

Summary of Results
Field Device Testing Needs Workshop
NTCIP Testing & Conformity Assessment Working Group
April 22, 2003

Background

The NTCIP Testing and Conformity Assessment Working Group (TCA) takes as given that appropriate testing of standards and standardized devices will help to promote the widespread adoption of standards in system specifications and products, and thereby help to promote greater interoperability, a more competitive marketplace, and more robust traffic management systems that are less expensive to acquire, operate, and maintain throughout their life cycle. The challenge is to determine what appropriate testing actually is and to provide the foundation and mechanisms through which this testing can be economically and reliably carried out.

To address this challenge, TCA conducted a Workshop on NTCIP Field Device Testing Needs, on April 22, 2003 in New Orleans. The Federal Highway Administration (FHWA), ITE, NEMA, and AASHTO supported this effort. About 80 people participated, representing:

- State and local departments of transportation
- The U.S. Department of Transportation
- Traffic management system manufacturers, vendors, contractors, and consultants
- Standards development organizations (SDOs) notably, but not exclusively, the SDOs that make up the NTCIP Group: AASHTO, ITE, and NEMA
- Testing organizations
- Universities

By design, a majority of the participants were working traffic engineers responsible for the specification, procurement, acceptance, installation, operation, and maintenance of real-world traffic management and control systems.

The participants were divided into nine discussion groups. Each group, to the extent possible, contained people with similar backgrounds and interests (i.e., state DOTs in one group, vendors in another, etc.)

A series of questions was posed, one at a time. Each question was discussed by the groups separately, and then a panel was formed, consisting of one representative from each group. Each panel member presented his or her group's conclusions to the entire workshop population and the question was discussed among the panelists and other workshop attendees. A summary of the responses to each of the questions appear below.

There were some overarching reactions and conclusions:

- Deploying agencies' primary testing interest is in determining whether field devices do what agencies want them to do. Testing conformity to standards is a distant second.
- Nonetheless, there was a recognition that good standards prescribe and encapsulate desirable device behavior and performance. To the extent that conformity testing assures these kinds of characteristics, it relieves deploying agencies from having to individually test for them.
- Many deploying agencies want to, or have to, rely on others for the bulk of testing. This reflects the fact that many agencies cannot afford to conduct their own testing. It also reflects the desire to avoid duplicated efforts. Finding and qualifying outside testing and testers is a major challenge.
- The ability to trace testing activities back to requirements (and to trace requirements forward to testing activities) is essential to success. Tools to assist in specifying systems and developing tests are greatly desired.

Summary of Responses to Questions

1. From a Technical Perspective, what is important to you with respect to Field Device Testing?

Testing was recognized as important. From an agency perspective, the best kind of testing would take place prior to acquisition, so that products can be produced and deployed seamlessly. This was recognized as hard to achieve, based on the variety of environments and circumstances under which devices would be deployed. It may be possible to pre-test certain core characteristics, including some functional characteristics and environmental robustness (e.g., heat and vibration resistance). These are the tests for which third-party testing is most viable. Even if testing is done in-house, a standard testing suite for core functionality would be valuable. The high speed at which product development and evolution occurs makes configuration management for devices and core testing processes essential.

Given the variety of operating and network environments in which devices have to work, some local testing will inevitably be necessary. For speed and to contain costs, an automated process for this testing is highly desirable.

Shared experience is also valuable, and a web site with information on testing results would be especially helpful to smaller, resource constrained agencies.

2. Think about the technical requirements you identified... Which ones are important to the interoperable deployment of field devices?

There was general recognition that, fundamentally, interoperability (and interchangeability) of field devices depends on common specifications and features, from high level functionality and environmental issues down to pin configurations in plugs. However, there is not currently general agreement on what the common core of features should be. (The TCA has recognized this issue as one it needs to deal with.)

Many agencies, particularly smaller ones, look to other agencies as a source of basic specifications that can be used or adapted. Standardizing some procurement specifications would potentially be helpful.

3. Which characteristics are relevant to product conformance (i.e., to whether a product behaves the way a standard says it should)?

A key insight was that if conformance (to a standard) is going to be tested, the standard should capture as many user functional requirements as possible. Participants noted that some standards include features that most of the user community is not interested in, potentially a waste of conformance testing effort.

Different existing approaches to meeting requirements, by manufacturers and agencies, has led to variability within standards. However, this kind of variability was felt by some to be a failure of the standardization process. Others felt that disallowing all variability could result in far longer times to get standards written and agreed on. Many participants felt that standards should at least strongly limit variability and alternate approaches, since they are antithetic to interoperability and interchangeability.

One distinction was made between benign and malignant extensions to standards. A benign extension provides functionality that the standard does not address. A malignant extension permits something to be done in a different way than the standard prescribes.

