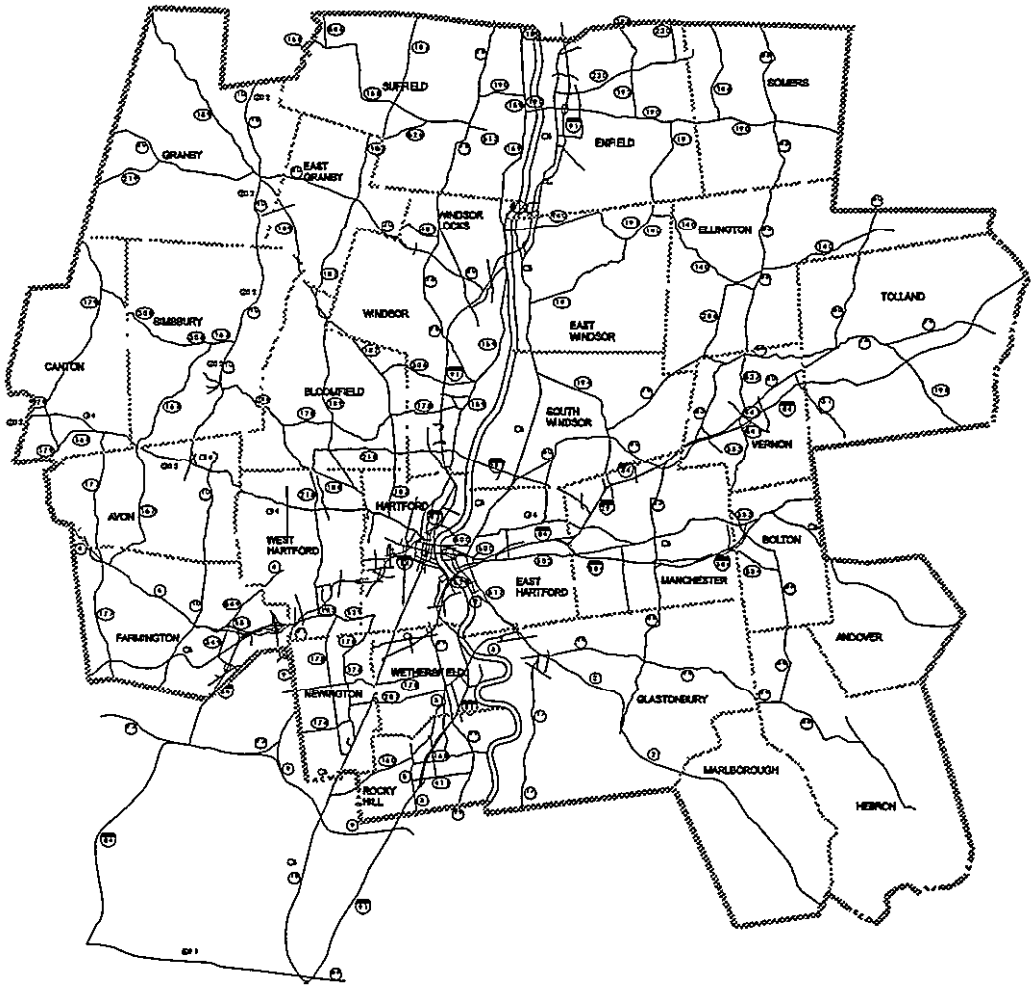
Intelligent Transportation Systems "ITS":

A Strategic Plan

for the

Capitol Region



Connecticut Department of Transportation
Capitol Region Council of Governments
DKS Associates

ACRONYMS and ABBREVIATIONS

ADA	Americans with Disabilities Act
ATA Foundation	American Trucking Association's Foundation
AVL	Automatic Vehicle Location
CCTV	Closed Circuit Television
CHAMP	Connecticut Highway Assistance Motorist Patrol
Ch.	Chapter
ConnDOT	Connecticut Department of Transportation
CRCOG	Capitol Region Council of Governments
CT Transit	Connecticut Transit
C V O	Commercial Vehicle Operations
DOT	Department of Transportation, unless otherwise specified: Connecticut Department of Transportation
EMS	Emergency Medical Service
GHTD	Greater Hartford Transit District
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HazMat	Hazardous Materials
HOC	Highway Operations Center
HOV Lanes	High Occupancy Vehicle Lanes
lEN	Information Exchange Network
ISP	Independent Service Provider
ITS	Intelligent Transportation Systems
MDI	Model Deployment Initiative
Op-Mnt. Costs	Operating-Maintenance Costs
RAFS	Regional Access Frequency System
RTIS	Regional Travel Information System
TBD	To Be Determined
TIS	Travel Information System
TRANSCOM	Transportation Operations Coordinating Committee
UTCS	Urban Traffic Control System
VMS	Variable Message Sign
VMT	Vehicle Miles Traveled

1. INTRODUCTION

The ITS Strategic Plan outlines a strategy for improving the efficiency of the Region's ***existing*** highway and transit systems. The Region's overall goal is to improve. the efficiency and effectiveness of existing systems so as to reduce the need to build new facilities or add new services. The specific objective of the lTS Plan is to identify ways of improving system efficiency through the application of various communications and information technologies.

The 1994 Capitol Region Transportation Plan stressed the need to improve the efficiency of existing transportation systems through better system management. Financial and environmental constraints make it increasingly difficult to solve mobility, congestion, and safety problems by building new highways or adding new transit services. We need to find more ways to make existing systems work better. One such way is to use advanced technologies to improve system efficiency.

1.1 What is ITS?

Intelligent Transportation Systems (ITS) involve the application of advanced technology to assist in the solution of transportation problems and the management of transportation systems. Of key importance are telecommunications and information technologies that allow information on the transportation systems and current conditions to be collected, processed, and disseminated. The information is valuable to transportation agencies that are responsible for operating and managing the systems. But it is also valuable to the traveling public who must make decisions about what mode to use, which route to take, or what time of day to travel. Collectively these applications of telecommunications and information technologies to improve transportation management and information are known as Intelligent Transportation Systems. These systems can help reduce congestion, improve safety, and improve mobility.

ITS systems are not new. They have been used for well over a decade to manage traffic signals on arterial roads. But ITS systems are increasingly being used for other transportation management purposes such as highway management, transit operations management, incident management, and travel information management.

The ITS Plan identifies strategies for addressing these individual management needs. It also provides a framework for ***integrating*** the individual ITS components into a more effective system.

1.2 Organization

The ITS Plan is organized into four primary chapters:'

- Travel Information,

[1] ITS systems for Commercial Vehicle Operations (CVO) are not included in this plan. A separate plan for CVO applications was developed for the entire State of Connecticut. The recommendations deal primarily with automated methods of licensing, registration, permitting, and enforcement The recommendations are contained in the report entitled "Connecticut ITSICVO Institutional Issues Study." prepared for the State of Connecticut by the ATA Foundation, 1995 More detailed (and agency specific) recommendations are bang prepared as part of an ITSICVO Business Plan which is currently under development

- Transit and Rideshare. Management,
- Highway Management, and
- Incident Management.

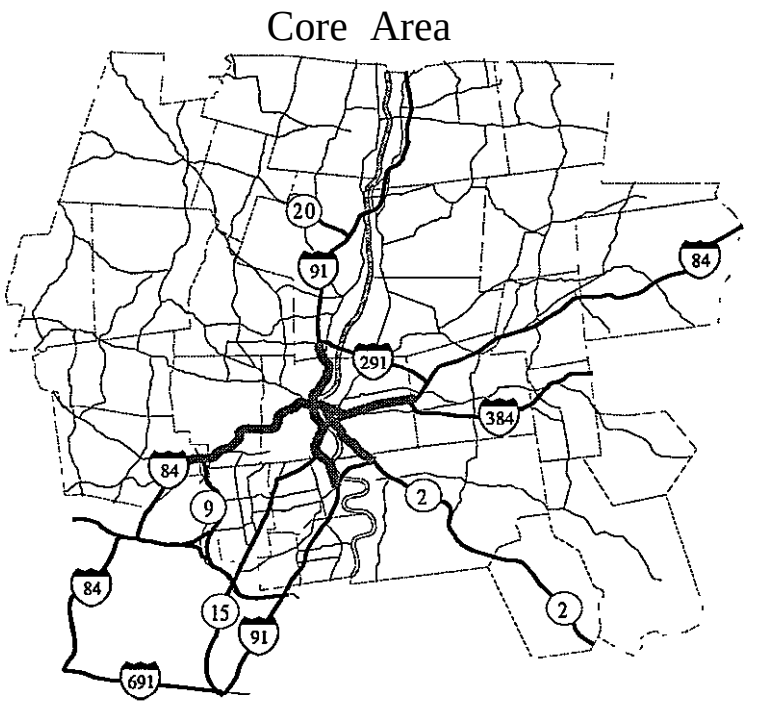
Each chapter contains recommendations regarding ways of improving the management of the respective transportation system or transportation support system. Each chapter also includes a section on the estimated cost of implementing each recommendation.

1.3 Phasing

The transportation management needs that can be supported by ITS technologies are substantial, and the geographic area to be covered is extensive. Therefore, the establishment of priorities, and a strategy for phasing the implementation, is important. In recognition of this, a three-phase implementation strategy is proposed: Phase 1 is the short term and includes years 1-5, Phase 2 is the moderate term (years 6-10), and Phase 3 is the long term or speculative phase (years 1 l-20).

Phase 1: Years 1-5: Phase 1 encompasses the first five years of the ITS program It contains the highest priority elements of the plan, and the freeway elements are restricted to the "core area" of the Region.

Core Area. The core area includes the central part of the Region where I-91, I-84, and Route 2 converge. The outer bounds of the area are generally set at the point where the radial freeways connect with a circumferential freeway. These junctions provide an opportunity for traffic to divert in order to avoid traffic problems in the core area. The core area includes: I-84 from Route 9 and Route 4 in Farmington to I-384 in East Hartford; I-91 from Route 3 in Wethersfield to I-291 in Windsor; and Route 2 from Route 3 in Glastonbury to Hartford.



Phase 2: Years 6-10: Phase 2 includes years six through ten (6-10) of the program The elements and locations in Phase 2 are considered important to the overall transportation management strategy. However, they are of lower priority, outside the core area, and can be scheduled in the second phase of the program.

Phase 3: Years 11-20: Phase 3 is the long term or speculative phase. Elements are included in this phase for any of three reasons: (1) they are not needed in the short or moderate term; (2) they are not cost effective at this point in time, but might become so as technology costs decrease in the future; or (3) the technology is still not proven. ***There is no commitment to fund Phase 3 at this time.*** However, it is useful to identify these potential future needs so that the basic system infrastructure can be designed in a way that will accommodate them.

Early Build. The proposed phasing is intended to serve as a "guide" for implementation. The phasing plan does not preclude any given element from being constructed earlier than indicated. Early construction is actually encouraged if the opportunity to do so becomes available. If extra funding for ITS implementation becomes available, the entire schedule can be advanced. Likewise, if a freeway reconstruction project is initiated on a Phase 2 section of freeway, the ITS elements for that section should be included in the freeway reconstruction project. Inclusion of ITS elements in larger road reconstruction projects is a cost-effective method of implementing ITS systems. This "piggyback" approach achieves lower unit costs and minimizes traffic disruptions due to construction activity.

1.4 Cost Summary

A cost summary is provided in Table 1.1 The total capital cost for the ten-year program (Phase 1 and Phase 2) is $38,388,000. On an annual basis, the cost is an average of $3,840,000 per year.

TABLE 1.1 COST SUMMARY

	PHASE 1	PHASE 2	PHASE 3	PHASE 1+2
Travel Information	800,000	440,000	2,000,000	1,240,000
Transit Management	626,000	3,165,000	1.630,OOO	3,791,000
Highway Management	11,368,000	21,534,000	11.297,OOO	32,902,OOO
Incident Management	390,000	65,000	0	455,000
TOTAL	13.184.000	25.204.000	14.927.000	38.388.000

1.5 Participating Agencies

The development of the ITS Plan was a cooperative effort among many agencies. The project was managed by the Highway Operations Section of ConnDOT with support from the Capitol Region Council of Governments (CRCOG). However, both technical and policy guidance was provided by many other agencies that served on a special ITS Steering Committee. Agencies and departments represented on the Steering Committee are listed below.

ITS Steering Committee

- American Trucking Association's Foundation
- Capitol Region Council of Governments
- Connecticut Department of Transportation
- City of Hartford - Transportation Department
- Connecticut State Police
- Connecticut Transit
- Federal Highway Administration
- Greater Hartford Transit District
- Motor Transport Association of CT
- The Rideshare Company
- Town of East Hartford - Engineering Department
- Town of West Hartford - Engineering Department
- University of Connecticut - Transportation Institute

ConnDOT divisions represented:

- Aviation
- Highway Operations
- Information Systems
- Planning - Inventory & Forecasting
- Public Transportation
- Research
- Traffic Engineering

1.6 Consulting Team

The consulting team included the following team members:

- DKS Associates (prime consultant)
- Apogee Research, Inc.
- F.R. Harris, Inc.
- Rockwell International, Inc.
- VN Engineers, Inc.

2. TRAVEL INFORMATION SYSTEMS

There is a limited amount of transportation system information available to travelers in the Capitol Region. Much of the existing travel information available is static in nature, and does not provide the real-time, up-to-date information required to make the most informed decision on alternative routes, travel modes or departure times. The transportation information sources that are available in the Capitol Region are listed below in ***Table 2.1.***

TABLE 2.1 EXISTING OR COMMITTED TRAVEL INFORMATION SYSTEMS

Component	Description
	Information Dissemination
Radio & TV Traffic Reports	• Media traffic reports provide some real-time information on highway travel conditions in the Capitol Region.
Variable Message Signs (VMS)	• ConnDOT operates 18 variable message signs in the Capitol Region.
Highway Advisory Radio (HAR)	• Two existing HAR sites inform motorists of planned construction activities, bus servicer and ridesharing opportunities. • Neither site is actively used to inform travelers of incidents or traffic conditions. • Existing sites are scheduled to be upgraded under a ConnDOT project. Two additional sites will be added, and the primary function of the HAR stations will be changed to provide incident information.
Transit and Ridesharing Information	• Carpooling information, park-and-ride lot locations and transit routes and schedules available on the Rideshare Internet web site. • Rail schedule information available by toll-free number. • Transit schedule information kiosk installed at Buckland Hills park-and-ride lot in Manchester.
Airport Information	• Flight schedule, weather and airline information available on Bradley Aiiort Internet website.
Information on Roadway Construction Activities	• Information on scheduled construction and maintenance activities is available on ConnDOT and Rideshare Internet web sites. • Information distributed from ConnDOT to the media and traffic services such as Metro Traffic and AAA.
	Information Collection
Traffic Watchers	• Traffic Watchers program operated by Rideshare will use carpools and vanpools equipped with cell-phones to report traffic Incident and problems to ConnDOT and the media.
Traffic Flow Monitors	• ConnDOT traffic flow monitors (also known as incident detectors) provide continuous information on current speeds at 10 sites on I-91 and I-84 in Hartford and Wethersfield. They also measure any unusual changes in speeds that might indicate an incident has occurred. • Roadway detectors used as part of computerized traffic signal systems allow agency staff to measure traffic density on surface streets.

Interagency Information Sharing	
Interagency Information Systems	• Expressway incident information transmitted across a northeast regional computerized interagency network system known as the Information Exchange Network (IEN). Agencies using the IEN include both ConnDOT Highway Operations Centers, New York and Massachusetts transportation agencies and TRANSCOM.

2.1 Traveler Information System Objectives

Both travelers and transportation agencies can benefit from better and more readily available information on the transportation systems they use or operate. With more information on traffic conditions and travel options, travelers can make better decisions on which route to take to avoid congested areas, which mode of travel to use, and whether to leave early or late in order to avoid congestion. Likewise, agencies responsible for managing the transit, highway, and airport systems can utilize their resources more effectively if they have better information of the current status of their operations. Thus, the primary goal of this section of the ITS Plan is to identify ways to improve the information available to both the users and managers of transportation. More specific objectives are stated below.

Objective 1: Improve Information Dissemination to Travelers. A primary objective of the Travel Information System is to provide more and better information about travel options and traffic conditions.

