Regional ITS Architecture for the Delaware Valley

Version 2.0

Executive Summary

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

June 2012

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The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website (www.dvrpc.org) may be translated into multiple languages. Publications and other public documents can be made available in alternative languages and formats, if requested. For more information, please call (215) 238-2871.

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Executive Summary

This document provides an overview of the Regional Intelligent Transportation System (ITS) Architecture for the Delaware Valley. It updates an earlier version completed in 2001, and was prepared by the Delaware Valley Regional Planning Commission (DVRPC) based on input from a broad range of stakeholders. It represents a collective vision of how each agency's systems work together by sharing information and resources with the goal of increasing transportation operational efficiency and capacity, improving safety, and enhancing personal mobility.

ITS is the application of advanced sensor, electronic, and communication technologies and collects information about the performance and operation of the transportation system, such as traffic speeds, traffic video images, travel times, and transit vehicle location data. To successfully manage the transportation system, the information collected must be shared with other agencies and the traveling public.

The Regional ITS Architecture is one method to facilitate coordination between organizations. In general, an ITS Architecture represents a coordinated approach to installing and operating technologies in the transportation system environment across jurisdictions. It establishes a framework for ITS systems at each agency to collect and distribute information with each other. It can also be used to identify ITS deployment priorities, coordinate projects, and understand agency roles and responsibilities associated with ITS.

One of the important phases in developing the architecture is to identify regional needs and determine ITS services that should be implemented to address those needs. User needs are defined from the perspective of those who operate and maintain transportation systems, as well as those who use the transportation system in the region. During the architecture development process, regional priorities were identified in the following areas:

- Traffic Management
- Traveler Information
- Emergency Management
- Public Transportation
- Maintenance and Construction

This document is a high-level overview of the Regional ITS Architecture for the Delaware Valley, describing its purpose, the types of products contained in it, and other supporting documentation. It walks the reader through the step-by-step process of how the Regional ITS Architecture was developed.

Document Organization

The Regional ITS Architecture is presented in six sections. Each follows architecture requirements established by USDOT. These sections are more fully described below.

Chapter 1 – Introduction contains background information and establishes the context for the Architecture effort.

Chapter 2 – Architecture Scope describes the region and major stakeholders.

Chapter 3 – Architecture Components contains the essential building blocks of the Regional ITS Architecture. It identifies and defines each pertinent ITS element in the region. Elements include organizational entities, for example PennDOT District 6-0 Regional Traffic Management Center (RTMC), the subsystems they operate, and interconnect/information flows with other ITS elements.

Chapter 4 – Functional Requirements and Operational Concept focuses on the roles and responsibilities of agency at a high level in the implementation and operation of the region's transportation systems.

Chapter 5 – Implementation bridges the gap between regional ITS architecture and regional ITS implementation. It defines project staging, enabling agency agreements, and supporting ITS standards that will support the efficient implementation of ITS in the region.

Chapter 6 – Regional ITS Architecture Conformity summarizes conformity by the Regional ITS Architecture for the Delaware Valley to the federal requirements. This section also establishes procedures to maintain the architecture.

The Appendices contain supplemental materials documenting the Architecture. These include: (A) ITS acronyms; (B) Regional Market Packages; (C) Subsystem Inventory and Definitions; (D) Elements by Stakeholder; (E) Concept of Operations – Agency Roles and Responsibilities, and (F) Functional Requirements.

CHAPTER 1

Introduction

ITS Architecture Overview

An ITS architecture functionally defines what the elements of the system do and the information that is exchanged between them. It is this common framework from which different regional, agency, or project level architectures can be developed, each one specifically tailored to meet the needs of the user, while maintaining the benefits of a common architecture and helping to ensure interoperability.

Another important aspect of ITS architecture is that it is functionally oriented and not technology specific. It defines what must be done, not how it will be done. The functions that the system performs remain the same while technology evolves. The Regional ITS Architecture is a living document and will evolve as needs, technology, stakeholders and funding change.

The Regional ITS Architecture for the Delaware Valley has been developed by interpreting the National ITS Architecture (Version 6.1, January 2009) sponsored by the U.S. Department of Transportation (USDOT) and adapting it to support integrated regional ITS solutions applicable to the stakeholders and the travelers of this region. It addresses the integration of ITS systems and components, the roles and responsibilities of a wide range of ITS stakeholders, the tailoring of ITS deployments and operations to local needs, the sharing of information between stakeholders, and the future expansion of ITS in the region. It complies with ITS Architecture and Standards Conformity regulations and guidance issued by USDOT.

The core of the Regional ITS Architecture resides in databases and graphics maintained by DVRPC and displayed on its website. This executive summary is a high-level overview of the Regional ITS Architecture serving as an introduction to the Architecture for a technical audience. Professionals who need to access the architecture diagrams and database are directed to the architecture website: www.dvrpc.org/operations/ITSArch.htm, or DVRPC staff.

Architecture Utility

Developing, maintaining, and utilizing the ITS Architecture offers a range of significant benefits to the region. These benefits include the following:

A regional ITS architecture enables planning and deployment to occur in an organized and coordinated manner. It offers a framework for systematically identifying and evaluating prospective

operations and technology solutions to the transportation challenges in the region. It establishes an environment for interagency cooperation and coordination. Stakeholders across the region may use the Regional ITS Architecture to plan their ITS projects and to support regional goals and priorities. Utilization of it also helps to ensure consistency among ITS stakeholder planning processes.

A regional ITS architecture establishes institutional mechanisms that promote the development and deployment of ITS projects. The Regional ITS Architecture compels the region to set up forums for the discussion of regional transportation requirements. These forums, in turn, encourage the building of relationships among transportation professionals and stakeholders across the region. These professionals are thereby given opportunities to understand the needs, issues, constraints, etc., of other transportation sectors. With institutional integration comes the sharing of technologies and information, so that innovative, region-wide thinking becomes a guiding principle in transportation planning and new, synergistic relationships take hold.

A regional ITS architecture promotes interoperability. The Regional ITS Architecture reveals to stakeholders key interrelationships presently established in the region and those planned for the future. These interrelationship requirements identify those areas where operational or technological bridges to multiple agencies are needed. In this way, the Regional ITS Architecture helps to anticipate and plan for integration requirements between state, regional, and local systems.

The Regional ITS Architecture promotes adherence to consistent and uniform standards across the region. By its very nature, it also ensures consistency in documentation of ITS elements across the region.

A regional ITS architecture encourages efficient investment. The Regional ITS Architecture offers regional stakeholders a basis for prioritizing ITS projects and making sound investment choices. As prospective new ITS projects are identified in the region, they can be plotted on the regional architecture and their interrelationships with existing and planned components can be assessed. This lessens the probability that a particular project will result in a dead-end investment. It also helps planners to identify and invest in projects capable of addressing multiple needs, such as Automatic Vehicle Location (AVL) systems that can both improve on-road performance and inform bus passengers of delays.

A regional ITS architecture satisfies Federal ITS Architecture and Standards Conformity Regulations. U.S. Federal Highway Administration (FHWA) requires that regions implementing ITS projects must have a regional ITS architecture in place by April 2005. All ITS projects using federal funds from the Highway Trust Fund and the Mass Transit Account must conform to a regional ITS architecture.

Architecture History

In March 2001, DVRPC issued the first version of the Regional ITS Architecture for the Delaware Valley. It was the accumulation of an extensive outreach process, with a wide array of stakeholders. That effort was one of the nation's first architecture efforts, and one of the few that was completed entirely by the staff of a Metropolitan Planning Organization (MPO).

Since 2001, there have been many changes to the National ITS Architecture that had to be incorporated into an update. For example, the National ITS Architecture now includes maintenance and construction operations that integrate key maintenance activities, such as maintenance of vehicle fleet management, roadway management, work zone management, and roadway and winter maintenance. Another big change to the National ITS Architecture was an upgrade to emergency management services. There are now user services in that category for roadway service patrols, disaster response and recovery, and transportation infrastructure protection.

In response to provisions of the Transportation Equity Act for the 21st Century (TEA–21), on January 8, 2001, USDOT promulgated ITS Architecture and Standards Conformity regulations (23 C.F.R. 940) and subsequently published several guidance documents to support it. The regulations and guidance documents specify the elements of a regional architecture and best practices to achieve them. Version 1 of this region's ITS Architecture was completed prior to adoption of federal regulations. While it fulfilled most of the federal requirements, it did not adhere to all required elements.

As a consequence of USDOT regulations, a statewide ITS architecture was completed in New Jersey, along with individual architectures for northern New Jersey and southern new Jersey outside the DVRPC region. In Pennsylvania, the Pennsylvania Department of Transportation (PennDOT) had a consultant develop regional architectures for each engineering district, exclusive of the DVRPC region. This update of the architecture incorporates aspects of their adjoining architectures. Differences in the way that each state operates, and their terminology, make it difficult to be fully consistent among architectures.

There have also been many changes in the ITS landscape of the region. In 2001, many of the region's stakeholders were in the beginning stages of their ITS deployments. The focus was more on their own individual agency operations. As stakeholders have built their own ITS systems, there is now a greater need for coordination.

Turbo Architecture

In 2001, when the Regional ITS Architecture – Version 1 was completed, it was developed manually using several off-the-shelf graphic software programs, such as Microsoft Visio, to produce each diagram on an individual basis. It was very difficult to maintain the architecture and keep it up-to-date, as the customized tables and charts were not easily modified.

In order to deliver an ITS Architecture that is easy to update and maintain, all of previous data and information was entered into Turbo Architecture Version 5.0, which is compatible with Version 6.1 of the National ITS Architecture. FHWA sponsored development of Turbo Architecture as a software application to generate regional and project-level ITS architectures. The Turbo Architecture database can generate a set of outputs including interconnect and architecture flow diagrams, inventory lists, stakeholder lists, market package lists, functional requirements, and other diagrams and reports. Collectively, these outputs can be used to prepare an ITS architecture document. The benefit of using Turbo Architecture to create and store a regional ITS Architecture is that the architecture is developed using a standard format that can be easily transferred or used by several stakeholders to develop project architectures. It will also allow for a simpler maintenance process for future updates.

Web Based

The core of the Regional ITS Architecture is the context and flow diagrams that were created using Turbo Architecture. These diagrams depict the interconnection and the information that flows between the various stakeholders. In Turbo Architecture, these diagrams are created for each stakeholder. With the large number of stakeholders in the region, printing out each of these diagrams would produce a very large, cumbersome document. The intent of this document is to provide the reader with an overview of the Regional Architecture and make the core of the architecture, which is the diagrams, available via the web at www.dvrpc.org/operations/ITSArch.htm.

CHAPTER 2

Architecture Scope

Description of Region

This Regional ITS Architecture for the Delaware Valley covers the nine counties in the metropolitan planning area covered by DVRPC: Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey.

One of the complexities of the Regional ITS Architecture is that it encompasses parts of two states: Pennsylvania and New Jersey: and is adjacent to another, Delaware. With a number of stakeholders within the Regional ITS Architecture operating facilities that extend outside the region, many elements of the architecture have more widespread application than just the immediate DVRPC coverage area. In fact, many of these elements are also included in other architectures among the three states. **Figure 1** depicts the DVRPC region covered by the Regional ITS Architecture. Also depicted on the figure is the geographic coverage of adjoining regional architectures.

To address the issue of stakeholders participating in multiple regional architectures, an effort was made to be as consistent as possible, where feasible, using the same nomenclature.

Timeframe

The timeframe of this Regional ITS Architecture correlates directly with the region's Transportation Operations Master Plan, which is a component of DVRPC's adopted 2035 Long-Range Plan. The Regional ITS Architecture represents a 25-year vision of how each agency's systems will work together in the future and share information. It represents a snapshot of the currently anticipated projects based on information from stakeholders. Accordingly, the Regional ITS Architecture will require updates to ensure that it consistently maintains an accurate representation of the region.

Regional Stakeholders

The success of the Regional ITS Architecture for the Delaware Valley depends on participation by a diverse set of stakeholders. In the context of this project, stakeholders are defined as a public agency; a private organization; or the traveling public with a vested interest, in one or more transportation elements within a Regional ITS Architecture. Below, listed in alphabetical order,

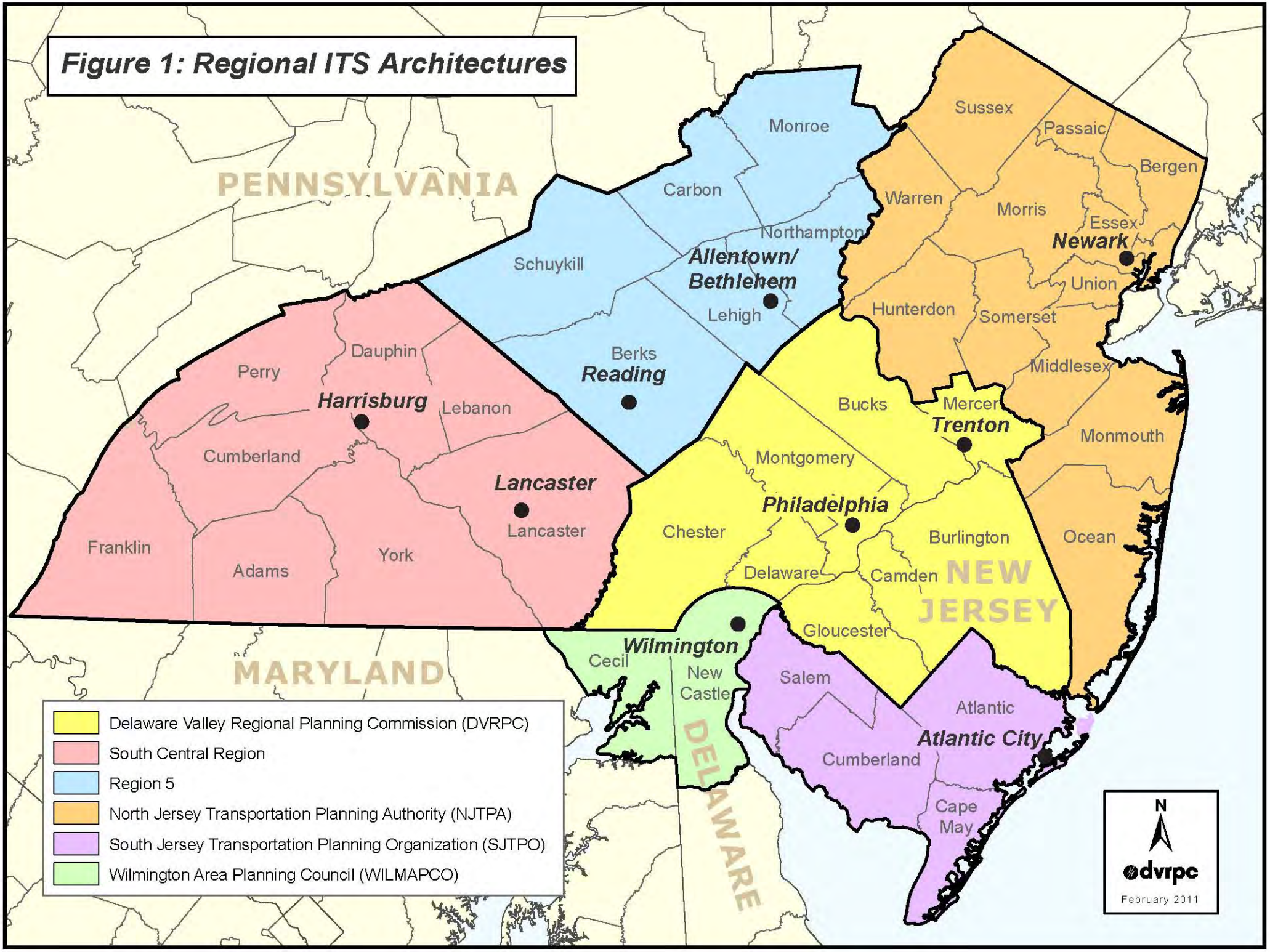
Figure 1: Regional ITS Architectures
PENNSYLVANIA
MARYLAND
NEW JERSEY
DELAWARE
Monroe
Carbon
Schuykill
Northampton
Allentown/
Bethlehem
Lehigh
Berks
Reading
Sussex
Passaic
Bergen
Warren
Morris
Essex
Newark
Union
Hunterdon
Somerset
Middlesex
Dauphin
Perry
Harrisburg
Lebanon
Cumberland
Lancaster
Lancaster
Franklin
Adams
York
Bucks
Mercer
Trenton
Monmouth
Montgomery
Philadelphia
Chester
Burlington
Ocean
Delaware
Camden
Gloucester
Wilmington
Cecil
New
Castle
Salem
Atlantic
Atlantic City
Cumberland
Cape
May
Delaware Valley Regional Planning Commission (DVRPC)
South Central Region
Region 5
North Jersey Transportation Planning Authority (NJTPA)
South Jersey Transportation Planning Organization (SJTPO)
Wilmington Area Planning Council (WILMAPCO)
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February 2011

is a list of stakeholders referenced in the Regional ITS Architecture. For consistency, a great effort was made to match stakeholder names to those used in adjoining architectures.

Amtrak: Amtrak is the nationwide passenger rail provider, with service to the entire Northeast Corridor. Regionally, it provides rail service to New York City, Harrisburg, and Washington, D.C.

Burlington County Bridge Commission (BCBC): This agency operates and maintains two toll bridges, the Burlington-Bristol Bridge and the Tacony-Palmyra Bridge, which cross the Delaware River between Pennsylvania and New Jersey. Each bridge has a toll plaza located on the New Jersey side of the river, with E-ZPass available as a toll option.

Commercial Vehicle and Fleet Operators: These type of stakeholders represent commercial vehicle operators and major commercial trucking fleets.

County Paratransit Services: Counties in the region operate paratransit systems to transport disabled people and senior citizens. The Southeastern Pennsylvania Transportation Authority's (SEPTA) Customized Community Transportation (CCT) provides service in the Pennsylvania portion of the region.

DART First State: DART First State is Delaware's public transportation provider. It serves New Castle County and funds SEPTA's commuter rail service between New Castle County and Philadelphia. Its DART Card is a stored value card that can be used statewide on all bus services except paratransit.

Delaware Department of Transportation (DelDOT): DelDOT is the Department of Transportation for the State of Delaware. It manages ITS on expressways, signal systems on arterials, and a statewide traveler information program.

Delaware River and Bay Authority (DRBA): DRBA, a New Jersey-Delaware bi-state agency, operates the Delaware Memorial Bridge (I-295) between New Castle County, Delaware, and Salem County, New Jersey. It also operates the following transportation services: the Cape May-Lewes Ferry system; the Three Forts Ferry Crossing; and the New Castle, Cape May, Millville, Delaware Airpark, and Dover Civil Air Terminal Airports.

Delaware River Joint Toll Bridge Commission (DRJTBC): DRJTBC operates 20 Delaware River crossings over 139 miles within its jurisdiction, stretching from northern Burlington County, New Jersey, and Bucks County, Pennsylvania, northward to the New York State Line. It operates seven toll bridges. Major bridges in the DVRPC region include the Scudder Falls Bridge (I-95), the Trenton-Morrisville Toll Bridge (US 1), and the New Hope-Lambertville Bridge (US 202).

Delaware River Port Authority (DRPA): DRPA is a bi-state agency serving southeastern Pennsylvania and southern New Jersey. DRPA operates four toll bridges in the region and the PATCO Speedline. It also operates the RiverLink Ferry, and the AmeriPort Intermodal Rail Center.

Delaware Valley Regional Planning Commission (DVRPC): DVRPC is the metropolitan planning organization for the Greater Philadelphia region, serving nine counties in Pennsylvania and New Jersey. The Regional Integrated Multi-modal Information Sharing (RIMIS) System, managed by DVRPC, provides an information exchange network for agencies to share transportation situational information. DVRPC also maintains extensive transportation information databases.

E-ZPass Inter-Agency Group (IAG): A coalition of E-ZPass agencies responsible for maintaining and coordinating interoperability standards for its member agencies. The consortium includes BCBC, DRJTBC, DRBA, DRPA, New Jersey Turnpike Authority, Pennsylvania Turnpike Commission, South Jersey Transportation Authority, and the Port Authority of New York and New Jersey.

Financial Institutions: Financial and banking institutions that play a role in electronic payment financial transactions.

Information Service Providers (ISP): ISP are public agencies and private companies that provide information to media outlets and the general public on the status of the transportation system, including delays, incidents, and facility closures. It includes entities that provide real-time traffic and logistics information solutions for consumers and businesses and disseminate information via regional media outlets. Locally, they include Traffic.com, SmartRoute Systems, TrafficLand, INRIX, and Metro Traffic.

Multimodal Transfer Terminal/Station Providers: Represents multimodal transportation facilities owners and operators. Examples include the Greyhound Bus Terminal or Walter Rand Transportation Center on the passenger side, and the CSX Greenwich Yard or the Norfolk Southern Morrisville Yard on the freight side.

Municipalities: There are 352 municipalities not including Philadelphia in the DVRPC region. Municipalities are responsible for maintaining local roads. In addition, municipal police and local fire/Emergency Medical Services (EMS) respond to transportation incidents. In Pennsylvania, municipalities own and operate traffic signals on the state highway system.

National Guard: The National Guard is comprised of state controlled forces that can provide assistance in an emergency situation.

National Park Service: Locally, the National Park Service operates Independence National Historical Park and Valley Forge National Historical Park, which are two major tourist destinations.

New Jersey Counties: These counties, comprising the New Jersey portion of the DVRPC region, include government departments for Burlington, Camden, Gloucester, and Mercer counties. Counties in New Jersey operate traffic signals and maintain an extensive county road network, and their 9-1-1 centers dispatch municipal police and fire departments.

New Jersey Department of Transportation (NJDOT): The NJDOT is the statewide transportation agency responsible for building, maintaining, and operating the state-owned roads, bridges, and tunnels. NJDOT's operations are divided into three regions: North, Central, and South. DVRPC's ITS Architecture overlaps portions of the South and Central regions.

New Jersey Office of Homeland Security: New Jersey Office of Homeland Security focuses on a range of important security needs and services, including transportation-related issues. Potential high-threat targets include nuclear power plants, chemical industry, major distribution of gas and electric utilities, and other critical infrastructure.

New Jersey State Police (NJSP): NJSP is responsible for patrolling expressways in New Jersey and providing law enforcement in rural municipalities that do not have their own police forces. Dedicated

NJSP troops are assigned to the Atlantic City Expressway, the Garden State Parkway, and the New Jersey Turnpike.

New Jersey Transit (NJ TRANSIT): NJ TRANSIT is New Jersey's public transportation provider. NJ TRANSIT operates bus, rail, and light rail transit, linking major points within New Jersey, and between New Jersey and New York and Philadelphia. NJ TRANSIT also administers several publicly funded transit programs for people with disabilities, senior citizens, and people living in the state's rural areas.

