



W E L C O M E



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

Welcome



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A screenshot of the website for the ITS Professional Capacity Building Program. The page has a blue header with the United States Department of Transportation logo and navigation links. The main content area features a large image of people in a classroom setting. A blue callout box contains a welcome message. Below this, there are sections for 'FREE TRAINING' and 'WHAT'S NEW' with various news items and links.

United States Department of Transportation
OFFICE OF THE ASSISTANT SECRETARY FOR RESEARCH AND TECHNOLOGY
Intelligent Transportation Systems
Joint Program Office

ITS Professional Capacity Building Program / Advancing ITS Education

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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

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T306: Applying Your Test Plan to the Electrical and Lighting Management Systems Based on NTCIP 1213 ELMS Standard v03



Instructor



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Learning Objectives

Describe ELMS Testing

Describe ELMS Test Plan Application

**Identify Relevant Elements
of an ELMS Test Plan**

Describe Adaptation of a Test Plan

Learning Objective 1

Describe ELMS Testing

Describe ELMS Testing

The testing life cycle, the role of test plans, and the testing to be undertaken for Electrical and Lighting Management Systems (ELMS)

- Why We Test ELMS
- Purpose of an ELMS Test Plan
- Components of an ELMS Test Plan
 - Test Design Specification
 - Test Case Specification
 - Test Procedure Specification



Why We Test

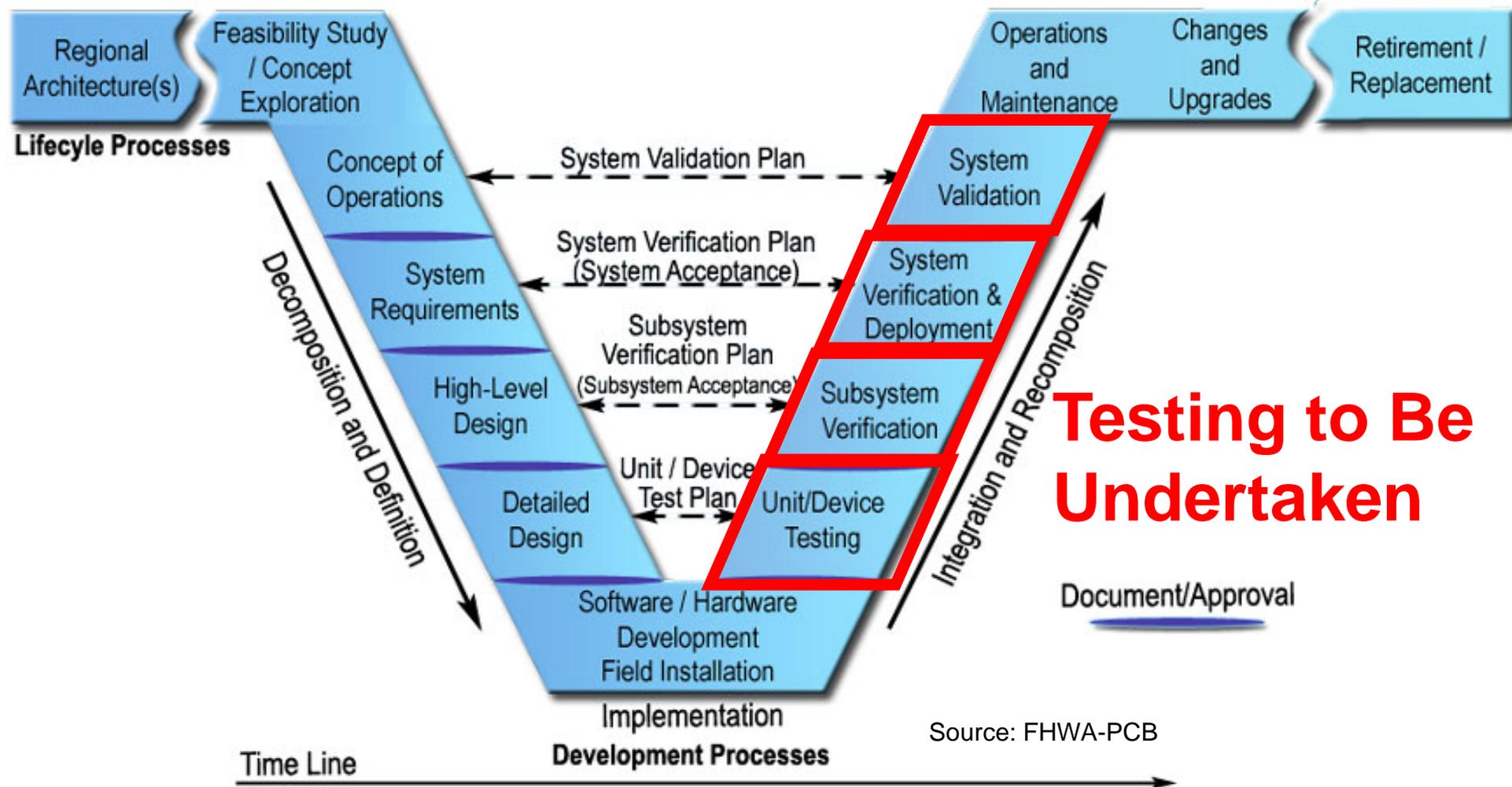
To confirm that an ELMS will work as intended

The testing process provides objective evidence that the system:

- Satisfies the system requirements
- Solves the right problem
- Satisfies the user needs

