Session Eleven
Closing Session: Looking to the Future
J. Robert Doughty, consultant — presiding

Transit and ITMS

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I appreciate the privilege of being invited to share some thoughts for the future at the conclusion of this symposium on a subject so close to my heart. I was here in May, as many of you were, for the second Annual Meeting of IVHS America. Perhaps you recall the remarks I made at that meeting on the paradigm shift the IVHS technologies are likely to cause.

I think the best explanation of this paradigm shift is provided in the strategic plan for IVHS in the United States: "IVHS is, in fact, a paradigm shift. The transportation/information infrastructure is a new way of looking at, thinking about, and improving mobility—a sociological as well as a technological revolution."

The best example I've heard for a paradigm shift occurred in the watch industry. The Swiss clearly never expected the microchip to make such a difference. It provided an alternative way to keep and display the time and provide other functions that many of us have found useful. The Swiss were too focused on their old way of doing business. It is important that we do not make the same mistake in traffic management as the use of IVHS technologies develop.

I believe IVHS technologies give us an exciting opportunity for responding in new and improved ways to the constraints now being placed on us. We no longer have the budget or the space to expand transportation facilities to meet growing travel needs. Public policy for energy conservation, clean air, and other societal concerns is forcing a new look at how we do things and the reason for doing them. As a result, new responses will be required.

My remarks today are focused on providing a few examples of how we as transportation professionals can work together to achieve effective new responses. The integration of vehicle management systems and traffic management systems provide rich opportunities to better serve the public in meeting their mobility needs. Perhaps we will come to view this as transportation system management.

As most of you know, the Federal Transit Administration (FTA) has developed an advanced public transportation systems (APTS) program as a component of the national IVHS initiative. The program is designed to assist operational tests and evaluations in the IVHS area. We have identified four important functions that cover our activities. These are vehicle management systems, electronic fare collection, enforcement, and user information.

Each function is highly dependent upon computers to collect, analyze, and interpret large amounts of data that feed into computations to optimize traffic flow and the movement of people. Indeed, the common thread connecting each of these functions is the computer. The computer permits the linking of each function to achieve results that are greater than the sum of their parts. When directed toward public transit operators and consumers, work in each functional area can directly benefit traffic engineers and planners. I first want to describe these areas of related technologies individually, and then discuss how they can work together in an integrated transportation management system.

Vehicle management systems (VMS) consist of several independent technologies that can be combined for general management and control of a large number of vehicles dispersed throughout a wide area. Included within the VMS area are several critical subsystems, including automatic vehicle location (AVL), computer-aided dispatch (CAD), sensor technology, and digital mapping.

Automatic vehicle location permits the tracking and effective command and control of a fleet of vehicles. Command and control is important for the management of fleets and the resulting efficiencies from such control. In transit applications, bus schedules and headways can be controlled to ensure on-time performance, paratransit vehicles can be routed to pick-up and destination points, and bus, paratransit, and rail services can be coordinated.

Transit security is improved as police cars can be dispatched to bus emergencies based on the actual bus location. Further, general public safety is improved as the most appropriate police vehicle can be assigned to a request for aid. Fire and emergency medical vehicles can be dispatched more efficiently and quickly. Indeed, some communities, like Dade County, Florida, are considering the comprehensive use of automatic vehicle location for all these services.

Computer-aided dispatch permits the effective management of a number of vehicles and assigns tasks to each vehicle. Taxi, para-transit, police, and trucking operations are a few examples of fleet operations that can benefit through this improved utilization of resources.

Sensor technologies are being developed that will identify individual and specific classes of vehicles, such as high-occupancy or emergency vehicles, so they can be granted access to reserved facilities. Vehicle identification opens the door to automatic traffic signal preemption for specific vehicles. These sensors will also feed information on traffic conditions to traffic management centers. Sensors on-board the transit vehicle can assist management in quickly learning of potential equipment problems and passenger loads. Signal preemption strategies may then be invoked based on the number of people being benefitted rather than the number of vehicles.

Digital maps provide the capability of storing geographic information on computers for vehicle and traffic management purposes. Because the maps are digitized, they can be easily updated and changed. Traffic engineers use digital maps to display road networks and traffic conditions. Transit and emergency service providers use digital maps to give visual representations to further aid the dispatch activities.