New Jersey Turnpike Authority (NJTA): The NJTA operates the New Jersey Turnpike and the Garden State Parkway. Both the Turnpike and Parkway have E-ZPass tolls, including some high-speed E-ZPass lanes. Sixty-two miles of the Turnpike and seven miles of the Parkway are in the DVRPC Region

NJ 2-1-1 Partnership: 2-1-1 connects New Jersey residents with important community services, such as paratransit for the disabled and senior citizens. The Department of Human Services has integrated into the 2-1-1 database its e-service directory to make state government programs and services easier to access.

North Jersey Transportation Planning Authority (NJTPA)/South Jersey Transportation Planning Organization (SJTPO): NJTPA is the MPO for northern New Jersey. Its area includes 15 sub regions, including Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren counties; the City of Newark and Jersey City. SJTPO is the MPO serving Atlantic, Cape May, Cumberland, and Salem counties in southern New Jersey. Some of these counties border the DVRPC region and interface with DVRPC counties and agencies.

NJTPA/SJTPO Counties: The county agencies and departments in New Jersey that are external to the DVRPC region. It explicitly includes county agencies and departments in counties abutting the DVRPC region, including Hunterdon, Middlesex, Monmouth, Somerset, and Ocean counties in the NJTPA region, and Atlantic, Cumberland, and Salem counties in the SJTPO region.

NJTPA/SJTPO Public Safety Agencies: This represents the municipal and county public safety agencies, including EMS, fire departments, police departments, and sheriff's department serving counties in New Jersey that are external to the DVRPC region. Some of these counties border the DVRPC region and interface with DVRPC counties and agencies.

NJTPA/SJTPO Transit Operators: These transit operators include municipalities, counties, and the private sector serving the NJTPA and SJTPO regions. In addition to traditional transit operators, Transportation Management Associations (TMA) also offers transit services.

Pennsylvania Counties: This represents the government agencies and departments for Bucks County, Chester County, Delaware County, and Montgomery County, the four suburban Pennsylvania counties in the DVRPC region surrounding Philadelphia. With the exception of Philadelphia, Pennsylvania counties do not own or operate an extensive highway network. County 9-1-1 centers are responsible for dispatching local police, fire, and EMS responders.

Pennsylvania Department of Transportation (PennDOT): PennDOT is the Commonwealth's statewide transportation agency responsible for building, maintaining, and operating the state-owned roads, bridges, and tunnels. PennDOT consists of a single Central Office and 11 District Offices throughout the state, which are responsible for their region. District 6-0 covers the five Pennsylvania counties in the DVPRC region. District 6-0's extensive deployment of ITS is managed by its RTMC, which also dispatches service patrol vehicles and feeds traveler information into 511PA. District 6-0's RTMC assumes control of Districts 4 and 5's ITS operations during off-hours.

Pennsylvania Emergency Management Agency (PEMA): PEMA coordinates state agencies' emergency response, including PennDOT, the Office of the State Fire Commissioner, and Office of Homeland Security. PEMA supports county and local governments in the areas of civil defense, disaster mitigation and preparedness, planning, and response to and recovery from man-made and natural disasters.

Pennsylvania Office of Homeland Security: The Pennsylvania Office of Homeland Security addresses the security needs of the state. The Homeland Security Office focuses on a range of important security needs and services, including transportation-related issues. Potential high-threat targets include nuclear power plants, chemical industry plants, major distribution of gas and electric utilities, and other critical infrastructure.

Pennsylvania Regional Incident and Mutual Aid Network: This stakeholder includes regional public safety communications networks, including Knowledge Center and other interagency communication networks.

Pennsylvania State Police (PSP): The PSP is a full service statewide law enforcement agency that fulfills law enforcement needs of the general public across the Commonwealth of Pennsylvania. Transportation services provided by the PSP include incident response, commercial vehicle inspections, and law enforcement on state highways. They are responsible for patrolling most of the expressways in the Pennsylvania portion of the region.

Pennsylvania Turnpike Commission (PTC): The PTC maintains and operates the 531-mile Pennsylvania Turnpike. It maintains a 24-hour-a-day, 365 day-a-year traffic operation control center in Harrisburg. Serving as the hub of all Turnpike communications, the control center continuously monitors Turnpike activities via an extensive radio system. Roadway conditions, construction status, and weather conditions are all monitored at the center. The center also serves as the focal point for all Turnpike incident management activities.

Philadelphia Fire Department: The Philadelphia Fire Department serves the City of Philadelphia. In addition to fire response duties, it also operates the city's Emergency Medical Services. The Fire Department's Hazardous Material (HAZMAT) operations and administrative units handle any HAZMAT emergencies. The Fire Communications Center is responsible for dispatching fire and medical units.

Philadelphia International Airport (PHL): The Philadelphia International Airport is the major airport serving the Philadelphia region. Owned by the City of Philadelphia, it is operated by the Department of Commerce's Division of Aviation.

Philadelphia Office of Emergency Management (OEM): Philadelphia's OEM is responsible for formulating and updating Philadelphia's emergency management plans. During an emergency, it is responsible for coordinating the city's response. Its operations center is staffed 24 hours, 7 days a week.

Philadelphia Parking Authority (PPA): The PPA provides comprehensive parking management services. Its responsibilities include developing the city's supply of off-street parking, regulating the use of on-street parking, and providing parking facilities at Philadelphia International Airport. It also administers the red-light running camera program in the city.

Philadelphia Police Department (PPD): The PPD serves the City of Philadelphia. In addition to the department's patrol districts, other special patrol functions include highway and traffic patrol, mounted and canine units, airport and park protection, SWAT unit, the detective bureau, special investigations, and emergency response. Major off-street functions of the PPD include the communications bureau, which manages radio and 9-1-1 operations.

Philadelphia Sports Complex Special Services District (SCSSD): The Philadelphia SCSSD is a non profit corporation. The district was created to address the unique needs of residents living next to the sports complex. The Philadelphia Sports Complex, which includes three major sports venues (Lincoln Financial Field, Citizens Bank Park, and Wells Fargo Center), has a combined capacity of over 135,000 seats. SCSSD fosters special events planning and coordination among its venues and with DRPA, PennDOT, PPD, the Streets Department, SEPTA, and others.

Philadelphia Streets Department: The City of Philadelphia Streets Department is responsible for 2,393 miles of streets within Philadelphia. The Highway Division is responsible for maintenance of this system. Together with the Sanitation Division, it salts and plows city streets. Within the Streets Department, the Bureau of Survey and Design is responsible for legal plan records and engineering services for the city's street system and bridges. The Traffic and Lighting Unit oversees nearly 3.000 signalized intersections, 15,000 conventional stop intersections, and 3,000 all-way stop intersections.

Port Authority Transit Corporation (PATCO): PATCO maintains and operates a 14.2 mile commuter rail line operating between Lindenwold, New Jersey, and Center City Philadelphia. The Hi-Speed Line has a total of 13 stations, 9 of which are in New Jersey and 4 are in Philadelphia. PATCO is a subsidiary of DRPA. Center Tower manages all PATCO operations.

Private Terminal Operators at Ports: Private terminal operators manage port facilities along the New Jersey and Pennsylvania sides of the Delaware River, including Packer Avenue, Tioga, Beckett, Broadway, and Gloucester marine terminals.

Railroad Operators: Railroad operators represent owners or operators of commercial or passenger rail services.

Regional Event Promoters: Regional event promoters fall into two categories: organizers who own venues where events occur and promoters who organize special events. Examples of the former are the Pennsylvania Convention Center and the Susquehanna Center.

Regional Fare Reciprocity Administrator: The organization responsible for arranging reciprocity among electronic transit fare payment systems in the region. It facilitates fare payment across transit systems.

South Jersey Transportation Authority (SJTA): SJTA operates the Atlantic City Expressway, including the connector and tunnel, and the Atlantic City International Airport. It also supports paratransit operations in South Jersey. The SJTA service area includes two counties in the DVRPC region (Camden and Gloucester counties), and four other South Jersey counties (Atlantic, Cape May, Cumberland, and Salem counties).

Southeastern Pennsylvania Transportation Authority (SEPTA): SEPTA is the public transportation operator serving Philadelphia and Bucks, Chester, Delaware, and Montgomery counties. Service also reaches out to portions of New Jersey and Delaware. The system is made up of buses, subways, trolleys, trackless trolleys, and high-speed rail and regional rail. SEPTA's operations center manages its services from a centralized location. Information from the operations center feeds SEPTA's traveler information programs, including its web site, interactive voice response system, dynamic message signs, and public announcements.

Towing Industry: The towing industry consists of privately owned towing agencies in the region responsible for incident cleanup and removal of vehicles at incident sites.

Transportation Operations Coordinating Committee (TRANSCOM): TRANSCOM is a not-for-profit organization comprised of 16 transportation and public safety agencies in the New York-New Jersey-Connecticut metropolitan area. TRANSCOM uses its Regional Architecture (RA) to collect and disseminate real-time regional incident and construction information, 24 hours a day, through an extensive center-to-center network. TRANSCOM is also RIMIS's system manager, allowing RIMIS to share information with NJDOT's SWIFT system and the RA.

Transportation Information Users: Users of transportation information, such as transportation planners.

Transportation Management Associations (TMA): TMAs are public-private partnerships dedicated to reducing traffic congestion and improving mobility. They are a partnership among state, county, and municipal governments and the local business community. TMAs typically offer ridesharing services, shuttle buses between rail stations and nearby business parks, and traveler information.

Travelers: The general public as a whole using the transportation system. The public may be an automobile driver or transit passenger. It also includes a computer user, cell-phone user, or any other person obtaining travel information or interacting with the transportation system in the region.

Weather Service Provider: Public agencies and private companies that provide weather forecast information to transportation agencies and emergency response agencies. This stakeholder represents the National Weather Service, Accuweather, and The Weather Channel.

CHAPTER 3

Architecture Components

Needs and Services

One of the important phases in developing the architecture is to identify regional needs and determine the ITS services that should be implemented to address those needs. To help in determining these local needs and services, DVRPC's adopted 2035 long-range plan *Connections: The Regional Plan for a Sustainable Future* (publication number: 09047) and associated *Transportation Operations Master Plan* (publication number: 09049) were reviewed. Many of the long-term policies and goals in these plans can be fulfilled by the services contained in the Regional ITS Architecture. For example, if major new facilities are planned for the region, then it is appropriate to incorporate network surveillance or freeway control into them. If the region is making major investments in enhancing transit service, transit vehicle tracking or transit traveler information should be reflected in the Regional ITS Architecture.

In an effort to further build consensus on regional needs and ITS service priorities, a series of meetings were held with DVRPC's Transportation Operations Task Force (TOTF) to select the market packages that correspond to their ITS needs and services. Market packages identify the ITS system elements required to implement a particular transportation service. That is, it identifies the necessary system level components, such as implementing electronic toll collection or work zone safety monitoring. The TOTF screened a list of 91 market packages contained in the National ITS Architecture in an effort to identify those packages that are most applicable to the Delaware Valley.

Table 1 lists those market packages that have been identified as a regional priority. A more complete list of market packages applicable to the Delaware Valley is contained in **Appendix B.**

Subsystem Inventory

Once needs and services were identified, the next step in the development of the Regional ITS Architecture was to identify the particular subsystems that are necessary to work together to deliver transportation services. These subsystems, and the interconnections and information exchanges among them, are the primary foundation of the architecture.

Subsystems are individual pieces that perform particular functions, such as managing traffic, providing traveler information, or responding to emergencies. Subsystems can be associated with

Table 1: High-Priority Regional Market Packages

Market Packages		
Traffic Management	ATMS01	Network Surveillance
	ATMS02	Traffic Probe Surveillance
	ATMS03	Surface Street Control
	ATMS04	Freeway Control
	ATMS06	Traffic Information Dissemination
	ATMS07	Regional Traffic Management
	ATMS08	Traffic Incident Management System
	ATMS10	Electronic Toll Collection
	ATMS16	Parking Facility Management
	ATMS21	Roadway Closure Management
Traveler Information	ATIS01	Broadcast Traveler Information
	ATIS02	Interactive Traveler Information
	ATIS06	Transportation Operations Data Sharing
Emergency Management	EM01	Emergency Call-Taking and Dispatch
	EM02	Emergency Routing
	EM03	Mayday and Alarms Support
	EM04	Roadway Service Patrols
	EM05	Transportation Infrastructure Protection
	EM06	Wide-Area Alert
	EM07	Early Warning System
	EM08	Disaster Response and Recovery
	EM09	Evacuation and Reentry Management
	EM10	Disaster Traveler Information
Public Transportation	APTS01	Transit Vehicle Tracking
	APTS04	Transit Passenger and Fare Management
	APTS05	Transit Security
	APTS07	Multi-Modal Coordination
	APTS08	Transit Traveler Information
Maintenance and Construction	MC01	Maintenance and Construction Vehicle and Equipment Tracking
	MC03	Road Weather Data Collection
	MC04	Weather Information Processing and Distribution
	MC08	Work Zone Management
	MC09	Work Zone Safety Monitoring
	MC10	Maintenance and Construction Activity Coordination
Archived Data Management	AD1	ITS Data Mart
	AD3	ITS Virtual Data Warehouse

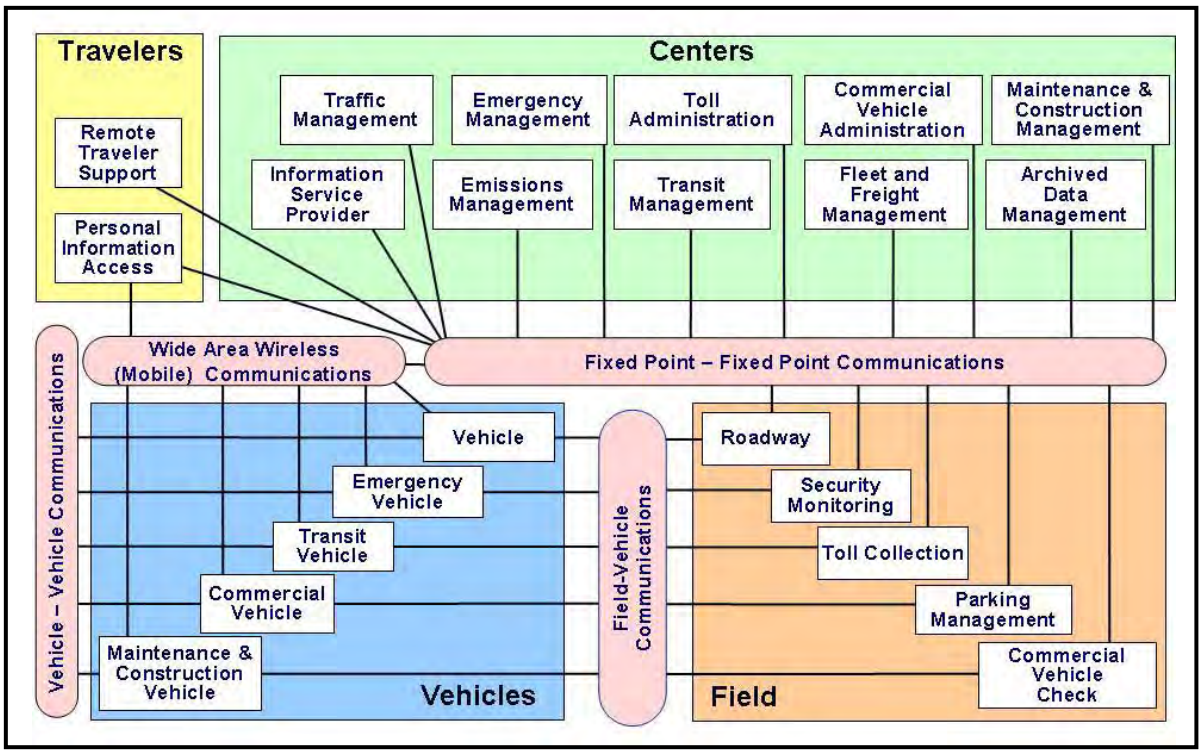
Source: DVRPC, 2012

particular organizations, such as departments of transportation, information service providers, or public safety agencies. They are sources and/or users of information provided by other subsystems. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers. Examples of subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem. In the physical world, they respectively represent traffic operations centers, automobiles, and roadside signal controllers.

One of the most recognized representations of the ITS architecture is the **ITS Sausage Diagram (Figure 2)**, which shows the subsystems and how they interconnect with each other. The "sausages" in the diagram describe communications technologies linking the subsystems. The diagram illustrates the National ITS Architecture's view of all the possible interactions among ITS elements.

A subsystem can have multiple implementations; for example, NJDOT, PennDOT, and PTC all operate Traffic Management Subsystems. Each particular implementation, such as PennDOT 6-0 RTMC, is a distinct ITS element. ITS elements are considered the basic building blocks of the architecture and are the names used by stakeholders to describe components of their ITS operations. Another way to look at subsystems is that a stakeholder like PennDOT typically operates several subsystems/elements, such as the PennDOT District 6-0 RTMC, ITS field equipment, maintenance and construction vehicles, and 511 system/traveler information services. **Table 2** depicts an abbreviated list of stakeholder elements that are associated with each type of subsystem to highlight the types of elements that make up each subsystem. The table is color coded to help distinguish among the four basic categories of subsystems as described in the sausage diagram. **Appendix C** provides a complete list of all the subsystems and terminators, a definition of their role and functions, and a comprehensive listing of all ITS elements in the region that fall under that particular subsystem. A complete listing of elements sorted by stakeholders is included in **Appendix D**.

Figure 2: ITS Sausage Diagram



Source: National ITS Architecture, Version 6.1, 2009

Table 2: Example Elements by Subsystem

Archived Data Management Subsystem	
DRPA Data Archive	PennDOT District 6-0 Data Archive
DVRPC Data Archive	Philadelphia Streets Dept. Data Archive
Commercial Vehicle Administration Subsystem	
NJ Commercial Vehicle Information Systems and Network (CVISN) System	PennDOT Driver and Vehicle Services
NJTA HAZMAT Permit System	
Emergency Management Subsystem	
DRPA Police - Bridge Unit	Municipal Police and Fire Dept. Operations
New Jersey County 9-1-1 Communication Centers	PennDOT District 6-0 RTMC
Fleet and Freight Management Subsystem	
Commercial Vehicle Dispatchers	Private Terminal Operators Systems
Information Service Provider Subsystem	
NJDOT 511 System/Traveler Information Services	SEPTA Traveler Information Services
PennDOT 511 System/Traveler Information Services	TMAs - Pennsylvania Traveler Information Services
Maintenance and Construction Management Subsystem	
NJDOT Maintenance	Philadelphia Streets Dept. Maintenance and Construction
PennDOT District 6-0 County Maintenance Offices	SJTA Traffic Operation Center (TOC) Maintenance
Toll Administration Subsystem	
BCBC Toll Plazas	DRPA Toll Plazas
DRJTBC Toll Plazas	PTC Toll Plazas
Traffic Management Subsystem	
NJDOT Statewide Transportation Management Center (STMC)	PennDOT District 6-0 RTMC
New Jersey County TOCs	PTC Operations Control Center (OCC)
Transit Management Subsystem	
NJ TRANSIT Fare Management System	PATCO Center Tower
County Paratransit Management Systems	SEPTA Operations Center
Commercial Vehicle Check Subsystem	
Municipal Police Commercial Vehicle Enforcement Division	PennDOT Central Office Organizations
NJSP Commercial Carrier/Safety Inspection Unit	PSP Motor Carrier Services and Enforcement Division

Table 2: Example Elements by Subsystem (continued)

Parking Management Subsystem	
PATCO Parking Facilities	PPA Parking Facilities
PHL Parking Facilities	SEPTA Parking Facilities
Roadway Subsystem	
DRPA ITS Field Equipment	NJDOT ITS Field Equipment
New Jersey County ITS Field Equipment	PennDOT District 6-0 ITS Field Equipment
Security Monitoring Subsystem	
BCBC Infrastructure Security Equipment	PATCO Security Equipment
DRPA Infrastructure Security Equipment	SEPTA Facility Security Equipment
Toll Collection Subsystem	
BCBC Toll Plazas	PTC Toll Plazas
NJTA Toll Plazas	SJTA Toll Plazas
Commercial Vehicle Subsystem	
Commercial Vehicles	
Emergency Vehicle Subsystem	
NJDOT Emergency Service Patrol (ESP) Vehicles	PennDOT District 6-0 ESP Vehicles
NJSP Vehicles	Police, Fire, and EMS Vehicles
Maintenance and Construction Vehicle Subsystem	
New Jersey County Public Works Dept. Vehicles	Philadelphia Streets Dept. Maintenance and Construction Vehicles
PennDOT District 6-0 Maintenance and Construction Vehicles	SJTA Maintenance Vehicles
Transit Vehicle Subsystem	
NJ TRANSIT Vehicles	PATCO Vehicles
County Paratransit Vehicles	SEPTA Vehicles
Vehicle Subsystem	
Travelers' Vehicles	
Remote Traveler Support Subsystem	
NJ TRANSIT Fare Point of Sale	PTC Service Plazas
PATCO Customer Display Systems	SEPTA Fare Point of Sale
Personal Information Access Subsystem	
Personal Traveler Information Devices	

Source: DVRPC, 2012

Interconnect Diagrams

Once the region's elements have been defined and the regional needs and services are understood, the connections between ITS elements can then be identified, creating a framework for integration that will support the exchange of information between ITS elements.

Turbo Architecture was designed to identify connections between ITS elements in the architecture inventory that support selected services or market packages. Although Turbo Architecture identifies all potential connections between ITS elements based on the National ITS Architecture, it pre-selected those connections required to support the desired services. Next, DVRPC staff undertook a thorough and intense process of evaluating the interconnects and flows for all key agencies in the region in order to confirm and/or eliminate connections. Once connections and flows were defined, a customized set of interconnect diagrams for the Regional ITS Architecture was generated using Turbo Architecture. Two types of graphics are produced: Context and Flow Diagrams. They are explained below.

Context Diagram

The sausage diagram presents a high-level view, from a regional architecture perspective, of how all the subsystems interact with each other. To drill down to an agency level perspective, Turbo Architecture generates a series of context diagrams to represent how each agency component, or element, interconnects with other elements in the region. **Context Diagrams** graphically show how a particular element within the ITS architecture connects to other relevant elements in the regional architecture.

