



W E L C O M E



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

What is the purpose of the Requirements to Test Case Matrix?

- A) Identify the requirements that are part of the project specification
- B) Identify all the test cases that must be passed to verify a requirement is fulfilled
- C) Identify the design content to fulfill a requirement
- D) Identify the design content to fulfill a requirement

The correct answer is:

Incorrect - Click
press Control Y

You did not answer this

You must answer the question
before continuing

Correct - Click
press Control Y to

Submit

Clear

Which of the following information is not provided in a test plan?

- A) What item is being tested?
- B) Who is responsible for performing the test?
- C) What are the inputs and outputs for the test case specification?
- D) What are the test deliverables?

Correct - Click anywhere or press Control Y to maximize.

Incorrect - Click anywhere or press Control Y to maximize.

Your answer:

You did not answer this

You must answer the question before continuing

Submit

Clear

What is the Requirements to Test Case Traceability Matrix (RTCTM) in a Test Design Specification based upon?

- A) Includes all the requirements supported by the standard
- B) Includes only the requirements selected in the PRL that the Test Design Specification is based upon
- C) Includes only those requirements that are mandatory to conform to the standard
- D) Includes all the requirements that are contained in the project specifications

Correct - Click anywhere or press Control Y to maximize

Incorrect - Click anywhere or press Control Y to maximize

Your answer:

You did not answer this

You must answer the question before continuing

Submit

Clear

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 training course listings.

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Intelligent Transportation Systems
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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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T311: Applying Your Test Plan to the NTCIP 1203 v03 DMS Standard



Instructor



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Learning Objectives

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

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

Describe the **application** of a good test plan to a DMS system being procured

Describe a **process** of adapting a test plan based on the selected user needs and requirements

Learning Objective 1

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

Why Do We Test?

Why This Module?

- As a procurer, operator or specification writer of dynamic message signs, need a method to check that the system provided fulfills **all** your requirements
- This module will walk through **the elements** on how to test!
- Develop a test plan that:
 - Checks your **requirements** have been **fulfilled**
 - **Satisfies** your (agency's) specific **needs**
 - **Conforms** to the appropriate **standards**

Why Do We Test?

Why Test?

- **Verify** the system **meets the procurement specification** and **fulfills the requirements** (Was the system built right?)
 - Requirements discussed in Module A311b: Specifying Requirements for DMS Based on NTCIP 1203 Standard
- **Validate** that the system **satisfies the user and operational needs** (Did you build the right system?)
 - User needs discussed in Module A311b: Understanding User Needs for DMS Systems Based on NTCIP 1203 Standard



Why Do We Test?

Why Test?

- **Test for conformance** to the NTCIP 1203 Standard – achieve off-the-shelf Interoperability
 - Interoperability: Ability of two or more systems or components to **exchange information** and **use** the information that has been exchanged
 - NTCIP 1203 supports interoperability for dynamic message sign systems!

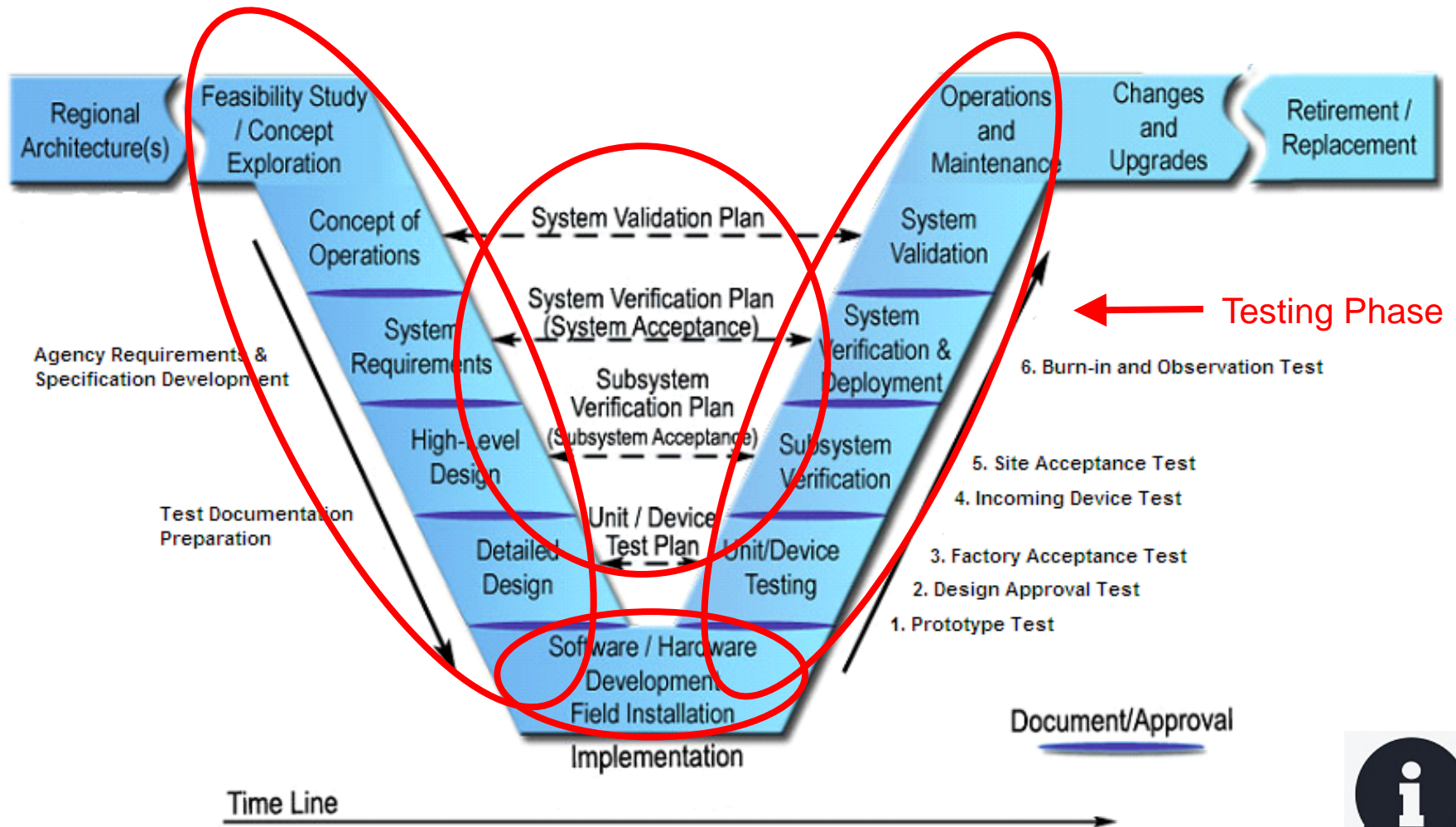


NTCIP 1203



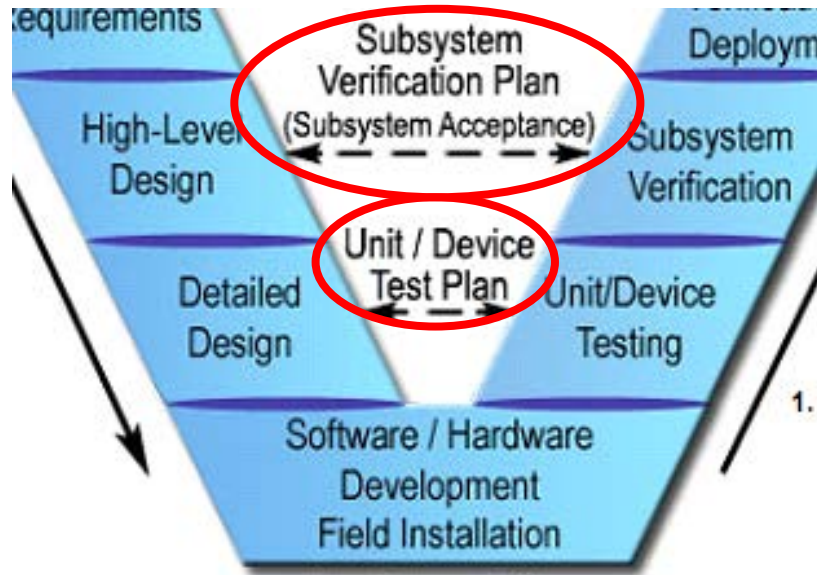
Why Do We Test?