If conformance testing is to be done generally, rather than individually by every agency, standards need to focus on the 80% of functionality that the vast majority of users would actually use. This can provide a baseline that everyone can agree on.

Products from different vendors should behave the same way, given a particular object value. Understanding inputs and outputs is very important and would facilitate testing.

4. Which characteristics are relevant to product compliance (i.e., to whether a product behaves the way its functional specifications say it should)?

If NTCIP standards for devices define device functional requirements, then conformance testing takes on a much bigger role. If not, then compliance testing has to bear most of the burden. Specifications often go beyond the standard, in which case compliance testing has to go beyond conformance testing.

An ongoing concern is whether a new device will work in an existing system. Agencies want to be able to open the box, plug in the device, and have it work. Users understand their own environment best (technical and political). They should be able to specify what they want and don't want.

A procurement document should specify everything that the agency wants, and will probably include things that aren't in the standard. Compliance testing provides confidence that the spec has been properly responded to.

At least a subset of requirements will be in the standard. If conformance testing is taking place, agencies should be able to restrict compliance testing to the features that are outside the standard.

Compliance testing, like conformance testing, should focus on a base level of functionality that can be used nationally. Consensus may be hard to reach, but we need to move forward using a base that agencies can build on if necessary.

5. How should third party testers be accredited so that they have credibility with you

Key characteristics of third party testers include independence, no vested interest in testing outcome, and ability to protect manufacturer intellectual property. The tester could be an individual, a company, or a university. (Different participants had varying levels of enthusiasm for these alternatives.) Accrediting organizations could be an individual SDO, a consortium of SDOs (like the NTCIP group), a consortium of leading states (e.g., Florida, California, New York), U.S. DOT, or a national accreditation board established by the industry.

Some participants felt that individual testers should be accredited (like Microsoft technical certification). Some felt that accreditation at the organizational level was more relevant. Testing tools and test suites may also require approval. One issue is whether the outside tester develops the test suites or just carries them out. Some participants argued for a national test suite to avoid an environment in which products may pass tests in some environments but not others, potentially making conformance/compliance a contest rather than a replicable process.

Some participants suggested that the key to success is accredited formal procedures and tester independence.

6. In the context of NTCIP testing, what has worked for you to help you confidently deploy field devices?

Defining and documenting a process for testing is essential. The process needs to be able to evolve over time and to be visible to interested parties. It needs to clearly define the test procedures with no leeway for being wishy-washy. Test procedures have to track back to requirements. The process can be embodied in a software tool.

Borrowing good testing processes from other states has worked well for some agencies. Several agencies have had good experience using system integrators or third party testers for doing the testing.

A good procurement document that lays out the test environment is extremely helpful. It should identify who does the testing, who is responsible for making fixes, etc.

Test equipment must be properly calibrated. Setting up compliance boards to certify testing results has been successfully used in some environments.

Planning for a “burn-in” period that covers major processing cycles can be valuable in areas where it is impossible to test all possible cases and variations.

Plan for a variety of different kinds of testing: conformance and compliance testing, simulation testing, field testing. Don’t deploy until the level of confidence is sufficiently high.

7. In moving forward with NTCIP testing that you would find valuable, what are the next steps that should be taken? What kinds of tools, training, outreach, etc., would be valuable?

Participants suggested that TCA needs to move forward with something meaningful. States are under severe funding constraints. If we can move forward with competent testing that can be shared among states, it would help. This might benefit from some regional standards management to coordinate with and inform local agencies on what is going on in standards and testing. A “reference design” might also be helpful, especially if it led to some model deployments and reference implementations. Model documents for procurement would also be helpful.

Standardized test procedures are needed, including a process that provides guidelines for developing and validating test procedures. The specific testing plans should be developed by the NTCIP working groups that write the standards, starting with mandatory objects and working toward covering optional objects. This kind of plan should facilitate the development of testing tools, perhaps oriented to specific devices (e.g., DMS, CCTV, ramp meters). Testing tools need to play many roles: central system testing, field device testing, eavesdropper on center-to-field communications (both passive and active), etc. Particularly for communications testing, a testing tool is needed that can be plugged in between components to check on communications without interfering with operations. Some participants felt that fully automated testing was interesting, but problematic.

Many agencies would welcome an independent NTCIP testing lab. However, it is going to be hard to make a business case for an NTCIP testing laboratory funded by vendor fees – the market isn’t big enough. If such a laboratory is desirable some public subsidy will be needed.

Training needs to be better targeted. More accessible, possibly web-based, training would be valuable. In the absence of this kind of flexibility, training tends to get delivered to the people who are available or who have ready travel funds, rather than those who need it most.

Success stories should be documented and shared. Peer-peer resources should be better utilized.

Agencies were unanimous in expressing the sentiment that additional Federal funding would be welcome.