Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency that provides continuing, comprehensive and coordinated planning to shape a vision for the future growth of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties, as well as the City of Philadelphia, in Pennsylvania; and Burlington, Camden, Gloucester and Mercer counties in New Jersey. DVRPC provides technical assistance and services; conducts high priority studies that respond to the requests and demands of member state and local governments; fosters cooperation among various constituents to forge a consensus on diverse regional issues; determines and meets the needs of the private sector; and practices public outreach efforts to promote two-way communication and public awareness of regional issues and the Commission.

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 its findings and conclusions, which may not represent the official views or policies of the funding agencies.
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### ITS Initiatives of Regional Significance

#### Current Initiatives

- Regional Integrated Multi-modal Information Sharing (RIMIS) Project
- Regional Video Sharing Program
- Policy for Traffic Signal Systems

#### Future Initiatives

- Traffic Operation Centers
- Regional ITS Standards
- Regional Fiber Optic Network Coordination Program
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- Probe Surveillance Technology Policy
- Regional Smart Card

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- ITS Capital Program
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**INTRODUCTION**

This Plan represents a long-term vision of ITS in the Delaware Valley. It was prepared by the Delaware Valley Regional Planning Commission's (DVRPC) ITS Technical Task Force (TTF), which is composed of traffic, transit, and emergency management operators in the region. Implementing ITS is largely the responsibility of individual agencies who have differing objectives. The purpose of the Plan is to present a comprehensive vision of ITS services to be implemented; more importantly, it proposes a list of projects that will bridge the individual programs and create more cohesive operations.

Three main components comprise the Plan. *ITS Vision* describes how ITS should operate in the region. *ITS Initiatives of Regional Significance* identifies projects that integrate individual agency efforts. *ITS Implementation* presents a ten-year capital program, advocates providing sufficient funding for ITS operations and maintenance, and recommends mechanisms to promote transportation operations.

**ITS VISION**

Basic tenets of the region's ITS Master Plan are: 1) build out the ITS infrastructure, 2) implement incident management programs, 3) implement transit management programs, and 4) provide traveler information services.

**Highway ITS Infrastructure**

*Deploy Basic Field Devices: CCTV Cameras, VMS Signs, Detectors -*

Over 190 Closed Circuit Television (CCTV) cameras and 60 Variable Message Signs (VMS) are deployed on the region's highway system. The long-term vision is to instrument all expressways (Figure 1, page 21) with basic ITS infrastructure consisting of full video coverage, VMS signs at decision points, and detectors to gather traffic flow information (i.e., traffic speed). ITS coverage on
toll facilities, with long distances between interchanges, may be more limited. Building this vision is a long-term process in which ITS is incrementally implemented either as part of larger construction projects or as stand-alone projects to fill in gaps in the ITS infrastructure. Deploying ITS on arterial roads is a lower regional priority and is covered in other sections of the Master Plan.

In addition to the basic ITS infrastructure, other field devices, including weather stations to monitor pavement conditions, equipment for commercial vehicle operations, and security cameras for bridges, tunnels, and other sensitive transportation structures, will be deployed as needed. Dedicated high-speed E-ZPass lanes to further minimize congestion at toll plazas should be constructed where feasible.

**Establish Fiber Optic Communications Networks: Field to Center, Center to Center** - Creating a backbone communications network to bring information back to operation centers and to interconnect operation centers is essential. The most significant cost associated with fiber is installing conduit. To minimize fiber costs, agencies will have to be more opportunistic, laying conduit as part of larger construction projects in anticipation of installing fiber at a later date. In Pennsylvania, increased use must be made of sharing fiber networks constructed as part of closed loop traffic signal projects on state highways.