Electronic fare collection is another area that can benefit many user groups. Essentially, the intent is to develop and deploy cashless fare collection systems that will speed up transactions, reduce time lost due to cash handling, and improve cash security. Requiring exact change provides one more barrier to using transit.

There are several techniques that can be employed for electronic fare collection including magnetic stripe cards and Smart Cards. Magnetic stripes are used on credit cards and in a number of transit applications. While universally available today, they have several significant limitations. They are able to handle only a limited amount of information, are subject to tampering and, due to their magnetic properties, can be inadvertently erased.

Smart Cards are plastic cards with a microchip embedded within them. They can be designed to be read through a proximity interface, so they do not have to be inserted into a reader. This will speed up the flow of users, as the cards may be read from a distance of several feet. The speed of these transactions is critical for line-haul transit services. In a toll road situation, these cards could be attached to an automobile just as tags are today.

The widespread application of electronic fare collection will give transportation system managers the capability to price transportation services according to their use. For example, road pricing using this technology becomes a feasible method of allocating charges in line with particular policy objectives. Pricing peak hour and off-peak periods, as well as single-occupancy and high-occupancy vehicle usage, now becomes feasible as a meaningful policy tool to encourage, or discourage, certain uses.

Enforcement functions using IVHS technologies may assist local supervision of the proper use of HOV lanes. For example, using an enforcement system, authorities can determine whether specific automobiles are eligible to use certain facilities. Unauthorized vehicles can be identified, and, local laws permitting, a traffic citation automatically issued.

A number of sensor technologies are available or under development to help accomplish this. Visual surveillance cameras can be used to visually determine whether the vehicle is authorized to use a facility. Infrared sensors may count the number of occupants by their infrared heat image, and determine whether the vehicle is a legitimate user of the facility.

Electronic tags can be issued that identify pre-approved vehicles and authorize their use of certain facilities. These tags may be license plates with an electronic sensor embedded in them. These technologies could be used to verify a person's or vehicle's legitimate use of a facility and minimize enforcement manpower requirements.

These enforcement technologies also have the capability of being used for other traffic monitoring purposes. By knowing the identity of individual vehicles, their individual speed and location, and the traffic signal status, it may be possible to effectively enforce traffic regulations automatically. A vehicle's compliance with various traffic regulations could be automatically determined. If a violation occurs, an enforcement citation could be automatically prepared and sent to the violator.

For example, on the North Dallas Toll Road, license plate numbers of vehicles not paying the toll are captured on a video camera and $200 fines are levied. Why not record someone running a traffic signal, which has potentially more serious consequences? No doubt these approaches to monitoring traffic will raise public policy questions regarding privacy and civil liberties that must be resolved locally.

User information relating to travel needs is a function that helps users make effective mode choice decisions. It is assumed that many people now using single-occupant modes will consider other alternatives if presented with reliable, up-to-date information. This function seeks to develop improved methods of presenting this information to users. Three important technologies are changeable message signs, video displays, and personal communication networks.

Changeable message signs present travelers with relevant messages on road and travel conditions so the they can be apprised of changing situations and take appropriate action. They are placed along highways, or—in the case of transit—on the vehicles or at heavy boarding points.

In-home or office displays present information relating to planned travel prior to departure. Using interactive television or computers, the traveler will be able to call up information regarding his or her transportation alternatives. Transit schedules, dynamic carpool information, road conditions, and transportation alternatives are some of the information that can be presented to consumers to guide intelligent choices among transportation alternatives.

If this information is presented properly, the consumer hopefully will see the advantages of high-occupancy transportation and select an HOV mode. Another important technological development unfolding in urban areas is the personal communication network (PCN). These networks are made up of small cells that allow widespread use of wireless telephones.

The system is similar to cellular telephone systems in the U.S., except it uses much smaller cells. In fact, one vehicle location supplier proposes to use these smaller cells to locate vehicles within 50 feet. Perhaps this will be a "person" location system, as it will locate a person using a wireless telephone even as he walks down a sidewalk. Closely coupled with the deployment of PCN is the development of palm-size telephones and computers. Prices of these devices will certainly drop just as they have for other electronic products.

