New Jersey Department of Transportation

ITS Investment Strategy

10-Year Program, FY07-16

Statewide Traffic Operations

ITS Engineering

March, 2007

Intelligent Transportation Systems

Investment Strategy

A 10-Year Program, FY07-16, to advance the design and construction of an ITS Infrastructure in NJ

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Executive Summary

NJDOT began installing ITS systems in 1992, and by early 2007 we will have some level of ITS infrastructure for traffic and incident management on approximately 105 miles of Interstates/Freeways and 235 miles of other State highways. This includes 208 cameras (CCTV), 87 permanent DMS, 36 portable DMS, 172 Travel Time Detectors, 211 computerized signals, and 14 HAR systems (see Appendix A). In 2004 we established a shared high-speed, redundant fiber connection network (Dense Wave) with the New Jersey Turnpike Authority (NJTA) which now also provides for IT networking and shared services with other agencies.

Two high tech Traffic Operations Centers (TOC), originally established in 1996, are the central focus for all transportation operations in the state. They use the ITS infrastructure to manage the flow of traffic on the highways and coordinate responses for traffic incidents. There is also a Central Dispatch Unit (CDU) co-located in 2004 with the NJSP & NJDEP Coordination centers to assist the TOC in coordinating work assignments for responding to incidents. Approximately 7,000 incidents are reported to the Traffic Operations Centers on an annual basis.

The Emergency Service Patrol Program (ESP) was launched in 1994 to help keep the highway lanes clear, reduce congestion and increase safety for all motorists. ESP crews have assisted motorists on over 84,000 instances in 2006. The ESP has a benefit to cost ratio of 19 to 1 based on the savings in time provided by clearing lane closing incidents. ESP units patrol from 4:00 a.m. – 8:30 p.m. Monday through Friday, with additional coverage on weekends and for the Route 29 Tunnel in Trenton. The ESP program currently covers over 325 miles of interstate and freeways. In the fall of 2006, tow trucks were added to the ESP program to enable clearing more serious accidents.

Incident Management Response Teams (IMRT) were established in 1995 with the New Jersey State Police with specially trained personnel who respond to major incident scenes to expedite coordinated multi-agency remediation efforts. Diversion plans for major routes are being established with all the Counties.

We have a web site that provides real time traffic information, including live camera views of actual highway conditions, with over 44 million “hits” in 2006.

Through the successful use of these systems; the average incident duration has been reduced to 1.77 hours from the 2.77 hours recorded in 1995.

CTSS optimization of Rt 73 in Camden County and Rt 37 in Ocean County provided a 15%-23% reduction in the time to travel during rush hours. Optimization assessments are currently underway at other CTSS statewide.

Construction contracts are now being developed to incorporate permanent and temporary cameras and traffic monitoring devices as a first item of work to assist in managing traffic flow through the construction impacts. Route 18, I-78, and Route 139 are some of the major projects this is currently being implemented on.

This report also provides a general strategy for other ITS related systems that are controlled by other groups outside Statewide Traffic Operations. These include 42 weather stations, 64 weigh-in-motion stations, 183 traffic data stations, other pavement/bridge sensors, and security cameras at building facilities. All movable bridges have cameras that allow the bridge operators to monitor the water way. In 2005, the Department completed its first automated anti-icing spray system on I-78 in Warren County. There is a coordination of efforts by all groups for mutual uses, especially in the emerging security needs of the Department.

The remaining pages of this Investment Strategy include the following:

- **Goals and Budget for Operating and Enhancing ITS**
- **Priority Corridors**
- **Summary and Projected Benefits**

Goals and Budget

- **Over $ 50m proposed in FY07 for all ITS work**
- **Over $ 1 billion (including escalation) for full build out**

Operating the System

A. Traffic Operation Centers (TOC), including Central Dispatch Unit

- $11m to staff and maintain the centers and all ITS equipment
- $0.6m for Incident Management Response Teams (IMRT)
- $12m, and additional staffing, for Emergency Service Patrol (ESP) coverage on all Interstates and Freeways
- $1m to operate a Traffic Information Web Site

