



W E L C O M E



U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Welcome



**Ken Leonard, Director
ITS Joint Program Office
Ken.Leonard@dot.gov**

United States Department of Transportation

OFFICE OF THE ASSISTANT SECRETARY FOR RESEARCH AND TECHNOLOGY

Intelligent Transportation Systems
Joint Program Office

About DOT | Briefing Room | Our Activities

About OST-R | Press Room | Programs | OST-R Publications | Library | Contact Us

Search

ITS Professional Capacity Building Program / Advancing ITS Education

About ▾ ITS Training ▾ Knowledge Exchange ▾ Technology Transfer ▾ ITS in Academics ▾ Media Library



WHAT'S NEW

New Web-Based Training from ITS Joint Program Office

- Connected Vehicle Reference Implementation Architecture Training now available

New NHI Course

- Systems Engineering for Signal Systems Including Adaptive Control (NHI-133123)

New ITS Case Study Available

- National ITS Architecture

Added to T3 Archive

- Learn from the Experts: Open Data Policy Guidelines for Transit - Maximizing Real Time and Schedule Data-Legalities, Evolutions, Customer Perspectives, Challenges, and Economic Opportunities - Part II
Presented on August 7, 2014
- Saving Lives and Keeping Traffic Moving: Quantifying the Outcomes of Traffic Incident Management (TIM) Programs
Presented on July 31, 2014

Welcome to ITS Professional Capacity Building

The ITS PCB Program is the U.S. Department of Transportation's leading program for delivering ITS training and learning resources to the nation's ITS workforce.

FREE TRAINING



The ITS PCB Program and partners offer many free ITS training courses.

- Web and Blended Courses from CITE
- ITS Standards Training
- Upcoming T3 Webinars

wwwpcb.its.dot.gov

T251:

Center-to-Center (C2C)
Reference Implementation (RI)
Introduction



Instructor



Kenneth Vaughn, P.E.

President
Trevilon LLC
Magnolia, TX, USA

Learning Objectives

Recognize **purpose** of C2C Reference Implementation

Acknowledge **key capabilities and limitations** of the C2C RI

Follow process for **producing test documentation** that relies upon the C2C RI

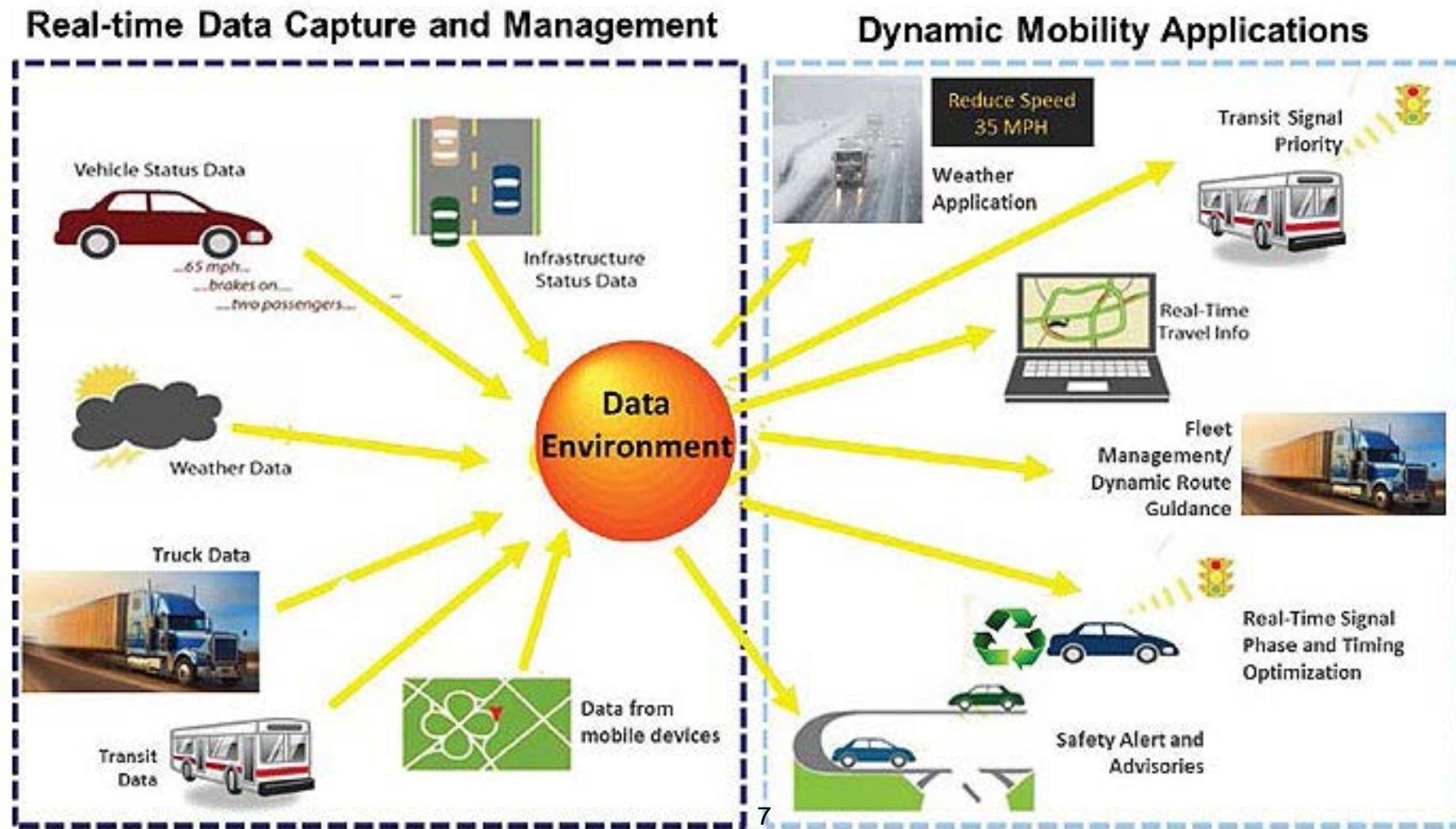
Recognize **results** a tester might produce after using the C2C RI