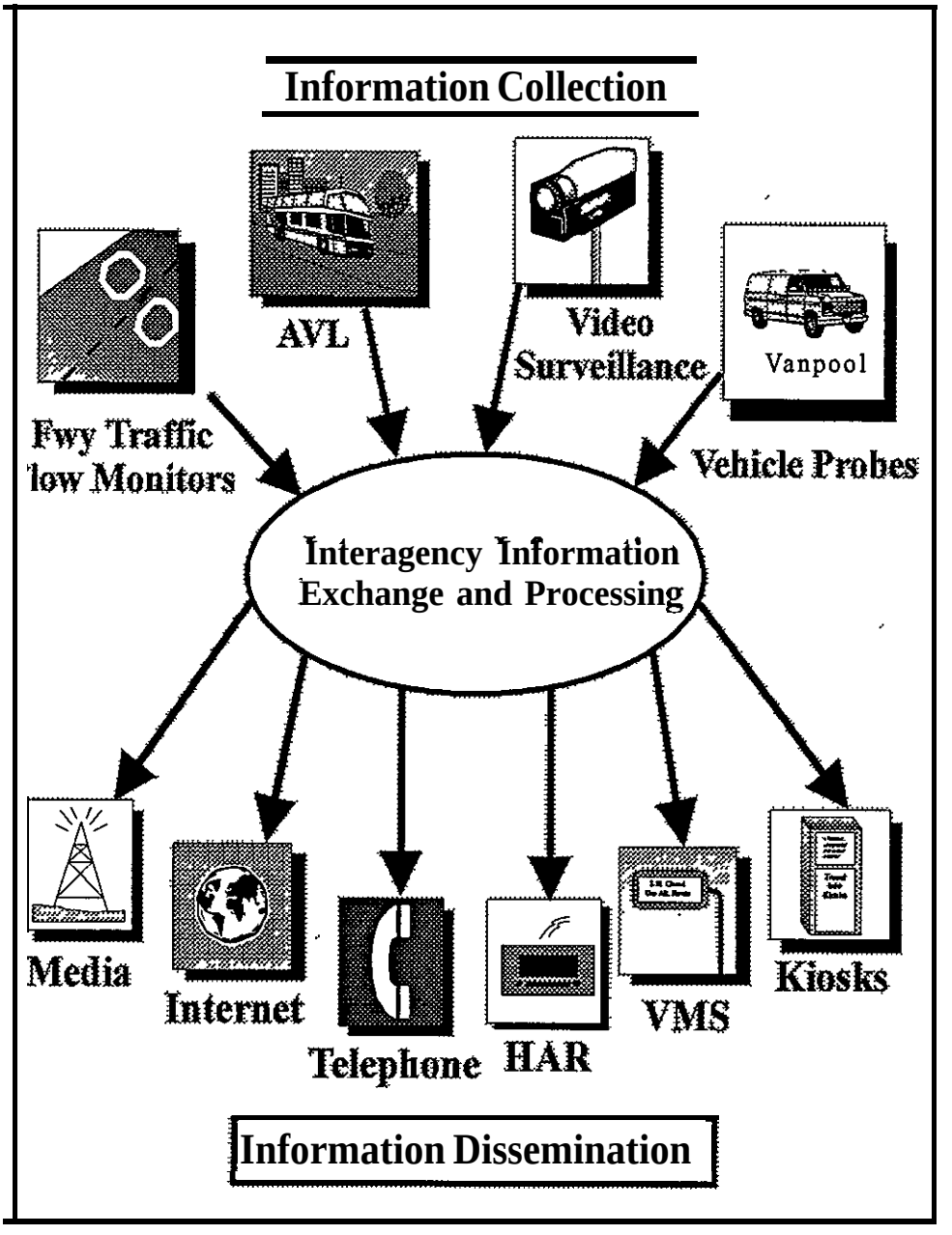
Improve Pre-Trip Information Dissemination. Pre-trip information systems are used by travelers before they begin their trip. A person can get travel information in his/her home or office on travel options (including transit services) and highway traffic conditions. Methods used to convey information include: the Internet, special “1-800” information phone lines, cable TV, and commercial radio and TV traffic reports.

Much of the existing pre-trip travel information available to Capitol Region travelers is static in nature (e.g., transit schedules and planned construction activities). The primary exception is the real-time information provided through the media traffic reports. Ultimately, real-time data on traffic conditions and transit service delays could be automatically forwarded from operating agencies directly to the public as well as to the media.

Improve En route Information Dissemination. In addition to helping travelers evaluate their pre-trip planning options, it is also necessary to advise and guide them during their trip. En route systems provide travelers with information on congestion, incidents, available routes, optional travel modes and transit transfer locations. En route systems include: variable message signs (VMS), highway advisory radio (HAR), and information kiosks at bus stops, rest areas, and ***airports.***

In the future, real-time traffic speed data can be transmitted directly to onboard navigation systems in private vehicles. Current guidance systems (e.g., Cadillac’s "OnStar" system) select best travel routes using average speed data that is preprogrammed into the computer. Future systems will use real-time speed data collected by transportation agencies through their traffic flow monitoring systems.

Travel Information System



Objective 2: Provide Better Information To Agencies Responsible For Operating Or Managing Transportation Systems. In order to manage their systems more efficiently, transportation agencies need better information and real-time data on the status of their systems. Agencies such as CT Transit, The Rideshare Company, Greater Hartford Transit District, Connecticut DOT, and the City of Hartford DOT need to know information such as the current location of vehicles, the operational status of traffic signals, and the current traffic speeds or congestion levels on highways. The ability to provide this information to operating agencies needs to be improved.

Improve Data Collection Systems. Accurate, real-time information on the transportation system must be collected by operating agencies before it can be disseminated to travelers or used by agencies responsible for managing transportation systems. Data collection systems need to be expanded and automated. These include systems like the following: traffic flow monitoring systems, video surveillance systems, automatic vehicle location (AVL) systems for transit operators, and roadway detectors used for traffic signal systems.

Improve Interagency Information Sharing. Data collected by one transportation agency is often useful to other agencies as well. Unfortunately, this information is not always easily or readily available to other agencies. Means of sharing existing (and future) data resources need to be developed.

2.2 Public-Private Partnership Opportunities

A certain amount of travel information needs to be provided by public transportation agencies, including messages on roadway signs and highway advisory radio sites. The private sector can also play a significant role in distributing the information to travelers. Public and private sector partners may team together to coordinate the information collection and distribution of information. For example, real-time traffic speed data and video images collected from Hartford area traffic management systems may be electronically transmitted to a private sector firm. The data can then reviewed, combined with other available travel information, and repackaged in a format for distribution on Internet web sites and information kiosks.

This type of public-private partnership is beneficial to both patties. Public agencies do not have to allocate the extensive resources required to disseminate the information they gather. In some cases, public agencies can participate in private sector revenue sharing. Private companies provide a service that is useful to transportation system users and may offer advertising space on their systems equipment for a fee, to recoup development, operations and maintenance costs.

The cost estimates for pre-trip information systems at the end of this chapter assume that Capitol Region public agencies will bear the full implementation and operations/maintenance costs of travel information systems. Actual capital, operations and maintenance costs may be greatly reduced or eliminated if public-private sector partnerships are initiated for the information dissemination process.

2.3 Pre-trip Travel Information

Transportation system users require access to accurate information (static and real-time) in order to make the most effective decisions on available travel routes and modes. Existing forms of pre-trip traveler information in the Capitol Region include traffic reports available on radio and

television stations, roadway construction advisories and static transit information on the Internet, and transit schedule/ridesharing information published in a number of printed formats.

Recommendations for Pre-Trip Travel Information	
Phase 1	• Provide real-time ConnDOT traffic information on the Internet.
	• Place CT Transit bus schedule information on the Internet.
	• Implement statewide "l-800" number for transit & rideshare information.
Phase 3	• Expand "1-800" number to include multimodal travel information.

Internet Travel Information. The Internet is a proven, effective tool for transmitting pre-trip travel information to the media and general public. Internet web pages utilize links to computer system databases to automatically update travel information without the need for operator intervention. Some web sites even have the capability to automatically notify travelers of problems on their specific travel routes. Connecticut DOT has an Internet web page that contains some static travel information including planned roadway construction activities. Real-time traffic information (travel speeds, incident information, etc.) is collected by the DOT Newington Highway Operations Center, but ***an automated*** means of transmitting this data to the media or public via the Internet does not yet exist.

There is some Hartford area transit information available on the Internet. The Rideshare Company maintains a web site with an up-to-date listing of available carp001 and vanpool options, park-and-ride lot locations, some transit route and schedule information, and links to several railroad web sites. Bus schedule information from CT Transit is not currently available on the Internet.

Increasing and improving the travel information available on the Internet will enable transportation system users to make better decisions on available travel options. Two forms of travel information that should be made available on the Internet are: real-time freeway travel speeds and CT Transit bus schedules.

Statewide Travel Information Telephone Number. A single "l-800" phone number would allow a caller to link into an information service for traffic conditions, incident information, transit and rideshare services, special events and construction information. The caller would select the desired service from a menu and the call would be. routed to the appropriate agency. The telephone system could initially supply transit schedule and other static data in the short term as described in Chapter 3 (Transit & Rideshare Systems). The system might be expanded over time to accommodate communication links and real-time. information on expressway and transit systems from various agencies.

2.4 En route Travel Information

The Capitol Region has several existing en route driver information systems operated by ConnDOT. A number of expressway variable message. signs were installed as part of the I-84/I-91 interchange reconstruction project. Additional DOT highway advisory radio transmitter stations that provide detailed incident and construction advisories to roadway travelers are also

planned for installation in the next few years. Existing transit en route devices include static information kiosks located at selected park-and-tide lots. Further discussion of existing and proposed en route traveler information systems and suggestions for implementation are contained in Chapters 3 and 4 (Transit/Rideshare and Highway Management Systems).

The existing en route travel information systems (VMS and HAR) should be expanded across the Capitol Region. These recommendations are further detailed (including costs) in Chapter 4 (Highway Management Systems).

Recommendations for En route Travel Information

Phase 1	Add new VMS signs where there are gaps in coverage (8), replace existing signs that reach the end of their useful life (16). and relocate existing signs (1) for better visibility.
	Upgrade existing HAR stations (2) and add two new sites to complete coverage of the central freeway system. Add Bradley Airport HAR transmitter site.
	Place static kiosks (50) with transit schedule information at critical locations such as major bus stations, major commuter parking lots and major employment sites.
Phase2	Continue to add new VMS where there are gaps in coverage, and relocate existing signs as needed for better visibility.
	Install electronic kiosks (3) to provide real-time travel information.
Phase3	Complete VMS coverage. Add new VMS where there arc gaps in coverage.
	Establish infrastructure required for emerging in-vehicle navigation/ information systems.

Variable Message Signs. The VMS system needs to be expanded to include additional signs at more critical junctions of the. highway system. Existing signs are located on highways entering Hartford. Additional signs are needed on highways exiting Hartford, at major freeway-to-freeway junctions, and circumferential roadways such as Rt. 9, I-291 and I-691.

Highway Advisory Radio. HAR radio transmitter systems broadcast travel information to motorists on the expressway system. HAR messages complement VMS systems by providing more detailed information on incidents, construction activities, carpooling opportunities, etc. A typical HAR transmitter has a five-mile radius broadcast range. Fixed roadway signs with flashing beacons activated by the HAR transmitter are typically placed along roadways to alert motorists of an urgent message broadcast. Four HAR stations should be installed to cover the Capitol Region core area, and an additional station should be installed at Bradley Airport to provide parking availability and other pertinent airport information.

Kiosks. Place information kiosks at critical locations such as rest areas, tourist attractions, transit centers and major employment sites. Initially, kiosks will be simple static displays, but eventually these units could be equipped with electronic touch screen displays that allow the user to get real-time data on expressway conditions or transit and rideshare services.

Since there is more than one target market for the information kiosks, the type of kiosks installed, and their locations will vary depending on the target audience. Kiosks targeted at the commuter market will be located at major transit centers (see Chapter 3) and provide all necessary transit and rideshare information. Kiosks targeted at tourists or other long distance travelers will be located at rest areas, Bradley Airport, and important tourist attractions, etc. They will contain information on highway traffic conditions, restaurants, hotels, tourist attractions, etc.

Navigation/Information Systems. In-vehicle navigation systems are currently used by many truck and bus fleet operators. At least two automobile manufacturers ***also*** offer navigation systems as options in their new cars. Current systems use static travel time data to calculate the best route to reach a given destination. These systems are. generally unable to find the best route around congested areas. To provide guidance around or through congested areas, real-time data is needed on traffic speed and flow conditions. In the future, the data will be available from sources such as the traffic flow monitoring systems proposed in Chapter 4. This will have to be complemented by the ability to transmit the data to individual vehicles equipped with navigation systems.

2.5 Travel Data Collection

Agency dissemination of travel information cannot be. properly accomplished without an effective means for collecting and verifying the data. Travel information sources such as detectors and vehicle probes allow agencies to collect real-time data on traffic system characteristics including average speeds, travel times and incident locations. Surveillance systems such as closed circuit television cameras (CCTV) are an important transportation agency tool for monitoring roadway traffic conditions and verifying traffic incidents. A more complete list of existing collection systems is provided in Table 2.1 above. Recommendations for system improvements, additions, and expansions are provided below.

Recommendations for Travel Data Collection	
Phase 1	• Install Automatic Vehicle Location (AVL) system for CT Transit buses (240) and Greater Hartford Transit District vehicles (60).
	• Provide full video coverage of freeways within the core area.
	• Expand traffic flow monitors for full coverage. in the core area.
Phase 2	. Expand freeway video coverage to segments beyond the core area.
	• Expand traffic flow monitor coverage to rest of central area.
Phase 3	• Expand AVL system to Greater Hartford Rideshare Company vans (210).
	. Expand freeway video coverage. to the balance of the freeway system.
	• Expand traffic flow monitors to outer portions of the freeway system.

Automatic Vehicle Location (AVL) System. AVL systems allow transit dispatchers to determine the exact location of all buses in the operating fleet. Satellite-based Global Positioning Systems (GPS) and Geographic Information Systems (GIS) track the locations of all fleet vehicles by using radio communications. Vehicle location systems allow transit dispatchers

to monitor schedule adherence, better coordinate connecting services and better plan schedule and travel routes. AVL systems should be installed on CT Transit buses and Transit District vans. Eventually AVL capability should be extended to the Rideshare van fleet as well. An additional benefit of the AVL system is that the vehicles equipped with AVL can serve. as vehicle probes that send back information on traffic speeds on various roadways. A description of the AVL system is provided in Chapter 3 (Transit & Rideshare Systems).

Traffic Video Surveillance Systems. Expansion of the existing ConnDOT and City of Hartford traffic surveillance systems will fulfill a critical agency need for increased monitoring of the roadway system and verification of traffic incidents and disturbances. Specific information on the video surveillance system is provided in Chapter 4 (Highway Management Systems).

Traffic Flow Monitoring (Detection). The traffic flow monitoring system needs to be expanded from its limited coverage area. This can be done in phases by first completing coverage in the core area and then expanding outward. Traffic flow monitors (detectors) can serve. as an important agency tool for measuring traffic speeds and volumes, and estimating travel times. This information can be provided to motorists using a variety of dissemination devices including the Internet, HAR, kiosks, etc. The details of the traffic flow monitoring system are provided in Chapter 4 (Highway Management Systems).

2.6 Interagency Information Sharing

Transportation operating agencies in the Capitol Region need to share real-time information on the transportation system in order to effectively manage their own systems as well as to coordinate interagency activities. Presented below are two examples of existing efforts at interagency information sharing. The two examples are followed by recommendations on how to improve information sharing in the Capitol Region.

Existing Data Sharing: Expressway Management Systems. The ConnDOT Newington Highway Operations Center has two existing video camera sites in the Capitol Region that offer a limited view of the highway and adjacent street system. The City of Hartford has a more extensive video system (28 cameras) used to monitor city traffic patterns and surface street congestion. It is also used to fine-tune the computerized signal system timings. Both agencies have expressed a need to share video camera images -- the surface street coverage provided by ConnDOT cameras is useful for monitoring local traffic conditions, and the highway system surveillance provided by the City cameras offers incident detection and verification capabilities for the Capitol Region expressways.

ConnDOT, with the cooperation of the City of Hartford, is pursuing installation of an interim remote video monitoring system that will allow the Highway Operations Center personnel to view images from selected City camera locations.

Existing Data Sharing: TRANSCOM Model Deployment Initiative (MDI). ConnDOT, through its affiliation with TRANSCOM (a New York, New Jersey and Connecticut coalition of highway, transit and public safety agencies), is participating in an FHWA endeavor known as the Model Deployment Initiative (MDI) program. The $10 million, five-year MDI project is a partnership between the TRANSCOM public agencies and a private sector team, and involves the institution of a New York metropolitan area Traveler Information Center at TRANSCOM's office. The Center will gather static and real-time travel information from highway and transit

agencies in the tri-state region. The information will be disseminated at no charge to the public via the Internet, kiosks, and a telephone access system. Customized, route-specific information will also be available to the public for a subscription fee.

Although some travel information from the Capitol Region will be made available to the MDI Information Center, much of the information from MDI will initially be focused on travelers in the New York metropolitan area (including southwestern Connecticut).

Recommendations for Interagency Information Sharing	
Phase 1	• Implement DOT-City of Hartford real-time data/video communications link. • Implement DOT-Troop H communications link. • Establish regional travel information database. for storing real-time and static multimodal travel information.
Phase 2 -3	• Expand DOT communications links to other entities as required. Potential sites that could be linked include Bradley Airport, ConnDOT' Bridgeport Highway Operations Center and future Springfield operations centers.
Phase 3	• Expand regional travel information database to include information on more travel modes and more transportation operators or services.

DOT-City of Hartford Communications Link. Coordination of traffic management activities between the City of Hartford and the ConnDOT operations centers will become crucial as both entities continue to deploy traffic control and roadway surveillance systems. The agencies will need to share traffic system data to ensure an efficient and coordinated response. to incidents or construction activities in the Capitol Region. At a minimum, the City will require real-time. incident report information from the ConnDOT Highway Operations Center so that an appropriate response to a traffic activity might be initiated. Similarly, both agencies have a need to access video images from each other's camera systems.

A high-speed communications link between the ConnDOT and City of Hartford operations centers provides the necessary bandwidth to share video images and traffic data in real-time. A dedicated fiber-optic/hard wire. connection between agency centers is recommended, as it will provide the infrastructure required to share traffic information and real-time video camera images. A DOT-owned fiber-optic cable installed as part of a Berlin Turnpike traffic signal system project will terminate a short distance from the City of Hartford communications network. Linking the ConnDOT and City of Hartford cable networks is considered ***a*** short-term priority need.

