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Joint Program Office

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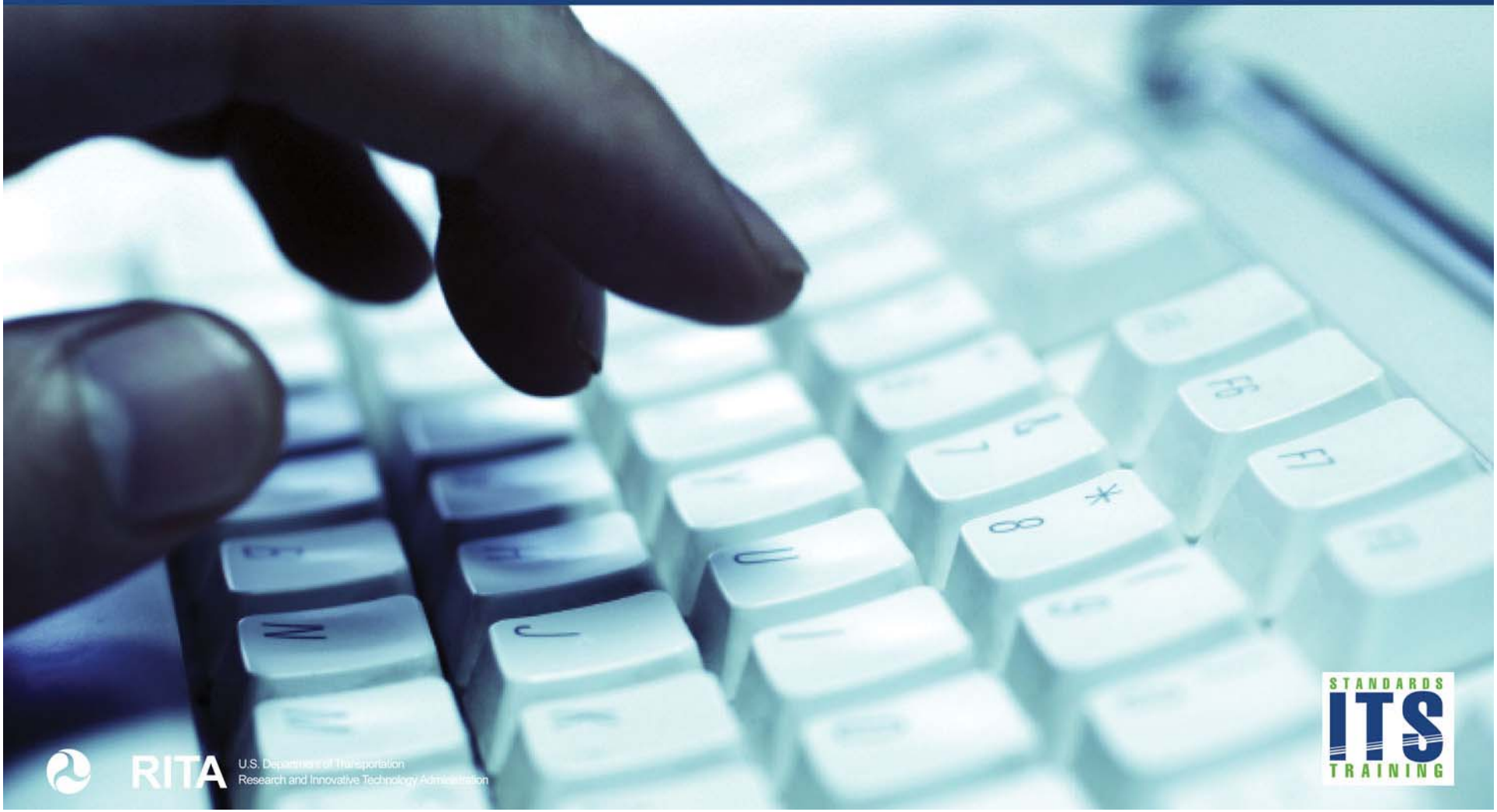

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STANDARDS ITS TRAINING

T317:
Applying Your Test Plan to NTCIP 1205 Standard

Instructor

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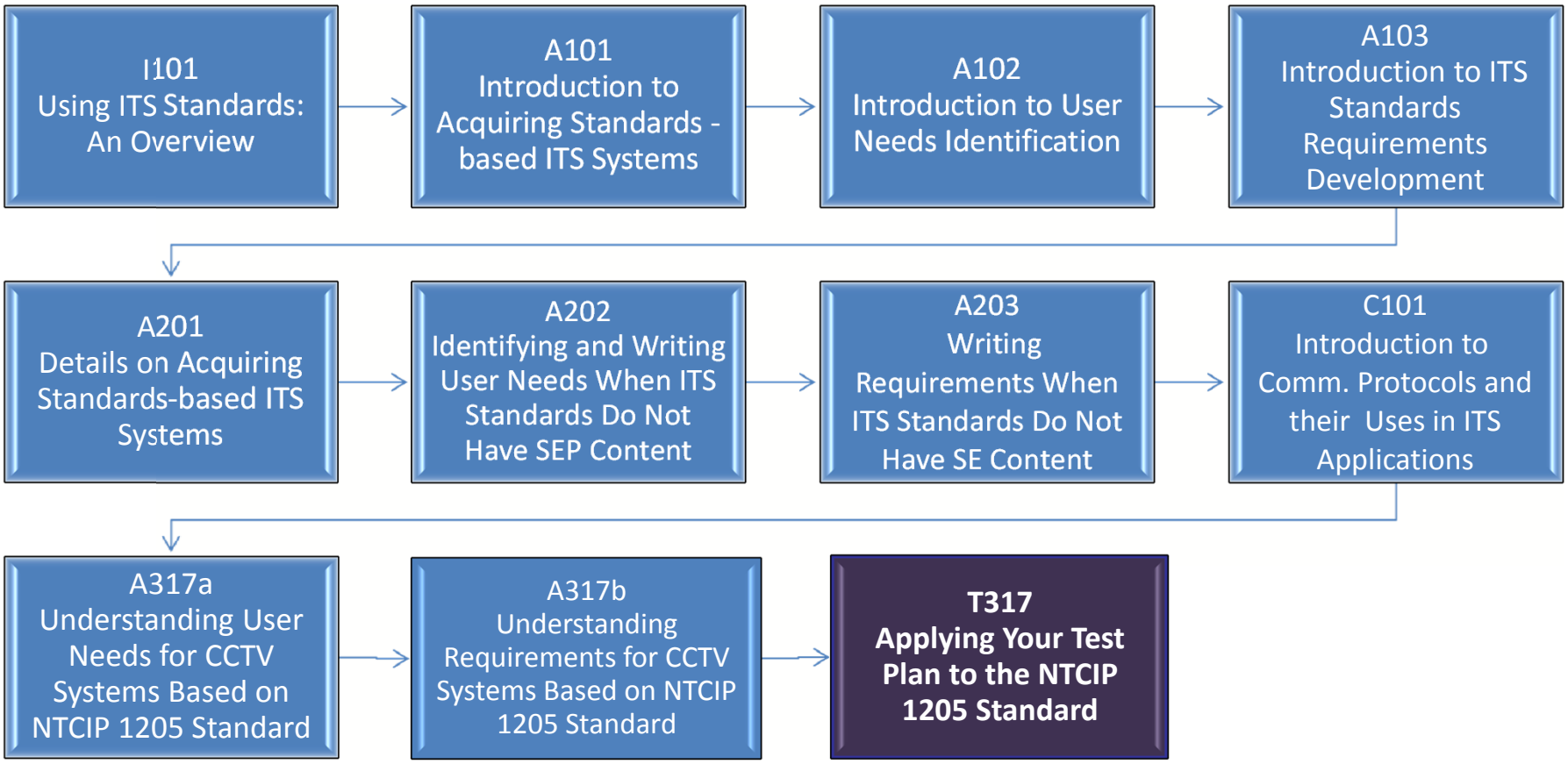
Target Audience

- 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)