This effort includes:

- Continuous troubleshooting and repairs to maintain the systems
- Periodic replacement or upgrades to existing equipment, hardware and software (see Appendix A for schedules)
- Periodic replacement of vehicles
- Communication and service usage costs
- Support through contractor and consultant contracts

B. ITS Engineering-

- Provide technical support to the TOC and others
- Maintain the ITS Architecture for coordination of efforts between all agencies
- Maintain a GIS database and web site to coordinate any work on or near ITS facilities

C. Other Agency Support

- $1.9m to fund dedicated State Police troopers for IMRT
- $0.1m for NJ Turnpike's maintenance and repair of the Dense Wave "Ring"
- $.5m to support TRANSCOM

Total cost of over $ 28m in FY07 to operate the full system. Projected increase to over $40m/year by 2016 for a fully enhanced system, including additional staff.

Enhancing the System

A. Expand Instrumentation

A.1. Interstates & Freeways: $ 400m over 10 years to complete remaining sections

- Cameras (CCTV) at every interchange and one at least every 2 miles for Urban areas and every 5 miles for Rural areas
- Cameras (CCTV) at all major bridges for both traffic and security coverage
- Signs (DMS) on each approach for interchanges with Interstates/Freeways, State highways, and other select roads
- Travel Time Detectors at every Sign location and other decision points

A.2. Selected High Priority Arterials

Controlled Traffic Signal Systems (CTSS): $ 150m over 10 years

This is based on completing the 220 miles of respective sections of highway locations currently listed as high priority corridors by the Congestion Management System for recurring and for non-recurring congestion (see Corridors below and Appendix A), and function as major relief/diversion routes such as Route 46 for I-80 and Route 130 for the NJ Turnpike. Costs include signal controller replacements, DMS, CCTV, and Detectors, but no other signal and geometric upgrades. Connections will be by fiber in some critical locations, with others by phone, cable, or wireless.

Isolated devices at selected locations: $30m over 10 year period

B. Enhance Operations Centers

In coordination with NJTA construct a Statewide Traffic **Management** Center (STMC)

- Scheduled opening by end of 2007
- 24/7 operation with staff from NJDOT, NJTA, NJSP, and others
- $2m in FY07 towards building/equipment, and developing a statewide traffic management software system

$1m in FY07 to develop and deploy an automated incident data system

C. Other ITS enhancements and initiatives

Deploy ITS for traffic mitigation during construction

Develop and maintain ITS & Traffic related web sites

- Develop and deploy an upgraded Traffic Information Web and Phone (511) System
- Provide real time projections
- Provide upgraded traffic camera images

Develop and deploy a common platform to share digital, "streaming" video and coordinate cameras statewide between all transportation, emergency, and security related agencies

Provide for automated coordination of data sharing between all ITS systems

Develop and maintain a full fiber network connection network

- Complete full "node" connectivity within the Dense Wave "Ring"
- Upgrade and expand the Department's fiber to provide for "sub-ring" redundancy and network connections to the Dense Wave
- Connect the existing TOC-N within the Dense Wave "Ring"
- In coordination with OIT/NJSP complete a Dense Wave "Ring" for Trenton facilities
- Use the network to minimize communications through private utilities

Develop & issue ITS standards and guidelines

Priority Corridors

Based on recommendations from the Congestion Management System, the following priority corridors were selected in 2005 as candidates to deploy ITS to address congestion. Noted in **bold** are those corridors currently in Study or Concept Development. The evaluations for these corridors will include using the latest in model simulation programs to determine the most effective use of ITS. While these evaluations proceed, the Department will also implement standard ITS facilities in key locations along these corridors and other spot locations as part of general infrastructure maintenance and improvement projects. Appendix A includes maps showing the latest Congestion Corridors and also ITS corridors based on both recurring and non-recurring congestion criteria.

