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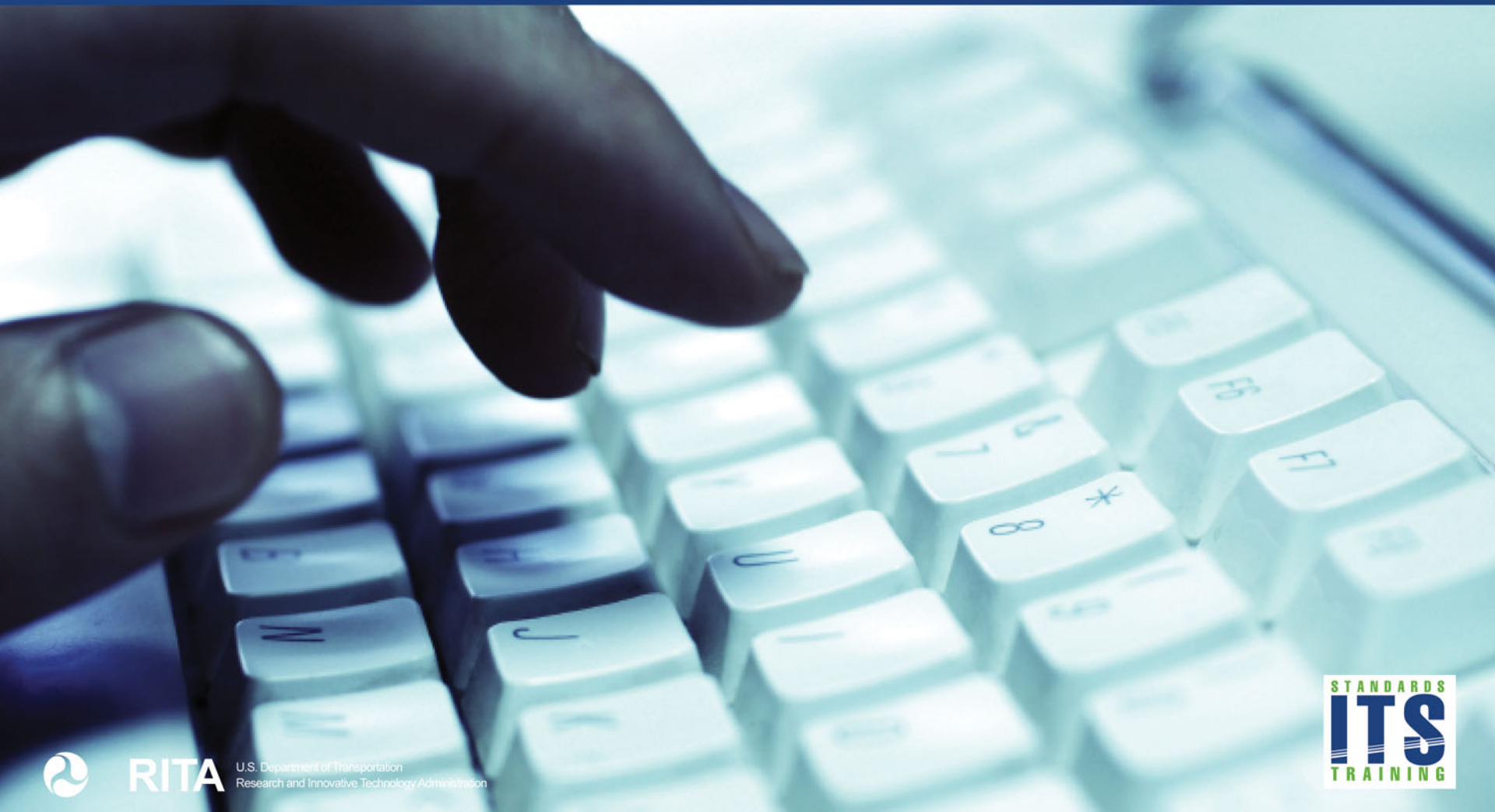

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STANDARDS ITS TRAINING

A312b:
Specifying Requirements for Transportation Sensor Systems (TSS) Based on NTCIP 1209 Standard