**Upgrade Traffic Operation Center Technology** - Many existing operation centers were constructed on an ad hoc basis, using stand-alone workstations where there is separate software for different VMS and CCTV systems. A major short-term emphasis will be to promote systems integration whereby a single software package will drive all VMS, CCTV, and detectors in an operations center.
Deploy Emergency Service Patrol Vehicles to Assist Motorists -
The most basic level of incident management is deployment of Emergency Service Patrol (ESP) vehicles on expressways. Existing ESP coverage area and the ultimate vision for ESPs are displayed in Figure 2, page 23. ESP hours of operation vary by agency: toll authorities have 24 X 7 operations; departments of transportation have more limited hours. At a minimum, ESPs should offer daily service, and hours of operation should account for special events that can extend into the evening.

Utilize Incident Management Task Forces to Improve Incident Management Coordination - Incident management requires close coordination of different types of organizations, many of which traditionally do not work well together. Incident management task forces foster greater cooperation by allowing emergency responders and other organizations to meet in a more relaxed atmosphere away from an incident to identify and resolve coordination issues. Results can be institutional solutions, such as assigning highway sectors to different responders based upon their accessibility; or physical improvements, such as constructing doors in sound walls. A list of corridors where incident management task forces should be implemented is shown in Figure 3, page 25.

Establish Incident Management Response Teams to Coordinate a Department of Transportation’s Response to Incidents -
Incident Response Management Teams (IRMT) are trained personnel with especially equipped vehicles that enable a department of transportation to coordinate the highway agency’s response to an incident. The long-term vision is to train and equip a sufficient number of department of transportation personnel so effectively that they will be positioned throughout the region to more rapidly respond to a major incident.

Implement Integrated Corridor Management Programs -
Integrated corridor management is a tool to dynamically change traffic signal timing on arterial highways and bring other resources together
in a corridor. In expressway corridors, integrated corridor management empowers agencies to control traffic on detour routes. It involves all modes of transportation. An infrastructure of closed loop traffic signal systems, blackout signs for route guidance, CCTV cameras for observation of traffic conditions, and a communications backbone is required. The Pennsylvania Department of Transportation (PennDOT) is developing a prototype program for the Delaware Valley in the Schuylkill Expressway Corridor (Figure 4, page 27). Figure 5, page 29, shows other corridors in the region where similar programs are proposed. For the program to work, especially in Pennsylvania, a mechanism must be found to coordinate signals among jurisdictions that the detour routes pass through.

**Transit Management**

Transit management represents the umbrella technology that automates and integrates subsystems dealing with train control, electrical systems, bus supervision, paratransit, fare collection, vehicle maintenance, passenger security, and traveler information.

**Deploy Advance Control Systems for Rail and Buses**

Supervisory Control and Data Acquisition (SCADA) systems track train location, signals and switches, and electrical systems that power rail vehicles. Southeastern Pennsylvania Transportation Authority (SEPTA) consolidated all their operations (rail, light rail, bus operations, and paratransit) in a single state-of-the-art operations center. PATCO eventually plans to replace its operations center with a new facility and the latest SCADA systems.

A major problem encountered by SEPTA and New Jersey Transit is coordination with Amtrak. All trains operating on Amtrak's right-of-way are controlled by Amtrak's Central Traffic Electrical Control (CTEC). Due to a combination of reasons, information received from Amtrak is spotty and often unreliable. The long-term solution is to either establish a data link between transit operators and Amtrak or install GPS devices on the trains so they can get real-time information independent of Amtrak.
Bus supervision relying upon Automatic Vehicle Location (AVL) technology enables transit agencies to track buses, monitor schedule adherence, and take corrective action as needed. SEPTA has implemented AVL technology on four bus routes and is expediting plans to instrument their entire fleet. New Jersey Transit needs to equip their buses and paratransit vehicles with AVL.

**Implement Advanced Traveler Information Systems for Transit Riders** - Real-time data generated by SCADA systems is triggering new, innovative traveler information initiatives. SEPTA is rolling out new dynamic message signs and public address systems on rail and regional rail stations. Operation center personnel can now impart to passengers, via these devices, accurate train arrival information. The long-term vision is to continue deploying traveler information systems in stations and on transit vehicles, and ultimately to deploy smart bus stops providing real-time arrival information.