DOT-State Police Troop H Communications Link. Successful coordination of incident management activities will require close. coordination between staff in the DOT Newington Highway Operations Center (HOC) and the dispatch area of State Police Troop H (Hartford Barracks). DOT requires timely information on highway incidents and breakdowns reported to the State Police so that service patrols may be dispatched. DOT will also need to notify motorists of an incident's impact on the highway system, including lane closures or alternate routes. State Police access to DOT video surveillance cameras will provide the capability to

monitor activities at an incident scene. Since it may not be possible for DOT and Troop H to share a common dispatch-operations center (as in the Bridgeport HOC), another technique for establishing effective agency communications will be required. This recommendation is described further in Chapter 5 (Incident Management Systems).

Other Agency Communications Links. The sharing of traffic data and video images between ConnDOT and other transportation agencies or operators in the Capitol Region can be initiated in the future as additional interagency communication links are established. Connecticut Transit and Bradley Airport are two examples of entities with a need for sharing real-time information with the DOT Newington HIghway Operations Center.

Regional Travel Information Database. Interagency information sharing and dissemination to the media and public needs to be accomplished in a coordinated and standardized manner. A regional travel information database would provide an efficient and economical system for storing and distributing real-time and static travel information collected by a number of agencies.

Following the concept of the "Metropolitan Area Network" established as an "ultimate" system architecture (as explained in Technical Memorandum 6: System Architecture Report), a regional travel information database can be initiated by simply providing electronic communication links between existing sources of travel information and a centralized computer database. Agencies that collect or store travel-related data may continue to do so, but information that can be shared with other agencies or the public is transmitted to a regional computerized database. The information may then be combined with transportation data from other agencies, and transmitted to system users via the Internet, electronic kiosks, the media or privately owned Independent Service Providers (ISP's).

The establishment of the database needs to be a cooperative effort among ConnDOT, CRCOG, local municipalities, transit agencies and other transportation providers. Following the initial setup, the database can evolve over time, eventually linking a number of agencies that supply information to the network and end users.

2.7 Costs and Phasing

The summary costs and phasing of the Travel Information ITS proposal are listed in ***Table 2.2.*** The entire cost of Phase 1 and 2 is estimated at $1,240,000. ***Table 2.3*** provides a phased listing of system elements.

TABLE 2.2 SUMMARY OF TRAVEL INFORMATION ITS COSTS

	PHASE1	PHASE2	PHASE3	PHASE1+2
Pre-Trip Travel Information	25,000	TBD	***TBD***	25,000
En route Travel Information	250,000	440,000	***TBD***	690,000
Travel Data Collection	0	0	0	0
Interagency Information Sharing	525,000	0	2,000,000	525,000
TOTAL	800,000	440,000	2.000,000	1,240,OOO

TABLE 2.3 TRAVEL INFORMATION: DETAILED COSTS & PHASING

A. Pre-trip Travel Information

Phase	Project	CapitalCost	Op- Mnt. Cost
I	Provide real-time traffic information on the Internet	25,000 *-a-*	5,000
l	Establish statewide l-800 number for transit & ridesharing informanon	sceCh 3	see Ch 3
1	Provide CT Transit schedule information on the Internet	see Ch. 3	see Ch. 3
3	Expand statewide l-800 number to *include other multimodal travel information*	*TBD* *-a-*	*TBD*
	TOTAL, Phase 1 + 2	25,000	5,000

B. En route Travel Information

Phase	Project	Capital Cost	Op - Mnt. Cost
1-3	Upgrade, add, and relocate variable message signs (VMS)	see Ch 4	see Ch. 4
1	Install highway advisory radio (HAR) sites	see Ch. 4	see Ch. 4
1	Install 50 static information kiosks at major travel sites	250,000	30,000
2	Convert 8 static display kiosks to electronic kiosks at 4 transit hub stations, 1 downtown, 3 rail stations	320,000	minimal
2	Install 3 electronic kiosks to incorporate real-time information	120,000	minimal
3	*Provide infrastructure required to support emerging in-vehicle navigation/information systems*	*TBD*	*TBD*
	TOTAL, Phase 1 + 2	690,000	30,000

C. Travel Data Collection

Phase	Project	Capital Cost	Op - Mnt. Cost
1-3	Implement AVL for transit vehicles	see Ch. 3	see Ch. 3
1-3	Expand existing traffic flow monitor system coverage	see Ch. 4	see Ch. 4
1-3	Install video surveillance cameras along freeway system	see Ch. 4	see Ch. 4
	TOTAL, Phase 1 + 2	--	--

D. Interagency Information Sharing

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Direct communications link: DOT - City of Hartford	25,000	1,000
1-3	Direct communications link: DOT - State Police Troop H	see Ch. 5	see Ch. 5
1	Establish regional travel information database	500,000	10,000
2-3	Establish future interagency communications links	TBD	TBD
3	*Expand regional database to include other operating agencies and provide information on various travel modes*	*2,000,000*	*40,000*
	TOTAL, Phase 1 + 2	525,000	11,000

-a- Assumes costs paid by the public sector Actual costs could be substantially reduced or eliminated if installed as part of a public-private sector partnership agreement.

3. TRANSIT & RIDESHARE SYSTEMS

The Capitol Region has an extensive transit and rideshare system that is comprised of many individual services operated by different agencies (see Table 3.1). The primary services include. local and express bus routes, demand responsive services for the elderly and disabled, and rideshare services. All of these can be made more effective and more. efficient through better system management -- and ITS can help achieve that goal.

TABLE 3.1 EXISTING TRANSIT & RIDESHARE SERVICES

Service	Description
Local Bus Service	• 29 local bus routes are operated by CT Transit.
Commuter Bus *Service*	• 15 express commuter routes are operated by CT Transit • 7 express commuter routes are operated by private operators.
Rideshare *Services*	• Carpool matching services are available through Rideshare. • 210 vanpools are managed through Easy Street, a Rideshare program. • 40-50 owner/operator vanpools are. financed through Rideshare. • I-84 & I-91 HOV lanes are operated by ConnDOT. • An "extensive" system of park&ride lots is operated by ConnDOT.
Elderly And Disabled Services	• A regional demand responsive service for the disabled (ADA) is managed by the Greater Hartford Transit District (GHTD). This service is also available to the elderly in some. towns. • Local demand responsive services for the elderly & disabled are operated by town governments and the GHTD.
Union station	• Union Station is a multimodal transit center served by trains, intercity buses, local buses, &taxis.
Scooter Shuttle Service	• A private shuttle bus service is funded by major employers in Hartford to shuttle employees between various work sites &parking lots. • The Scooter service is managed by the GHTD.
Passenger Rail *Service*	• Amtrak operates a Springfield - New Haven service. • Light rail service is proposed for the Griffin Line.
Intercity Buses	• Bonanza, Peter Pan, & Greyhound operate intercity services from Union Station.
Taxi Services	• Private taxi service is available.

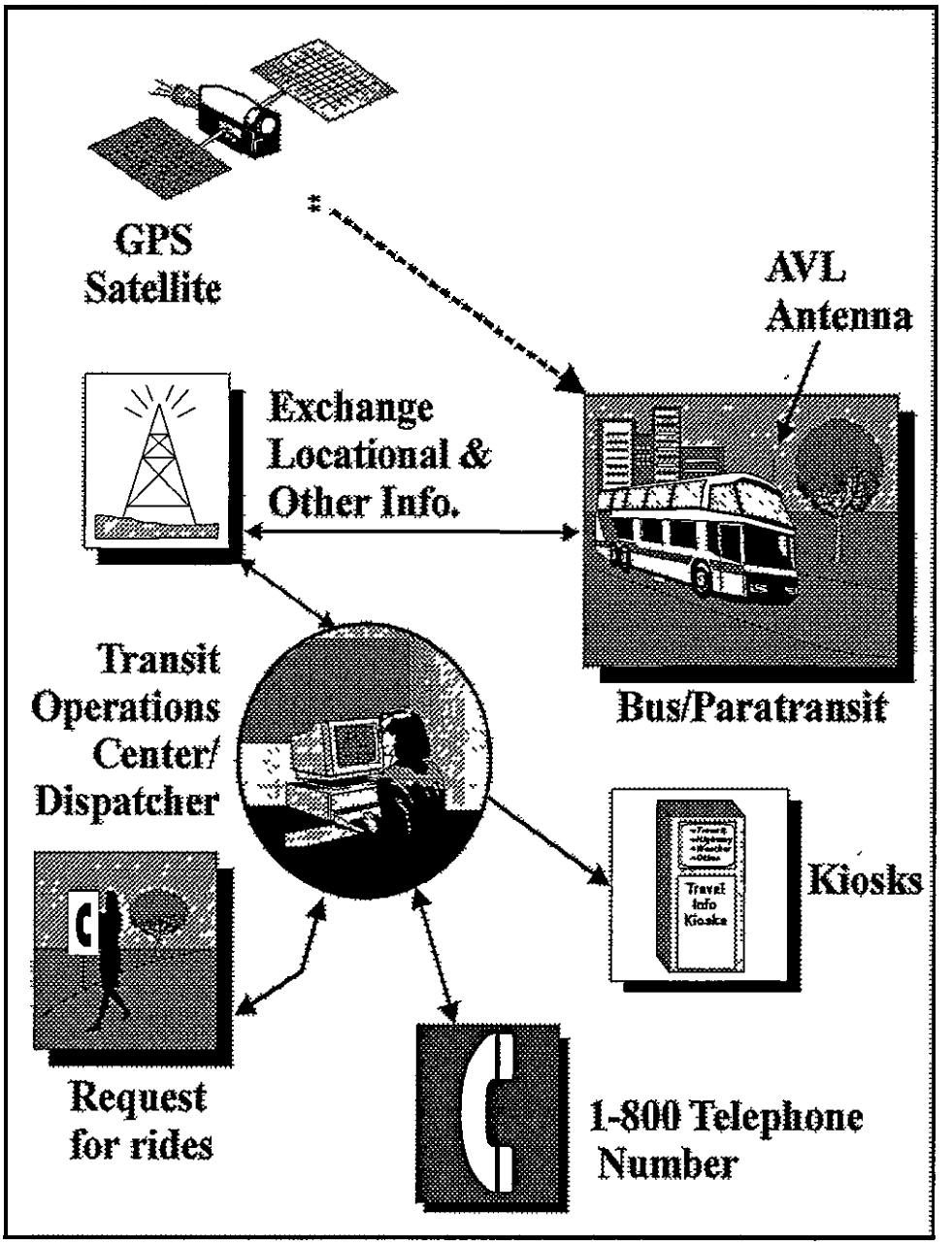
3.1 System Management Goals for Transit

A primary goal of the lTS Strategic Plan is to make more efficient use of "existing" transit and rideshare services. This system management goal is achieved in two ways:

1. Helping "operators" of transit and rideshare ***services*** run their services more efficiently, and

2. Helping transit/rideshare "customers" by improving the quality of information provided to them.

Transit Management System



Objective 1: Improve Operator Efficiency. Many of the routine functions that transit and rideshare operators perform are labor intensive. If techniques ***can*** be found to accomplish these tasks more efficiently, both the operating agency and the customer can benefit. Some of the routine functions that might benefit from technological assistance include:

- Dispatching
- Data Collection
- Monitoring Schedule Adherence
- Fare Collection & Accounting
- Monitoring Vehicle Performance & Maintenance Schedules
- Customer Information Services

Objective 2: Improve Availability and Quality of Transit Information. The second major ITS objective reagarding transit and rideshare ***services is*** to ***increase*** the customer's access to transit/rideshare information and improve the quality of the information provided. The primary purpose is to make information on transit and rideshare services more readily available to potential users. The hope is that more travelers will use transit or ridesharing as an alternative to driving alone if they are aware of the options available to them. A longer-term objective is to provide real-time schedule information to transit users. With "up to the minute" information on bus arrival times or schedule delays, travelers can alter their travel plans or make other adjustments.

3.2 Local & Express Bus Service

CT Transit is the primary provider of bus service in the Capitol Region. It operates nearly 200 buses during the peak morning and afternoon periods. The efficiency and effectiveness of the bus system can be improved through ITS related applications.

Existing Technology Applications. CT Transit already uses advanced electronic or communication systems for some of its functions. These include. two-way radio systems on buses, electronic display signs on most of its buses, electronic fare boxes on all buses, and on-board video cameras on three buses.

New ITS Priorities. Recommendations for priority areas of ITS applications are as follows:

Recommendations for CT Transit	
Phase 1	• Video Cameras.
Phase 1-2	• Customer & Travel Information Services.
Phase 2	• Automated Vehicle Location (AVL).
	• Other "Smart Bus" Applications.

Video Cameras. Video cameras have proven useful in reducing undesirable behavior on buses, in reducing vandalism, and in identifying vandals. They have also proven useful when defending the transit company against personal injury claims. It is not necessary to equip every vehicle with an active camera. An enclosure that serves as a cover for the camera may be installed on all fleet buses. Actual cameras can then be rotated through the system. Passengers are aware of the "camera," but do not know whether the camera is active or not.

Customer & Travel Information Services. CT Transit hopes to automate its existing telephone-based information service, but it also wants to provide other ways for travelers to get information. The goal is to make more information available, make it easier to access the information, and provide real-time information rather than just the traditional static schedule information.

Add New Ways to Access Schedule Information. Adding new ways to access schedule information will make it easier for travelers to get the information. Methods under consideration include:

- Internet: Place bus schedule information on the Internet (home page). CT Transit currently has such a page under development.
- Kiosks: Place kiosks with schedule information at critical locations such as major bus stations, major commuter parking lots, and major employment sites. Initial kiosks would be simple static displays (example: a paper schedule posted under glass). One such kiosk is already installed at the park/ride lot on Buckland Street in Manchester. Kiosks could eventually be equipped with electronic touch screen displays that allow the user to "page" through schedules and even get real-time data on bus arrival times. (See also Ch. 2.)
- Statewide Transit Information Phone: Designate a "l-800" phone number that would allow the caller to link into the information service of any major transit & rideshare service in the State of Connecticut. The caller would select the service wanted from a menu and the call would then be rerouted to the appropriate agency.

Automatic Vehicle Location (AVL) System. AVL is a system that allows dispatchers to determine the exact location of all buses in the operating fleet. The most recent AVL systems use radios, satellite-based Global Positioning Systems (GPS), and Geographic Information Systems (GIS) to track the locations of all vehicles in a fleet. Vehicle location systems can help serve several existing transit functions:

- Schedule adherence: allow dispatchers to monitor how well buses are adhering to schedules.
- Connecting service: allow dispatchers to better coordinate connecting services and transfers.
- Schedule & route planning: assist in the development of more realistic schedules.

They can also be used in conjunction with other systems to implement the following functions:

- Silent alarm system: send police assistance when driver security is threatened.
- Automated data collection: collect data on the location of passenger boardings in conjunction with automatic passenger counters.
- Stop announcement system: provide location information to a stop announcement system that notifies visually impaired passengers of upcoming bus stops.
- Travel information svstem: provide up to the minute travel time and schedule adherence information that can be given to customers waiting at major bus stops, or in their home or office.

AVL is a priority of CT Transit.

Other "Smart Bus" Applications. In addition to an automatic vehicle location system, CT Transit could benefit from other technologies generally grouped under the heading of "Smart Bus" systems. Most of these are intended to automate functions that are traditionally done manually. Systems that could benefit CT Transit are listed below.

Detailed Recommendations for Smart Bus System

System	Comments
Centralized electronic control system	necessary to accommodate AVL connections to onboard systems
Automated monitoring of various electronic and mechanical systems (engine, transmission, etc.)	manual data download in place for some buses; automated system under development
Stop announcement systems	responds to Americans with Disabilities Act requirements, can be activated through AVL
Automatic passenger counters	awaiting technological improvements
Electronic fare boxes	basic system already installed, increased functionality when connected to AVL
Electronic destination signs	already installed, increased functionality when connected to AVL

3.3 Demand Responsive Transit Services

The primary provider of demand responsive transit service in the Region is the Greater Hartford Transit District. The District operates a 50-vehicle fleet with about 40 vehicles in service during peak periods. In addition, the District leases another 130 vehicles to municipal agencies that choose to operate their own local services. Most of the vehicles are vans or small buses and service is primarily for elderly or disabled individuals.

Existing Technology Applications. GHTD uses a sophisticated computerized system to take reservations, match rides to bus routes, dispatch vehicles, and bill for rides provided. All vans in GHTD's regional service are equipped with two-way radios.

New ITS Priorities. GHTD's priorities for ITS applications derive from the demand responsive nature of the service and the need to increase the efficiency of ride matching, vehicle dispatching, and vehicle routing. There is also a need to reduce the amount of paperwork and data entry required to record trip information at the end of the day.

Recommendations for GHTD	
Phase 1	• Onboard or mobile data terminals with AVL.
Phase 2	• Coordination of transfer with CT Transit.
	• Localized weather & road condition forecasting.
Phase 3	• Onboard navigation.

Mobile Data Terminals. To help achieve its efficiency goals, GHTD has set its ITS priorities on mobile data terminals, AVL, and onboard vehicle navigation for each vehicle. The onboard data terminals will allow drivers' schedules to be updated automatically, instantaneously, and remotely from the dispatch office. They will also eliminate the need for office staff to manually enter trip records for each passenger and vehicle at the end of the day.

Automatic Vehicle Location (AVL) System. The automatic vehicle location system (AVL) allows the dispatcher to monitor the location of all vehicles. The locational information allows the dispatcher to be more efficient when modifying vehicle schedules to accommodate new ride requests, cancellations or delays.

GHTD also wants to use the AVL in conjunction with efforts to coordinate GHTD services with CT Transit services and the proposed CT Transit AVL system. This will help facilitate real-time scheduling of transfers between GHTD and CT Transit.