Learning Objective 1

Recognize purpose of C2C
Reference Implementation

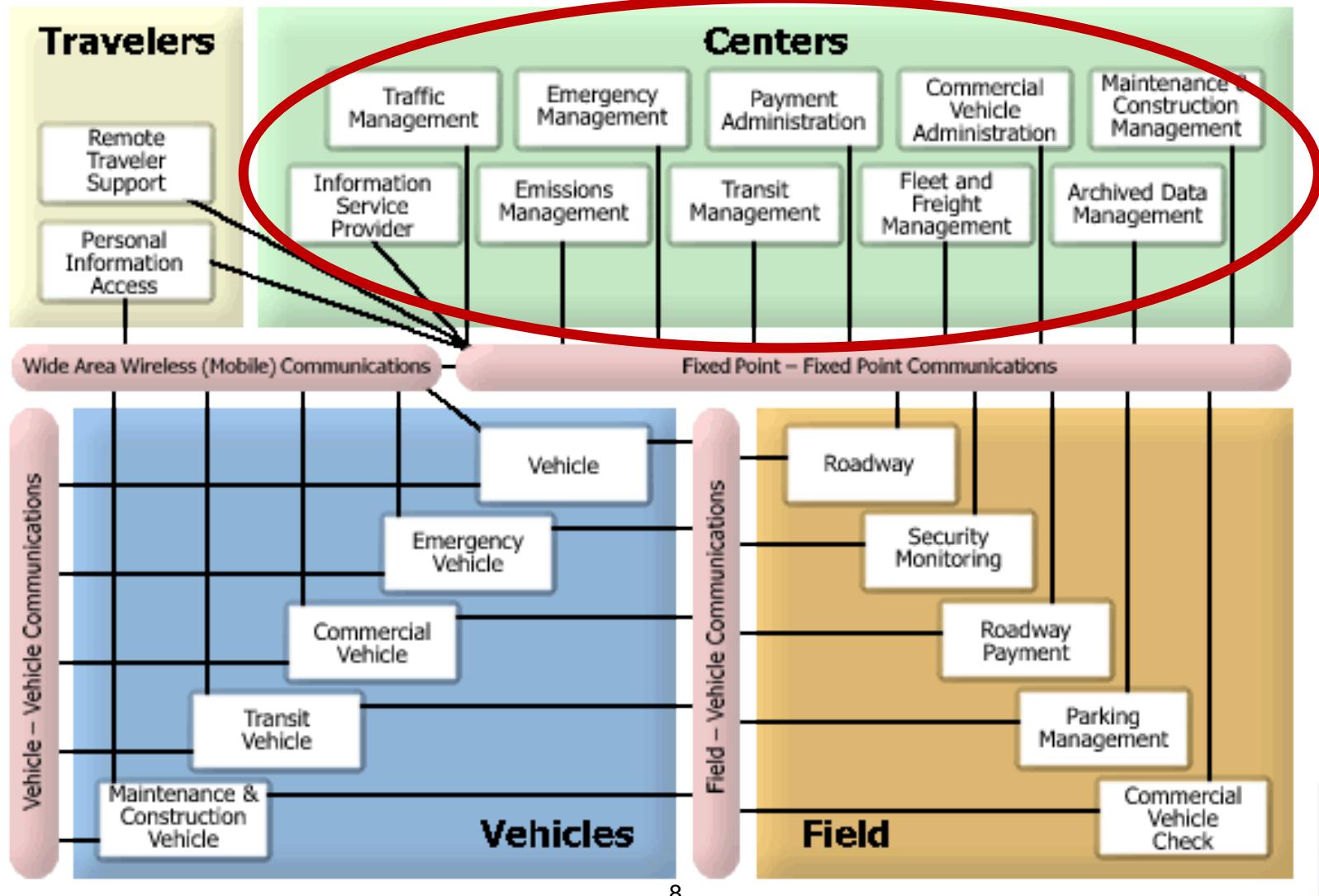
Understand C2C Communications

ITS: A complex network that needs proper analysis



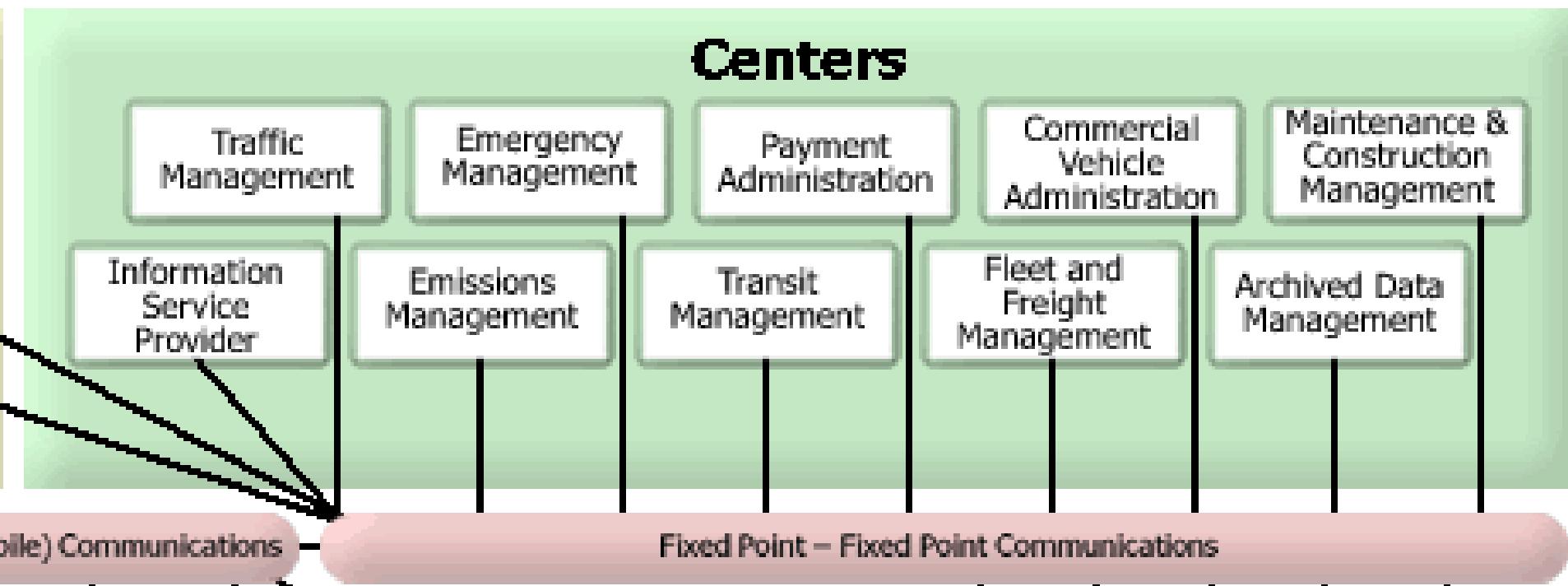
Understand C2C Communications

National ITS Architecture is the result of the analysis



Understand C2C Communications

This module focuses on center-to-center only



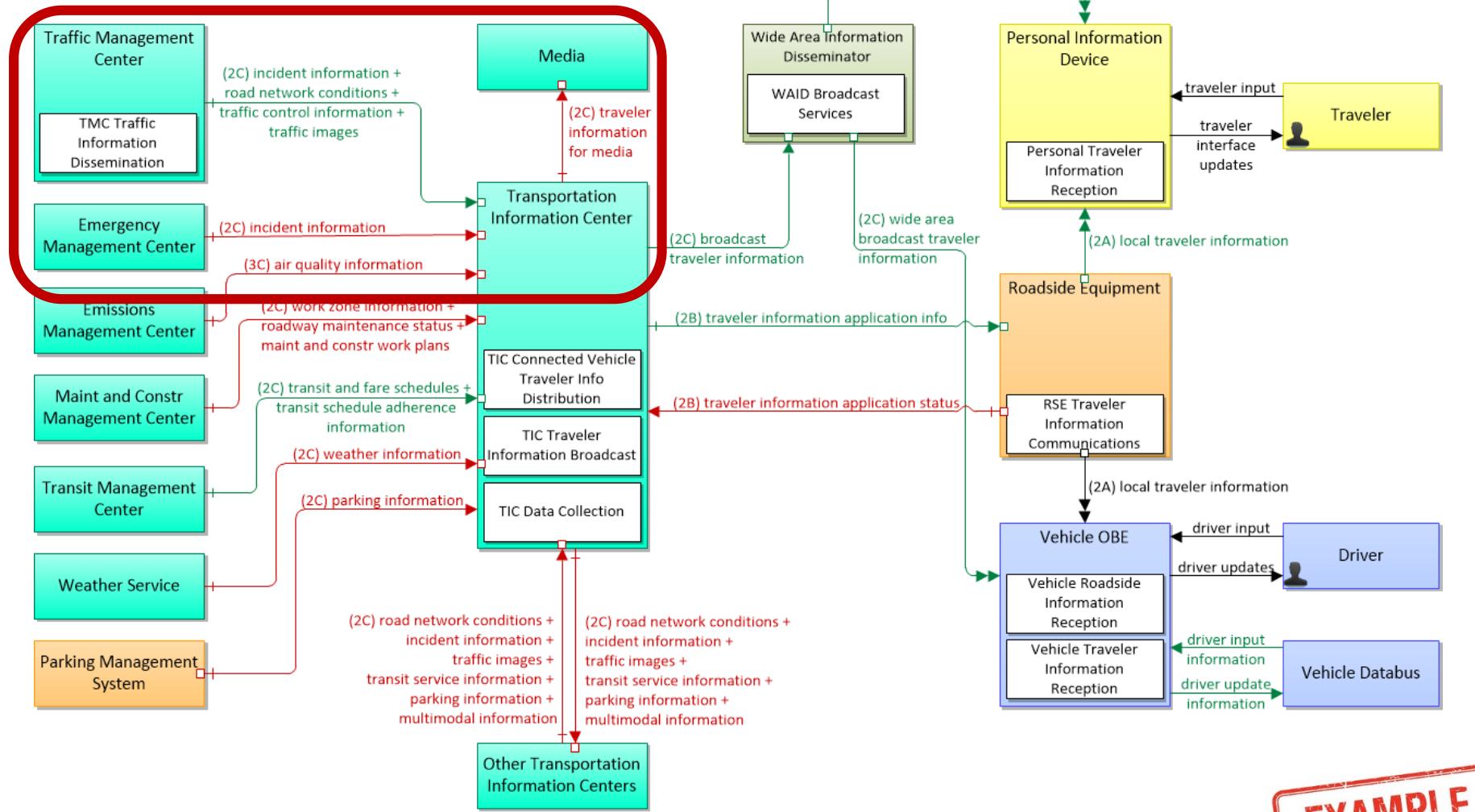
Understand C2C Communications

National ITS Architecture service packages (sample)

Group	Service Package Name
Traffic Signals	Emergency Vehicle Preemption
	Freight Signal Priority
	Intelligent Traffic Signal System
	Transit Signal Priority
Transit	Dynamic Ridesharing
	Dynamic Transit Operations
	Integrated Multi-Modal Electronic Payment
	Intermittent Bus Lanes
	Smart Park and Ride System
	Transit Connection Protection
	Transit Stop Request
Traveler Information	Advanced Traveler Information Systems
	Traveler Information – Smart Parking

Understand C2C Communications

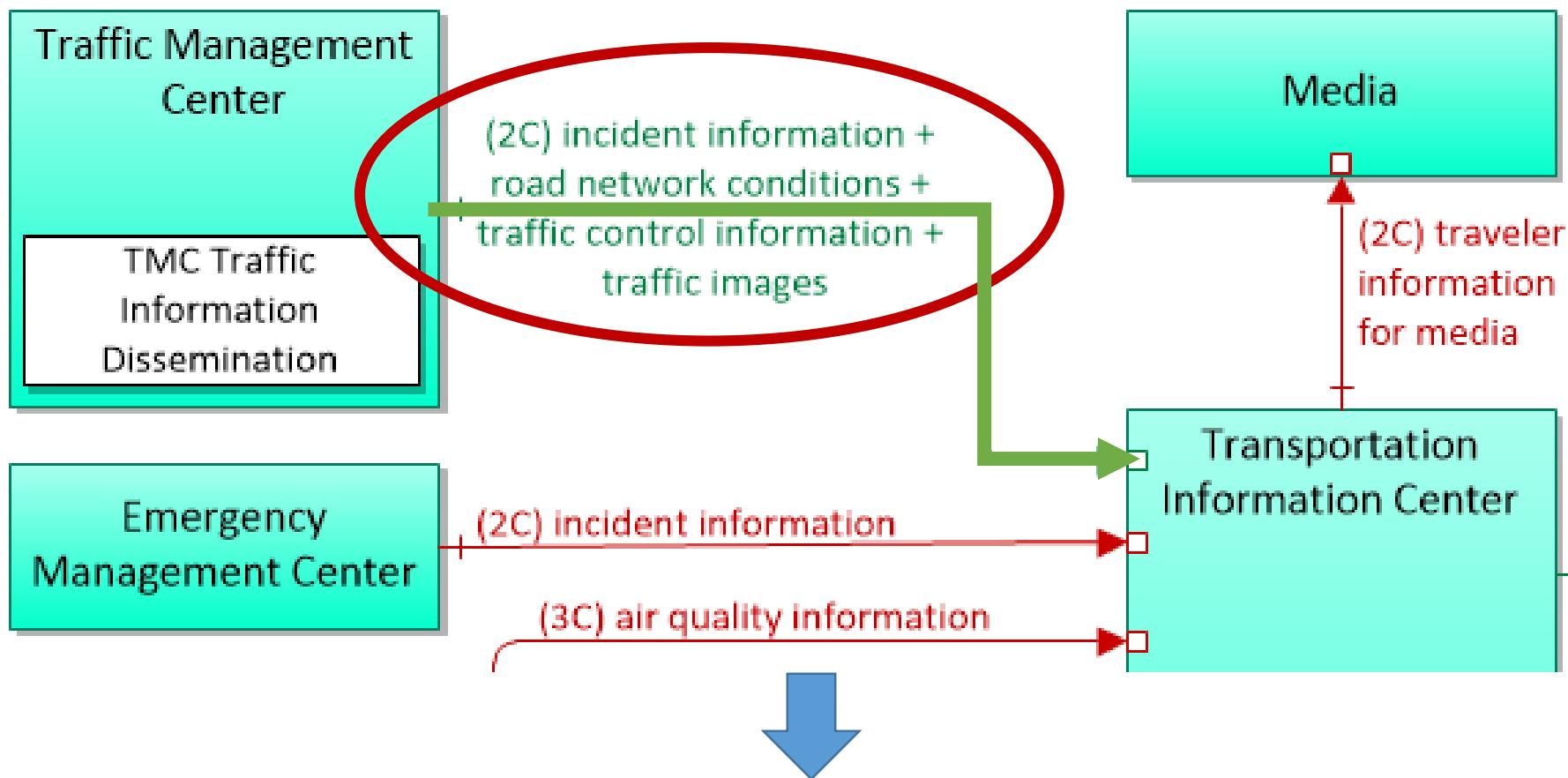
Service packages depict information flows