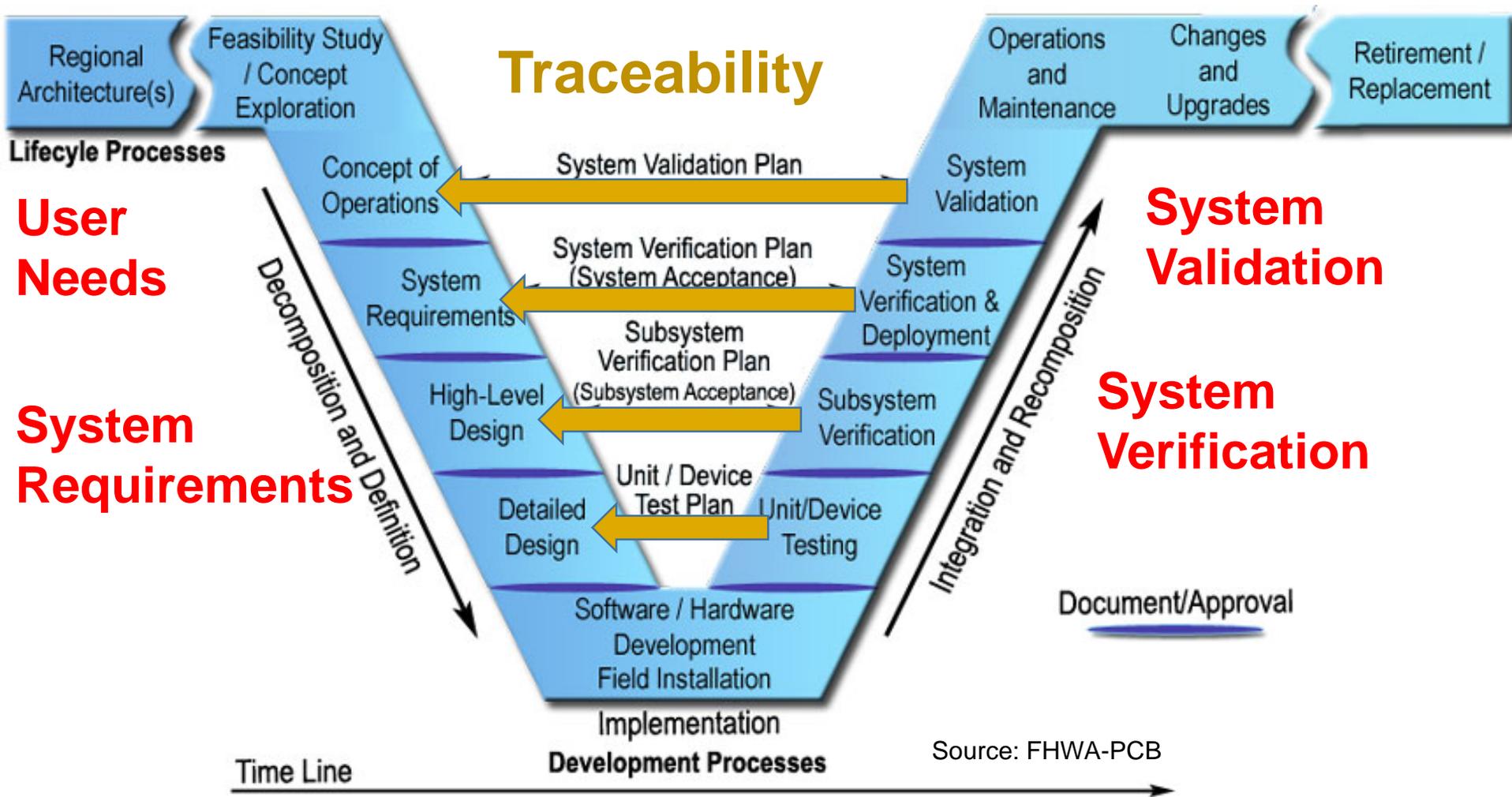
Why We Test

Testing and the Systems Life Cycle



Why We Test

To confirm that an ELMS system will work as intended



Purpose of a Test Plan

Does the system conform to the requirements

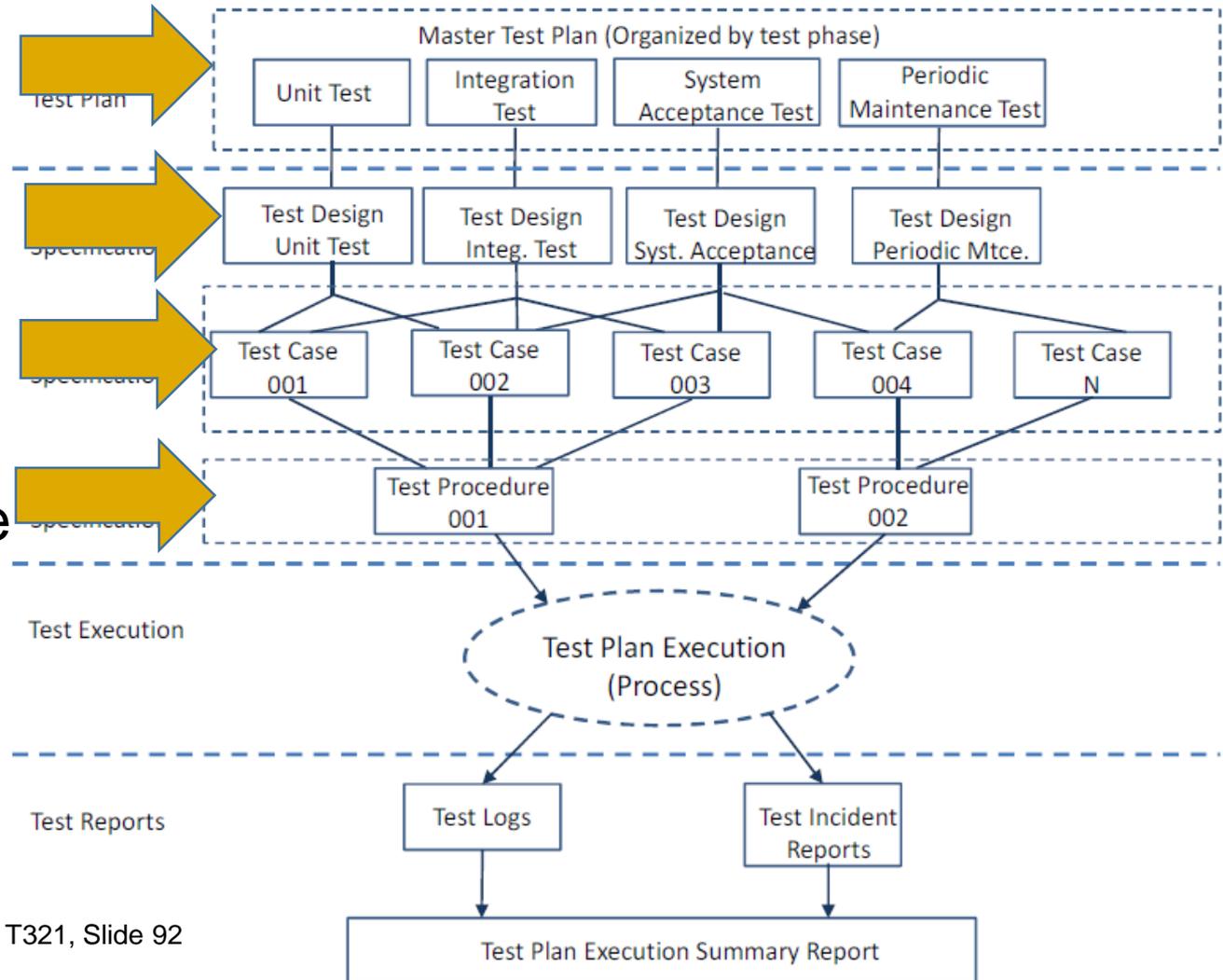
- A test plan is a document describing:
 - Scope (technical management)
 - Approach
 - Resources needed
 - Schedule to complete
- A test plan identifies:
 - Test items
 - Features to be tested
 - Testing tasks
 - Risks requiring contingency plan

Testing determines whether the system conforms to the requirements and whether it satisfies its intended use and user needs (IEEE-829-2008).

Components of a Test Plan

Relationship between Components

- Test Plan Specification
- Test Design Specification
- Test Case Specification
- Test Procedure Specification



Components of a Test Plan

Test Plan Specification

- Test plan specifications detail objectives, target market, internal beta team, and processes for a specific test for a software or hardware product
- Test plan specifications contain a detailed understanding of the comprehensive workflow

Components of a Test Plan

Test Design Specification

- Test design specifications result in a collection of test cases that are intended to be used to test a specified set (test suite) of behavior
- A test suite contains detailed instructions or goals for each collection of test cases and information on the system configuration to be used during testing

Components of a Test Plan

Test Case Specification (TCS)

A test case specification is a set of conditions under which a tester will determine whether the system is working as it was originally intended to do

Components of a Test Plan

Test Procedure Specification

- Test procedure specification defines a process that produces a test result
- It is a technical operation that consists of determining the characteristics of a given product, process, or service according to a specified procedure

ACTIVITY



Question

Which is not a component of an ELMS test plan?

Answer Choices

- a) Test Facilitation
- b) Test Design Specification
- c) Test Case Specification
- d) Test Procedure Specification

Review of Answers



a) Test Facilitation

Correct! Test facilitation is not part of an ELMS test plan.



b) Test Design Specification

Incorrect. Test Design Specification is part of an ELMS test plan.



c) Test Case Specification

Incorrect. Test Case Specification is part of an ELMS test plan.



d) Test Procedure Specification

Incorrect. Test Procedure Specification is part of an ELMS test plan.

Learning Objectives

Describe ELMS Testing

Describe ELMS Test Plan Application

Learning Objective 2

**Describe ELMS Test Plan
Application**

ELMS Test Plan Application

Steps in Developing an ELMS Test Plan

- Identify requirements to be tested/not to be tested for each testing phase
- Identify test methodology
- Introduce and describe the Requirements to Test Case Traceability Matrix (RTCTM)
- Plan logistics of testing
- Estimate level of effort for testing
- Evaluate risks
- Plan project closeout



ELMS Test Plan Application

Develop a Sample Test Plan

Identify Requirements to Test:

- Requirements are found in the Protocol Requirements List (PRL)
- Module A306b identified how to define ELMS requirements
 - See Participant Student Supplement for list of sample requirements
- Every requirement should be tested:
 - During at least one test phase
 - Using at least one method
 - By at least one party
- Extent of agency testing is a risk management issue

ELMS Test Plan Application

Develop a Sample Test Plan

Identify Test Plan Level

- Each test level will have its own test plan
 - Prototype
 - Design Approval
 - Factory Acceptance
 - Incoming Device
 - Site Acceptance
 - Burn-in
- Often further divided
 - NTCIP testing
 - Hardware testing
 - Etc.

ELMS Test Plan Application

Develop a Sample Test Plan Approach

- Identify Test Methodology
- Inspection
- Analysis
- Demonstration
- Formal testing
- Consider testing scenarios
 - Positive test(s)
 - Negative test(s)
 - Boundary test(s)

ELMS Test Plan Application

Develop a Sample Test Plan

Requirements to Test Case Traceability Matrix (RTCTM)

