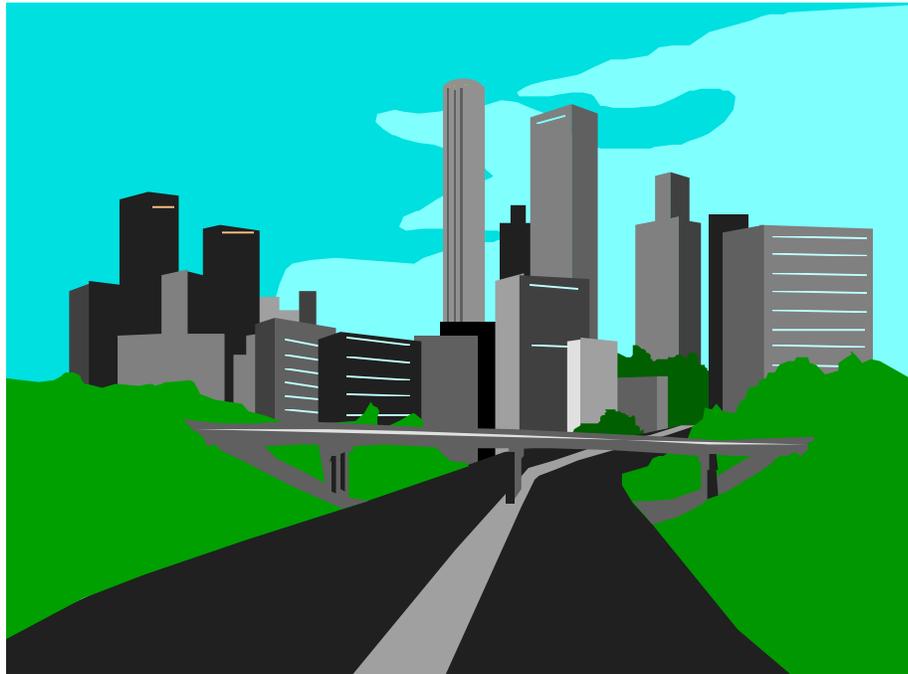




U.S. Department
of Transportation

Developing Intelligent Transportation Systems Using the National ITS Architecture

An Executive Edition for Senior Transportation Managers



**U.S. Department of Transportation
Intelligent Transportation Systems Joint Program Office**

July 1998

Notice

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

**Prepared for the Federal Highway Administration
by Mitretek Systems, Inc.**



WHICH HAT DO YOU WEAR?

Are you a manager in a transportation agency? If so, please KEEP READING! This information is for YOU! It will fill you in on the use of regional ITS architectures as a way to achieve the benefits of integrating and coordinating ITS efforts of the various transportation agencies in your area...and if your agency needs help in using the National ITS Architecture to deploy ITS, we'll tell you how and where to get it.

Are you called upon to manage transportation assets with limited transportation funds in the face of overwhelming growth of transportation demands? If you are a policy maker or someone who oversees the planning, design, or implementation of transportation management programs, then this brochure is meant for you. If you are a transportation planner or engineer, this brochure will help you implement integrated intelligent transportation, but you'll probably want to see the Technical Editions which go along with this. And if you wear one of these hats...



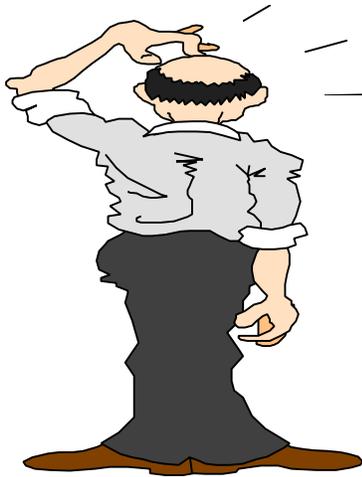
YOU KNOW THE PROBLEM!

Traffic congestion – It affects both the quality of life and the economy. In the past 10 years, the amount of travel on the Interstate Highway System has grown by 30 percent, and the demand for travel is expected to increase by another 50 percent over the next 20 years. For transportation system users, this means more lost time. In 1995, Americans spent more than 2 billion hours in traffic jams—that's 83 million days or more than 22,800 years. The annual cost of congestion to the Nation in lost productivity is over \$100 billion, exclusive of the cost of wasted fuel and environmental damage. According to the Federal Highway Administration, in 1995, over 1/3 of all urban freeway miles, and 55% of all urban freeway travel, experienced congested conditions during peak periods.

"...the construction of more roadways and roadway lanes is no longer feasible or credible in many areas as the primary solution to traffic congestion."

