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T304:
Applying Your Test Plan to Field Management Stations (FMS) – Part 1 Signal System Masters (SSM) Based on NTCIP 1210 Standard v01

Instructor

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Learning Objectives

Describe within the context of the system lifecycle the **role of a test plan** and testing to be undertaken

Recognize the purpose, structure, and content of well-written test documentation for an SSM based on IEEE 829-2008 formats

Explain how to **develop** the complete test documentation package for an SSM specification based on NTCIP 1210 Standard v01

Describe the **testing of an SSM** using a sample test document

Learning Objective 1

Describe within the context
of the system lifecycle
the **role of a test plan** and testing
to be undertaken

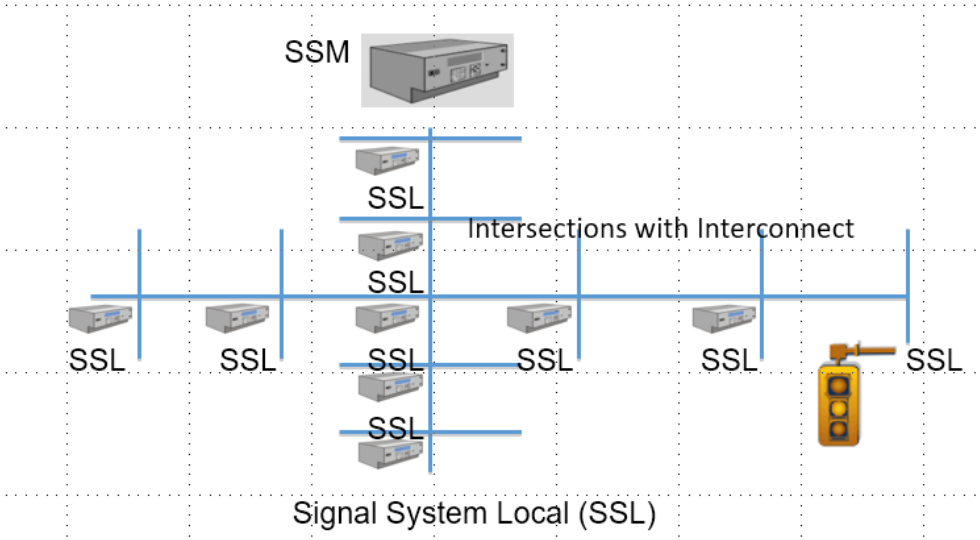
How Is an SSM Used in a Traffic Management System?

Role of a Signal System Master (SSM)

SSM is a Portion of a Field Management Station **(FMS)**

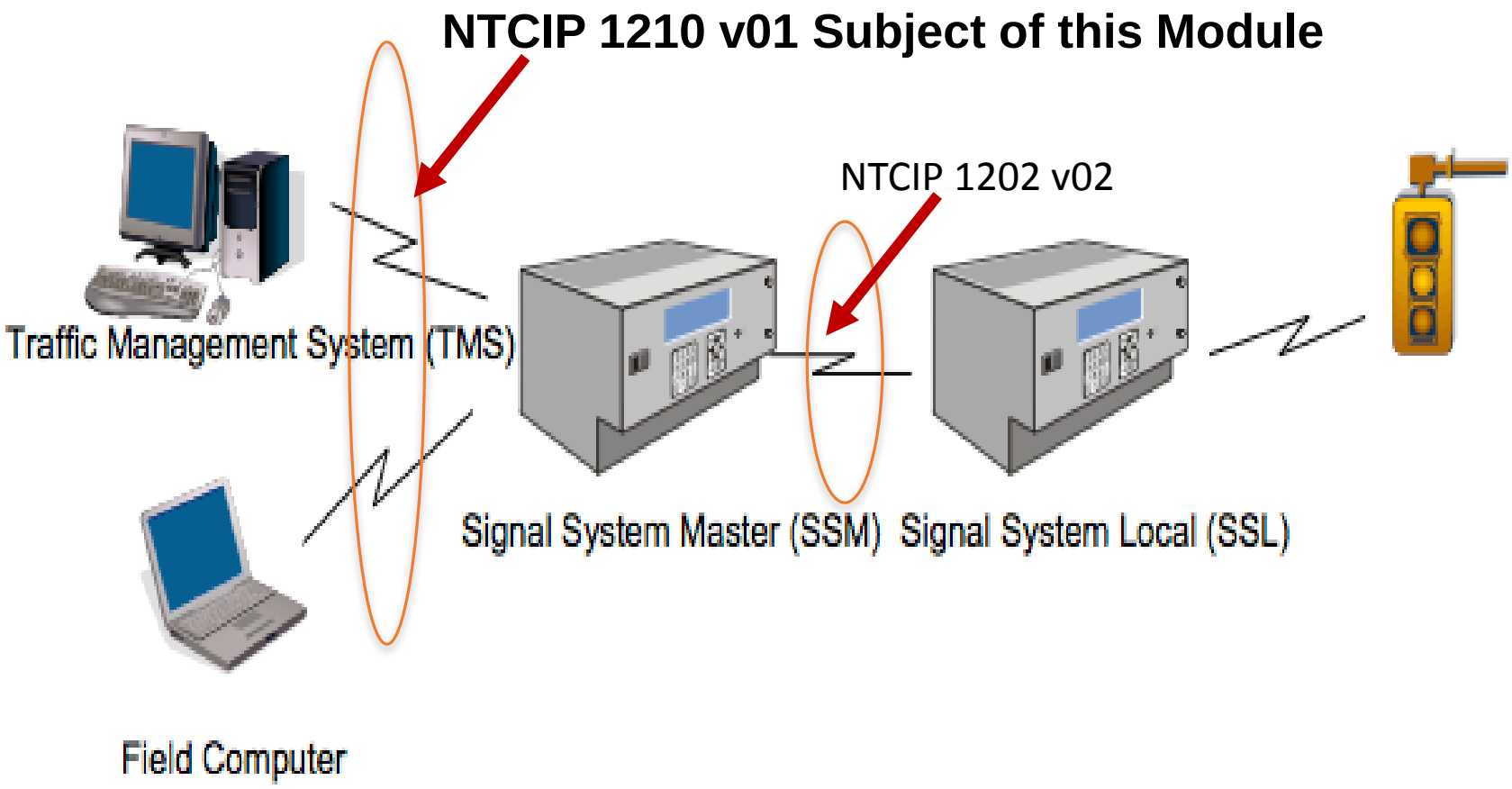
Source: FHWA

SSM Coordinates **Signal System Locals-SSLs** (Intersection Controllers)



How Is an SSM Used in a Traffic Management System?

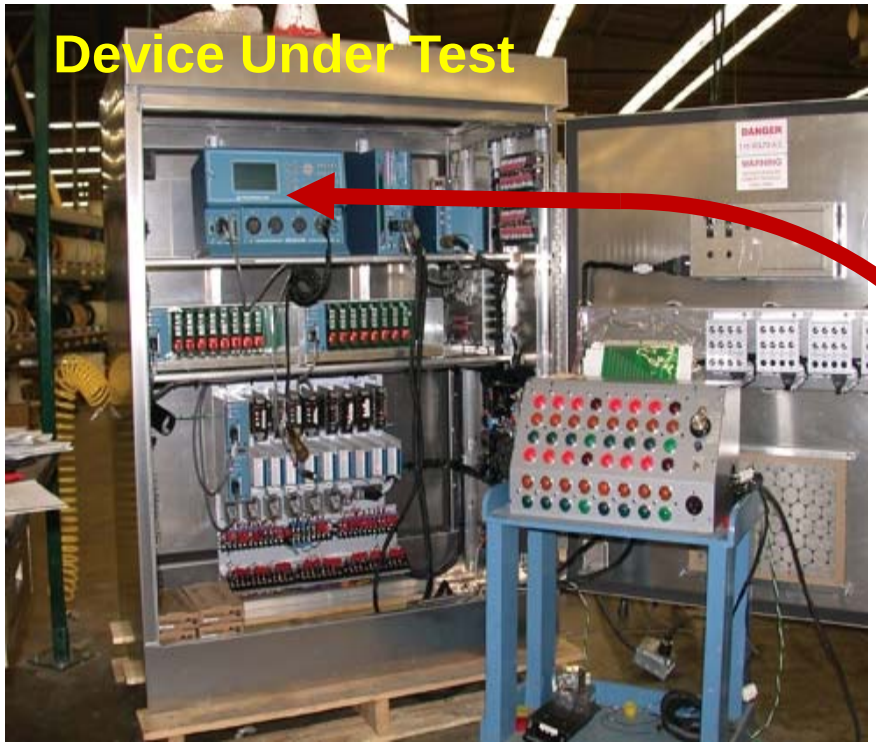
How an SSM Is Used Within the Typical Physical Architecture



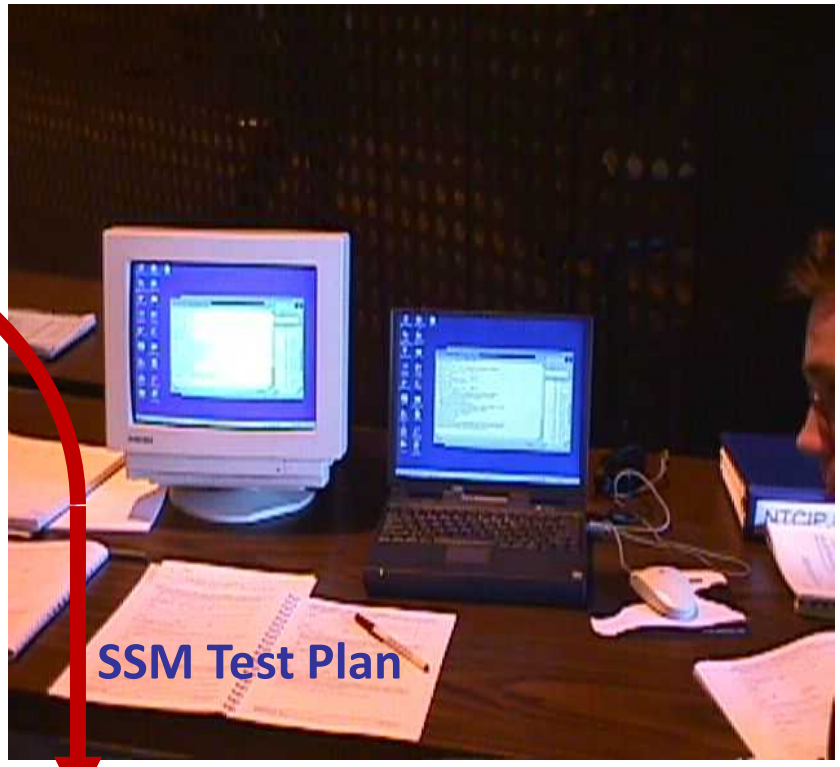
Source: NTCIP 1210, Fig. 3, p. 13

Purpose of Testing an SSM

Testing Is a Process That Uses a Documented Test Plan



Source: FHWA



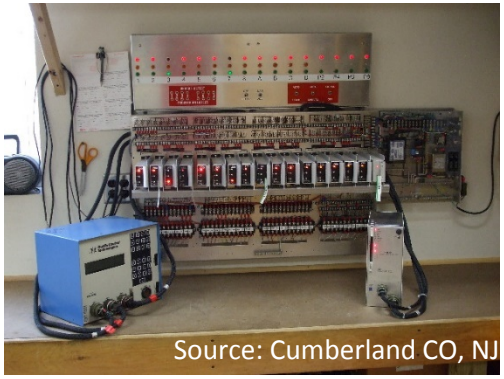
Source: ITE OET-Patel

Verify that an SSM Fulfills Each **Requirement** Stated in the Test Plan

Was the system built right?

