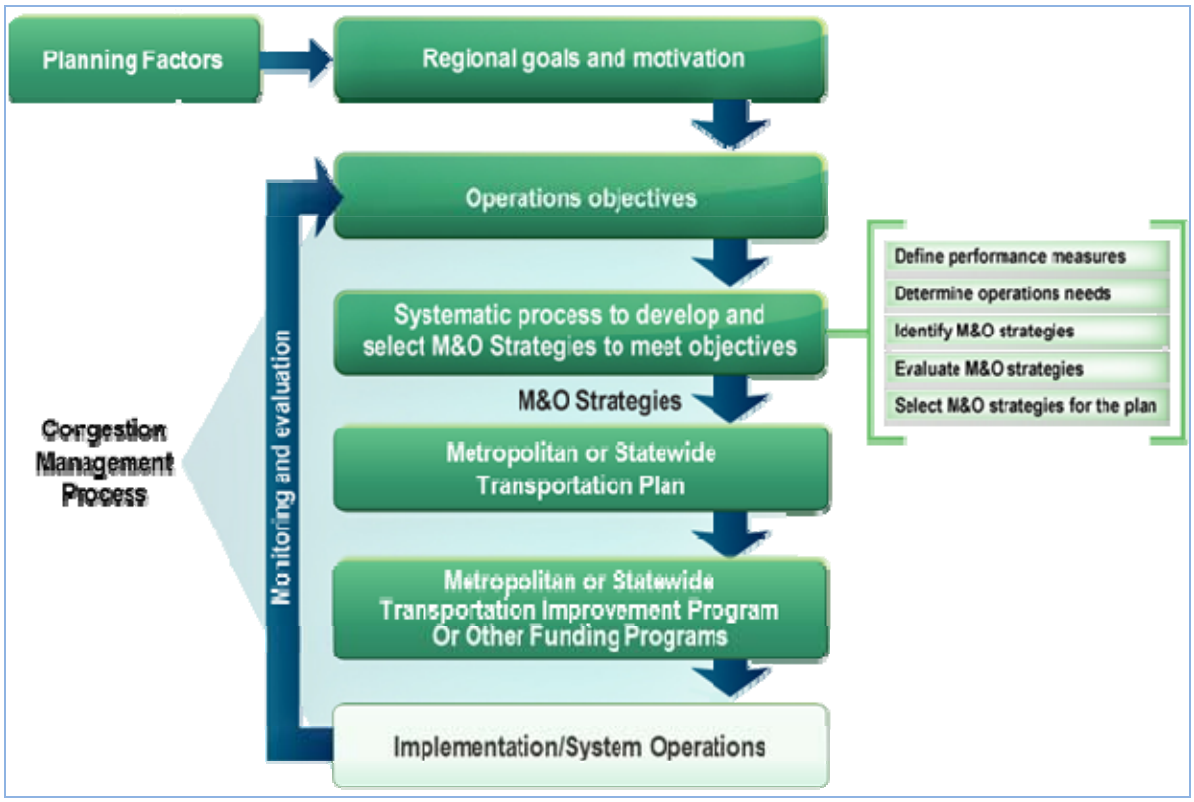
Version 2.0

Revision Date: 5/13/2022

3 Relationship to Regional Planning

Technology-based systems can pose real challenges for transportation planning. No one can accurately forecast progressive technology advances over a 20-year timeframe, particularly in the event of CV/AV technologies but we know that technology advances will occur. Using the regional ITS architecture, a region can plan for technology application and integration to support more effective planning for operations. The regional ITS architecture provides context for ITS projects so that each project can build a piece of the envisioned transportation system. By using the architecture as a planning tool, the steps taken by each project will be on the path to fulfilling the larger objectives set forth in the long range transportation plan. The details of how the regional ITS architecture can be used as a tool to support metropolitan and statewide transportation planning is defined in this planning view, shown below.

Regional ITS Architecture and Transportation Planning



Source: Regional ITS Architecture Guide, U.S. DOT, 2020

4 ITS Stakeholders

Identifying stakeholders is an important task in ITS architecture development since effective ITS involves the integration of multiple stakeholders and their transportation systems. This section describes the stakeholders who either participated in the creation of the Miami Valley Regional ITS Architecture or whom the participating stakeholders felt were needed to be included in the architecture. Some stakeholders have been grouped in order to better reflect mutual participation or involvement in transportation services and elements. Every stakeholder in this section is related to one or more of the transportation inventory elements described in the next chapter, either as an individual stakeholder or as a member of a stakeholder group.

Table 1 – ITS Stakeholders

Stakeholder Name	Stakeholder Description
City of Dayton	Represents the Public Works Department of the City of Dayton.
City of Springfield	Represents the City of Springfield Engineering and Service Departments.
Clark County	Represents divisions of Clark County.
Clark County-Springfield Transportation Coordinating Committee (CCSTCC)	The Clark County-Springfield Transportation Coordinating Committee (CCSTCC) is the Metropolitan Planning Organization for Clark County in Ohio.
County Sheriff Offices	Represents the county public safety agency for the four counties in the region.
Cyclists	Represents those using non-motorized travel modes, and in particular bicyclists that sometimes share motor vehicle lanes.
Dayton Area Chamber of Commerce	Largest business organization representing businesses in the Dayton region; also houses the Dayton Area Logistics Association (DALA).
Dayton International Airport	The Miami Valley Region's major airport, located in Dayton.
Dayton Metro Area Counties	Represents the various government departments and agencies of Miami, Greene and Montgomery Counties other than those specifically called out in the architecture.
Dayton Metro Area County Hazmat	The hazard materials agencies for Miami, Greene and Montgomery Counties.
DriveOhio	DriveOhio is Ohio's center for smart mobility. Ohio is home to dozens of public and private entities all involved in the design, development, testing, use and regulation of autonomous and connected technologies. DriveOhio brings all of these organizations together under one umbrella, serving as the hub for all things autonomous and connected in Ohio. Supported by the Ohio Department of Transportation, DriveOhio also works to ensure Ohio's regulatory environment and public policies are conducive to the development of the infrastructure and technologies needed for smart mobility.
Driver	Represents the person that operates a vehicle on the roadway, including operators of private, transit, commercial, and emergency vehicles.
FHWA	Federal Highway Administration
Financial Institutions	Financial companies that handle electronic transactions.
Fleet and Freight Managers	Represents private companies that operate commercial vehicle fleets.
General Public	Private travelers and personal computing device users.
Greater Dayton Regional Transit Authority (GDRTA)	Fixed route and demand response transit services for Montgomery County.
Greene CATS Public Transit	Flex routes and Demand response transit services for Greene County.
Greene County	Represents divisions of Greene County.

Stakeholder Name	Stakeholder Description
Local Event Sponsors	Represents local special event sponsors that have knowledge of events that may impact travel on roadways or other modal means.
Media	Represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.
Miami County	Represents divisions of Miami County.
Miami County Transit System	Demand response transit services for Miami County.
Miami Valley Regional Planning Commission (MVRPC)	The Miami Valley Regional Planning Commission is the Metropolitan Planning Organization for Greene, Miami, and Montgomery Counties, and the communities of Carlisle, Franklin, Springboro, and Franklin Township in Northern Warren County in Ohio.
Montgomery County	Represents divisions of Montgomery County.
Municipal and Township Public Works Departments	Represents the engineering and street departments of all major jurisdictions in the region except for the cities of Dayton and Springfield, which have more advanced traffic systems.
Neighboring Transit Agencies	Represents transit agencies outside of the MVRPC region. Includes SORTA and BCRTA.
NOAA	National Oceanic and Atmospheric Administration, which includes the National Weather Service.
Ohio Department of Transportation (ODOT)	Includes ODOT Central Office and Districts 7 and 8. Responsible for planning, designing, and maintaining state and interstate highways and arterials.
Ohio Emergency Management Agency	Runs the State Emergency Operations Center. When an emergency exceeds the capacity of local government, they request the assistance of the state through the Ohio EMA.
Ohio Environmental Protection Agency (OEPA)	Works throughout Ohio to protect human health and the environment by establishing and enforcing standards for air quality, drinking water and stream water quality, wastewater treatment, and solid and hazardous waste disposal, and to provide comprehensive environmental education.
Ohio Rail Development Commission (ORDC)	ORDC is an independent commission within the Ohio Department of Transportation that funds safety improvements at railroad-highway grade crossings, supports rail-related economic development efforts, and coordinates railroad interactions with ODOT highway projects.
Ohio State Highway Patrol (OSHP)	Agency responsible for public safety of rural highways and freeways.
Other Cities	Represents the various government departments and agencies of municipalities other than those specifically called out in the architecture including the region's large cities like Beavercreek, Centerville, Kettering, Moraine, and Springboro.
Passengers	Represents passengers riding in motorized vehicles.
Pedestrians	Represents people who travel by foot.
Private Companies	Represents private companies that provide various transportation information and services to the transportation agencies and the general public traveling along roadways. Including towing and recovery service providers throughout the state.
Private Parking Operators	Includes all private parking operators in the Region.
Private Traffic Information Providers	Private company providing traveler information services for the region.
Private Transit Companies	Companies that provide private transit services such as taxis and Greyhound buses.
Private Weather Services	Private companies that provide weather information tailored for transportation purposes.
Public Parking Operators	Operators of public parking facilities in the Dayton metro area.
Public Transportation Agencies	Public traffic/public works/engineering agencies within the region.
Public Utilities Commission of Ohio (PUCO)	Regulates providers of utility services, including electric and natural gas companies, local and long distance telephone companies, water and wastewater companies, and rail and trucking companies.
Rail Operations	Represents companies that operate freight railroad in the region and the associated RR equipment.

Stakeholder Name	Stakeholder Description
Regional Event Operators	Represents special event sponsors and organizers that have knowledge of events that may impact travel on roadways or other modal means. Examples of regional event operators include sporting events, conventions, motorcades/parades, and public/political events. These operators interface to the ITS to provide event information such as date, time, estimated duration, location, and any other information pertinent to traffic movement in the surrounding area.
Regional Public Safety	Includes county and municipal emergency operation centers, public service answering points, and municipal emergency management offices including police and fire services.
Research Institutes	Represents research institutes or research centers that perform transportation-related research.
School Districts	Regional school districts
Social Services	Organizations operating paratransit operations such as dial-a-ride.
Springfield City Area Transit (SCAT)	Fixed route and demand response transit services for the City of Springfield.
Transit Agencies	A stakeholder group representing transit agencies in the region.
University of Dayton	Major private university in Dayton.
Weather Services	Weather Services include the National Weather Service as well as private disseminators of weather data.
Wright State University	A major public university of the region located in Greene County.
Wright-Patterson Air Force Base (WPAFB)	Located in parts of both Montgomery and Greene Counties. Missions range from acquisition and logistics management, to research and development, education, flight operations, and many other defense related activities. It has a workforce numbering approximately 22,000 people, making it the fifth largest employer in the state of Ohio and the largest employer at a single location.

5 ITS Inventory

An inventory of existing and planned transportation systems is the basis for the Miami Valley Regional ITS Architecture. The transportation system inventory was developed based on input from stakeholders throughout the region. The inventory includes a list of ITS elements and the associated stakeholder responsible for system operation.

This section describes every surface transportation inventory element for the region. A transportation element can be either a center, support, vehicle, traveler or field equipment. Each transportation element listed below has one or more stakeholders associated with it. In order to reduce the complexity of the architecture, some transportation elements with like functionality have been grouped together. Each transportation inventory element is mapped to at least one ARC-IT physical object. In addition, physical standards may be identified that define the form, fit, and function of individual ITS elements to enable interchangeability, vendor independence, and facilitate future interconnections.

Table 2 – ITS Inventory

Element Name	Element Description	Stakeholder	Element Status
CCSTCC	The Clark County-Springfield Transportation Coordinating Committee (CCSTCC) is the Metropolitan Planning Organization for Clark County in Ohio. Will collect and manage archived ITS data.	Clark County-Springfield Transportation Coordinating Committee (CCSTCC)	Existing
City of Dayton Civil Engineering Department	The Division of Civil Engineering is responsible for the design, construction, and management of public facility infrastructure projects.	City of Dayton	Existing
City of Dayton Civil Engineering Department	The Division of Civil Engineering is responsible for the design, construction, and management of public facility infrastructure projects.	County and City Public Works Departments	Existing
City of Dayton Civil Engineering Department Roadside Equipment	ITS field equipment operated by the City of Dayton Civil Engineering Department. Equipment may include traffic signals, cameras, dynamic message signs and others.	City of Dayton	Existing
City of Dayton Street Maintenance Department	The Division of Street Maintenance or Streets Department or Service Department maintains the bridges and 660 miles of roadway, and is responsible for snow and ice removal, gutter cleaning, street flushing and repair, fallen tree removal, and dead animal pick-up.	City of Dayton	Existing
City of Dayton Street Maintenance Department	The Division of Street Maintenance or Streets Department or Service Department maintains the bridges and 660 miles of roadway, and is responsible for snow and ice removal, gutter cleaning, street flushing and repair, fallen tree removal, and dead animal pick-up.	County and City Public Works Departments	Existing
City of Springfield Engineering and Service Department_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	City of Springfield	Existing
City of Springfield Engineering and Service Department_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling.	City of Springfield	Existing

Element Name	Element Description	Stakeholder	Element Status
City of Springfield Engineering Department	The Engineering Department is responsible for the engineering tasks of the design, construction, and management of transportation-related infrastructure projects.	City of Springfield	Existing
City of Springfield Service Department	The Service Department is responsible for the maintenance of streets.	City of Springfield	Existing
Clark County Emergency Management Agency_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Clark County	Existing
Clark County Engineering Department	Monitors and controls traffic and the road network.	Clark County	Existing
Clark County Engineering Department MCO	Monitors and manages roadway infrastructure construction and maintenance activities	Clark County	Existing
Clark County Engineering Department_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Clark County	Existing
Clark County Engineering Department_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling.	Clark County	Existing
Commercial Vehicles	Commercial vehicles include ITS equipment that supports safe and efficient commercial vehicle operations. This equipment monitors vehicle operation, provides the driver and motor carrier real-time information, and supports mainline electronic screening.	Fleet and Freight Managers	Existing
Connected/Automated Vehicles	Connected vehicle technology enables cars, trucks, buses, and other vehicles to "talk" to each other with in-vehicle or aftermarket devices that continuously share important safety and mobility information. Fully automated, autonomous, or “self-driving” vehicles are defined by the U.S. DOT's National Highway Traffic Safety Administration (NHTSA) as “those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration, and braking and are designed so that the driver is not expected to constantly monitor the roadway while operating in self-driving mode.”	Drivers	Existing
County and City Connected Vehicles Roadside Equipment	This element represents the Connected Vehicle roadside devices that are used to send messages to, and receive messages from, nearby vehicles using Dedicated Short Range Communications (DSRC) or other alternative wireless communications technologies. Communications with adjacent field equipment and back office centers that monitor and control the RSE are also supported. This device operates from a fixed position and may be permanently deployed or a portable device that is located temporarily in the vicinity of a traffic incident, road construction, or a special event. It includes a processor, data storage, and communications capabilities that support secure communications with passing vehicles, other field equipment, and centers.	County and City Public Works Departments	Existing
County Emergency Management Agency_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario. Representing Miami, Greene and Montgomery Counties.	Dayton Metro Area Counties	Existing
County Engineers Office_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Dayton Metro Area Counties	Existing
County Engineers Office_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling, cameras, dynamic message signs, traffic sensors and traffic signals.	Dayton Metro Area Counties	Existing

Element Name	Element Description	Stakeholder	Element Status
County Sheriff Office	Dispatches police and/or fire calls and handles emergency alerts and advisiories such as AMBER alerts.	County Sheriff Offices	Existing
Cyclists	Cyclist participates in ITS services that support safe, shared use of the transportation network by motorized and non-motorized transportation modes. Representing those using non-motorized travel modes, and in particular bicyclists that sometimes share motor vehicle lanes, cyclists provide input (e.g. a call signal requesting right of way at an intersection) and may be detected by ITS services to improve safety.	General Public	Existing
Dayton International Airport	The Miami Valley Region's major airport, located in Dayton. Provides and receives traffic information from local entities.	Dayton International Airport	Existing
Drivers	This terminator represents the human entity that operates a licensed vehicle on the roadway. Included are operators of private, Transit, Commercial, and Emergency vehicles where the data being sent or received is not particular to the type of vehicle. Thus this terminator originates driver requests and receives driver information that reflects the interactions which might be useful to all drivers, regardless of vehicle classification. The Driver terminator is the operator of the Basic Vehicle terminator. Information and interactions which are unique to drivers of a specific vehicle type (e.g., fleet interactions with transit, commercial, or emergency vehicle drivers) are covered separately.	General Public	Existing
Emergency Vehicles	Emergency vehicles include ITS equipment that provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response.	Regional Public Safety	Existing
GDRTA Dispatch_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Greater Dayton Regional Transit Authority (GDRTA)	Existing
GDRTA Transit Data Archives	Represents transit data archives operated by GDRTA.	Greater Dayton Regional Transit Authority (GDRTA)	Existing
Greene CATS Dispatch_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Greene CATS Public Transit	Existing
Greene County Engineering Department	Monitors and controls traffic and the road network.	Greene County	Existing
Greene County Engineering Department MCO	Monitors and manages roadway infrastructure construction and maintenance activities.	Greene County	Existing
MCO Field Devices	MCO Field Devices include sensors, displays, and cameras for operational purposes of maintenance and construction.	Public Transportation Agencies	Existing
MCO Vehicles	MCO vehicles include ITS devices that provide the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction.	Public Transportation Agencies	Existing
Miami County Engineers Office	The Miami County Engineer's Office is responsible for engineering and surveying activities including: design, coordination and inspection of county construction projects, review of proposed site development plans and performance of inspection, and processing of permits for work in the road right-of-way.	Miami County	Existing
Miami County Engineers Office MCO	Responsible for the maintenance and upgrade of the county highway system. Responsibilities include paving, traffic control, safety projects, mowing and snow removal. The County Engineer maintains 434 Miles of roadway, 7,739 signs, and 341 bridges.	Miami County	Existing

Element Name	Element Description	Stakeholder	Element Status
Miami County Transit System_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Miami County Transit System	Existing
Montgomery County Engineers Office	Responsible for the maintenance of 320 miles of county roads and 541 bridges. Duties includes repair, replacement, and improvement of roads and bridges within jurisdiction.	Montgomery County	Existing
Montgomery County Engineers Office Operations Division	The primary function of the Operations Division is to maintain the 320 miles of roads and 541 bridges that are in the jurisdiction of the County Engineer.	Montgomery County	Existing
Municipal and Township Engineering Departments	Represents the engineering departments of all major jurisdictions in the region except for the cities of Dayton and Springfield, which have more advanced traffic systems.	Municipal and Township Public Works Departments	Existing
Municipal and Township Public Works Departments_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Municipal and Township Public Works Departments	Existing
Municipal and Township Public Works Departments_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling.	Municipal and Township Public Works Departments	Existing
Municipal and Township Street Departments	Represents the street departments of all major jurisdictions in the region except for the cities of Dayton and Springfield, which have more advanced traffic systems.	Municipal and Township Public Works Departments	Existing
Municipal Public Service Agencies Dispatch	Represents the dispatch for the police and fire agencies for all major local municipalities utilizing ITS strategies and technologies.	Regional Public Safety	Existing
Municipal Public Service Agencies_Personnel	Represents the public safety personnel that monitor emergency requests, receive 911 calls, and dispatch emergency responses.	Regional Public Safety	Existing
MVRPC	The Miami Valley Regional Planning Commission is the Metropolitan Planning Organization for Greene, Miami, and Montgomery Counties, and the communities of Carlisle,Franklin, Springboro, and Franklin Township in Northern Warren County in Ohio. Will collect and manage archived ITS data.	Miami Valley Regional Planning Commission (MVRPC)	Existing
ODOT ATMS	ODOT's Advanced Traffic Management System (ATMS). The ATMS software enables ODOT to monitor and control various ITS field devices from its Statewide Traffic Management Center (TMC) and district offices. The Statewide TMC is located in Columbus at the ODOT Central Office. The Statewide TMC operates traffic management and traveler information systems on Ohio's interstates, freeways, expressways, and state highways in each of the State's major metropolitan areas including Akron/Canton, Cincinnati, Cleveland, Columbus, Dayton/Springfield, and Toledo. TMC operators can control cameras and post traveler information messages to ODOT's DMS, HAR, and to the OHGO website. TMC operators can also act as liaisons between the Safety Patrol Vehicles and various other public agencies that respond to the scenes of vehicle incidents. For redundancy, it is able to remotely operate district traffic management centers. It also communicates with RWIS Roadside Equipment throughout the state. To support CV applications, the Statewide TMC may also include "CV TMC Application Equipment" for centrally generating and digitally signing CV messages (e.g. J2735 MAP, RTCM, and others).	Ohio Department of Transportation (ODOT)	Existing
ODOT District 7 Headquarters	Provides central administrative focus for transportation engineering. District 7 includes Clark, Miami, and Montgomery Counties from the ITS study region.	Ohio Department of Transportation (ODOT)	Existing

Element Name	Element Description	Stakeholder	Element Status
ODOT District 7 Headquarters_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 7 Headquarters_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 7 HQ Maintenance and Construction	Provides central administrative focus for maintenance and construction. District 7 includes Clark, Miami, and Montgomery Counties from the ITS study region.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 8 Headquarters	Provides central administrative focus for transportation engineering. District 8 includes Greene County from the ITS study region.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 8 Headquarters_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 8 Headquarters_Roadside Equipment	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling.	Ohio Department of Transportation (ODOT)	Existing
ODOT District 8 HQ Maintenance and Construction	Provides central administrative focus for maintenance and construction. District 8 includes Greene County from the ITS study region.	Ohio Department of Transportation (ODOT)	Existing
ODOT Freeway Safety Patrol Vehicles	Freeway service patrol vehicle that will be dispatched by the ODOT ATMS to provide basic incident response services to freeway travelers.	Ohio Department of Transportation (ODOT)	Existing
ODOT Snow Spotters Vehicle	An ODOT Vehicle with sensors that detect road surface temperature. Used primarily during winter maintenance.	Ohio Department of Transportation (ODOT)	Existing
ODOT Speed Monitoring Roadside Equipment	Represents the field equipment that monitors vehicle speeds for enforcement purposes or to advise motorists of their current speeds.	Ohio Department of Transportation (ODOT)	Existing
ODOT Traffic Data Archive System	Represents a statewide archive of traffic data that receives inputs from Vehicle Detection Devices installed by Ohio DOT throughout the state.	Ohio Department of Transportation (ODOT)	Existing
ODOT Traffic Signal Control System		Ohio Department of Transportation (ODOT)	Existing
Ohio DPS Crash Database	This element refers to a statewide database of crash records that is shared with the Ohio DOT, which reviews the number, frequency and severity of accidents that occur on its system. It can be accessed at: https://ohtrafficdata.dps.ohio.gov/crashstatistics/home	Ohio Department of Public Safety	Existing
OSHP Dispatch_Personnel	Personnel represent the people who directly interface with an element of the ITS infrastructure. They provide operator data and command inputs to direct systems operations to varying degrees, depending on the type of system and the deployment scenario.	Ohio State Highway Patrol (OSHP)	Existing
OSHP Patrol Posts	Each operate the 911 cell call center for their respective county. Posts are located in Dayton, Springfield, Piqua, and Xenia.	Ohio State Highway Patrol (OSHP)	Existing
OSHP Vehicles	Represents the ITS equipment, e.g., mobile data terminals and AVL systems, on highway patrol vehicles.	Ohio State Highway Patrol (OSHP)	Existing
OSU Center of Automotive Research	The Center for Automotive Research (CAR) is the preeminent research center in sustainable and safe mobility in the United States and an interdisciplinary research center in The Ohio State University's College of Engineering.	Ohio State University	Existing

Element Name	Element Description	Stakeholder	Element Status
Pedestrians	This terminator provides input (e.g. a request for right of way at an intersection) from a specialized form of the Traveler who is not using any type of vehicle (including bicycles) as a form of transport. Pedestrians may comprise those on foot and those in wheelchairs.	General Public	Existing
Regional PSAP Dispatch Centers	Receive incident response requests and dispatch emergency response personnel.	Regional Public Safety	Existing
Regional PSAP Dispatch Centers_Personnel	Represents the public safety personnel that monitor emergency requests, receive 911 calls, and dispatch emergency responses.	Regional Public Safety	Existing
SCAT Dispatch_Personnel	Personnel in the transit control center that monitor and manage transit operations.	Springfield City Area Transit (SCAT)	Existing
Transit Vehicle Operators	This terminator represents the human entity that receives and provides additional information that is specific to operating the ITS functions in all types of transit vehicles. . To support transit vehicle security features, the Transit Vehicle Operator can input to the Transit Vehicle Subsystem a silent alarm. The operator can also be required to enter an authentication command (used to enable operation of the vehicle). The information received by the operator would include status of on-board systems. Additional information received depends upon the type of transit vehicle. In the case of fixed route transit vehicles, the Transit Vehicle Operator would receive operator instructions that might include actions to take to correct schedule deviations. In the case of flexible fixed routes and demand response routes the information would also include dynamic routing or passenger pickup information.	Transit Agencies	Existing
Transit Vehicles	Transit vehicles include ITS devices on board of the vehicles that support the safe and efficient movement of passengers. These systems collect, manage, and disseminate transit-related information to the driver, operations and maintenance personnel, and transit system patrons.	Transit Agencies	Existing
Transportation Research Centers	Represents research institutes or research centers that perform transportation-related research.	Research Institutes	Existing
Traveler Information Devices	This element refers to personal devices used by the traveling public, including mobile computers, tablets, smartphones, etc.	General Public	Existing
Travelers	This terminator represents any individual (human) who uses transportation services. At the time that data is passed to or from the terminator the individual is neither a driver, pedestrian, or transit user. This means that the data provided is that for pre-trip planning or multi-modal personal guidance and includes their requests for assistance in an emergency. Subsequent to receipt of pre-trip information, a Traveler may become a vehicle driver, passenger, transit user, or pedestrian.	General Public	Existing
WPAFB	Located in parts of both Montgomery and Greene Counties. Missions range from acquisition and logistics management, to research and development, education, flight operations, and many other defense related activities. It has a workforce numbering approximately 22,000 people, making it the fifth largest employer in the state of Ohio and the largest employer at a single location.	Wright-Patterson Air Force Base (WPAFB)	Existing

6 ITS Services

ITS services, or service packages, describe what can be done to improve the efficiency, safety, and convenience of the regional transportation system through better information, advanced systems and new technologies. Some services are specific to one primary stakeholder while others require broad stakeholder participation. This section describes the ITS services that meet the transportation needs in the region.