Localized Weather and Road Condition Forecasting. GHTD drivers would benefit significantly from the monitoring and forecasting of localized weather and road conditions. Broad brush forecasting by national and local weather services provide limited information to both drivers and dispatchers. Drivers need to know exactly when roads will begin freezing. Present technology allows for the immediate monitoring of road temperatures, and consequently the potential for roadway icing, through the use of radiometers attached to the tires of the vehicles. These monitors are considered a priority of the GHTD.

Onboard Navigation. Onboard navigation systems are computerized mapping systems that determine the best route to reach a destination, and then display the route to the driver on a video screen mounted on the dashboard. The onboard navigation system would eliminate driver uncertainty and error that occurs when a driver is trying to find a newly served address. With a large service area, 40 or more drivers, and continuously changing routes and schedules, this is a significant problem for GHTD. A simple, low cost version is available through the mobile data terminal and is proposed until the computerized mapping systems become more cost effective.

3.4 Rideshare Services

The State contracts with The Rideshare Company to be the primary provider of ridesharing services in the Capitol Region. These services range from a simple matching service for people trying to join a carp001 to a full service Vanpool program.

The Vanpool fleet that is managed by The Rideshare Company is comprised of 210 vanpools and is expandmg. This full service vanpool program provides for all aspects of the vanpool except the driving, The vanpool program combines several State programs, including van financing,

insurance, and property, sales, and gas tax incentives, with operation and maintenance of the fleet to offer attractive vanpooling options. Rideshare delivers a spare van when one breaks down on the road and provides emergency rides home for all passengers. In this "no hassles" approach to ridesharing, the passenger simply pays a monthly fee. Rideshare also provides passenger-matching services for potential carpoolers and vanpoolers.

In addition, the State, through Rideshare, facilitates private vanpooling through another van-financing and vehicle insurance program for owner/operators. This program is presently funding between 40 and 50 vehicles. The Rideshare Company provides a State-funded loan for vans that are owner operated. When the loan is fully repaid, ownership of the vehicle is transferred to the owner/operator. Rideshare's not-for-profit status allows the owner/operator to pay sales tax on only the depreciated value of the vehicle.

Existing Technology Applications. Rideshare already relies heavily on advanced data and communications systems. Its ride-matching service is computerized, many of its vanpool administrative and financial functions are computerized, and it has an information page on the Internet.

Rideshare is currently under contract to the State to develop a program in which all of its vanpools and carpools participants will be afforded the opportunity to purchase low cost cellular phones. This program, Traffic Watchers, is being pursued as an incentive package for Vanpool and carp001 participants, but the phones will also be used to report traffic conditions to traffic reporting services used by the local media. A public/private undertaking, Traffic Watchers, brings together diverse interest groups: cellular phone servers, radio media programmers, corporate sponsors, and the traveling public. It will allow the gathering and dissemination of real-time travel information to a wide audience through the radios already installed in most automobiles today.

New ITS Priorities. The Rideshare Company's priorities for additional ITS applications reflect its desire to capture more commuters in ridesharing modes through improved marketing (information dissemination) and through better Integration of vanpool services with other transit services.

Recommendations for The Rideshare Co.	
Phase 1	• Travel Information Services. • More dynamic ride matching. • Integration with other transit services.
Phase 3	• Installation of AVL in vans.

Travel Information Services. The Rideshare Company is supportive of regional and statewide efforts to centralize and improve transit and rideshare "information" services. These include projects such as the placement of information kiosks at major bus stops and commuter lots, a single central transit/rideshare information phone line, and a transit/rideshare information service on the Internet. If ridesharing and transit information is included in these centralized systems, it will serve most of the commuter's needs for travel information systems. Since Rideshare needs to market directly to commuters, the systems will need to be easily accessible from the

commuter's place of work. This can be accomplished via Internet services at the workplace and via electronic kiosks at major employment sites.

Dynamic Ride Matching. The Rideshare Company is trying to develop a more dynamic ride matching system. Initially this will be focused on changing vanpool or seat assignments on a monthly or weekly basis. This will allow some riders with irregular schedules or short-term schedule changes to be reassigned to other vanpools during the period of their schedule change. It will also allow Rideshare to fill more seats in its vans by capturing riders whose irregular work schedules would otherwise preclude their use of a vanpool. Ultimately, Rideshare hopes to accommodate changes on a daily or even an hourly basis.

Integration with Other Transit Services. The Rideshare Company considers integration of its service with bus or other transit services as a primary goal for the future. The initial focus might be on the development of commuter parking lots as true multimodal facilities serving commuter buses, vanpools, and carpools. Information kiosks at such facilities would include schedule information for vanpools as well as buses. The availability of a universal ticket that would allow vanpoolers to transfer between vans and local buses or even trains seamlessly is a priority. The ability to take a bus one way and a van the other way to work is a longer-range goal.

Installation of AVL System in Vans. The primary purpose of providing Rideshare vans with AVL capability is to allow the vehicles to be used as traffic probes, sending travel speed information back to the DOT operations center. This proposal is contingent upon technological advances making AVL systems more cost effective, and it is therefore shown as Phase 3.

3.5 Rail Services

Existing Amtrak Service. Amtrak is the only passenger rail service currently operating in the Region. It operates a Springfield-Hartford-New Haven route. There are 12 trips a day (6 northbound, 6 southbound) and the primary access to the service is through Union Station in Hartford. Some stops are also scheduled for the smaller stations in Windsor and Windsor Locks.

Recommendations for Existing Intercity Rail	
Phase 1	• Travel Information Services.

The limited rail service in the Region could benefit most from improved information services. All three stations could benefit from information kiosks that display train schedules. Ultimately the kiosks might even inform users if the train is running on schedule or behind schedule. This would be similar to the information provided to airplane passengers at airport terminals.

Information about train service could also be included in the centralized travel information system. This could include information about the Sprmgfield-Hartford-New Haven service, but it would also include information about connecting services in New Haven and Springfield.

Future Rail Services. There is the potential that other rail services will be introduced in the Region. The Regional Transportation Plan recommends institution of light rail service on the Griffin Line from Hartford to Bloomfield (and possibly to Bradley International Airport). The Regional Transportation Plan also recognizes the possibility of eventually starting rail service in the Hartford West corridor and the Hartford South corridor.

If any of these services are initiated, they will undoubtedly include some ITS elements. Therefore, the potential for these additional ITS services must be recognized, and the ITS plan needs to allow for eventual integration of new rail services into the regional ITS system. The following are the types of ITS services that are likely to be incorporated into any new rail service:

Recommendations for New Rail Systems	
Phase 2 - 3	• AVL & coordination of transfers with buses. • Travel Information Systems. o kiosks at stations 0 inclusion of new rail service in the travel information system for ***remote access*** • "Smart" train systems. 0 electronic fare collection 0 security systems o stop announcement system o electronic destination signs • Automated monitoring of mechanical systems.
Phase 3	• Regional fare card. o Electronic fare cards for rail service compatible with bus services

3.6 Intermodal Services

There is a need in the Region for increasing the ease with which passengers switch from mode to mode. This comes about by linking the transit services at several intermodal facilities throughout the Region and by facilitating transfers across modes.

There are several important intermodal facilities in the Region. They deserve separate recognition even though most of their ITS needs are addressed in the modal services discussed above. The intermodal facilities are listed in ***Table 3.2.***

TABLE 3.2 INTERMODAL FACILITIES SERVING TRANSIT & RIDESHARING

Service	Description
union station	• Union Station is a large multimodal transit center served by trains, intercity buses, local buses, & taxis. It has separate parking and loading areas for both taxis and buses. A large parking lot for cars is also available. The building also houses restaurants, newspaper stands, and the offices of the Greater Hanford Transit District.
Suburban train stations	• Small tram stations are located in Windsor and Windsor Locks. They have small loading platforms and parking lots for cars. The Windsor station has a small indoor waiting area as well as a covered platform.

Commuter parking lots	• The Region has an extensive system of commuter parking lots. The system is a valuable asset that helps support both the bus system and rideshare system. • In the Region there are a total of 38 state-owned commuter lots with a total of 6,080 parking spaces. All the lots are available for use by vanpools or carpools, and most are served by express or local buses.

Travel Information System. The larger facilities such as Union Station and some of the larger commuter lots with bus service should be served by information kiosks. Travelers can use the kiosks to get information on train schedules, bus schedules, and rideshare services. In addition, the location of all commuter lots should be available.

Universal Fare Card. A universal fare card would allow passengers the opportunity to make one fare purchase and use it on any of the available transit and paratransit services in the region. This would allow seamless transferring between modes, without the passenger having to figure out differing fare and/or transfer policies. It would allow the passenger to make a mode choice based on daily needs rather than being locked into a weekly or monthly decision.

A basic universally accepted fare card can be implemented rather simply through coordination among the transit and paratransit operators. An automated fare card that would allow for collection of detailed ridership information including boardings, deboardings and linked transfer information would be extremely useful to both transit operators and transit planners. It would also allow for the accurate sharing of fares among the transit and paratransit operators. However, the technology is not presently cost effective. At some time when the technology has improved as the costs are lower, this will become a higher priority. The addition of any new train service in the region, particularly the Griffin Line, would also increase the priority of a universally accepted fare card.

3.7 Costs and Phasing

The summary costs and phasing of the Transit and Rideshare ITS proposals are listed in *Table 3.3.*

TABLE 3.3 SUMMARY OF TRANSIT AND RIDESHARE ITS COSTS

	PHASE 1	PHASE 2	PHASE 3	PHASE 1 + 2
RTIS	75,000	0	0	75,000
CT Transit	196,000	3,000,000	*480,000*	3,196,000
GHTD	250,000	165,000	*100,000*	415,000
Rideshare	65,000	0	*1,050,000*	65,000
Rail	0	0	0	0
Intermodal	40,000	0	*TBD*	40,000
TOTAL	626,000	3,165,000	*1,630,000*	3,791,000

The entire cost of Phase 1 and 2 is about $3.79 million. Most of the start-up and base program costs of high priority items are listed under Phase 1 at a cost of $626 thousand. A cost breakdown by agency and phase is shown in ***Table 3.4*** below.

TABLE 3.4 TRANSIT AND RIDESHARE: DETAILED COSTS & PHASING

A. Regional Travel Information System

Phase	Project	Comments	Capital Cost	Op – Mnt. Cost
1	Statewide phone number	List information on CT Transit, GHTD, Rideshare, private bus operators, Amtrak.	50,000	15,000
1	Internet Page	List information on CT Transit, GHTD, Rideshare, private bus operators, Amtrak.	25,000	18,000
1	Information kiosks – static display	Locate 50 kiosks at major bus stations, major commuter parking lots, major employment sites, rail stations, airports	see Ch. 2	see Ch. 2
2	Electronic kiosks	Convert 8 static display kiosks to electronic kiosks at 4 transit hub stations, 1 downtown, 3 rail stations.	see Ch. 2	see Ch.2
		TOTAL, Phase 1 + 2	75,000	33,000

B. CT Transit ITS System

Phase	Project	Comments	Capital Cost	Op - Mnt. Cost
1	Video cameras	Install 80 video cameras and 240 camera enclosures.	196,000	
2	AVL: Install basic system in CT Transit buses	Basic system; builds on existing equipment and radio system. Installed in 240 buses. Coordinate with GHTD.	1,500,000	
2	AVL: Integrate basic AVL with Smart Bus features	More sophisticated system allowing integration of Smart Bus features (automated passenger counters, fareboxes, electronic destination signs, remote mechanical system monitoring).	1,500,000	
3	*Stop announcement system*	*Install in 240 buses.*	*480,000*	
		TOTAL, Phase 1 + 2	3,196,000	0

C. GHTD ITS System

Phase	Project	Comments	Capital Cost	Op- Mnt. Cost
1	Onboard data terminals	Install terminals with AVL capability in 60 vehicles.	250,000	
2	Weather and road condition service	Install radiometers in 60 vehicles.	165,000	3,000
3	*Onboard navigation system*	*Install advanced systems in 60 vehicles.*	*100,000*	
		TOTAL, Phase 1 + 2	415,000	3,000

D. Ridershare ITS System

Phase	Project	Comments	Capital Cost	Op – Mnt. Cost
1	List GHRS services in Travel Information System	TIS includes phone number, Internet page, kiosk. Coordinated with other transit services.	-a-	
1	Traffic watchers program	Equip vanpools with cellular phones in return for traffic updates provided to ConnDOT Highway Ops Center.	-b-	-c-
1	"Dynamic" ride matching service	On-line rideshare matching which would allow for weekly or daily changes to vanpool assignments.	65,000	20,000
3	*Equip vans with AVL*	*Allows 210 vans to serve as "probe" vehicles for DOT's traffic monitoring program.*	*1,050,000*	*-c-*
		TOTAL, Phase 1 + 2	65,000	20,000

E. Rail ITS System

Phase	Project	Comments	Capital Cost	Op – Mnt. Cost
1	List rail service information in Travel Information System	TIS includes phone number, Internet page, kiosks, coordinate with other transit services.	-a-	
2-3	Any new rail service	Include AVL, TIS, and other ITS components as part of any new rail service budget.	0	
		TOTAL, Phase 1 + 2	--	--

F. Intermodal ITS System

Phase	Project	Comments	Capital Cost	Op – Mnt. Cost
1	Universal fare card-basic	Study of fare coordination among transit and paratransit providers	40,000	Minimal
3	*Universal fare card-electronic*	*Available systems not yet sufficiently reliable.*	*TBD*	
		TOTAL, Phase 1 + 2	40,000	--

-a- costs included in Regional TIS above
-b- capital costs already committed
-c- inkind costs only

4. HIGHWAY MANAGEMENT SYSTEMS

ITS technologies can play an important role in the Region's efforts to improve the efficiency and effectiveness of existing freeways and arterials.[2] The 1994 Capitol Region Transportation Plan recognized the fact that financial and environmental constraints seriously limit opportunities to solve congestion problems by building new or bigger roads. Increasingly, the Region will have to find ways to reduce congestion without building new roadway capacity. This means existing roads will have to operate more efficiently. The Region will have to employ more and better highway management techniques. ITS technologies are among the system management techniques that will have to be applied.

Why Is Better Highway Management Important?

Historically, management of our existing roadway system has not been an important element in long-range transportation plans. The dominant strategy in the Capitol Region over the past four decades has been the expansion of highway system capacity. Capacity expansion has bee" very effective at reducing congestion in the past. However, its viability as a planning option is greatly reduced today. Stricter environmental regulations, reduced federal funding for system expansion, and fewer opportunities to locate new roads in a more developed landscape all mea" that it is much more difficult to build a new road today than it was 20 or eve" 10 years ago.

If we cannot expand the system appreciably, then we must make more effective use of the existing system. More specifically, this means we must do a better job of managing the "flow of traffic" on our arterials and freeways.

Capitol Region System Management Policy, 1994

Some ITS technologies are particularly well suited to improving roadway efficiency and traffic flow without adding capacity. ITS highway management systems include: computer-controlled traffic signal systems, variable message signs, highway advisory radio, video surveillance systems, and traffic flow monitoring systems. A brief explanation of each is given in ***Table 4.1.***

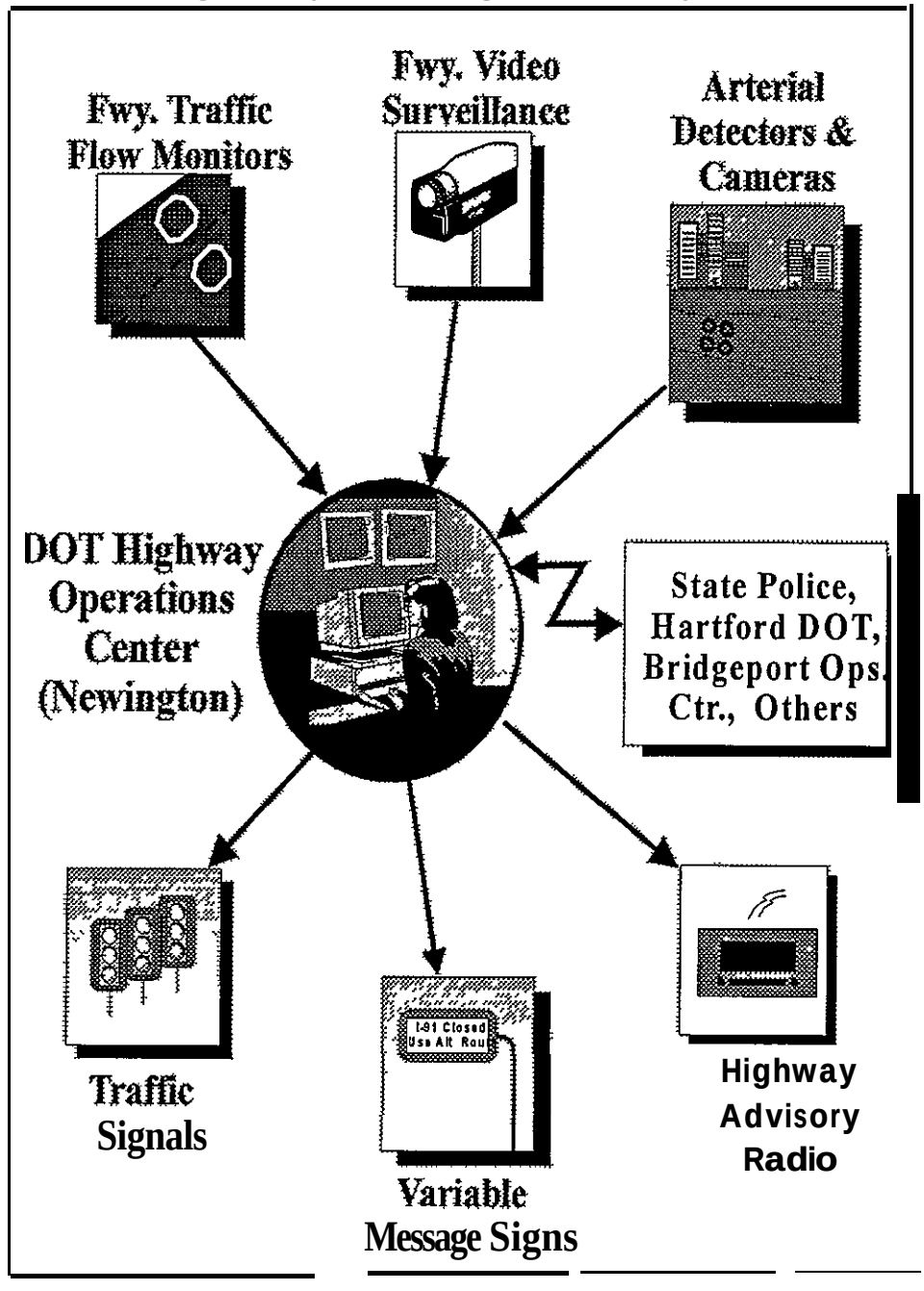
TABLE 4.1 ITS HIGHWAY MANAGEMENT SYSTEMS

Component	Description
Variable Message Signs (VMS)	• VMS includes electronic signs mounted over highways that provide information to motorists about traffic conditions, lane closures, detours. expected delays, etc. Messages are sent from the highway operations center using leased telephone lines or via a special communications network.
Highway Advisory Radio (HAR)	• Highway advisory radios are low-powered radio systems that are located near major highways and used to broadcast traffic information to motorists. The messages broadcast from a roadside HAR transmitter are relayed to the station from the operations center via leased telephone lines or a special communications network. . A" advantage of HAR over VMS is that more information can be provided in a broadcast than is possible on a single small sign. The broadcast also covers a large area (typical broadcast range is a radius of 5 miles).