Instructor

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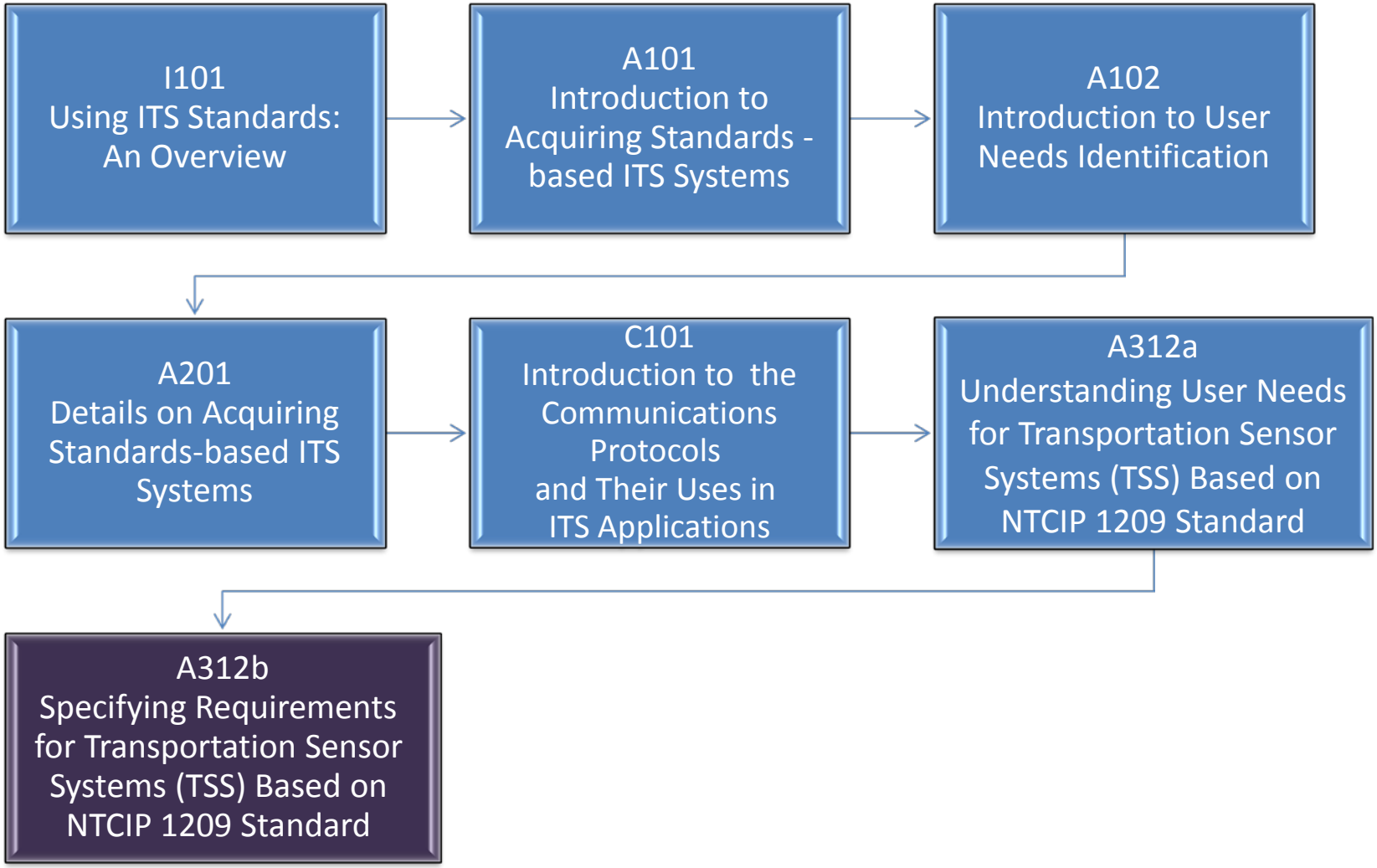
Target Audience

- Traffic engineering staff
- Traffic management center (TMC)/Operations staff
- System developers
- Private and public sector users including manufacturers

Recommended Prerequisite(s)

- I101: Using ITS Standards: An Overview
- A101: Introduction to Acquiring Standards-based ITS Systems
- A102: Introduction to User Needs Identification
- A201: Details On Acquiring Standards-based ITS Systems
- C101: Introduction to the Communications Protocols and Their Uses in ITS Applications
- A312a: Understanding User Needs for Transportation Sensor Systems (TSS) Based on NTCIP 1209 Standard

Curriculum Path (SEP)



Learning Objectives

1. Describe requirements included in the NTCIP 1209 v02 Standard
2. Use the Protocol Requirements List (PRL) to specify an NTCIP TSS interface
3. Achieve interoperability and interchangeability using the Requirements Traceability Matrix (RTM)
4. Incorporate requirements not covered by the standard
5. Explain the NTCIP 1209 v02 SNMP interface and dialogs