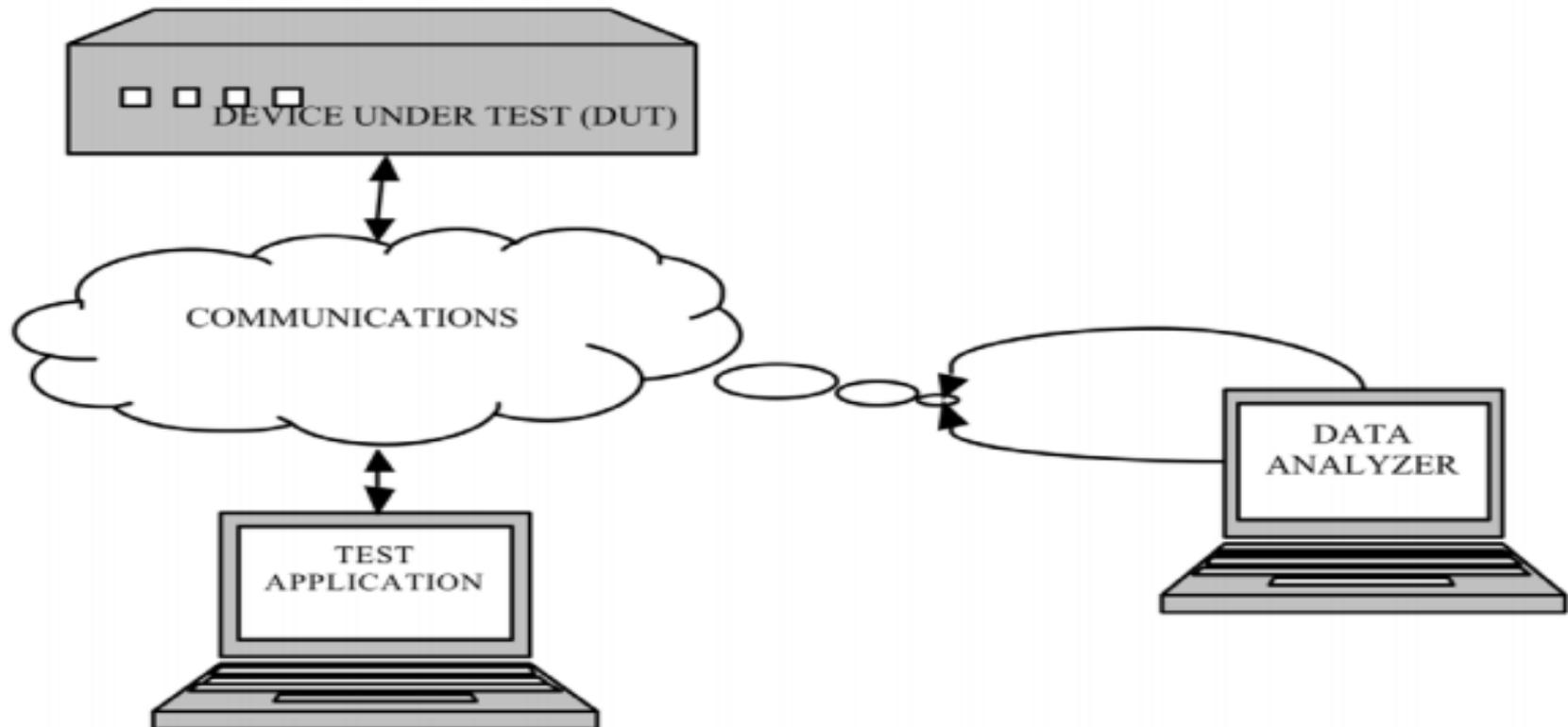
Requirement ID	Requirement	Test Case ID	Test Case
3.5.4.1.1.1	Retrieve Luminaire Pole Identifier	3.5.4.1.1	Retrieve Luminaire Pole Identifier
3.5.4.1.1.2	Retrieve Luminaire Location	3.5.4.1.1.2	Retrieve Luminaire Location
3.5.4.1.3	Configure Luminaire Mode	3.5.4.1.3.1	Configure Luminaire Mode
		3.5.4.1.3.2	Incorrectly Configure Luminaire Mode
3.5.4.1.4.1	Configure Luminaire Color Temperature	3.5.4.1.4.1.1	Configure Luminaire Color Temperature
		3.5.4.1.4.1.2	Incorrectly Configure Luminaire Color Temperature

EXAMPLE

ELMS Test Plan Application

Develop a Sample Test Plan

Identify the Test Environment



Source: NTCIP 8007, page 13

ELMS Test Plan Application

Develop a Sample Test Plan

Plan Logistics of Testing

- Where will tests be performed?
 - Safety during on-site testing
- Who is responsible for what?
 - Power
 - Tools
 - Tables
 - Protection from elements
 - Local assistance for remote testing
- What happens if testing is suspended?

ELMS Test Plan Application

Develop a Sample Test Plan

Estimate effort, schedule, and budget for:

- Preparing test plan
- Preparing test cases
- Preparing test procedures
- Performing multiple rounds of testing
 - Performing tests
 - Investigating problems
 - Preparing test documentation

ELMS Test Plan Application

Develop a Sample Test Plan

Understanding the Impact of a Failure

Requirement ID	Requirement	Test Case ID	Test Case
3.5.4.1.1.1	Retrieve Luminaire Pole Identifier	3.5.4.1.1	Retrieve Luminaire Pole Identifier
3.5.4.1.1.2	Retrieve Luminaire Location	3.5.4.1.1.2	Retrieve Luminaire Location
3.5.4.1.3	Configure Luminaire Mode	3.5.4.1.3.1	Configure Luminaire Mode
		3.5.4.1.3.2	Incorrectly Configure Luminaire Mode
3.5.4.1.4.1	Configure Luminaire Color Temperature	3.5.4.1.4.1.1	Configure Luminaire Color Temperature
		3.5.4.1.4.1.2	Incorrectly Configure Luminaire Color Temperature

EXAMPLE

ELMS Test Plan Application

Develop a Sample Test Plan

Understanding the Impact of a Failure

User Need ID	User Need	Requirement ID	Requirement
2.5.2.1.1.1	Retrieve Luminaire Information		
		3.5.4.1.1.1	Retrieve Luminaire Pole Identifier
		3.5.4.1.1.2	Retrieve Luminaire Location
		3.5.4.1.1.3	Retrieve Luminaire Mode
		3.5.4.1.1.4	Retrieve Luminaire Zone
		3.5.4.1.1.5	Retrieve Luminaire Vendor Information
		3.5.4.1.1.6	Retrieve Luminaire Light Source Type
		3.5.4.1.1.7	Retrieve Luminaire Wattage
		3.5.4.1.1.8	Retrieve Luminaire Voltage



ELMS Test Plan Application

Develop a Sample Test Plan

Plan Project Closeout

- Have a plan
- Understand the impacts of accepting a failure

ACTIVITY



Question

Which of the following ELMS statements is false?

Answer Choices

- a) Every ELMS requirement should be tested
- b) You should only need to perform your ELMS test plan once
- c) Some ELMS testing may be performed by the manufacturer
- d) ELMS traceability tables can help you assess the impact of a test failure

Review of Answers



a) Every ELMS requirement should be tested

True. Every requirement should be tested.



b) You should only need to perform your ELMS test plan once

False (correct). This statement is not true. Testing will often reveal problems; these should be fixed and the device retested.



c) Some testing may be performed by the manufacturer

True. Testing may be performed by the agency, the manufacturer, or a third party.



d) ELMS traceability tables can help you assess the impact of a test failure

True. Traceability tables allow you to identify the user needs that will not be completely fulfilled.

Learning Objectives

Describe ELMS Testing

Describe ELMS Test Plan Application

**Identify Relevant Elements
of an ELMS Test Plan**

Learning Objective 3

**Identify Relevant Elements
of an ELMS Test Plan**

What Is Being Tested?

Only Project-Specific Requirements Are Tested

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.2			Control Electrical Service	O	Yes/ No	
		3.5.5.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.5.5.2.2	Control Electrical Service by Transitory Override	O	Yes/ No	
		3.5.5.2.3	Control Electrical Service by Timed Override	O	Yes/ No	
		3.5.5.2.4	Control Electrical Service in Stagger Mode	O	Yes/ No	
		3.5.5.2.5	Control Electrical Service by Photocell	O	Yes/ No	
		3.5.5.2.6	Control Electrical Service by Adaptive Means	O	Yes/ No	

Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications and Procedures

- Review guidance from IEEE 829-2008 and NTCIP 8007
- Apply guidance to sample dialog
- Key Differences Between the Two Approaches
 - IEEE standard approach is applicable to all ITS standards including C2C and C2F
 - IEEE standard approach separates test cases from test procedures, while previous efforts combined both, such as per NTCIP 8007 information report
 - IEEE standard approach allows reuse of test procedures, where agencies typically place more efforts
 - IEEE standard approach includes a test plan and method to split testing into test designs, and includes test reports

Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications and Procedures

What Does IEEE 829-2008 Provide?

- Test Plan
- Test Design Specification
- Test Case Specification
- Test Procedure Specification
- Test Reports
 - Test Logs
 - Test Anomaly Report
 - Test Report
- Testing professionals across ITS are familiar with these definitions/formats

Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications and Procedures

NTCIP 8007 Components

- NTCIP 8007 describes how these can be combined for NTCIP testing
 - Test case identifier
 - Purpose
 - Inputs
 - Pass/Fail criteria
 - Procedure steps
 - Can reference other often used procedures
 - Expected outputs
 - Features tested
- Defines terms that can be used in test steps for NTCIP testing

Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications and Procedures

Sample Basic Dialog: Set Time Dialog



Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications and Procedures

- Specify Test Case First
 - “What You Are Testing”
- Then Specify Test Procedure
 - “How You Run The Test”

Test Design, Test Cases, and Test Procedures

Designing Test Case Specifications

Specify Each Test Case

Requirement ID	Requirement	Test Case ID	Test Case
2.2.1	Set Time	2.2.1	Set Time

Test Case		
Test Case 2.2.1	Test Case Name	Set Time
	Description	This test case verifies that the ELMS properly tracks time. It advances the clock by a user-defined amount, waits a few seconds, retrieves the time, and verifies it indicates an appropriate value.
	Variable	GlobalTime as defined in NTCIP 1213 V3.0
	Pass/Fail Criteria	The DUT shall pass every verification step included within the Test Case to pass the Test Case.