Table 3 – ITS Services

Service Package	Service Package Name	Service Package Description	Service Package Status
CVO05	Commercial Vehicle Parking	This service package provides parking information to commercial vehicle operators both pre-trip and en route. The parking information will be based on information collected from each truck parking area using individual sensors in each space, or in/out sensors for the area. The raw data is processed by state DOT or third party providers and supplied to fleet managers, to mobile devices used by commercial vehicle operators, to DMS on the roadway or directly to in vehicle systems as commercial vehicles approach roadway exits with key facilities such as parking. This service package also provides the ability for the commercial vehicle driver, or fleet manager to request a parking reservation.	Existing
CVO12	HAZMAT Management	This service package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material transport, including response to incidents. HAZMAT tracking is performed by the Fleet and Freight Management Center. The Emergency Management Center is notified by the Commercial Vehicle and the Fleet and Freight Management Center of the HAZMAT vehicle location and information about the HAZMAT load. If an incident occurs, the Emergency Management Center can use the information to coordinate the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Center. The latter information can be provided prior to the beginning of the trip, during the trip, or gathered following the incident depending on the selected policy and implementation.	Existing
DM01	ITS Data Warehouse	This service package provides access to transportation data to support transportation planning, condition and performance monitoring, safety analysis, and research. Configurations range from focused repositories that house data collected and owned by a single agency, district, private sector provider, or research institution to broad repositories that contain multimodal, multidimensional data from varied data sources covering a broader region. Both central repositories and physical distributed ITS data repositories are supported. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse service package may be parsed by the local repository and dynamically translated to requests to other repositories that relay the data necessary to satisfy the request. The repositories could include a data registry capability that allows registration of data identifiers or data definitions for interoperable use throughout a region.	Planned

Service Package	Service Package Name	Service Package Description	Service Package Status
DM02	Performance Monitoring	The Performance Monitoring service package uses information collected from detectors and sensors, connected vehicles, and operational data feeds from centers to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data. Additional data are collected including accident data, road condition data, road closures and other operational decisions to provide context for measured transportation performance and additional safety and mobility-related measures. More complex performance measures may be derived from the collected data.	Existing
MC01	Maintenance and Construction Vehicle and Equipment Tracking	This service package tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Checks can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.	Existing
MC02	Maintenance and Construction Vehicle Maintenance	This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle and equipment maintenance.	Planned
MC04	Winter Maintenance	This service package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.	Existing
MC05	Roadway Maintenance and Construction	This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.	Existing
MC06	Work Zone Management	This service package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This service package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.	Existing
MC08	Maintenance and Construction Activity Coordination	This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to Transportation Information Centers who can provide the information to travelers. Center to center coordination of work plans supports adjustments to reduce disruption to regional transportation operations.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
PM01	Parking Space Management	This service package monitors and manages parking spaces in lots, garages, and other parking areas and facilities. It assists in the management of parking operations by monitoring parking lot ingress and egress, parking space occupancy and availability. Infrastructure-based detectors and/or connected vehicles may be used to monitor parking occupancy. The service package shares collected parking information with local drivers and information providers for broader distribution.	Planned
PM03	Parking Electronic Payment	This service package supports electronic collection of parking fees. This includes all types of parking fee collection including short term and long term parking and pay-for-use loading zones. It collects parking fees from in-vehicle equipment, contact or proximity cards, or any smart payment device. This service package supports both payment via a local point of sale in the parking area or direct payment via wide area wireless communications. User accounts may be established to facilitate secure payment using only a secure ID and enhance services offered to frequent customers.	Existing
PM05	Parking Reservations	This service package manages parking reservations, allowing a traveler to reserve parking as part of the trip planning process. Parking reservations may be part of a trip plan provided by a Transportation Information Center (TIC) based on parking information provided by one or more parking facilities. This parking plan is provided to the traveler/driver, which includes the option to make a reservation if available. If the parking reservation is selected by the traveler/driver, then the TIC will negotiate the parking reservation with the parking facility and provide a confirmation to the traveler/driver.	Planned
PS01	Emergency Call-Taking and Dispatch	This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel. This service package also provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.	Existing
PS02	Emergency Response	This service package supports emergency/ incident response by personnel in the field. It includes emergency vehicle equipment used to provide response status as well as video or images from either the vehicle or from emergency personnel in the field. Wide area wireless communications between the Emergency Management Center, Emergency Personnel and Emergency Vehicles supports a sharing of emergency response information. The service package also includes tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders at or near the incident scene to support local management of an incident, including the functions and interfaces commonly supported by a mobile command center.	Existing
PS03	Emergency Vehicle Preemption	This service package provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
PS04	Mayday Notification	This service package provides the capability for a vehicle to automatically transmit an emergency message when the vehicle has been involved in a crash or other distress situation. An automatic crash notification feature transmits key data on the crash recorded by sensors mounted in the vehicle (e.g. deployment of airbags) without the need for involvement of the driver. The emergency message is sent to emergency response services, which determines and carries out the appropriate response. This service package allows passing vehicles to receive and forward mayday requests in areas where no communications infrastructure exists. Emergency notifications from personal devices are also supported.	Existing
PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders	This service package will provide situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The service package also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).	Planned
PS08	Roadway Service Patrols	This service package supports roadway service patrol vehicles that monitor roads and aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The service package monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.	Existing
PS10	Wide-Area Alert	This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information websites.	Existing
PS11	Early Warning System	This service package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The service package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.	Planned
PT01	Transit Vehicle Tracking	This service package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
PT02	Transit Fixed-Route Operations	This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service monitors the transit vehicle trip performance against the schedule and provides information displays at the Transit Management Center.	Existing
PT03	Dynamic Transit Operations	The Dynamic Transit Operations service package allows travelers to request trips and obtain itineraries using a personal device such as a smart phone, tablet, or personal computer. The trips and itineraries cover multiple transportation services (public transportation modes, private transportation services, shared-ride, walking and biking). This service package builds on existing technology systems such as computer-aided dispatch/ automated vehicle location (CAD/AVL) systems and automated scheduling software, providing a coordination function within and between transit providers that would dynamically schedule and dispatch or modify the route of an in-service vehicle by matching compatible trips together. TI06 covers other shared use transportation options.	Existing
PT04	Transit Fare Collection Management	This service package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device such as a smart phone. Readers located either in the infrastructure or on-board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Center. This service supports ad-hoc payments to the transport provider (typically through the 'payment' and 'fare' flows), payments using a transport provider's account system using account-based tokens or integrated multi-provider account systems (typically through the 'account', 'secureID' and 'authorization' flows).	Existing
PT05	Transit Security	This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment performs surveillance and sensor monitoring in order to identify potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this service package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).Most of the surveillance and sensor data that is collected by this service package may be monitored by either the Emergency Management Center or the Transit Management Center, providing two possible approaches to implementing this service package. This service package also supports remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.	Existing
PT06	Transit Fleet Management	This service package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Center. The Transit Management Center processes this data and schedules preventative and corrective maintenance. The service package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks and the assignment of transit vehicle operators to runs.	Existing
PT07	Transit Passenger Counting	This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
PT08	Transit Traveler Information	This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.	Existing
PT09	Transit Signal Priority	The Transit Signal Priority service package uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The service package provides feedback to the transit driver indicating whether the signal priority has been granted or not. This service package can contribute to improved operating performance of the transit vehicles by reducing the time spent stopped at a red light.	Planned
PT14	Multi-modal Coordination	This service package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transit transfer points and clusters (a collection of stops, stations, or terminals where transfers can be made conveniently) and also improve operating efficiency.	Existing
PT18	Integrated Multi-Modal Electronic Payment	The Integrated Multi-Modal Electronic Payment (IMMEP) service package provides electronic payment capability for transit fares, tolls, road use, parking, and other areas requiring electronic payments. IMMEP enables the provision of payment for transportation services using a single account for multiple public transportation providers. The transportation user establishes an account with a financial service provider (modeled as the Payment Administration Center (PAC)), and the PAC communicates with various public transportation providers to coordinate charges. IMMEP also supports the management of transportation user access rights (i.e., this user can use the subway but not the bus). Payment transactions are centralized; the user provides only a secure, registered token (the 'secureID') to the transportation provider's access control equipment. The transportation provider uses that token and context to initiate transactions with the PAC.	Planned
TI01	Broadcast Traveler Information	This service package provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies. This service package also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility service packages for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This service package provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.	Existing
TI02	Personalized Traveler Information	This service package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
TM01	Infrastructure-Based Traffic Surveillance	This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.	Existing
TM03	Traffic Signal Control	This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the TM07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.	Existing
TM05	Traffic Metering	This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the TM01 service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.	Planned
TM06	Traffic Information Dissemination	This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.	Existing

Service Package	Service Package Name	Service Package Description	Service Package Status
TM07	Regional Traffic Management	This service package provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the TM03-Traffic Signal Control and TM05-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.	Existing
TM08	Traffic Incident Management System	This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. This service package is closely related with the Public Safety service packages, which focus on services that support first responders. In particular, local management of the incident using an incident command system is covered by PS02.	Existing
TM09	Integrated Decision Support and Demand Management	This service package recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this service package may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This service package also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.	Planned

Service Package	Service Package Name	Service Package Description	Service Package Status
TM13	Standard Railroad Grade Crossing	This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the ITS Roadway Equipment and the Driver in the physical view.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification of an approaching train by interfaced wayside equipment. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the Traffic Management Center.	Planned
TM14	Advanced Railroad Grade Crossing	This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This service package includes all capabilities from the Standard Railroad Grade Crossing service package and augments these with additional safety features to mitigate the risks associated with higher rail speeds and leverage Connected Vehicle technologies. The active warning systems supported by this service package include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this service package, the wayside equipment provides additional information about the arriving train so that the train's direction of travel, estimated time of arrival, and estimated duration of closure may be derived. This service package will alert and/or warn drivers who are approaching an at-grade railroad crossing if they are on a crash-imminent trajectory to collide with a crossing or approaching train. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This service package also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.	Planned
WX01	Weather Data Collection	This service package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. It also collects data from vehicles in the road network that can be used to directly measure or infer current environmental conditions. It leverages vehicle on-board systems that measure temperature, sense current weather conditions (rain and sun sensors) and also can monitor aspects of the vehicle operational status (e.g., use of headlights, wipers, and traction control system) to gather information about local environmental conditions. In addition, environmental sensor systems located on Maintenance and Construction Vehicles are also potential data sources. The collected environmental data is used by the Weather Information Processing and Distribution service package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The service package may also request and receive qualified data sets from meteorological systems.	Existing
WX02	Weather Information Processing and Distribution	This service package processes and distributes the environmental information collected from the Weather Data Collection service package. This service package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so operational centers and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination service package, and aid operators in scheduling work activity.	Existing

7 Roles and Responsibilities

The Operational Concept lists the roles and responsibilities that each participating agency must take on to provide the ITS services included in the ITS Architecture. Changing needs may arise that will require an agreement to be formed between all affected parties that defines new or additional roles. Defining the roles and responsibilities of the participating stakeholders in the region and the willingness of agencies to accept their roles and responsibilities is an important step in realizing the common goal of an interoperable ITS system throughout the region.

Table 4 – Roles and Responsibilities

RR Area Name	Stakeholder	Stakeholder Group	Stakeholder Group Members
Archived Data Systems for Miami Valley ITS Regional Architecture	Clark County-Springfield Transportation Coordinating Committee (CCSTCC)	No	
Archived Data Systems for Miami Valley ITS Regional Architecture	Miami Valley Regional Planning Commission (MVRPC)	No	
Archived Data Systems for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Commercial Vehicle Operations for Miami Valley ITS Regional Architecture	Ohio State Highway Patrol (OSHP)	No	
Emergency Management for Miami Valley ITS Regional Architecture	County Sheriff Offices	No	
Emergency Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Greene County
Emergency Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Miami County
Emergency Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Montgomery County
Emergency Management for Miami Valley ITS Regional Architecture	Municipal and Township Public Works Departments	No	
Emergency Management for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Emergency Management for Miami Valley ITS Regional Architecture	Ohio Emergency Management Agency	No	
Emergency Management for Miami Valley ITS Regional Architecture	Ohio Environmental Protection Agency (EPA)	No	
Emergency Management for Miami Valley ITS Regional Architecture	Ohio State Highway Patrol (OSHP)	No	
Emergency Management for Miami Valley ITS Regional Architecture	Regional Public Safety	No	
Freeway Management for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Incident Management for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Incident Management for Miami Valley ITS Regional Architecture	Ohio State Highway Patrol (OSHP)	No	
Incident Management for Miami Valley ITS Regional Architecture	Regional Public Safety	No	
Maintenance and Construction for Miami Valley ITS Regional Architecture	City of Dayton	No	
Maintenance and Construction for Miami Valley ITS Regional Architecture	City of Springfield	No	

RR Area Name	Stakeholder	Stakeholder Group	Stakeholder Group Members
Maintenance and Construction for Miami Valley ITS Regional Architecture	Clark County	No	
Maintenance and Construction for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Greene County
Maintenance and Construction for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Miami County
Maintenance and Construction for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Montgomery County
Maintenance and Construction for Miami Valley ITS Regional Architecture	Fleet and Freight Managers	No	
Maintenance and Construction for Miami Valley ITS Regional Architecture	Municipal and Township Public Works Departments	No	
Maintenance and Construction for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Surface Street Management for Miami Valley ITS Regional Architecture	City of Dayton	No	
Surface Street Management for Miami Valley ITS Regional Architecture	City of Springfield	No	
Surface Street Management for Miami Valley ITS Regional Architecture	Clark County	No	
Surface Street Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Greene County
Surface Street Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Miami County
Surface Street Management for Miami Valley ITS Regional Architecture	Dayton Metro Area Counties	Yes	Montgomery County
Surface Street Management for Miami Valley ITS Regional Architecture	Municipal and Township Public Works Departments	No	
Transit Services for Miami Valley ITS Regional Architecture	Greater Dayton Regional Transit Authority (GDRTA)	No	
Transit Services for Miami Valley ITS Regional Architecture	Neighboring Transit Agencies	No	
Transit Services for Miami Valley ITS Regional Architecture	Springfield City Area Transit (SCAT)	No	
Traveler Information for Miami Valley ITS Regional Architecture	Media	No	
Traveler Information for Miami Valley ITS Regional Architecture	Ohio Department of Transportation (ODOT)	No	
Traveler Information for Miami Valley ITS Regional Architecture	Private Traffic Information Providers	No	
Traveler Information for Miami Valley ITS Regional Architecture	Weather Services	No	

8 Functionality

Each ITS system operated by the stakeholders must perform certain functions to effectively deliver the envisioned project capabilities. The primary functions that each system needs to perform are broadly defined in the Miami Valley Regional ITS Architecture as a set of Functional Objects that make up the physical elements of the architecture. As projects get implemented requirements will need to be written to determine what each element must do in order to achieve its given set of functions.

Information about the regional functional requirements is contained in the RAD-IT database.

9 Interfaces Between Systems

The interfaces of the transportation systems in the Miami Valley Regional ITS Architecture are based on ARC-IT and tailored to reflect the plan for the region. Architecture diagrams display the transportation systems in the Miami Valley ITS Regional Architecture, and more importantly, how these systems are and will be connected with one another so information can be exchanged and transportation services can be coordinated. Stakeholders may use these diagrams to identify integration opportunities. Each system in the region is represented with two types of diagrams, a context diagram and an interface diagram. Detailed diagrams for each service package can be found in Appendix A, except for services packages MC08 and WX02 which were too complex to include in the document and are available upon request.

Information about the interfaces of the systems in the region is contained in the RAD-IT database. RAD-IT can be used to create tailored interconnect and information flow diagrams for any system in the database.

10 Communications

Communications standards are essential to cost-effective integration of ITS throughout the region. ITS standards are fundamental to the establishment of an open ITS environment that achieves the goal of interoperability for ITS. Standards facilitate deployment of interoperable systems at local, regional, national and international levels without impeding innovation as technology advances and new approaches evolve.

Establishing communications standards for exchanging information among ITS systems is important not only from an interoperability point of view; it also provides interchangeability and expandability thereby reducing risk and cost. Since an agency using standardized interfaces can select among multiple vendors for products and applications, competition is maintained and prices are lower in the long term.

In ARC-IT and in this regional architecture, the relevant communications standards for a particular interface are grouped together into 'Communication Solutions' that define the set of standards that are required for the interface. The first table identifies all of the communications solutions that have been selected for this region.

Frequently, more than one communications solution will be available for a given interface. Many standards overlap in applicability and offer varying features and levels of performance and security. This provides flexibility in the design of ITS systems allowing agencies to choose the most applicable communications solution for their needs. Before systems are designed, all stakeholders involved in the applicable ITS service(s) should agree on the communications solution and any required/desired tailoring. Once a decision is made, all future systems supporting that interface should use the agreed upon communications solution.

Table 5 – Relevant Communications Solutions

Name	Description	Type
(None-Data) - Secure Wireless Internet (ITS)	This solution is used within the U.S.. It combines standards associated with (None-Data) with those for I-M: Secure Wireless Internet (ITS). The (None-Data) standards include an unspecified set of standards at the upper layers. The I-M: Secure Wireless Internet (ITS) standards include lower-layer standards that support secure communications between two entities, either or both of which may be mobile devices, but they must be stationary or only moving within wireless range of a single wireless access point (e.g., a parked car). Security is based on X.509 or IEEE 1609.2 certificates. A non-mobile (if any) endpoint may connect to the service provider using any Internet connection method.	ARC-IT
Data for Distribution (TBD) - Apache Kafka	This solution is used within the U.S.. It combines standards associated with Data for Distribution (TBD) with those for Apache Kafka. The Data for Distribution (TBD) standards include a placeholder for upper-layer standards necessary to define the data (elements and structures) necessary to complete a solution for the information flow based on data distribution technologies. The data standard will need to include a specific customization for the desired data distribution technology used (e.g., Kafka, DDS, etc.).. The Apache Kafka standards include lower-layer open source code that supports data distribution of specific types of data.	ARC-IT
US: NTCIP CCTV - SNMPv3/TLS	This solution is used within the U.S.. It combines standards associated with US: NTCIP CCTV with those for I-F: SNMPv3/TLS. The US: NTCIP CCTV standards include upper-layer standards required to implement center-to-field CCTV communications (data only). The I-F: SNMPv3/TLS standards include lower-layer standards that support secure center-to-field and field-to-field communications using simple network management protocol (SNMPv3); implementations are strongly encouraged to use the TLS for SNMP security option for this solution to ensure adequate security.	ARC-IT

Name	Description	Type
US: NTCIP Message Sign - SNMPv3/TLS	This solution is used within the U.S.. It combines standards associated with US: NTCIP Message Sign with those for I-F: SNMPv3/TLS. The US: NTCIP Message Sign standards include upper-layer standards required to implement center-to-field message sign communications. The I-F: SNMPv3/TLS standards include lower-layer standards that support secure center-to-field and field-to-field communications using simple network management protocol (SNMPv3); implementations are strongly encouraged to use the TLS for SNMP security option for this solution to ensure adequate security.	ARC-IT
US: NTCIP Transportation Sensors - SNMPv3/TLS	This solution is used within the U.S.. It combines standards associated with US: NTCIP Transportation Sensors with those for I-F: SNMPv3/TLS. The US: NTCIP Transportation Sensors standards include upper-layer standards required to implement center-to-field transportation sensors (e.g., vehicle detectors) communications (e.g., real-time). The I-F: SNMPv3/TLS standards include lower-layer standards that support secure center-to-field and field-to-field communications using simple network management protocol (SNMPv3); implementations are strongly encouraged to use the TLS for SNMP security option for this solution to ensure adequate security.	ARC-IT
US: NTCIP Video Switches - SNMPv3/TLS	This solution is used within the U.S.. It combines standards associated with US: NTCIP Video Switches with those for I-F: SNMPv3/TLS. The US: NTCIP Video Switches standards include upper-layer standards required to implement center-to-field video switch communications. The I-F: SNMPv3/TLS standards include lower-layer standards that support secure center-to-field and field-to-field communications using simple network management protocol (SNMPv3); implementations are strongly encouraged to use the TLS for SNMP security option for this solution to ensure adequate security.	ARC-IT

11 Agreements

This section identifies the list of existing and future agreements between each of the stakeholder organizations whose ITS systems will be exchanging information. This list identifies the agreements that should be established but does not define the agreements themselves.

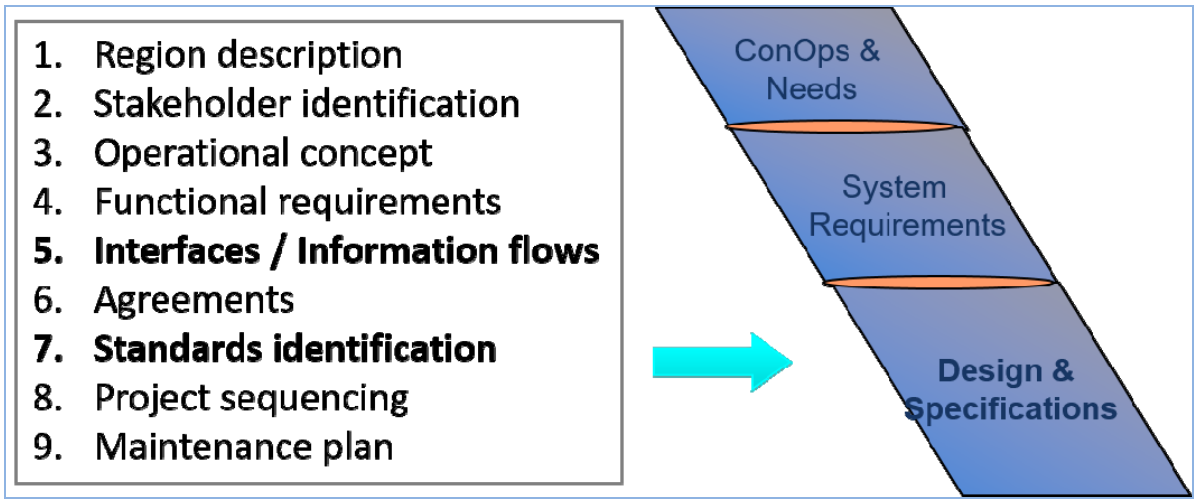
Table 6 – Agreements

Agreement Number	Agreement Title	Agreement Status	Description	Lead Stakeholder
1	Transit Trip Planning	Existing	Share traveler information across systems to promote regional transit trips	Greene CATS Public Transit
2	D/SFMS Information Sharing	Planned	As the D/SFMS comes on-line, ODOT will need to partner with various regional stakeholders to gain the most impact from the system. This includes sharing incident and operational information on a daily and sometime real-time basis with key regional entities.	
3	Safety and Mutual Aid	Planned	Home rule issues are a major hurdle to overcome in the region for effective incident management. Mutual aid agreements which are in place in other parts of the state will have to be developed in the D/S region to promote rapid incident response and management.	
4	Archived Data Structure	Planned	Promote an archive data structure and maintenance procedure for the realtime and other key data that should be archived for enhance planning and research.	Miami Valley Regional Planning Commission (MVRPC)

12 ITS Projects

The Miami Valley ITS Regional ITS Architecture vision is ultimately implemented one ITS project at a time but the regional ITS architecture can aid project designers as the starting point for the project high-level design and to identify the ITS standards that may be applicable to the project as shown in the figure below.

Regional ITS Architecture Use in Project Design



Source: Regional ITS Architecture Guide, U.S. DOT, 2020

The subset of the regional ITS architecture identified with the project can form the basis for the high-level or architectural design for the project. The subset of the regional ITS architecture should identify the key inter-agency interfaces (if any) that the project must support as well as major system interfaces. The exact nature of the information will be a function of how the regional ITS architecture has made the connection to each ITS project. This might include customized service package diagrams, identification of the elements that are a part of the project and/or the triples (source element, destination element, information flow) that are a part of the project. The project architectural design then adds significant detail, but retains traceability back to the architecture framework. By developing an architectural design for the project that maps back to the regional ITS architecture, there is traceability through the process, connecting planning and implementation.

The regional ITS architecture also includes a map to ITS standards that can be used to identify the applicable ITS standards for the project. Standards are mapped to physical elements and to information flows as part of the overall set of communications solutions in the project architecture.

Appendix A. Interfaces Details

The interfaces of the transportation systems in the Miami Valley ITS Regional ITS Architecture are based on ARC-IT and tailored to reflect the plan for the region. Architecture diagrams display the transportation systems in the Miami Valley ITS Regional ITS Architecture, and more importantly, how these systems are and will be connected with one another so information can be exchanged and transportation services can be coordinated. Stakeholders may use these diagrams to identify integration opportunities. Each system in the region is represented with two types of diagrams, a context diagram and an interface diagram.

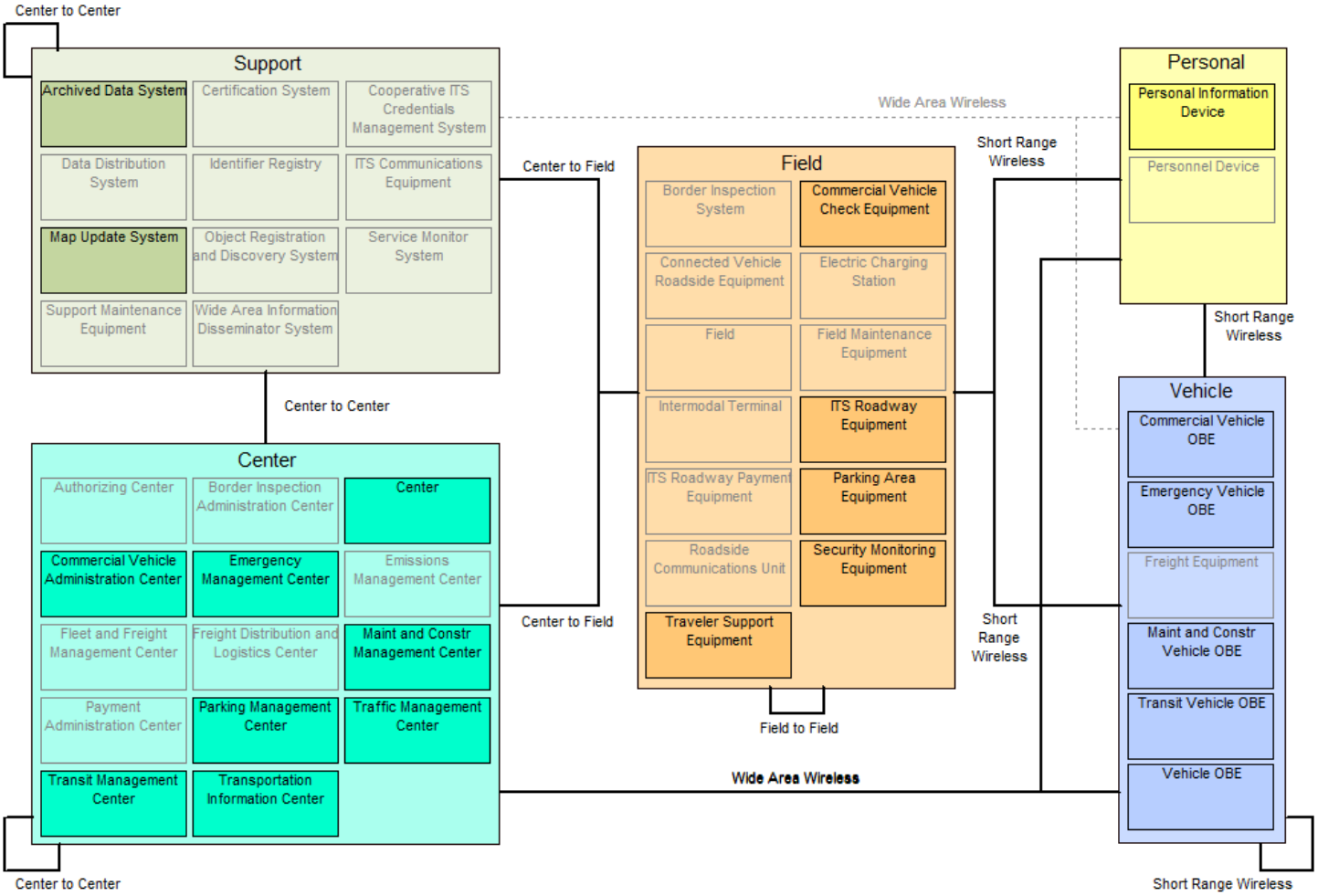
A context diagram shows a particular system and all other systems with which it shares information. Interconnects are represented as single lines and indicate information sharing without specifying the type of information being shared or the direction of the information movement.

Following each interconnect context diagram are a series of information flow diagrams showing the information (i.e. information flows) movement between the various systems. Descriptions of the information flows are included at the end of the chapter.

Information about the interfaces of the systems in the region is contained in the RAD-IT database. RAD-IT can be used to create tailored interconnect and information flow diagrams for any system in the database.

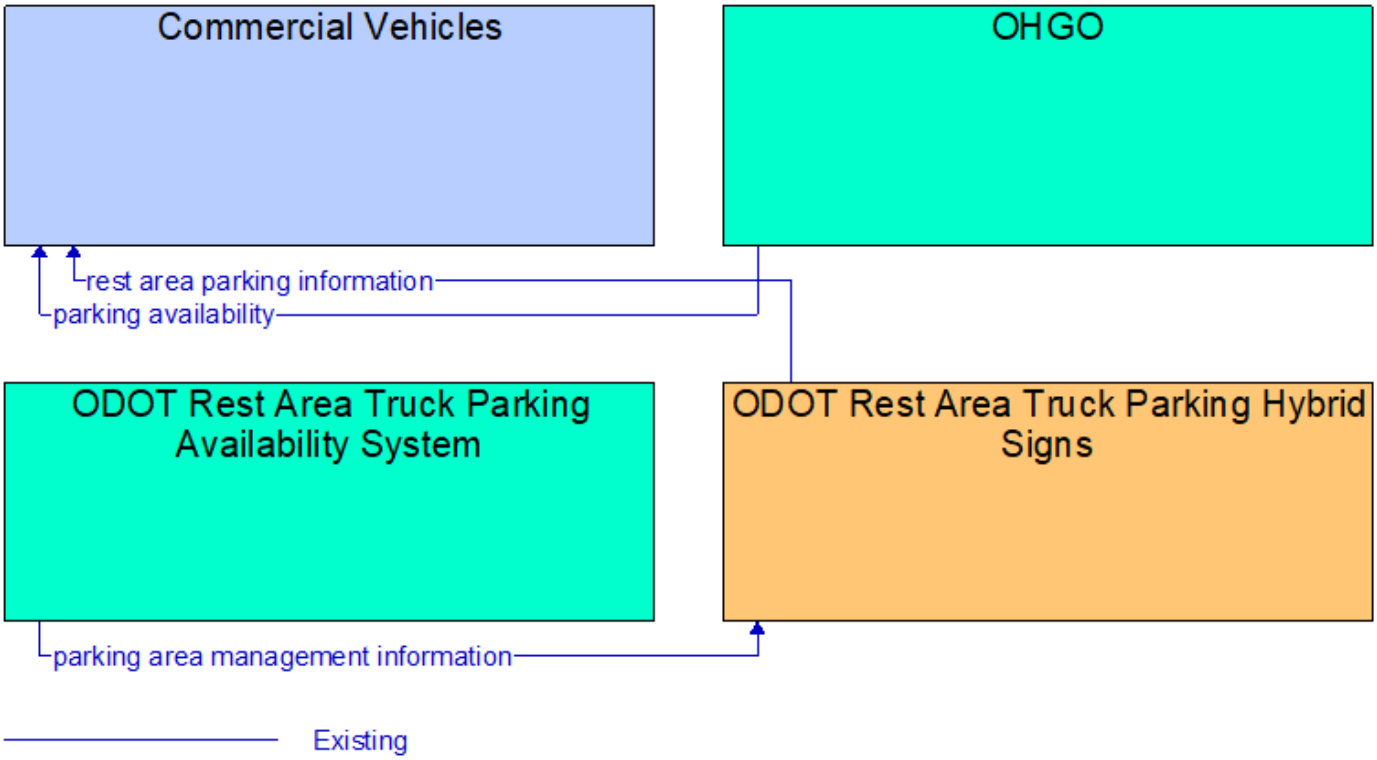
Miami Valley ITS Regional Architecture Interface Diagrams

Miami Valley Regional ITS Architecture Subsystem Diagram

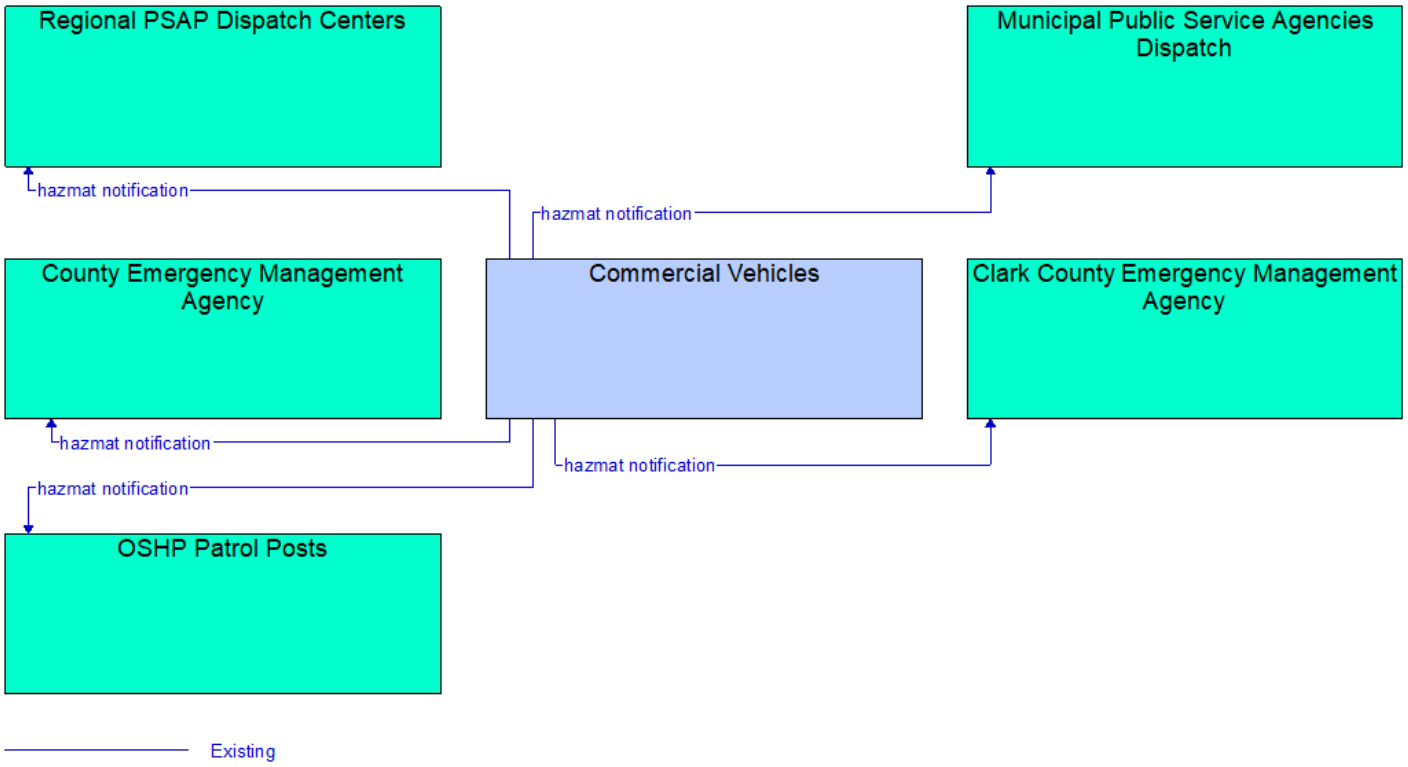


Note: The different colors, light green (support), turquoise (centers), orange (field), yellow (traveler,) and purple (vehicles) are repeated throughout the interface diagrams.

