



**Meeting Summary and Conclusions
Standards Testing Stakeholders Workshop
April 3, 2002**

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Overview

Grant Zammit (FHWA Southern Resource Center) provided a brief introduction to the day's meeting. FHWA is seeking to determine its appropriate role in testing related to ITS standards. The overarching Congressionally-mandated objective for FHWA is to promote interoperable ITS, especially in areas related to the infrastructure. Today's discussion will center around NTCIP, as the major infrastructure-oriented ITS standards effort currently underway, but other standards area are fair game as well. FHWA's premise is (a) standards-related testing can help to promote greater, quicker, broader and more confident deployment of standardized ITS products and services and (b) such deployment will contribute significantly to the desired national interoperability. FHWA's objective today is to explore this premise with stakeholders, learn what kinds of testing would be valuable (and for whom), and gather stakeholder views on the appropriate role for FHWA in this process.

The remainder of the day consisted of open discussion on five primary subjects. (The numbering starts at 0 to preserve the numbers of the last four topics):

0. Interchangeability and interoperability: What deployers think they are getting
 1. Testing needs of deploying agencies
 2. Testing needs of manufacturers
 3. Testing needs of designer/system integrators
 4. Opportunities and future directions

Each of these areas is summarized below. This report concludes with a series of Action Items from the meeting.

Discussion 0 - Interoperability and Interchangeability

Meaning of interoperability and interchangeability still controversial.

There is still a lot of controversy about what is meant by interoperability and interchangeability. Part of the issue is that NTCIP is a communications protocol, but traffic engineers out on the street don't look at communications streams, they look at the behavior of devices. The concern was expressed that people think "conformance to NTCIP" implies interoperability and interchangeability. People are disappointed to discover that this not the case and that NTCIP conformance also doesn't necessarily mean that devices will include all of the functionality that is expected (or more to the point, all the functionality that they had in a previous system). Compliance is a necessary condition for interoperability, but it is generally not a sufficient one.

Conformance does not necessarily produce interoperability and interchangeability.

Conformance statements must reflect user expectations.

It was noted that end user expectations need to be captured in the conformance statements associated with a standard (NIST has guidelines for doing this).

Functionality is the important issue.

Nonetheless, there was general agreement that defined functionality was the important issue for interoperability and interchangeability. Once proper standards relating to functionality are in place, then talking about interoperability and interchangeability becomes much easier.

Summit to get more agency people involved?

The idea was proposed for a follow-on testing summit to get more agency operating personnel involved.

Some agencies have difficulty specifying desired functionality

It was observed that some deploying agencies don't really know how to specify the functionality they want and have no way of judging whether a manufacturer is in compliance with these specifications. One problem is that the NTCIP Management Information Blocks¹ are sometimes too complicated to agencies to understand. Agencies would benefit from having functionality broken down into smaller, more easily digested pieces.

Many agencies use only part of available functionality.

On the other hand, it was observed that many agencies only use a small fraction of the available functionality. They don't have the resources to exploit sophisticated features and may not actually have much need for them.

¹ MIBs; "computer text" that describes the organization of a database that will be created in the memory area of the computers where it's installed. -- <http://www.ntcip.org/library/mibs.asp>

Discussion 1 – Agency Needs

The focus of this discussion was where standards and standards testing fit into the process that an agency goes through to procure, install, operate, and maintain an intelligent transportation system that makes use of accepted industry standards.

Three kinds of testing of interest to agencies. The first observation was that there are at least three kinds of testing that may be of interest:

- a) Testing of the standards themselves to make sure they address the features they're supposed to, to enable the implementation of ITS. This is the subject of the Battelle testing effort now going on.
- b) Conformance testing, to see if a product does what the standard says it should do (communications and/or functional testing)
- c) Acceptance testing, to help users determine if the products they bought meet their needs (functional testing)

Some of this is in place, but it is not consistent.

