CHAPTER 8 INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Intelligent Transportation Systems (ITS) enables people and goods to move more safely and efficiently through a state-of-the-art multi-modal transportation system. ITS programs incorporate the application of advanced sensor, computer and communication technologies and management strategies to increase the safety and efficiency of the surface transportation system. ITS technologies are utilized to:

- Collect and transmit information on traffic conditions and transit schedules for travelers before and during their trips;
- Decrease congestion by reducing the number of traffic incidents, clearing them more quickly when they do occur, rerouting traffic flow around them, and automatically collecting tolls and fees;
- Improve the productivity of commercial, transit, and public safety fleets by using automated tracking, dispatch and weigh in motion systems; and
- Assist drivers in reaching a desired destination with navigation systems enhanced with path find or route guidance.

To fully maximize the potential of ITS technologies, ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility/interoperability of individual systems. At the core of this process is an architecture that provides overall guidance to ensure coordination and integration of individual ITS deployment projects, without limiting design options.

REGIONAL ITS ARCHITECTURE

In 2010, the MassDOT Office of Transportation Planning (OTP) conducted a formal update of the Regional ITS Architectures for all four regions across the Commonwealth. The regional architecture developed for Metropolitan Boston included the area generally within I-495, encompassing the Northern Middlesex region. Development of a regional ITS architecture offers three important benefits to the region: improved interagency coordination, cost savings for transportation operations, and better services for the traveling public. The regional architecture was developed through a four-step process that included a needs analysis, actual architecture development, an operational concept, and an implementation plan.

As part of the update process for the regional architecture, the latest versions of the RTP and TIP were reviewed. A series of meetings were held to allow stakeholders for each region to comprehensively update their ITS inventory, identifying the ITS-related initiatives that have already been deployed, those ready for implementation, and those still in the planning stages. During the needs analysis process,

stakeholders also re-examined the broad transportation needs and priorities for their respective regions. The Final Report for each region included an updated Operational Concept that reflects changes in interagency interfaces. The Implementation Plan chapter in each Final Report was also revised to reflect the current status of planned ITS initiatives. The architecture and the Final Report will guide future regional and statewide ITS strategic planning efforts.

All ITS projects funded from the Highway Trust Fund (which includes transit projects funded from the Mass Transit account) must be in conformance with the National and Regional ITS Architecture. Therefore, it is vital that project proponents use the architecture as a guideline during project development, as FHWA and FTA will be using the architecture when reviewing the project.

Examples of ITS projects include interconnecting traffic signals, transit signal priority systems, traffic signal control software, variable message signs, closed-circuit television cameras, electronic fare payment systems, and automatic passenger counters. It is important to note, however, that a project does not have to be exclusively concerned with ITS to be subject to the federal requirements. A project that has any ITS component, such as a roadway widening project that includes the installation of CCTV cameras, is considered an "ITS Project" and must meet federal requirements.

Traveler information services provide real-time information on traffic conditions and travel times to motorists and transit users on upcoming arrival times. These strategies can help to improve traveler decision-making by providing critical information, such as downstream congestion, incidents, travel times, next-bus arrival times, and cautionary alerts from adverse weather conditions. This information is made available to roadside devices, websites, or mobile apps. Some ITS applications that are suitable for this region include the following:

- **Network surveillance systems** that monitor traffic, transit, and roadway conditions and convey a wide range of information ranging from travel conditions and alerts for travelers to system status and performance for the managing agencies. Devices include visual tools, such as closed circuit television (CCTV), and passive data collection devices, like traffic sensors using microwave, inductive micro loops, or Bluetooth frequency from mobile devices.

- **Advanced transportation management and arterial operations systems** focus directly on roadway and signal control to improve traffic operations in real time. Typically focused at locations where disruptions may be greatest, they generally result in improved safety and flow.

- **Regional transportation and transit management/dispatch centers** bring together many ITS services in one facility to coordinate responses to traffic incidents and travel emergencies, through adjustments in signal timing, issuance of traveler information, and communications with emergency responders. A co-location facility shared by multiple agencies promotes data sharing and the coordination of response. Such facilities also improve coordination of signal

timing on corridors that involve multiple agencies. Data archiving is also important in ITS planning and can be streamlined through regional transportation management centers.