Purpose of Testing an SSM

Testing Methods Used for Conformance Verification

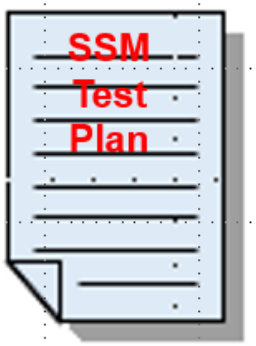


Visual Observation

Demonstration

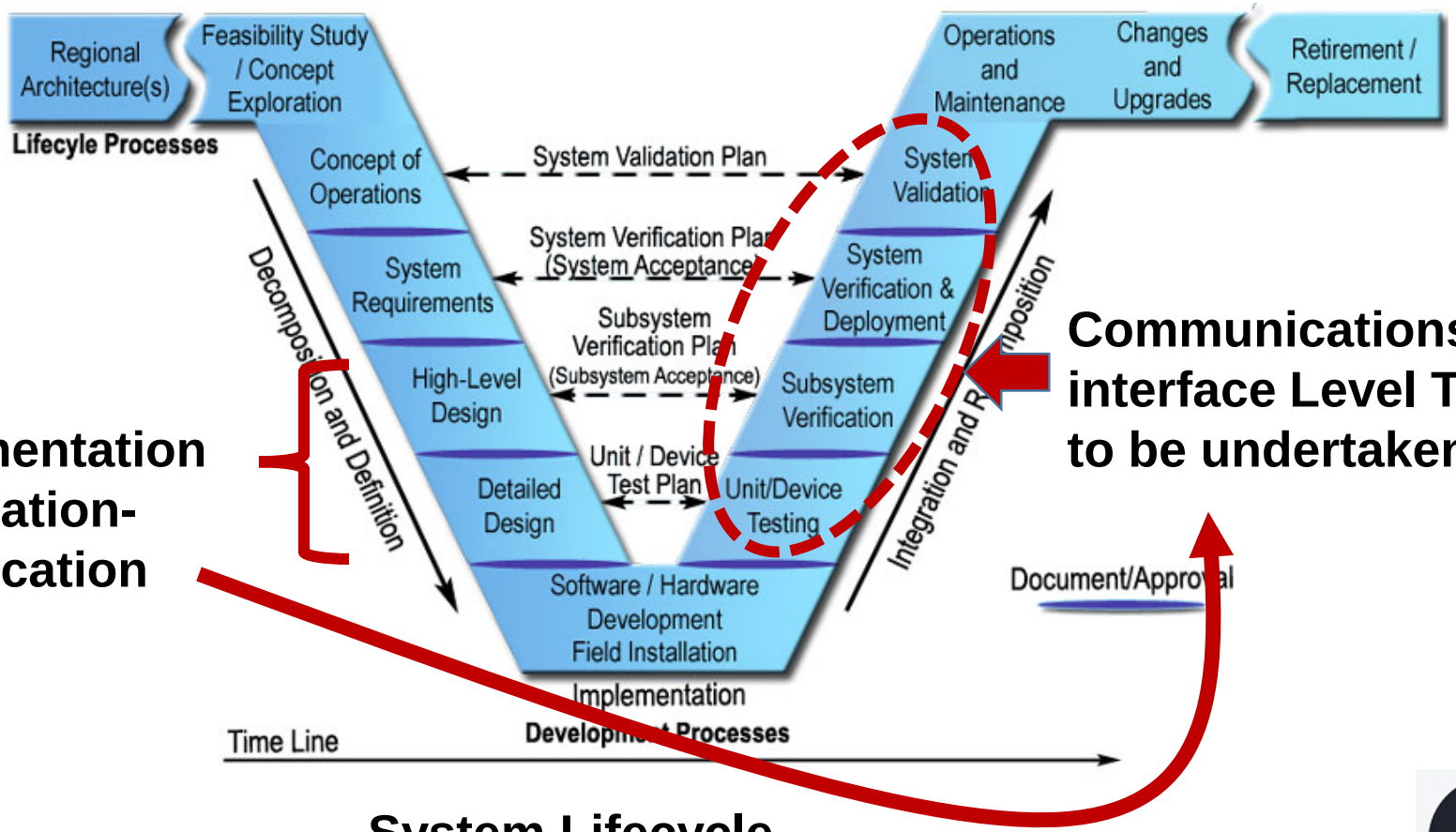
Source: Henry Liu, University of Minnesota

Testing Using Testing Documentation



Purpose of Testing an SSM

System Lifecycle and Testing to Be Undertaken



Verification Methods Specific to SSM Functions

Unit/Device (Bench) Testing

Source: ITE OET DMS-Patel

- SSM under test in a lab or workshop environment
- Testing with PC-based test software
- Exercise of the SSM data elements and dialogs to check conformity with standard

Cautionary Word on Unit Testing

- Need to **prioritize** tests by **failure consequences**, amount of time (available to test), and **boundary test,** as opposed to trying to test over 100% span
- NTCIP 1210 v01 data elements are exercised for **key functionality** to the extent possible

Verification Methods Specific to SSM Functions

Subsystem Verification (Is the system being "built right"?)

SSM requirements will be tested to ensure that the **SSM communicates with SSLs** properly, including use of central software.

3.3.1 Support Basic Communications

Requirements for making requests follow.

Examples

3.3.1.1 Accept Data from the TMS

The SSM shall accept data (e.g., configuration data, commands, etc.) from the TMS.

3.3.1.2 Deliver Data to the TMS

The SSM shall deliver data (e.g., configuration data, status, etc.) to the TMS. If not specified, the response start time shall be not greater than 2000 milliseconds.

3.3.1.3 Explore SSM Data by the TMS

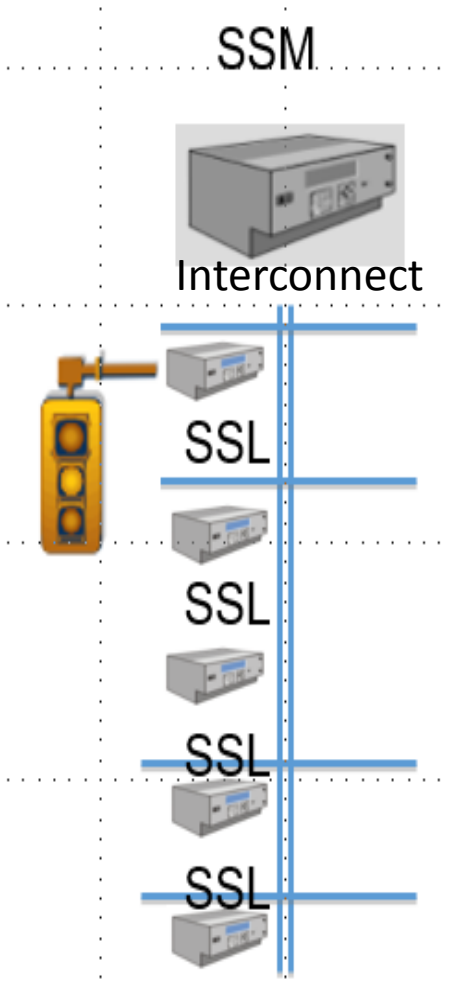
The SSM shall allow the TMS to discover what data and data instances are supported by the SSM. If not specified, the response start time shall be not greater than 2000 milliseconds.

3.3.1.4 Accept Data from the SSLs

The SSM shall accept data (e.g., configuration data, status, etc.) from the SSLs.