Arterials

NJ 3, MP 0.0 to 10.84	Passaic, Bergen, & Hudson	
NJ 4, MP 0.0 to 10.89	Passaic and Bergen	**(ex. corridor study in Bergen)**
US 9 MP 70 to 122.5	Ocean, Monmouth, & Middlesex	
NJ 17, MP 5.76 to 26.0	Bergen	**(existing corridor study)**
NJ 21, MP 0.0 to 4.1	Essex	**(Scoping MP 2-3.2)**
US 22, MP 19 to 55	Somerset, Union, & Essex	**(Scoping MP 37-40)**
NJ 23 MP 5.0 to 16.7	Passaic & Morris	**(P&R Scoping at I-80)**
US 46, **MP 42.5 to 72.1**	Morris, Passaic & Bergen	
NJ 47, MP 0 to 17	Cape May - Shore Evacuation/Seasonal Congestion	
NJ 47, MP 40.8 to 51.8	Cumberland & Gloucester	**(Scoping MP 17-35)**
US 130, MP 61.5 to 74.5	Mercer & Middlesex - Incident Diversion	
NJ 166, MP 0.0 to 3.73,	Ocean	

Interstate/Freeway

78, MP 24-59	**Hunterdon, Somerset, Union, and Essex**
80, MP 28-43	**Morris**
280, MP 10-17	**Essex County**
287, MP 0-21	**Middlesex & Somerset**
295, MP 14-25	**Gloucester**
295, MP 56-67	**Burlington & Mercer**

Corridors in development that should be completed by 2011:

Rt 1: I-287 to Garden State Parkway – under construction
Rt 18: Rt 27 to MP 39 – under construction
Rt 22: MP 40 to 47 – CTSS project to initiate design in 2007
Rt 29: Rt 1 to I-295 – enhanced tunnel operations, including new SCADA system
I-78: Newark to I-287 – Rt 24 to Garden State Parkway under construction
Rt 130: MP 61.4 to 74.4 – initiate scoping in 2007
Rt 139: Rt 1&9 to Holland Tunnel – under construction
I-280: MP 10 to 17 - fiber and partial instrumentation under design for 2007 construction
I-287: I-78 to Rt 440 – fiber and partial instrumentation under design for 2007 construction
I-295: MP 14 to 24 – fiber and instrumentation under construction in 2007

Summary and Projected Benefits

Although the national reports and the data we have collected show that ITS provides a significant benefit, we have conducted limited studies to fully evaluate the ITS system. The majority of other States are also developing how they will track performance for ITS systems. There are complications associated with measuring the benefits of ITS projects, especially when the ITS components are incorporated with other improvements. Many of the benefits involve an increased awareness for the driver so that better decisions can be made by each individual to provide an overall improvement to the safety and congestion of the system for all.

It is intended that future ITS improvements will include an evaluation component to bench mark pre-construction conditions and ascertain the benefits of each project after completion. In general, we will be evaluating the following major categories:

- Reduction in Incident Durations
- Reduction in Congestion – recurring capacity versus incident and other isolated factors
- Increase in Safety
- Well informed public
- System preservation

Committing $1 billion is a major investment to provide what we envision to be an optimum, operating ITS system, however, in a State like New Jersey, where construction expansion is restricted, deploying ITS is one of the best mechanisms to providing significant improvements for the motoring public. With limited resources and the need to maintain the existing roadway and bridge infrastructure, the Department currently has been able to provide approximately $50 on an annual basis to ITS. This includes the Smart Moves Program at an annual level of $5-10m to provide for low cost, short time frame, spot improvements and other quick evaluation efforts.

The majority of the Department's ITS Program is expected to be federally funded, including operation and maintenance of the system. Any expansion and enhancement of the system must include the commitment to funding the respective operating needs in order to fully realize the benefits. Construction will be completed through separate ITS contracts and as components of other improvement contracts through Capital Program Management and Operations.

Overview of ITS

As stated on the Department's web site**,** "Nothing is more frustrating to the traveler by automobile or bus than being delayed in traffic."