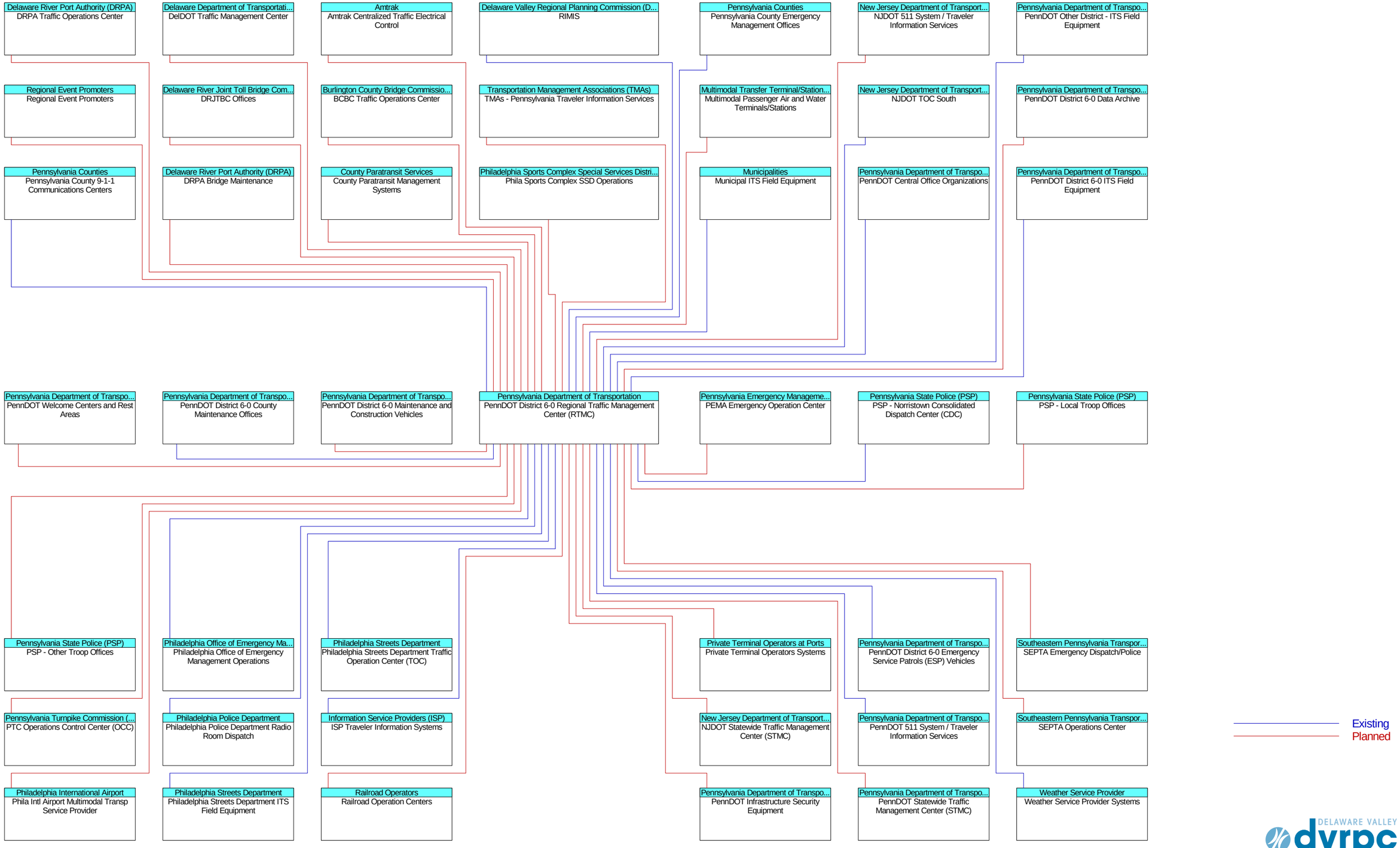
For example, **Figure 3** represents a context diagram for PennDOT District 6-0 RTMC. It shows all of the elements within the region with which the center may need to share information. Each block in the diagram represents an ITS element. The name of the stakeholder is in the top shaded portion of the block and the element name is below it. The interconnect lines between elements are solid or dashed, indicating existing or planned connections. Note that context diagrams do not show source and destination of the information because, depending upon the type of information, it may be a one-way or two-way flow.

Information Flow Diagram

For each connection represented in a context diagram, Turbo Architecture also generates **Information Flow Diagrams**, which graphically depict the types of information flowing between the subsystems, whether it is traffic information, incident information, or surveillance and sensor control data. Information Flow Diagrams represent the next level of detail to the Interconnect Diagram. They depict ITS integration by illustrating the type of information shared between different subsystems.

Figure 4 depicts a sample information flow diagram for PennDOT showing information flows between District 6-0 RTMC and its ITS field equipment. Again, each block represents an ITS inventory element, including the name of the stakeholder in the top shaded portion, with the information flows being solid or dashed, indicating existing or planned connections. Unlike a context diagram, information flow diagrams do show the source and destination of information.

Figure 3: PennDOT – District 6 Regional Traffic Management Center - Context Diagram



REGIONAL ITS ARCHITECTURE FOR THE DELAWARE VALLEY

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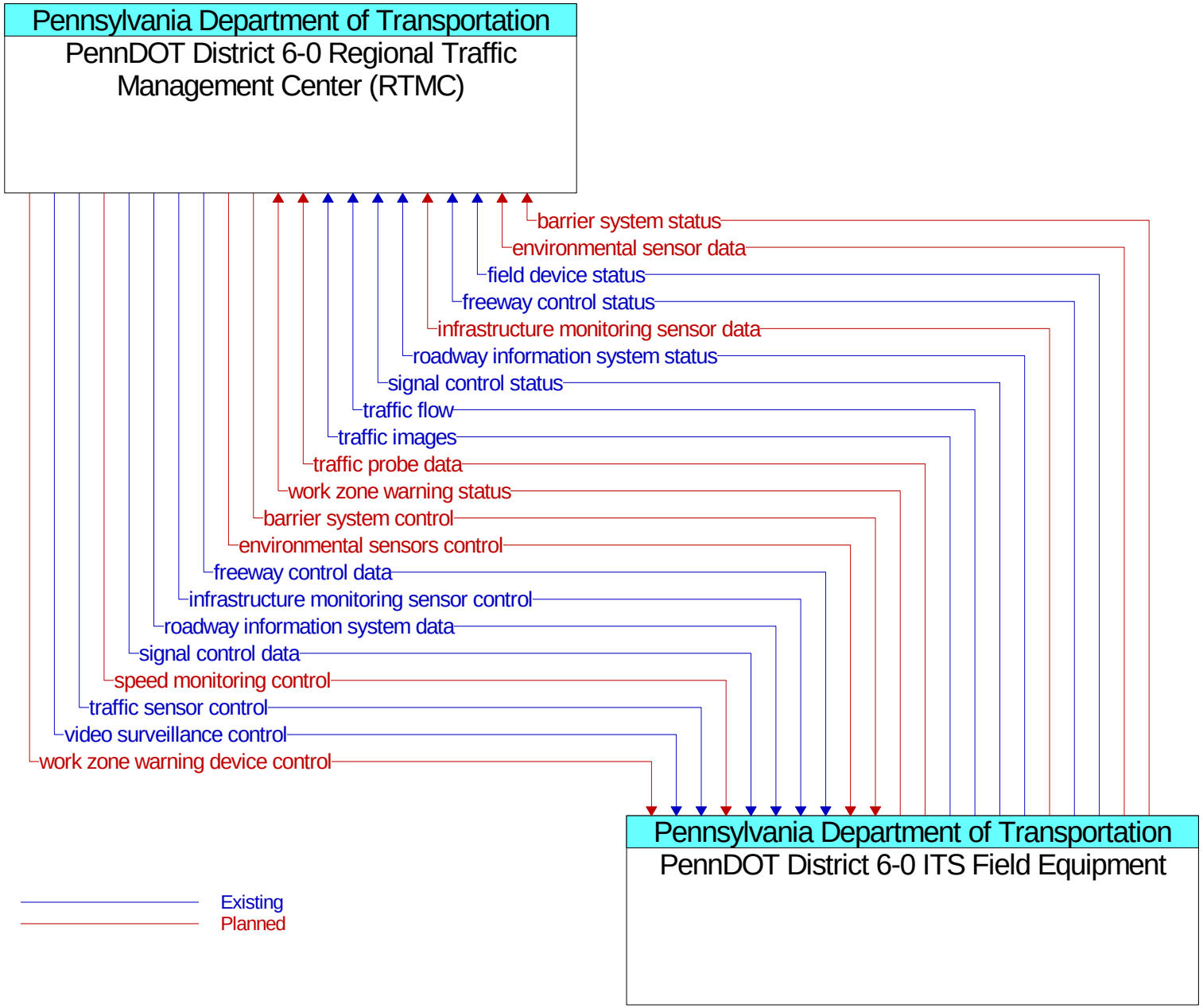
Figure 4: PennDOT – 6-0 RTMC to ITS Field Equipment Flow Diagram



CHAPTER 4

Functional Requirements and Operational Concept

In the previous chapter of the Regional ITS Architecture, ITS subsystems and individual elements were identified, and context diagrams and information flow diagrams showed how the various ITS elements interface with each other. This chapter will define the architecture from an operational perspective. First, subsystems functions will be described documenting the types of operations they perform. Next, the roles and responsibilities of key stakeholders will be examined.

Functional Requirements

Functional requirements define the tasks or activities that individual subsystems perform. For example, a TMC may be responsible for traffic surveillance, freeway management, traffic signal control, or incident detection. In turn, each of these activities involve numerous subtasks: traffic surveillance may involve collecting and analyzing traffic sensor data, monitoring and controlling Closed Circuit Television (CCTV), or distributing surveillance information to other entities. This section will define high-level functional requirements for select subsystems.

Equipment Packages were used to define functional requirements. The National ITS Architecture defines equipment packages as a group of similar processes that a subsystem performs, the grouping takes into account user services and functionality. For each equipment package, the National ITS Architecture provides a brief description and a set of high-level functional requirements. These were customized to reflect local requirements of the Regional ITS Architecture.

An analysis was conducted to identify equipment packages that support priority ITS user services or market packages. The list of equipment packages was further refined by eliminating those associated with subsystems on the fringe of the architecture, like emergency vehicles or fleet and freight management that are not under direct control of transportation agencies.

Table 3 provides an example of functional requirements for a traffic management system. In the table, priority equipment packages associated with traffic management are listed in the left column, the center column briefly summarizes its purpose, and the right column lists high-level functional requirements for that functional area. Again, these are high-level requirements outlining general functions. The complete package of functional requirements is presented in **Appendix E.**

Table 3: Traffic Management System Functional Requirements

Equipment Package	Purpose	Functional Requirements
Collect Traffic Surveillance	Remotely monitors and controls traffic sensors and surveillance equipment, and collects, processes, and stores the collected traffic data. Current traffic information and other real-time transportation information are also collected from other centers.	■ TMC shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field equipment under remote control at the center ■ TMC shall monitor, analyze, and distribute traffic images from CCTV systems under remote control at the center ■ TMC shall distribute road network conditions data based on collected and analyzed traffic sensor and surveillance data to other centers
TMC Freeway Management	Provides for TMC monitoring and control of freeway traffic control systems, including ramp control, interchange control, and mainline lane control systems.	■ TMC shall remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls ■ TMC shall collect operational status from ramp meters, mainline metering, and lane contro,l and compare against the control information sent by the center ■ TMC shall implement control strategies on some or all of the freeway network devices, based on data from sensors monitoring traffic conditions upstream and downstream, and queue data on the ramps themselves
TMC Signal Control	Provides the capability to monitor and manage signalized intersections.	■ TMC shall remotely control traffic signal controllers ■ TMC shall collect traffic signal controller operational status and compare against the control information sent by the center ■ TMC shall implement control plans to coordinate signalized intersections, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, transit vehicle priority, and equipment faults
TMC Traffic Information Dissemination	Disseminates traffic and road conditions, closures and detours, incident information, driver advisories, and other traffic-related data to other centers, the media, and motorists.	■ TMC shall remotely control Variable Message Signs (VMS) for dissemination of traffic and other information to drivers ■ TMC shall retrieve locally stored traffic information, including current traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions ■ TMC shall distribute traffic data to maintenance and construction, transit operation centers, emergency management centers, and ISPs

Table 3: Traffic Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
TMC Regional Traffic Management	Supports coordination between TMCs, including sharing traffic information and control of field equipment.	■ TMC shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information ■ TMC shall exchange traffic control information with other TMCs to support remote monitoring and control of traffic management devices
TMC Incident Detection	Enables TMC to identify and verify incidents using remote surveillance devices, and receive notifications from external sources.	■ TMC shall collect and store traffic flow and image data from the field equipment to detect and verify incidents ■ TMC shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents ■ TMC shall receive information concerning upcoming events that would affect the traffic network from event promoters and other entities
TMC Incident Dispatch Coordination/Communication	Formulates, manages, and monitors an incident response. Supports dispatch of emergency response and service vehicles, as well as coordination with other cooperating agencies.	■ TMC shall support requests from emergency management centers to remotely control sensor and surveillance equipment, provide special routing for emergency vehicles, and provide responding emergency vehicles with signal preemption ■ TMC shall exchange incident information with emergency management centers, maintenance and construction, transit centers, and ISPs ■ TMC shall share resources with allied agency centers to implement special traffic control measures, assist in clean up, verify an incident

Source: DVRPC, 2012

Operational Concept

According to the National ITS Architecture, an operational concept defines the roles and responsibilities of participating key stakeholder agencies in the implementation and operation of the region's transportation systems. It is a high-level description of the ITS system and provides a big-picture view of how the services will be performed in the region, and of the stakeholders' general responsibilities in providing the service.

Instead of developing operational concepts for each market package or service area, which would produce a fragmented perspective of how operations actually work, a different approach was taken. Using DVRPC's *Transportation Operations Master Plan's* goals and objectives, the six major operational service areas that the region intends to implement were used to illustrate their interactions. Given the number of market packages and stakeholders involved with each service area, this macro approach is more effective. These service areas are:

- Incident Management
- Traffic Management
- Integrated Corridor Management
- Construction and Maintenance Activity
- Traveler Information
- Transit Operations

Table 4 provides an example of the operational concept for incident management. The table identifies the stakeholders involved in incident management and their general roles and responsibilities with respect to incident detection, emergency response, on-scene management, traffic management, and debris removal. It should be noted that not all stakeholders listed in the table currently exist, and each stakeholder may not perform each responsibility identified. The complete package of operational concepts for all service areas is presented in **Appendix F**.

Table 4: Example Roles and Responsibilities – Incident Management

Area	Stakeholders	Roles and Responsibilities
Traffic Management Centers	NJDOT STMC/ TOC South PennDOT District 6-0 - RTMC BCBC TOC DRPA TOC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Conduct traffic surveillance, identify incidents ■ Notify 9-1-1 center that an incident has occurred ■ Dispatch ESP vehicles for traffic control ■ Post information on VMS signs ■ Enter incident information into 511 ■ Notify other entities via RIMIS ■ Modify traffic signal timings on detour routes ■ Request maintenance crews for clean up ■ Provide information to ISPs and media ■ Develop/implement traffic control plan for special events
9-1-1 Call Centers	NJ County 9-1-1s PA County 9-1-1s	■ Receive 9-1-1 call from the public ■ Dispatch first responder ■ Verify incident from traffic management video ■ Dispatch additional police, fire, EMS resources
Emergency Responders	NJSP PSP Municipal Police, Fire, EMS DRPA Police	■ Determine resources needed as a first responder ■ Conduct traffic investigation, traffic control ■ Implement Incident Command System (ICS) procedures ■ Request additional resources as needed

Table 4: Example Roles and Responsibilities – Incident Management (continued)

Area	Stakeholders	Roles and Responsibilities
Information Service Providers	NJ 511/Traveler Info PA 511/Traveler Info NJ and PA TMAs	■ Update ISP/TMAs databases and maps ■ Issue traveler alerts to people signed up for them
Maintenance Management	NJDOT Maintenance PennDOT District 6-0 - County Maintenance Philadelphia Streets Department	■ Receives request for assistance from 9-1-1, police, or traffic management ■ Dispatch maintenance crew

Source: DVRPC, 2012

CHAPTER 5

Implementation

Previous sections of the architecture, through tables and graphics, described ITS stakeholders, the components or systems they operate, and how these elements interconnect with each other to share information. While this information is very useful in terms of fostering institutional relationships and designing ITS projects, it does not help advance critical ITS initiatives toward implementation. This chapter bridges the gap between the formal architecture and project implementation. It accomplishes this in three ways. First, project sequencing underscores is described, underscoring the interdependency among ITS projects by identifying enabling projects that lay the foundation for future ITS implementations. Next, interagency ITS agreements are described, which are needed to share information or ITS devices. Lastly, this chapter addresses national ITS standards that USDOT is promulgating to ensure interoperability among agencies.

Project Sequencing

This architecture presents a framework for the types of ITS services envisioned for the region, specifying the entities and information flows that constitute these services. However, in the real world, ITS is implemented on a project-by-project basis, whether as a stand-alone project, or as part of a larger transportation improvement. Project sequencing begins bridging the gap between the services identified in the architecture and actual projects programmed on the region's Transportation Improvement Program (TIP).

FHWA's Regional ITS Architecture Guidance suggests methodology to package the architecture into implemental projects. For DVRPC, this process was short-circuited by the need to develop a *Transportation Operations Master Plan*, which is one component of DVRPC's 2035 long-range plan *Connections: The Regional Plan for a Sustainable Future*. As part of the regional architecture outreach, DVRPC's TOTF was asked to prioritize ITS services and begin identifying ITS projects to implement them. TOTF ideas fed into the master plan processes where they helped to define operations objectives, which in turn defined projects and programs.

Tables 5 to 10 link the projects and programs listed in the *Transportation Operations Master Plan* to the Regional ITS Architecture. It accomplishes this by describing the ITS services that it supports and the project's dependency, if any, on having enabling technology in place. Project priority and lead agencies come directly out of the Master Plan. Projects in the tables are categorized by:

- ITS Infrastructure Programs
- Traffic Management Centers
- Incident Management

- Traffic Management Programs
- Traveler Information
- Transit Management

Table 5: Project Sequencing – ITS Infrastructure Programs

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
ITS Infrastructure Programs				
ITS Infrastructure on Expressways	■ Install basic ITS on expressways as per *2035 ITS Infrastructure Vision* ■ Install CCTV, VMS signs, RTMS, probe detectors, and fiber ■ Support network surveillance, freeway control, and incident management	High	None (TMCs already in place)	■ NJDOT ■ PennDOT
ITS Infrastructure at Select Expressway Crossroads	■ Deploy ITS on expressway crossroads ■ Install VMS, CCTV, and fiber ■ Support network surveillance, freeway control, and incident management	Medium	ITS infrastructure on expressway	■ NJDOT ■ PennDOT
Philadelphia ITS Infrastructure	■ Deploy ITS on Philadelphia's major arterials ■ Install CCTV, VMS, and Remote Traffic Microwave Sensor (RTMS) ■ Support network surveillance, surface street control, and incident management	Medium	Signal system with fiber network	■ Philadelphia Streets Department ■ PennDOT
DRPA ITS Infrastructure	■ Complete ITS installation on DRPA bridges ■ Install VMS, CCTV, RTMS, probe detectors, and infrastructure sensors ■ Support network surveillance, freeway control, and incident management	Medium	Concurrent to constructing TMC	■ DRPA
Road Weather Information System (RWIS)	■ Monitor regional road conditions ■ Install weather and road sensors and CCTV ■ Support winter maintenance	Low	None	■ NJDOT ■ PennDOT
Roadway Treatment Systems	■ Spray anti-icing chemicals ■ Support winter maintenance	Low	None	■ NJDOT ■ PennDOT

Source: DVRPC, 2012

Table 6: Project Sequencing – Traffic Management Centers

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Traffic Management Centers				
DOT Traffic Management Center Support	■ Install TMC equipment and software upgrades and enhancements ■ Support network surveillance, freeway control, and incident management	High	None (TMCs already in place)	■ NJDOT ■ PennDOT
DRPA Traffic Operations Center	■ Construct DRPA TOC ■ Control and supervision of CCTV, VMS, and traffic sensors ■ Support network surveillance, freeway control, and incident management	High	Concurrent to completing DRPA ITS infrastructure	■ DRPA
City of Philadelphia Traffic Operations Center	■ Construct Philadelphia TOC ■ Manage traffic signals, CCTV, and VMS ■ Support network surveillance, surface street control, and incident management	High	None (partial signal system in place)	■ Philadelphia Streets Department
New Jersey County TOCs	■ Install TOC equipment and software upgrades and enhancements ■ Construct county traffic operations centers ■ Support surface street control	Low	None (TOC already in place) Construction of county signal systems	■ Burlington County ■ Camden County ■ Gloucester County ■ Mercer County

Source: DVRPC, 2012

Table 7: Project Sequencing – Incident Management

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Incident Management				
Emergency Service Patrols	■ Deploy ESP vehicles at levels specified in *2035 Emergency Service Patrol Vision* ■ Support incident management	High	None	■ NJDOT ■ PennDOT
RIMIS	■ Deploy regional exchange information network for incidents, special events, and construction activity ■ Support incident management, traveler information, and construction and maintenance coordination	High	None	■ DVRPC
Arterial Management	■ Deploy CCTV, VMS signs, traffic surveillance, and traveler information capabilities on arterials ■ Support surface street control, integrated corridor management, incident management, and evacuation management	High	Communications network must be in place, usually constructed as part of signal systems	■ NJDOT ■ PennDOT
PennDOT Manages Traffic Signals in Emergencies	■ Take operational control of municipal traffic signal systems during expressway road closures, and emergency evacuations	High	Traffic signal system already in place	■ PennDOT
Emergency Communications Network	■ Construct fiber communications network linking DOTs, 9-1-1s, and state police ■ Support regional traffic management, incident management, and evacuation management	Medium	Dependent upon existing and future fiber networks built as part of expressway and arterial systems	■ NJDOT ■ PennDOT
Crash Investigation Equipment	■ Purchase additional crash investigation equipment to reduce incident duration ■ Train additional police officers to use equipment ■ Support incident management	Low	None	■ NJ State Police ■ PA State Police
On-Ramp Gates	■ Construct on-ramp gates to prevent vehicles entering a closed highway ■ Support roadway closure management, incident management, and evacuation management	Low	ITS infrastructure on the expressway	■ NJDOT ■ PennDOT
Share Computer-Aided Dispatch (CAD) Information	■ Share 9-1-1 and state police CAD information with TMCs ■ Support incident management	Low	Secure fiber communications network between CAD system and TMC	■ TBD