Wide variation in agency capabilities for developing specs and for testing. Many participants observed that agency capabilities vary widely and that testing (and other) needs also vary widely, including the need for U.S. DOT to help. Some states are leaders (e.g., California DOT) and other states sometimes adopt the specs they develop. However, there is no assurance that these specifications actually conform to standards or that they can always be successfully or consistently adopted by others. This is in part because the conformance statement for the standard has not been finalized. Some specifications may be very specific to the lead state, and it is not their job to support other states that want to adopt their spec. It would be helpful for the lead states' specifications to get validated in conjunction with the national standards efforts. However, the priority of this task, among all the other needs, is undetermined. Some large states including Texas and Florida are willing to be flexible on how they do things in order to be standardized.

Helpful to validate specs of "lead" states.

Many states are not deploying standardized technology. We need to understand why many jurisdictions are not deploying standardized technology. There is a need first to better incorporate the grass roots functional requirements and be able to answer questions like How much does it cost? How does it work? How can I minimize the number of change orders? For example, the NTCIP ASC standard does not include the requirement to download *time*. This limits its functionality. Operational issues always need to be considered in developing functionality.

Grass roots issues, including cost and risk, need to be addressed New technology and standardized systems are viewed as high risk by many agencies. We need to better enhance the awareness of agency personnel on what standardized technology can do for the user and to find ways to mitigate both actual and perceived risk.

Need common functional specs. Want national QPL.

Costs need to be shared.

Standards should help agencies write their specs.

NTCIP tries to do this, but problems exist.

Agency requirements need to be clearly articulated in standards

Need to distinguish states that have testing capabilities from those that don't.

Simple automated tools would be very helpful, but some agency

Common functional requirements are essential. This is difficult but doable. Many states would like to see standards and a qualified product list (QPL) that would help to contain risk. Some states are already testing products to see if they conform to standards. However many states can't afford such a program and no state can afford an unbounded program of this kind. Having national standards allows this burden to be spread and for results to be better shared.

It is important to write standards that help agency's write conforming specs. It can be very helpful if another agency has already put products through their paces.

It was noted that the conformance components of NTCIP standards are intended to help users create NTCIP compliant specifications in a straightforward way and that this information is delivered in NTCIP training courses. This is working in some projects; however, a gap remains in overall community acceptance and widespread inclusion.

It was suggested that the specification callouts are at too low a level and that important functionality is not represented. It was observed that the standard ends up providing "least common denominator" specifications. This is the price of getting consensus, but it tends to leave important functionality out and sometimes makes the list of exceptions to a base specification longer than the base spec itself. Having a table of mandatory requirements doesn't provide a good connection to the testing process – more guidance is needed in getting from one to the other.

A better job needs to get done of incorporating actual agency requirements into the standards, requirements that are broad enough to be serviceable. One problem is ambiguities in definitions that don't show up until later – we think the definitions are clear, but they are read differently by the suppliers. This is an area in which a lead state could be helpful.

This has been a particular problem in the case of signals, for which the existing communications infrastructure is often not capable of supporting the requirements of the standards, and retrofitting is awkward or cost prohibitive. Communications analysis is not getting done at the right point in the process.

It was observed, however, that included functionality is often a negotiation between users and manufacturers on what can be done.

In thinking about testing and related roles, a distinction should be made between states with in-house testing capabilities and those without such capabilities. Testing capabilities need to include both the ability to test products against standards and to test products against needed functionality. Tools, especially simple, automated tools that help to identify problems would be very helpful. Testing tools should separate communications testing from functionality testing. Products have to get messages correctly, but also have to act on them correctly. Most agencies don't have the communications experts on hand who can decipher protocols as messages

capabilities are still needed.

through wires. One helpful tool would be one that indicates whether messages are correctly received and acted on.

FHWA already has some testing software (e.g., to ping controllers), but the concern was expressed that this software tends to be piecemeal and not always easy to use. However, agencies would welcome simple tools (e.g., via a CD-ROM that accompanies a product that finds and tests all devices) and establishing labs to exercise them. Ideally, the product would produce a “green light” indicating no problems, or a “red light” accompanied by a list of problems. It was suggested that standards include conformance criteria which tools can validate against. It was also observed that while people like neatly packaged solutions, a basic level of capability is still going to be needed at agencies.

