WELCOME

RITA
Intelligent Transportation Systems
Joint Program Office
Welcome

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T317: Applying Your Test Plan to NTCIP 1205 Standard
Instructor

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Target Audience

- Engineering staff
- Operations and maintenance staff
- System integrators
- Device manufacturers
- Testing contractors
- Installation contractors
- Construction inspectors
Recommended Prerequisites

- T101: Introduction to ITS Standards Testing
- T201: How to Write a Test Plan
- T202: Overview of Test Design Specifications, Test Cases, and Test Procedures
- C101: Introduction to the Communications Protocols and Their Uses in ITS
- A317a: Understanding User Needs for CCTV Systems Based on NTCIP 1205 Standard
- A317b: Understanding Requirements for CCTV Systems Based on NTCIP 1205 Standard
Curriculum Path (Non-SEP)

I101 Using ITS Standards: An Overview

A101 Introduction to Acquiring Standards - based ITS Systems

A102 Introduction to User Needs Identification

A103 Introduction to ITS Standards Requirements Development

A201 Details on Acquiring Standards-based ITS Systems

A202 Identifying and Writing User Needs When ITS Standards Do Not Have SEP Content

A203 Writing Requirements When ITS Standards Do Not Have SE Content

C101 Introduction to Comm. Protocols and their Uses in ITS Applications

A317a Understanding User Needs for CCTV Systems Based on NTCIP 1205 Standard

A317b Understanding Requirements for CCTV Systems Based on NTCIP 1205 Standard

T317 Applying Your Test Plan to the NTCIP 1205 Standard
Learning Objectives

1. Describe within the context of a testing life cycle the role of a test plan and the testing to be undertaken.

2. Recognize the purpose, structure, and content of well-written test plans.

3. Describe test documentation for NTCIP 1205.

4. Describe the application of a good test plan to a CCTV system based on NTCIP 1205 Standard using a sample Requirements to Test Case Traceability Table.

5. Describe test tools and test conditions for NTCIP 1205.
Learning Objective #1—Describe within the context of a testing life cycle the role of a test plan and the testing to be undertaken

- What is the purpose of testing a CCTV system?
- Review the concept of system life cycle and testing to be undertaken
- Review verification methods
- Describe the testing process in relation to the system life cycle
Purpose of Testing a CCTV system

How do we know a CCTV system will work as intended?

- Testing process provides objective evidence that the system and its associated products (IEEE 829):
  - Satisfy the allocated system requirements
  - Solve the right problem (e.g., correctly model physical laws, implement business rules, and use the proper system assumptions)
  - Satisfy the intended use and user needs
System Life Cycle

Testing to be undertaken

Source: http://www.fhwa.dot.gov/cadiv/segb/
System Life Cycle (cont.)

Learning Objective #1

Verification Methods

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

- This determination may be based on one or more of the following methods:
  - Inspection
  - Demonstration
  - Analysis
  - Testing
Testing Process

According to IEEE 829, the testing process provides an objective assessment of the system products throughout each project’s life cycle:

- At the completion of each development iteration
- At installation and go-live
- During operations and maintenance
- System upgrades
- System replacement
Testing Process (cont’)

Three major stages:

- **Step 1 - Test Planning**
  - Test plan
- **Step 2 - Test Documentation Preparation**
  - Test design
  - Test case
  - Test procedure
- **Step 3 - Test Execution and Reporting**
  - Test report
Testing Process and System Life Cycle

Source: http://www.fhwa.dot.gov/cadiv/segb/
ACTIVITY
Learning Objective #1

Which of the following Statements is not correct?

Answer Choices

a) Requirements can be verified by inspection, demonstration, analysis, and testing of the system products.

b) The testing process provides an objective assessment of system products throughout the system life cycle.

c) Test documentation needs to be prepared only at the completion of system development.

d) Development of test plans can begin as soon as the system ConOps is being developed.
Review of answers

a) Requirements can be verified by inspection, demonstration, analysis, and testing of the system products.

Incorrect. The statement is true.

b) The testing process provides an objective assessment of system products throughout the system life cycle.

Incorrect. The statement is true.
Review of answers (cont.)

c) Test documentation needs to be prepared only at the completion of system development.

Correct. The statement is not correct. The test documentation is typically prepared at the system design stage and not after the system development is complete.

d) Development of test plans can begin as soon as the system ConOps is being developed.

