



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

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## 1. Module Description

This module is based on the IEEE 829-2008 formats for testing documentation (the NTCIP 1210 v01 standard does not offer testing documentation preparation information). The IEEE 829-2008 approach has already been amply covered by testing series modules. This module will help users leverage their NTCIP 1210 v01-based specifications to produce and apply a sample test plan, including test design specifications, test case specifications, and test procedure specifications, for SSM.

Thus, the development of clear and unambiguous NTCIP 1210 v01-based testing documentation can be used by system developers and integrators during procurement specifications preparation, system acceptance, and ongoing maintenance efforts. The module will guide agencies in verifying that delivered products conform to NTCIP standards and comply with the agency's specifications.

The logical step for the participant is to consider modules in the testing lifecycle, which are T101, T201, and T202, as well as T203 Parts 1 and 2, and T204, which lead up to the T304 module: Applying Your Test Plan to Field Management Stations - Part 1 Signal System Masters (SSMs) Based on NTCIP 1210 Standard v01.

## 2. Introduction to the Signal System Master (SSM)

The Signal System Master (SSM) is a traffic controller device used in the field as a supervising device that operates above the intersection traffic controllers. As a Field Management Station (FMS), a Signal System Master (SSM) acts as a traffic controller device assigned to supervise several Signal System Locals (SSLs) located at intersections in close vicinity. The current NTCIP 1210 v01 SSM standard is systems engineering (SE) process based and provides for the SSM needs and requirements and related design content. The current standard does not provide information on testing procedures. NTCIP 1210 Standard v01-based user needs and requirements were covered under modules A304a and A304b, respectively (see reference below). This module will direct participants to consult these two modules for gaining necessary knowledge and understanding of SSM user needs and specifying SSM requirements prior to preparation of SSM testing documentation, which is covered in this module.

There is a need to understand what to test, when to test, and why to test SSM so that users get what they have specified (a communications interface with field SSMs), and to learn to prepare testing documentation required for the agency's SSM procurement specification. Keeping this overall need in mind, this module aims to create SSM test documentation based on standardized formats (IEEE 829-2008) and relate the formats to key elements of the NTCIP 1210 Standard v01. This will ensure central Traffic Management System's (TMS's) connectivity and data communication interface with the field SSMs within the reference architecture provided by the standard. (Note, the reference architecture shows three parts: TMS, SSMs and SSLs).



### 3. Case Study: An Outline of an SSM Test Plan

Testing is a process that uses a documented test plan designed to check conformance to the SSM standard. Testing of SSM is done to verify that requirements are fulfilled, reduce risks of misinterpretation between agency and manufacturers, and ensure interoperability. A testing process is guided by a test plan, which prescribes the Scope, Approach, Resources, and Schedule for the testing. Some of the testing aspects covered by a test plan include:

- 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

The following outline is typically used for SSM testing based on IEEE 829-2008 formats and guidance provided. An agency may be able to inject local project needs and requirements based on this template.

#### **1.0 Introduction**

##### 1.1 Testing Documentation Identifier

*SSMCommTP v01.01*

*SSM Communications Test Plan v01.01*

*11 June 2016, City of Midsize*

##### 1.2 Scope

##### 1.3 References

##### 1.4 Level Test Plan Testing to be covered

#### **2.0 Details of Level Test Plan: Unit/Bench Testing**

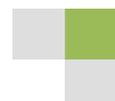
##### 2.1 Test items and their identifiers

##### 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

2.8 Test Deliverables

SSM Communication Test Plan

SSM Communication Test Designs

SSM Communication Test Cases

SSM Communication Test Procedures

Reporting results

SSM Communication Test Logs

SSM Communication Test Incident Reports

SSM Communication Interim Test Status Reports

SSM Communication Test Reports (one for each test design)

### **3.0 Test Management**

3.1 Planned activities and tasks; test progression

3.2 Environment/infrastructure

3.3 Responsibilities and authority

3.4 Resources and their allocation

3.5 Training

3.6 Schedule: As per project schedule (see main contract)

### **4.0 General**

4.1 Quality assurance procedures

The testing quality will fall under the Testing QA Procedures established by the city and Company Name.

4.2 Metrics

The percentage of test cases passed per test design will be recorded.