Who should build testing tools?

Participants discussed whether tools should be developed by the public or private sector. It was noted that the Southwest Research Institute built an NTCIP compliance tester with funding from TxDOT and that Trevilon is working on a commercial product for compliance testing.

One tool for consistency or competing tools to encourage market development and test product evolution?

The tradeoff was discussed between having a single tool that everyone uses vs. encouraging marketplace competition to drive development of good tools. It was observed how important it is not to have a proliferation of tools. For example, NIST developed an XML tester incorporating contributions from the private sector, but retained overall control. It is important to have tools and test suites perceived as unbiased.

The dilemma is that multiple tools may not yield consistent nationwide results, but as soon as FHWA says it will develop its own tool, all private sector development stops. If this development lags, the industry ends up in limbo with no tool. There is also the issue of who is responsible for maintenance and upgrade. It was observed that standards are subject to interpretation and that there are some holes in NTCIP, which makes uncontrolled test tool development risky.

Tools could/should be independently certified.

One approach is for testing tools to be independently certified. This implies the need for well-defined requirements and usability rules. One oversight responsibility is to run the proposed test tool against multiple product implementations to work out bugs. If ambiguities are revealed in this process, they should be fixed. However, ambiguities should not be regarded as a license to reinterpret a standard to serve your own purposes. This needs to be controlled. However, who should do the certification and control? In general, standards developers should not be test tool developers, since they will carry over their particular view and not root out the ambiguities as readily.

Testing tools must be traceable back to original standard.

Is the testing tool a simulator? a reference implementation? For NTCIP, it will need to include both mandatory and optional MIBs. Does the test tool *become* the standard, for practical purposes? One clear requirement for validating test tools is traceability back to the original standard. The working groups that develop the standards need to develop conformance statements that will be used in developing the test tools. If the working

group states the test procedures, then the tool is just a way of automating these procedures. Testing will probably still uncover some additional ambiguities.

The Spec Wizard itself may in some way influence the traceability to the original standard, or influence the approach for developing testing tools.

Test procedures should be part of standards development.

Ideally, establishing the test procedures will help clarify the language and intent of the standard, especially regarding functionality. That's a good reason to write the test procedures as part of standards development.

There is an opportunity for FHWA, through its resource centers and divisions, to work with state agencies to minimize misinterpretations.

Object definitions → operations scenarios → functional requirements → standards and tools

In general, it was suggested that the first thing needed was an operations scenario that everyone could agree on and that would cover a wide range of individual cases. Clear definitions of the objects need to precede the development of the scenarios. The scenarios would then lead to requirements for functionality and communications, to which both standards and testing tools/ simulators could be responsive.

Consensus possible if enough people brought to the table.

It was felt that a consensus on the operational scenario could be reached, provided there was sufficiently broad participation, especially from people at the grass roots level who don't ordinarily participate in standards work. The concern was expressed that it can be difficult to get these folks to the table, especially if they are really not interested in changing the way they do things. It was observed that the approach to getting agencies to adopt standards will be different for agencies who simply don't want to change vs. agencies who perceive new technologies as potentially risky.

May need to re-document practices and requirements for existing standards.

The particular approach, and the people who need to be gathered, may vary from one kind of product to another. If the process of defining scenarios and selecting objects is different for, say, DMS than for Signal Systems, then we need to deal with them one at a time. There may be a need to go back and re-document actual practices and requirements, perhaps as part of the Expedited Process.

