Michigan Department of Transportation

Line of Business Strategy for Vehicle-Infrastructure Integration

Part IV: History and Background

Vision of
Partnership and
National Leadership

Final Report

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Title

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Vehicle-Infrastructure Integration
Line of Business Strategy for
Vehicle Infrastructure Integration

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Abstract

The purpose of the Michigan Department of Transportation's (MDOT) VII Strategic and Business Plan is to capture the vision, mission, needs, goals and activities that will guide a coordinated, efficient, safe, and integrated vehicle-infrastructure system throughout the state, and initiate steps toward establishing the required public and private sector partnerships to ensure leadership, innovation, and progress across the State of Michigan. This document provides the background and history for the preparation of the plan.

The VII Strategic and Business Plan was organized and developed by MDOT with support from the Michigan State Police, the Michigan Economic Development Corporation, Michigan Department of Information Technology, the Road Commission of Macomb County, and the Road Commission for Oakland County.

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INTRODUCTION

The future of wireless roads and connected cars is being written here in Michigan. Innovation in mobile communications is linking our cars and highways and helping make our lives easier and our driving safer. In the future, cars will communicate with traffic signals and make intersections safer. Cars will also communicate with other cars and warn drivers of unsafe conditions. Traffic managers will receive wireless messages from moving cars and trucks (serving as traffic probes) that will detect traffic problems, like traffic jams and potholes, as they emerge.

Communication technologies are now more versatile and cost-effective than at any time in the past enabling the design of new digital highways that will help us enjoy greater freedom, mobility and safety. The same wireless communication technologies also offer more cost-effective ways to manage traffic and road transportation assets. The future of integrated vehicle-highway systems gives Michigan an opportunity to take the lead in supporting a new high growth industry leveraging existing automotive design resources. This report describes Michigan's plans to capitalize on this opportunity by partnering with other stakeholders and laying the infrastructure foundation for Vehicle-Infrastructure Integration (VII).

Safety is one of the greatest concerns of motorists, and for good reason. In the United States, road transportation poses a greater risk to life and health than gun violence or common diseases like flu and pneumonia. In fact, over 2.6 million rear-end, run-off-the-road, and lane-change accidents occur every year in the United States. The USDOT has estimated that active safety systems and similar countermeasures could prevent nearly half of those crashes and save thousands of lives. Information systems will play a critical role in improving safety by making it possible to warn drivers of dangerous situations like approaching emergency vehicles, dangerous curves, icy road conditions and hazardous intersections as well as in helping traffic agencies and emergency services respond more quickly to life threatening situations.

Modern mobility that was made possible by completion of the US national highway system is now threatened by congestion due to trends in urban sprawl and Americans' mobile lifestyles. Motorists want to get to their destinations quickly and without any delays, shifting the focus of road transportation services from supporting basic travel to promoting more efficient transportation. Information systems can help by detecting incidents more quickly and informing drivers of impending delay or alternate routing. An informed driver can make better travel decisions to avoid the frustrations of traffic tie-ups. In addition, the information can help the road authority respond better to the problems that are causing the delays.

Freedom is made possible by an ever-increasing number of communications technologies and services that are imbedded in objects we use everyday, including our vehicles. Mobile connectivity is now feasible and is becoming more common in varied situations. From cell phones to high-speed wireless technology, the U.S. is quickly turning into a connected mobile population. Furthermore, most of the motor vehicles produced today have sensors that collect a wide array of information on vehicle condition and performance. Combine wireless

communication with performance data and accurate global positioning systems, and a whole host of new services are made possible.

The time has come for state and federal transportation departments to cooperate with automotive manufacturers and suppliers to test the value of nationwide deployment of wireless vehicle-to-vehicle and vehicle-to-roadside communications that will increase motorist freedom, mobility and safety and enable a host of new services and commercial benefits.

When will all of this happen? It is happening now.

- Public and private partners are developing "digital cities" and municipalities around the nation. Wireless Washtenaw and Oakland Counties here in Michigan are just two examples.
- Private services, such as OnStar, are deployed more broadly and are becoming more safety-focused by incorporating crash detection sensors.
- A national working group of representatives from the state transportation agencies, the automotive industry and the USDOT are investigating services and exploring strategies for deploying Dedicated Short Range Communications and other pipelines that will enable wireless vehicle communications.
- MDOT, in partnership with the automotive and telecommunications industries, is investing in testing and deploying new technology through the Vehicle-Infrastructure Integration (VII) test bed. VII will facilitate the design of prototypes and the testing of new products. The State's investment will leverage Michigan's base of automotive intelligence and help to build a nascent industry and create new jobs.

A number of system design challenges must be addressed to make this a success. A crucial issue is how to assure the privacy of people who use the system. The system will never be accepted by the public unless civil liberties are adequately guaranteed. The national working group is addressing this up-front and designing a system architecture that assures the individual's right to privacy.

One of the most frequently discussed premises promoting cooperation between the automotive companies and public agencies on VII can be summarized as:

- Automotive companies getting safer cars and transmission of vehicle data at low cost by providing vehicle sensor data for public applications, and
- Public agencies getting safer roads, improved traffic management, and a new source of planning data by providing the right-of-way for roadside communication transceivers.

Cooperation is necessary to deal with the core dilemma inherent in setting up a wireless transportation network: wireless roads require the auto industry to design and sell vehicles to travel on them, and wireless vehicles require a national public telecommunications infrastructure. So, which will come first: the vehicles or the infrastructure? This is the classic "chicken or the

egg" question. In this instance, a partnership between the public and private sector stakeholders is a fundamental building block to success.

Michigan is committed to providing the infrastructure and collaborating with the automotive companies, the telecommunications companies, the consumer electronics companies, the service providers, the systems and software development companies, local public agencies, the USDOT, and whoever else offers value and assistance to make this partnership work.

Michigan is a particularly desirable site for a VII Test Bed. A Michigan test bed will attract the attention of the automotive industry executives who make the decision on full deployment. A "litmus test" of a test site is to ask what will happen if a national program for VII fails to take hold. Will the deployment have value even if there is not a national program? This would appear to be the case in Michigan. Even if there is never any agreement to proceed nationally with VII, the automotive companies may find that regional wireless deployment will help with their local leased vehicle remote diagnostic and warrantee analysis needs. That is, the automotive companies may still use the deployed infrastructure for their own internal monitoring and evaluation. Moreover, even if there is never an agreement to proceed nationally with VII, local and state government fleets (including construction, EMS, snow removal, police, etc.) may benefit from a regional roadside "digital highway" deployment.

The purpose of the Michigan Department of Transportation's (MDOT) VII Strategic and Business Plan is to capture the vision, mission, needs, goals and activities that will guide a coordinated, efficient, safe, and integrated vehicle-infrastructure system throughout the state, and initiate steps toward establishing the required public and private sector partnerships to ensure leadership, innovation, and progress across the State of Michigan.

The VII Strategic and Business Plan was organized and developed by MDOT with support from the Michigan State Police, the Michigan Economic Development Corporation, Michigan Department of Information Technology, the Road Commission for Macomb County, and the Road Commission for Oakland County.

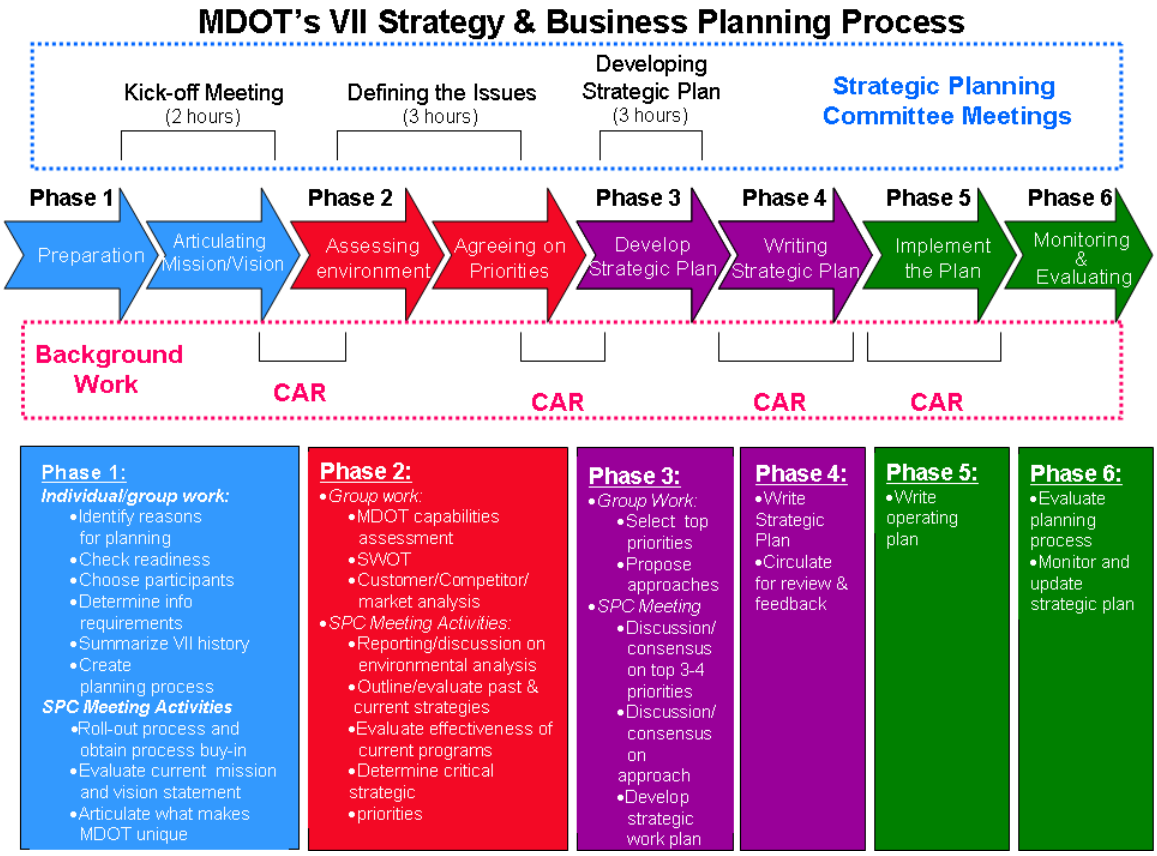
Figure 1 describes the Center for Automotive Research (CAR) project to develop and write the business plan. MDOT led the VII strategic and business planning process through six planning phases. Phase one involved general preparation and organization. The overall purpose was: to make sure that MDOT was ready and that the appropriate resources and the right people were committed, and to create momentum to get a successful process started. This phase involved creating the steps for the process, getting the participants involved and preparing an organizational profile on how we got to the point where we needed a VII plan, In the kickoff meeting, the planning group reviewed the history of the VII efforts and articulated a draft mission.