New Jersey, the most densely populated state in the nation, needs a fully operable Intelligent Transportation System (ITS) because it is a vital tool in the effective management of traffic. In 2003, the cost of congestion in yearly economic loss to NJ was estimated at $8.1 billion in time, fuel and additional vehicle operating costs. In 2004, NJ suffered over 320,000 crashes with 731 fatalities, and 76,500 injuries.

NJ Statute 27:1B-21.16 requires "the deployment of the best available technologies on roads and highways".

According to the Federal Highway Administration (FHWA), metropolitan ITS systems on average have a cost benefit ratio of greater than 8 to 1. Freeway management systems can reduce accidents by 15% and increase capacity by 17% to 25% while Incident Management programs can reduce incident related congestion by up to 50%.

By optimizing traffic flow, controlled traffic signal system (CTSS) can also provide capacity improvements of 15% or more with a significant reduction in fuel usage and fumes generated for an additional environmental benefit.

How can the use of technology on highways help reduce congestion? For example, the system will detect problems and then use Dynamic Message Signs (DMS) and Highway Advisory Radio (HAR) to provide advanced notice of pending trouble ahead and offer alternatives to motorists so that they can change their route and avoid unnecessary delays and hazardous conditions, or simply remind them to slow down and maintain safe distances so that crashes don't happen. When problems are detected, the system can also dispatch emergency service patrol personnel as soon as possible in order to remove the stalled or damaged vehicle(s) and clear the roadway so that traffic can flow safely again. The system also distributes the information to all the respective agencies that may be affected to ensure that they can more efficiently manage their traffic to reduce additional adverse impacts. Weather stations provide the conditions on the road so snow crews can mobilized and when conditions such as fog develop advance notices can be provided to traffic to prepare accordingly. In general, ITS provides the Department with the tools to manage traffic and the transportation system effectively.

Keeping with the goals of the Department, the deployment of ITS technology helps to reduce traffic congestion, improve public health and safety associated with transportation, increases opportunities for local and region-wide economic development by improving transportation mobility, and enhances the quality of life for towns and communities.