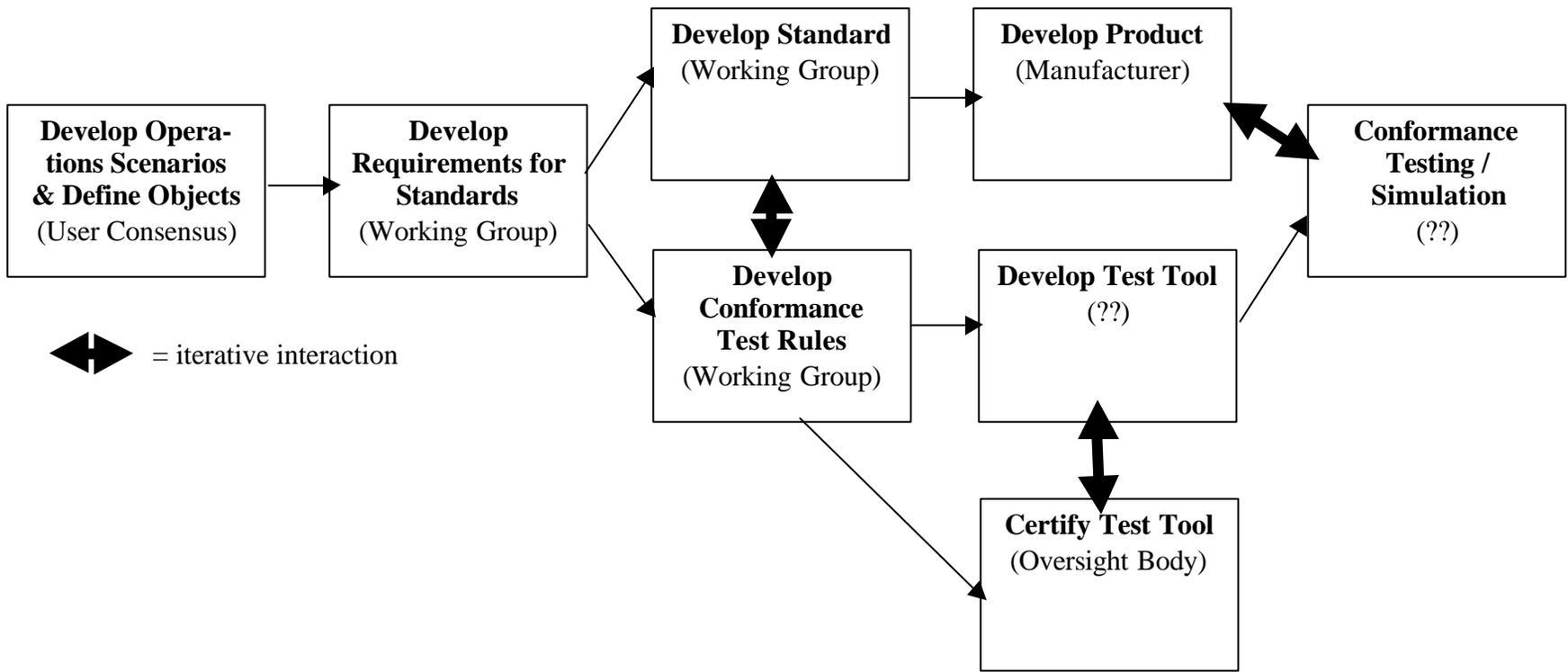
Federal role.

The Federal role was discussed. There continue to be concerns that Federal direction and requirements are not always a good fit to agency needs and that too much Federal push on standards could result in a poor product. Federal funding is of course welcome, as well as Federal participation in working groups. A desire was expressed to see the same level of cooperation between states and U.S. DOT on electronic infrastructure as there has been on physical infrastructure.

Federal cooperation and funding needed and welcome.

Need to develop comprehensive strategic plan.

The development of a comprehensive strategic plan was proposed that would belong to state agencies and vendors as well as to U.S. DOT. An important objective of such a plan should be to engineer a level of confidence so that the industry proceeds to adopt standards without mandates. FHWA representatives expressed the desire for FHWA to serve as a facilitator and partner.



Discussion 2 – Manufacturer Needs

The focus of this discussion was on where testing fits in the process that a manufacturer goes through to create ITS products and systems that adhere to relevant standards and respond to marketplace needs.

