TAMPA BAY AREA

INTEGRATED TRANSPORTATION INFORMATION SYSTEM

Final Report

Prepared for the
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by the

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EXECUTIVE SUMMARY

This report gives recommendations for a regional real-time traffic information center for the Tampa Bay Area. The proposed name of the center is the “Traffic Vision Center” or “NC”, thus emphasizing a real-time, regional congestion map as one of the center’s primary outputs.

The center shall have access to every existing source of traffic information in the Tampa Bay area, including:

- City of Tampa Traffic Control Center
- Pinellas County Traffic Control Center
- City of Clearwater Traffic Control Center
- City of St. Petersburg Traffic Control Center
- Hillsborough County Traffic Control Center
- Florida Department of Transportation
- Florida Highway Patrol
- HARTline Automatic Vehicle Location System
- Metro Traffic Control
- Land Mobile Probes
- Citizen Call-In

The TVC will receive traffic information via coaxial cable from several sources. The information received will be in a standardized form, with each report containing a time stamp, location and nature of incident or congestion.

The TVC will compile information from these various sources, disseminating its information in two forms:

- Color video map of Hillsborough and Pinellas Counties showing Interstates and major arterials. Sections of road will be color coded by degree of congestion (i.e. existing operating speeds) and major incidents will be highlighted.

- Database of all current locations of congestions and incidents for the TVC's coverage area.

In keeping with the consensus expressed by the project advisory committee and focus group participants, it is recommended that the TVC be run by a private vendor. One public agency, such as FDOT, will administer a contract with this vendor. Several companies should bid competitively for this contract. The contract will address issues of public accountability and accuracy of the traffic information disseminated. A detailed protocol for operations and reporting will be established.

It is recommended that the contract be funded by a mix of federal, state and other funds for an initial period of two years. During the initial period, the vendor must be able to demonstrate the ability to generate revenue from this service.

The following additional features of the TVC are recommended:

Coverage: interstate System and major arterials of Hillsborough and Pinellas counties

Operation: fully operational weekdays 6:00 a.m. - 9:00 a.m. and 4:00 p.m. - 7:00 p.m. and on weekends as required by major special events
able to receive data 24-hours a day, seven days a week

Staff: one general manager and assistant, plus three eight-hour shifts of (typically) two traffic technicians and one computer operator

Space: 1,600 to 2,000 square feet

Location: Four alternative locations are recommended for the <u>single</u> site:

- Downtown Tampa
- Fowler/USF Area
- St. Petersburg/Clearwater Airport
- Westshore Area

Hardware: personal computers linked by a Wide Area Network

Software: a package which extends capabilities of but is still compatible with the Urban Traffic Control System

Transmission Media:

- narrow-band for links between center and sources
- narrow-band for transmission of traffic information database
- wide-band for transmission of color-coded video map

The TVC make its traffic information available to:

- Cable TV stations
- Metro Traffic Control
- Radio and Television stations, either directly or through Metro Traffic Control
- Bay Area Commuter Services, the primary source of information via telephone
- GTE MobileNet, using a voice mailbox for cellular phone users
- Variable message signs and highway advisory radio operated by FDOT

Finally, the TVC system implementation and completion timeframe staging into five stand-alone stages and an order-of-magnitude cost estimate for each stage are provided.

I. PURPOSE

The Florida Department of Transportation entered into a contract with the University of South Florida on behalf of the Center for Urban Transportation Research (CUTR) to develop an action plan for the implementation of an Integrated Transportation Information Center for the Tampa Bay area.

This report is a compilation of three previous technical memoranda, a summary of focus group interview sessions and feedback from project Advisory Committee members. The first technical memorandum analyzed different methods of gathering real-time traffic information. The second memorandum evaluated methods of disseminating that information to a variety of audiences: local traffic operations, fleet operators, broadcast media and commuters. The third technical memorandum catalogued existing traffic control centers and other traffic information resources in the Tampa Bay area. In addition, the report described other traffic control centers and traffic management projects in North America, as possible models for the recommended system. The focus group sessions, as well as input from the project advisory committee, were intended to solicit public perceptions about and reaction to a real-time regional traffic information center.

Finally, this report contains the recommendation for the implementation of a regional, real-time traffic information center in the Tampa Bay area: geographic coverage, staffing, physical location, hours of operation, system architecture (hardware and software, transmission media) and organizational structure. A consensus-building process led to CUTR's recommendation. This report contains an estimation of operating costs and describes possible sources of funding.

A summary of this report will be published in a brochure format intended for mass distribution to the general public throughout the metropolitan area.

II. INTRODUCTION

The term Intelligent Vehicle Highway Systems (IVHS) is used to describe projects which apply advanced technologies to improve the efficiency and capacity of existing transportation systems.

Advanced Traffic Management Systems (ATMS) are the application of advanced technologies to improve safety and reduce congestion in urban traffic systems. ATMS projects primarily involve coordinating traffic signal timings throughout an urban area so that all cars in the area move as efficiently as possible. Advanced Traveler Information Systems (ATIS) are the application of advanced technologies to improve the reliability and accuracy of information available to travelers. ATIS projects typically involve providing the traveler with up-to-the-minute information on the locations of severe traffic congestion or directions on how to get to a particular destination. Information can be transmitted through high-tech in-vehicle displays, or through traditional media such as radio and telephone.

Passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, with its emphasis on IVHS, focused national attention on this emerging field. The ISTEA brought more than exposure to IVHS, authorizing $660 million in appropriations through 1997. The ISTEA also formally recognized IVHS America as a utilized federal advisory committee to the USDOT. IVHS America formed in 1990 to promote IVHS in the United States.

In 1992, The Tampa Bay area was selected by the Federal Highway Administration (FHWA), along with Louisville, KY and Atlanta, GA as one of three sites in the southeastern U.S. to develop an “early deployment” plan for traveler information and traffic management technologies. The FHWA seeks early deployment plans to emphasize a strategic plan for implementation that represents the unified vision of all the local municipalities, and is multi-model in its approach.

This report contains a proposed action plan for a Integrated Transportation Information Center for the Tampa Bay area. The proposed center is “integrated” because it involves both traffic management and traveler information. The five city and county owned centers in the Tampa Bay area which currently control traffic signal timings will be linked (in "read-only" fashion) to the center. (The local centers will retain autonomy over the traffic signal timings in their jurisdictions.) The proposed center will take information from multitude of traffic information sources, integrate the information and cross-check conflicting reports for improved accuracy. Finally, the proposed center will disseminate this information to the traveling public through a variety of media. If this plan were realized, it would be possible for Tampa Bay area commuters to receive accurate, timely traffic information by listening to the radio, watching television or dialing a toll-free telephone number.

Focus group interview sessions conducted as part of this project have shown that in the Tampa Bay area there is indeed a market for a regional traffic information center, although the public is not willing to pay for it through direct user fees. Tampa Bay area residents currently have access to free traffic information, however this information is frequently not accurate nor timely enough to fit the public's needs.

In addition, there is also interest in this project from local agencies and businesses. To solicit public participation and enhance public awareness of a regional traffic information center, CUTR formed an advisory committee consisting of intended users of the system. By listening to advisory committee and focus group members, the particular characteristics of the Tampa Bay metropolitan area were brought into each stage of the conceptual design process.

III. BACKGROUND

A. Information Collection Techniques

This section examines several methods of collecting traffic information: inductance detectors, piezoelectric sensors, microwave radar sensors, ultrasonic detectors, closed circuit television, machine vision, compressed video surveillance, land-mobile units, automatic vehicle identification and location, aerial surveillance and citizen call-in. Each technique is evaluated using the following criteria: implementation time frame, performance reliability, scale of observation, cost and institutional considerations. Most of these techniques are used to collect traffic information in the Tampa Bay area. The results of an infrastructure inventory survey among project Advisory Committee members are contained in Appendix G.

1. Inductance Detectors

inductance detectors record the presence or passage of a vehicle and are used for actuated traffic signal controls, freeway data collection and other surveillance tasks.

There are three main types of inductance detectors: inductive loop detectors, magnetometers and magnetic detectors. The basic configuration consists of a sensor buried in the roadway, a lead-in cable connecting the sensor to a controller via a pull-box, and an electronic unit housed in the controller.

Most detectors have two modes of operation: pulse or presence. “Pulse” means that the loop generates an electric pulse whenever a vehicle passes over it. This mode is used primarily for traffic counts. “Presence” means that the loop generates an output for as long as the vehicle stays within its sphere. This mode is used for traffic signal control.

Loop Detectors

The most widely known and utilized inductance detector is the inductive loop. The loop is constructed by placing one or more turns of wire in a slot cut into the pavement, which is covered with a sealant. The loop system is constructed with electrical characteristics to match that of an oscillator/amplifier which also serves as the source of energy. A vehicle passing over the loop, or stopping within it, reduces the loop inductance and increases the frequency of the oscillator. The resulting change sends an electrical signal to the controller signifying the presence or passage of a vehicle.

Hillsborough County, Pinellas County, Tampa, Clearwater and St. Petersburg all maintain extensive networks of loop detectors for actuated traffic signals. The Florida DOT maintains a network of over 200 loop detectors throughout the Tampa Bay area.

Magnetometric Detectors

Magnetometric detectors are small cylindrical devices that are embedded in the pavement. They detect the presence or passage of a vehicle by measuring the resulting focusing effect in the vertical component of the earth's magnetic field. They can be used either in place of, or in combination with, loop detectors. They are the more reliable choice on bridge decks or in locations where pavement conditions are extremely poor. Different configurations can be used for identifying a variety of different vehicle types. There is an additional feature that allows multi-axle trucks and tractor trailers to be detected as one vehicle - an attractive advantage over loop detectors.

Being much easier to install gives magnetometers the advantage of reduced costs, and less inconvenience to motorists during installation. The main disadvantage, however, is that they have a poorly defined detection zone which diminishes accuracy.

Magnetic Detectors

Magnetic detectors (also known as Microloop Probes) are cylindrical probes that detect vehicles based on changes in the flux-lines of the earth's magnetic field. Their simplicity and rugged design allows them to operate where poor pavement condition or frost can contribute to the failure of other types of detectors. Magnetic detectors are also useful for traffic-actuated signal controls. But they are only operable in a "pulse" mode for recording the passage of a vehicle and are therefore limited in their application.

All three classes of inductance detectors require some type of in-pavement installation. Apart from the time required for purchasing the necessary hardware and construction materials, and performing other administrative tasks, the only other factor that can affect the implementation time frame will be the size of installation crew and how it impacts on the time needed for installation. If the crew is large enough, for example, many of the tasks involved can be performed concurrently in order to minimize delay and inconvenience to motorists Installing loop detectors requires more saw-cutting than for probes, which implies greater delay.

The rate of loop detector failure nationwide has been significant enough to generate concern. However, recent studies have shown that inductance detectors can generally be expected to operate maintenance free for at least two years and as long as seven, and that failure rates can be greatly reduced by improving installation techniques.

Magnetic and magnetometric detectors are generally less effective in slow-moving or stationary traffic; hence they are frequently used in combination with surveillance cameras for incident management or traffic control systems.

On a price-per-unit basis, the cost of loop and magnetic detectors ranges from $400 to $600, including the unit, lead-in cable and controller. Magnetic detectors require less saw-cutting and are therefore less expensive to install. However, the fact that as many as three probes may be required per lane (depending on the vehicle size and required data accuracy) makes them a much more expensive alternative. In addition, probes require the use of a magnetic field analyzer ($1,100) for determining the most effective location site of installation.

2. Piezoelectric Sensors

Saratec Traffic of Sarasota, Florida manufactures a piezoelectric sensor which measure changes in electric polarity generated when pressure is applied to a crystalline substance. A roadside recorder collects, stores and analyzes data transmitted from piezoelectric sensors installed in the pavement. It allows for the collection of axle weight, vehicle classification and speed data for a maximum of four lanes per machine, either on an aggregate, or lane-by-lane basis. Data is optionally available in real-time using a specialized port and an on-site printer or personal computer; remote data retrieval is possible by linking the roadside recorder to a telephone line via a modem.

Site installation is simple and requires no more preparation than is needed for the installation of an inductive loop detector. The system uses telephone lines for remote data transmission.

The system is operable over a wide range of temperature. Saratec Traffic claims that the sensor is accurate to within 1% for weight and speed measurements, and 5% for vehicle classification at ideal temperatures (20” Celsius). Site configuration can be varied from one-lane to four-lane coverage depending on needs.

Costs per site installation varies from approximately $6,000 for a one-lane configuration, to $23,000 for a two-lane configuration and $34,000 for a four-lane configuration. An on-site controller cabinet will cost an additional $2,500.

3. Roadside Detectors

Microwave Radar Sensors

In the past, radar detector usage was limited by such factors as high maintenance costs, high risk of vandalism and the fact that they could only record the passage of vehicles. Recent developments in this field, however, have produced detectors capable of recording presence as well as passage. These newer components utilize a low power microwave beam to detect the presence or movement of traffic in one direction and its conical beam can be focused to cover either one or multiple lanes.

A major advantage of radar sensors over loop detectors is the fact that no pavement cutting is required for installation. The units can be mounted on overhead mast-arms or roadside light poles. (Optimal performance requires overhead positioning at a height of 14 ft. to 18 ft.) These sensors would be easy and inexpensive to install where such overhead or roadside fixtures are already in place.

Some components carry a range of different operating frequencies and can be adjusted to reduce or eliminate interference between units. For small intersections, radar sensors are an efficient, low-cost alternative to loop detectors, however, their accuracy diminishes as the complexity of the intersection increases.

Unlike loop detectors, since radar sensors do not come into direct physical contact with the observed vehicles, they are far less susceptible to environmental damage. The radar sensors' aluminum housing also reduces the effects of changing weather conditions.

According to Microwave Sensors, Inc., Unit cost varies from approximately $500 for a presence detector to $800 for a microprocessor-controlled vehicle detector, not including installation or supporting mast.

<u>Ultrasonic Detectors</u>

Similar to microwave radar detectors, ultrasonic detectors emit pulses of ultrasonic energy through a transducer. Passage of a vehicle causes these beams to be reflected back to the transducer at a different frequency. When the transducer senses a change in frequency it sends an electrical impulse to the controller recording the vehicle.

Ultrasonic detectors were a popular choice for traffic data collection in the United States in the 1950's. However, low reliability caused many agencies to abandon their use. However, recent improvements have led to a resurgence of interest in the technology. Ultrasonic detectors are extensively used in Japan for traffic signal-actuation and the real-time collection of traffic data. (Japanese government policy prohibits the cutting of pavements.)

With proper positioning, ultrasonic detectors can provide simultaneous coverage of up to three lanes. Used in pairs they can provide vehicle classification information as well as speed, occupancy and straight vehicle counts.

Unfortunately, no cost information is available at this time.

4. Video-Based Surveillance

Video Surveillance

Videos cameras, like loop detectors, have been used since the early 1960's for monitoring traffic. When used alongside loop detectors to provide confirmation, it provides one of the major configurations used today for traffic monitoring. The City of Clearwater, Hillsborough County and Florida DOT all utilize cameras as part of their traffic surveillance systems. Figure 1 shows a surveillance camera located on the Sunshine Skyway bridge.

Sensitivity of the equipment involved implies that most installations should be considered permanent, thus requiring housing, power, lighting and communications infrastructure. Remote transmission would require the availability of optic-fiber trunks to handle real-time

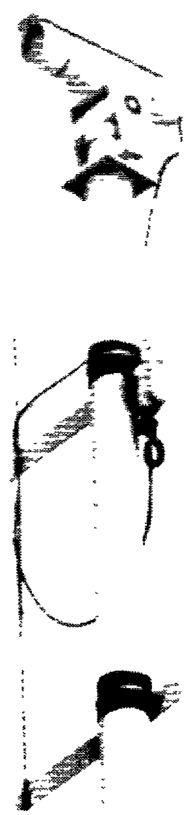

Figure 1. Video Surveillance Cameras on the Sunshine Skyway Bridge

video processing. Along with protecting against vandalism, care also must be taken to make the housing weatherproof to protect both the camera and lighting fixtures. These factors would obviously lengthen the implementation period.

Shadows created by bright light, even strong sunlight, can compromise the accuracy of the information generated. At night, a reliable light source must be provided.

Detailed traffic counting requires one camera per lane. For general freeway surveillance, cameras should be located one half-mile to one mile apart, depending on the degree of coverage required.

Cost per camera varies from $10,000 to $50,000, not including fiber-optic trunks and other necessary infrastructure.

Machine Vision Systems

Machine vision systems use a camera and computer software to perform real-time optical character recognition. The License Plate Reading System (LPRS), available from Computer Recognition Systems, Inc., is capable of reading vehicle license plates at speeds in excess of 100 m.p.h. The system is light-sensitive, adjusting as light conditions change, which reduces the problem of shadows in strong sunlight. Each camera monitors a single lane although a system can be configured to handle several cameras.

The LPRS system is composed of a camera, lens with control unit, light source, image processor, visual display unit and TV monitor. Each license plate is processed in less than one second and a buffer allows for up to eight license plates to be acquired concurrently. The output can be remotely transmitted to a computer database via a modem. The ability to read license plates will be useful for specific applications such as origin-destination surveys, police surveillance and electronic toll collection enforcement.

As with video surveillance, sensitivity of the equipment involved implies that most installations should be considered permanent, thus requiring housing, power, lighting and communications infrastructure. Along with protecting against vandalism, care also must be taken to make the housing weatherproof to protect both the camera and lighting fixtures. The system also requires forced air cooling to be provided to the bottom of the rack at a specified rate. Hence a suitable site plan needs to be prepared for each location.

As expected with most high-technology equipment, frequent maintenance checks and servicing will be required to ensure continuous operation.

The manufacturer claims 70% to 90% accuracy, even at speeds above 100 m.p.h. Actual field test results are closer to 50%. This would severely limit the applicability of the LPRS in cases where accurate vehicular counts are needed. However, the method can be used for highway surveillance or in conjunction with loop detectors to verify classification counts. In slow traffic the camera will require the use of a sensor as a triggering mechanism when a vehicle arrives.

At least one camera is needed per lane at the point of observation; but as many as four cameras per lane could be installed to improve accuracy of coverage in high speed zones. The field of view of the camera must be carefully set in order to assure maximum resolution and to allow the camera to easily read the plates. Artificial illumination is needed for night operation, either in the form of visible light or infrared, depending on the camera being used.

A basic configuration costs approximately $25,000 per lane, including one week of training for agency personnel. This estimate does not include construction costs, maintenance needs and other infrastructure considerations.

If an automatic system is used to photograph and record the license plate numbers of the individual vehicles, there is the potential for public concern about privacy violation. Appropriate safeguards and guidelines on the control and use of license plate information must be established to protect the privacy of motorists.

The growing use of products such as “PHOTO-COP” to automatically enforce speeding tickets has resulted in privacy protection legislation in some states. (The PHOTO-COP system photographs speeders and sends a pre-printed citation through the mail.) Most states have legislation requiring that traffic and toll violations be witnessed by a human being for the violations to be prosecutable. However, the law regarding privacy of information collected through electronic means is undergoing rapid change. Illinois is the first state to win conviction of a driver using pictures generated from remote video cameras as evidence. To date, Colorado, New York and Florida have passed legislation allowing automatic video-based enforcement of toll payment violators.

Compressed Video Surveillance

Developed by the Texas Transportation Institute for the Texas DOT, compressed video surveillance system operates by first capturing ("grabbing") a frame from a live video camera. The analog image is then digitized within a fraction of a second, transforming it into a computer readable format. The digitized image is then compressed by a special computer called a digital signal processor and can be transmitted by a high speed modem to a remote monitoring station.

At the other end of transmission, the process is reversed. A decompression computer passes the image to a digital signal processor, where it is expanded to a full digital image. The digital image is then placed in the memory of a display converter where it is transformed once again to an analog format that can be represented on a video monitor.

SmartRoute Systems, Inc., a private company which operates a traffic information center for the Boston Metropolitan area, attributes the low annual operating costs of their system ($3 million, an order of magnitude less than comparable centers) to their extensive use of compressed video surveillance. Figure 2 shows a compressed video surveillance system used by the Los Angeles DOT. An alternative is a wide-band system, such as fiber-optics, coaxial cable and terrestrial microwave. Wide-band systems have a wider transmission channel and do not require compression and decompression of images.

Compressed video systems are useful for freeway incident detection monitoring and rapid dispatch of emergency and service vehicles. The system is not as suitable for situations where detailed, accurate traffic data are needed.

As expected with most high-technology equipment, frequent maintenance checks and servicing will be required to ensure continuous operation.

System developers recommend that one camera be installed for every mile of freeway, where permanent surveillance stations are desired. However, the system's greatest benefits are realized when its mobility is exploited. Using the high data transmission rate of cellular phones (10,000 bits per second), compressed video surveillance systems can be used on a short-term basis for such situations as accident locations or construction sites.

For a permanent surveillance station the expected cost is approximately $30,000, although the "per-camera" costs will be reduced with multi-camera units.

Figure 2. Compressed Video Surveillance Used by the Los Angeles DOT

5. Fleet Vehicles as Probes

Land Mobile Units

Several businesses in the Tampa Bay area have vehicles which traverse the road network, assist stranded motorists, and serve as **a** source of information on traffic congestion. These businesses usually have a partnership with a local radio station who occasionally broadcasts directly from the probe vehicle, supplementing reports produced by Metro Traffic Control. Some of the existing land mobile units in the Tampa Bay area are shown in Table 1.