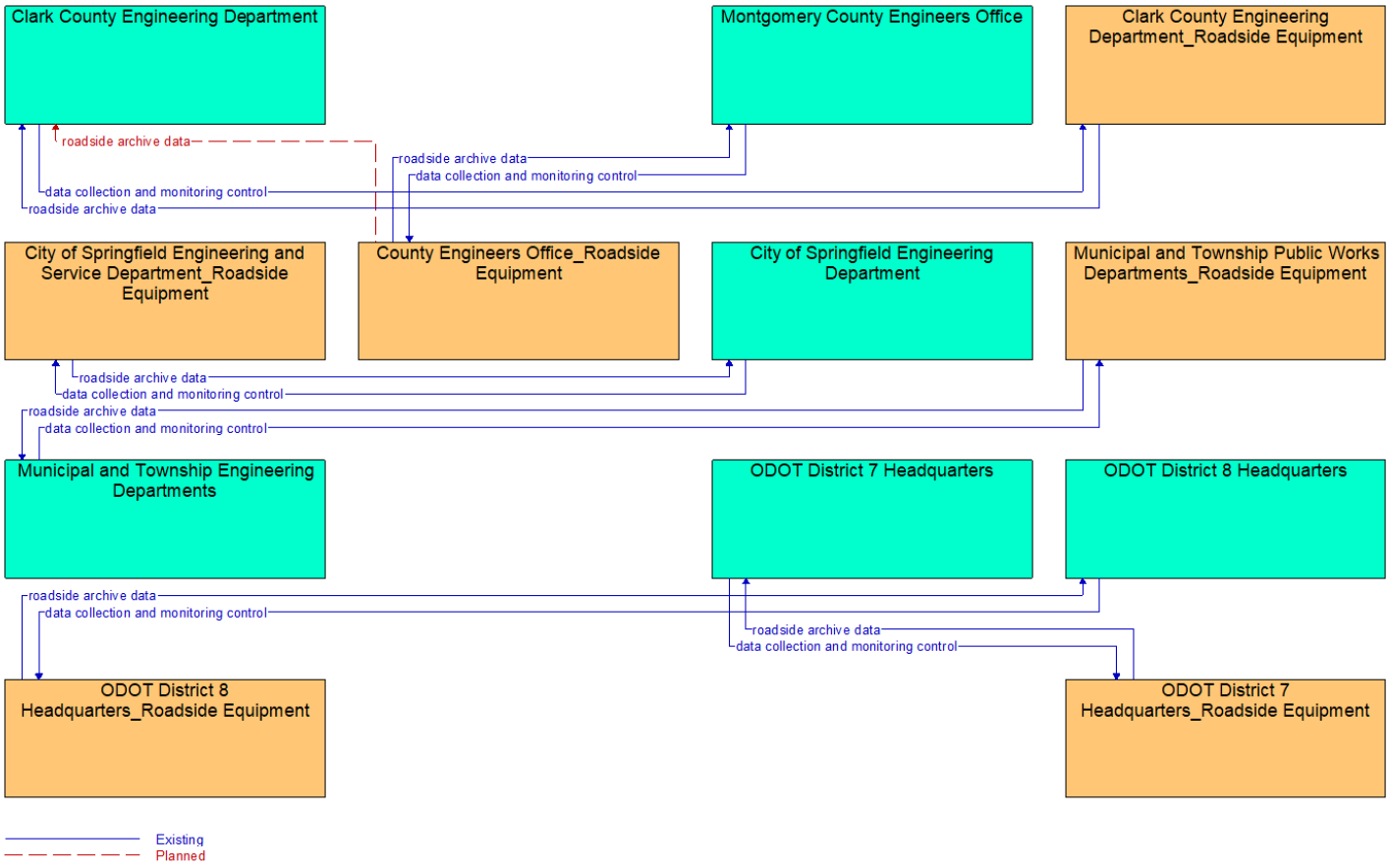
CVO05 – Commercial Vehicle Parking



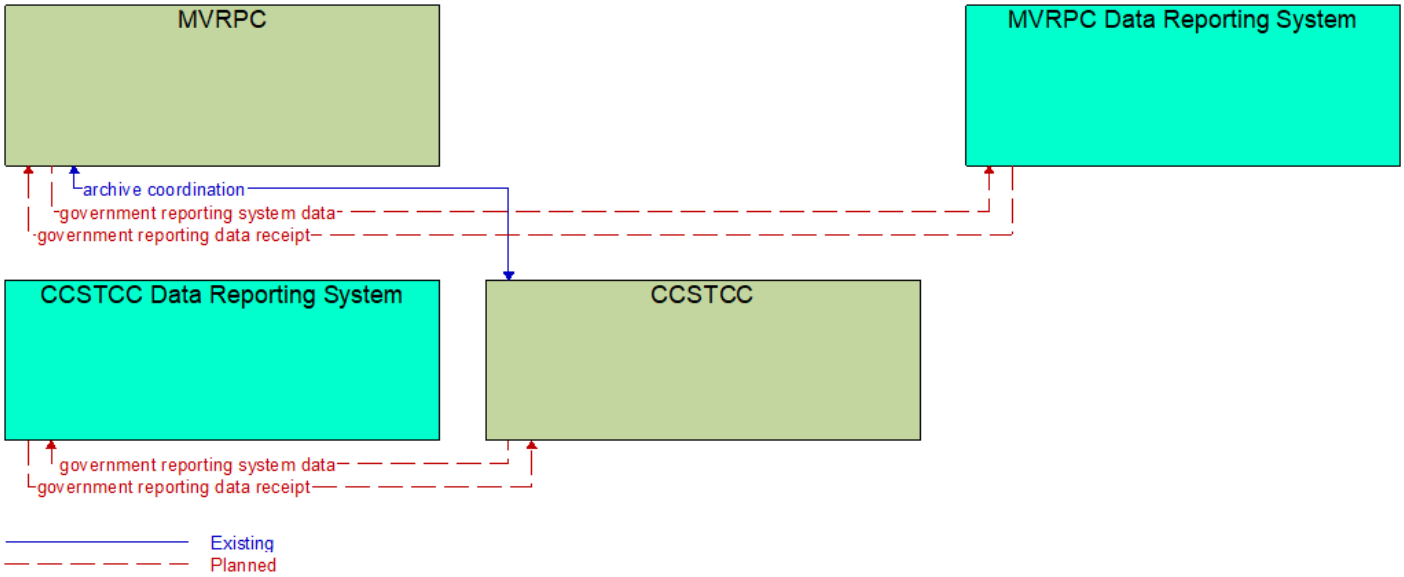
CVO012 – HAZMAT Management



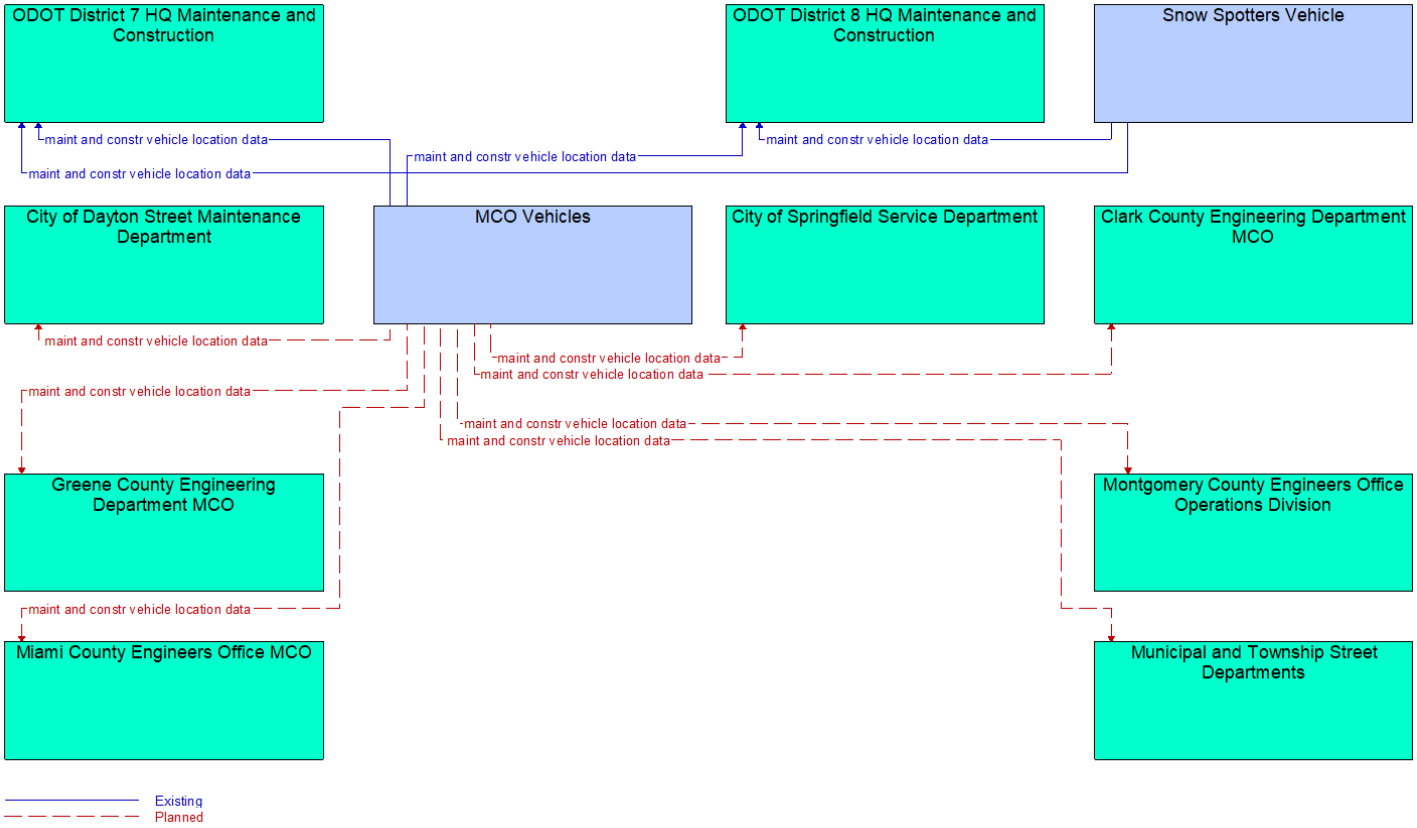
DM01 – ITS Data Warehouse



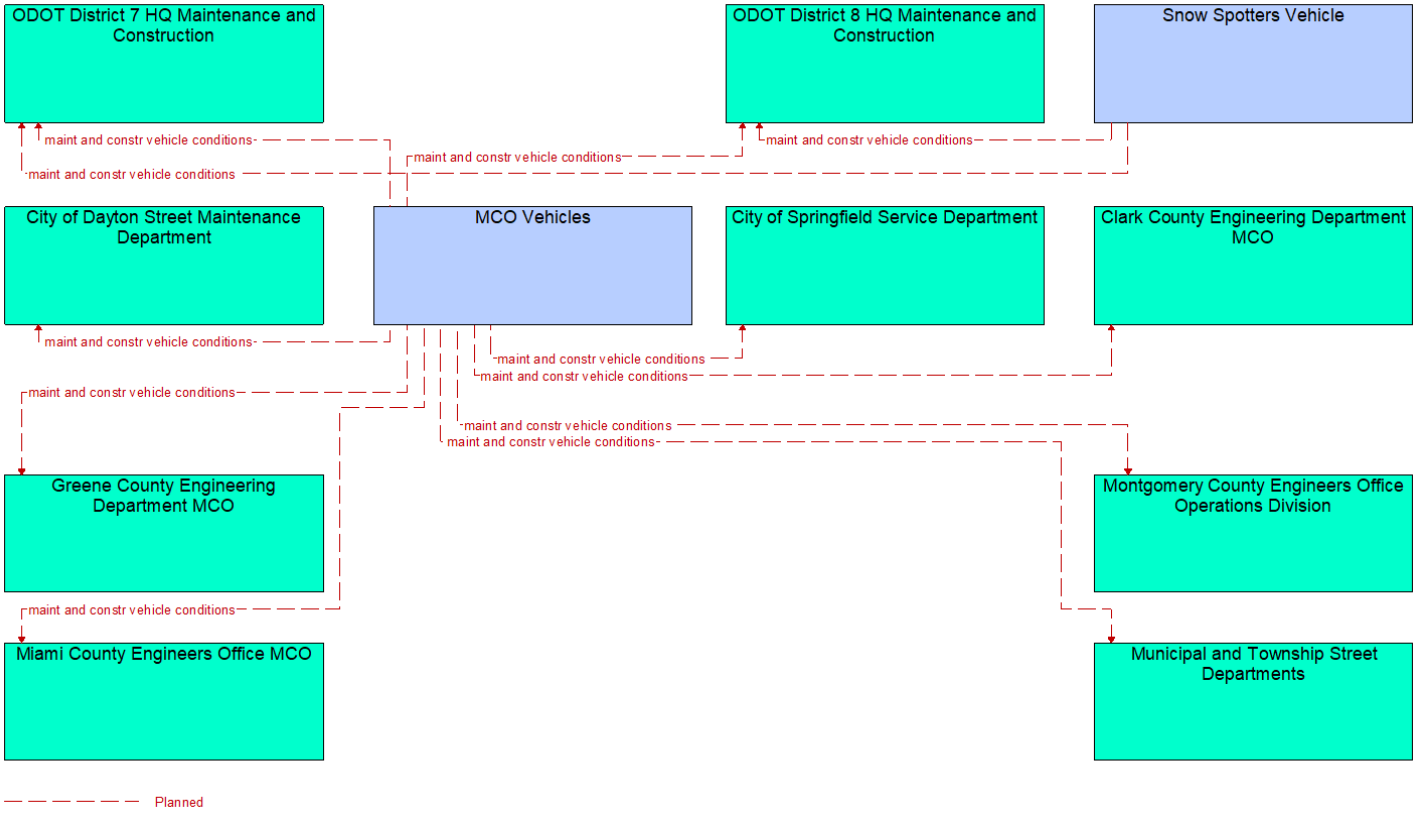
DM02 – Performance Monitoring



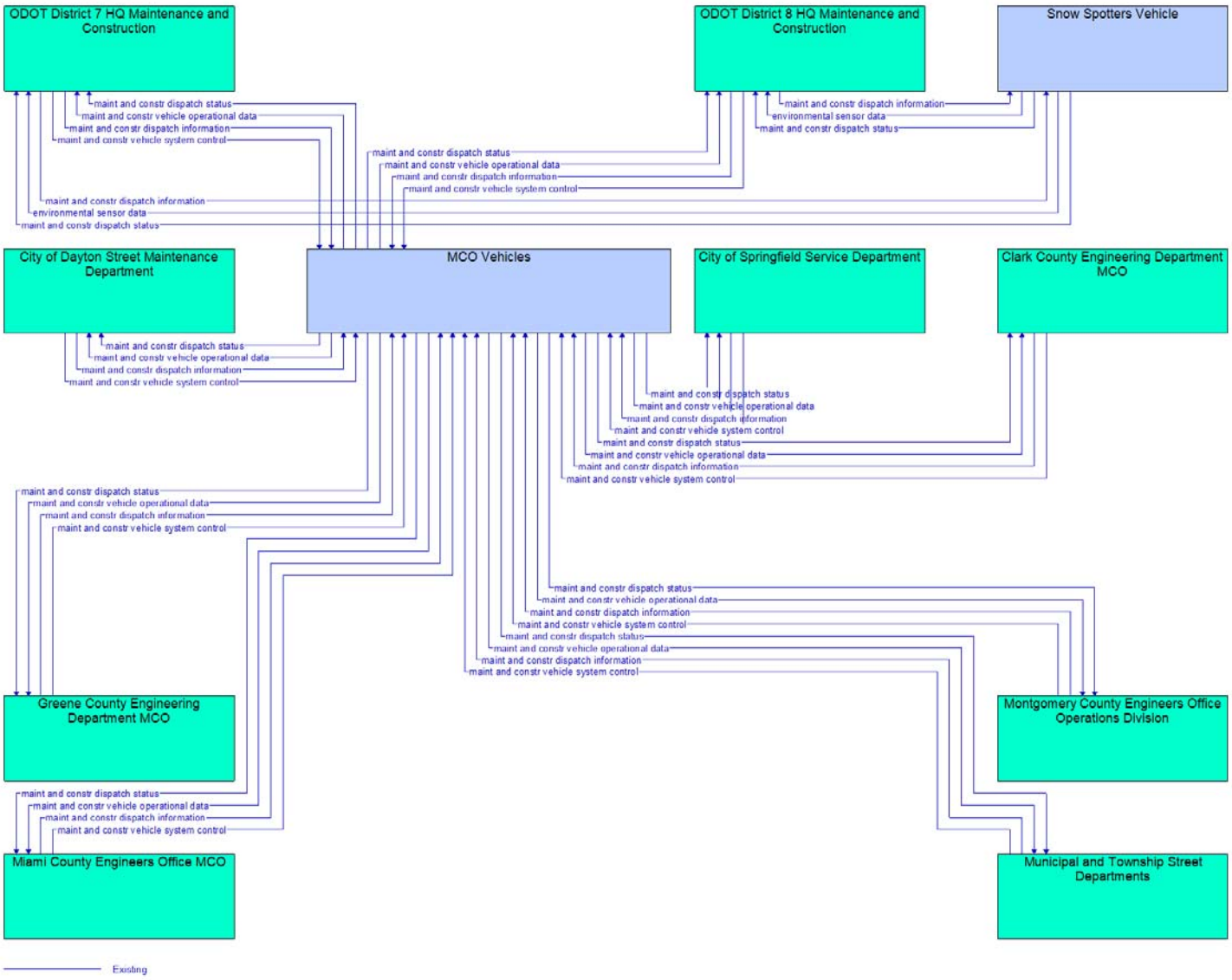
MC01 – Maintenance and Construction Vehicle and Equipment Tracking



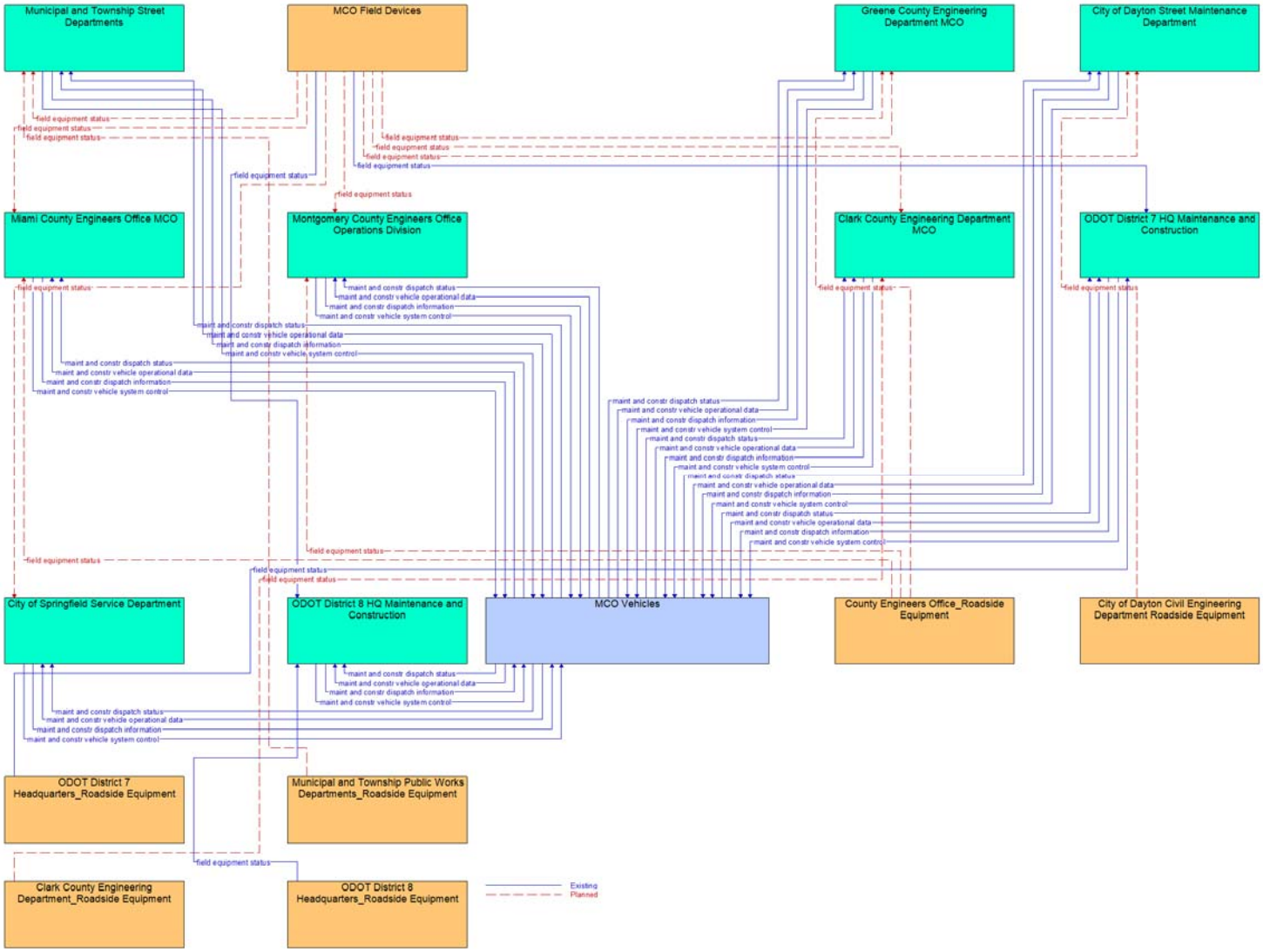
MC02 – Maintenance and Construction Vehicle Maintenance



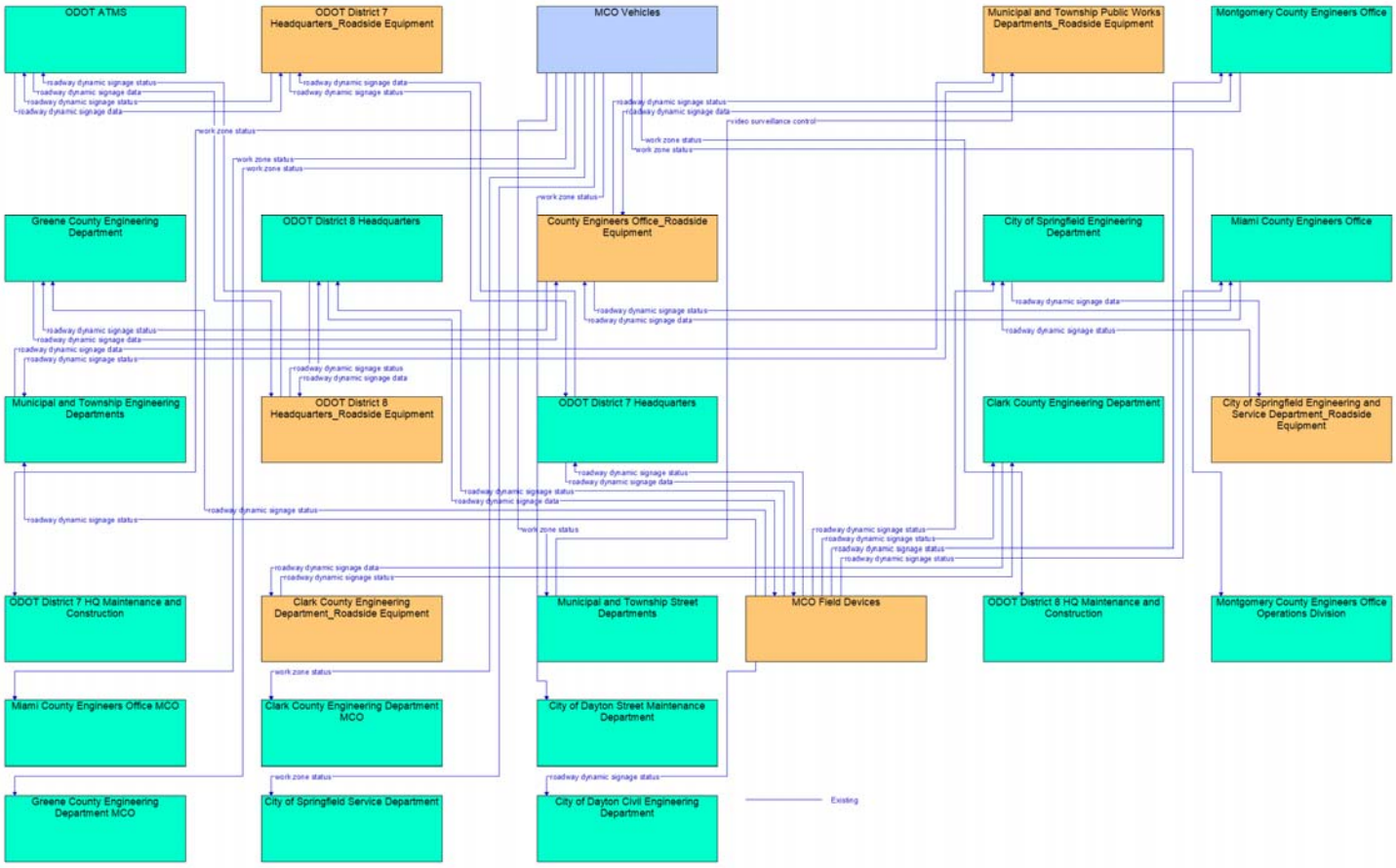
MC04 – Winter Maintenance



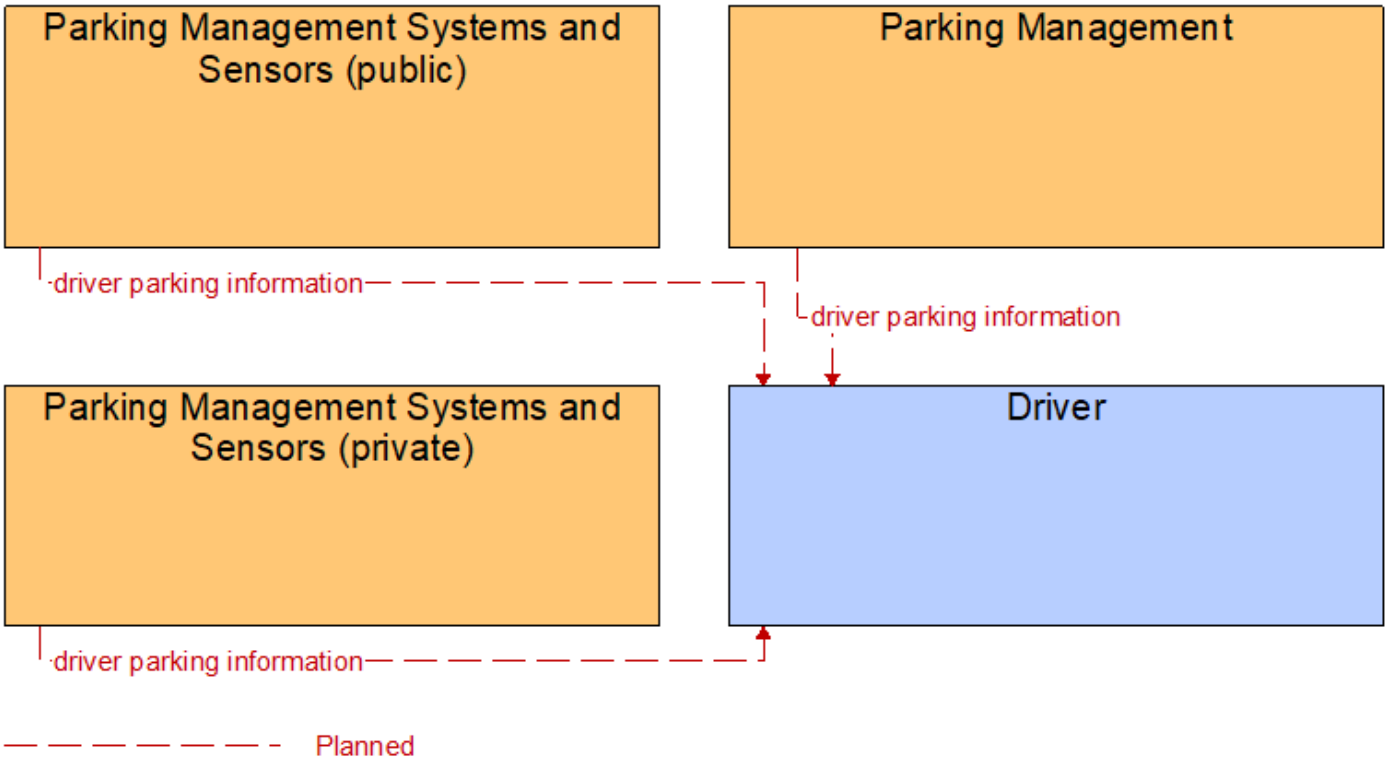
MC05 – Roadway Maintenance and Construction