Incorrect. The statement is true. It is worth noting that development of test plans may begin early in the system life cycle, but they cannot be finalized until the requirements are fully developed.
Summary of Learning Objective #1

Describe within the context of a testing life cycle the role of a test plan and the testing to be undertaken

- Discussed the purpose of testing a CCTV system
- Reviewed the concept of system life cycle and testing to be undertaken
- Reviewed verification methods
- Discussed the testing process in relation to the system life cycle
Learning Objective #2 — Recognize the purpose, structure, and content of well-written test plans

- Purpose of test plans
- What is a test plan?
- Structure of test plans
  - Master Test Plan (MTP)
  - Level Test Plan (LTP)
- Content of test plans
Purpose of Test Plans

- Provide an overall document for:
  - Test planning
  - Test management
- Identify test activities and efforts
- Set objective for each test activity
- Identify the risks, resources, and schedule
- Determine requirements for test documentation
What is a Test Plan?

**IEEE 829 defines Test Plan as:**

- A document describing the **scope**, (technical and management) **approach**, **resources**, and **schedule** of intended test activities.
- It identifies test items, the features to be tested, the testing tasks, who will do each task, and any risks requiring contingency planning.
- The document may be a **Master Test Plan (MTP)** or a **Level Test Plan (LTP)**.

**Test Plan is not defined in NTCIP standards!**
Structure of Test Plans

- **Master Test Plan (MTP)**
  - Integrity level scheme and choice
  - Overall test processes, activities, and tasks
  - Test levels and documents

  - **Unit Test Plan (LTP)**
  - **Subsystem Integration Test Plan (LTP)**
  - **System Acceptance Test Plan (LTP)**
    - Scope of test level
    - Resources
    - Test method(s)

A Master Test Plan may not always be required!
An Example of ITS Test Plans

- ITS Master Test Plan (MTP)
  - CCTV Unit Test Plan (LTP)
  - DMS Unit Test Plan (LTP)
  - TSS Unit Test Plan (LTP)
- CCTV Subsystem Integration Test Plan (LTP)
- DMS Subsystem Integration Test Plan (LTP)
- TSS Subsystem Integration Test Plan (LTP)
- System Acceptance Test Plan (LTP)
An Example of CCTV Test Plans

- **CCTV Master Test Plan (MTP)**
  - CCTV Factory Test Plan (LTP)
  - CCTV Field Standalone Test Plan (LTP)
  - CCTV System Integration Test Plan (LTP)
  - CCTV System Operation Test Plan (LTP)
  - CCTV System Acceptance Test Plan (LTP)
Master Test Plan Outline (IEEE 829)

- **Introduction**
  - Document identifier, scope, and references
  - System overview and key features
  - Test overview (organization, schedule, integrity level, resources, responsibilities, tools, methods, etc.)

- **Details of the Master Test Plan**
  - Test processes including definition of test levels
  - Test documentation requirements
  - Test administration requirements
  - Test reporting requirements

- **General**
  - Glossary
  - Document change procedures and history

Provide requirements for NTCIP 1205 test documents
Level Test Plan Outline (IEEE 829)

- **Introduction**
  - Document identifier, scope, and references
  - Level in the overall sequence
  - Test classes and overall test conditions

- **Details for the level of test plan**
  - Test items and their identifiers
  - Test Traceability Matrix
  - Features to be tested
  - Features not to be tested
  - Approach
  - Item pass/fail criteria
  - Suspension criteria and resumption requirements
  - Test deliverables

For developing test cases and test procedures for NTCIP 1205
Level Test Plan Outline (cont.)

- Test Management
  - Planned activities and tasks; test progression
  - Environment/infrastructure
  - Responsibilities and authority
  - Interfaces among the parties involved
  - Resources and training
  - Schedules, estimates, and costs
  - Risk(s) and contingency(s)
Level Test Plan Outline (cont.)

- General
  - Quality assurance procedures
  - Metrics for specific measures
  - Test coverage (% of requirements tested)
  - Glossary
  - Document change procedures and history
Develop a Sample CCTV Unit Test Plan

Refer to the Student Supplement for details.