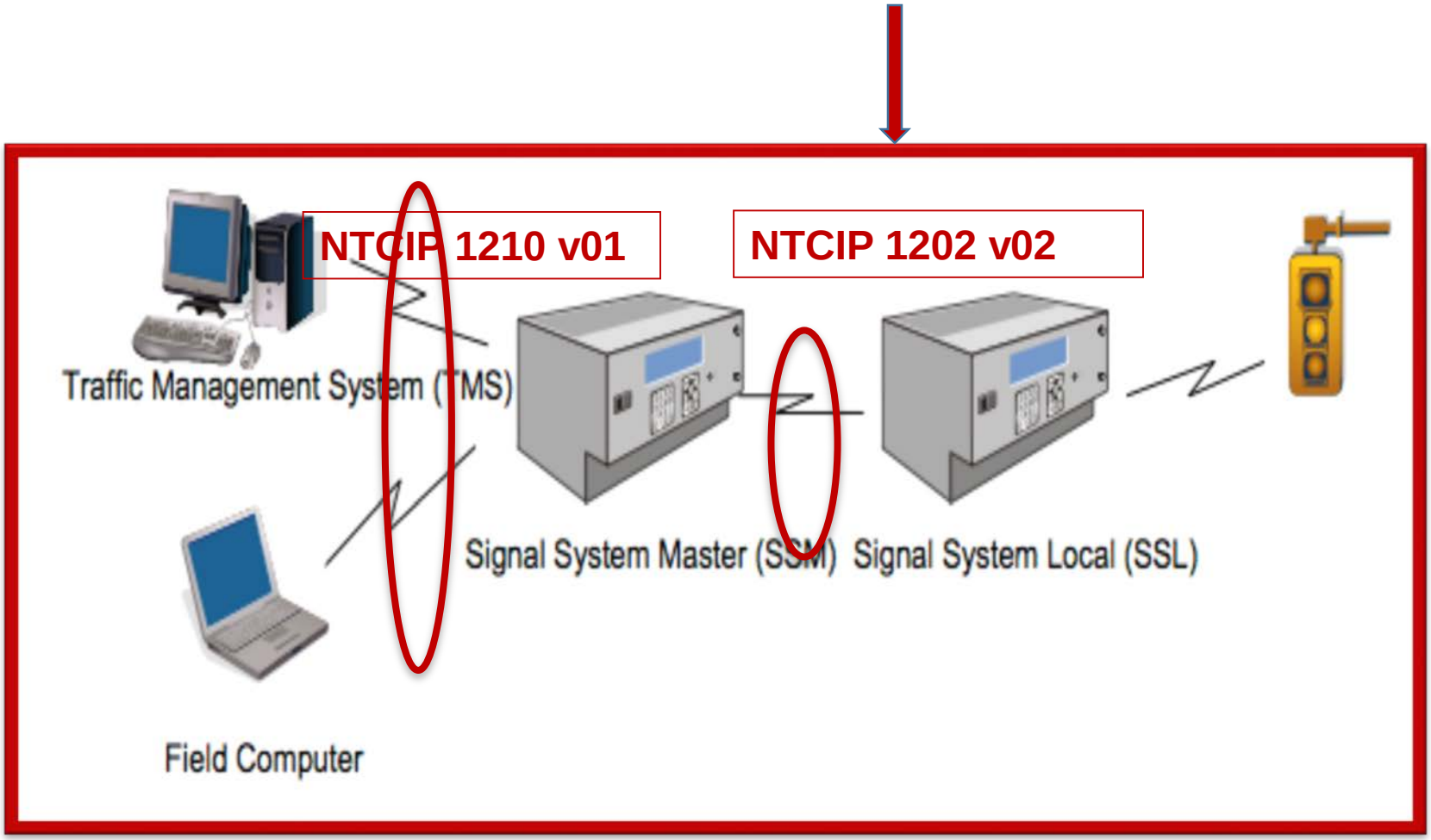
3.3.1.5 Deliver Data to the SSLs

The SSM shall deliver data (e.g., configuration data, commands, etc.) to the SSLs.



Verification Methods Specific to SSM Functions

System Verification Ensures That the Entire System Meets System Requirements—the Physical Architecture



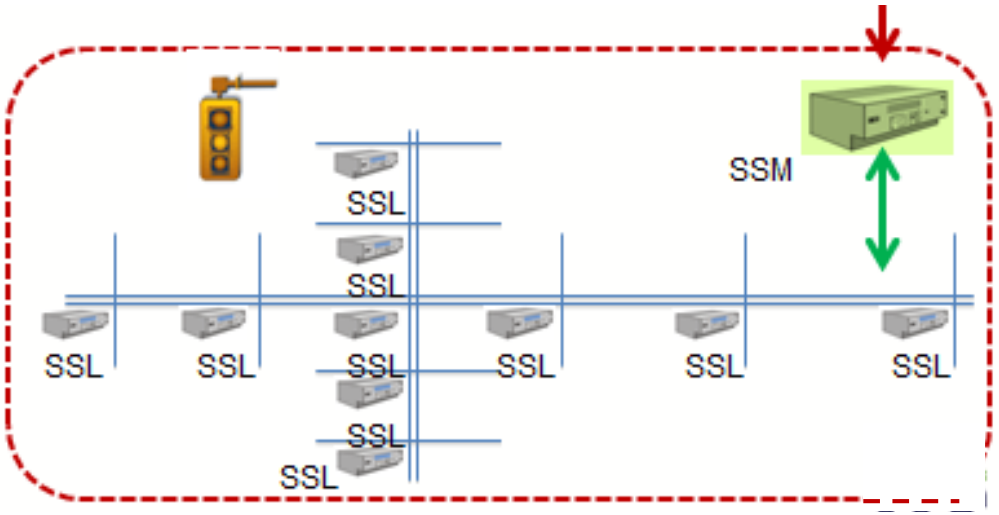
Verification Methods Specific to SSM Functions

System Validation Shows Whether the *"Right"* System Is Built

Implemented system is validated against specified user needs to support system operators, including communications

Central TMS ⟷ **Field System**

Source: City of Lexington, KY



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Question

Which is NOT part of the testing process in a system lifecycle?

Answer Choices

a) Test planning

b) Preparation of test documentation

c) Test execution and reporting

d) Identification of system requirements

Review of Answers

a) Test planning

Incorrect. Test planning is done when system requirements have begun.

b) Preparation of test documentation

Incorrect. Test documents are created during high-level design and detailed design.

c) Test execution and reporting

Incorrect. Test execution and reporting are done at each level of the testing workflow using test documentation.

d) Identification of system requirements

Correct! Identification of system requirements is NOT a part of the testing process.

Learning Objectives

Describe within the context of the system lifecycle **the role of a test plan** and testing to be undertaken

Recognize the **purpose, structure, and content** of well-written test documentation for an SSM based on **IEEE 829-2008 formats**

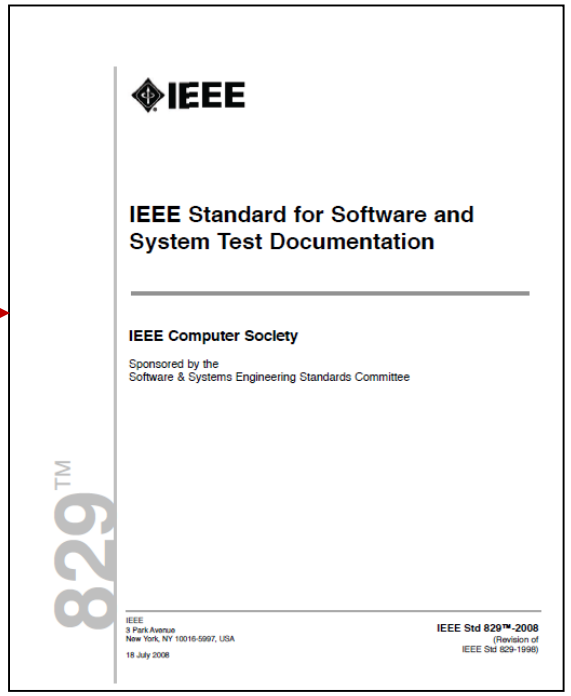
Learning Objective 2

Recognize the **purpose, structure, and content** of well-written test documentation based on **IEEE 829-2008 formats**

Purpose of Test Documentation in an SSM Specification

Objectives of the SSM Testing Documentation

1. Outline What to Test
2. State Clearly How to Test
3. Report Results/Outcomes During/After Test
4. Use IEEE 829-2008 Formats



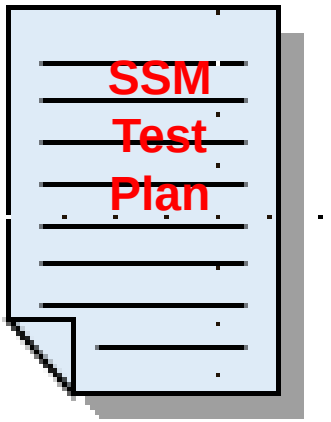
SSM Communications Interface Specification

Testing Documentation

Testing Documentation is made part of the SSM Communications Interface Specification

What Is a Test Plan?

From IEEE 829-2008 Standard

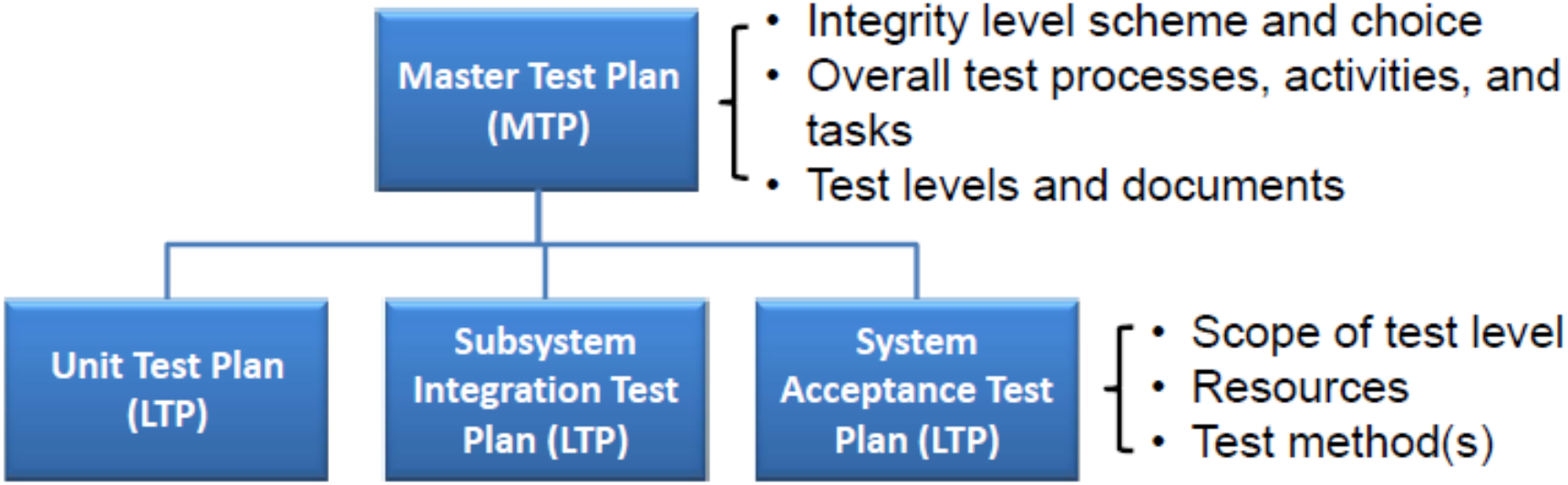


- Test Plan is a document describing:
  - Scope (technical management)
  - Approach
  - Resources needed
  - Schedule to complete
- Test Plan identifies
  - Test items
  - Features to be tested
  - Testing tasks
  - Risks requiring contingency plan