- **Incident detection and emergency management** improves roadway operations by connecting dispatch with network surveillance and traveler information systems, to reduce response times and to ensure that correct equipment can be dispatched based on actual needs and conditions.
- **Roadside weather information** provides valuable alerts to travelers on the environmental conditions that affect the roadway surface and driving conditions. Information on ambient conditions (i.e., visibility, temperature, wind, and precipitation, as well as road-surface conditions, such as ice, moisture and/or flooding) is disseminated via traveler information and roadway maintenance services.
- **Public transportation operations and management** benefits from ITS deployment through services that provide real-time monitoring of transit vehicle operations and dispatch services, trip planning information, and real time bus location/arrival time information available immediately to the user via mobile apps. Transit station security is also supported via the deployment and remote monitoring of surveillance cameras at transit stations.
- **Commercial vehicle/freight management** relies on ITS to ensure efficient movement of truck freight. Automated Vehicle Inspections (AVI) reduce delays with passive inspection-station certification capabilities that allow responder-equipped freight traffic to eliminate costly inspection stops. In effect, a "bypass" of these stations is allowed while adhering to necessary permitting requirements.
- **Work zone/construction management** serves to minimize the impacts of construction zones by alerting travelers to anticipated delays, detouring, and other cautionary actions needed to avoid hazards in the construction zone.
- **Bicycle ITS** includes installing bicycle detection at traffic signals, modifying signal timings for bicycles, and modifying traffic signals to support bicycle lanes and sharrows.

STATEWIDE ITS STRATEGIC PLAN

In 2014, MassDOT completed a Statewide ITS Strategic Plan. NMMPO staff participated in this process as a project stakeholder. The plan is intended to deliver user friendly Intelligent Transportation Systems and solutions, addressing the following goals:

- **Coordination:** To create a seamless system, coordination of activities among partner organizations is essential;

- **Safety and Security:** A core function of government and transportation organizations is to ensure public safety and to secure the total system against natural and man-made catastrophes.
- **Reliability and Efficiency:** This goal focuses attention on developing and deploying devices and systems that enable both business and travel reliability and efficiency.
- **User-friendly:** Equity, access, and quality are essential to providing a user-friendly transportation experience to enhance quality of life in Massachusetts.

The ITS Strategic Plan was developed to coordinate the implementation and use of technology throughout the state's transportation network. The Plan has a ten-year horizon and will be updated periodically. Based on the four goals outlined above, forty-six strategies were developed to serve as the roadmap for meeting the Plan's mission. The strategies were refined into tangible action plans, which identify lead agencies, key stakeholders, time frames, costs and the expected outputs that will result from implementing the actions. The details contained in this Action Plan provide the basis for the implementation process, and the level of effort that will be required to execute the forty-six strategies. To help facilitate the initial Action Plan, a task force was created to ensure that proposed actions were aligned with the correct agencies.

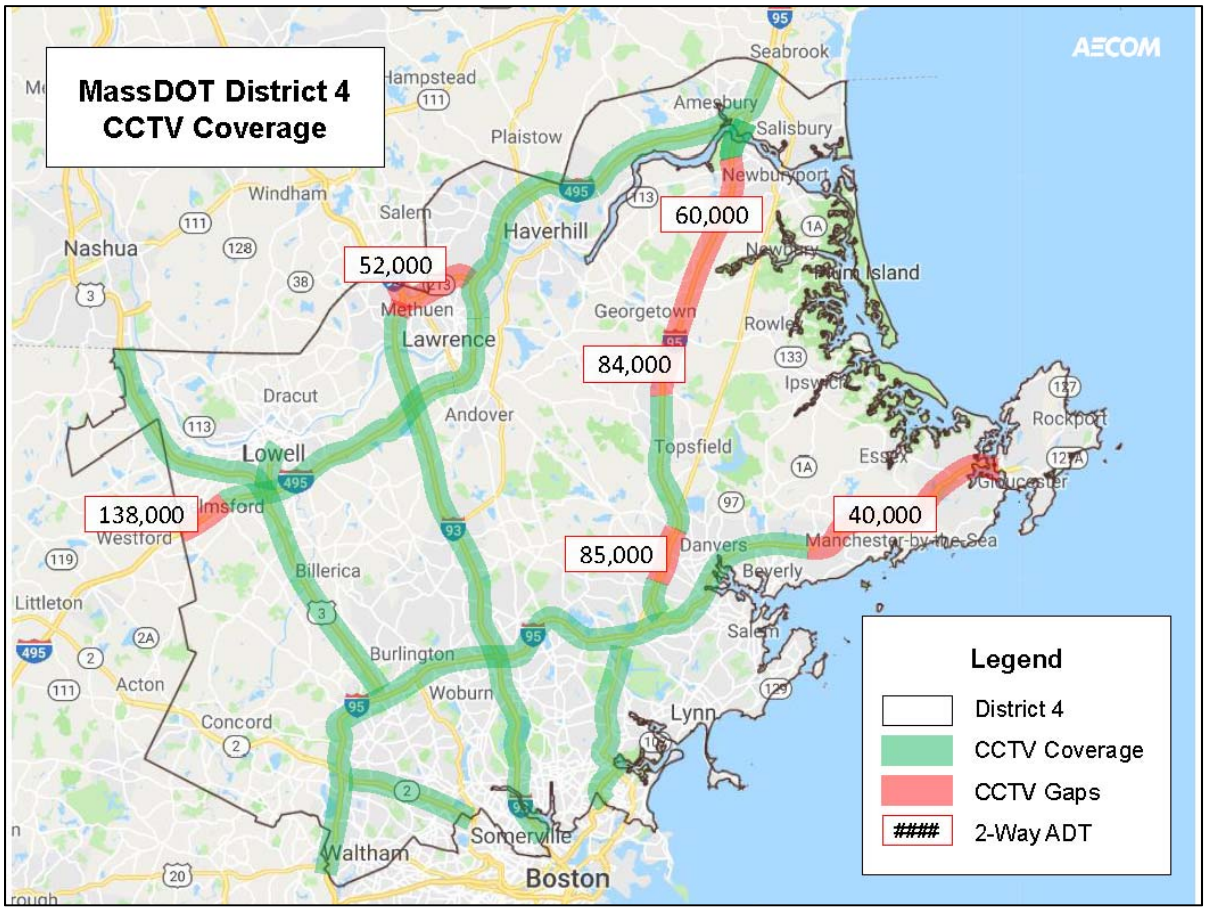
ITS DEVELOPMENT IN THE NORTHERN MIDDLESEX REGION