- **Level in the overall sequence**
  - Show the CCTV unit testing in the overall test hierarchy – a diagram will be helpful

- **Test classes and overall test conditions**
  - Describe the attributes of the CCTV camera unit test – Pan-Tilt-Zoom (PTZ), presets, focus, iris, alarms & zones
  - Positive testing – valid input values
  - Negative testing – invalid values for error processing
  - Boundary testing – input values just above, just below, and just on each limit
Develop a Sample CCTV Unit Test Plan (cont’)

- **Test Items**
  - CCTV camera model, make, firmware version, etc.
  - Reference to the CCTV user manual, operations guide, installation guide, etc.
  - Transfer from other environments to the test environment

- **Test Traceability Matrix**
  - Provide a list of requirements and corresponding test cases or procedures - *Requirements to Test Case Matrix defined in NTCIP 8007*
  - Or a reference to a larger Test Traceability Matrix for all levels of test
Develop a Sample CCTV Unit Test Plan (cont’)

- **Features to be tested and not to be tested**
  - CCTV features based on project-specific requirements
    - Requirements Traceability Matrix (RTM)
  - Remote control functions may not be tested

- **Test Approach**
  - Overall approach for the unit testing
  - Commonly combined in a Test Matrix with features to be tested
  - Test methods – black box, white box, analysis, and inspection
# Features to be Tested – CCTV Configuration

<table>
<thead>
<tr>
<th>RQ. ID</th>
<th>Requirement</th>
<th>Dialog</th>
<th>Object Reference and Title (NTCIP 1205 Section 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.1</td>
<td>Data Exchange Requirements for Managing Configuration</td>
<td>D.3 Generic SNMP SET Interface</td>
<td></td>
</tr>
<tr>
<td>3.3.1.1</td>
<td>Configure Range Maximum presets</td>
<td>3.2.1 rangeMaximumPreset</td>
<td></td>
</tr>
<tr>
<td>3.3.1.2</td>
<td>Configure Range-Pan Left Limit</td>
<td>3.2.2 rangePanLeftLimit</td>
<td></td>
</tr>
<tr>
<td>3.3.1.3</td>
<td>Configure Range-Pan Right Limit</td>
<td>3.2.3 rangePanrightLimit</td>
<td></td>
</tr>
<tr>
<td>3.3.1.4</td>
<td>Configure Range Pan Home Position</td>
<td>3.2.4 rangePanHomePosition</td>
<td></td>
</tr>
<tr>
<td>3.3.1.5</td>
<td>Configure True North Offset</td>
<td>3.2.5 rangeTrueNorthOffset</td>
<td></td>
</tr>
<tr>
<td>3.3.1.6</td>
<td>Configure Range Iris Limit</td>
<td>3.2.10 ranglirisLimit</td>
<td></td>
</tr>
<tr>
<td>3.3.1.13</td>
<td>Configure Timeout Pan</td>
<td>3.3.1 timeOurPan</td>
<td></td>
</tr>
<tr>
<td>3.3.1.16</td>
<td>Configure Timeout Focus</td>
<td>3.3.4 timeOutFocus</td>
<td></td>
</tr>
<tr>
<td>3.3.1.19</td>
<td>Configure Label Table</td>
<td>3.11.2 labelTable</td>
<td></td>
</tr>
</tbody>
</table>

Features to be Tested: Table 3.3.1.2, Table 3.3.1.4, Table 3.3.1.5, Table 3.3.1.6, Table 3.3.1.13, Table 3.3.1.16, Table 3.3.1.19
# Features to be Tested – Camera Control

<table>
<thead>
<tr>
<th>Rq. ID</th>
<th>Requirement</th>
<th>Dialog</th>
<th>Object Reference and Title NTCIP 1205 Section 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.2</td>
<td>Camera Control</td>
<td>D.3 Generic SNMP SET Interface</td>
<td></td>
</tr>
<tr>
<td>3.3.2.1</td>
<td>Preset Go to Position</td>
<td>3.4.1 presetGotoPosition</td>
<td></td>
</tr>
<tr>
<td>3.3.2.2</td>
<td>Go to a Stored Position</td>
<td>3.4.2.presetStorePosition</td>
<td></td>
</tr>
<tr>
<td>3.3.2.6</td>
<td>Zoom Operation</td>
<td>3.2.8 rangeZoomLimit 3.3.3 timeoutZoom 3.3.3 positionZoomLens</td>
<td></td>
</tr>
<tr>
<td>3.3.2.4</td>
<td>Camera Position Horizontally (Pan)</td>
<td>3.2.2 rangePanLeftLimit 3.2.4 rangePanHomePosition 3.2.11 rangeMinimumPanStepAngle 3.3.1 timeoutPan 3.5.1 positionPan 3.2.3 rangePanRightLimit 3.2.4 rangePanHomePosition 3.2.11 rangeMinimumPanStepAngle 3.3.1 timeoutPan 3.5.1 positionPan</td>
<td></td>
</tr>
</tbody>
</table>
# Features to be Tested – CCTV Monitoring

