



Deploying ITS Standards Using USDOT Testing Tools

Test Procedure Generator (TPG) and C2C Reference Implementation Tools

April 2019



What you will 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
 - A local Agency's experience with the RI



Today's Speakers



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Drennan Hicks, ASEP, PMP, Noblis



**Walter Crear, Associate Vice
President, TransCore**



**Manny Insignares, Vice President
Technology, ConSysTec**



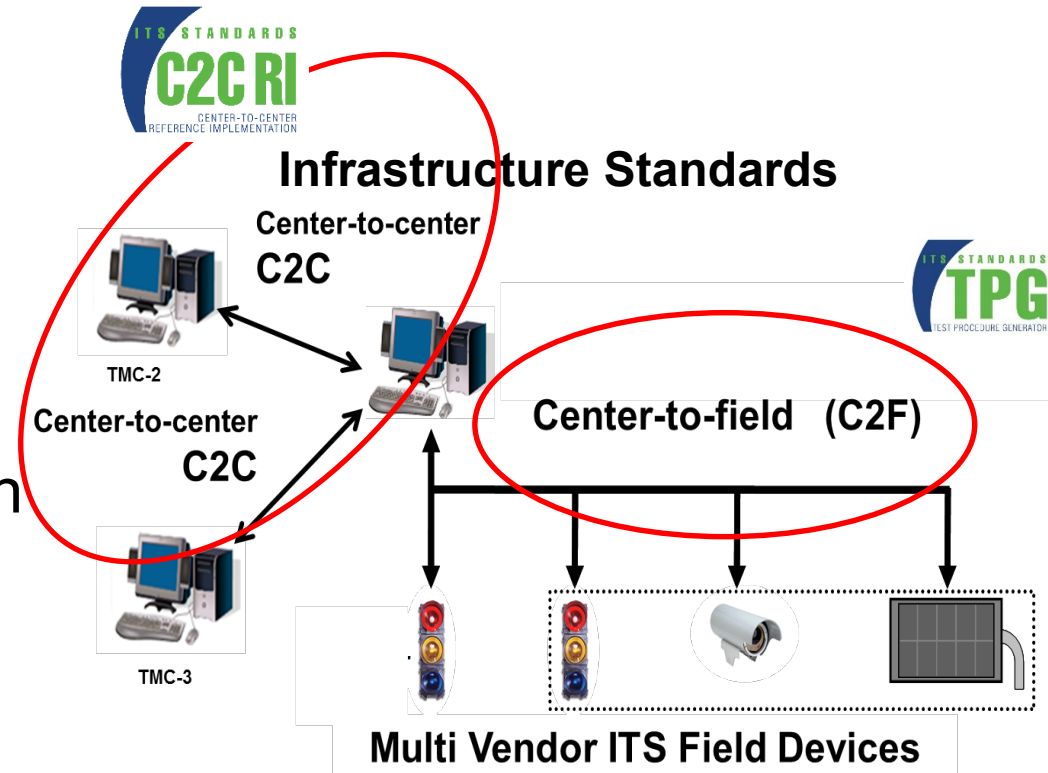
What Are Standards?

- 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 Intelligent Transportation 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



Polling Question

Have you heard of the TPG or C2C RI tools?

- ☐ Yes, I have heard of the TPG
- ☐ Yes, I have heard of the C2C RI
- ☐ No, I have not heard about either tool



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.

Standards with System Engineering Content

- **NTCIP 1203v03** Object Definitions for Dynamic Message Signs (DMS), September 2014*
- **NTCIP 1204v03** Environmental Sensor Station (ESS) Interface Standard – Version 03 with Errata, September 2014
- **NTCIP 1209v02** Data element Definitions for Transportation Sensor Systems (TSS) – Version 02, May 2014*
- **NTCIP 1210v01** Field Management Station (FMS) – Part 1: Object Definitions for Signal System Masters (SSM), September 2013
- **NTCIP 1211v02** Signal Control and Prioritization (SCP), Sept. 2014*
- **NTCIP 1213v02.20** Object Definitions for Electrical and Lighting Management Systems (ELMS), March 2011

**Standards with TPG Versions Published*

NTCIP 1203 and NTCIP 1204 Already have Published Test Procedures

NTCIP 1202 Actuated Signal Controller (ATC) Coming Soon



What is the TPG and How Does it Work?



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



What is the TPG and How Does it Work?

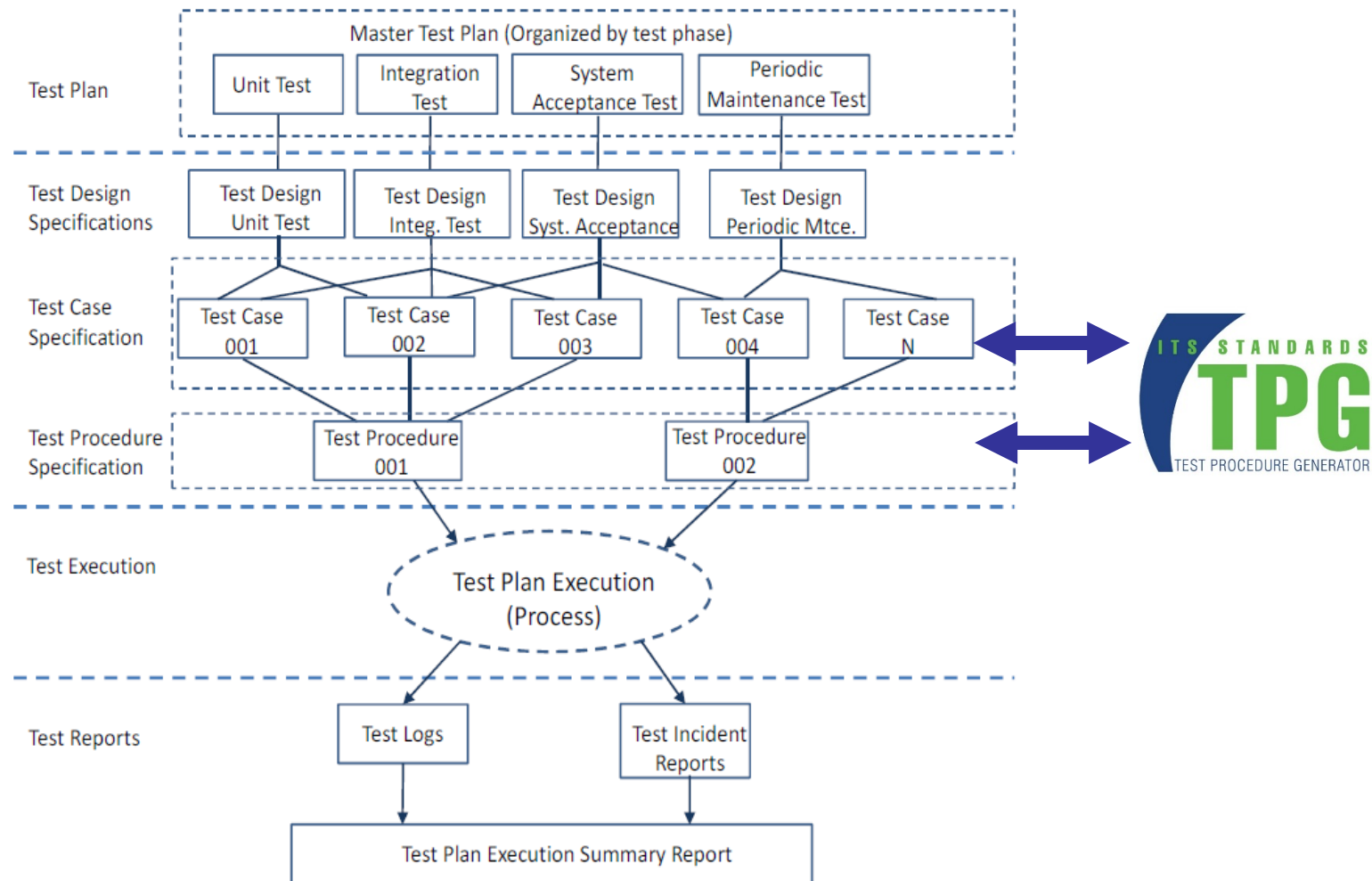


- Uses standardized and consistent language for Test Procedures development:
 - Standard keywords, variables, and object names imported from standards
- Outputs an XML file for consistent interpretation of test suites
- Standards Developers use the TPG to create consistent Test Procedures and verify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

The TPG is not a testing tool!