[2]The Capitol Region has over 100 miles of limited access highways and over 580 miles of arterial roads.

Video Surveillance (Television Cameras)	• Video surveillance systems typically consist of a series of closed circuit TV cameras that allow staff at a highway operations center, State Police Barracks, or other key agencies to view conditions on the highway. They are used to determine if problems exist on the highways, the nature. and severity of the problem, and the type of emergency services that need to be dispatched to an Incident. • Cameras require a two-way communications system. Operators need to be able to control the cameras (swivel, tilt, zoom) to focus on a problem area, and the video information needs to be transmitted back to the operators.
Traffic Flow Monitors (Detectors)	• Traffic flow monitors (sometimes called incident detectors) include a variety of devices that measure the flow or speed of traffic. This monitoring can serve three different purposes. o Current travel time information: Monitoring systems are the primary data source for the travel information system discussed in Chapter 2. Information on current traffic speeds is provided to travelers and to transportation agencies. o Planning data Transportation agencies use monitoring systems to gather data about system usage (volume & VMT) and performance (average speeds & duration of congestion). The data is used for planning and administrative purposes. o Incident detection: Speed monitors can serve. as incident detectors since drastic decreases in traffic speed often indicate an incident has occurred. This function has become less critical as cellular phones have become more common Motorists often report incidents to police before the speed monitors indicate a problem.
Computerized Signal Systems	• Traffic signals can be controlled by computers in a central office or highway operations center. Computer control helps achieve coordination among signals, and good progression of vehicles through multiple signals. It also allows the diagnosis and correction of signal problems from a central office. This reduces the number of field visits required.
Ramp Meters	• Ramp meters are special traffic signals on highway entrance ramps. Signal timing is set to control the flow of cars onto the highway so that the merging traffic does not cause a major disruption to the flow of traffic on the highway itself.
Lane Control Signs	. Lane control signs include lane use indicators located over each travel lane on a highway or arterial. The indicators designate whether the lane is open or closed. They can also indicate if the lane is closed ahead and warn drivers to shift over one lane. The signs are electronic and are controlled from a highway operations center.
Communications Network	. All the ITS systems listed above require a fast communications system that can transmit large volumes of data. The most effective way of meeting this need is to install a communications network dedicated exclusively to serving ITS needs. The basic component of such a system is the communication cable (probably fiber optic) installed along the major freeways This cable network needs to be connected directly to the highway operations center.

Highway Management System



4.1 Existing ITS Systems

ITS highway management systems are not new to the Capitol Region. Some ITS highway management systems, such as computerized traffic signal systems, have been in use for over a decade and are already widely deployed. Other lTS technologies, including video surveillance and motorist information systems, have been deployed on a limited basis or as pilot projects. A summary of the existing system is provided in **Table 4.2.**

Included in **Table 4.2** are existing ITS highway management systems and an ITS support system (communications network). The latter is needed to provide a high-speed, high-volume communications link between the DOT Highway Operations Center, various ITS components (such as video cameras, variable message signs, and traffic signal systems), and various affiliated agencies such as the State Police.

TABLE 4.2 EXISTING OR COMMITTED HIGHWAY MANAGEMENT SYSTEMS

Component	Description
Variable Message Signs	• ConnDOT operates 18 variable message signs in the Capitol Region. The existing system is extensive & effective. It is the primary means by which ConnDOT informs motorists of traffic problems. The signs are operated 24 hours a day.
Highway Advisory Radio	• There are two existing HAR sites. Both sites are used to inform motorists of planned construction activities, ridesharing opportunities, and bus services. • Neither existing HAR station is actively and regularly used to inform motorists of current traffic conditions or incidents. • A project is scheduled to upgrade theexisting two transmitters and add another two HAR sites.
Video Surveillance	• ConnDOT operates onlytwo cameras in the Capitol Region: one at I-91/I-84 & one at I-91/Rt 15. DOT is installing 6-8 cameras on the Berlin Turnpike. • Most of the existing freeway system has no video coverage. • The City of Hartford operates 28 cameras in Hartford.
Traffic Flow Monitors (Detectors)	• 10traffic flow monitor stations are located on I-91 & I-84 in Hartford & Wethersfield. The stations utilize radar units to monitor traffic speeds to identify any unusual changes in speeds that might indicate an incident has occurred.
Communications Infrastructure	• There is no dedicated communications network for highway management purposes. • Some communications conduits and cables are being installed. The cable installation is an ancillary part of larger construction projects. It is being done in anticipation of the ultimate construction of a regional communications network for transportation management. The initial elements include: o A fiber optic cable along the Berlin Turnpike (part of a traffic signal system project) It includes a direct connection to DOT's Operations Center. o A fiber optic conduit along I-84 in Farmington & West Hartford (part of a major resurfacing &safety project). o A fiber optic conduit (no cable) along I-91 from Route 9 to Route 3 (part of a major resurfacing & safety project).

Operation Centers	• ConnDOT Newington Operations Center staffed 24 hours, ConnDOT Bridgeport Operation Centers staffed 24 hours, State Police Troop H staffed 24 hours, City of Hartford staffed normal hours.
Computerized Signal Systems	• Computer-controlled signal systems are installed on most arterials in the Region. • ConnDOT: 179 signals on UTCS, and 107 signals on closed loop systems in the Capitol Region. • City of Hartford: 200 signals on the UTCS operated by City of Hartford of which 110 use "170~type" controllers.
Ramp Meters	• None
Lane Control Signs	• None

4.2 System Management Objectives

A primary goal of the Capitol Region Transportation Plan and the associated System Management Policy is to make more efficient use of the Region's "existing" highway system. ITS systems can help achieve this larger system management goal by serving the three objectives described below.

Objective 1: Reduce Congestion on Freeways Due to Incidents. lTS technologies such as video surveillance, variable message signs, and highway advisory radio are effective means of reducing congestion due to Incidents. They help reduce the time needed to verify incidents, allow quicker dispatching of emergency services, and provide information to motorists on the location of the incident.

Objective 2: Improve Traffic Flow on Arterial Streets. ITS components such as computerized traffic signal systems are a fundamental tool for reducing congestion and delay on the arterial system in the Capitol Region. They are a proven and effective means of improving traffic flow and reducing accidents.

Objective 3: Better Motorist Information. I" the effort to mitigate non-recurring congestion and recurring congestton, it is essential to provide the motoring public with information. By providing motorists with information on traffic conditions, they can make personal decisions on the best route to avoid congested areas.

4.3 Overview of Highway Needs

The need for lTS system deployment and improvement varies substantially depending on the type of ITS system. Some are already well deployed and need only moderate expansion and upgrading. Others are deployed on a very limited basis and require a major expansion.

The two most proven ITS systems in the Capitol Region are computer-controlled traffic signal systems and VMS systems. Signal system coverage is very good in the Region. As a result, the recommendations for stgnal systems are to maintain the existing systems we have, and to upgrade them as needed. VMS system coverage is also good, but there are some critical freeway junctions where signs do not exist. Filling in these gaps in the VMS system is a high priority.

The other ITS systems are not as widely deployed. Therefore, the recommendation for these systems is to expand the coverage area. These include:

- the HAR system,
- the video surveillance system, and
- traffic flow monitoring.

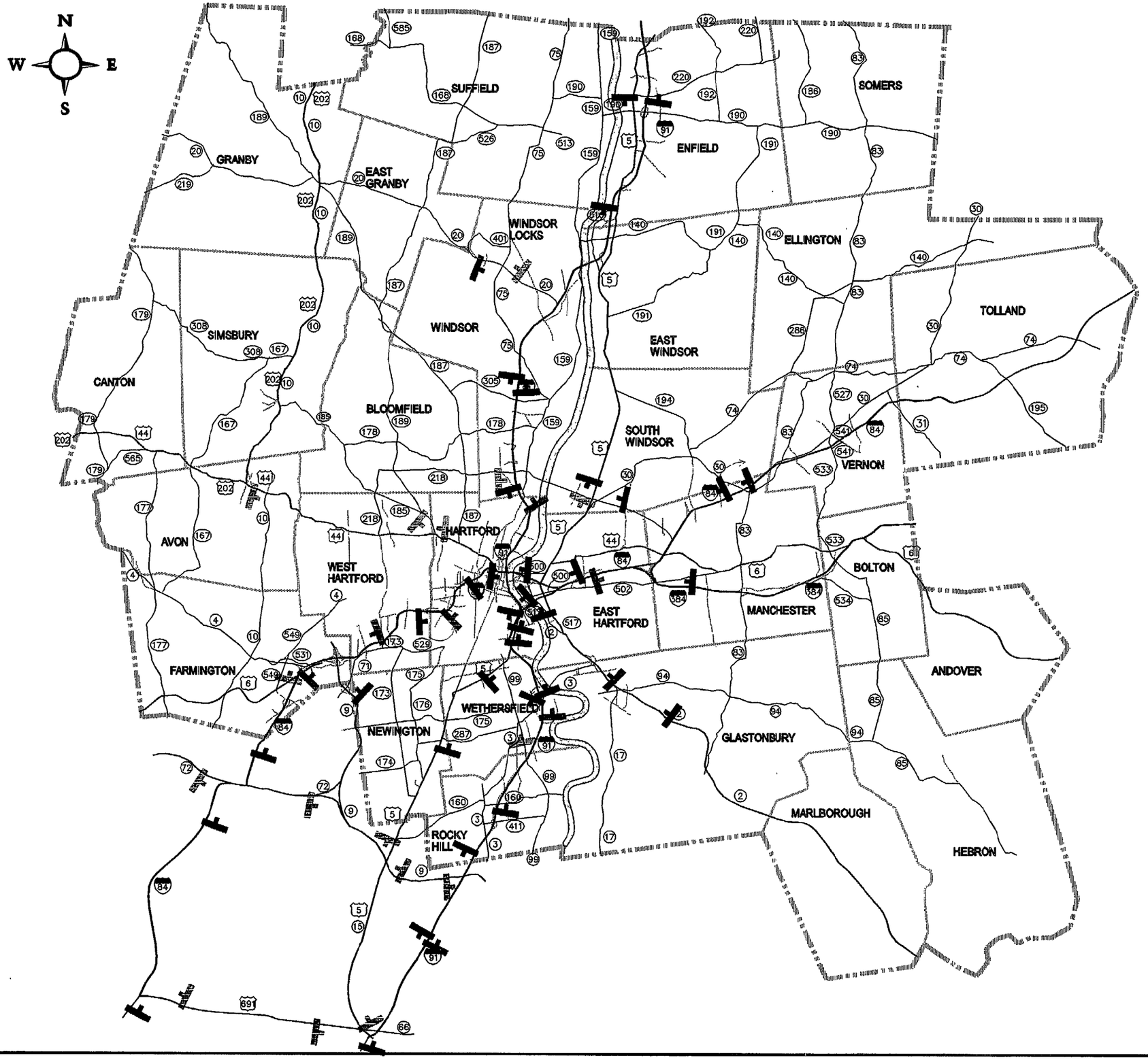
For all these systems to work, a high-speed, high-volume communications network is needed. Therefore, the fiber optic communication network is the highest priority element of the highway management system.

4.4 Variable Message Signs (VMS)

Variable message signs (VMS) have been used in the Capitol Region since 1990 and have proven to be an effective and reliable way of informing motorists of incidents and other potential traffic problems. The system of 18 signs provides fairly good coverage, but there are some notable gaps. Most of the signs are directed to motorists on the ***inbound*** direction of the radial freeways that intersect in Hartford (I-91, I-84, and Route 2). The system is not effective at getting information to travelers outbound from Hartford. There is also a lack of signs at some critical freeway-to-freeway junctions. Signs are needed at these junctions since circumferential freeways such as Route 9, I-691, Route 3, and I-291 can serve as important diversion routes.

The proposed VMS system is illustrated in ***Figure 4.1*** on the next page. It shows the existing VMS sign locations, and new locations proposed for Phase 1, Phase 2, and Phase 3. The recommendations are summarized below.

Recommendations for VMS	
Phase 1	• Add new signs where there are gaps in coverage (8). o Provide VMS signs for outbound traffic o Provide signs at critical junctions • Replace existing signs that reach the end of their 12-year life cycle (16). • Relocate existing signs for better visibility (1).
Phase 2	• Add new signs where there are gaps in coverage (9). • Relocate existing signs for better visibility (3).
Phase 3	• Add new signs where there are gaps in coverage (16).



Legend:

- Existing
- Proposed Phase 1
- Proposed Phase 2
- Proposed Phase 3

Figure 4.1

VMS Locations

INTELLIGENT TRANSPORTATION SYSTEMS
A STRATEGIC PLAN FOR THE
CAPITOL REGION

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4.5 Highway Advisory Radio (HAR)

Two highway advisory radio stations exist in the Capitol Region. However, they are not used for broadcasting information on current traffic conditions and major incidents. It is proposed to change the use of these stations to provide current traffic condition and incident information. It is also proposed to add two other HAR stations to provide full coverage in the central part of the Region. A fifth HAR station will be added near Bradley International Airport to provide information to motorists arriving and departing the Airport. Recommendations are stated below, and HAR sites are depicted in Figure 4.2.

Recommendations for HAR

Phase 1

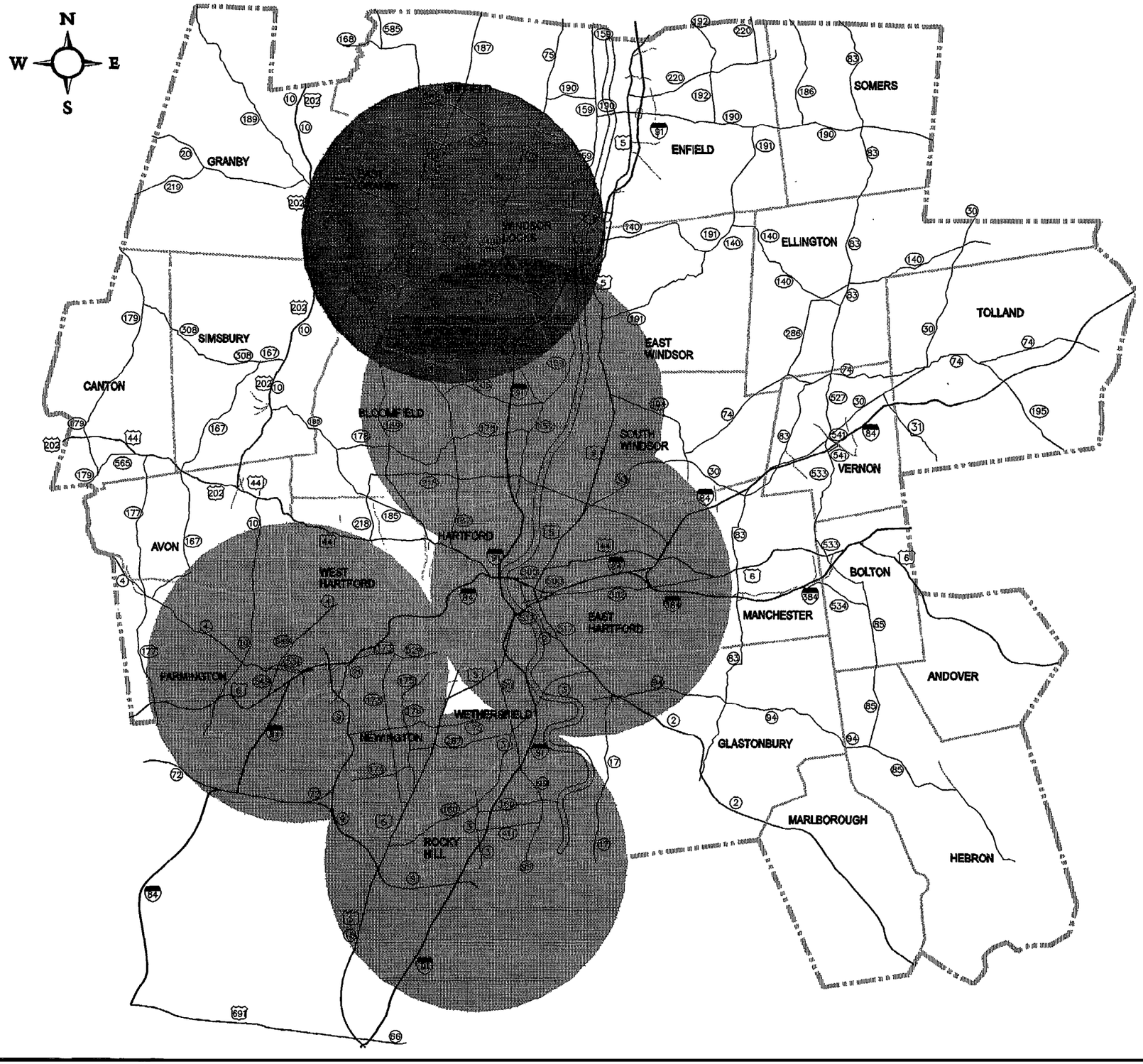
- Upgrade two existing HAR stations.
  - East Hartford: I-84 east of Hartford
  - Windsor: I-91 north of Hartford
- Change function of existing HAR system from providing static information on road construction activity, bus services, and rideshare services to providing current information on traffic conditions and incidents. The DOT Operations Center will assume responsibility for updating and broadcasting traffic information.
- Add two HAR sites to complete coverage of central part of freeway system.
  - Rocky Hill: I-91 south of Hartford
  - Farmington: I-84 west of Hartford
- Add station at Bradley International Airport. Bradley station will broadcast airport and highway information to motorists traveling to and from the airport. The Bradley station will be operated by airport personnel.