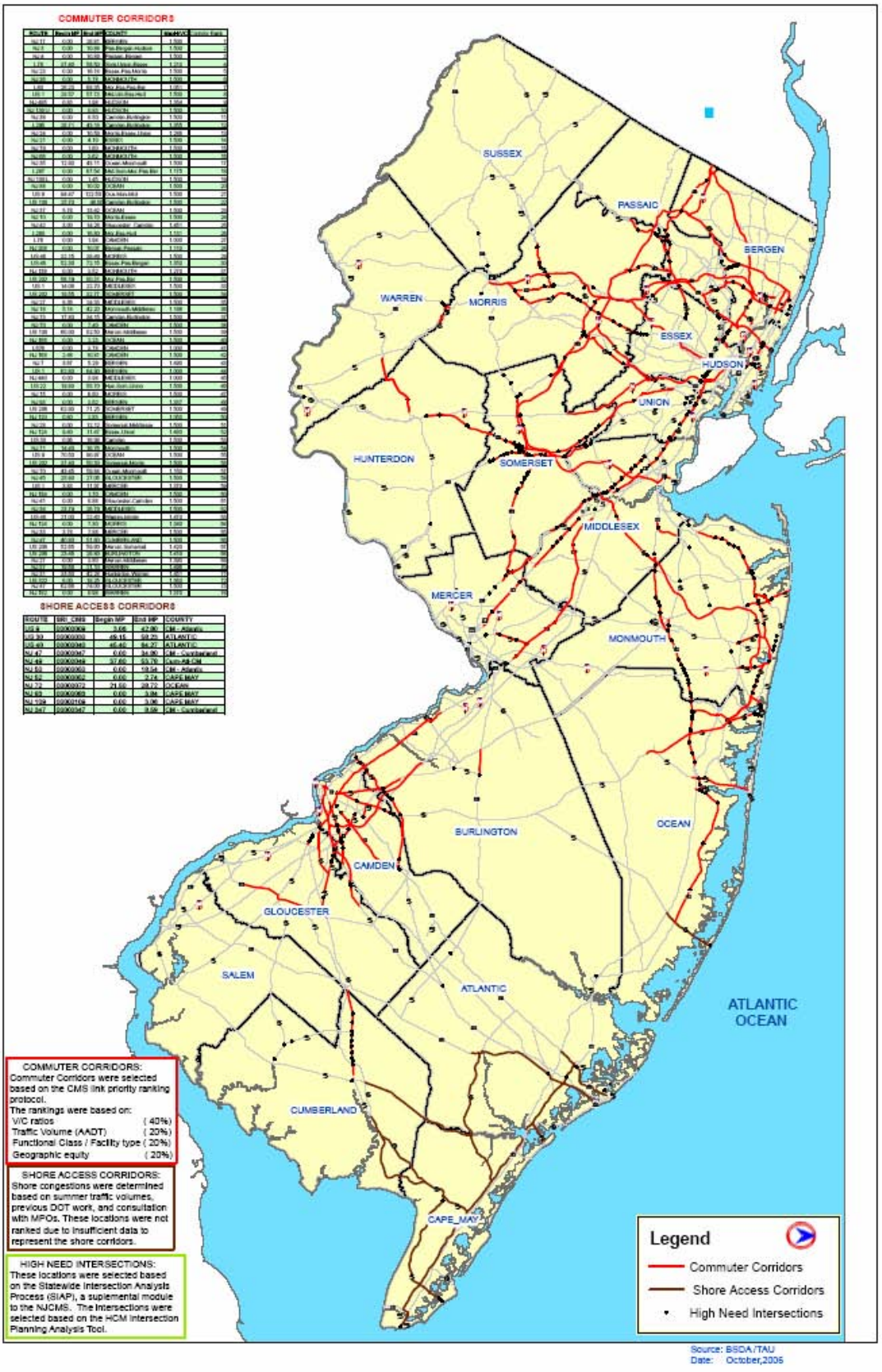
APPENDIX

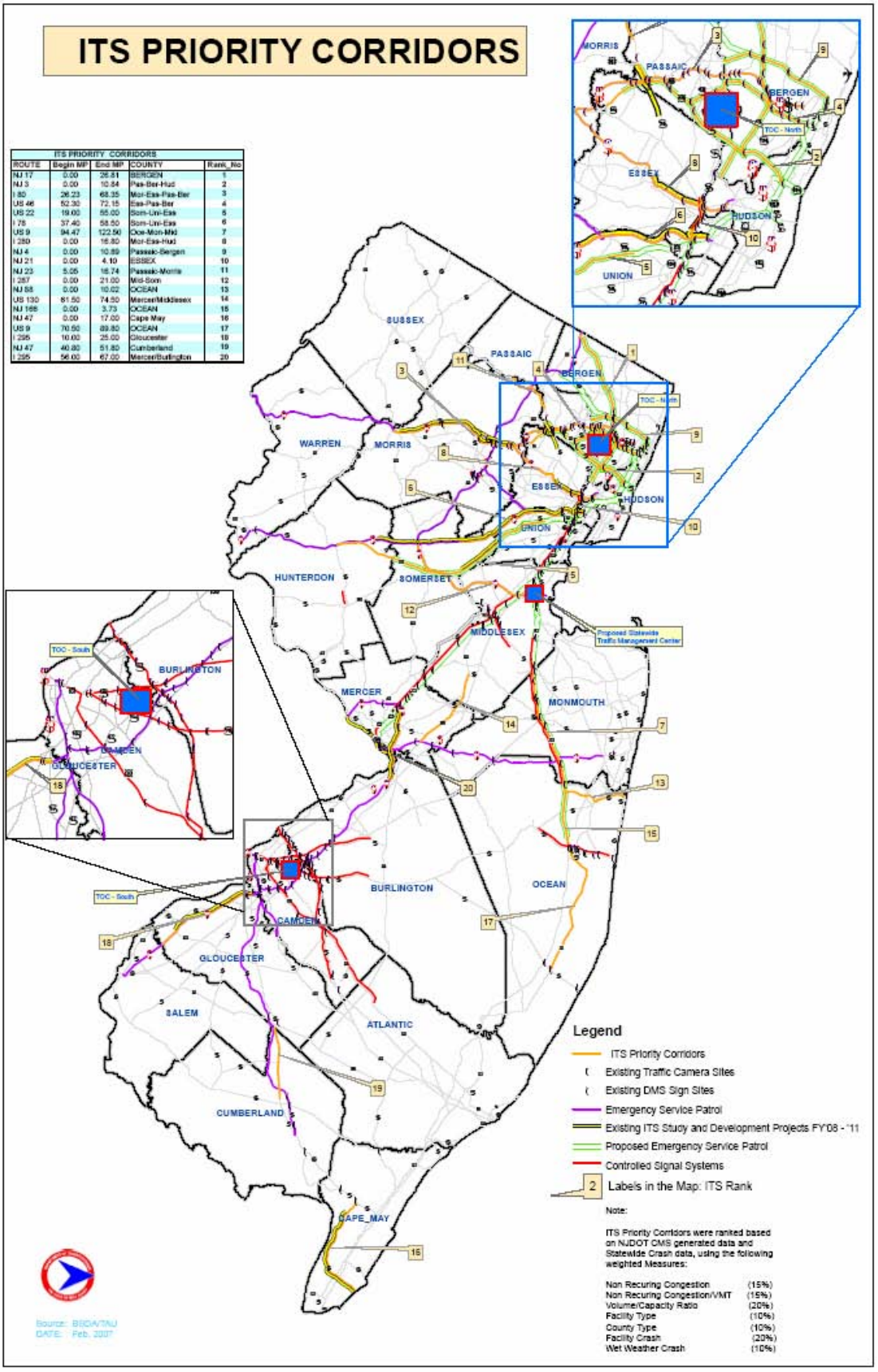
According to a study done by the New Jersey Institute of Technology (NJIT), "in order to mitigate congestion in New Jersey, there must be a balance between the construction of new highway and transit facilities with the use of advanced technology such as advanced traffic control and intelligent transportation systems."