NTCIP Testing



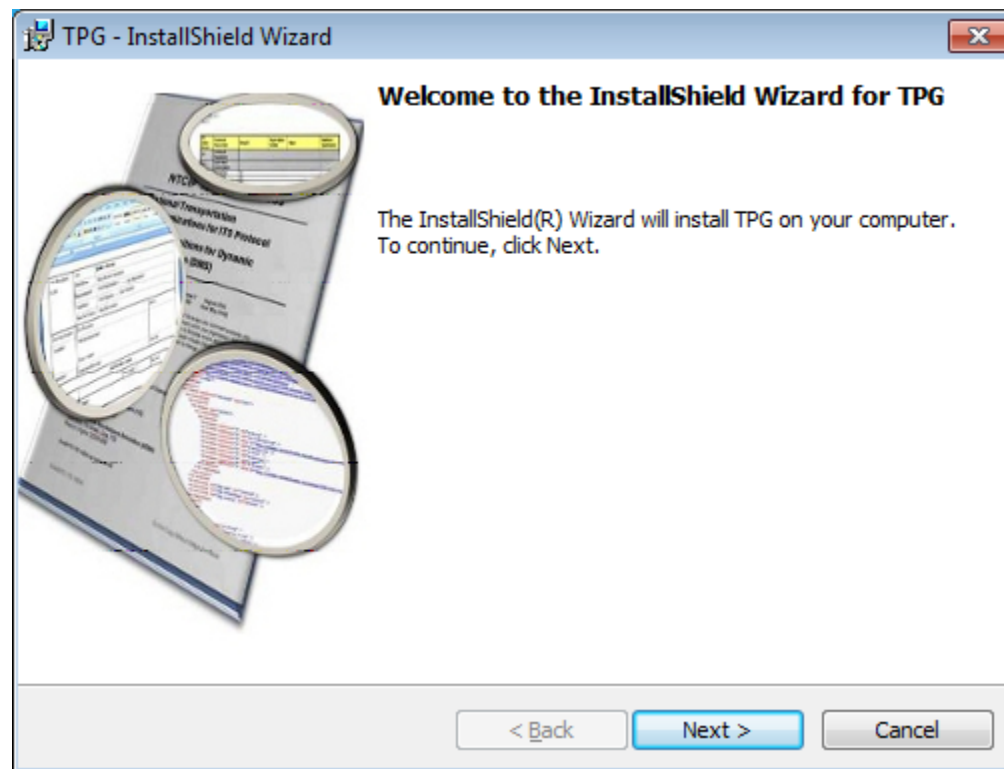
Role of the TPG in Testing

- Supports off-the-shelf interoperability
- Promotes the systems engineering process by giving users support in creating test procedures
- Standardized and easily available Test Procedures that are conformant to the standard helping to eliminating proprietary system elements



Using the TPG

- Install the TPG



Using the TPG

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

Standard Set of Test Procedures Current Test Procedure Reports

New Session

NTCIP C2F Device Interface Standard Number: 12 03 (i.e. 1203)

NTCIP Standard Major Version Number: 03 (i.e. 03)

NTCIP Standard Minor Version Number: 01 (i.e. 01)

NTCIP Standard Revision Letter (Optional): b (i.e. a)

New Session Options

☒ Open NTCIP C2F Device Interface Standard

☒ Open Most Recent Set of Test Procedures

Verification Options

☐ Verify NTCIP C2F Device Interface Standard

☐ Allow Duplicates in the RTM

☐ Open External MIB Files

Browse OK Cancel

TPG Session Closed ... TPG NTCIP Set of Test Procedures Not Loaded

TPG Status: New Session Command Accepted...



TPG Graphical User Interface

The screenshot displays the TPG Graphical User Interface, which is a Microsoft Word 2010 application. The interface includes a menu bar with options like File, Test Procedure, Reports, Tools, Session Panel, and Help. Below the menu bar is a ribbon with tabs for File, Home, Insert, Page Layout, References, Mailings, Review, and View. The main document area shows a Microsoft Word 2010 document titled "A User Comment Draft of the Joint Committee on the NTCIP". The document content includes the text "NTCIP 1203 version v03" and "National Transportation Communications for ITS Protocol".

Callouts identify the following components:

- TPG Menu Items:** Points to the menu bar at the top of the application.
- Document Tabs:** Points to the tabs at the top of the application, including "Standard", "Set of Test Procedures", "Current Test Procedure", and "Reports".
- Session Panel:** Points to the left sidebar containing a list of test procedure items.
- Embedded Microsoft Word 2010 Document Menu Items:** Points to the ribbon at the top of the embedded Word document.
- Embedded Microsoft Word 2010 Document:** Points to the main content area of the embedded Word document.
- TPG Session Status:** Points to the status bar at the bottom of the application, showing "TPG Status: Command Completed".
- TPG Command Status:** Points to the status bar at the bottom of the application, showing "TPG Status: Command Completed".



New Test Procedure

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

NTCIP 1203v03-01b

- 3.4 Architectural Requirements
 - 3.4.1 Support Basic Communication
 - 3.4.1.1 Retrieve Data
 - 3.4.1.2 Deliver Data
 - 3.4.1.3 Explore Data
 - 3.4.2 Support Logged Data
 - 3.4.2.1 Determine Current Configure
 - 3.4.2.2 Configure Logging Service
 - 3.4.2.3 Retrieve Logged Data
 - 3.4.2.4 Clear Log
 - 3.4.2.5 Determine Capabilities of Ev
 - 3.4.2.6 Determine Total Number of
 - 3.4.3 Support Exception Reporting
 - 3.4.4 Manage Access
 - 3.4.4.1 Determine Current Access S
 - 3.4.4.2 Configure Access
 - 3.5.1 Manage the DMS Configuration
 - 3.5.1.1 Identify DMS
 - 3.5.1.1.1 Determine Sign Type and
 - 3.5.1.1.2 Determine Message Display
 - 3.5.1.2.1 Determine Basic Message
 - 3.5.1.2.1.1 Determine the Size of the
 - 3.5.1.2.1.2 Determine the Size of the
 - 3.5.1.2.1.3 Determine Beacon Type
 - 3.5.1.2.1.4 Determine Sign Access
 - 3.5.1.2.2 Determine Matrix Capabilit
 - 3.5.1.2.2.1 Determine Sign Face Siz
 - 3.5.1.2.2.2 Determine Character Siz
 - 3.5.1.2.2.3 Determine Pixel Spacing
 - 3.5.1.2.3 Determine VMS Message
 - 3.5.1.2.3.1 Determine Maximum Num
 - 3.5.1.2.3.2 Determine Maximum Me
 - 3.5.1.2.3.3 Determine Supported Co
 - 3.5.1.2.3.4 Determine Message Dis
 - 3.5.1.2.4 Delete All Messages of a l
 - 3.5.1.3 Manage Fonts
 - 3.5.1.3.1 Determine Maximum Numl
 - 3.5.1.3.2 Determine Maximum Char
 - 3.5.1.3.3 Determine Maximum of Ch

