Intelligent Transportation Systems

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Executive Summary

- Intelligent transportation system technologies—everything from traffic cameras to real time road and traffic information lines—being implemented in many states hold the promise of making travel safer, more efficient and less impactful on the environment.
- These technologies allow drivers to avoid accident sites, get real time traffic updates and pay tolls at full highway speeds, among other things. In the future, technology will also allow cars to wirelessly exchange data on location and braking to prevent accidents from occurring in the first place and to connect with the larger transportation network (including traffic lights) in order to decrease congestion and improve efficiency and mobility.
- But the Washington, D.C.-based think tank Information Technology and Innovation Foundation reports the U.S. is falling behind other industrialized nations in deploying these new technologies due primarily to a lack of investment. The U.S. spends just $100 million annually, mostly on research rather than deployment. The foundation recommends significantly increasing federal funding for intelligent transportation systems by $2.5 billion to $3 billion annually.
- Intelligent transportation system technologies can be grouped into five categories: advanced traveler information systems, advanced transportation management systems, intelligent transportation system-enabled transportation pricing systems, advanced public transportation systems and fully-integrated intelligent transportation systems.
- Researchers at the U.S. Department of Transportation are developing a suite of technologies and
applications called IntelliDrive, which uses wireless communications to provide connectivity with and between vehicles; between vehicles and roadway infrastructure; and among vehicles, infrastructure and wireless consumer devices.

- The goals of intelligent transportation systems include maximizing the capacity of infrastructure and reducing the need for additional highway capacity, improving traffic flow, reducing congestion and emissions, collecting real-time data to measure and improve transportation system performance, and delivering more benefits at a lower cost compared to heftier investments to build more roads or expand existing roads.
- While highway capacity investments can deliver a benefit-cost ratio of 2.7-to-1, intelligent transportation system technologies can deliver a 9-to-1 ratio. Moreover, while a national real-time traffic information system is estimated to cost $1.2 billion, it would deliver value benefits of $30.2 billion, a 25-to-1 ratio. Other research shows that a $9.9 million annual cost of a traffic operations management system in Broward County, Florida yielded a benefit of $142 million in reduced travel time, fuel consumption, emissions and secondary accidents (a 14-to-1 ratio).
- Intelligent transportation system technology is used in rural areas to enhance safety, improve emergency response, provide information on road and weather conditions, make public transportation more accessible and efficient, deter large animals from dangerous roadways, and enhance tourism and recreation.
- While some intelligent transportation system technologies are local, many others must be deployed on a national scale—a key challenge. Also, transportation funding is allocated without consideration of performance, giving transportation planners little incentive for investments that can have a maximum impact on optimizing system performance such as intelligent transportation systems.
- Thirdly, intelligent transportation system projects often compete for funding with road repairs that may be more immediately pressing and more politically popular but don’t deliver the same long-term returns.
- The Dallas and San Diego areas are among the nation’s first to use new intelligent transportation system technologies to help fight congestion and enhance travel.
- Forty-one state, local or regional agencies around the country disseminate traffic information through 511 Traveler Information Services via telephone and the Internet in all or parts of 36 states. Tennessee and Florida recently expanded traffic-monitoring systems. The I-95 Corridor Coalition between North Carolina and New Jersey, the North/West Passage Coalition in the upper Midwest, and the Transportation Operations Coordinating Committee in the New York City metro, area also provide traffic information. Other states are expected to roll out new or expanded systems to provide real time warnings about traffic congestion.
- A federal rule that could go into effect later this year would require states to make available a certain level of real-time information or data—whether it be by 511 or other dissemination methods—to public and private sector entities for their use in various applications. The proposed rule would give states two years to make such information available for interstates and four years for other major roads.
- In 2009, at least 22 states sought American Recovery and Reinvestment Act funds to invest in intelligent transportation system technologies including traffic cameras, express toll lanes, and improved traffic signals or accident alert systems. These projects can be online quickly and can create good jobs. An average of 50 percent of the spending goes directly to wages and salaries, according to the U.S. Department of Transportation.