Table 1. Existing Land Mobile Units

SPONSORING BUSINESS	RADIO STATION PARTNER
Bill Currie Ford	WQYK
Ernie Haire Ford	WRBQ
Coca-Cola	WFLZ
Tyrone Isuzu "Road Amigo"	WDAE
Clearwater Nissan	WMTX

Automatic Vehicle Identification and Location (AVI/AVL)

Automatic Vehicle Identification and Location (AVI/AVL) takes the probe vehicle concept one step further by automating the process of determining the location of each fleet vehicle and communicating their positions to a central computer. The computer tracks how long each probe vehicle takes to traverse a link in the road network. By comparing the time actually required by each vehicle to traverse its route to the time required under normal traffic conditions, the computer can determine the degree of congestion in the road network. There are several technologies which can be used for determining the location of individual vehicles: on-board odometer, LORAN-C ground-based signal triangulation, communication beacons placed on signposts, and the satellite-based global positioning system (GPS). Manufacturers of AVL system which use GPS claim that the positioning system has the highest precision and accuracy. However, GPS is also the newest, most unproven and most expensive technology.

AWA Traffic Systems America, Inc., manufacturers of a system called Automated Network Travel Time System (ANTTS), recommend a minimum size fleet of 500 vehicles and readers spaced one-half mile apart for metropolitan area the size of the Tampa Bay area. Tag prices vary from $2 to $275 each, and readers cost approximately $3,200 each, including housing and components.

Figure 3 shows the Hillsborough Regional Transit Authority (HARTline)'s AVL control center, with one of the monitored bus routes on the computer screen (front).

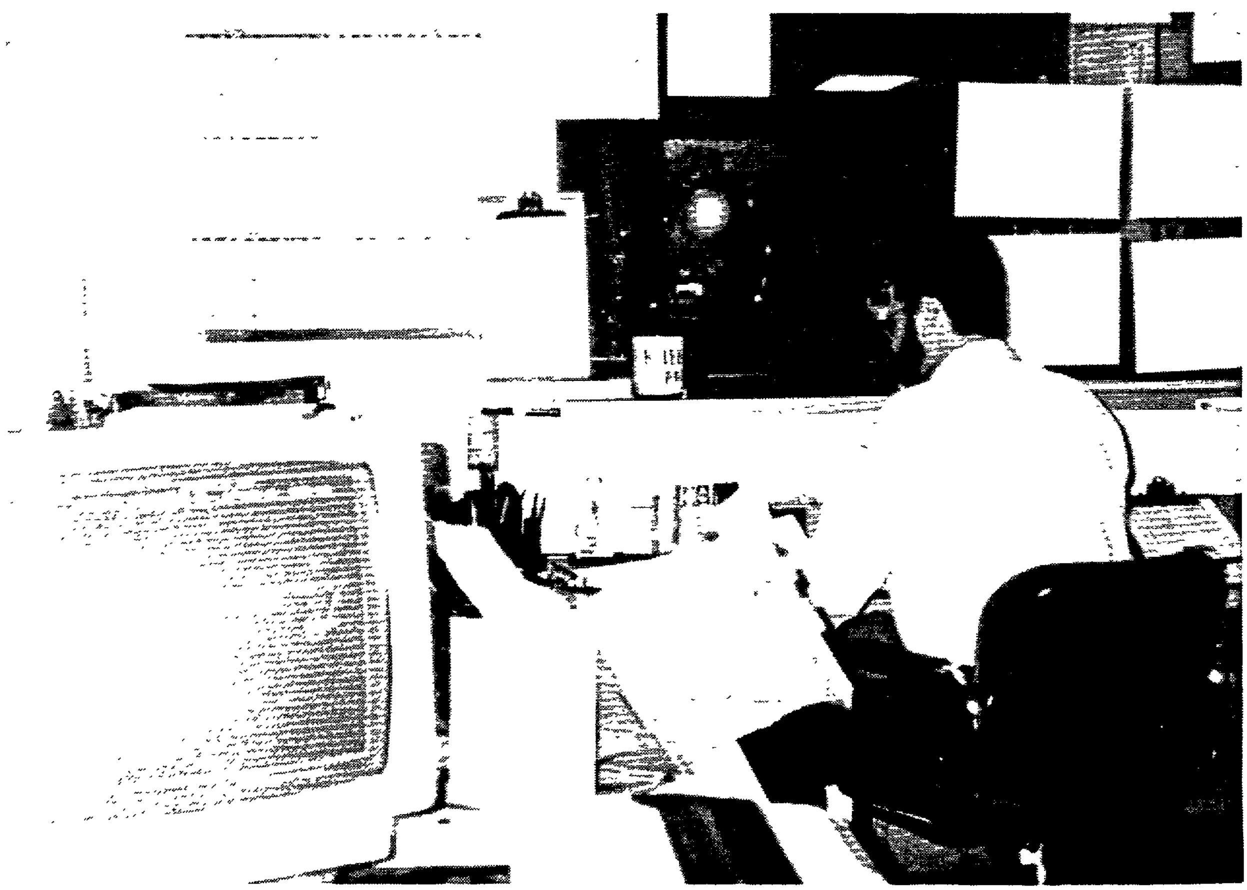

Figure 3. HARTline's AVL Control Center

HARTline is presently installing an AVL (Motorola's sign-post and odometer system) for monitoring their fleet of 172 buses. HARTline conducted a performance test of the system on August 9, 1993; the system should be operational by October 1993. These buses can be used as probes for the area's arterial network. Taxi cabs are another possible source for recruitment as probes.

6. Aerial Surveillance

Aircraft are used to conduct visual, panoramic surveys of the road network. In the Tampa Bay area, aerial surveillance is conducted by Metro Traffic Control. The company uses two leased Cessna-172's to cover Hillsborough and Pinellas counties. The planes operate for three hours in the morning and two hours in the evening, covering both peak congestion periods. Pilots provide a verbal description of what they are able to observe from the air by radio to their control station. Visibility and distance and general weather conditions affect the reliability of this method. The main benefit of aerial surveillance is the fact that it allows simultaneous coverage of wide areas of the network. Figure 4 is a sample of Metro Traffic Control's traffic information database, which is compiled from aerial surveillance, listening to police radio and other sources.

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MTC INSTATRAK PRINTOUT AT AUG 30 1993 12:38 PM

[12:38 PM] Bridges
BRIDGES ARE UP TO SPEED NO DELAYS AT ALL

[12:37 PM] Tampa
TRAFFIC STEADY ALONG SOUTHBOUND 275 APPROACHING THE INTERCHANGE, NO MAJOR
BACKUPS.

[12:37 PM] Tampa
MINOR ACCIDENT AROUND 78TH AND CAUSEWAY

[12:37 PM] Tampa
MINOR ACCIDENT NEAR HIMES AND WATERS IN TAMPA

[12:38 PM] Pinellas
EXPECT DELAYS DUE TO CONSTRUCTION AROUND 19 AND COUNTRYSIDE.

[12:36 PM] Pinellas
ACCIDENT INVOLVING INJURIES 5 AV SOUTH AND 31ST STREET IN ST PETE
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Figure 4. Metro Traffic Control's Traffic Information Database

Metro Traffic Control uses “wet-leased” aircraft, leaving maintenance operations and other costs to the lessor. Actual purchasing of aircraft would make this method a considerably less attractive, high-cost alternative, considering the sizeable initial capital outlay that would be required to house, maintain and operate an airplane.

7. Citizen Call-In: CB Radios, Cellular Telephones, Emergency Call Boxes

Figure 5. An Emergency Call Box on the Sunshine Skyway Bridge

Citizens’ Band (CB) radios and cellular phones are readily available sources of information that can be easily integrated into the system at marginal cost. Emergency call boxes are standard freeway fixtures that can also provide information. Figure 5 illustrates a call box in used in the Tampa Bay area.

CB radio users are required by protocol to keep Channel 9 open for emergency use. This channel is monitored by the Highway Patrol and other emergency services. Call boxes along the freeways are provided for a similar purpose. An “800” emergency number can easily be made available for use by travellers wishing to report incidents via cellular phones. For emergency call boxes, implementation will largely depend on the time it would take to install the necessary infrastructure, such as telephone lines, housing units and power sources.

Verbal, subjective reports based on human observations may not always be first-hand or accurate. However, giving the opportunity for citizens to report on traffic conditions has an unseen civic benefit. Individuals who call in gain a feeling that they have made an altruistic contribution. New York City’s Metro Traffic Control receives calls from motorists, but never uses them as a source of information until the report has been confirmed by another method: aerial surveillance, police radio, probe vehicle, etc.

Although exact figures are not available, the cost of monitoring CB channels or establishing a telephone line for cellular phones is marginal. Emergency call boxes will require significant capital investment if not already in place. Florida DOT is planning to install a network of 200 emergency call boxes along I-75 and along I-275 in sparsely populated areas.

Table 2 lists the basic characteristics for each information collection technique noted above.

Table 2. Traffic Information Collection Techniques

COLLECTION TECHNIQUE	GENERAL CHARACTERISTICS
Inductance Detectors	• Extensive networks already exist • In-pavement installation required • Rate of failure has been significant • Generally less effective in slow-moving or stationary traffic • Per unit costs range from $400-$1,100, depending on vehicle size and required accuracy

COLLECTION TECHNIQUE	GENERAL CHARACTERISTICS
Piezoelectric Sensors	- Remote data retrieval is possible with telephone lines • Operable over a wide range of temperatures • 1 % accuracy for weight, 5% accuracy for vehicle classification • Costs per site vary from $6,000 (1-lane) to $34,000 (4-lane)
Roadside Detectors	• Recent technology improvements in microwave and ultrasonic detectors now permit recording of vehicle presence as well as passage, and have improved low reliability of the past - No pavement cuts are required for installation, typically installed on overhead mast arms or light poles • Far less susceptible to damage compared to inductance detectors • No cost available for ultrasonic, microwave detectors vary from $500~$800
Video-Based Surveillance	• Frequent maintenance checks and servicing will be required to ensure continuous operation • Machine vision systems (one required per lane) are 70%-90% accurate even at 100 mph, and cost about $25,000 - Compressed video systems are useful for incident detection where rapid dispatch is required (high data transmission rate), not useful where accurate traffic data are needed • Per camera costs for compressed video surveillance is approximately $30,000
Fleet Vehicles as Probes	• Partnerships exist between several local businesses and local radio stations in Tampa Bay to have vehicles that assist motorists and traverse the road network • On-board odometer, LORAN-C ground-based signal triangulation, communication beacons on signposts, and satellite-based global positioning systems are the technologies available in vehicle fleet monitoring • Automatic vehicle locating (AVL) system is being implemented by HARTline (Motorola sign-post and odometer system) • Electronic license plates (transponders) range in price from $2 to $275, and readers cost about $3,200 each
Aerial Surveillance	• Metro Traffic Control leases two Cessna-172's to cover Hillsborough and Pinellas counties, operating three hours in A.M. rush and two hours in P.M. rush • Allows simultaneous coverage of wide areas of the roadway network • Actual purchasing of aircraft would make this method cost prohibitive
Citizen Call-In	• CB radios, cellular phones, and emergency call boxes are readily available and easily integrated at marginal cost • Typically used for on-site verification of incidents/congestion • FDOT currently planning to install 200 emergency call boxes along I-75 and I-275

B. Information Dissemination Techniques

This section examines several method of disseminating traffic information: radio and television spot traffic announcements, dedicated radio frequency, cable television, telephone information service, highway advisory radio, variable message signs, facsimile, electronic mail and real-time access by modem. Each technique is evaluated using the following criteria: feasibility of implementation, utility of information, size of potential customer base, cost and institutional considerations.

1. Broadcast Media

Radio and Television Soot Traffic Announcements

Most radio and TV stations in metropolitan areas already broadcast traffic reports at various intervals during the morning and evening rush hours. Stations either collect their own traffic information or contract with other organizations. Here in the Tampa Bay area, 21 of the 25 major radio stations and 3 of the 4 major television stations contract with Metro Traffic Control (MTC), a private company which monitors the area traffic conditions from helicopter and police radio. MTC feeds the live broadcasts directly to stations. Figure 6 shows Metro Traffic Control's traffic congestion map displayed in the WTVT Channel 13 (CBS affiliate) studio. Their revenue comes from sponsors whose advertisements accompany each traffic announcement.

The arrangement between the stations and Metro Traffic Control demonstrates that spot traffic announcements are a valuable service for radio and TV audiences. There are several ways to improve the arrangement between stations and MTC. By becoming a partner to regional traffic information interchange, MTC could have access to more detailed and more frequently updated reports.

An advantages of these media is that the infrastructure needed to support them is already in place. Routing traffic data either directly to radio and TV stations from the traffic information center or through Metro Traffic Control involves almost no cost to the project. In addition, there is a demonstrated market for these media, and the devices needed to receive traffic data are widespread in Tampa Bay homes and vehicles. Ninety-eight percent (98%) of U.S. households have at least one television; 85% have an AM/FM radio available for use in the home; 94.5% of all vehicle owners have an AM radio in their cars; and 81.3% have an AM/FM radio in their cars.

Metro Traffic Control is the only private agency in the area to operate its own aircraft for aerial traffic surveillance, although some television and radio reports make it appear that the aerial surveillance is being conducted by the station's own traffic reporter. A handful of local radio and TV stations use probe vehicles on the ground to investigate major traffic problems.

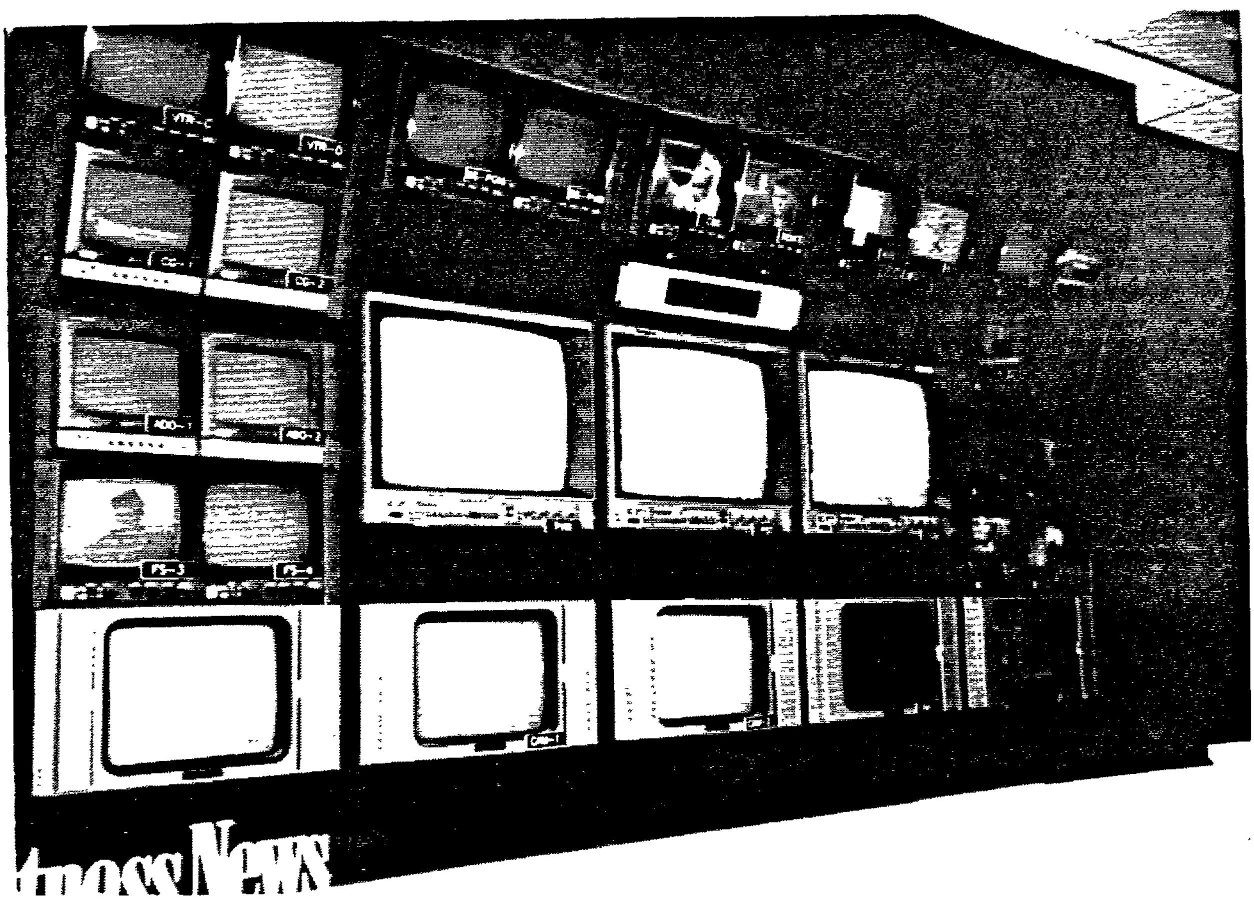


Figure 6. Metro Traffic Control's Traffic Congestion Map

Dedicated Radio Station

In the 1970's, the Federal Communications Commission (FCC) designated the two frequencies adjacent to the standard AM band (520 kHz and 1610 kHz) for broadcast of local traveler information. These frequencies are most often used for low power, short-range radio transmissions called highway advisory radio (HAR). Drivers must turn their radios to this frequency to receive the messages, but no special equipment is required. HAR systems have been set up in dozens of areas around the country, both for urban traffic congestion information and rural weather advisory warnings. A few metropolitan areas are planning to incorporate HAR into advanced traffic management/traveler information projects and coordinated incident management plans.

There is currently a HAR system operating at Tampa International Airport, which uses the 1610 kHz frequency. However, operating a full-time radio station can be quite expensive. WUSF, a non-commercial radio station affiliated with the University of South Florida, reports that its operating expenses are $250,000 per year, not including program content.

It is also important to consider the market appeal of such systems. When traffic information is integrated into the standard rush hour radio broadcast, no special demands are placed on the driver to receive the traffic updates, A dedicated radio channel which broadcasts only traffic information may not hold a driver's interest. As part of the ADVANCE Traveler Information project in Chicago, the local HAR system continually broadcasts estimated travel times for specific road segments.

Private ownership of a dedicated traffic channel would disqualify the station from using the 520 kHz and 1610 kHz frequencies. Applying to the FCC for an operating license on an existing radio frequency is a time consuming and expensive process.

Cable TV

As proscribed by the 1986 Cable Broadcasting Act, local governments enter into agreements with cable companies to provide cable services to residents. The four major local government agencies in the Tampa Bay area which supervise cable television are listed in Table 3, along with their current cable TV vendors. Note that the companies with which the agencies do business could change at any time.

Table 3. Cable Television Service Agreements

LOCAL GOVERNMENT AGENCIES	VENDORS
City of Tampa	Jones Intercable
Hillsborough County (not including Tampa)	Paragon Cable
City of Clearwater	Vision Cable
City of St. Petersburg	Paragon Cable

If the Traffic Information Center was a publicly-owned entity, then traffic information could be broadcast over public access cable channels. Also proscribed in the Cable Broadcasting Act, cable companies are required to include public information, such as C-Span, the weather channel and city council meetings, in the basic package of cable services. Every cable subscriber (50% of Tampa Bay households) has access to these broadcasts.

For traffic information to be broadcast on a dedicated channel, or during dedicated time slots during the morning and evening rush hours, the Traffic Information Center would have to negotiate an agreement with each of the various local government cable offices. Representatives at the Tampa Cable Office indicate a dedicated time slot or channel is highly possible. Their only concern is that the visual information is ready for broadcast from the Center and requires no pre-processing by the city office or the local public access studio. If the Center chose to make graphic information available, these graphics could be fed directly to the cable broadcasts.

Tampa Bay would not be the first area to set up a transportation-related cable channel. The transit systems of Ann Arbor, Michigan and Champaign-Urbana, Illinois are experimenting with the use of public access cable TV to provide estimated arrival times of buses. Minneapolis-St. Paul utilizes part of the screen of a general information cable channel to show real-time video from several surveillance cameras in the metropolitan area.

SmartRoute Systems, Inc. of Boston advocates that traffic information be broadcast over a dedicated cable station, not part of the basic cable package. (Since SmartRoute Systems is a private company, it is not allowed to broadcast via public access channels.) SmartRoute Systems predicts that the quality of their traffic information broadcasts will be of such high quality that cable subscribers will be willing to pay for the service. In the Tampa Bay area, broadcasting traffic data over a non-public access, dedicated cable channel would require negotiation with the cable companies in each area, i.e., Jones Intercable, Paragon Cable and Vision Cable.

2. Inquiry-Based Media

Telephone Information Service

In a few metropolitan areas around the country, callers can receive recorded messages about traffic conditions over the telephone. In the San Francisco Bay area, callers receive general traffic information plus transit schedules. In Boston, callers use a touch-tone menu to receive traffic information for specific routes. In both the Boston and San Francisco projects, the services are supported with public funds and inquiries are free. Many transit agencies in North America provide schedule and route information through a local telephone number.

Telephone menu systems are controlled by a computerized router called an “Automated Attendant.” The device is available from GTE for about $3,000. Remember that such an automated attendant system can only answer as many simultaneous calls as there are dedicated phone lines. The cost of leasing a business line from GTE is $47.23 per month. A system that automatically forwards calls to the next available phone line costs from $40,000 to $50,000.

Although still a small percentage (3.0%) of the telephone market, cellular phones provide an increasingly popular method of getting real-time traffic information to the traveler during his/her trip. In Boston, the cellular phone company NYNEX pays SmartRoute a set fee so that NYNEX can offer real-time traffic information as a discount service to its cellular phone customers. Here in the Tampa Bay area, Metro Traffic Control feeds their traffic announcements to a voice mailbox, which GTE Mobilnet's cellular phone customers can access at discounted phone rates.

In Boston, public reaction to SmartRoute System's telephone information service has been extremely positive. SmartRoute System receives an average of 2,000 inquiries per day, although the daily volume of calls varies greatly depending on weather conditions. The office stayed open over the weekend during the March 1993 "Storm of the Century," and call volume was triple that of the normal weekday rush hour. The free telephone service is becoming so popular that SmartRoute may become a victim of its own success. Subscriptions to SmartRoute's profit-generating subscription-based media, such as facsimile and e-mail, have leveled off since introduction of the free telephone service in January 1993.