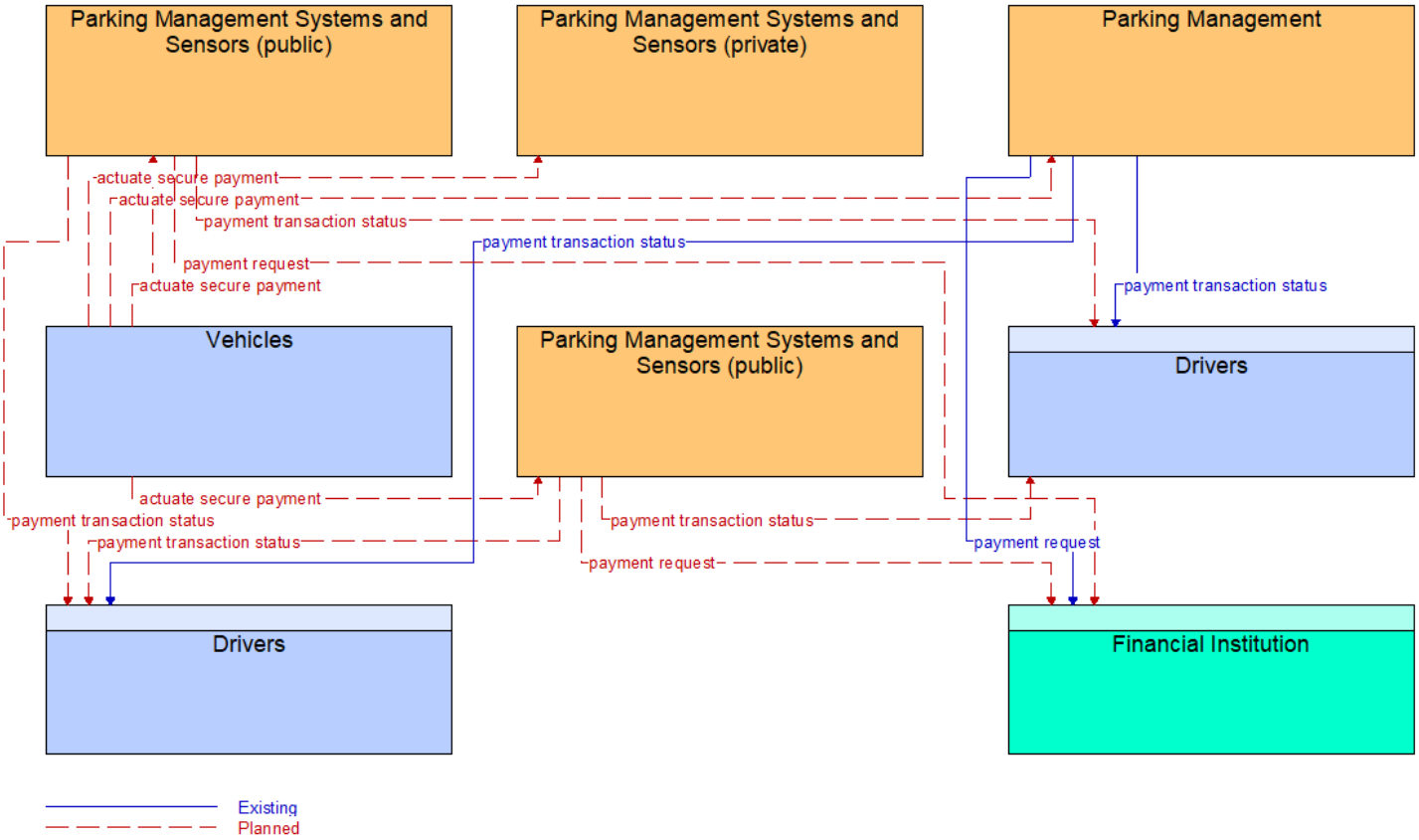
MC06 – Work Zone Management



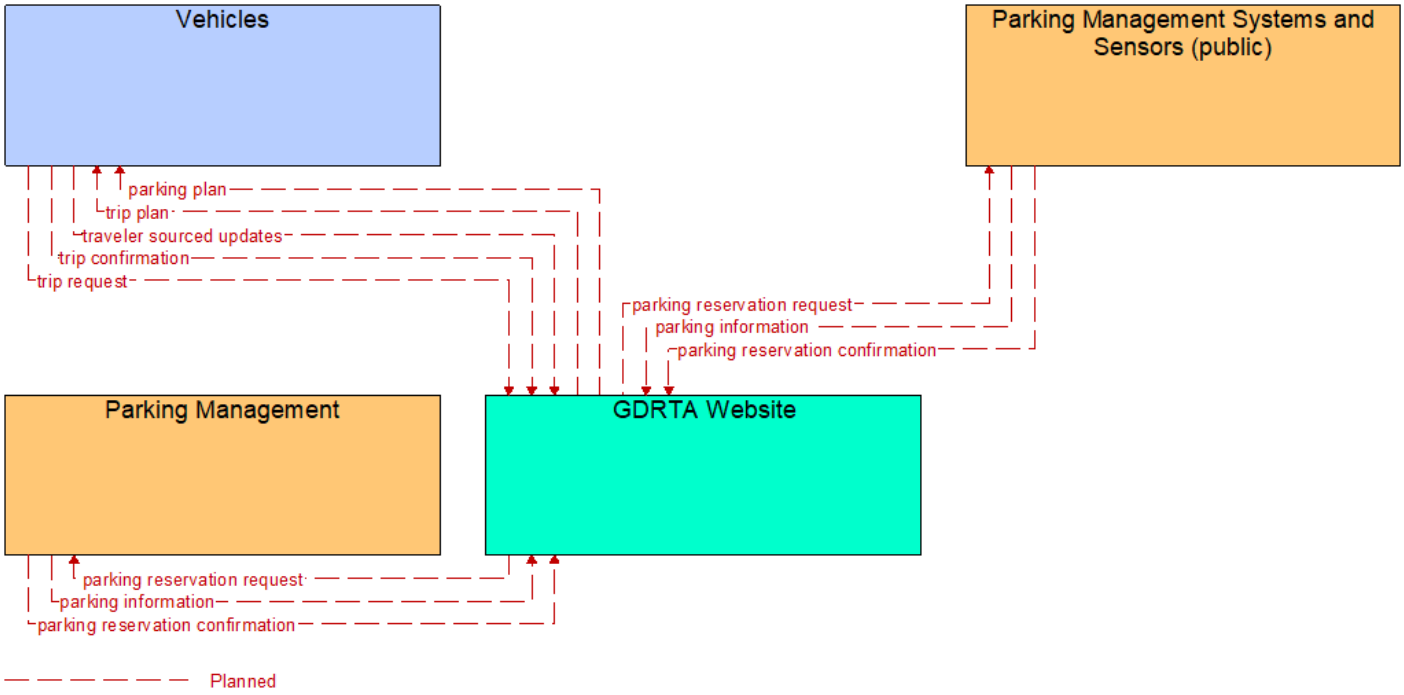
PM01 – Parking Space Management



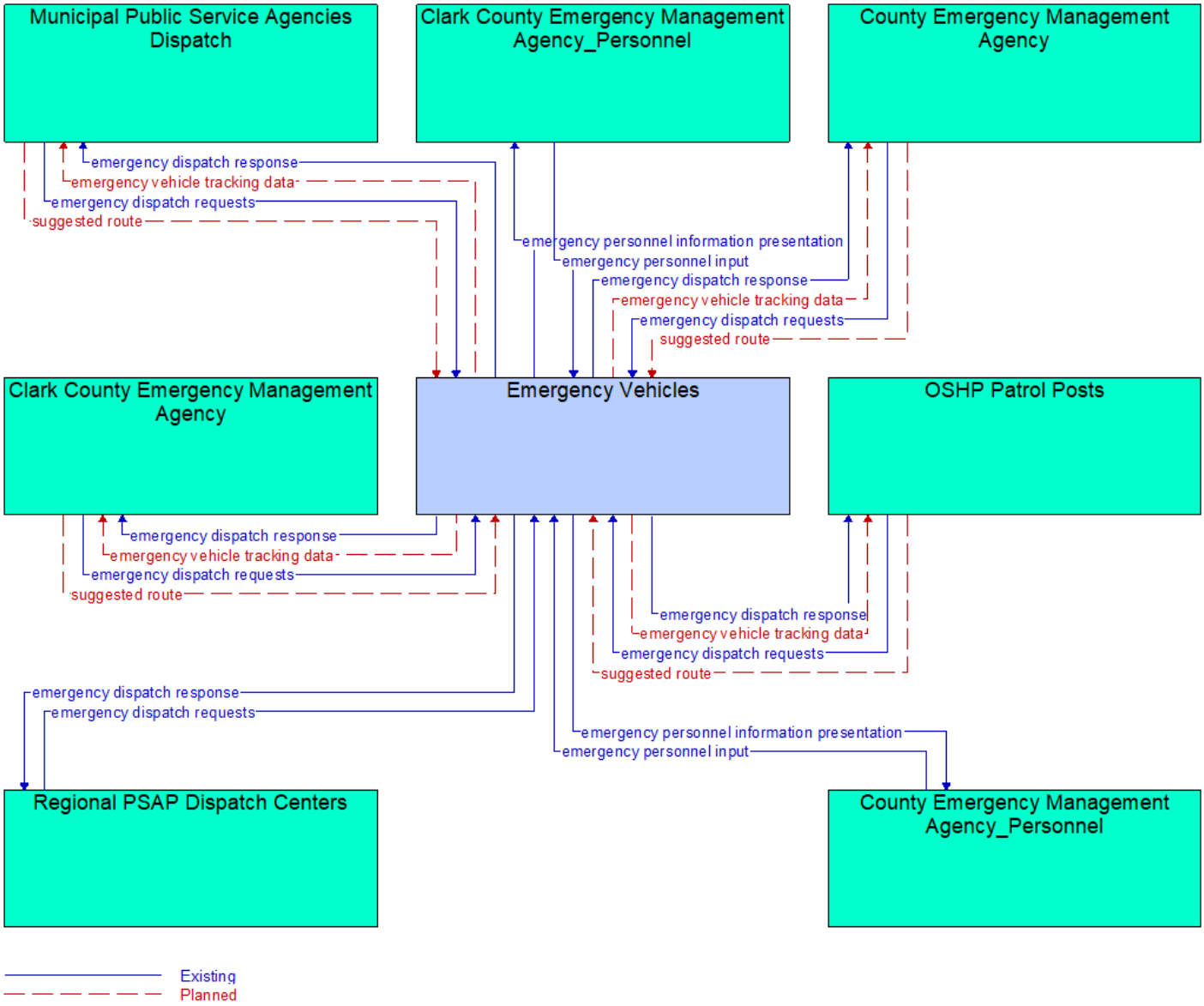
PM03 – Parking Electronic Payment



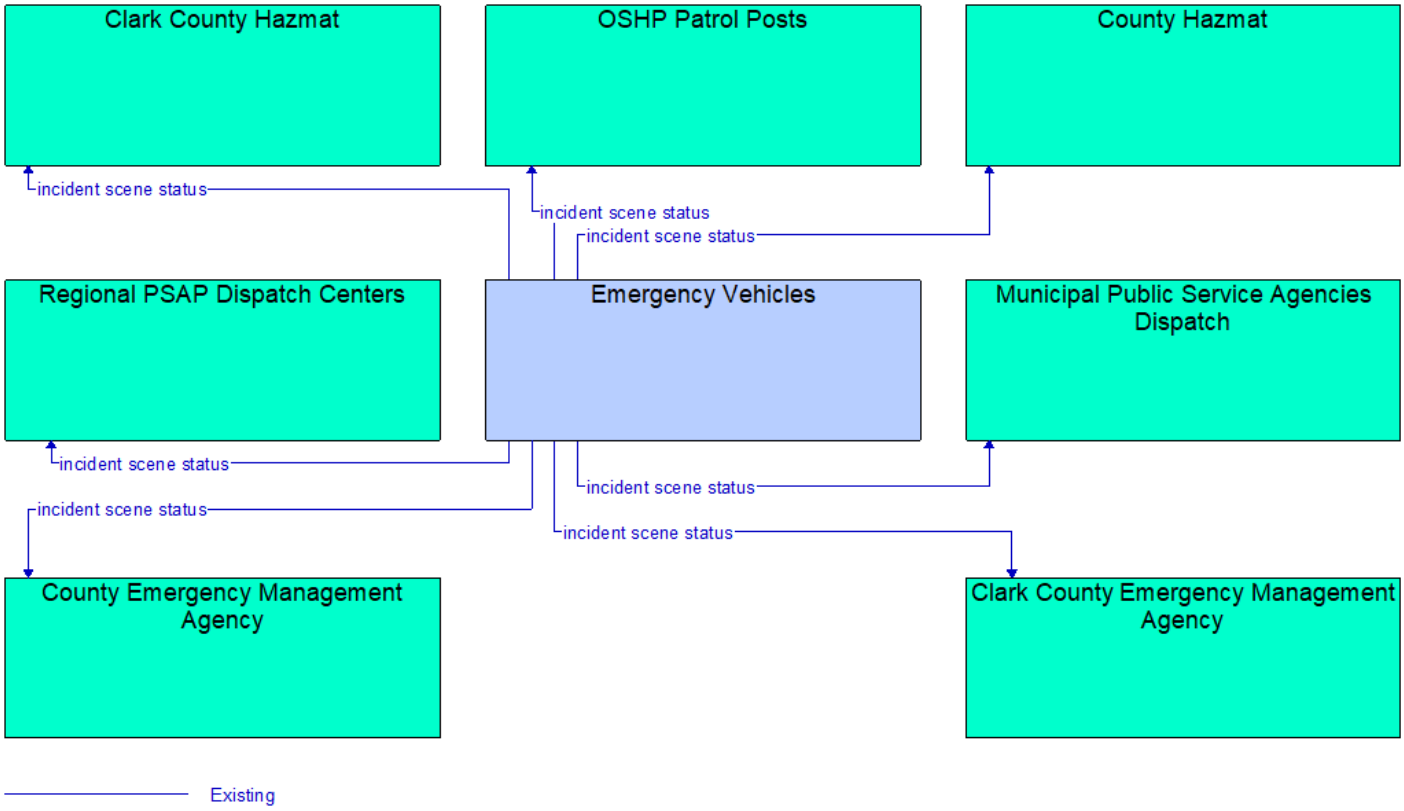
PM05 – Parking Reservations



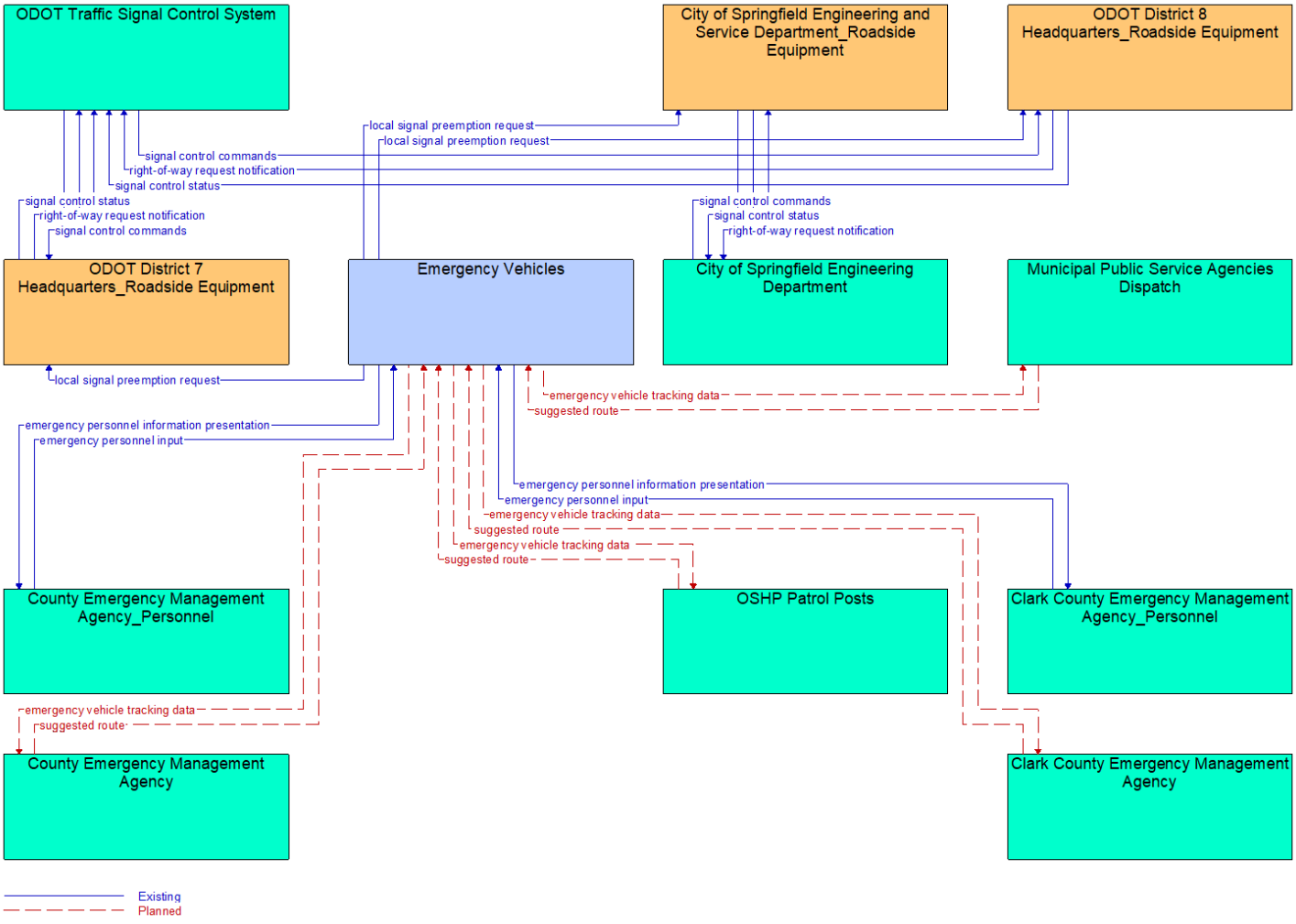
PS01 – Emergency Call- Taking and Dispatch



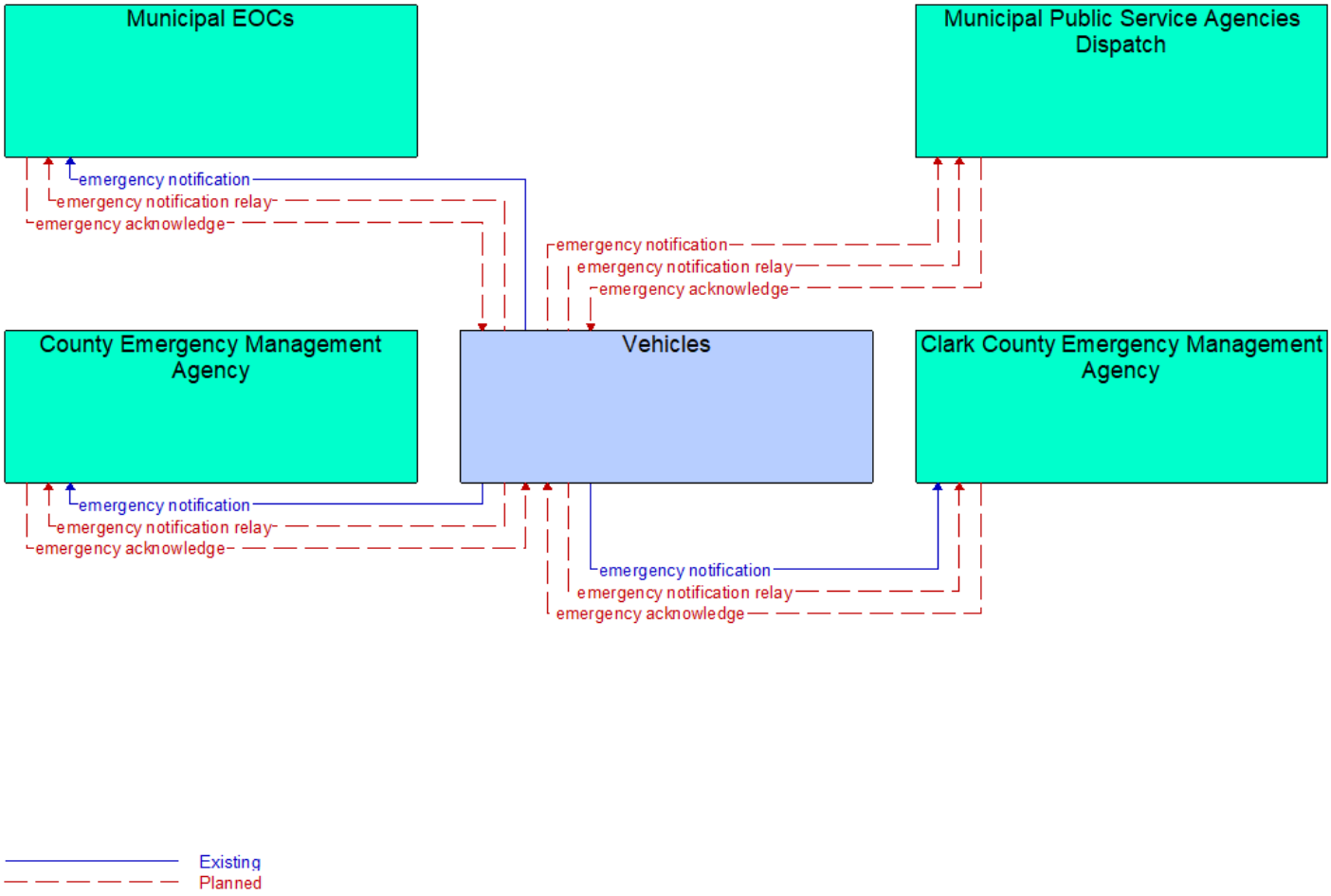
PS02 – Emergency Response



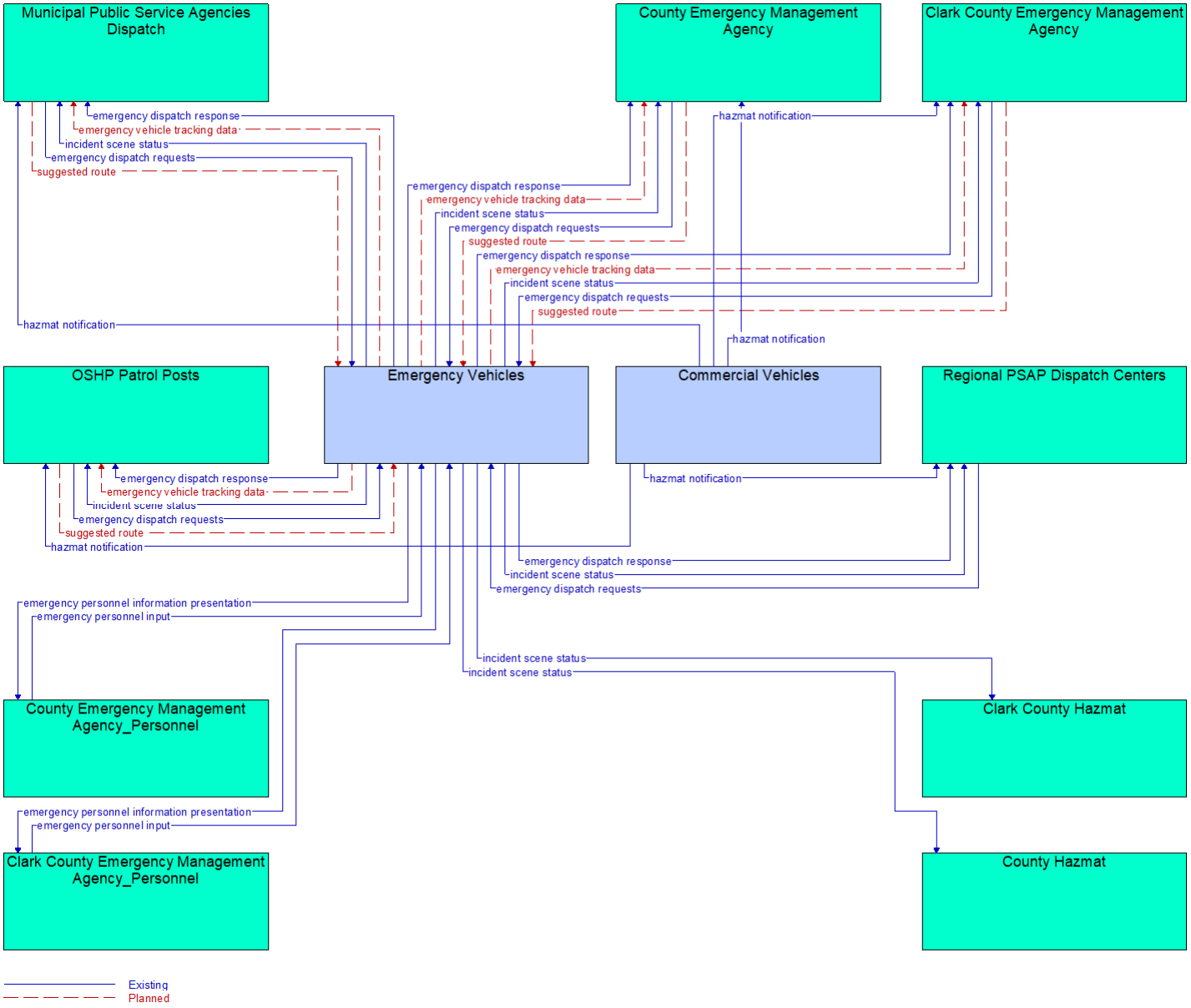
PS03 – Emergency Vehicle Preemption



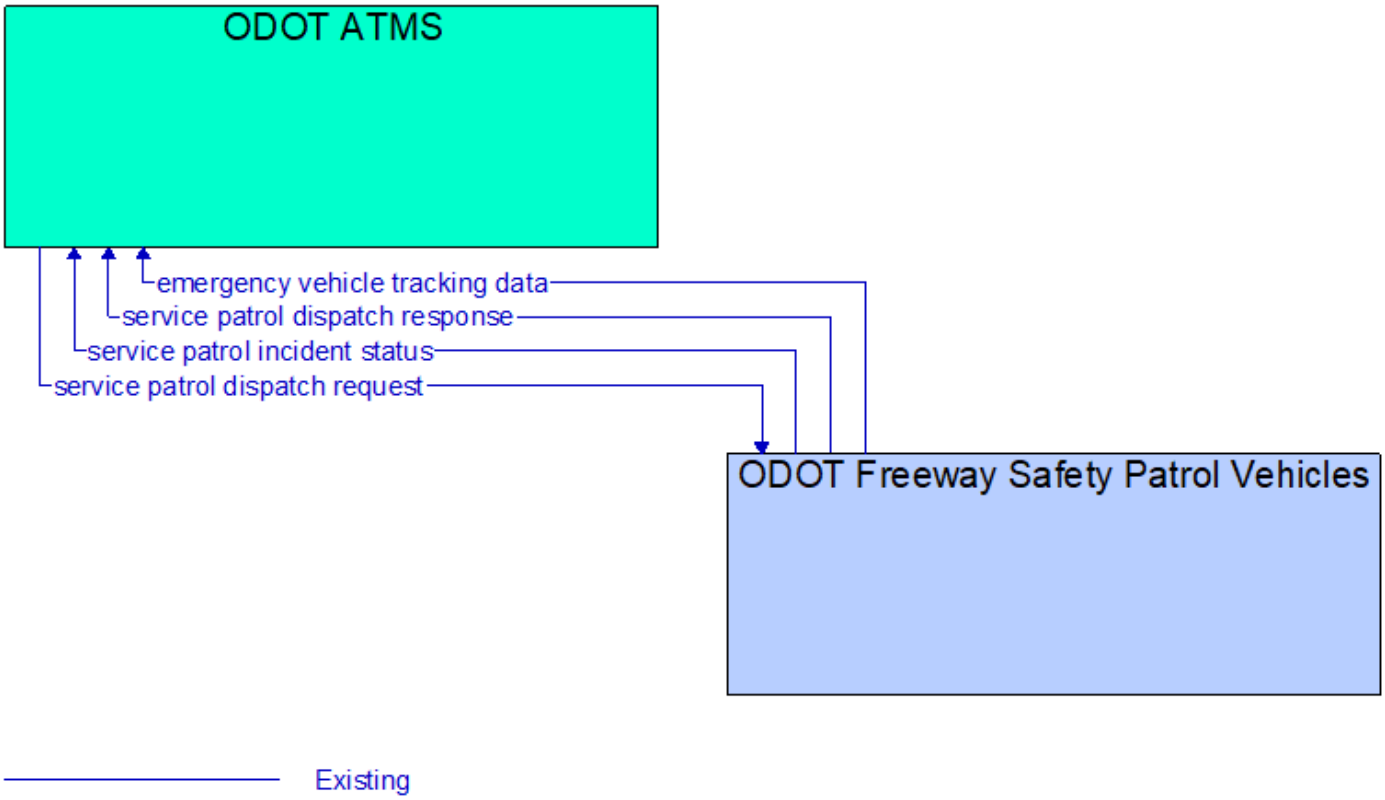
PS04 – Mayday Notification



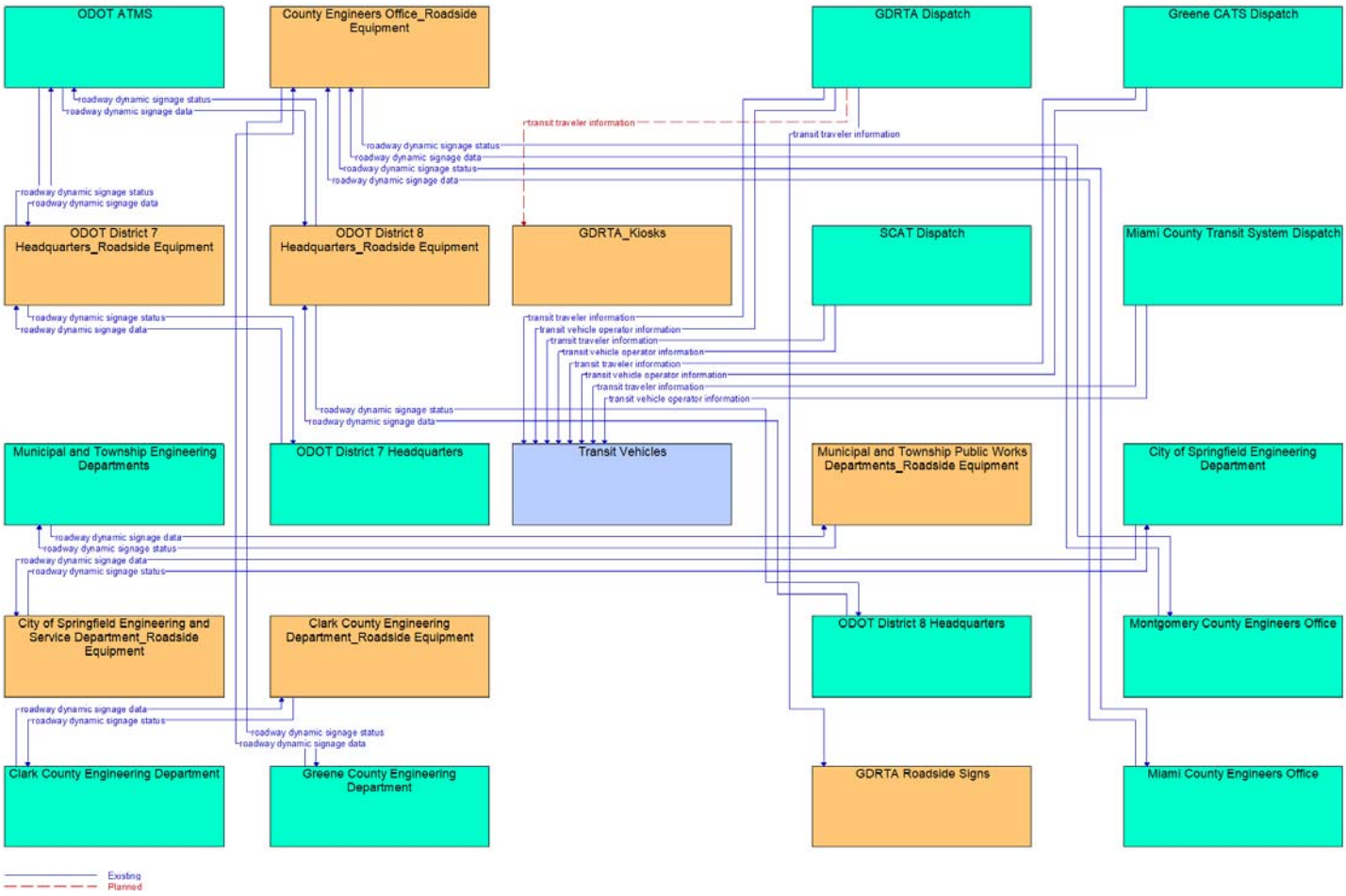
PS06 – Incident Scene Pre-Arrival Staging Guidance for Emergency Responders