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

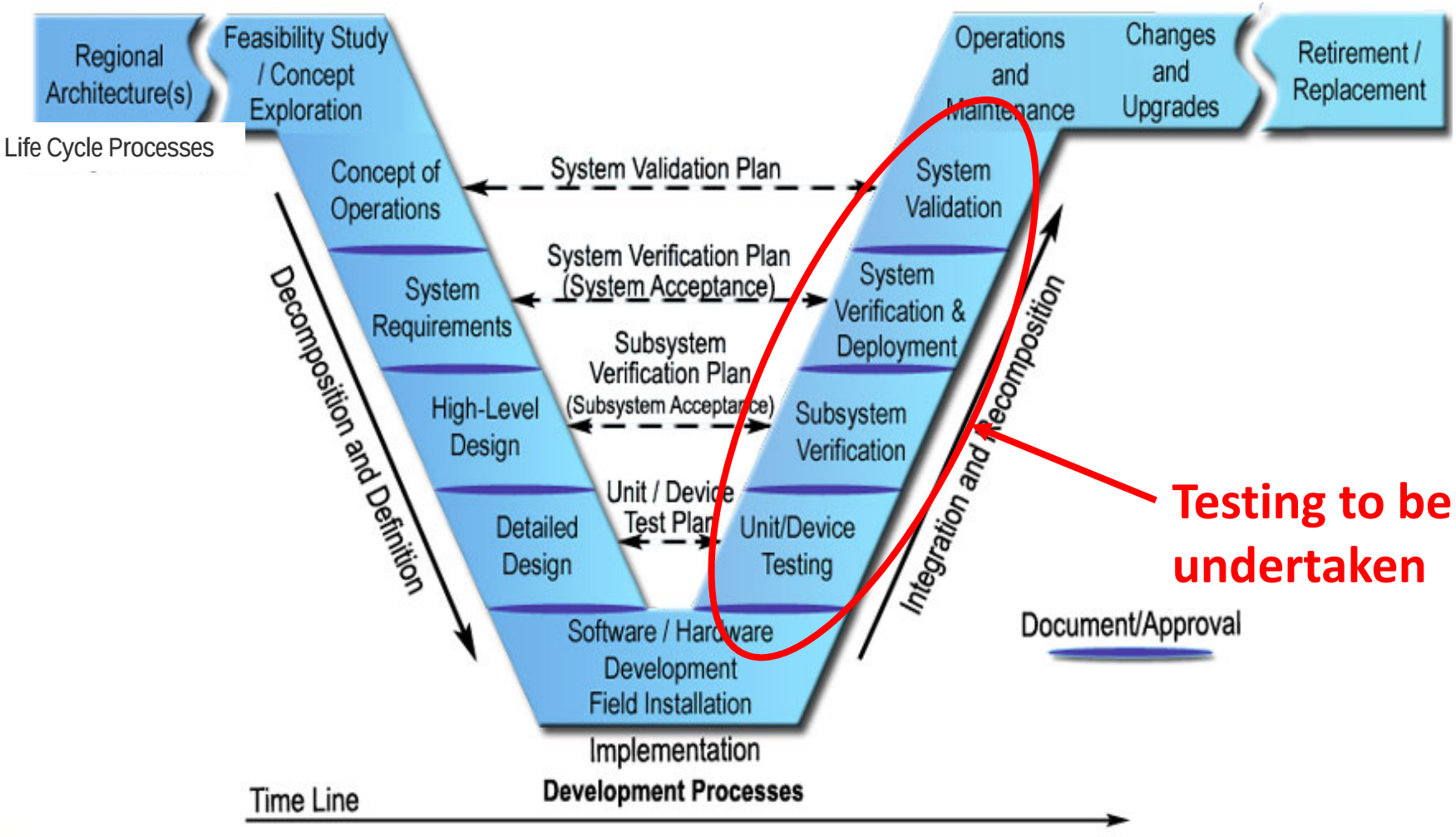
- What is the purpose of testing a CCTV system?
- Review the concept of system life cycle and testing to be undertaken
- Review verification methods
- Describe the testing process in relation to the system life cycle

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



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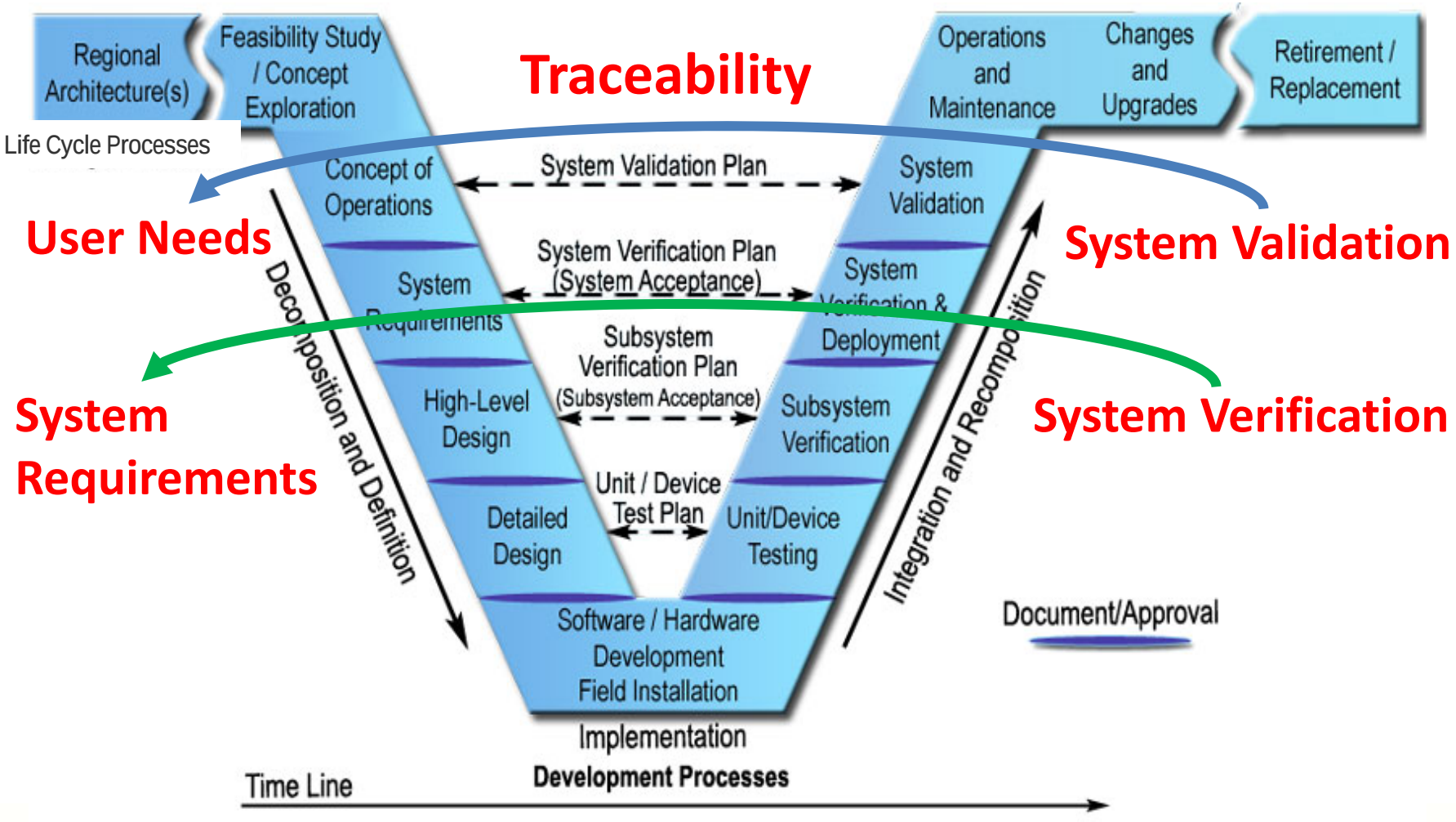
System Life Cycle (cont.)



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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

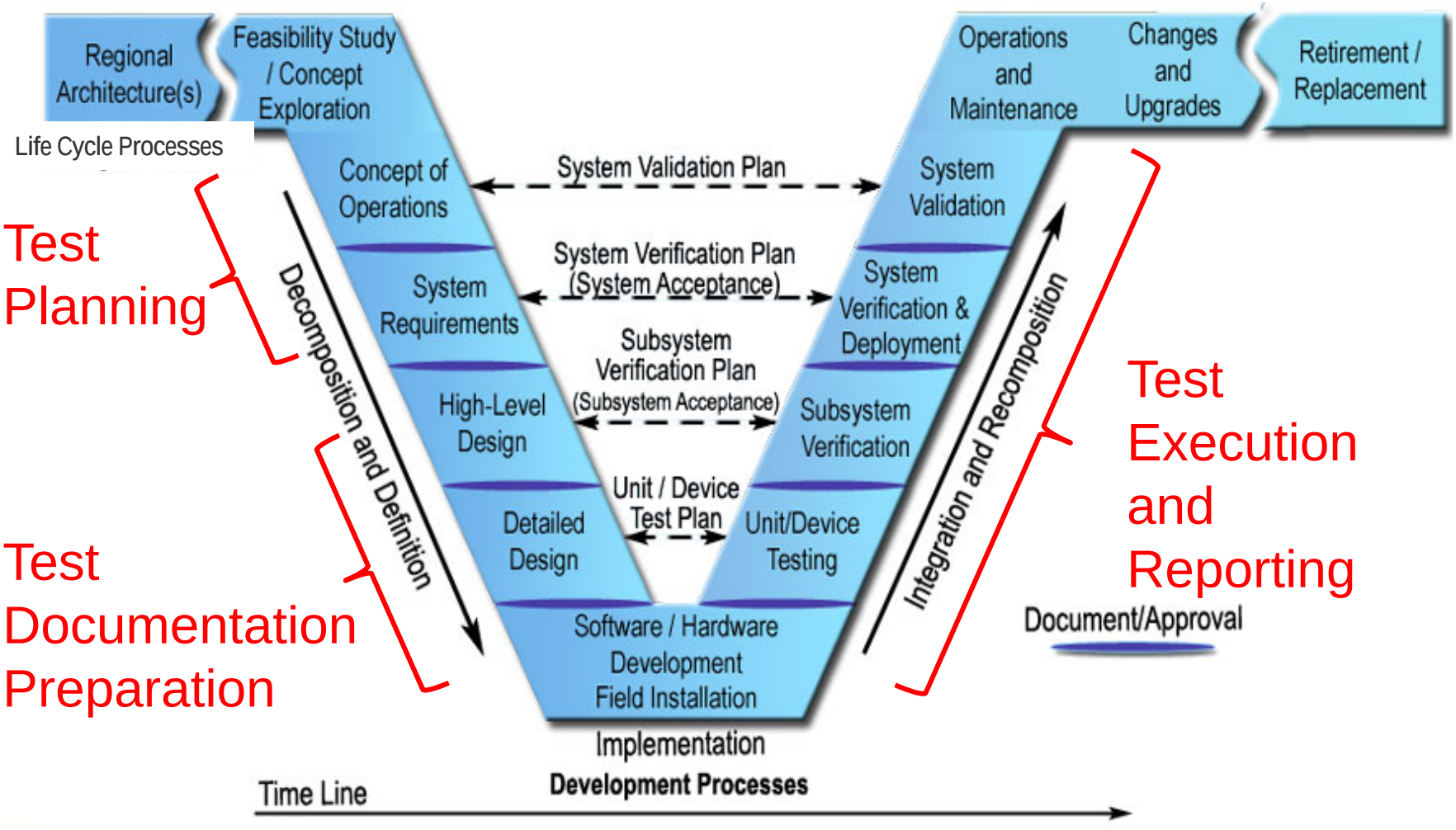
- According to IEEE 829, the testing process provides an objective assessment of the system products throughout each project's life cycle:
  - At the completion of each development iteration
  - At installation and go-live
  - During operations and maintenance
  - System upgrades
  - System replacement