Standard Set of Test Procedures Current Test Procedure Reports

File Edit View Insert Format Tools Table Window Help

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Final Showing Markup Show

1 2 3 4 5 6 7

Test Procedure:	01.00	Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Title
Description:		Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Description
Requirement(s):		Select the Test Procedure->Select Requirements Menu Item to enter the Test Procedure Requirements
Variable(s):		Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables
Pass/Fail Criteria:		Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Pass/Fail Criteria
Test Step		

Page 1 Sec 1 1/1 At 2" Ln 6 Col 13 REC TRK EXT OVR

NTCIP Standard is not Conformant to NTCIP 8002 Annex B1 ... Set of Test Procedures Not Verified

TPG Status: Command Completed



Define Header Information

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

NTCIP 1203v03-01b

Standard Set of Test Procedures Current Test Procedure Reports

File Edit View Insert Format Tools Table Window Help

Type a question for help

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130%

Define Test Procedure Header

Test Procedure Title

Determine Sign Type and Technology

Test Procedure Description

This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.

Test Procedure Pass/Fail

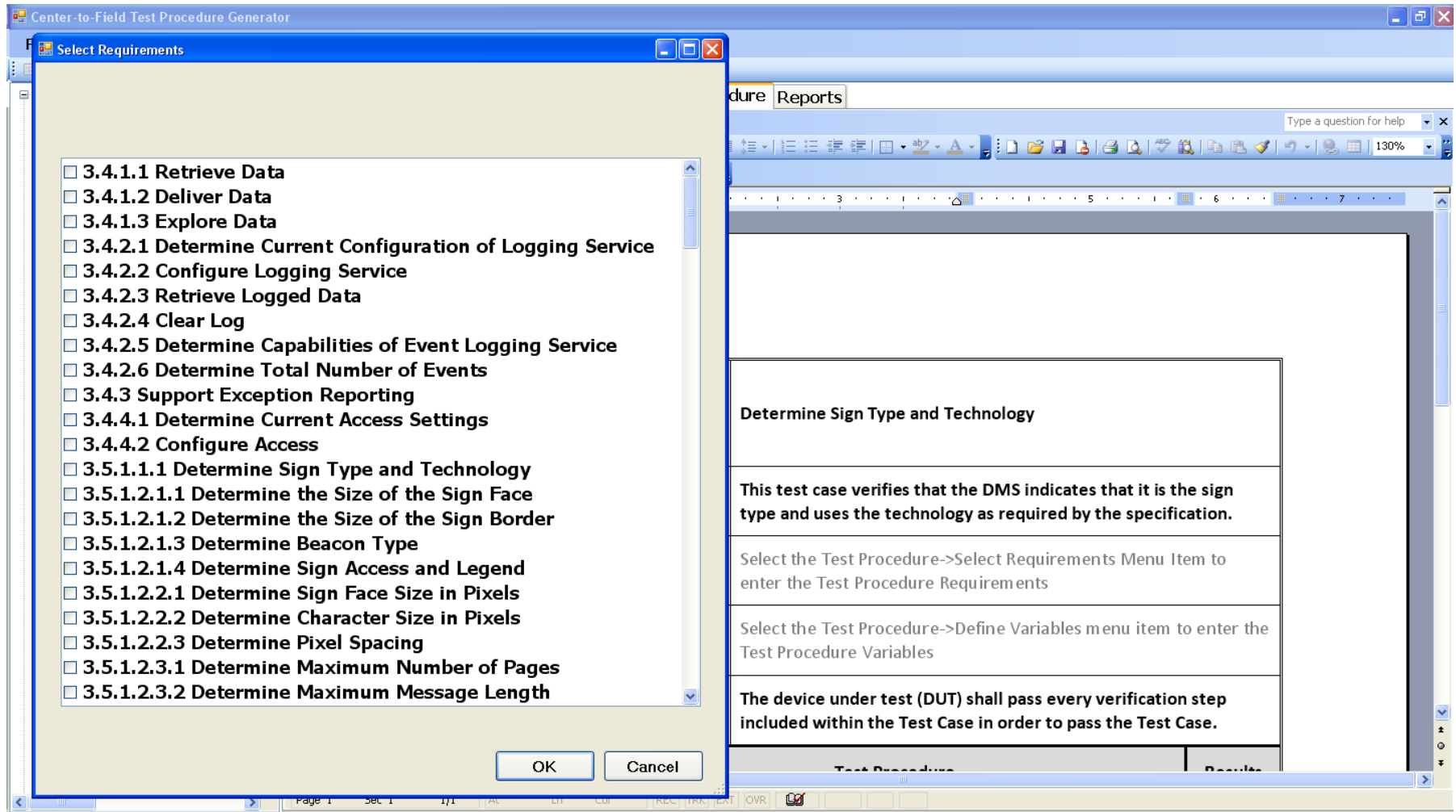
The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case.

Note: To enter a new line, press the <CTRL><ENTER> keyboard combination.

☒ Recheck Spelling

OK Cancel

Select Requirements



Test Procedure

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

NTCIP 1203v03-01b

- 3.4 Architectural Requirements
 - 3.4.1 Support Basic Communication
 - 3.4.1.1 Retrieve Data
 - 3.4.1.2 Deliver Data
 - 3.4.1.3 Explore Data
 - 3.4.2 Support Logged Data
 - 3.4.2.1 Determine Current Configuration
 - 3.4.2.2 Configure Logging Service
 - 3.4.2.3 Retrieve Logged Data
 - 3.4.2.4 Clear Log
 - 3.4.2.5 Determine Capabilities of Event
 - 3.4.2.6 Determine Total Number of Events
 - 3.4.3 Support Exception Reporting
 - 3.4.4 Manage Access
 - 3.4.4.1 Determine Current Access Settings
 - 3.4.4.2 Configure Access
- 3.5 Manage the DMS Configuration
 - 3.5.1 Identify DMS
 - 3.5.1.1 Determine Sign Type and Technology
 - 3.5.1.1.1 Determine Message Display
 - 3.5.1.1.2 Determine Basic Message
 - 3.5.1.1.3 Determine the Size of the Message
 - 3.5.1.1.4 Determine the Size of the Message
 - 3.5.1.1.5 Determine Beacon Type
 - 3.5.1.1.6 Determine Sign Access
 - 3.5.1.1.7 Determine Matrix Capability
 - 3.5.1.1.8 Determine Sign Face Size
 - 3.5.1.1.9 Determine Character Size
 - 3.5.1.1.10 Determine Pixel Spacing
 - 3.5.1.1.11 Determine VMS Message
 - 3.5.1.1.12 Determine Maximum Number of Messages
 - 3.5.1.1.13 Determine Maximum Message Length
 - 3.5.1.1.14 Determine Supported Character Set
 - 3.5.1.1.15 Determine Message Display
 - 3.5.1.1.16 Determine Message Display
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 - 3.5.1.1.98 Determine Message Display
 - 3.5.1.1.99 Determine Message Display
 - 3.5.1.1.100 Determine Message Display