Technologies being implemented in states across the country hold the promise of making travel safer, more efficient and less impactful on the environment. They are part of an effort to create an intelligent transportation system. That kind of system will connect every vehicle in a network of users and allow drivers to avoid accident sites along the highway, get real time traffic updates and directions to less congested roads. In such a system, drivers could pay tolls and fees at full highway speeds, among other things. Eventually, transportation analysts say, technology will allow cars to
wirelessly exchange data on location and braking to prevent accidents from occurring in the first place and to connect with a larger transportation network to decrease congestion and improve efficiency and mobility. Information technology experts believe such a system will be costly to deploy but will provide a significant return on investment. They recommend increasing annual funding for research and deployment from $100 million currently to as much as $3 billion. A national real-time traffic information program is estimated to cost $1.2 billion but would deliver value benefits of $30.2 billion, a 25-to-1 benefit-cost ratio.

But other countries are leading the way in implementing intelligent transportation systems. The U.S. spends just $100 million annually, mostly on research rather than deployment. That’s a fraction of what countries like Japan (just under $700 million annually) and South Korea ($230 million annually) are spending. States, however, are playing an important role in testing and implementing many components of an intelligent transportation system. This brief examines the potential benefits of these technologies, the likely costs, and the states that are making the most progress toward a safer, greener, more mobile and more intelligent transportation system.

**U.S. Lags Behind in Intelligent Transportation System Deployment**

A January 2010 report by the Washington, D.C.-based think tank Information Technology and Innovation Foundation said the U.S. is falling behind other industrialized nations in the use of new technologies to address major transportation congestion, safety and environmental problems.

“Other industrialized nations have learned that a major key to transportation efficiency and economic growth is by deploying intelligent transportation systems to allow for the safe and easy movement of goods and people,” said Scott Belcher, president and CEO of the trade group ITS America, at a seminar where the report was released. “We have the opportunity to reverse this disparity if we don’t continue to ignore 21st century technology in addressing our transportation problems.”

The report has several recommendations for Congress to help reduce the disparity, including:

- Significantly increasing funding for intelligent transportation systems by $2.5 billion to $3 billion annually, including funding for large-scale demonstration projects, deployment and ongoing operations and maintenance of already-deployed technologies;
- Expanding the role of the U.S. Department of Transportation’s Intelligent Transportation Systems Joint Program Office to move beyond research and development to include deployment;
- Tying federal surface transportation funding to states’ actual improvements in transportation system performance;
- Charging the U.S. Department of Transportation with developing, by 2014, a national real time traffic information system, particularly in the top 100 metropolitan areas, with this vision including the significant use of probe vehicles to assess road conditions. Several countries already deploy such probe vehicles—usually taxis or government-owned vehicles—equipped with wireless technology that reports their speed and location to a central traffic operations management center, where probe data is aggregated to generate an area-wide picture of traffic flow and to identify congested locations.
- Authorizing a comprehensive research and development agenda including investments in basic research, technology development and pilot programs to begin moving to a mileage-based user fee system, sometimes called a vehicle miles traveled tax or VMT fee, by 2020.

According to the report, Japan, South Korea and Singapore lead the world in intelligent transportation system development. Japan has a vehicle information and communication system linking navigational systems in cars to real time traffic information. South Korea has an advanced electronic fare-pay and toll collections system called T-money. Singapore has a fleet of 5,000 probe vehicle taxis that collect
Traffic information as well as a parking guidance system for all public parking areas throughout the city. Other countries leading the way include Australia, France, Germany, the Netherlands, New Zealand, Sweden and the United Kingdom. According to the report, while the limited land mass of each of those countries played a major role in making transportation efficiency a top priority, all had clear and comprehensive nationwide visions for what an intelligent transportation system should look like.

The story is somewhat different in the U.S.