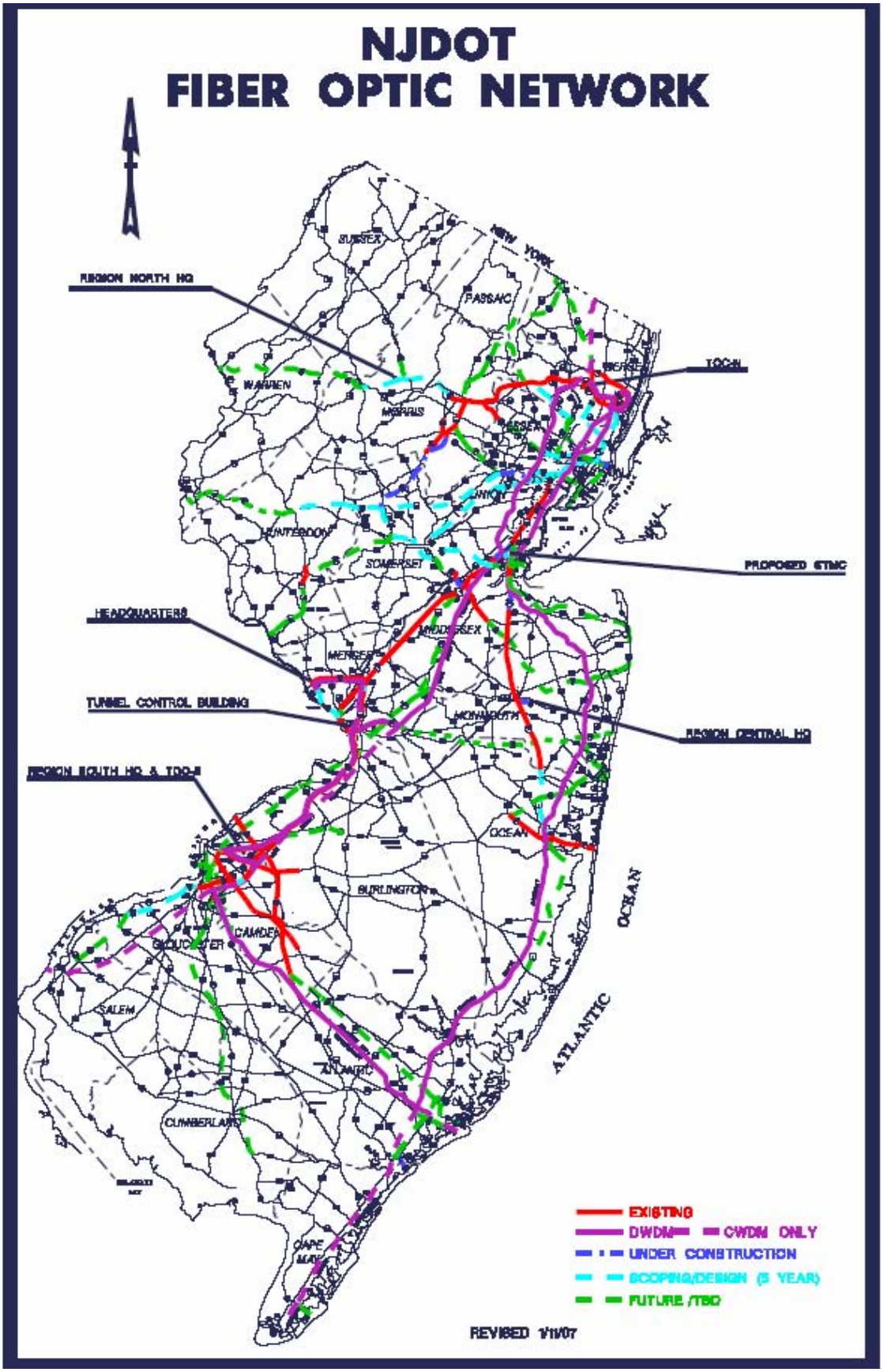
In 1999, the Institute of Transportation Engineers (ITE) prepared the recommended practices for the proper management and operation of ITS. The following list contains key elements of their findings.