The National Intelligent Transportation Systems (ITS) program is focused on the development and deployment of "user services," the individual tools used by travelers and transportation providers. Twenty-nine user services have been defined as part of the national program planning process. The users of a particular service will vary and could include travelers of any mode, operators of transportation management centers, transit operators, Metropolitan Planning Organizations (MPOs), commercial vehicle owners and operators, state and local governments, and many others who ultimately may take advantage of ITS. ITS user services are in various stages of development and will be deployed according to different schedules. ITS technologies deployed in the Northern Middlesex region are discussed below.

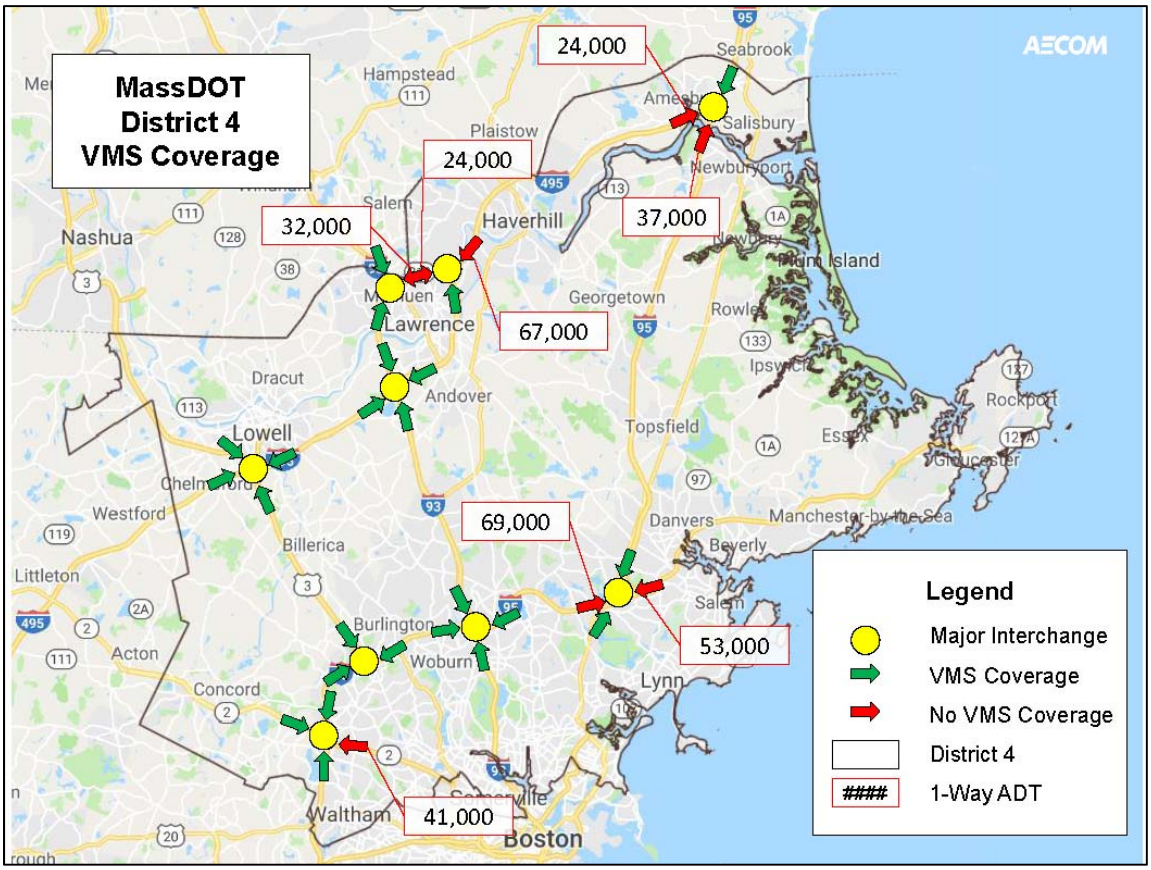
ITS AND THE HIGHWAY NETWORK

There are a number of ITS technology applications that have been deployed within the state and the region. ITS technology is being integrated into regional highways via closed circuit cameras, variable message signs and real time travel time signs along I-495 and I-93. These serve to help users of the transportation system make informed decisions along their travel routes. The ITS technologies also help responders monitor congestion and improve incident response times. Variable message boards are unique in that they can notify motorists of emergencies, traffic incidents along the corridor, construction, or hazardous weather conditions. Maps 8.1 and 8.2 show the coverage of closed circuit cameras and variable message signage along the highways in the Northern Middlesex region.

Map 8.1: Closed Circuit Camera Coverage in the Northern Middlesex Region



Map 8.2: Variable Message Sign Locations in the Northern Middlesex Region



The Mass511 service monitors real-time information regarding traffic conditions and transit operations for the Commonwealth of Massachusetts, including the Northern Middlesex region. This service, developed by the IBI Group using INRIX technology, went into operation in 2013. Information provided by Mass511 is collected through surveillance cameras, mobile monitoring that reports to the operations center, monitoring of hundreds of radio frequencies used by emergency vehicles, and direct contact with the State Police, MassDOT and the MBTA.

MassDOT has launched an App (GoTime) displaying real time travel conditions along Commonwealth roadways to complement the roadside travel time signs. The App can display over 130 locations to better plan trips along highways in the State.

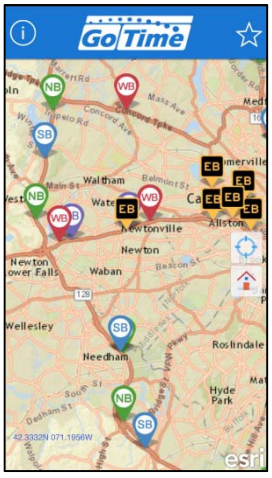


Image 8.1: MassDOT GoTime App

ITS AND THE LRTA