4.6 Video Surveillance System

Video surveillance in the Capitol Region is currently limited to the major Hartford arterials covered by the City's 28 cameras, and a small section of freeway covered by ConnDOT's two video cameras. ConnDOT and the City of Hartford are currently attempting to increase the freeway coverage. They hope to use City cameras near I-84 to provide video information to the ConnDOT HOC. ConnDOT also plans to install six to eight cameras along the Berlin Turnpike.

Video surveillance needs to be expanded substantially on the freeway system. It also needs to be extended to critical locations on the arterial system.

Camera Spacing. Camera coverage of the freeway system needs to be continuous within each section. This requires camera spacing of about one camera every half mile. Coverage of the arterial system does not have to be continuous. Typically, coverage is limited to one camera per critical intersection. The proposed system coverage is shown in Figure 4.3. Recommendations and phasing are summarized below.



Legend:

- Committed
- Proposed Bradley Airport HAR

Figure 4.2

HAR Locations

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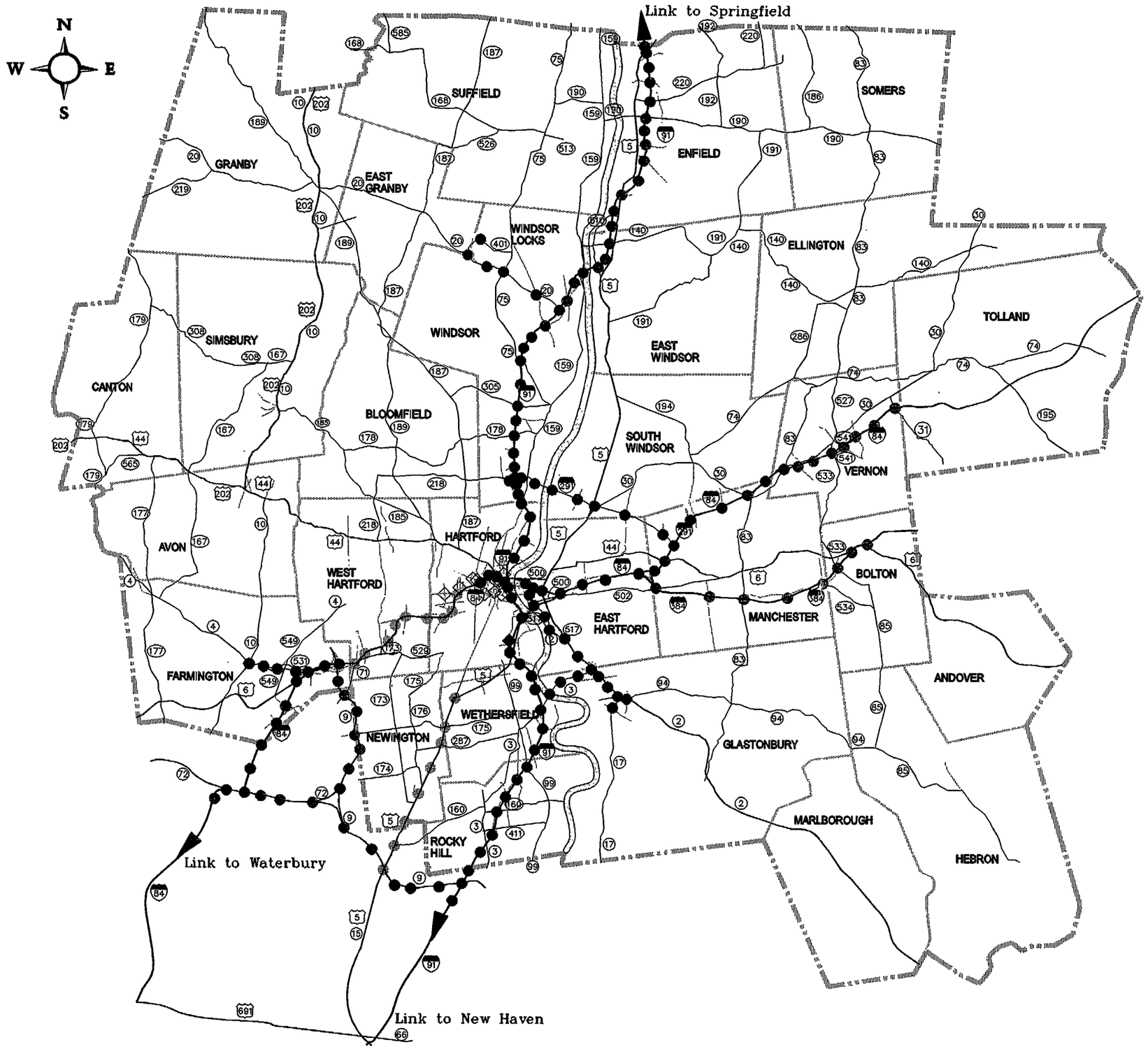

Legend:

- ◆ Existing – State of Connecticut
- ◇ Existing – City of Hartford
  (Only those cameras with freeway coverage are shown. Other City–owned cameras are not shown).
- ● Pending Commitment
- ● Proposed Phase 1
- ● Proposed Phase 2
- ● Proposed Phase 3
- Proposed Arterials

Note: Icons represent area covered and phasing only. Actual number and placement to be determined by Design.

Figure 4.3

Video Surveillance Cameras

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A STRATEGIC PLAN FOR THE
CAPITOL REGION

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Recommendations for Video Surveillance	
Phase 1	• Provide complete video coverage of freeways within the core area. • Provide direct link between ConnDOT Highway Operations Center and State Police - Troop H to enable police dispatchers to view video camera images. • Provide direct link between ConnDOT Highway Operations Center and Hartford Operations Center to allow exchange of video camera images.
Phase 2	• Expand freeway coverage to segments immediately beyond the core area. • Provide camera coverage at signalized intersections where video surveillance is needed, such as those located at critical points on traffic diversion routes.
Phase 3	• Expand coverage to the balance of the freeway system. o Most important are the links on I-91 to the New Haven system to the south and future Springfield systems to the north

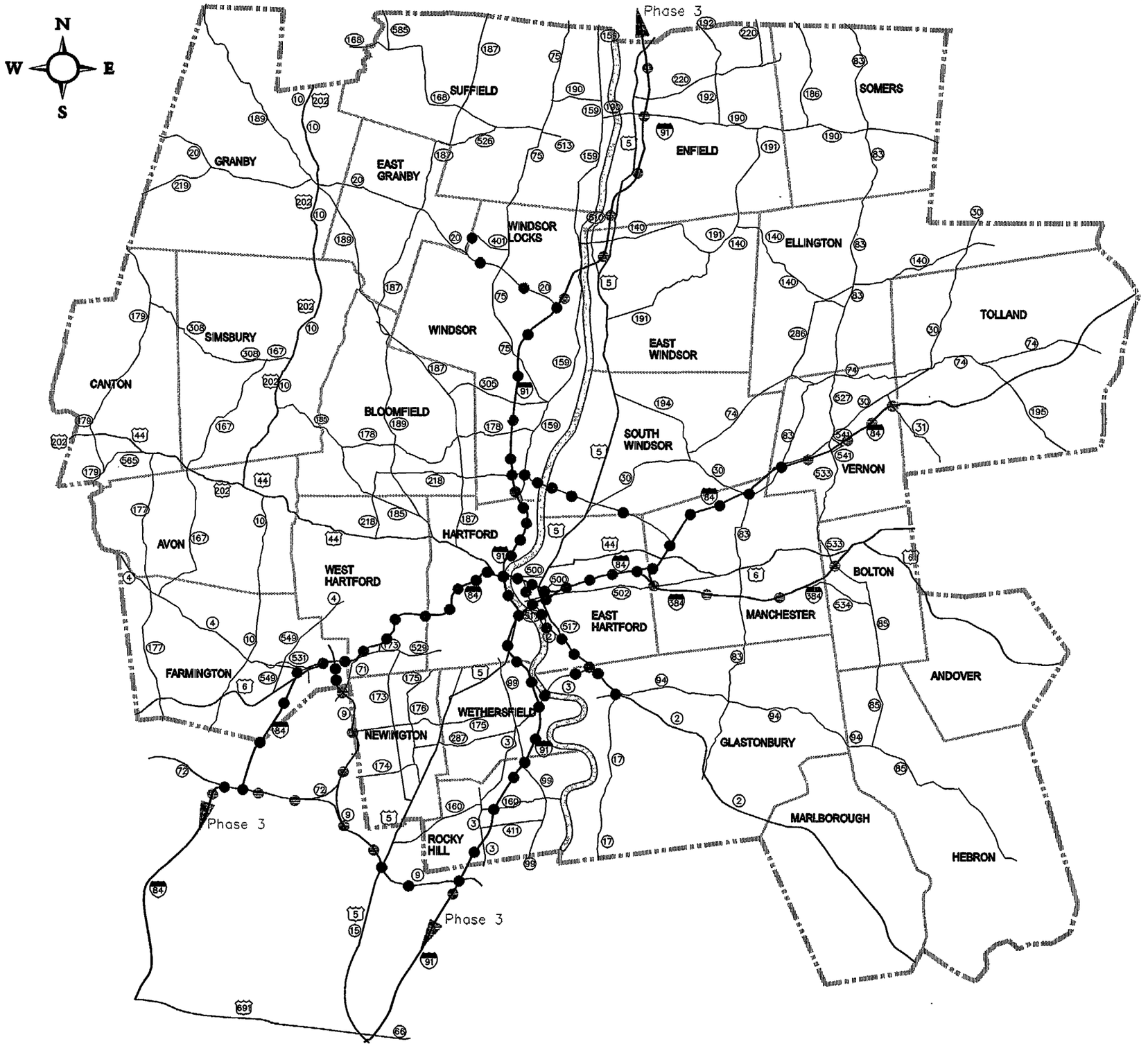
4.7 Traffic Flow Monitoring (Detection)

Traffic flow monitoring is currently limited to I-84 and I-91 in Hartford and Wethersfield. It needs to be expanded to provide complete coverage of the central portion of the freeway system. Phasing should be coincident with the video surveillance system and communications network. The coverage and phasing is depicted in Figure 4.4.

Station Spacing. While the monitoring system might continue to play some role in incident detection, its primary role will be to provide traffic speed data to the travel information system. Therefore, the spacing of monitoring stations can be greater than is normally required for detection purposes. Proposed spacing is one station per half-mile in the core area, and one station per mile outside the core.

Types of Data. A secondary function of the monitoring stations will be to collect traffic volume data for normal planning and administrative purposes. Thus, the system should be designed to collect traffic volume data as well as speed data.

Recommendations for Traffic Flow Monitoring	
Phase 1	• Provide traffic monitoring coverage to freeways within the core area.
Phase 2	• Expand traffic monitorin, system coverage to segments immediately beyond the core area.
Phase 3	• Expand traffic monitoring system to outer portions of freeway system.



Legend:

- Existing
- Proposed Phase 1
- Proposed Phase 2
- Proposed Phase 3

Fig Figure 4.4

Traffic Flow Monitors/Detectors

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A STRATEGIC PLAN FOR THE
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4.8 Communications Infrastructure

A key component of the Highway Management System is the communications infrastructure. The communications network provides the link between the operations center and the highway management components. The communications infrastructure recommended for the Capitol Region highway management system is fiber optic conduit and cable. The primary cable lines (or trunk lines) will be installed along the major freeways. The trunk lines will serve the communications needs of the ITS systems installed on the freeways (VMS, HAR, video, traffic monitoring) and the communication needs of some of the adjacent arterial roads (computer-controlled signal systems).

Public/Private Partnerships. Communications cable can be expensive to install. However, it is not always necessary for the public sector to pay the full cost of installation. Many communications companies would like to use the publicly owned right-of-way next to freeways to install their own cables. In return for the right to install their cables, some companies might offer to install extra cable for use by ConnDOT at no cost to the State. These potential cost reduction measures need to be explored further. For purposes of this report, it has been assumed that ConnDOT will have to bear the full cost of installing new cable. The cost estimates at the end of the chapter reflect this conservative assumption.[3]

The proposed communications network and its phasing are depicted in ***Figure 4.5.*** Recommendations are summarized below.

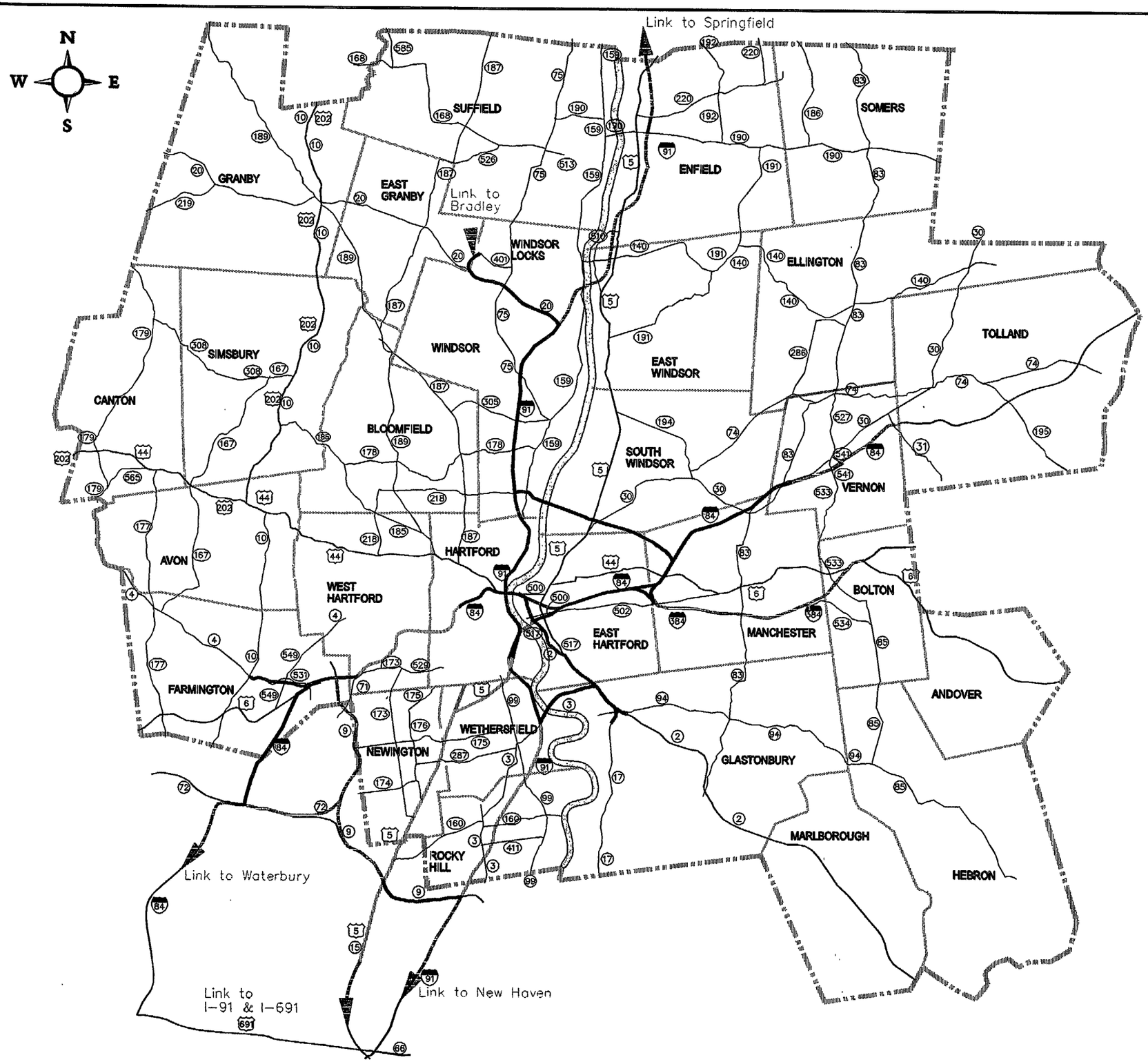
Recommendations for Communications Network

Phase 1
- Install fiber optic cable in conduits along freeways within the core area.
- Link the trunk lines along the freeways directly to the ConnDOT Operations Center on the Berlin Turnpike (project under design).
- Provide direct link between ConnDOT Highway Operations Center and State Police - Troop H.
- Provide direct link between ConnDOT Highway Operations Center and Hartford Operations Center.
- Provide links to adjacent arterial roads as appropriate. This allows traffic signal systems to be linked directly to the operations center rather than relying on telephone links.

