

This Report is About:

- *Using National Transportation Communications for ITS Protocol (NTCIP) standards for Dynamic Message Signs (DMSs) to develop interoperable systems using interchangeable equipment.*

Key Lessons Learned:

- *Using NTCIP Standards is a big step toward obtaining interchangeability and interoperability for DMSs. Standards help you select from a larger choice of DMS vendors and avoid using proprietary software.*
- *During procurement, building on what others have learned helps you get just what you need.*
- *It is wise to obtain references on DMS vendors. Use of vendors who already have installed NTCIP-based DMSs reduces risk. Research several DMS manufacturers and ask for their NTCIP specifications and timeframe for installation before selection.*
- *Access to expertise in specification writing and testing is crucial. If you do not have experience with NTCIP and DMS communications, hire someone who does.*
- *It is helpful to have a tight RFP - one that is very specific about DMS communications (i.e., the computer “vocabulary” and the management and control of data) and other ITS standards that apply to the project.*



PREFACE

This Lessons Learned Report was drawn from the experiences of nine agencies who were among the first to use DMSs built to NTCIP specifications (see box). NTCIP is a group of Intelligent Transportation Systems (ITS) standards. DMSs are a key component of traffic management and traveler information systems. DMSs were also one of the first systems to use elements of NTCIP and prove that it works.

ITS standards allow systems to talk to one another by supporting information exchange. That information is composed of data elements (the smallest unit of data), messages (a string of data elements that carry a meaning), and protocols (sets of common rules for exchanging data). ITS standards are defined for each of these information groups.

ITS standards are designed to promote interchangeability and interoperability. Interchangeability is specifically the capability to exchange devices of the same type (e.g., DMSs) from different vendors without changing the software. Interoperability is the capability to operate devices from different manufacturers or different device types, such as signal controllers and DMSs, on the same communications channel and exchange information between subsystems.

THE PROBLEM

Without standards, agencies that deploy ITS may be locked into proprietary specifications, custom interfaces, reduced options for vendor competition and price stability, early obsolescence, and a need for unique training and specialized skills. Moreover, ITS deployments will have limited interchangeability and interoperability. Without standards, you have two choices in expanding your system: buy the same brand of equipment, or re-design/re-build your system.

Agencies Responding To The NTCIP / DMS Survey:

- Virginia DOT
- New York State Thruway Authority
- New York State DOT
- Minnesota DOT
- Washington State DOT
- Arizona DOT
- Illinois State Toll Highway Authority (ISTHA)
- Pennsylvania DOT
- Delaware DOT

THE SOLUTION

Use of standards can help avoid disadvantages created by procuring custom DMS solutions. Let's examine how DMS standards come into play. Operation of DMS requires a communications protocol—a set of rules for coding and transmitting messages between electronic devices. With the support of the USDOT, standards development organization (SDO) committees developed a comprehensive set of ITS standards in order to standardize the way transportation systems exchange data. Among these is a group of standards known as the National Transportation Communications for ITS Protocol (or NTCIP). Specifically, NTCIP standard 1203 was developed for deploying DMS.

Standardized message sets format the data sent to the DMS. Interoperability and interchangeability—a goal of the ITS community and the National ITS Architecture—can be achieved if all DMS recognize the same data elements in the same format or structure.

THE PROCESS

In September and October 2000, personnel from nine transportation agencies (see box on front) responded to a comprehensive questionnaire about lessons learned during their implementation of NTCIP-based DMSs. The nine agencies had implemented nearly 60 DMSs, with nearly 80 others in process or planned; altogether, these DMSs represented five manufacturers.

The questionnaire solicited information about experiences and observations concerning DMS procurement, installation, and operational stages. As the agencies answered the questionnaire, their DMSs were in different stages of completion—installation in progress, in acceptance or operational testing, or in full use.

The agencies decided to use NTCIP standards for DMS implementation for several reasons:

- Ease of integration and interoperability
- Elimination of software compatibility issues during implementation
- Avoidance of proprietary software issues (particularly with multiple vendors)
- A desire to be proactive and in the forefront of standards compliance
- Recognition that standards are encouraged for Federally funded ITS projects.