4.3 Test coverage

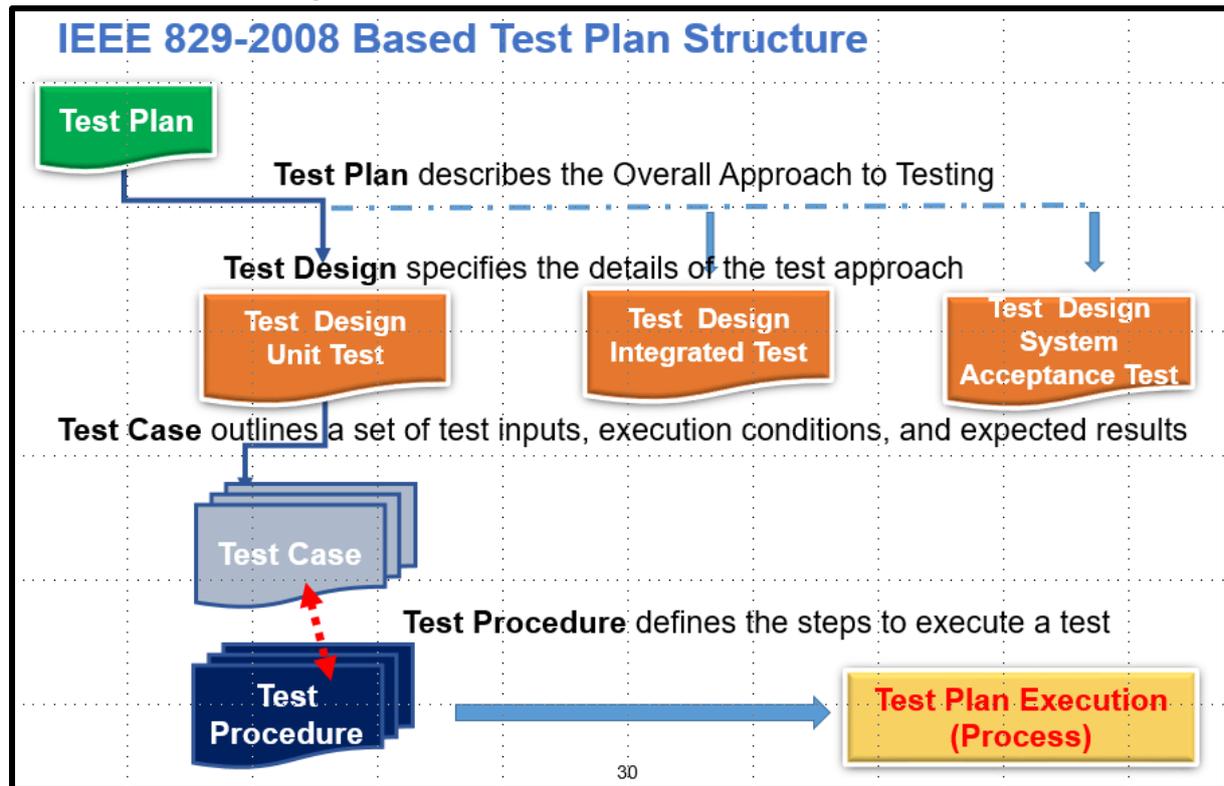
All data elements specified by the SSM PRL and RTM shall be included in at least one test using nominal values. An RTCTM guides the linkages.

4.4 Glossary

4.5 Document change procedures and history



## Test Plan Structure per IEEE 829-2008 Standard

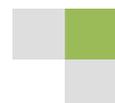


**Testing Process:** Consider Testing as an activity that is carried out with a series of steps in a lifecycle of an ITS project. To ensure that the system interface delivers what the users have specified, a testing process is necessary to assess outcomes. Such requirements are “communicated” in the testing documentation, beginning with a Test Plan (Test Case Specification is a component of the Test Plan). The purpose of software and software-based systems testing is:

- To help **build quality** into the software and system during the lifecycle processes and to validate that the quality was achieved
- To determine whether the products of a given lifecycle activity conform to the requirements of that activity, and whether the product satisfies its intended use and user needs
- Includes inspection, demonstration, analysis, and testing of software and software-based system products
- To perform test activities in parallel with development efforts, not just at the conclusion of the development effort

**Test Plan:** A test plan provides a description of the overall approach to testing all of the requirements to be verified. The Test Plan outlines the scope, approach, resources, and schedule of testing activities.

Breakdown of this Key Point: This first key point of the Testing Process describes a test plan – the master document that will include the test cases. Explaining this key point shows the hierarchical structure (test plan – test design specification – test case) that is required to develop a fully system-engineered test plan.



**Test Design Specification (TDS):** A test design breaks apart testing into smaller efforts and describes a test design specification – the specification that outlines the requirements to be tested and which test cases cover which requirements. This key point shows the hierarchical structure (test plan – test design specification – test case) that is required to develop a fully system-engineered test plan.

**Test Case Specification (TCS):** A test case identifies and specifies the inputs, outcomes, and conditions for execution of a test and is included in a document called Test Case Specification (TCS) as part of an ITS project overall Test Plan. It identifies a specific input and/or output that needs to be tested and records the purpose of the test, a description of the test, the input and output test specification, and the environmental needs, and references the test procedure and describes the results of the test.

The suggested outline for a TCS is shown below:

- Test Case Identifier
- Objective
- Inputs
- Outcomes
- Environmental Needs
- Special Procedural Requirements
- Intercase Dependencies

### **What does a Test Case verify?**

- A Test Case verifies the requirements related to information exchanged between two systems by:
  - Verifying the sequence of information exchanged is correct
    - Standards use dialogs to define the information exchange sequence
  - Verifying the structure of information exchanged is correct
    - Standards define the order of Messages-Data Frames-Data Elements
  - Verifying the content of information exchanged is correct
    - Standards define the valid value rules (e.g., value ranges) for data exchanged

**Test Procedure Specification (TPS):** defines the steps to execute a test. Multiple Test Cases may reference a single Test Procedure.