EXAMPLE

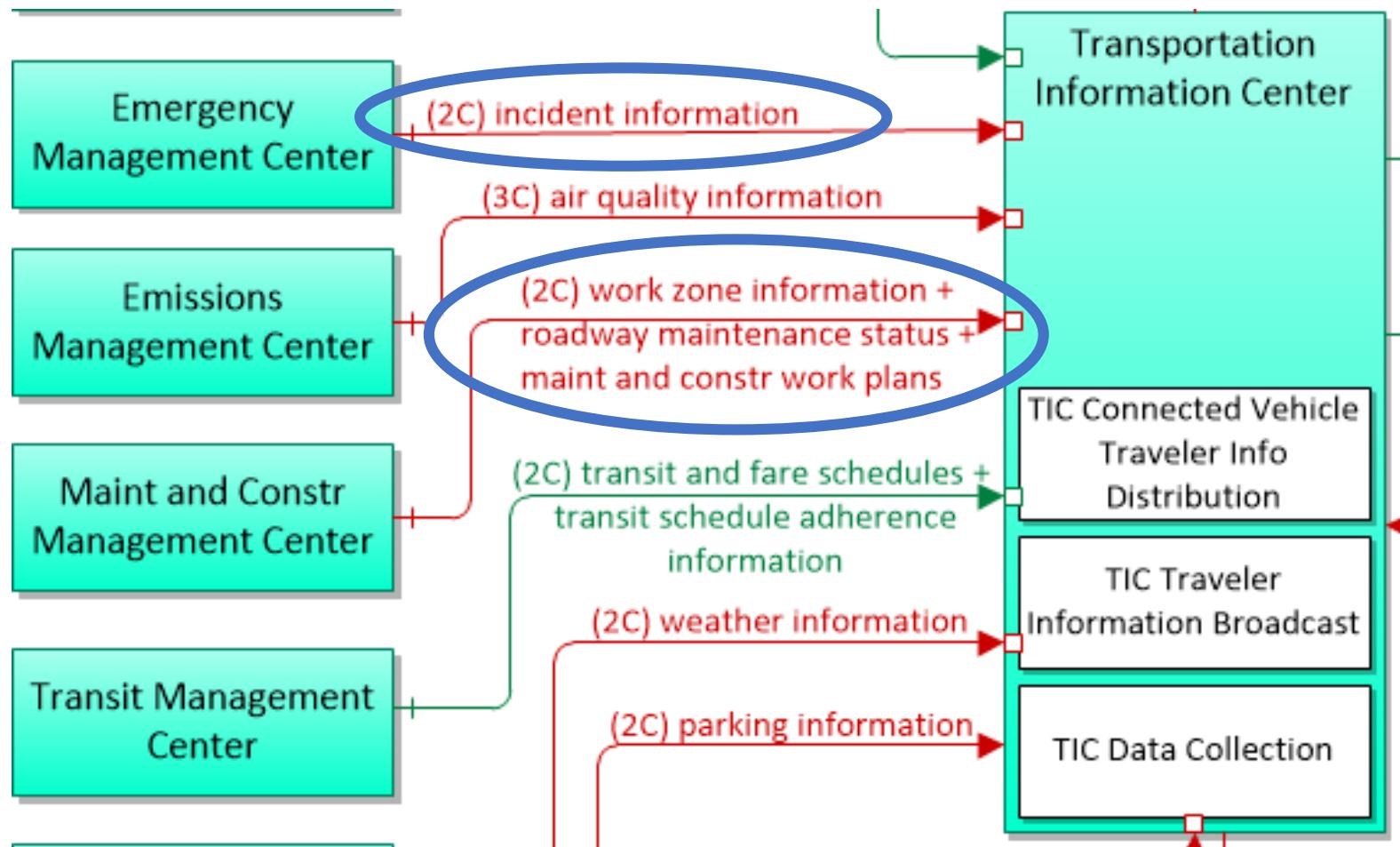
Understand C2C Communications

C2C RI focuses on Traffic Management flows



Understand C2C Communications

Same flows may be provided by other centers



Understand C2C Communications

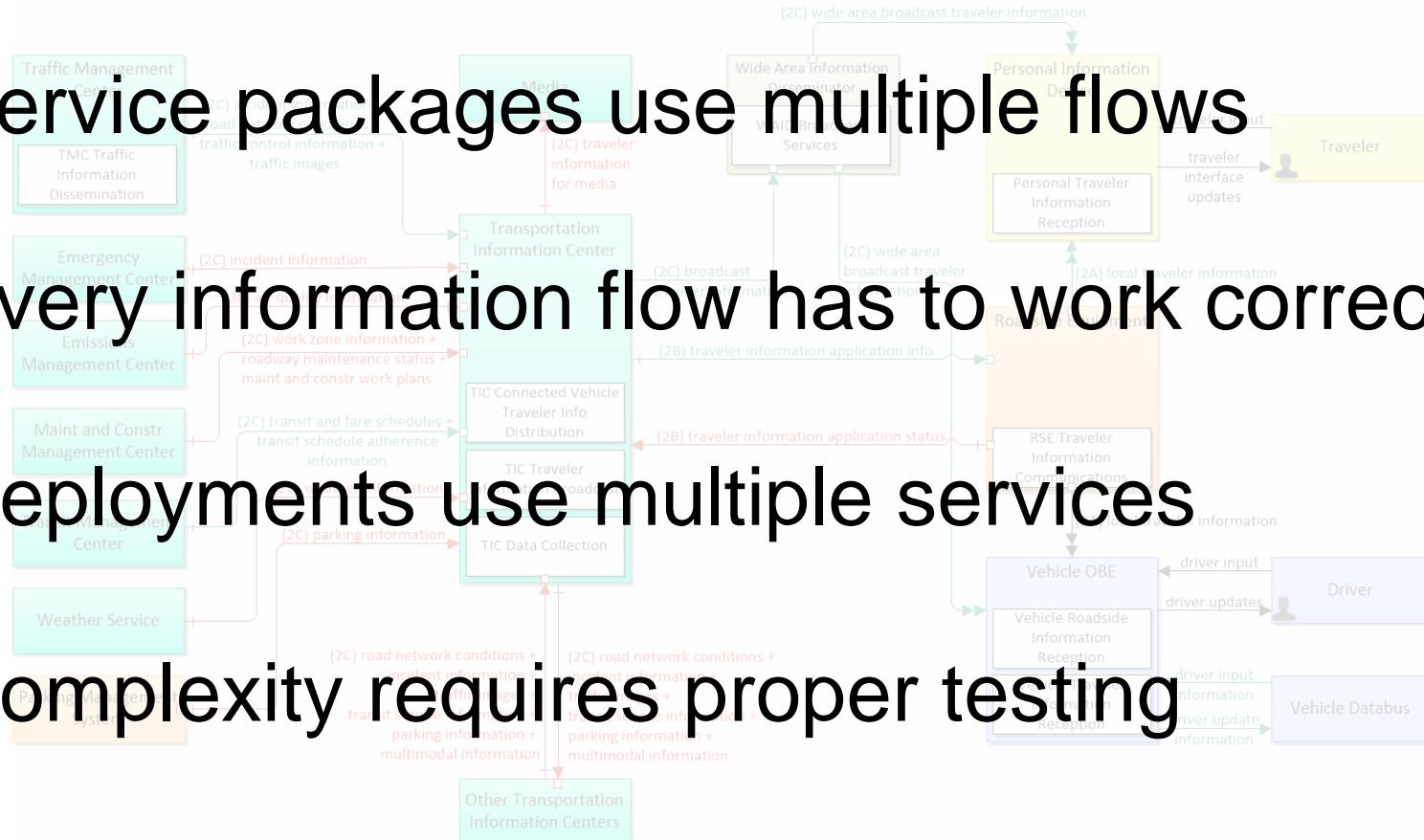
Complex systems require proper testing

Service packages use multiple flows

Every information flow has to work correctly

Deployments use multiple services

Complexity requires proper testing



Purpose of the C2C RI

Testing verifies interoperability

Interoperability is the main purpose of ITS Standards

The ability of two or more systems or components to exchange information and use the information that has been exchanged

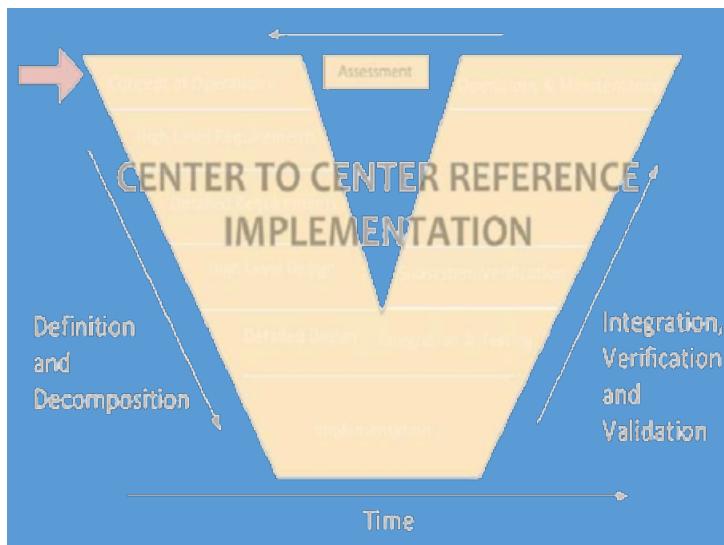
-- IEEE 610.12

To realize interoperability, we need:

- User needs (Module A321a)
- Requirements (Module A321b)
- Design (TMDD Standard)
- Verification (Module T321)
- Validation (Module T321)