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



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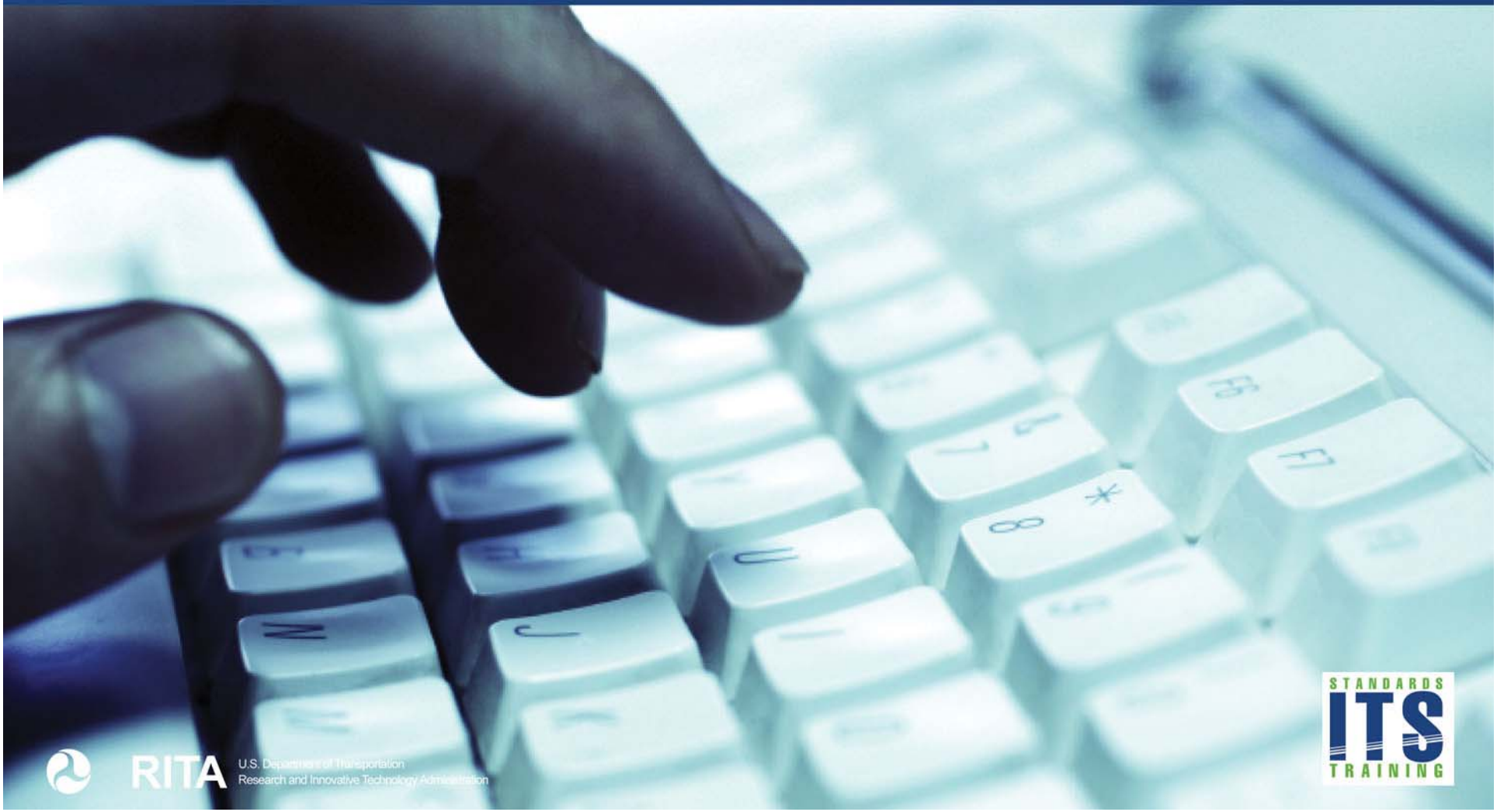

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Which of the following Statements is not correct?

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

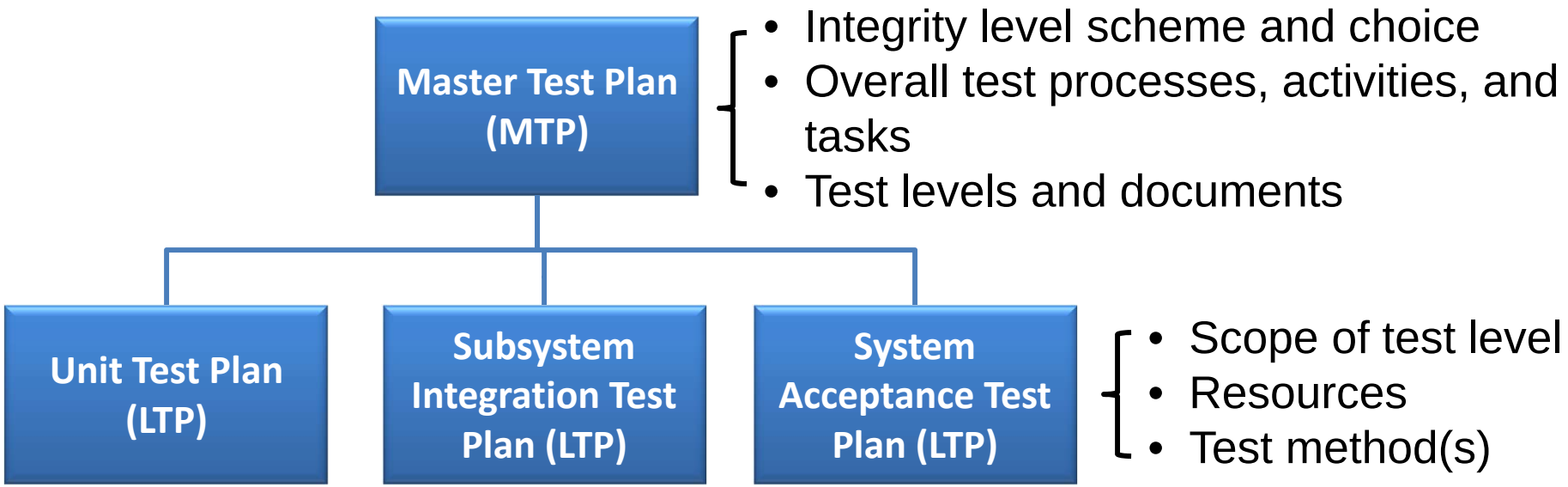
What is a Test Plan?

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).