Whether the telephone information system is publicly owned (as in San Francisco) or privately owned (as in Boston), it is also important to consider whether or not callers should pay for the service. Because pay-per-minute calling services suffer from a bad reputation, setting up a "900" number is a time-consuming and expensive process. A $2,000 deposit is required and the long distance company must see samples of advertisements for the service. In contrast, toll free "800" numbers are comparable in cost to a normal business line and can be set up in less than 24 hours.

3. Highway-Based Media

Highway advisory radio transmitters and changeable message signs both require roadside installation. In addition to the cost of the units themselves, the labor required for hardware procurement, administrative project management and installation will affect the cost and implementation time frame of these systems.

Highway Advisory Radio

As discussed previously, . highway advisory radio transmits localized traffic advisory messages via either of two frequencies adjacent to the standard AM broadcast band (520 kHz and 1610 kHz). Low power radio transmitters are installed along the roadside and broadcast messages specific to a small segment of the road ("Bridge may be icy." or "Congestion next 5 miles."). Drivers must turn their radios to this frequency to receive the messages, but no special in-vehicle equipment is required.

The Los Angeles Smart Corridor project completed testing of this technology in March 1993. The low power transmitters use the 530 kHz AM radio frequency. It has been reported that the HAR performed well during the test. Transmitter range was adequate for their purposes, and the system did not suffer interference from local power sources or cellular phones.

The Minnesota GuideStar project is experimenting with FM subcarrier transmissions, using a frequency licensed by the Minneapolis public school system. (FM radio stations use only a small fraction of the spectrum space for which they are licensed. Stations usually sell the remaining space to telephone paging companies.) These systems transmit text through the unused spectrum space, and require specialized equipment to receive the messages. Such systems are popular in Europe; most radios sold in Europe today come with subcarrier receivers. However, the system remains experimental in the United States.

The DIRECT project in Detroit, Michigan, will be testing low-power radio messages, FM subcarrier transmissions and a new type of transmitter which automatically interrupts radio broadcasts. Testing should begin in July 1993. In an early test of HAR for rural traveler advisory warnings in Iowa, 5% to 10% of travelers regularly listened to the HAR broadcasts; the listening audience increased to 20% during adverse weather conditions. The Colorado DOT reports that their fixed HAR transmitters cost around $14,000, the portable HAR unit cost $12,000. As mentioned previously, private ownership would disqualify the HAR system from using the 520 kHz and 1610 kHz frequencies.

Variable Message Signs

Traffic management agencies across the country have been using variable message signs (VMS) for years to warn drivers about road construction, weather conditions, traffic congestion and high occupancy vehicle (HOV) restrictions. In Tampa, a flip-disc VMS system exists on i-275 westbound near Dale Mabry, but is not currently working because of maintenance problems. Drivers provide a captive audience for information transmittal, however variable message signs are expensive to purchase, install and maintain. An Arizona State University study estimated that a VMS based on fiber-optic technology would cost $118,000 to purchase and $20,000 per year to operate and maintain; a light emitting diode (LED) VMS would cost $141,000 to purchase and $25,000 per year to operate and maintain. These costs do not include the foundation and structure on which

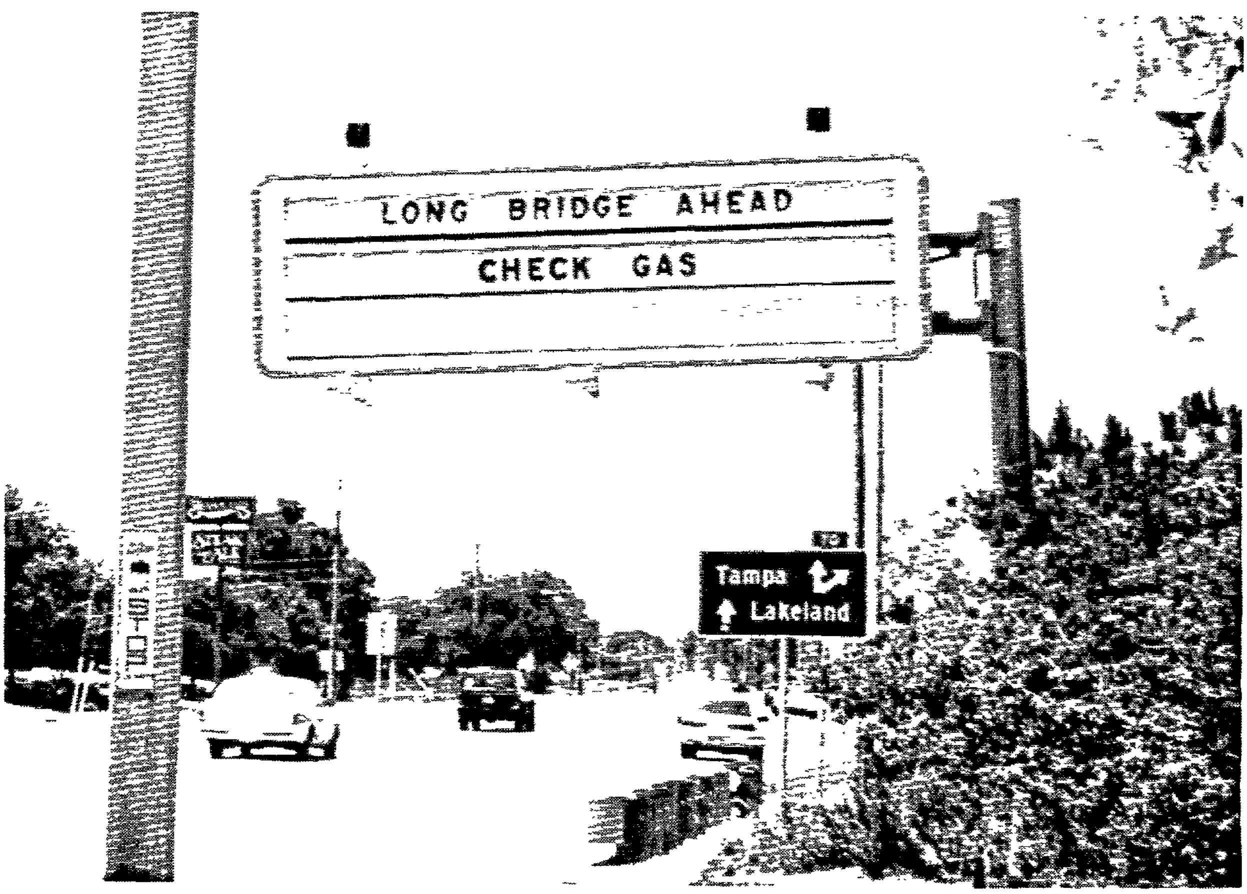


Figure 7A. Variable Message Signs on the Sunshine Skyway Bridge Flip-Disc Type

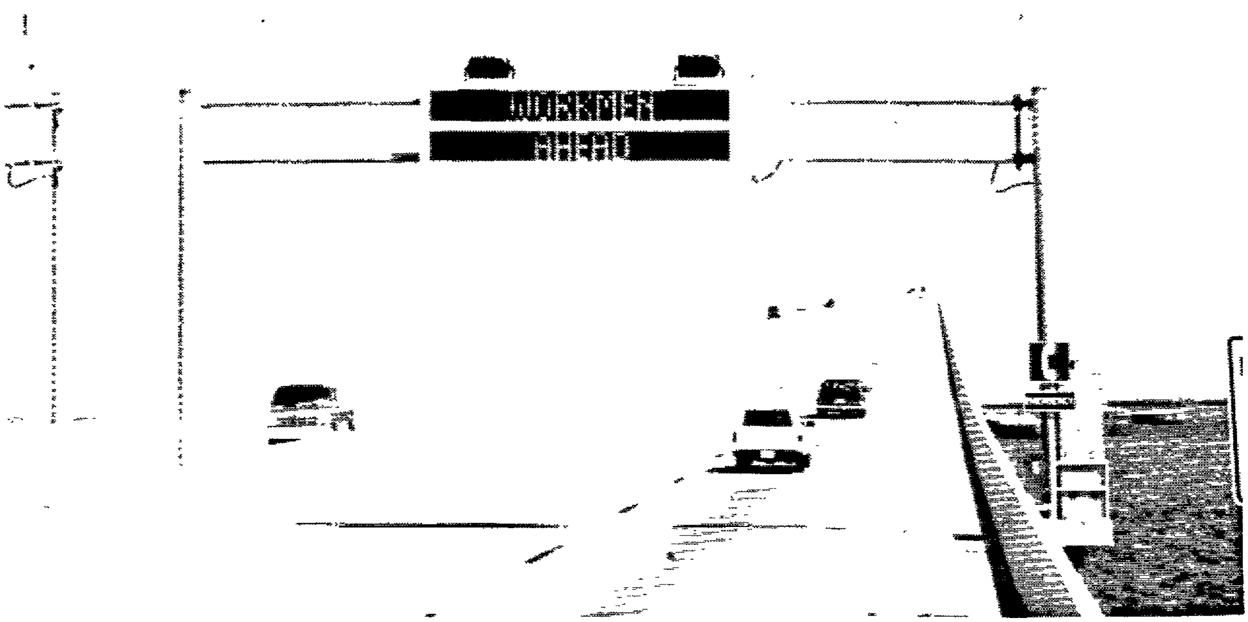


Figure 7B. Variable Message Signs on the Sunshine Skyway Bridge LED Type

the VMS must be installed. Variable message signs based on the simpler flip-disc technology are less expensive. The Colorado DOT reports that their portable flip-disc VMS costs about $22,000. Since road signs have traditionally been owned and operated by public transportation agencies, and since it is unlikely that this medium will produce self-sustaining revenue, variable message signs are well suited to continue under public ownership. Figures 7A and 7B show variable message signs located on the Sunshine Skyway Bridge, both flip disk and LED types.

4. Subscription-Based Media

All of the information dissemination media discussed previously are services the Traffic Information Center could easily provide free to the general public. Access to subscription-based media, in contrast, requires the customer to have specialized equipment and to sign-up before receiving the service. The Center would then send out traffic reports to its list of subscribers through various media.

The advantage of private ownership of subscription-based media is that the public sector would not have the responsibility of marketing this service. Competition among different information brokers would lead, theoretically, to increased quality and decreased costs. However, the Traffic Information Center would no longer have control over a crucial step in the traffic information dissemination process.

Facsimile

Facsimile is a major part of SmartRoute System's traffic information dissemination. Customers can sign up for three levels of service, depending on how often they wish to receive traffic reports. "Sunrise Reports" send out messages every morning and are intended for commuters. "Flash Fax" send out immediate reports of emergencies and incidents whenever they occur throughout the day. "Traffic Fax" sends a report on roadway conditions every 30 minutes during business hours. These two levels of service are intended for fleet operators. In the Tampa Bay area, Metro Traffic Control sends its traffic reports via fax once per rush hour to a local Spanish-language radio station.

There is also the possibility that customers who are primarily interested in traffic during their home-work-home commute could receive location-specific information. Customers would inform the Center of their commute destinations when they sign up for the service.

Most plain paper fax machines on the market today (average price $1,200) have a "broadcast" mode, in which the same message can be sent to numerous telephone numbers. Some can even store fax mailing lists of up to 200 numbers in the machine's memory.

A more sophisticated method of broadcast faxing is to control the process with a computer and internal fax modem. The computer's information processing capabilities would also enable the Center to send graphic and site-specific traffic information. The cost of such a system would entail a personal computer (average price $1,200) and fax modem {average price $200). Software would have to be specially written for this purpose.

The Greater Tampa Chamber of Commerce estimates that 90% of its membership have fax machines. A small (1.1%) but growing number of people also use fax machines in their homes.

Electronic Mail

Receiving traffic reports by electronic mail requires a telephone line, personal computer, modem, modem-controlling software and electronic mail account. The customer must log onto his account to read the reports. Because it is cumbersome to receive more messages than one can easily read and digest, it is important to let the customer determine how often he would like to receive traffic reports via e-mail.

Numerous IVHS projects across the country are considering giving commuters access to traffic information via modem, however such projects remain in the experimental or concept design stage. The California Smart Traveler project intends to use modem communications to give riders access to real-time ride-matching services. SmartRoute Systems in Boston began taking e-mail subscribers in March 1993. This medium has a smaller potential customer base than facsimile machines. While 15% of U.S. households have a personal computer, only 3.2% have the computer-plus-modem configuration. It has been the experience of SmartRoute Systems that the primary users of traffic information through electronic mail messages are fleet operators.

The Unix operating system's electronic mail program can easily send messages to computers of different platforms (e.g. IBM, Macintosh, DEC, etc.). The Unix system can also interface with popular information services packages such as Prodigy and CompuServe. Because Unix is based on multi-tasking (performing many functions at once), it has historically been the operating system of choice for mini-computers and work stations. However, newer versions of Unix can now run on high-end personal computers, such as the IBM 386 machines ($800 for the Unix operating system).

Real-Time Access by Modem

Systems in which multiple users access a large database by computer, modem and phone lines are called bulletin board systems (BBS). Dissemination of traffic information using a BBS requires a computer on which to store and process the traffic reports, a modem with extensive auto-answer capabilities (average price $300), and software to manage the bulletin board system. Either the software must be written especially for the project, or the Center must make arrangements with an existing bulletin board system.

Bulletin board systems are a well-established medium, so communications among different types of computers is not a problem. Inexpensive communications software packages enable different types of computers access to bulletin board systems. Metro Traffic Control currently has a real-time computer link between its traffic report database, stored on an Apple llgs computer, and three Tampa Bay area radio stations.

It is also important to remember that the system can only answer as many simultaneous modem links as there are dedicated phone lines. (See Section on “Telephone Information Service” for cost estimates.)

Just as traffic congestion is caused by too many people wanting to use the roads at the same time, there could be a similar rush hour demand for access to a traffic information database by modem. Therefore, it is important to develop ways to keep users’ access time to a minimum and consider limiting the total number of subscribers. This medium may be more appropriate for customers in need of detailed, area-wide, real-time traffic information, such as fleet operators.

Table 4 lists the basic characteristics for each information dissemination technique noted above.

Table 4. Traffic Information Dissemination Techniques

TECHNIQUE	GENERAL CHARACTERISTICS
Broadcast Media	- 21 of 25 major radio stations and 3 of 4 television stations contract with Metro Traffic Control ● Infrastructure needed to support this media is already in place ● Highway advisory radio (HAR) is designated at 520 kHz and 1610 kHz, Tampa airport uses 1610 kHz ● A dedicated radio station could be expensive ($250,00O/year for operating expenses) ● Visual information for dedicated cable TV broadcast must require no pre-processing
Inquiry-Based Media	● Touch-tone telephone can provide recorded (updated) messages for route specific information - "900" numbers (pay per minute) is time-consuming and expensive, whereas "800" number are comparable in cost to a normal business line ● Metro Traffic Control feeds their traffic announcements to a voice mailbox, which GTE Mobilnet cellular phone users can access at discounted rates
Highway-Based Media	- HAR and variable message signs (VMS) require roadside installation - HAR requires drivers to tune to a specific frequency to receive messages, but no special in-vehicle equipment is required ● VMS based on fiber-optic technology would cost about $118,000 per sign and $20,00O/yr to operate and maintain - Light emitting diode (LED) VMS would cost 10%-20% more than fiber-optic ● VMS, unlikely to produce self-sustaining revenue, are best suited for public ownership
Subscription-Based Media	- Requires customer to have specialized equipment, and to sign-up before receiving service ● Metro Traffic Control sends traffic reports via facsimile to a local Spanish radio station once per rush hour ● Fax machines cost about $1,200, and have "broadcast" mode - About 90% businesses have fax machines, but only about 1% of homes - Electronic mail programs can give commuters access to traffic information via modem (15% U.S. homes have computers, but only 3% have modems) for about $800 - Bulletin board systems (about $300) require extensive auto-answer capabilities - Metro Traffic Control has a real-time computer link with three area radio stations - Most appropriate for customers in need of detailed information such as fleet operators

C. Traffic Control and Information Centers

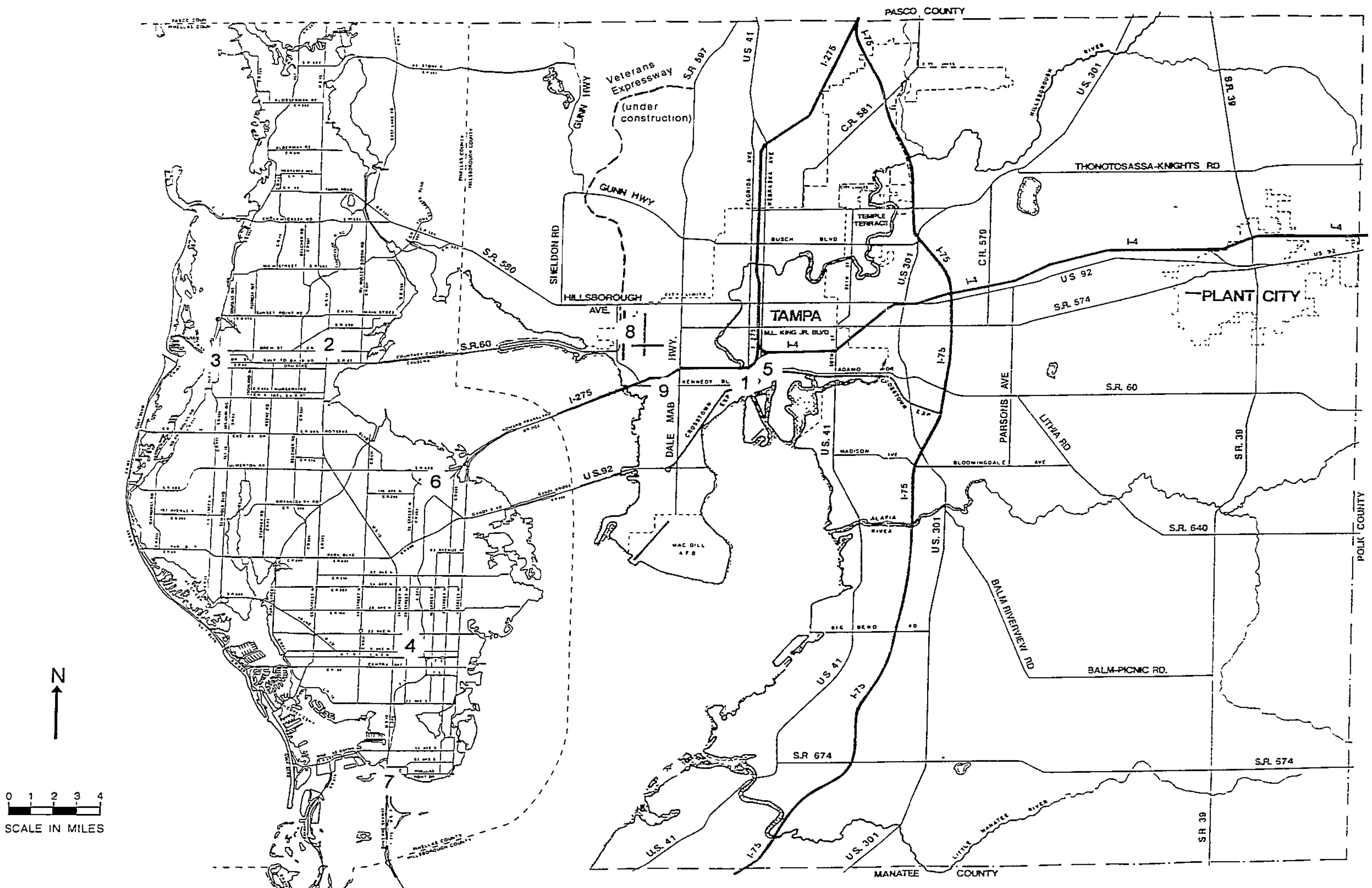
1. Tampa Bay Area City and County Owned Centers

The section describes the operating characteristics of five city and county owned traffic control centers: Tampa, Hillsborough County, Clearwater, St. Petersburg and Pinellas County. A map of these centers is shown in Figure 8. These centers control the timing of actuated traffic signals using information collected through inductance loop detectors. The Hillsborough County center has different methods of collecting information and different uses for that information, and thus has very different operational characteristics from the other four centers.

The five centers share many of the same operating characteristics, and with the exception of the Hillsborough County center, the Tampa Bay area city and county owned traffic control centers share the common features pointed out in Table 5.

Table 5. Common Features of Tampa Bay Area Traffic Control Centers

FEATURES OR OPERATING CHARACTERISTICS
Utilization of an OS/32 operating system
Utilization of software compatible with Urban Traffic Control Svstem (UTCS)
Operation Monday through Friday, from the beginning of the morning rush hour to the end of the evening rush hour
Utilization of twisted-pair copper wire telephone lines as a communications medium
Utilization of Concurrent Model processors of the 3200 family
Require an average annual operating cost of $650 per intersection, $2300 per intersection including maintenance
Require average staffing levels of 2 people per 100 intersections



Legend

1. City of Tampa Traffic Control Center
2. Pinellas County Traffic Control Center
3. City of Clearwater Traffic Control Center
4. City of St. Petersburg Traffic Control Center
5. Hillsborough County Traffic Control Center
6. Howard Frankland Bridge (currently not in operation)
7. Sunshine Skyway Bridge
8. Metro Traffic Control
9. Bay area Commuter Services

Figure 8. Tampa Bay Area Traffic Control Centers

The St. Petersburg, Clearwater and Pinellas County centers all were financed through the same initiative and consequently share many similarities in systems architecture. The centers were financed through a local gas tax which provided $15 million in total revenue for the establishment of the three municipal traffic control centers. Of this, a total of $11.2 million has been spent in bringing the centers on line. No state or federal funding was involved.

All three centers use an upscaled version of the UTCS software that has been extended and enhanced. This updated version is known as MTCS - Metropolitan Traffic Control System. An important feature of the system is the on-line database which allows timing and phasing patterns to be generated by the computer, unlike the City of Tampa system. The system also uses a time-based coordinator system back-up in the controller, through which the computer is constantly downloading the date and time to the traffic signal. The benefit is that in the event of a breakdown, the signal can change from on-line to stand-by mode almost instantly, without the need to spend time synchronizing with the rest of the system, as is necessary with older versions of the software. This translates to minimal inconvenience and delay to the motorist during maintenance or communications breakdown.