The Vee Model



Why Do We Test?

Verification



- **Unit/Device Testing** – Verify **functionality** at the DMS itself
 - e.g., Tests a standalone DMS
- **Subsystem Verification** – Verify **functionality** over the installed communications systems using NTCIP 1203
 - E.g., Tests a DMS and its immediate environment, including the cabinet, power supply, and communications equipment

Why Do We Test?

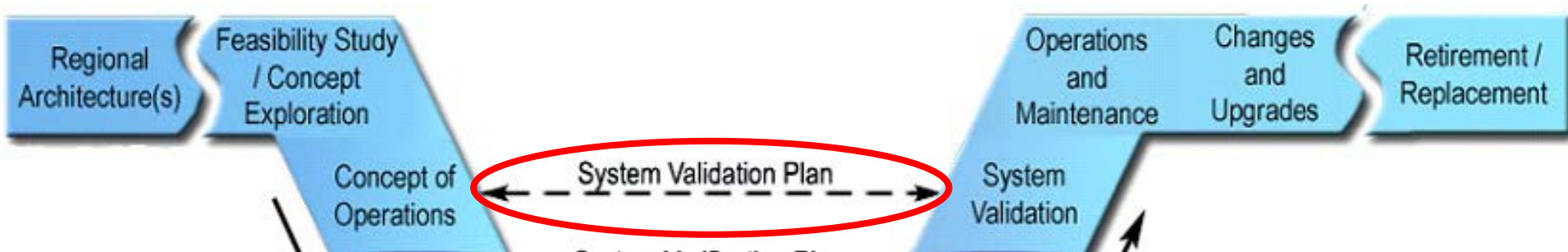
Verification



- **System Verification** – Verify **functionality**, using the TMC software, over the installed communications systems.
 - e.g., Tests the entire DMS system, including the Traffic Management Center (TMC) software.

Why Do We Test?

Validation

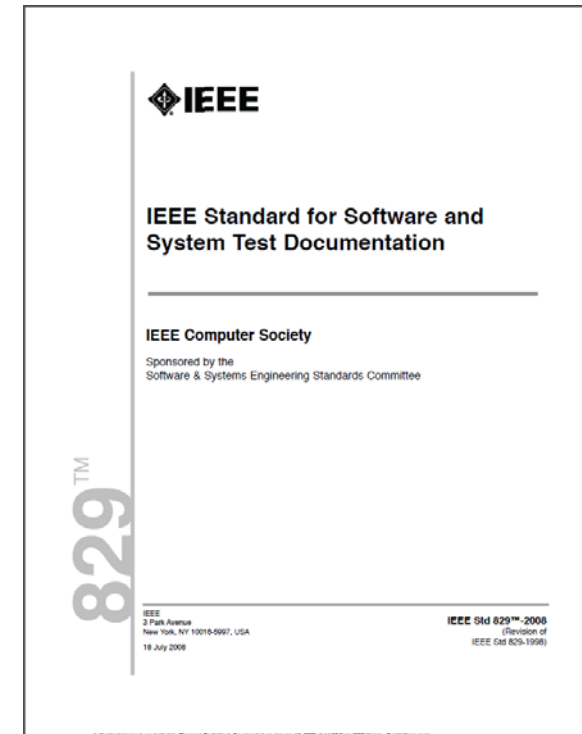


- **System Validation** – confirms that the system, as built, satisfies the stakeholder's stated needs.
- The system is **validated** when:
 - **Approved** by the agency and the key stakeholders.
 - **All** the project **requirements are fulfilled**.
 - **Corrective actions have been implemented** for any anomalies that have been detected.

Purpose of a Test Plan

Test Plan

- Test Plan - Documents and identifies the testing activities
- High-level document that **identifies**:
 - **What** item is to be tested?
 - **How** is the item to be tested?
 - **Who** is to test the item?
 - In what **detail** is the item to be tested?
 - What are the **test deliverables**?
 - **When** is the testing to take place?
- Test Plans are defined in **IEEE 829-2008**
- Module T201 – How to Write a Test Plan



Purpose of a Test Plan

Test Plan Items

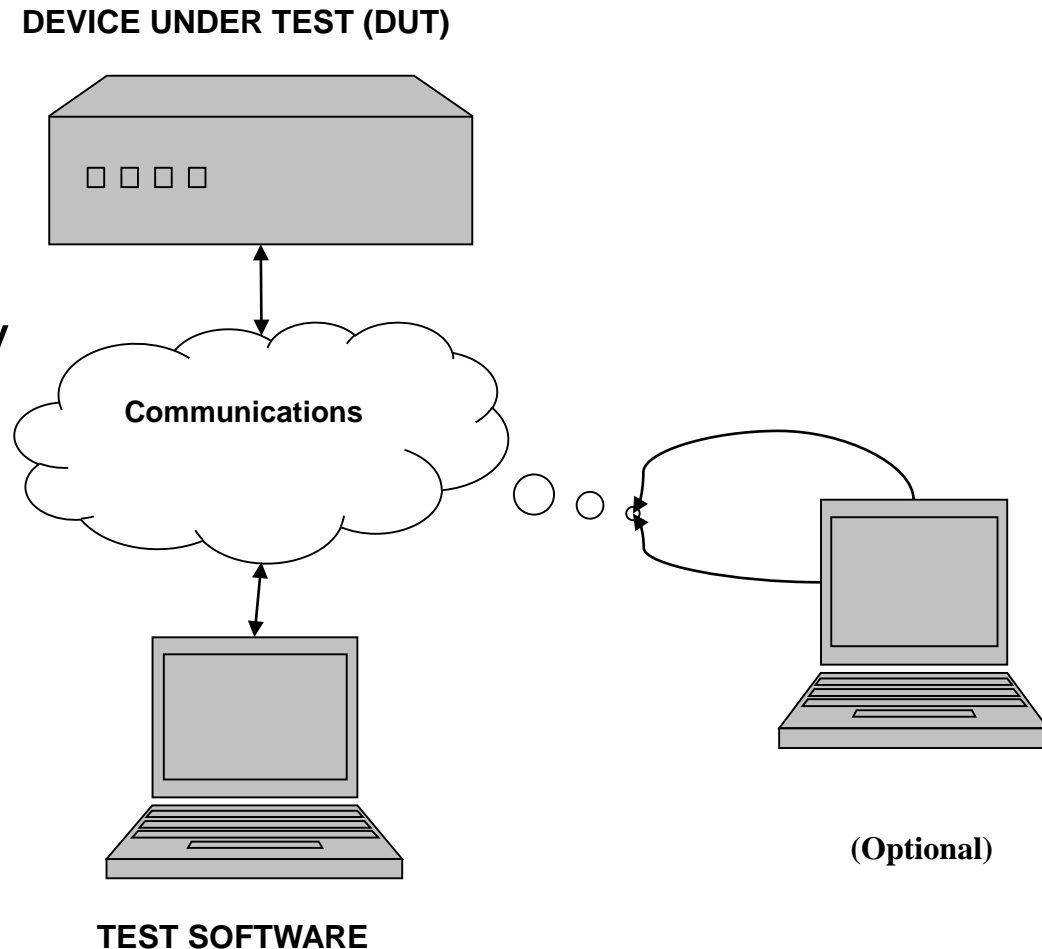
- **What** is being tested?
 - Identifies the **scope** of the test plan
 - Is it just the dynamic message signs? Which ones?
 - There may be a **separate** test plan for each type of testing or DMS **OR** it may be one single test plan for the entire system