Phase two involved defining the strategic and business planning issues and included assessing MDOT's current VII position, gaining a better understanding of the business landscape in which

MDOT operates and where VII will unfold, identifying strategic opportunities for VII in Michigan, and listing strategic initiatives to address the opportunities. The second meeting had participants contribute to an environmental scan of VII and an internal analysis, including strengths, weaknesses, opportunities, resources, and core competencies.

Phases three and four involved crafting the plan and included selecting MDOT's top VII priorities and considering how resources would be allocated toward those activities. The planning team also created the first draft of the action plan. Phase five involved writing and editing the plan. Phase six involved monitoring success in carrying out the strategies.

Figure 1: MDOT's VII Strategy and Business Planning Process



MDOT's mission is to provide the highest quality integrated transportation services for economic benefit and improved quality of life. With regard to technology, the MDOT Intelligent Transportation Systems (ITS) mission is to develop and sustain a program at MDOT to improve transportation systems safety and operational performance using existing and innovative Intelligent Transportation Systems technologies. The vision is MDOT as a public leader and a supporting partner in the research, deployment, operation, and maintenance of ITS. Part of this vision is for MDOT to be recognized nationally for Vehicle Infrastructure Integration (VII) research and deployment. The VII Strategic and Business Plan presents the strategy and activities for accomplishing this objective.

VEHICLE INFRASTRUCTURE INTEGRATION

Vehicle Infrastructure Integration (VII) can be described as a systems approach to road transportation that relies on wireless communication technology to communicate between vehicles and between vehicles and the roadside. The VII National Working Group prepared a national VII architecture and vision that elaborates on the systems perspective. VII can also be described as a set of use cases that utilize wireless communication technologies to increase safety and mobility and provide other wireless services to drivers and organizations interested in vehicle and road transportation network information. Finally, VII represents a set of key public and private sector initiatives and programs that address the development of these wireless communications systems in North America. The following sections present each of these perspectives to help the reader get a sense of how VII may be defined and addressed in MDOT's strategy for public leadership in VII.

USDOT Vehicle-Infrastructure Integration (VII) Initiative

Vehicle-Infrastructure Integration is also the name of a new Intelligent Transportation System (ITS) program initiative for the United States Department of Transportation (USDOT). The Michigan Department of Transportation has been an instrumental participant in the USDOT's VII activities since their inception. VII is one of nine new ITS initiatives aimed at improving transportation safety, relieving congestion, and enhancing productivity. VII is viewed as providing the enabling infrastructure for vehicle-to-vehicle and vehicle-to-infrastructure communications as well as for the benefits the system offers to the traveling public and the opportunities for improved agency operations. The goal of the USDOT VII initiative is "to achieve nationwide deployment of a communications infrastructure on the roadways and in all production vehicles and to enable a number of key safety and operational services that would take advantage of this capability." (USDOT, 2004)

According to the USDOT, the VII initiative "builds on the availability of advanced vehicle safety systems developed under the IVI and the availability of radio spectrum at 5.9GHZ recently approved by the FCC for Dedicated Short Range Communications. The VII would enable deployment of advanced vehicle-vehicle and vehicle-infrastructure communications that could keep vehicles from leaving the road and enhance their safe movement through intersections. (USDOT, 2004)

The VII initiative "builds on the research and operational tests conducted under the Department's Intelligent Vehicle Initiative. Vehicle manufacturers would install the technology in all new vehicles (beginning at a particular model year) to achieve the safety and mobility benefits. At the same time, the federal/state/local transportation agencies would facilitate installation of the roadside communications infrastructure. Vehicles would serve as data collectors, transmitting traffic and road condition information from every major road within the transportation network. Access to this information would allow transportation agencies to implement active strategies to relieve congestion. In addition to these direct benefits to the traveling public and the operators of

the transportation network, the automotive companies view VII as an opportunity to develop new businesses to serve their customers. To determine the feasibility and an implementation strategy, a three-party consortium has been formed consisting of the seven vehicle manufacturers involved in the IVI, AASHTO, ten State Departments of Transportation and the USDOT." (USDOT, 2004).

The 2006 goal for the VII program is to accelerate availability of vehicle-to-vehicle and vehicle-to-infrastructure communications by facilitating nationwide deployment of a communications infrastructure on the roadways and in all production vehicles through public private partnerships. The USDOT has already developed aVII architecture, identified initial applications, started the development process, started the VII design contracts for the network infrastructure with the VII Consortium for the vehicle and Booz Allen Hamilton, and initiated the investigation of privacy principles. The plans for 2006 include: completing the DSRC standard and prototype testing, starting system integration testing, defining the operational test approach, finalizing privacy principles, and developing the initial benefits and cost estimates.

National VII Architecture

The National VII Working Group formulated the vision of a cooperative venture among state and federal transportation departments and vehicle manufacturers and suppliers to implement a nationwide VII deployment for the enhancement of safety, traffic management, and driver convenience. The actual deployment would include support for wireless communication between the vehicle and infrastructure. The initial concept involves an evaluation of the Dedicated Short Range Communication (DSRC) wireless communications standard along with alternative communications pipelines for sustainable growth and expansion of the system. DSRC is a general purpose radio frequency communications link using the Federal Communications Commission (FCC) allocated 75 MHz of spectrum at 5.850 to 5.925 GHz, above the UNII band, for a wireless link to transfer data and information between vehicles and the roadside. The communications portion of the architecture will be linked with vehicle location technologies and other vehicle data applications as well as remote data processing and analysis for both public and private products and services.

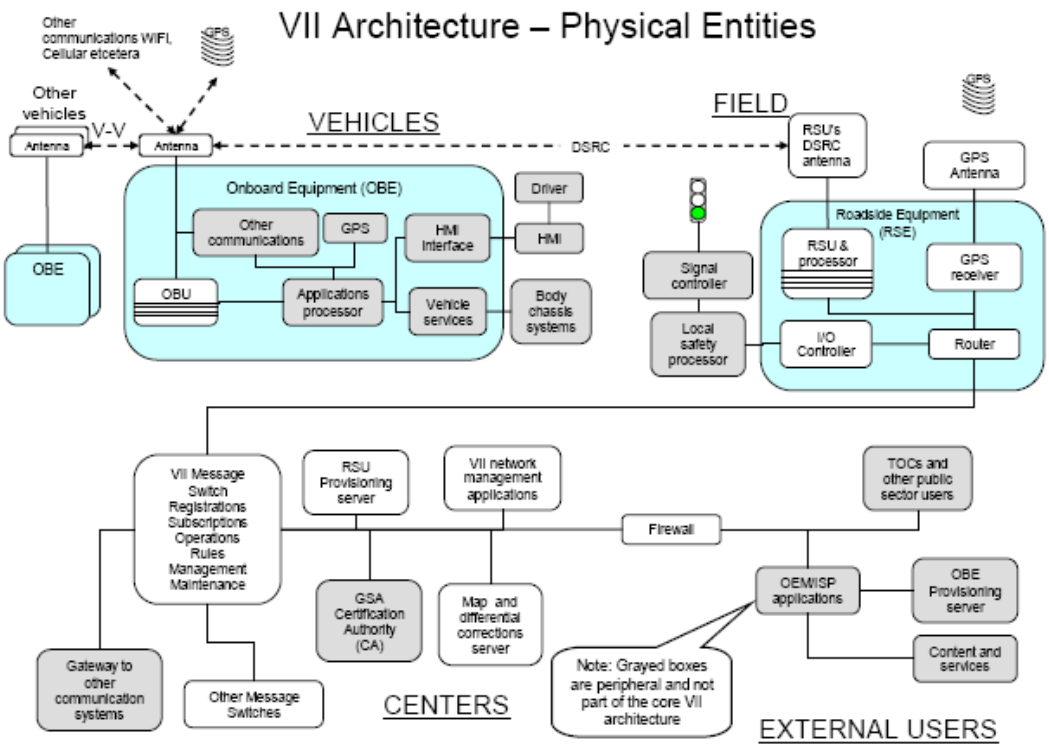
The national vision calls for the deployment of DSRC transceivers along the highway infrastructure and DSRC wireless networking interface cards in the vehicles. There has been some discussion about installing DSRC roadside units at every signalized intersection in the United States in addition to other units strategically placed throughout the Interstate system. The current architecture calls for something short of a million communication "hotspots" for DSRC on the nation's transportation infrastructure. In all likelihood, the interface cards would support DSRC and other Wi-Fi communication standards in the vehicles. The vehicle would transmit data through the DSRC roadside unit through a switch that would relay the message to private services or to a public data cache. Public agencies would then use the anonymous data in the public data cache to analyze traffic and respond to incidents. The system design would assure the privacy of contributors. Again, safety applications would have the highest priority. (For an

overview of DSRC, Wi-Fi, and other wireless communications technologies please refer to Appendix B.)