“While the United States certainly has pockets of strengths with regard to ITS in particular regions and applications ... overall the implementation of ITS varies significantly by state and region, thus tending to be sporadic and isolated and not connected into a nationally integrated intelligent transportation system,” the report concludes.

But some states and communities are taking it upon themselves to implement various components of an intelligent transportation system to reap the benefits these technologies afford.

In a late 2009 letter, members of ITS America along with a coalition of transportation, environmental and business leaders called on President Obama to invest in these technologies as a way of speeding up job creation and economic recovery. They emphasized since the projects require little new construction or rights of way, they can be deployed quickly. In the parlance of 2009’s Recovery Act, they are essentially “shovel-ready projects.” Moreover, an average of 50 percent of intelligent transportation system spending goes directly to wages and salaries, according to the U.S. Department of Transportation.

“As you work with Congress to draft a jobs bill, we urge you to invest in Intelligent Transportation Systems and operational improvements that will expand green jobs, small businesses and the smart-tech industry while also saving lives, time and consumption and CO₂ emissions, improving transportation system performance, and creative more livable, sustainable communities,” the letter says.

What is an Intelligent Transportation System?

A wide and growing group of technologies and applications are associated with intelligent transportation systems. The Information Technology and Innovation Foundation breaks it down this way:

“Intelligent transportation systems empower actors in the transportation system—from commuters, to highway and transit network operators, to the actual devices, such as traffic lights, themselves—with actionable information to make better-informed decisions, whether it’s choosing which route to take; when to travel; whether to mode-shift (take mass transit instead of driving); how to optimize traffic signals; where to build new roadways; or how to hold providers of transportation services accountable for results.”

The organization says many intelligent transportation system applications can be grouped into five categories:

- Advanced traveler information systems—These provide drivers with real time information including information about delays due to congestion, accidents, weather conditions or road repairs.
- Advanced transportation management systems—These include coordinated traffic signals, ramp meters (which regulate the flow of traffic onto major highways) and variable message signs (which inform motorists of potential problems ahead).
- Intelligent transportation system-enabled transportation pricing systems—These include electronic toll collection, congestion pricing, fee-based express lanes and vehicle miles traveled usage-based fee systems.
- Advanced public transportation systems—These allow trains and buses to report their position so passengers know arrival and departure information in real time.
- Fully-integrated intelligent transportation systems—These include vehicle-to-infrastructure and vehicle-to-vehicle technologies that enable communication among links in the transportation system.

At the federal level, the U.S. Department of Transportation attempts to define the parameters of an intelligent transportation system in its ITS Strategic Research Plan. The plan is “designed to achieve a vision of a national, multi-modal surface transportation system that features a connected transportation environment among vehicles, the roadway infrastructure (including traffic lights, for example) and passengers’ portable devices (smart phones and GPS units, for example). This connected environment will leverage technology to maximize safety, mobility and environmental performance,” according to the department’s Research and Innovative Technology Administration Web site.

At the heart of the plan is a suite of technologies and applications transportation department researchers are developing called IntelliDrive that uses wireless communications to provide connectivity with and between vehicles; between vehicles and roadway infrastructure; and among vehicles, infrastructure and wireless consumer devices.

Researchers say vehicle-to-vehicle and vehicle-to-infrastructure communications technology based on dedicated short range communications—one-way or two-way wireless signals just for vehicles—can increase drivers’ situational awareness and reduce or eliminate crashes by warning those drivers about dangerous situations. U.S. roads each year see 5.8 million crashes and 37,000 deaths at a direct economic cost of $230.6 billion. Experts believe the IntelliDrive system could potentially address 82 percent of vehicle crash scenarios involving unimpaired drivers.