<u>City of Tampa Traffic Control Center</u>

The center is housed on the ground floor of the old City Hall Building in downtown Tampa. The center operates from 7:00 a.m. to 6:00 p.m., Monday through Friday and as may be required for special events. The annual budget is approximately $350,000, which includes salaries, and replacement and maintenance of the computer equipment. The center operates as an arm of the Design Department of the City's Transportation Division. Maintenance of field equipment is the responsibility of the Operations Department, which has an annual budget of approximately $1.2 million.

The center maintains a close working relationship with FDOT and Hillsborough County, as exemplified by the fact that the existing Hillsborough County system is housed at the same location. Maintenance and other responsibilities are shared.

Except where necessary, as in the case of an emergency or disaster, there is no day-to-day cooperation or communication between the City's Traffic Control Center and other regional centers.

At the heart of the system are three Concurrent Model 3210 processors. Each has the capability of handling approximately 256 intersections and the processing workload of the existing network is divided equally between the three.

The existing network comprises a total of 710 intersections, of which 550 are under the control of the City and 160 are under the control of Hillsborough County. The system covers the entire City of Tampa limits. Data is transmitted to the center via a copper-wire system that operates with two main trunks. One trunk serves northern Tampa, running along Nebraska Avenue; the other runs west along Kennedy Boulevard.

Of the total number of intersections in the system, 20% are fixed-time, 60% are semi-actuated, and 20% are fully-actuated signals. All intersections in the system can be remotely monitored, if not controlled, via loop detectors. No freeway lane-mileage is covered by the system.

The center uses an older version of the UTCS package developed by the Federal Highway Administration. The software is Fortran-based and is not user-friendly.

Operating staff consider the existing system to be quite reliable. However, the lack of an on-line database requires that the system be shut-down several times each day while information is downloaded to the database. The problem can be solved by updating the UTCS software version presently in use, but this would require major changes in the hardware configuration and retraining of the staff.

<u>Pinellas County Traffic Control Center</u>

The Pinellas County Center, shown in Figure 9, is located on the grounds of the Pinellas County Division of Public Works. The center began operation just over a year ago. It is located on the second floor as a measure against flooding. The processing units are also stored above the level of the main floor of the center as an additional safety measure.

The center operates from 7:00 a.m. to 5:30 p.m., Monday through Friday, although staff are always on call. In addition, the system can be accessed via modem from any location by certain key staff. The total annual budget is approximately $180,000, of which about $10,000 is spent on the physical upkeep of the center. There is an annual expense of $450,000 incurred from the use of GTE's telephone line which is paid directly by the county. Maintenance of field hardware and the manpower involved is covered by the budget for this department.

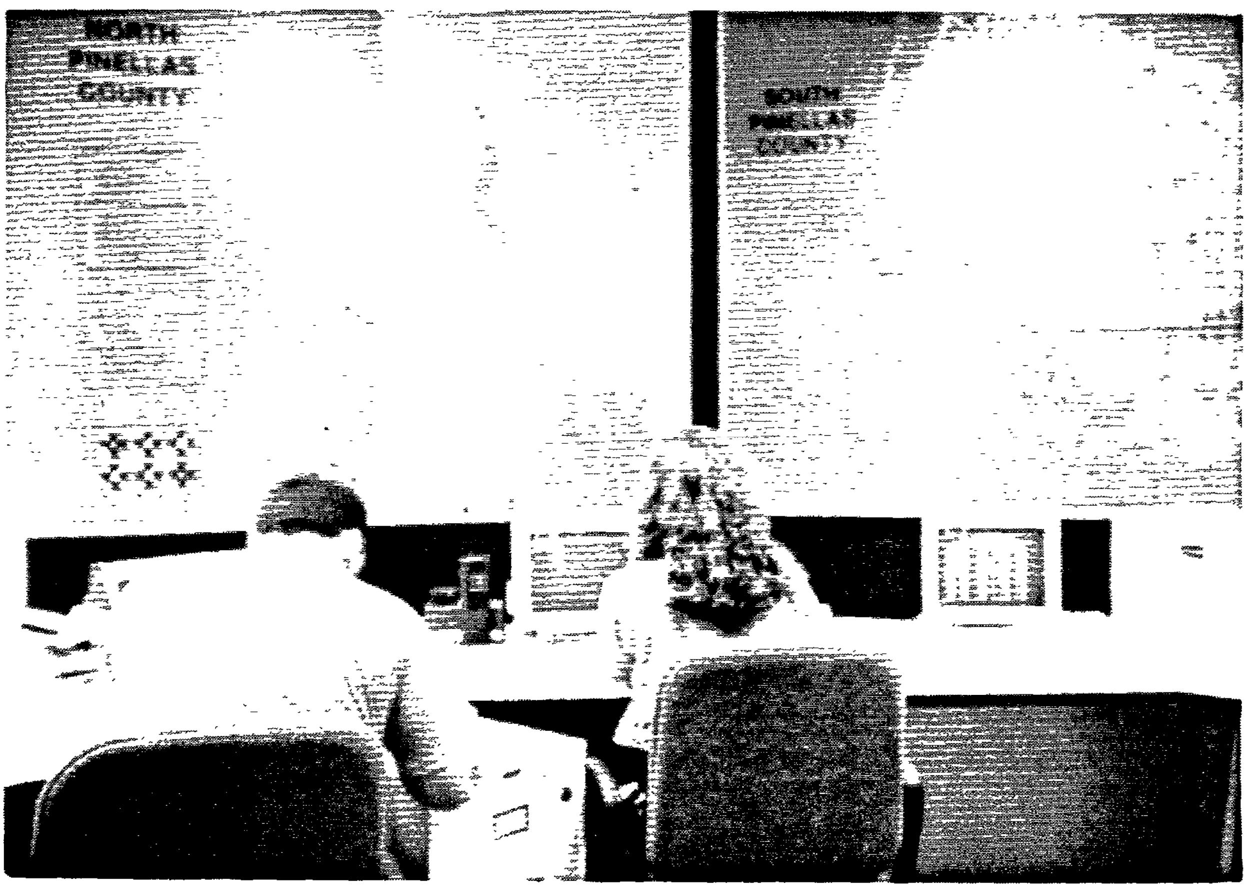


Figure 9. Pinellas County Traffic Control Center

The cities of Largo, Pinellas Park and Dunedin each have traffic control networks that number between 30 - 50 intersections. These sub-systems are tied into the Pinellas County traffic control system and operate as satellites of the main network. All timing plans are developed by the county, although the state and cities may submit timing plans if they wish. The timing plans are input into the database by the personnel at the center. The software used also provides for the uploading of traffic data to the FDOT mainframe computer, although this capability is not presently in use.

The existing network comprises 295 intersections: 235 intersections are semi-actuated and the other sixty are fully-actuated. Transmission takes place via dedicated GTE telephone lines. No freeway mileage is covered by the center.

City of Clear-water Traffic Control Center

This center is located on the ground floor of the Cleat-water City Hall Annex. The computers and related peripherals are housed in an enclosed area of approximately 1600 square feet. The center has been in operation since 1980, but was remodeled as part of a larger project that included the Pinellas County and St. Petersburg centers. The new center began operations just over a year ago.

The center is run by a system engineer and a signal engineer. They are supervised by a Transportation Engineer. The entire staff, including maintenance and other field staff, fall under the administration of the City's Department of Public Works.

The center operates from 8:00 a.m. to 5:00 p.m., Monday through Friday, although staff are constantly on call. In addition, the system can be accessed via modem from any location by certain key staff such as the engineers in charge. Because the center is located in the City of Clearwater Traffic Engineering office, they are able to share staffing and facilities with other related agencies. The location was also chosen for its accessibility to GTE's duct network which are used for running the transmission cables owned by the City.

Total annual operating budget is approximately $120,000, including the maintenance and replacement of field equipment and communications hardware. Of this amount, about $15,000 is spent on the physical upkeep of the center, including hardware and software. Three-fourths of the cable, transmission network is owned by the City; the other one-fourth is GTE telephone lines. The City is also taking steps to replace the remaining portion of the network presently served by GTE telephone lines with its own transmission cable.

The software used also provides for the uploading of traffic data to the FDOT mainframe computer, although this capability is not presently utilized. FDOT has statutory control over state-owned roadways, but in practice the City provides timing plans for these signals. Occasionally the center may provide data to other public and private interests, upon request. Traffic count data are provided to the county on an annual basis to be compiled into a county-wide report.

The existing network comprises 143 intersections. About 100 intersections are fully-actuated. The remaining 43 are semi-actuated, although the City is in the process of installing loops on the main streets of all semi-actuated intersections. Unlike the County's network where loop detectors are installed only in one lane, the City of Clear-water has installed loop detectors in all approach lanes at most of their intersections. Data is transmitted via a twisted-pair cable network. The City of Cleat-water will soon install graphic-display monitors that will use menu driven software called MAPS to generate on-line, on-screen displays of intersections in operation.

City of St. Petersburg Traffic Control Center

This center is located on the grounds of the St. Petersburg Traffic Engineering Department. It shares facilities with a number of other related agencies including Parking Enforcement, Signs & Markings and Parking & Building Maintenance. The computers and related peripherals are housed in an enclosed area of a building that is raised approximately three feet above ground level. The center began operations just over a year ago as part of a larger project that included the Pinellas County and City of Clearwater centers.

Unlike the case with Pinellas County and the City of Clearwater, the entire maintenance crew falls directly under the administration of the traffic control center and their salaries and related expenses are included in the center's budget.

The center operates from 7:30 a.m. to 4:30 p.m., Monday through Friday, although staff are constantly on call. In addition, the system can be accessed via modem from any location by certain key staff. The city uses telephone lines owned by GTE for transmitting data and information. GTE holds an escrow account of $3 million from which the accrued annual interest goes towards the payment of the City's monthly usage charges.

Total annual operating budget is approximately $700,000 including the maintenance of field equipment and communications hardware. Of this amount, about $30,000 is required for the physical upkeep of the center, including hardware and software.

A telephone line and modem provides direct link to FDOT for the uploading of traffic data to the FDOT mainframe computer. FDOT has statutory control over state-owned roadways, although in practice the City provides timing plans for these signals.

In a few instances, St. Petersburg has found it more practical to swap maintenance and signal-timing responsibilities with the Pinellas County center. Occasionally, the center may provide hard copies of data to other public and private interests, upon request. This includes real estate agencies, newspapers and other private business organizations. Traffic count data is provided to the county on an annual basis to be compiled into a county-wide report.

The existing network comprises 288 intersections. One-third are pre-timed; the remaining two-thirds are semi-actuated. Data is transmitted via a twisted-pair cable network owned by GTE. No freeway mileage is covered by the center, although some metered ramps are included.

Hillsborough County Traffic Control Center

A portion of the Hillsborough County traffic control system is presently housed at the City of Tampa Traffic Control Center. Another portion comprised of 57 intersections in Brandon is housed in the Hillsborough County office building in downtown Tampa. However, the county is presently installing its own traffic control center which will begin operations in November 1993. Control of the 160 Hillsborough County intersections currently controlled by the City of Tampa Center will be transferred to the Hillsborough County Center at that time. The center will be located on the 23rd floor of the newly acquired Hillsborough County Building, a 28-floor structure on Kennedy Boulevard in downtown Tampa.

The Hillsborough Center's network is not expected to include any city-owned signals. The center is expected to be linked to the following agencies via a Wide Area Network (WAN):

- FDOT District Seven Office;
- Thirteenth Judicial Court District;
- Florida Highway Patrol;
- Hillsborough County Sheriff's Office; and
- City of Tampa Police.

A miniature redundant system is expected to be installed at the FDOT District Seven Office. FDOT will be allowed read-only communication access to the county's center.

At present the county monitors 20 permanent count stations tied into a Concurrent Model 3210 processor at the existing City of Tampa center. However, the planned center will operate on the personal computer-based system called Management Information System for Traffic (MIST) developed by Farradyne Systems, Inc. The system will utilize three closed-circuit cameras, with an additional four planned for installation in the near future. Each camera will allow observation of 10 intersections, when operating under normal conditions. The cameras will be interfaced with standard television monitors. Ultimately, the county plans to install video surveillance cameras on the following major routes:

- State Highway 60
- Dale Mabry Highway
- Hillsborough Avenue
- Fletcher Avenue
- I-275
- Waters Avenue

In addition to the existing 20 count stations, loops are being installed at 65 permanent count locations throughout the county.

Transmission will take place via conventional telephone lines, although the county has recently received federal funding for the design and installation of a fiber-optic system over the next two years.

The new MIST system will run on an OS/2 operating system in a Windows environment with pull-down menus. The system is compatible with a wide variety of field equipment used by the traffic control centers of the Tampa Bay area and provides a compatible front-end interface for the UTCS system. It is also able to control and monitor variable message signs, HAR stations, ramp metering equipment, closed-circuit television cameras and incident management algorithms, according to Farradyne Systems, Inc.

The expansion of the Hillsborough County Traffic Control Center is being financed through $950,000 of capital funds, as part of the State's Five Year Capital Program. The county is seeking an additional $3.1 million in federal funding for the installation of a fiber-optic network over the next two years.

2. Other Tampa Bay Area Centers

In addition to city and county owned centers which control traffic signal timings, Tampa Bay has several other installations and organizations which monitor traffic conditions and disperse transportation information. Four projects described here are two control system on Bay area bridges and two traffic control centers which are privately and quasi-privately owned.

Howard Frankland Bridge

In 1982, an integrated traffic incident management system was put in place to divert traffic from the Howard Frankland Bridge to alternative bridges spanning Tampa Bay. The system included the components listed below in Table 6.

The purpose of the system was to divert traffic from the Howard Frankland Bridge to one or more alternative routes in the event of any incident or emergency. The computerized surveillance system, Surveillance and Control System (SCS), could automatically sense a disruption of traffic flow and exercise control over the system elements for traffic control. An operator also monitored incidents using mast-mounted cameras.

Table 6. Components of the 1982 Howard Frankland Bridge Incident Detection and Management System

MAJOR SYSTEM COMPONENTS
113 total inductive loops for the purpose of monitoring traffic flow
8 mast-mounted cameras on the bridge
15 mechanical drum-type signs positioned before each bridge at diversion points
48 Flap-type lane control signs (red X's and green arrows)
4 matrix signs for driver information along the bridge
A computer system located in the Florida Highway Patrol office to integrate all the components and to inform FHP of the status of known incidents along the bridge

The system was dismantled in 1992 just before construction of an additional parallel bridge. Increased capacity of the new bridge included the addition of emergency lanes, and the radio frequency used for communication was reallocated by the Federal Communications Commission.

FDOT is currently investigating two alternatives for reactivating a reduced version of the old system. One alternative recommends using a cellular telephone-based system, primarily for communicating with the variable message signs. The second possibility is to use the telephone lines for motorist call boxes currently in use on the Interstate System. What may eventually result is a system of video cameras and message signs, since no loops have been installed in the upgraded bridges. Some of the video equipment components have been transferred to the monitoring system on the Sunshine Skyway Bridge.

Sunshine Skyway Bridge

The Sunshine Skyway Bridge has a video camera-based, monitoring system for incident detection and management. The system components for the existing bridge are listed in Table 7. The bridge surveillance and control system console is shown in Figure 10

Table 7. Components of the Existing Sunshine Skyway Bridge Incident Detection and Management System

MAJOR SYSTEM COMPONENTS
13 video cameras
6 variable message signs, flip-disc type
2 stop lights just before the main span on each end of the bridge
18 call boxes each hard-wired directly to a monitoring station

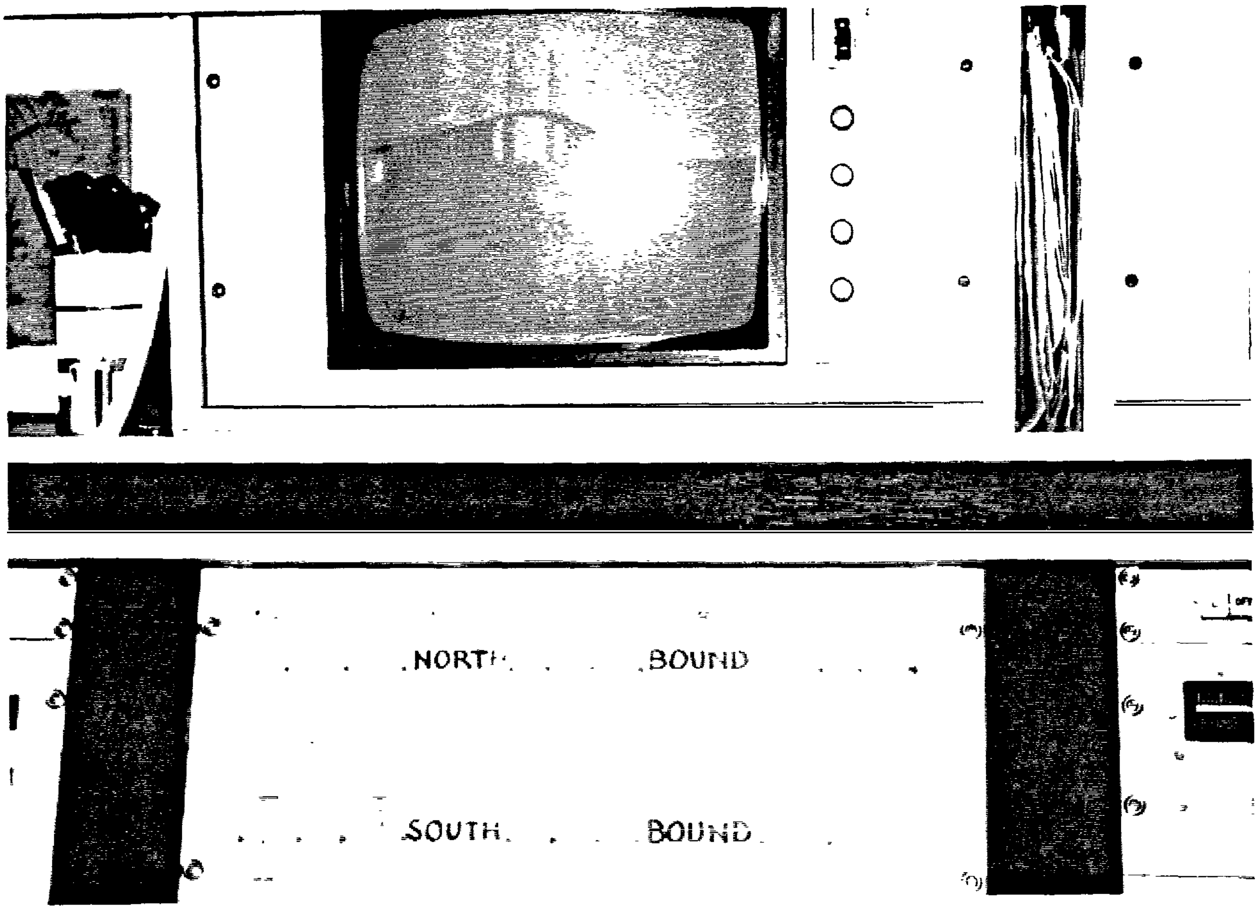


Figure 10 Sunshine Skyway Bridge Surveillance and Control System

An FDOT employee monitors the bridge 24-hours a day from a station on the northern end. Information on the physical condition of the intricate system of cables is also constantly monitored by data-logging equipment.

Metro Traffic Control

The Metro Traffic Control (MTC) center is located in the Marriott Hotel of the Tampa International Airport. MTC produces spot traffic announcements for 22 of the 25 major radio stations and 3 of the 4 major television stations in the Tampa Bay area. MTC gets its information from aerial surveillance and from listening to police radio scanners. However it has no means of verifying the accuracy of its traffic reports. MTC's revenue comes from sponsors whose advertisements accompany each traffic announcement. The frequency of traffic report updates varies from station to station, from once per rush hour to every 15 minutes.

MTC has a direct computer link with three local radio stations and sends a report via fax to a local Spanish-language station. MTC announcers also produce traffic reports for a voice mailbox which GTE Mobilenet cellular phone customers can access at a discount rate.

MTC has two Apple llgs computers, one to store a database of traffic conditions and the other to produce a visual map of incidents. This map is fed directly to a local TV station during the evening broadcast. The computer stores ten maps of the Tampa Bay region showing major roads. The location of traffic incidents are indicated by flashing arrows.

Metro Traffic Control in Tampa is a branch of a nationwide network of traffic information services, headquartered in Houston. MTC currently operates in 40 of the largest metropolitan areas in the United States. In 1990, MTC expanded to television with "Roadwatch America," reporting traffic conditions on a national basis. The primary audience of Roadwatch America is heavy vehicle operators.

Bay Area Commuter Services

In September 1988, Hernando, Hillsborough, Pasco and Pinellas counties were selected by FDOT as the site for a regional commuter service program that would integrate existing transportation demand management (TDM) services in the Tampa Bay area as well as promote other feasible alternatives to the single-occupant vehicle.

From its central office in the Kennedy/Westshore area, Bay Area Commuter Services (BACS) serves an area containing more than 15% of the total population of Florida. The center operates a toll-free telephone customer service that provides prompt computerized information on ride-sharing and public transportation. BACS also operates a computerized ride matching program. The center has the benefit of a functioning marketing framework for the dissemination of traffic and transportation information.

3. Tampa Bay Interstate Study Master Plan

In 1988, Greiner Engineering completed an Interstate Study Master Plan for the Tampa Bay area. The project grew out of an identified need to update the existing, and in some cases, substandard Interstate System built in the 1960's. The study was also a recognition that the Interstate System (I-4, I-75 and I-275) should continue to serve as the backbone of the Tampa Bay area surface transportation system.