The architecture, a framework for information flow to the various system users, can be described as network-centric: its main function, like the Internet, is to provide a connection between a user and the data source with a minimum of interference. The On-Board Equipment (OBE) communicates with other OBE and with Roadside Equipment (RSE). The RSE sends its data to a VII Message Switch to support end user applications. Only a small fraction of the sensor data within the vehicle is transmitted to the RSUs (Roadside Units) to support VII applications. The data needed to support the local applications is communicated and processed at the intersection RSE to ensure immediate response (i.e., low latency).

The architecture is illustrated in Figure 2 below and can be referenced by the VII Architecture Framework document (v1.1) available through the National VII Coalition website: (http://www.vehicleinfrastructure.org).

Figure 2: Vehicle Infrastructure Integration Architecture

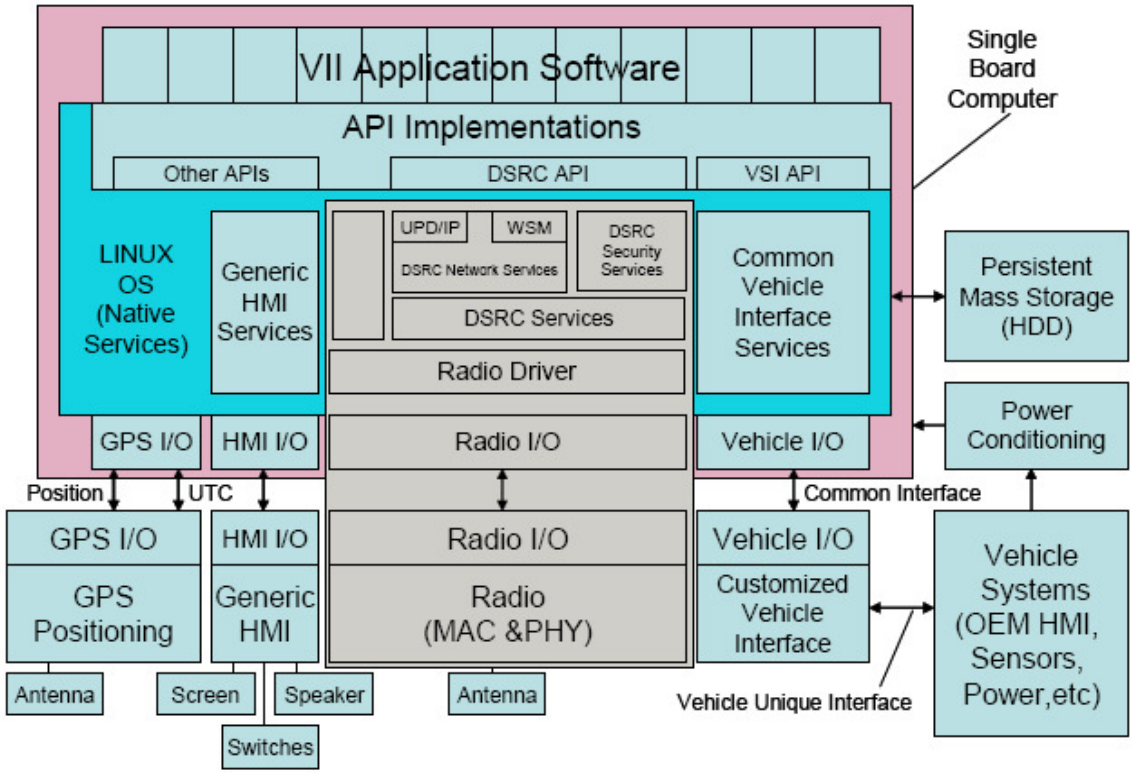


Source: USDOT (2005)

The following software architecture, illustrated in Figure 3, has been proposed by the Vehicle Infrastructure Integration Consortium (VIIC) and includes OSGi software provisioning

capability, JAVA Virtual Machine with standard API I/F, and open software architecture. It accommodates a JINI interface for native "C" code applications and supports integrated wireless capability (Wi-Fi, DSRC, cellular), Ethernet and USB 2.0 connectivity, automotive I/O and vehicle CAN network, and a GPS receiver.

Figure 3: VII Software Architecture



Source: VIIC (2005)

Michigan's Systems Perspective

VII takes a comprehensive systems perspective on road transportation and views the roadway infrastructure and the vehicles traveling along the roadway together as a single integrated transportation system supporting improved mobility and safety. The transportation professionals working in this new area take a systems approach to transportation that typically involves using wireless communication technology to enhance and exploit linkages between the motor vehicles and the roadway infrastructure. More specifically, VII generally refers to real-time wireless communication among vehicles as well as communication between vehicles and roadside "hot spots", linking transportation agencies and commercial service providers and providing a wide range of enhanced safety, mobility and convenience services. This new transportation systems perspective paves the way to new solutions for chronic transportation problems like traffic accidents, and the associated traffic delays, by enabling new traffic management, driver warning, and vehicle control capabilities previously unknown. It also represents a significant step in the emergence of the North American automotive industry and transportation agencies into the world of wireless communication..

Vehicles can be designed to download and transmit data from traffic signals, upcoming intersections, roadside warning signs, construction zones, weather alerts, detours, and school zones, providing the driver with assistance in responding to conditions and events. Equipment along the roadside can be designed to sense the presence of a vehicle and warn drivers to approach and act in ways that improve their safety and the flow of traffic. Cars with sensors and transmitters can perform as information probes and collectively communicate information on traffic patterns and road conditions so that other drivers can adapt immediately to incidents and congestion. All vehicles will know where they are using a Global Positioning System (GPS) and they will communicate their locations and other vehicle performance data to the infrastructure where it is aggregated and analyzed. In turn, the appropriate information service providers will respond to emerging situations and send messages and data to help customers and to help manage traffic.

VII has the potential to offer a myriad of other important services to a wide range of customers. Transportation agencies are likely to provide better highway planning and operations by using traffic probes to monitor traffic conditions, monitor weather conditions, assess pavement conditions, and analyze traffic patterns between selected trip origins and destinations. Automobile companies will be able to remotely diagnose problems within the vehicle, alert drivers to potential trouble and update maintenance schedules. Drivers will also benefit from warnings about unsafe and/or slow traffic situations and suggestions for alternative routes. The same technology would also provide drivers with access to travel information, vehicle operator information, and entertainment downloads in a variety of media formats. Additionally, VII offers potential relief from the expense of installing in-pavement traffic detectors and variable message signs. The ability to use the vehicles for real-time mapping could greatly improve the accuracy of maps.

The essential elements of vehicle-infrastructure integration are: (1) equipping vehicles to communicate with the infrastructure and (2) deploying telecommunications infrastructure to allow service providers to transmit messages to individual vehicles and to communicate with individual drivers. Most vehicles that are manufactured today have the ability to determine their location, speed, direction of travel, travel time by road segment, and road conditions. VII would take this a step further and allow this vehicle data to be transmitted to service providers to compose a real-time view of traffic throughout the highway and surface street network.

Figure 4: Integrated Systems View of Road Transportation

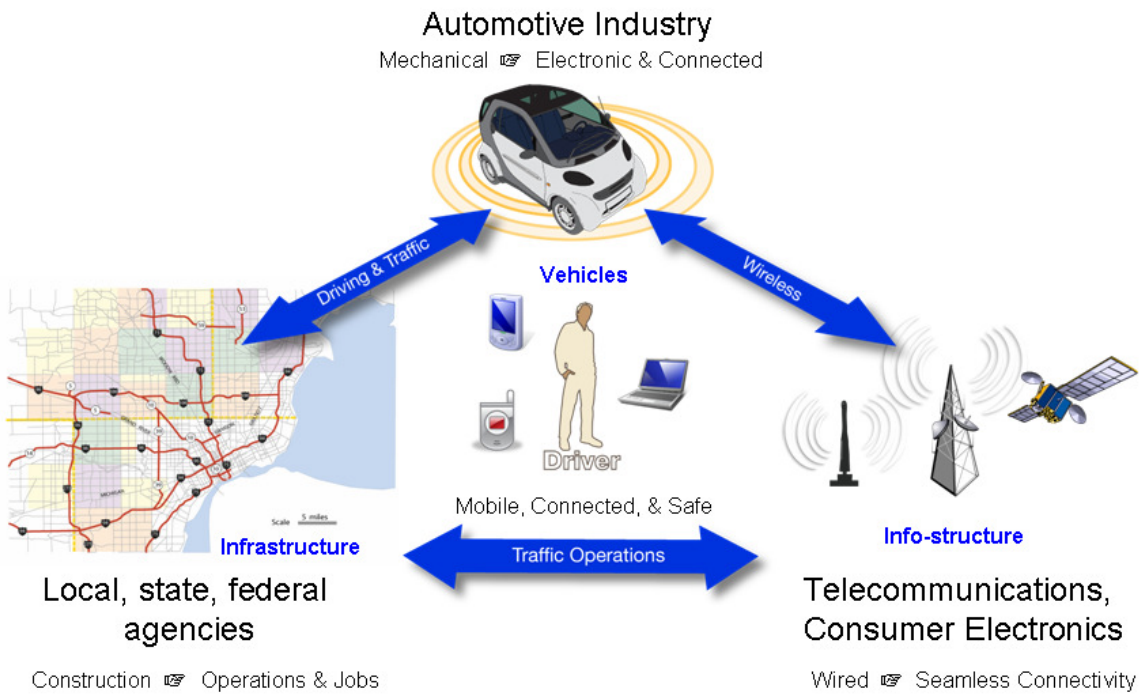


Figure 4 depicts a systems outlook of vehicle-infrastructure integration. It presents a complete systems view of road transportation focusing on safety and mobility from the perspective of system users, including drivers and passengers.