The federal IntelliDrive program also seeks to tackle mobility issues by using vehicle-to-infrastructure capabilities as well as anonymous information from passengers’ wireless devices relayed through the vehicle’s wireless communications and other transmission means. The information can be used to provide transportation agencies with improved real time traffic, transit and parking data, making it easier to manage transportation systems for maximum efficiency and minimum congestion. Travelers will be able to change their route, time and mode of travel, and avoid traffic jams all based on real time data. Transportation managers will be able to use the information collected to adjust traffic signals, modify transit operations and dispatch maintenance crews or emergency services.

That’s all important because Americans annually spend 4.2 billion hours and 2.8 billion gallons of fuel sitting in traffic. Traffic congestion is an $87.2 billion annual drain on the U.S. economy.

Finally, IntelliDrive research is providing data transportation managers can use to better understand the environmental impacts of transportation management decisions made in real time. Vehicles that are sitting still, idling and traveling in a stop-and-go pattern due to congestion emit more greenhouse gases contributing to climate change than free flowing vehicles. Vehicles communicating to the larger transportation network can allow motorists to drive through traffic signal networks at optimum speeds to reduce stopping.

Benefits of an Intelligent Transportation System
As previously mentioned, intelligent transportation technologies hold the potential to have significant benefits in the areas of safety, mobility and environmental performance.

The Information Technology and Innovation Foundation cites the following specific potential benefits:

- Because intelligent transportation technologies can maximize the capacity of existing infrastructure, it can reduce the need to build additional highway capacity.
- Applying real time traffic data to signal lights can improve traffic flow, reduce stops by as much as 40 percent, cut gas consumption by 10 percent and cut emissions by 22 percent.
- Intelligent transportation systems can reduce congestion by as much as 20 percent or more.
- They can also enable transportation agencies to collect the real time data needed to measure and improve the performance of the transportation system.
- Intelligent transportation systems can deliver superior benefit-cost returns (a ratio of 9-to-1) when compared to traditional investments in highway capacity (which have a benefit-cost ratio of 2.7-to-1).²

The Government Accountability Office estimates if the U.S. were to implement a national real time traffic information program at a present value cost of $1.2 billion, it would deliver value benefits of $30.2 billion, a 25-to-1 benefit-cost ratio.³

Moreover, researchers at Florida International University found that the $9.9 million annual cost of a traffic operations management system in Broward County yielded a benefit of $142 million in reduced travel time, fuel consumption, emissions, and secondary accidents (a 14-1 ratio).

A study of 26 traffic signal optimization projects in Texas found that traffic signal optimization benefits outweighed costs by a 38-to-1 ratio.²

In addition, the Insurance Institute for Highway Safety reports an estimated 31 percent of the nearly 40,000 fatal traffic crashes each year could be reduced or even prevented through such intelligent transportation systems innovations as lane-departure warnings, blind-spot detection, and other collision-avoidance technologies.³

As states face high unemployment rates, intelligent transportation systems could also mean job creation. According to projections from the Department of Transportation, intelligent transportation systems could create nearly 600,000 new jobs over the next 20 years.

“With a federal commitment to ITS deployment, these figures could be significantly higher,” ITS America CEO and President Scott Belcher wrote in December.

The economy as a whole stands to benefit as well, according to Belcher.

“Researchers from the London School of Economics and the Information Technology and Innovation Foundation have found that investment in ITS creates a ‘network effect’ throughout the economy and directly benefits economic growth by stimulating high-tech job creation across multiple sectors, including green jobs, high-tech, automotive, information technology, consumer electronics, and related industries, and provides a foundation for long-term benefits, including government cost savings, economy-wide productivity, and an improved quality of life.”³

**Potential for Intelligent Transportation Systems in Rural America**

These technologies hold great possibilities for busy major highways and congested big cities, but they also provide innovative solutions to transportation challenges in rural areas. As the National Association of Development Organizations points out, rural residents and transportation planners
have to contend with steeply graded mountain highways, dirt roads, bridges, ferries and extreme weather conditions, among other factors. Intelligent transportation systems technology is used in rural areas to enhance safety, improve emergency response, provide information on road and weather conditions, make public transportation more accessible and efficient, deter large animals from dangerous roads and enhance tourism and recreation.\(^\text{10}\)

For example, in northwest New Mexico, the National Consortium on Remote Sensing in Transportation used remote sensing equipment on rural roads to collect information on current and recent weather and road conditions which was made available in near real time over the Internet. That allows residents to plan ahead and change travel plans as necessary.