Purpose of a Test Plan

Test Plan Items

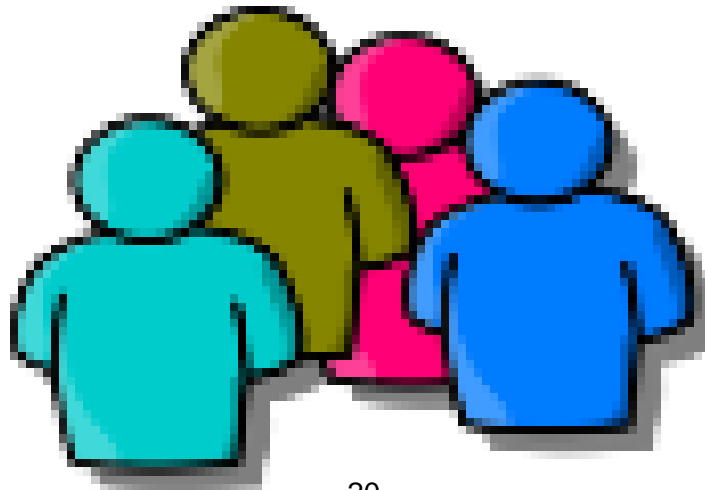
- **How** is the item to be tested?
 - **Identifies the test environment**
 - NTCIP testing typically takes the form of interface testing
 - May require specialized equipment to simulate environmental conditions



Purpose of a Test Plan

Test Plan Items

- **Who** is to test the items?
 - Identifies the **roles and responsibilities** for each person in managing, designing, preparing, executing, and resolving
 - Potential conflicts of interest: Vendor wants a quick test to meet payment; agency wants a thorough test to assure years of useful service



Purpose of a Test Plan

Test Plan Items

- In what **detail** will the items will be tested?
 - Permit **identification** of the major testing **tasks** and **estimation of time**
 - Trace the **requirements to be tested**
 - **Identify** significant **constraints**, such as item availability, resource availability, and deadlines



Purpose of a Test Plan

Test Plan Items

- What are the **Test Deliverables**?
 - **Test Plans**
 - **Test Logs**
 - **Test Summary Reports**
 - Identifies the testing **milestones**, including submittals, time to perform each task, and testing resources

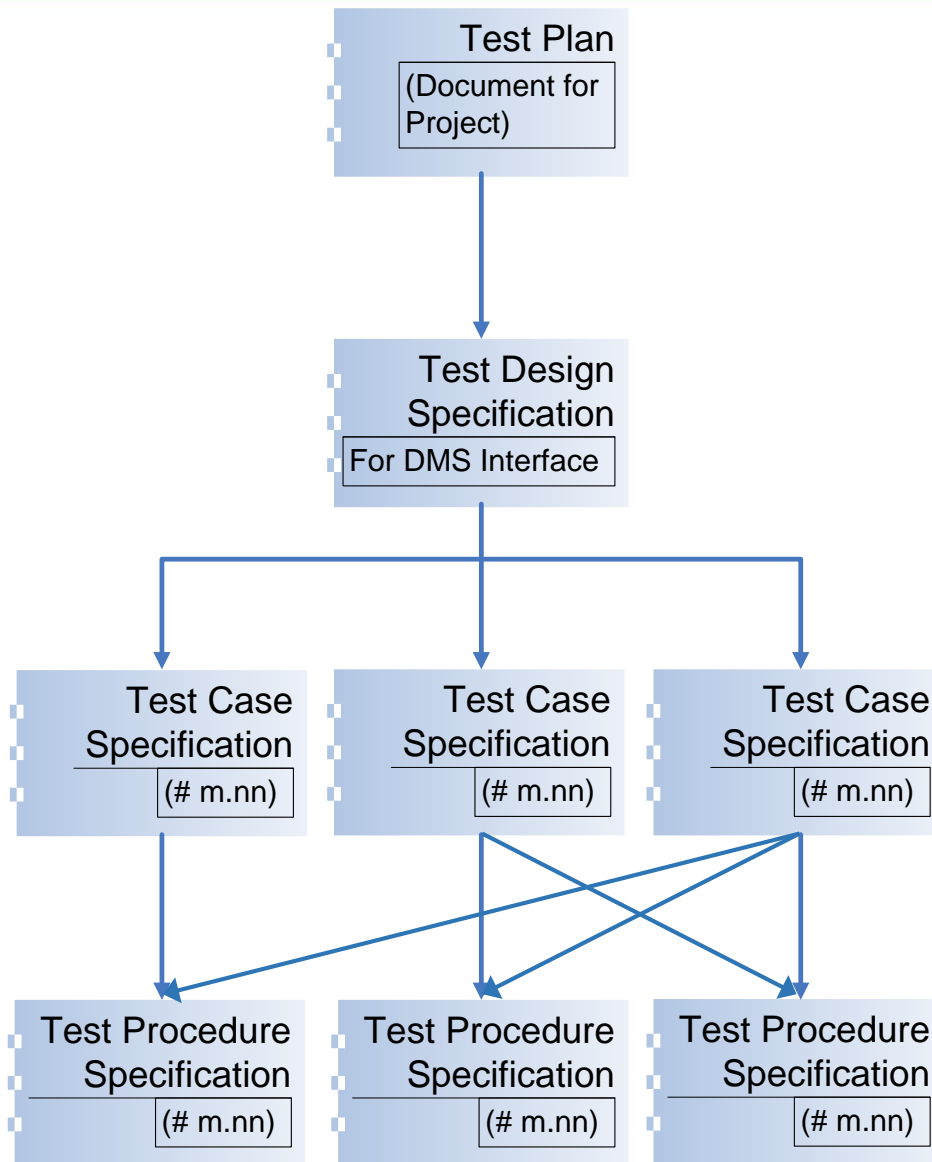


Components of a Test Plan

A well-written test plan consists of [IEEE 829-2008]:

- **Test Design Specification.** Specifies the details of the test approach for a feature or combination of features and identifies the test case specifications to be performed
- **Test Case Specification.** Specifies the inputs, predicted results, a set of execution conditions and the pass/fail criteria for the test item
- **Test Procedure Specification.** Specifies a sequence of actions for the execution of a test

Components of a Test Plan



- A test plan may consist of several test design specifications
- There may be a separate test design specification for each implementation
- Each test design specification may consist of several test cases and test procedures

ACTIVITY



What does a “test case specification” do?