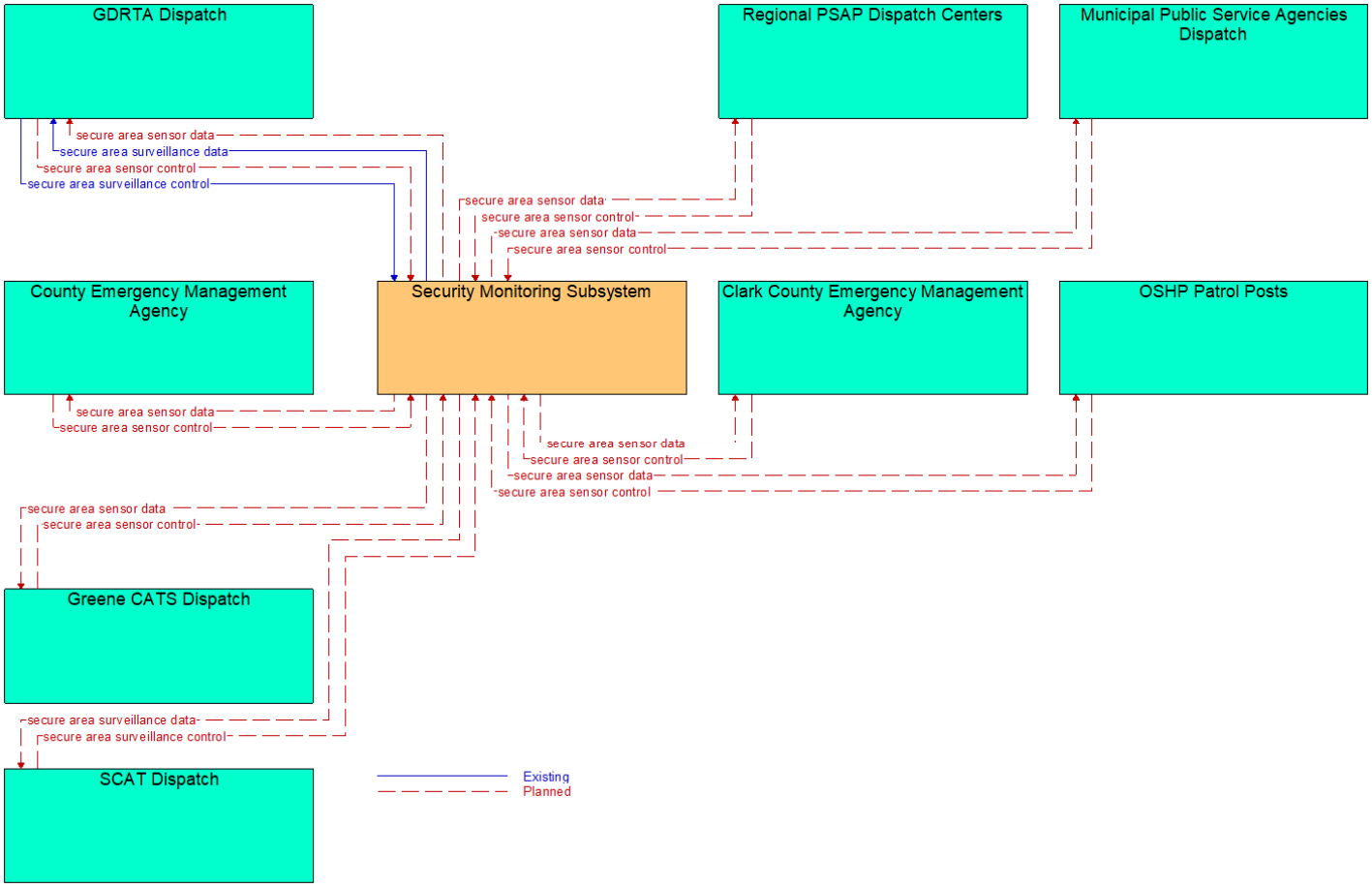
PS08 – Roadway Service Patrols



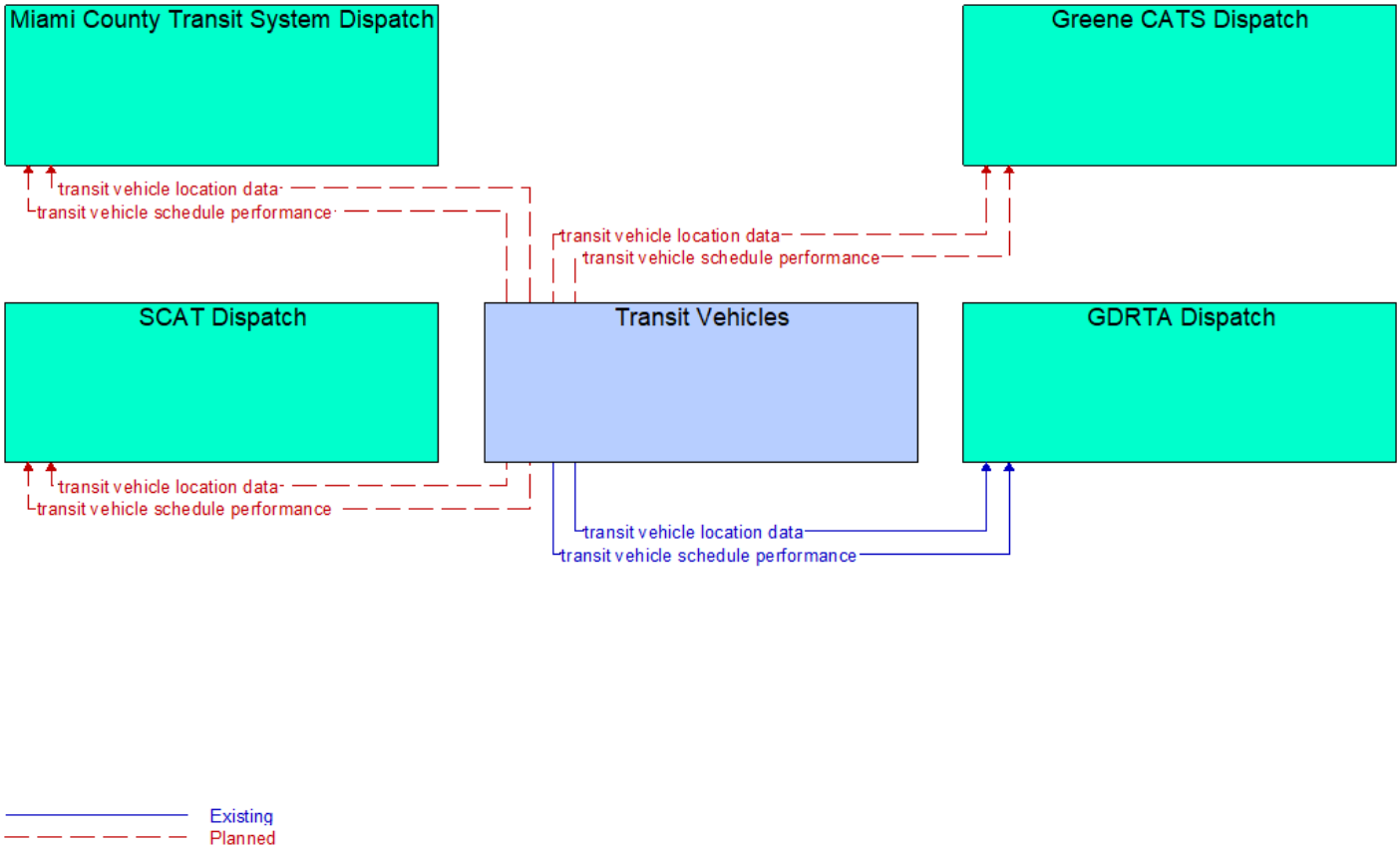
PS10 – Wide-Area Alert



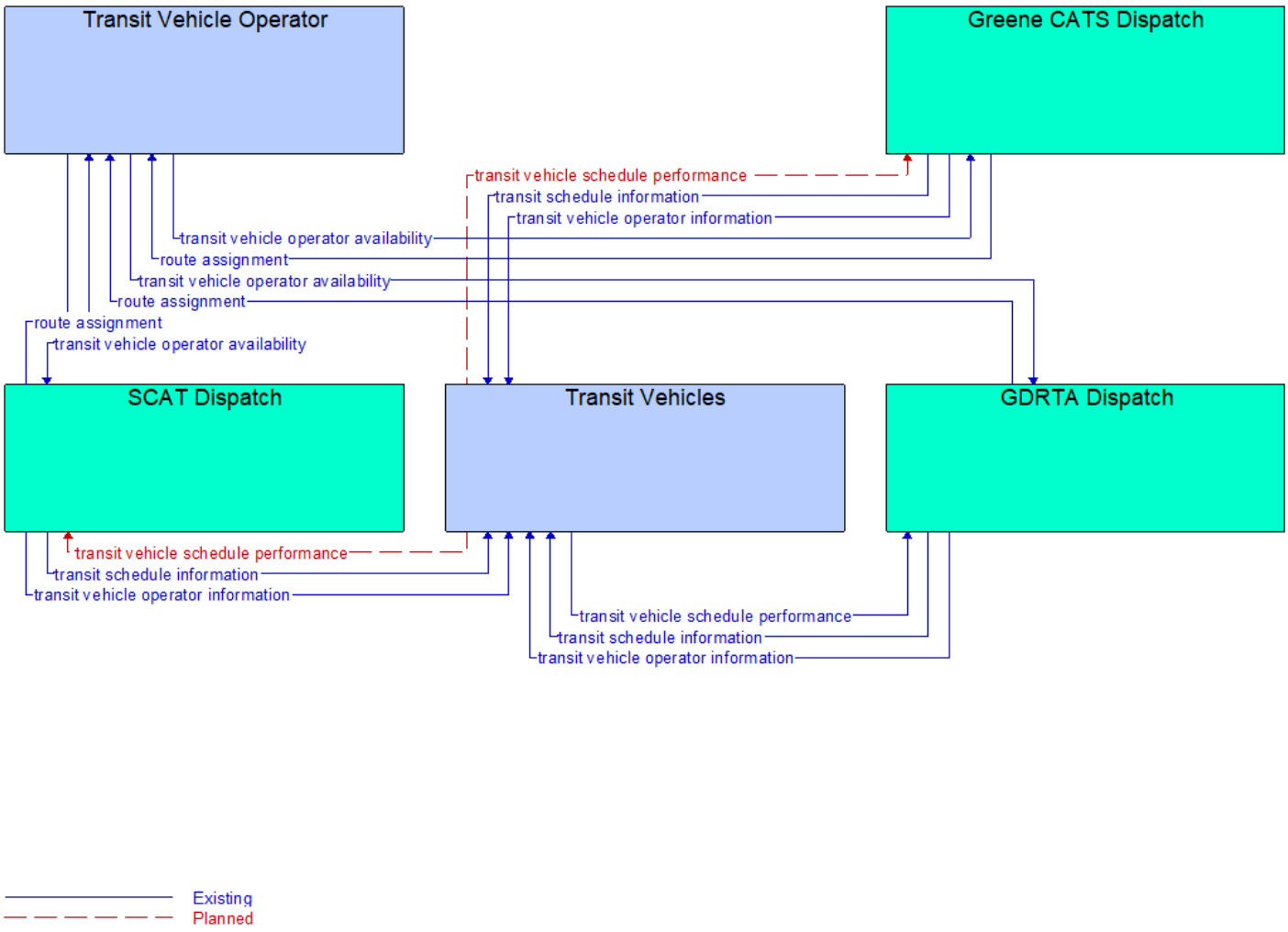
PS11 – Early Warning System



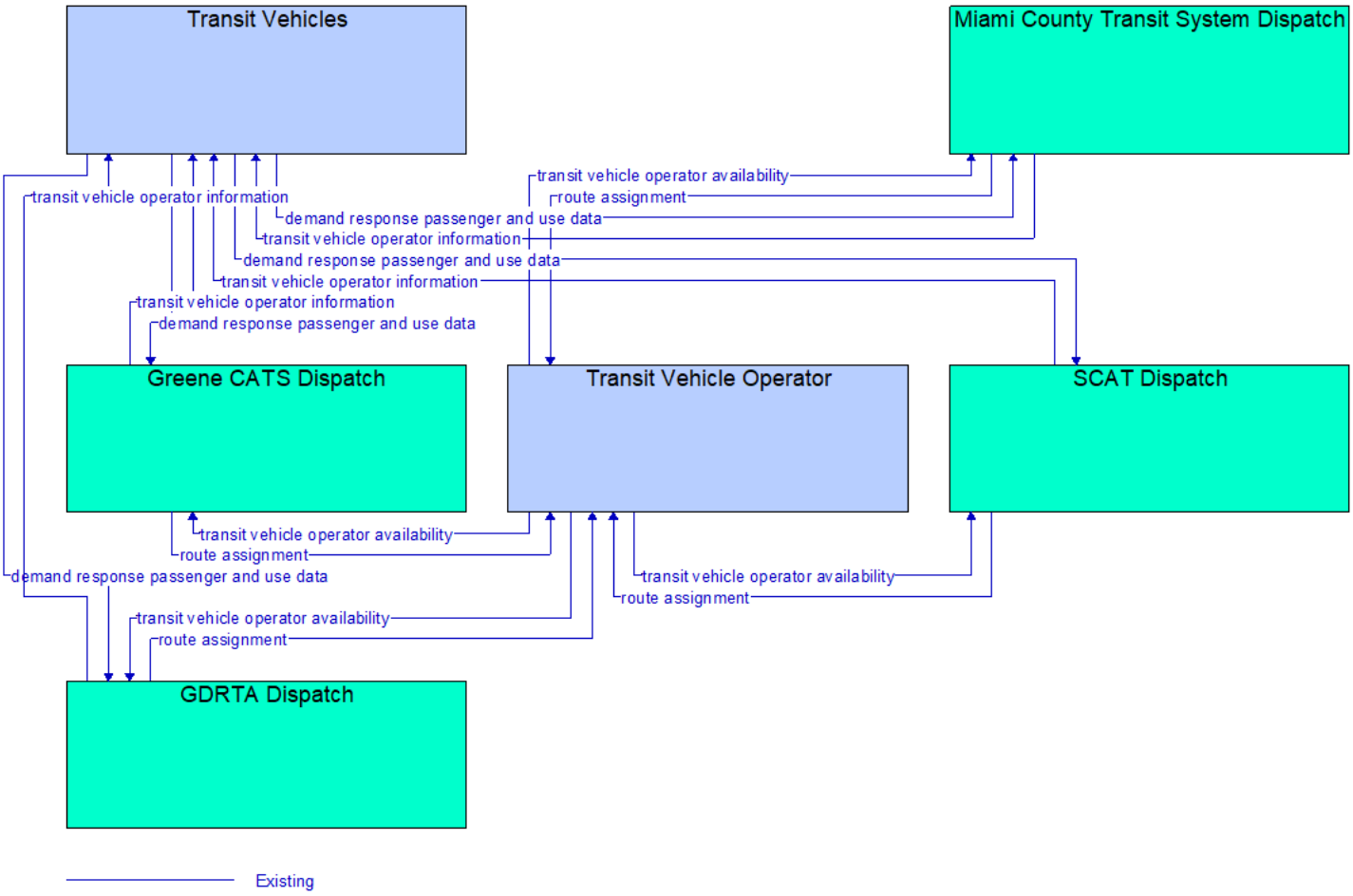
PT01 – Transit Vehicle Tracking



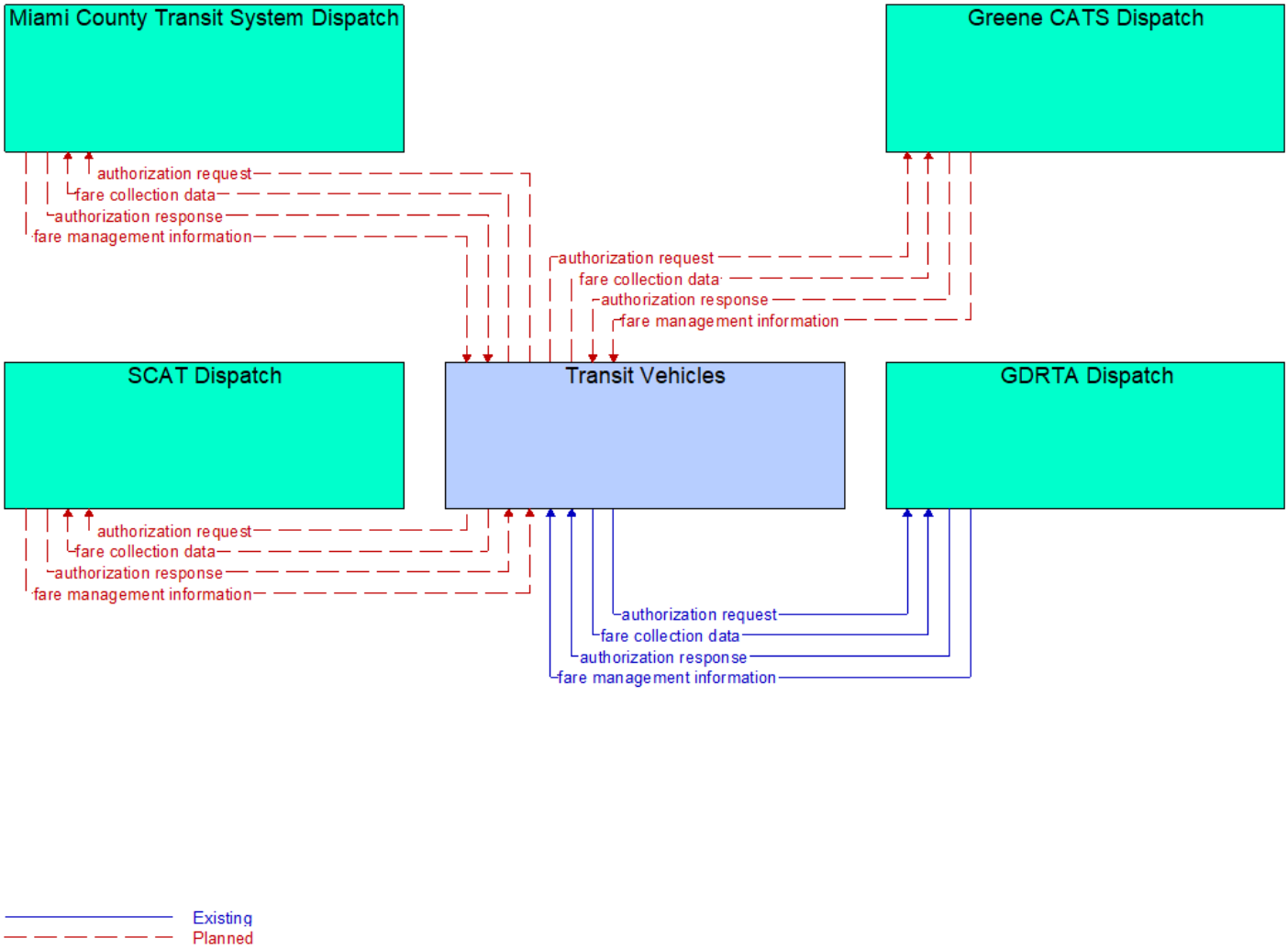
PT02 – Transit Fixed-Route Operations



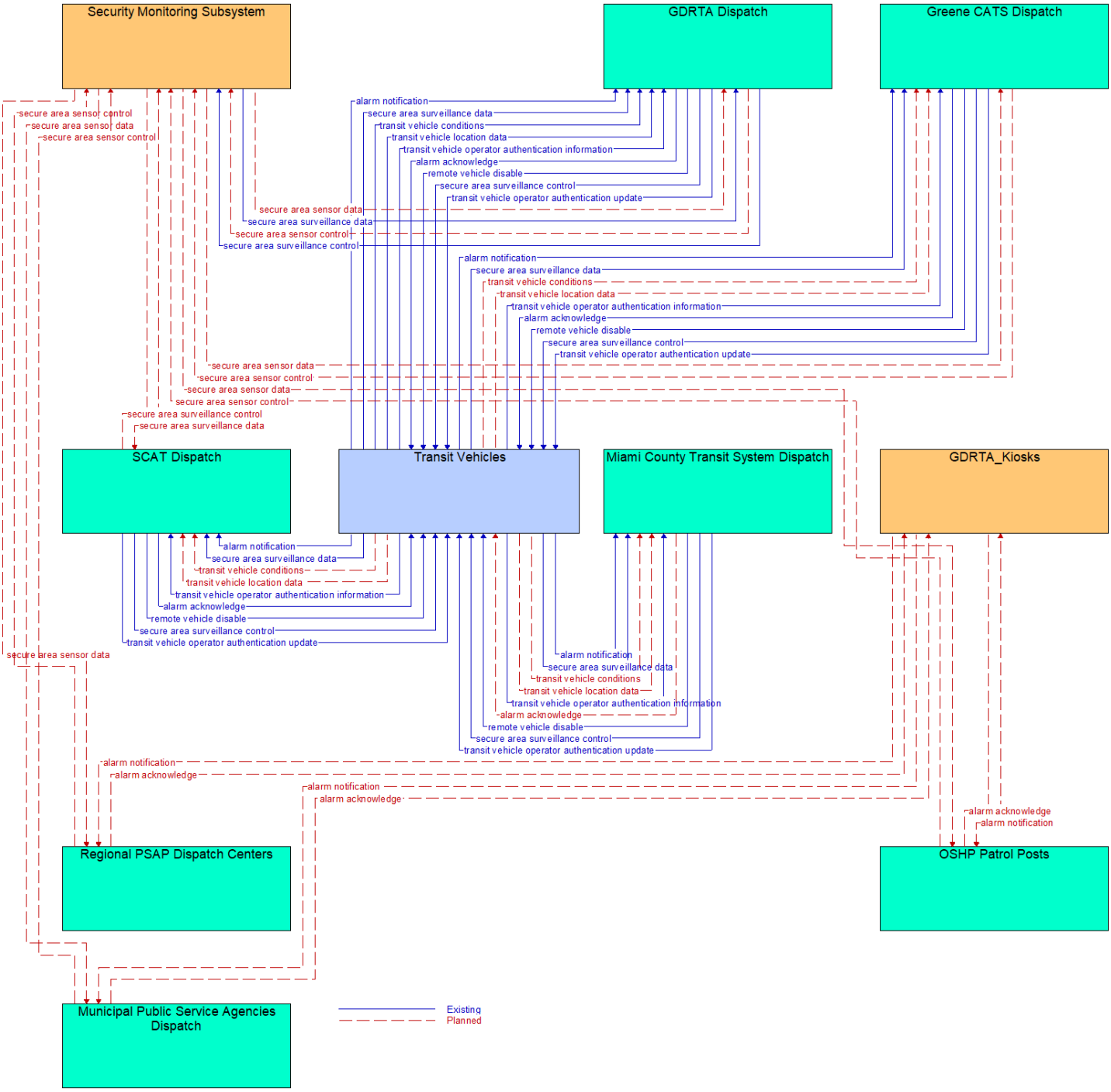
PT03 – Dynamic Transit Operations



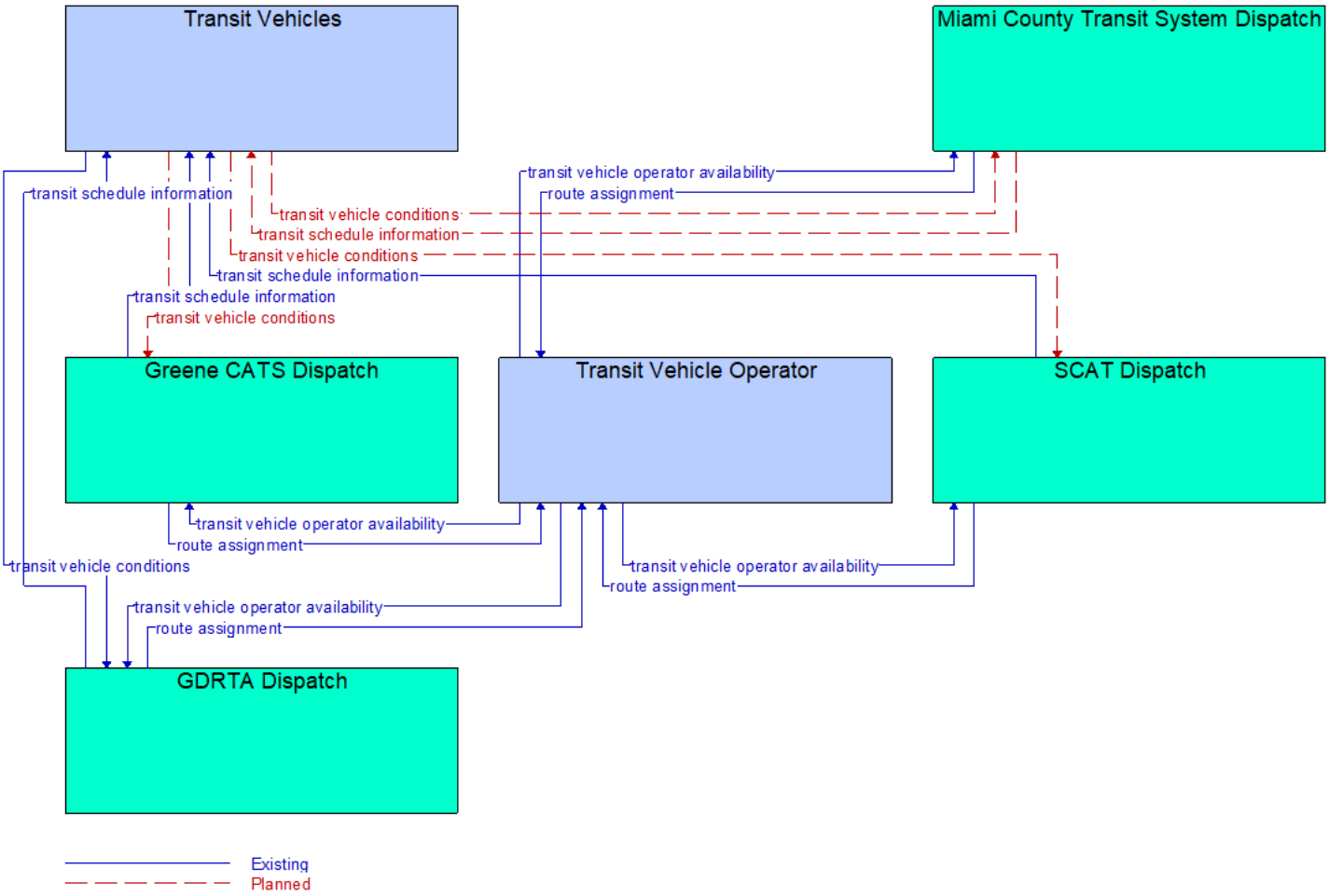
PT04 – Transit Fare Collection Management