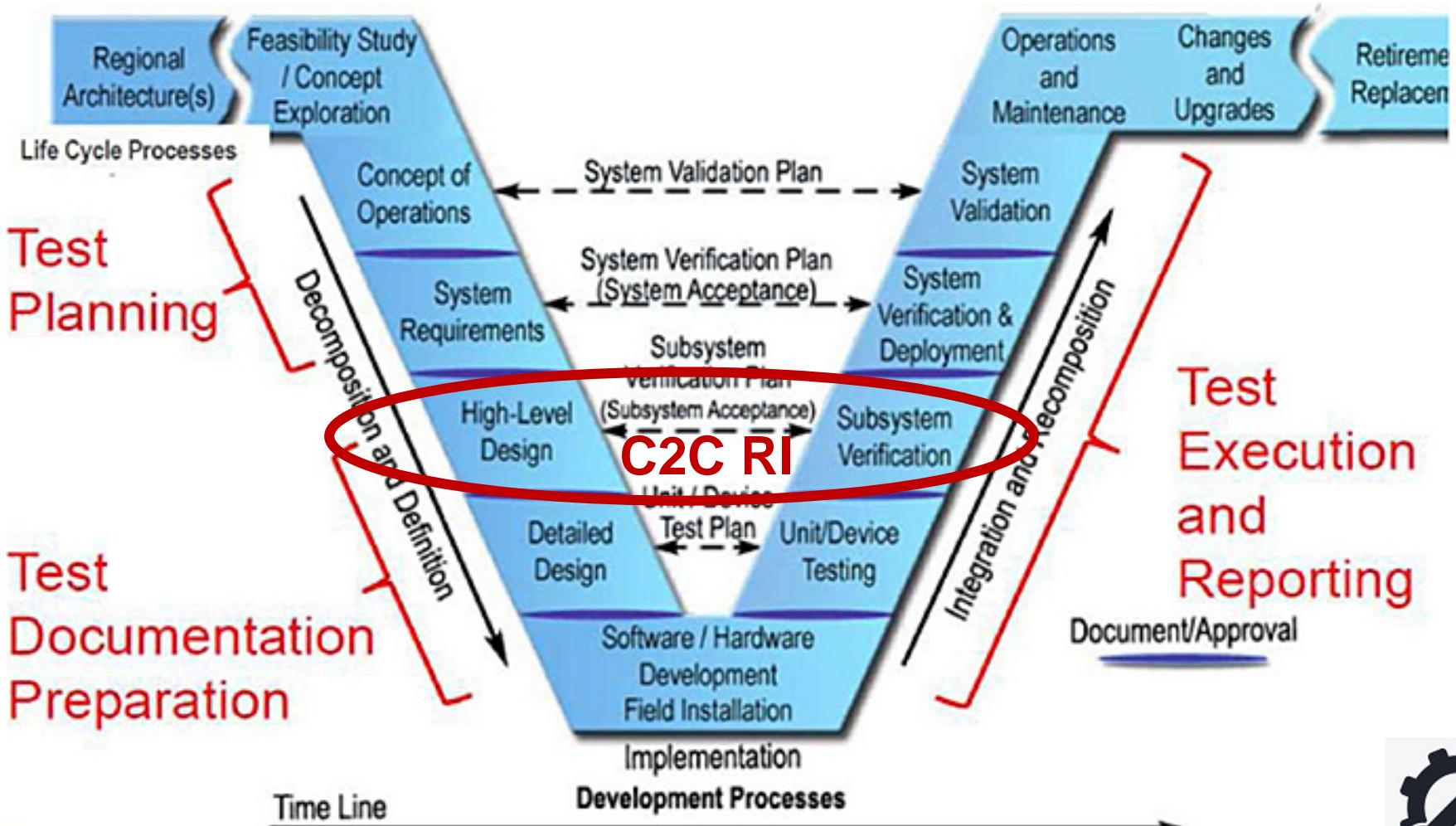
Purpose of the C2C RI

Verification is a key step in Systems Engineering



Purpose of the C2C RI

Subsystem verification is midway through right side



Purpose of the C2C RI

C2C RI is customizable to your project

Three operational modes of the RI

- **Configure:** Define which flows are implemented, etc.
- **Test:** Verify that the flows are properly implemented
- **Report:** Tests performed and errors discovered

C2C RI Communications Stack

Architecture, standards, and C2C RI work together

Traffic Management Center --> Transportation Information
incident information

Definition

Included In

Communication Diagrams

Characteristics

Security

Definitions

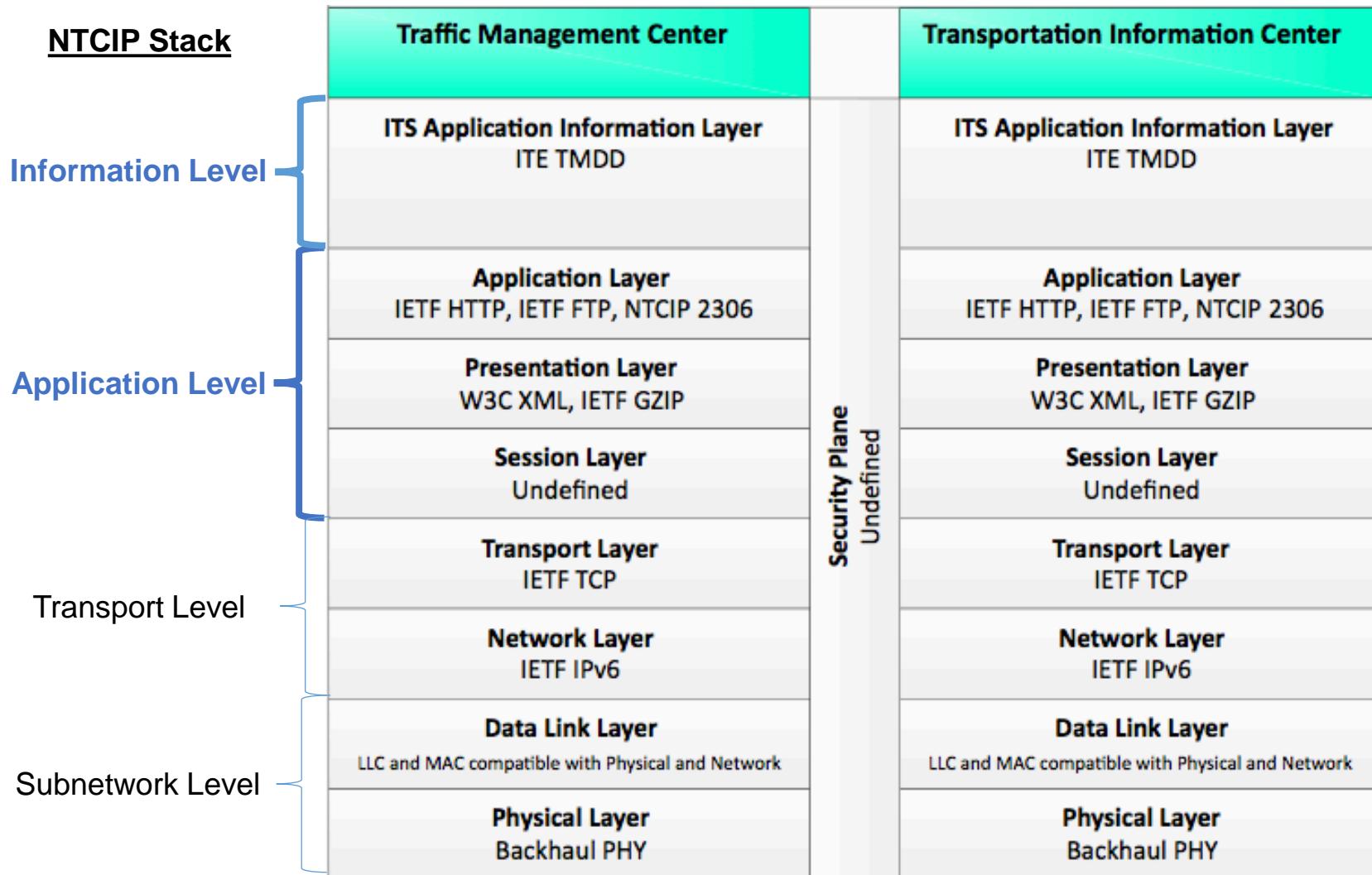
incident information (Information Flow): Notification of existence of incident and expected severity, location, additional information is gathered and the incident evolves, updated incident information is provided. Incidents range from transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) to caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional responses, closures, and other planned events that may impact the transportation system.

Traffic Management Center (Source Physical Object): The 'Traffic Management Center' monitors and controls centers that manage a broad range of transportation facilities including freeway systems, rural and suburban traffic control systems. It communicates with ITS Roadway Equipment and Connected Vehicle roadside units to manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field transportation resources to support allied agencies in responding to, and recovering from, incidents ranging from routine to caused disasters.

Transportation Information Center (Destination Physical Object): The 'Transportation Information Center'

C2C RI Communications Stack

Architecture identifies the standards in the stack



C2C RI Communications Stack

Detailed view of the layers tested by C2C RI

WSDL <i>Allows an owner center to advertise which services are available</i>	TMDD Messages <i>Defines various messages to perform TMC-related operations</i>		
	SOAP <i>Preferred solution for exchanges with error handling, includes Publish/Subscribe support</i>	Direct XML <i>Simple solution for one-way exchanges and request-reply without error handling</i>	
	HTTP/S <i>Supports bi-directional exchanges with optional security</i>		FTP <i>One-way information</i>

- TMDD: Traffic Management Data Dictionary for C2C Communications
 - NTCIP 2306: XML Message Encoding and Transport in ITS C2C Communications
 - TMDD – Traffic Management Data Dictionary
 - SOAP – Simple Object Access Protocol
 - XML – eXtensible Markup Language
 - HTTP/S – Hypertext Transfer Protocol with optional Security
 - FTP – File Transfer Protocol
 - WSDL – Web Services description Language
- See Supplement for full list of acronyms*

C2C RI Communications Stack

What does the C2C RI support?

C2C RI is able to **verify**:

- TMDD v3.03c
- NTCIP 2306 v1.69
- Over standard Internet stack

Others with user-customized test procedures

C2C RI Communications Stack

How do I obtain the C2C RI?

Download at:

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

FREE!

User Manual is included in installation files

Technical support via e-mail at: c2crisupport@transcore.com



A C T I V I T Y



Question

Which standard is not supported by the C2C RI (without customization)?

Answer Choices

- a) Internet Protocol (v4)
- b) XML Center-to-Center Profile (NTCIP 2306 v1.69)
- c) Transit Communications Interface Profiles (TCIP v5.0)
- d) Traffic Management Data Dictionary (TMDD v3.03c)

Review of Answers



- a) Internet Protocol

Incorrect. The C2C RI uses IP for all communications and allows the user to configure the IP address.



- b) XML Center-to-Center Profile (NTCIP 2306)

Incorrect. The C2C RI includes a suite of tests to verify that a test system conforms to NTCIP 2306.



- c) Transit Communications Interface Profiles (TCIP)

Correct! The C2C RI does not include a test suite for transit data; however, a custom test suite could be developed.



- d) Traffic Management Data Dictionary

Incorrect. The C2C RI includes a suite of tests to verify that a test system conforms to the TMDD.