Answer Choices

- A) Specifies the inputs, predicted results, and the conditions for one or more functions in the test item
- B) Specifies the details of the test approach for a feature or combination of features
- C) Describes the scope, approach, and resources for the testing activities
- D) Specifies the sequence of actions for the execution of a test

The correct answer is:

Incorrect - Click any
press Control Y to c

You did not answer this
You must answer the question
before continuing

Submit

Clear

Correct - Click anyw
press Control Y to continue

Review of Answers



- a) Specifies the inputs, predicted results, and the conditions for one or more functions in the test item

Correct! A test case does all of the above.



- b) Specifies the details of the test approach for a feature or combination of features

Incorrect. This describes a test design specification.



- c) Describes the scope, approach, and resources for the testing activities

Incorrect. This describes a test plan.



- d) Specifies the sequence of actions for the execution of a test

Incorrect. This defines a test procedure specification.

Learning Objectives

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

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

Learning Objective 2

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

What Is Being Tested?

NTCIP 1203

- What is NTCIP 1203?
 - Is a **communications interface standard**
 - **Specifies the interface** between the dynamic message signs in the field and the host systems that control them
 - **Contains the object definitions** (vocabulary) that allow for the monitoring and control of dynamic message signs



What Is Being Tested?

NTCIP 1203

- NTCIP 1203 v01 (1999)
- NTCIP 1203 Amendment 1 (2001)
- NTCIP 1203 v02 (2010)
 - Added new functionality and **systems engineering content**
- NTCIP 1203 v03 (2014)
 - **Adds** Test Cases and Test Procedures
 - Allows agencies procuring DMS systems to consistently test for conformance to the DMS Standards

A Recommended Standard of the Joint Committee on the NTCIP

NTCIP 1203 version v03

**National Transportation
Communications for ITS Protocol**

**Object Definitions for Dynamic
Message Signs (DMS)**

v03.04 Part 1 plus Part 2 Annex C May 2011

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**NTCIP 1203 v03 Part 1,
use with Part 2 Annex C**

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What Is Being Tested?

Interface/Communications Testing

- **Compliance with the procurement specification**
- **Conformance with the NTCIP Standard**
 - The **Protocol Requirements List** (PRL) defines the user needs and requirements for a procurement specification
 - The DMS system must fulfill the mandatory requirements and other specified (selected optional) requirements of NTCIP 1203 and the standards it references.
- **Conformance is NOT compliance!**

What Is Being Tested?

Interface/Communications Testing

- **Communications requirements are fulfilled**
 - The **Requirements Traceability Matrix** (RTM) in NTCIP 1203 defines the manner to fulfill a standard requirement
 - Do the data exchanges (**Dialogs**) occur as defined by the standard?
 - Are all the **data objects** used as defined by the standard?
- **Functional requirements are fulfilled**
- **Performance requirements**

Test Cases and Test Procedures in NTCIP 1203 v03

RTCTM

NTCIP 1203 v03 provides a **Requirements to Test Case Traceability Matrix** (RTCTM)

- Lists the test case(s) that must be passed to fully test whether a requirement has been fulfilled by the implementation



Test Cases and Test Procedures in NTCIP 1203 v03

RTCTM

For the requirement “Activate Pixel Testing,” both test case C.3.5.1 and C.3.5.2 must be passed to verify the requirement.

Requirement		Test Case	
ID	Title	ID	Title
3.5.3	Monitor the Status of the DMS		
3.5.3.1	Perform Diagnostics		
3.5.3.1.1	Test Operational Status of DMS Components		
3.5.3.1.1.1	Execute Lamp Testing		
		C.3.5.21	Verify Lamp Test with No Errors
		C.3.5.22	Verify Lamp Test with Errors
3.5.3.1.1.2	Activate Pixel Testing		
		C.3.5.1	Pixel Test - No Errors
		C.3.5.2	Pixel Test - Errors
3.5.3.1.1.3	Execute Climate-Control Equipment Testing		
		C.3.5.3	Climate-Control Equipment Test - No Errors
		C.3.5.4	Climate-Control Equipment Test - Errors

Test Cases and Test Procedures in NTCIP 1203 v03

RTCTM

- Multiple test cases may be needed to completely test a requirement
 - Each test case may **test different conditions** – e.g., there are separate test cases for “no errors are detected” and for “an error was reported for a pixel test”
 - Each test case may **test a different set of values** – e.g., there are separate test cases to verify left, center, and right justification
- An implementation must **pass all test cases that the requirement traces** to before claiming that the requirement is fulfilled

Test Cases and Test Procedures in NTCIP 1203 v03

Test Case Specifications

Test Case Specification. A document specifying inputs, predicted results, and execution conditions. This information can be found in the header of each table.

- An agency may wish to perform a test case specification multiple times, each iteration with a different input and different expected output.
- A test case specification needs to be performed only once to verify **CONFORMANCE** to the standard, however more instances may be required to verify **COMPLIANCE** with the project specifications.
- May wish to perform negative (exception) testing - e.g., invalid values – to verify DMS behavior.



Test Cases and Test Procedures in NTCIP 1203 v03

Test Case Specifications

If the project specification requires that a DMS comes preconfigured with three fonts, *Test Case C.3.2.4, Retrieve a Font Definition*, might be performed three times, once for each font.

3.5.1.3.4 Retrieve a Font Definition

The DMS shall allow a management station to upload the fonts defined in the sign controller.

Requirement		Test Case	
ID	Title	ID	Title
3.5.1.3.4	Retrieve a Font Definition		
		C.3.2.4	Retrieve a Font Definition



Test Cases and Test Procedures in NTCIP 1203 v03

Test Case Specifications

- Can be used for NTCIP 1203 v01 and v02 systems!

C.3.5.1 Pixel Test - No Errors

Test Case: 5.1	Title:	Pixel Test - No Errors	
	Description:	This test case verifies that the DMS executes a pixel test and verifies that there are no failed pixels.	
	Variables:	Pixel_Test_Time	From Manufacturer's Documentation
		Message_Display_Test_Time	From Manufacturer's Documentation
Pass/Fail Criteria:	The DUT shall pass every verification step included within the Test Case to pass the Test Case.		

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

- **Test Procedure Specification.** A document that contains the sequence of actions for the execution of a test.
 - Only defines the steps necessary to test the function.
- Standard test procedures ensure that the conformance testing is performed in the same manner on separate test occasions.
 - A test procedure in a test case specification may be “called” by another test procedure in a different test case specification.
- It is important not to skip any steps in the test procedure to ensure proper conformance testing.



remember!

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

- NTCIP 1203 v03 **combines test cases and test procedures** into one test case.

C.3.5.1 Pixel Test - No Errors

Test Case: 5.1	Title:	Pixel Test - No Errors	
	Description:	This test case verifies that the DMS executes a pixel test and verifies that there are no failed pixels.	
	Variables:	Pixel_Test_Time	From Manufacturer's Documentation
		Message_Display_Test_Time	From Manufacturer's Documentation
	Pass/Fail Criteria:	The DUT shall pass every verification step included within the Test Case to pass the Test Case.	

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		

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

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.		

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

- **CONFIGURE.** Indicates the test step as a predicate to identify a configurable variable.
- **SET-UP.** Indicates the test step is a preparatory step to set up the environment for the actual test.