Test Design, Test Cases, and Test Procedures

Designing Test Case Procedures

- Data exchanges should follow defined **dialogs**
- Return the device to its original state (generally)
- Verification steps should cite the **relevant requirement**
 - A test case typically tests multiple requirements
- NTCIP 8007 precisely defines standardized step types
- A “SET” operation includes **nine specific verification checks** related to the Simple Network Management Protocol (SNMP) response packet

Test Design, Test Cases, and Test Procedures

Designing Test Case Procedures

Steps of a Sample Procedure

Step Number	Test Procedure	Results
1	CONFIGURE: Determine the number of seconds to advance the clock in the ELMS	
2	GET the following object(s): globalTime.0	Pass/Fail
3	RECORD the RESPONSE VALUE for globalTime.0 as Start_Time	
4	SET the following object(s): globalTime.0 = Start_Time + Time_Offset	Pass/Fail
5	DELAY for 15 seconds	
6	GET the following object(s): globalTime.0	Pass/Fail
7	VERIFY that the RESPONSE VALUE for globalTime.0 is roughly equal to Start_Time + Time_Offset + 15	Pass/Fail

Adapting the Test Plan

The process of adapting the test plan based on selected user needs and requirements

- We have described the components of a **test plan**
- We have examined the major components of **test cases** and **test procedures** in detail
- Next we will create a **project-specific ELMS test plan**

ACTIVITY



Question

Where can you find definitions for terms that can be used in NTCIP test steps?

Answer Choices

- a) IEEE 829
- b) NTCIP 8007
- c) ISO 9001
- d) Student Supplement

Review of Answers



a) IEEE 829

Incorrect. IEEE 829 defines sample outlines for test documentation, but does not define steps for NTCIP.



b) NTCIP 8007

Correct! NTCIP 8007 defines a number of terms that can be used in test steps for NTCIP testing.



c) ISO 9001

Incorrect. ISO 9001 deals with quality management, but does not deal directly with NTCIP testing.



d) Student Supplement

Incorrect. The student supplement provides samples of test procedures, but it does not define the test terms.

Learning Objectives

Describe ELMS Testing

Describe ELMS Test Plan Application

**Identify Relevant Elements
of an ELMS Test Plan**

Describe Adaptation of a Test Plan

Learning Objective 4

Describe Adaptation of a Test Plan

Develop an NTCIP 1213 v03 Test Design Specification

Background

Information Sources:

NTCIP 1213 v03 – National Transportation Communications for ITS Protocol Object Definitions for Electrical and Lighting Management Systems

- Protocol Requirements List (PRL)
- Requirements Traceability Matrix (RTM)
- Testing documentation
 - Required but not supplied in standard
 - Must be created

Develop an NTCIP 1213 v03 Test Design Specification

Background

Characteristics of the NTCIP 1213 v3.0 (ELMS) Standard

- ELMS is a Center-to-Field Communications Standard
- ELMS contains System Engineering (SE) content (the standard has a PRL and an RTM)
- ELMS does not contain Test Procedures

Develop an NTCIP 1213 v03 Test Design Specification

Background

Protocol Requirements List (PRL)

- Contains user needs
- Contains functional requirements
- Describes relationship between needs and requirements
- **Project-specific** requirements are identified by project-level Protocol Requirements List (PRL)

Develop an NTCIP 1213 v03 Test Design Specification

Background

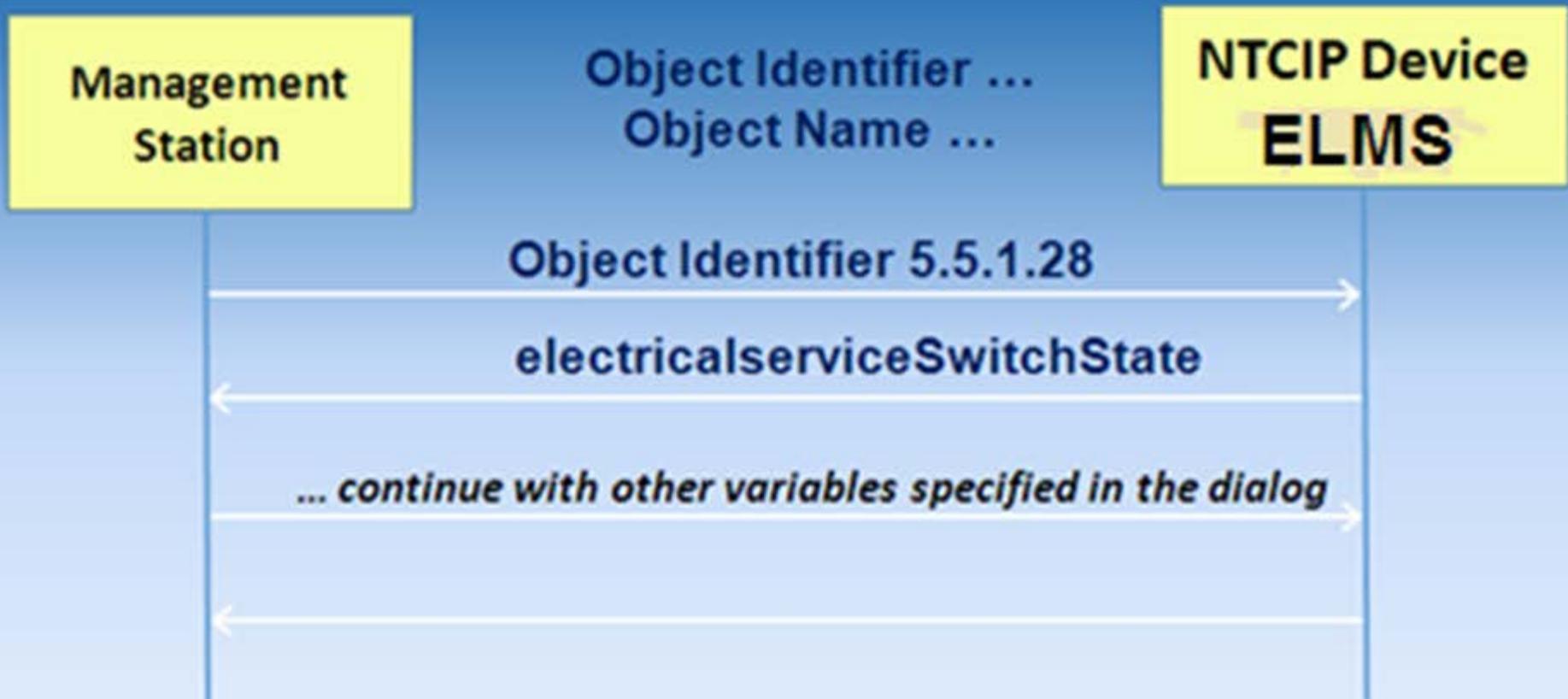
Requirements Traceability Matrix (RTM)

- Contains functional requirements
- Contains object dialogs
- Describes relationship between requirements and object dialogs
- A **project-specific** Requirements Traceability Matrix (RTM) references relevant design content needed to define the inputs and outputs for the test case specification

Develop an NTCIP 1213 v03 Test Design Specification

Background

Context Diagram



NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 1: Select Your User Needs in the PRL

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.2			Control Electrical Service	O	Yes/No	
		3.5.5.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.5.5.2.2	Control Electrical Service by Transitory Override	O	Yes/No	
		3.5.5.2.3	Control Electrical Service by Timed Override	O	Yes/No	
		3.5.5.2.4	Control Electrical Service in Stagger Mode	O	Yes/No	
		3.5.5.2.5	Control Electrical Service by Photocell	O	Yes/No	
		3.5.5.2.6	Control Electrical Service by Adaptive Means	O	Yes/No	

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 2: Use Project RTM to Identify Objects and Dialogs to Be Tested

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5.5.2.2	Control Electrical Service by Transitory Override	G.3			
			5.5.1.6	electricalserviceSwitchMode	
3.5.5.2.3	Control Electrical Service by Timed Override	4.2.13			
			5.5.1.6	electricalserviceSwitchMode	
			5.5.1.7	electricalserviceSwitchModeTime	
3.5.5.2.4	Control Electrical Service in Stagger Mode	G.3			
			5.5.1.28	electricalserviceSwitchState	
3.5.5.2.5	Control Electrical Service by Photocell	G.3			
			5.5.1.29	electricalservicePhotocellIndex	
3.5.5.2.6	Control Electrical Service by Adaptive Means	G.3			
			5.5.1.6	electricalserviceSwitchMode	