A complete systems perspective also addresses the integration of the basic components: vehicles, infrastructure, and infostructure. Driving behavior and traffic fall at the interface between vehicles and infrastructure. For example, safety and mobility can be improved by taking vehicle dynamics and driver behavior into account when designing highways. Or, crash avoidance technologies can help drivers by taking into account both the vehicle dynamics and the design and condition of the roadway infrastructure.

Improvements in safety and mobility can also surface by improving the way that traffic information is managed at the interface between the roadway infrastructure and the telecommunications infostructure. For example, information about traffic problems can be

transmitted to the traffic control center and elicit an immediate and appropriate response based on the type and severity of the incident.

Telematics falls at the interface between the vehicles and the infostructure. Services like remote diagnostics and route guidance can help drivers get to their destinations faster, while using less fuel and having fewer problems.

Some more innovative services emerge when all three components, vehicles, infrastructure, and infostructure, are brought together and viewed as a single system. Imagine that some or all of the vehicles on the roadway can communicate their location, speed, and other conditions sensed by the vehicle back to a centralized service provider. Each vehicle with this capability can essentially serve as a real-time probe for traffic, weather, and road conditions along the path it is traveling. Now, imagine that the service provider is collecting this type of information from a reasonable sample of vehicles throughout the entire road network and is able to describe all current traffic conditions, including emerging traffic incidents as they occur.

MICHIGAN'S VEHICLE INFRASTRUCTURE INTEGRATION

Vehicle Infrastructure Integration offers an incredible opportunity for the automotive manufacturers, automotive suppliers, consumer electronics companies, telecommunications suppliers, and public agencies to cooperate on new vehicle communication products and services that will improve safety and mobility and that are ripe for commercialization. It is also clear that effective design and deployment of VII systems will require a high level of collaboration among public and private sector leaders. Michigan is an excellent site for this collaborative effort.

Michigan faces substantial economic challenges as plant closings and worker downsizing become more prevalent due to significant shifts in the traditional operations of the auto industry. If the State's automotive OEMs do not address the need to drastically cut costs in every aspect of their business, including R&D and personnel, they will languish in the face of global competition. Yet, there has never been a time in which technological development and skilled workers are more essential to this major industrial sector, and thus to the state's economy. Irrespective of these challenges, the industry and the state are better positioned to emerge as major global forces in the automotive industry. With leadership, the potential for collaboration focused on both innovation and investment in the workforce provides significant long term answers for this changing industrial sector.

Michigan is committed to supporting the development of advanced automotive technologies and transportation job growth. According to Transportation Secretary Mineta, "transportation is the engine that fuels our economy." One out of every ten jobs in the United States depends upon new automobile production and sales. Every $1 billion in highway construction creates 47,500 jobs. Furthermore, over three percent of the gross domestic product in the United States is based on new light vehicle sales.

Governor Granholm opened her 2006 State-of-the-State Address with the statement "Michigan ***will*** attract and keep good jobs." Automotive and transportation-related jobs are central to Michigan's 21st Century Jobs Fund where the state intends to invest in new high-tech companies and jobs that will diversify the Michigan economy. The intent is to "capitalize on the best research and commercialization opportunities in the life sciences, homeland security/defense, alternative energy, and advanced automotive, manufacturing, and materials fields to foster a robust, entrepreneurial private sector, thereby advancing technology and promoting collaborative partnerships which enhance job growth and diversify Michigan's economy."

Michigan recognizes the immense potential for VII to capitalize on Michigan's automotive design resources and to lay the foundation for a growing new industry that provides communications products and service to the traveling public. The telecommunications industry is changing rapidly and mobile technologies are becoming an integrated part of daily life for automotive consumers. Furthermore, competition is growing in the area of telematics and related mobile connectivity products, and customers are going to demand competitive products from Michigan automotive companies.

Vehicle safety is a shared priority for the automotive industry and the State of Michigan. In the United States, over 42,000 lives have been lost in traffic crashes at a cost of $230 billion. The American Association of State Highway Transportation Officials (AASHTO) has a goal of reducing national highway crash rates to 1.0 fatality per 100 million vehicle miles traveled. The automotive industry has identified safety as a critical differentiator in the sale of new vehicles to prospective buyers. In his speech on his "Way Forward" Plan, Bill Ford stated that innovation will be the compass by which Ford Motor Company will set its direction going forward, with a special focus on safety, technology and design innovation. This is a point of common interest in the automotive community; it is no surprise that the national VII program has a safety focus.

The State of Michigan's strategy for the VII program is internally inclusive and benefits from the contributions of the Michigan Department of Transportation (MDOT), the Department of Labor and Economic Growth (DLEG), the Michigan Economic Development Corporation (MEDC), and the Michigan State Police (MSP), to mention a few of the lead organizations. MDOT is very well suited to build, operate and maintain roads. MEDC and D-LEG are adept at supporting the development of companies in Michigan. The MSP are providing input on safety and security concerns. The VII program requires partnerships with the automakers, communications providers and technology experts to be successful, and Michigan has embraced that concept.

The importance of this strategy in moving the national program forward has been confirmed in a study being performed by the Center for Automotive Research (CAR), sponsored by MDOT and Florida DOT (CAR, 2005). This study, although not yet complete, involves interviewing industry experts and decision makers. Preliminary results document that the strategy of including partners with diverse backgrounds and using multiple technologies is moving the industry in the right direction. Michigan ultimately has the potential to become the center, or hub, of the VII industry when a full national and international deployment is rolled out over the next 10 years.

MDOT has moved ahead by taking action and creating a number of informal partnerships around activities that will support a sustained deployment of VII in Michigan. So far Michigan has:

- Held coordination meetings with the Original Equipment Manufacturers (OEMs). These meetings have resulted in the only plan for VII development efforts that has the support of General Motors, Chrysler and Ford.
- Witnessed and supported the creation of the Connected Vehicle Trade Association (CVTA), a Michigan-based group dedicated to the promotion and development of VII.
- Worked with Motorola on their deployment of a test facility (at their corporate offices in Farmington Hills). This facility is being used to support the Michigan VII program as well as the OEMs.
- Hosted the American Association of State Highway Transportation Officials (AASHTO) VII Executive Leadership Team (ELT) in Dearborn in March. The meeting was attended by Governor Granholm, demonstrating the State's commitment to the national and local VII development efforts.

- Announced the investment of over $7 million in VII infrastructure deployment and application development, aimed at providing a permanent test bed infrastructure in Southeast Michigan that will promote investment by the private sector in the research, testing and development of VII-type programs.
- Partnered with Chrysler and the Road Commission for Oakland County, to deploy VII-type infrastructure around the Chrysler Technology Center in Auburn Hills, using technology developed by a Grand Haven-based Business, AzulStar.
- Supported a southeast Michigan-based business, MTS Technologies, in their development of in-car technologies and central data processing capabilities being used by Chrysler to improve the quality of their production automobiles and reduce the impact of recalls.
- Worked with companies such as Navteq and Intel to develop future technologies and applications that combine in-vehicle systems with roadside systems and the associated central infrastructure to improve safety and mobility on our roadways, thus improving productivity for all Michigan residents.

Michigan has also taken a proactive role contributing to the Vehicle Infrastructure Integration Consortium (VIIC) national VII design efforts. VII systems on the USDOT drawing board are technically sophisticated and highly integrated, requiring extensive coordination among all parties to be successful.

Michigan's Vehicle-Infrastructure Test Bed

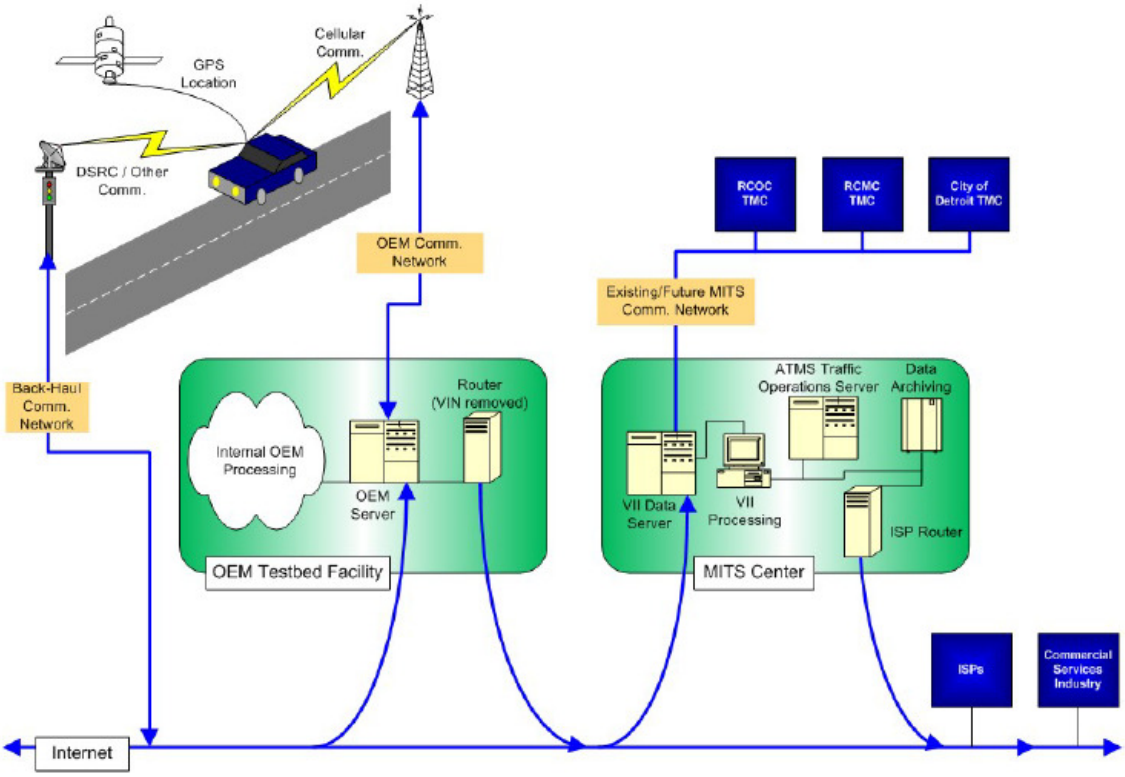
MDOT has taken the lead in developing a concept of operations for VII test bed activities. Michigan's VII Test Bed Program provides a real-world laboratory to test a range of products and technologies and foster the development of new technologies and applications. The intent is to provide a scalable system that adopts national standards and can be scaled up geographically from small to large numbers of locations. The entire effort is coordinated with the USDOT's VII architecture design and the automotive industry Vehicle-Infrastructure Integration Consortium (VII-C) effort's to develop and test various technologies and deployment scenarios.