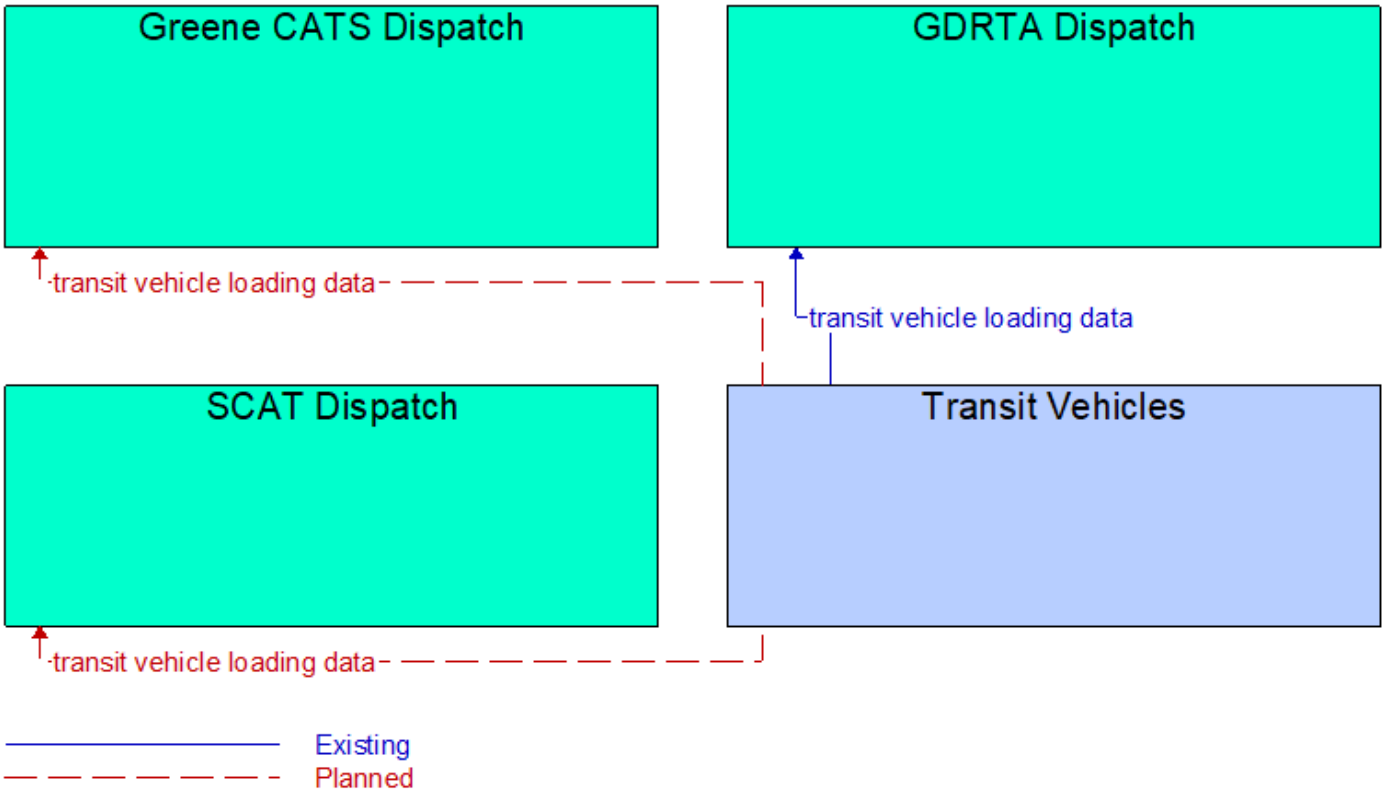
PT05 – Transit Security



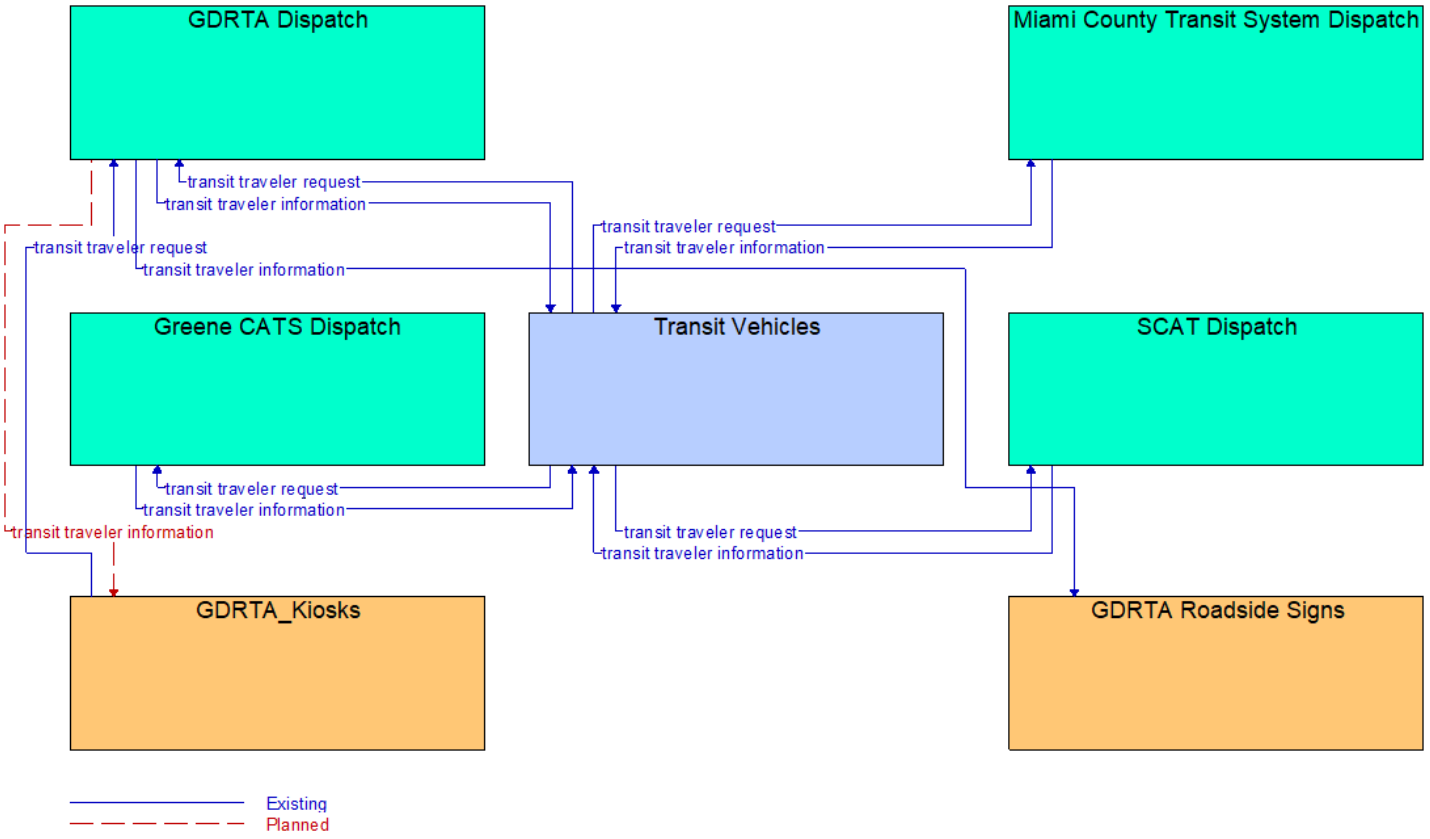
PT06 – Transit Fleet Management



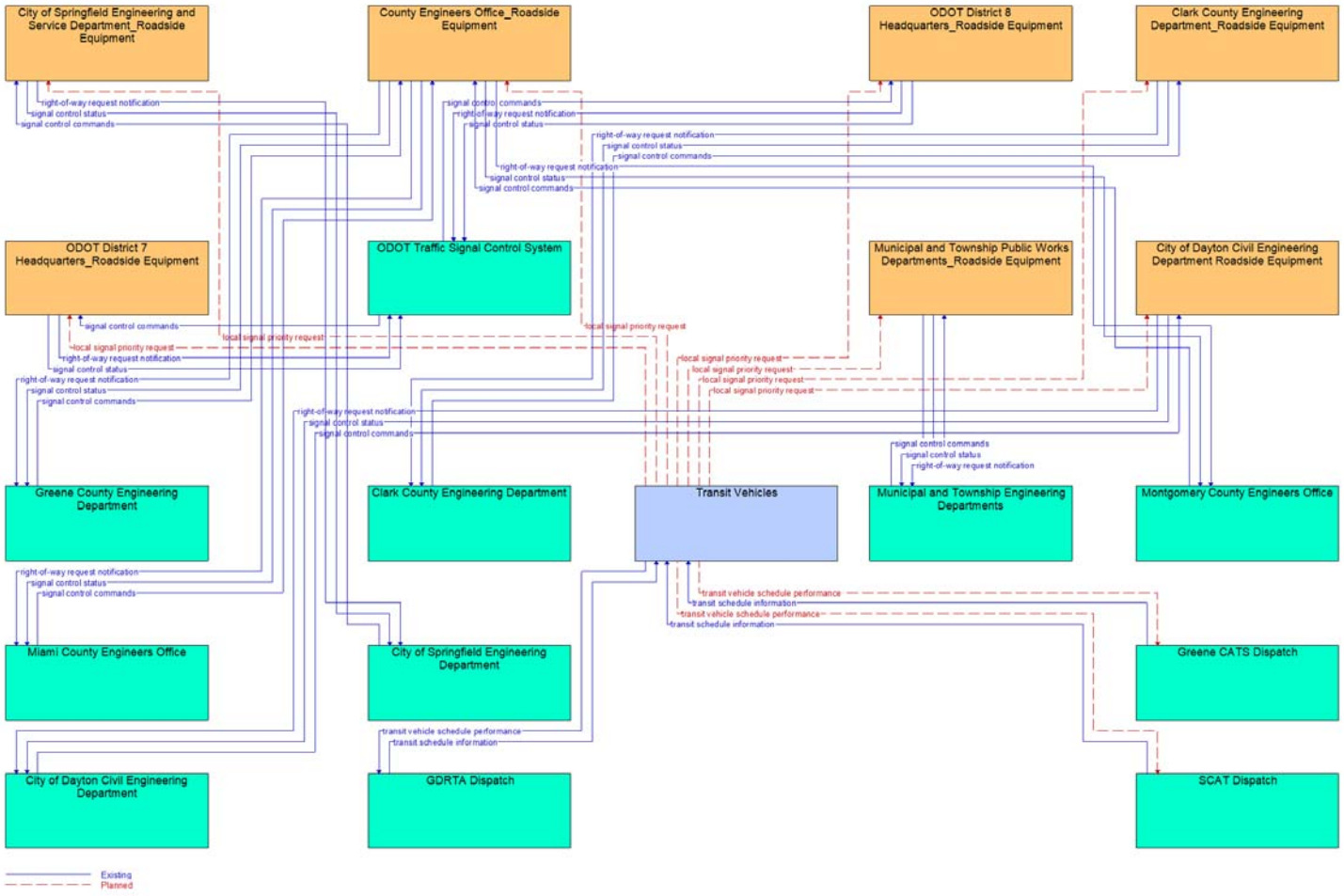
PT07 – Transit Passenger Counting



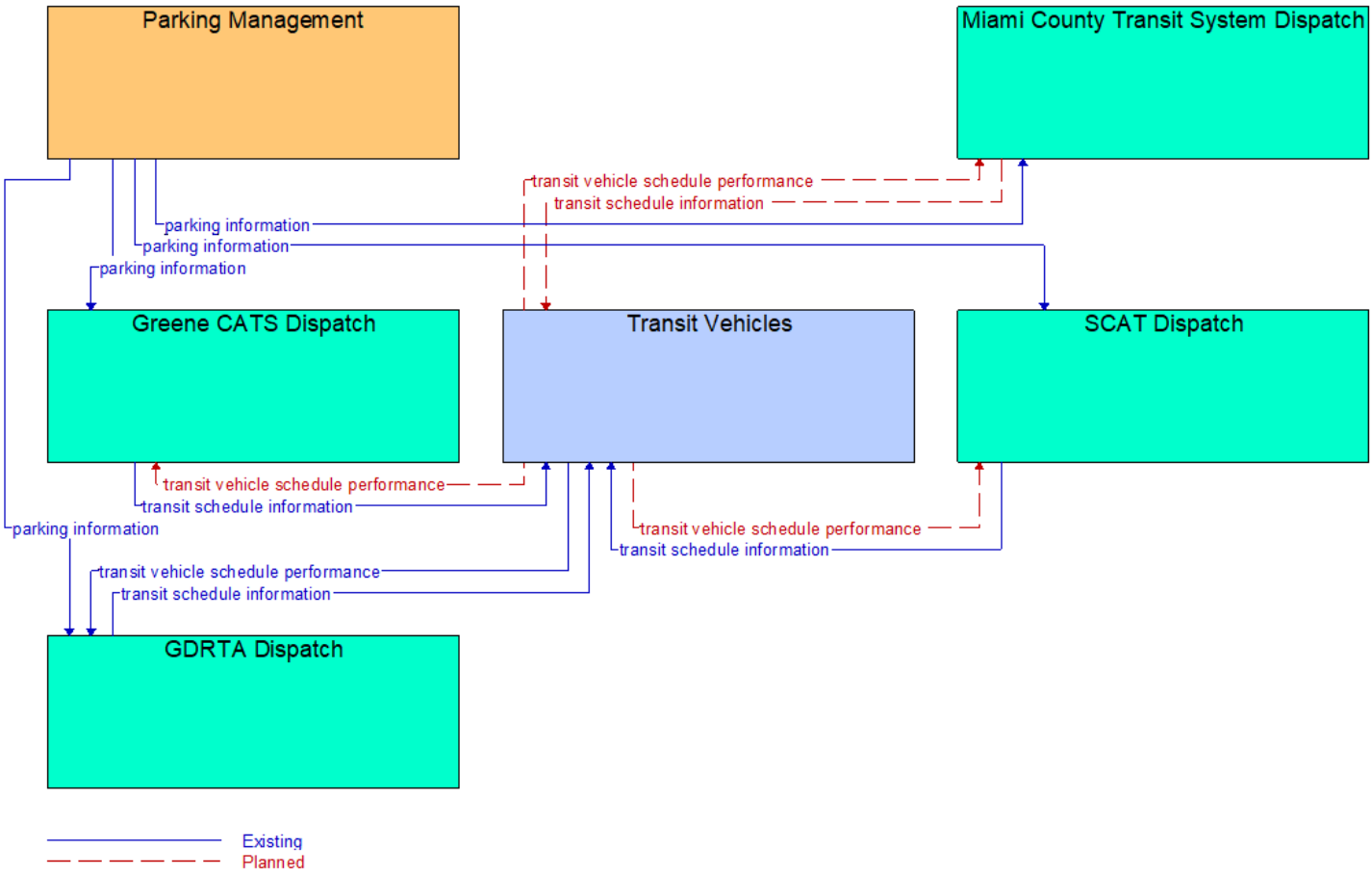
PT08 – Transit Traveler Information



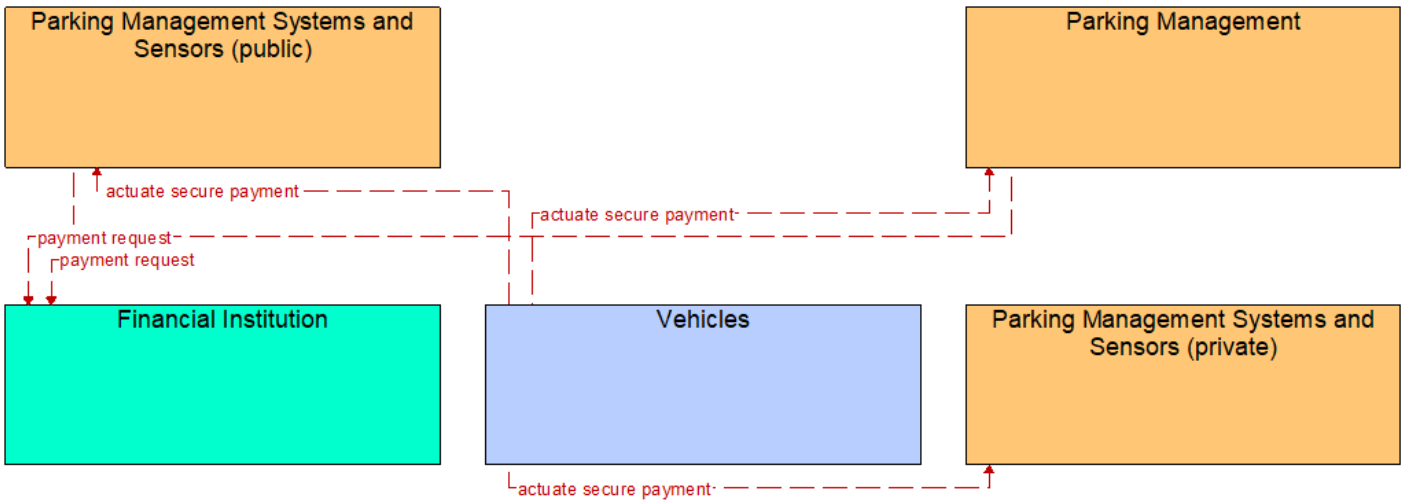
PT09 – Transit Signal Priority



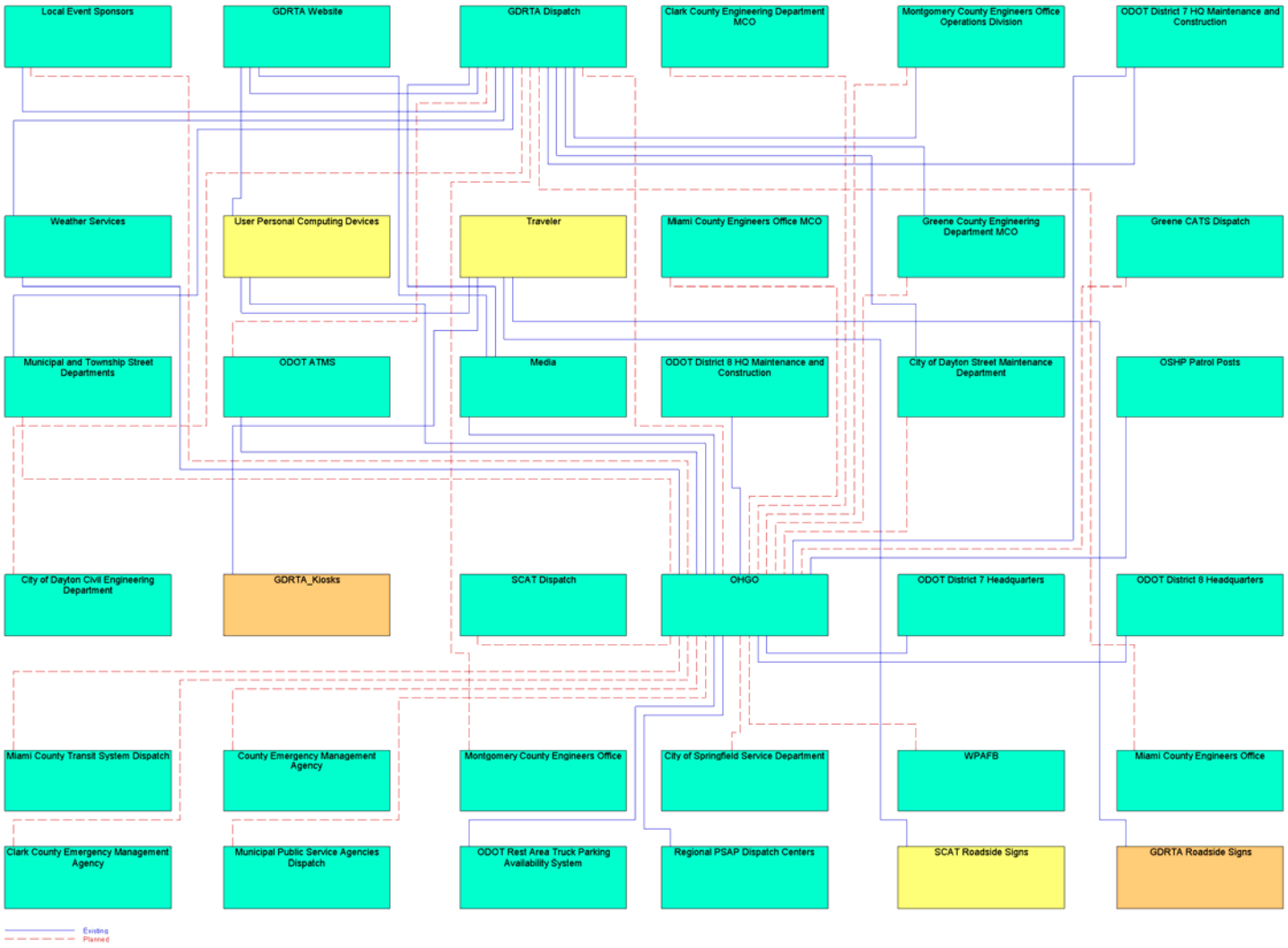
PT14 – Multi-modal Coordination



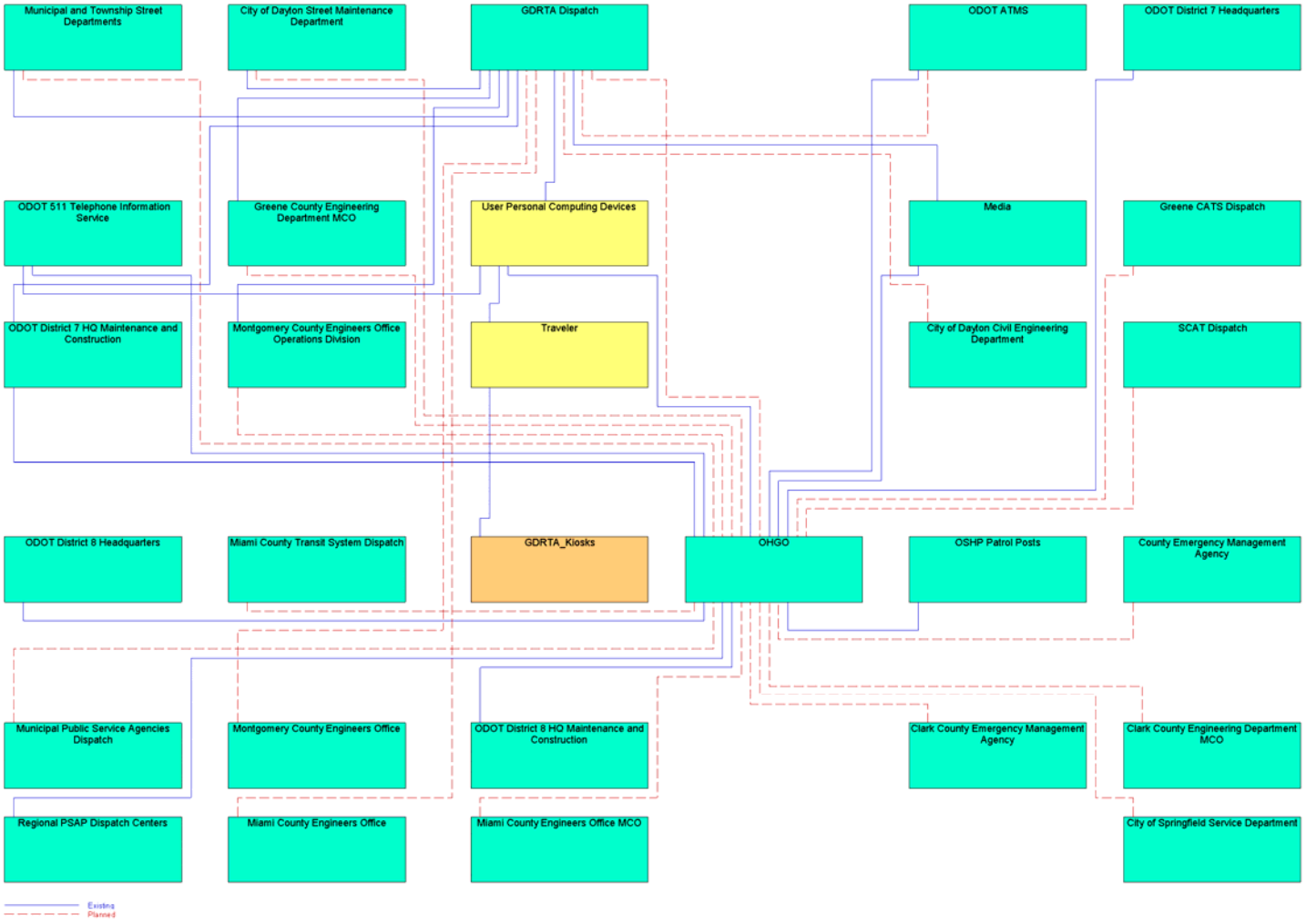
PT18 – Integrated Multi-modal Electronic Payment



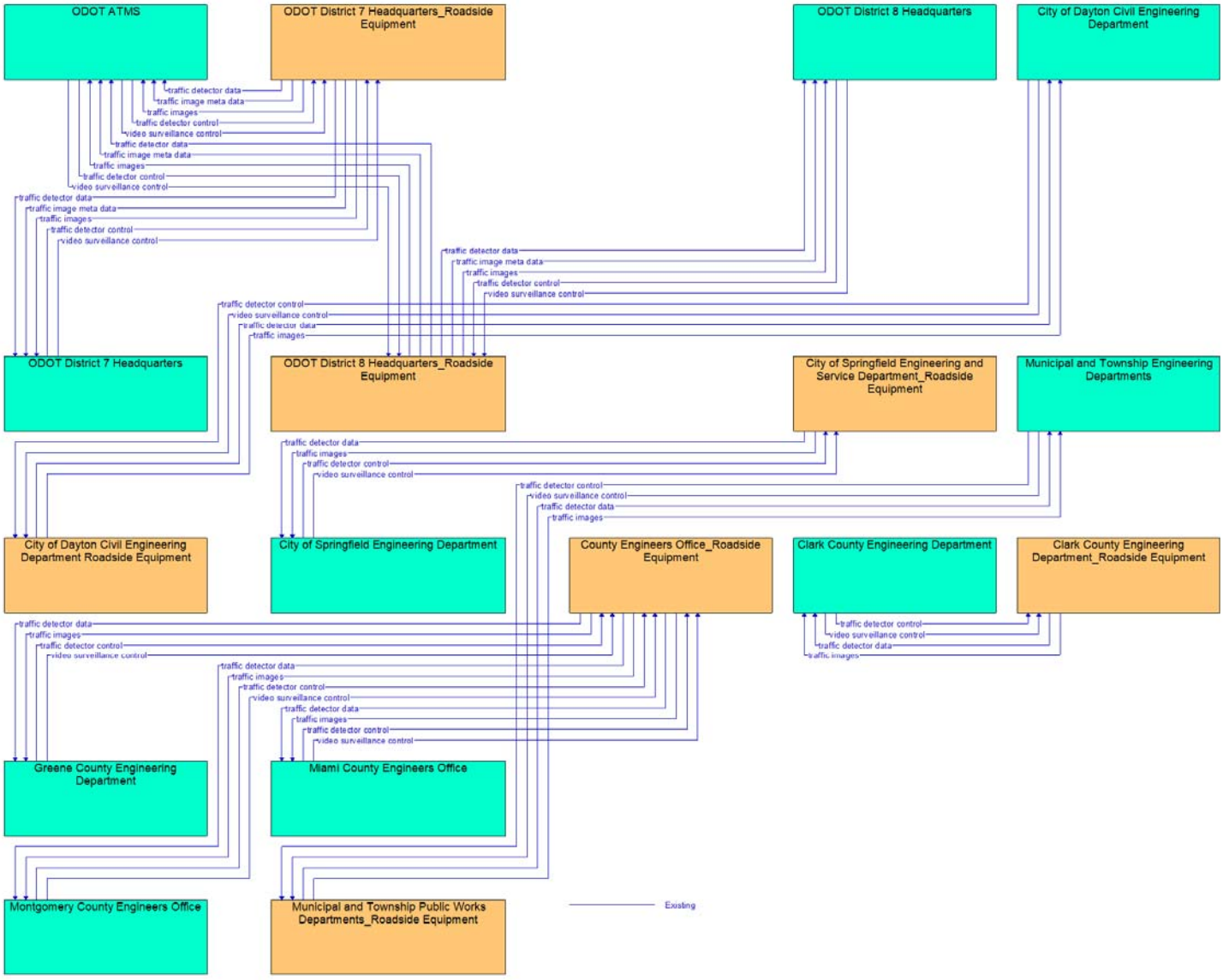
TI01 – Broadcast Traveler Information



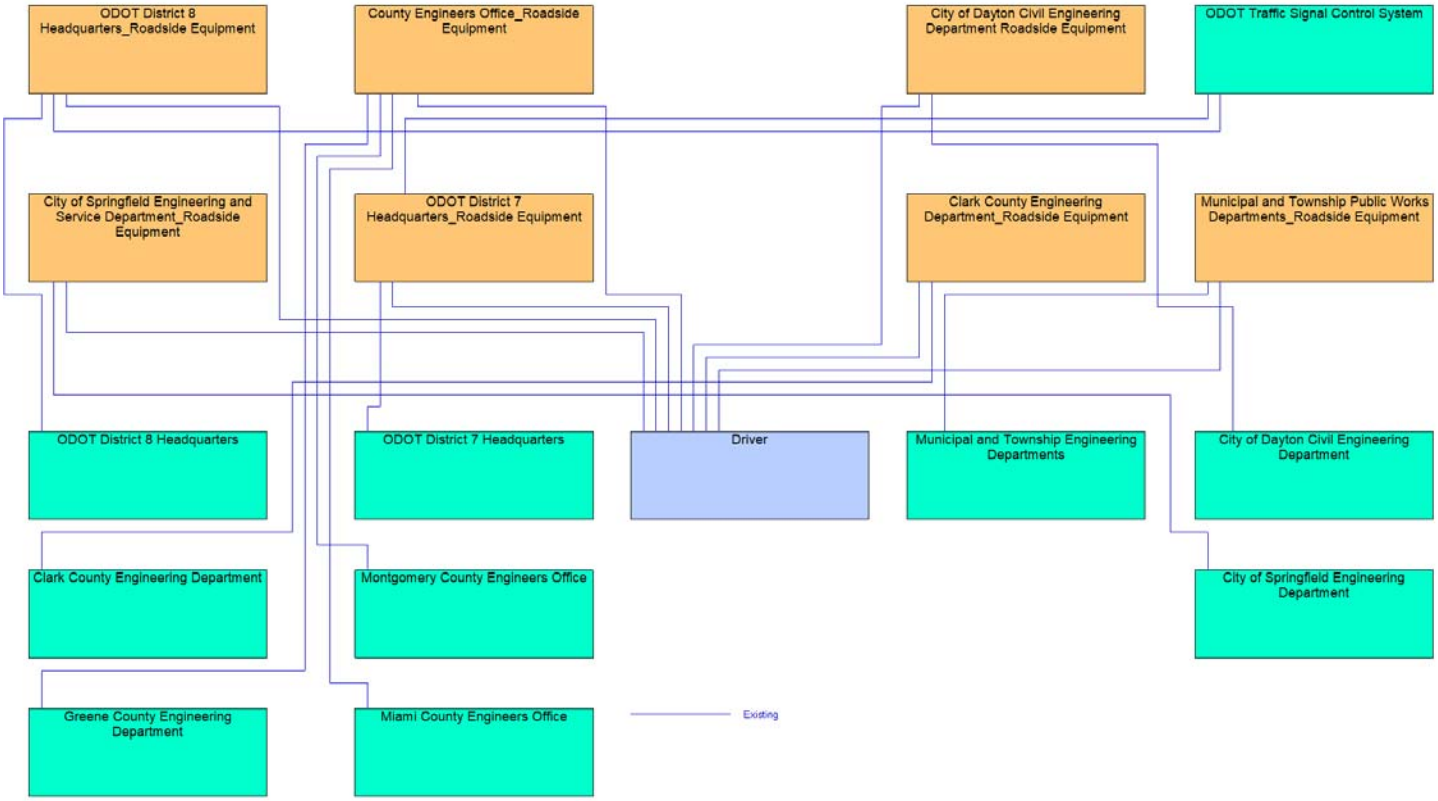
TI01 – Personalized Traveler Information