<table>
<thead>
<tr>
<th>Rq. ID</th>
<th>Requirement</th>
<th>Dialog</th>
<th>Object Reference and Title NTCIP 1205</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.3</td>
<td>Status condition within the device</td>
<td>D.1 Generic SNMP GET Interface</td>
<td>Section 3</td>
</tr>
<tr>
<td>3.3.3.2</td>
<td>Temperature</td>
<td></td>
<td>3.7.5 alarmTemperatureCurrentValue</td>
</tr>
<tr>
<td>3.3.3.2</td>
<td>Pressure</td>
<td></td>
<td>3.7.6 alarmPressureHighLowThreshold 3.2.7 alarmPressureCurrentValue</td>
</tr>
<tr>
<td>3.3.3.2</td>
<td>Washer fluid</td>
<td></td>
<td>3.7.8 alarmWasherFluidHighLowThreshold 3.2.9 alarmWasherCurrentValue</td>
</tr>
<tr>
<td>3.3.3.3</td>
<td>ID Generator</td>
<td></td>
<td>3.11 cctv label Objects</td>
</tr>
</tbody>
</table>

Note that these are only examples and do not include all NTCIP objects that are required for the project. All required objects included in the project RTM will need to be included in the test plans.
Which of the following is included in a Level Test Plan (LPT) but not in a Master Test Plan (MTP)?

**Answer Choices**

a) Test scope  
b) Test processes  
c) Test resources and responsibilities  
d) Test Traceability Matrix
Review of answers

a) Test scope
   *Incorrect! Included in both the LTP and MTP.*

b) Test processes
   *Incorrect! Included in the MTP only.*

c) Test resources and responsibilities
   *Incorrect! Included in both the LTP and MTP.*

d) Test Traceability Matrix
   *Correct! Test Traceability Matrix is only included in the LTP, but not in the MTP.*
Summary of Learning Objective #2

Recognize the purpose, structure, and content of well-written test plans

- Discussed the definition of Test Plan per IEEE 829
- Identified the difference between the Master Test Plan (MTP) and the Level Test Plan (LTP), and when and how to use them
- Discussed the structure and content of the MTP and LTP
Learning Objective #3 — Describe test documentation for NTCIP 1205

- Overview of test documentation
- Understand the difference between test plans and test documentation
- Overview of a test design and the relationships between test plans, test design, test cases, and test procedures
Test Documentation

According to IEEE 829:

- Test documentation requirements specified in MTP, if any.
- A detailed list of test deliverables specified in LTPs:
  - Test Plans
  - Test Designs
  - Test Cases
  - Test Procedures
  - Test Logs
  - Anomaly Reports
  - Interim Test Status Reports
  - Test Reports
  - Master Test Reports (if there is a MTP)
Learning Objective #3

Test Documentation prior to Test Execution

- **Master Test Plan (MTP)**
  - Integrity level scheme and choice
  - Overall test processes, activities, and tasks
  - Test levels and documents

- **Unit Test Plan (LTP)**
  - Detail updates for test methods
  - Features to be tested

- **Subsystem Integration Test Plan (LTP)**

- **System Acceptance Test Plan (LTP)**
  - Scope of test level
  - Resources
  - Test method(s)

- **Unit Test Design**

- **Unit Test Cases**
  - Input
  - Output

- **Unit Test Procedures**
  - Test setup
  - Execution instructions
Test Documentation during and after Test Execution

- Unit Interim Test Status Reports
  - Testing progress
  - Test results summary
- Unit Test Logs
  - All detailed results
- Anomaly Reports
  - Incorrect or unexpected results
- Unit Test Report
- Subsystem Integration Test Report
- System Acceptance Test Report
- Master Test Report
  - Aggregate pass/fail
  - Aggregate test results
Understand the Difference between Test Plans and Test Documentation

- **Test plans**
  - Defines the test documents required
  - Developed earlier than test documents

- **Test documentation includes all information that is to be delivered by test activities:**
  - Test documents – test cases, test procedures, test reports, etc.
  - Test input and output data
  - Test tools
IEEE 829 defines a test design as a test document that:

- Specifies the details of the test approach
- Identifies the features to be tested by this design
  - Requirements Test Case Traceability Matrix
- Identifies the associated tests – commonly including the organization of the tests into groups
  - Test cases
  - Test procedures
## Requirements Test Case Traceability Matrix