Standard Set of Test Procedures Current Test Procedure Reports

File Edit View Insert Format Tools Table Window Help

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Final Showing Markup Show

1 2 3 4 5 6 7

Test Procedure:	01.00	Determine Sign Type and Technology
Description:	This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.	
Requirement(s):	3.4.1.1 Retrieve Data 3.4.1.2 Deliver Data 3.4.1.3 Explore Data 3.4.2.1 Determine Current Configuration of Logging Service 3.4.2.2 Configure Logging Service	
Variable(s):	Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables	
Pass/Fail Criteria:	The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case	



Create Variables

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

Standard Set of Test Procedures Current Test Procedure Reports

Document1 - Microsoft Word

TableTools

File Home Insert Page Layout References Mailings Review View Design Layout

Normal No Spaci... Heading 1 Heading 2 Title Subtitle Subtle Em... Emphasis Intense E... Strong Quote

Change Styles Find Replace Select Editing

NTCIP 1203v03-01b
Total Requirements: 180
Number of Requirements: 146
Number of Header Requirements: 34
Set of Test Procedures
01.00 Title

Create a New Variable

ASN.1 Types Object Types

Required_Sign_Type INTEGER New

Select Test Procedure Variable(s)

- ☒ Required_Sign_Technology [eventClassClearTime]
- ☒ Required_Sign_Type [INTEGER]

Delete OK Cancel

variable(s):

1.1 Retrieve Data
1.2 Deliver Data
1.3 Explore Data
1.1 Determine Current Configuration of Logging Service
1.2 Configure Logging Service

the Test Procedure->Define Variables menu item to enter the Test Procedure Variables

Page: 1 of 1 Words: 108

TPG Status: Define Variables Command Accepted...



Test Procedure

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

NTCIP 1203v03-01b
Total Requirements: 180
Number of Requirements: 146
Number of Header Requirements: 34
Set of Test Procedures
01.00 Title

Standard Set of Test Procedures Current Test Procedure Reports

Document1 - Microsoft Word

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Clipboard Font Paragraph Styles

Test Procedure:	01.00	Determine Sign Type and Technology
Description:	This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.	
Requirement(s):	3.4.1.1 Retrieve Data 3.4.1.2 Deliver Data 3.4.1.3 Explore Data 3.4.2.1 Determine Current Configuration of Logging Service 3.4.2.2 Configure Logging Service	
Variable(s):	Required_Sign_Technology [eventClassClearTime] Required_Sign_Type [INTEGER]	
Pass/Fail Criteria:	The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case.	
Test Step	Test Procedure	Results

Page: 1 of 1 Words: 99

NTCIP Standard Not Verified Set of Test Procedures Not Verified

TPG Status: Command Completed





Test Procedure Results

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

NTCIP 1203v03-01b
Total requirements: Not Available
Header requirements: Not Available
Requirements: Not Available
Set of Test Procedures

Standard Set of Test Procedures Current Test Procedure Reports

TPG NTCIP 1203v03-01b Set of Test Procedures DRAFT v16.docx - Microsoft Word

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Clipboard Font Paragraph Styles

Navigation

Search Document

01.01 Determine Sign Typ...
Annex A - TPRIM

Pass/Fail Criteria:		The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case.	
Test Step Number	Test Procedure	Results	
01.00	CONFIGURE 'Determine the enumerated value for the sign type required by the specification (PRL 2.3.2.1 and 2.3.2.3).' RECORD 'this information as: »Required_Sign_Type' NOTE 'Valid enumerated values are defined in NTCIP 1203, Section 5.2.2 (Sign Type Parameter).' NOTE 'Due to an anomaly in the standard, the type field here actually references both the type and the configuration.'	N/A	
02.00	CONFIGURE 'Determine the enumerated value for the sign technology required by the specification (PRL 2.3.2.2).' RECORD 'this information as: »Required_Sign_Technology' NOTE 'Valid enumerated values are defined in NTCIP 1203, Section 5.2.9 (Sign Technology Parameter).'	N/A	
03.00	GET 'the following object(s): »dmsSignType.0 »dmsSignTechnology.0' NOTE '[Pass/Fail]For the Device (Section 3.5.1.1.1)' NOTE '[Pass/Fail]For the Device (Section 3.5.1.1.1)'	Pass/Fail	

Page: 3 of 15 Words: 1,686

NTCIP Standard XML Data Content Files Loaded Set of Test Procedures Not Verified

TPG Status: Command Completed



Set of Test Procedures

File Test Procedure Reports Tools Session Panel Help

Standard Set of Test Procedures Current Test Procedure Reports

TPG NTCIP 1203v03-01b Set of Test Procedures DRAFT v5.docx - Microsoft Word

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Clipboard Font Paragraph Styles Editing

NTCIP 1203v03-01b

National Transportation Communications
for ITS Protocol

NTCIP 8007 Conformant Set of Test Procedures
Version 5 - Jul 25, 2016

Page: 1 of 13 Words: 1,423

NTCIP Standard is not Conformant to NTCIP 8007 Annex B1 ... Set of Test Procedures Not Verified

TPG Status: Command Completed



Test Procedure to Requirements Traceability Matrix (TPRTM)

File Test Procedure Reports Tools Session Panel Help

Standard Set of Test Procedures Current Test Procedure Reports

TPG NTCIP 1203v03-01b Set of Test Procedures DRAFT v5.docx - Microsoft Word

Annex A - TPRTM

Test Procedure	Requirement
[Requirement Not in Standard]	3.4 Architectural Requirements
[Header Requirement]	3.4.1 Support Basic Communications
	3.4.1.1 Retrieve Data
	3.4.1.2 Deliver Data
	3.4.1.3 Explore Data
[Header Requirement]	3.4.2 Support Logged Data
	3.4.2.1 Determine Current Configuration of Logging Service
	3.4.2.2 Configure Logging Service
	3.4.2.3 Retrieve Logged Data
	3.4.2.4 Clear Log
	3.4.2.5 Determine Capabilities of Event Logging Service
	3.4.2.6 Determine Total Number of Events

Page: 3 of 13 Words: 3/1,423

NTCIP Standard is not Conformant to NTCIP 8002 Annex B1 ... Set of Test Procedures Not Verified

TPG Status: Command Completed



Summary

- Agencies can use the TPG to develop consistent and reusable test procedures for verifying conformance and compliance.
- Using the TPG tool will reduce risks, effort, and the cost of developing test procedures.
- Promotes off-the-shelf interoperability.
- USDOT is actively seeking local or state agencies partners to deploy a NTCIP C2F Standard using the TPG
 - Use the experience to make any necessary updates to the software
 - Get the tool into the hands of agencies to prove its worth in the field and encourage more agencies to use the software

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



For more information and to acquire the Tools please visit:
<https://www.standards.its.dot.gov/DeploymentResources/Tools>



CENTER-TO-CENTER (C2C) REFERENCE IMPLEMENTATION (RI)



Introduction

- 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



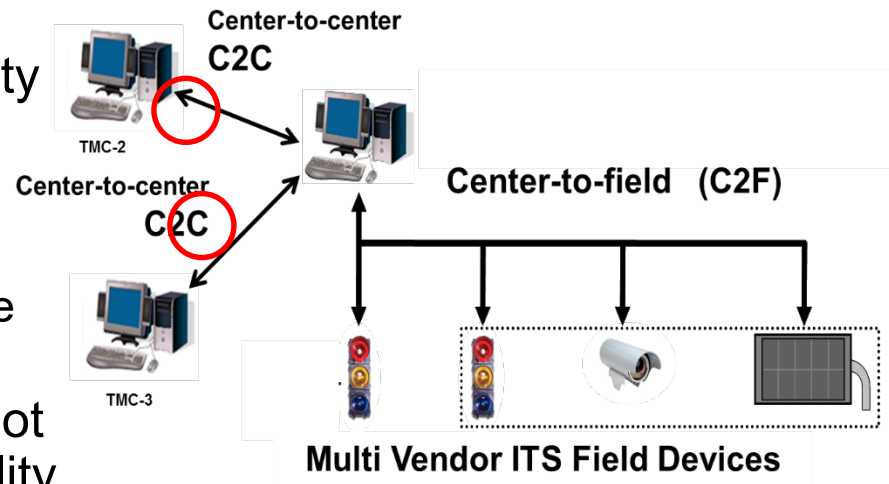
What will you get from this session

- This session will provide:
 - An understanding of what the C2C RI test tool is and how it works
 - How to achieve interoperability using the C2C RI tool
 - Benefits of the C2C RI tool
 - How to obtain a copy from USDOT
 - How to receive technical support for the C2C RI tool