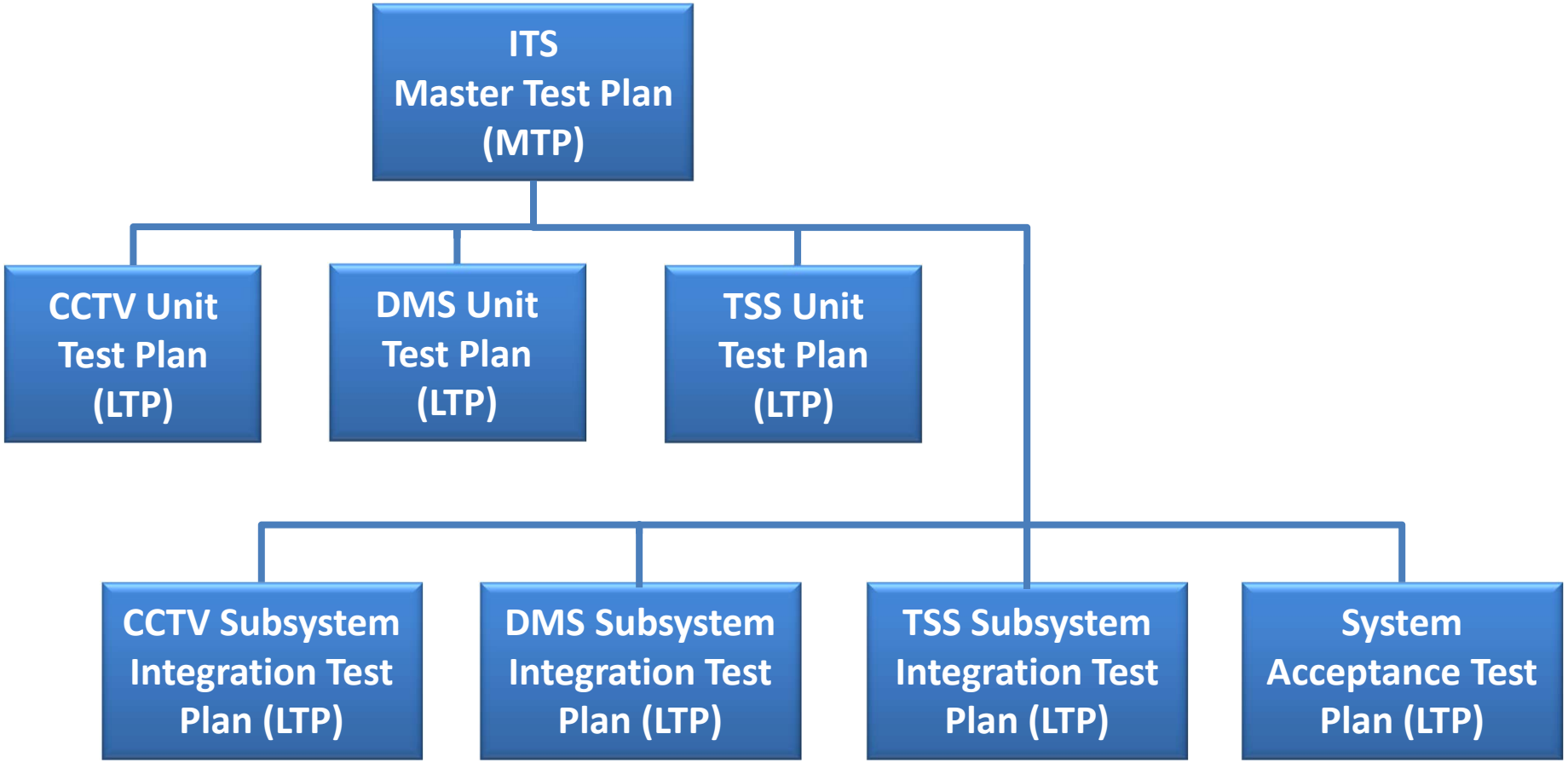
Test Plan is not defined in NTCIP standards!

Structure of Test Plans

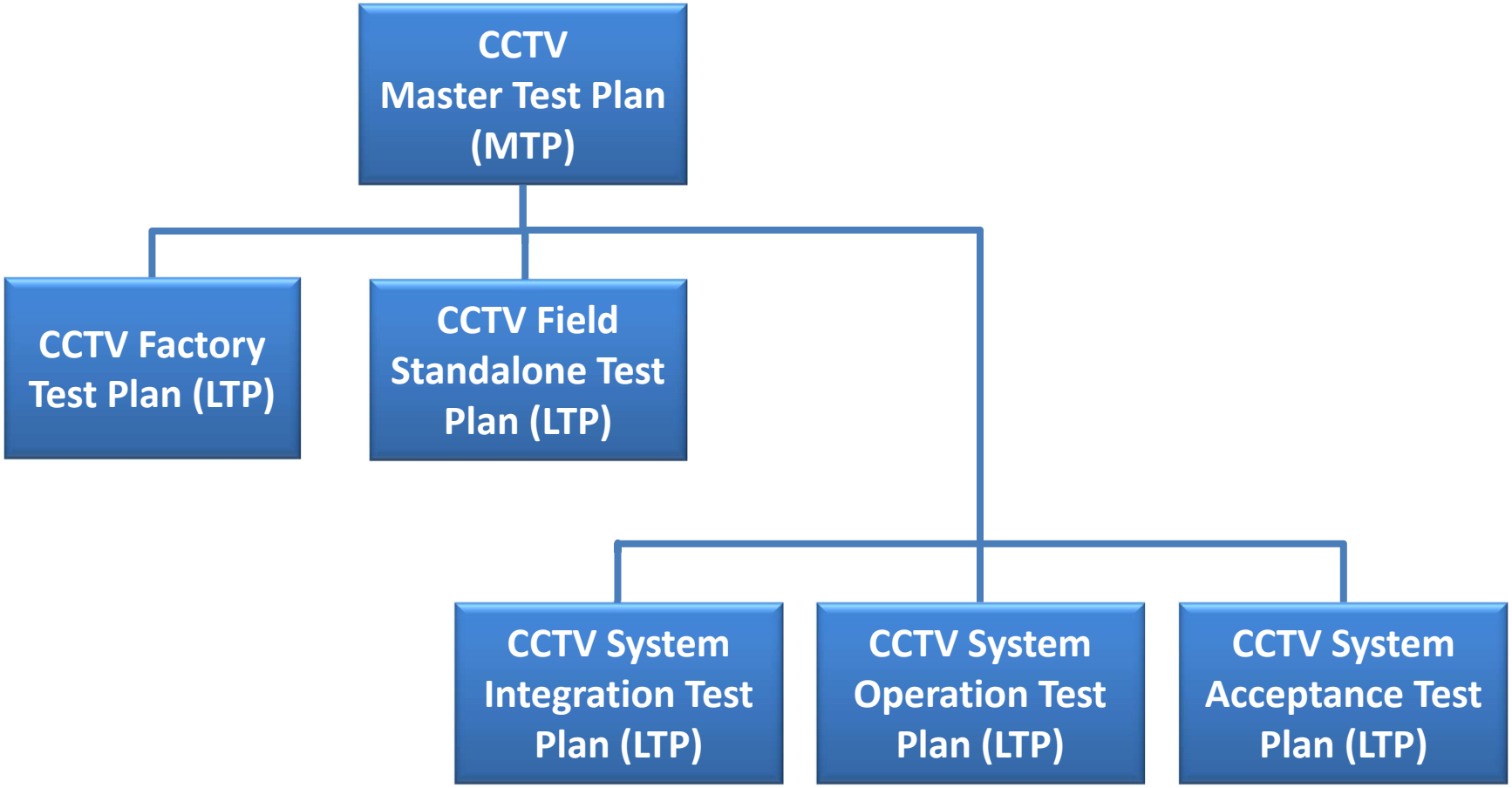


A Master Test Plan may not always be required!

An Example of ITS Test Plans



An Example of CCTV Test Plans



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

CASE STUDY

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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

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

Features to be Tested

Features to be Tested – Camera Control

Rq. ID	Requirement	Dialog	Object Reference and Title NTCIP 1205 Section 3
3.3.2	**Camera Control**	D.3 Generic SNMP SET Interface	
3.3.2.1	Preset Go to Position		3.4.1 presetGotoPosition
3.3.2.2	Go to a Stored Position		3.4.2.presetStorePosition
3.3.2.6	Zoom Operation		3.2.8 rangeZoomLimit 3.3.3 timeoutZoom 3.3.3 positionZoomLens
3.3.2.4	Camera Position Horizontally (Pan)		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

Features to be Tested – CCTV Monitoring

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

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.