### Learning Objective #3

From project requirements or Protocol Requirement List (PRL)

<table>
<thead>
<tr>
<th>Requirement</th>
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<tr>
<td>3.3.1.2</td>
<td>Configure Range - Pan Left Limit</td>
</tr>
<tr>
<td>3.3.1.x</td>
<td>.... (see A317b for additional requirements)</td>
</tr>
</tbody>
</table>
Learning Objective #3

Relationship between Test Plan, Test Design, Test Case, and Test Procedure

### Unit Test Plan (LTP)
- Scope of test level
- Resources
- Test method(s)

### Unit Test Design
- Detail updates for test methods
- Features to be tested

#### Unit Test Case 1
- Input
- Output

#### Unit Test Case 2
- Test setup
- Execution instructions

#### Unit Test Case 3
- Input
- Output

#### Unit Test Procedure 1

#### Unit Test Procedure 2

#### Unit Test Procedure 3
Learning Objective #3

Relationship between Test Plan, Test Design, Test Case, and Test Procedure (cont.)

- **Test Plan vs. Test Design**
  - Only one test design for each test plan

- **Test Design vs. Test Case**
  - One test design may be associated with multiple test cases
  - Any one test case is associated with only one test design

- **Test Case vs. Test Procedure**
  - One test case may be associated with multiple test procedures, and vice versa – *IEEE 829*
  - For simple devices (e.g. CCTV), NTCIP combines test case and test procedure
Which of the following is part of test documentation?

Answer Choices

a) Test Data
b) Test Plans
c) Requirement Test Case Traceability Matrix
d) All of the above
Review of answers

a) Test Data

Incorrect! Included in test deliverables, so it is part of the test documentation.

b) Test Plans

Incorrect! Included in test deliverables, so it is part of the test documentation.

c) Requirement Test Case Traceability Matrix

Incorrect! Included in both LTP and test design, so it is part of the test documentation.

d) All of the above

Correct! All of the above are part of test documentation.
Summary of Learning Objective #3

Describe test documentation for NTCIP 1205

- Reviewed test deliverables/documentation
- Discussed the difference between test plans and test documentation
- Reviewed the test design and the relationships between the test plan, test design, test cases, and test procedures
Learning Objective #4 — Describe the application of a good test plan to a CCTV system based on NTCIP 1205 Standard using a sample Requirements to Test Case Traceability Table

- Describe the basis of a CCTV system and its test environment
- Identify key elements of the NTCIP 1205 standard that are relevant to the testing
- Develop sample test documents including test design, test cases, and test procedures
Basis of a CCTV System

CCTV Field Hardware

- Camera and enclosure
- Lens assembly – focus, iris
- Pan/Tilt assembly
- Camera control receiver
- Equipment cabinet
- Communications device
- Accessories – camera power supply, wiper, heater, washer, blower, environmental sensor, etc.
CCTV Camera Test Environment for Unit Testing

- Simulated Inputs (e.g. cabinet alarm)
- Video Output (e.g. verification of video loss)
- Camera Control Data (NTCIP 1205)
- Data Analyzer (as required)
- Test Software (Management Station)

Communications Network
Identify Key Elements of NTCIP 1205

What are included in NTCIP 1205?

- CCTV Management Information Base (MIB)
  - CCTV Objects (range, timeout, preset, position, system feature, alarm, input, output, zone, label, on-screen menu)

- Conformance Groups
  - CCTV Configuration
  - Extended Functions
  - Motion Control
  - On-screen Menu Control
Identify Key Elements of NTCIP 1205 (cont.)

What are NOT included in NTCIP 1205, but required for developing test documents?

- User Needs
- Requirements
- Dialogs
- Protocol Requirements List (PRL)
- Requirements Traceability Matrix (RTM)
- Requirements Test Case Traceability Matrix (RTCTM)
- Test Cases
- Test Procedures

Included in A317a & A317b modules
Develop Test Documents – Test Design

Develop a Requirements Test Case Traceability Matrix (RTCTM)

- The main purpose of Test Design is to identify the features to be tested by a particular test (e.g. unit test)
- The features to be tested are included in the RTCTM
- Based on a Requirements Traceability Matrix (RTM)
## Learning Objective #4