Transit agencies have implemented web sites and interactive voice response telephone systems for pre-trip travel information. The underlying databases driving these systems will eventually become populated with real-time information from the operation centers. Besides traveler information, another major concern of passengers is safety and security. CCTV technology combined with fiber communications has increased the transit agencies' ability to monitor their properties. Transit police can now monitor stations and parking lots for suspicious activity. Rail operators can monitor platforms for overloading, preventing accidents.

**Traveler Information**

Until fairly recently, the only way to receive traffic and transit information was to listen to commercial radio. With the advent of ITS, there are now increased and more sophisticated means to access travel information via the Internet, satellite radio, OnStar type devices, or cellular text messaging.
Maintain Public-Private Partnerships with Traffic Reporting Services -
The primary responsibility of transportation agencies is to manage their highways or transit lines, especially during incidents. Because of this, New Jersey Department of Transportation (NJDOT) and PennDOT have, to various extent, relied upon the private sector to assist them in disseminating travel information to the public. Since the public sector does not have the resources, financially or technically, to compete with the private sector in packaging travel information, this symbiotic relationship should continue. The relationship should be strengthened by more formally integrating the communication linkages between the operation centers and the traffic reporting services.

Provide Basic Pre-trip and Enroute Travel Information to the Public -
Relying upon the private sector to disseminate traffic information does not relieve the public agencies of the responsibility for providing basic travel information to the public. Highway agencies should routinely post travel times and construction / maintenance activity notifications on the Internet and their VMS signs. CCTV images will become more widely available on the Internet. Agencies need to take more advantage of Transportation Management Agencies (TMAs) who have close relationships with the business community throughout the region and can rapidly disseminate information to them.

Deploy 511 Telephone Number for Traveler Information -
Both NJDOT and PennDOT are developing plans to deploy 511 traveler information services within their states. They should offer both highway and transit information and not be restricted to highway information. Because travelers seamlessly travel over different roadway systems and between states, without knowing who owns or manages the road, it is incumbent upon the 511 programs to present multi-jurisdictional travel information.
ITS INITIATIVES OF REGIONAL SIGNIFICANCE

This section outlines regional ITS initiatives that will result in improved interoperability and coordination among transportation agencies in the region and between the transportation agencies and emergency service providers. It is divided into two components: current initiatives that are to various degrees underway, and future initiatives that have not yet begun.

Current Initiatives

Regional Integrated Multi-modal Information Sharing (RIMIS) Project - RIMIS is an information exchange network linking highway and traffic operation centers, transit agencies, emergency management organizations, traffic reporting services, and other organizations involved in transportation operations or incident management. Its two primary objectives are to facilitate information sharing and provide a means to foster interagency coordination. When an accident occurs, operation center staff do not have time to notify every organization impacted. RIMIS will function as a notification or messaging system broadcasting information to all appropriate organizations. RIMIS will also provide the "big picture," giving control center staff a broader perspective of what is happening in the region and allowing them to make a more informed response.

While RIMIS is still in preliminary stages of development, certain needs have already been identified. Information to be shared includes incident notification, incident tracking, traffic and transit conditions, traffic control resources, and emergency support resources. Incidents include accidents, special events, adverse weather conditions, construction and maintenance activity, and emergency evacuation. Agencies will use RIMIS to notify each other about incidents, request incident updates from another agency, request the posting of traffic alerts, or request special assistance. The long-term goal is to integrate RIMIS into each agency's systems so that information is populated into RIMIS automatically, without the need for double data entry.
**Regional Video Sharing Program** - Emergency responders urgently need highway video to confirm an accident, its location, determine which equipment to dispatch, and to optimize routing emergency vehicles to the accident scene. Highway departments and toll authorities want video to determine if traffic backups will impact their roadways. Access to CCTV video is also crucial in emergency evacuation situations. A regional video sharing program among highway organizations, state police, county 911s, and municipal police and fire departments is a high regional priority.