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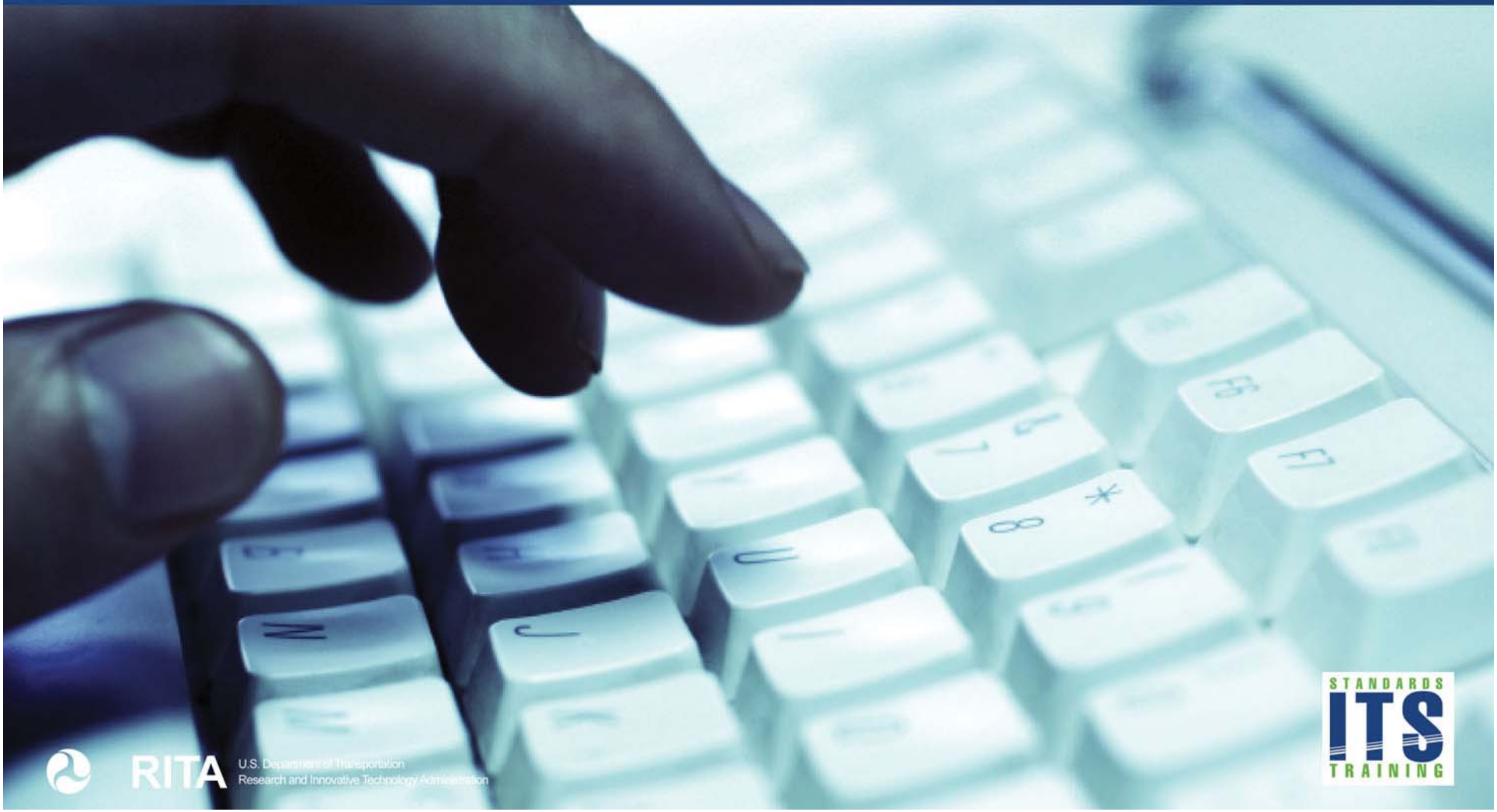

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Which of the following is included in a Level Test Plan (LPT) but not in a Master Test Plan (MTP)?

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

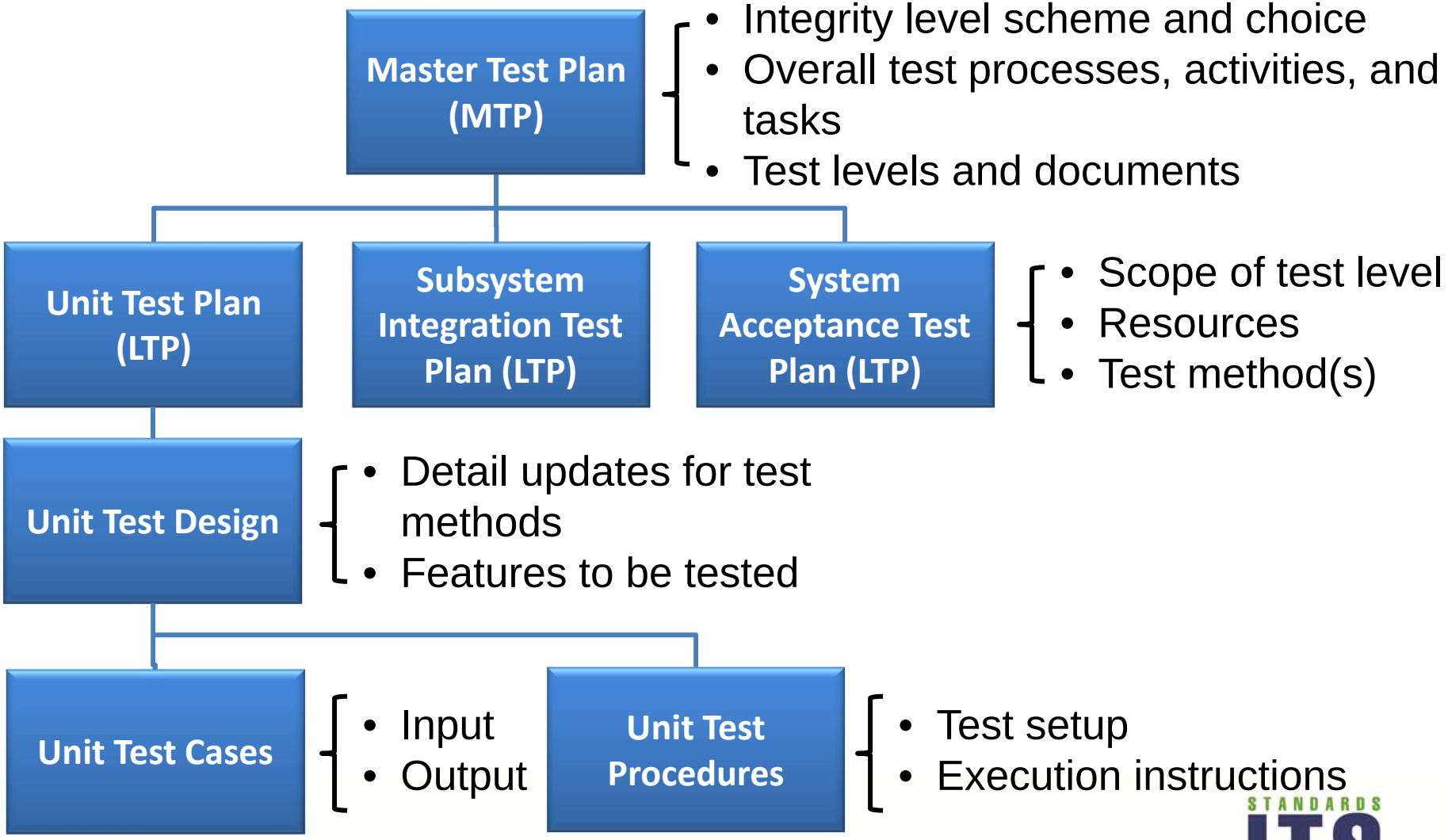
According to IEEE 829:

- 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)

