USDOT Tools for ITS Standards Deployment

Test Procedure Generator (TPG) and Center-to-Center Reference Implementation (C2C RI)

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What Will You Learn

- What are Intelligent Transportation System Standards?
- Introduction to the Test Procedure Generator (TPG)
  - Why is it important and what are the benefits?
  - How to obtain the software and get support
- Introduction to the Center-to-Center (C2C) Reference Implementation (RI)
  - Why is it important and what are the benefits?
  - How to obtain the software and get support
What are Standards?

- Established norm or requirement about technical systems that establishes:
  - Uniform engineering or
  - Technical criteria, methods, processes, and practices

- Most standards are:
  - Voluntary
  - Consensus-based
  - Open
What are ITS Standards?

- Define how ITS systems, products, and components:
  - Interconnect
  - Exchange information
  - Interact
  - Within a transportation network
Benefits

• Supports interoperability
• Supports Rule 940 compliance
• Minimizes future integration costs
• Facilitates regional integration
• Supports incremental measurable development
• Prevents technological obstacles
• Minimizes operations and maintenance costs
• Prepares for emerging technologies
• Makes procurements easier
• Easier and more robust test for conformance
Test Procedure Generator (TPG)
NTCIP Purpose

- National Transportation Communications for ITS Protocol (NTCIP) Standards provide:
  - Rules for communicating (protocols)
  - Vocabulary (objects and dialogs) for electronic traffic control equipment among different manufacturers to interoperate

- NTCIP Standards
  - Promote vendor independence
  - Reduce life-cycle costs

- NTCIP Standards address communication between
  - Field Devices
  - Management Centers and Field Devices
  - Two or more Management Centers
Test Procedure Generator (TPG)

- A survey of state and local transportation agencies in 2006-2007 indicated a need for assistance from the USDOT in developing procurement and testing documents when implementing ITS Standards.

- The ITS Standards Program determined one way to assist would be to develop a tool that generates test procedures for the center-to-field (C2F) ITS Standards in a consistent manner.

- To develop complete and correct test procedures, ITS Standards must contain requirements and other System Engineering content.
What is the TPG and How Does it Work?

- Windows based software tool that processes NTCIP Standards and outputs Test Procedures.
- Supports ITS Standard developers as well as deployers (local and state agencies) of NTCIP C2F Standards.
- TPG guides the development of test procedures by:
  - Loading and processing standard to be implemented including requirements, dialogs, and objects
  - Test Procedures based on user selected requirements in NTCIP C2F Standard
What is the TPG and How Does it Work?

- Uses standardized and consistent language for Test Procedures development:
  - Standard keywords, variables, and object names imported from standard
- Outputs an XML file for consistent interpretation for test suites
- Standards Developers use the TPG to create consistent Test Procedures and verify standards

_The TPG is not a testing tool_
Center-to-Center Reference Implementation (C2C RI)
What is C2C and Why is it Important?

- Center-to-Center (C2C) communications
- Coordination between centers
  - Incident management between agencies
  - Traffic coordination
  - Transit coordination
  - Status of network
  - Integrated Corridor Management
  - Smart Region/Smart Cities
- How do we achieve interoperability
  - Needed for exact and prompt coordination
  - Protocol must be the same
  - Message contents must have same meaning
- Proprietary implementations do not achieve off-the-shelf interoperability
Why was the C2C RI Needed?

- C2C identified in National ITS Architecture
- Regional coordination is occurring (driven by congestion issues)
- No consistent means to verify standards conformance
- The C2C standards were still a moving target
- Extensions common for C2C breaking standardized capabilities – not invented here common
- Interoperability not being achieved
- Agencies asking how to test for conformance
- USDOT sponsored development of C2C RI to encourage deployments and interoperability
C2C RI

- The Center-to-Center Reference Implementation (C2C RI) is a test tool designed to test for conformance to ITS Standards for center-to-center communications.
- Sponsored development and provided for free by USDOT to help promote implementation of center-to-center communications standards.
How Does the C2C RI Work?

• C2C RI currently works with:
  • Traffic Management Data Dictionary (TMDD) v3.03c and v3.03d
  • NTCIP 2306 v1.69

• Can verify both transmissions from owning centers and requests from external centers

• Emulates devices (version 2)

• Provides test for SAFETEA-LU Section 1201

• Verifies formats, protocols, and performance requirements
How Does the C2C RI Work?

- Can be configured to test for only your center’s requirements
- Provides test reports and logs test results
- Can be used for debugging, conformance testing, and acceptance testing
## C2C RI Capabilities Summary

| C2C RI Capabilities | Verifies TMDD v3.03c and 3.03d | Supports request/response operations | Supports Publication/Subscription operations | Provides Emulation of devices (DMS, ESS, Traffic Controller, Ramp Meter, CCTV control, Vehicle Detector, HAR, Lane Closure Gate, Lane Control Signal, Signal Section & Video Switch) | Provides Emulation of Events | Allows for local extensions as per TMDD v3.03c | Supports debugging and conformance | Configures for project needs and requirements | Automatically selects test cases and procedures | Logs test activities and results | Provides tester the ability to confirm key content in an automated testing environment | Generates test reports for conformance | Generates SAFETEA-LU section 1201 conformance report | Provides test suspension and termination capabilities | Verifies NTCIP 2306 v1.69 | Supports XML Text, GZIP, SOAP encoding | Supports XML over HTTP, XML over FTP, SOAP over HTTP | Supports WSDL & WSDL for SOAP Request-Response messaging | Supports WSDL & WSDL for SOAP Subscription-Publication messaging |
How to Obtain the Tools

- TPG v3 is now available updates include:
  - Compatibility with Windows 7 and 10 Professional
  - Compatibility with Microsoft Office 2010

- TPG Support: TPGSupport@noblis.org

- C2C RI v2.1 is now available updates include:
  - Test Case and Test Procedure Reports
  - Section 1201 Conformance Reports
  - Support for 32-bit operating systems
  - Entity Emulation Mode Option

- C2C RI Support: c2crisupport@transcore.com

For more information and to acquire the Tools please visit:
https://www.standards.its.dot.gov/DeploymentResources/Tools
Benefits of the TPG and C2C RI

**TPG**
- Agencies can use the TPG to develop consistent test procedures for verifying conformance and compliance.
- Using the TPG tool reduces developmental risks, effort, and cost of developing standards and project test procedures.

**C2C RI**
- Reduces development risks, and Costs to achieve interoperable systems.
- Easier and more robust test for conformance to standards.
- Allows you to select the requirements you want to verify.
Summary

- Agencies can use the TPG to develop consistent and reusable test procedures for verifying conformance and compliance.
- Using the TPG and C2C RI tool will reduce risks, effort, and the cost of developing test procedures.
- Promoting off-the-shelf interoperability.
- USDOT is actively seeking local or state agencies to partner with in deployment of NTCIP C2F Standards or C2C Standards using the Tools
  - Use the experience to make any necessary updates to the software
  - Get the tool into the hands of the agencies to prove its worth in the field and encourage more agencies to use the software
Contact Information

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https://www.standards.its.dot.gov/DeploymentResources/Tools