Source: DVRPC, 2012

Table 8: Project Sequencing – Traffic Management Programs

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Traffic Management Programs				
Traffic Signal Retiming Program	■ Retime traffic signal timings periodically to reflect current traffic conditions ■ Support surface street control	High	None	■ NJDOT ■ NJ Counties ■ PennDOT ■ Philadelphia Streets Dept
Traffic Signal Modernization and Interconnect Program	■ Install traffic signal systems and upgrade traffic controllers ■ Support surface street control	High	None	■ NJDOT ■ NJ Counties ■ PennDOT ■ Philadelphia Streets Dept
PennDOT Operates Traffic Signals	■ Assume responsibility for traffic signal operations on key interregional arterials identified in *2035 ITS Infrastructure Vision* during incidents ■ Support surface street control, and regional traffic management	High	Signal system and fiber connection to PennDOT TMC already in place	■ PennDOT
Construction Coordination	■ Establish a regional database of construction and maintenance activity ■ Support maintenance and construction activity coordination, and incident management	High	RIMIS in place	■ DVRPC
Archive Traffic Data	■ Archive traffic data from ITS devices, and construction and incident information ■ Support achieve data management, regional traffic management, and incident management	Medium	ITS infrastructure in place, construction and incident management logs in electronic format	■ NJDOT ■ NJ Counties ■ PennDOT ■ DVRPC
PennDOT Traffic Signal Monitoring Program	■ Monitor municipal operation of traffic signal systems ■ Provide communications and software for program ■ Support regional traffic control, and surface street control	Medium	Deployment of traffic signal systems	■ PennDOT

Table 8: Project Sequencing – Traffic Management Programs (continued)

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Integrated Corridor Management (ICM) Initiatives	■ Develop and implement ICM initiatives ■ Improve highway-transit coordination ■ Install transit vehicle priority treatments, and smart bus stops ■ Enhance traveler information programs ■ Support transit signal priority, transit traveler information, incident management, and regional traffic control coordination	Medium	Freeway and signal systems in place	■ NJDOT ■ PennDOT ■ SEPTA ■ NJ TRANSIT ■ DVRPC
Work Zone Traffic Management Initiatives	■ Apply technology and improved planning to minimize work zone traffic disruptions ■ Install CCTV, and speed detectors ■ Implement traveler information systems ■ Install warning and intrusion devices ■ Support work zone management, and work zone safety monitoring	Medium	None	■ NJDOT ■ PennDOT
Ramp Metering	■ Deploy ramp metering to maintain mainline traffic flow ■ Identify ramps with adequate geometrics ■ Install CCTV, barrier controls ■ Support freeway control	Medium	Fiber communications network	■ NJDOT ■ PennDOT
Variable Speed Limits	■ Deploy Dynamic Message Signs (DMS) to modify speed limits based on traffic conditions, incidents, maintenance, construction activity, and weather conditions ■ Support speed monitoring	Medium	TMC, CCTV, RTMS, vehicle probes, fiber	■ NJDOT ■ PennDOT

Source: DVRPC, 2012

Table 9: Project Sequencing – Traveler Information

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Traveler Information				
511 and Traveler Information Websites	■ Expand 511 to include real-time transit information, all bridge and toll authorities, Philadelphia Streets Department, and NJ counties ■ Support interactive traveler information	High	511 systems already in place	■ NJDOT ■ PennDOT
Continue Public-Private Partnerships	■ Improve information sharing with ISPs ■ Install CCTV, incidents, construction, and maintenance activity ■ Obtain vehicle probe information from ISPs ■ Support network and traffic probe surveillance	High	CCTV, RTMS devices, vehicle probe detection	■ NJDOT ■ PennDOT ■ toll authorities ■ bridge authorities
Centralize Construction, Maintenance, and Special Events Information	■ Establish a regional database of construction and maintenance activity ■ Provide information to 511s, ISPs, and media ■ Support broadcast and interactive traveler information	Medium	RIMIS is a potential central repository	■ TBD
Travel Information at Service Plazas and Visitor Centers	■ Construct travel information kiosks ■ Provide highway and transit information ■ Support broadcast and interactive traveler information	Low	ITS infrastructure on expressways, 511 systems	■ NJTA ■ PTC ■ PennDOT

Source: DVRPC, 2012

Table 10: Project Sequencing – Transit Management

Project and Program Title	Project Description	Priority	Project Dependencies	Lead Agencies
Transit Management				
PATCO Operations Center	■ Construct PATCO operations center ■ Manage power and signal systems, train control, fare collection, and traveler information ■ Support transit fixed-route operates, transit fare collection management, and transit traveler information	High	Power, signal, fare collection, and traveler information systems	■ PATCO
New Jersey Transit Bus Operations South Operations Center	■ Construct dispatch center for NJ TRANSIT Bus Operations South ■ Install AVL and CAD systems ■ Support transit fixed-route operations	High	None	■ NJ TRANSIT
Smart Bus Stops and Stations	■ Install DMS signs at bus stops to display real-time arrival information ■ Install DMS, AVL, and communications ■ Support transit traveler information	High	AVL on buses, communications network	■ NJ TRANSIT ■ SEPTA
Bus Priority Treatment	■ Install equipment to extend green signal time ■ Support transit signal priority	High	Dependent upon technology used	■ NJ TRANSIT ■ SEPTA
Fare Collection System/Smart Card Technology	■ Employ Smartcard technology ■ Install fare collection equipment, and backroom hardware software ■ Support transit fare collection management	High	None	■ NJ TRANSIT ■ SEPTA
Passenger Surveillance and Safety Systems	■ Monitor and protect passenger environments ■ Install CCTV and passenger alarm devices ■ Deploy two-way communications ■ Support transit security	High	Communications network	■ NJ TRANSIT ■ SEPTA
Security Systems	■ Install systems to monitor and protect transit infrastructure and equipment ■ Install CCTV, intrusion detectors, fire/smoke detectors, and radiological/biological detectors ■ Support transit security	High	Communications network	■ NJ TRANSIT ■ PATCO ■ SEPTA

Source: DVRPC, 2012

ITS Agreements

This architecture establishes a framework for a common regional vision. Agency agreements further enhance the vision by detailing how agencies will work together to foster interoperability and advance projects identified in the architecture. The objective of this section is not to replicate actual agreements, but rather to take a broader perspective and identify where agreements are needed to support interagency initiatives. This might entail sharing information, mutually controlling field devices, purchasing common technology, or co-managing a project.

Table 11 lists existing and planned agency technology agreements in the region. Due to the informal nature of many of the agreements, and the large number of stakeholders in the region, it is not feasible to document every single agreement. Therefore, the list tends to focus on the more significant technology agreements.

Agency agreements were identified from the following sources:

- Existing agency agreements.
- Current projects and proposals in preliminary discussion.
- A review of projects listed in the *Transportation Operations Master Plan*.

Agencies currently employ a wide range of types of agreements. Some are very informal, typically oral agreements with no paper trail; others are formal legal documents requiring extensive negotiations and legal review. USDOT's Regional ITS Architecture Guidance identifies several types of potential agency agreements. The following types are applicable to the DVRPC region:

- **Handshake Agreement –** An informal agreement, usually an oral agreement, with minimal or no documentation.
- **Memorandum of Understanding (MOU) –** A written agreement with minimal detail. Generally outlines areas of agreement. ITS engineers and TMC managers usually use MOUs due to the difficulty of obtaining general counsel approval of more formal contracts.
- **Master Agreement –** A standard contract or verbiage used by an agency for specific purposes.
- **Interagency Agreement –** Individual agencies sign a formal legal agreement

Agreement status can be categorized as existing, planned, or ongoing. Since many of the agreements in the region are planned and/or contain a large number of stakeholders, it is difficult to identify specific stakeholders to the agreement. In these instances, generic stakeholders, such as county 9-1-1s are identified in lieu of a particular county. Ongoing agreement status is used to depict a situation, such as municipal traffic signal coordination, where developing agreements among different entities is an ongoing process.

Table 11: Existing and Planned Agency Agreements

Agreement	Stakeholders	Agreement Type	Agreement Status	Agreement Objectives
ISP Video Sharing	■ NJDOT ■ PennDOT ■ ISPs	Master Agreement	Existing	ISPs receive live CCTV video feeds from TMCs.
9-1-1/PennDOT District 6-0 Information Sharing	■ PennDOT District 6-0 ■ County 9-1-1s ■ PSP Consolidated Dispatch Center (CDC) ■ Municipal police	Handshake	Existing Planned Planned	County 9-1-1s to receive PennDOT District 6-0 video feeds via fiber. 9-1-1's have ability to Pan-Tilt-Zoom (PTZ) Video conferencing capability, and share RIMIS and Knowledge Center information. Add select municipalities to the network.
Regional Emergency Communications Network	■ DelDOT ■ NJDOT ■ PennDOT District 6-0 ■ DRBA ■ DRPA ■ NJTA ■ NJSP ■ PSP	MOU	Planned	Regional agencies to formally establish a fiber communications link, and share video, RIMIS, and Knowledge Center information; and the ability for video conferencing.
RIMIS	■ DVRPC ■ DRPA ■ NJDOT ■ PennDOT ■ Philadelphia ■ PTC ■ SEPTA	MOU	Planned	Joint management of RIMIS information exchange network.
Incident Management Protocols	■ NJDOT ■ PennDOT ■ NJSP ■ PSP ■ County 9-1-1s ■ Municipal police and fire	NJ – MOU PA – Handshake	Ongoing	Policy and procedures for responding, managing, and clearing an incident. May eventually involve technology.
Construction Coordination	■ Departments of transportation ■ Bridge and toll authorities ■ Phila. Streets Department ■ Utilities ■ DVRPC	MOU	Planned	Establish a central database to store maintenance and construction activity, work with each other to avoid conflict.
NJ STMC	■ NJDOT ■ NJTA ■ NJSP	MOU	Existing	Design, construction, and operation of the NJ STMC.

Table 11: Existing and Planned Agency Agreements (continued)

Agreement	Stakeholders	Agreement Type	Agreement Status	Agreement Objectives
I-95/PA Turnpike Operations Agreement	■ PTC ■ PennDOT District 6-0 ■ NJTA ■ NJDOT	MOU	Planned	Joint operation of ITS devices deployed as part of this project.
Inter Municipal Traffic Signal Coordination	■ PA Municipalities	MOU	Ongoing	Operation of arterial traffic signal systems across municipal boundaries.
Emergency Traffic Signal Operation	■ PennDOT District 6-0 ■ PA Municipalities	MOU	Planned	PennDOT to operate municipal traffic signals during emergency expressway road closures and detours.
Philadelphia TOC-PennDOT RTMC Coordination Agreement	■ PennDOT District 6-0 ■ Streets Dept.	MOU	Planned	PennDOT after-hour operation of Philadelphia traffic signal system. PennDOT and Philadelphia TOC to jointly operate CCTV and VMS devices.
Fiber Sharing	■ PennDOT District 6-0 ■ SEPTA ■ Philadelphia ■ DRPA	MOU	Planned	Each agency will allot strands of their fiber network for use by others.
Regional Fare Collection	■ NJ TRANSIT ■ PATCO ■ SEPTA	Interagency Agreement	Planned	Permit passengers to use fare media across transit properties.
E-ZPass	■ Members of the E-ZPass Consortium	Interagency Agreement	Existing	Establish E-ZPass technical and accounting protocols.

Source: DVRPC, 2012

ITS Standards

ITS standards are industry-consensus standards that define how system components operate within a consistent framework. By specifying how systems and components interconnect, ITS standards promote interoperability. A seamless transportation system relies on clear communication among agencies, systems, and individuals. To ensure that different entities can communicate with each other, their systems must be designed according to standards.

An interoperable and seamless transportation system provides several benefits. For example, many transportation agencies are now increasingly communicating with law enforcement, as police are usually the first to learn of incidents. Consequently, transportation agencies are increasingly linking their TMCs with police dispatch CAD systems. When these systems are interoperable, police and emergency units can respond faster to crashes and TMCs can more rapidly post traffic alerts. This

will result in reduced congestion and improved safety. To achieve these types of benefits, systems and the underlying equipment must be designed according to standards that enable interoperability. Future systems, and enhancements to existing equipment, should be designed to meet ITS standards.

The USDOT's ITS Standards Program is working with existing Standards Development Organizations (SDOs) to establish a collection of national ITS standards. SDOs are composed of professional and engineering societies, industry associations, and standards-specific organizations. Each organization is typically responsible for a set of standards targeted at a specific ITS area. The following organizations are responsible for the development of ITS standards used in the Regional ITS Architecture

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Public Transportation Association (APTA)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- National Electrical Manufacturers Association (NEMA)
- Society of Automotive Engineers (SAE)

FHWA has an extensive website describing the various standards, their status in the development process, and where the latest information about the standards can be obtained. For more information on ITS standards, visit www.standards.its.dot.gov

CHAPTER 6

Regional ITS Architecture Conformity

Maintaining the Regional Architecture

The Regional ITS Architecture was created to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in the *Transportation Operations Master Plan*. The intent for the Regional ITS Architecture is to be a living document. As ITS projects are planned and implemented, and the ITS needs and services evolve in the region, the Regional ITS Architecture will need to be updated to reflect the new ITS priorities.

Why Update the Regional ITS Architecture?

There are many actions that may cause a need to update the architecture, including:

- **Changes in regional needs.** Regional ITS architectures are created to support transportation planning in addressing regional needs. Over time, these needs can change and the corresponding aspects of the Architecture that address these needs may have to be updated. These changes in needs will typically be expressed in updates to planning documents, such as regional transportation plans.
- **New stakeholders.** As new stakeholders become active in ITS, the Regional ITS Architecture should be updated to reflect their place in the regional view of ITS elements, interfaces, and information flows. Why might new stakeholders emerge? The stakeholders might represent new organizations that were not in place during the original Architecture development.
- **Changes in scope of services considered.** The range of services considered by the ITS Regional Architecture expands. This might happen because the National ITS Architecture has been expanded and updated to include new user services. Alternatively, regional stakeholders may want to better define how existing elements satisfy the user services. Changes in the National ITS Architecture are not of themselves a reason to update a regional ITS architecture, but the region may want to consider any new services in the context of regional needs.
- **Changes in stakeholder or element names.** An agency's name, or the name used to describe its element(s), undergoes change. Transportation agencies occasionally merge, split, or just rename themselves. In addition, element names may evolve as projects are defined. The Regional ITS Architecture should be updated to use the current names for both stakeholders and elements.

- **Changes in other architectures.** A regional ITS architecture covers not only elements and interfaces within the region, but also interfaces to elements in adjoining regions. Changes in one region may necessitate changes in the architecture in an adjoining region to maintain consistency between the two.

There are also changes relating to project definition that will cause the need for updates.

- **Change due to project definition or implementation**. When actually defined or implemented, a project may add, subtract, or modify elements, interfaces, or information flows in the architecture. Because the Regional ITS Architecture is meant to describe the current (as well as future) regional implementation of ITS, it must be updated to accurately reflect how the developed projects integrate into the region.
- **Change due to project addition/deletion**. Occasionally, a project will be added or deleted through the planning process, or even during project delivery. Some aspects of the Regional ITS Architecture that are associated with the project may be expanded, changed, or removed.
- **Change in project priority.** Due to funding constraints or other considerations, the planned project sequencing may change. Delaying a project may have a ripple effect on other projects that depend on it; or conversely, raising the priority of other projects.

Who Is Responsible for Architecture Maintenance?

The TOTF has been designated as the appropriate entity to oversee updates to the architecture. DVPRC's Office of Transportation Operations Management staff will maintain the architecture, making changes and updating the document as part of their staff support to the TOTF. Although DVRPC will lead in this effort, the maintenance of the architecture is a recurring, long-term effort that requires input from all stakeholders in the region.

One of the significant aspects of this current update is that all the data and information was entered into Turbo Architecture, allowing for a simpler maintenance process and future updates. At a minimum, the architecture should be maintained through updates in the database using Turbo Architecture. The Regional ITS Architecture database is held by the DVRPC and is available for general distribution upon request.

When will the Architecture be Updated?

Since updating the Regional ITS Architecture is a long, arduous process, two levels of update are envisioned:

- Minor updates, only affecting a finite number of architectural elements, encompasses project definition changes, project additions/deletions, changes in project priority, changes in stakeholder/element names, and project sequencing. This category of updates will occur on a yearly basis, or as specifically requested by a stakeholder.
- A major rewrite of the Architecture could be triggered either by changes to DVRPC's long-range plan and/or the National ITS Architecture. Federal planning regulations require MPO long-range plans be updated on a four to five year basis. Plan updates tend to address

project identification, the financial plan, or specific regional issues. However, periodically, there is a major rewrite of the plan, necessitating updates of all plan elements. An update of this magnitude will require updating the operations plan, and, consequently, the Regional ITS Architecture. Similarly, a major update to the National ITS Architecture could prompt an update of the Regional ITS Architecture.

Conformity Checklist

This architecture provides all the components required by the USDOT ITS Architecture and Standards Conformity regulations (23 C.F.R. 940). **Table 12** lists the FHWA and Federal Transit Administration (FTA) requirements for a regional ITS architecture and the compliance details of the Delaware Valley ITS Regional Architecture.

Table 12: Regional Architecture Conformity Checklist

Architecture Requirement	Regional Architecture Location
1. Is there a description of the Region?	Chapter 2
2. Are the stakeholders identified?	Chapter 2
3. Are interface requirements demonstrated?	Chapter 3
4. Are functional requirements shown?	Chapter 4
5. Is an operational concept provided?	Chapter 4
6. Is there a list of agreements relative to ITS?	Chapter 5
7. Are ITS standards provided?	Chapter 5
8. Are ITS projects shown?	Chapter 5
9. Is there a plan for maintenance of the Architecture?	Chapter 6

Source: DVRPC, 2012

APPENDIX A

Acronyms

Table A-1: Acronyms

Acronym	Description
AASHTO	American Association of State Highway and Transportation Officials
AD	Archived Data
ADMS	Archived Data Management Subsystem
ANSI	American National Standards Institute
APTA	American Public Transportation Association
APTS	Advanced Public Transportation System
ASTM	American Society of Testing and Materials
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
BCBC	Burlington County Bridge Commission
BRT	Bus Rapid Transit
CAD	Computer-Aided Dispatch
CCT	Customized Community Transportation
CCTV	Closed Circuit Television
CDC	Consolidated Dispatch Center
CTEC	Central Traffic Electrical Control
CV	Commercial Vehicle
CVAS	Commercial Vehicle Administration Subsystem
CVC	Commercial Vehicle Check
CVCS	Commercial Vehicle Check Subsystem
CVISN	Commercial Vehicle Information Systems and Network
CVO	Commercial Vehicle Operations
CVS	Commercial Vehicle Subsystem
DelDOT	Delaware Department of Transportation
DMS	Dynamic Message Sign
DRBA	Delaware River and Bay Authority
DRJTBC	Delaware River Joint Toll Bridge Commission
DRPA	Delaware River Port Authority

Table A-1: Acronyms (continued)

Acronym	Description
DVRPC	Delaware Valley Regional Planning Commission
EM	Emergency Management
EMMS	Emissions Management Subsystem
EMS	Emergency Medical Services
ESP	Emergency Service Patrol
ETC	Electronic Toll Collection
EVS	Emergency Vehicle Subsystem
FCC	Fire Communications Center
FHWA	Federal Highway Administration
FMS	Fleet and Freight Management Subsystem
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
IAG	Inter-Agency Group
ICM	Integrated Corridor Management
ICS	Incident Command System
IEEE	Institute of Electrical and Electronics Engineers
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IVR	Interactive Voice Response
LRT	Light Rail Transit
MC	Maintenance Construction
MCM	Maintenance and Construction Management
MCMS	Maintenance and Construction Management Subsystem
MCVS	Maintenance and Construction Vehicle Subsystem
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
NJ	New Jersey
NJDOT	New Jersey Department of Transportation
NJSP	New Jersey State Police

Table A-1: Acronyms (continued)

Acronym	Description
NJTA	New Jersey Turnpike Authority
NJTPA	North Jersey Transportation Planning Authority
OCC	Operations Control Center
OEM	Office of Emergency Management
PA	Pennsylvania
PATCO	Port Authority Transit Corporation
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PHL	Philadelphia International Airport
PIAS	Personal Information Access Subsystem
PMS	Parking Management Subsystem
PPA	Philadelphia Parking Authority
PPD	Philadelphia Police Department
PSP	Pennsylvania State Police
PTC	Pennsylvania Turnpike Commission
PTZ	Pan-Tilt-Zoom
RA	Regional Architecture
RCRS	Road Condition Reporting System
REOC	Regional Emergency Operations Centers
RIMIS	Regional Integrated Multimodal Information Sharing
ROIC	Regional Operations Intelligence Center
ROW	Right-of-Way
RS	Roadway Subsystem
RTMC	Regional Traffic Management Center
RTMS	Remote Traffic Microwave Sensor
RTS	Remote Traveler Support
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SCSSD	Sports Complex Special Services District
SDO	Standards Development Organization
SEPTA	Southeastern Pennsylvania Transportation Authority
SJTA	South Jersey Transportation Authority

Table A-1: Acronyms (continued)

Acronym	Description
SJTPO	South Jersey Transportation Planning Organization
SMS	Security Monitoring Subsystem
STMC	Statewide Traffic Management Center
TAS	Toll Administration Subsystem
TCC	Traffic Control Center
TCS	Toll Collection Subsystem
TEOC	Trenton Emergency Operations Center
TIP	Transportation Improvement Plan
TMA	Transportation Management Association
TMC	Traffic Management Center
TMS	Traffic Management Subsystem
TOC	Traffic Operations Center
TOTF	Transportation Operations Task Force
TRANSCOM	Transportation Operations Coordinating Committee
TRMS	Transit Management Subsystem
TRVS	Transit Vehicle Subsystem
USDOT	United States Department of Transportation
VII	Vehicle Infrastructure Integration
VMS	Variable Message Signs
VS	Vehicle Subsystem

Source: DVRPC, 2012

APPENDIX B

Regional Market Packages

The following table lists all of the market packages within the National ITS Architecture and specifically identifies those that that have been deemed relevant to this region. It also identifies those market packages considered a regional priority by TOTF stakeholders.