There is a number of embryotic video sharing programs in the region. For example, PennDOT currently shares its video with the Philadelphia Police Department and Chester and Montgomery County 911s. These prototypes have been accomplished using agency fiber optic networks, rented T1 telecommunication lines, or outdated technology. To expand these model deployments to a regional program is both time consuming and costly.

A regional video sharing program, using MP4 technology similar to video streaming on home computers, can drastically reduce implementation time and cost. Web-based video sharing technology is readily implementable, does not require expensive infrastructure and equipment, and the video quality is constantly improving. A secondary benefit of the program is that agencies can place the images on their website, instantly enhancing their traveler information programs. Agencies consistently report that their video web pages, even though they are limited, are very popular with the public.

Three potential drawbacks to a regional video sharing program exist. First is the cost to hire a contractor to perform the technical work and host a central video website. Second is the telecommunication cost to stream video between an agency and the communications hub serving the website. It should be noted that both costs may be partially offset through new sources of federal funding and/or permitting the contractor to commercialize the video images. The third concern deals with security: the reliability of the web during emergency situations and protecting the public from
unsetting images. Because of this concern, an Internet-based video sharing program would not negate the need for a secure private fiber optic network to interconnect agencies.

**Policy for Traffic Signal Systems** - DVRPC’s FY 2005 - FY 2008 Transportation Improvement Program contains over 40 traffic signal projects, worth approximately $86 million, for the Pennsylvania portion of the region. Projects include signal interconnects, closed loop traffic signal systems, and signal modernization. There is no regional policy or priorities for such a major capital investment.

Pennsylvania is one of the few states where the responsibility for operating and maintaining traffic signals on state highways resides with the municipalities not the state department of transportation. Due to this unique situation, initiatives to upgrade and coordinate traffic signals traditionally originated with the municipalities, not PennDOT. With increasing congestion and tight budgets, funding for traffic signal system projects should be based on regional priorities, not local wishes. Funding priorities must account for traffic and congestion levels, filling in gaps in existing signal systems, integrated management corridors, and expressway detour routes. PennDOT and DVRPC are working together to inventory existing signal systems and identify future system needs. Working with the counties, the intent is to ultimately establish regional traffic signal system funding priorities.

Inter-municipal signal coordination and coordination with PennDOT’s Traffic Control Center are operational issues. Manual adjustments to system timing must be coordinated with adjoining municipalities. When traffic is diverted from expressways, a superseding mechanism must be in place to trigger signal timing adjustments along the detour route. In the Schuylkill Expressway Corridor TSM project, PennDOT and Montgomery County are exploring various mechanisms to coordinate signal timing when there is a diversion off I-76. One scenario calls for giving PennDOT District 6-0 Traffic Control Center authority to preempt signal timing. This prototype effort may eventually evolve into a regional policy.
Establishing high-level planning criteria for signal systems is another priority. The type of signal coordination (time based, hard wire, closed loop system) should be based on traffic conditions, not the desire to construct a state-of-the-art system. In integrated management corridors, sufficient communication bandwidth must be incorporated into the design to permit PennDOT to install CCTV and VMS signals on arterial roads. Planning criteria should be established at the corridor level to facilitate inter-system coordination and operations.

New Jersey faces similar traffic signal issues; however, their magnitude is not as severe. While NJDOT and most counties manage their signal systems, a few counties, like Camden County, delegate their signals to the municipalities.

**Future Initiatives**

**Traffic Operation Centers** - While most agencies have centers, three key regional organizations - DRPA, the City of Philadelphia Streets Department, and the Sports Complex - lack operation centers. While not technically a regional initiative, construction of these centers is crucial to implementing the Plan and managing the region's transportation system.