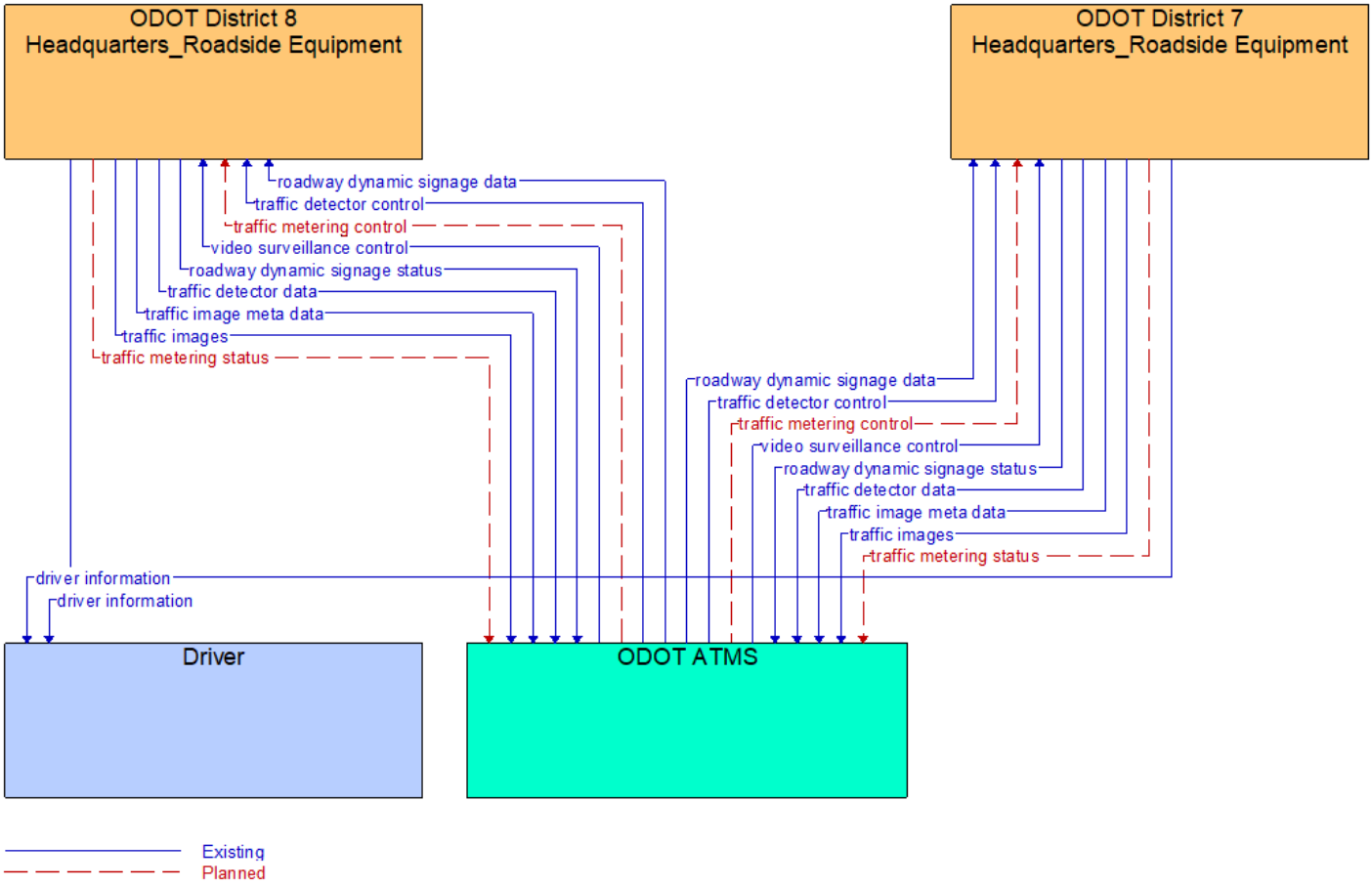
TM01 – Infrastructure-Based Traffic Surveillance



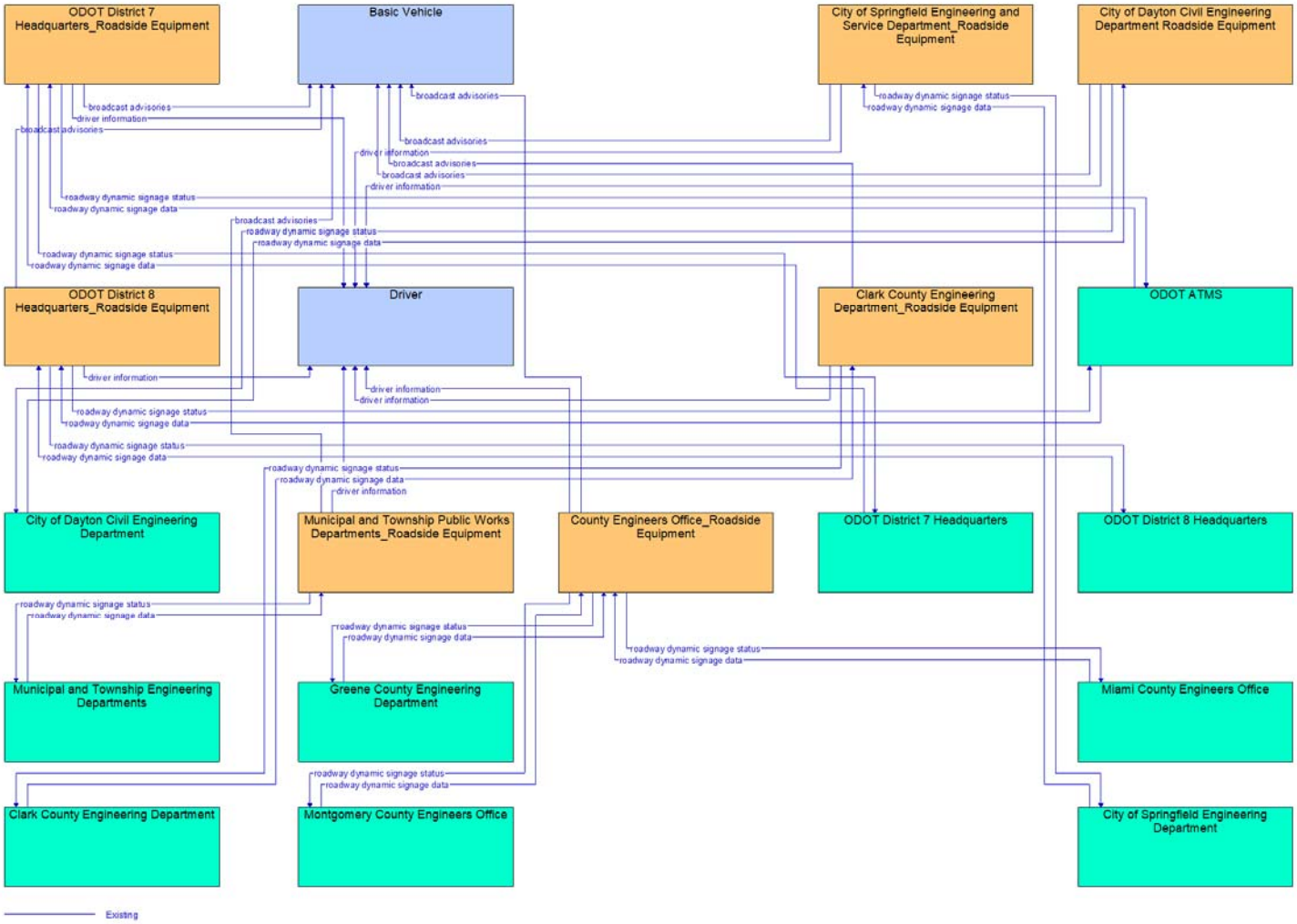
TM03 – Traffic Signal Control



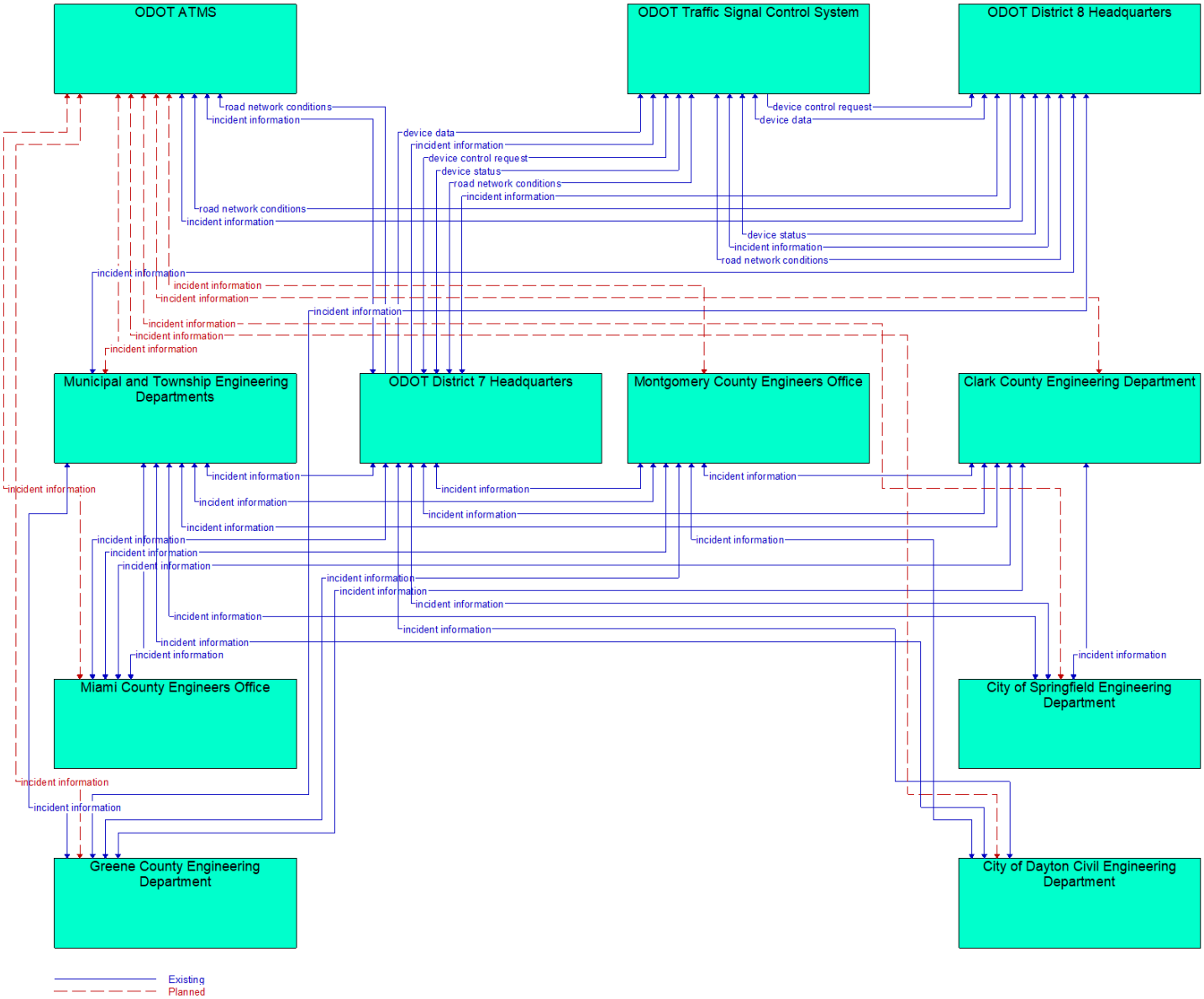
TM05 – Traffic Metering



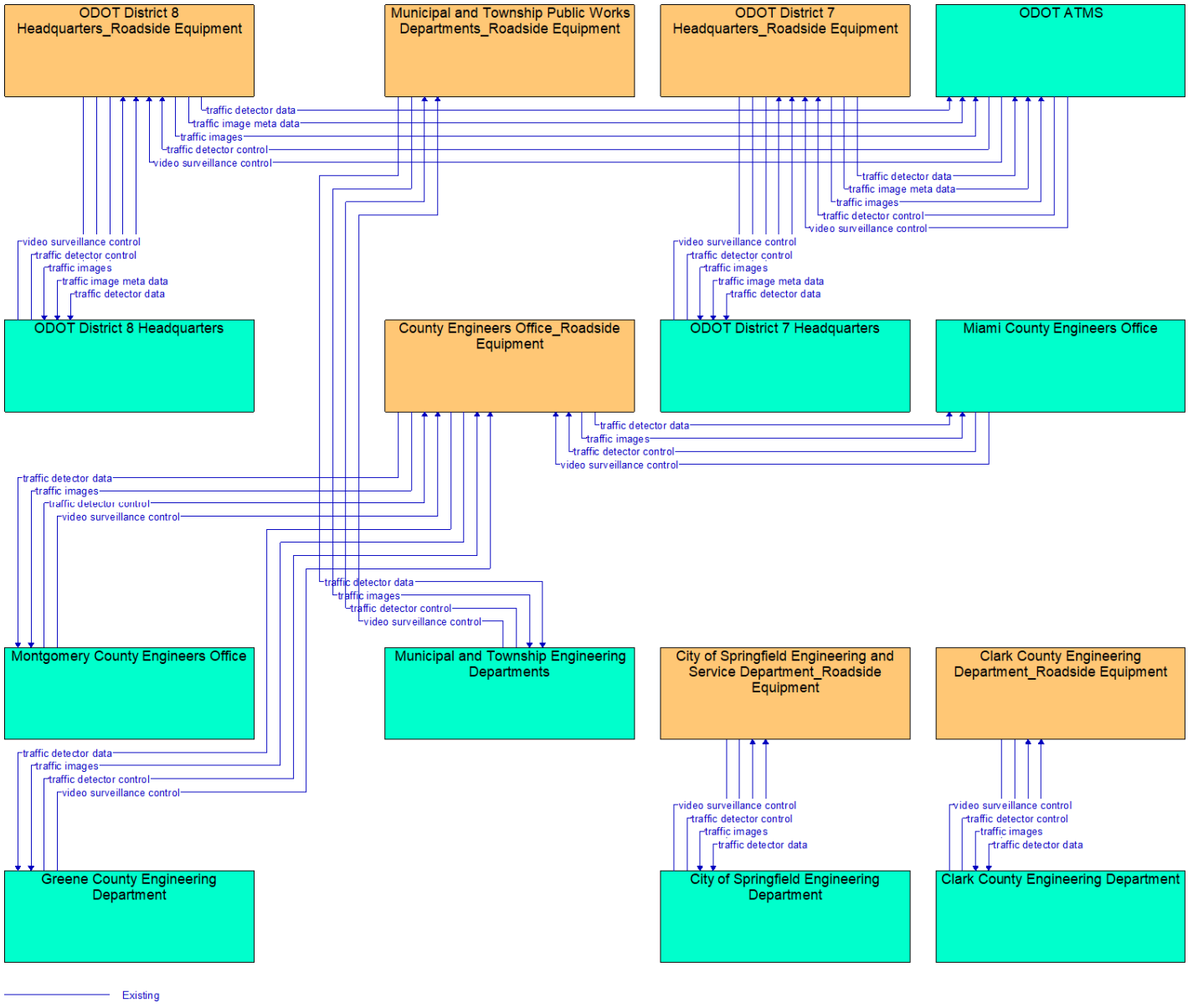
TM06 – Traffic Information Dissemination



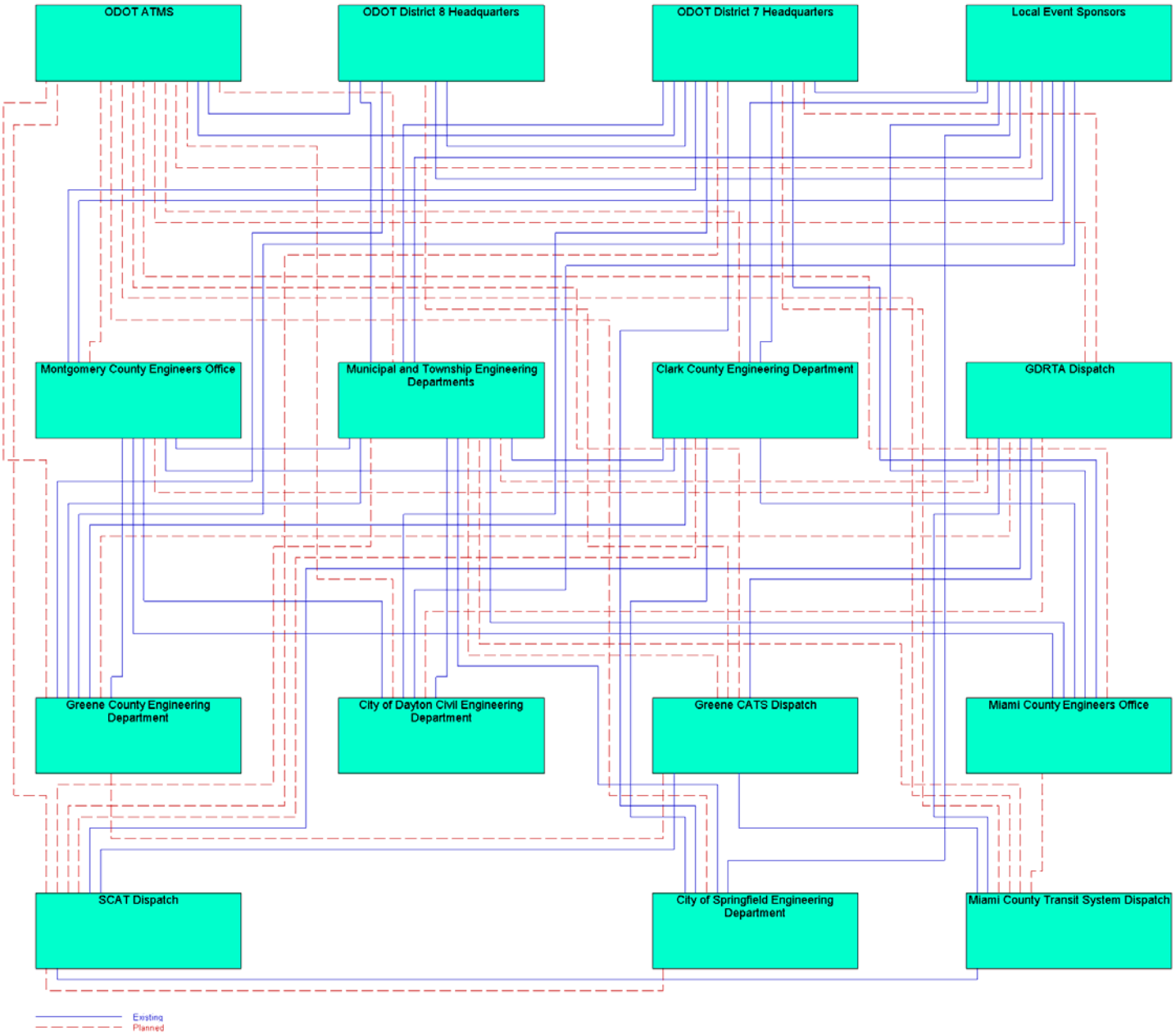
TM07 – Regional Traffic Management



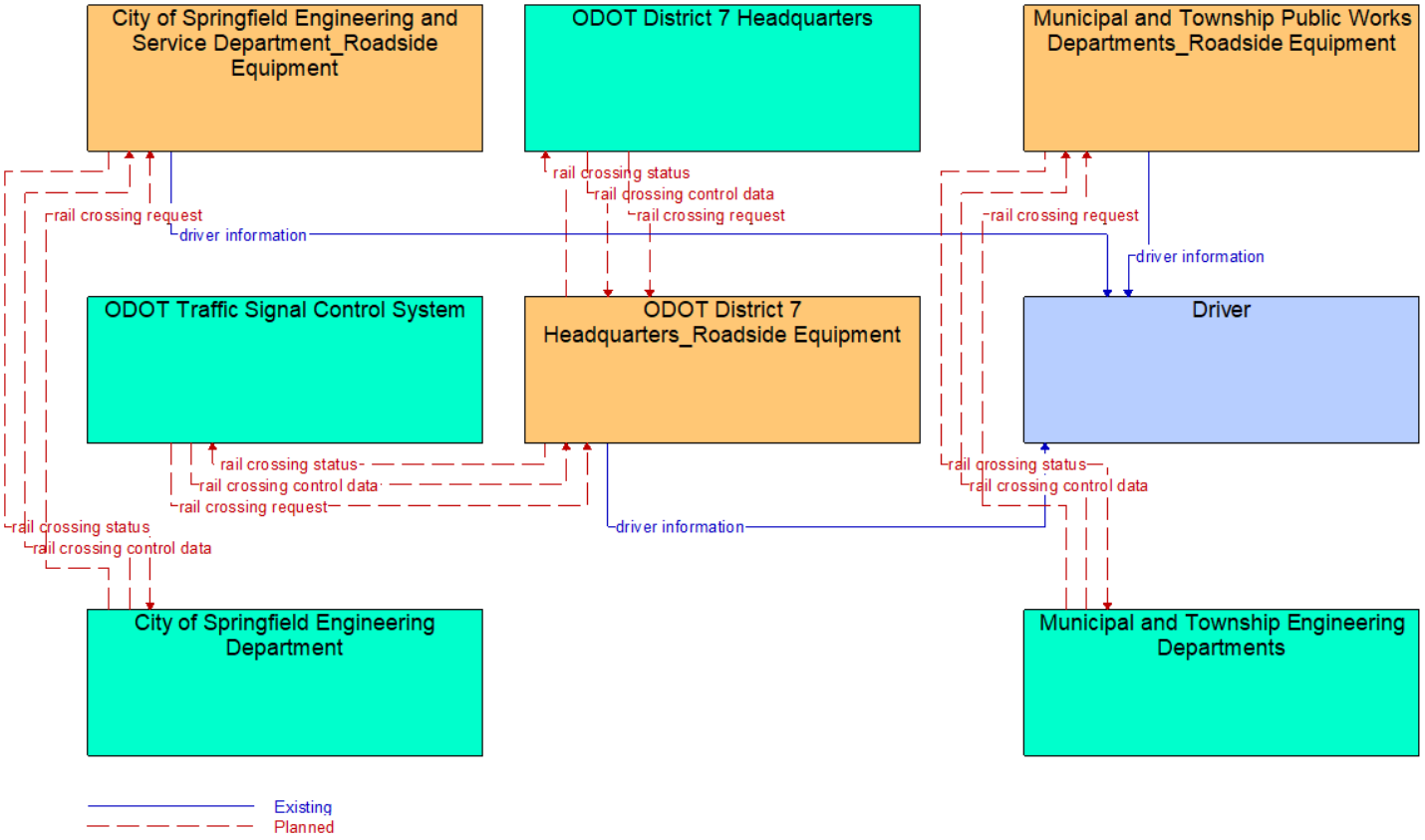
TM08 – Traffic Incident Management System



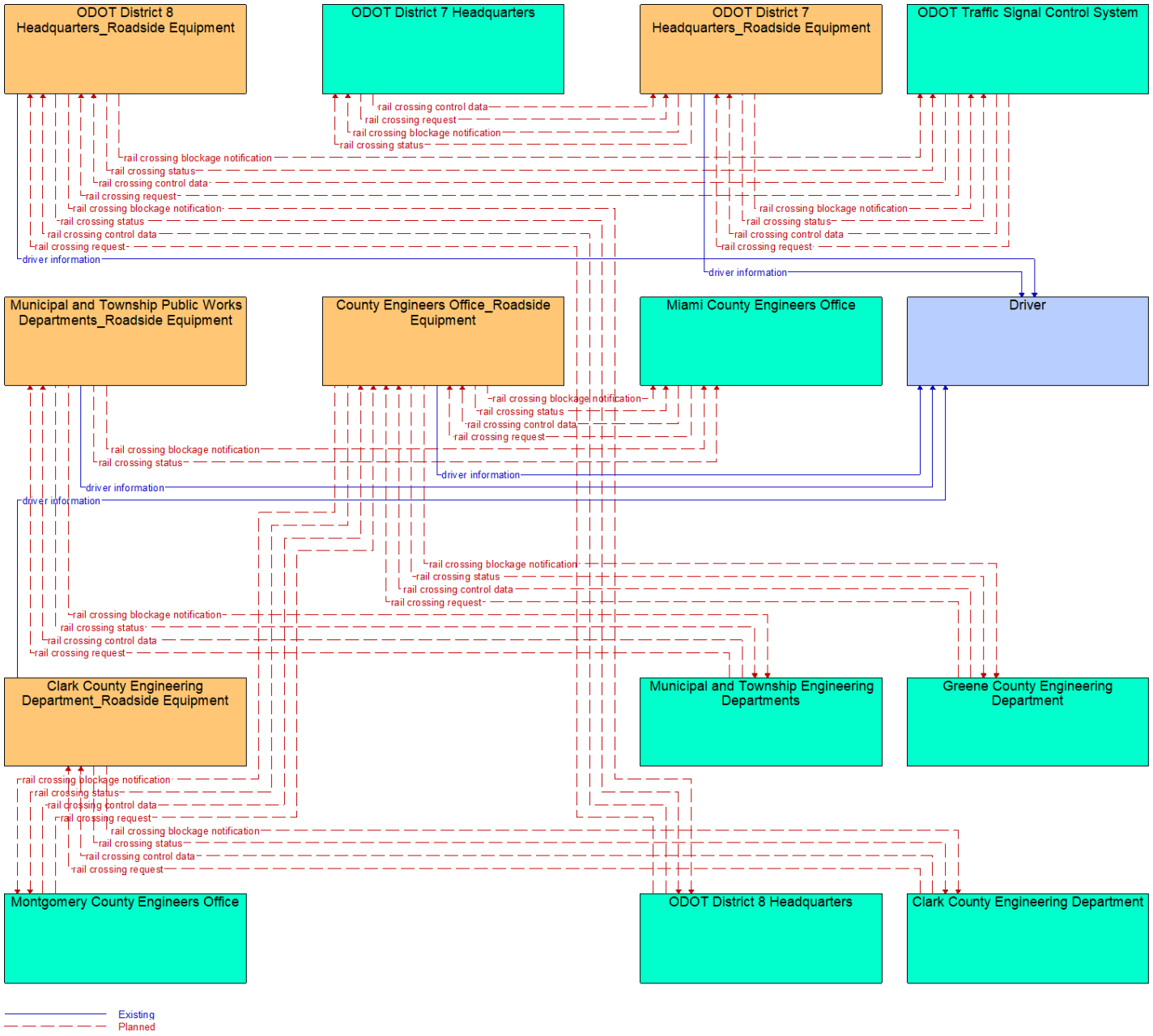
TM09 – Integrated Decision Support



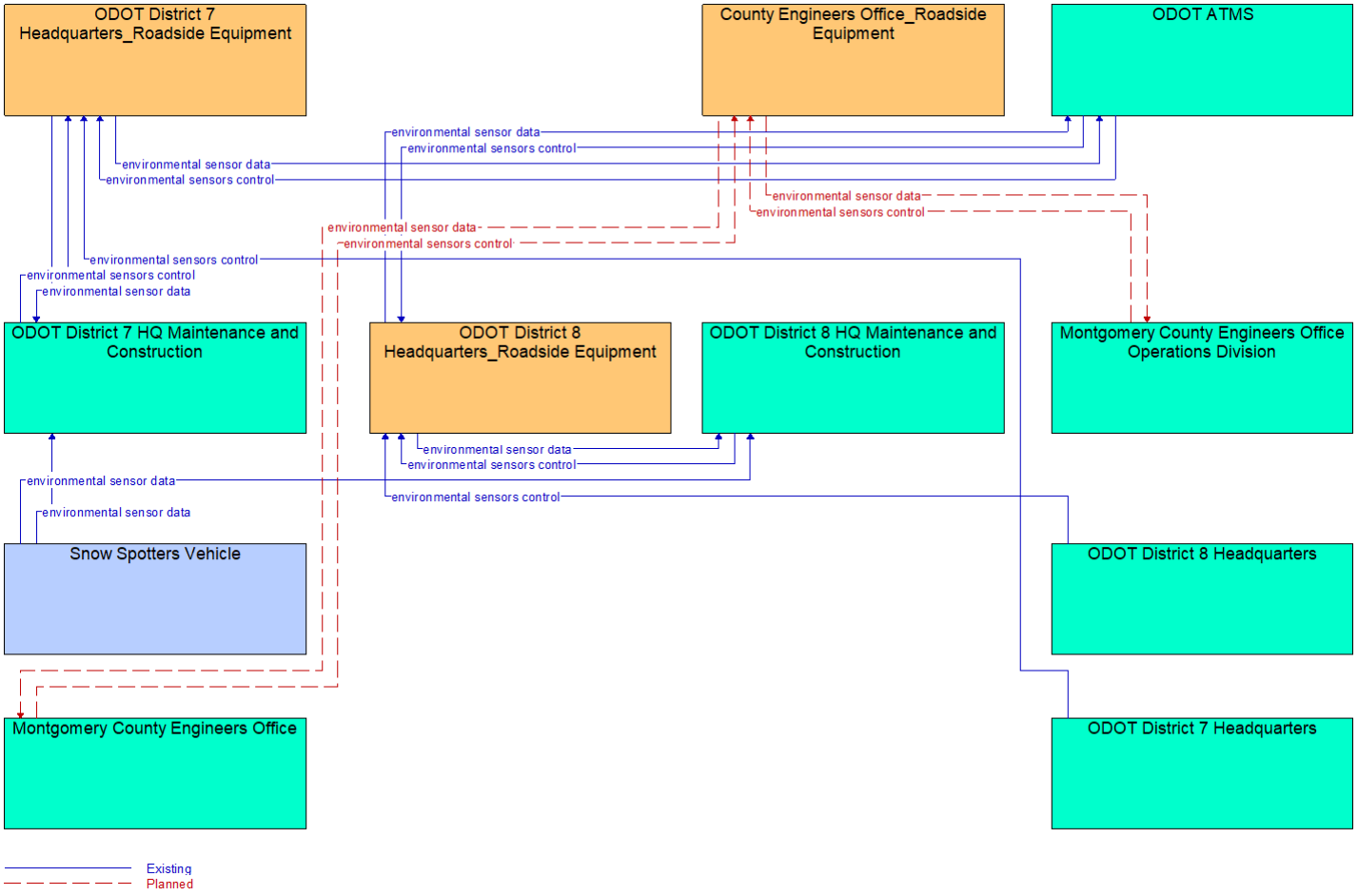
TM13 – Standard Railroad Grade Crossing



TM14 – Advanced Railroad Grade Crossing



WX01 – Weather Data Collection



Information Flow Definitions

Flow Name	Description
driver information	Regulatory, warning, and guidance information provided to the driver while en route to support safe and efficient vehicle operation.
right-of-way request notification	Notice that a request has occurred for signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.
roadway dynamic signage data	Information used to initialize, configure, and control dynamic message signs. This flow can provide message content and delivery attributes, local message store maintenance requests, control mode commands, status queries, and all other commands and associated parameters that support remote management of these devices.
roadway dynamic signage status	Current operating status of dynamic message signs.
roadway dynamic signage status	Current operating status of dynamic message signs.
signal control commands	Control of traffic signal controllers or field masters including clock synchronization.
signal control device configuration	Data used to configure traffic signal control equipment including local controllers and system masters.
signal control plans	Traffic signal timing parameters including minimum green time and interval durations for basic operation and cycle length, splits, offset, phase sequence, etc. for coordinated systems.
signal control status	Operational and status data of traffic signal control equipment including operating condition and current indications.
signal fault data	Faults reported by traffic signal control equipment.
signal system configuration	Data used to configure traffic signal systems including configuring control sections and mode of operation (time based or traffic responsive).
traffic detector control	Information used to configure and control traffic detector systems such as inductive loop detectors and machine vision sensors.
traffic detector data	Raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic detectors
traffic image meta data	Meta data that describes traffic images. Traffic images (video) are in another flow.
traffic images	High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications. This flow includes the images. Meta data that describes the images is contained in another flow.
video surveillance control	Information used to configure and control video surveillance systems.