1. Commitment - Assurance of a firm commitment is recommended at the appropriate level by State DOT's and participating agencies.
2. Information Sharing – Traffic control strategies must reach across jurisdictional boundaries and form an integrated network management system. Agencies should consider sharing operation, control and monitoring functions through regional coordination.
3. Planning – A systems engineering process is necessary to build and integrate systems. ITS devices need to be brought **into** compliance with adopted national standards and the overall strategic plan needs to be updated and made current over the course of time.
4. Incremental Design – Staged development and deployment of the system is an ongoing part of each individual project. Projects should be proposed in incremental steps in order to produce the most immediate effects on operations and so that the potential benefits of the systems are realized.
5. Computer Systems – A long-term program is necessary for supporting computerized traffic management systems. As systems grow in complexity and interaction with other devices increases, hardware and software components will need upgrading, debugging, troubleshooting, replacement, and revision. Automatic traffic management systems are ever-changing with technology advancements, therefore making a program of configuration management necessary for modification control. Design changes can then be made logically and efficiently without backtracking. Disaster recovery is needed for restoration of damaged or failed equipment.
6. Procurement – Spare equipment and warranties are critical for continued operation once systems are put in place. Purchasing rights to source code and protocols is also smart for software acquisition development contracts.
7. Interagency Opportunities – Agencies should look for and capitalize on transportation technology sharing opportunities in order to develop win-win situations such that benefits are maximized. Communications paths and devices and most importantly the traffic data should be shared when possible among multiple jurisdictions. Joint operations through an "open systems architecture" makes information transfer between computer operating environments more easily accomplished and is strongly recommended.