The Interstate Master Plan recommended that the following equipment, listed in Table 8, be installed at locations throughout the Interstate network.

Table 8. Recommendations for the Tampa Bay Area Interstate Master Plan

MAJOR SYSTEM COMPONENTS
A traffic management center (2,000 sq. ft. minimum), operating 24 hours/day, seven days per week
43 closed circuit television cameras, spaced at one-mile intervals
19 variable message signs
7 Highway Advisory Radio (HAR) transmitters
213 lane signal controllers
35.7 miles of communication cable
Over 2,600 inductance loop detectors, spaced 2000 feet apart
131 call boxes for an emergency roadside telephone system
23 accident investigation sites
23 heliports for Life Flight

4. Existing North American Traffic Operations Centers

As guidance in determining the most appropriate characteristics for a future Tampa Bay Integrated Traffic Information System, basic characteristics of a selection of systems are summarized below. Detailed information on the four sites visited by CUTR staff is provided, along with a brief description of a sampling of other traffic centers and similar projects from around the U.S.

Westchester Commuter Central

Westchester County, immediately north of New York City, and Metro Traffic Control signed a five-year contract in September 1992 to establish a center for gathering and relaying immediate traffic information about the roads and mass transit in the County. Westchester Commuter Central (WCC) represents one of the first cooperative efforts in the U.S. to merge the resources of the public and private sectors into a single-source traffic information system. The 1,500 square-foot center, which was pre-approved by the County, is centrally located in the City of White Plains, and serves 42 separate municipalities with a combined population of approximately 850,000.

Metro Traffic Control paid all start-up costs (which have not been identified), and operates and maintains WCC, approximately $6,300 per month, at no cost to Westchester County. The center provides real-time traffic information at no charge to public entities within Westchester County, but WCC is concurrently marketing customized traffic information for a minimal cost to the private sector which includes corporations, radio and television stations, commercial real estate developers, delivery services, and individuals in Westchester County. For example, NYNEX is currently paying $50 per month for five different information services from WCC.

Metro Traffic Control’s helicopters, planes, and land mobile units already in the New York City area, and the county’s police patrol cars, buses, and motorists with cellular phones in their cars gather and send traffic information to the center. This information is verified, analyzed, processed and incorporated manually into concise, user-friendly reports. All the data collected at the center is disseminated to the public through radio, TV or cable broadcasts, information kiosks, a “900” telephone number and variable message signs along the roads. WCC also has a working relationship with Samaritania, a Boston-based company that provides roadside assistance to motorists. Through this service, the WCC obtains traffic information on the Tappan Zee Bridge and the New York State Thruway. The center has four employees. Three can handle normal rush-hour operations, according to WCC. Hours of operation are 5:30 a.m. to 9:00 p.m., Monday through Friday. No expansion of the current center is expected.

Up to this point, Westchester County has been quite impressed by the service provided by Metro Traffic Control and has even suggested private clients for the WCC. Metro Traffic Control has brought its expertise in gathering and disseminating real-time traffic information, enabling WCC to achieve its primary operational goals: to benefit citizens and businesses in Westchester County by reducing overall traffic congestion and commuter travel times, and improve air quality and motorist safety.

SmartRoute Systems, Inc.

The SmartRoute Systems, Inc. traffic center, located in Cambridge and serving the metropolitan Boston area (about 122 separate municipalities), is currently the only privately owned and operated traffic center in the United States. The company was formed about five years ago primarily because Boston had no single comprehensive metropolitan traffic control center. This center represents a $2 million investment by SmartRoute Systems, Inc., and other private investors. The center is just under 3,000 square feet in area and has a total staff of 12 people. Four can operate the information center during normal rush hours. Hours of operation are 5:30 a.m. to 7:00 p.m., Monday through Thursday, 5:30 a.m. to 9:00 p.m. on Fridays, and noon to 9:00 p.m. on Sundays. Operations and maintenance costs are approximately $1 million per year. If the center did not also house its corporate staff, “typical“ space requirements would be about 2,000 square feet and operational costs would be substantially less, according to SmartRoute Systems. SmartRoute staff estimate that a “typical” center would require $750,000 to $1.0 million in capital setup costs. The center is strategically located adjacent to the regional telephone switching station. (Audiotext is one technique SmartRoute Systems uses extensively for information dissemination.) SmartRoute Systems has minimized the number of separate surveillance cameras needed by mounting them on city buildings with strategic lines of sight to major congestion areas.

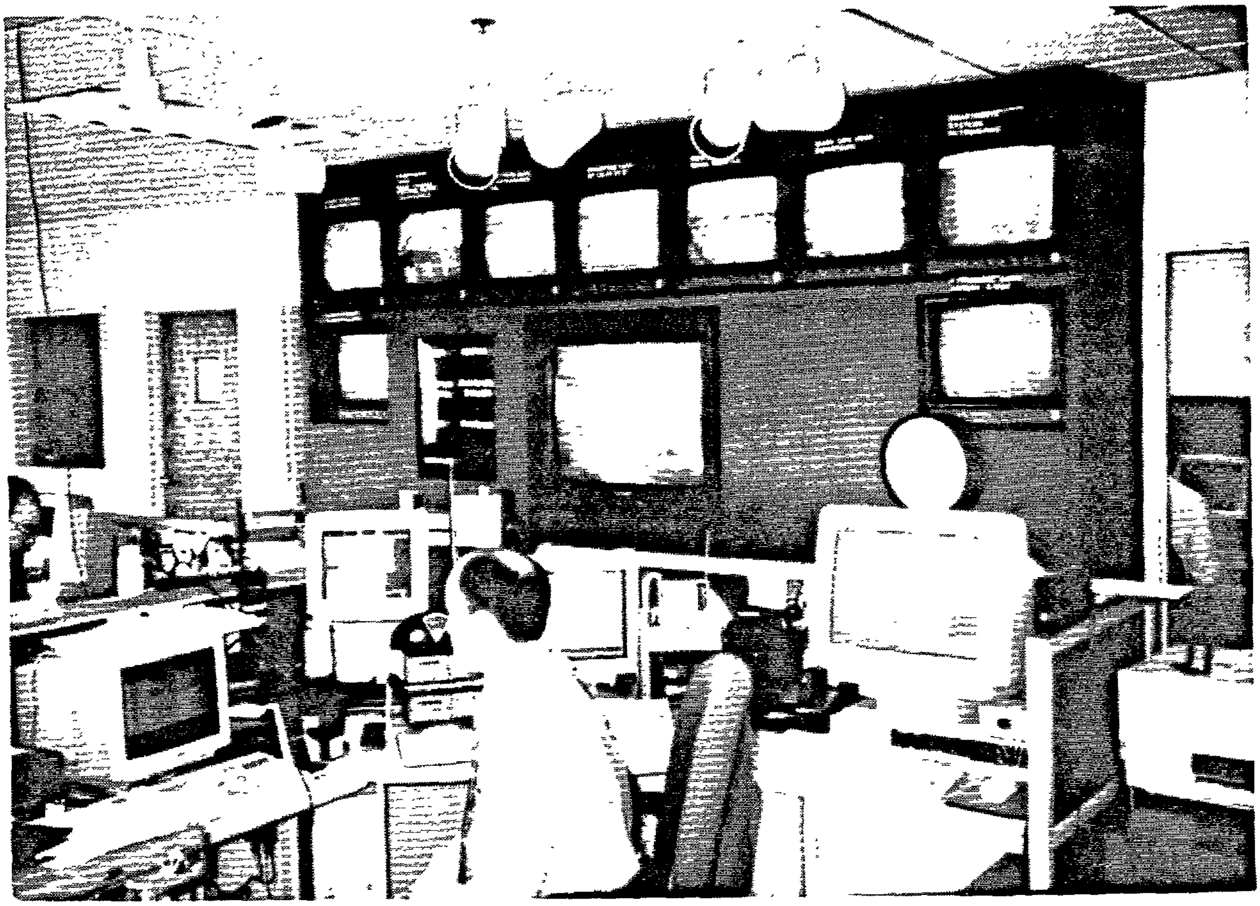


Figure 11. SmartRoute Systems Traffic Operations Center

The center, shown in Figure 11, receives its information from 47 slow-scan, black-and-white cameras via microwave transmission and approximately 400 mobile probe vehicles via two-way radios. Pre-arranged van pool drivers and public agency express bus drivers operate the probe vehicles. Additionally, the SmartRoute Systems center monitors 350 publicly available radio frequencies for police, fire and ambulance. They have direct "ring-down" lines to the state police communications center, two Amtrak dispatchers, the Massachusetts Highway Department radio room, and the Massachusetts Bay Transportation Authority (MBTA) operations center. Approximately 700 square miles of the metropolitan Boston area are covered, including all major arterials circumferentials and adjacent major feeder roads. Real-time traffic information is provided over TV (WCVB Channel 5 the local ABC affiliate), WODS radio, and SmarTraveler telephone (617-374-1234). Information is updated every 10 minutes.

On January 13, 1993, the SmarTraveler program was initiated by SmartRoute Systems, Inc. Partners in this project include the Massachusetts Department of Transportation, Massachusetts Bay Transportation Authority, Massachusetts Port Authority, Massachusetts Turnpike Authority, the State Police, the Federal Highway Administration, WCVB Channel 5, WODS Radio, the American Trucking Association Foundation, and CellularOne. Using a proprietary synchronous audiotext system, the service provides real-time traffic and transit information free of charge to the public over the telephone throughout eastern Massachusetts. During the first 10 weeks of the service, SmarTraveler received an average of 2,000 calls per day. (During the blizzard weekend of March 13 and 14, SmarTraveler received 11,000 calls.) As of mid-June the average daily call count on the system had risen to about 5,000, with the current system capable of handling up to 40,000 calls per day in a market area of about 400,000 commuters. A recent survey was conducted among users of the system which indicated 82% found the service "very useful", and 96% of the users changed the time, route, or mode of their travel due to the information they received. The federal government is providing $1.5 million for the year-long operational test, which has a total price tag of about $3.5 million. An independent evaluation of the operational test will also be conducted.

SmartRoute Systems, Inc., attributes the early success of their system to: accomplishing their goal of relieving public agencies of traffic information gathering and dissemination duties which they wished to relinquish; instant credibility gained from sponsorship by the major public transportation agencies, including the Governor's office; and a sustained marketing and education effort in order to build consumer awareness and acceptance as well as modify travel behavior in a positive fashion.

Minnesota GuideStar

Minnesota GuideStar's mission and strategic themes provide a framework for developing a statewide intelligent transportation system. The GuideStar program was conceived from discussions that began in 1989 involving the Minnesota Department of Transportation, the Center for Transportation Studies at the University of Minnesota, and the Federal Highway Administration (FHWA). Program initiatives have been built around multi-modal solutions, customer involvement, and public-private partnerships.

The Minnesota DOT traffic management center is the communications center for managing traffic in the Minneapolis/St. Paul area of about 2.5 million residents and over 100 separate municipalities. As the center is integrated with the GuideStar program, the foundation to create an advanced traffic management and information system for the state will be established. This system is envisioned to expand and subdivide, eventually linking the entire state. The 10,000 square foot center currently has 37 employees involved in design, operations and maintenance. The center has outgrown this original building constructed in 1972, and a new facility is planned to be added in about five years. The dozen Guidestar personnel are currently not fully integrated with the center, nor are they housed in the same facility. Operations and maintenance costs for the center are high, about $7 million per year. The center utilizes 108 video surveillance cameras, 400 ramp meters, 3,000 loop detectors, and aerial surveillance from two radio station aircraft. About 40% of the metropolitan freeway system is covered by the fixed information gathering infrastructure. Information is disseminated over the radio stations, two cable TV stations that include video feeds from the surveillance cameras and 30 variable message signs. One radio station, KVEB 88.5 FM, is shared with the Minneapolis public school system. The 2-3 minute public radio station broadcasts occur every 10 minutes during the weekday peak traffic periods. The original center was established from a federal grant and continues to receive a substantial federal subsidy.

Since the GuideStar program began in 1989, three major advanced technology projects have been initiated: Genesis, Travlink, and Autoscope.

Genesis is a joint venture project between Motorola and Minnesota DOT which began in September 1992 under a $390,000 federal grant. Personal Communication Devices (PCDs), hand-held units being developed by Motorola, are to provide real-time highway and transit information. Costs for these prototype units are estimated at $2,000 to $6,000 each depending on the level of sophistication, and major employers will be approached to encourage and perhaps subsidize purchase by their employees. The program recently received a $3 million grant from the FHWA IVHS Operational Test program.

The operational test for Travlink is scheduled to begin in Spring 1994. This project will be a joint effort among Westinghouse, US West, 3M, and the Minneapolis-St. Paul Regional Transit Board. This project will involve transit vehicles that only travel the I-394 authorized vehicle lane. About 800 homes will be equipped with a videotext communication system and about 20 information kiosks will be installed at major public facilities in the corridor. The purpose of this effort will be to increase transit ridership by providing real-time ride-sharing information and highway travel times.

Autoscope cameras use machine vision techniques to process a digitized image and emulate the output of inductance loop detectors. Autoscope cameras are capable of counting traffic and measuring vehicle speeds by lane. Invented at the University of Minnesota, they cost $20,000 to $30,000 per unit and have been installed along I-394 to conduct continuous travel time studies. The cost-effectiveness of this technology will be evaluated.

The effectiveness of the traffic management center and GuideStar programs are constantly being monitored and evaluated. Recent in-house reports have shown that traffic accidents have been reduced by 25%, and travel speeds have increased by 33%, as a direct result of the program.

<u>Los Angeles ATSAC Operations Center</u>

The Automated Traffic Surveillance and Control (ATSAC) center is located four stories below street level in the new City Hall building in downtown Los Angeles. The city embarked on its ambitious traffic control system to handle traffic conditions during the 1984 Olympics, and has expanded it considerably since then. A total of $47 million in federal funding has been spent on the system over the last three years, more than any other traffic management project in the United States. According to industry sources, this operations center may also be the most technologically advanced traffic management system currently operating in the U.S. An “expert system” to handle incident detection and management is now being installed and tested and is expected to be fully operational by the end of 1993. The ATSAC center has a staff of nine, housed in 2,200 square feet, but will soon be taking over adjacent office space and expanding to about 5,000 square feet.

ATSAC currently controls 915 (23%) of the city's 4,000 traffic signals. A total of 1,650 (40%) signals will ultimately be integrated into the ATSAC operations center. The ATSAC operations center automatically adjusts the signal timing in response to both the conditions at the intersection and according to system-wide conditions. A few dozen "intelligent" traffic signals that communicate with each other are also located around the L.A. Coliseum. These signals perform regional pattern matching to detect special traffic situations.

All maintenance of the high-tech equipment is performed by city employees. The nearby cities of Pasadena and Anaheim have traffic control centers, however ATSAC has no direct data link with them. The California Department of Transportation (Caltrans) operates a traffic control center across the street from the building in which ATSAC is housed. This control center monitors the freeways, whereas ATSAC is responsible for the surface streets. The Caltrans center controls ramp metering, highway advisory radio, variable message signs and produces the map for the "Freeway Vision" cable TV service. There is a direct modem link between the Caltrans and ATSAC centers.

A variety of transmission media is utilized for communication between the traffic controllers and ATSAC such as fiber-optic cable, RF microwave, copper cable and leased phone lines, depending on the distance required for transmission. City engineers are currently working on compressed video technology to transmit video images over coaxial cable where fiber-optic trunks are unavailable. Within the operations center, video information displays are updated every 60 seconds. Vehicle speeds, volumes, queue lengths and travel time delay can also be color coded on the roadway network image. The traffic control software is based on the UTCS software, developed by FHWA, which utilizes a centralized control algorithm.

Public traffic information is available to commuters via three different radio frequencies. "Airport Radio" plays on 530 AM, Caltrans runs a HAR frequency at 1610 AM, and the city operates another HAR service at 1520 AM. Eventually, the "expert system" will automatically generate messages and voice for the HAR.

The L.A. Smart Corridor project centers around the Santa Monica Freeway (Interstate 10), from Los Angeles International Airport to downtown Los Angeles. The freeway carries about 340,000 vehicles per day; five arterial streets parallel the freeway. The objective of the "Smart Corridor" project is to divert motorists off the congested Santa Monica Freeway on to the parallel arterials using radio broadcasts and variable message signs. City engineers believe that because of the phenomenally high volume to capacity ratio, operating conditions can be improved significantly by diverting 10% of the traffic onto local arterials. Caltrans assists in this effort by conducting coordination workshops for the local media to induce them to provide alternative routes in their traffic broadcasts. Intersections which lead to the freeway ramps have low-range HAR transmitters, variable message signs and traffic signals tied into the ATSAC operations center. A comprehensive evaluation of the Smart Corridor project will be conducted in late 1993. This evaluation will be performed from both the operator and user perspective. The goal is to divert 10% of the drivers off Interstate 10.

Atlanta, GA

In preparation for the 1996 Olympics, the first-fully integrated computerized traffic and transportation management system is being installed in Atlanta. This system will enable traffic managers from local governments to send and receive information through a networked communications system. Georgia DOT has secured $70 million in funding ($12 million in state and local funds, $58 million from federal sources) for this project. The system will cover five counties and six cities and will include 600 "intelligent" traffic signals, video surveillance cameras, variable message signs and numerous loop detectors. A $13.2 million system design contract was recently awarded to TRW, Inc. from Cleveland.

Columbus, OH

Developed in 1990, the “Paving the Way” traffic management program was used on the 7.5-mile, Interstate 71 reconstruction north of downtown Columbus, Ohio, to provide traveler information to drivers navigating through construction zones. The three-year $4.6 million program received 90% of its funding from FHWA and 10% from the Ohio DOT. This public information network issued press releases every day to 70 agencies. Three park-n-ride lots and 46 peak direction bus trips were added, along with an “800” number providing car and van pool information. Complaints to the city and Ohio DOT were considerably reduced as a result of the project.

San Jose, CA

Beginning in 1988, a six-year implementation schedule for the Traffic Signal Management Program costing $12 million was undertaken by the city. A total of 526 intersections were combined into 54 control groups. The communications network was comprised of a mixture of city-owned and leased telephone lines. The program is being enhanced to include closed-circuit television to provide real-time display of critical intersections.

Baltimore/Washington, D.C.

The Chesapeake Highway Advisories Routing Traffic (CHART) is Maryland’s entry into advanced traffic management systems. The perennial, seasonal traffic jam between the Baltimore-Washington metropolitan area and the ocean resorts of Maryland’s Eastern Shore was the catalyst for this program. “Reach the Beach” provides real-time motorist information through variable message signs, HAR, an “800” telephone number and a roving sound truck patrolling the corridor. CHART is also spearheading one of the first network approaches to linking multiple traffic operation centers along a long (125-mile) travel corridor. When fully operational in 1994, the statewide operations center will function 24 hours a day, seven days a week, requiring 12 operators in the control room.

Orange County, CA

In late 1991, Orange County approved a plan to build and operate a state-of-the art traffic operations center using closed-circuit televisions, ramp meters, freeway detectors, variable message signs and freeway service patrols. The system is planned to be fully operational by the mid-1990's. The center will act as a single, county-wide freeway operations center staffed by Caltrans and the California Highway Patrol. The center will manage and control all existing freeways in the county, new public freeways, and proposed public and private toll roads. Capital costs for the system are estimated at $25 to $30 million, and annual maintenance and operations costs are expected to be about $12.4 million.

Oakland County, MI

The first phase of an integrated traffic operations center in Troy, Michigan, was completed in October 1992 for the Oakland County Road Commission. This traffic operations center forms the first part of a five-year, $70 million IVHS program called FAST-TRAC. The traffic operations center was designed by Rockwell International Corporation's Autonetics Strategic Systems Division. Real-time traffic routing is provided through a system comprised of a network of roadside infra-red beacons, specially equipped vehicles with on-board computer systems and a centralized computer system linking the two.

Northern Virginia

The Virginia Department of Transportation's traffic management system is a computerized highway surveillance and control system that monitors 30 interstate miles on I-395, I-495 and I-66. The system consists of 550 loop detectors, 48 closed-circuit cameras and 100 variable message signs. The center, located in Arlington, Virginia, operates seven days a week from 5:00 a.m. to midnight. Its staff includes five operators, two supervisors, and seven field technicians. Virginia DOT plans to extend the system another 36 miles, and incorporate the Autoscope monitoring component.

New York City

A system of traffic sensors and “smart” traffic signals costing $100 million is being planned for the New York City area. This summer the first phase of the system is being installed in Manhattan: it involves the installation of 1,100 electromagnetic sensors linked to 3,000 traffic signals to better control the 880,000 vehicles that enter the borough on an average day. This system will be one of the most elaborate and expensive systems in the world. After spending $45 million in Manhattan, the city plans to spend $50-$60 million to expand the network to the Bronx, Brooklyn and Queens by 1996. City officials are hoping that by the end of the decade, motorists may be using computers in their vehicles, homes, and offices to plan the fastest and most convenient routes around and through the city.

San Antonio. TX

The Bendix Field Engineering Corporation under contract with the Texas Department of Highways and Public Transportation (District 15, San Antonio) has recently begun developing a Freeway Traffic Management System for the city of San Antonio. This $32 million, 2-year effort will cover 191 freeway miles, and includes a 30,000 square-foot control center. The hardware for the control center will include 72 video monitors and 18 operator workstations. The system will consist of a 50-mile fiber-optic communications network, 85 miles of communications cable linking system components, 52 video surveillance cameras, 51 variable message signs, 73 lane control signals and 536 loop detectors.

D. Funding Options

Typical sources for financing traveler information and traffic management projects include federal, state and local highway and transportation improvement funds. Information obtained through site visits by CUTR staff indicate that traffic control centers receive funding from a variety of different sources, including regional entities and the private sector.