### An example of RTM from A317b module

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<td></td>
</tr>
</tbody>
</table>
## Develop a Requirements Test Case Traceability Matrix (RTCTM)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Title</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Camera Control</td>
</tr>
<tr>
<td>3.3.2.1</td>
<td>Preset Go to Position</td>
</tr>
<tr>
<td>3.3.2.2</td>
<td>Move Camera to a Stored Position</td>
</tr>
<tr>
<td></td>
<td>C3.01</td>
</tr>
<tr>
<td>3.3.2.3</td>
<td>Zoom Operation</td>
</tr>
<tr>
<td></td>
<td>C3.05</td>
</tr>
<tr>
<td></td>
<td>C3.06</td>
</tr>
<tr>
<td></td>
<td>C3.07</td>
</tr>
<tr>
<td></td>
<td>C3.08</td>
</tr>
</tbody>
</table>
### Develop a Requirements Test Case Traceability Matrix (RTCTM) (cont.)

<table>
<thead>
<tr>
<th>Requirement Description</th>
<th>Test Case Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.2 Camera Control</td>
<td></td>
</tr>
<tr>
<td>3.3.2.4 Camera Position Horizontally (Pan)</td>
<td></td>
</tr>
<tr>
<td>C3.11 Delta Pan Motion</td>
<td></td>
</tr>
<tr>
<td>C3.12 Absolute Pan Motion</td>
<td></td>
</tr>
<tr>
<td>C3.13 Continuous Pan Motion with Timeout</td>
<td></td>
</tr>
<tr>
<td>C3.14 Continuous Pan Motion with Stop</td>
<td></td>
</tr>
</tbody>
</table>
Develop Test Documents – Test Case

Use “C3.01 Preset Position” as an example

- Test Case Identifier
  - C3.01
- Test Case Title
  - Preset Position
- Test Case Description
- Variables
  - input and output values and timing are included in test procedures
- Pass/Fail Criteria
### Develop Test Documents – Test Case (cont.)

<table>
<thead>
<tr>
<th>Test Case: C3.01</th>
<th>Title:</th>
<th>Preset Position</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>This test case stores and moves the camera to preset positions</td>
<td></td>
</tr>
<tr>
<td><strong>Variables:</strong></td>
<td>Max_Preset</td>
<td>From Project Requirements</td>
</tr>
<tr>
<td></td>
<td>Preset_Speed</td>
<td>From the Test Plan</td>
</tr>
<tr>
<td></td>
<td>Preset_Pan_Position1</td>
<td>From the Test Plan</td>
</tr>
<tr>
<td></td>
<td>Preset_Pan_Position2</td>
<td>From the Test Plan</td>
</tr>
<tr>
<td></td>
<td>Preset_Tilt_Position1</td>
<td>From the Test Plan</td>
</tr>
<tr>
<td></td>
<td>Preset_Tilt_Position2</td>
<td>From the Test Plan</td>
</tr>
<tr>
<td><strong>Pass/Fail Criteria:</strong></td>
<td>The Device Under Test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case</td>
<td></td>
</tr>
</tbody>
</table>
Develop Test Documents – Test Procedure

Use “C3.01 Preset Position” as an example

- Test Procedure Identifier
  - NTCIP combines Test Procedure with Test Case
- Inputs, outputs, and special requirements
- Ordered description of the steps to be taken to execute the test case
- Keywords
  - Defined in NTCIP 8007
- Test results
  - Pass or Fail
Develop Test Documents – Test Procedure (cont.)

Continued after the test case

<table>
<thead>
<tr>
<th>Step</th>
<th>Test Procedure</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>CONFIGURE</strong>: Determine a preset position for the camera between 0 and rangeMaximumPreset.0 (per the project requirement). <strong>RECORD</strong> this information as: ▶️Max_Preset</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>SET-UP</strong>: if Max_Preset is less than 2, then <strong>EXIT</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>GET</strong> the following object: ▶️rangeMaximumPreset.0</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>4</td>
<td><strong>SET-UP</strong>: <strong>VERIFY</strong> that the RESPONSE VALUE is equal to Max_Preset; otherwise, <strong>EXIT</strong>.</td>
<td></td>
</tr>
</tbody>
</table>
# Develop Test Documents – Test Procedure (cont.)