Along the steep grades and sharp curves of Interstate 84 in Oregon and Interstate 70 in Colorado, downhill speed warning systems with variable message signs and other technologies were installed and produced sharp reductions in the number of truck accidents.\(^\text{11}\) Wind and fog warning systems have been installed in other parts of the country.

The California Center for Innovative Transportation reports while rural areas may face even greater challenges than urban areas in finding the funds to invest in intelligent transportation systems, the need for them in rural areas is even greater. Rural accident fatality rates are higher than in urban areas, according to the Federal Highway Administration. Mobility is also a big issue. Thirty-eight percent of the rural population has no access to public transportation and one in 14 rural households are without a private vehicle. Limited telecommunications systems in rural areas also make incident management and information dissemination to travelers difficult.\(^\text{12}\)

A brief prepared for the Federal Highway Administration outlined the benefits of rural intelligent transportation systems. They included:

- More efficient highway operations and management activities such as snow removal;
- Quicker response to traffic incidents and crashes;
- More efficient rural transit operations and vehicle fleet management;
- Greater peace of mind from advanced safety and security systems;
- Better traveler information through in-vehicle communications and roadway signage, particularly for hazardous weather conditions; and
- Fewer fog-related, multi-vehicle crashes in rural areas through advanced sensor systems.\(^\text{13}\)

**Challenges in Implementing Intelligent Transportation Systems**

The Information Technology and Innovation Foundation notes while some of these technologies, such as ramp meters or adaptive traffic signals, can be deployed locally and prove effective, many others positioned to deliver the most benefits to the transportation network must be deployed on a national scale. That may raise significant system interoperability and coordination challenges as states and localities continue to deploy technologies on their own in different configurations.

The foundation also points out one of the reasons the U.S. has traditionally underinvested in intelligent transportation systems is that transportation funding has often been allocated without consideration of performance, giving transportation planners little incentive to preference investments in the technology that can have a maximum impact on optimizing system performance.

The projects often have to compete for funding with road repairs that may be more immediately pressing but that don't necessarily deliver the same long-term returns. Many state transportation departments often barely have enough money to do needed maintenance, much less invest in new technologies, and politicians may simply be more comfortable investing in concrete. But that sends a
message to private industry that those companies engaged in intelligent transportation systems research and development may have a hard time selling its products in the marketplace. In other words, state reluctance to invest is producing a reluctance by industry to invest in developing the new technologies that could greatly benefit those states.

The foundation also said a number of jurisdictional and organizational issues will have to be worked out, including deciding which level of government is best equipped to oversee intelligent transportation systems deployments.

But states and localities looking to implement intelligent transportation systems technologies can learn from not only the successful projects, but also those not as successful. The E-ZPass automated toll collection system in New Jersey, for example, ran into long delays and huge cost overruns. It launched two years behind schedule and cost the state more than $100 million, instead of paying for itself through higher collections and lower labor costs as supporters had predicted.

States & Communities Leading the Way

The Dallas and San Diego areas are among the nation’s first demonstration sites for new technologies designed to help fight congestion and enhance travel.

Dallas Area Rapid Transit is contributing $3 million and receiving $5.3 million from the U.S. Department of Transportation for using a transportation management model to predict travel conditions 30 minutes into the future. Travelers will be able to access real time information about traffic, public transit and expected travel times, through wireless and Web-based alerts.