The DMSs of the responding agencies are generally part of a larger system, such as a city or state traffic management system, rather than individual signs for traveler information. While their ITS deployments involved different groups (e.g., city, state, and Federal decision-makers, traffic engineers, vendors, consultants, information service providers, and motorists), the responses in this report were primarily from agency transportation engineers.

THE IMPACT

The survey demonstrated that diverse experiences resulted from implementing ITS standards in DMSs. The degree of ease in using the NTCIP standards for deploying DMSs also varied. Some agencies were clear that the standards helped them achieve interoperability and/or interchangeability, though most used some type of qualifying remarks in that regard. However, most agreed that the overall impact of standards on their final DMSs was both positive and a good decision.

BENEFITS REALIZED

Overall, participating agencies realized significant benefits. Achieving interoperability and interchangeability was the major incentive to use standards. Most respondents agreed that the use of standards allowed them to get more benefits than with the more typical custom procurements.

Respondents also commented on the benefits they expect to realize when future system enhancements and maintenance are needed. For example, enhancements to standards-based systems should be transferable among different sites. Also, system maintenance and life cycle costs should be more affordable. In time, engineers will be able to maintain standards-based systems more easily because they will be familiar with the operations used consistently in the systems. Thus, engineering staff will not have to be retrained to work on a new system.

The participants recognized that they will have a larger choice of vendors as standards mature. The resultant expanded competition will keep prices down and provide options. Also, the standards will enable them to use non-proprietary software and help achieve interoperability.

PROBLEMS ENCOUNTERED

Use of draft standards can cause problems. Three of the agencies issued an RFP based on draft standards, but were disrupted by software changes and inconsistencies resulting from changes to the standard. These respondents felt that NTCIP standards were slow to mature. For example, when one agency added a second vendor, they had to make software modifications; they felt this was due partly to the use of draft standards and partly to deficiencies or vagueness in the current published standard.

Specifying NTCIP alone is not adequate. An agency must further define its requirements, specifying the required and optional parts of a standard in detail during procurement. There are payoffs when an agency understands what it needs and properly specifies its standards requirements in its procurements.

Other problems the agencies noted include:

- Difficulty and expense associated with getting the references in the NTCIP Guide (i.e., would have been helpful to have a summary of all the NTCIP references)
- Specifications that are too loose
- The need to rely heavily on available consultants because of scarce in-house expertise

One agency thought it would be useful to have a standard list of examples on how to do certain steps (i.e., have an example of a complete message broken out so that the agency or vendor developing the code could understand and interpret it). Another agency found testing and verification to be difficult in most of their NTCIP implementations; they found that the NTCIP Exerciser has good overall qualities, but needs to be enhanced to provide a more robust user interface verification of NTCIP standards. (Note: The Exerciser is a software tool developed to test the ability to transmit and receive NTCIP objects. It is designed to verify the communications process by allowing the user to determine if the objects are in an NTCIP format and are transportable.)

NEXT STEPS

A number of ITS standards associated with key ITS elements are anticipated to mature in the 2001-2003 timeframe. In some cases, maturity will bring additional functionality and data elements. To a large extent, this maturing process must build on previous experience of ITS standards lessons learned to help personnel who are interested in deploying comparable devices in projects of roughly comparable size and scope (see the sidebar on the last page for contact information).

Interested parties are strongly encouraged to review the ITS Standards website at <http://www.its-standards.net>. The website provides access to valuable standards information as well as a database on contacts who have successfully used DMS standards to develop operational systems.

Another useful reference is the ITS Peer-to-Peer Program, which provides free technical assistance to agencies seeking to improve transportation operations through the deployment of ITS. Any public agency that is involved in the deployment of integrated ITS technologies is eligible to receive assistance through the program. Contact the ITS Peer-to-Peer Program at 1-888-700-7337.

The primary ITS standard tested by the agencies was a device object definition: *National Transportation Communications for ITS Protocol (NTCIP) - Object Definitions for Dynamic Message Signs (DMS) (NTCIP 1203, formerly NEMA TS 3.6-1997)*.