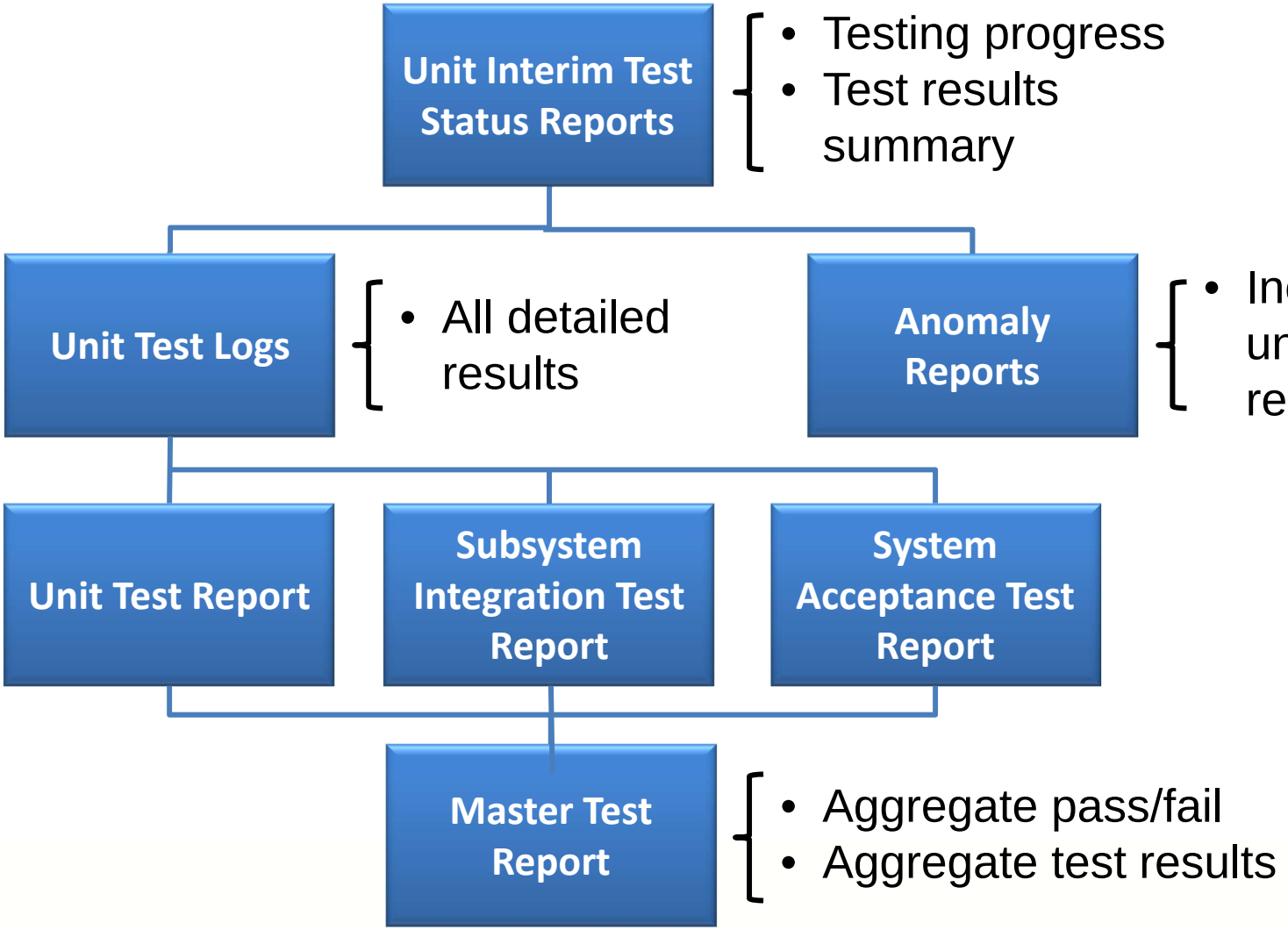
Developed prior to test execution

Documentation during and after test execution

Test Documentation prior to Test Execution



Test Documentation during and after Test Execution



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

Test Design

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

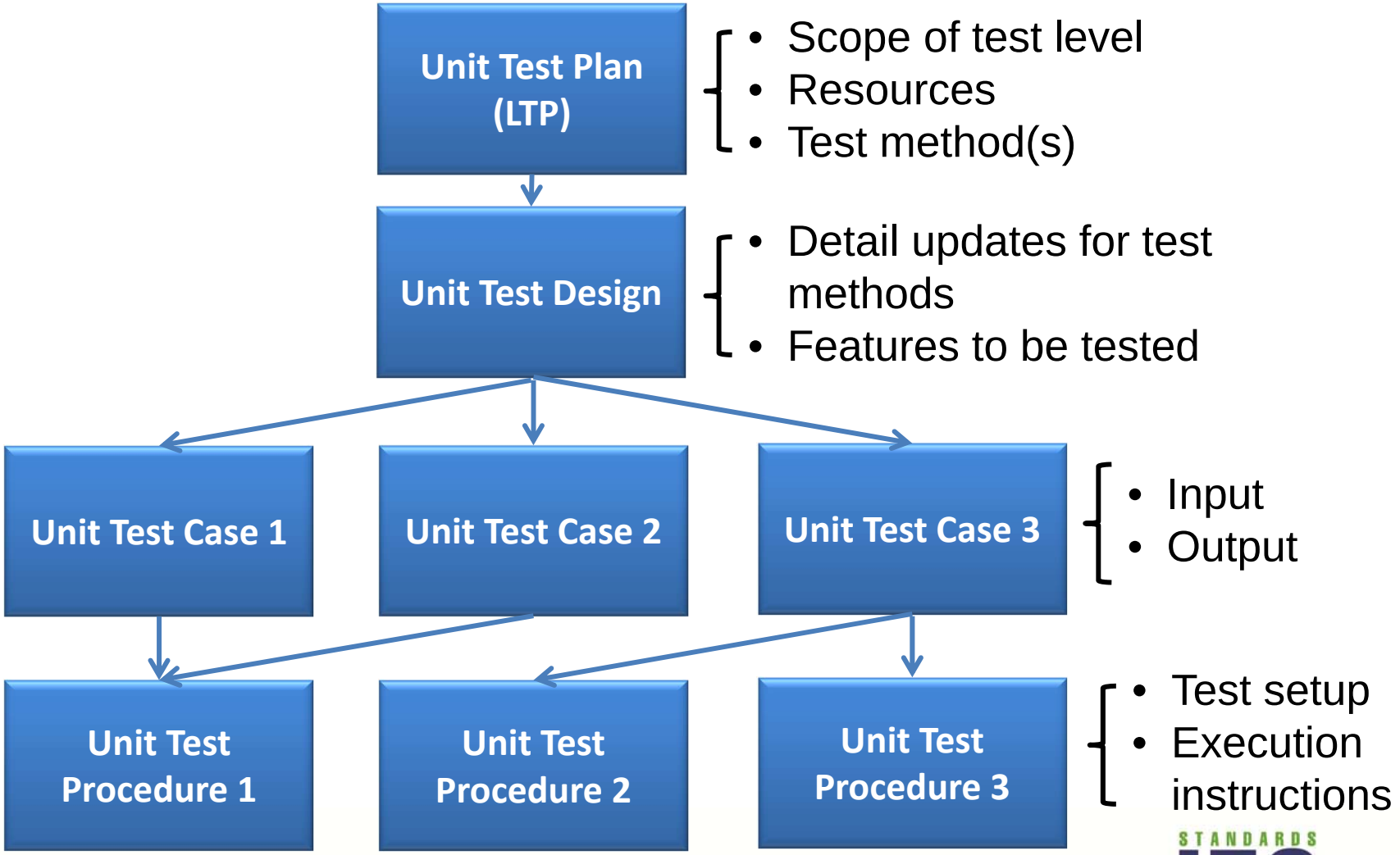
Requirements Test Case Traceability Matrix

From project requirements
or Protocol Requirement List (PRL)

Requirement		**Test Case**	
ID	Title	ID	Title
3.3.1	Data Exchange Requirements for Managing Configuration		
3.3.1.1	Configure Range Maximum Presets		
		TCx.x	Configure Max # of Presets
3.3.1.2	Configure Range - Pan Left Limit		
		TCx.x	Configure Plan Left Limit
3.3.1.x	…. (see A317b for additional requirements)		

Developed during
Test Design

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



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

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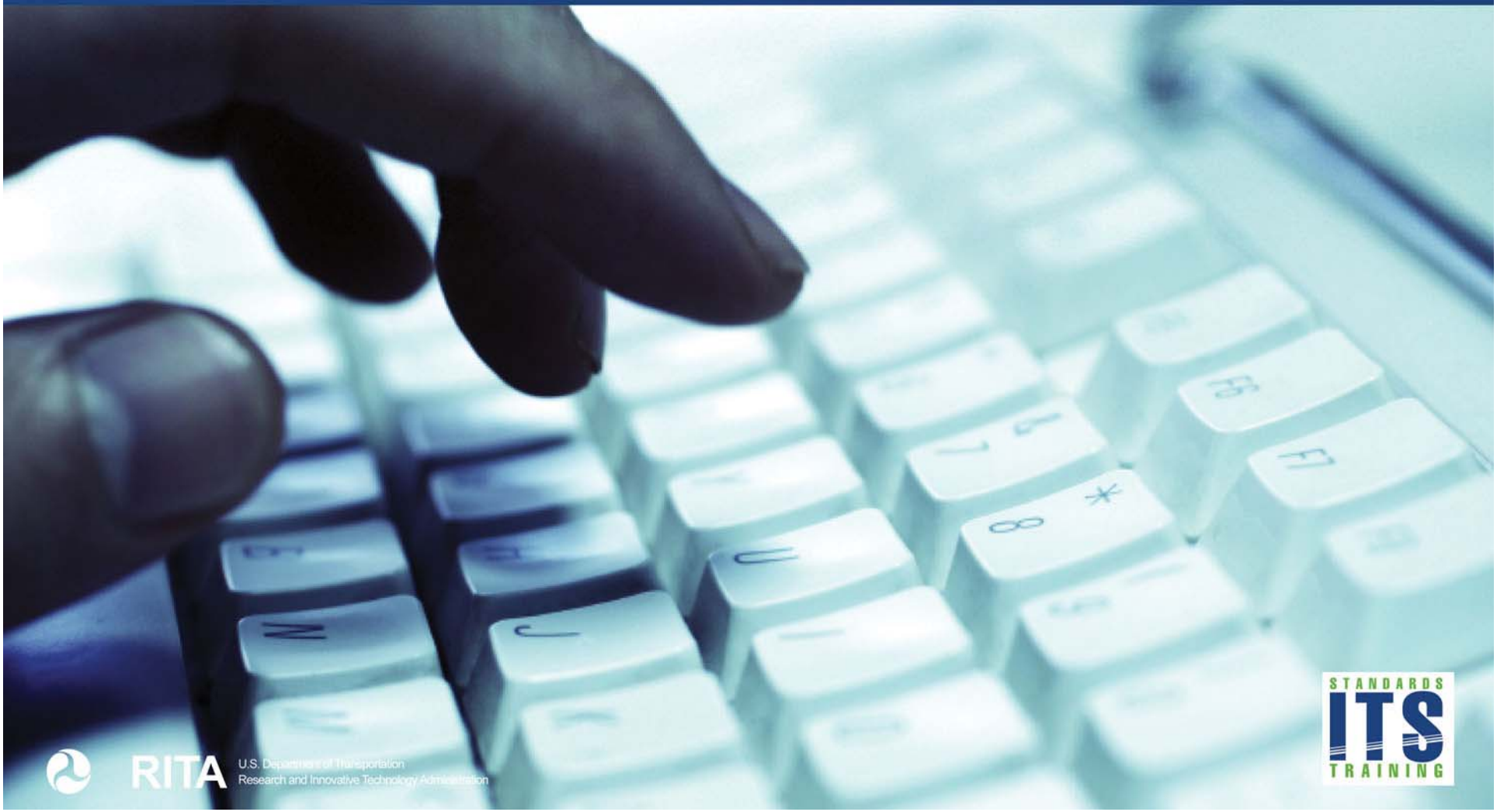

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Which of the following is part of test documentation?