Structure of a Test Plan

From IEEE 829-2008 Standard

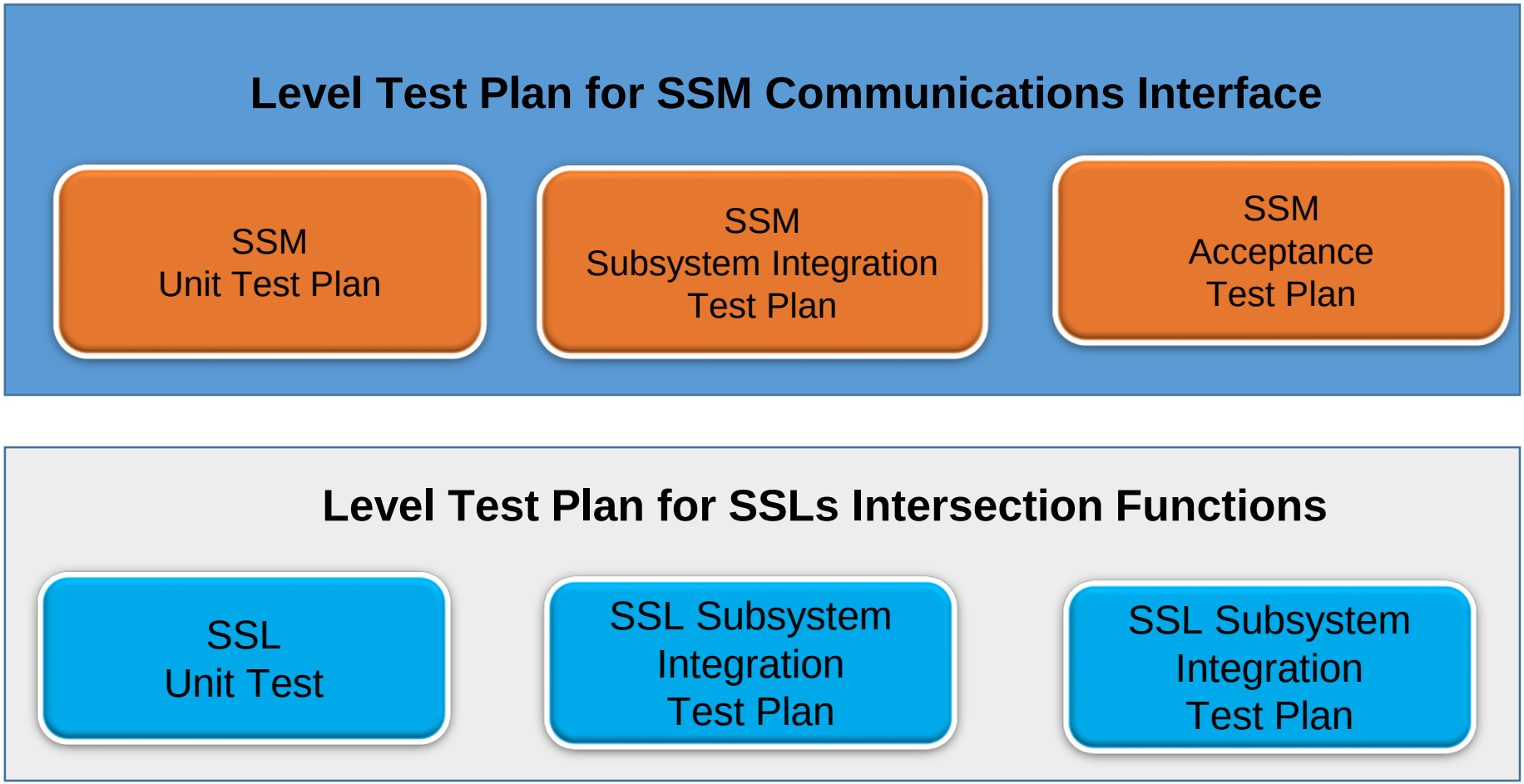
Sets overall workflow context



A Master Test Plan may not always be required!

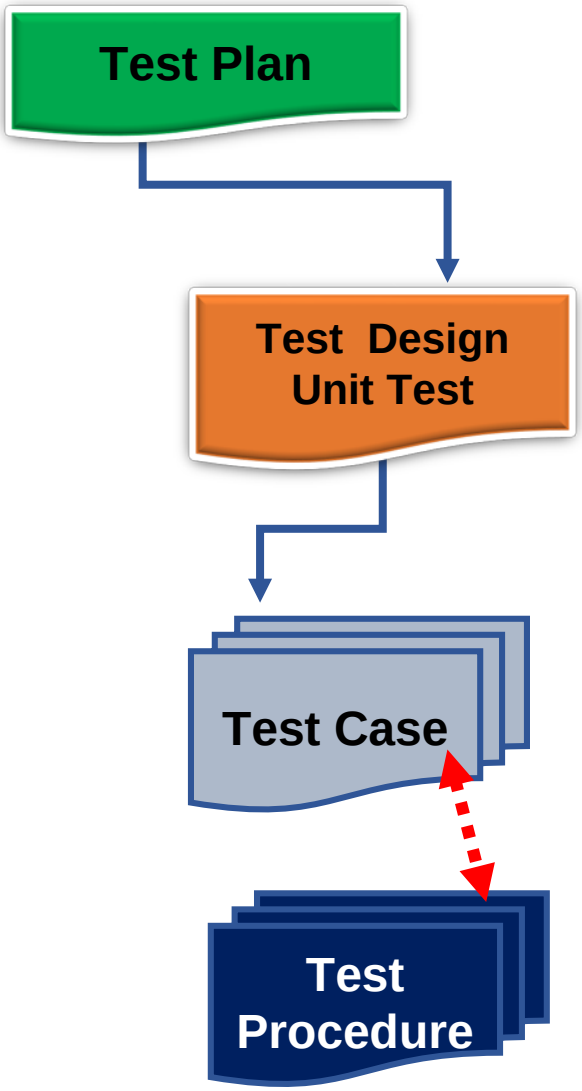
Structure of a Test Plan

MTP Structure Provides for Workflow for Multiple Devices



Structure of a Test Plan

SSM Test Plan Structure Based on IEEE 829-2008



Test Plan describes the **Overall Approach** to SSM Testing.

Test Design specifies the details of the test approach – **what is to be tested**. It is shown here for Unit Test – similar designs exist for Integration Test and Acceptance Test.

Test Case specification outlines a set of test **inputs,** execution conditions**,** and expected **results** (outputs).

Test Procedure specification defines the **steps** to execute a test.

Content of a Test Plan

Level Test Plan (LTP) Outline per IEEE 829-2008

- **Introduction**
  - Document identifier, scope, and references
  - Level in the overall sequence (First Unit Test…)
  - Test classes and test conditions

- **Details of the Level Test Plan**
  - Test items and their identifiers
  - Protocol Requirements List (PRL) for NTCIP 1210 objects and dialogs (may include RTCTM)
  - Features to be tested/not to be tested
  - Test approach
  - Pass/fail criteria
  - Suspension criteria and requirements to resume testing
  - Test deliverables

SUPPLEMENT

Content of a Test Plan

Level Test Plan (LTP) Outline per IEEE 829-2008

- **Test Management**
  - Planned activities and tasks
  - Test progression
  - Environment/infrastructure
  - Responsibilities/authorities
  - Interfaces among stakeholders
  - Resources and training
  - Schedules, estimates, and costs
  - Risk(s) and contingencies
- **General**
  - Quality assurance procedures
  - Metrics for specific measures
  - Glossary
  - Document change procedures and history

Content of a Test Plan

Sample Outline of Test Design as Per IEEE 829-2008

1. Introduction

1.1. Document identifier

1.2. Scope

1.3. References

2. Details of the Level Test Design

2.1. Features to be tested

2.2. Approach refinements

2.3. Test identification

2.4. Feature pass/fail criteria

2.5 Test deliverables

3. General

3.1. Glossary

3.2. Document change procedures

PRL-Provided Requirements are traced to a test Case

Req. ID	Req.	Test Case ID	Test Case
3.4.2.2.1	Explore SSL Data		
		TC3.4.3.1.6-1	Verify max number of intersections

Content of a Test Plan

Sample Outline of Test Case as Per IEEE 829-2008

Test Case	
ID: TCx.x	
Objective:	State which requirement(s) will be verified: testing a dialog correct sequence or correct structure and content of data
Inputs:	Input variable needed for testing
Outcome(s):	Expected results-behavior, errors
Environmental Needs	Test Set Up
Intercase Dependencies	Test cases that must be executed prior to this test case