What is the 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
- 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



Center-to-Center RI

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



High-Level Description of the C2C RI

- C2C RI currently works with:
 - Traffic Management Data Dictionary 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 SAFETY-LU Section 1201
- Verifies formats, protocols, and performance requirements



High-Level Description of the C2C RI

- 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
- Version 2 available now



Benefits of the C2C RI

- Reduce the 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



Testing Process for C2C

- Provide NRTM (system requirements)
- Configure C2C RI to communicate with the C2C system under test (SUT)
- Configure C2C RI to SUT requirements (from NRTM)
- C2C RI then selects the test cases
- Run test cases
 - Tester may verify results in some cases
 - C2C RI logs all test results and displays the results for the tester
- Request test reports and save test logs
- Verify all test cases passed

C2C RI capabilities summary

Table 1 - C2C RI Capabilities

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> • 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 and 3.03d • Supports debugging and conformance | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 |
|--|---|---|



Configuration screen

The C2C RI supports specific configurations to support your user needs and communications setup

Unique identifier to verify your configuration has not been altered

You can configure the following

You can select the standards and test suites supported

You can select the mode the C2C RI operates in

The screenshot shows the 'Configuration' window of the C2C RI software. The window has a sidebar on the left with a tree view containing: Configuration, SUT Panel, Information Layer Panel, Application Layer Panel, Information Layer Test Cases, and Application Layer Test Cases. The main area has tabs for Configuration, System Under Test, Information Layer Parameters, Application Layer Parameters, Information Layer Test Cases, and Application Layer Test Cases. The 'Configuration' tab is active, showing fields for Test Configuration (Name, Description, Version CheckSum) and Test Suite (Information Layer Standard, Application Layer Standard). The 'RI Mode' section on the right has radio buttons for 'External Center' (selected) and 'Owner Center'. At the bottom are buttons for 'Validate', 'Save As', 'Save', 'Close', and 'Cancel'.

6.ricfg

Configuration

- Configuration Panel
- SUT Panel
- Information Layer Panel
- Application Layer Panel
- Information Layer Test Cases
- Application Layer Test Cases

Configuration | System Under Test | Information Layer Parameters | Application Layer Parameters | Information Layer Test Cases | Application Layer Test Cases

Test Configuration

Name: C:\C2CRI\TRANSCOM Test 6.ricfg

Test Configuration Desc... TRANSCOM Stand-alone Test 2 and C2C RI 1.0.6.

Version CheckSum: 38F02F287231829ED977A3C843159F7E

Test Suite

Information Layer Standard

Test Suite Name: TMDD v3.03c

Standard Name: TMDDv303c

Authorized Predefined Test Suite

Description: TMDD v3.03c Test Suite

Application Layer Standard

Test Suite Name: NTCIP 2306 v1.69

Standard Name: NTCIP 2306v1

Authorized Predefined Test Suite

Description: NTCIP 2306 v1.69 Test Suite

RI Mode

☒ External Center

☐ Owner Center

Validate Save As Save Close Cancel



Configure Needs and Requirements

C2C RI Configuration File: C:\C2CRI\TRANSCOM Test 6.ricfg

File Tools Help

Configuration

- Configuration Panel
- SUT Panel
- Information Layer Panel
- Application Layer Panel
- Information Layer Test Cases
- Application Layer Test Cases
- Entity Emulation Parameters

Application Layer Parameters | Information Layer Test Cases | Application Layer Test Cases | Entity Emulation Parameters

Configuration | System Under Test | Information Layer Parameters

Select Need

Title	Text	UN Selected	FlagValue
2.3.1.1	Verify Connection Active	Mandatory	<input checked="" type="checkbox"/>
2.3.1.2	Need to Support Requests	Mandatory	<input checked="" type="checkbox"/>
2.3.1.3	Need to Support Subscriptions	Optional	<input type="checkbox"/>
2.3.2	Need to Provide Information on Organizations_ Centers_ and Contacts	Optional	<input checked="" type="checkbox"/>

Clear Optional

Select Requirements

Title	TextData	ProjectRequirement	FlagValue
3.3.1.1.1	Send Center Active Verification Upon Request	M	<input checked="" type="checkbox"/>
3.3.1.1.2	Publish Center Active Verification Information	Subscription:O	<input type="checkbox"/>
3.3.1.1.3	Subscribe to Center Active Verification Information	Subscription:O	<input type="checkbox"/>
3.3.1.1.4	Contents of the Center Active Verification Request	M	<input checked="" type="checkbox"/>
3.3.1.1.5	Required Center Active	..	<input type="checkbox"/>

Clear Optional

Test Parameters

ReqID	OtherRequirement	Value

Validate Save As Save Close Cancel

Mandatory standard needs and requirements are pre-selected

Optional Project specific needs and requirements may be selected

Verify that project selections are conformant to the standard



Configure System Under Test

C2C RI Configuration File: C:\C2CRI\TRANSCOM Test 6.ricfg

File Tools Help

- Configuration
 - Configuration Panel
 - SUT Panel
 - Information Layer Panel
 - Application Layer Panel
 - Information Layer Test Cases
 - Application Layer Test Cases
 - Entity Emulation Parameters

Application Layer Parameters	Information Layer Test Cases	Application Layer Test Cases	Entity Emulation Parameters
Configuration	System Under Test	Information Layer Parameters	