Appendix B. 2022 Architecture Update – CV/AV Elements

The State of Ohio initiated a Systems Engineering Analysis (SEA) in 2018 to create a statewide framework to guide Connected Vehicle / Automated Vehicle (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.

Additional information about the Ohio Systems Engineering Analysis (SEA) can be found at https://drive.ohio.gov/about-driveohio/cv-av-systems#page=1

The statewide CV/AV elements have been fully incorporated into the Miami Valley Regional ITS Architecture.

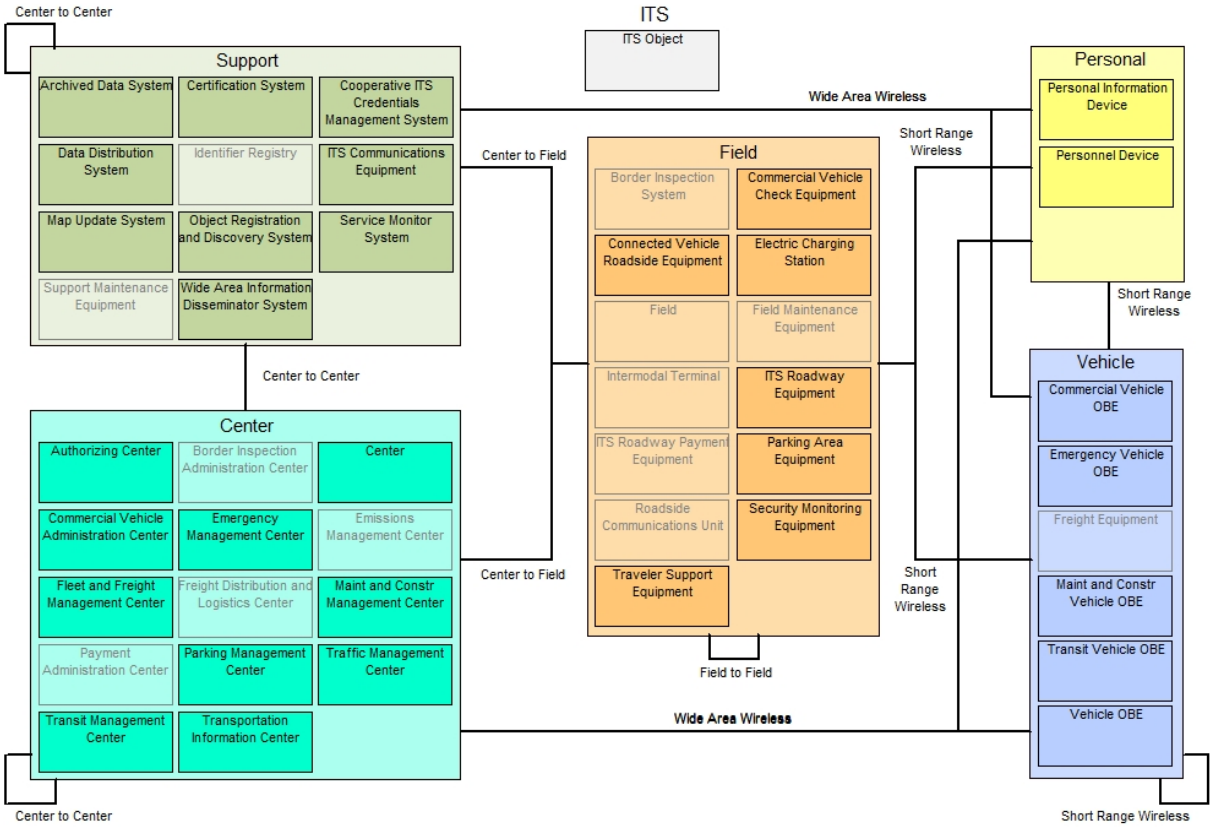
Summary of Changes

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

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.

Regional ITS Architecture Physical Objects Interconnect Diagram (CV/AV)



ITS Inventory Elements

The 2022 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.

ITS Elements Added to the Regional ITS Architecture

Stakeholder	New ITS Element
Counties and Cities	• County and City CV Authorizing Center • County and City Equipment and Fleet Service Facilities • County and City CV Service Monitoring Systems
County and City Public Works Departments	• County and City Connected Vehicles Roadside Equipment • County and City Traffic Data Archives • County and City Traffic Information Websites
Dayton International Airport	• Dayton International Airport Connected Vehicle Roadside Equipment • Dayton International Airport CV Authorizing Center • Dayton International Airport CV Service Monitoring System
DriveOhio	• Ohio Certification System • Ohio Cooperative ITS Credentials Management System • Ohio CV Authorizing Center • Ohio CV Service Monitor System • Ohio Event Streaming Platform • Ohio Object Registration and Discovery System • Ohio Smart Mobility Program
Driver	• Connected/Automated Vehicles
Fleet and Freight Managers	• Fleet and Freight Management Systems
General Public (Stakeholder Group)	• Cyclists
Greater Dayton Regional Transit Authority (GDRTA)	• GDRTA Equipment and Fleet Service Facilities • GDRTA Transit Data Archive
ODOT	• ODOT Automated Gate Closure Systems • ODOT Connected Vehicle Roadside Equipment • ODOT District 7 Maintenance Repair Facilities • ODOT District 8 Maintenance Repair Facilities • ODOT Lane Control Devices • ODOT Rest Area Tourist Information Centers • ODOT Speed Monitoring Roadside Equipment • ODOT Traffic Data Archive System • ODOT Variable Speed Limit Signs • ODOT Wide Area Information Disseminator System
Ohio Department of Public Safety	• Ohio DPS Crash Database
Ohio Emergency Management Agency	• Ohio Emergency Alert System
Ohio State Highway Patrol (OSHP)	• OSHP Vehicles • OSHP Weigh-in-Motion Stations
Ohio State University	• OSU Center of Automotive Research
Private Companies	• Private EV Charging Stations
Private Traffic Information Providers	• Private Traveler Information Systems
Public Agencies (Stakeholder Group, including DriveOhio)	• ITS Communications Equipment • Public Agency EV Charging Stations
Research Institutes	• Transportation Research Centers
University of Dayton	• University of Dayton On-Campus Shuttle Service
Wright State University	• Wright State University Raider Ride Campus Transportation

Service Packages

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

Service Packages Added to the Regional ITS Architecture

Service Package	Service Package Name	Service Package Description
CVO06	Freight Signal Priority	--Instance of CVO06-- The Freight Signal Priority service package (FSP) provides traffic signal priority for freight and commercial vehicles traveling in a signalized network. The goal of the freight signal priority service package is to reduce stops and delays to increase travel time reliability for freight traffic, and to enhance safety at intersections.
CVO08	Smart Roadside and Virtual WIM	--Instance of CVO08-- This service package includes the delivery of capabilities related to wireless roadside inspections and electronic screening/virtual weigh stations. Wireless roadside inspection is defined by a safety screening capability that employs communications technologies to obtain information from a commercial vehicle that will allow safety screening of the vehicle and its driver. This capability provides for the interrogation at mainline speeds of a commercial vehicle when it has entered a control segment or geofenced area. Vehicle identification and driver information are provided to the roadside unit. The information communicated can be used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. A more advanced version of this service package would download safety information measured on the vehicle including driver related information such as the driver log allowing real time evaluation that the vehicle and driver are meeting safety requirements. The electronic screening/virtual weigh stations capability employs communications technologies to obtain information from a commercial vehicle that will allow verification of permits or credentials for the vehicle. The information communicated is used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. This service package can also be used to verify that the commercial vehicle meets vehicle weight (via weigh in motion capability) or dimension requirements.
CVO09	Freight-Specific Dynamic Travel Planning	--Instance of CVO09-- This service package provides both pre-trip and en route travel planning, routing, and commercial vehicle related traveler information, which includes information such as truck parking locations and current status. The information will be based on data collected from the commercial fleet as well as general traffic data collection capabilities. The information, both real time and static can be provided directly to fleet managers, to mobile devices used by commercial vehicle operators, or directly to in vehicle systems as commercial vehicles approach roadway exits with key facilities such as parking. The service package can also provide oversize/ overweight permit information to commercial managers.
CVO10	Road Weather Information for Freight Carriers	--Instance of CVO10-- The service package is a special case of the Road Weather Advisories and Warnings for Motorists service package that focuses on Freight Carrier users. It provides the capability to collect road weather data from connected vehicles and using that data to develop short term warnings or advisories that can be provided to individual commercial vehicles or to commercial vehicle dispatchers. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather commercial vehicle alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial vehicle dispatchers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.
MC07	Work Zone Safety Monitoring	--Instance of MC07-- This service package provides warnings to maintenance personnel within a work zone about potential hazards within the work zone. It enables vehicles or the infrastructure to provide warnings to workers in a work zone when a vehicle is moving in a manner that appears to create an unsafe condition (e.g., moving at high speed or entering the work zone).
MC09	Infrastructure Monitoring	--Instance of MC09-- This service package monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure (e.g., culverts) using both fixed and vehicle-based infrastructure monitoring sensors. Fixed sensors monitor vibration, stress, temperature, continuity, and other parameters and mobile sensors and data logging devices collect information on current infrastructure condition. This service package also monitors vehicle probes for vertical acceleration data and other probe data that may be used to determine current pavement condition.
PM04	Regional Parking Management	--Instance of PM04-- This service package supports communication and coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems. This service package also shares information with transit management centers and transportation information centers to support multimodal travel planning. Information including current parking availability, system status, and operating strategies are shared to enable local parking facility management that supports regional transportation strategies.

Service Package	Service Package Name	Service Package Description
PM06	Loading Zone Management	--Instance of PM06-- This service package manages the occupancy of spaces in a loading/ unloading zone. It monitors the current status of each loading/unloading zone space under its control and makes this information available to arriving vehicles. The service package also operates a reservation system for loading zones, providing the capability for loading zone users, including commercial vehicle drivers or fleet operators, to reserve and pay for future use of a loading/unloading space. Interfaces to the general Vehicle OBE are included since loading zones may be used by any vehicle, though commercial vehicles are the most frequent users.
PS07	Incident Scene Safety Monitoring	--Instance of PS07-- This service package employs communications technologies to provide warnings and alerts relating to incident zone operations. One aspect of the service is an in-vehicle messaging system that provides drivers with merging and speed guidance around an incident. Another aspect is providing in-vehicle incident scene alerts to drivers, both for the protection of the drivers as well as incident zone personnel. A third aspect is a warning system for on-scene workers when a vehicle approaching or in the incident zone is being operated outside of safe parameters for the conditions.
PS09	Transportation Infrastructure Protection	--Instance of PS09-- This service package includes the monitoring of transportation infrastructure (e.g., bridges, tunnels and management centers) for potential threats using sensors and surveillance equipment and barrier and safeguard systems to control access, preclude an incident, and mitigate the impact of an incident if it occurs. Threats can result from acts of nature (e.g., hurricanes, earthquakes), terrorist attacks or other incidents causing damage to the infrastructure (e.g., stray barge hitting a bridge support). Infrastructure may be monitored with acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors and video and audio surveillance equipment. Data from such sensors and surveillance equipment may be processed in the field or sent to a center for processing. The data enables operators at the center to detect and verify threats. When a threat is detected, agencies are notified. Detected threats or advisories received from other agencies result in an increased level of system preparedness. In response to threats, barrier and safeguard systems may be activated to deter an incident, control access to an area or mitigate the impact of an incident. Barrier systems include gates, barriers and other automated and remotely controlled systems that manage entry to transportation infrastructure. Safeguard systems include blast shields, exhaust systems and other automated and remotely controlled systems that mitigate impact of an incident.
PT08	Transit Traveler Information	--Instance of PT08-- This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.
PT09	Transit Signal Priority	--Instance of PT09-- The Transit Signal Priority service package uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The service package provides feedback to the transit driver indicating whether the signal priority has been granted or not. This service package can contribute to improved operating performance of the transit vehicles by reducing the time spent stopped at a red light.
PT11	Transit Pedestrian Indication	--Instance of PT11-- The Transit Pedestrian Indication service package provides vehicle to device communications to inform pedestrians at a station or stop about the presence of a transit vehicle. In addition, this service package would inform the transit vehicle operator about the presence of pedestrians nearby and those waiting for the bus. It would help prevent collisions between transit vehicles and pedestrians.
PT12	Transit Vehicle at Station/Stop Warnings	--Instance of PT12-- The Transit Vehicle at Station/Stop Warnings service package inform nearby vehicles of the presence of a transit vehicle at a station or stop. The service package also indicates the intention of the transit vehicle in terms of pulling into or out of a station/stop.
PT13	Vehicle Turning Right in Front of a Transit Vehicle	--Instance of PT13-- The Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV) service package determines the movement of vehicles near to a transit vehicle stopped at a transit stop and provides an indication to the transit vehicle operator that a nearby vehicle is pulling in front of the transit vehicle to make a right turn. This service package will help the transit vehicle determine if the area in front of it will not be occupied as it begins to pull away from a transit stop.
PT16	Route ID for the Visually Impaired	--Instance of PT16-- This service package assists visually impaired travelers to identify the appropriate bus and route to their intended destination. It provides information from bus stop infrastructure to visually impaired travelers portable devices that can be converted to audible information regarding the appropriate bus and route. It also allows the visually impaired traveler to query the portable device to identify route options.
PT17	Transit Connection Protection	--Instance of PT17-- This service package allows travelers to initiate a request for connection protection anytime during the trip using a personal device or on-board equipment and receive a confirmation indicating whether the request is accepted. Connection protection uses real time data to examine the arrival status of a transit vehicle and to transmit a hold message to a vehicle or other mode of transportation (e.g. rail) in order for the traveler to make a successful transfer from one vehicle to another. Connection protection can be performed within a single agency, across multiple agencies, and across multiple modes. In an intermodal, multimodal or interagency environment, a transfer request brokerage system, represented by the Transit Management System, can be used to determine the feasibility of a connection protection request and support schedule coordination between agencies.

Service Package	Service Package Name	Service Package Description
ST05	Electric Charging Stations Management	--Instance of ST05-- The Electric Charging Station Management service package provides an exchange of information between the electric vehicle and charging station to manage the charging operation. The agency or company operating the charging station can use vehicle information such as the capability of the vehicle (e.g. operational status of the electrical system, how many amps can the vehicle handle, and % charge complete) to determine that the charge is being properly applied and determine an estimated time to complete charging.
ST08	Eco-Approach and Departure at Signalized Intersections	--Instance of ST08-- The Eco-Approach and Departure at Signalized Intersections service package uses wireless data communications sent from a connected vehicle roadside equipment (RSE) unit to connected vehicles to encourage 'green' approaches to and departures from signalized intersections. The vehicle collects intersection geometry information and signal phase movement information using V2I communications and data from nearby vehicles using V2V communications. Upon receiving this information, the service package performs calculations to provide speed advice to the driver, allowing the driver to adapt the vehicle's speed to pass the next traffic signal on green or to decelerate to a stop in the most eco-friendly manner. The service package also considers a vehicle's acceleration as it departs from a signalized intersection.
SU01	Connected Vehicle System Monitoring and Management	--Instance of SU01-- This service package provides monitoring, management and control services necessary to other applications and/or devices operating within the Connected Vehicle Environment. This service package maintains and monitors the performance and configuration of the connected vehicle system. This includes tracking and management of the infrastructure configuration as well as detection, isolation, and correction of infrastructure service problems. It also includes monitoring of performance of the infrastructure and mobile equipment, which includes RSEs, OBEs, the back office applications, as well as the communication links that connect the system.
SU02	Core Authorization	--Instance of SU02-- This service package manages the authorization mechanisms to define roles, responsibilities and permissions for connected vehicle applications . This allows system administrators to establish operational environments where different connected vehicle system users may have different capabilities. For instance, some Mobile elements may be authorized to request signal priority, or some Centers may be permitted to use the geographic broadcast service, while those without those permissions would not.
SU03	Data Distribution	--Instance of SU03-- This service package manages the distribution of data from data providers to data consumers and protects those data from unauthorized access. It informs data providers of how to provide data, manages data subscriptions, and provides data forwarding capabilities. The service package also maintains a directory of System Users that want data and supports multiple distribution mechanisms including publish-subscribe and directly from data provider to data consumer. It allows data consumers to specify (and change the specification of) data they wish to receive.
SU04	Map Management	--Instance of SU04-- This service package defines interfaces that can be used download or update all types of map data used to support intelligent transportation systems. This map data will be accessed by centers, field, and vehicle physical objects. The service package can also be used to harness the Connected Vehicle Environment to provide rich source data that can be used to verify, refine, and enhance geographic map data.
SU05	Location and Time	--Instance of SU05-- This service package identifies the external systems and interfaces that provide accurate location and time to intelligent transportation system devices and systems.
SU06	Object Registration and Discovery	--Instance of SU06-- This service package provides registration and lookup services necessary to allow objects to locate other objects operating within the Connected Vehicle Environment.An object registry is like a phone book for all the connected centers, systems, and equipment in the transportation system (the "objects"). In this service package, each object registers itself with the ORDS and tells the registry where it lives in the communication network (e.g., host, port, node name) and information about the services it provides - information that other objects can use to determine the type of service, the geographic scope of the service, and other information that helps users of the registry to make informed decisions about which object(s) support a needed service or information stream. This is the "Discovery" part of the service. Connected objects can use the registry to find (discover) objects that can be used to get needed information or services.
SU08	Security and Credentials Management	--Instance of SU08-- This service package is used to ensure trusted communications between mobile devices and other mobile devices or roadside devices and protect data they handle from unauthorized access. The service package grants trust credentials to qualified mobile devices and infrastructure devices in the Connected Vehicle Environment so that those devices may be considered trusted by other devices that receive trust credentials from the SCM service package. The service package allows credentials to be requested and revoked and secures the exchange of trust credentials between parties, so that no other party can intercept and use those credentials illegitimately. The service package provides security to the transmissions between connected devices, ensuring authenticity and integrity of the transmissions. Additional security features include privacy protection, authorization and privilege class definition, as well as non-repudiation of origin.
SU09	Device Certification and Enrollment	--Instance of SU09-- This service package is used to illustrate the certification of devices, typically but not exclusively those intended for the connected vehicle environment. This assumes some independent certification body that can verify the performance and behavior of devices and applications, and provide that information to credentials-granting entities.

Service Package	Service Package Name	Service Package Description
SU12	Vehicle Maintenance	--Instance of SU12-- This service package identifies the interfaces and functionality that support vehicle maintenance, including maintenance of ITS equipment on board the vehicle. An interface with a Vehicle Service Center supports vehicle monitoring to support timely, effective maintenance. It also supports software configuration management and updates as part of maintenance of the software-based on-board systems. While this service package covers only maintenance of the Vehicle OBE, it is defined at the highest level of abstraction so that any center that is contemplating advanced maintenance concepts for its fleet vehicles can use this service package. Other service packages that provide maintenance support for fleet vehicles include CVO01, MC02, and PT06.
TI06	Dynamic Ridesharing and Shared Use Transportation	--Instance of TI06-- This service package addresses dynamic ridesharing/ride matching services to travelers and other forms of shared use transportation. Dynamic ridesharing allows travelers to arrange carpool trips through a personal device with a wireless connection to a ride matching system (e.g., a web-based application). It uses inputs from both passengers and drivers pre-trip, during the trip, and post-trip . These inputs are then translated into “optimal” pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations. After the trip, information is provided back to the service package to improve the user’s experience for future trips.The shared use aspect of the service package addresses three types of shared use that may be arranged using an internet connected personal device. In the first type, a traveler arranges for the temporary use of a vehicle. In the second type of shared use, a traveler arranges for a vehicle to pick them up at a specific location and take them to another location. The second type of shared use may be implemented as a ride matching or ridesharing service, including those provided by Uber and Lyft. The third type of shared use is a bikeshare capability.
TI07	In-Vehicle Signage	--Instance of TI07-- This service package augments regulatory, warning, and informational signs and signals by providing information directly to drivers through in-vehicle devices. The information provided would include static sign information (e.g., stop, curve warning, guide signs, service signs, and directional signs) and dynamic information (e.g., current signal states including highway intersection and highway-rail intersection status and local conditions warnings identified by local environmental sensors). This service package also includes the capability for maintenance and construction, emergency, and transit vehicles to transmit sign information to vehicles in the vicinity so that in vehicle signing can be used without fixed infrastructure in areas such as work zones, around incidents, and at bus stops.
TM02	Vehicle-Based Traffic Surveillance	--Instance of TM02-- This service package uses probe data information obtained from vehicles in the network to support traffic operations, including incident detection and the implementation of localized operational strategies. Since traffic data is collected from vehicles, travel times and other related traffic performance measures are available. This service package includes the capability to collect data from Connected Vehicles so that "probe" data can be collected from all equipped vehicles, providing access to a large vehicle population as penetration increases. Incident detection enables transportation agencies to determine the location of potential incidents so the agencies can respond more quickly to the incident and mitigate any negative impacts to the transportation network. Vehicle data that can be used to detect potential incidents include changes in vehicle speeds indicating the disruption of traffic flow, when a vehicle’s safety systems have been activated or deployed, or sudden vehicle turns or deceleration at a specific location (indicating a potential obstacle in the roadway).
TM04	Connected Vehicle Traffic Signal System	--Instance of TM04-- This service package uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The service package utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other service package provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.
TM19	Roadway Closure Management	--Instance of TM19-- This service package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The service package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this service package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This service package covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other Traffic Management service packages.

Service Package	Service Package Name	Service Package Description
TM21	Speed Harmonization	--Instance of TM21-- This service package determines speed recommendations based on traffic conditions and weather information and uses connected vehicle technologies to assist in harmonizing speeds to these recommendations. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events, and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The service package utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies for upstream traffic, and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.
TM22	Dynamic Lane Management and Shoulder Use	--Instance of TM22-- This service package provides for active management of travel lanes along a roadway. The package includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control specific lanes and/or the shoulders. This equipment can be used to change the lane configuration on the roadway according to traffic demand and lane destination along a typical roadway section or on approach to or access from a border crossing, multimodal crossing or intermodal freight depot. This package can be used to allow temporary or interim use of shoulders as travel lanes. The equipment can be used to electronically reconfigure intersections and interchanges and manage right-of-way dynamically including merges. Also, lanes can be designated for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. Prohibitions or restrictions of types of vehicles from using particular lanes can be implemented.The lane management system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.Dynamic lane management and shoulder use is an Active Traffic Management (ATM) strategy and is typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM12-Dynamic Roadway Warning).
VS01	Autonomous Vehicle Safety Systems	--Instance of VS01-- This service package improves vehicle safety using on-board sensors that monitor the driving environment surrounding the vehicle. All levels of driving automation are supported ranging from basic warning systems that warn the driver through full automation where the vehicle controls the steering and acceleration/deceleration in all scenarios and environments, without driver intervention. Unlike other Vehicle Safety service packages, this service package includes autonomous capabilities that rely only on on-board systems without communication with other vehicles or the infrastructure.
VS02	V2V Basic Safety	--Instance of VS02-- This service package exchanges basic safety messages with surrounding Connected Vehicles to support and augment the safety warning and control automation features identified in VS01. These exchanges support Connected Vehicle safety applications defined in SAE J2945/1: Emergency Electronic Brake Lights, Forward Crash Warning, Blind Spot Warning/Lane Change Warning, Intersection Movement Assist, Left Turn Assist, and Control Loss Warning. It also supports other safety applications that benefit from the exchange of basic safety messages that provide additional information about surrounding vehicles beyond what can be determined by vehicle-based sensors.
VS03	Situational Awareness	--Instance of VS03-- This service package shares information about potentially hazardous road conditions or road hazards with other vehicles to support enhanced driver warnings and control automation. Vehicles broadcast relevant road condition information that is collected by the vehicle, such as fog or icy roads. This service package supports the capability for connected vehicles to share situational awareness information even in areas where no roadside communications infrastructure exists. It can be useful to vehicles that are not fully equipped with sensors, or vehicles entering an area with hazardous conditions. Roadside communications infrastructure, if available, can extend the situational awareness range to cover wrong way vehicles where closing rates can require notification beyond DSRC communications range.
VS05	Curve Speed Warning	--Instance of VS05-- This service package allows connected vehicles to receive information that it is approaching a curve along with the recommended speed for the curve. This capability allows the vehicle to provide a warning to the driver regarding the curve and its recommended speed. In addition, the vehicle can perform additional warning actions if the actual speed through the curve exceeds the recommended speed.
VS06	Stop Sign Gap Assist	--Instance of VS06-- This service package is intended to improve safety at non-signalized intersections where only the minor road has posted stop signs. It includes both onboard (for connected vehicles) and roadside signage warning systems (for non-equipped vehicles). The service package helps drivers on a minor road stopped at an intersection understand the state of activities associated with that intersection by providing a warning of unsafe gaps on the major road. The SSGA service package collects all available sensor information (major road, minor road, and median sensors) data and computes the dynamic state of the intersection in order to issue appropriate warnings and alerts.

Service Package	Service Package Name	Service Package Description
VS07	Road Weather Motorist Alert and Warning	--Instance of VS07-- This service package collects road weather data from connected vehicles and uses that data to develop short term warnings or advisories that can be provided to individual motorists. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather motorist alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial service providers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.
VS08	Queue Warning	--Instance of VS08-- This service package utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications, to enable vehicles within the queue event to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to centers (such as the TMC). The infrastructure will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions. This service package is not intended to operate as a crash avoidance system. In contrast to such systems, this service package will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. It performs two essential tasks: queue determination (detection and/or prediction) and queue information dissemination using vehicle-based, infrastructure-based, or hybrid solutions.
VS09	Reduced Speed Zone Warning / Lane Closure	--Instance of VS09-- This service package provides connected vehicles that are approaching a reduced speed zone with information on the zone's posted speed limit and/or if the configuration of the roadway is altered (e.g., lane closures, lane shifts). Reduced speed zones include (but are not be limited to) construction/work zones, school zones, pedestrian crossing areas, and incorporated zones (e.g., rural towns). The connected vehicle uses the revised speed limit along with any applicable changed roadside configuration information to determine whether to provide an alert or warning to the driver. Additionally, to provide warnings to non-equipped vehicles, infrastructure equipment measures the speed of the approaching vehicles and if greater than the reduced speed zone posted speed limit will provide warning signage. It will provide an alert to drivers in advance when aggressive braking is required to reduce to the posted speed limit.
VS12	Pedestrian and Cyclist Safety	--Instance of VS12-- This service package supports the sensing and warning systems used to interact with pedestrians, cyclists, and other non-motorized users that operate on the main vehicle roadways, or on pathways that intersect the main vehicle roadways. These systems allow automated warning or active protection for this class of users. It integrates traffic, pedestrian, and cyclist information from roadside or intersection detectors and new forms of data from wirelessly connected, non-motorized traveler-carried mobile devices to request right-of-way or to inform non-motorized travelers when to cross and how to remain aligned with the crosswalk or pathway based on real-time Signal Phase and Timing (SPaT) and MAP information. In some cases, priority will be given to non-motorized travelers, such as persons with disabilities who need additional crossing time, or in special conditions (e.g., weather) where non-motorized travelers may warrant priority or additional crossing time. This service package will enable a service call to be routed to the traffic controller from a mobile device of a registered person with disabilities after confirming the direction and orientation of the roadway that the individual is intending to cross. It also provides warnings to the non-motorized user of possible infringement of the crossing or pathway by approaching vehicles.
VS13	Intersection Safety Warning and Collision Avoidance	--Instance of VS13-- This service package enables a connected vehicle approaching an instrumented signalized intersection to receive information from the infrastructure regarding the signal timing and the geometry of the intersection. The vehicle uses its speed and acceleration profile, along with the signal timing and geometry information to determine if it appears likely that the vehicle will be able to pass safely through the intersection without violating the signal or colliding with other vehicles. If the vehicle determines that proceeding through the intersection is unsafe, a warning is provided to the driver and/or collision avoidance actions are taken, depending on the automation level of the vehicle.
VS14	Cooperative Adaptive Cruise Control	--Instance of VS14-- This service package adds vehicle to vehicle (V2V) communications to adaptive cruise control (ACC) systems, which provides enhanced information so that groups or 'strings' of CACC-equipped vehicles can follow a lead vehicle with better accuracy, quicker response, and shorter time gaps, enhancing traffic flow stability. In ACC systems, sensors (e.g., radar or lidar) and longitudinal control automation are used to measure and maintain a safe distance from the lead vehicle. V2V communications enables direct communication between the vehicles so that acceleration and deceleration can be more directly coordinated between vehicles in the string.
VS15	Infrastructure Enhanced Cooperative Adaptive Cruise Control	--Instance of VS15-- This service package adds Infrastructure to Vehicle (I2V) communications to Cooperative Adaptive Cruise Control systems so that strings of compatible CACC-equipped vehicles can be more efficiently formed and cooperating vehicles gain access to speed recommendations and traffic control status from the infrastructure, further enhancing traffic flow stability and improving highway capacity and throughput. Speed recommendations provided by the infrastructure can be used to stabilize traffic flow, reducing speed differentials and enhancing throughput along a route that includes a bottleneck. Access to traffic control information such as signal phase and timing enables synchronized starts by adjacent CACC-equipped strings of vehicles, increasing intersection throughput. The infrastructure can also assist with broader coordination between CACC-equipped vehicles, enabling strings of vehicles to be more efficiently formed that share performance parameters and destinations.

Service Package	Service Package Name	Service Package Description
VS16	Automated Vehicle Operations	--Instance of VS16-- This service package provides full vehicle automation, controlling both the steering and acceleration/deceleration on areas of the highway system that support full automation. Communications between vehicles and between the vehicles and supporting infrastructure equipment supports cooperative check-in to the automated portion of the system and transition to automated mode, coordination of maneuvers between vehicles in automated mode, and checkout from the automated system. This service package is distinguished from the most advanced CACC systems in that full longitudinal and lateral control automation are supported, enabling closely spaced, tightly coupled platoons of vehicles to operate with short fixed gaps, providing greatly enhanced highway capacity and throughput with enhanced efficiency since aerodynamic drag is reduced.
WX03	Spot Weather Impact Warning	--Instance of WX03-- This service package will alert drivers to unsafe conditions or road closure at specific points on the downstream roadway as a result of weather-related impacts, which include, but are not limited to high winds, flood conditions, ice, or fog. The service packages is designed to use standalone weather systems to warn drivers about inclement weather conditions that may impact travel conditions. Real time weather information is collected from fixed environmental sensor stations and vehicle based sensors. The information is processed to determine the nature of the alert or warning to be delivered and then communicated to connected vehicles. If the warning includes road closure then diversion information can be provided. For non-equipped vehicles the alerts or warnings will be provided via roadway signage. In addition, the roadway equipment may calculate the appropriate speed for current weather conditions and provide this information to the connected vehicle or on roadway signage.

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.

With the inclusion of the CV/AV systems in the regional ITS architecture, CV/AV projects within the MVRPC and CCSTCC planning areas may utilize the streamlined review and approval process developed by DriveOhio and ODOT.