At this time, the private sector facilities include installations at Ford Motor Company (Dearborn), Chrysler (Auburn Hills), Nissan Motors North America (Farmington Hills), Collision Avoidance Metrics Partnership (CAMP) (Farmington Hills), Motorola (Farmington Hills), General Motors (Detroit), and the University of Michigan Transportation Research Institute (UMTRI) (Ann Arbor). Other partners include RCOC, RCMC, OttawaWireless, SBC, and others.

Testing will include evaluation of the subsystems, applications and proving the concept of VII in a real-world testing environment. It will also support the testing of products and technologies related to vehicle sensors and data collection, vehicle-to-roadside communication of data, data archiving, vehicle data reception, and backhaul to remote sites. The system will be set up to support the evaluation of alternative technologies for roadside to vehicle communications.

Further into the future, the test bed will provide an environment to evaluate full- use cases for VII that require either advanced technologies or a higher level of saturation of VII-enabled vehicles in the vehicle fleet. One of the Michigan advantages is the number of fleet vehicles that the OEMs can modify for testing purposes. Leased vehicles also provide high visibility for private-sector partners. Fleets from public agencies are likely to be used to test public applications. Figure 5 depicts an example VII test-bed and its component functions.

Figure 5: VII Test Bed



Michigan's Automotive Industry

Both the safety products that require connection to the public infrastructure and mobile consumer electronic projects will require careful design and testing for effectiveness, usability, and appropriate new business models that deliver safe, profitable, and sustainable services. Michigan's advantage is based on the predominance of automotive research and engineering in the area. Michigan is the birthplace of the automotive industry and continues to be a center of automotive industry intelligence. Automotive companies with a major presence in Michigan include General Motors, Ford, Chrysler, Toyota, Honda, Nissan, Mitsubishi, Delphi, Visteon and Denso (among others). Even more have a major R&D presence (MEDC, 2005).

Michigan employs one out of every four automotive workers in the United States and is home to more than 186,000 skilled trades workers. No other state can offer the concentration of

automotive engineers familiar with the requirements of in-vehicle safety and communications systems. No other state can offer the concentration of OEMs and suppliers that will take responsibility for setting standards, designing, and deploying these systems. Michigan is the North American hub of the automotive industry.

The automotive industry is one of the largest industries in the United States. It creates 6.6 million direct and spin-off jobs and produces $243 billion in payroll compensation, or 5.6% of private sector compensation. For every worker directly employed by an automaker, nearly seven spin-off jobs are created. (Alliance of Automobile Manufacturers)

The automotive industry worldwide spends over one trillion dollars every year on goods and services in the automotive supply chain. Even though GM, Ford, and Chrysler spend over $200 billion of this amount, there are enough players in the game (including OEMs and suppliers) to assure that fierce competition is the norm, and that this competition extends well beyond the major vehicle makers. Telematics is likely to become a competitive differentiator of automobiles and will increasingly help sell cars to safety-conscious and connectivity-oriented car buyers.

Furthermore, the electronic content of the automobile is expected to grow to between 35 and 40 percent of a car's cost by 2010. Entertainment systems and navigation aids continue to grow in popularity as suppliers explore how to incorporate systems without distracting drivers. Sensor and electronic controls are regulating mechanical systems such as transmissions, engines, and stability. Instrument panel displays are growing more sophisticated. An electronic throttle control regulates the throttle based on the pressure the driver puts on the gas pedal. Some are considering a master control module to coordinate all systems.

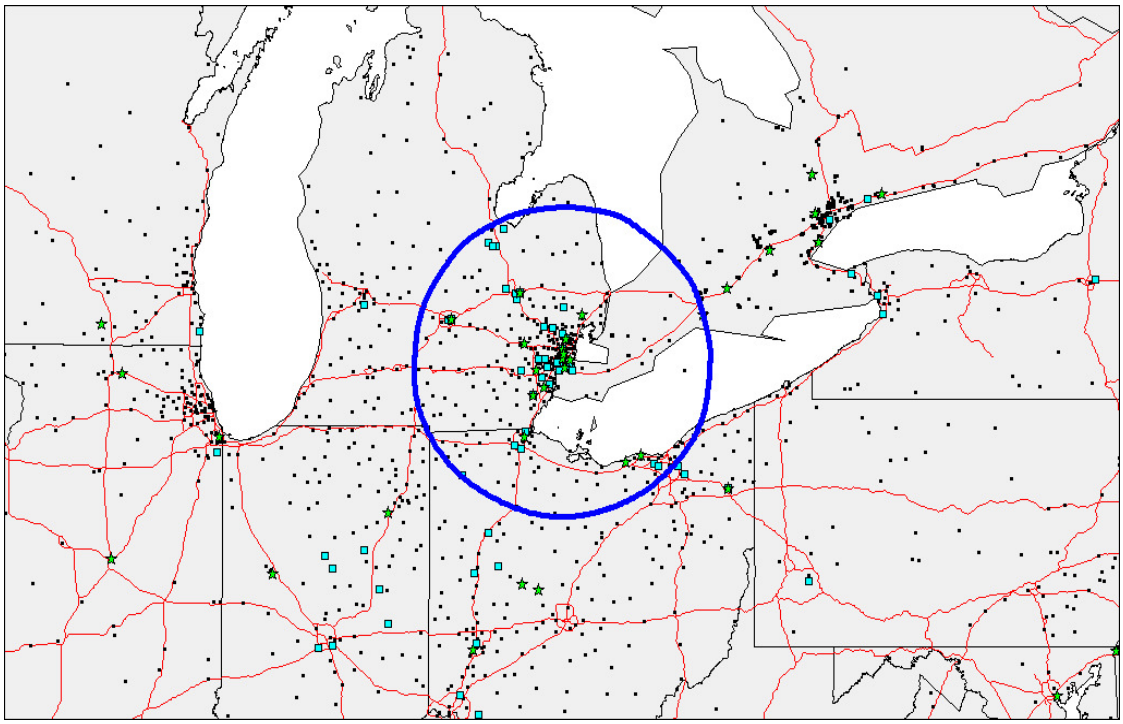
According to noted auto industry analyst David Cole: "The business model that defined the auto industry for the past half century is broken and there is a clear understanding that the industry as a whole must restructure in order to remain competitive." Given the complexity of cars today involving the sophisticated integration of numerous subsystems, it may be more appropriate to view competition in the automotive industry as being between the supply chains rather than between the OEMs. In fact, the configuration and management of the supply chains determine many of the crucial consumer choice factors including cost, build quality, and delivery lead times. Some of the chief factors at play in shaping the automotive industry are: (1) shifting automotive design responsibilities from the OEMs to the tier one suppliers, (2) increasing purchases of subsystems like engines and gearboxes rather than components, (3) sharing electronic design and manufacturing information between OEMs and suppliers, (4) increasing reliance on just-in-time delivery schedules, (5) managing to minimize inventories, and (6) continuing emphasis on cost reduction.

An important consequence of supply chain competition is the continuing withdrawal of the OEMs from self-supply. The divestiture of Delphi and Visteon are evidence of this trend. The automotive manufacturers seem to be retrenching in vehicle design, assembly, and market research, while more of the detailed engineering is becoming the responsibility of the Tier 1

suppliers. Suppliers, on the other hand, are expanding their resources through he acquisition and cooperation of other suppliers. Figure 6 illustrates Michigan's higher density of automotive industries as compared to other areas in the United States. It is critical to understand the transition that the automotive industry is making toward the integration of automotive electronics in the vehicles:

- Total U.S. employment in automotive electronic equipment was 80,200 in 2005.
- Electronics content is going to quadruple in the next five years.
- Electronics and software will represent 80–90% of vehicle innovations through 2010.
- The marginal increase in employment could be in the tens of thousands in the United States.
- OEMs will transition to systems integration and assembly of electronic and communication components.

Figure 6: Michigan Is the North American Hub of the Automotive Industry
Dots and stars represent automotive facilities, with larger dots showing assembly plants and stars depicting headquarters.