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

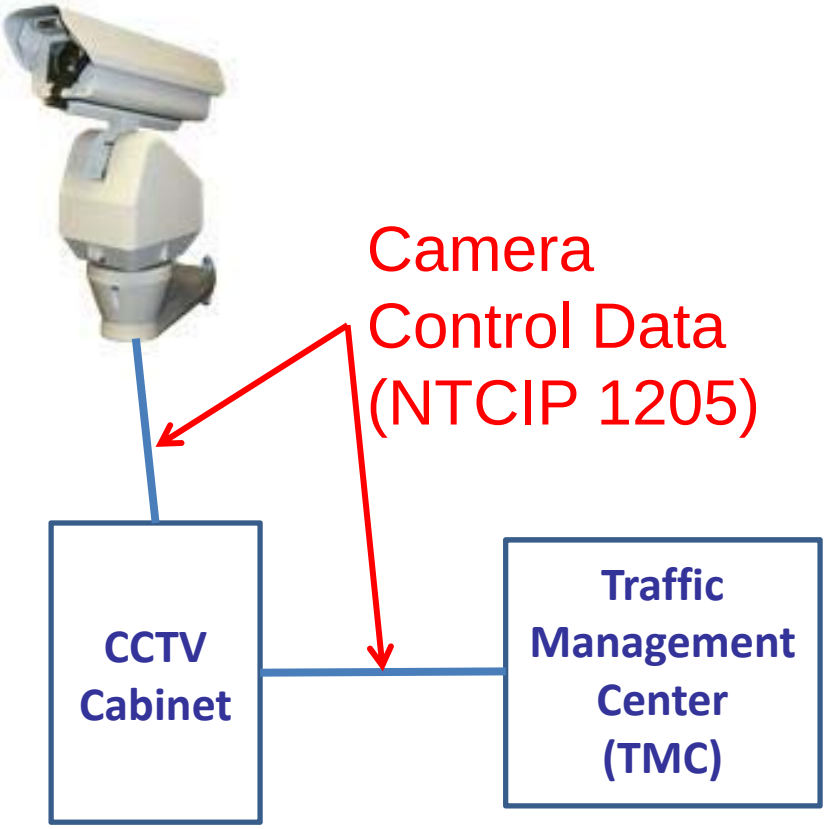
Learning Objective #4 — Describe the application of a good test plan to a CCTV system based on NTCIP 1205 Standard using a sample Requirements to Test Case Traceability Table

- 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)

Communications Network

Test Software (Management Station)

Data Analyzer (as required)

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)

An example of RTM from A317b module

Rq. ID	Requirement	Dialog	Object Reference and Title (NTCIP 1205 Section 3)
3.3.2	**Camera Control**	D.3 Generic SNMP SET Interface	
3.3.2.1	Preset Go to Position		3.4.1 presetGotoPosition
3.3.2.2	Go to a Stored Position		3.4.2.presetStorePosition
3.3.2.6	Zoom Operation		3.2.8 rangeZoomLimit 3.3.3 timeoutZoom 3.3.3 positionZoomLens
3.3.2.4	Camera Position Horizontally (Pan)		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

Develop a Requirements Test Case Traceability Matrix (RTCTM)

Requirement		**Test Case**	
ID	Title	ID	Title
3.3.2	**Camera Control**		
3.3.2.1	Preset Go to Position		
3.3.2.2	Move Camera to a Stored Position		
		C3.01	Preset Position
3.3.2.3	Zoom Operation		
		C3.05	Delta Zoom Motion
		C3.06	Absolute Zoom Motion
		C3.07	Continuous Zoom Motion with Timeout
		C3.08	Continuous Zoom Motion with Stop

Develop a Requirements Test Case Traceability Matrix (RTCTM) (cont.)

Requirement		**Test Case**	
ID	Title	ID	Title
3.3.2	**Camera Control**		
…	…		
		…	…
3.3.2.4	Camera Position Horizontally (Pan)		
		C3.11	Delta Pan Motion
		C3.12	Absolute Pan Motion
		C3.13	Continuous Pan Motion with Timeout
		C3.14	Continuous Pan Motion with Stop

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.)

Test Case: C3.01	**Title:**	Preset Position	
	Description:	This test case stores and moves the camera to preset positions	
	Variables:	Max_Preset	From Project Requirements
		Preset_Speed	From the Test Plan
		Preset_Pan_Position1	From the Test Plan
		Preset_Pan_Position2	From the Test Plan
		Preset_Tilt_Position1	From the Test Plan
		Preset_Tilt_Position2	From the Test Plan
	Pass/Fail Criteria:	The Device Under Test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case	

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

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

Develop Test Documents – Test Procedure (cont.)

Step	Test Procedure	Results
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 >>postionTilt.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

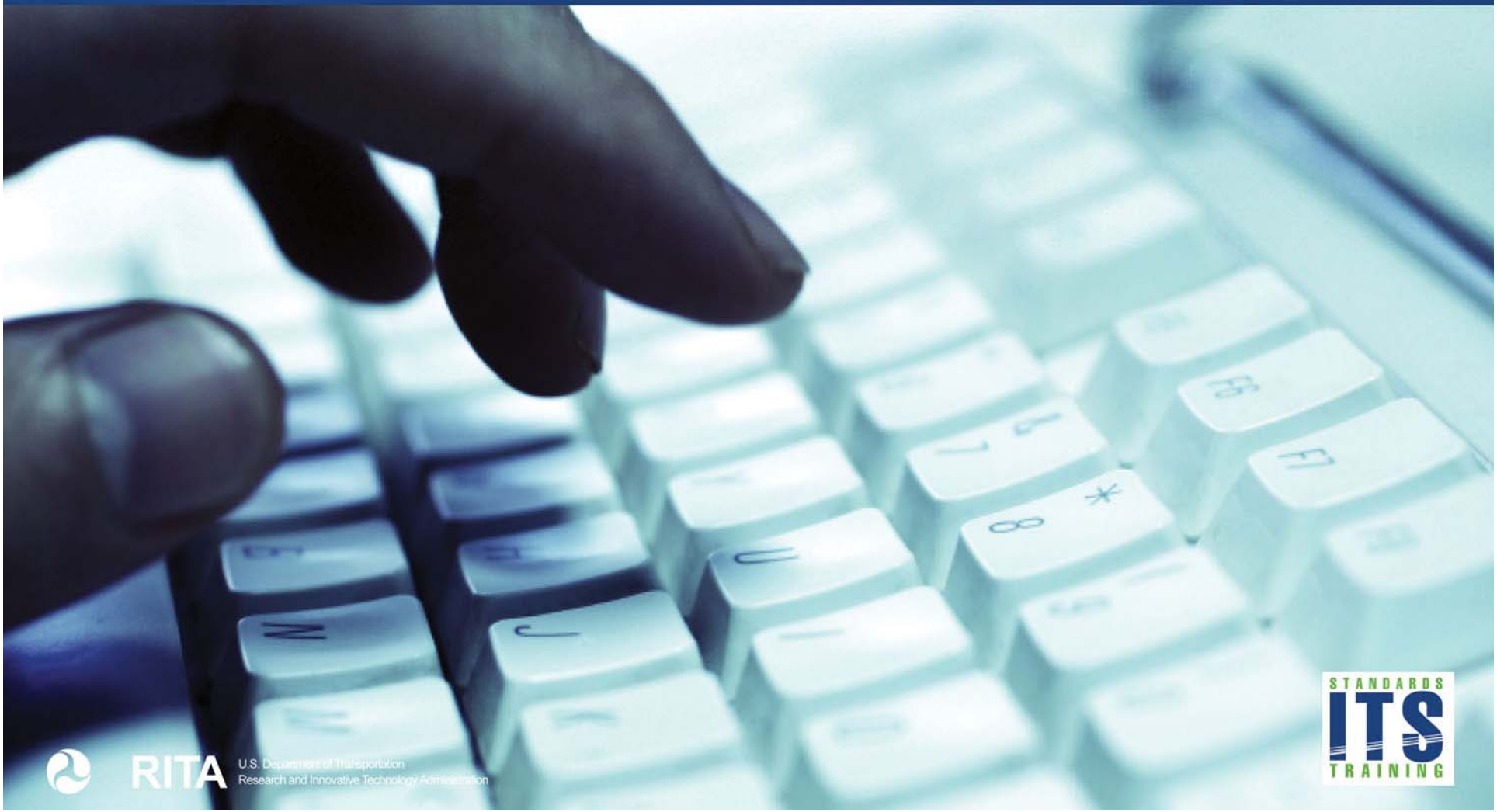
Develop Test Documents – Test Procedure (cont.)

Step	Test Procedure	Results
9	SET the following objects to the values shown: >>positionPan.0 = 02 Preset_Speed Preset_Pan_Position2 >>postionTilt.0 = 02 Preset_Speed Preset_Tilt_Position2	Pass / Fail
10	VERIFY that camera moved to position 2.	Pass / Fail
11	SET presetStorePosition.0 to 2	Pass / Fail
12	SET presetGotoPosition.0 to 1	Pass / Fail
13	VERIFY that camera moved in position 1.	Pass / Fail
14	GET presetPositionQuery.0	Pass / Fail
15	VERIFY that RESPONSE VALUE = 1	Pass / Fail
16	SET presetGotoPosition.0 to 2	Pass / Fail

Develop Test Documents – Test Procedure (cont.)