Now I would like to discuss the opportunities for an integrated approach to ITMS. Thus far, I have described the individual functional areas and related technologies. However, these individual functions can be integrated into a system to aid transportation operations and planning. By combining data from several of these functions, powerful transportation system management tools are created. Equipping transit and other public service vehicles with AVL will empower them to act as probes to help monitor traffic.

Occupancy data for HOVs may even be used for warrants guiding traffic signal timing decisions. Traffic conditions can also be transmitted to buses, carpools, and vanpools so alternative routes can be selected. My concern is that these routes be protected from diversions by SOVs. If an accident or some other event occurs that causes traffic to completely stop, the probes will quickly identify the situation and add first-hand observations to guide responses.

The same equipment that converts a transit bus into a traffic probe will also permit the transit dispatcher to effectively manage the bus fleet. The AVL system will identify the location of a vehicle to a central computer, which can compare the actual location of a bus to its scheduled location. Through an in-vehicle display, the driver can be advised of various corrective actions to get back on schedule. Clearly, it will be helpful if the timing of traffic signals can be adjusted to assist the vehicle in getting back on schedule. This electronically collected data can also be used for schedule planning purposes, at cost levels significantly less than manual data collection.

The same computer-aided dispatch technology that performs taxicab assignments will also assign the optimum police car or ambulance to an emergency request. These technologies can also be directed toward increasing the use of carpools, vanpools, and other high-occupancy vehicles. One interesting possibility is the development of systems to assist dynamic carpooling. Data bases are being developed through projects in the APTS program to link drivers of single-occupant automobiles and people desiring a ride to a common destination in real-time.

Also, cellular telephones are helping to coordinate "connections" between people waiting at fringe parking with vanpools on a nearby freeway. The availability of HOV lanes give drivers further incentives to share trips with those desiring rides.

Information about each carpool formed will aid traffic engineers since they will know the origin, destination, and number of people in each vehicle. This can be used to fine-tune computerized traffic control systems to optimize the flow of people through the metropolitan area. The green time at traffic signals can be extended where appropriate to permit additional high-occupancy vehicles through an intersection.

Personal communication networks (PCNs) will permit people to maintain contact with data banks providing transit schedules and transit options. These close links between people and information will permit even greater possibilities for the development of shared rides.

Further, these networks, which are presently based on cellular technology, can also be adapted to palm-sized telephones and computers. In the future, it can be envisioned that people with small wireless telephones will be able to call for transit information from any location, even walking along the sidewalk. Directions for walking to the closest transit stop may be given or a bus diverted to pick the person up.

Think of the many opportunities to keep people advised of changing travel conditions through the use of this technology. Using a paging system, people could be buzzed when their bus is a few minutes away. We might even buzz them when an incident occurs and when it has cleared.

I have presented a brief vision of how a number of new IVHS technologies can impact our world as transportation management professionals. These new technologies are linked together—and with users—through information systems that permit people to make good decisions based on real-time information.

We are in the information age. The trend toward even greater information interchange is accelerating. As electronic and communication devices become smaller, less expensive, and more reliable, people will avail themselves of the great benefits these devices provide.

Information interchange is becoming easier and quicker. Access to more information that is relevant to people's daily lives will permit them to make better decisions. Our challenge is to design a system that is consistent with developing public policies on clean air and energy.

Yes, there is a paradigm shift underway. As we look to the future, there is indeed a new way of looking at, thinking about, and improving mobility.

Congestion Management Systems: Requirements and Opportunities

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I would like to take a slightly broader perspective and focus my comments on how all the different elements and systems can be coordinated into an overall congestion management system. I want to talk specifically about the congestion management system required in the ISTEA. When the Symposium Planning Committee met for the last time this past January, we thought the symposium would provide a great opportunity to discuss the requirements, issues, and opportunities of the congestion management system contained in the ISTEA. Unfortunately, the regulatory process has not been completed and the requirements have not been issued yet.

Although there are no requirements at this point, there are a number of issues and opportunities that can be discussed. I think the fact that we have a policy legislated by Congress on an issue most transportation professionals felt needed to be addressed presents us with the