The Lowell Regional Transit Authority (LRTA) currently posts service advisories, schedule and vehicle location information on its website. In 2011, the LRTA began operation of the Charlie Card fare collection system. The Scheidt and Bachmann system, presently used by the MBTA and several other Massachusetts regional transit authorities, enables riders to seamlessly travel between systems without having to change payment cards.

Image 8.2: Farebox Collection Systems are available on LRTA buses

Each Charlie Card can store up to three regional transit passes and up to $200 in prepaid debit. The Charlie Cards are preprogrammed for either full fare or senior and disabled half fares. The correct fare is then deducted from the available card fund balance. The Scheidt and Bachmann system also maintains accurate ridership information, which is available to transit operators for performance analysis. This information can be sorted by vehicle, route, direction, time, and payment type. In 2017, the LRTA partnered with UMass Lowell on a program where students can use their college IDs on the LRTA system. The University covers the fees related to student use of the LRTA.

The LRTA rolled out the automatic vehicle location system (AVL) on their fixed-route bus fleet in 2015. The AVL system, developed by Route Match Software, Inc., enables riders to determine where each bus is located along the route, and provides an estimated time of arrival. The system can be accessed from any computer or smart phone. It also provides real-time arrival estimates for the next bus via the Route Shout App. The data generated by the AVL system is an important element in the transit performance analysis. The data provides on-time performance statistics for each route and run. Additionally, six of the buses are equipped with automatic passenger counters (APC), allowing for greater analysis ridership trends.

ITS AND THE MBTA

With service in the region, the Massachusetts Bay Transit Authority (MBTA) provides traveler information on its website, and next trip information for the MBTA system may also be accessed via the internet. Real-time vehicle location has been implemented for both the fixed-route bus system and subway lines, to provide information to users of the system relative to where buses and trains are located and when they will arrive. This information can be accessed via web applications for smart phones and tablets.

FUTURE DEPLOYMENT OF ITS TECHNOLOGIES

Other technologies outlined in the Regional ITS Architecture that may be suitable for future deployment in the region include the following:

- Installation of signal priority equipment on key commuter routes;
- A truck information service to optimize freight routing and management;
- Centralized signal control in area communities; and
- Emergency call boxes for the LRTA.