DRPA is responsible for managing the four major river crossings between New Jersey and Pennsylvania, providing access to Center City from New Jersey. Traffic and incident management is controlled by DRPA Police supervisors stationed at each bridge. Without a centralized operations center it is arduous for outside agencies to coordinate effectively with DRPA.

The City of Philadelphia has one of the most proactive programs in the region to implement closed loop traffic control systems. These systems enable the Streets Department to change signal timing in response to an incident, such as a closure of I-95. Without an operations center, staff are unavailable to monitor the highway and street systems and implement signal changes when needed.
Events at the Sports Complex in South Philadelphia have a wide impact on regional traffic. Numerous organizations share responsibility for managing traffic at the Sports Complex including the Philadelphia Police Department Traffic Police, Sports Complex Special Services District, and the Streets Department. An operation center will provide a formal structure for these organizations to jointly monitor and manage traffic at the Sports Complex and coordinate with regional agencies that control transportation facilities that funnel fans into the complex.

Regional ITS Standards - One of the biggest ITS challenges is insuring interoperability: the ability of different systems to communicate with each other. The United States Department of Transportation, in cooperation with the ITS community, has promulgated standards for different ITS elements including traffic signal equipment, VMS signs, and traveler information. Adherence to standards will expedite device interoperability.

As agencies implement integration software to manage their field devices and operation centers from a single software package, center-to-center communications becomes a regional concern unless they adopt common standards. National Transportation Communications for ITS Protocols (NTCIP), Transit Interface Communication Protocols (TCIP), and 1512 Incident Management Standards are three examples of standards that bridge this gap. Agencies that implement ITS projects need to jointly establish a formal mechanism to adopt and implement common standards applicable to the region.

Regional Fiber Optic Network Coordination Program -
As mentioned under Highway ITS Infrastructure, fiber optic networks are costly to construct. From a regional perspective, it is imperative for agencies to cooperatively develop a regional fiber plan that will maximize the use of fiber and provide critical redundancy if part of the network is impaired. This requires identifying opportunities where agencies can interconnect with each other’s networks. A subgroup of the Delaware Valley ITS Technical Task Force will be assigned the task to develop a fiber plan for the region.
**Incident Coordination Incentive Program** - Integrated corridor management and incident management task forces rely upon the participation and cooperation of local emergency responders. Fire and police departments are more focused on other priorities and tend to under fund and minimize highway incident management programs. To gain their interest and cooperation, an Incident Coordination Incentive Program (ICIP) targeted to emergency responders would fund programs to foster greater coordination and/or purchase equipment to control traffic or improve inter-agency communications. The program, if advanced, would be funded through DVRPC's Transportation Improvement Program.

ICIP would supplement current incident management efforts by enabling organizations to fund needed highway incident management activities that were always wanted, but they could not afford. Grants would be available on a competitive basis. Selection criteria would stress consistency with the goals of the ITS Master Plan.

A partial list of eligible organizations include municipal and volunteer fire companies, EMS services, municipal police departments, county 911 centers, and municipal and county emergency management agencies. Funding would be available for two types of grants: incident management services and incident management equipment purchases. Incident management services would include the following types of activities: training programs pertaining to incident management and highway responder safety; table top or mock exercises of highway incidents; and developing and printing educational materials, procedure manuals, and detour routes. Incident management equipment purchases would include the following types of equipment: traffic control equipment to be used by local emergency responders; trailers to haul pre-staged traffic control equipment to the scene of an incident; permanent or temporary trailblazer detour signs; portable VMS signs for on-scene traffic control and/or detour routes; and purchasing accident investigation equipment.
**Probe Surveillance Technology Policy** - Collecting travel speeds and traffic volumes are critical for detecting traffic incidents and providing traveler information. A number of technologies exist including detectors (radar or microwave devices) that generate travel speeds at the location of the detector, and probe surveillance devices that can track vehicles traveling over the highway system via an assortment of different technologies. The problem is most probe technologies are still in the development or testing phase; it is unclear which specific technology will emerge as the best choice for the region, and whether it will be preferable to detectors. A regional approach to evaluating and selecting probe technology is needed. Ideally, employing common technology reduces development and acquisition costs and more readily facilitates information sharing among agencies.