Table B-1: Market Packages

Market Package Name		Relevant Market Packages	Regional Priority
Traffic Management			
ATMS01	Network Surveillance	✔	✘
ATMS02	Traffic Probe Surveillance	✔	✘
ATMS03	Surface Street Control	✔	✘
ATMS04	Freeway Control	✔	✘
ATMS05	High-Occupancy Vehicle Lane Management		
ATMS06	Traffic Information Dissemination	✔	✘
ATMS07	Regional Traffic Management	✔	✘
ATMS08	Traffic Incident Management System	✔	✘
ATMS09	Traffic Forecast and Demand Management		
ATMS10	Electronic Toll Collection	✔	✘
ATMS11	Emissions Monitoring and Management		
ATMS12	Roadside Lighting System Control		
ATMS13	Standard Railroad Grade Crossing	✔	
ATMS14	Advanced Railroad Grade Crossing		
ATMS15	Railroad Operations Coordination	✔	
ATMS16	Parking Facility Management	✔	✘
ATMS17	Regional Parking Management	✔	
ATMS18	Reversible Lane Management	✔	
ATMS19	Speed Monitoring	✔	
ATMS20	Drawbridge Management	✔	
ATMS21	Roadway Closure Management	✔	✘

Table B-1: Market Packages (continued)

Market Package Name		Relevant Market Packages	Regional Priority
Traveler Information			
ATIS01	Broadcast Traveler Information	✔	✘
ATIS02	Interactive Traveler Information	✔	✘
ATIS03	Autonomous Route Guidance	✔	
ATIS04	Dynamic Route Guidance	✔	
ATIS05	ISP-Based Trip Planning and Route Guidance	✔	
ATIS06	Transportation Operations Data Sharing	✔	✘
ATIS07	Yellow Pages and Reservation	✔	
ATIS08	Dynamic Ridesharing	✔	
ATIS09	In Vehicle Signing	✔	
ATIS10	VII Traveler Information	✔	
Emergency Management			
EM01	Emergency Call-Taking and Dispatch	✔	✘
EM02	Emergency Routing	✔	✘
EM03	Mayday and Alarms Support	✔	✘
EM04	Roadway Service Patrols	✔	✘
EM05	Transportation Infrastructure Protection	✔	✘
EM06	Wide-Area Alert	✔	✘
EM07	Early Warning System	✔	✘
EM08	Disaster Response and Recovery	✔	✘
EM09	Evacuation and Reentry Management	✔	✘
EM10	Disaster Traveler Information	✔	✘
Public Transportation			
APTS01	Transit Vehicle Tracking	✔	✘
APTS02	Transit Fixed-Route Operations	✔	
APTS03	Demand Response Transit Operations	✔	
APTS04	Transit Passenger and Fare Management	✔	✘
APTS05	Transit Security	✔	✘
APTS06	Transit Fleet Management	✔	

Table B-1: Market Packages (continued)

Market Package Name		Relevant Market Packages	Regional Priority
APTS07	Multimodal Coordination	✔	✘
APTS08	Transit Traveler Information	✔	✘
APTS09	Transit Signal Priority	✔	
Maintenance and Construction			
MC01	Maintenance and Construction Vehicle and Equipment Tracking	✔	✘
MC02	Maintenance and Construction Vehicle Maintenance	✔	
MC03	Road Weather Data Collection	✔	✘
MC04	Weather Information Processing and Distribution	✔	✘
MC05	Roadway Automated Treatment	✔	
MC06	Winter Maintenance	✔	
MC07	Roadway Maintenance and Construction	✔	
MC08	Work Zone Management	✔	✘
MC09	Work Zone Safety Monitoring	✔	✘
MC10	Maintenance and Construction Activity Coordination	✔	✘
MC11	Environmental Probe Surveillance	✔	
MC12	Infrastructure Monitoring	✔	
Archived Data Management			
AD1	ITS Data Mart	✔	✘
AD2	ITS Data Warehouse	✔	
AD3	ITS Virtual Data Warehouse	✔	✘
Commercial Vehicle Operations			
CVO01	Fleet Administration	✔	
CVO02	Freight Administration	✔	
CVO03	Electronic Clearance	✔	
CVO04	CV Administrative Processes	✔	
CVO05	International Border Electronic Clearance	✔	
CVO06	Weigh-In-Motion	✔	

Table B-1: Market Packages (continued)

Market Package Name		Relevant Market Packages	Regional Priority
CVO07	Roadside CVO Safety	✔	
CVO08	On-board CVO and Freight Safety & Security	✔	
CVO09	CVO Fleet Maintenance	✔	
CVO10	HAZMAT Management	✔	
CVO11	Roadside HAZMAT Security Detection and Mitigation	✔	
CVO12	CV Driver Security Authentication	✔	
CVO13	Freight Assignment Tracking	✔	
Vehicle Safety Systems			
AVSS01	Vehicle Safety Monitoring		
AVSS02	Driver Safety Monitoring		
AVSS03	Longitudinal Safety Warning		
AVSS04	Lateral Safety Warning		
AVSS05	Intersection Safety Warning		
AVSS06	Pre crash Restraint Deployment		
AVSS07	Driver Visibility Improvement		
AVSS08	Advanced Vehicle Longitudinal Control		
AVSS09	Advanced Vehicle Lateral Control		
AVSS10	Intersection Collision Avoidance		
AVSS11	Automated Highway System		
AVSS12	Cooperative Vehicle Safety Systems		

Source: DVRPC, 2012

APPENDIX C

Subsystem Inventory and Definitions

The following are the official definitions provided by the National ITS Architecture, Version 6.1, for each of the subsystems within the Regional Architecture. After each subsystem definition, a table lists each regional element that falls under that type of subsystem. The tables do not differentiate between existing and proposed elements. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers.

Some elements in the architecture are not included in these subsystems and are categorized as Terminators, which are elements on the boundary of the Regional Architecture.

Centers Subsystems

Archived Data Management Subsystem

The Archived Data Management Subsystem collects, archives, manages, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications. The subsystem prepares data products that can serve as inputs to federal, state, and local data reporting systems.

Table C-1: Archived Data Management Subsystem

Archived Data Management Subsystem (ADMS)	
BCBC Data Archive	NJTPA/SJTPO Data Archive
DRPA Data Archive	PATCO Data Archive
DVRPC Data Archive	PennDOT Central Office - Data Archive
ISP Data Archive	PennDOT District 6-0 - Data Archive
Municipal TOCs	Philadelphia Streets Dept. Data Archive
New Jersey County TOCs	PSP - Norristown CDC
NJ TRANSIT Data Archive	PTC Data Archive
NJDOT Data Archive	SEPTA Data Archive
NJSP Data Archive	SJTA Data Archive
NJTA Data Archive	

Source: DVRPC 2012

Commercial Vehicle Administration Subsystem

The Commercial Vehicle Administration Subsystem performs administrative functions supporting credentials, tax, and safety regulations. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. This subsystem communicates with the Fleet and Freight Management Subsystems associated with the motor carriers to process credential applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. The subsystem also receives applications for, and issues, special oversize/overweight and HAZMAT permits in coordination with other authorities.

Table C-2: Commercial Vehicle Administration Subsystem

Commercial Vehicle Administration Subsystem (CVAS)	
NJ CVISN System	PennDOT Driver and Vehicle Services
NJTA HAZMAT Permit System	

Source: DVRPC 2012

Emissions Subsystem

The Emissions Subsystem provides the capabilities for air quality managers to monitor and manage air quality. These capabilities include collecting emissions data from distributed emissions sensors within the Roadway Subsystem. These sensors monitor general air quality within each sector of the area and also monitor the emissions of individual vehicles on the roadway. The sector emissions measures are collected, processed, and used to identify sectors exceeding safe pollution levels. This information is provided to traffic management to implement strategies intended to reduce emissions in and around the problem areas. Emissions data associated with individual vehicles, supplied by the Roadway Subsystem, is also processed and monitored to identify vehicles that exceed standards. This subsystem provides functions necessary to inform the violators and otherwise ensure timely compliance with emissions standards.

Emissions Subsystem is a function generally conducted at the state level, and therefore, there is no Emission Subsystem applicable to this region.

Emergency Management Subsystem

The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications. The subsystem includes the functions associated with fixed and mobile public safety communications centers, including public safety call taker and dispatch centers operated by

police (including transit police), fire, and emergency medical services. It includes the functions associated with emergency operations centers that are activated at local, regional, state, and federal levels for emergencies, and the portable and transportable systems that support incident command system operations at an incident. This subsystem also represents other similar systems, including centers associated with towing and recovery,emergency service patrols and HAZMAT response teams.

Table C-3: Emergency Management Subsystem

Emergency Management Subsystem (EM)	
Amtrak Emergency Dispatch/Police	NJSP Regional Operations Intelligence Center (ROIC)
BCBC Police	NJSP/NJDOT/NJDEP Statewide Dispatch Center
DRJTBC Offices	PATCO Center Tower - Police Dispatch
DRPA Police - Bridge Unit	PEMA Emergency Operation Center
DRPA Police - Transit Unit	PennDOT District 6-0 - RTMC
DRPA TOC	PennDOT STMC
Municipal Police and Fire Dept. Operations	Pennsylvania County 9-1-1 Communications Centers
National Guard	Pennsylvania County Emergency Management Offices
National Park Service Management Center	Pennsylvania Office of Homeland Security
New Jersey County 9-1-1 Communication Centers	Philadelphia Fire Department FCC
New Jersey County Emergency Management Offices	Philadelphia OEM Operations
New Jersey Incident and Mutual Aid Network	PPD Radio Room Dispatch
New Jersey Office of Homeland Security	PSP - Local Troop Offices
NJ State Office of Emergency Management	PSP - Norristown CDC
NJ TRANSIT Police Dispatch/Command Center	PTC OCC
NJDOT STMC	SEPTA Emergency Dispatch/Police
NJDOT TOC South	SJTA TOC
NJDOT Trenton Emergency Operations Center (TEOC)	Towing Industry Responders
NJSP - Troop Dispatch	

Source: DVRPC 2012

Fleet and Freight Management Subsystem

The Fleet and Freight Management Subsystem provides the capability for commercial drivers and fleet or freight managers to receive real-time routing information and access databases containing vehicle and/or freight equipment locations, as well as carrier, vehicle, freight equipment, and driver information. In addition, the capability to purchase credentials electronically

is also provided, with automated connections to financial institutions and regulatory agencies, along with post-trip automated mileage and fuel usage reporting. The Fleet and Freight Management Subsystem provides the capability for fleet managers to monitor the safety and security of their commercial vehicle drivers and fleet. The subsystem also supports application for HAZMAT credentials and makes information about HAZMAT cargo available to agencies.

Table C-4: Fleet and Freight Management Subsystem

Fleet and Freight Management Subsystem (FMS)	
Commercial Vehicle Dispatchers	Private Terminal Operators Systems

Source: DVRPC 2012

Information Service Provider Subsystem

The ISP Subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The subsystem can play several different roles in an integrated ITS. In one role, the ISP provides a data collection, fusing, and repackaging function, collecting information from transportation system operators and redistributing this information to other system operators in the region. Another role of an ISP is focused on delivery of traveler information to subscribers and the public at large. Information provided includes basic advisories, traffic and road conditions, transit schedule information, yellow pages information, ride-matching information, and parking information. The subsystem provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. The 511 traveler information systems and private sector services, such as those offered by Navteq (Traffic.com) and Garmin, fall under this subsystem.

Table C-5: Information Service Provider Subsystem

Information Service Provider Subsystem (ISP)	
Amtrak Traveler Information Services	PennDOT 511 System/Traveler Information Services
DRPA/PATCO Traveler Information	PennDOT Road Condition Reporting System (RCRS)
ISP Traveler Information Systems	PennDOT Welcome Centers and Rest Areas
National Park Service Management Center	PHL Traveler Information Services
New Jersey County Traveler Information	PTC Traveler Information Services
NJ 2-1-1	SEPTA Traveler Information Services
NJ TRANSIT Corporate Customer Information Center Systems	SJTA 511 System/Traveler Information Services
NJ TRANSIT Web Site	TMAs - New Jersey Traveler Information Services
NJDOT 511 System/Traveler Information Services	TMAs - Pennsylvania Traveler Information Services
NJTA 511 System/Traveler Information Services	

Source: DVRPC 2012

Maintenance and Construction Management Subsystem

The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. Representing both public agencies and private contractors that provide these functions, this subsystem manages fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment). The subsystem receives a wide range of status information from these vehicles and performs vehicle dispatch, routing, and resource management for the vehicle fleets and associated equipment. The subsystem participates in incident response by deploying maintenance and construction resources to an incident scene, in coordination with other center subsystems. The subsystem manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions. The subsystem manages the repair and maintenance of both non-ITS and ITS equipment, including the traffic signal controllers, detectors, VMS, signals, and other equipment associated with the roadway infrastructure.

Table C-6: Maintenance and Construction Management Subsystem

Maintenance and Construction Management Subsystem (MCMS)	
DRJTBC Offices	NJDOT TEOC
DRPA Bridge Maintenance	NJTA Maintenance
DRPA TOC	PennDOT Central Office Organizations
New Jersey County Public Works Depts.	PennDOT District 6-0 - County Maintenance Offices
NJDOT Construction Management System	PennDOT District 6-0 - RTMC
NJDOT Maintenance	Philadelphia Streets Dept. Maintenance and Construction
NJDOT Regional Emergency Operations Centers (REOC)	PTC Maintenance Offices
NJDOT STMC	SJTA TOC - Maintenance
NJDOT TOC South	SJTA TOC

Source: DVRPC 2012

Toll Administration Subsystem

The Toll Administration Subsystem provides general payment administration capabilities and supports the electronic transfer of authenticated funds from the customer to the transportation system operator. This subsystem supports traveler enrollment and collection of both pre-payment and post-payment transportation fees in coordination with the existing and evolving financial infrastructure supporting electronic payment transactions. This subsystem posts a transaction to the customer account and generates a bill (for post payment accounts), debits an escrow account, or interfaces to the financial infrastructure to debit a customer's designated account. It supports communications with the Toll Collection Subsystem to support fee collection operations. The subsystem also sets and administers the pricing structures and includes the capability to implement road pricing policies in coordination with the Traffic Management Subsystem.

Table C-7: Toll Administration Subsystem

Toll Administration Subsystem (TAS)	
BCBC Toll Plazas	NJTA Toll Plazas
DRJTBC Toll Plazas	PTC Toll Plazas
DRPA Toll Plazas	SJTA Toll Plazas
E-ZPass Customer Service Center	

Source: DVRPC 2012

Traffic Management Subsystem

The Traffic Management Subsystem monitors and controls the traffic and the road network. It represents centers that manage a broad range of transportation facilities, including freeway systems, rural and suburban highway systems, and urban and suburban traffic control systems. This subsystem communicates with the Roadway Subsystem to monitor and manage traffic flow and monitor the condition of the roadway. This subsystem coordinates with the Maintenance and Construction Management Subsystem to maintain the road network and coordinate and adapt to maintenance activities, road closures, and detours. Incidents are detected, verified, and incident information is provided to allied agencies, drivers through Roadway Subsystem VMS and Highway Advisory Radio (HAR), and ISPs. This subsystem also manages traffic and transportation resources to support agencies in responding to, and recovering from, incidents ranging from minor traffic incidents to major disasters. The subsystem communicates with other Traffic Management Subsystems to coordinate traffic information and control strategies in neighboring jurisdictions.

Table C-8: Traffic Management Subsystem

Traffic Management Subsystem (TMS)	
BCBC TOC	NJSP/NJDOT/NJDEP Statewide Dispatch Center
DRJTBC Offices	NJTA TMC
DRPA Police - Bridge Unit	PennDOT District 6-0 - RTMC
DRPA TOC	PennDOT RCRS
Municipal TOCs	PennDOT STMC
National Park Service Management Center	Philadelphia SCSSD Operations
New Jersey County TOCs	Philadelphia Streets Department TOC
NJDOT REOCs	PTC OCC
NJDOT STMC	RIMIS
NJDOT TOC South	SJTA TOC
NJDOT TEOC	

Source: DVRPC 2012

Transit Management Subsystem

The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning, and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, paratransit services, transit rail, and Bus Rapid Transit (BRT) services. The subsystem's interfaces allow for

communication between transit and with other operating entities such as emergency response services and traffic management systems. The subsystem furnishes travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the subsystem supports transit security features. This includes monitoring silent alarms (both passenger and operator initiated) on-board transit vehicles.

Table C-9: Transit Management Subsystem

Transit Management Subsystem (TRMS)	
Amtrak Centralized Traffic Electrical Control (CTEC)	NJ TRANSIT Rail Operations Center Systems
DVRPC Regional Fare Reciprocity Network	County Paratransit Management Systems
NJ TRANSIT Access Link Paratransit Dispatch	PATCO Center Tower
NJ TRANSIT Bus Operations South	PATCO Fare Management System
NJ TRANSIT Corporate Customer Information Center Systems	SEPTA Fare Management System
NJ TRANSIT Corporate DVPRC Region Transit Coordination Network	SEPTA Operations Center
NJ TRANSIT Fare Management System	SJTA Transportation Services Division
NJ TRANSIT Light Rail Transit (LRT) - River Line Operations Center	

Source: DVRPC 2012

Field Subsystems

Commercial Vehicle Check Subsystem

The Commercial Vehicle Check Subsystem supports automated vehicle identification at mainline speeds for credential checking, roadside safety inspections, and weigh-in-motion using two-way data exchange. These capabilities include providing warnings to the commercial vehicle drivers, their fleet managers, and proper authorities of any safety problems that have been identified, accessing and examining historical safety data, and automatically deciding whether to allow the vehicle to pass or require it to stop with operator manual override. The Commercial Vehicle Check Subsystem also provides supplemental inspection services to current capabilities by supporting expedited brake inspections, the use of operator hand-held devices, mobile screening sites, on-board safety database access, and the enrollment of vehicles and carriers in the electronic clearance program.

Table C-10: Commercial Vehicle Check Subsystem

Commercial Vehicle Check Subsystem (CVCS)	
Municipal Police Commercial Vehicle Enforcement Division	PennDOT Central Office Organizations
NJSP Commercial Carrier/Safety Inspection Unit	PSP Motor Carrier Services and Enforcement Division

Source: DVRPC 2012

Parking Management Subsystem

The Parking Management Subsystem provides electronic monitoring and management of parking facilities. It supports a Field-Vehicle Communications link to the Vehicle Subsystem that allows electronic collection of parking fees and monitors and controls parking meters that support conventional parking fee collection. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles.

Table C-11: Parking Management Subsystem

Parking Management Subsystem (PMS)	
National Park Service Management Center	PHL Parking Facilities
NJ TRANSIT Parking Facilities	PPA Parking Facilities
PATCO Fare Management System	Philadelphia SCSSD Parking Facilities
PATCO Parking Facilities	SEPTA Parking Facilities

Source: DVRPC 2012

Roadway Subsystem

This Roadway Subsystem includes the equipment distributed on and along the roadway that monitors and controls both traffic and the roadway. Equipment includes traffic detectors, environmental sensors, traffic signals, HAR, VMS signs, CCTV cameras and video image processing systems, grade crossing warning systems, and freeway ramp metering systems.

Table C-12: Roadway Subsystem

Roadway Subsystem (RS)	
BCBC ITS Field Equipment	NJTA Turnpike ITS Field Equipment
DRJTBC ITS Field Equipment	PennDOT District 6-0 - ITS Field Equipment
DRPA ITS Field Equipment	PennDOT Other District - ITS Field Equipment
ISP ITS Field Equipment	Philadelphia Streets Dept. ITS Field Equipment
Municipal ITS Field Equipment	PTC ITS Field Equipment
New Jersey County ITS Field Equipment	SJTA ITS Field Equipment
NJDOT ITS Field Equipment	

Source: DVRPC 2012

Security Monitoring Subsystem

This subsystem includes surveillance and sensor equipment used to provide enhanced security and safety for transportation facilities or infrastructure. The equipment represented by this subsystem is located in non-public areas of transportation facilities (e.g., maintenance and transit yards) or near non-roadway parts of the transportation infrastructure (e.g., transit railway). This subsystem also includes surveillance and sensor equipment located on or near major roadway features, such as bridges, tunnels, and interchanges, when the equipment's primary function is one of safety and security.

Table C-13: Security Monitoring Subsystem

Security Monitoring Subsystem (SMS)	
BCBC Infrastructure Security Equipment	PATCO Facility Security Equipment
DRJTBC Infrastructure Security Equipment	PennDOT Infrastructure Security Equipment
DRPA Infrastructure Security Equipment	Philadelphia Infrastructure Security Equipment
NJ TRANSIT Police Facility Security Equipment	PTC Infrastructure Security Equipment
NJDOT Infrastructure Security Equipment	SEPTA Facility Security Equipment
NJTA Infrastructure Security Equipment	SJTA Infrastructure Security Equipment

Source: DVRPC 2012

Toll Collection Subsystem

The Toll Collection Subsystem provides the capability for vehicle operators to pay tolls without stopping their vehicles, and it includes the capability to implement various variable road pricing policies. Each transaction is accompanied by feedback to the customer indicating the general

status of the customer account. A record of the transactions is provided to the Toll Administration Subsystem for reconciliation, and so the customer can periodically receive a detailed record of the transactions.

Table C-14: Toll Collection Subsystem

Toll Collection Subsystem (TCS)	
BCBC Toll Plazas	NJTA Toll Plazas
DRBA Toll Plaza	PTC Toll Plazas
DRJTBC Toll Plazas	SJTA Toll Plazas
DRPA Toll Plazas	

Source: DVRPC 2012

Vehicle Subsystems

Commercial Vehicle Subsystem

This subsystem resides in a commercial vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient commercial vehicle operations. The subsystem provides two-way communications between the commercial vehicle drivers, their fleet managers, attached freight equipment, and roadside officials, and provides HAZMAT response teams with timely and accurate cargo contents information after a vehicle incident. This subsystem provides the capability to collect and process vehicle cargo information from the attached freight equipment, driver safety data and status, and alerts the driver whenever there is a potential safety or security problem. Basic identification, security, and safety status data is supplied to inspection facilities at mainline speeds.

Table C-15: Commercial Vehicle Subsystem

Commercial Vehicle Subsystem (CVS)	
Commercial Vehicles	

Source: DVRPC 2012

Emergency Vehicle Subsystem

This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient incident response. The

subsystem represents a range of vehicles, including those operated by police, fire, and emergency medical services. In addition, this subsystem represents other incident response vehicles, including towing and recovery vehicles and freeway ESP. The Emergency Vehicle Subsystem includes two-way communications to support coordinated responses to emergencies in accordance with an associated Emergency Management Subsystem. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond to each emergency is determined. Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency. In addition, the emergency vehicle may be equipped to support signal preemption through communications with the Roadway Subsystem.

Table C-16: Emergency Vehicle Subsystem

Emergency Vehicle Subsystem (EVS)	
NJDOT ESP Vehicles	Municipal Police, Fire, and EMS Vehicles
NJSP Vehicles	PSP Vehicles
PennDOT District 6-0 - ESP Vehicles	SJTA ESP Vehicles

Source: DVRPC 2012

Maintenance and Construction Vehicle

This subsystem resides in maintenance, construction, or other specialized service vehicle or equipment, and it provides the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction. All types of maintenance and construction vehicles are covered, including heavy equipment and supervisory vehicles. The subsystem provides two-way communications between drivers/operators and dispatchers and maintains and communicates current location and status information. A wide range of operational status data information is monitored depending on the specific type of vehicle or equipment.