1	<p>CONFIGURE: Determine the enumerated value corresponding to the beacon type required by the specification (PRL 2.3.2.4). RECORD this information as:</p> <p>»Required_Beacon_Type</p> <p>NOTE--Valid enumerated values are defined in Section 5.2.8 (Beacon Type Parameter).</p>
2	<p>SET-UP: Determine the enumerated value indicating the actual type of beacons on the sign (See Section 5.2.8). RECORD this information as:</p> <p>»Actual_Beacon_Type</p>

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

Output Specifications

- What are the expected values/output?
- E.g., VERIFY that the RESPONSE VALUE for shortErrorStatus.0 has bit 5 cleared

17	VERIFY that the RESPONSE VALUE for shortErrorStatus.0 has bit 5 (pixel error) cleared.	Pass / Fail (Section 3.5.3.1.2)	
18	PERFORM the test case labeled 'Blank the Sign' (C.3.7.15).	Pass / Fail (Section 3.5.2.3.1)	
Test Case Results			
Tested By:		Date Tested:	Pass / Fail
Test Case Notes:			

Test Cases and Test Procedures in NTCIP 1203 v03

Test Procedure Specifications

Intercase Dependencies

- Identify any test cases to be performed during this test case.
- E.g., PERFORM the test case labeled...

17	VERIFY that the RESPONSE VALUE for shortErrorStatus.0 has bit 5 (pixel error) cleared.	Pass / Fail (Section 3.5.3.1.2)	
18	PERFORM the test case labeled 'Blank the Sign' (C.3.7.15).	Pass / Fail (Section 3.5.2.3.1)	
Test Case Results			
Tested By:		Date Tested:	Pass / Fail
Test Case Notes:			

ACTIVITY



Question

What is the purpose of the Requirements to Test Case Matrix?

Answer Choices

- a) Identify the requirements that are part of the project specification
- b) Identify all the test cases that must be passed to verify a requirement is fulfilled
- c) Identify the design content to fulfill a requirement
- d) Identify one of the possible test cases that must be passed to verify a requirement is fulfilled

Review of Answers



a) Identify the requirements that are part of the project specification

Incorrect. The Protocol Requirements List (PRL) identifies the requirements that are part of a project specification.



b) Identify all the test cases that must be passed to verify a requirement is fulfilled

Correct! The RTCTM identifies all the test cases that must be passed to verify a requirement is fulfilled.



c) Identify the design content to fulfill a requirement

Incorrect. The Requirements Traceability Matrix identifies the design content to fulfill a requirement.



d) Identify one of the possible test cases that must be passed to verify a requirement is fulfilled

Incorrect. All the test cases traced to a requirement must be passed to verify the requirement is fulfilled.

Learning Objectives

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

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

Describe the **application** of a good test plan to a DMS system being procured

Learning Objective 3

Describe the application of a good test plan to a DMS system being procured

Test Plan for a DMS System

Introduction and Test Items

[IEEE 829-2008]

- Test Plan Identifier
- Introduction:
 - Purpose: Verify compliance to the Procurement No. 11-xxx, and verify conformance to NTCIP 1203 v03
- Test Items:
 - ATMS software, Build yy;
 - 5 Blank Out Signs – Procurement No. 11-xxx
 - 5 VMSs (3 lines x 24 characters) – Procurement No. 11-XXX



Test Plan for a DMS System

Features Being Tested and Approach

- Features to be tested
 - Can just be a copy of the **completed Protocol Requirements List (PRL)**
 - User needs and requirements selected for the project
- Features not to be tested
- Approach - Discussion of how the tests are organized and how the results are logged
- Items pass/fail
 - To pass the test, the item under test shall pass all test procedures associated with requirements for the test item

EXAMPLE

Test Plan for a DMS System

Features Being Tested and Approach

- Suspension criteria and resumption requirements
- Test deliverables
 - Test plan, test log reports, test summary reports
- Testing tasks
- Environmental needs
 - Test environment (facility, software programs, firmware version), test item hardware (power supplies, DMS components), test hardware (protocol analyzer), communications (RS-232 cables, Ethernet connections)



Test Plan for a DMS System

Responsibilities, Schedule, and Approvals

- Responsibilities
 - The agency will design, prepare and execute the tests
 - The consultant will manage, review, and witness the tests
 - The vendor will witness the tests and provide repairs to anomalies
- Staffing and training needs
- Schedule
- Risks and contingencies
- Approvals
 - Names and titles of all persons to approve this plan



ACTIVITY



Question

Which of the following information is not provided in a test plan?

Answer Choices

- a) What item is being tested?
- b) Who is responsible for performing the test?
- c) What are the inputs and outputs for the test case specification?
- d) What are the test deliverables?

Review of Answers



a) What item is being tested?

Incorrect. A test plan identifies the test item.



b) Who is responsible for performing the test?

Incorrect. A test plan identifies the roles and responsibilities of the persons involved with the test.



c) What are the inputs and outputs for a test case?

Correct! The inputs and outputs for a test case is defined in a test case specification.



d) What are the test deliverables?

Incorrect. A test plan does identify the deliverables of the testing, such as test documentation.

Learning Objectives

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

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

Describe the **application** of a good test plan to a DMS system being procured

Describe a **process** of adapting a test plan based on the selected user needs and requirements

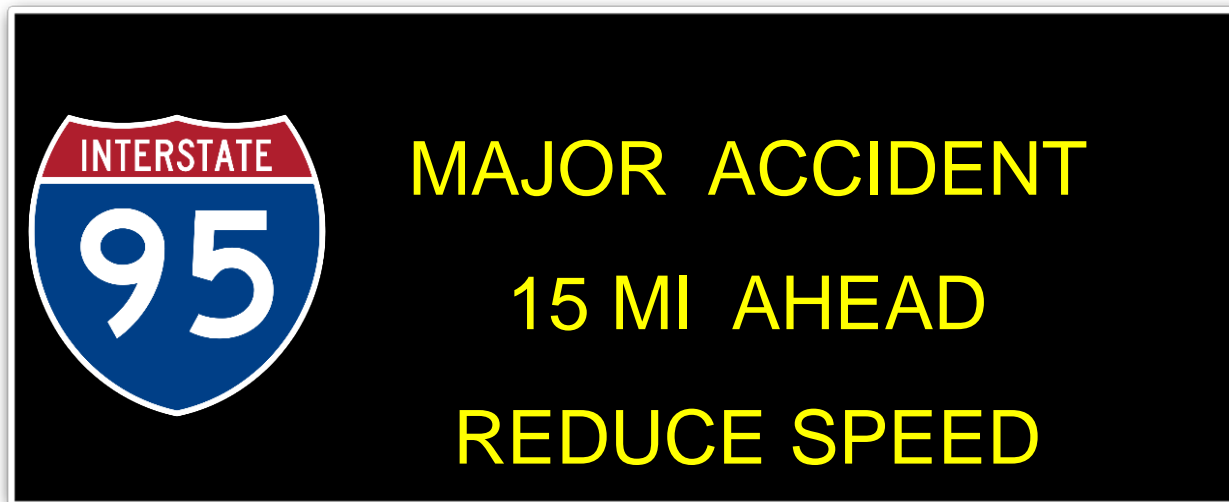
Learning Objective 4

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

Develop a Test Design Specification Based on NTCIP 1203 v03

Definition

- **Test Design Specification.** Identifies the features to be covered by the design and its associated tests. It also identifies the test cases and test procedures required to accomplish the testing and specifies the pass/fail criteria.
 - For example, Test Design Specifications for color variable message signs and blank-out signs.