Secondary NTCIP communications standards or device object definitions tested by some of the agencies include:

- *Simple Transportation Management Framework (STMF) (NTCIP 1101, formerly NEMA TS 3.2-1996)*
- *Class B Profile (NTCIP 2001, formerly NEMA TS 3.3-1996)*
- *Global Object Definitions (NTCIP 1201, formerly NEMA TS 3.4-1996)*
- *Point-to-Multi-Point Protocol Using RS-232 Subnetwork Profile (NTCIP 2101, formerly NEMA TS 3.PMP232)*
- *Simple Transportation Management Framework (STMF) – Application Profile (NTCIP 2301).*

LESSONS LEARNED

The following advice is offered to future deployers of NTCIP-based DMSs:

- Using NTCIP standards is a big step toward obtaining interchangeability and interoperability for DMS. Standards help you select from a larger choice of DMS vendors and avoid using proprietary software.
- During procurement, building on what others have learned helps you get just what you need.
- It is wise to obtain references on DMS vendors. Use of vendors who already have installed NTCIP-based DMSs reduces risk. Research several DMS manufacturers and ask for their NTCIP specifications and timeframe for installation before selection.
- Access to expertise in specification writing and testing is crucial. If you do not have experience with NTCIP and DMS communications, hire someone who does.
- It is helpful to have a tight RFP - one that is very specific about DMS communications (i.e., the computer “vocabulary” and the management and control of data) and other ITS standards that apply to the project.
- Make sure you specify in the RFP, not just NTCIP but the exact standards—and even the DMSs and global objects—you want. In particular, be very specific about communications planned for the signs, and lay out specifications for fiber, phone lines, and data exchange rates.
- Consider using a weighted RFP that allocates points for standards use, functionality, manufacturer’s experience, warranty, price, and documentation.
- Specifications should call for just the standards and data message sets needed to support the proposed system. If you follow a blanket approach of specifying all standards and data message sets, the development cost will increase greatly due to software that will not be used.
- Give specific information about the capabilities to be provided and a test procedure to demonstrate the capabilities.
- Ensure that the software is compatible with the operating system used by each component.
- Get a warranty that covers firmware and software from the vendor.
- Consider placing firmware and software code in trust; you will then have a guarantee that if the owner becomes unavailable, another vendor can work on the code and use it in the future.
- Try to devise a solution that minimizes the use of custom message sets.
- Document in great detail all vendor-specific data message sets and vendor and integrator software.
- If multiple agencies are involved, make sure they are communicating during the development of data message sets.
- It is critical to follow standards for communications installation and maintenance.
- Make sure the vendor will provide assistance during the testing (passing the test will also benefit the vendor).
- Try to use the NTCIP Exerciser to test DMSs.
- Finally – and extremely important - don’t assume that best price is the solution! Incorporating standards is an investment in the future.

Contribute to the next series of lessons learned

The ITS Joint Program Office of U.S. DOT has initiated a program to document lessons learned by first-time users of ITS standards. The program helps users of ITS standards build on the success—and avoid the problems—that early users have experienced. The reports are to be short, written in a non-technical style, and targeted to state and local public transportation audiences. To contribute lessons learned in your area in order to help others use the ITS standards, contact Jerry Pittenger at pittengj@battelle.org, or call 614-424-5189.

“Good planning now ensures interoperability in the future.”

CONTACT INFORMATION

For further information on the Lessons Learned Program:
 Name: Jerry Pittenger
 Organization: Battelle
 Telephone: 614-424-5189
 Email: pittengj@battelle.org

For further information about the NTCIP testing process, contact individual transportation agencies listed or obtain contact information via:
 Name: Don Creighton
 Organization: Battelle
 Telephone: 509-375-2333
 Email: don.creighton@pnl.gov

This document is one of a series of reports on lessons learned about ITS Standards deployment. The report was prepared by interviewing state departments of transportation and other transportation agencies during September and October 2000.



U.S. Department of Transportation

ITS Joint Program Office
 Room 3401, HOIT
 400 7th Street, SW
 Washington, DC 20590
 Phone (202) 366-9536
 Facsimile: (202)366-3302
 Or visit our ITS Standards Web site at:
<http://www.its-standards.net>

Publication#
 Doc#
 Spring 2001