Phase 2
- Expand the cable system to freeway segments immediately beyond the core area.
- Provide links to adjacent arterial roads as appropriate.

Phase 3
- Expand cable system to the balance of the freeway system.
  - o Most important are the links on I-91 to the New Haven system to the south and the Springfield system to the north

[3] Opportunities for public/private cost sharing can occur even after installation of the cable. Private firms might be willing to share in the cost of maintenance and upgrading in exchange for use of right-of-way and/or conduit.



Legend:

- Committed Fiber Optic Conduit + Cable
- Proposed Fiber Optic Conduit + Cable Phase 1
- Proposed Fiber Optic Conduit + Cable Phase 2
- Proposed Fiber Optic Conduit + Cable Phase 3

Figure 4.5

Communications Infrastructure

INTELLIGENT TRANSPORTATION SYSTEMS
A STRATEGIC PLAN FOR THE
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Early Build	• Every opportunity should be taken to install conduit and cable during freeway reconstruction projects. This results in substantial cost savings and it minimizes the disruption of traffic due to construction activity.
Public-Private	• Seek opportunities to reduce costs through public-private partnerships.

4.9 Highway Operations Centers

The ConnDOT Highway Operations Centers located in Newington and Bridgeport are the focal point of traffic management and incident management activities for the Department of Transportation. The Newington Operations Center is responsible for the coordination of these activities in the Capitol Region. The continued implementation of the highway management system components will require that the configuration, design and staffing of the Newington Operations Center be modified to help achieve the goals of this section and those outlined in the Travel Information section (Chapter 2) and the Incident Management section (Chapter 5). The Newington Operations Center will also need to exchange video and highway management system information with other Connecticut operations centers, including the City of Hartford Operations Center, State Police Troop H Barracks, and DOT's Bridgeport Operations Center. Long-term expansion could include a link to the Bradley Airport operations center and any future operations centers located in Massachusetts.

The additional highway management components to be installed **in** Phases 1 and 2 of this plan will require modification of the existing Newington Operations Center video display system and space surrounding the operations console. The operations console will need to be expanded or modified to accommodate the additional computer and system equipment required to operate the new highway management systems.

Recommendations for ConnDOT Newington Highway Operations Center	
Phase 1, 2, & 3	• Add video displays for additional cameras and other equipment as needed to accommodate system expansion.

4.10 Computer-Controlled Traffic Signal Systems

Agencies in the Capitol Region have made a significant investment in computerized traffic signal systems over the years. Computerized signal systems are an extremely effective traffic management tool that yields many benefits beyond congestion relief. Documented benefits of these systems include reduced travel times, decreased accident rates, reduced vehicle exhaust emissions, and fuel conservation. Computerized signal systems also allow agency personnel to monitor signal operation and perform minor troubleshooting from the central office. The ability to communicate with the signals from a central office reduces the need for field trips. Computerized traffic signals have also been used to collect traffic volume data.

Most of the important arterial routes are already served by computerized signal systems, however there are still State and municipal arterials without traffic signal systems. Many of these are potential locations for computerized signal control. It is anticipated that more arterials will warrant installation of computerized signal systems as land development and general traffic growth continue to increase in the Region.

In addition to installing new computerized signal systems, it is also necessary to maintain and upgrade the existing systems so that they can continue to provide useful service. There are some older computerized signal systems in the Capitol Region that use outdated control equipment. Some of the signal equipment is no longer supported by the manufacturer. Several ConnDOT projects have been proposed or initiated to upgrade many of the existing State-owned computerized signal locations that utilize discontinued equipment. The City of Hartford has also made a concerted effort to replace and upgrade traffic signal locations that utilize older, less-reliable control equipment.

Recommendations for Computerized Traffic Signal Systems

Phase 1	• State-Owned Arterials: Interim upgrade of ConnDOT's computerized signal system locations that utilize older, obsolete UTCS equipment. Modify for closed loop operation without direct interconnection.
Phase 2	• State-Owned Arterials: Permanent upgrade of ConnDOT computerized signal system locations that utilized older, obsolete UTCS equipment. Convert to full closed loop operation with direct signal interconnections. (UTCS uses an individual phone line to communicate with each signal.)
	• Municipally Owned Arterials: Some expansion and upgrade of the Hartford-owned signal systems may be required. Installation of computerized signal systems might also be beneficial for towns such as Manchester, West Hartford and Windsor.
Phase 3	• Extension of computerized control systems to other arterials will be required in the future as signals are added at more locations.

4.11 Ramp Metering

Ramp metering involves the use of special traffic signals on expressway entrance ramps to regulate the flow of traffic entering the highway. The flow of traffic entering the highway is not allowed to exceed the road's capacity to absorb the entering traffic.

Ramp metering is an effective management tool for reducing recurring congestion on expressways. Substantial improvements in traffic flow have been reported in cities where ramp metering is installed. Ramp metering can break up platoons of vehicles entering an expressway by allowing only a few vehicles to enter at a time. This can reduce turbulence and "stop-and-go" traffic flow in the highway merge zones, resulting in a decrease of traffic accidents and an increase in average traffic speed. A previous ConnDOT study estimates that ramp metering could reduce recurring congestion in the Hartford area by 15 percent. Using this estimate, 215,000 hours of annual delay could be avoided and 130,000 gallons of fuel saved.

Ramp metering can also play a significant role in reducing non-recurring congestion. In the occurrence of an incident, upstream ramp meters can be used to close the ramp or severely restrict the entering traffic flow. Downstream ramp meters can be adjusted to allow a greater flow of traffic diverted around the incident. The identification of potential ramp metering sites is beyond the scope of this report, but further investigation of the feasibility of ramp metering in the Capitol Region should be performed.

Recommendations for Ramp Meter	
Phase 1, 2, & 3	• Perform study to determine the feasibility of ramp metering in the Capitol Region, including examination of potential ramp metering locations.

4.12 Lane Control Signs

Lane control signs can improve the uniformity and stability of traffic flow by helping to guide, warn, and regulate traffic on the main expressway or arterial lanes. The signs are used to inform motorists in advance of a temporary lane blockage caused by a maintenance activity or incident. Lane control signs consist of special overhead illuminated signals with lane use indicators. The lane use indicators permit or prohibit the use of specific lanes, or provide advance warning of lane closure. Special symbols and colors are used to signify the status of a travel lane. (Examples: red X = lane closed, yellow X = lane closed ahead, green arrow = lane open.) Supplementary signs help explain the signal displays to travelers. The sign system is typically controlled from a highway operations center.

Lane control signs are an effective tool for reducing non-recurring congestion on expressways. Traffic could be gradually shifted out of a travel lane that is blocked by an incident, thus reducing the potential for rear-end and sideswipe accidents. In order for a lane control sign system to be effective, sign stations must be set up at standardized intervals (e.g., l/2 mile spacing) along the expressway.

Recommendations for Lane Control Signs	
Phase 1,2, & 3	• Initiate study to determine the feasibility of a lane control sign system in the Capitol Region, including identification of potential control sign locations.

4.13 Costs and Phasing

The summary costs and phasing of the Highway Management Systems ITS proposal are shown in ***Table 4.3.*** The entire cost for Phase 1 and 2 is estimated at ***$32,902,000. Table 4.4*** provides a detailed listing of system elements.

TABLE 4.3 SUMMARY OF HIGHWAY MANAGEMENT ITS COSTS

	PHASE 1	PHASE 2	PHASE 3	PHASE 1+2
Variable Message Signs	2,548,000	1,900,000	*2,112,000*	4,448,000
Highway Advisory Radio	100,000	0	*0*	100,000
Video Surveillance System	1,480,000	2,640,000	*2,112,000*	4,120,000
Traffic Flow Monitoring (Detection)	1,212,000	900,000	*718,000*	2,112,000
Communication Infrastructure	4,468,000	6,394,000	*6,355,000*	10,862,000
Highway Operations Center	660,000	0	*0*	660,000
Computerized Signal Systems	700,000	9,700,000	*TBD*	10,400,000
Ramp Meters & Lane Control Signs	200,000	0	*0*	200,000
TOTAL	11,368,000	21,534,000	*11,297,000*	32,902,000

TABLE 4.4 HIGHWAY MANAGEMENT; DETAILED COSTS & PHASING

A. Variable Message Signs

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Upgrade, add and relocate VMS	2,548,000	45,000
2	Add and relocate VMS	1,900,000	45,000
3	***Add VMS***	***2,112,000***	***80,000***
	TOTAL, Phase 1 + 2	4,448,OOO	90,000

B. Highway Advisory Radio

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Upgrade 2 HAR sites, add 2 HAR sites	-a-	8,000
1	Install HAR site at Bradley International Airport	100,000	2,000
	TOTAL, Phase 1 + 2	100,000	10,000

C. Video Surveillance System

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Install video cameras in core area	1,480,000	68,000
2	Expand video coverage to rest of central area	2,640,000	100,000
3	***Expand to outer portions offreeway system***	2,112,000	96,000
	TOTAL,, Phase 1 + 2	4,120,000	168,000

D. Traffic Flow Monitoring (Detection)

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Expand system to cover core area	1,212,000	46,000
2	Expand system coverage to rest of central area	900,000	34,000
3	***Expand to*** *outer* ***portions offreeway system***	718,000	27,000
	TOTAL Phase 1 + 2	**2,112,000**	**80.000**

E. Communication Infrastructure

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Install fiber optic cable in core area	4,468,OOO	24,000
2	Expand network to rest of central area	6,394,OOO	36,000
3	***Expand network to*** outer ***portions offreeway system***	6,355,OOO	24,000
	TOTAL, Phase 1 + 2	10,862,OOO **-b-**	60,000

F. Highway Operations Center

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Upgrade and modify existing DOT Center	660,000	
	TOTAL, Phase 1 + 2	660,000	

G. Computerized Signal Systems

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Interim upgrade of ConnDOT's older UTCS signal systems. Modify for closed loop operation without direct signal interconnection.	400,000 -d-	-c-
1	Conduct study of municipal traffic signal operations in communities with 20 or more town-owned signals. Identify needs for signal coordination, communications links between controllers and municipal operations rooms, and coordination between State and municipal systems.	300,000	
2	Permanent upgrade of ConnDOT's older UTCS systems. Convert to full closed loop operation with direct signal interconnection.	9,700,000	-c-
3	***Continued expansion of signal systems***	***TBD***	***-c-***
	TOTAL Phase 1+2	10,400,000	

H. Ramp Metering

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Perform study to determine feasibility of Ramp Metering in the Capitol Region	200,000	
	TOTAL, Phase 1 + 2	200,000	

I. Lane Control Signs

Phase	Project	Capital Cost	Op - Mnt. Cost
1	Perform study to determine feasibility of Lane Control Sign System in the Capitol Region	-e-	
	TOTAL, Phase 1 + 2	0	

-a- Costs included as part of previously committed projects. Four (4) sites cost approximately $75,000 per location.
-b- Assumes costs paid by the public sector. Actual costs could be substantially reduced if installed as part of a public-private sector partnership agreement.
-c- In-kind costs only.
-d- Costs included as part of a proposed $800,000 statewide traffic signal system upgrade project.
-e- May be performed in conjunction with the Ramp Metering feasibility study described above.

5. INCIDENT MANAGEMENT SYSTEMS

50-60% of delay is caused by incidents

Incident management is the coordinated, preplanned use of human and technical resources to restore full use of a highway after an incident (accident, breakdown, debris dropped on the highway, etc.). Incident management is an important tool for improving highway efficiency since an estimated 50-60 percent of all congestion is caused by incidents. Incidents cause congestion by reducing roadway capacity for the duration of the incident. For example, on a three-lane highway, the blockage of one lane reduces capacity by 50 percent. Even a car stalled on the shoulder of the highway reduces capacity by 20 percent due to "rubbernecking."

5.1 System Management Goal: Reduce Congestion

A primary goal of the Region's System Management Policy is make more effective use of existing highways. Incident management offers a way to reduce congestion on the existing facilities without adding new capacity. Incidents are responsible for a large proportion of roadway delay, and often lead to secondary incidents that further hamper traffic flow. As traffic volumes increase on roadways in the region without a commensurate increase in capacity, incidents will become an even more critical problem. Rapid detection, verification and clearance of incidents will substantially enhance the performance of the transportation system.

5.2 Incident Management Functions

Incident Management Functions

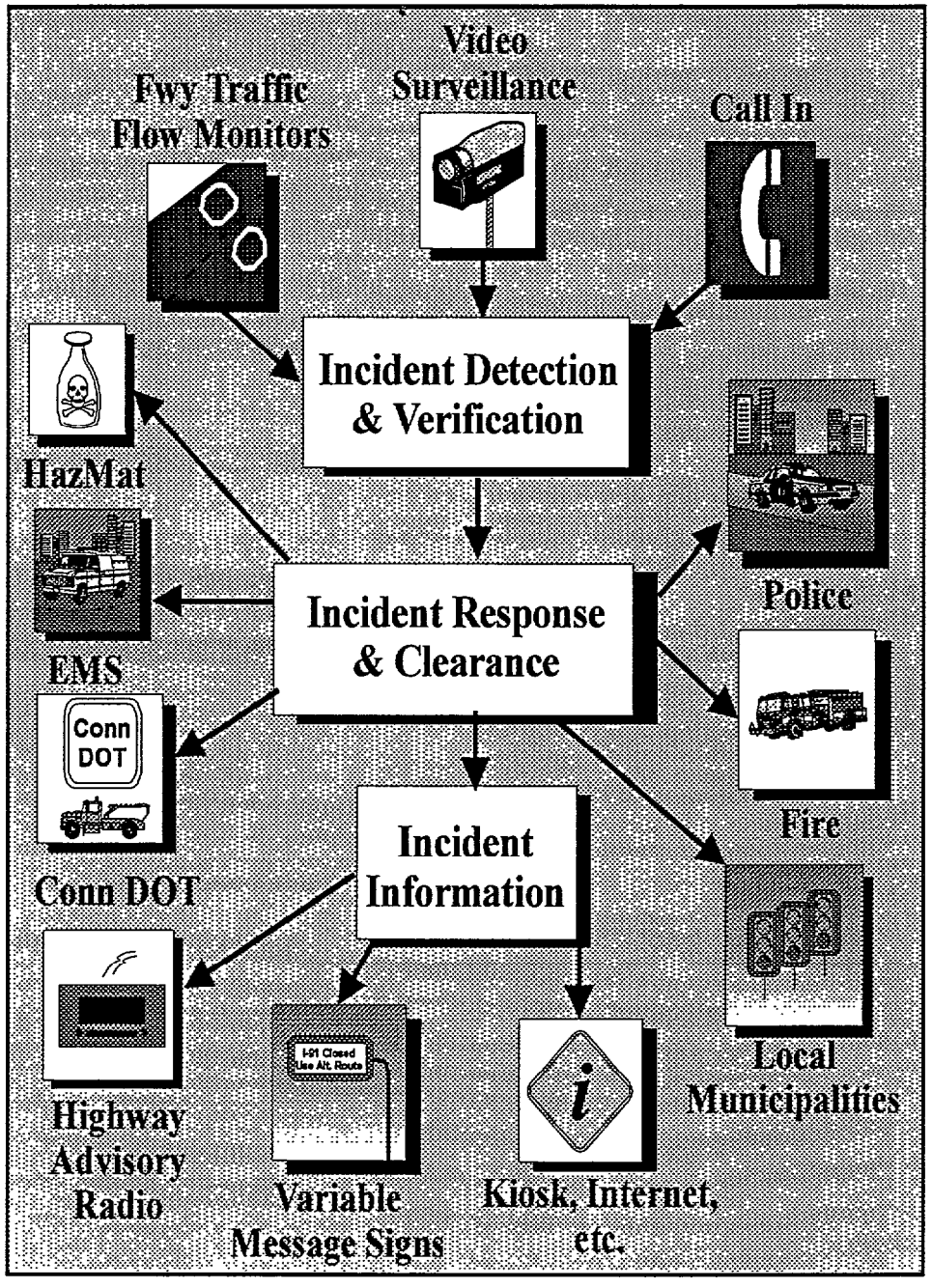
- **Detection & Verification**
- **Response & Clearance**
- **Traffic Management**

Incident management programs consist of a wide variety of elements and can vary in complexity from very basic programs to very complex and sophisticated ones. In general, program elements are grouped into three categories reflecting the major functions: (1) incident detection and verification, (2) response and clearance of the incident, and (3) traffic management during the incident.

Detection & Verification. Detection and verification of incidents are the first steps in incident management. Detection is the process by which an appropriate public agency is made aware that a problem exists. Verification is a complementary step in which the existence of a problem is confirmed and the nature of the problem is determined. Verification is important in order to determine the type of equipment and personnel needed for the response.

Response & Clearance. Once an incident is detected and verified, an appropriate response must be initiated to clear the incident. For minor incidents, the response might be handled by a police officer and/or a DOT service patrol. More serious incidents require services such as police, fire, medical, towing, debris removal, and hazardous waste handling. It is important to have an incident management plan to assure: (1) that all appropriate agencies are notified, (2) that there are good communications among all agencies, (3) that the actions of all agencies are coordinated, and (4) that procedures allow for clearing the incident as quickly as possible.