- Testing tool beneficial to manufacturers.** Manufacturers generally felt that a good testing tool would be very helpful, with the potential to save a great deal of time and cost. There was agreement that having a disinterested third party do final testing is a good idea: manufacturers tend to be a little optimistic based on their own testing, which is done under laboratory conditions rather than real-world conditions. But having objective test tools for manufacturers to use would considerably speed up their process.
- Uniformity is important.** Uniformity is a major issue. Manufacturers do not want to have to repeat tests over and over again for different jurisdictions. If manufacturers pass tests in one jurisdiction but fail in another, the tool is not doing its job. Although each implementation has different requirements, the basic components of a system are the same: objects are objects, and they are either properly supported or they aren't.
- International model for mutual test recognition might work for states, too.** It was observed that in international commerce, there are mutual recognition agreements among countries. These usually work by agreeing to recognize the outputs of a test report. There may be different requirements on what the scores have to be, but at least the test report is in common. If this kind of arrangement works among different countries, it ought to be workable among states.
- Reasonable test series could provide 80% of need.** While a single test would probably not provide sufficient coverage, it was felt that a reasonable series of tests could be devised to cover at least 80% of what was needed. (For the remaining 20%, the requirement is for a standardized process for assembling and conducting the more specialized tests.) The main body of tests and their related tools would need to be certified, configuration managed, and maintained. It is recognized that this development and other life cycle activities require time, money, and independence from undue vendor influence.
- Need to be certified and maintained.**
- Independent testing lab for certification.** Ownership and funding issues were discussed along with appropriate mechanisms for defining and developing the tests and tools. It was felt that getting the right people around the table was an SDO responsibility. If there are multiple competing tools, certification and consistency of results is particularly important. One approach is a private sector (or state- or university-affiliated) testing lab certified by users. If the tool is in the public domain, there needs to be a commitment from FHWA on funding for development and continued support and upgrade. One possibility is initial Federal funding to get a testing facility started, but with the intention to be fee-based in the future.
- Funding model to support lab.**

Federal Role

The discussion of manufacturer needs generally characterized the Federal role as one of oversight, coordination, and seed funding, but with as much delegation of activities to the private sector and the states. These activities included tool development and the establishment and certification of testing laboratories. U.S. DOT could also provide leadership and a forum for establishing mutual multi-state recognition of test results.

Discussion 3 – Integrator / Designer Needs

The focus of this discussion was on the ways that standards-related testing could serve the needs of system integrators and designers, as part of their process of developing, marketing, implementing, and supporting standards-adherent solutions.

Many system integrator problems are unrelated to testing.

System integrator problems regarding NTCIP for the most part are not related to testing. Integrators find that the market is relatively small, and it has been hard to sell NTCIP and the benefits of conformance and compliance. Integrators [state agencies] mostly don't see the benefit of being the first to offer [adopt] NTCIP solutions, and they do see additional up-front costs. In addition, the integrator is caught between users' needs and vendors' abilities to supply to needs. The standards specified by deploying agencies are sometimes out of date. Better education is needed for the agencies on where technology is today and what standards are applicable.

Need for education and tools.

Agency consultants not always well trained on standards.

The consultants who are often involved in writing specification for agencies are not participating in the NTCIP outreach/training process. Therefore, they are not always well informed on standards and not able to advise customers regarding them. Agencies need to provide encouragement to consultants to get this training. They might get better systems if they were willing to defray the cost of this training. It was observed that consultants often can't get into NTCIP classes and that many of their customers are not interested in having NTCIP pitched to them. Agencies ask if NTCIP is compulsory and are relieved when they hear it isn't.

System level testing support is a long term goal, but it is not too soon to get started.

Testing support (e.g., a testing clinic that provides an ability for consultants, vendors, and agencies to network and to walk through the testing process) is viewed as a long term goal. First, the testing group has put together a plan and procedures. However, it may not be too early to start getting everyone on board, possibly via a workshop at the TRB 2003 Annual Meeting.

In any case, there are lots of short term developments that would be helpful.