<table>
<thead>
<tr>
<th>Step</th>
<th>Test Procedure</th>
<th>Results</th>
</tr>
</thead>
</table>
| 5    | **CONFIGURE:** Determine the following value from the test plan. **RECORD** the information as:  
>>Preset_Speed  
>>Preset_Pan_Position1  
>>Preset_Pan_Position2  
>>Preset_Tilt_Position1  
>>Preset_Tilt_Position2 |               |
| 6    | **SET** the following objects to the values shown:  
>>positionPan.0 = 02 Preset_Speed Preset_Pan_Position1  
>>positionTilt.0 = 02 Preset_Speed Preset_Tilt_Position1 | Pass / Fail   |
| 7    | **VERIFY** that camera is in position 1. | Pass / Fail   |
| 8    | **SET** presetStorePosition.0 to 1 | Pass / Fail   |
# Develop Test Documents – Test Procedure (cont.)

<table>
<thead>
<tr>
<th>Step</th>
<th>Test Procedure</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>SET the following objects to the values shown: &gt;&gt;positionPan.0 = 02 Preset_Speed Preset_Pan_Position2 &gt;&gt;positionTilt.0 = 02 Preset_Speed Preset_Tilt_Position2</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>10</td>
<td>VERIFY that camera moved to position 2.</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>11</td>
<td>SET presetStorePosition.0 to 2</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>12</td>
<td>SET presetGotoPosition.0 to 1</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>13</td>
<td>VERIFY that camera moved in position 1.</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>14</td>
<td>GET presetPositionQuery.0</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>15</td>
<td>VERIFY that RESPONSE VALUE = 1</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>16</td>
<td>SET presetGotoPosition.0 to 2</td>
<td>Pass / Fail</td>
</tr>
</tbody>
</table>
Develop Test Documents – Test Procedure (cont.)

<table>
<thead>
<tr>
<th>Step</th>
<th>Test Procedure</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>VERIFY that camera moved in position 2.</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>18</td>
<td>GET presetPositionQuery.0</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>19</td>
<td>VERIFY that RESPONSE VALUE = 2</td>
<td>Pass / Fail</td>
</tr>
</tbody>
</table>

Test Case Results

<table>
<thead>
<tr>
<th>Tested By:</th>
<th>Date Tested:</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Case Notes:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which is a test document included in NTCIP 1205?

Answer Choices

a) Protocol Requirements List (PRL)
b) Requirements Traceability Matrix (RTM)
c) Requirements Test Case Traceability Matrix (RTCTM)
d) None of the above
Review of answers

a) Protocol Requirements List (PRL)
   Incorrect, PRL is not a test document and not included in NTCIP1205

b) Requirements Traceability Matrix (RTM)
   Incorrect, RTM is not a test document and not included in NTCIP 1205

c) Requirement Test Case Traceability Matrix (RTCTM)
   Incorrect, RTCTM is a test document, but not in NTCIP 1205

d) None of the above
   Correct! None of the above are correct answers
Summary of Learning Objective #4

Describe the application of a good test plan to a CCTV system based on NTCIP 1205 Standard using a sample Requirements to Test Case Traceability Table

- Reviewed the basis of a CCTV system and its test environment
- Identified key elements of the NTCIP 1205 standard that are relevant to the testing
- Developed sample test documents including test design, test cases, and test procedures
Learning Objective #5 — Describe test tools and test conditions for NTCIP 1205

- NTCIP test tools and equipment
- Address the consequences of positive and negative testing
- Address the consequences of testing boundary conditions
- Understand the complexity of NTCIP testing
NTCIP Test Tools and Equipment

- Review of NTCIP test environment
- Minimum requirements for test tools and equipment
- Types of NTCIP test tools
Review of NTCIP Test Environment

- Device Under Test (DUT)
  - NTCIP device that is the object of testing
  - Controller, CCTV camera, DMS, etc.

- “Certified” Test Software
  - Approved for use prior to the testing

- Data Analyzer
  - Capture data exchanged
  - Use for in-depth analysis when anomalies occur

- Communication network
  - Ethernet, serial (RS232/RS422/RS485), wireless, etc.
Review of NTCIP Test Environment (cont.)

- DUT
- Simulated Inputs (e.g. cabinet alarm)
- Video Output (e.g. verification of video loss)
- Communications Network
- Camera Control Data (NTCIP 1205)
- Data Analyzer (as required)

Test Software (Management Station)
Minimum Requirements for Test Tools

- Capable of performing tests for conformance to specific NTCIP information level standards
- Support for communication testing such as SNMP
- Scripting features to support automated testing
- Support various protocols including PPP, PMPP, TCP/IP, etc.
- Support a wide variety of media including Ethernet and Serial
Types of NTCIP Test Tools

Passive Test Tools

- Used as data analyzer
- Monitor data exchange only
- Live data capture
- Do NOT provide or respond to an ITS device stimulus

Examples
- Serialtest
- Ethereal
- Other protocol analyzers
Types of NTCIP Test Tools (cont’)

Active Test Tools

- Used as main test software
- Provide a means to send message to DUT and await response

Limitations
- Do NOT support all objects in NTCIP such as proprietary logical blocks
- Do NOT support sophisticated communication testing, e.g. communication load testing
- Special purpose software needs to be developed to perform additional testing
Types of NTCIP Test Tools (cont.)