For many years, state highway departments and localities responded to traffic congestion problems by building more roadways and roadway lanes. In the 1980s, transportation planners began facing greater public concerns about land use, highway safety, environmental sensitivity, and transportation efficiency. In addition, government budgets were shrinking. Construction of additional lanes to handle increasing traffic loads became more expensive due to higher land values and roadway construction costs. As a result, the construction of more roadways and roadway lanes was no longer feasible or credible in many areas as the primary solution to traffic congestion.

You probably knew all that.



BUT DID YOU KNOW...?

A group of technologies, known collectively as Intelligent Transportation Systems, or ITS, is being developed and deployed globally to improve transportation system efficiency.

ITS uses a number of technologies, including information processing, communications, and control. By coordinating and integrating these technologies with our transportation system, we can improve safety, reduce congestion, improve mobility, improve economic productivity, and save public investment dollars without negatively affecting the environment.

ITS applies innovative techniques and advanced technologies to make transportation systems safer, more efficient, and more customer service-oriented.

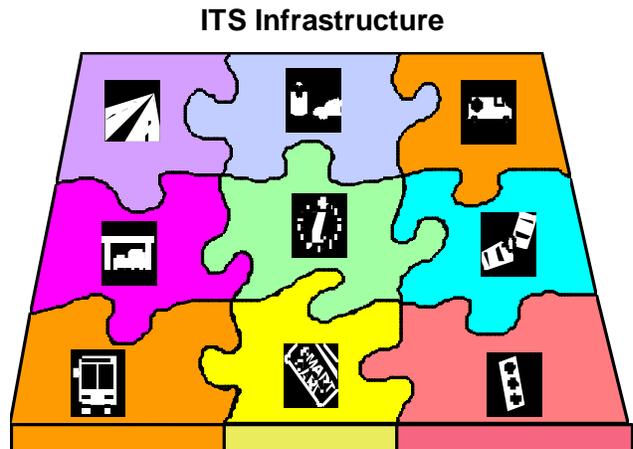
ITS offers an alternative to traditional measures for addressing transportation problems and needs. It applies advanced technologies to transportation systems to make them safer, more efficient and more customer service-oriented. The technology includes systems for communicating transportation options, conditions, and schedule information to transportation consumers; smarter vehicles and smarter roads; flexible traffic control; and enhanced fleet management systems. Creative ideas include new ways to disseminate information to travelers, public/private partnerships, linking various public partners to provide real-time information, innovative financing and techniques, and leveraging of non-transportation investments.

While the advent of ITS has been heralded as a new way of doing business, the underlying concepts are not new.

What is new? The concept of integrating the transportation systems within a region.

U.S. DOT has identified nine ITS infrastructure components that can be integrated to become a platform for managing travel in metropolitan areas and support a variety of other services on the technology horizon:

- ◆ Traffic Signal Control Systems
- ◆ Freeway Management Systems
- ◆ Transit Management System
- ◆ Regional Multi-modal Traveler Information System
- ◆ Emergency Management System
- ◆ Electronic Fare Payment System
- ◆ Electronic Toll Collection System
- ◆ Incident Management Program
- ◆ Railroad Grade Crossing Warning System
- ◇ And over time there will be others



The Key to the solution is Integration

Implementing these systems or services is not that tricky. You've been doing many of these for years. The difficulty arises in integrating these systems, so that information from one is passed to another, rather than using multiple sensors or systems to accomplish the same task. This integration allows individual components of ITS to work together and will pay great dividends to your transportation customers and resultant cost savings to agencies. According to studies published in *ITI Benefits: Expected and Experienced*, the benefits provided by an integrated transportation system include increased safety (e.g., fewer accidents), decreased travel time, decreased delay, decreased fuel consumption, reduced emissions.



But beyond these “technical” benefits, institutional benefits are also to be expected with the integration of transportation systems. Does your agency obtain and use information that originates from other agencies in your area? Do you provide information to others? Does your agency coordinate with others on traffic control on a regular basis or for incident management? Better, more complete information allows the job of managing transportation to be done better. Every agency has a piece of the picture – by sharing this information through integrated systems, everyone sees the same, whole picture. The exchange of information between agencies requires the keepers of the information or stakeholders to be involved from the initial planning of these systems to address transportation operations and management issues. The integration of systems across institutional and modal boundaries fosters team-building while allowing all participants to make good use of scarce resources and save money – now and into the future.

You may have heard about the National ITS Architecture ... which was developed for US DOT as the framework for implementing modern transportation operations systems. Systems design based on the Architecture will change the way you do business. But do you know how to make use of this resource? Keep reading to find out....