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 3: Develop Test Case Objective

Test Case	
ID: TC001	Title: RequestStatus Condition within the Device Dialog Verification (Positive Test Case)
Objective:	To verify system interface implements (positive test case) requirements for a sequence of OBJECTS requests for: OBJECTS requests for: <ul style="list-style-type: none">• 3.5.5.2.1 electricalserviceSwitchMode• 3.5.5.2.2 electricalserviceSwitchModeTime• 3.5.5.2.3 electricalserviceSwitchState• 3.5.5.2.4 electricalservicePhotocellIndex 1) The test case v ranges. The object ide specification is definitions.
Inputs:	
Outcome(s):	
Environmental Needs:	
Tester/Reviewer	
Special Procedure Requirements:	
Intercase Dependencies:	

To verify system interface implements (positive test case) requirements for a series of object requests for:

- 3.5.5.2.2 electricalserviceSwitchMode
- 3.5.5.2.3 electricalserviceSwitchModeTime
- 3.5.5.2.4 electricalserviceSwitchState
- 3.5.5.2.5 electricalservicePhotocellIndex

The test case verifies that the data value of the OBJECTS requested are within specified ranges.

The object identifier (OID) of each object requested is the only input required. An output specification is provided to show valid value constraints per the NTCIP 1205 v01 object definitions.

EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 3: Develop Test Case Objective (continued)

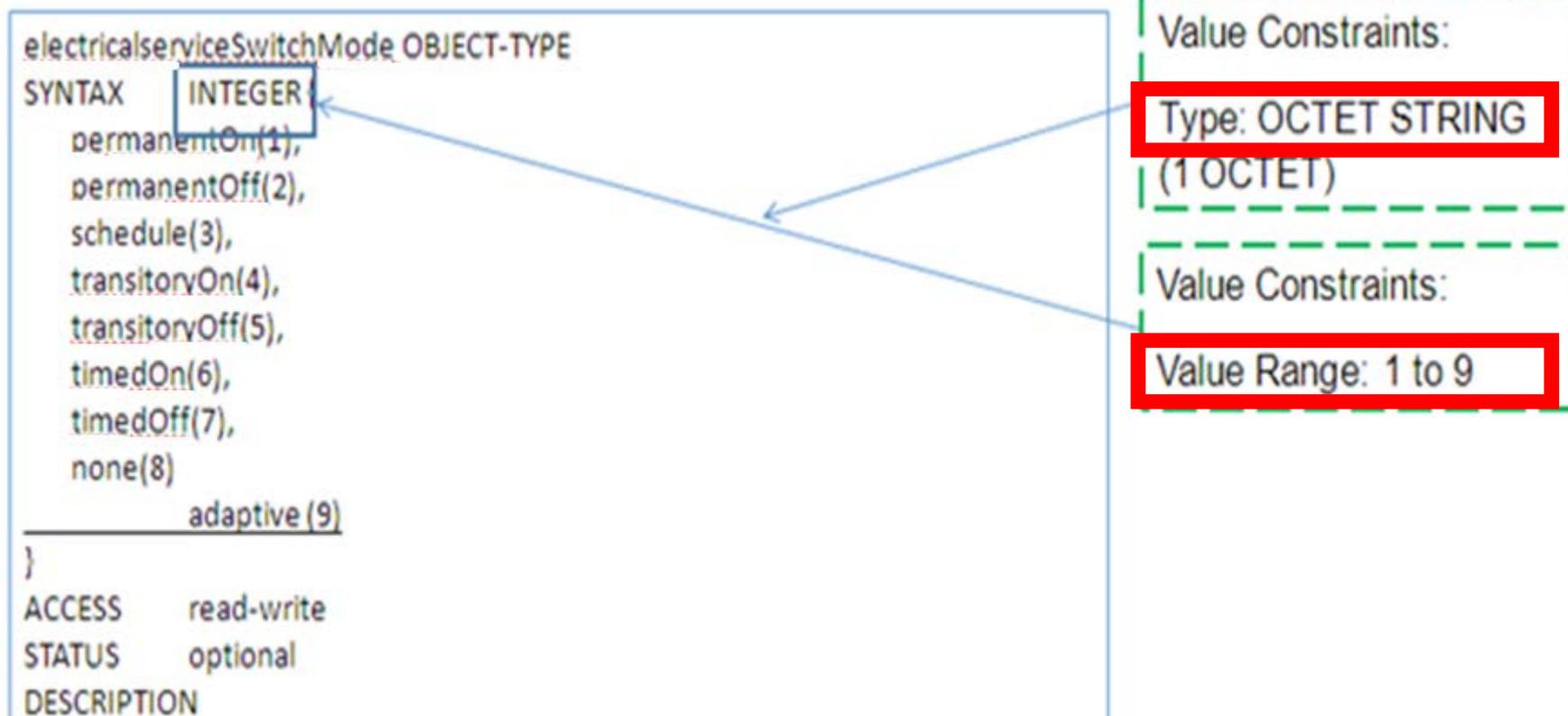
Test Case Output Specification			
ID: TCOS001		Title: Status Condition within the Device	
Data Concept ID	Data Concept Name (Variable)	Data Concept Type	Value Constraints
3.5.5.2.2	electrcialserviceSwitchMode	Data Element	
3.5.5.2.3	electrcialserviceSwitchModeTime	Data Element	
3.5.5.2.4	electrcialserviceSwitchModeState	Data Element	
3.5.5.2.5	electrcialservicePhotocellIndex	Data Element	

EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 4: Identify Dialogs, Inputs, Outputs

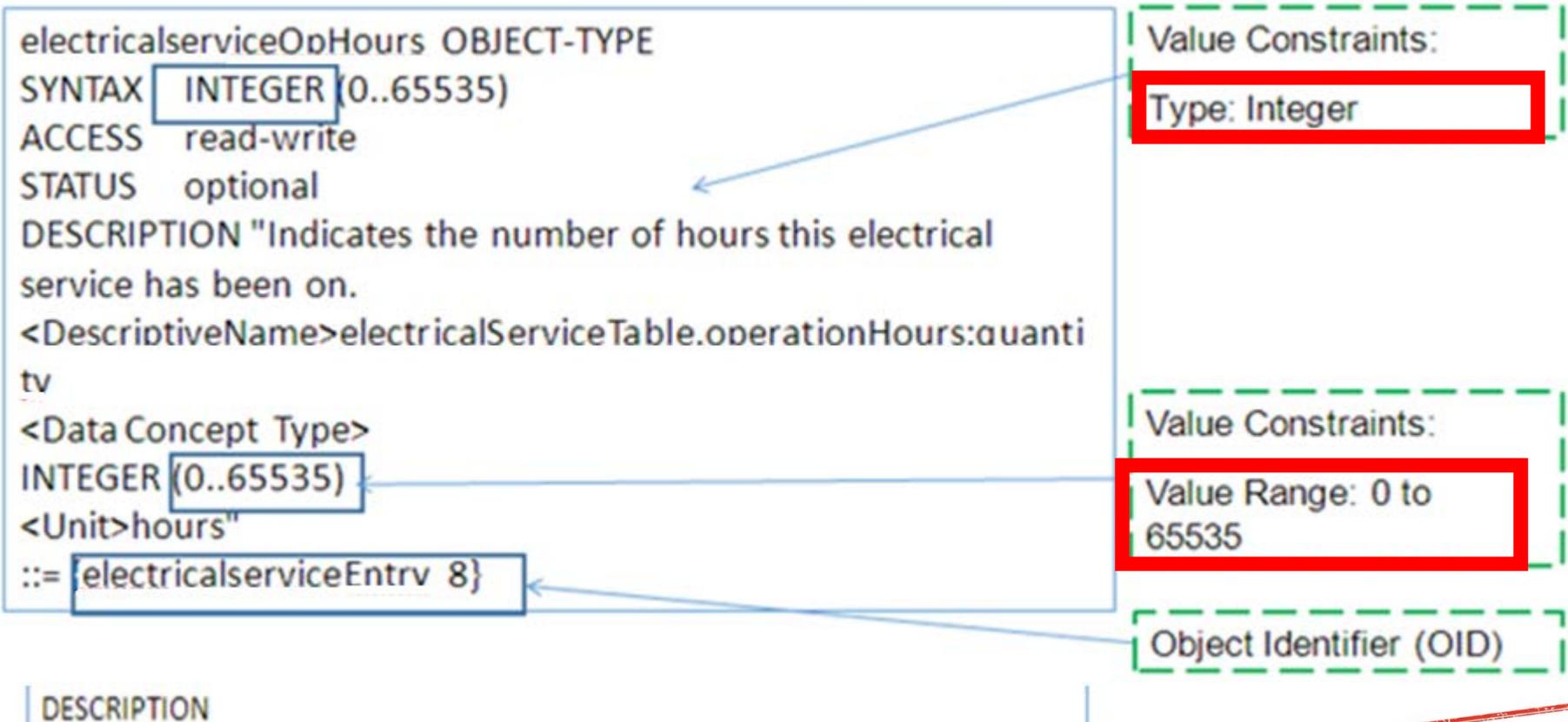


EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 4: Identify Dialogs, Inputs, Outputs (continued)



EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 5: Document Value Constraints for Inputs

Test Case Input Specification

ID TCI201		Title: Input Specification for electricalserviceSwitchMode (Positive test case)	
Data Concept ID	Data Concept Name (Variable)	Data Concept Type	Value Constraints
3.5.5.52.2	electricalserviceSwitchMode	Data Element	1 = "permanentOn" 2 = "permanentOff" 3 = "schedule" 4 = "transitoryOn" 5 = "transitoryOff" 6 = "timedOn" 7 = "timedOff" 8 = "none" 9 = "adaptive"

EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 5: Document Value Constraints for Outputs

Test Case Output Specification

ID TCI201		Title: Output Specification for electricalserviceSwitchMode (Positive test case)	
Data Concept ID	Data Concept Name (Variable)	Data Concept Type	Value Constraints
3.5.5.52.2	electricalserviceSwitchMode	Data Element	1 = "permanentOn" 2 = "permanentOff" 3 = "schedule" 4 = "transitoryOn" 5 = "transitoryOff" 6 = "timedOn" 7 = "timedOff" 8 = "none" 9 = "adaptive"

EXAMPLE

NTCIP 1213 v03 Test Design Specification

Testing Documentation

Step 6: Complete Test Case

Test Case	
ID TCI201	Title: electricalserviceSwitchMode Dialog Verification (Positive Test Case)
Objective	To verify system interface implements(positive test case) requirements for object: electricalserviceSwitchMode
Inputs	Use valid inputs as defined by test case input specification
Outcomes	All data are returned and verified as correct: correct sequence of message exchanges, structure of data, and valid value of data content. See Test Case Output Specification for details.
Environmental Needs:	No additional needs outside of those specified in the test plan.
Tester/Reviewer	JF
Special Procedure Requirements	None
Intercase Dependencies	None

EXAMPLE

Developing Test Cases and Procedures for Extensions

Supporting Objects Not in the Standard

Extending the Standard complicates interoperability and interchangeability

- Not achievable unless all design details are known
- Extensions are relatively custom solutions, resulting in:
 - Increased specification costs
 - Increased development costs
 - Increased testing costs
 - Increased integration costs
 - Longer deployment timeframe
 - Increased maintenance costs

Developing Test Cases and Procedures for Extensions

Supporting Objects Not in the Standard

Extensions should only be considered when:

- NTCIP features are inadequate to meet needs
- Benefits of extension outweigh added costs

Developing Test Cases and Procedures for Extensions

Supporting Objects Not in the Standard

Extended equipment should be designed to:

- Appropriately integrate with NTCIP-only deployments
- Minimize added complexity

Developing Test Cases and Procedures for Extensions

If You Do Choose to Test Objects Not in the Standard

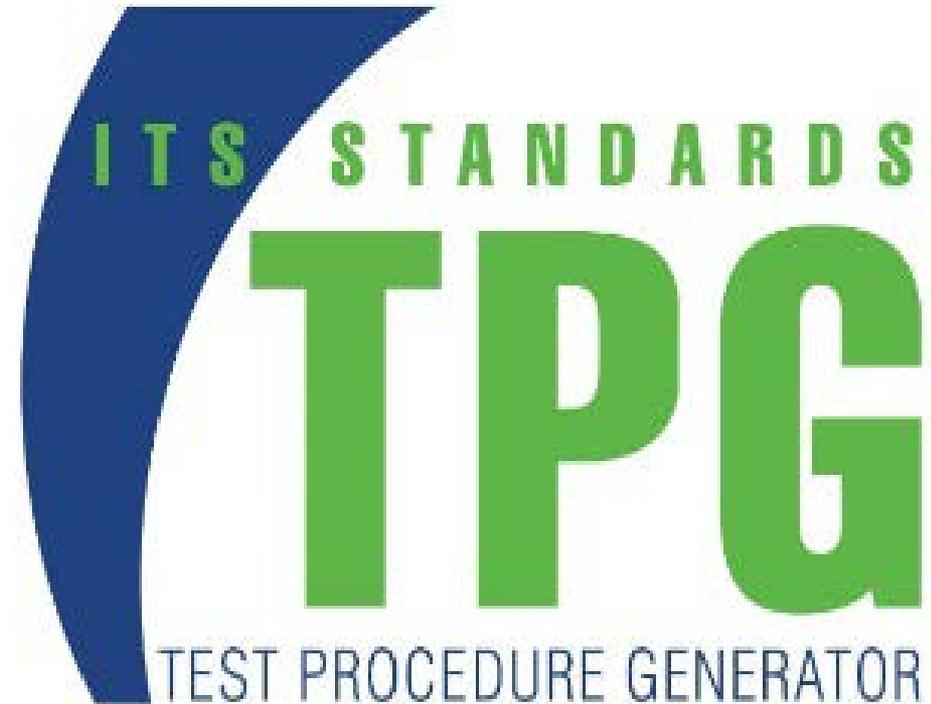
- Adhere to the relationships between the PRL, RTM, and RTCTM, as well as the underlying user needs and measurable functional requirements
- The main purpose of Test Design is to identify the features to be tested by a particular level test (e.g., unit test)
- The features to be tested are included in the RTCTM
 - Based on a Requirements Traceability Matrix (RTM)



Test Procedure Generator Tool (TPG)

Introduction to the Test Procedure Generator

- What is the TPG?
- Why is the TPG important?
- What are the benefits?
- How do you use the TPG?
- How does it fit into testing for NTCIP Standards?
- Where does a user obtain the TPG?



Test Procedure Generator Tool (TPG)

What Is the TPG and How Does It Work?

- USDOT has released the version 2.1 of the TPG tool for the ITS Standards communities
- TPG v2.1 supports development and deployment NTCIP Center-to-Field (C2F) Device Interface Standards with Systems Engineering Content
- TPG is a Windows-based software tool that uses Microsoft Word to input the NTCIP Standards and output Test Procedures
- TPG supports ITS Standard developers as well as deployers (local and state agencies) of NTCIP C2F Standards

Test Procedure Generator Tool (TPG)

What Is the TPG and How Does It Work?

- For deployers and local agencies, the TPG guides the development of test procedures by: Loading and processing the standard to be implemented including the requirements, dialogs, and objects
- Basing the Test Procedures on the user-selected requirements in NTCIP C2F Standard

Test Procedure Generator Tool (TPG)

What Is the TPG and How Does It Work?