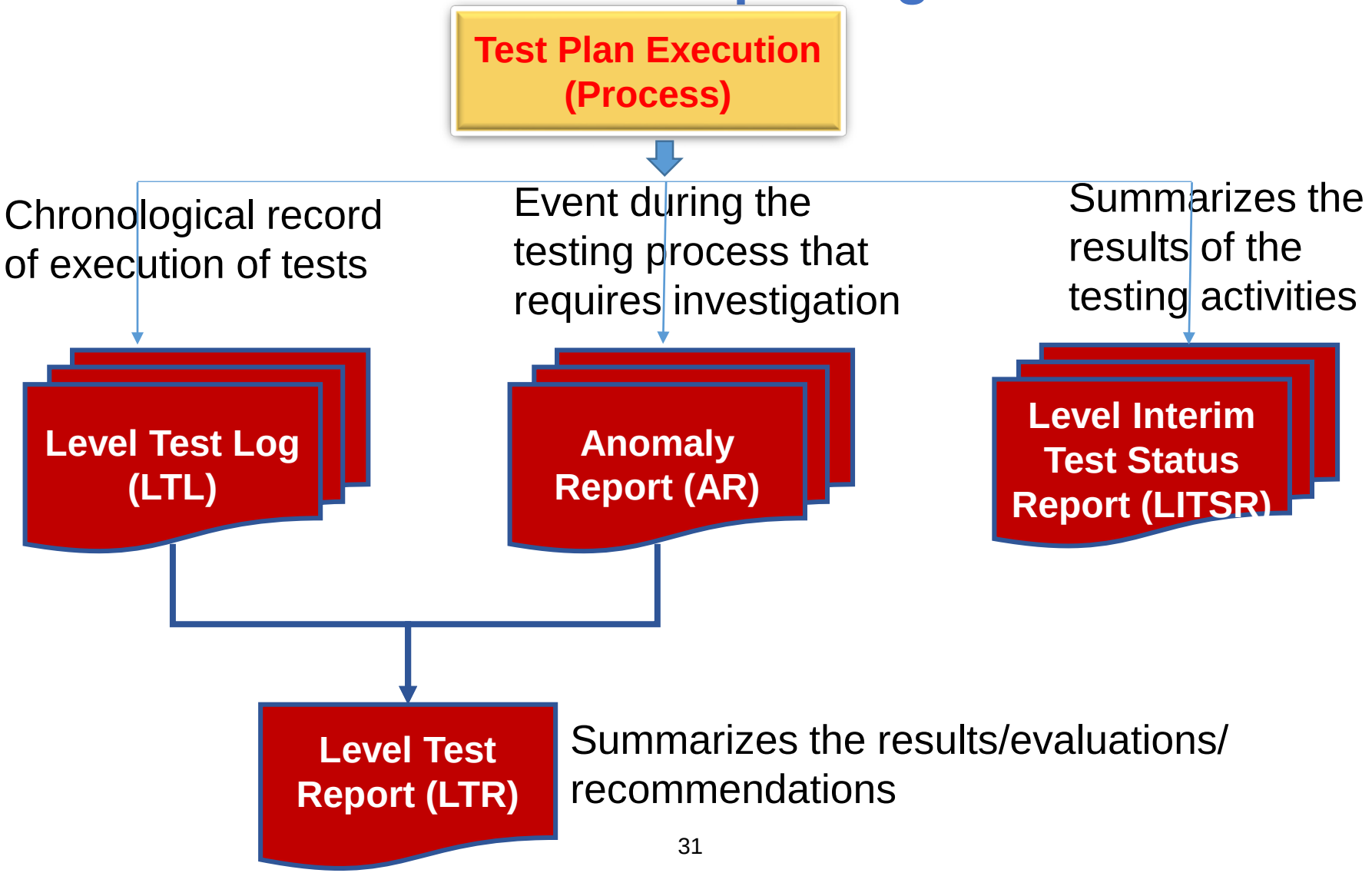
Content of a Test Plan

Sample Outline of a Test Procedure from NTCIP 1203 v03

Step	Test Procedure	Results	Additional References
1	CONFIGURE: Determine the maximum period of time that the pixel test should require (based on manufacturer documentation). RECORD this information as: »Pixel_Test_Time		
2	CONFIGURE: Determine the maximum period of time that the message display pixel test should require (based on manufacturer documentation). RECORD this information as: »Message_Display_Test_Time		
3	SET-UP: Ensure that all pixels are functioning prior to this test.		
4	SET the following object(s) to the value(s) shown: »pixelTestActivation.0 = 'test' (3) NOTE--Valid enumerated values are defined in Section 5.11.2.4.3 (Pixel Test Activation Parameter).	Pass / Fail (Section 3.5.3.1.1.2)	Section 4.2.4.2 Step a
5	GET the following object(s): »pixelTestActivation.0	Pass / Fail (RFC 1157)	Section 4.2.4.2 Step b
6	IF the RESPONSE VALUE for pixelTestActivation.0 equals 'test' (3), then GOTO Step 5; otherwise, GOTO Step 7. NOTE--If the RESPONSE VALUE remains at 'test' (3) for more than Pixel_Test_Time seconds, this test fails.		

Content of a Test Plan

Documentation for Test Reporting



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Question

Which is NOT included in a structure of a test plan?

Answer Choices

a) Test logs

b) Test design

c) Test case with inputs/outputs

d) Test procedures with steps

Review of Answers

a) Test logs

Correct! Test logs are not part of the structure of a test plan. Test logs are developed during and after test execution as part of test reports. This is per the IEEE 829-2008 standard.

b) Test design

Incorrect. The statement is true. Test design provides details on what to test.

c) Test case with inputs/outputs

Incorrect. The statement is true. Test cases detail inputs/outputs.

d) Test procedures with steps

Incorrect. The statement is true. One or more steps are outlined to actually conduct the test.

Learning Objectives

Describe within the context of the system lifecycle the **role of a test plan** and testing to be undertaken

Recognize the **purpose, structure, and content** of well-written test documentation for an SSM based on **IEEE 829-2008 formats**

Explain how to **develop** the complete test documentation package for an SSM specification based on NTCIP 1210 Standard v01

Learning Objective 3

Explain how to **develop** the complete documentation package for an SSM specification based on NTCIP 1210 Standard v01

Key Elements of NTCIP 1210 Standard v01 Tied to a Test Plan

Identify Key Elements Used in Preparation of a Test Plan

- User Needs
- Requirements

Protocol Requirements List (PRL)

Module A304a

- Objects
- Dialogs

Requirements Traceability Matrix (RTM)

Module A304b

Key Elements of NTCIP 1210 Standard v01 Tied to a Test Plan

Use the Project PRL to Identify Features to Be Tested

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.4.3	Connect Communication Networks			M	Yes/No	
		3.3.1.6	Explore SSL Data by the TMS	M	Yes/No	
2.5.2	Manage SSLs			O	Yes / No	
		3.3.1.6	Explore SSL Data by the TMS	M	Yes/No	
		3.3.1.7	TMS Acceptance of Data from the SSL	M	Yes/No	
		3.3.1.8	TMS Delivery of Data to the SSL	M	Yes/No	

Module A304a

2.5.2 Manage SSLs

These features are to be tested to verify capability to upload-download-retrieve data. Must be selected YES.

Key Elements of NTCIP 1210 Standard v01 Tied to a Test Plan

Use the Project RTM to Identify Objects to Be Verified

Functional Requirement Reference	Functional Requirement	Dialog Reference	Object Reference	Object	Comments (Informative)
3.4.2.1	Synchronize SSM Clock with TMS	4.1.3	1201.2.4.1	globalTime	
3.4.2.2.1	Determine SSLs Currently Connected	4.2.2.3	5.2.1	maxIntersections	
			5.2.2.1.3	intersectionSection	
3.4.2.2.2	Determine Pattern Selection Capabilities	4.2.6.3	5.1.1	maxSections	
			5.23.1	algorithmSupport	

Dialog

Module A304b

4.2.2.3 SSM Intersection / Section Assignment Dialog

The standardized dialog for a TMS to determine the SSLs assigned to a Section within an SSM shall be as follows:

5.2.1 Maximum Number of Intersections SSLs

```
maxIntersections  OBJECT-TYPE
      SYNTAX      INTEGER (8..255)
```

A Test Case Will Be Created Using RTM to Verify Range Values

Developing Test Design, Test Cases, and Test Procedures

Develop an SSM Test Plan

- Describes the Scope, Approach, Resources, and Schedule for the testing
- Some of the testing aspects covered:
  - Item(s) to be tested
  - Features to be tested
  - Features not to be tested
  - Testing tasks to be performed
  - Personnel responsible for each task
  - Risks associated with the plan

Developing Test Design, Test Cases, and Test Procedures

Develop an SSM Test Design Using PRL

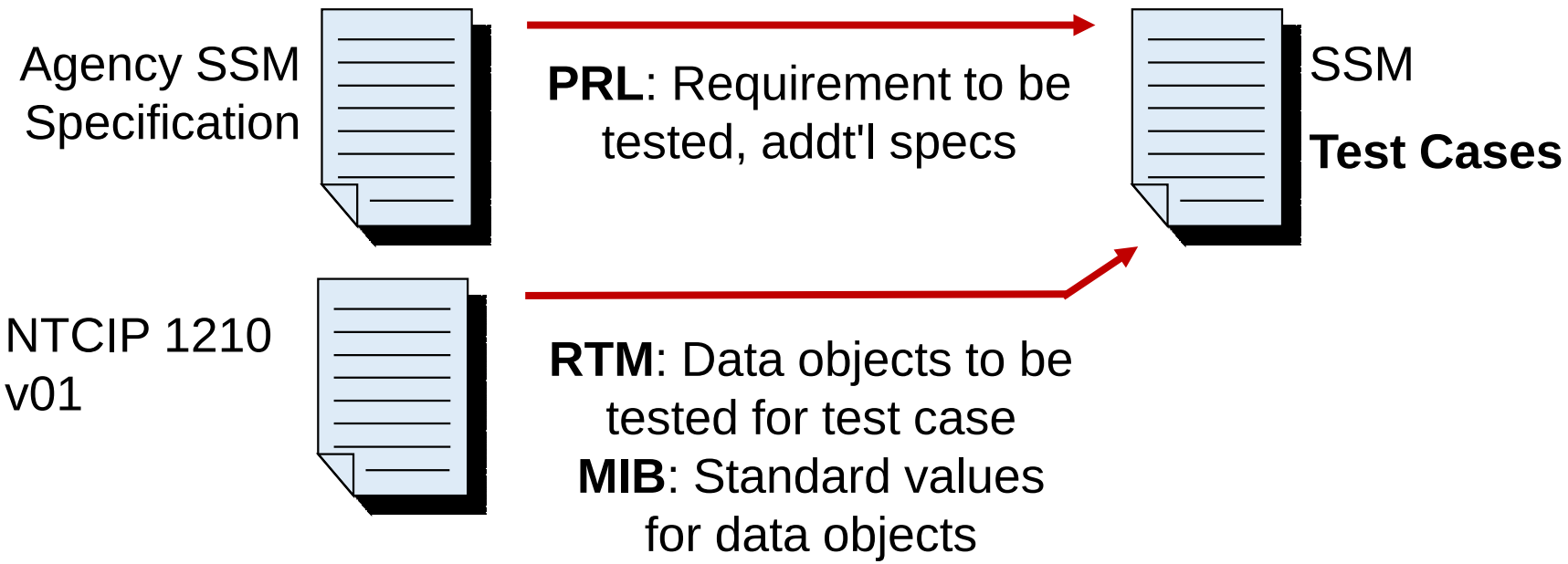
- Specifies the detailed approach (design) for exercising a collection of tests
- Identifies the features to be tested by the test design
- Identifies the requirements to be tested by the test design
- Identifies the tests (test cases) associated with the design