The San Diego Association of Governments and its partnering agencies will contribute $2.2 million and receive $8.7 million from the federal government for a project along Interstate 15 using a “smart” traffic management system combining road sensors, video and traveler information to take steps to reduce congestion. The system will deliver information to commuters via the Internet and message signs along the road. It will also enable managers to adjust traffic signals and ramp meters to direct travelers to high-occupancy vehicle and high-occupancy toll lanes, bus rapid transit and other options.

Forty-one state, local or regional agencies around the country currently disseminate traffic information and other types of traveler information through 511 Traveler Information Services via the telephone and the Internet. That makes such services available to more than 181 million Americans or 66 percent of the population, according to the U.S. Department of Transportation. The types of information provided by these services vary widely, but can include traffic and road conditions, construction- and weather-related traffic problems, and travel times.

Over the next four years, many states are expected to roll out new or expanded systems to provide real time warnings about traffic congestion. A federal rule that could go into effect later this year would require states to make available a certain level of real-time information or data—whether it be by 511 or other dissemination methods—to public and private entities for their use in various applications. The proposed rule would give states two years to make such information available for interstates and four years for other major roads.

Among the other related projects underway or already complete:

- Tennessee’s multimillion-dollar, eight-year expansion of Nashville’s traffic-monitoring system, scheduled for completion this fall, seeks to double the number of overhead message boards and traffic cameras that warn motorists of problems ahead on the interstate.
Florida is filling the gaps in electronic traffic-monitoring systems in Jacksonville, Tampa and St. Petersburg. State transportation officials say about 60 percent of the state’s interstates should be covered by electronic monitors within five years and they are currently studying how to collect and disseminate information on the remaining 40 percent of roads, which are primarily rural highways.

The Interstate 95 Corridor Coalition’s new Web site at www.95coalition.org [3] shows real time traffic conditions along the interstate from North Carolina to New Jersey.

A similar alliance in the upper Midwest called the North/West Passage Coalition provides traffic information both online and by phone to interstate travelers.4

State and local agencies in New York, New Jersey and Connecticut formed the Transportation Operations Coordinating Committee, which collects and disseminates real time incident and construction information to more than 100 member agencies and the public in the New York City metro area.6

But a November 2009 report by the U.S. Government Accountability Office found that while the real time information coverage provided by state and local agencies is expanding, gaps remain. Those gaps include the overall quality of data collected (including its timeliness and accuracy) and the extent to which agencies are sharing information. Moreover, states such as Texas and Michigan have no plans in place to implement such services, either because they lack adequate traffic data or because they lack funding.14

Source: General Accountability Office

Recovery Act Helps Advance Intelligent Transportation

In 2009, the American Recovery and Reinvestment Act gave states the opportunity to not only repave roads and fix bridges but to invest in intelligent transportation systems technologies. Stateline reported that at least 22 states sought Recovery Act funds to install traffic cameras, create express toll lanes and improve traffic signals or accident alert systems. The projects included ramp meters for Colorado, E-Z Pass toll booths for Delaware, and new traffic lights connected to fiber optic cable in Utah.

One of the biggest intelligent transportation projects to get stimulus funding was a $74 million effort in Pennsylvania to upgrade 72 miles of the Interstate 95 corridor in the Philadelphia area. Fifty-nine closed-circuit video cameras were added to a network of 175 cameras that feed into the Pennsylvania Department of Transportation’s regional traffic control center in King of Prussia. In addition, 39 new electronic signs that can display travel times, accident alerts and other information were installed. Vehicle sensors and devices used to calculate travel times were also part of the upgrade.11

Conclusion

While the U.S. continues to lag other countries in deployment of intelligent transportation systems technologies, many believe a federal push is just around the corner, perhaps as part of new legislation to authorize federal transportation programs. The most recent authorization bill, known as SAFETEA-LU, officially expired in September 2009 and Congress is working on its successor. Proponents believe the potential benefits of intelligent transportation systems not only for safety, mobility and the environment but also for job creation are simply too great to ignore for long. Fortunately, many states and localities are already leading the way in investing in smarter roads and more informed drivers.

Resources


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