Table C-17: Maintenance and Construction Vehicle Subsystem

Maintenance and Construction Vehicle Subsystem (MCVS)	
DRJTBC Maintenance Vehicles	PennDOT District 6-0 - Maintenance and Construction Vehicles
DRPA Maintenance Vehicles	Philadelphia Streets Dept. Maintenance and Construction Vehicles
New Jersey County Public Works Dept. Vehicles	PTC Maintenance and Construction Vehicles
NJDOT Maintenance and Construction Vehicles	SJTA Maintenance Vehicles

Source: DVRPC 2012

Transit Vehicle Subsystem

This subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The types of transit vehicles containing this subsystem include buses, paratransit vehicles, light rail vehicles, other vehicles designed to carry passengers, and supervisory vehicles. The subsystem collects accurate ridership levels and supports electronic fare collection. The subsystem supports a traffic signal prioritization function that communicates with the roadside subsystem to improve on-schedule performance. AVL functions enhance the information available, enabling more efficient operations. On-board sensors support transit vehicle maintenance. The subsystem supports on-board security and safety monitoring. This monitoring includes transit user or vehicle operator activated alarms (silent or audible), as well as surveillance and sensor equipment. The subsystem also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.

Table C-18: Transit Vehicle Subsystem

Transit Vehicle Subsystem (TRVS)	
NJ TRANSIT Vehicles	SEPTA Vehicles
County Paratransit Vehicles	SJTA Transportation Services Division Vehicles
PATCO Vehicles	

Source: DVRPC 2012

Vehicle

This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel. These functions reside in general vehicles, including personal automobiles, commercial vehicles, emergency vehicles, transit vehicles, or other vehicle types. Information services provide the driver with current travel conditions and the availability of services along the route and at the destination. Both one-way and two-way communications options support a spectrum of information services, from low-cost broadcast services to advanced, pay-for-use personalized information services. Route guidance capabilities assist in formulation of an optimal route and step-by-step guidance along the travel route. Advanced sensors, processors, enhanced driver interfaces, and actuators complement the driver information services so that, in addition to making informed mode and route selections, the driver travels these routes in a safer and more consistent manner.

Table C-19: Vehicle Subsystem

Vehicle Subsystem (VS)	
Traveler's Vehicles	

Source: DVRPC 2012

Traveler Subsystems

Remote Traveler Support

This subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes (e.g., rest stops, merchant locations), and major trip generation locations, such as special event centers, hotels, office complexes, amusement parks, and theaters. Traveler information access points include kiosks and informational displays supporting varied levels of interaction and information access. At transit stops, simple displays providing schedule information and imminent arrival signs can be provided. This basic information may be extended to include multi-modal information, including traffic conditions and transit schedules, along with yellow pages information, to support mode and route selection at major trip generation sites. Personalized route planning and route guidance information can also be provided based on criteria supplied by the traveler. The subsystem also supports electronic payment of transit fares.

In addition to the traveler information provisions, this subsystem also supports security and safety monitoring of public areas. This monitoring includes traveler-activated silent alarms, as well as surveillance and sensor equipment.

Table C-20: Remote Traveler Support

Remote Traveler Support Subsystem (RTS)	
NJ TRANSIT Corporate Customer Information/Display Systems	PATCO Fare Point of Sale
NJ TRANSIT Fare Point of Sale	PennDOT Welcome Centers and Rest Areas
NJ TRANSIT Police Facility Security Equipment	PTC Service Plazas
NJTA Service Plazas	SEPTA Customer Display Systems
PATCO Customer Display Systems	SEPTA Facility Security Equipment
PATCO Facility Security Equipment	SEPTA Fare Point of Sale

Source: DVRPC 2012

Personal Information Access

This subsystem provides the capability for travelers to receive formatted traffic advisories from their homes, place of work, major trip generation sites, and personal portable devices, over multiple types of electronic media. These capabilities also provide basic routing information and allow users to select those transportation modes that allow them to avoid congestion, or more advanced capabilities to allow users to specify those transportation parameters that are unique to their individual needs and receive travel information. This subsystem provides travelers with the capability to receive route planning from the infrastructure at fixed locations, such as their homes, and their place of work, and at mobile locations using personal portable devices and vehicle-based devices.

Table C-21: Personal Information Access Subsystem

Personal Information Access Subsystem (PIAS)	
Personal Traveler Information Devices	

Source: DVRPC, 2012

Terminators

Terminators define the boundaries of the ITS Architecture. They represent the people, systems, and general environment that are needed to communicate or interact with ITS subsystems. Essentially, each of the terminators represents an external entity that communicates data to, or receives data from, elements within the Regional Architecture. Many of these elements may be outside of the DVRPC region, such as the DelDOT TMC, which is categorized as an Other Traffic Management system. Another example is the Weather Service, which provides data to many stakeholders. Terminators applicable to the Delaware Valley area are identified in the following table.

Table C-22: Terminators

Terminator	Element
Archived Data User	Transportation Information Users Systems
DMV	NJDOT Driver and Vehicle Services
	PennDOT Driver and Vehicle Services
Enforcement Agency	DRPA Police - Transit Unit
	NJ TRANSIT Police Dispatch/Command Center
	NJSP - Troop Dispatch
	NJSP Commercial Carrier/Safety Inspection Unit
	NJSP/NJDOT/NJDEP Statewide Dispatch Center
	PSP - Norristown CDC
	PSP Motor Carrier Services and Enforcement Division
	SEPTA Emergency Dispatch/Police
Event Promoters	Philadelphia SCSSD Operations
	Regional Event Promoters
Financial Institution	E-ZPass Customer Service Center
	Financial Institution
	NJ TRANSIT Fare Management System
	PATCO Fare Management System
	PPA Fare Management System
	SEPTA Fare Management System
Intermodal Freight Depot	Private Terminal Operators Systems
Multimodal Crossings	BCBC Tacony Palmyra Drawbridge

Table C-22: Terminators (continued)

Terminator	Element
Multimodal Transportation Service Provider	Multimodal Passenger Air and Water Terminals/Stations
	Philadelphia International Airport Multimodal Transportation Service Provider
Other EM	DelDOT TMC
	DRBA TMC
	NJTPA/SJTPO Counties Emergency Operations Centers
	NJTPA/SJTPO Region Public Safety Dispatch
	Pennsylvania Regional Incident and Mutual Aid Network
	PSP – Other Troop Offices
Other ISP	DelDOT TMC
	TRANSCOM Center
Other MCMS	DelDOT TMC
	NJDOT Maintenance and Construction – North
	NJTPA/SJTPO Counties Public Works Department Operations
Other Roadway	PennDOT Other District – ITS Field Equipment
	Philadelphia Streets Department ITS Field Equipment
Other TAS	DRBA Toll Plaza
Other TMS	DelDOT TMC
	DRBA TMC
	Municipal TOCs
	NJTPA/SJTPO Counties TOCs
	PennDOT Other District – TMC
	TRANSCOM Center
	DART First State Transit Operations
	NJTPA/SJTPO Counties/Municipalities Transit Systems
Rail Operations	Amtrak Centralized Traffic Electrical Control
	NJ TRANSIT Light Rail Transit – River Line Operations Center
	NJ TRANSIT Rail Operations Center Systems
	PATCO Center Tower

Table C-22: Terminators (continued)

Terminator	Element
	Railroad Operations Centers
	SEPTA Operations Center
Traveler Card	Regional Personal Traveler Card
Wayside Equipment	NJ TRANSIT Rail Grade Crossing Protection
Weather Service	Weather Service Provider Systems

Source: DVRPC, 2012

APPENDIX D

Element by Stakeholder

For each stakeholder in the Regional ITS Architecture, the ITS elements associated with them, and the subsystems or the terminators that the architectural elements are associated with, are documented. The listings do not distinguish between existing and proposed ITS elements. For simplicity, the National ITS Architecture abbreviations are used to specify the subsystem.

Subsystem Designations

Table D-1: Subsystem Designations

Type of Subsystem	Abbreviation	Description
Centers	ADMS	Archived Data Management Subsystem
	CVAS	Commercial Vehicle Administration Subsystem
	EM	Emergency Management
	EMMS	Emissions Management Subsystem
	FMS	Fleet and Freight Management Subsystem
	ISP	Information Service Provider
	MCMS	Maintenance and Construction Management Subsystem
	TAS	Toll Administration Subsystem
	TMS	Traffic Management Subsystem
	TRMS	Transit Management Subsystem
Field	CVCS	Commercial Vehicle Check Subsystem
	PMS	Parking Management Subsystem
	RS	Roadway Subsystem
	SMS	Security Monitoring Subsystem
	TCS	Toll Collection Subsystem
Vehicles	CVS	Commercial Vehicle Subsystem
	EVS	Emergency Vehicle Subsystem
	MCVS	Maintenance and Construction Vehicle Subsystem
	TRVS	Transit Vehicle Subsystem
	VS	Vehicle Subsystem
Travelers	PIAS	Personal Information Access Subsystem
	RTS	Remote Traveler Support

Source: DVRPC, 2012

Elements by Stakeholders

Table D-2: Elements by Stakeholders

Stakeholder	Element	Subsystem/Terminator
Amtrak	Amtrak CTEC	TRMS, Rail Operations
	Amtrak Emergency Dispatch/Police	EM
	Amtrak Traveler Information Services	ISP
Burlington County Bridge Commission	BCBC Data Archive	ADMS
	BCBC Infrastructure Security Equipment	SMS
	BCBC ITS Field Equipment	RS
	BCBC Police	EM
	BCBC Tacony Palmyra Drawbridge	Multimodal Crossings
	BCBC Toll Plazas	TAS, TCS
	BCBC Traffic Operations Center	TMS
Commercial Vehicle and Fleet Operators	Commercial Vehicle Dispatchers	FMS
	Commercial Vehicles	CVS
DART First State	DART First State Transit Operations	Other TRMS
Delaware Department of Transportation	DelDOT TMC	Other EMS, Other ISP, Other MCMS, Other TMS
County Paratransit Services	County Paratransit Management Systems	TRMS
	County Paratransit Vehicles	TRVS
Delaware River and Bay Authority	DRBA Toll Plaza	Other TAS
	DRBA TMC	Other TMS
Delaware River Joint Toll Bridge Commission	DRJTBC Infrastructure Security Equipment	SMS
	DRJTBC ITS Field Equipment	RS
	DRJTBC Maintenance Vehicles	MCVS
	DRJTBC Offices	EM, MCMS, TMS
	DRJTBC Toll Plazas	TAS, TCS

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
Delaware River Port Authority	DRPA Bridge Maintenance	MCMS
	DRPA Data Archive	ADMS
	DRPA Infrastructure Security Equipment	SMS
	DRPA ITS Field Equipment	RS
	DRPA Maintenance Vehicles	MCVS
	DRPA Police - Bridge Unit	EM, TMS
	DRPA Police - Transit Unit	EM, Enforcement Agency
	DRPA Toll Plazas	TAS, TCS
	DRPA TOC	EM, MCMS, TMS
	DRPA/PATCO Traveler Information	ISP
Delaware Valley Regional Planning Commission	DVRPC Data Archive	ADMS
	RIMIS	TMS
E-ZPass Inter Agency Group	E-ZPass Customer Service Center	TAS, Financial Institution
Financial Institution	Financial Institution	Financial Institution
Information Service Providers	ISP Data Archive	ADMS
	ISP ITS Field Equipment	RS
	ISP Traveler Information Systems	ISP
Multimodal Transfer Terminal/Station Providers	Multimodal Passenger Air and Water Terminals/Stations	Multimodal Transportation Service Provider
Municipalities	Municipal Police Commercial Vehicle Enforcement Division	CVCS
	Municipal ITS Field Equipment	RS
	Municipal Police and Fire Department Operations	EM
	Municipal TOCs	ADMS, TMS
	Municipal Police, Fire, and EMS Vehicles	EVS
National Guard	National Guard	EM
National Park Service	National Park Service Management Center	EM, ISP, TMS, PMS

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
New Jersey Counties	NJ County 9-1-1 Communication Centers	EM
	NJ County Emergency Management Offices	EM
	NJ County ITS Field Equipment	RS
	NJ County Public Works Department Vehicles	MCVS
	NJ County Public Works Departments	MCMS
	NJ County TOCs	ADMS, TMS
	NJ County Traveler Information	ISP
New Jersey Department of Transportation	NJ CVISN System	CVAS
	NJDOT 511 System/Traveler Information Services	ISP
	NJDOT Construction Management System	MCMS
	NJDOT Data Archive	ADMS
	NJDOT Drivers and Vehicle Services	DMV
	NJDOT ESP Vehicles	EVS
	NJDOT Infrastructure Security Equipment	SMS
	NJDOT ITS Field Equipment	RS
	NJDOT Maintenance	MCMS
	NJDOT Maintenance and Construction – North	Other MCMS
	NJDOT Maintenance and Construction Vehicles	MCVS
	NJDOT REOCs	MCMS, TMS
	NJDOT STMC	EM, MCMS, TMS
	NJDOT TOC South	EM, MCMS, TMS
	NJDOT TEOC	EM, MCMS, TMS
New Jersey Office of Homeland Security	New Jersey Office of Homeland Security	EM

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
New Jersey State Police	New Jersey Incident and Mutual Aid Network	EM
	NJ State Office of Emergency Management	EM
	NJSP - Troop Dispatch	EM, Enforcement Agency
	NJSP Commercial Carrier/Safety Inspection Unit	CVCS, Enforcement Agency
	NJSP Data Archive	ADMS
	NJSP ROIC	EM
	NJSP Vehicles	EVS
	NJSP/NJDOT/NJDEP Statewide Dispatch Center	EM, TMS, Enforcement Agency
New Jersey Transit	NJ TRANSIT Access Link Paratransit Dispatch	TRMS
	NJ TRANSIT Bus Operations South	TRMS
	NJ TRANSIT Corporate Customer Information/Display Systems	RTS
	NJ TRANSIT Corporate Customer Information Center Systems	ISP, TRMS
	NJ TRANSIT Corporate DVPRC Region Transit Coordination Network	TRMS
	NJ TRANSIT Data Archive	ADMS
	NJ TRANSIT Fare Management	TRMS, Financial Institution
	NJ TRANSIT Fare Point of Sale	RTS
	NJ TRANSIT LRT - River Line Operations	TRMS, Rail Operations
	NJ TRANSIT Parking Facilities	PMS
	NJ TRANSIT Police Dispatch/Command Center	EM, Enforcement Agency
	NJ TRANSIT Police Facility Security Equipment	SMS, RTS
	NJ TRANSIT Rail Grade Crossing Protection	Wayside Equipment
	NJ TRANSIT Rail Operations Center	TRMS, Rail Operations
	NJ TRANSIT Vehicles	TRVS
	NJ TRANSIT Web Site	ISP

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
New Jersey Turnpike Authority	NJTA 511 System/Traveler Information Services	ISP
	NJTA Data Archive	ADMS
	NJTA HAZMAT Permit System	CVAS
	NJTA Infrastructure Security Equipment	SMS
	NJTA Maintenance	MCMS
	NJTA Service Plazas	RTS
	NJTA Toll Plazas	TAS, TCS
	NJTA TMC	TMS
	NJTA Turnpike ITS Field Equipment	RS
NJTPA/SJTPO	NJTPA/SJTPO Data Archive	ADMS
NJTPA/SJTPO Counties	NJTPA/SJTPO Counties Public Works Department Operations	Other MCMS
	NJTPA/SJTPO Counties TOCs	Other TMS
NJTPA/SJTPO Public Safety Agencies	NJTPA/SJTPO Counties Emergency Operations Centers	Other EM
	NJTPA/SJTPO Counties Public Safety Dispatch	Other EM
NJTPA/SJTPO Transit Operators	NJTPA/SJTPO Counties/Municipalities Transit Systems	Other TRMS
Pennsylvania Counties	PA County 9-1-1 Communications Centers	EM
	PA County Emergency Management Offices	EM
Pennsylvania Department of Transportation	PennDOT 511 System/Traveler Information Services	ISP
	PennDOT Central Office - Data Archive	ADMS
	PennDOT Central Office Organizations	CVCS, MCMS
	PennDOT District 6-0 - County Maintenance Offices	MCMS
	PennDOT District 6-0 - Data Archive	ADMS
	PennDOT District 6-0 - ESP Vehicles	EVS
	PennDOT District 6-0 - ITS Field Equipment	RS

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
Pennsylvania Department of Transportation	PennDOT District 6-0 - Maintenance and Construction Vehicles	MCVS
	PennDOT District 6-0 - RTMC	EM, MCMS, TMS
	PennDOT Driver and Vehicle Services	CVAS, DMV
	PennDOT Infrastructure Security Equipment	SMS
	PennDOT Other District - ITS Field Equipment	RS
	PennDOT Other District - TMC	Other TM
	PennDOT RCRS	ISP, TMS
	PennDOT STMC	EM, TMS
	PennDOT Welcome Centers and Rest Areas	ISP, RTS
Pennsylvania Emergency Management Agency	PEMA Emergency Operation Center	EM
Pennsylvania Office of Homeland Security	Pennsylvania Office of Homeland Security	EM
Pennsylvania Regional Incident and Mutual Aid Network	Pennsylvania Regional Incident and Mutual Aid Network	Other EM
Pennsylvania State Police	PSP - Local Troop Offices	EM
	PSP - Norristown CDC	ADMS, EM, Enforcement Agency
	PSP Motor Carrier Services and Enforcement Division	CVCS, Enforcement Agency
	PSP Vehicles	EVS
Pennsylvania Turnpike Commission	PTC Data Archive	ADMS
	PTC Infrastructure Security Equipment	SMS
	PTC ITS Field Equipment	RS
	PTC Maintenance and Construction Vehicles	MCVS
	PTC Maintenance Offices	MCMS
	PTC OCC	EM, TMS
	PTC Service Plazas	RTS
	PTC Toll Plazas	TAS, TCS
	PTC Traveler Information Services	ISP

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
Philadelphia Fire Department	Philadelphia FCC	EM
Philadelphia International Airport	PHL Multimodal Transportation Service Provider	Multimodal Transportation Service Provider
	PHL Parking Facilities	PMS
	PHL Traveler Information Services	ISP
Philadelphia Office of Emergency Management	Philadelphia OEM Operations	EM
Philadelphia Parking Authority	PPA Fare Management System	Financial Institution
	PPA Parking Facilities	PMS
Philadelphia Police Department	Philadelphia Infrastructure Security Equipment	SMS
	Philadelphia Police Department Radio Room Dispatch	EM
Philadelphia Sports Complex Special Services District	Philadelphia SCSSD Operations	TMS, Event Promoter
	Philadelphia SCSSD Parking Facilities	PMS
Philadelphia Streets Department	Philadelphia Streets Department Data Archive	ADMS
	Philadelphia Streets Department ITS Field Equipment	RS
	Philadelphia Streets Department Maintenance and Construction	MCMS
	Philadelphia Streets Department Maintenance and Construction Vehicles	MCVS
	Philadelphia Streets Department TOC	TMS
Port Authority Transit Corporation	PATCO Center Tower	TRMS, Rail Operations
	PATCO Center Tower - Police Dispatch	EM
	PATCO Customer Display Systems	RTS
	PATCO Data Archive	ADMS
	PATCO Facility Security Equipment	SMS, RTS
	PATCO Fare Management System	TRMS, PMS, Financial Institution
	PATCO Fare Point of Sale	RTS
	PATCO Parking Facilities	PMS
	PATCO Vehicles	TRVS

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
Private Terminal Operators at Ports	Private Terminal Operators Systems	FMS, Intermodal Freight Depot
Railroad Operators	Railroad Operation Centers	Rail Operations
Regional Event Promoters	Regional Event Promoters	Event Promoters
Regional Fare Reciprocity Administrator	DVRPC Regional Fare Reciprocity Network	TRMS
South Jersey Transportation Authority	SJTA 511 System/Traveler Information System	ISP
	SJTA Data Archive	ADMS
	SJTA ESP Vehicles	EVS
	SJTA Infrastructure Security Equipment	SMS
	SJTA ITS Field Equipment	RS
	SJTA Maintenance Vehicles	MCVS
	SJTA Toll Plazas	TAS, TCS
	SJTA TOC - Maintenance	MCMS
	SJTA TOC	EM, MCMS, TMS
	SJTA Transportation Services Division	TRMS
	SJTA Transportation Services Division Vehicles	TRVS
Southeastern Pennsylvania Transportation Authority	SEPTA Customer Display Systems	RTS
	SEPTA Data Archive	ADMS
	SEPTA Emergency Dispatch/Police	EM, Enforcement Agency
	SEPTA Facility Security Equipment	RTS, SMS
	SEPTA Fare Management System	TRMS, Financial Institution
	SEPTA Fare Point of Sale	RTS
	SEPTA Operations Center	TRMS, Rail Operations
	SEPTA Parking Facilities	PMS
	SEPTA Traveler Information Services	ISP
	SEPTA Vehicles	TRVS
Towing Industry	Towing Industry Responders	EM
TRANSCOM	TRANSCOM Center	Other ISP, Other TMS
Transportation Information Users	Transportation Information Users	Archived Data User Systems

Table D-2: Elements by Stakeholders (continued)

Stakeholder	Element	Subsystem/Terminator
Transportation Management Associations	TMAs - New Jersey Traveler Information Services	ISP
	TMAs - Pennsylvania Traveler Information Services	ISP
Travelers	Personal Traveler Information Devices	PIAS
	Regional Personal Traveler Card	Traveler Card
	Traveler's Vehicles	VS
Weather Service Provider	Weather Service Provider Systems	Weather Service