SUT Settings

IP Address: 192.168.101.145

Port: 443

Host Name: standards2.xcmdata.org

Web Service URL: https://standards2.xcmdata.org/wsdl/XCM-TMDD.wsdl

☐ User Name Required

User Name: anonymous

☐ Password Required

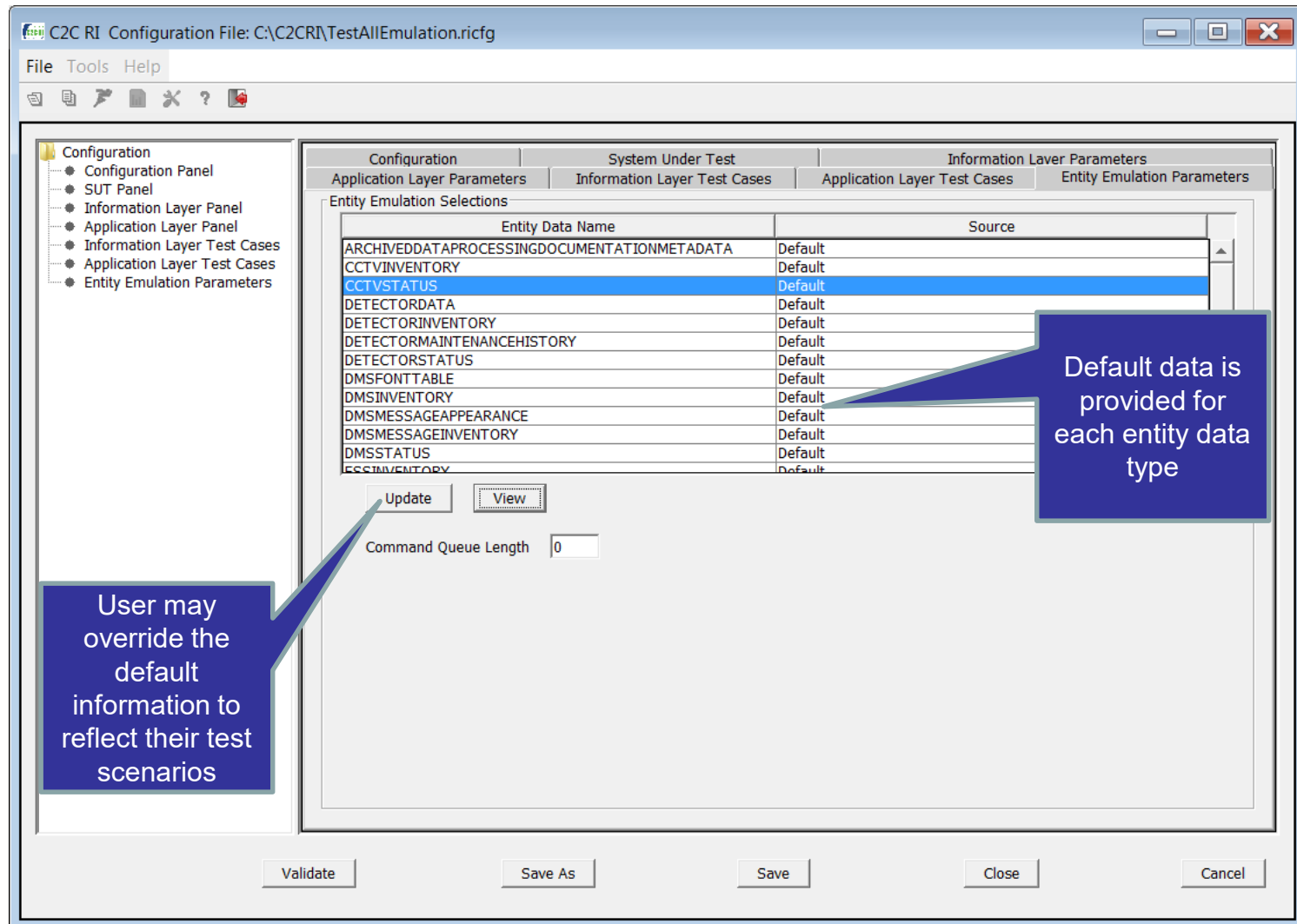
Password: passwordgiven

Validate Save As Save Close Cancel

For NTCIP 2306 compliant deployments a WSDL for the service must be specified



Configure Entity Emulation Data



Run & test results screen

Test Case (based on your user needs and configuration)

Test control buttons

Test Case summary report

Test Step results (per test case selected)

The screenshot displays a software interface for running and viewing test results. On the left, a tree view lists various test cases under the heading 'Information Application'. The main area on the right contains a 'Test Case Results' table and a 'Test Step Results' table. Above the tables are control buttons: 'Run', 'Pause', 'Resume', and 'Close'. A 'Test Name' field is also present.

Test Case Results Table:

#	TestCaseID	Status	Run ID	Run Cou...	Fai Counts	Execution Time
1	TCS-C2CRI-NTCIP2306-WSDL-1a1-GeneralVali	PASSED	1	1	0	3.142s
2	TCS-C2CRI-NTCIP2306-WSDL-1a2-DefinitionsValid	PASSED	1	1	0	1.623s
3	TCS-C2CRI-NTCIP2306-WSDL-1a3-TypesValid	PASSED	1	1	0	1.577s

Test Step Results Table:

TimeStamp	Description	Result
2013-10-07 10:52:48.138	Step 1 VERIFY that the specified WSDL file exists.	PASSED
2013-10-07 10:52:48.149	Step 2 VALIDATE the WSDL file using the W3C WSDL 1.1 Schema	PASSED
2013-10-07 10:52:48.159	Step 3 VERIFY that the WSDL file consists of 5 child sections: types/schema, message, portType, binding, service.	FAILED - TESTSTEP FAILURE: Verification Error -- Expected:Passed Received: Not Tested Description: The requested test was not performed. Verification Error -- Expected:Passed Received:Failed Description: The WSDL definitions does not contain the required 5 child sections.

At the bottom of the interface, there are tabs for 'Test Results' and 'Test Log'.



Run Entity Emulation Test

The screenshot shows the C2C RI software interface. On the left, a tree view under 'Application' lists various test cases, with 'EntityEmulationTester' selected. A blue callout points to this list with the text 'Special Entity Emulation Test Case Provided'. The main window displays the 'Test Case Results' for 'EmulationTest'. A 'Test Case Description' field contains the text 'This test case is used for E'. A 'Test Step Results' table shows the execution progress. A modal dialog box titled 'C2C RI' is open, prompting the user to 'Enter the value to perform the following:' and listing steps 1) Initialize through 10) Exit. A blue callout points to this dialog with the text 'User can modify entity data during the test'.

Test Case Results

#	Test Case
1	EntityEmulationTester

Test Case Description

This test case is used for E

Test Step Results

TimeStamp	Test Step	Result
2019-04-12 17:45:40:543	RECORD this information as: ApplicationLayerStandard: NTCIP 2306v1 Step 2 CONFIGURE: Determine the Information Layer Standard that will be used for this test. RECORD this information as: InformationLayerStandard: TMDDv3.03c	NA
2019-04-12 17:45:41:215	Step 3 WHILE CONTINUEEMULATION is equal to TRUE then CONTINUE, OTHERWISE skip the following substeps.	PASSED
2019-04-12 17:45:41:234	Step 3.1 GET the User's selection. Returns: returnString	Running

Test Results | **Test Log**

Test case result report

Port Viewer

C2C RI Test Case Detail Log Report

C2C RI Version: Version 1.0.7
Created by: crearw
Test Suites:
Application: NTCIP 2306 v1.69
Information: TMDD v3.03c
08/01/2016 11:35:43

Log File Name: C:\c2cm\TrialTest.2016-08-01_11-35-43.xml
Log File Creator: crearw
Log File Creation Date: 2016-08-01_11-35-43
File Description:

Time	Test Case Name	Test Step Description	Pass/Fail	Fail Reason
01/08/2016 11.35.49.051	TCS-1- dlCenterActiveVerificationRequest- DC-Valid		FAILED	
01/08/2016 11.35.49.082		Step 1 CONFIGURE: Determine the Application Layer Standard that will be used for this test. RECORD this information as: ApplicationLayerStandard: NTCIP2306v01	PASSED	
01/08/2016 11.35.49.082		Step 2 CONFIGURE: Determine the dialog performance requirement for Send Center Active Verification Upon Request (NTRM 3.3.1.1.1). RECORD this value as: TMDD_N1R1_Send_Center_ Active_Verification_Upon_Re quest_Parameter = 60000	PASSED	
01/08/2016 11.35.49.098		Step 3 CONFIGURE: Determine whether Restrictions - Center Active is required by the specification. (NRTM 3.3.1.1.5.2.1). RECORD this information as: TMDD_N1R8_Restrictions_ Center_Active_Supported = false	PASSED	
01/08/2016 11.35.49.113		Step 4 CONFIGURE: Determine whether Restrictions - Error Report is required by the specification.	PASSED	