Developing Test Design, Test Cases, and Test Procedures

Develop SSM Test Cases Using Project PRL/RTM

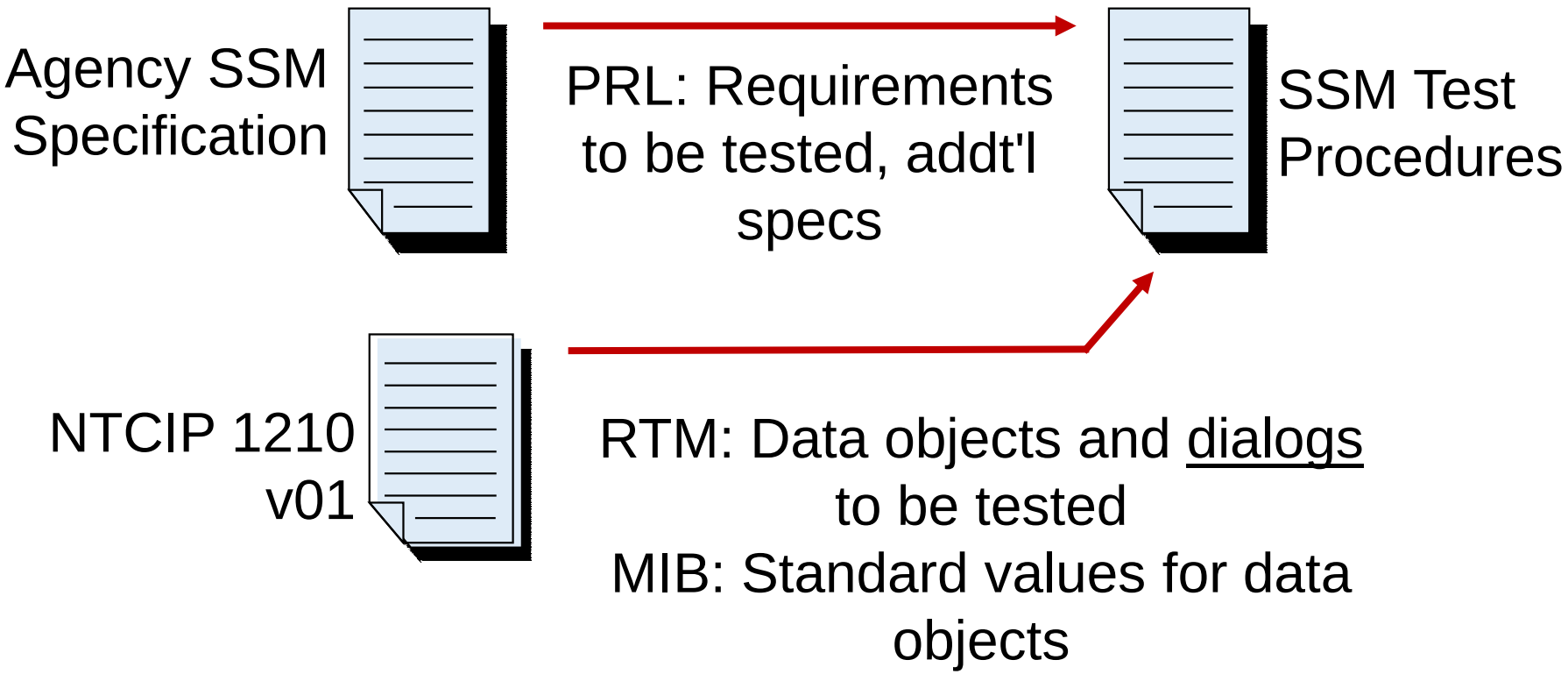
SSM Test Cases

- Defines a test case identified by a test design specification
- Input and output specifications



Developing SSM Test Procedures

SSM Test Procedures specify the steps for executing one or more test cases



Developing Test Design, Test Cases, and Test Procedures

Test Case for Intersection Unit Control Status

(See Module T203 Parts 1 and 2 for Formats)

ID: TC001	Title: Request Status Condition within the Device Dialog Verification (Positive Boundary Test Case)
Objective:	To verify system interface implements (positive test case) requirements for a sequence of OBJECT requests for: The test case verifies that the SSM returns an appropriate value given valid data content for the OBJECTs requested at valid value ranges. An output specification is provided, showing valid value constraints per the NTCIP 1210 v01 object definitions.
Inputs: `INTEGER { other (1), systemControl (2), systemStandby (3), backupMode(4), manual (5), timebase (6), interconnect (7), interconnectBackup (8) }`	Step through each object and set a value at the valid value range for the object. For example: Set object **5.8.1.1.5 intersectionUnitControlStatus to '1'** (which is just at the valid value range of 1 to 8 inclusive) Set object **5.8.1.1.5 intersectionUnitControlStatus to '8'** (which is just at the valid value range of 1 to 8 inclusive)
Outcome(s):	The SSM responds with valid status objects. See Test Case Output Specification TCOS001 – Status Condition within the Device (Boundary Positive Test Case)
Environmental Needs:	No additional needs outside of those specified in the test procedure
Special Procedural Requirements:	None
Intercase Dependencies:	None

5.8.1.1.5	intersectionUnitControlStatus
5.8.1.1.6	intersectionCurrentEventLogSize

EXAMPLE

Develop Requirements to Test Case Traceability Matrix (RTCTM) for an SSM

Developing an SSM RTCTM

- An RTCTM is a table that provides traceability from **requirements** to **test cases** to **test procedures**
- Each SSM Test Design (Test Plan) has an RTCTM

Req. ID	Req.	Test Case ID	Test Case	Test Proc ID	Test Procedure
3.4.2.2.1	Explore SSL Data by the TMS				
		TC3.4.3.1.6-1	Verify maximum intersections		
				TP3.4.3.1.6-1	Verify object range 8-40

Develop Requirements to Test Case Traceability Matrix (RTCTM) for an SSM

RTCTM Lists Test Procedures for Each Test Case

- RTCTM has one or more Test Cases to verify conformance to NTCIP 1210 v01
- RTCTM lists one or more **Test Procedures** to verify object range

Req. ID	Req.	Test Case ID	Test Case	Test Proc ID	Test Procedure
3.4.2.2.1	Explore SSL Data by the TMS				
		TC3.4.3.1.6-1	Verify maximum intersections (SSLs)		
				TP3.4.3.1.6-1	Verify object range 8-40

Develop Requirements to Test Case Traceability Matrix (RTCTM) for an SSM

Test Case/Test Procedures

(See Module T204 Parts 1 and 2)

Test Case: TC1.1	Title:	Test the Boundaries	
	Description	This test case verifies the maximum number of SSMs that can be SET by the central station. The test is conducted just below, just above, and exactly at the boundary.	
	Variables	Max SSMs	From project requirements
		Max SSMs - 1	From the test plan
		Max SSMs +1	From the test plan
	Pass/Fail Criteria	1. The DUT shall accept data at Max SSMs 2. The DUT shall accept data at Max SSMs -1 3. The DUT shall return an error at Max SSMs +1	

Steps are formal executions and results oriented (must have an outcome)

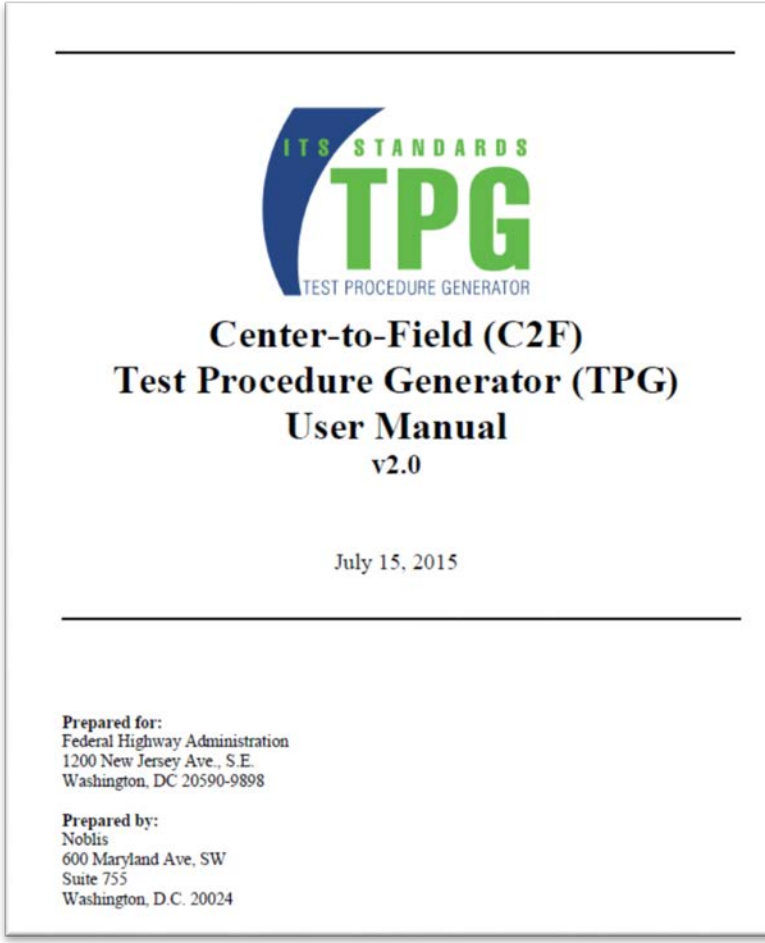
Step	Test Procedure	Expected Results
1	Configure: SET the Max SSMs = 8, record the DUT response	Responds with Max SSMs = 8
2	SET the number of SSMs = 1, record the DUT response	Response = 1
3	SET the number of SSMs = 2, record the DUT response	Response = 2
4	SET the number of SSMs = 10, record the DUT response	Error, exceeds Max SSMs = 8

EXAMPLE

Introduction to the Test Procedure Generator (TPG) and How to Use It for SSM Testing

Test Procedure Generator (TPG)

- TPG is a **software** that guides the development of the test procedures
- Used for Center to Field (C2F) devices
- Relatively new product


ITS STANDARDS TPG TEST PROCEDURE GENERATOR

Center-to-Field (C2F)
Test Procedure Generator (TPG)
User Manual
v2.0

July 15, 2015

Prepared for:
Federal Highway Administration
1200 New Jersey Ave., S.E.
Washington, DC 20590-9898

Prepared by:
Noblis
600 Maryland Ave, SW
Suite 755
Washington, D.C. 20024

- v2.1 downloadable at:

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

How to Use the Test Procedure Generator (TPG)

- Install the TPG Software
- Import the Standard, and the TPG will process the requirements, objects, dialogs, and RTM
- Create “Set of Test Procedures” (Note: This feature will allow a user to begin to develop test procedures)
- Develop Test Procedures (covered in detail on the next slide)

Test Procedure with the TPG by User

- Defines the title, description, and pass/fail criteria in the header information
- Selects the requirements to be tested (TPG has imported the list from the standard)
- Creates the variables to be used in the test procedure (the TPG uses the objects imported from the standard)
- Develops the detailed steps using the TPG tools

TPG Benefits

- Test procedures come from the **agency specification**, NOT from vendors:
  - Reduces developmental risks, effort, and the cost
  - Ensures **traceability, and conformance** to the Center to Field (C2F) Standards such as DMS, ESS, and SSM
  - Helps determine compliance to extended standard
  - Promotes interoperable C2F systems
- Creates in-house expertise

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Question

What is the primary purpose of RTCTM?