Source: DVRPC, 2012

APPENDIX E

Functional Requirements

Table E-1: Roadway System Functional Requirements

Equipment Package	Purpose	Functional Requirements
Basic Roadway Surveillance	Monitors traffic conditions using fixed equipment such as detectors and CCTV.	■ Field equipment shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the TMC for further analysis and storage, under remote center control ■ Field equipment shall collect, process, and send traffic images to the TMC for further analysis and distribution ■ Field equipment shall return sensor and CCTV system operational status to the controlling TMC ■ Field equipment shall return sensor and CCTV system fault data to the controlling TMC for repair
Roadway Equipment Coordination	Supports field equipment that controls and sends data to other field elements. This includes coordination between remote sensors and field devices.	■ Field equpment shall include sensors (such as work zone intrusion detection sensors) that provide data and status information to other field element devices (such as VMS, ramp meters, traffic signals, work zone intrusion alert systems), without center control ■ Field equipment shall include sensors that receive control information from other field element devices, without remote center control ■ Field equipment shall include devices (such as arterial or freeway controllers, barrier systems, or work zone intrusion alert systems) that provide data and status information to other field element devices (such as VMS, traffic controllers on adjacent intersections), without remote center control ■ Field equipment shall include devices (such as arterial or freeway controllers, barrier systems, or work zone intrusion alert systems) that receive control information from other field element devices, without remotecenter control
Roadway Incident Detection	Use traffic detectors and other surveillance equipment to identify unusual traffic conditions that may indicate an incident. Provide potential incident information, as well as traffic flow data and images, to the TMC.	■ Field equipment shall collect, process, and send traffic images to the TMC for further analysis and distribution ■ Field equipment shall collect, process, and send sensor data to the TMC for further analysis and distribution ■ Field equipment shall remotely process video and sensor data and provide an indication of potential incidents to the TMC ■ Field video devices shall be remotely controlled by a TMC

Table E-1: Roadway System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ Field equipment shall provide operational status and fault data to the TMC
Roadway Traffic Information Dissemination	Provision of information to drivers using VMS and HAR devices.	■ Field equipment shall include VMS for dissemination of traffic and other information to drivers, under remote center control ■ Field equipment shall include driver information systems that communicate directly from a TMC to the vehicle radio (such as HAR) for dissemination of traffic and other information to drivers, under remote center control ■ Field equipment shall provide to TMC the operational status of driver information systems equipment ■ Field equipment shall provide to TMC maintenance driver information systems equipment fault report
Roadway Freeway Control	Manage field equipment used to control traffic on freeways, including ramp meters.	■ Field equipment shall include ramp metering controllers under TMC control ■ Field equipment shall monitor operation of ramp meters and report to the TMC any instances in which the indicator response does not match that expected from the indicator control information ■ Field equipment shall return ramp metering controller operational status to the TMC ■ Field equipment shall return ramp metering controller fault data to the center for repair
Roadway Signal Controls	Functionality to operate traffic signals, including traffic signal controllers, signal heads, detectors, and other ancillary equipment, that supports traffic signal control. Also supports central control, using master controllers, and communications devices.	■ Field equipment shall control traffic signals at intersections and on main highways, under TMC control. ■ Field equipment shall monitor operation of traffic signal controllers and report to the TMC any instances in which the indicator response does not match that expected from the indicator control information ■ Field equipment shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from known indicator preemptions ■ Field equipment shall return traffic signal controller operational status to the controlling center ■ Field equipment shall return traffic signal controller fault data to the center for repair
Roadway Signal Priority	Supports signal priority and/or signal preemption requests from vehicles approaching a signalized intersection.	■ Field equipment shall respond to requests for signal preemption from emergency vehicles ■ Field equipment shall respond to requests for signal priority from transit vehicles

Table E-1: Roadway System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ Field equipment shall notify traffic management center that the signal timing has changed based on a signal pre emption/priority request
Roadway Work Zone Traffic Control	Monitors and controls traffic in work zones using field devices, such as CCTV, VMS, and gates/barriers. Also provides work zone speeds and delays to motorists.	■ Field equipment shall collect, process, and send work zone images to the center for further analysis and distribution, under center control ■ Under TMC control, VMS and HAR field devices shall advise drivers of activity around the work zone through which they are currently passing ■ Under control of field personnel, VMS, and HAR field devices shall advise drivers of activity around a work zone through which they are currently passing ■ Field equipment shall control access to the work zone using automated gate/barrier systems or automated flagger assistance devices ■ Field equipment shall provide operational status for the surveillance (e.g., CCTV), driver information systems, and gates/barriers in work zones to the center ■ Field equipment shall provide fault data for the surveillance, driver information systems, and gates/barriers in work zones to the center for repair
Roadway Work Zone Safety	Provision of field equipment that detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment. Crew movements are also monitored so the crew can be warned of movement beyond the designated safe zone.	■ Field equipment shall include work zone intrusion detection devices that detect when a vehicle has intruded upon the boundary of a work zone, under center control ■ Field equipment shall include work zone intrusion detection devices that detect when crew workers have crossed the boundary between the work zone and vehicle traffic, under center control ■ Field equipment shall include work zone intrusion alerting devices that alert crew workers of a work zone emergency or safety issue, such as the intrusion of a vehicle into the work zone area or movement of field crew into the travel lanes ■ Field equipment shall include work zone intrusion alerting devices that alert drivers that they have intruded upon the perimeter of the work zone, or are about to do so ■ Field equipment shall provide operational status for the work zone intrusion detection devices and work zone inrtusion alerting devices to the center ■ Field equipment shall provide operational status for the work zone intrusion alerting devices to the center ■ Field equipment shall provide fault data for the work zone intrusion alerting devices to the maintenance center for repair

Table E-1: Roadway System Functional Requirements (continued)

Roadway Environmental Monitoring	Functionality to measure a broad array of weather and road surface information and communicate the information back to a center where it can be monitored and analyzed.	■ Field equipment shall include surface and sub surface environmental sensors that measure road surface temperature, moisture, and icing ■ Field equipment shall include environmental sensors that measure weather conditions, including temperature, wind, humidity, precipitation, and visibility ■ Field equipment's environmental sensors shall be remotely controlled by either a TMC and/or a maintenance center ■ Field equipment shall provide weather and road surface condition data to centers
Field Barrier System Control	Manages barrier systems used to control access to transportation facilities. Barrier systems include automatic or remotely controlled gates, barriers, and other access control systems.	■ Field equipment shall activate barrier systems for transportation facilities under TMC control ■ Field equipment shall return barrier system operational status to the TMC ■ Field equipment shall return barrier system fault data to a center for repair

Source: DVRPC, 2012

Table E-2: Traffic Management System Functional Requirements

Equipment Package	Purpose	Functional Requirements
Collect Traffic Surveillance	Remotely monitors and controls traffic sensors and surveillance equipment, and collects, processes, and stores the collected traffic data. Current traffic information and other real-time transportation information is also collected from other centers.	■ TMC shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field equipment, under remote control of the center ■ TMC shall monitor, analyze, and distribute traffic images from CCTV systems, under remote control of the center ■ TMC shall distribute road network conditions data based on collected and analyzed traffic sensor and surveillance data to other centers
TMC Freeway Management	Provides monitoring and control of freeway traffic control systems, including ramp control, interchange control, and mainline lane control systems.	■ TMC shall remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls ■ TMC shall collect operational status from ramp meters, mainline metering, and lane controls, and compare against the control information sent by the center ■ TMC shall collect fault data from ramp meters, mainline metering, and lane controls ■ TMC shall implement control strategies, under control of the center, on some or all of the freeway network devices, based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the ramps themselves
TMC Signal Control	Provides the capability to monitor and manage signalized intersections.	■ TMC shall remotely control traffic signal controllers ■ TMC shall collect traffic signal controller operational status and compare against the control information sent by the center ■ TMC shall collect traffic signal controller fault data from the field ■ TMC shall implement control plans to coordinate signalized intersections based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, transit vehicle priority, and equipment faults
TMC Traffic Information Dissemination	Disseminates traffic and road conditions, closures and detours, incident information, driver advisories, and other traffic-related data to other centers, the media, and motorists.	■ TMC shall remotely control VMS for dissemination of traffic and other information to drivers ■ TMC shall remotely control HAR for dissemination of traffic and other information to drivers ■ TMC shall collect operational status for the driver information systems equipment (VMS, HAR, etc.)

Table E-2: Traffic Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ TMC shall collect fault data for the driver information systems equipment ■ TMC shall retrieve locally stored traffic data, including current traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions ■ TMC shall distribute traffic data to maintenance and construction, transit centers, emergency management centers, and ISPs ■ TMC shall distribute traffic data to the media
TMC Regional Traffic Management	Supports coordination between TMCs, including sharing of traffic information and control of field equipment.	■ TMC shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information ■ TMC shall exchange traffic control information with other TMCs to support remote monitoring and control of traffic management devices
TMC Transportation Operations Data Collection	Collects real-time traffic information for operational use by the center.	■ The center shall collect real-time information on the state of the regional transportation system, including current traffic and road conditions, weather conditions, special event, and incident information ■ The center shall support the capability for the TMC operators to monitor and control the information collection service
TMC Incident Detection	Enables TMC to detect and verify incidents using remote surveillance devices, and receive notifications from external sources.	■ TMC shall collect and store traffic flow and image data from the field equipment to detect and verify incidents ■ TMC shall receive information concerning upcoming events that would effect the traffic network from event promoters and other entities ■ TMC shall receive alerts concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergencies ■ TMC shall exchange incident information with emergency management centers, as well as maintenance and construction, including incident notification, location, expected severity, and time and nature of incident ■ TMC shall support requests from emergency management centers to remotely control sensor and surveillance equipment ■ TMC shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents

Table E-2: Traffic Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ TMC shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents
TMC Incident Dispatch Coordination/Communication	Formulates, manages, and monitors an incident response. Supports dispatch of emergency response and service vehicles as well as coordination with other cooperating agencies.	■ TMC shall coordinate planning for incidents with emergency management centers ■ TMC shall support requests from emergency management centers to remotely control sensor and surveillance equipment, provide special routing for emergency vehicles, and provide responding emergency vehicles with signal preemption ■ TMC shall exchange incident information with emergency management centers, maintenance and construction, transit centers, and ISPs ■ TMC shall share resources with allied agency centers to implement special traffic control measures, assist in clean up and verify an incident ■ TMC shall receive inputs concerning upcoming events that would effect the traffic network from event promoters ■ TMC shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and ISPs ■ TMC shall monitor incident response performance and calculate incident response and clearance times ■ TMC shall exchange road network status assessment information with emergency management and maintenance centers, including an assessment of damage sustained by the road network, required closures, alternate routes and necessary restrictions ■ TMC shall coordinate information and controls with other TMCs ■ TMC shall receive inputs from emergency management and transit management centers to develop an overall status of the system
TMC Work Zone Traffic Management	Coordinates work plans with maintenance and develops work zone traffic maintenance plans. Manages traffic control strategies to mitigate work zone traffic impacts, and provides information to drivers.	■ TMC shall receive work zone CCTV images ■ TMC shall analyze work zone images for indications of a possible incident ■ TMC shall remotely control driver information systems (e.g., VMS, HAR) to advise drivers of activity around a work zone ■ TMC shall collect operational status for the driver information systems equipment in work zones

Table E-2: Traffic Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ TMC shall collect fault data for the driver information systems equipment in work zones ■ TMC shall receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback
TMC Multimodal Coordination	Support coordination between TMCs and transit operations centers. Upon request from transit operations center, provides traffic signal priority for transit vehicles.	■ TMC shall respond to requests from transit operations centers for signal priority at one or more intersections along a particular transit route
Traffic Maintenance	Enables TMC to monitor the operational status of ITS field equipment and detect failures. It tracks the repair or replacement of the failed equipment.	■ TMC shall collect and store traffic sensor operational status ■ TMC shall collect and store CCTV surveillance system operational status ■ TMC shall collect and store traffic sensor fault data and send to maintenance center for repair ■ TMC shall collect and store CCTV surveillance system fault data and send to maintenance center for repair ■ TMC shall collect environmental sensor operational status ■ TMC shall collect environmental sensor equipment fault data and send to maintenance center for repair ■ TMC shall exchange data with maintenance center concerning the reporting of faulty equipment and the schedule/status of its repair
TMC Evacuation Support	Supports development, coordination, and execution of traffic management strategies during an emergency evacuation, and subsequent reentry, triggered by a disaster or major emergency.	■ TMC shall coordinate planning for an emergency evacuation with emergency management centers, establishing evacuation routes, traffic control points, and signal timings ■ TMC shall support requests from emergency management centers to activate emergency traffic control plan and barrier closure systems ■ TMC shall coordinate information and controls with other TMCs ■ TMC shall coordinate execution of evacuation strategies with emergency management centers

Table E-2: Traffic Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
TMC Environmental Monitoring	Assimilates current and forecast road conditions and surface weather information. This information can be used to issue general traveler advisories and support location- specific warnings to drivers.	■ TMC shall remotely control environmental sensors that measure road surface conditions, such as temperature, moisture, icing, salinity, and other measures ■ TMC shall remotely control environmental sensors that measure weather conditions, including temperature, wind, humidity, precipitation, and visibility ■ TMC shall assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information, data from roadway maintenance operations, and environmental data collected from sensors deployed on and about the roadway
Barrier System Management	Monitors and controls barrier systems under control of TMC personnel. Barrier systems include automatic or remotely controlled gates, barriers, and other access control systems.	■ TMC shall remotely control barrier systems for transportation facilities ■ TMC shall collect barrier system operational status ■ TMC shall collect barrier system fault data and send to maintenance for repair ■ TMC shall accept requests for barrier system activation from other centers to support emergency response and detours

Source: DVRPC, 2012

Table E-3: Construction and Maintenance Functional Requirements

Equipment Package	Purpose	Functional Requirements
Maintenance and Construction Management (MCM) Roadway Maintenance and Construction	Provide overall management and support for routine maintenance on a roadway or right-of-way. Services managed include landscape maintenance, hazard removal (e.g., roadway debris), routine maintenance activities, and repair and maintenance of both ITS and non-ITS equipment.	■ Maintenance and construction shall maintain an interface with asset management systems to track the repair needs, status updates, and inventory of transportation assets including current maintenance status, vendor/contractor, installation and materials information, etc. ■ Maintenance and construction shall respond to requests from emergency management and TMCs for hazard removal, field equipment repair, and other roadway maintenance ■ Maintenance and construction shall exchange information with administrative systems to support the planning and scheduling of maintenance activities ■ Maintenance and construction shall provide emergency management and TMCs with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations ■ Maintenance and construction shall collect the status and fault data from roadside equipment, such as traffic, infrastructure, and environmental sensors ■ Maintenance and construction shall collect the status and fault data from the centers that operate the equipment, including data for traffic, infrastructure, and environmental sensors ■ Maintenance and construction shall receive equipment availability and materials storage status information from storage facilities to support the scheduling of roadway maintenance and construction activities ■ Maintenance and construction shall collect current and forecast traffic and weather information from TMCs and weather service providers ■ Maintenance and construction shall dispatch and route maintenance and construction vehicle drivers and support them with route-specific environmental, incident, advisory, and traffic congestion information ■ Maintenance and construction shall track the status of roadway maintenance and construction activities by monitoring data from the dispatched vehicles ■ Maintenance and construction shall report the status of field equipment maintenance activities to the centers that operate the equipment
MCM Vehicle Tracking	Facilitate tracking of location of maintenance and construction vehicles and other equipment.	■ Maintenance and construction shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction

Table E-3: Construction and Maintenance Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
MCM Incident Management	Support maintenance and construction's participation in coordinated incident response.	■ Maintenance and construction center shall exchange incident information with emergency management centers, as well as TMCs, including notification of existence of incident and expected severity, location, time, and nature of incident ■ Maintenance and construction shall respond to requests from emergency management and TMCs to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. ■ Maintenance and construction shall coordinate planning for incidents with emergency management centers and TMCs, including pre planning activities for implementing detour routes, disaster response, evacuation, and recovery operations ■ Maintenance and construction shall provide work zone activities affecting the road network,including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits ■ Maintenance and construction shall receive alerts and advisories concerning the possibility or occurrence of severe weather or other major emergencies, including information provided by an emergency alert system ■ Maintenance and construction shall exchange alert information and status with emergency management centers ■ Maintenance and construction shall exchange road network status assessment information with emergency management and TMCs, including an assessment of damage sustained by the road network, location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery ■ Maintenance and construction shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management
MCM Work Activity Coordination	Disseminate work activity schedules and current asset restrictions to other agencies. Work schedules are coordinated with operating agencies.	■ Maintenance and construction shall provide work zone activities affecting the road network, including the nature of the activity, location, impact to the roadway, and duration of impact ■ Maintence and construction shall provide to TMCs, emergency management agencies, transit agencies, other centers, and the media status information about scheduled maintenance and construction activities, including anticipated closures and impact

Table E-3: Construction and Maintenance Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		to the roadway, alternate routes, anticipated delays, closure times, and durations ■ Maintenance and construction shall collect and respond to feedback from other agencies concerning scheduled maintenance and construction activities ■ Maintenance and construction shall disseminate any temporary asset restrictions, such as height, width, and weight restrictions, imposed during maintenance and construction activity
MCM Work Zone Management	Remotely monitors and supports ITS devices deployed in and around work zones.	■ Maintenance and construction shall generate new work zone activity schedules for use by maintenance and construction vehicles, and operators, and for information coordination purposes ■ Maintenance and construction shall control the collection of work zone status information, including video images from cameras located in or near the work zone ■ Maintenance and construction shall disseminate work zone information to other agencies and centers, including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media ■ Maintenance and construction shall control traffic in work zones by providing remote control of VMS, HAR systems, gates, and barriers located in or near the work zone ■ Maintenance and construction shall collect real-time information on the state of the road network, including current traffic and road conditions, to support work zone scheduling and management ■ Maintenance and construction shall exchange information with administrative systems to support the planning and scheduling of work zone activities, including equipment, personnel, and consumables
MCM Work Zone Safety Management	Remotely monitors work zone safety systems that detect vehicle intrusions in work zones and warn crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone.	■ Maintenance and construction shall provide remote monitoring and control of work zone safety devices, including intrusion detection devices, that have been installed in work zones or maintenance areas ■ Maintenance and construction shall provide remote monitoring and control of intrusion alert devices that have been installed in work zones ■ Maintenance and construction shall collect status information of work zone safety device status from field equipment or the maintenance and construction vehicles ■ Maintennace and construction shall collect and store work zone data collected from work zone monitoring devices (such as intrusion detection or alert devices and speed monitoring devices)

Table E-3: Construction and Maintenance Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
MCM Environmental Information Collection	Collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway, in addition to fixed sensor stations at the roadside.	■ Maintenance and construction shall remotely control environmental sensors that measure road surface temperature, moisture, icing, salinity, and other measures ■ Maintenance and construction shall remotely control environmental sensors that measure weather conditions, including temperature, wind, humidity, precipitation, and visibility ■ Maintennace and construction shall assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (e.g., National Weather Service), data from TMCs, and environmental data collected from sensors deployed on and about the roadway ■ Maintenance and construction shall collect operational status and fault data for the roadside and vehicle-based environmental sensor equipment
MCM Environmental Information Processing	Processes current and forecast weather data, road condition information, and local environmental data, and uses internal models to develop specialized, detailed forecasts of local weather and surface conditions.	■ Maintenace and construction shall assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (e.g., National Weather Service) and local environmental sensor data ■ Maintenance and construction shall use the various data inputs of environmental sensors and road weather data to develop a view of current and predicted road weather and road conditions ■ Maintenace and construction shall disseminate current and forecasted road weather and road condition information to traffic, emergency, and transit management, ISPs, media, and other maintenance management centers

Source: DVRPC, 2012

Table E-4: Transit Management System Functional Requirements

Equipment Package	Purpose	Functional Requirements
Transit Center Fixed-Route Operations	Manages fixed-route transit operations, including automated dispatch of transit vehicles, vehicle schedule adherence, and generating scenarios for schedule adjustment, supporting creation of schedules and dissemination of schedules.	■ Transit center shall generate transit routes and schedules for bus and rail operations ■ Transit center shall dispatch fixed route or flexible route transit vehicles ■ Transit center shall provide instructions or corrective actions to the transit vehicle operators based upon operational needs ■ Transit center shall collect transit operational data for use in the generation of routes and schedules ■ Transit center shall manage large deviations of individual transit vehicles and deviations of large numbers of vehicles ■ Transit center shall generate the necessary corrective actions, which may involve more than the vehicles concerned and more far-reaching action, such as the introduction of extra vehicles or signal priority by TMCs ■ Transit center shall exchange information with maintenance and construction and TMCs concerning work zones, roadway conditions, asset restrictions, work plans, etc ■ Transit center shall disseminate up-to-date schedules and route information to other centers for fixed and flexible route services ■ Transit center shall provide the interface to the system operator to control the generation of new routes and schedules (transit services), including the ability to review and update the parameters used by the routes, schedule generation processes, and initiate these processes ■ Transit center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning transit routes and schedules
Transit Center Vehicle Tracking	Monitors transit vehicle location via a data communication link between transit vehicles and the transit center.	■ Transit center shall monitor the locations of all transit vehicles ■ Transit center shall determine adherence of transit vehicles to their assigned schedule ■ Transit center shall provide on-time performance data to ISPs ■ Transit center shall provide collected transit probe data to TMCs for use in measuring current traffic conditions

Table E-4: Transit Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
Transit Fare Management	Manages fare collection management at the transit center. It provides the back office functions that support transit fare collection, supporting payment reconciliation with links to financial institutions and enforcement agencies for fare violations.	■ Transit center shall support the payment of transit fare transactions using data provided by the traveler cards and/or payment instruments ■ Transit center shall process the financial requests from the transit vehicles or fare vending machines and manage an interface to a financial institution ■ Transit center shall process requests for transit fares to be paid in advance ■ Transit center shall exchange fare information with other transit centers, including a potential regional fare reciprocity network ■ Transit center shall maintain a list of invalid traveler credit identities or bad tag lists that can be forwarded to transit vehicles and transit stops or stations ■ Transit center shall collect data on fare payment violations and send the data, including images of the violator, to the appropriate enforcement agency ■ Transit center shall collect fare statistics data
Transit Center Information Services	Collects the latest available transit service information and makes it available to transit passengers through several modes of communications.	■ Transit center shall provide passengers using public transportation with traveler information upon request, including transit routes, schedules, transfer options, fares, real-time schedule adherence, and special events information ■ Transit center shall provide passengers real-time arrival information for buses and trains ■ Transit center shall broadcast transit advisory alerts and advisories pertaining to major service disruptions, delays, incidents, or special events ■ Transit center shall provide transit information to the media, including details of major service disruptions and plans for special events ■ Transit center shall exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems ■ Transit center shall provide transit service information to ISPs, including routes, schedules, schedule adherence, and fare information
Transit Center Security	Monitors transit vehicles, transit properties, and operator or traveler activated alarms received from on-board a transit vehicle or from a transit station.	■ Transit center shall receive reports of emergencies on-board transit vehicles entered directly by the transit vehicle operator or from a traveler through interfaces such as panic buttons or alarm switches ■ Transit center shall receive reports of emergencies in transit stations and adjoining property directly from transit personnel or from a traveler through interfaces such as panic buttons or alarm switches