Examples of Active NTCIP Test Software

- DeviceTester
- NTCIP Exerciser
- Ntester
- SimpleTester
Address the Consequences of Positive and Negative Testing

- **Positive testing**
  - Valid input values
  - DUT should process successfully

- **Negative testing**
  - Invalid input values, dialogs, or data exchange sequence
  - DUT should NOT process
  - DUT should remain in normal operation
  - DUT should provide an appropriate error processing
    - For example, DUT responds with an error message when the test moves camera to an invalid zone
Address the Consequences of Testing Boundary Conditions

- All boundary values should be tested
  - just below each limit
  - just above each limit
  - just on each limit

- If the boundary value is valid, DUT should:
  - Process it successfully and respond accordingly

- If error conditions occur, DUT should:
  - Respond with proper error messages
  - Remain in normal operation
  - No communications “lock-up”
Understand the Complexity of NTCIP Testing

- Testing is a complex process
  - Test planning
  - Test documentation preparation
  - Test execution
  - Test result reporting

- All NTCIP objects required by the project should be tested
  - Perform sampling of valid inputs
  - Test boundary conditions
  - **Selectively** test error conditions for critical functions
Understand the Complexity of NTCIP Testing (cont.)

- Progression testing
  - Testing new and corrected features as a result of new releases of software

- Regression testing
  - Testing to ensure that no unintended changes have occurred
  - Test agency will determine the extent of tests that must be repeated
  - At a minimum, regression testing should be done for all the software affected by the test failure
Which of the following statements is correct?

Answer Choices

a) Data analyzer is an active test tool and can be used to respond to the DUT’s request

b) All possible permutations and combinations of valid input values need to be tested

c) Performing boundary analysis is not necessary during NTCIP testing

d) None of the above
Review of answers

a) Data analyzer is an active test tool and can be used to respond to the DUT’s request

Incorrect. Data analyzer is a passive test tool and can only be used to monitor the data exchanged between two components.

b) All possible permutations and combinations of valid input values need to be tested

Incorrect. It is impossible to test all possible permutations and combinations of valid input values; Instead, testing samples within the required range should produce acceptable test results.
Review of answers

c) Performing boundary analysis is not necessary during NTCIP testing

Incorrect. Performing boundary analysis with positive and negative range is necessary to verify the DUT’s response to all required dialogs and objects.

d) None of the above

Correct. None of the above are correct answers.
Summary of Learning Objective #5

Describe test tools and test conditions for NTCIP 1205

- Reviewed the test tools and equipment
- Discussed the consequences of positive and negative testing
- Discussed the consequences of testing boundary conditions
- Discussed the complexity of NTCIP testing
What We Have Learned

1) The testing process determines whether the system conforms to the requirements and whether it satisfies its intended use and user needs.

2) Requirements can be verified by inspection, demonstration, analysis, and testing of the system products.

3) The testing process provides an objective assessment of system products throughout the system life cycle.

4) A test plan is a document that describes the scope, approach, resources, and schedule of intended test activities.

5) The test plan may be a Master Test Plan or a Level Test Plan.
What We Have Learned

6) A list of test documents delivered at the completion of the test is included in __Level Test Plans__. 
7) The details of Requirements Test Case Traceability Matrix are developed as part of __test design__.
8) __Test cases__ define test input and output values.
9) Keywords used in test procedures are defined in __NTCIP 8007__.
10) NTCIP test tools include __passive__ and __active__ test tools.
Resources

- **NTCIP 1205 v01.08, National Transportation Communications for ITS Protocol: Object Definition for Closed Circuit Television (CCTV) Camera Control**, AASHTO/ITE/NEMA, December 2001 (or Revision Amendment 1, November 2004).
Resources


- PCB Training Modules Available at [www.pcb.its.dot.gov/standards_training.aspx](http://www.pcb.its.dot.gov/standards_training.aspx)
QUESTIONS?