Page 2 / 10

Tester, standards,
& Log file
information

Test Case (you
can have more
than one)

Time
Stamp

Step Description

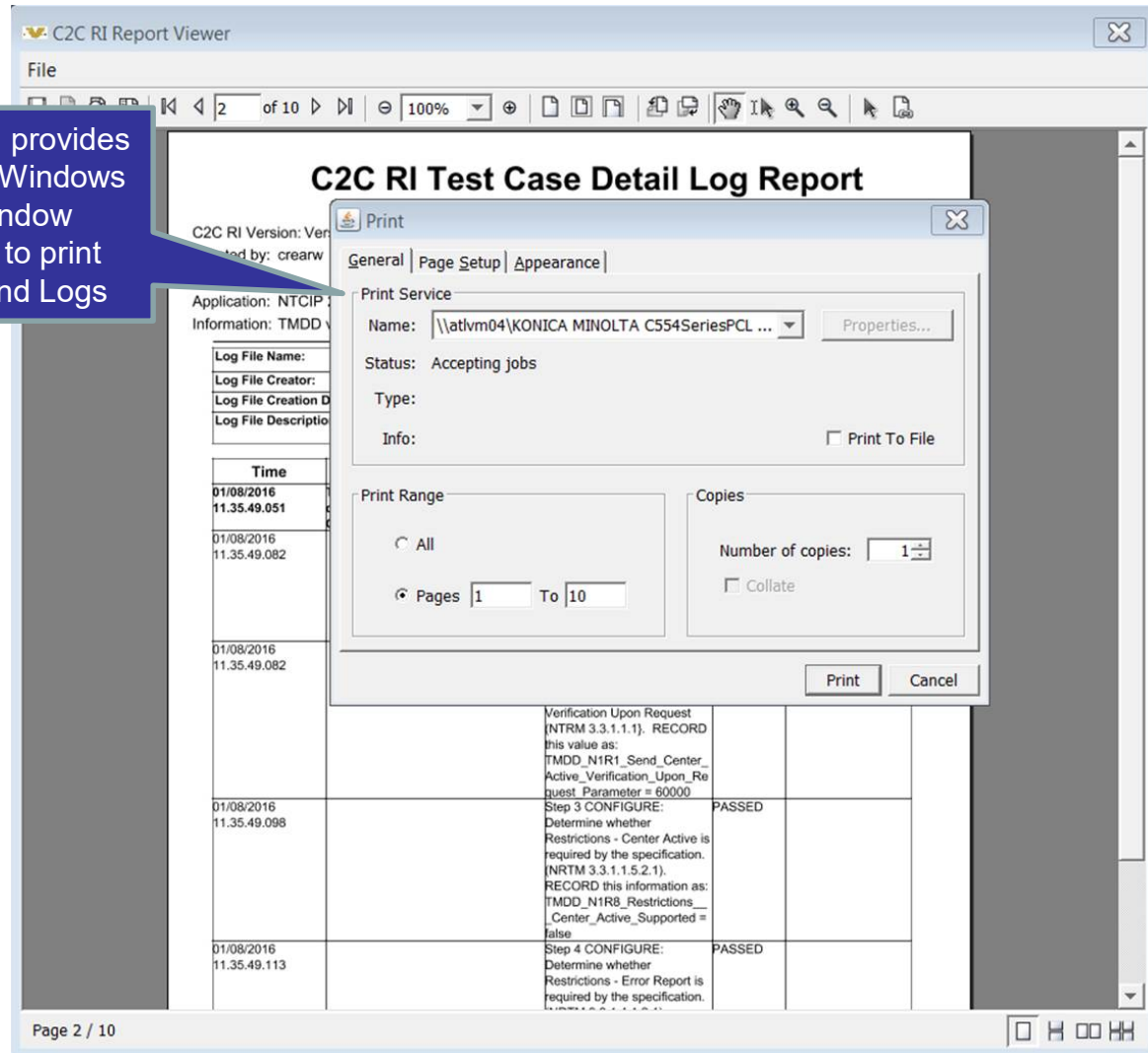
Pass/Fail Indicator for
test case and for each
step

Failure
Description



Print reports screen

The C2C RI provides a standard Windows Print window capability to print Reports and Logs



Role of C2C RI in Testing Process

- Selection of requirements
- C2C RI provides Test cases
- Run tests
- Provides Reports
 - Conformance to standards
 - Compliance to requirements
 - Verifies conformance to Section 1201
 - Provides Test Logs



Summary

- The C2C RI is a test tool that verifies conformance to C2C Standards
- It currently supports
 - TMDD v3.03c
 - TMDD v3.03d
 - NTCIP 2306 v1.69
- You can obtain a copy for free
- There is technical support for it



How to Obtain the C2C RI and Get Help

- The C2C RI and user manual can be downloaded at:
<https://www.standards.its.dot.gov/DeploymentResources/Tools>
- You can get technical support help on the C2C RI at:
c2crisupport@transcore.com



















TRANSCOM Background

- TRANSCOM is a coalition of 16 transportation and public safety agencies in the New York – New Jersey – Connecticut metropolitan region. It was created in 1986 to provide a cooperative, coordinated approach to regional transportation management.
- *Video available at www.xcm.org*



TRANSCOM Member Agencies

TRANSCOM's systems are driven by the communications and information exchange needs of its member agencies.

 New Jersey Turnpike Authority	 New Jersey Department of Transportation	 New York City Department of Transportation	 New Jersey State Police
 New York State Police	 Port Authority of New York and New Jersey	 Connecticut Department of Transportation	 New York City Police Department
 New York State Thruway Authority	 Metropolitan Transportation Authority	 New York State Department of Transportation	 MTA New York City Transit
 New York State Bridge Authority	 New Jersey Transit Corporation	 Port Authority Trans-Hudson Corporation	 MTA Bridges and Tunnels