Automotive Engineering and R&D

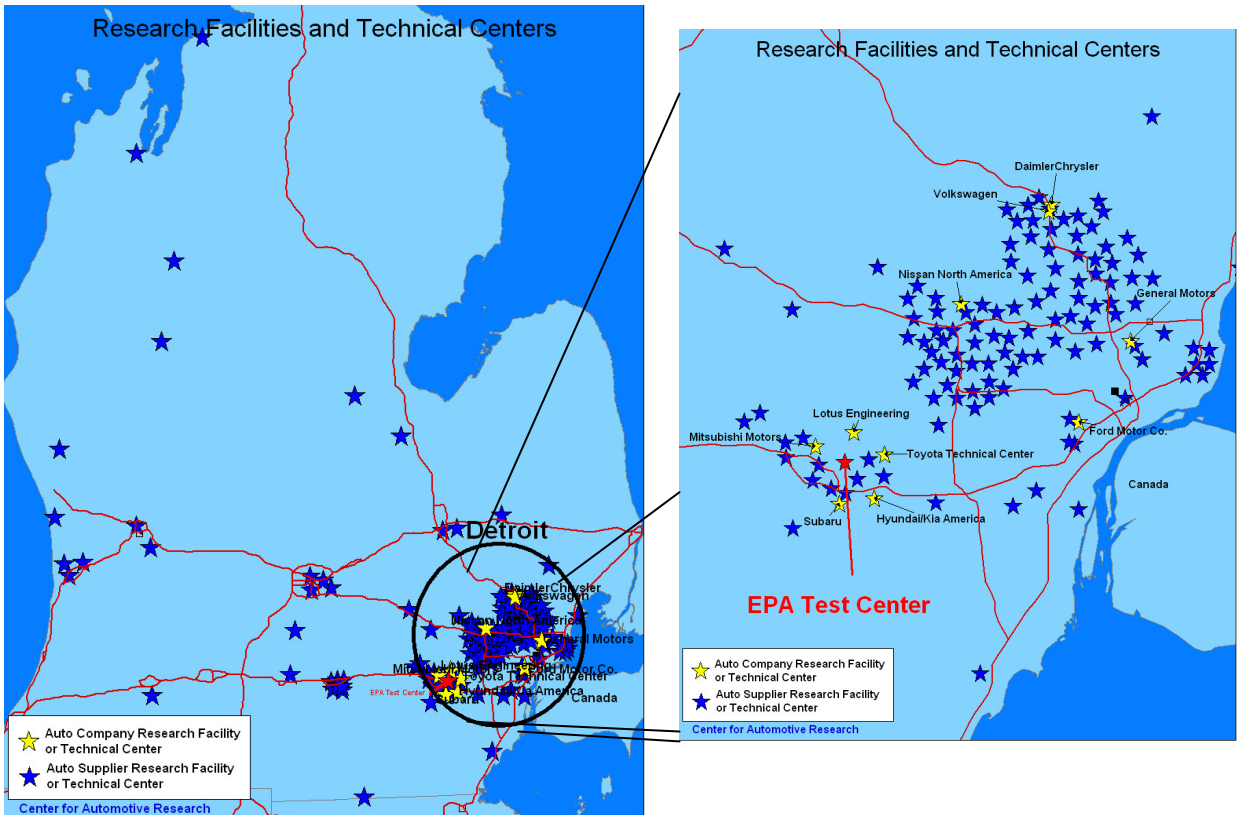
The State of Michigan is uniquely poised to form the first innovation-oriented state-industry partnership to support VII. Michigan has been the home of the Chrysler Group's Technology Center, the Ford Scientific Research Labs, and General Motors R&D Center since their inceptions. The additions of the Toyota R&D Center, Nissan Design Center, and the Hyundai

R&D Center demonstrate an evolving automotive R&D innovation cluster that is supported by the multitude of resources within Michigan. The challenge for growth is that strategic mechanisms are lacking to foster synergies between all of these R&D centers and direct state and federal resources to meet collectively determined OEM needs.

Further, the UAW Joint Centers with Chrysler, Ford and General Motors are also headquartered within the state. These joint programs provide a significant amount of training for the existing automotive workforce which could be critical to these economic development innovation initiatives.

Detroit's SAE chapter has 14,000 members, which is 16 percent of SAE's worldwide membership. Sixty percent of the top 150 automotive suppliers to North America are headquartered in Michigan. Furthermore, Michigan is home to more than 215 automotive R&D companies. These include engineering centers, applied and basic research centers, and testing centers. Figure 7 shows that most of these are clustered in southeast Michigan. Michigan is the leading state for vehicle-related R&D activity, with $10.3 billion in annual expenditures. These model research centers are more readily developed in Michigan due to the high automotive presence. In addition to the major corporations listed above, Michigan is also home to hundreds of other automotive research organizations.

Figure 7: Michigan Research and Technical Facilities



International automotive companies are bringing their R&D facilities to Michigan. In the spring of 2006, Toyota broke ground for its new research and development facility located in Washtenaw County. According to Dennis Cuneo, former Senior Vice President for Toyota Motor Company of North America, "If you want to expand your technical research, you have to be in Michigan because that's where most of the engineers are

Simultaneously, the state and its Michigan-based automotive OEMs are uniquely positioned to enter into new and emerging models of innovation that will revolutionize the industry. Examples of these new innovation models include:

- The Chrysler/Mitsubishi/Hyundai joint engine development program (Global Engine Manufacturing Alliance)
- The General Motors/Chrysler/BMW hybrid powertrain development program
- The Ford/General Motors 6-speed transmission program
- The Chrysler/VW announcement that the Chrysler Group will engineer and produce minivans for VW

These joint programs result in significantly reduced costs as well as expedite the introduction of new technologies. While these examples are meritorious, the challenge is that no strategic mechanism exists to further encourage the development of new business models within the state's auto OEM community.

These are proven innovations based on collaboration; new automotive business models are distinguished by the following characteristics:

- They are business-need based.
- They are agile and flexible.
- They are designed to remove non-differentiating costs while developing new technologies that drive innovation into the vehicle.
- They are close to production.
- They are driven by new and emerging leaders in Detroit.

The Vehicle-Infrastructure Initiative will benefit from the lessons learned from these ongoing innovation efforts and could serve as the initial focus for planning and review of a partnership between Michigan, the Michigan OEMs and other key members of the automotive industry. One of the potential benefits of this partnership is the draw of federal funds to Michigan in support of a VII field operational test.

Automotive Consortia

One of the byproducts of Michigan's automotive engineering leadership and the concentration of automotive R&D resources in Michigan is a corollary concentration of advanced automotive consortia and innovative R&D relationships. Michigan is home to the Alliance of Automobile

Manufacturers (the "Alliance"), a trade association formed in 1999 to serve as a lead advocacy group for the automobile industry on a range of public policy issues with a special commitment to improving the environment and motor vehicle safety. The Alliance is open to all car and light truck manufacturers and has the direct participation of nine of these manufacturers (the BMW Group, Chrysler, Ford Motor Company, General Motors, Mazda, Mitsubishi Motors, Porsche, Toyota, and Volkswagen). Alliance members account for more than 90 percent of vehicle sales in the United States. Through the Alliance, the automotive companies speak with one voice to the public, government, and other interested parties to address shared goals.

Michigan is also home to the United States Council for Automotive Research (USCAR). While Chrysler, Ford, and General Motors are fierce competitors in the marketplace, they formed USCAR in 1992 to provide an appropriate venue to work together on shared pre-competitive technological and environmental concerns. The goal of this industry association is to further strengthen the technological base of the domestic automotive industry by leveraging the research efforts of the companies in non-competitive areas.

The Crash Avoidance Metric Partnership is also headquartered in Michigan. An important element in the IVI program is a cooperative research agreement between FHWA and the Crash Avoidance Metrics Partnership (CAMP). CAMP is a research partnership between Ford and GM that creates a consortium with other car manufacturers and their first-tier suppliers for crash avoidance research. There are currently four projects being performed by CAMP: Enhanced Digital Maps for Safety, Driver Workload Metrics, Forward Crash Warning, and Vehicle Safety Communications. The CAMP offices are located in Farmington Hills, Michigan; this proximity suggests that by locating portions of the test bed near CAMP in Oakland County, some of CAMP's IVI research needs could be addressed. This year, CAMP will be advancing the deployment of intersection collision avoidance systems at the most hazardous signalized intersections by developing and testing an intersection violation warning system. They are cooperating with MDOT to create a test facility to help conduct research on gap assistance, signal and stop sign violation with associated cost-benefit analysis and independent evaluation. (For additional detail on CAMP and its activities, see Appendix B.)

The IVBSS program has awarded a $25 million contract to the University of Michigan Transportation Research Institute (UMTRI). Visteon, Eaton, AssistWare Technology, Honda R&D Americas, Battelle and MDOT are partnering with UMTRI. This consortium will develop and test a new, integrated crash warning system in a fleet of 16 passenger cars and 10 heavy-duty trucks. UMTRI will serve as the primary contractor, coordinating the work of the partnership and conducting the field experiments. The partners will contribute an additional $6.6 million.

The involvement of the University of Michigan and CAMP also offers an opportunity to test the Cooperative Intersection Collision Avoidance Systems (CICAS) developments that are advancing the state-of-the-art for Vehicle Infrastructure Integration. There are even more opportunities for involvement in the Vehicle Infrastructure Integration for Mobility programs that emphasize adaptive traffic control, among other applications.

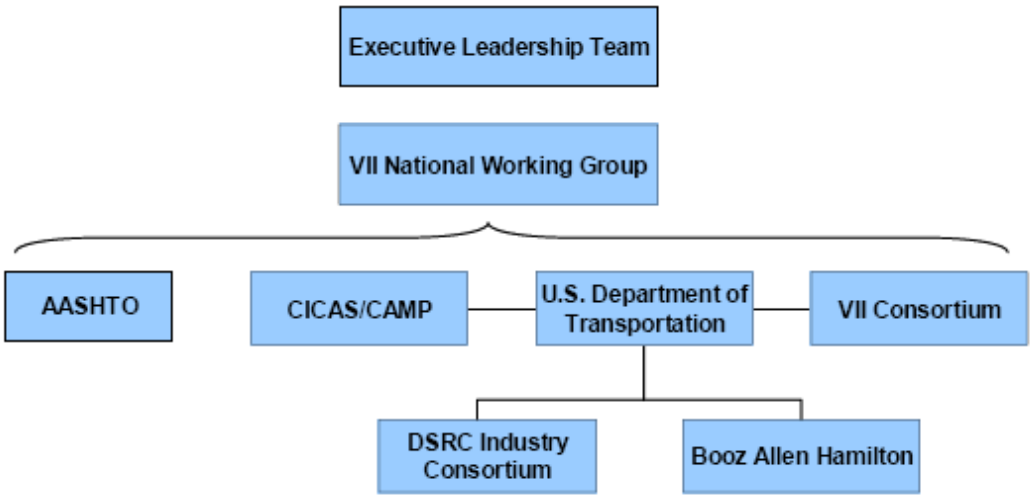
Other Michigan consortia and related organized advanced technology efforts include the Automotive Multimedia Interface Collaboration (AMI-C), University of Michigan Transportation Research Institute (UMTRI), Intelligent Transportation Systems Society of Michigan (ITSmi), Commercial Vehicle Trade Association (CVTA), Center for Automotive Research (CAR), Dedicated Short Range Communication (DSRC) Industry Consortium, Michigan Small Tech Association (MISTA), NextEnergy, SmartZones and Technology Accelerators, Technology Tri-Corridor, US Army Tank-Automotive and Armaments Command (TACOM), U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), and the National Automotive Center (NAC).