Getting started...A Regional Architecture

Your region is unique. It's different in size, geography, demographics, and institutional arrangements. Because of these differences, you'll want to craft your transportation operations system to fit your own problems and needs. These specific needs really come to the forefront when dealing with systems that are already in place. A regional architecture maps out how the various ITS components are ultimately tied together and integrated -- both physically as well as institutionally. Gathering a wide range of stakeholders and developing a regional architecture which responds to local transportation needs and problems can serve as a guiding framework for coordinated development of ITS within a region. This gathering of stakeholders will evoke the discussion of operations roles and responsibilities, phasing considerations for planned ITS enhancements, and regional agreements on technology or standards. This approach also allows systems to be built and installed incrementally, to accommodate the real world of incremental funding. To ensure that everything "plays together" the way it should, it is imperative for your region to have an ITS architecture tailored to your specific needs.

OK, so you want to deploy Intelligent Transportation Systems which will help alleviate the problems you and your customers face. But you also want these deployments to be sound investments; investments that are wise expenses now, and will continue to pay dividends into the future. Your transportation engineers and planners are implementing ITS to solve problems today and taking advantage of the gains made possible by the "information age" and integration of technologies. Just as they followed "good engineering principles" with earlier transportation investments, they are following a systems engineering approach. The system engineering process, a structured approach to system design, is really the way to attack the design effort. This design is tailored toward the unique features of your region. On a larger scale, your regional architecture is a road map of the information flows between the various systems (and institutions) that are essential to you (e.g., you might want to establish a connection between the Traffic Management Center and the regional transit operations center so that information on operating conditions may be exchanged). But all of this design and architecture effort could take a lot of time and money.



How can you help your staff through the systems engineering - regional architecture process? You don't need to reinvent the wheel! The integration of many different ITS functions is more easily accomplished by using the National ITS Architecture. It is available as a resource and is ready to be used. The National ITS Architecture is a highly developed functional analysis of ITS elements integrated together. It does not dictate the design of your system, but rather helps you to align your requirements for the deployment you envision. Detailed technical information on the National ITS

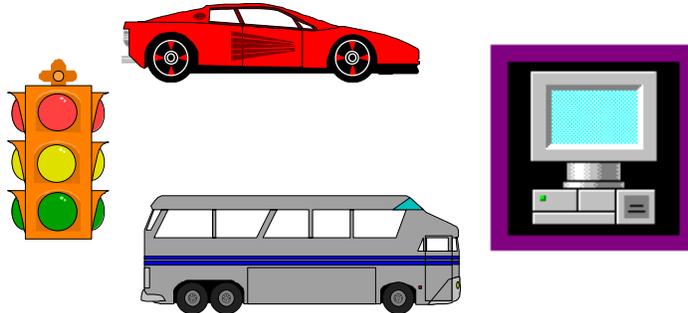
Architecture can be found in the series of supplemental publications on *Developing Systems Using the National ITS Architecture Technical Edition*. These Technical Editions are written for:

Freeway Management

Traveler Information

Traffic Signal Control

Transit



Each Technical Edition is written for system project management personnel and staff. They provide guidance and recommended practices for developing and deploying systems using the National ITS Architecture as a tool. They also include helpful hints and lessons learned from transportation agencies that have already deployed ITS systems. The Technical Editions also describe how to conduct regional ITS planning activities (as part of the planning process) to guide the overall deployment of systems.

A Regional ITS Architecture...Just why should you bother?

A lot of time and effort went into developing the National ITS Architecture...for a very good reason. To make the process of designing and implementing these systems easier for you. YOU CAN SAVE STAFF HOURS AND ENGINEERING DESIGN COSTS.



Your Regional ITS Architecture guides transportation agencies in interconnecting and coordinating individual ITS applications, such as traveler information systems, traffic signal control systems, freeway management systems, and transit systems. Individually, these applications provide their own benefits. When integrated together, the whole is greater than the sum of its parts.



The National ITS Architecture...The right tool for the job

How do you build your regional architecture? The National ITS Architecture is a tool that will help. It will help you ensure that systems are integrated and improve the benefits to customers and transportation agencies. Think of the National ITS Architecture as a template that is similar to a model home design. You can tailor the existing blueprint to meet your unique needs, but it's much cheaper than hiring an architect to start from scratch.