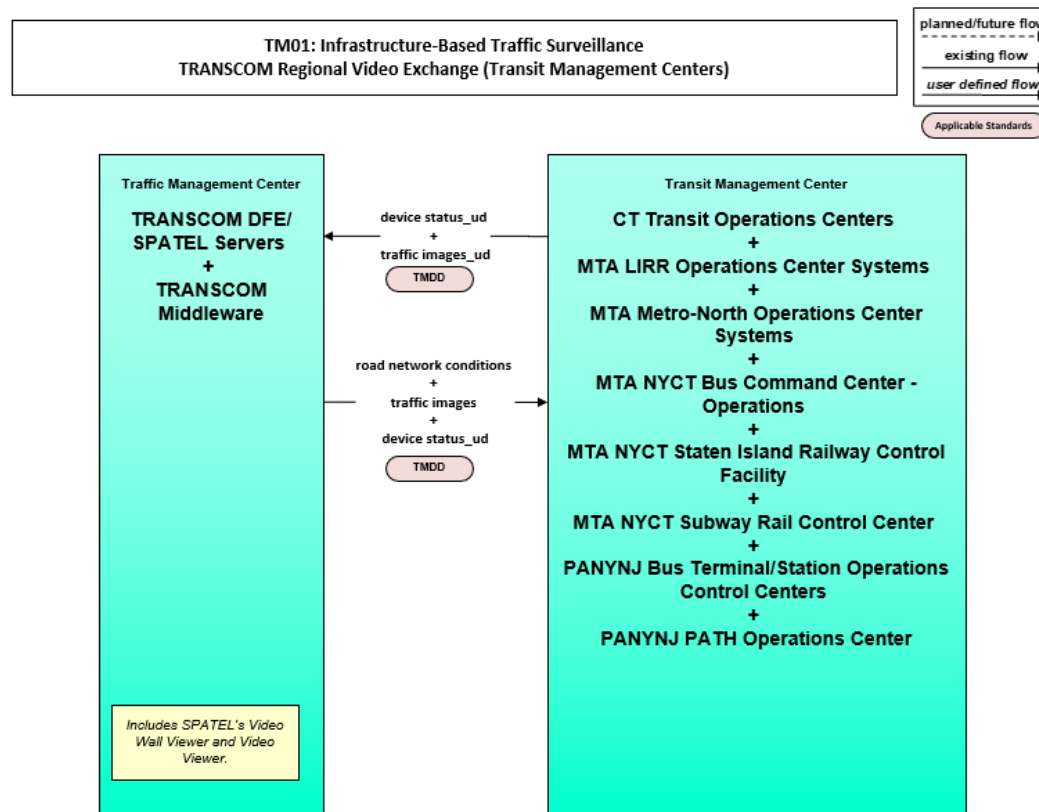
TRANSCOM Background

- TRANSCOM has achieved a level of success by demonstrating that 100+ operations centers can achieve an interoperability advantage and provide a real benefit at the operations level by conforming to these ITS standards.



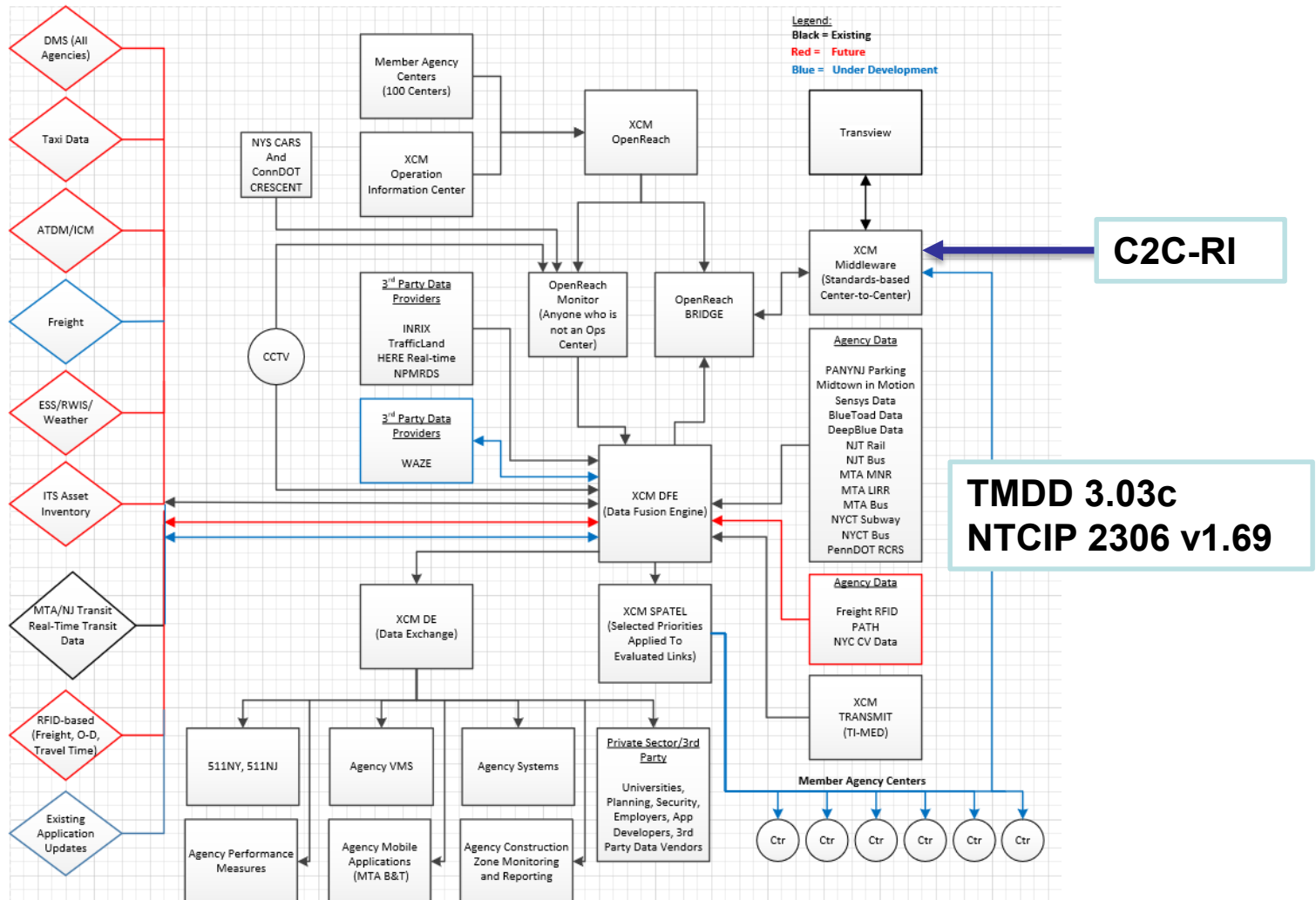
TRANSCOM and ITS Standards

- TRANSCOM integrates ITS Standards into its systems planning. An example ITS Architecture service package diagram is shown below.



TRANSCOM's System Architecture

Middleware and other native systems.



Lessons Learned: General

- Using the C2C RI tool and testing TMDD conformance of a system is a process.
- It is recommended to take simple steps first, then build upon your successes.
- The project would have been very difficult to implement without TRANSCOM Middleware, TMDD, NTCIP 2306, and C2C RI expertise available.
 - Plus, system developer staff available to make necessary modifications to the software.
 - Plus, access to the C2C RI development staff who are thoroughly familiar with how the tool works.



Pre-Test Activities

- TRANSCOM had developed a specification for the system (called Middleware), based on the TMDD “Needs to Requirements Traceability Matrix”.
 - As a result, there were no problems configuring the C2C RI tool, which also uses the NRTM to determine TMDD XML message exchanges.
- Used an off-the-shelf tool called SOAP UI to assess and verify that the XML message structure is conformant with TMDD.
 - As a result, there were no problems with C2C RI verification of XML messages.



Pre-Test Activities

- Test Plan (Prepared by the Test Engineer)
- Test Case Specifications (Generated from the C2C RI tool)
- Test Procedure Specifications (Generated from the C2C RI tool)



Conformance Testing

- Pre-Test/Training Phase – Verified WSDL, ability to connect the systems and exchange messages. Two messages tested:
 - Connection Verification
 - Node Inventory
- Conformance Test Phase – Ensure the full set of requirements messages being sent from the center conform to TMDD v3.03c and NRTM.
- Anomaly Reports (Prepared by the Test Engineer)



Conclusion of Testing Process

- TRANSCOM had completed, using C2C RI version 1.0.7, testing conformance of the TRANSCOM Middleware with TMDD v3.03c and NTCIP 2306 v1.69 standards.
- The TRANSCOM Middleware system is conformant with TMDD v3.03c.



Lessons Learned: Specific

- Need C2C RI Tool Technical Support readily available!
- For project-specific extensions: only include extensions in response messages.
 - Changed the logic of Middleware so that request messages did not include mandatory elements nor extensions.
 - Changed the logic of Middleware to follow TMDD/C2C RI extension tag requirement.
- Configuring C2C RI to make modifications to messages sent (request messages) is time consuming.



Polling Question

After today's presentation are you or your agency likely to use the TPG or C2C RI?

- Yes, we are likely to use the TPG
- Yes, we are likely to use the C2C RI
- Need additional information before deciding
- No, we are not likely to use either tool





QUESTIONS?

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