Develop a Test Design Specification Based on NTCIP 1203 v03

Features to Be Tested

- NTCIP 1203 v02 and v03
 - The completed PRL indicates what **features** and **requirements** have been **selected** for the procurement specification.
 - Those requirements should be tested as part of the test plan.

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.5.2.3.1	Activate and	Display a Message		M	Yes	
		3.5.2.3.1	Activate a Message	M	Yes	
		3.5.2.3.3.5	Retrieve Message	M	Yes	
		3.5.2.3.6	Activate a Message with Status	Drum:M	Yes NA	

Develop a Test Design Specification Based on NTCIP 1203 v03

Features to Be Tested

- For example, “Activate Pixel Testing” is a selected requirement in the completed PRL
 - See Student Supplement for the full description

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5.3	Monitor the Status of the DMS			M	Yes	
2.5.3.1	Perform Diagnostics			M	Yes	
2.5.3.1.1	Determine Sign Error Conditions - High-Level Diagnostics			M	Yes	
		3.5.3.1.1.1 (LampTest)	Execute Lamp Testing	Lamp OR Fiber:M	Yes / NA	
		3.5.3.1.1.2 (PixelTest)	Activate Pixel Testing	Matrix:M	Yes / NA	
		3.5.3.1.1.3 (ClimateTest)	Execute Climate-Control Equipment Testing	O	Yes / No	
		3.5.3.1.2	Provide General DMS Error Status Information	M	Yes	



Develop a Test Design Specification Based on NTCIP 1203 v03

Requirements Traceability Matrix

- The Requirements Traceability Matrix (RTM) defines the **dialogs** and **data objects** that must be used to **fulfill** the requirement.
 - The **dialogs** are **the sequence of data exchanges** (and events) that are defined by the standard.
- **Conformance testing** confirms that the DMS system performs the same sequence of data exchanges (and events) as defined in the standard (and referenced standards).

Develop a Test Design Specification Based on NTCIP 1203 v03

Requirements Traceability Matrix

The RTM defines the dialog and object needed to fulfill the requirement “Activate Pixel Testing.”

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5.3	Monitor the Status of the DMS				
3.5.3.1	Perform Diagnostics				
3.5.3.1.1	Test Operational Status of DMS Components				
3.5.3.1.1.1	Execute Lamp Testing	4.2.4.1			
			5.11.2.3.5	lampTestActivation	
3.5.3.1.1.2	Activate Pixel Testing	4.2.4.2			
			5.11.2.4.3	pixelTestActivation	
3.5.3.1.1.3	Execute Climate Control Equipment Testing	4.2.4.3			
			5.11.2.3.5.6	dmsClimateCtrlTestActivation	
			5.11.2.3.5.7	dmsClimateCtrlAbortReason	

Develop a Test Design Specification Based on NTCIP 1203 v03

Requirements Traceability Matrix

Below is the dialog that fulfills the requirement Activate Pixel Testing

4.2.4.2 Activating Pixel Testing

The standardized dialog for a management station to command the DMS to activate pixel testing shall be as follows:

- a) The management station shall SET pixelTestActivation.0 to 'test'.
- b) The management station shall repeatedly GET pixelTestActivation.0 until it either returns the value of 'noTest' or a maximum time-out is reached. If the time-out is reached, the DMS is apparently locked and the management station shall exit the process.
- c) (PostCondition) The following objects will have been updated during the pixel test to reflect current conditions. The management station may GET any of these objects as appropriate.
 - 1) pixelFailureTableNumRows
 - 2) any object within the pixelFailureTable

Develop a Test Design Specification Based on NTCIP 1203 v03

Requirements to Test Case Traceability Matrix

- Based on the project **requirements selected in the PRL**, an agency can **create a RTCTM** containing only those **selected requirements** and their associated test cases.

Requirement		Test Case	
ID	Title	ID	Title
3.5.3	Monitor the Status of the DMS		
3.5.3.1	Perform Diagnostics		
3.5.3.1.1	Test Operational Status of DMS Components		
3.5.3.1.1.1	Execute Lamp Testing		
3.5.3.1.1.2	Activate Pixel Testing		
		C.3.5.1	Pixel Test - No Errors
		C.3.5.2	Pixel Test - Errors
3.5.3.1.1.3	Execute Climate-Control Equipment Testing		
		C.3.5.3	Climate-Control Equipment Test - No Errors
		C.3.5.4	Climate-Control Equipment Test - Errors

Develop a Test Design Specification Based on NTCIP 1203 v03

Requirements to Test Case Traceability Matrix

- The tailored RTCTM becomes **part of the test design specification**.
 - **Identifies the requirements** to be tested.
 - **Identifies the test cases and test procedures** to be performed.

Test Design Specification

Test Design Specification

- Test Design Specification (TDS) identifier
 - One TDS for the blank out signs
 - One TDS for the VMSs
- Features to be tested
 - Copy of the completed PRL for the specific test item (e.g., one PRL for the BOS, one PRL for the VMS)
- Approach refinements
- Test identification
 - Tailored RTCTM
- Feature pass/fail criteria



How to Develop Test Cases and Test Procedures for Extensions

Extensions

- Extensions – to **support agency-specific features and/or requirements not supported by the standard**
- Permitted but not encouraged
 - Interoperability is not achieved

How to Develop Test Cases and Test Procedures for Extensions

Extensions

- For communication interface features not covered by the standard, procurers should **document** and clearly **define**:
 - The user need/feature
 - **Customized requirements** to satisfy the new user need
 - The dialogs and objects to fulfill each customized requirement
- Test cases should be created for testing the customized requirements
- The identifier of the customized requirements and test cases should be **included** in the **tailored RTCTM** and the **test design specification**

How to Use the Test Procedure Generator Tool

Test Procedure Generator (TPG)

- Free tool from USDOT to guide the development of test procedures for requirements in NTCIP Center-to-Field (C2F) standards with systems engineering content to:
 - **determine an implementation's conformance** to the NTCIP C2F Device Interface Standard
 - **determine compliance to a project specification**
 - **develop test procedures for extensions**
- Also used by NTCIP C2F Standards developers to verify traceability and conformance to NTCIP 8002
- <https://www.standards.its.dot.gov/DeploymentResources/Tools>

How to Use the Test Procedure Generator Tool

Starting 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: 05 (i.e. 01)

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

New Session Options

- Open NTCIP C2F Device Interface Standard
- Open Most Recent Set of Test Procedures

Verification Options

- Verify NTCIP C2F Device Interface Standard
- Allow Duplicates in the RTM
- Open External MIB Files

Browse OK Cancel

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

TPG Status: New Session Command Accepted...