National ITS Architecture Benefits

The National ITS Architecture provides a common structure for the design of intelligent transportation systems. It defines the framework around which many different design approaches can be developed, each one specifically tailored to meet specific regional needs, while maintaining the benefits of a common architecture within current (legacy) and planned systems. Your Regional ITS Architecture defines the functions (e.g., traffic signal control, freeway management, or incident management) that must be performed by components or subsystems, where these functions reside (e.g., roadside, traffic management center, or in-vehicle), the interfaces and information flows between subsystems, and the communications requirements for the information flows (e.g., wireline or wireless).

There are specific benefits to be gained in the transportation community through informed application of the National ITS Architecture methodology, knowledge base, and tools. The major benefits of the National ITS Architecture are discussed below.

The National ITS Architecture can provide short term benefits -- saving time and money in the development of a project from its inception through its implementation, since it:

- ◆ Correlates needs and problems to services that must be performed, thus providing traceability for a project to overall transportation needs.
- ◆ Illustrates efficiencies that can be gained by eliminating redundant implementations of similar functions.
- ◆ Provides a view into the future to identify services and functionality that may not have been initially considered, currently needed, or even feasible. This provides a checklist of future capabilities that could be planned for now in anticipation of future needs (e.g., you may want to plan for an information service provider to distribute traffic and other information to subscribers in the future).
- ◆ Provides an extensive list of the transportation agencies (by matching the functions they perform with the corresponding subsystem names in the National ITS Architecture) that an agency should consider talking to during initial planning of an implementation (i.e., the stakeholders).
- ◆ Defines the kind of information one should consider sharing among these agencies. The agency can use this information as a checklist in planning the project and in discussions

with other stakeholders to show how they can participate through sharing of the information.

- ◆ Serves as a good starting point or template (which can be tailored) for developing the architecture that will drive the design for a specific project. Starting with the National ITS Architecture, one can merely delete the functions and information flows that do not apply and then incorporate modifications or additions to address specific local requirements and considerations.
- ◆ Provides a departure point for developing functional requirements and system specifications to be included in a procurement package.
- ◆ Identifies the interfaces (some of which may have standards work under way) and data exchanges that must be included (e.g., a number of potential data exchanges are identified between the Traffic Management and Roadway subsystems).
- ◆ Helps reduce the need for costly changes late in the design and implementation process.
- ◆ Provides ballpark estimates of costs for a wide range of ITS-related equipment and services that can be used for initial project costing.
- ◆ Provides a check on the product being provided by a design contractor (if the contractor is asked to demonstrate the use of the National ITS Architecture and its relationship to the design being offered).

Using the National ITS Architecture and ITS standards will also provide broad longer term benefits. These will benefit the nation and your region as well:

- ◆ *Interoperability*: The National ITS Architecture has identified where standards are needed for system interoperability (interfaces and products). Because the National ITS Architecture is serving as the common foundation for ongoing ITS standards development work, factoring it into your current system enhancements will facilitate the transition to a standard interface definition in the future. Using standard interfaces will provide for national and regional interoperability and interchangeability of systems and devices used in ITS travel management.
- ◆ *Increased competition*: By requiring use of open (non-proprietary) standards, multiple vendors that can meet the standards will be able to respond to RFPs. Support and upgrades can also be obtained from multiple potential sources, avoiding the problems of being locked in to one source by increasing competition.
- ◆ *Future expandability*: By designing within a common framework and using open standards, you will create an environment that integrates legacy systems with new ITS applications and allows more functionality to be added when desired or as needed.
- ◆ *Lower costs*: Long-term costs of deployment will go down by the economies of scale for off-the-shelf ITS equipment and products and competition through multiple vendors.
- ◆ *Increased transportation system integration*: The open nature and structure of the National ITS Architecture and use of standards-compliant components will make integration of complex traffic management components and other regional system components easier. Improved integration of systems operated by different agencies will permit effective

tive information sharing and more effective use of resources. Seamless traveler services across agency lines will become a reality.

The National ITS Architecture...You've got help!



The National ITS Architecture guides regions in developing integrated and compatible Intelligent Transportation Systems that provide even more benefits to customers and transportation agencies. The National ITS Architecture offers a great deal of guidance on the development and implementation of ITS -- providing agencies with specific suggestions on how to optimize their transportation management systems by integrating key functions, eliminating redundancy, and sharing information with other local agencies and systems - - and wraps it all up in a comprehensive package.

The National ITS Architecture is available in several formats (paper , the Web, and CD-ROM) and is ready to be put to work -- today!

How do you Find Out More About ITS and the National ITS Architecture? We've made it easy for you...