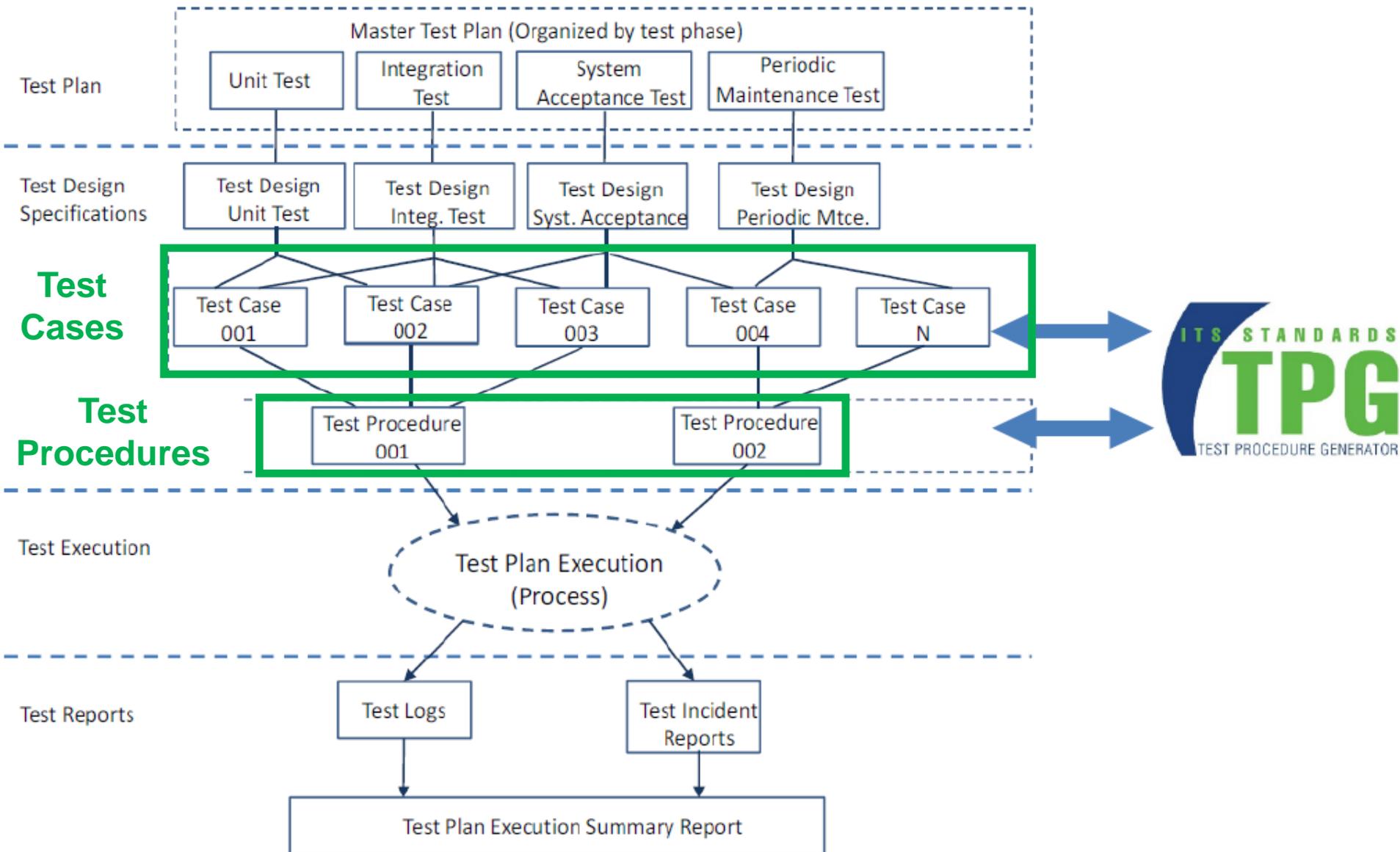
- Uses standardized and consistent language for Test Procedures development, including:
 - Standard keywords, variables, and object names imported directly from the standard
- Outputs an XML file that can be consistently interpreted by vendors and testing staff for their test suites
- Standards Deployers can use the TPG to create consistent Test Procedures
- ***Remember: The TPG is not a testing tool!***

Test Procedure Generator Tool (TPG)

Benefits of the TPG

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

Test Procedure Generator Tool (TPG)



Test Procedure Generator Tool (TPG)

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 help to eliminate the proprietary system elements

Test Procedure Generator Tool (TPG)

Using the TPG – Start a New Session

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

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object
3.4	Architectural Requirements			
3.4.1	Support Basic Communications			
	Retrieve Data	0.1		
		0.3		
		1.1		

NTCIP

National Transportation Communications for ITS Protocol

Conditions for Dynamic

(DMS)

Annex C

TSB

August 2010

from May 2010]

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

TPG Status: New Session Command Accepted...

Test Procedure Generator Tool (TPG)

Using the TPG – The Graphical User Interface

The screenshot displays the Center-to-Field Test Procedure Generator (TPG) application window. The interface includes a menu bar with 'File', 'Test Procedure', 'Reports', 'Tools', 'Session Panel', and 'Help'. Below the menu bar are document tabs: 'Standard', 'Set of Test Procedures', 'Current Test Procedure', and 'Reports'. The main workspace is an embedded Microsoft Word 2010 document. On the left side, there is a 'Session Panel' containing a tree view of test procedure items, such as '3.4 Architectural Requirements' and '3.5.1.1 Identify DMS'. The document content shows a title 'A User Comment Draft of the Joint Committee on the NTCIP' and a large heading 'NTCIP 1213 version v03'. Below this is the main title 'National Transportation Communications for ITS Protocol'. At the bottom of the window, a status bar shows 'TPG Status: Command Completed'. Several callout boxes with arrows point to specific features: 'TPG Menu Items' points to the menu bar; 'Document Tabs' points to the tab bar; 'Embedded Microsoft Word 2010 Document Menu Items' points to the Word ribbon; 'Embedded Microsoft Word 2010 Document' points to the document content; 'TPG Session Status' points to the Session Panel; and 'TPG Command Status' points to the status bar.

TPG Command Status

Test Procedure Generator Tool (TPG)

Using the TPG – Create a New Test Procedure

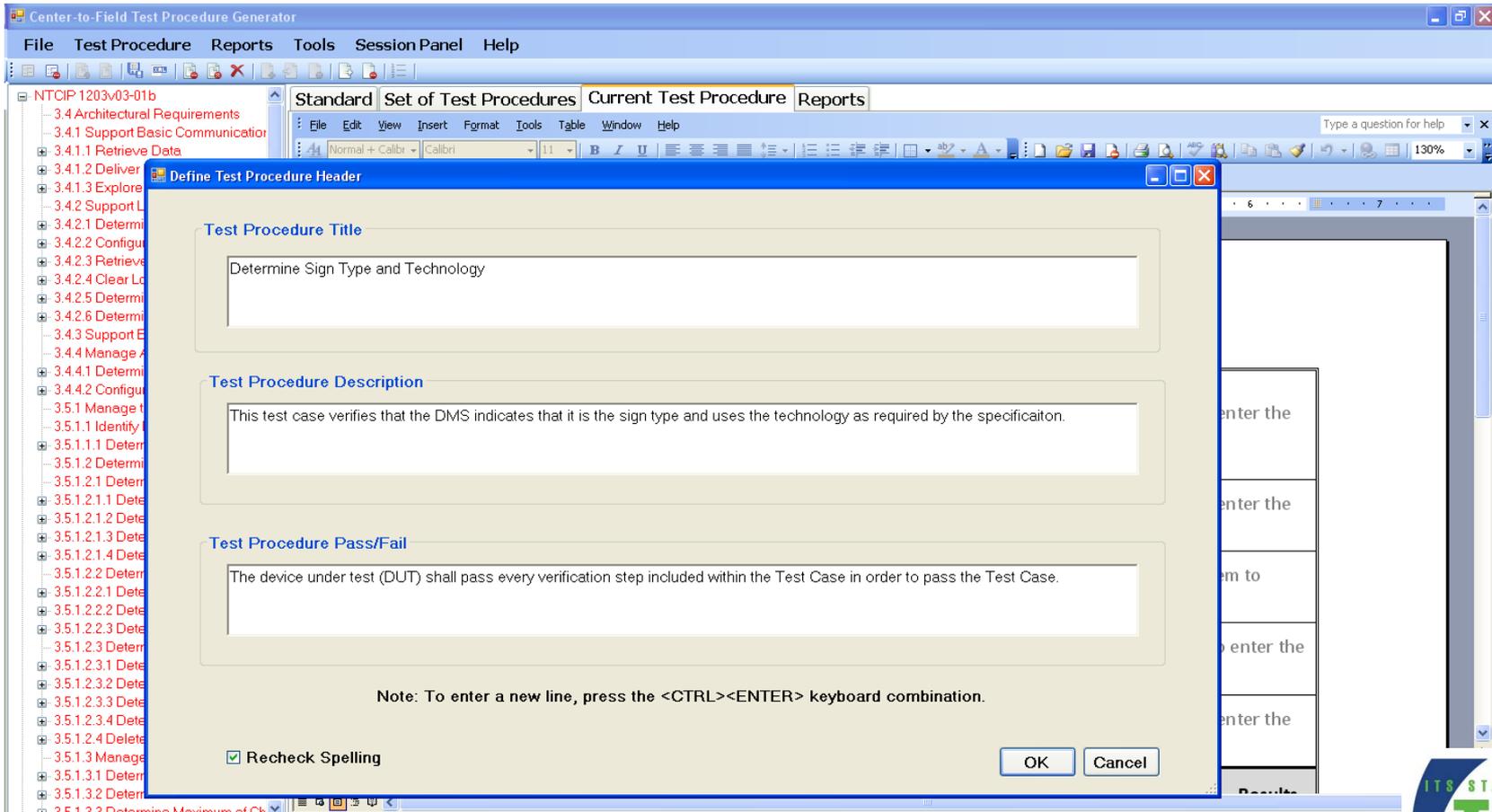
Test Step	Test Procedure	Results										
	<table border="1"><tr><td>Test Procedure: 01.00</td><td>Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Title</td></tr><tr><td>Description:</td><td>Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Description</td></tr><tr><td>Requirement(s):</td><td>Select the Test Procedure->Select Requirements Menu Item to enter the Test Procedure Requirements</td></tr><tr><td>Variable(s):</td><td>Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables</td></tr><tr><td>Pass/Fail Criteria:</td><td>Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Pass/Fail Criteria</td></tr></table>	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 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											