Learning Objectives

Recognize **purpose** of C2CReference Implementation

Acknowledge **key capabilities and limitations** of the C2C RI

Learning Objective 2

Acknowledge
**key capabilities and
limitations
of the C2C RI**

Operational Environment Required

Recommended Minimum System Requirements

- Windows 7 or 8
 - 64-bit Professional
- 2 GHz processor
- 4 GB RAM
- 1 GB Storage
- 1 Gbps Ethernet interface
- Java SE Runtime Environment (JRE) V7.17

Capabilities and Limitations

What are current limitations?

User needs **extensive skillset**

Information Layer limited to **TMDD**

Application Layer limited to **NTCIP 2306**

Skills Required to Use C2C RI

Skills Needed



Encoding languages



Protocols



Windows networking



ITS standards



Testing experience



Scripting language



System under test



Skills Required to Use C2C RI

Necessary encoding language skills

Basic understanding of:



- XML
 - eXtensible Markup Language
- XSD
 - XML Schema Definition
- WSDL
 - Web Services Description Language

Basic understanding means:

- Familiar with **basic structures** defined by standards
- Capable of **developing and inspecting** packets and/or documents, as needed

Skills Required to Use C2C RI

Necessary protocol skills

Basic understanding of:



- SOAP (if used)
 - Simple Object Access Protocol
- HTTP and/or FTP (as used)
 - Hypertext Transfer Protocol
 - File Transfer Protocol
- TCP/IP networking
 - Transport Control Protocol
 - Internet Protocol

Skills Required to Use C2C RI

Necessary IT networking skills

Basic understanding and **permissions** for configuring Windows:

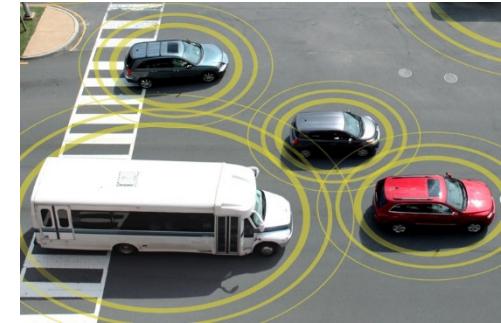


- Internet security

Skills Required to Use C2C RI

Necessary ITS standards skills

Thorough understanding of:



- **Information** Layer standards (e.g., TMDD v3.03c)
- **Application** Layer standards (e.g., NTCIP 2306 v1.69)

Thorough understanding means:

- Familiar with **basic structure** of standards
- Understand **conformance**
- Understand **compliance** (options)
- Understand **traceability** (NRTM and RTM)
- Capable of **quickly referencing** all details

Skills Required to Use C2C RI

Necessary systems engineering skills

Experience in:

- Preparing and understanding **test documentation**
- Using a **Needs to Requirements** Traceability Matrix (NRTM)
- Using a **Requirements (to design)** Traceability Matrix (RTM)
- Using a **Requirements to Test Case** Traceability Matrix (RTCTM)



Skills Required to Use C2C RI

Necessary programming skills

To create **custom test suites**, you also need to know how to:



- Define your custom **user needs**
- Define your custom **requirements**
- Write C2C test **script files**
- Combine this information into a **test suite** package

Detailed process will be included in the User Manual

Skills Required to Use C2C RI

Other necessary knowledge

Knowledge of System Under Test (SUT)

- Custom **configuration** for each system
- Based on supported **user needs and requirements**



Permissions to operate the SUT



C2C RI



SUT

Source: NYCDOT

Skills Required to Use C2C RI

Skill set summary



Encoding languages



Protocols



Windows networking



ITS standards



Testing experience



Scripting language



System under test



What Functions Can Be Tested

What does the C2C RI test?

- **Standards**
 - NTCIP 2306 v1.69
 - TMDD v3.03c
- **Center Type**
 - Owner center emulation
 - External center emulation
- **Types of Tests**
 - Valid conditions
 - Invalid conditions



What Functions Can Be Tested

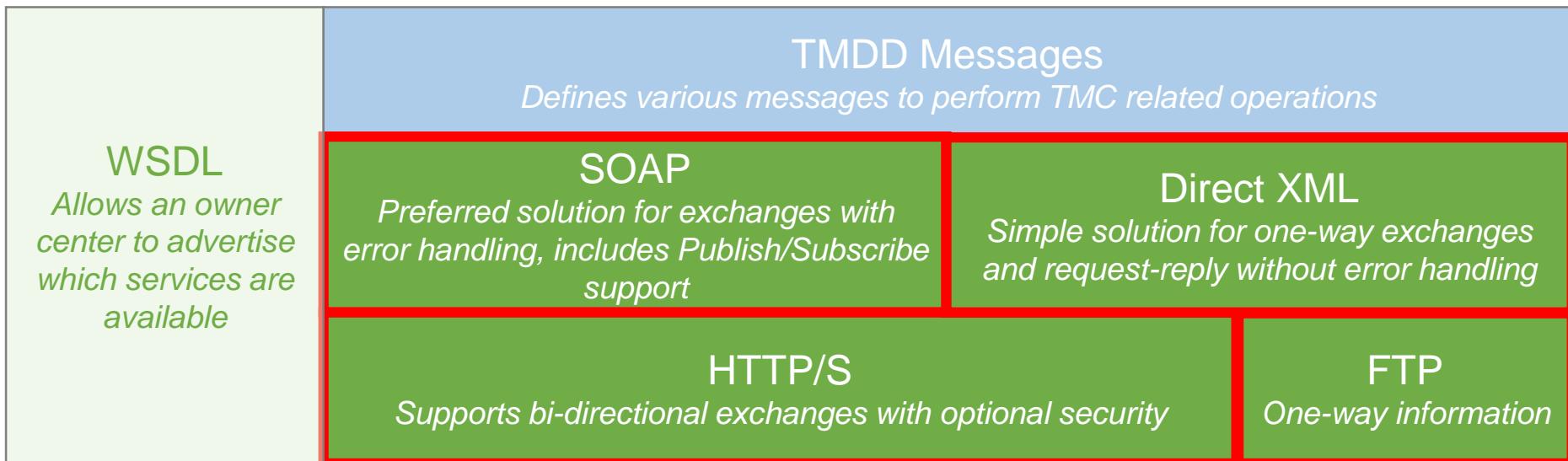
Sample test cases for NTCIP 2306

<p>WSDL <i>Allows an owner center to advertise which services are available</i></p>	<p>TMDD Messages <i>Defines various messages to perform TMC related operations</i></p>
<p>SOAP <i>Preferred solution for exchanges with error handling, includes Publish/Subscribe support</i></p>	<p>Direct XML <i>Simple solution for one-way exchanges and request-reply without error handling</i></p>
<p>HTTP/S <i>Supports bi-directional exchanges with optional security</i></p>	<p>FTP <i>One-way information</i></p>

- For NTCIP 2306, C2C RI verifies that a system:
 - Advertises its web services in a conformant manner
 - Ensures advertised file is conformant
 - Ensures advertised file supports the required interfaces

What Functions Can Be Tested

Sample test cases for NTCIP 2306



- Is able to connect through the required and advertised interface(s)
 - Defined communication stacks
 - Defined exchange patterns
 - Request/Reply
 - Subscription/Publication
 - Publication only

What Functions Can Be Tested

Sample C2C RI test cases for TMDD

TMDD Messages <i>Defines various messages to perform TMC related operations</i>			
WSDL <i>Allows an owner center to advertise which services are available</i>	SOAP <i>Preferred solution for exchanges with error handling, includes Publish/Subscribe support</i>	Direct XML <i>Simple solution for one-way exchanges and request-reply without error handling</i>	
HTTP/S <i>Supports bi-directional exchanges with optional security</i>			FTP <i>One-way information</i>

- For the TMDD, the C2C RI verifies that a system:
 - Supports a valid request
 - Properly handles invalid requests
 - Missing fields
 - Incorrect values
 - Etc.
 - Similar tests, reversed, when C2C RI acts as an Owner Center

Unavailable/Planned Functions

What are planned enhancements?

- Enhanced emulation
 - If RI is acting as Owner Center:
 - RI **responds** to EC requests, such as:
 - Inventory request
 - Status request
 - Information request
 - Control request

Version 1

Response message is **statically** determined based on

- A user-defined configuration file

Version 2

Response message is **dynamically** determined based on

- A user-defined configuration file and
- The contents of the request
 - E.g., if the request contains filters, the response may contain only a subset of the configuration file

Unavailable/Planned Functions

What are planned enhancements?

Version 2

- Verification for compliance to §1201 of SAFETEA-LU

Information Layer Standard Conformance Report				
UN ID	User Need			Results
2.3.1.1	Verify Connection Active			Passed
Reference to Standard req'ts		Requirement ID	Related DXFS Requirement	Results
		3.3.1.1.1	3.4.1.1.1	Passed
		3.3.1.1.2	3.4.1.1.2	Passed
		3.3.1.1.3	3.4.1.1.3	Passed
Reference to §1201 req'ts		3.3.1.1.4	3.4.1.1.4	No Test Cases Applicable in this Test Mode
		3.3.1.1.4.1	3.4.1.1.5	No Test Cases Applicable in this Test Mode
Results of testing each requirement		3.3.1.1.5	3.4.1.1.6	Passed

A C T I V I T Y



Question

What skill is not needed to use the C2C RI?

Answer Choices

- a) Windows networking
- b) X.509 certificates
- c) HTTP
- d) WSDL

Review of Answers



- a) Windows networking

Incorrect. The user needs to be able to configure the RI host to support incoming messages.



- b) X.509 certificates

Correct! The user does not necessarily need to understand how X.509 certificates work as they are not required.



- c) HTTP

Incorrect. The user needs to be aware of HTTP as this is often used as an underlying protocol for NTCIP 2306.



- d) WSDL

Incorrect. The user needs to be familiar with WSDL as this is how the interface to the system is described.