NEW JERSEY CMS-RANKED CORRIDORS AND INTERSECTIONS




ITS PRIORITY CORRIDORS
ITS PRIORITY CORRIDORS
ROUTE | Begin MP | End MP | COUNTY | Rank_No
NJ 17 | 0.00 | 26.81 | BERGEN | 1
NJ 3 | 0.00 | 10.84 | Pas-Ber-Hud | 2
I 80 | 26.23 | 68.35 | Mor-Ess-Pas-Ber | 3
US 46 | 52.30 | 72.15 | Ess-Pas-Ber | 4
US 22 | 19.00 | 55.00 | Som-Uni-Ess | 5
I 78 | 37.40 | 58.50 | Som-Uni-Ess | 6
US 9 | 94.47 | 122.90 | Oce-Mon-Mid | 7
I 280 | 0.00 | 16.80 | Mor-Ess-Hud | 8
NJ 4 | 0.00 | 10.89 | Passaic-Bergen | 9
NJ 21 | 0.00 | 4.10 | ESSEX | 10
NJ 23 | 5.05 | 16.74 | Passaic-Morris | 11
I 287 | 0.00 | 21.00 | Mid-Som | 12
NJ 88 | 0.00 | 10.02 | OCEAN | 13
US 130 | 61.50 | 74.50 | Mercer/Middlesex | 14
NJ 166 | 0.00 | 3.73 | OCEAN | 15
NJ 47 | 0.00 | 17.00 | Cape May | 16
US 9 | 70.50 | 89.80 | OCEAN | 17
I 295 | 10.00 | 25.00 | Gloucester | 18
NJ 47 | 40.80 | 51.80 | Cumberland | 19
I 295 | 56.00 | 67.00 | Mercer/Burlington | 20
MORRIS
PASSAIC
BERGEN
ESSEX
HUDSON
UNION
TOC - North
SUSSEX
WARREN
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
OCEAN
BURLINGTON
CAMDEN
GLOUCESTER
ATLANTIC
SALEM
CUMBERLAND
CAPE_MAY
TOC - South
Proposed Statewide Traffic Management Center
Legend
ITS Priority Corridors
Existing Traffic Camera Sites
Existing DMS Sign Sites
Emergency Service Patrol
Existing ITS Study and Development Projects FY'08 - '11
Proposed Emergency Service Patrol
Controlled Signal Systems
2 Labels in the Map: ITS Rank
Note:
ITS Priority Corridors were ranked based on NJDOT CMS generated data and Statewide Crash data, using the following weighted Measures:
Non Recuring Congestion (15%)
Non Recuring Congestion/VMT (15%)
Volume/Capacity Ratio (20%)
Facility Type (10%)
County Type (10%)
Facility Crash (20%)
Wet Weather Crash (10%)
Source: BSDA/TNJ
DATE: Feb. 2007


NJDOT
FIBER OPTIC NETWORK
REGION NORTH HQ
TOCN
PROPOSED STMC
HEADQUARTERS
TUNNEL CONTROL BUILDING
REGION CENTRAL HQ
REGION SOUTH HQ & TOC-5
SUSSEX
NEW YORK
PASSAIC
WARREN
MORRIS
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
OCEAN
BURLINGTON
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
ATLANTIC OCEAN
EXISTING
DWDM
CWDM ONLY
UNDER CONSTRUCTION
SCOPING/DESIGN (5 YEAR)
FUTURE /TBD
REVISED 1/11/07

ITS Equipment Schedules

Cameras

- Clean and calibrate twice a year
- Replace camera and controller every 7 years

Dynamic Message Signs

- Replace power supplies every 5 years
- Replace controller & wiring every 10 years
- Full replacement every 20 years

Controlled Traffic Signal Systems

- Replace system loops every 10 years
- Upgrade controllers every 15 years

Fiber Network

- Upgrade switches/circuits every 10 years
- Replace fiber every 20 years

Operation Centers

- Replace servers every 5 years
- Upgrade software system as required by each application
- Replace video monitors every 10 years

Travel Time Detection systems

- Calibrate every 2 years

Weigh-in-Motion (WIM) Stations

- Calibrate every year
- Replace sensors and controllers every 5 years

Roadway Weather Information Stations (RWIS)

- Calibrate every year
- Replace sensors every 5 years