1. Federal Funding

Part B of Title VI, "Research," of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is titled the "Intelligent Vehicle Highway Systems Act of 1991 " This portion of the ISTEA defines ways of using federal funds for development of traveler information and traffic management systems. Section 6055 "Technical, Planning and Operational Testing Project Assistance" states

> *'the Secretary shall assist state* and local *officials in developing plans for area-wide traffic management control centers among other projects. This section enables* the *Secretary to* make *grants to state and local governments for feasibility and planning studies for development and implementation of IVHS* "

Any inter-agency traffic and incident management entity, including independent authorities contracted by a state for implementation of a traffic management system, are eligible to receive federal assistance for development of an IVHS program.

Section 6058 "Funding" authorizes $71 million for FY92 and $86 million for FY93 through FY97 for the IVHS Corridors program; and $23 million for FY92 and $27 million for FY93 through FY97 for other IVHS activities. The federal share cannot exceed 80% on any IVHS projects except those that are determined to be "innovative, high-risk operational or analytical tests that do not attract non-Federal commitments but are determined by the Secretary as having significant potential to help accomplish long-term goals."

In addition to Part B of Title VI, the ISTEA identifies three other sources of funding for projects and activities that fall within commonly accepted definitions of traveler information and traffic management systems. They are the National Highway Systems (NHS), the Surface Transportation Program (STP), and the Congestion Mitigation and Air Quality Improvement (CMAQ) program.

ISTEA Section 1006(d) cites operational improvements as eligible for funding with NHS funds. Section 1005, paragraph (f) of ISTEA defines "operational improvement" as *“a capital improvement for installation of traffic surveillance and control equipment, computerized signal systems, incident management programs, and transportation demand management facilities, strategies and programs.”*

In addition, NHS funds can be used for

“startup costs for traffic management and controls such that costs are limited to the time period necessary to achieve operable status but not to exceed two years following the date of the project approval, if such funds are not used to replace existing funds.”

Startup costs for traffic management and control are defined in Section 1005 as

“‘initial costs (including labor costs, administration costs, cost of utilities, and rent) for integrated traffic control systems, incident management programs, and traffic control centers.”

Section 1007 of ISTEA describes the STP. Paragraph (1) under “Eligible Projects” notes that operational improvements are eligible for STP funding. Paragraph (6) lists “capital and operating costs for traffic monitoring, management, and control facilities and programs” as eligible. There are no time limitations for STP funds.

Section 1008 of ISTEA describes the Congestion Mitigation and Air Quality Improvement Program. Types of projects eligible for use of these funds are cited in Section 108(f)(l)(A) of the Clean Air Act which lists transportation control measures that include “traffic flow improvement projects that achieve emission reductions.”

2. State and Local Funding

State and local funding sources will certainly be required at least for continuing operations and maintenance activities. The prioritization of federal dollars within states and metropolitan regions has caused state and local agencies to assume much of the burden for initial construction and implementation. The money can be raised from traditional revenue sources, such as general taxes, special bonding initiatives or local gasoline taxes.

3. Private Funding

Private companies may work jointly with public agencies or provide substantial funding through user fees. Quasi-public transportation authorities, such as ports or toll roads, that can benefit from a regional traffic information center could contribute to startup and operational costs. Tampa Bay area commuters who participated in the focus group interview sessions indicated, however, that they are not willing to pay for real-time traffic information through direct user fees.

In cases where public agencies contribute no funding whatsoever, it is recommended that the public agency still must have an “anchor relationship” with the project. One such relationship could be permission to use the agency’s name in marketing. Traveler information and traffic management systems will always be of interest to public transportation agencies because these systems have a wide public benefit. Informed travelers who avoid congested routes (possibly by using transit) provide a system-wide benefit because overall congestion is reduced. In addition, an early findings report conducted by SmartRoute Systems indicates that the public has more confidence in traffic information from an identified public agency.

4. Case Studies

An on-going debate exists among the proponents of traveler information technologies on the merits of public versus private ownership of various ATIS services. The only consensus reached so far is that there is no one configuration which works best in every context. The following case studies present different models of ownership of ATIS functions.

The Westchester Commuter Central project is unique in that the traffic control center is paid for almost entirely by private funds. Metro Traffic Control paid for the construction and operation of the center. Operational costs run about $75,000 annually. Westchester

County's only financial contribution is one county employee on staff at the center as a liaison to public agencies. Westchester County received a grant from the New York State Department of Transportation to pay for this employee's salary. Metro Traffic Control hopes to recoup their investment outlay by selling the traffic information to local media outlets, large employers and other customers.

The Boston SmarTraveler project is funded by almost equal portions of public and private monies. Like Metro Traffic Control in Westchester County, SmartRoute Systems plans to recoup their investment by selling their traffic information database to a variety of customers. The company will be flexible in its response to varying degrees of public and private financial support. Eventually, the company hopes that projects such as "SmarTraveler" Systems will be supported entirely by the private sector. However, SmartRoute Systems is willing to accept public funding while the commercial market develops.

The Minnesota Traffic Management Center was built in 1973 mostly with federal funds as part of FHWA's Urban Corridor Management program. Eventually, the annual operation and maintenance costs were transferred to the Minnesota DOT. These costs run approximately $7 million per year. GuideStar grew out of the research division of the Traffic Management Center and is now a separate entity. GuideStar is an amalgam of IVHS-related projects and will use a 3.5-mile section of I-394 as a laboratory for testing new IVHS technologies. GuideStar receives substantial federal funding - approximately $9 million per year from the FHWA's IVHS Operational Test program.

The $47.2-million, L.A. Smart Corridor project was financed through a mix of Federal, State and local funds. The Metropolitan Transportation Authority (MTA) contributed $13 million. The MTA is the result of a merger between the Los Angeles County Transportation Commission and the Southern California Rapid Transit District. Smart Corridor is but one of the many projects funded by the MTA special assessment half-cent sales tax. Caltrans contributed $12.4 million as part of its Transportation Systems Management program. Seven million dollars came from the Petroleum Violation Escrow Account (PVEA), a fund administered jointly by the state of California and the U.S. Department of Energy into which companies pay compensation for environmental pollution. The Smart Corridor project also received around $1 .0 million from developers to assist in mitigation of the traffic impact of their projects, as required by city statute. The City of Los Angeles did not contribute directly to this $47.2 million total. Instead, Los Angeles DOT bears the full cost of operation and maintenance of the Smart Corridor project and ATSAC control center. This money comes out of the city general fund and could not be quantified at this time.

One reason why the Westchester County project and Boston SmarTraveler can rely so heavily on private, instead of public funds, is that their traffic information collection techniques rely almost exclusively on information collection techniques traditionally used by private agencies, such as aerial surveillance, monitoring of police radios and fleets of private "probe" vehicles. In contrast, a significant portion of data collection for both the Minnesota Traffic Management Center and the Los Angeles ATSAC Control Center are in-pavement detectors. Both projects are supported almost entirely through federal funds.

IV. PUBLIC INVOLVEMENT

In addition to studying available evaluation results of ATIS projects around the country, this project used several techniques to gauge public perception concerning a real-time traffic information center for the Tampa Bay area. Consensus-building techniques included assembling an advisory committee composed of intended users of the system and conducting focus group interview sessions with both “commercial” and “commuter” users of real-time traffic information. By listening to advisory committee and focus group members, the particular characteristics of the Tampa Bay metropolitan area were brought into each stage of the conceptual design process.

A. Advisory Committee Input

To solicit public participation and enhance public awareness of a regional traffic information center, CUTR formed an advisory committee consisting of intended users of a Tampa Bay real-time traffic information system: local radio and television stations, transit agencies, transportation management associations, taxi companies, delivery companies and the police, traffic engineering and road maintenance divisions of the local governments in the region. Advisory committee members are listed in Appendix A. CUTR conducted four advisory committee meetings throughout the year-long contract period. At each meeting, CUTR staff presented their most recent findings and received comments from advisory committee members. The following points have emerged as items of consensus:

<u>Information Collection:</u>

Use resources currently available in order to save money.

<u>Traffic Management Center:</u>

Information processing functions (the “brain”) and dissemination functions (the “mouth”) should be performed by the same organization.

A central information collection point is needed that is “politically neutral,” such as a private or quasi-private organization. There have historically been problems with the kind of interagency cooperation that is necessary for a regional system.

The center should be operated by a private vendor. Concerns about accountability and accuracy could be addressed in the contractual agreement between the public agency and the private vendor.

<u>Information Dissemination:</u>

Public perception of the accuracy of traffic reports is essential for widespread support for the system.

The center should improve the level of detail and accuracy of reported information by cross-checking information from various sources.

B. Focus Group Interview Sessions

The focus group interview sessions provided an opportunity to obtain qualitative feedback on the relevance, basic features and performance characteristics of the proposed Integrated Transportation Information Center. Table 9 lists the primary questions posed during the focus group interview sessions.

To select the focus group participants, CUTR staff initially identified over 100 potential focus group member organizations, then divided the list into two groups according to the organizations’ need for traffic information, i.e. “commercial” and “commuter” users. Some organization fell into both categories. An example is GTE, which needs traffic information for both its employees and its fleet of vehicles.) CUTR staff then identified individuals from those organizations who were willing to participating in the sessions.

The focus group interviews sessions were conducted on July 30, 1993, at the Center for Urban Transportation Research on the University of South Florida main campus. Ten people participated in the Commuter Group session; 11 people participated in the

Commercial Group session. Participants are listed in Appendix B. Both sessions were videotaped in their entirety. In addition, CUTR research staff were assigned to take detailed written notes. The participants of each group were given a brief questionnaire in order to get them thinking about their need for real-time traffic information. A copy of the questionnaires are contained in Appendix C.

Table 9. Primary Questions for Focus Group Interviews

PRIMARY QUESTIONS
What is the perception of traffic conditions in the Tampa Bay area, overall and during rush hours?
What are the most appropriate media for disseminating information?
What portion of the cost could be expected to be borne directly by the public?
How does the public rate existing means of receiving traffic information?
What are essential features of real-time traffic information broadcasts?
What are major congestion areas in the Tampa Bay area?

1. Commuter Group

The Commuter Group session was conducted from 9:00 a.m. to 12 noon on July 30, 1993. Ten people participated in the session; they are listed in Appendix B.

Perception of Traffic Conditions

Rush hour traffic conditions were rated poor to fair, even when compared to other larger cities. They think that there is no longer any significant degree of seasonality to the problem and that traffic conditions are poor even in the summer. During rush hours the traffic seems to progress in waves, separated by lull periods. Timing can therefore make a significant difference in the degree of delay experienced. A five minute delay in leaving home in the morning can result in an additional 15-to-20 minute delay. Because of the high volumes, the traffic situation is extremely volatile, with any minor incident resulting in a major back-up.

In addition to the morning and evening rush hours there is also a distinct midday rush hour period, lasting from about midday to 2:00 p.m.

Participants rated overall traffic conditions as poor and traffic congestion as continuous. Several participants noted that they would prefer to drive during rush-hour, since the rush hour drivers are normally more experienced. Participants noted that most serious accidents take place during the off-peak period.

Existing Traffic Reports

The car radio is the most popular medium used for accessing information on traffic conditions. A few participants also tune in to television broadcasts before leaving home in the mornings. Participants found broadcasts to be generally useful, notwithstanding the perceptions indicated in Table 10.

Table 10. Focus Group Perceptions of Existing Traffic Reports

PERCEPTIONS OF FOCUS GROUPS
Traffic condition reports are not frequent and timely enough, and participants are unable to get "what they need, when they need it"
Commuters sometimes hear news of a congestion area or incident after they are already stuck in traffic
Traffic reports are often lacking in geographic detail since they must cover such a large area
Traffic reports are often limited to the interstates, excluding major arterials
Participants expressed some skepticism concerning accuracy of traffic reports over the radio

Traffic reports are viewed as much more valuable in the morning before leaving for work. Only three of the ten participants indicated that they sometimes tune in to evening traffic report broadcasts before leaving their place of work.

Participants revealed that traffic reports are also useful during the weekend, though not with the same degree of urgency. Most of the more popular radio stations would notify their listening audiences of special events or unusual traffic incidents.

Information on Alternative Routes

Most participants responded that they appreciated being advised to take alternative routes, however, they would prefer to find their own route rather than follow the advice given in the broadcast. One reason given was that it was likely that everyone else tuned in to the broadcast would try to use the alternative route, thus simply transferring the congestion problem elsewhere.

Some participants felt that they would be more responsive to the broadcast if they were in a familiar area and had some knowledge of the alternative route. They would also be willing to respond to such advice at any time, regardless of the purpose of their trip. However, advice on alternative routes should include detailed, descriptive information on the routes recommended.

Desired Features of a Traffic Report

The following features were seen by participants as the most important features of a good traffic report. They are listed in the order of importance as perceived by the group:

1. **Broad, but Specific Coverage:** The group felt that a traffic report should be regional in its coverage, but should contain detailed geographical information. The main broadcast should be broken into segments each specific to a well-defined, geographical area that would be identified before each segment of the report begins.

2. **In-depth Description of Incident:** The report should be specific enough to describe the nature of the incident causing the delay. This will allow the traveller to make his/her own judgement as to the extent of the resulting delay.

3. **Indications of Operating Speeds:** Some indication of average operating speed should be included in the report. The group suggested that a speed index would provide an indication of the degree of congestion.

4. **Projected Delay:** The group expressed a desire for the broadcast to give some indication of the expected delay that would result from an incident.

5. **Suggested Alternative Routes:** Some information on alternative routes should be included in the report.

6. **Length of Traffic Backup:** The extent of the existing traffic back-up resulting from the incident would be useful in deciding on alternative routes.

The group felt that the personality behind the report was not important, although it was agreed that some reports are more professionally done than others. They cited clarity, depth and accuracy as important considerations.

Timing and Frequency of Reports

The group felt that there was a need for a radio station solely dedicated to disseminating traffic information. Ideally, it would operate around-the-clock, seven days per week. A bare minimum service would be one that offers traffic reports every ten minutes during the three daily rush-hour periods, Monday through Friday. It would also include notices concerning special events. At the middle of the spectrum would be a system that provides a continuous update on traffic conditions only during rush hours, Monday through Friday.

Communication Media

Despite the importance attached to the car radio as a means of disseminating traffic information, the group felt that other media were necessary to ensure that traffic information reaches as wide an audience as possible. They suggested the following media as alternatives to the car radio that they might also find useful:

- variable message signs;
- newspaper articles for information on special events and road construction; and
- an "800" telephone number with a menu driven system that would allow access to information on specific routes.

Willingness to Pay

The group was hard-pressed to identify conditions under which they would be willing to pay directly for traffic information. However, participants recognized that a portion of the cost of a traffic information system must be borne by the public, either directly through user fees or indirectly through taxes. One suggestion was that major employers underwrite the cost, since they would benefit from increased punctuality and productivity of their employees.

Major Congestion Areas

The following were cited as some of the most serious congestion points in the Tampa Bay area:

- the Ulmerton merge;
- the I-4/I-275 interchange;
- the Fowler Ave./I-275 interchange;
- Dale Mabry Highway.; and
- the intersection of Florida Ave. and Bearss Ave.

Additional Comments

The group appeared to share the opinion that although the proposed Integrated Transportation Information System would provide a useful service for the travelling public, it was at best a piecemeal solution to the problem of congestion on the road network. In particular, they expressed a desire to see an expansion in transit service: increased operating hours, increased number of routes and linkage between Pinellas and Hillsborough counties.

2. Commercial Group

The Commercial Group session was conducted from 2:00 p.m. to 5:00 p.m. on July 30, 1993. Eleven people participated in the session; they are listed in Appendix B. Participants were asked to present their opinions and perspectives not from their personal point of view, but from the standpoint of their affiliated business organization or agency. The group felt that reliable traffic information was important and, in some cases, critical to the productivity of their organization.

Perceptions of Traffic Conditions

The group's assessment of traffic conditions during rush hours varied from poor to fair, with one participant expressing the opinion that it was very poor. Participants said that the main cause of traffic congestion was the archaic conditions of the highway system. One participant noted that congestion was worse on Tuesdays than any other day of the week. Participants also cited buses stopping at pick-up points as a major cause of traffic back-up and delay along certain routes. Participants also noted that problems are compounded by the absence of alternative routes.

Traffic conditions overall were generally rated fair to good, although two participants rated them very poor. Participants also noted that most serious accidents took place during the off-peak period of the day.

Existing Traffic Reports

Similar to the commuter group, the most popular medium for traffic reports among this group is radio, although some of the participants did convey that they would use the television report if it was available. Accuracy was seen as an important requirement, but the perception was that traffic reports were usually late or after the fact.

Desired Features of a Traffic Report

The following features were viewed as essential features of a traffic report and are listed in order of importance as seen by the group:

1/2. **Location of Incident/Cause of Delay:** The group felt that specific details on the location of the incident and cause of the delay are the most essential feature of a traffic report.

3/4. **Degree of Blockage/Time of Incident:** There was some disagreement as to which of these two features is next in importance. Some felt that they would be able to deduce the amount of delay involved if they were notified as to how many lanes were blocked. Others felt that it would be sufficient to be given the time of the incident and be left to make an estimation of the time required for the situation to return to normal.

5. **Nature of incident:** In order for the traveller to estimate the degree of resulting delay, the group felt that it was necessary to receive some information on the nature of the incident or cause of delay.

6. **Other Features:** Projected clearance time, the length of the resulting backup and instructions on alternative routes were felt to be important. The opinion was expressed, for example, that there are so few alternative routes available as to render this information virtually useless in many cases.

Timing and Frequency of Reports

The group felt that a dedicated radio station would be an ideal and justifiable option, broadcasting traffic information 24-hours a day, seven days a week. As a minimum, participants felt that accurate, information on major incidents as they occur would be sufficient to make traffic reports useful to their organization. At the middle of the spectrum would be updates every 10 to 15 minutes, from 6:00 a.m. to 6:00 p.m., Monday through Friday. In addition, updates on special events or incidents should be broadcast on weekends as the need arises.

Communication Media

The medium of choice is the radio. Participants felt that by far it is the most convenient and affordable alternative. Variable message signs were also cited by representatives of the taxi and limousine services as useful and helpful to their drivers.

Willinaness to Pay

In general, the group was not very enthusiastic in their response to the notion of having to pay directly for traffic information. To some, though, the idea of paying for commercial slots in a radio broadcast was more acceptable.

Major Congestion Areas

The general perception of the group was that traffic congestion was widespread; but they listed the following locations as being most severe:

- Dale Mabry Highway;
- Fowler Ave, from I-275 to the USF campus;
- I-4/I-75 interchange;
- Courtney Campbell Causeway on the Hillsborough County side;
- Access routes to the beaches in Pinellas County.

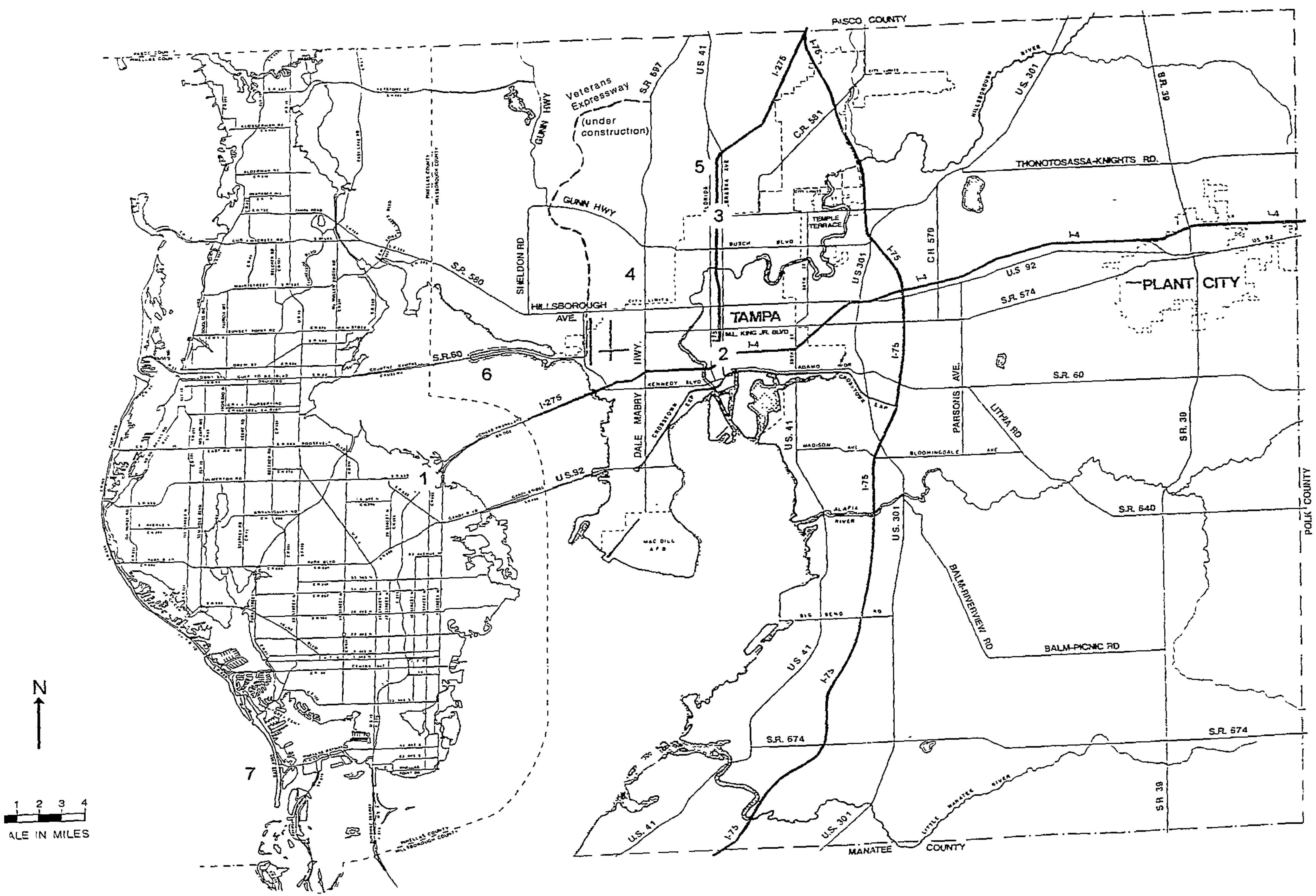
A map of major congestion areas, as indicated by the Commercial and Commuter groups, is shown in Figure 12.

