T351: Center-to-Center (C2C) Reference Implementation (RI) Applying C2C RI

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1. Module Description

The Center-to-Center (C2C) Reference Implementation (RI) is a tool developed under contract to the USDOT that mimics an operational traffic management system. It supports all features defined in the traffic management data dictionary (TMDD) v3.03 standard and serves as a useful development and testing tool to verify that the system being tested is able to interoperate with a known reference.

Data exchanges among multiple management centers are termed "Center-to-Center" (C2C) communications. The mechanisms used to enable these exchanges are defined in NTCIP 2306 v1.69. Traffic management centers (TMCs) often rely upon this standard to exchange data with other centers (external centers) to enable ITS services. TMDD v3.03 is an information level standard jointly developed and published by ITE and AASHTO that defines the data that TMCs might need to exchange with external centers.

Previously developed Modules, A321a and A321b, covered the details of TMDD user needs and requirements, respectively. Module T321 covered testing of deployments based on the TMDD standard, and Module T251 introduced the C2C Reference Implementation (RI).

The focus of this **updated** module is to explain how to use the Center-to-Center (C2C) Reference Implementation (RI) to test a system for conformance to the TMDD v3.03 standard. It will describe installation, configuration, operation, and reporting features of the software; it will also alert participants to the limitations of the software and the resources required for its proper use.

The module is intended for hands-on users of the software. The module will use sample TMDD v3.03 data exchanges and explains how the tool can be used to verify that a deployed system conforms to the standardized exchanges as per TMDD v03.03 and NTCIP 2306 XML v1.69.

2. Introduction/Purpose

This module will be placed in the context of the SE process as well in the acquisition curriculum path. The complete series of ITS Standards Training Modules for acquisition of a C2C system is as follows: I101, A101, A102, A103, A201, A321a, A321b, T101, T201, T202, T203, T204, T321, T251, and T351.

This is the final module in this series of training modules.

At the conclusion of this course, participants will be able to:
1. Install and configure the C2C RI on a host system
    *   Review how to obtain
    *   Review requirements
    *   Explain basic configuration
    *   Explain configuration for a specific test

2. Operate the C2C RI
   - Handling request-reply exchanges
   - Handling subscriptions
   - Creating events within C2C RI and publications

3. Retrieve the C2C RI results from a test
   - Viewing results
   - Understanding and interpreting results
   - Capturing results for archives

4. Prepare a report based on the C2C RI results
   - IEEE 829 report formats
   - Preparing your report

3. Process to Customize Data Files

Data files allow you to automate the entry of variable values rather than using prompts. The easiest way to produce a data file is to obtain a copy of the current data file for the desired test case and then edit the values assigned within it. The following steps describe this process.

1. Use file archiving software to navigate to and open the archive:

   <C2CRI Installation Directory>\TestSuites\<Test Suite>Signed.jar

   For example, the NTCIP2306 test suite is typically located at:
   C:\C2CRI\TestSuites\NTCIP2306v01_69Signed.jar

2. Navigate to the <Layer>\Data directory within the .jar file

   For example, the NTCIP2306 test suite defines tests at the application layer so we would go to:
   AppLayer\Data

3. Select the *.data file(s) that you would like to customize. For example, to create a custom data file for the TCS-C2CRI-NTCIP2306-WSME-SUT-SHRR-EC test case, select the file named "TCS-C2CRI-NTCIP2306-WSME-SUT-SHRR-EC.data"

4. Copy the selected files to your desired location. For example, right click on the selected files and select "Copy To…" and then enter the location where you would like to store the copies such as C:\C2CRI

5. Close the archiving software and open the newly saved *.data file with a text editor

6. Replace instances of "#USERDEFINED#" with real values as desired. (The "#USERDEFINED#" keyword causes the C2C RI to prompt the user for the value during test execution)

7. Save the file.

8. Within the C2C RI configuration file, go to the "<Layer> Test Cases" tab and change the "Source" for the desired "Test Case" to reference the customized *.data file just created.

4. Reference to Other Standards

ITE TMDD v03.03c – Traffic Management Data Dictionary, July 16, 2014.

http://www.ite.org/standards/tmdd/

NTCIP 2306 v01.69 – National Transportation Communications for ITS Protocol: Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications, December 2008.

https://www.ntcip.org/library/standards/default.asp?documents=yes&qreport=no&standard=2306

5. Glossary

Term	Definition
AASHTO	American Association of State Highway and Transportation Officials
ASCII	American Standard Code for Information Interchange
C2C	Center-to-Center
Conformance	A condition that exists when an item meets all of the mandatory requirements as defined by a standard. It can be measured on the standard as a whole, which means that it meets all mandatory (and applicable conditional) requirements of the standard or on a feature level (i.e., it conforms to feature X as defined in section X.X.X), which means that it meets all mandatory (and applicable conditional) requirements of the feature.
EC	External Center
Gbps	Gigabits per second
GB	Gigabytes
GHz	Gigahertz
Interoperability	The ability of two or more systems or components to exchange information and use the information that has been exchanged
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
JRE	Java standard edition Runtime Environment
NTCIP	National Transportation Communications for ITS Protocol
OC	Owner Center
PC	Personal Computer
PCB	Professional Capacity Building
PDF	Portable Document Format
RI	Reference Implementation
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SOAP	Simple Object Access Protocol
SUT	System Under Test
TCS	Test Case Specification
TMC	Traffic Management Center

Term	Definition
TMDD	Traffic Management Data Dictionary
URL	Uniform Resource Locator
USDOT	United States of America Department of Transportation
WSDL	Web Service Definition Language
XML	eXtensible Markup Language
XSD	XML Schema Definition

6. Study Questions

1. Which of the following statements is untrue?

   a) C2C standards define how services can be discovered

   b) A C2C exchange occurs between an "Owner center" and an "External center"

   c) The C2C RI software is available for free

   d) ITS standards only define how to exchange information

2. What is the primary purpose of a WSDL file?

   e) Configure the C2C RI

   f) Report errors to the user

   g) Define the services offered by the owner center

   h) All of the above

3. How can you get the C2C RI to publish multiple publications for one subscription?

   a) Enter the number of publications in the configuration file

   b) Use the #ITERATION keyword in the associated data file

   c) Multiple publications are not supported by the C2C RI

   d) The C2C RI can receive but not publish multiple publications

4. Which of the following might cause the C2C RI to report a failure?

   a) Ambiguity in the standard

   b) SUT configuration error

   c) C2C RI configuration error

   d) All of the above

5. Which C2C RI report will assist in developing an anomaly report?

   a) Test Case Details

    b) Message Summary

    c) Message Details

    d) All of the above

7. Icon Guide

The following icons are used throughout the module to visually indicate the corresponding learning concept listed out below, and/or to highlight a specific point in the training material.

1) **Background information:** General knowledge that is available elsewhere and is outside the module being presented. This will be used primarily in the beginning of slide set when reviewing information readers are expected to already know.

2) **Tools/Applications:** An industry-specific item a person would use to accomplish a specific task, and applying that tool to fit your need.

3) **Remember:** Used when referencing something already discussed in the module that is necessary to recount.

4) **Refer to Student Supplement:** Items or information that are further explained/detailed in the Student Supplement.

5) **Example:** Can be real-world (case study), hypothetical, a sample of a table, etc.

6) **Checklist:** Use to indicate a process that is being laid out sequentially.