Step	Test Procedure		Results
17	VERIFY that camera moved in position 2.		Pass / Fail
18	GET presetPositionQuery.0		Pass / Fail
19	VERIFY that RESPONSE VALUE = 2		Pass / Fail
Test Case Results			
Tested By:		Date Tested:	Pass / Fail
Test Case Notes:			

ACTIVITY



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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

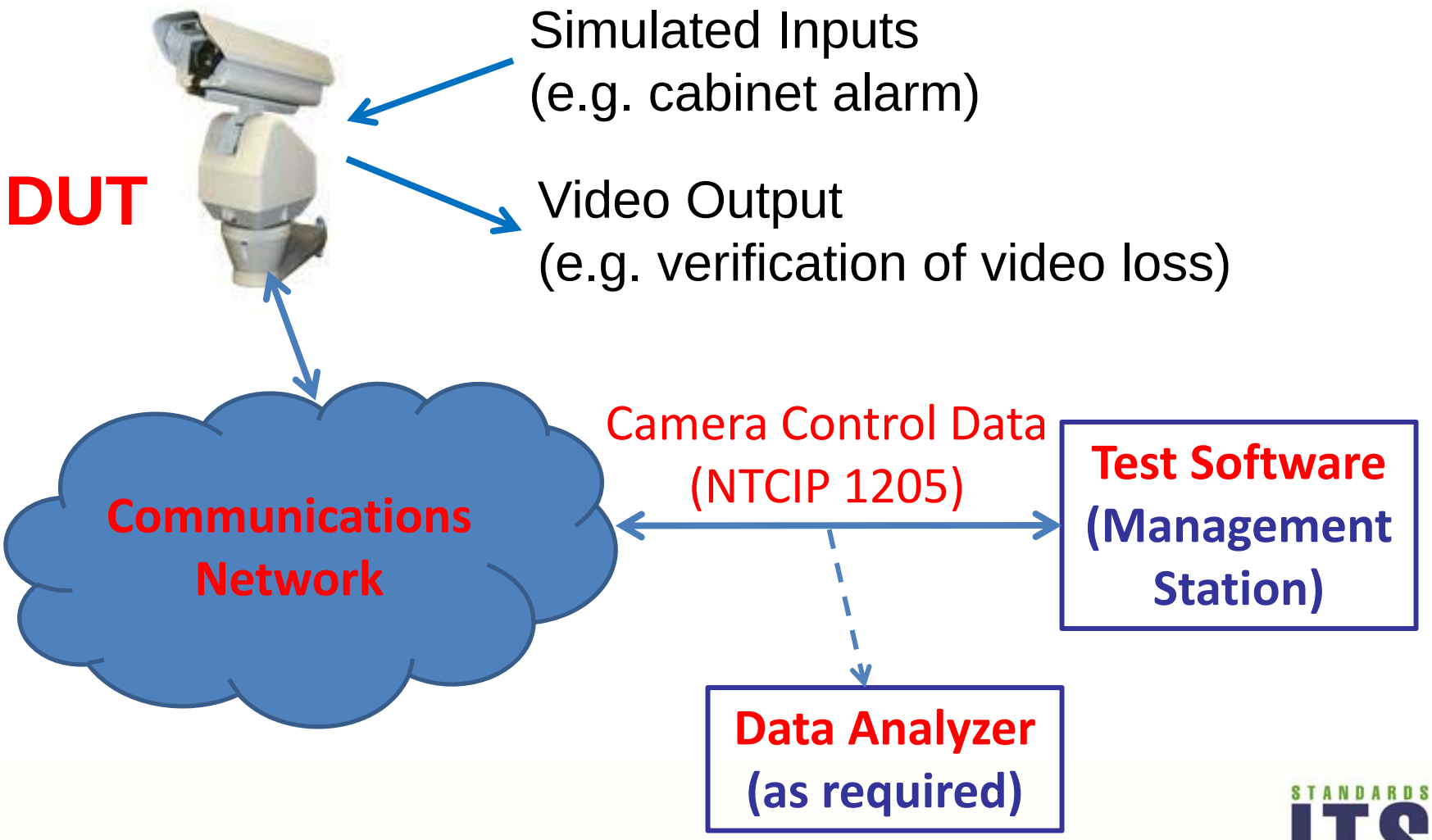
NTCIP Test Tools and Equipment

- 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.)



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

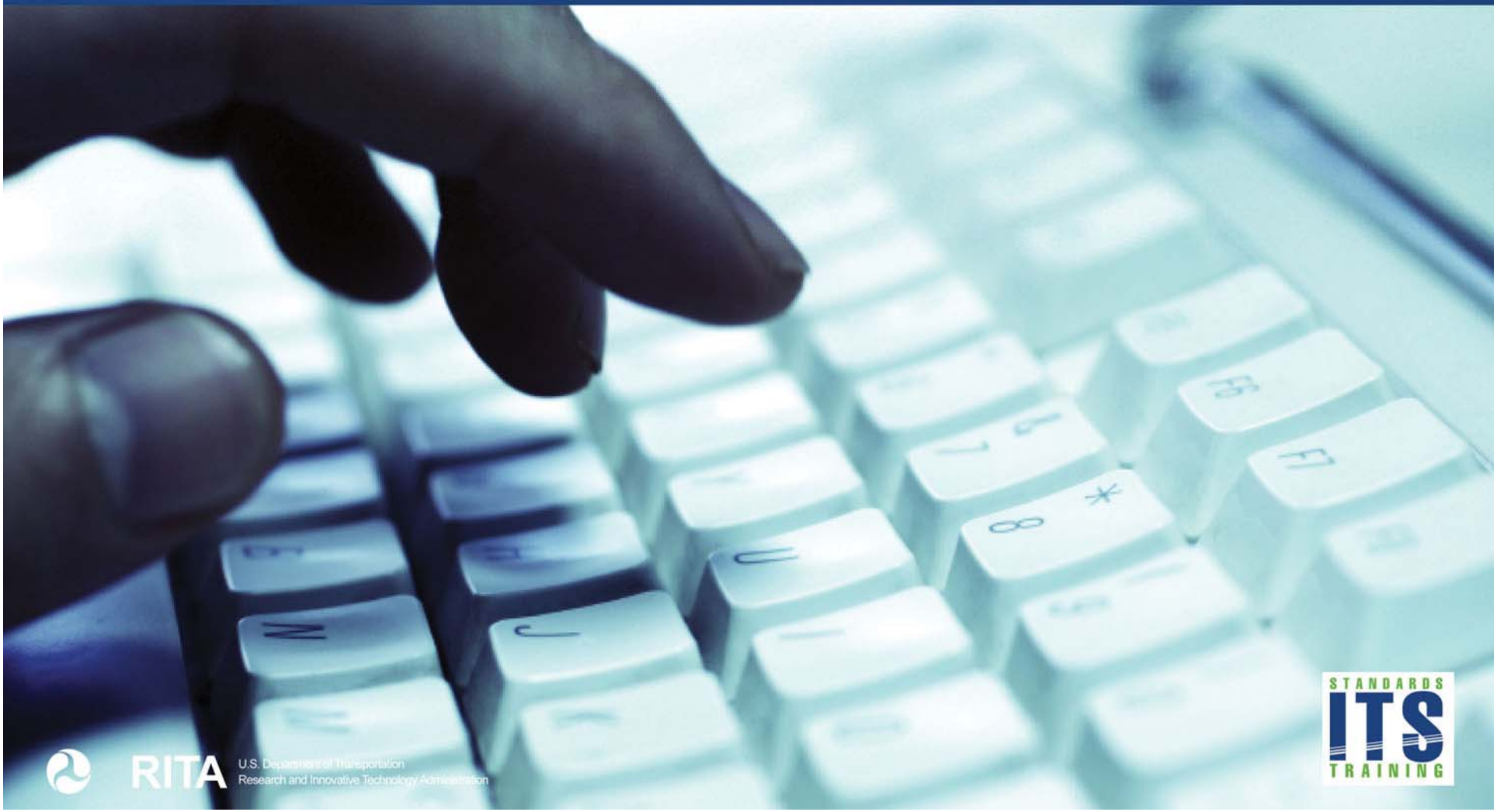
- Testing is a complex process
  - Test planning
  - Test documentation preparation
  - Test execution
  - Test result reporting

- 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

ACTIVITY



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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

- IEEE 829, *IEEE Standard for Software Test Documentation*, IEEE, 1998 or 2008 version.
- *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).
- *NTCIP 8007:2008, National Transportation Communications for ITS Protocol: Testing and Conformity Assessment Documentation within NTCIP Standards Publications*, v01, AASHTO/ITE/NEMA, May 2008.

Resources

- *NTCIP 9001 Version v04, National Transportation Communications for ITS Protocol, The NTCIP Guide,* AASHTO/ITE/NEMA, July 2009.
- *Systems Engineering Guidebook for Intelligent Transportation Systems* Version 3.0, United States Department of Transportation, November 2009.
- PCB Training Modules Available at www.pcb.its.dot.gov/stds_training.aspx

QUESTIONS?

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