### **Requirements to Test Case Traceability Matrix (RTCTM) for SSM**

- An RTCTM table provides traceability from requirements to test cases to test procedures
- Each SSM Test Design has an RTCTM for the requirements and test cases applicable to the Test Design



## Role of PRL in Testing: Identify Features to Be Tested

### 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		Yes/No	

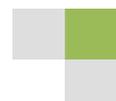
#### 2.5.2 Manage SSLs

These features are to be Tested for ability to uploading-downloading-retrieving data

### Use PRL to Connect to Testable Requirements (Parameters)

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**



### Find What Needs to be Tested from the Project PRL

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	
		3.4.2.2.1	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	will NOT be tested
		3.4.2.2.4.2	Determine Cycle Timer Capability	O	Yes / No	
		3.4.2.2.5	Determine SSM Software Version	M	Yes / No	
		3.4.3.7.4	Sync SSL by Direct Command	O	Yes / No	

### Role of RTM in Testing Design Objects

#### Find Objects 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	Case Study has 30
3.4.2.2.2	Determine Pattern Selection Capabilities	4.2.6.3	5.2.2.1.3	intersectionSection	Case Study has 3
			5.1.1	maxSections	
			5.23.1	algorithmSupport	

**5.2.1 Maximum Number of Intersections**  
 maxIntersections OBJECT-TYPE  
 SYNTAX INTEGER (8..255)

**5.2.2.1.3 Intersection Section**  
 intersectionSection OBJECT-TYPE  
 SYNTAX INTEGER (0..16)

**EXAMPLE**



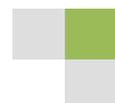
## Role of RTCTM in Testing

### Prepare RTCTM for Testing Documentation

Req. ID	Req.	Test Case ID	Test Case	Test ProcID	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
3.4.2.2					
.X					

## 4. Glossary

Term	Definition
LTP	Level Test Plan
MIB	Management Information Base
MTP	Master Test Plan
NTCIP	National Transportation Communications for ITS Protocols
PRL	Protocol Requirements List
RTCTM	Requirements to Test Case Traceability Matrix
RTM	Requirement Traceability Matrix
SNMP	Simple Network Management Protocol
SEP	Systems Engineering Process
SSL	Signal System Local
SSM	Signal System Master
TMC	Traffic Management Center
TMS	Traffic Management System
TPG	Test Procedures Generator
Term	Definition



Term	Definition
Agency Specification	A document that has been prepared by an agency to define requirements for a subject item or process when procured by the agency.
Compliance	A condition that exists when an item meets all of the requirements of an agency specification.
Concept of Operations	A document that describes the purpose for a system project, including a description of the current and proposed system, as well as key user needs that the new system is required to address.
Conformance	A condition that exists when an item meets all of the mandatory requirements as defined by a standard. It can be measured on the standard as a whole, which means that it meets all mandatory (and applicable conditional) requirements of the standard or on a feature level (i.e., it conforms to feature X as defined in section X.X.X), which means that it meets all mandatory (and applicable conditional) requirements of the feature.

## 5. References

- **NTCIP 1210 v01:** *National Transportation Communications for ITS Protocol Field Management Stations-Part 1: Object for Signal System Masters*  
<http://www.ntcip.org/library/documents/>
- **NTCIP 1201 v03.13a,** *National Transportation Communications for ITS Protocol, Global Object Definitions* ([www.ntcip.org](http://www.ntcip.org))
- **IEEE 829-2008,** *IEEE Standard for Software and System Test Documentation.* IEEE, 2008.  
<http://standards.ieee.org/findstds/standard/829-2008.html>
- **Professional Capacity Building Training Modules 24:** A304a , Understanding User Needs for Field Management Stations - Part 1 Object Definitions for Signal System Masters Based on NTCIP 1210 Standard [https://www.pcb.its.dot.gov/stds\\_training.aspx](https://www.pcb.its.dot.gov/stds_training.aspx)
- **Professional Capacity Building Training Module 25:** A304b, Specifying Requirements for Field Management Stations - Part 1 Object Definitions for Signal System Masters Based on NTCIP 1210 Standard  
[https://www.pcb.its.dot.gov/stds\\_training.aspx](https://www.pcb.its.dot.gov/stds_training.aspx)
- **NTCIP 9001-NTCIP Guide Version 04.** <http://www.ntcip.org/library/documents/>



## 6. Study Questions

1. Which is **NOT** a part of the testing process in a system lifecycle?
  - a) Test planning
  - b) Preparation of test documentation
  - c) Test execution and reporting
  - d) Identification of system requirements
2. Which is **NOT** included in a structure of a test plan?
  - a) Test logs
  - b) Test design
  - c) Test case with inputs/outputs
  - d) Test procedures with steps
3. What is the primary purpose of RTCTM?
  - 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
4. Which is **NOT** a valid statement related to an SSM testing documentation?
  - 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

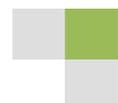
## 7. Icon Guide

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

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



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





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



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



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



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