VII Consortium

The VII Consortium offices are located in Michigan; the membership directorate is composed mostly of automotive industry representatives with offices in Michigan. The Vehicle Infrastructure Integration Consortium (VIIC) was formed in early 2005 by a group of light-duty vehicle manufacturers to actively engage in the design, testing and evaluation of a deployable VII system for the U.S. To accomplish this evaluation, the VIIC is working under a cooperative agreement with the U.S. Department of Transportation (USDOT). All partners and contractors are coordinating their evaluation activities with the National VII Coalition, which is ultimately tasked with deciding, based on the information gathered during evaluation, whether to recommend national deployment of a VII system. This decision is expected to be made in late 2008.

The USDOT has contracted the development of the network and roadside equipment (RSE) to Booz Allen Hamilton (BAH), and the development of the on-board electronics to the VIIC. Figure 8 below represents the connection between groups in the VIIC.

Figure 8: Vehicle Infrastructure Integration Consortium

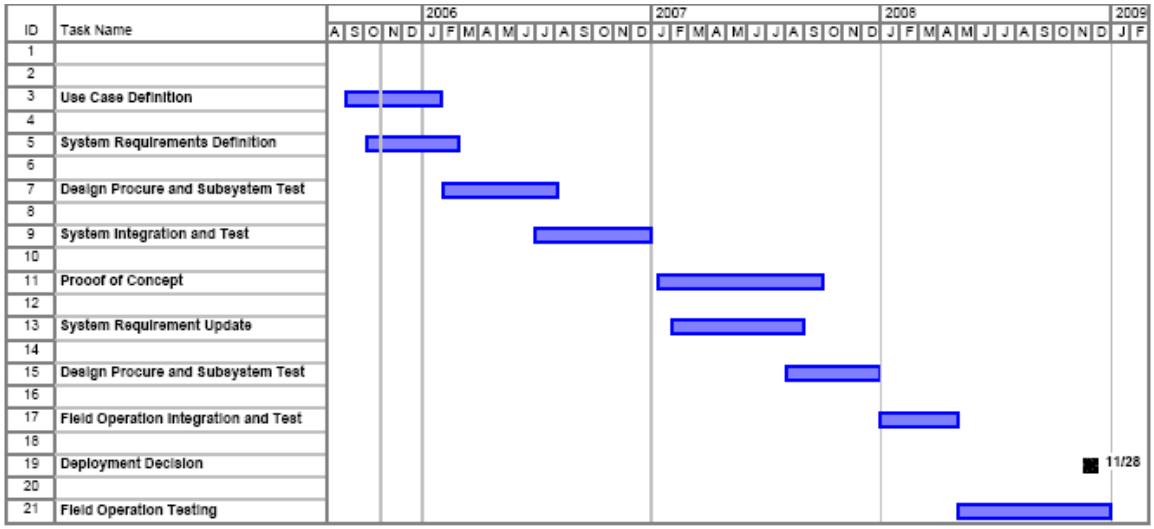


In order for the USDOT to come to a decision to recommend deployment of a VII system nationwide, a two-phase feasibility demonstration has been planned. The responsibility for delivering this demonstration is vested jointly with Booz Allen Hamilton (BAH) and the VIIC. In general, BAH is responsible for design and deployment of the network and roadside units and VIIC is responsible for the design of the OBE. The demonstration is planned in two phases:

a) Proof of Concept (POC) beginning January 2007
b) Field Operational Trial (FOT) beginning January 2008

The responsibility for both POC and FOT is vested jointly with BAH and VIIC. The associated project timing is detailed in Figure 9.

Figure 9: VIIC Timeline of Tasks



Michigan Representative Mike Rogers is targeting his ITS Caucus toward the next election and the future highway bill to ensure that this larger systems perspective of VII is anticipated and addressed.

Automotive Fleet Vehicles

Perhaps most importantly, no other state can offer as high a geographic concentration of potential test vehicles. There are thousands of automotive leased vehicles that arrive at Michigan automotive company parking lots daily. Most of these vehicles can be used by the automotive companies as test platforms for new products. This concentration of potential test vehicles will provide the necessary traffic densities to test the effectiveness and benefits of traffic management and safety systems and offers the automotive companies an exceptional opportunity to monitor the performance of a large number of vehicles remotely. One could speculate that, even without national deployment, a Michigan deployment of a wireless infrastructure that would support close-to-continuous broadband remote diagnostics would have continuing appeal to the

automotive companies. Furthermore, other competing states will have difficulty demonstrating both real-world urban, rural, and international border environments under a variety of weather conditions.

Michigan's Transportation Info-Structure

Michigan is committed to leading the wireless revolution. Counties, cities, and other jurisdictions are deploying wireless technology and exploring value-added ways to make this expansion to transportation and other mobile applications. Wireless Washtenaw is an exciting new initiative for the Washtenaw community. The goal for this project is to provide a wireless network for the urban, suburban and rural settings, in 2007. Objectives include providing citizens and visitors a pleasant, seamless wireless Internet experience; supporting economic development; and improving the quality of life in Washtenaw County; serving as a model for other communities to observe, learn from and use the knowledge gained to promote similar services in their own communities; and providing a model of cooperation and collaboration between government, business and education. The initial partners for Wireless Washtenaw include the University of Michigan, Washtenaw County, the City of Ann Arbor, the Washtenaw Development Council, the Washtenaw Intermediate School District, Eastern Michigan University, and various local units of governments.

Similarly, Wireless Oakland is an initiative launched by County Executive L. Brooks Patterson that consists of three goals. The first goal is to blanket the county's 910 square miles with wireless internet service, with a portion of bandwidth available free to every person in Oakland County. The second goal will directly address the "digital-divide" that exists within Oakland County and provide low-cost or no-cost PCs and technology training to vulnerable population groups. Finally, the third goal of the initiative will develop a Telecommunication and Technology Planning Toolkit for Local Governments that supports continued high-tech investments in local government and promotes the integration of those investments with local community character and quality of life.

Michigan's Intelligent Transportation Systems

Michigan was one of the first states to test and adopt ITS with an early investment in the Michigan Intelligent Transportation Systems Center (MITSC) in Detroit and extend these traffic management functions to Grand Rapids, in 2003.

MDOT currently manages a 180-mile freeway ITS system in the greater Detroit area, covering major freeways, including and within the I-696/I-275 circumferential freeway system. The roots of this system go back to the 1960s when surveillance and detection devices were installed on several freeway segments in downtown Detroit. By the mid-1990s, the freeway management system included 32 miles. A major expansion took place in the late 1990s and included 148 miles of freeway and the development of a dedicated operations center located in downtown Detroit. The most recent expansion provided additional Variable Message Signs and cameras on

approaches to Metro Airport, in support of the opening of Metro's new McNamara Terminal in February, 2002. The Center houses MDOT personnel, contractor personnel involved in both operations and maintenance, and a Michigan State Police Dispatch Center.

MDOT has a significant set of sensors and road sign messaging in locations throughout the greater Detroit area. MDOT also has cooperative agreements in place with local, county, and other state agencies, including the Michigan State Police, the Suburban Mobility Authority for Regional Transportation (SMART), the Southeast Michigan Council of Governments (SEMCOG), the Road Commission for Oakland County (RCOC), the Detroit-Canada Tunnel Corporation, and General Motors.

The Road Commission for Oakland County (RCOC) maintains the freeway system in Oakland County (north of Detroit) under contract to MDOT, involving activities like plowing and fixing potholes. They also maintain the traffic signal system throughout Oakland County. The FAST-TRAC operational field test helped outfit Oakland County with new adaptive traffic signals, demonstrating the benefits of adaptive signal coordination. Traffic moved more efficiently when the signals were coordinated and planned for directional demand. Furthermore, adaptive control helps with managing traffic in response to major events. Centralized signal monitoring and management, enabling operators to change signal settings at the central office, is an important operational benefit of FAST-TRAC. This feature could also help adjust traffic signals in response to traffic diverted from the freeway due to an incident.

FAST-TRAC also includes the use of video detection at major intersections. The video detection system increases the flexibility of road management, because the sensors can be repositioned in response to modifications of the traffic control plan.

As a result of FAST-TRAC and its aftermath, centralized and closed-loop control and electronic surveillance systems have been installed at most intersections along the major arterials in Oakland County. RCOC maintains its own equipment, including 4 CCTV cameras and 450 intersections under SCATS and Autoscope (video) control. RCOC operators can also access one camera at a time from MDOT's 180 CCTV cameras, 25 of which are in Oakland County. Adaptive signal control has reduced delay from 14 percent to nearly 50 percent in some cases. These improvements to traffic signal control systems have also reduced fuel consumption between 2 and 13 percent.

Michigan's Emerging Telematics Industry

Perhaps the best example of how the business model and design environment is changing in the automotive industry is in the area of telematics. Telematics is the English language version of the French word "telematique," which was coined in 1978 to merge the French words "telecommunications" and "informatique" and describes the convergence of telecommunications and information processing. The term has evolved over recent years to refer primarily to

automobile systems that combine wireless communications and on-board information processing to assist or entertain the vehicle occupants.