Additional Comments

Although radio was by far the most popular medium, the group suggested that a conglomeration of different means may be necessary in order to fully realize the true worth of the proposed Integrated Transportation Information System. Some suggested a TV monitor with a color-coded map showing the location and severity of incidents.

Variable message signs were also mentioned as a useful communication medium, particularly to cab drivers and delivery trucks.

It was suggested that large private corporations be solicited to assist in meeting the costs of operations, since they would benefit from increased punctuality and productivity of their employees.



Legend

1. Ulmerton Merge
2. I-4/I-275 Interchange "malfunction junction"
3. Fowler Avenue /I-275 Interchange
4. Dale Mabry Highway
5. Intersection of Florida Avenue and Bearass Avenue
6. Courtney Campbell Causeway on the Hillsborough side.
7. Access routes to the beaches in Pinellas County

Figure 12.
Major Congestion Areas as Indicated by Focus Group Participants

V. RECOMMENDED SYSTEM

Consistent with the consensus reached by the project advisory committee, this section contains the recommendation for a regional real-time traffic information center for the Tampa Bay Area. The proposed name of the center is the “Traffic Vision Center” or "TVC”, thus emphasizing a real-time, regional congestion map as one of the center’s primary outputs. The name is open to revision, as part of a metropolitan area-wide marketing program.

The recommended traffic information system contained in this report, and illustrated in Figure 13, conceptually the same as the Surveillance, Communications and Control (SC&C) system included in the Tampa Interstate Master Plan freeway traffic management and incident detection/response system.

A. System Description

1. Data Collection

Every existing source of traffic information in the Tampa Bay area is included in the schematic design (Figure 13) in order to maintain the autonomy and infrastructure already established for each source. There is a wide range of detail in the data collected by various sources, ranging from real-time traffic counts collected by the city and county owned traffic control centers to the anecdotal reports on areas of traffic congestion provided by Metro Traffic Control. Some pre-processing at the source points is required.

It is recommended that a computer terminal be installed at the locations noted below, linked by a narrow-band transmission medium such as coaxial cable allowing two-way communication with the proposed center. Entry of observed congested areas and incidents should be performed manually unless otherwise noted.

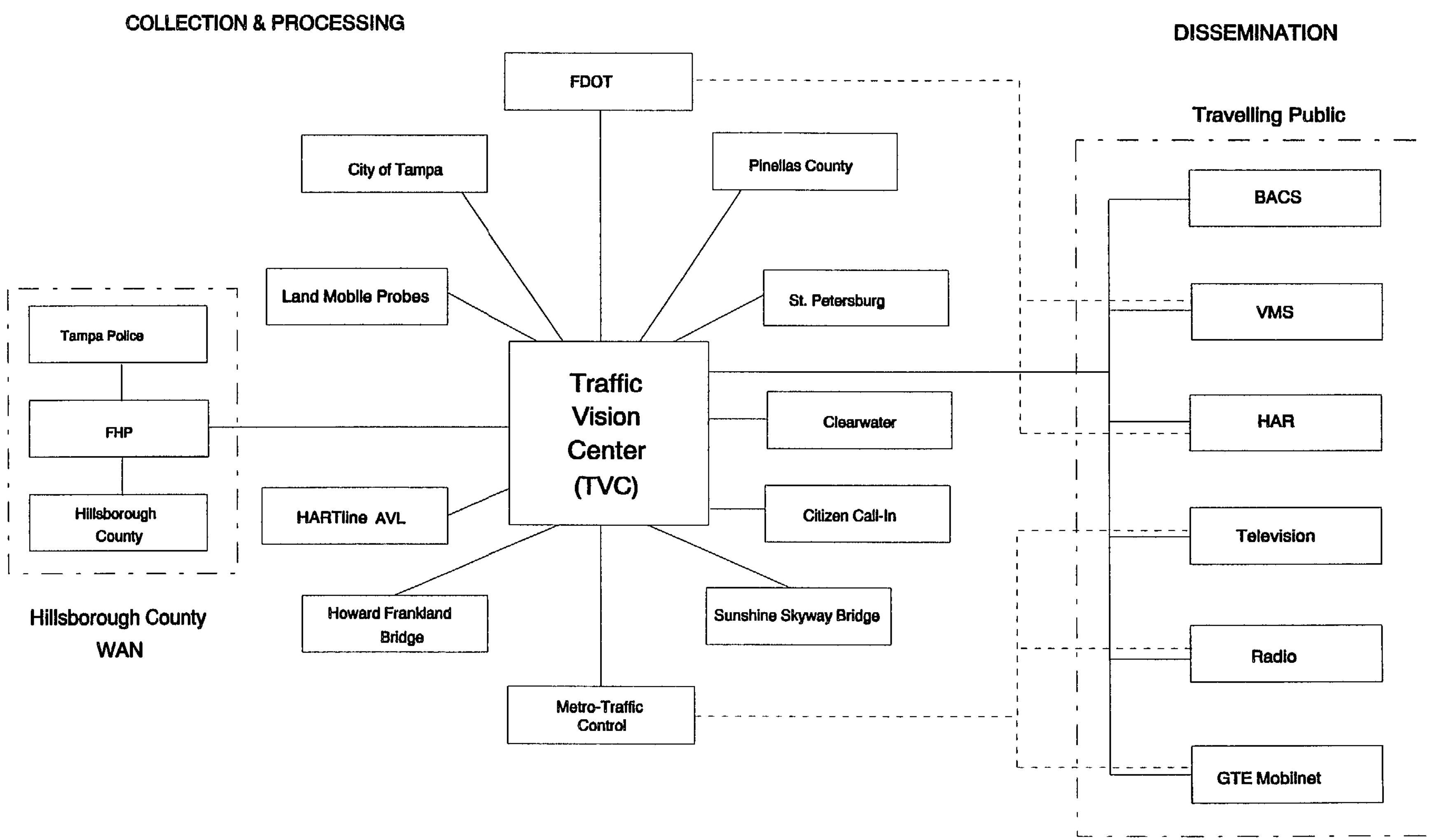


Figure 13. Schematic Diagram of the Recommend System

City and County Owned Traffic Control Centers

It is recommended that the city and county owned traffic control centers be linked to the regional center via coaxial cable. Software must be installed at all five city and county owned centers to convert the data obtained from loop detectors to reports of traffic congestion. The Management Information System for Traffic (MIST), available from Traffic Control Technologies, a subsidiary of Farradyne Systems, Inc., can perform this function. The Hillsborough County Traffic Control Center will use a personal computer-based version of MIST when the newly-constructed center begins operations in November of 1993. The existing city and county owned traffic control centers in the Tampa Bay area are as follows:

- City of Tampa
- Pinellas County
- City of Clearwater
- City of St. Petersburg
- Hillsborough County

Hillsborough County

The planned Hillsborough County Traffic Control Center will operate up to seven closed-circuit television cameras. Ultimately, the county plans to install video surveillance cameras on State Road 60, Dale Mabry Highway, Hillsborough Avenue, Fletcher Avenue, I-275 and Waters Avenue. The TVC will be linked to the Hillsborough County's fiber-optic cable wide area network, so that it will have direct video access to these cameras.

Florida Department of Transportation

FDOT maintains a number of permanent count stations at various locations around the Tampa Bay area. Information from these stations can also be integrated into the proposed surveillance system. A redundant center with a read-only data link to Hillsborough County will also be housed at FDOT.

Sunshine Skyway and Howard Frankland Bridges

FDOT operates the Sunshine Skyway Bridge surveillance and control system. FDOT will operate the surveillance and control functions on the Howard Frankland Bridge if plans for reviving such a system are implemented.

Florida Highway Patrol

The Florida Highway Patrol obtains its information by monitoring the emergency channel of CB radios and by call-ins from their patrol cars and motorists FHP will also be opening a new command center immediately adjacent to the Florida DOT District Seven Offices in Tampa.

HARTline Automatic Vehicle Location System

HARTline has recently installed an Automatic Vehicle Location system that will allow real-time monitoring of the operations of its fleet of 172 buses. The transit agency conducted a performance test of the system on its entire route network on August 9, 1993. The system should be operational by October 1993. This system can provide a useful source of traffic information if integrated into the proposed system.

Metro Traffic Control

Metro Traffic Control operates a surveillance center located at the Marriott Hotel of the Tampa International Airport. Its information is obtained from aerial observation and monitoring police radio frequencies. Metro Traffic Control already maintains a database of congested areas and traffic incidents. This database should be linked directly with the TVC

Land Mobile Probes

Five business in the Tampa Bay area, previously listed in Table 1, have vehicles which traverse the road network, assist stranded motorists, and serve as a source of information on traffic congestion. The TVC will establish a dedicated phone line to receive traffic reports via cellular phone from these probe vehicles. TVC staff will record these reports into the TVC's database.

Citizen Call-In

The TVC will institute two telephone numbers (one "800" number and the other with toll-free access by cellular phones) for motorists to call in and report traffic incidents. TVC staff will record these reports into the TVC's database.

Additional Sources

One of results of the focus group sessions was a listing of locations perceived as the most congested areas in the Tampa Bay metropolitan area, listed in Table 11 and previously illustrated in Figure 12. It is recommended that each municipal center fully evaluate those locations which it deems most critical and ensure that surveillance and data collection is sufficient at these particular locations.

Table 11. Major Congestion Areas as Indicated by Focus Group Participants

PERCEIVED CONGESTED AREAS (in no order of severity)
Ulmerton merge
I-4/I-275 interchange ("malfunction junction")
Fowler Avenue, from I-275 to the USF campus
Dale Mabry Highway
Florida Avenue and Bearss Avenue intersection
Courtney Campbell Causeway,on the Hillsborough County side
Access routes to the beaches in Pinellas County

While the Sunshine Skyway and Howard Frankland bridges have either planned or operating surveillance and control systems, no infrastructure is currently in place or planned for incident detection on either the Courtney Campbell Causeway or the Gandy

Bridge. It is also recommended that a suitable system be installed on these bridges, allowing interface between the City of Tampa and Pinellas County centers.

It is recommended that the TVC have access to information collected by newly installed traffic surveillance equipment. For example, the Tampa Interstate Master Plan recommends that Florida DOT install closed circuit television cameras and inductance loop detectors throughout the Tampa Interstate System. The TVC will have access to the data collected by this equipment by its coaxial cable link to Florida DOT.

2. Center

Input Processing and Output

The TVC will receive traffic information in text form via coaxial cable from several sources. The information received will be in a standardized form, with each report containing a time stamp, location and nature of incident or congestion.

The TVC will process all reports received, adhering to the following principles, as indicated by advisory committee meetings and focus group interview sessions.

- Whenever possible, the TVC's reports will provide expected time of delay and specific alternative routes to avoid incidents and non-recurring congestion. However, the TVC must coordinate with local jurisdictional staff when recommending local arterial streets as alternate routes.

- The TVC's reports will contain detailed information about the location of congestion and incidents, including direction (e.g. "northbound" vs. "southbound".) The reports will also use a standard procedure for naming of roads and avoiding colloquialisms (e.g. "malfunction junction") so that the reports are understandable to newcomers and tourists.

- Each reported traffic incident in the TVC's database will be accompanied by both a time stamp and "sunset estimate", i.e. an estimate of how long it will take for traffic conditions to return to normal. After the "sunset estimate" has elapsed, the TVC will stop reporting that incident, unless another source reports that the incident is still causing traffic congestion and delay.

- Traffic reports from the citizen call-in telephone number must be verified by at least one other source before being reported.

The TVC will compile information from these various sources. The TVC will disseminate traffic reports in the following two forms:

- Color video map of Hillsborough and Pinellas Counties showing Interstates and major arterials. Sections of road will be color coded by degree of congestion (i.e. existing operating speeds) and major incidents will be highlighted.

- Database of all current locations of congestions and incidents for the TVC's coverage area.

As a future enhancement, the center shall develop software to detect incidents within three to four minutes, to operate communications and control devices automatically and verify ail operations.

<u>Ownership and Operation</u>

It was the consensus of the advisory committee that the TVC be operated by a private contractor, with a public agency, such as Florida DOT, administering the contract with this contractor. Specifically, the following points emerged during the four advisory committee meetings held during the year-long contract period:

- Information processing functions and dissemination functions should be performed by the same organization. This structure lends itself more easily to private operation.

- A central information collection point is needed that is "politically neutral." There have historically been problems with the kind of interagency cooperated that in necessary for a regional system.

- Public agencies lack the flexibility in employee work hours and hiring/firing policies needed to operate the center effectively.

- Concerns about accountability and accuracy should be addressed in a contractual agreement between a public agency and the private vendor.

Several companies should bid competitively for this contract. The contract will address issues of public accountability and accuracy of the traffic information disseminated. A detailed protocol for operations and reporting will be established.

It is recommended that the contract be funded by a mix of federal, state and other funds for an initial period of two years. It is anticipated that the contractor would be able to generate revenue from this service by making real-time traffic information available to other groups.

The vendor will not be able to charge any fee to public agencies, nor will the vendor be able to charge a fee to any agency which is itself a source for traffic information for the TVC. However, the vendor will be able to charge user fees to other organizations, such as large employers and major activity centers (e.g. Convention Center, Bush Gardens, Tampa Stadium, Florida ThunderDome, Tampa International Airport, the Pier area in downtown St. Petersburg and beach resort hotels.) It is unlikely that radio and television stations would be willing to pay for the service, considering that they have free access to traffic reports from Metro Traffic Control. MTC's revenue comes from advertisements which accompany each report.

<u>Coverage</u>

Based on the information available from the sources listed above, the TVC will receive traffic reports on the entire Interstate System and most major arterials. It is recommended that the boundaries of the TVC's designated area of coverage be Hillsborough and Pinellas counties. However, some interfacing on the Interstates will be required from Pasco and Manatee counties.

Hours of Operation

It is recommended that the TVC be fully operational weekdays during peak periods: 6:00 a.m. - 9:00 a.m. and 4:00 p.m. -7:00 p.m., and on weekends as necessitated by major special events. It is also recommended that the TVC receive traffic information 24-**hours** a day, seven days a week. Because data intake of the center would not be fully automated at first, continuous operation would require three eight-hour shifts, as discussed in the staffing section below. As the data collection and dissemination functions become more fully automated, the staff would be reassigned and the staffing level for the TVC reduced.

Staffing

The required staff for each of three eight-hour shifts will be comprised of:

- two traffic technicians, responsible for the overall operations of the TVC (one technician for the midnight to 8:00 a.m. shift) and

- one computer operator, responsible for ensuring that the system remains up-and-running.

The entire staff would report to a general manager and an assistant, who would be present at the TVC during regular work-hours (7:00 a.m. to 6:00 p.m.), but will have access to the TVC at all times. Along with the supervision of the staff, they would be responsible for the strategic planning and marketing of the TVC and its services, as would be the case with any private, profit-oriented organization. An administrative assistant, responsible for looking after the general administrative needs of the NC would also be available during regular working hours. It is further recommended that at least one member of the staff be a certified traffic engineer. The TVC would be directly accountable to the FDOT District Seven Office which will coordinate operations between the regional TVC and the various municipalities and set operational guidelines and protocol.

Space Requirements

Based on the recommended staff, the TVC will require 1,600 to 2,000 square feet, preferably 2,000 square feet to allow for archival storage of traffic data.

Physical Location

Four possible sites for the physical location of the TVC are recommended for consideration, as illustrated in Figure 14. A single location should be selected after further review and analysis.

- Downtown Tampa

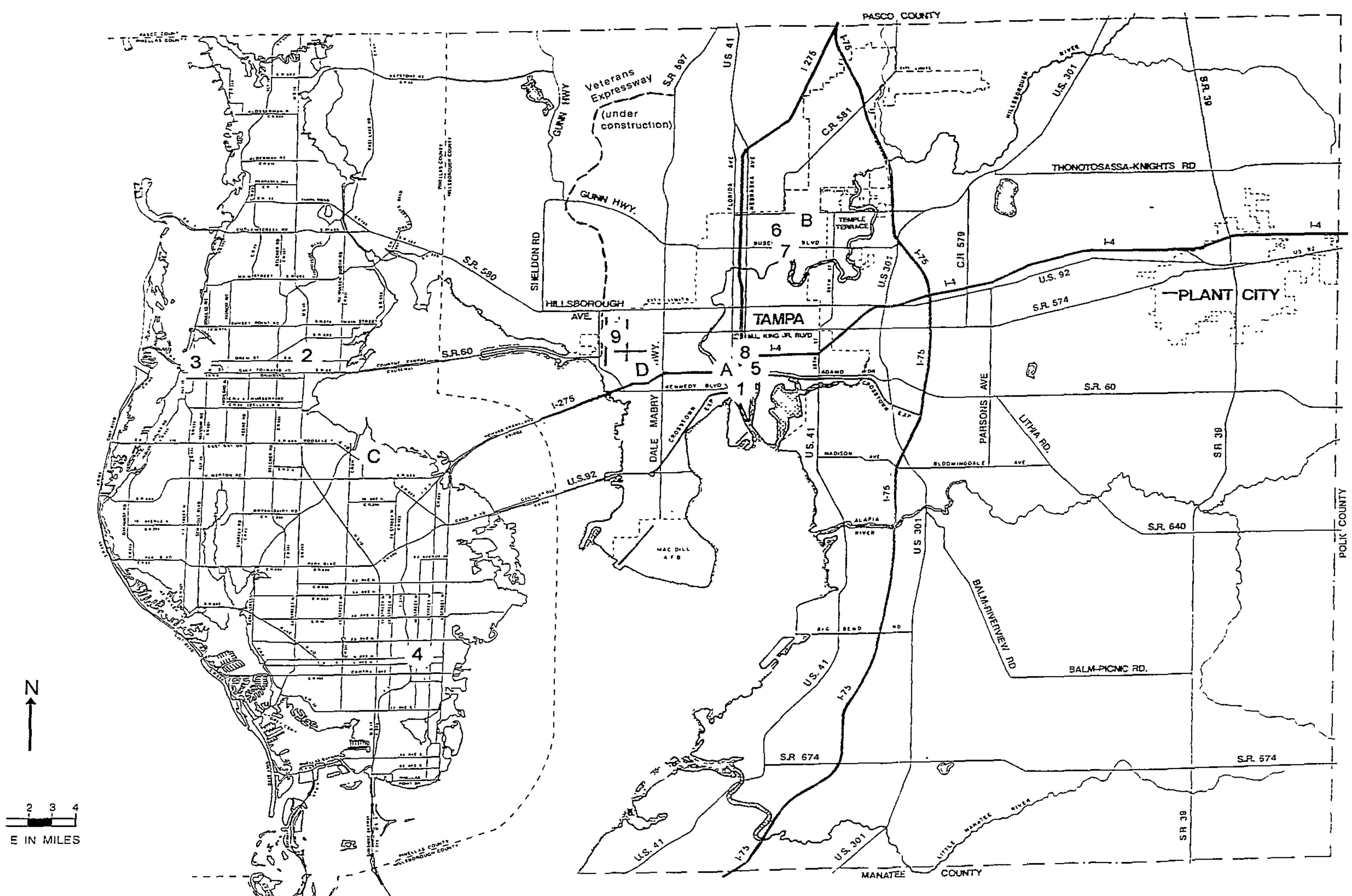
Because the City of Tampa comprises one of the largest single traffic generators on a regional scale, its seems appropriate that the TVC be located in downtown Tampa within centralized access to many of its contributing agencies and clients.

· Fowler/USF Area

Location in the East Fowler/USF area would enable the TVC to take advantage of the close proximity to Florida DOT District Seven Offices and the future Florida Highway Patrol Command Center. This location will also facilitate CUTR to use the TVC for experimental research and data analysis.

· St. Petersburg/Clearwater Airport

This location is central to the Tampa Bay metropolitan area and is in close proximity to the west entry point onto the Howard Frankland Bridge, as well as a close vantage point to several reoccurring congestion areas in Pinellas county.



Legend

Sources of Traffic Information
1. City of Tampa
2. Pinellas County
3. City of Clearwater
4. City of St. Petersburg
5. Hillsborough County
6. Florida DOT
7. Florida Highway Patrol
8. HARTline AVL Control Center
9. Metro Traffic Control
10. Bay Area Commuter Services

Recommended Location:
A. Downtown Tampa
B. Fowler/ USF Area
C. St. Petersburg/ Clearwater Airport
D. Westshore

Figure 14. Sources of Traffic Information and Recommended Locations for the TVC

· **Westshore Area**

This location is centrally located and in close proximity to the existing bay crossings, and also is located in the first priority reconstruction segment for the Tampa Interstate Master Plan. This location would enable the TVC to take advantage of the close proximity to Bay Area Commuter Services and Metro Traffic Control.

Hardware

The main criteria for determining hardware needs would be the amount of storage needed for the data generated by the system. Since the information being processed at the TVC would be summary information received from the local traffic control centers, required storage would not be of the magnitude of that of the local centers. It would appear that a system based on personal computers (PC) may be feasible. The TVC would be comprised of a series of work stations, one workstation per staff member on duty. The stations would be served through a local area network (IAN) system that transmits this information from the work stations to a common central processing unit (CPU).

In addition, the TVC will have the software and hardware capability to store and retrieve video surveillance data from the cameras operated by Hillsborough County and any newly installed cameras. This video data will be merged with other sources to simulate response to incidents to assist the Tampa Bay incident management team.

Software

An appropriate LAN operating system would be necessary. In addition the system would require software that provide the capabilities of generating summary maps of varying levels of geographic detail from the common, regional database of the minicomputer. MIST is one example of an appropriate software that may fit these requirements, although its summary reports are not the primary output of the system. In addition, MIST runs on a PC platform and may not be compatible with UTCS. Detailed research and analysis of the available options would be necessary.