TPG Status: **Command Completed**

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

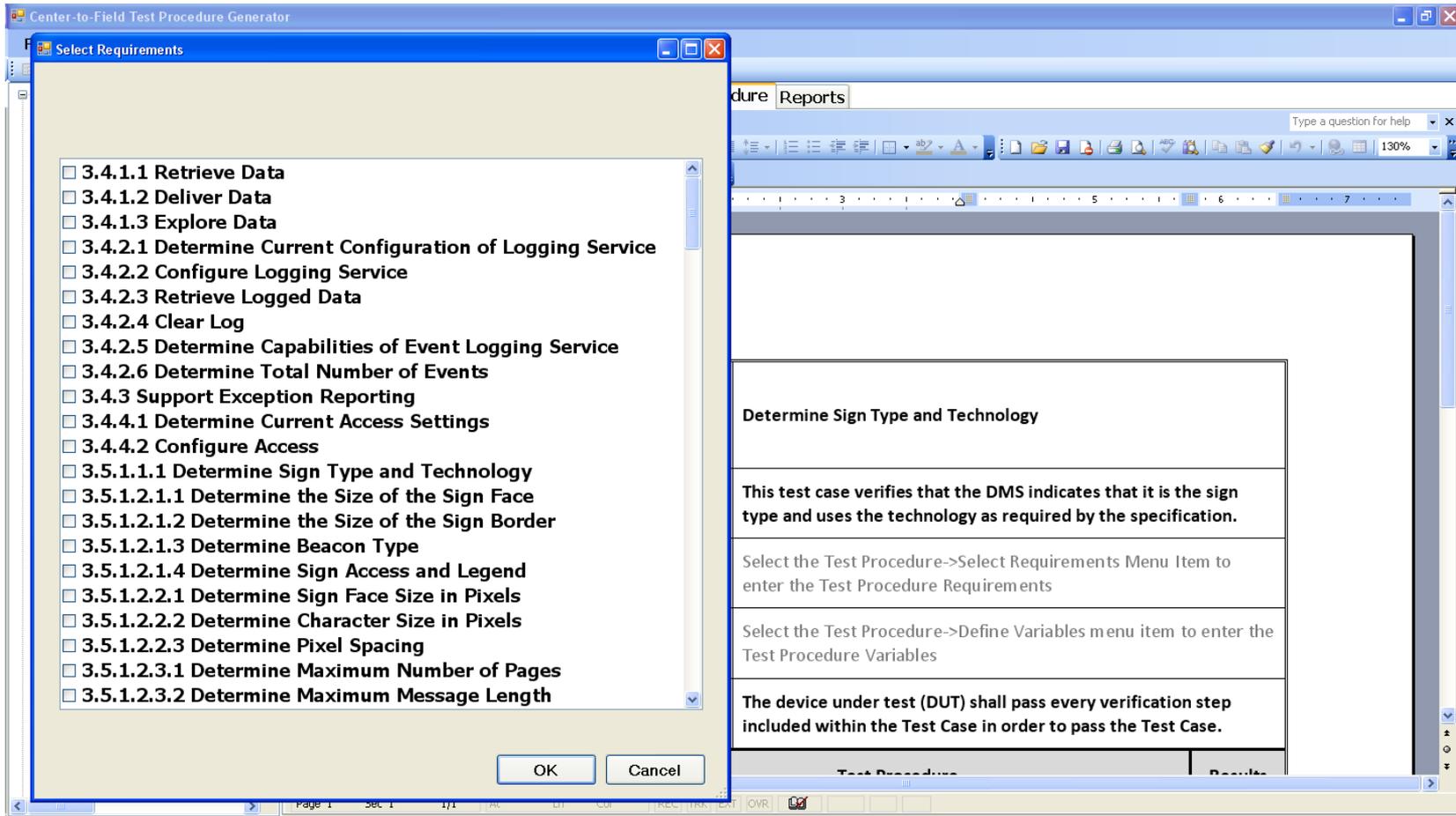
Test Procedure Generator Tool (TPG)

Using the TPG – Create a New Test Procedure



Test Procedure Generator Tool (TPG)

Using the TPG – Select Your Requirements



Test Procedure Generator Tool (TPG)

Using the TPG – The Test Procedure

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

Test Procedure Generator Tool (TPG)

Using the TPG – Create Your Variables

The screenshot displays the Center-to-Field Test Procedure Generator (TPG) software interface. The main window shows a project tree on the left with details for 'NTCIP 1203v03-01b', including 'Total Requirements: 180', 'Number of Requirements: 146', and 'Number of Header Requirements: 34'. The 'Test Procedure Variables' dialog box is open, allowing the user to create and select variables. In the 'Create a New Variable' section, the variable name 'Required_Sign_Type' is entered, and 'INTEGER' is selected from the 'Object Types' dropdown. The 'Select Test Procedure Variable(s)' list contains two checked items: 'Required_Sign_Technology [eventClassClearTime]' and 'Required_Sign_Type [INTEGER]'. The background shows a Microsoft Word document with test procedure text, including 'Determine Sign Type and Technology' and a list of steps: '1 Retrieve Data', '2 Deliver Data', '3 Explore Data', '1 Determine Current Configuration of Logging Service', and '2 Configure Logging Service'. The status bar at the bottom indicates 'TPG Status: Define Variables Command Accepted...'

Test Procedure Generator Tool (TPG)

Using the TPG – Create Your Test Procedure Step

The screenshot displays the Center-to-Field Test Procedure Generator (TPG) software interface. The main window is titled "Center-to-Field Test Procedure Generator" and features a menu bar with "File", "Test Procedure", "Reports", "Tools", "SessionPanel", and "Help". A tree view on the left lists various test procedures, including "NTOP 1203/03-01b" and "3.4 Architectural Requirements". The central editor area shows a "Test Procedure: 01.00" with fields for "Description:", "Requirement(s):", and "Variable(s):". A "Test Procedure Step" dialog box is open, displaying the following information:

- Step ID: 01.00
- Keyword: GET
- Syntax: GET the following object(s): [object 1] {, object ...} [Pass/Fail]
- Test Step Preview: (Empty text area)
- Nesting Level: 0

The dialog box includes buttons for "Reset", "Preview", "Close", and "Insert".

Test Procedure Generator Tool (TPG)

Using the TPG – Test Procedure Results

The screenshot displays the TPG software interface, which is integrated with Microsoft Word. The document title is "TPG NTCIP 1203v03-01b Set of Test Procedures DRAFT v16.docx". The interface includes a menu bar (File, Test Procedure, Reports, Tools, Session Panel, Help) and a ribbon with tabs for Standard, Set of Test Procedures, Current Test Procedure, and Reports. A navigation pane on the left shows a document structure with "01.01 Determine Sign Typ..." and "Annex A - TPRTM".

The main content area shows a table with the following data:

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	

At the bottom of the window, a status bar indicates: "Page: 3 of 15 Words: 1,696" and "NTCIP Standard XML Data Content Files Loaded ... Set of Test Procedures Not Verified". A green status message at the bottom left reads "TPG Status: Command Completed".



Test Procedure Generator Tool (TPG)

How to Obtain the TPG

- TPG v2.1 updates include: Compatibility with Windows 7 Professional
- Compatibility with Microsoft Office 2010
- For more information and to acquire the TPG, please visit: <https://www.standards.its.dot.gov/DeploymentResources/Tools>
- The free download package includes:
 - TPG v2.1 Installation file
 - TPG User Manual
- TPGSupport@noblis.org



ACTIVITY



Question

Which of the following statements is false?

Answer Choices

- a) TPG v2.1 supports development and deployment NTCIP Center-to-Field (C2F) Device Interface Standards with Systems Engineering Content
- b) TPG is a testing tool
- c) TPG is a Windows-based software tool that uses Microsoft Word to input the NTCIP Standards and output Test Procedures
- d) TPG supports ITS Standard developers as well as deployers (local and state agencies) of NTCIP C2F Standards

Review of Answers



- a) TPG v2.1 supports development and deployment NTCIP Center-to-Field (C2F) Device Interface Standards with Systems Engineering Content

Incorrect. TPG does support development and deployment NTCIP Center-to-Field (C2F) Device Interface.



- b) TPG is a testing tool

Correct! False, TPG is not a testing tool.



- c) TPG is a Windows-based software tool that uses Microsoft Word to input the NTCIP Standards and output Test Procedures

Incorrect. TPG is a Windows-based software tool.



- d) TPG supports ITS Standard developers as well as deployers (local and state agencies) of NTCIP C2F Standards.

Incorrect. TPG supports ITS Standard developers as well as deployers.

Module Summary

Describe **ELMS Testing**

Describe **ELMS Test Plan Application**

Identify **Relevant Elements**
of an **ELMS Test Plan**

Describe **Adaptation** of a **Test Plan**

We Have Now Completed the ELMS Curriculum



Module A306a: Understanding **user needs** for Electrical and Lighting Management Systems Based on NTCIP 1213 v03



Module A306b: Specifying **requirements** for Electrical and Lighting Management Systems Based on NTCIP 1213 v03



Module T306: Applying Your **Test Plan** to the Electrical and Lighting Management Systems Based on NTCIP 1213 v03

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!