Learning Objectives

Recognize **purpose** of C2C Reference Implementation

Acknowledge **key capabilities and limitations** of the C2C RI

Follow process for **producing test documentation** that relies upon the C2C RI

Learning Objective 3

Follow process for
producing test documentation
that relies upon the C2C RI

IEEE 829 Test Documentation

Relationships of IEEE 829-2008 test documents

Test Plan

Test Design

Test Cases

Test
Procedures

Execute

Test
Reports



For more information see modules

- T101: Introduction to Standards Testing
- T201: How to Write a Test Plan
- T202: Test Design, Cases & Procedures
- T203: How to Develop Test Cases
- T204: How to Develop Test Procedures
- T321: Applying your Test Plan to TMDD



Test Plan for C2C

Test plan is a high level document



- Types
 - Master Test Plan
 - Level Test Plan
- Context
- Project management issues
- Reference to test design

Test Plan for C2C

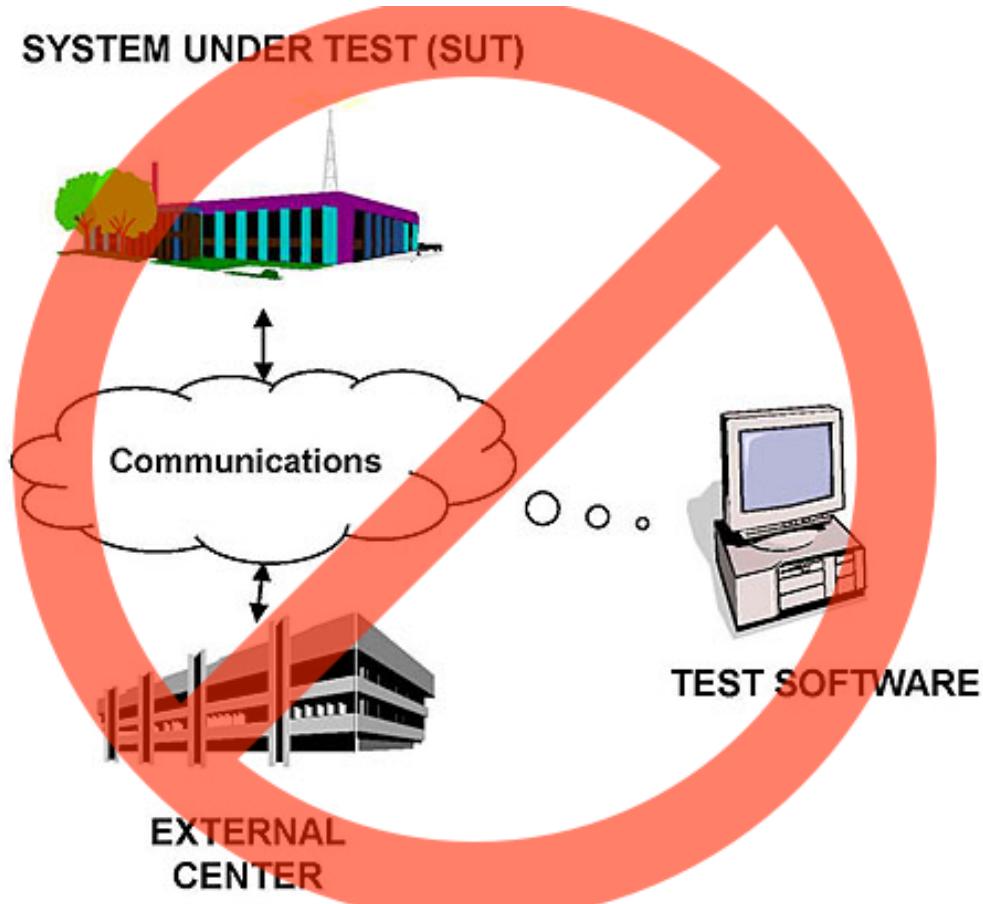
Example C2C RI test plan context

Test plan using C2C RI

- Communications/Functional/Environmental
- Factory/Laboratory/On-Site
- Verification/Validation
- Component/Integration
- Acceptance/Deployment
- Which standards? (NTCIP 2306, TMDD, any custom extensions)

Test Plan for C2C

C2C RI is an active emulator, not just a sniffer



Example Test Environment in Module T321

Test Plan for C2C

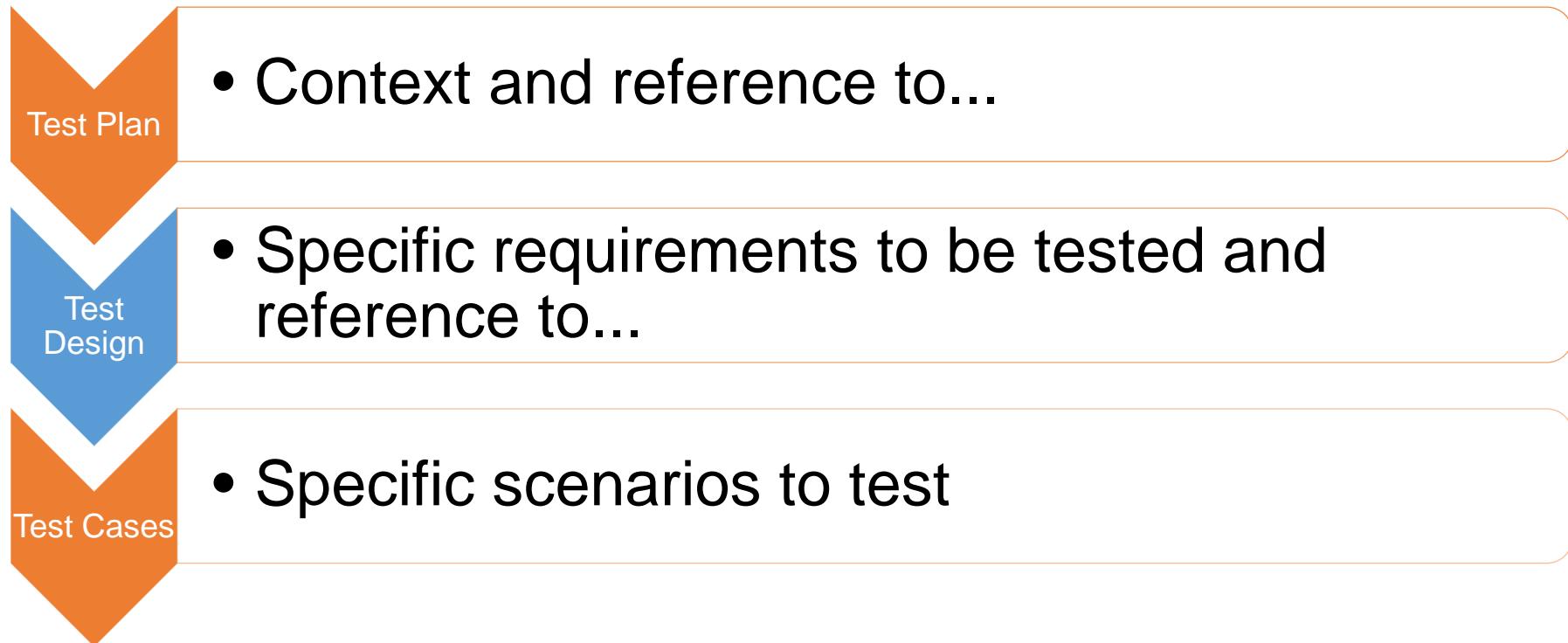
C2C RI does not develop a test plan

Test plan is not covered by C2C RI

- Test plan is a management plan that should be defined before using C2C RI
- Outline defined by IEEE 829-2008 and provided in Student Supplement

Test Design for C2C

Test design defines traceability from requirements



Test Design for C2C

Test design example

Test Plan

- Verify TMDD interface in a **laboratory environment** for approval of Stage 1 payment

Test Design 1

- Verify that the system supports **SOAP message encodings**
 - Reference to appropriate test cases

Test Design 2

- Verify that the system supports **connection active requests**
 - Reference to appropriate test cases

Test Design for C2C

Test Design Specifications for TMDD

Table 5: TMDD v3.03c Test Case to Requirements Mapping

Need ID	Test Case Identifier	Requirements
2.3.1.1	TCS-1-dlCenterActiveVerificationRequest-OC-Valid	3.3.1.1.1, 3.3.1.1.5, 3.3.1.1.5.1, 3.3.1.1.5.2.1
	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-1	3.3.1.1.1, 3.3.1.4.1, 3.3.1.4.1.1, 3.3.1.4.1.2.1
	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-2	3.3.1.1.1, 3.3.1.4.1, 3.3.1.4.1.1, 3.3.1.4.1.2.1
	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-3	3.3.1.1.1, 3.3.1.4.1, 3.3.1.4.1.1, 3.3.1.4.1.2.1
	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-4	3.3.1.1.1, 3.3.1.4.1, 3.3.1.4.1.1, 3.3.1.4.1.2.1
	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-5	3.3.1.1.1, 3.3.1.4.1, 3.3.1.4.1.1, 3.3.1.4.1.2.1

EXAMPLE

Test Design for C2C

Test designs in the RI Reports

Complete traceability table available on request

Version 1

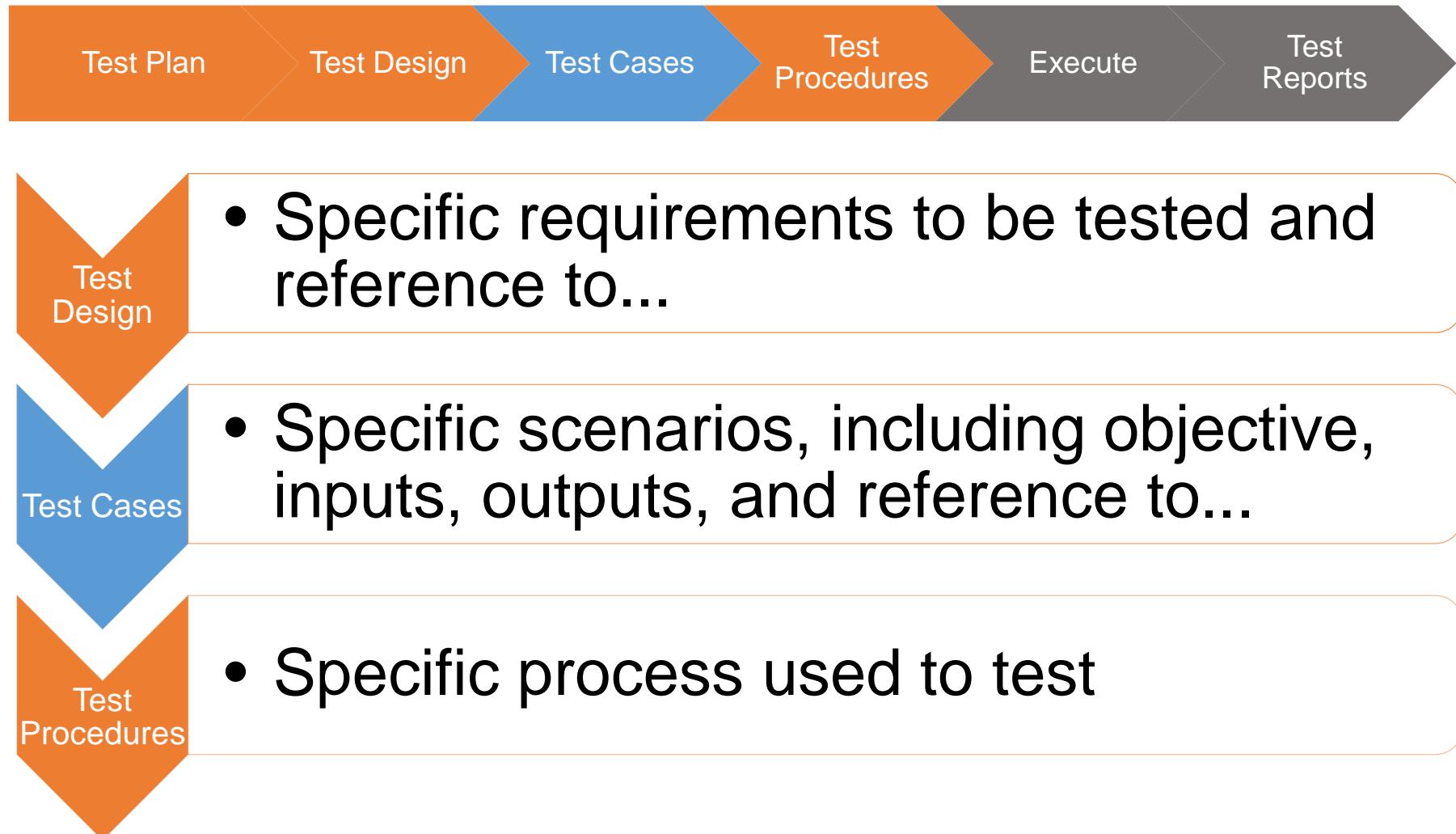
- Includes a built-in traceability table
- Shows every test that traces to any selected requirement
- Allows user to select when to perform the tests