For the long term, a national program to help with / do testing could be very helpful, since testing is a very expensive undertaking for integrators and their clients. Software tools that created a baseline would be of advantage to integrators and give them something tangible to bring to their customers. In the meantime, it would be helpful to have a program that certifies field devices. At present, there are a lot of mandatory and optional, as well as proprietary objects that could be tested, even if we're not ready to do testing at the system level. Again, consistency of results from these test tools is very important.

Federal Role

The most pressing activity requiring Federal assistance is the expansion and modest redirection of the standards education and outreach program so that it will more reliably reach (a) grass-roots agency personnel responsible for deploying, operating, and maintaining infrastructure based system, and (b) the consultants who are often deeply involved in system specification.

As above, a Federal role is appropriate to help ensure a nationally consistent testing program.

Discussion 4 - History, Opportunities and Future Direction

The focus of this discussion was on next steps in the light of past experience.

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| Cradle-to-grave support for a small number of early adopters may not be the best way to proceed. | Encouraging early adoption of standardized products and providing selective cradle-to-grave support was discussed. It was observed that in the NTCIP realm, initial efforts at supporting early adoption may have been counterproductive, since only a single vendor was providing products. Going forward, supporting a single pilot project may provide an unfair advantage to a particular vendor or integrator. |
| Inputs needed from other ITS-related SDOs. | Interest was expressed in getting views and experiences on early adoption from outside the NTCIP community (e.g., from SAE, ASTM, IEEE). |
| Targeted assistance may be more productive. | The concern was expressed that the people who are responsible for construction tend not to be the people who sit at the strategic table. Field personnel look at change orders and how to get projects in under budget and on time. One possible approach is to provide targeted assistance to adopting projects that run into snags, rather than picking projects for cradle-to-grave support. This could provide an alternative to giving up too soon, abandoning standards, refocusing on tried and true, and giving standards a bad name. Although it may not be easy to redirect funds on the fly, if the goal is properly stated, a mechanism might be found to implement this approach. |
| Federal support for expedited NTCIP projects could be fruitful. | The NTCIP project has proposed a small grant program in which early adopters would agree to use current versions of standards in deployments. A small grant from FHWA would provide technical services to aid projects that were committed and well under way. The grant would fund domain experts to help with the development of procurement specifications, fund case studies, and provide for workshops and marketing of the successes (or revealing the problems). The early adopters would also receive kudos for their pioneering spirit. Faster results and findings will lead to faster enhancements and revisions to the standards. |

Action items

The following action items resulted from the concluding discussion:

1. Develop a strategic plan focusing on ITS standards testing. The NTCIP Testing Working Group will draft a strawman plan for others to comment on. The plan should at least address:
 - Long range issues
 - The role of a testing laboratory, including who would operate it and how it would be funded
 - The creation of a national qualified product list (QPL)
 - Early adopter issues
 - Where in the system lifecycle testing should be applied (with more focus on early testing)
2. Develop a paper providing an overall perspective on ITS standards testing that includes all the SDOs who contribute to the ITS marketplace, i.e., at least SAE, IEEE, and ASTM as well as the NTCIP group. – FHWA
3. Develop a new focus on education and outreach that:
 - Provides training for the consultants who write system specs
 - + Spec Wizard may be part of training, but it needs to be vetted and a number of other issues need to be resolved – FHWA and ITE
 - Does a better job of including the grass roots field personnel who are actually responsible for deployment – FHWA and ITE
 - Coordinates with IMSA (International Municipal Signal Association). NTCIP already has a speaking slot reserved at their August 2002 meeting in Crystal City – ITE
 - Does greater outreach to other members of the ITS community FHWA and ITE
4. Develop operational plans and scenarios to back up the standards requirements that will turn into testing requirements. – Respective Working Groups
5. Establish a framework for the development of testing tools (both individual tools and sets of tools for suites of standards), for bringing resources to bear to assist in implementing and using the tools and for their long-term support. – NTCIP Testing Working Group, in cooperation with FHWA
6. Work with NIST to identify suitable ways for NIST to serve as a resource in our process. – FHWA
7. FHWA should clearly identify and state its wishes and expectations for standards testing, desired outcomes, support for early adopters, case studies, etc. – FHWA