Answer Choices

a) Sets the testing workflow sequences

b) Correlates User Needs to Requirements

c) Contains only test cases

d) Traces Requirement to Test Case to Test Procedure

Review of Answers

a) Sets the testing workflow sequences

Incorrect. Testing workflow is part of the Level Test Plans.

b) Correlates User Needs to Requirements

Incorrect. User Needs to Requirements are part of the Protocol Requirements List (PRL).

c) Contains only test cases

Incorrect. It contains test cases and test procedures for each test case.

d) Traces Requirement to Test Case to Test Procedures

Correct! RTCTM depicts the Test Cases that will be used to verify each Requirement with test procedures.

Learning Objectives

Describe within the context of the system lifecycle the **role of a test plan** and testing to be undertaken

Recognize the **purpose, structure, and content** of well-written test documentation for an SSM based on **IEEE 829-2008 formats**

Explain how to **develop** the complete test documentation package for an SSM specification based on NTCIP 1210 Standard v01

Describe the **testing of an SSM** using sample test document

Learning Objective 4

Describe the **Testing of an SSM** Using Sample Test Document

Walk Through a Sample SSM Test Plan

Where Is the SSM Test Plan Located?

General Procurement Contract Documents

Communications Interface Specifications

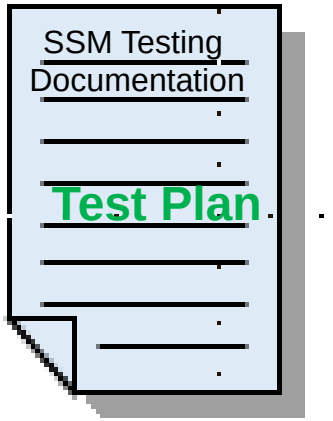
I. General

II. SSM User Needs

III. SSM Functional Req.

IV. SSM Project PRL, RTM

V. **Testing Documentation**

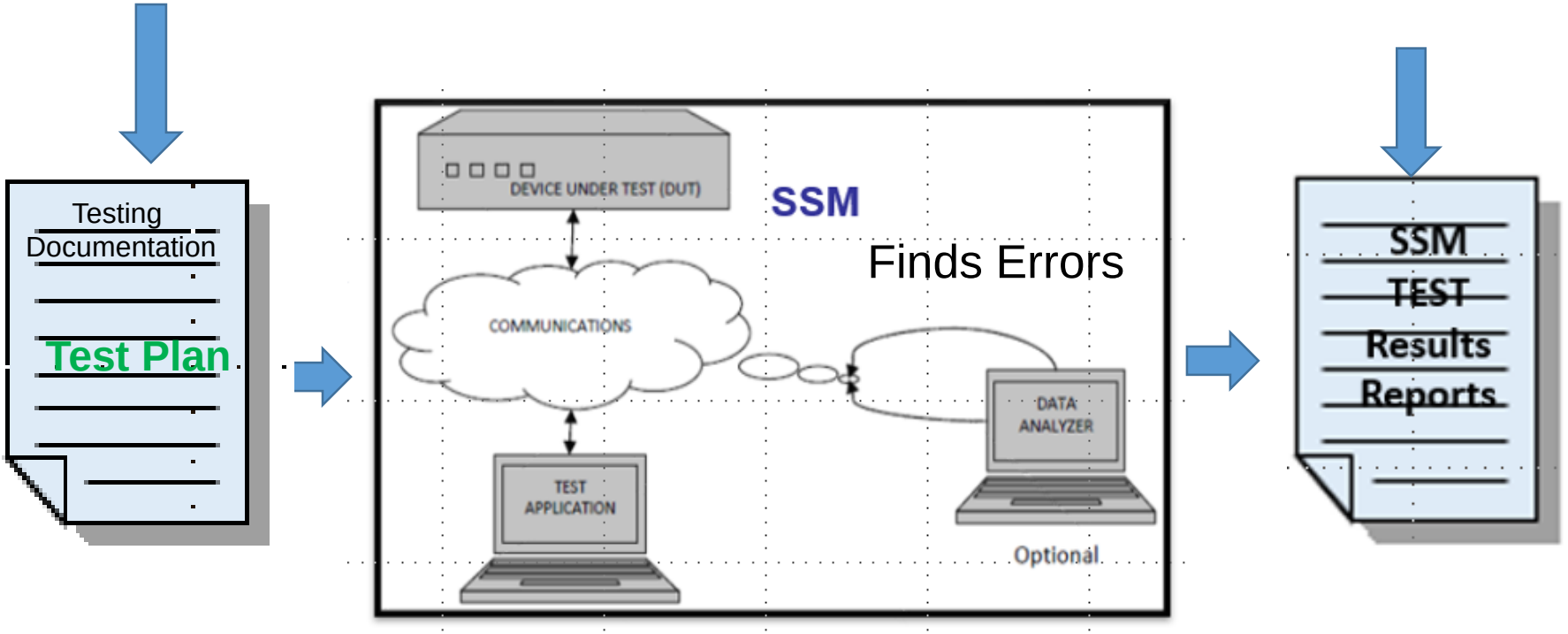


Walk Through a Sample SSM Test Plan

Description of an SSM Testing Setup

What to test: verifies features, requirements

Records results and outcomes



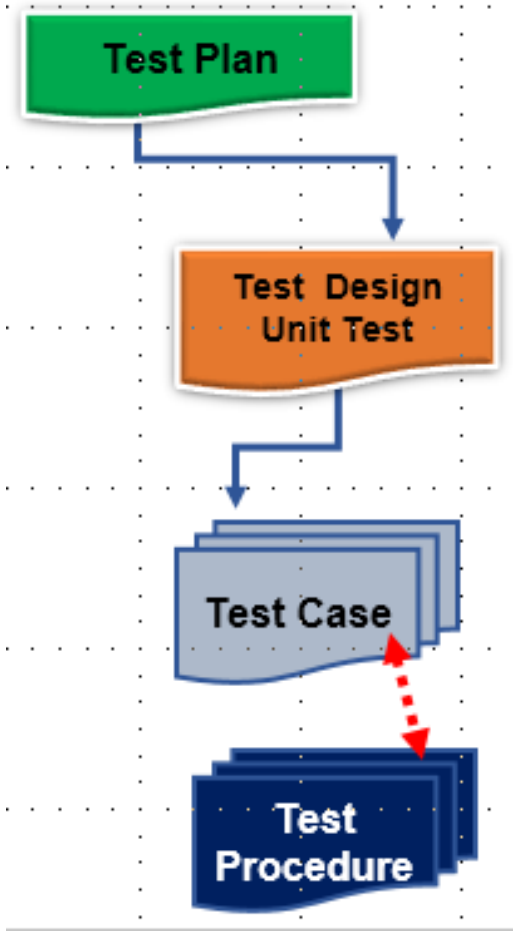
Walk Through a Sample SSM Test Plan

How Is the SSM Test Plan Developed?

Test documentation is developed for a given project using IEEE Std 829-2008 formats

Test Design and a Test Plan can be in **one document** for a single test design

Test Cases and Test Procedures can be combined in **one document**



Walk Through a Sample SSM Test Plan

Test Plan Outline

Key Parts

1. Introduction
2. Details of Unit Testing
   - 2.1 Test items and their identifiers
   - 2.2 RTCTM (Test Design/Test Procedures)
   - 2.3 List of SSM Features to be tested (PRL)
   - 2.4 Objects to be tested (RTM)
   - 2.5 Approach
   - 2.6 Item Pass/Fail criteria
   - 2.7 Suspension Criteria and Resumption Requirements

Forms basis for what to test

SUPPLEMENT

Walk Through a Sample SSM Test Plan

Test Plan Outline

Key Parts (cont.)

2.8 Test Deliverables (Before Testing)

SSM Communication Test Plan
SSM Communication Test Designs
SSM Communication Test Cases
SSM Communication Test Procedures

<u>Reporting Results (During/After Testing)</u>

SSM Communication Test Logs
SSM Communication Test Incident Reports
SSM Communication Interim Test Status Reports
SSM Communication Test Reports

CASE STUDY

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U.S. Department of Transportation
ITS Joint Program Office
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Walk Through a Sample SSM Test Plan

The City of Midsize: SSM Communications Interface Specification

- ✓ Central TMS requires NTCIP 1210 v01 communications interface with response time of 600 msecs.
- ✓ One SSM monitors/controls maximum of 10 SSLs located.
- ✓ Traffic responsive strategy covers 30 SSLs spread over three sections.
- ✓ Existing communication interconnect is declared adequate for the controllers.
- ✓ Project PRL and RTM are also included in the specification.

EXAMPLE

Walk Through a Sample SSM Test Plan

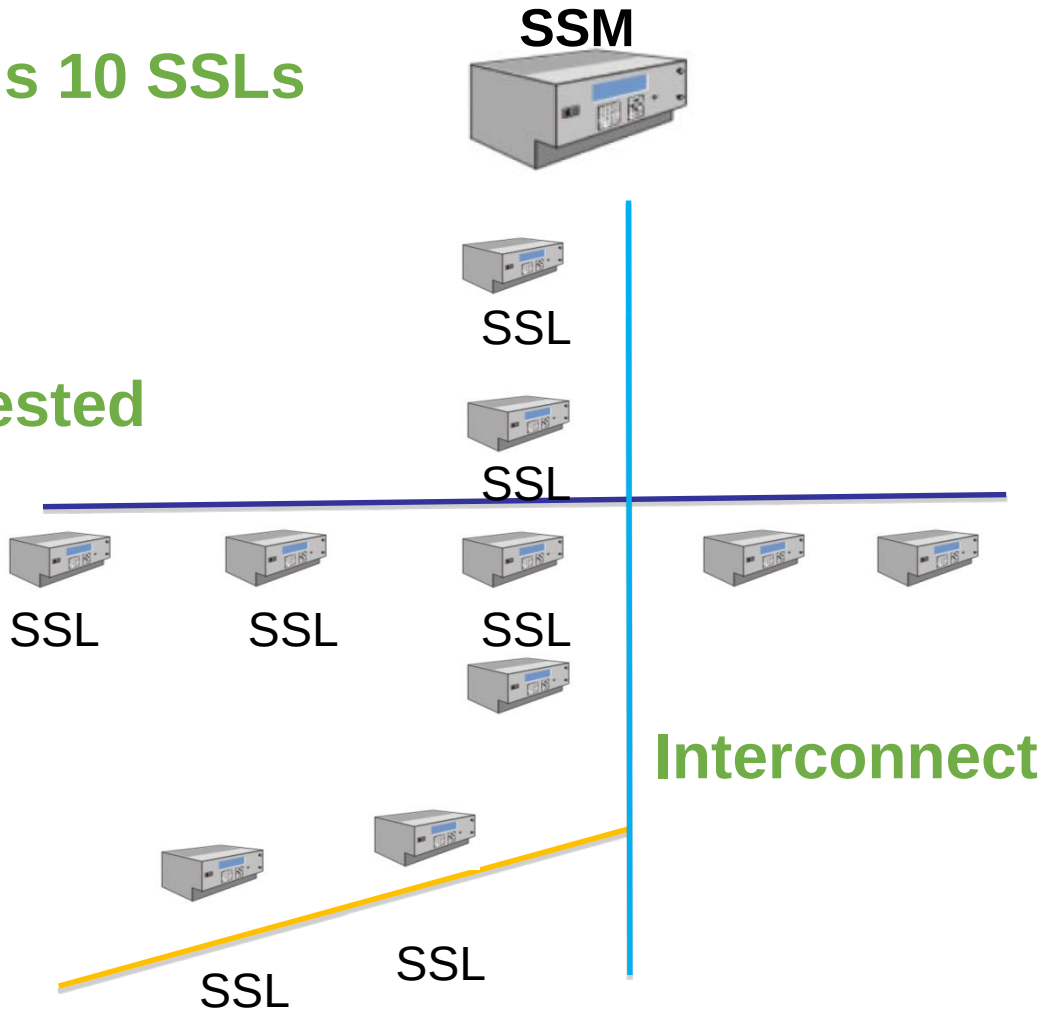
What Are the Project Parameters?