Incident Management System



Traffic Management & Incident Information. Traffic must be managed at the incident site itself, and on diversion routes. On-site traffic management issues include moving disabled vehicles, positioning emergency vehicles so as not to block lanes, and providing a safe work area for emergency workers. A traffic diversion plan is also needed for major incidents when traffic must be directed off the highway and onto detour routes. An important part of traffic management is informing motorists of incidents that can cause them delay. Informed drivers can choose alternate routes and thereby reduce the amount of traffic and congestion near the incident site.

5.3 Existing Incident Management Process

The Capitol Region is only beginning to organize a formal incident management process. While there are several elements of a system in place, much work remains to be done to improve veriftcation, clearance procedures, and traffic management. The basic elements of the existing process are listed in ***Table 5.1.***

TABLE 5.1 EXISTING INCIDENT MANAGEMENT PROCESS

Component	Description
Detection	• Most incidents are first reported to State Police by motorists who call 911 using their cellular phones. The method is low cost & relatively effective. • A system of electronic sensors monitors traffic flows on I-91 and I-84 in Hartford and Wethersfield to detect sudden reductions in traffic speed.
Verification	• Verification is provided primarily by sending a State Police officer to the incident scene. Other emergency services are typically not dispatched until the officer assesses conditions at the scene. • ConnDOT operates two video cameras in Hartford (at I-91/I-84 and I-91/Rt 15). These cameras allow DOT staff to determine if they need to post warnings to motorists on DOT's variable message signs. • ConnDOT cameras are supplemented by cameras operated by the City of Hartford.
Response & Clearance	• No formal plan currently exists to coordinate response and clearance activities of emergency responders. • An incident management task force was recently formed to develop a plan. • State law now requires motorists to move their cars from the travel lanes after a non-injury accident.
Traffic Mgmt. & Information	• No traffic management plans currently exist for incidents. • An effort to develop a traffic diversion plan was recently initiated by the new incident management task force. • Variable message signs (VMS) currently provide some advance warning to motorists.

5.4 Overview of Incident Management Needs & Priorities

As explained above, the incident management process in the Capitol Region is not yet formally organized, and is conducted mostly without the aid of technologies such as video surveillance.

The process can be improved by preplanning, by creating new and better interagency or institutional arrangements, and by expanding the use of ITS technology.

The review of existing systems indicated that the incident management functions that require the most improvement are: verification, response-clearance, and traffic management. The current detection process is effective and results in notifications to State Police almost immediately in most cases. The proposed improvement plan is therefore focused on methods of improving these three functions: verification, response-clearance, and traffic management. The actions most needed in order to improve incident management in the Capitol Region ***are*** summarized in ***Table*** 5.2. More detailed explanations are provided in the following sections.

TABLE 5.2 PRIORITIES FOR INCIDENT MANAGEMENT SYSTEMS

System	Improvement Needed	Comment
Detection	• None	• cellular phone reporting system works well
Verification	• Video surveillance system	• video surveillance will reduce time needed to verify & allow more effective use of State Police
Response & Clearance	• Incident mgmt. task force • Communications system • DOT service patrols	• need task force to improve interagency coordination • need interagency radio communications system to improve coordination • need direct communications link between DOT HOC & State Police barracks • need service patrols to reduce clearance time for vehicular breakdowns & to allow more effective use of State Police
Traffic Mgmt. & Information	• Traffic management plan • Incident information	• need a plan for managing traffic during incidents • need more ways to inform motorists during incidents

5.5 Incident Verification

The existing verification process relies almost entirely on sending a state trooper to the site to assess the problem. This is time consuming and can delay the dispatching of required services. A faster, more efficient method is needed.

Video Surveillance System. The time needed to verify and dispatch emergency services can be reduced substantially through the use of video surveillance camera systems. The video system recently installed on I-95 in the New Haven - Greenwich area is an effective verification tool that has yielded many benefits.

Benefits of Video System

- determine exact location of incident
- determine nature and severity of incident
- reduce overall verification time
- more effective use of State Police resources

It is recommended that a video surveillance system be installed in the Hartford area. The system should be focused on the most critical parts of the Region's highway system. The system must be directly accessible to both the State Police Barracks (Troop H) and the ConnDOT Highway Operations Center in Newington.

Recommendations for Video Surveillance	
Phase 1 - 3	• Provide full coverage of core area of regional freeway system (see Chapter 4). • Provide full video work station to State Police - Troop H. • Provide full video work station to DOT Ooerations Center.

The details of the video system are provided in Chapter 4 (Highway Management Systems). Chapter 4 includes the geographic limits of the coverage area, the proposed phasing, and the estimated cost.

5.6 Incident Response & Clearance Procedures

Response and clearance procedures can be improved in numerous ways. For purposes of this study, three primary areas of improvements have been identified. They are: a need to improve interagency coordination, a need to improve radio communications between agencies, and a need to improve the way minor incidents are cleared. It is proposed to address interagency coordination issues through an Incident Management Task Force. Radio communications can be improved with minor modifications to some existing radio systems. Clearance of vehicular breakdowns and other minor incidents can be aided by the creation of special DOT service patrols.

Interagency Coordination: Incident Management Task Force. Institutional problems often impede efficient management of incidents on highways. The problems arise from the nature of the response and clearance stage of incident management. Unlike the detection and verification stage, the problems faced at the response stage are largely institutional rather than technical. State police, local police, fire fighters, emergency medical services, tow truck operators, DOT officials, local highway officials, and State environmental officials might all be involved in any given incident. Furthermore, major incidents often affect traffic in several towns and require services from multiple towns. Coordinating the actions of so many different parties is difficult and requires planning.

Perhaps the most effective way to improve interagency coordination is to form an incident management task force. A task force is composed of all agencies that respond to highway incidents. The team's purpose is to formulate plans, policies, and guidelines for assuring coordinated and effective responses to incidents.

The 1994 Capitol Region Transportation Plan recommended the creation of a task force. This recommendation was recently initiated and several meetings with fire and police officials were held to introduce task force members to the concepts of incident management.

Recommendation for Interagency Coordination	
Phase 1	• Continue efforts to form an incident management team.

It is recommended that efforts to organize an incident management task force be continued. The task force needs to develop appropriate plans and policies to guide emergency service personnel

when they respond to incidents on the highway system. Incident management guidelines that the task force needs to prepare include: incident command and control procedures, guidelines for traffic control at an incident site, and traffic diversion plans.

Radio Communications. Emergency service agencies that respond to a highway incident often do not have the capability of communicating with other responding agencies. This is due to the fact that each agency operates its own radio equipment on its own frequency. The lack of direct agency-to-agency radio communications can greatly hamper coordination efforts.

There are technical solutions to these radio problems, but they can often be expensive. Fortunately for the Capitol Region there is a low cost solution. The solution is based on previous efforts in the Region to improve radio communications between police in different towns. The police departments in the Capitol Region operate a regional police radio system known as RAFS. The system includes radio transmitters and two radio frequencies. Whenever inter-jurisdictional radio communications are required, police officers switch their car radios to one of the two regional frequencies. In this manner, a police officer in Simsbury can establish direct radio communications with one in Bloomfield or any other town.

Recommendations for Radio Communications	
Phase 1	• Create regional radio system for incident management. o build on regional police system (2 frequencies) o modify police system to provide full area coverage o add extra frequency donated by EMS system o make available to all emergency services o provide portable radios to agencies as needed

It is recommended that a regional radio system[4] be established for incident management. The system can be created by modifying the existing regional police radio system. For a relatively low cost, the existing police system can be modified to also serve incident management purposes. This requires adjusting transmitters to provide complete area coverage (the current police system has some "dead" spots where radio transmissions cannot reach), adding a third radio frequency (which the North Central EMS Council has agreed to donate), and providing portable radios to those agencies that do not currently have portables.

DOT-State Police Communications Link. Communications between the State Police dispatcher and DOT's Highway Operations Center are important during an incident. The State Police need to notify DOT when incidents are reported via the 911 system. Early notification to DOT allows them to activate the video surveillance system to verify the incident. It also allows DOT to dispatch service patrols and to post travel advisories on the VMS system when appropriate. Likewise DOT needs to provide accurate and timely verification information to the State Police once an incident is detected. Ideally DOT should be able to transmit video images of the incident site directly to the State Police dispatcher. This requires a direct communications link (probably fiber optic cable) between DOT and State Police. State Police will also need a full video work station to receive and utilize the transmission.

4 The basic elements of this proposal have been developed by CRCOG's Public Safety Coordinator working with the Capitol Region Chiefs of Police Association, the North Central EMS Council, and the Capitol Region Incident Management Task Force.

Important to Service Patrol Program. Successful implementation of a service patrol program discussed below will require close coordination between the HOC and the State Police. DOT will need timely information on highway incidents and breakdowns reported to the State Police so that service patrol vehicles may be properly dispatched. DOT will also need to notify State Police of service vehicle activities including requests for State Police on-site presence, ambulances, tow trucks, etc. Since it might not be possible for DOT and Troop H to share a common dispatch-operations center (as in the Bridgeport HOC), an alternate means of establishing effective communications will be provided by this direct communications link.

It is recommended that a direct communications link is established between DOT's Highway Operations Center and the State Police dispatcher at Troop H. A full video workstation should also be installed at the State Police barracks to receive transmissions of video images from DOT's video surveillance system.

Recommendations for DOT-State Police Communications	
Phase 1	• Install a direct communications link between DOT's Highway Operations Center and the State Police barracks (Troop H). • Install a full video work station at the State Police barracks.

DOT Service Patrols (CHAMP). Service patrols are an effective means to respond to vehicular breakdowns and other minor incidents, minimize their duration, and reduce risks to motorists. Since even minor incidents, such as a breakdown on a shoulder, can reduce highway capacity by 20 percent, a means of clearing them quickly is needed. Service patrols have proven effective at fulfilling this type of response and clearance function.

Service patrols typically consist of specially equipped trucks that patrol a limited section of highway during peak traffic periods. Each truck is equipped to repair minor mechanical problems, provide an emergency supply of gasoline, fix a flat tire, and push a car out of a travel lane. In many states, the service patrols are operated by the state DOT or the respective turnpike authority.

ConnDOT operates an expressway service patrol system known as CHAMP (Connecticut Highway Assistance Motorist Patrols) along 60 miles of I-91 and I-95 in southwestern Connecticut. Four DOT-owned vehicles each patrol a 12-18 mile segment of I-91 and I-95 between 6:00 a.m. and 6:30 p.m. Cellular 911 motorist-aid calls received at the State Police Troop G barracks in Bridgeport are relayed to DOT Highway Operations staff who dispatch the CHAMP vehicles via two-way radio. CHAMP vehicles

CHAMP Program in Southwestern CT
• Covers 60 miles of southwestern I-91 and I-95 • Consists of 4 vehicles each covering 12-18 miles • Operates Monday-Friday, 6:00 AM to 6:30 PM • Typically handles 1 ,OOO-1,200 calls per month • Often first responder to a highway incident • Often notify police of need for emergency services • Remove highway debris • Set up signs for accidents & detour routes • Equipped with push-bumpers, crash barrels, flashing arrow signs, spare gas, oil, water, etc.

offer motorist assistance for routine breakdowns, assist State Police at accident sites, and push vehicles from unsafe locations within the travel lanes to a shoulder or other safe area. The CHAMP program has proven to be extremely beneficial in eliminating non-recurring congestion due to vehicle breakdowns and minor incidents, and is popular with motorists traveling along the I-95 corridor. The program is funded through the National Highway System program administered by the Federal Highway Administration.

It is recommended that a CHAMP program be initiated in the Hartford area. A service patrol program will reduce response and clearance time for minor incidents such as vehicular breakdowns. The DOT-State Police communications link described in the previous recommendations should be installed prior to the initiation of service patrols.

Recommendation for Service Patrols	
Phase 1 & 2	• Initiate a service patrol program (CHAMP).

Short Term (Years 1-5) - Initiation of two (2) CHAMP patrols covering the core area. Three (3) CHAMP vehicles (two daily patrol vehicles, one spare vehicle) will be required for this phase. Coverage hours of 6:00 a.m. to 6:30 p.m. will be instituted to ensure coverage during peak traffic periods. Staffing for the service patrol program will be provided by reassignment of existing DOT maintenance personnel (four full-time individuals plus "fill-in" alternates when needed). CHAMP patrol vehicle maintenance will be performed by existing State equipment repair facilities.

Medium Term (Years 6-10) - Addition of another service patrol vehicle and two (2) full-time drivers, expansion of the I-84, I-9 1 and Route 2 coverage area as needed.

5.7 Traffic Management & Incident Information

Traffic management during an incident consists of three tasks: controlling traffic at the site itself, diverting traffic off the highway during major incidents, and informing motorists of the incident and possible alternate routes. No formal traffic management plans currently exist for the Capitol Region. Some variable message signs are in place and are used by DOT to provide some incident information. The recommendations in this plan identify methods of improving all three of these procedures.

Traffic Management During Incidents. Traffic management during incidents can be improved simply by preplanning. Existing traffic management problems are not technological; rather they are primarily organizational. If proper guidelines are put in place, and if detours are planned in advance, traffic management can be greatly improved. The recommendations are listed below.

Recommendations for Traffic Management		
Phase 1	• Traffic management guidelines (on-site)	o The Capitol Region Incident Management Task Force should develop and adopt on-site traffic management guidelines.
	• Traffic diversion plan	o The Capitol Region Incident Management Task Force should develop and adopt a traffic diversion plan for major incidents.

Incident Information. Providing information to travelers during incidents is as important as directing traffic during the incident. For motorists stuck in the traffic back up, knowing what the problem is, and how long the delay is, can reduce frustration levels. For drivers not yet stuck in the back up, information on its location and alternate routes will help the driver decide whether or not to seek an alternate route. Encouraging drivers to avoid the incident area can also help reduce congestion levels.

The existing incident information system consists of variable message signs operated by DOT and commuter travel advisories broadcast by commercial radio and television stations. The VMS does not yet provide complete geographic coverage and commercial radio broadcasts are available only at certain times during the hour.

It is recommended that incident information dissemination be improved. The improvements should be focused on expanding the existing VMS system and installing a special highway advisory radio system. These recommendations are based on the travel information system improvements suggested in Chapters 2 and 4 of this report. There are no additional expenses beyond those already stated in Chapters 2 and 4.

Recommendations for Incident Information

Phase 1, 2 & 3	• VMS	o The VMS system needs to be expanded to provide signs at more critical junctions in the freeway system. Drivers need more advance warning of incidents & more opportunities to divert around the incident. Freeway-to-freeway diversions are particularly important so full signing is needed at all junctions such as 1-84/I-691, I-84/Rte 72, and I-84/Rte 9.
Phase 1	• HAR	o Highway advisory radio (HAR) systems are low-powered AM stations that broadcast traffic information to drivers on freeways. They complement the VMS systems in that they can provide more information and the broadcast can reach a relatively large section of highway. (Broadcast range is about a 5-mile radius.) o HAR coverage should be provided for the entire core area. o Post signs to advise drivers to tune to the HAR station. Equip signs with flashing lights that can be activated in the case of an urgent broadcast.

5.8 Costs and Phasing

The costs and phasing of the Incident Management proposals ***are*** summarized in ***Table 5.3. The*** entire cost of Phase 1 and 2 is estimated to be $455,000. The detailed costs and phasing are presented in ***Table 5.4***. Costs are low because most of the costs are already included in elements of the Highway Management System recommended in Chapter 4.

TABLE 5.3 SUMMARY OF INCIDENT MANAGEMENT ITS COSTS

	PHASE 1	PHASE 2	***PHASE 3***	PHASE 1+2
Incident Verification	0	0	0	0
Incident Response & Clearance	390,000	***65,000***	***0***	***455,000***
Traffic Management & Incident Information	0	0	0	0
TOTAL	390.000	***65.000***	***0***	***455.000***

TABLE 5.4 INCIDENT MANAGEMENT: DETAILED COSTS & PHASING

A. Incident Verification

Phase	Project	Capital Cost	Op.-Mnt. Cost
1-3	Install video surveillance cameras along freeway system	see Ch. 4	see Ch. 4
	TOTAL,, Phase 1+2	--	--

B. Incident Response & Clearance

Phase	Project	Capital Cost	Op.-Mnt. Cost
1	1. Organize Incident Management Task Force	-a-	-a-
	2. Create regional radio communication system		
1	a. modify police system to provide full coverage	120,000	0
1	b. add third radio frequency	-b-	0
1	c. provide portable radios to those agencies without them	40,000	0
1	3. Install direct communications link: DOT- State Police (includes video station for Troop H)	30,000	TBD
	4. Initiate service patrol program (CHAMP):		
1	a. initial 2 patrols - 3 vehicles, 4 staff	200,000	-c-
2	b. additional patrol - 1 vehicle, 2 staff	65,000	-c-
	TOTAL, Phase 1 + 2	455,000	TBD

C. Traffic Management & Incident Information

Phase	Project	Capital Cost	Op.-Mnt. Cost
	1. Develop traffic management plan		
1	a. develop on-site traffic management plan	-a-	-a-
1	b. develop traffic diversion plan	-a-	-a-
	2. Improve incident information system		
1-3	a. upgrade, add, and relocate variable message signs (VMS)	see Ch. 4	see Ch. 4
1	b. upgrade, add, and relocate highway advisory radio (HAR) system	see Ch. 4	see Ch. 4
	TOTAL, Phase 1 + 2	--	--

-a- Coordination (inkind) costs only

-b- Donated by North Central EMS Council

-c- Anticipates reassignment of ConnDOT maintenance personnel at no additional cost