Table E-4: Transit Management System Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirements
		■ Transit center shall monitor transit vehicle operational data to determine if the transit vehicle is off route and assess whether a security incident is occurring ■ Transit center shall coordinate the response to transit incidents with other agencies, including emergency management and other transit agencies ■ Transit center shall exchange transit incident information, along with other service data, with other transit agencies ■ Transit center shall receive information pertaining to wide-area alerts, such as weather alerts, disaster situations, or child abductions ■ Transit center shall monitor transit assets, including stations, vehicles, rail right-of-way, maintenance facilities, and yards for non authorized intrusions and other suspicious activity ■ Transit center shall receive threat information and status on the integrity of the transit infrastructure
Transit Center Multi Modal Coordination	Manages transit service coordination between transit properties and coordinates with other surface and air transportation modes.	■ Transit center shall coordinate schedules and services between transit agencies and other surface or air transportation modes ■ Transit center shall coordinate transit services for special events, planning services for the event and managing transit services on the day of the event
Transit Data Collection	Collects and stores transit data that is collected in the course of transit operations.	■ Transit center shall collect transit management data , such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc. ■ Transit center shall archive the data collected
Transit Evacuation Support	Manages transit resources to support an emergency evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.	■ Transit center shall manage the use of transit resources to support emergecy evacuation and subsequent reentry ■ Transit center shall coordinate regional evacuation plans with Emergency Management, identifying transit's role in an evacuation and the transit resources that would be used ■ Transit center shall adjust and update transit service and fare schedules and provide that information to other agencies as they coordinate an emergency evacuation

Source: DVRPC, 2012

Table E-5: Information Service Provider Functional Requirements

Equipment Package	Purpose	Functional Requirement
Basic Information Broadcast	Disseminates traveler information to travelers who are equipped with either personal devices or to vehicles especially equipped with interfaces to receive it. 511 websites and IVR systems provide basic traveler information to the general public.	■ Center shall disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes ■ Center shall disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities ■ Center shall disseminate transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers ■ Center shall disseminate parking information to travelers, including location, availability, and fees ■ Center shall disseminate toll information to travelers ■ Center shall disseminate weather information and road surface conditions to travelers ■ Center shall disseminate event information to travelers ■ Center shall provide the capability to support requests from the media for traffic and incident data ■ Center shall provide the capability for a system operator to control the type and update the frequency of broadcast traveler information
Traveler Telephone Information	Support voice-based traveler requests for information that supports traveler telephone information systems like 511.	■ Center shall provide the capability to process voice-formatted requests for traveler information from a traveler telephone information system and return the information in the requested format ■ Center shall provide the capability to process traveler information requests from a traveler telephone information system ■ Center shall provide information on traffic conditions in the requested voice format and for the requested location ■ Center shall provide work zone and roadway maintenance information in the requested voice format and for the requested location ■ Center shall provide weather, road surface, and event information in the requested voice format and for the requested location ■ Center shall provide transit service information in the requested voice format and for the requested location ■ Center shall provide the capability to support both specific caller requests as well as bulk upload of regional traveler information

Table E-5: Information Service Provider Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirement
ISP Traveler Information Alerts	Provides personalized traveler information alerts, notifying travelers of congestion, incidents, transit schedule delays or interruptions, parking availability, special events, air and ferry service issues, and road/weather conditions that may impact a current or upcoming trip. Relevant alerts are selected based on user-configurable parameters, thresholds, and preferences that are submitted by travelers. The travel alert service offered by this equipment package is available to the Vehicle and Personal Information Access subsystems.	■ Center shall accept traveler profiles that establish recurring trip characteristics, including route, mode, and timeframe information ■ Center shall accept traveler profiles that define alert thresholds and establish the severity and types of alerts that are provided to each traveler ■ Center shall disseminate personalized traffic alerts reporting congestion, incidents, delays, detours, and road closures that may impact a current or planned trip ■ Center shall disseminate personalized transit alerts reporting transit delays and service interruptions ■ Center shall disseminate personalized road weather alerts reporting adverse road and weather conditions ■ Center shall disseminate personalized event alerts reporting special event impacts on the transportation system ■ Center shall provide an operator interface that supports monitoring and management of subscribers and the content and format of alert messages
Interactive Infrastructure Information	Disseminates personalized traveler information, including traffic and road conditions, transit information, maintenance and construction information, multimodal information, event information, and weather information. Tailored information is provided based on the traveler's request in this interactive equipment package. The interactive service offered by this equipment package is available to the Vehicle Remote Traveler Support, and Personal Information Access subsystems.	■ Center shall disseminate customized traffic and highway condition information to travelers, including incident information, detours and road closures, recommended routes, and current speeds on specific routes upon request ■ Center shall disseminate customized maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities upon request ■ Center shall disseminate customized transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers upon request ■ Center shall disseminate customized event information to travelers upon request ■ Center shall provide all traveler information based on the traveler's current location or a specific location identified by the traveler, and filter or customize the provided information accordingly ■ Center shall accept traveler profiles for determining the type of personalized data to send to the traveler

Source: DVRPC, 2012

Table E-6: Toll Administration Functional Requirements

Equipment Package	Purpose	Functional Requirement
Toll Administration	Provide administration and management of an Electronic Toll Collection (ETC) system, including back office functions that support enrollment, pricing, payment reconciliation with financial institutions, and violation notification with enforcement agencies.	■ Center shall manage toll transactions, including maintaining a log of all transactions and toll pricing structure information ■ For electronic toll payments requiring financial payment, the center shall process the financial information from toll plazas and manage an interface to a financial institution ■ Center shall manage a local billing database for toll customers ■ Center shall manage the details of toll payment violations based on vehicle information from the toll plaza, registration information from the Department of Motor Vehicles, invalid payment information from a financial institution, and previous violation information stored locally, and report such violations to appropriate law enforcement agencies ■ Center shall exchange data with other toll agencies to coordinate toll transactions ■ Center shall support requests for advanced toll payment and provide this information to its toll plazas
Toll Data Collection	Collects and stores toll information that is collected in the course of toll operations.	■ Center shall collect toll operational data and pricing data ■ Center shall archive toll operational data

Source: DVRPC, 2012

Table E-7: Toll Collection Functional Requirements

Equipment Package	Purpose	Functional Requirement
Toll Plaza Toll Collection	Provides toll plazas with the capability to identify properly equipped vehicles, collect electronic tolls, and provide a positive indication to the driver that a toll was collected.	■ Toll plaza equipment shall read data from passing vehicles to support toll payment transactions ■ Toll plaza shall calculate the toll due based on the vehicle characteristics (vehicle size, weight, axle count, etc.) and stored toll prices ■ Toll plaza shall update the stored value after debiting the toll amount and send a record of the transaction to a center ■ Toll plaza equipment shall read the credit identity from the passing vehicle and send that identity and the amount to be debited to a center ■ In the case of closed toll systems, the toll plaza shall update the vehicle on-board data with the system entry point, and upon toll system exit, use the stored data in the calculation of the toll ■ Toll plaza shall control roadside displays indicating success or failure of the toll transaction to the driver ■ Toll plaza shall control cameras, obtain images, and forward images of toll violators to a center

Source: DVRPC, 2012

Table E-8: Transit Vehicle Functional Requirements

Equipment Package	Purpose	Functional Requirement
On-board Transit Trip Monitoring	On-board equipment package tracks vehicle location, collects operational status, and sends the collected data to the transit center.	■ Transit vehicle shall track its current location ■ Transit vehicle shall support the computation of its location using on-board sensors to augment the location determination function, including proximity to the transit stops or other known reference points, as well as recording trip length ■ Transit vehicle shall record transit trip monitoring data, including vehicle mileage and fuel usage ■ Transit vehicle shall record transit trip monitoring data, including operational status information such as doors open/closed, running times, etc ■ Transit vehicle shall send the transit vehicle trip monitoring data to the transit center
On-board Schedule Management	Monitors transit vehicle schedule performance and identifies corrective actions when a deviation is detected.	■ Transit vehicle shall receive a vehicle assignment, including transit route information, transit service instructions, traffic information, road conditions, and other information ■ Transit vehicle shall use the route information and its current location to determine the deviation from the predetermined schedule ■ Transit vehicle shall calculate the estimated times of arrival at transit stops ■ Transit vehicle shall determine scenarios to correct the schedule deviation ■ Transit vehicle shall provide the schedule deviations and instructions for schedule corrections to the transit vehicle operator ■ Transit vehicle shall send the schedule deviation and estimated arrival time information to the transit center ■ Transit vehicle shall support the operations of a flexible route service ■ Transit vehicle shall notify the transit center of vehicle location and operational status as the vehicle exits and returns to the transit facility to support future vehicle assignments
On-board Transit Fare Management	Supports fare collection using a standard fare card or other non monetary fare medium and detects payment violations.	■ Transit vehicle shall read data from the traveler card/payment instrument presented by boarding passengers ■ Transit vehicle shall provide an image of all travelers, which shall be used for violation processing of those who do not have a traveler card/payment instrument or whose transit fare transaction fails ■ Transit vehicle shall calculate the traveler's fare based on the origin and destination provided by the traveler, as well as factors such as the transit routing, transit fare category, traveler history, and route-specific information

Table E-8: Transit Vehicle Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirement
		■ Transit vehicle shall include a database on-board the transit vehicle for use in fare processing from which the fares for all possible trips within the transit operational network can be determined ■ Transit vehicle shall provide a transit fare payment interface that is suitable for travelers with physical disabilities, senior citizens, school children, and other special fare schedules ■ Transit vehicle shall provide fare statistics data to the transit center
On-board Passenger Counting	Collects transit vehicle passenger loading data and makes it available to the transit center.	■ Transit vehicle shall count passengers boarding and alighting ■ Passenger counts shall be related to location to support association of passenger counts with routes, route segments, bus stops, or station ■ Passenger counts shall be time stamped so that ridership can be measured by time of day and day of week ■ Transit vehicle shall send the collected passenger count information to the transit center
On-board Transit Information Services	Furnishes en route transit users with real-time travel-related information on-board a transit vehicle.	■ Transit vehicle shall broadcast advisories about the imminent arrival of the transit vehicle at the next stop via an on-board automated annunciation system ■ Transit vehicle shall enable travel advisory information to be requested and output to the traveler, including transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events ■ Transit vehicle shall tailor the output of the requested traveler information based on the current location of the transit vehicle ■ Transit vehicle shall support input and output forms that are suitable for travelers with physical disabilities ■ Transit vehicle shall gather transit advisory data, including alerts and advisories pertaining to major emergencies and special events
On-board Transit Security	Provides security and safety functions on-board the transit vehicle.	■ Transit vehicle shall accept emergency inputs from either the transit vehicle operator or a traveler through such interfaces as panic buttons, silent or audible alarms, etc ■ Transit vehicle shall output reported emergencies to the transit center ■ Transit vehicle shall receive acknowledgments of the emergency request from the transit center and output this acknowledgment to the transit vehicle operator or to the passengers

Table E-8: Transit Vehicle Functional Requirements (continued)

Equipment Package	Purpose	Functional Requirement
		■ Transit vehicle shall be capable of receiving an emergency message for broadcast to the passengers or to the transit vehicle operator ■ Transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either monitoring by the transit vehicle operator, remote monitoring, or for local storage (e.g., in an event recorder) ■ Transit vehicle shall perform local monitoring of video or audio surveillance data collected inside of transit vehicles, and identify potential incidents or threats based on received processing parameters ■ Transit vehicle shall output an indication of potential incidents or threats and the processed video or audio information to the transit center, along with the vehicle's current location ■ Transit vehicle shall detect potential threats via sensors for chemical agents, toxic industrial chemicals, biological agents, explosives, and radiation ■ Transit vehicle shall output an indication of potential incidents or threats and the processed sensor information to the transit center along with the vehicle's current location ■ Transit vehicle shall accept sensor control data to allow remote control of the sensors

Source: DVRPC, 2012

APPENDIX F

Concept of Operations

Table F-1: Incident Management Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC BCBC TOC DRJTBC Offices DRPA TOC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Conduct traffic surveillance, identify incidents ■ Notify 9-1-1 center that an incident has occurred ■ Dispatch ESP vehicles for traffic control ■ Post information on VMS signs ■ Enter incident information into 511 ■ Notify other entities via RIMIS ■ Modify traffic signal timings on detour routes ■ Request maintenance crews for clean up ■ Provide information to ISPs and media ■ Develop/implement traffic control plan for special events
9-1-1 Call Centers	NJ County 9-1-1s NJSP Troop Dispatch PA County 9-1-1s PPD Radio Room Dispatch PSP Norristown CDC	■ Receive 9-1-1 call from the public ■ Dispatch first responders ■ Verify incident from traffic management video ■ Dispatch additional police, fire, EMS resources
Emergency Responders	NJSP PSP BCBC Police DRPA Police Municipal Police, Fire, EMS PPD Philadelphia Fire Dept.	■ Determine first responder resources needed ■ Conduct traffic investigation, traffic control ■ Implement ICS procedures ■ Request additional resources as needed
Information Service Providers	NJDOT 511/Traveler Info PennDOT 511/Traveler Info NJTA 511/Traveler Info PTC Traveler Info	■ 511 systems update their databases and maps ■ Update ISP/TMAs databases and maps ■ Issue traveler alerts to people signed up for them

Table F-1: Incident Management Roles and Responsibilities (continued)

Area	Stakeholders	Roles and Responsibilities
	SJTA 511/Traveler Info	
	ISPs	
	NJ and PA TMAs	
Maintenance Offices	NJDOT Maintenance	■ Receives request for assistance from 9-1-1, police, or traffic management ■ Dispatched maintenance crew
	PennDOT District 6-0 - County Maintenance	
	DRPA Bridge Maintenance	
	BCBC Maintenance	
	DRJTBC Offices	
	NJTA Maintenance	
	NJ County Public Works Departments	
	Philadelphia Streets Dept	
	PTC Maintenance Offices	
	SJTA Maintenance	
Special Events Operators	Event operators	■ Notify traffic management about upcoming special events

Source: DVRPC, 2012

Table F-2: Traffic Management Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC BCBC TOC DRJTBC Offices DRPA TOC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Conduct traffic surveillance using CCTV and traffic detectors ■ Monitor traffic signal system, signal equipment status, timing plans ■ Display travel times on VMS signs ■ Enter information into 511 ■ Import data interface information into RIMIS ■ Request maintenance crews when field equipment/signal malfunctions are detected ■ Display traffic advisories on VMS signs when traffic congestion is detected ■ Update 511and RIMIS databases ■ Modify signal timings on alternative routes
Maintenance Offices	NJDOT Maintenance PennDOT District 6-0 - County Maintenance BCBC Maintenance DRJTBC Offices DRPA Bridge Maintenance NJTA Maintenance NJ County Public Works Departments Phila Streets Department PTC Maintenance Offices SJTA TOC - Maintenance	■ Dispatch field crews to repair field equipment/traffic signals
Information Service Providers	NJDOT 511/Traveler Info PennDOT 511/Traveler Info NJTA 511/Traveler Info PTC Traveler Info SJTA 511/Traveler Info ISPs TMAs – New Jersey Traveler Info TMAs - Pennsylvania Traveler Info	■ Update ISPs/TMAs databases and maps

Source: DVRPC, 2012

Table F-3: Integrated Corridor Management Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Conduct surveillance on expressways and arterials ■ Coordinate signal timings/plans with adjacent entities ■ Implement transit vehicle priority treatment ■ Implement emergency vehicle pre emption ■ Implement ramp metering ■ Display travel times on VMS signs ■ Identify incidents and congested conditions ■ Display traffic alerts on VMS signs ■ Determine if detour routes can handle surge in traffic ■ Implement emergency detour timings ■ Display detour route information on VMS signs ■ PennDOT assumes signal control in emergencies
Transit Management Centers	NJ TRANSIT Bus Operations South NJ TRANSIT Rail Operations Center River Line Operations Center PATCO Center Tower SEPTA Operations Center	■ Request TMCs post-transit information on VMS signs ■ Request transit vehicle priority treatment ■ Adjust bus schedules based on highway network information conditions
Emergency Responders	NJSP PSP Municipal Police, Fire, EMS PPD Philadelphia Fire Department	■ Monitor CCTV surveillance and travel times ■ Respond when notified of an incident ■ Determine optimum routing based on situational information ■ Staff predetermined traffic control points when notified of a traffic diversion

Source: DVRPC, 2012

Table F-4: Construction and Maintenance Activity Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Maintenance Offices	NJDOT Maintenance NJDOT TEOC/REOC PennDOT District 6-0 - County Maintenance BCBC Maintenance DRJTBC Offices DRPA Bridge Maintenance NJTA Maintenance NJ County Public Works Departments Phila Streets Department PTC Maintenance Offices SJTA TOC - Maintenance	■ Dispatch maintenance vehicles and crews ■ Monitor maintenance vehicles and equipment ■ Dispatch crews for emergency cleanup and repairs ■ Notify traffic management centers of street closure activity ■ Notify traffic management centers of maintenance and construction work plans ■ Obtain work zone status from field crews ■ Monitor work zone traffic impact via CCTV ■ Notify 9-1-1 about work zone incidents ■ Monitor RWIS devices ■ Monitor winter road conditions ■ Enter winter road conditions into 511/traveler information systems
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC BCBC TOC DRJTBC Offices DRPA TOC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Notify other entities of street closures, maintenance and construction plans ■ Provide work plan feedback, coordinate construction activity with other entities ■ Monitor work zone traffic impact via CCTV ■ Post travel times and construction information on VMS signs ■ Provide maintenance and construction traffic condition information ■ Request shut down of work zones for detours ■ Request maintenance crews for clean up ■ Enter maintenance and construction information into 511/traveler information systems

Source: DVRPC, 2012

Table F-5: Traveler Information Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC BCBC TOC DRJTBC Offices DRPA TOC NJ County TOCs NJTA TMC Philadelphia TOC PTC OCC SJTA TOC	■ Enter road network conditions into 511/traveler information systems ■ Enter incident information into 511/traveler information systems ■ Enter maintenance and construction information into 511/traveler information systems ■ Post traveler information on VMS signs ■ Post travel times on VMS signs ■ Make CCTV video available to ISPs, media, agency websites ■ Disseminate traffic information to ISPs, TMAs, media
Transit Management Centers	Amtrak CTEC NJ TRANSIT Bus Operations South NJ TRANSIT Rail Operations Center River Line Operations Center PATCO Center Tower SEPTA Operations Center	■ Enter schedule adherence and service disruptions into agency traveler info system ■ Make schedule adherence and service disruptions available to 511/traveler information systems ■ Disseminate schedule adherence and service disruptions to ISPs
Maintenance Offices	NJDOT Maintenance NJDOT TEOC/REOC PennDOT District 6-0 - County Maintenance BCBC Maintenance DRJTBC Offices DRPA Bridge Maintenance NJTA Maintenance NJ County Public Works Departments Phila Streets Department Maintenance PTC Maintenance Offices SJTA TOC - Maintenance	■ Enter road conditions into 511/traveler information systems

Table F-5: Traveler Information Roles and Responsibilities (continued)

Area	Stakeholders	Roles and Responsibilities
Information Service Providers	NJ 511/Traveler Info PA 511/Traveler Info NJ County Traveler Info NJTA 511/Traveler Info PTC Traveler Info SJTA 511/Traveler Info ISPs TMAs - New Jersey Traveler Info TMAs – Pennsylvania Traveler Info	■ Update ISPs/TMAs databases and maps ■ Issue traveler alerts to people signed up for them ■ Update transit schedules and fares ■ Update transit schedule adherence and service disruption information
Transit Traveler Information Systems	Amtrak Traveler Info DRPA /PATCO NJ TRANSIT Corp Info SEPTA Traveler Info	■ Post schedule adherence and service disruptions on DMS signs ■ Broadcast traveler alerts ■ Update website and Interactive Voice Response (IVR) systems

Source: DVRPC, 2012

Table F-6: Transit Operations Roles and Responsibilities

Area	Stakeholders	Roles and Responsibilities
Transit Management Centers	Amtrak CTEC NJ TRANSIT Bus Operations South NJ TRANSIT Rail Operations Center River Line Operations Center PATCO Center Tower SEPTA Operations Center	■ Monitor transit vehicle schedule performance ■ Communicate with transit vehicle operators ■ Monitor power and signal systems ■ Dispatch maintenance crews and supervisors ■ Develop transit vehicle and driver assignments ■ Enter schedule adherence and service disruptions into agency traveler information system ■ Disseminate schedule adherence and service disruptions to ISPs

Table F-6: Transit Operations Roles and Responsibilities (continued)

Area	Stakeholders	Roles and Responsibilities
Transit Fleet Management	Amtrak NJ TRANSIT PATCO SEPTA	■ Assign vehicles to routes ■ Monitor transit vehicle condition ■ Schedule routine maintenance ■ Dispatch crews to repair transit vehicles ■ Notify transit management centers of vehicle status and availability
Transit Police	Amtrak Police DRPA Transit Police NJ TRANSIT Police SEPTA Police	■ Monitor transit stations, vehicles, yards, rail right-of-way ■ Respond to passenger alerts ■ Dispatch transit police officers ■ Notify other emergency responders about incidents ■ Coordinate with Transit Management Centers
Traffic Management Centers	NJDOT STMC/TOC South PennDOT District 6-0 RTMC DRPA TOC NJ County TOCs Philadelphia TOC	■ Provide road conditions, incident information, and maintenance and construction work plans ■ Implement transit vehicle priority treatment
Transit Traveler Information Systems	Amtrak Traveler Info DRPA /PATCO Traveler Info NJ TRANSIT Corp Info SEPTA Traveler Info	■ Post schedule adherence and service disruptions on DMS signs ■ Broadcast traveler alerts ■ Update websites and IVR systems
Information Service Providers	NJ 511/Traveler Info PA 511/Traveler Info ISPs TMAs – NJ Traveler Info TMAs – PA Traveler Info	■ Update transit schedules and fares ■ Update transit schedule adherence and service disruption information

Source: DVRPC, 2012

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Abstract: The purpose of this document is to present the Regional ITS Architecture for the Delaware Valley. This structure, modeled after and consistent with the National ITS Architecture developed by USDOT, maps out how the various ITS components in the Delaware Valley region should be ultimately tied together and integrated–both physically as well as institutionally. This architecture was developed through a coordinated process with a wide array of stakeholders, and addresses 1) the integration of ITS systems and components, 2) the roles and responsibilities of a wide range of ITS stakeholders, 3) the tailoring of ITS deployment and operations to local needs, 4) the sharing of information between stakeholders, and 5) the future expansion of ITS. The document is targeted to professionals who require in-depth knowledge of the regional ITS architecture for the Delaware Valley

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