Version 2

Also allows user-generated traceability report

Test Case for C2C

Role of test case



Test Case for C2C

Test case example

Test Design 1

- Verify that the system supports SOAP message encodings

Test Case 1

- Ensure that the system accepts valid SOAP messages
 - Input: Valid TMDD file
 - Output: System accepts message without error
 - Procedure: <reference>

Test Case 2

- Ensure that the system rejects an invalid SOAP message (type element)
 - Input: TMDD file with invalid type element
 - Output: System rejects message with distinct error code
 - Procedure: <reference>

Test Case for C2C

2306 Test Case Specification

69.1 Test Case Specification Identifier

Identifier	Description
TCS-C2CRI-NTCIP2306-WSME-SUT-SHRR-OC	To verify that the SUT can communicate with the RI using the protocol stack for SOAP over HTTP with Request-Response defined in the SUT's WSDL document.

69.3 Input Specifications

Inputs	Procedures
The WSDL input file will be user defined for the owner center.	TPS-NTCIP2306-SOAP-RR-OC

69.4 Output Specifications

Outputs	Procedures
The input execution shall generate an RI Test Result Status of Passed or Failed associated with the matching expected result shown in the Test Case Data Variable Table in the appendix.	

EXAMPLE

Test Case for C2C

Test cases in the RI Reports

Supplement contains a complete example of the Test Case Specification

Version 1

- Shows test case descriptions within tool

Version 2

- Will also allow a user to print reports showing test cases

Test Procedure for C2C

Role of test procedure



- Specific scenarios, including objective, inputs, outputs, and reference to...
 - Step-by-step process used to test
 - Specific actions of tester
-
- Test Case
 - Test Procedures
 - Test Steps

Test Procedure for C2C

Test procedure example

Test Case

- Ensure that the system accepts valid SOAP messages
 - Input: Valid TMDD file
 - Output: System accepts message without error
 - Procedure: <reference>

Test Procedure defines steps such as

- Configure the Application Layer standard to be used
- Verify that the specified WSDL file exists
- If the file is acceptable, do ...
- Send message ...

Test Procedure for C2C

TMDD Test Procedure

Test Step Number	Test Procedure	Results
1	CONFIGURE: Determine the Application Layer Standard that will be used for this test. RECORD this information as: ApplicationLayerStandard	NA
2	CONFIGURE: Determine the dialog performance requirement for Send Center Active Verification Upon Request (NRTM 3.3.1.1.1). RECORD this value as: TMDD_N1R1_Send_Center_Active_Verification_Upon_Request_Parameter	NA
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	NA
4	CONFIGURE: Determine whether Restrictions - Error Report is required by the specification. (NRTM 3.3.1.4.1.2.1). RECORD this information as: TMDD_N1R14_Restrictions_Error_Report_Supported	NA
5	CONFIGURE: Define the message that will be sent to the SUT. RECORD this information as: RequestMessage	NA
6	CONFIGURE: Determine whether an error response message is expected for this test. RECORD this information as: ErrorResponseExpected	NA
7	CONFIGURE: IF ErrorResponseExpected is true, determine the expected error code response for this test. RECORD this information as: ErrorTypeExpected	NA
8	REQUEST-RESPONSE-EC with the following parameters: DIALOG=dICenterActiveVerificationRequest RESPONSETIMEREQUIRED=TMDD_N1R1_Send_Center_Active_Verification_Upon_Request_Parameter REQUESTMESSAGE = RequestMessage	PASS/FAIL (3.3.1.1.2, 3.4.2)

EXAMPLE

Test Procedure for C2C

Implemented test procedures

Supplement contains a complete example of this test procedure

Version 1

- Built in procedures implemented in scripts

Version 2

- Will allow a user to print test procedures

A C T I V I T Y



Question

Which test document requires information from sources beyond the C2C RI?

Answer Choices

- a) Test plan
- b) Test design specification
- c) Test cases
- d) Test procedures

Review of Answers



- a) Test plan

Correct! The test plan is a high-level document and contains management information beyond the scope of the the C2C RI.



- b) Test design specification

Incorrect. The C2C RI Configuration Report allows the user to map between the requirements and associated test cases.



- c) Test cases

Incorrect. The C2C RI Configuration Report identifies the test script used for each test case.



- d) Test procedures

Incorrect. The C2C RI Test Script Report provides the test scripts as implemented in the C2C RI tool.

Learning Objectives

Recognize **purpose** of C2C Reference Implementation

Acknowledge **key capabilities and limitations** of the C2C RI

Follow process for **producing test documentation** that relies upon the C2C RI

Recognize **results** a tester might produce after using the C2C RI

Learning Objective 4

Recognize results
a tester might produce
after using the C2C RI

Hands-On Guidance

Benefits of C2C RI

Test Plan

Test Design

Test Cases

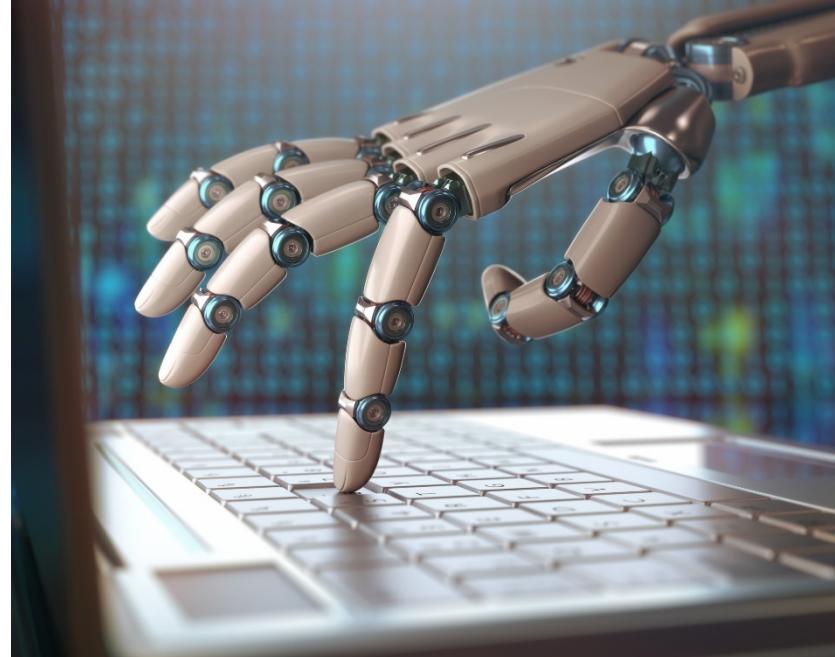
Test
Procedures

Execute

Test
Reports

C2C RI

- Largely automates testing
 - Simpler
 - More repeatable
 - Less prone to error
- Decreases costs
 - Labor
 - Schedule
- Increases thoroughness
 - Improves quality of product
 - Identifies bugs faster/earlier



See Module T351 for more information

C2C RI Test Reports

Types of Reports

Test Plan

Test Design

Test Cases

Test
Procedures

Execute

Test
Reports

Assist in developing formal test reports:

- Test logs
- Anomaly reports
- Test summary

C2C RI test reports

- Test logs
- Test summaries



C2C RI Test Reports – Test Logs

Purpose of Log

Purpose of a Test Log

- Chronological record of details
- Assists in repeating process
- Assists in debugging



C2C RI Test Reports – Test Logs

C2C RI Test Log Reports

- Test Case Detail Log Report
- Test Script Action Log Report
- Message Detail Report



C2C RI Test Reports – Test Logs

Test Case Detail Log

Purpose of a Test Case Detail Log

- Logs test steps in order of execution
- Logs values used and calculations made
- Logs results of pass/fail steps
- Summarizes reason for failure
- Timestamp
- Script being executed



C2C RI Test Reports – Test Logs

Test Case Detail Log Report

C2C RI Version: Version 1.0.7

Created by: MInsignares

Test Suites:

Application: NTCIP 2306 v1.69

Information: TMDD v3.03c

08/09/2016 11.20 AM

Log File Name:	C:\c2cri\TRANSCOM Stand-alone Test 2 Run 2.2016-08-09_10-31-35.xml
Log File Creator:	MInsignares
Log File Creation Date:	2016-08-09_10-31-35
Log File Description:	Second run of the TRANSCOM Stand-alone test 2, circumventing a problem discovered in the

Time	Test Case Name	Test Step Description	Pass/Fail	Fail Reason
09/08/2016 10.31.56.368	TCS-C2CRI-NTCIP2306-WSDL-SUT		FAILED	
09/08/2016 10.32.00.879		Step 1 CONFIGURE: Determine the URL for the WSDL file that will be used for this test. RECORD this information as: WSDLFile = http://standards2.xcmdata.org:8080/MiddlewareOutbound/wsdl/XCM-TMDD.wsdl	PASSED	
09/08/2016		Step 2 CONFIGURE:	PASSED	