How to Use the Test Procedure Generator Tool

Creating a New Set of Test Procedures

The screenshot shows the 'Center-to-Field Test Procedure Generator' application. The 'File' menu is open, listing several options with their respective keyboard shortcuts:

- New Session (Ctrl+N)
- Display Requirement Text
- Display Dialog Text
- Close Session (Ctrl+C)
- New Set of Test Procedures (Ctrl+T)**
- Open Set of Test Procedures (Ctrl+O)
- Save Set of Test Procedures / TPG
- Save XML Set of Test Procedures
- Delete Set of Test Procedures (Ctrl+D)
- Exit TPG (Ctrl+X)

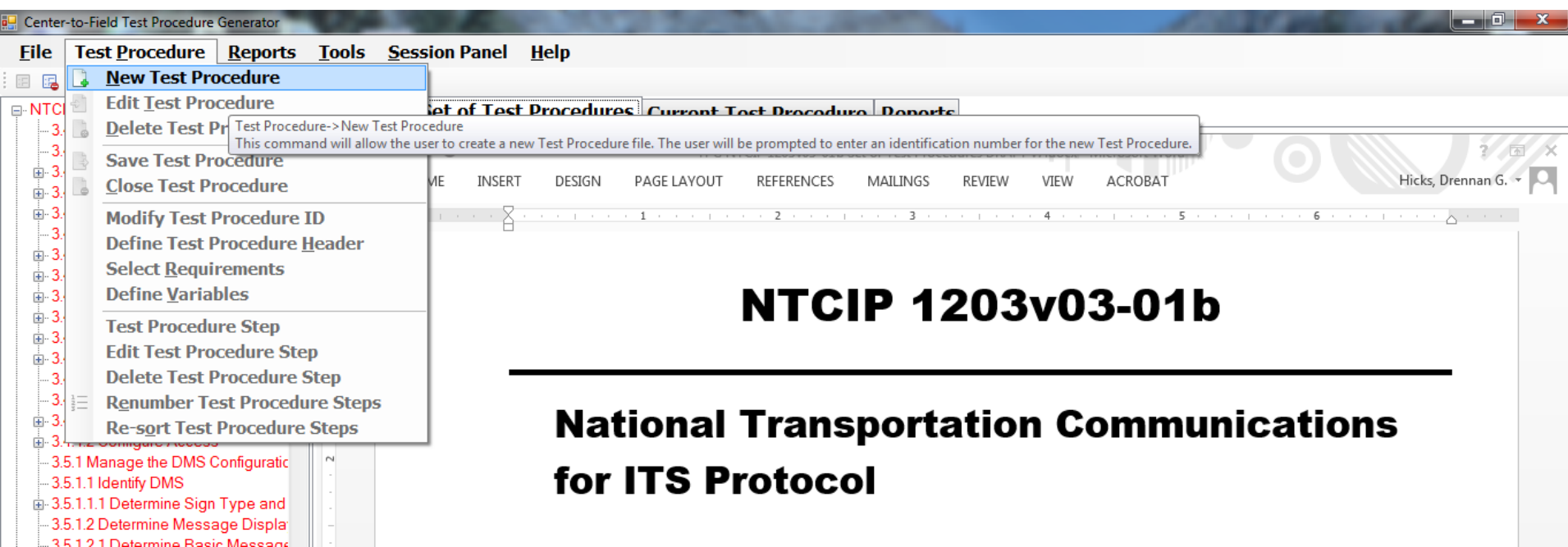
A tooltip for the 'New Set of Test Procedures' option provides additional information: 'File -> New Set of Test Procedures. This command will create a new Set of Test Procedures file. The user will be prompted to enter an identification number for the new file.'

The main window displays a Microsoft Word document titled '1203v03-01b.doc'. The document content includes a table of contents on the left and a draft comment in the center: 'A User Comment Draft of the Joint Committee on the NTCIP'. Below the comment, the text 'NTCIP 1203 version v03' is displayed in a large, bold font.

The status bar at the bottom of the application shows 'PAGE 1 OF 48', '98011 WORDS', and 'TPG Status: Command Completed'. There are also two error messages: 'NTCIP Standard Not Verified' and 'TPG NTCIP Set of Test Procedures Not Loaded'.

How to Use the Test Procedure Generator Tool

Creating a New Test Procedure



How to Use the Test Procedure Generator Tool

Creating a New Test Procedure

The screenshot displays the 'Center-to-Field Test Procedure Generator' application. The left sidebar shows a tree view of test procedure categories, including '3.4 Architectural Requirements' and '3.5.1 Manage the DMS Configuration'. The main window is titled 'Current Test Procedure' and contains a table with the following data:

Test Step	Test Procedure	Results
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

At the bottom of the window, a status bar indicates: 'Page 1 Sec 1 1/1 At 2" Ln 6 Col 13 REC TRK EXT OVR'. A red error message at the bottom left reads: 'NTCIP Standard is not Conformant to NTCIP 8002 Annex B1 ... Set of Test Procedures Not Verified'. The bottom status bar shows 'TPG Status: Command Completed'.

How to Use the Test Procedure Generator Tool

Creating a New Test Procedure

The screenshot displays the 'Center-to-Field Test Procedure Generator' application. A 'Select Requirements' dialog box is open, listing various requirements with checkboxes. The requirements 3.4.1.1 through 3.4.2.2 are checked and highlighted with a red border. The 'Reports' window in the background shows a list of reports, including 'Determine Sign Type and Technology' and 'Verify that the device under test (DUT) shall pass every verification step'.