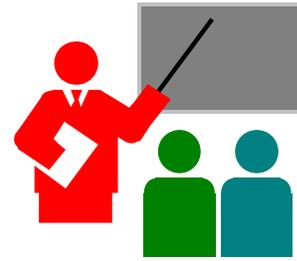
A lot of time and effort has already gone into making the Architecture easy to use. This brochure is the lead-in to *Developing Intelligent Transportation Systems Using the National ITS Architecture Technical Editions*. These documents detail the process for implementing Freeway Management, Traffic Signal Control, Traveler Information, and Transit Systems. The Technical Editions are written for managers of transportation systems and their staff. They provide guidance and recommended practices for developing and deploying intelligent transportation systems using the National ITS Architecture. These resources also include project application scenarios, helpful hints and lessons learned from transportation agencies that have deployed ITS systems. These documents, as well as other good sources of information related to the National Architecture are listed below:



For more information on the availability of these resources, contact your local FHWA Division or FTA Region Office, or use the additional contact information provided.

National ITS Architecture Training

- ◆ *Using the National ITS Architecture for Deployment Training Course* -- This 2 or 3 day course given by the Architecture Team gives the student the mechanics for implementing regional systems using the Architecture.
- ◆ A half day overview course is also being developed by the Architecture Team.



Technical Resources

- ◆ National ITS Architecture documents, databases, and other useful navigational tools on a single CD-ROM at no charge.
- ◆ *Developing Intelligent Transportation Systems Using the National ITS Architecture - Technical Editions*: These are the accompanying volumes to this document intended for those involved in the planning, development, deployment and operation of particular systems.
 - o *Developing Freeway and Incident Management Systems Using the National ITS Architecture -- Technical Edition.*
 - o *Developing Traveler Information Systems Using the National ITS Architecture -- Technical Edition.*
 - o *Developing Traffic Signal Control Systems Using the National ITS Architecture -- Technical Edition.*
 - o *Developing Transit Systems Using the National ITS Architecture -- Technical Edition.*
- ◆ The National ITS Architecture documents on the World-Wide Web at:
 - <http://www.its.dot.gov>
 - <http://www.itsa.org/public/archdocs/national.html>
 - <http://www.odetics.com/itsarch/>
- ◆ ITS Joint Program Office, (HVH-1), Federal Highway Administration, U.S. Department of Transportation, 400 Seventh Street SW, Washington, DC 20590; phone: 202-366-9536, fax: 202-366-3302
 - *The National Architecture for ITS: A Framework for Integrated Transportation into the 21st Century*
 - *Building the ITI: Putting the National ITS Architecture into Action*
- ◆ ITS America, 400 Virginia Avenue SW, Suite 800, Washington, DC 20024; phone: 202-484-4847
 - Copies of the National ITS Architecture documents are available for a fee. Specific National ITS Architecture volumes are available from the ITS America bookstore at 202-484-4584 or 800-374-8472.



Further Information on ITS

- ◆ *Intelligent Transportation Infrastructure Benefits: Expected and Experienced*, MITRE Corporation, The. 1996. Washington, DC, U.S. Department of Transportation, Federal Highway Administration, FHWA-JPO-96-008.
- ◆ *Benefits Assessment of Advanced Public Transportation Systems*, Volpe National Transportation Systems Center, Research and Special Programs Administration, U.S. Department of Transportation, Cambridge, MA

- ◆ ITS Procurement Resource Guide, ITS JPO, FHWA-JPO-97-0025. Contains several articles or reports with helpful information on ITS procurement issues.
- ◆ Telecommunications Resource Guide, ITS JPO, FHWA-JPO-97002. A compilation of studies on telecommunications issues and guidance on deploying telecommunications systems.
- ◆ ITS Information Security Resource Guide, ITS JPO, FHWA-JPO-98-011. A compilation of analyses on the potential information security risks and the mitigation of those risks for transportation agencies.
- ◆ *ITE Operations and Maintenance Conference - Summary of Findings*. Kraft, Walter H. 1995. Washington, DC, Institute of Transportation Engineers.
- ◆ *Guidelines for Funding Operations and Maintenance of ITS/ATMS*, Ginger Daniels and Tim Starr, Texas Transportation Institute, January 1996. Presented at the 76th Annual Meeting, Transportation Research Board, Washington, DC.

Acknowledgments

This work was funded by the U.S. Department of Transportation ITS Joint Program Office. There have been contributions to this document by people from several organizations. In particular, the editor and prime authors would like to express their sincere appreciation to the contributing authors from TransCore and PB Farradyne. In addition, the review efforts of FHWA ITS Joint Program Office, FHWA Office of Traffic Operations and ITS Applications, and the various individuals representing state and local transportation agencies are greatly appreciated.