Detectors employ microwave or sound wave technology to sense traffic flow. There are three approaches to probe technology. TRANSMIT, which is employed in the New York metropolitan area, tracks vehicles with E-ZPass transponder as they pass by roadside E-ZPass readers. A second approach involves tracking cell phone calls as they pass from one cell tower to another. The least advanced technology relies upon GPS devices embedded in vehicles or cell phones. All technologies scramble information to preserve the motorist's privacy.

**Regional Smart Card** - New Jersey Transit, SEPTA, PATCO, and DART First State all employ different fare media ranging from tokens or tickets to weekly/monthly passes. Many transit agencies across the county are migrating to Smart Card technology. Smart Cards store a value on a memory chip embedded on the card; they are resistant to fraud and permit secure data transfer leading to increased automation of fare collection. Benefits include interoperable fare payment media among transit systems, using a common media to pay for fares and parking at stations, contactless fare collection that will result in lower maintenance costs, automated passenger counting, and potentially innovative fare polices. If transit agencies agree to migrate to Smart Card technology, a common
Smart Card would maximize benefits to the agencies and their passengers. However, passenger expectations and the structure of some of the agencies may prevent its adoption.
ITS IMPLEMENTATION

This section will recommend how to integrate ITS and transportation operations into the region's transportation planning, capital funding, and administrative processes. Integration means both providing funding not only to implement ITS projects, but also sustainable funding to maintain the investment in ITS equipment and provide sufficient personnel to operate and manage the transportation system. A core component of ITS implementation is a ten-year capital program.

Currently this section just outlines the themes that will ultimately be addressed. The intent is to present these issues to DVRPC's ITS Coordinating Council and gain guidance and input from the region's policy decision makers. DVRPC will then work with the ITS Technical Task Force, technical level staff, to develop specific policies.

ITS Capital Program

DVRPC's long-range transportation plan, Direction 2030, contains a list of major regional transportation projects envisioned for the next 20 years. Projects listed in the Plan are eligible for federal funding through the region's Transportation Improvement Plan. The list includes highway / transit rehabilitation / reconstruction projects, operational improvements, and new capacity; projects are broken down by timeframe, and location. For the first time ITS projects and operations have been incorporated into the Plan's list of major transportation projects (see right). ITS projects are generally placeholders, in that they show funding by category without listing specific projects. This section will flesh out specific projects based upon the ITS Vision.
## ITS AND TRANSPORTATION MANAGEMENT PROJECTS IN DVRPC’S DESTINATION 2030 LONG RANGE PLAN

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* No Transportation Improvement Program funding (to be funded by federal earmarks and DRPA monies)
IMPLEMENTATION STRATEGIES

Section Undergoing Preparation
Title of Report:
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Geographic Area Covered:
DVRPC’s nine county region

Key Words: ITS, master plan, ITS vision, ITS implementation, ITS infrastructure, traffic operations, transit management, incident management, traveler information, integrated corridor management, RIMIS, traffic signals

Abstract: This Plan represents a long-term vision of ITS in the Delaware Valley. It was prepared by the Delaware Valley Regional Planning Commission’s (DVRPC) ITS Technical Task Force. Implementing ITS is largely the responsibility of individual agencies who have differing objectives. The purpose of the Plan is to present a comprehensive vision of ITS services to be implemented; more importantly, it proposes a list of projects that will bridge the individual programs and create more cohesive operations.

Three main components comprise the Plan. ITS Vision describes how ITS should operate in the region. ITS Projects of Regional Significance identifies projects that integrate individual agency efforts. ITS Implementation presents a ten-year capital program, advocates providing sufficient funding for ITS operations and maintenance, and recommends mechanisms to promote transportation operations.

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