Select Requirements

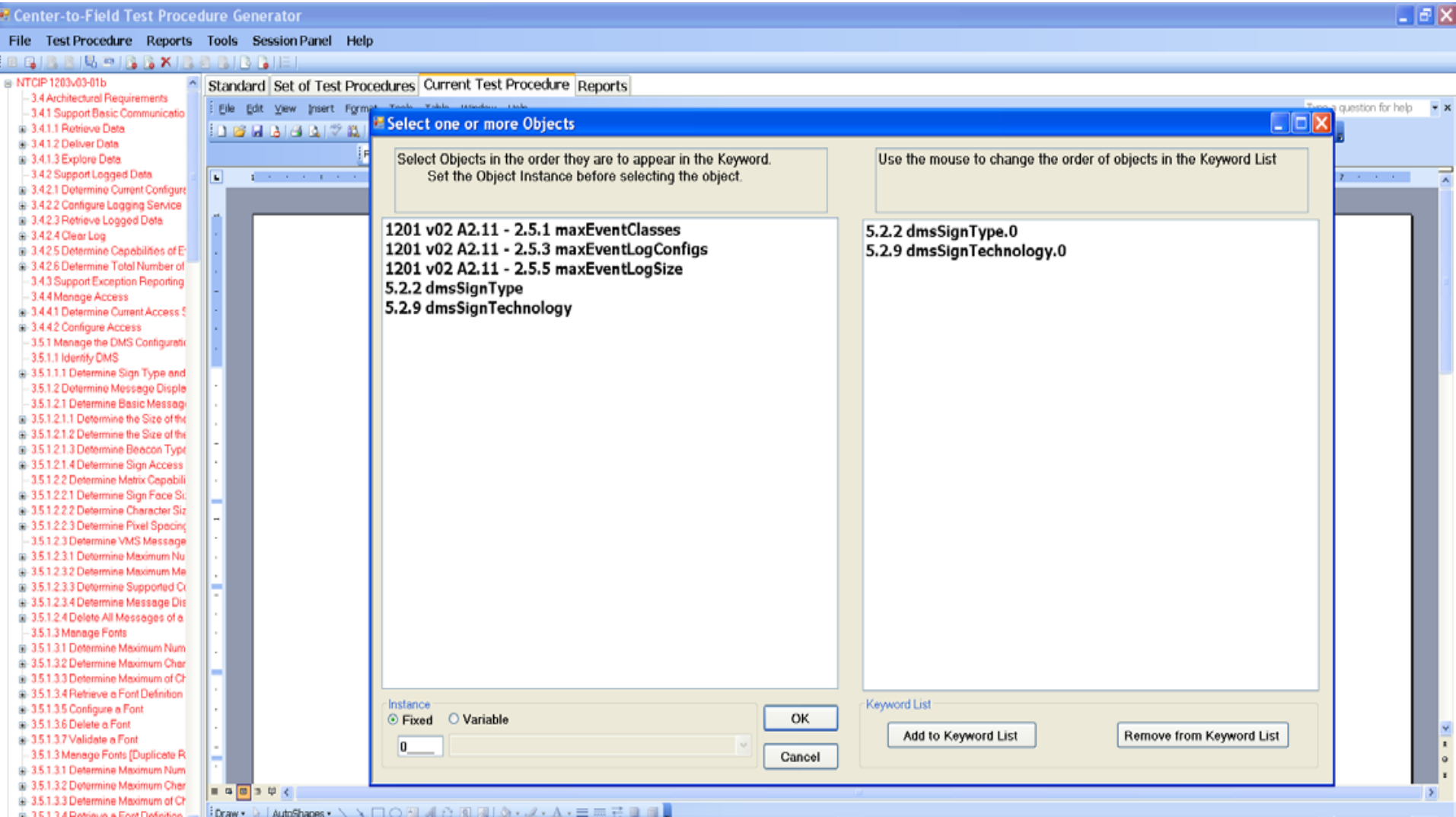
- 3.4.1.1 Retrieve Data
- 3.4.1.2 Deliver Data
- 3.4.1.3 Explore Data
- 3.4.2.1 Determine Current Configuration of Logging Service
- 3.4.2.2 Configure Logging Service
- 3.4.2.3 Retrieve Logged Data
- 3.4.2.4 Clear Log
- 3.4.2.5 Determine Capabilities of Event Logging Service
- 3.4.2.6 Determine Total Number of Events
- 3.4.3 Support Exception Reporting
- 3.4.4.1 Determine Current Access Settings
- 3.4.4.2 Configure Access
- 3.5.1.1.1 Determine Sign Type and Technology
- 3.5.1.2.1.1 Determine the Size of the Sign Face
- 3.5.1.2.1.2 Determine the Size of the Sign Border
- 3.5.1.2.1.3 Determine Beacon Type
- 3.5.1.2.1.4 Determine Sign Access and Legend
- 3.5.1.2.2.1 Determine Sign Face Size in Pixels
- 3.5.1.2.2.2 Determine Character Size in Pixels
- 3.5.1.2.2.3 Determine Pixel Spacing
- 3.5.1.2.3.1 Determine Maximum Number of Pages
- 3.5.1.2.3.2 Determine Maximum Message Length

Reports

- Determine Sign Type and Technology
- Verify that the device under test (DUT) shall pass every verification step

How to Use the Test Procedure Generator Tool

Creating a New Test Procedure



How to Use the Test Procedure Generator Tool

Creating a New Test Procedure

The screenshot displays the 'Center-to-Field Test Procedure Generator' application interface. The main window is a Microsoft Word document titled 'Document1 - Microsoft Word'. The ribbon is set to 'Table Tools' with the 'Design' tab selected. A 'Test Procedure Step' dialog box is open in the foreground, showing the following details:

- Step ID:** 01.00
- Keyword:** (empty field)
- Syntax:** (empty field)
- Test Step Preview:**

```
CONFIGURE 'Determine the enumerated value for the sign type required by the specification (PR
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 an
```
- Nesting Level:** 0
- Buttons:** Reset, Preview, Remove Last Keyword, Close, Update

In the background, the Word document shows a table with columns for 'Test Procedure', 'Description', and 'Requirements'. The 'Test Procedure' column contains the text 'at it is the sign e specification.' and 'Menu Item to'.

How to Use the Test Procedure Generator Tool

Opening Test Procedures

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

- New Session Ctrl+N
- Display Requirement Text
- Display Dialog Text
- Close Session Ctrl+C
- New Set of Test Procedures Ctrl+T
- Open Set of Test Procedures Ctrl+O**
- Save Set of Test Procedures / TPTM Ctrl+S
- Save XML Set of Test Procedures
- Delete Set of Test Procedures
- Exit TPG

File -> Open Set of Test Procedures
This command will open a Set of Test Procedure file.

If the 'Open Most Recent Set of Test Procedures' option is selected, the TPG will automatically open the latest version defined for this Session.

If the option is not set, the user is prompted to select a file to open.

1203v03-05a.docx - Microsoft Word

3.4.2.6 Determine Total Number of Messages
3.4.3 Support Exception Reporting
3.4.4 Manage Access
3.4.4.1 Determine Current Access Settings
3.4.4.2 Configure Access
3.5 Data Exchange and Operations
3.5.1 Manage the DMS Configuration
3.5.1.1 Identify DMS
3.5.1.1.1 Determine Sign Type and Color
3.5.1.2 Determine Message Display Parameters
3.5.1.2.1 Determine Basic Message Display Parameters
3.5.1.2.1.1 Determine the Size of the Message
3.5.1.2.1.2 Determine the Size of the Message Text
3.5.1.2.1.3 Determine Beacon Type
3.5.1.2.1.4 Determine Sign Access
3.5.1.2.2 Determine Matrix Capabilities
3.5.1.2.2.1 Determine Sign Face Size
3.5.1.2.2.2 Determine Character Size
3.5.1.2.2.3 Determine Pixel Spacing
3.5.1.2.3 Determine VMS Message Parameters
3.5.1.2.3.1 Determine Maximum Number of Messages
3.5.1.2.3.2 Determine Maximum Message Length
3.5.1.2.3.3 Determine Supported Character Sets
3.5.1.2.3.4 Determine Message Display Parameters

A Recommended Standard of the Joint Committee on the NTCIP

NTCIP 1203 version v03

**National Transportation
Communications for ITS Protocol
Object Definitions for Dynamic
Message Signs (DMS)**

ACTIVITY



Question

What is the Requirements to Test Case Traceability Matrix (RTCTM) in a Test Design Specification based upon?

Answer Choices

- a) Includes all the requirements supported by the standard
- b) Includes only the requirements selected in the PRL that the Test Design Specification is based upon
- c) Includes only those requirements that are mandatory to conform to the standard
- d) Includes all the requirements that are contained in the project specifications

Review of Answers



a) Includes all the requirements supported by the standard

Incorrect. The RTCTM should list only those requirements specified in the TDS.



b) Includes only the requirements selected in the PRL that the TDS is based upon

Correct! The RTCTM is based on the requirements selected.



c) Includes only those requirements that are mandatory to conform to the standard

Incorrect. The RTCTM includes selected optional requirements.



d) Includes all the requirements that are contained in the project specifications

Incorrect. Could be correct, but the PRL is complete, accurate and contains only the applicable requirements.

Module Summary

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

Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

Describe the **application** of a good test plan to a DMS system being procured

Describe a **process** of adapting a test plan based on the selected user needs and requirements

We Have Now Completed the DMS Curriculum



Module A311a: Understanding **User Needs** for DMS Systems based on NTCIP 1203 Standard v03



Module A311b: Specifying **Requirements** for DMS Systems based on NTCIP 1203 Standard v03



Module T311: Applying Your **Test Plan** to Dynamic Message Signs based on NTCIP 1203 DMS Standard 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!