Transmission Media

In an effort to keep project costs down, a narrow-band medium such as coaxial cable will be used as the transmission medium from traffic information sources to the TVC The transmission medium from the TVC to points of dissemination will depend on the form that information takes. Transmission of the color-coded video map will require a wide-band medium such as fiber-optic cable. Transmission of the regional database will require a narrow-band medium such as coaxial cable.

3. Information Dissemination

Cable TV Stations

The primary area cable television operators in the area - Jones, Paragon and Vision Cable -will have direct access to the TVC's color video map, pending negotiation with their corresponding municipal cable television offices. The video map can be broadcast on public access channels, so that it is offered at no additional cost to cable subscribers. Another option is to offer the service as part of a non-standard cable package, requiring additional subscription fees. If the service is offered on the public access channel, the TVC should pay for the installation of high-bandwidth transmission medium. If the service is a revenue generator, the cable companies should pay the cost of transmission.

Metro Traffic Control

Metro Traffic Control will continue to provide their “ value added” , professionally produced audio traffic reports to local radio and television stations for free, generating revenue through advertisements which accompany each traffic report, Radio and television stations will have indirect access to the TVC's traffic reports through Metro Traffic Control. Local radio and television stations will have the option of direct access to either the TVC's traffic report database or video map, however the stations must install a transmission medium to the TVC at their own expense. (This scenario assumes that MTC is not selected to operate the NC, although it is possible that they could be selected.)

Metro Traffic Control will have access to the TVC's traffic report database via coaxial cable. MTC may have access to the video map, but must install a wide bandwidth transmission medium at their own expense.

Bay Area Commuter Services

Bay Area Commuter Services will have access to the TVC's traffic report database via coaxial cable. Commuters can use BACS' toll free telephone number to access the traffic information by phone.

BACS has offered to play a major role in the information dissemination component of this system. In addition, BACS would be able to offer commute alternatives to the single occupant vehicle. Therefore, BACS has been selected as the primary source of traffic information via telephone.

GTE MobileNet

GTE MobileNet users have direct access to the TVC's traffic report database through the voice mailbox currently updated by Metro Traffic Control. This voice mailbox could be directly linked to the TVC's traffic report database, however, conversion of the TVC's database into a 60-second audio report would be at GTE Mobilenet's expense.

Variable Message Signs and Highway Advisory Radio

Florida DOT currently operates a highway advisory radio channel near the Tampa International Airport and variable message signs on the Sunshine Skyway Bridge. Renewed operation of FDOT's variable message signs on the Howard Frankland Bridge has also been proposed. Since Florida DOT is one of the TVC's sources of traffic information, it will have access to the TVC's database. Future variable message signs and HAR broadcasters should be controlled by FDOT, with input from the TVC.

Other Dissemination Methods

The TVC will offer access to its traffic information database to any public agency which installs new dissemination media so that these dissemination media would be broadcasting more comprehensive and accurate traffic information. However, it is likely that the public agencies will already have a data link to the TVC. For example, the Tampa Bay interstate Master Plan recommended that Florida DOT install 19 variable message signs and seven HAR broadcasters throughout the Tampa Interstate network.

B. Implementation Staging

The recommendations for implementation staging are intended to segregate the total TVC (Surveillance and Control System) into manageable, stand-alone projects. In the worst case scenario that funding was no longer available to implement the ultimate system, any phase that had been previously constructed could operate and serve a functional purpose. Therefore, the implementation stages outlined in Table 12 is comparable to the staged implementation recommended in the Tampa Interstate Master Plan for its SC&C system. Table 12 indicates the recommended general stages for TVC implementation and the approximate timeframe for completion.

Table 62. Proposed Implementation Stages for Tampa Bay TVC

PHASE	IMPLEMENTATION STAGES+	
Phase I	Stage 1 (up to 2 yrs*)	Select site, design and construct new building OR lease existing building for the TVC/SC&C
	Stage 2A (2-4 years')	Design and "linkage" of all existing city and county owned traffic control centers, and other existing traffic data collection sources, with the TVC/SC&C (including operational performance test and evaluation for entire in-place system)
	Stage 26 (13 years')	Design and "linkage" of the TVC/SC&C with public dissemination sources (including operational performance test and evaluation for entire in-place system)
Phase II	Stage 3 (1-3 years*)	Design and "linkage" of video-surveillance stations at most congested areas with TVC/SC&C (including operational performance test and evaluation for entire in-place system)
Phase III	Stage 4 (unknown)	Design and detailed comprehensive "linkage" with ordered priority segments of Tampa Interstate Master Plan (as defined by Technical report F6f - Freeway Traffic Management Plan), and comparable Pinellas county roadway network improvements (including operational performance test and evaluation for entire in-place system)
Phase IV	Stage 5 (1-2 years*)	Development of software for incident detection/response/management (including operational performance test and evaluation for entire in-place system)

. Duration timeframe, not year of implementation. + Stages can, and are intended to, overlap.

C. Cost Estimate

At this point in the conceptual design of the TVC/SC&C system only order-of-magnitude cost estimates can be made. Based on cost estimates contained in the Tampa Interstate Master Plan and other cost estimates contained in this report for component features, this cost estimate is intended to provide an average "generic" capital and operating cost estimate. A more detailed estimate can be determined only after future detail design is completed.

Table 13 indicates these average costs by implementation stage (defined previously in Table 12). In order to develop this order-of-magnitude estimate, direct comparison has been made to the cost estimates in the Tampa Interstate Master Plan (for general costs by extent of coverage area and/or components) and extrapolated, as necessary.

Table 13. Order-of-Magnitude Cost Estimate

CONSTRUCTION PHASE	IMPLEMENTATION STAGE	CAPITAL COST	ANNUAL OPERATING & MAINTENANCE COSTS
Phase I	1 2A 2B	$0* $5,000,000 $1,000,000	$400,000 $1,000,000 $200,000
Phase II	3	$350,000	$70,000
Phase III	4	$12,000,000+	$2,400,000+
Phase IV	5	$500,000	$100,000

* If new building is constructed, then capital costs would be approximately $850,000.

+ Included in cost estimates of proposed Tampa Interstate improvements.

VI. CONCLUSION

The objective of this report was to develop an early deployment plan (i.e. conceptual design) for an integrated transportation information system for the Tampa Bay area. This system was broken down and analyzed according to three basic system components: (1) information collection, (2) information dissemination, and (3) control centers. Through a consensus-building process of soliciting public involvement from focus groups and a technical project advisory committee, the consolidation of the most feasible system component features was obtained and a recommended system identified. Further, this recommended system has had the benefit of consideration of lessons learned from other similar transportation information centers, and assured compatibility with existing and planned traffic surveillance activities in the Tampa Bay area.

Given the recommended system definition, implementation staging and order-of-magnitude cost, the "next steps" to undertake have been outlined. In order to provide the highest probability of successful and timely deployment, all of the following thirteen tasks should be accomplished. In order of importance these deployment tasks are as follows:

1. Obtain formal commitment from "core group" to move forward with the project.

2. Identify a "champion" for the "cause." This could be a public agency, private company, or individual.

3. Identify and formalize cost-sharing partnership(s), including clear and mutually agreed upon roles and responsibilities of the partnership(s).

4. Create market incentives for private sector involvement.

5. Conduct detailed market area analysis regarding ultimate system features.

6. Refine protocol and operational features/components of the recommended system in preparation of an RFP package for bidders, and seek qualified bidders list from IVHS America and other sources.

7. Develop system architecture and performance specification suitable for solicitation of Request for Proposals (RFP).

8. Establish a detailed schedule commitment for staged system procurement and installation.

9. Refine first phase implementation staging that is both self-contained and suitable for stand-alone operational test and includes comprehensive evaluation.

10. Seek opportunities for vendors performing product demonstrations, at no cost to locals, that are compatible with recommended system component features.

11. Advertise for qualified bidders for first phase staging of overall system.

12. Develop specific measurable short-term and long-range performance objectives for the system.

13. Provide a continuing means of education and information sharing regarding project (i.e., marketing campaign) to both potential system providers and users.

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Appendix C
Focus Group Questionnaires

Commuter Focus Group Session

Introductory Questionnaire

Name: ______________________
Address:
- Home: ______________________
____
____
- Office: ______________________
____
____

(Where should check be mailed? ___ Home ___ Office.)

SS#: - -

1. Briefly outline the route you most often use to get to and from your place of work?
____
____
____

2. How often on average do you use this route?
_____ times per week

3. At what time do you normally leave home for work?
_____ a.m./p.m.

4. At what time do you normally leave your place of work to return home?
_____ a.m./p.m.

5. As a regular commuter how would you rate travel conditions in the Tampa Bay area during rush hours, i.e., 7:00 - 9:00 a.m. and 4:00 - 6:00 p.m.?
poor ---
fair —
good —
excellent —

6. How would you rate overall travel condition, in the Tampa Bay area?

poor ___
fair ___
good ___
excellent ___

7. Are there any alternative routes available to you in getting to and from work?

Yes ___ No ___

8. How willing would you be to switch to an alternative route if you were advised to do so by traffic authorities?

not willing ___
somewhat willing ___
very willing ___

Why?: ____

Business Organizations Focus Group Session

Introductory Questionnaire

Name: ______________________

Company Address: ______________________

____

____

Ph. No.: ( ) ________

Fax. No.:( ) ________

Home Address: ______________________

____

____

Ph. No.:( ) ________

(Where should check be mailed? ___ Home ___ Work.)

SS#: __ / __ / __

1. How important are traffic conditions in the Tampa Bay area to the performance of your organization or business?

2. How would you rate traffic conditions in the Tampa Bay area during rush hours, i.e., 7:00 - 9:00 a.m. and 4:00 - 6:00 p.m.?

poor ---
fair ---
good ---
excellent _

3. How would you rate traffic conditions overall, in the Tampa Bay area?

poor ---
fair —
good —
excellent _

4. How important is reliable traffic information in your line of business?

not important ---
slightly important ---
somewhat important —
very important ---

5. In your opinion, would your organization be willing to pay **for,** or subsidize the cost of obtaining reliable traffic information?

___ Yes ___ no

Why?____

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Appendix F
Glossary of Abbreviations

AN-ITS	Automated Network Travel Time System A Automatic Vehicle Location system manufactured by AWA Traffic Systems America.
ATIS	Advanced Traveler Information Systems The application of advanced technologies to improve information available to travelers. A subset of Intelligent Vehicle Highway Systems.
ATMS	Advanced Transportation Management Systems The application of advanced technologies to improve the management of urban traffic systems. A subset of Intelligent Vehicle Highway Systems.
ATSAC	Automated Traffic Surveillance and Control A traffic management center operated by the City of Los Angeles DOT in Los Angeles, California.
AVI	Automatic Vehicle Identification Wireless communications between a transponder mounted on a vehicle and a sensor located at the roadside. Uses include toll collection, traffic management and fleet management.
AVL	Automatic Vehicle Location The installation of devices on a fleet of vehicles (e.g. buses, trucks or taxis) to enable the fleet manager to determine the level of congestion in the road network. AVL is also used to enable the fleet function more efficiently by knowing the location of vehicles in real-time
BACS	Bay Area Commuter Services CoordinatesTransportation Demand Management activities for Hillsborough, Pinellas, Pasco and Hernando counties.
BBS	Bulletin Board System A database accessible to multiple users via computer, modem and phone lines.
CB	Citizen's Band Radio A band of radio frequency designated by the FCC for civilian use.
CHART	Chesapeake Highway Advisories Routing Traffic Provides traffic information to motorists travelling between the Baltimore-Washington metropolitan area and Maryland's Eastern Shore.

CMAQ	Congestion Management and Air Quality A federal program which funds air quality improvement projects.
CPU	Central Processing Unit The part of the computer or computer system which performs core processing functions.
CUTR	Center for Urban Transportation Research A transportation research center based at the University of South Florida; conducted this conceptual design study for Florida DOT.
DOT	Department of Transportation Either local or state transportation agency, e.g. Florida DOT, Los Angeles DOT.
FAST-TRAC	Faster and Safer Travel Through Traffic and Advanced Controls A traveler information and traffic management project in Oakland County, Michigan.
FCC	Federal Communications Commission The federal agency which regulates telecommunications in the United States.
FDOT	Florida Department of Transportation Funded 20% and served as project manager for this study.
FHP	Florida Highway Patrol
FHWA	Federal Highway Administration Funded 80% of this study; authorized by the ISTEA legislation to spend $660 million on IVHS projects from FY92 through FY97.
HAR	Highway Advisory Radio The transmission of localized traffic advisory messages using 520 AM and 1610 AM frequencies.
HARTline	Hillsborough Area Regional Transit The public transit provider for Hillsborough County.
HOV	High Occupancy Vehicle Any vehicle containing more than one person, such as buses, carpools, vanpools.

GPS	Global Positioning System A method of determining the position of vehicles using communication with a satellite.
ISTEA	Intermodal Surface Transportation Efficiency Act Passed in 1991, this legislation authorized national surface transportation funding for the next six years. The ISTEA legislation was unusual in the fact that it allowed transportation funds to be spent on uses not traditionally classified as transportation-related (such as Intelligent Vehicle Highway Systems.)
IVHS	Intelligent Vehicle Highway Systems The application of advanced technologies to improve the efficiency and safety of transportation systems.
LAN	Local Area Network A method of connecting several computers together using either high or low bandwidth communication media.
LPRS	License Plate Reading System A product manufactured by Computer Recognition Systems, Inc. which automatically reads the license plates of moving vehicles.
MBTA	Massachusetts Bay Transit Authority The public transit authority of the Boston metropolitan area.
MIST	Management Information System for Traffic A software package used from converting low-level traffic count data to high-level congestion reports; written by Farradyne Systems, Inc. and distributed by Traffic Control Technologies.
MTA	Metropolitan Transportation Authority The public transit authority of the Los Angeles metropolitan area.
MTC	Metro Traffic Control A private company which collects and disseminates traffic information through radio and television spot announcements
MTCS	Metropolitan Traffic Control System A software package used for controlling the timing of traffic signals in an urban road network; written and distributed by Computran Corporation; compatible with UTCS; extends the capabilities of UTCS.

NHS	National Highway Systems A federal program which funds transportation projects.
PC	Personal Computer
PCD	Personal Communication Device A small, portable device used for communications, such as pagers and cellular phones.
PVEA	Petroleum Violation Escrow Account A fund administered jointly by the state of California and the US. Department of Energy into which companies pay compensation for environmental pollution.
RFP	Request for Proposals
SC&C	Surveillance and Control System A traffic management system proposed in the Tampa Interstate Master Plan
SCS	Surveillance and Control System A software package which collects traffic information and manages traffic flow on the Howard Frankland Bridge.
STP	Surface Transportation Program A federal program which funds transportation projects
TDM	Transportation Demand Management An attempt to reduce demand for transportation through various means, such as encouraging the use of high occupancy vehicles, alternative work hours, telecommuting, improvement of jobs/housing balance.
TVC	Traffic Vision Center The integrated traffic management and traveller information system for the Tampa Bay metropolitan area proposed in this report.
UTCS	Urban Traffic Control System A software package used for controlling the timing of traffic signals in an urban road network; developed by the Federal Highway Administration and used by most local traffic engineering departments in the United States.
VMS	Variable Message Signs Highway signs which can change the message they display.

WAN Wide Area Network
A method of connecting several computers together using fiber-optic cable.

WCC Westchester Commuter Central
A traffic management center operated by Metro Traffic Control in Westchester County, New York.

Appendix G
Infrastructure Inventory Survey

	Hills. County Traffic Engineering	PSTA	Yellow Cab of Tampa	City of Tampa	Florida Higway Patrol	City of St. Petersburg
DATA COLLECTION						
1 Type of Information:						
Traffic Counts						
– Classified	X				X	
– Unclassified	X			X		X
Travel Conditions		X	X		X	
Truck Weight						
Other		Roadway Construction				
2 Number of Employees:						
Full–Time	7 to 8			3	70	4
Part–time						
Temporary						
3 Method of Collection:						
Loop Detectors						
–Temporary						
– Permanent	X			X		X
Sensors						
Weigh–In–Motion Sts.						
Aerial Surveillance				X	X	
Cameras	X				X	
Other		Radio Commun.	Radio	Permanent Trafffic	Broadcasts	12 Traffic Centers
4 No. of Data Coll. Stat.:	20 (68 Proposed)	2	1			Varies–Citywide
5 Frequency of Retrieval:						
Continuously		X	X	X	X	X (as needed)
Hourly						
Daily	X					X
Weekly						
Monthly						
On Request				X		X (traffic studies)
6 Purpose:						
Transportation Plng./Engr.	X		X	X	X	X
Enforcement				X	X	X
Traffic Control	X				X	X
Public Info.			X			X
Other		Fixed Route/ Sched. Bus/ Paratransit Svc. Del.				Neighborhood Partnership
TRAFFIC CONTROL						
7 No. of Signal Intersections	300 to 400			600		289
8 Percent of Network. . .						
Pretimed				20%		
Semi–actuated	25%			10%		
Actuated				20%		
Computer Controlled	75%			50%		100%
9 Proposed Intersections	50 to 100			75 to 100		4
10 Percent of Proposed. . .						
Pretimed						
Semi–actuated						
Actuated	25%					100%
Computer Controlled	75%					
DATA PROCESSING						
11 Method of Collection:						
Manually	X		X	X		X
Actual Observation	X		X	X	X	X
Remote Transmission	X		X			X
Other		2–Way Radio				
12 Method of Processing:						
Real Time	X	X	X		X	X
Batches	X (1/Day)			X (per request)		
13 Method of Presentation:						
Radio/TV			X		X	
Display Monitors	X		X			X
Periodic Reports	X			X		X
Other		2–Way Radio				
14 Future Projects:						
15 Comments:						

	Pinellas County Sheriff's Office	BACS	WUSA-FM	Federal Express	HARTline	City of Clearwater Transportation Div.
DATA COLLECTION						
1 Type of Information:						
Traffic Counts						
– Classified						X
– Unclassified						X
Travel Conditions			X	X		X
Truck Weight						
Other	Citations/ Patrols/Etc.				AVI	
2 Number of Employees:						
Full–Time	1		1		402	4
Part–time			1			
Temporary						
3 Method of Collection:						
Loop Detectors						
–Temporary						
– Permanent						X
Sensors						
Weigh–In–Motion Sts.						
Aerial Surveillance			X			
Cameras						X
Other	Citations Reports		Metro/ Road Asst.	Radio Courier	AVL/GFI	Portable Rubber Tubes
4 No. of Data Coll. Stat.:			3–Rotating	1	232	145 Intersections
5 Frequency of Retrieval:						
Continuously	X		X (6–9a;4–6p)	X	X	X
Hourly						
Daily					X	
Weekly						
Monthly						
On Request						X
6 Purpose:						
Transportation Plng./Engr.					X	X
Enforcement	X					
Traffic Control						X
Public Info.	X				X	
Other	Personnel Deployment			Expedite Delivery	Service Mgmt.	Concurrency Checks
TRAFFIC CONTROL						
7 No. of Signal Intersections						145
8 Percent of Network. . .						
Pretimed						
Semi–actuated						
Actuated						
Computer Controlled						95%
9 Proposed Intersections						4 TO 5
10 Percent of Proposed. . .						
Pretimed						
Semi–actuated						
Actuated						
Computer Controlled						100%
DATA PROCESSING						
11 Method of Collection:						
Manually					X	X
Actual Observation				X	X	
Remote Transmission			X		X	X
Other	Computer			Couriers Rept.		
12 Method of Processing:						
Real Time	X			X	X	X
Batches					X	
13 Method of Presentation:						
Radio/TV						
Display Monitors					X	X
Periodic Reports	X				X	X
Other				X		
14 Future Projects:						
15 Comments:						

	Clearwater. Police	FDOT	FHWA	Pinellas County	WFLA-TV	Metro Traffic Control	Hills. County Sheriff's Office
DATA COLLECTION							
Type of Information							
Traffic Counts							
- Classified		X		X			
- Unclassified		X		X			
Travel Conditions	X	X			X	X	
Truck Weight		X					
Other		Speed Occupancy			Radio/WFLA Metro	Accidents	Crash Statistics
2 Number of Employees							
Full-Time		100		8		15	3
Part-time					2		
Temporary							
3 Method of Collection:							
Loop Detectors							
-Temporary		X					
- Permanent		X		X			
Sensors		X					
Weigh-In-Motion Sts.		X					
Aerial Surveillance		X				X	
Cameras		X					
Other	Radio Reporting	Motorist Aid Call Box		Man. Cnts. Rood Tube	Phone/ Metro	Phone In/ Out	Data Entry From Crash Reports
4 No. of Data Coll. Stat.:		200		180	1	1	Countywide
5 Frequency of Retrieval:							
Continuously	X	X		X			
Hourly		X				X	
Daily							
Weekly							
Monthly		X					X
On Reqluest		X		X		X	X
6 Purpose:							
Transportation Plng./Engr.		X		X			X
Enforcement							X
Traffic Control	X	X		X			X
Public Info.		X			X	X	
Other							
TRAFFIC CONTROL							
7 No. of Signal Intersections		6000		270			
8 Percent of Network. . .							
Pretimed		10%					
Semi -actuated							
Actuated		10%					
Computer Controlled		60%		65%			
9 Proposed Intersections		300		10			
10 Percent of Proposed. . .							
Pretimed							
Semi-actuated							
Actuated		50%					
Computer Controlled		50%		100%			
DATA PROCESSING							
11 Method of Colllection							
Manually		X		X		X	
Actual Observation				X		X	
Remote Transmission		X		X	X		
Other							
12 Method of Processing:							
Real Time		X		X	X	X	
Batches		X (as needed)					
13 Method of Presentation:							
Radio/TV		X			X	X	
Display Monitors		X		X			
Periodic Reports		X		X			
Other							
14 Future Projects;				Expand			
15 Comments;					Interested		