Back-ground

Detail

EXAMPLE

C2C RI Test Reports – Test Logs

Test Script Action Log

Purpose of a Test Script Action Log

- Primarily a tool for debugging test scripts
- Chronological log of the start and end of each test script
- Logs results of the test script
- Filenames and line numbers
- Shows timestamps



C2C RI Test Reports – Test Logs

Test Script Action Log Report

TimeStamp	Test Script Action	Results
09/08/2016 10.31.54.539	User Started the Test with selected Test Case Scripts:Application Layer: TCS-C2CRI-NTCIP2306-WSDL-SUT	
09/08/2016 10.31.56.352	testCase - Begin Script: jar:file:/C:/C2CRI/dist/RIGUI.jar!/org/fhwa/c2cri/testmodel/TestCaseLauncher.xml line: 14 column: 58	
09/08/2016 10.31.56.664	ri-execute-script - Begin Script: jar:file:/C:/C2CRI/dist/RIGUI.jar!/org/fhwa/c2cri/testmodel/TestCaseLauncher.xml line: 22 column: 79 functionId: TCS-C2CRI-NTCIP2306-WSDL-SUT	
09/08/2016 10.32.00.879	testStep - Begin Script: jar:file:/C:/C2CRI/.TestSuites/NTCIP2306v01_69Signed.jar!/AppLayer/Scripts/TPS-NTCIP2306-WSDL.xml line: 13 column: 187 functionId: Step 1 CONFIGURE: Determine the URL for the WSDL file that will be used for this test. RECORD this information as: WSDLFile =	
09/08/2016 10.32.00.895	testStep - End Script: jar:file:/C:/C2CRI/.TestSuites/NTCIP2306v01_69Signed.jar!/AppLayer/Scripts/TPS-NTCIP2306-WSDL.xml line: 13 column: 187 functionId: Step 1 CONFIGURE: Determine the URL for the WSDL file that will be used for this test. RECORD this information as: WSDLFile =	PASSED

EXAMPLE

C2C RI Test Reports – Test Logs

Message Detail Report

- Purpose of a Message Detail Report
 - Logs the messages that are transmitted/received
 - Source and destination
 - Shows complete details of contents
 - Shows timestamps



C2C RI Test Reports – Test Logs

Message Detail Report

Log File Name:	C:\c2cri\TRANSCOM Stand-alone Test 2 Run 2.2016-08-09_10-31-35.xml
Log File Creator:	MInsignares
Log File Creation Date:	2016-08-09_10-31-35
Log File Description:	Second run of the TRANSCOM Stand-alone test 2, circumventing a problem discovered in the

Time	Message	Source	Destination
08/09/16 10:33:24.605	REQUEST(centerActiveVerificationRequestMsgErrorAddOn)	192.168.2.168:64673	160.79.9.145:8080

tmdd:centerActiveVerificationRequestMsgErrorAddOn.authentication.user-id = tmdd
tmdd:centerActiveVerificationRequestMsgErrorAddOn.authentication.password = tmdd@123
tmdd:centerActiveVerificationRequestMsgErrorAddOn.authentication.operator-id = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-id = agency.com
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-name = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-location = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-function = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-contact-details.contact-id = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-contact-details.person-name = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-contact-details.person-title = string
tmdd:centerActiveVerificationRequestMsgErrorAddOn.organization-requesting.organization-contact-details.phone-number = string

EXAMPLE

C2C RI Test Reports – Test Summaries



C2C RI Test Reports – Test Summaries

C2C RI Test Summary Reports

- Test Case Summary
- Test Message Summary
- Test Conformance/Compliance



Version 2

- Section 1201 Conformance/Compliance

C2C RI Test Reports – Test Summaries

Test Case Summary Report

Purpose of a Test Case Summary Report

- Identifies test cases performed, in order
- Identifies each performance as passed/failed
- Timestamp



C2C RI Test Reports – Test Summaries

Test Case Summary Report

Log File Name:	C:\c2cr\TRANSCOM Stand-alone Test 2.2016-08-09_09-31-32.xml
Log File Creator:	Mlnsignares
Log File Creation Date:	2016-08-09_09-31-32
Log File Description:	TRANSCOM Stand-alone Test 2. Aug 9 2016. C2C RI 1.0.7.

Time	Test Case Name	Pass/Fail
Tue Aug 09 09:32:34 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-2	FAILED
Tue Aug 09 09:42:29 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-2	PASSED
Tue Aug 09 09:42:58 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-3	PASSED
Tue Aug 09 09:43:16 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-4	PASSED
Tue Aug 09 09:43:34 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-5	PASSED
Tue Aug 09 09:43:52 EDT 2016	TCS-1-dlCenterActiveVerificationRequest-OC-InValid-6	PASSED

C2C RI Test Reports – Test Summaries

Test Message Summary Report

Purpose of a Test Message Summary Report

- Logs summary of messages transmitted/received
- Shows source and destination
- Shows timestamps



C2C RI Test Reports – Test Summaries

Test Message Summary Report

Log File Name:	C:\c2cri\TRANSCOM Stand-alone Test 2 Run 2.2016-08-09_10-31-35.xml
Log File Creator:	Mlinsignares
Log File Creation Date:	2016-08-09_10-31-35
Log File Description:	Second run of the TRANSCOM Stand-alone test 2, circumventing a problem discovered in the

Time	Message	Source	Destination
08/09/16 10:33:24.605	REQUEST (centerActiveVerificationRequestMsgErrorAddOn)	192.168.2.168:64673	160.79.9.145:8080
08/09/16 10:33:24.605	RESPONSE (errorReportMsg)	160.79.9.145:8080	192.168.2.168:64673
08/09/16 10:33:43.315	REQUEST (centerActiveVerificationRequestMsg)	192.168.2.168:64683	160.79.9.145:8080
08/09/16 10:33:43.315	RESPONSE (errorReportMsg)	160.79.9.145:8080	192.168.2.168:64683
08/09/16 10:34:00.837	REQUEST (Unknown)	192.168.2.168:64693	160.79.9.145:8080
08/09/16 10:34:00.837	RESPONSE (errorReportMsg)	160.79.9.145:8080	192.168.2.168:64693

EXAMPLE

C2C RI Test Reports – Test Summaries

Test Conformance/Compliance Report

Purpose of a Test Conformance/Compliance Report

- Summarizes results against tested requirements/needs
 - Using traceability tables discussed earlier
- Assists in identifying the practical impacts of failure



C2C RI Test Reports – Test Summaries

Test Conformance/Compliance Report

Information Layer Standard Conformance Report

UN ID	User Need			Results
2.3.1.1	Verify Connection Active			Passed
		Requirement ID	Other Requirements	Results
		3.3.1.1.1	The owner center shall respond within ____ (100 ms - 1 hour; Default = 1 minute) after receiving the request. See Section 3.4.2.	Passed
		3.3.1.1.4		No Test Cases Applicable in this Test Mode
		3.3.1.1.4.1		No Test Cases Applicable in this Test Mode
		3.3.1.1.5		Passed
		3.3.1.1.5.1		Passed
		3.3.1.4.1		Passed
		3.3.1.4.1.1		Passed

EXAMPLE

C2C RI Test Reports – Test Summaries

Section 1201 Conformance/Compliance Report

Purpose of Section 1201 Report

- Summarizes results against
 - SAFETEA-LU Section 1201 requirements
 - CFR Title 23 Part 511 regulations
- An extension of the more basic conformance/compliance report
- Assists in identifying impacts related to Section 1201 compliance



C2C RI Test Reports – Test Summaries

Section 1201 Conformance/Compliance Report

Information Layer Standard Conformance Report

UN ID	User Need			Results
2.3.1.1	Verify Connection Active			Passed
		Requirement ID	Related DXFS Requirement	Results
		3.3.1.1.1	3.4.1.1.1	Passed
		3.3.1.1.2	3.4.1.1.2	Passed
		3.3.1.1.3	3.4.1.1.3	Passed
		3.3.1.1.4	3.4.1.1.4	No Test Cases Applicable in this Test Mode
		3.3.1.1.4.1	3.4.1.1.5	No Test Cases Applicable in this Test Mode
		3.3.1.1.5	3.4.1.1.6	Passed
		3.3.1.1.5.1	3.4.1.1.7	Passed

C2C RI Test Reports – Test Summaries

Complete test summary

Additional information for complete test summary

- Tester needs to compile data to prepare IEEE 829 summary
- These reports aid in that preparation
- Tester is ultimately responsible for analysis and recommendations



Interpret Test Results

Complete test summary

C2C RI output is algorithmic

- May report false failures due to external problems
- Provides information about problem
- Does not judge severity or impact

Tester needs to analyze results

Ultimately needs to determine impact to project

Limitations of Test Results

What is not tested?

C2C RI does not test

- Implied functionality of messages
- User interface
- Algorithms
- Reliability of the system

Master test plan should consider all aspects

A C T I V I T Y



Question

Which is the best way to describe the C2C RI-generated test reports?

Answer Choices

- a) The conformance report provides the final assessment of whether the implementation conforms to the communications interface
- b) When combined together, the various reports produce all of the elements of IEEE 829 test documentation
- c) The reports assist the tester in identifying potential issues for further analysis
- d) The reports fail to provide the information that they were intended to provide

Review of Answers



- a) Conformance report provides the final assessment

Incorrect. The conformance report produces a formulaic result & may produce an erroneous result if an error was made in testing.



- b) When combined, the various reports produce all elements

Incorrect. A proper test summary includes analysis that requires manual review.



- c) Reports assist the tester in identifying issues

Correct! Issues identified in the reports should be investigated to determine why a failure was reported.



- d) Reports fail to provide what was intended

Incorrect. The reports provide useful information, as intended, but require analysis before final conclusions are drawn.

Module Summary

Recognize **purpose** of C2C Reference Implementation

Acknowledge **key capabilities and limitations** of the C2C RI

Follow process for **producing test documentation** that relies upon the C2C RI

Recognize **results** a tester might produce after using the C2C RI

TMDD Testing Curriculum



Module T321: Applying your **test plan** to the TMDD standard.



Module T251: Center-to-Center (C2C) **Reference Implementation** (RI) – **Introduction**.

Curriculum complete for those not needing hands-on experience with C2C RI

Module T351: Center-to-Center (C2C) Reference Implementation (RI) – **Applying the C2C Reference Implementation**.

Next Course Module

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

Concepts taught in next module (Learning Objectives):

- 1) Install and configure the C2C RI on a host system
- 2) Operate the C2C RI
- 3) Retrieve the C2C RI results from a test
- 4) Prepare a report based on the C2C RI results

Thank you for completing this module.

Feedback

Please use the Feedback link below to provide us with your thoughts and comments about the value of the training.

Thank you!