1 SSM controls 10 SSLs

30 SSLs

3 SSM to be tested

3 Sections



Walk Through a Sample SSM Test Plan

PRL Example: What Needs to Be Tested/Not to Be Tested

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.1.1	Configure Cycle Timers and Unit Backup Time			M	Yes	
		3.4.2	**Manage the SSM Configuration**			
		3.4.2.2.1	Determine SSLs Currently Connected	M	Yes	will be tested
		3.4.2.2.2	Determine Pattern Selection Capabilities	M	Yes	
		3.4.2.2.3	Determine SSM Section Characteristics	M	Yes	
		3.4.2.2.4.1	Configure Cycle Timer Reference	O	Yes / No	
		3.4.2.2.4.2	Determine Cycle Timer Capability	O	Yes / No	will NOT be tested
		3.4.2.2.5	Determine SSM Software Version	M	Yes No	

Walk Through a Sample SSM Test Plan

Find Object Ranges from Project RTM to Prepare Test Cases

Functional Requirement Reference	Functional Requirement	Dialog Reference	Object Reference	Object	Comments (Informative)
3.4.2.1	Synchronize SSM Clock with TMS	4.1.3	1201.2.4.1	globalTime	
3.4.2.2.1	Determine SSLs Currently Connected	4.2.2.3	5.2.1	maxIntersections	
			5.2.2.1.3	intersectionSection	
3.4.2.2.2	Determine Pattern Selection Capabilities	4.2.6.3	5.1.1	maxSections	
			5.23.1	algorithmSupport	

5.2.1 Maximum Number of Intersections

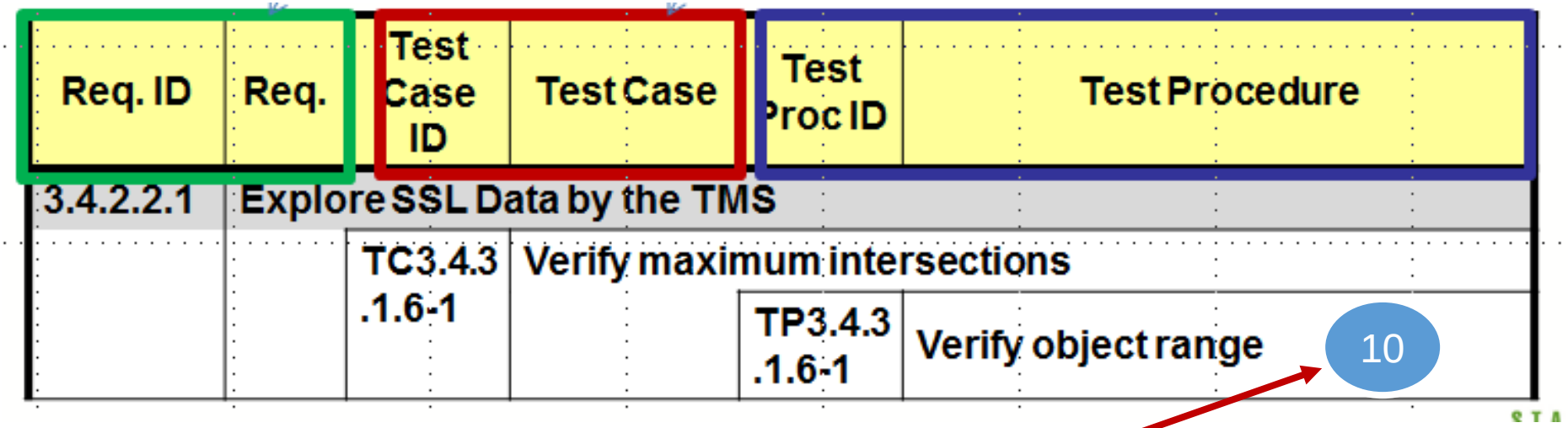
```
maxIntersections   OBJECT-TYPE
        SYNTAX          INTEGER (8..255)
```

Recall, case study has 10 SSLs requirement here

EXAMPLE

Walk Through a Sample SSM Test Plan

Prepare RTCTM for Testing Documentation



Recall, Case Study has 10 SSLs:

Test Procedure will be carried out to check boundary condition at **10**, just below at **8**, and just above at **12**

Results-Error Conditions

Testing for Boundary Conditions

- **All boundary conditions are tested:**
  - Just below each limit
  - Just above each limit
  - Exactly on each limit
- **Boundary is valid, SSM should:**
  - Process successfully
  - Respond accordingly
- **If error conditions occur, SSM should:**
  - Respond with error message
  - Remain in normal operation
  - No communications loss

Results-Error Conditions

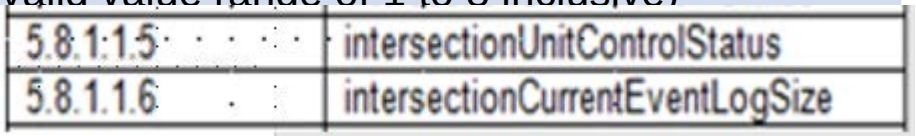
How Are we Checking for Error Conditions?

- **Positive testing for**:
  - Validating input values, dialogs, and sequences per test procedure
  - Expected outputs from SSM - Device Under Test (DUT)

- **Negative testing for**:
  - Asserting invalid input values, dialogs, or sequences per the test procedure
  - Errors are examined for next action on test continuity

Results-Error Conditions

Testing for Value Outside Valid Boundary Range

ID: TC001	Title: Request Status Condition within the Device Dialog Verification (Positive Boundary Test Case)
Objective:	To verify system interface implements (positive test case) requirements for a sequence of OBJECT requests for: The test case verifies that the SSM returns an appropriate value given valid data content for the OBJECTs requested at valid value ranges. An output specification is provided, showing valid value constraints per the NTCIP 1210 v01 object definitions.
Inputs: `INTEGER { other (1), systemControl (2), systemStandby (3), backupMode(4), manual (5), timebase (6), interconnect (7), interconnectBackup (8)`	Step through each object and set a value at the valid value range for the object. For example: Set object **5.8.1.1.5 intersectionUnitControlStatus to '9'** (which is outside the valid value range of 1 to 8 inclusive) 
	The SSM responds with an error status. See object ssmBlockErrorStatus. See Test Case Output Specification TCOS001 – Status Condition within the Device (Boundary Negative Test Case)
Environmental Needs:	No additional needs outside of those specified in the test procedure
Special Procedural Requirements:	None
Intercase Dependencies:	None

EXAMPLE

Results-Error Conditions

PRL Example: What Needs to Be Tested: Mandatory Requirements

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.4.1	Provide Live Data			M	Yes	
		3.3.1.1	Accept Data from the TMS	M	Yes	
		3.3.1.2	Deliver Data to the TMS	M	Yes	
		3.3.1.3	Explore SSM Data by the TMS	M	Yes	
		3.3.3.1	Determine Access Settings	M	Yes	
		3.3.3.2	Configure Access	M	Yes	

All are to be tested

Communications Testing Tools Available

- Many generic Simple Network Management Protocol (SNMP) test tools available for Ethernet communications
- Data Analyzers
- NTCIP Testing Tools
  - Test both Ethernet and serial communications
  - Test all objects within the MIB with Set/Get operations
  - Verify that **read-only objects** are not settable
  - Logs and reports (various levels)

Testing Tools

Where to Find Additional Test Procedure Information

Additional Information on Test Procedures:

- NTCIP 1203 v03 DMS Standard, Annex C
- NTCIP 1204 v03 ESS Standard, Annex C
- Module T313: *Applying Your Test Plan to NTCIP 1204 ESS*
- Test Procedure Generator (TPG v2.1)

ACTIVITY

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

Question

Which is NOT a valid statement related to an SSM testing documentation?

Answer Choices

a) Test plan contains an overall testing approach

b) Test design contains project RTCTM

c) Test procedures are provided by the manufacturer

d) Test procedure includes error detection

Review of Answers

a) Test plan contains an overall testing approach

Incorrect. The statement is true. A plan has an overall approach and scope.

b) Test design contains project RTCTM

Incorrect. RTCTM correlates requirements, test cases, and set procedures to verify a requirement.

c) Test procedures are provided by the manufacturer

Correct! The statement is NOT true. ONLY agency specification specifies test procedures.

d) Test procedure includes error detection

Incorrect. The statement is true. The test includes both positive and negative testing for expected and unexpected results, respectively.

Module Summary

Describe within the context of the system lifecycle the **role of a test plan** and testing to be undertaken

Recognize **the purpose, structure, and content** of well-written test documentation for an SSM based on **IEEE 829-2008 formats**

Explain how to **develop** the complete test documentation package for an SSM specification based on NTCIP 1210 Standard v01

Describe the **testing of an SSM** using sample test document

We Have Now Completed the SSM Curriculum

Module A304a: Understanding **User Needs** for Field Management Stations - Part 1 Object Definitions for Signal System Masters (SSM) Based on NTCIP 1210 Standard

Module A304b: Specifying **Requirements** for Field Management Stations - Part 1 Object Definitions for Signal System Masters (SSM) Based on NTCIP 1210 Standard

Module T304: Applying Your **Test Plan** to Field Management Stations - Part 1 Signal System Masters (SSM) Based on NTCIP 1210 Standard v01

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!