While early telematics systems combined GPS satellite tracking and wireless communications for automatic roadside assistance and remote diagnostics, the concept continues to evolve and now includes navigation and route guidance, traffic information that integrates dynamically with route guidance features, multifunction multimedia systems covering display-based entertainment, Internet-based infotainment, and vehicle computing functions. Sometimes, telematics is further defined as systems that have built-in terminals with automatic positioning and wireless network capability. In most cases, telematics refers to the convergence of mobile telecommunications and information processing in cars.

Telematics offers a new value chain for delivering products and services to the customer. The car radio is evolving into a system with greater communications and entertainment functionality. Audio and navigation functions are becoming integrated into a single entertainment unit along with the possibility of PDA functionality, gaming features, and Internet connectivity. As wireless data transfer rates increase, the higher cost of hardware can be offset with server-based applications. In devising a successful business model, the service providers must take into account the customers' views of the tradeoff between incurring the cost of in-vehicle hardware and the airtime charge per byte. In this model, the mobile phone manufacturers and the wireless card manufacturers will work with the network providers to offset the cost of the hardware. At the present time, about 3 million vehicles, out of a total 220 million vehicles on U.S. roads, have some form of telematics devices. It is predicted that, by 2012, over half of the annual vehicle production will be fitted with some form of electronic communications device.

Furthermore, services from data aggregation can be provided to more than just the driver.

- Automotive insurance companies can reduce insurance premiums if drivers allow them to track vehicles to ensure the cars are meeting safe driving criteria.
- Remote vehicle diagnostic information can be transferred to the vehicle manufacturers to help them assess the performance of new vehicles coming off the line and the performance of aging vehicles relative to the manufacturer warrantee criteria.
- Vehicles can be tracked anonymously and behave in aggregate as traffic probes to help public traffic management agencies respond more quickly and effectively to incidents.

All of these, and similar services, will be integrated with the direct safety and information services provided to the vehicle drivers; these integrated services will be combined with an integrated customer payment structure to help build and sustain the market.

The telematics supply chain includes telematics manufacturers of hardware and products like antennas, transmitters, and interfaces that help send and receive wireless signals; telecommunications service providers linking existing wireless companies to permit seamless nationwide access; telematics service providers to coordinate all information and services

delivered to the car Internet and their own databases; Internet service providers delivering web-based services and the personalized information that drivers want in their cars; and vehicle location support to help locate the car's position for location-specific service provision. The full telematics value chain includes information provision, content aggregation, systems and software development, service provision, wireless networks, client components, product distribution, and the customer.

VII and telematics offer Michigan a newly emerging and growing high-tech industry where Michigan companies have a competitive advantage because of its large and unique automotive research and engineering community. Michigan's focus on this program is intended to result not only in improved traffic safety and transportation efficiency, but in advancing the state of the art in this new industry. By focusing these efforts in Michigan, we are attracting highly skilled, highly educated workers, as well as retaining jobs in the automotive technology fields. (See Appendix F for an overview and history of the telematics industry. See Appendix G for a recent article from the Wall Street Journal providing a description of how things are currently standing in the Telematics industry and a positive vision for the future.)

Michigan's Transportation Infrastructure

The Michigan Department of Transportation has been engaged in infrastructure-related projects with the automotive industry for decades. This only makes sense because Detroit was the birthplace of the North American automotive industry.

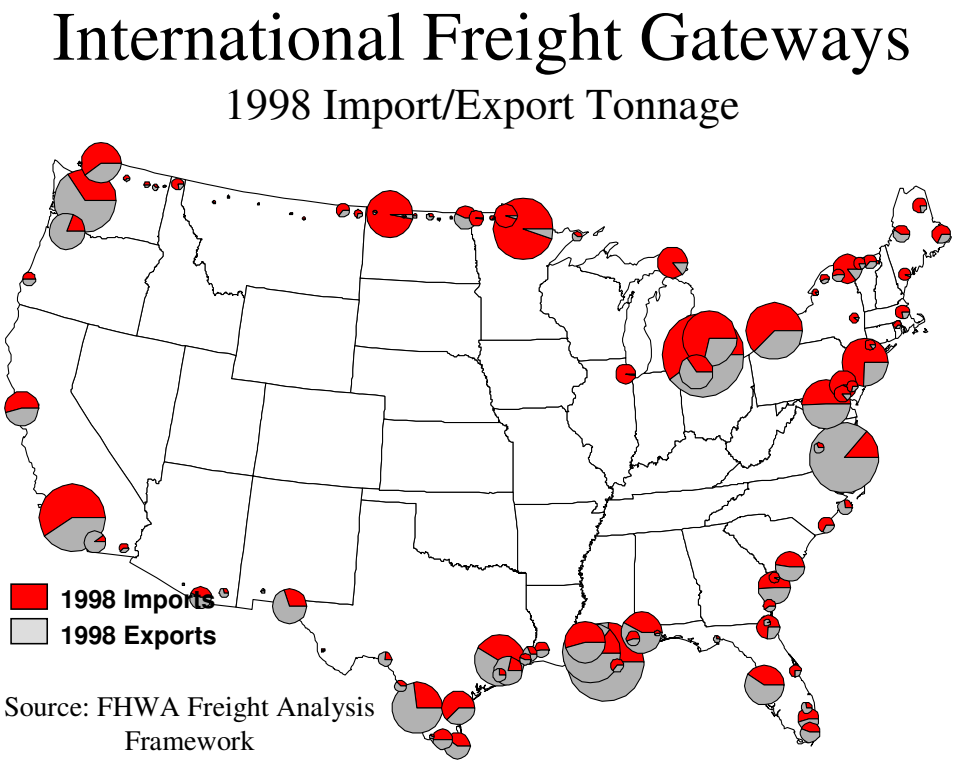
Construction started on Michigan's Davison freeway (M-8) in 1941; many historians say it was the nation's first freeway. It is more than a coincidence that most of Michigan's early freeways have names tied to the automotive industry including Edsel Ford (I-94), Walter P. Chrysler (I-75), Walter Reuther (I-696), and Fisher (I-75) (named for the Fisher brothers).

The North American automotive industry would never have grown as fast or as large as it is today without corresponding public investment in the roads and the national highway system. Motor vehicles and road infrastructure emerged jointly over the last century as products of complementary public and private commitments to investment, design, and deployment. The value of each depended on the other. Together, they changed the way of life in America and laid the foundation for the most dominant economy in the world.

The growth of the new connected vehicle industry will depend on complementary and coordinated investments, design, and deployment. Without a wireless infrastructure the connected vehicle has little value. Without connected vehicles designed to a national standard there is little need for a roadside wireless infrastructure. In fact, if one of the core user services of Vehicle Infrastructure Integration is driver safety, then a high level of coordination and collaboration is required.

Michigan has a unique testing and deployment environment that supports the advancement of VII. It has the largest international boarder crossing in the United States, with the greatest volume of commercial traffic crossing the U.S.-Canada border. Michigan, therefore, offers a significant opportunity to evaluate wireless Homeland Security applications as a port and as a border crossing.

Figure 10: International Freight and Border Crossing



While Michigan has the urban density that creates the type of traffic congestion that will generate and benefit from probe vehicle information, it also has extensive rural areas that have lower volumes of traffic and depend heavily on tourist traffic to Northern Michigan, the Upper Peninsula, and all around the Great Lakes. Furthermore, Michigan is subject to weather variations with extremes between humid heat and arctic cold that provide excellent test conditions for roadside and in-vehicle equipment that must meet quality standards under all weather and terrain conditions. Finally, Michigan has an extensive history of Intelligent Transportation Systems (ITS) projects and field operational tests including: FAST-TRAC with SCATS signals and Ali-Scout, DIRECT I & II, SEMSIM, SMART, GLITS, and others.

MDOT is collaborating with counties and other local jurisdictions to link VII efforts to the local authority and technical integration of local infrastructure, including local roads and traffic signals. The Michigan VII program envisions vehicles that will transmit alerts to traffic lights

about vehicle location and speed, forcing the lights to adapt to traffic demands. During rush hour, cars would inform a traffic signal to alter the intervals between light changes. The signal would then shorten the time the light is red and prolong the time it's green, to process cars more quickly. The idea is that, by the time the car reaches the signal, the light would be green.

An adaptive traffic control system that uses roadside video image sensors is already in place along the major corridors of Oakland County. The SCATS deployment in Oakland County is the largest adaptive traffic control system deployment in the world. The new system would use signals transmitted wirelessly directly from the vehicles to transceivers wired to the traffic lights. Furthermore, the Road Commission for Oakland County has a state-of the art traffic management center that shares information with the Michigan Intelligent Transportation Systems Center in Detroit. Clearly, the new Highway Bill, SAFETEA-LU, emphasizes improvements to traffic safety. This regional integration of advanced traffic management systems is supported by the national ITS architecture and is just one more advantage Michigan has to offer.

These and other advanced systems applications will benefit tremendously from Michigan's regionally connected traffic management infrastructure. Michigan has a multi-jurisdictional environment with regional operations organizations (e.g., South East Michigan Council of Governments). Michigan has one of the most coordinated and advanced regional incident management and response systems in the nation. Metro Detroit is involved in an FHWA initiative to define how the sharing of transportation operations information can lead to safer, more efficient regional transportation operations. The Metro Detroit Traffic Incident Management Coordinating Committee has already established a basis for regional cooperation through transportation operations. Building on this base, metro Detroit will chart a path of voluntary cooperation over a broader range of transportation operations activities, a step in evolving to a Regional Transportation Operations Organization.

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DEFINITIONS OF ACRONYMS

DIT -- Department of Information Technology

DLEG -- Department of Labor and Economic Growth

MEDC -- Michigan Economic Development Corporation

MSP -- Michigan State Police

MTP -- Michigan Transportation Partnership

OEM -- Original Equipment Manufacturer

POC -- Proof of Concept