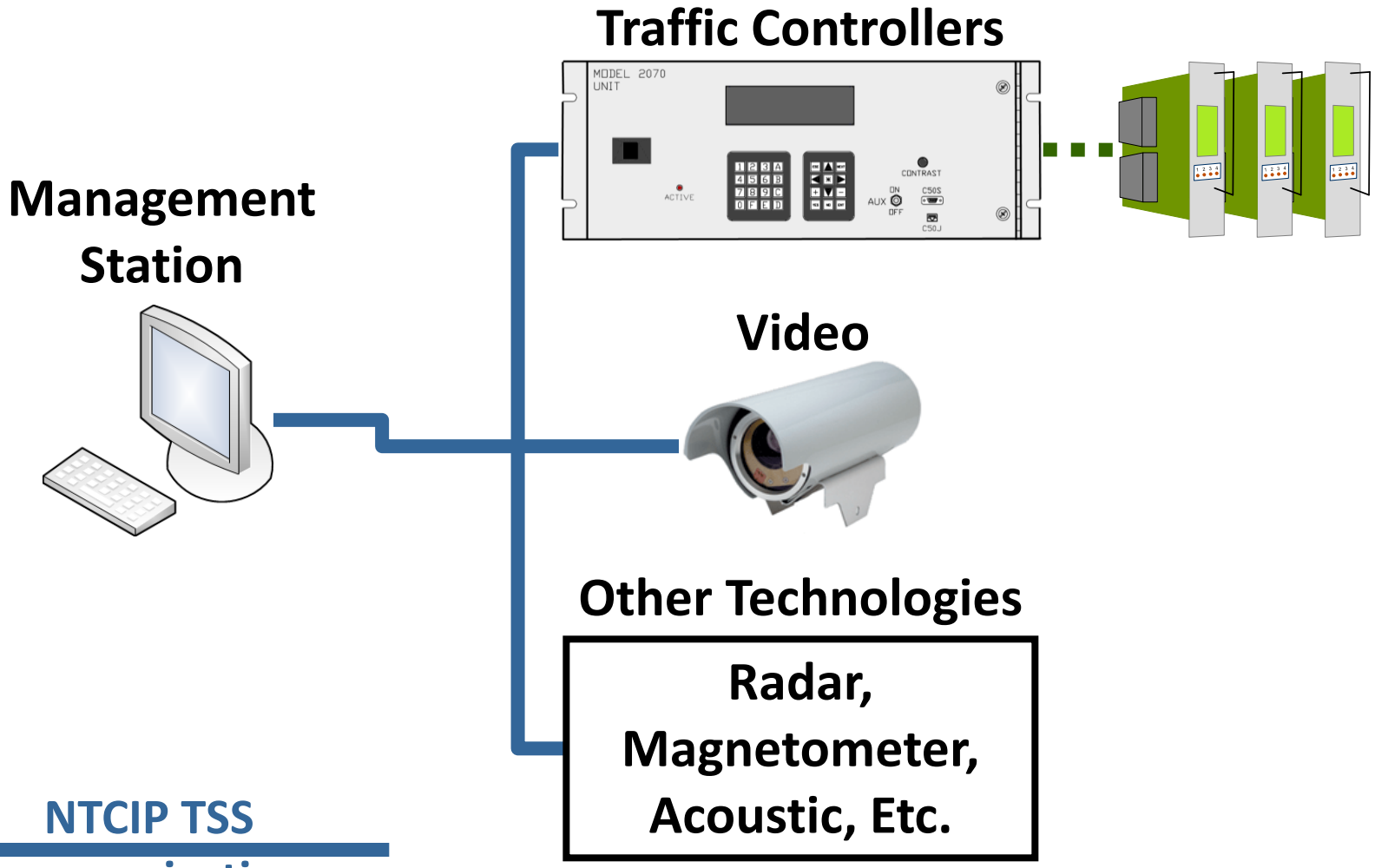
Learning Objective #1 – Describe requirements included in the NTCIP 1209 v02 Standard

- Review components and structure of the NTCIP 1209 v02 Standard
- Use the PRL to trace the user needs to requirements
- Organization and decomposition of requirements of the NTCIP 1209 v02 Standard

Definition of a TSS within NTCIP 1209

A Transportation Sensor System (TSS) is defined as any system or device capable of sensing and communicating near real-time traffic parameters using NTCIP.

NTCIP 1209 Detection Architecture



Graphics: Ralph W. Boaz

History of NTCIP 1209

- NTCIP 1209 v01
  - Oriented towards inductive loop technology
  - Did not contain Systems Engineering Process (SEP) information

- NTCIP 1209 v02
  - Added SEP information
  - Organized towards features
  - Options for selecting requirements for specific technologies (inductive loop and machine vision)
  - Structure conducive for including additional specific technology requirements in the future

Structure of the NTCIP 1209 v02 Standard

1 General

2 TSS Concept of Operations

3 TSS Functional Requirements (includes Protocol Requirements List)

4 TSS Dialogs

5 Management Information Base (MIB)

Structure of the NTCIP 1209 v02 Standard (cont.)

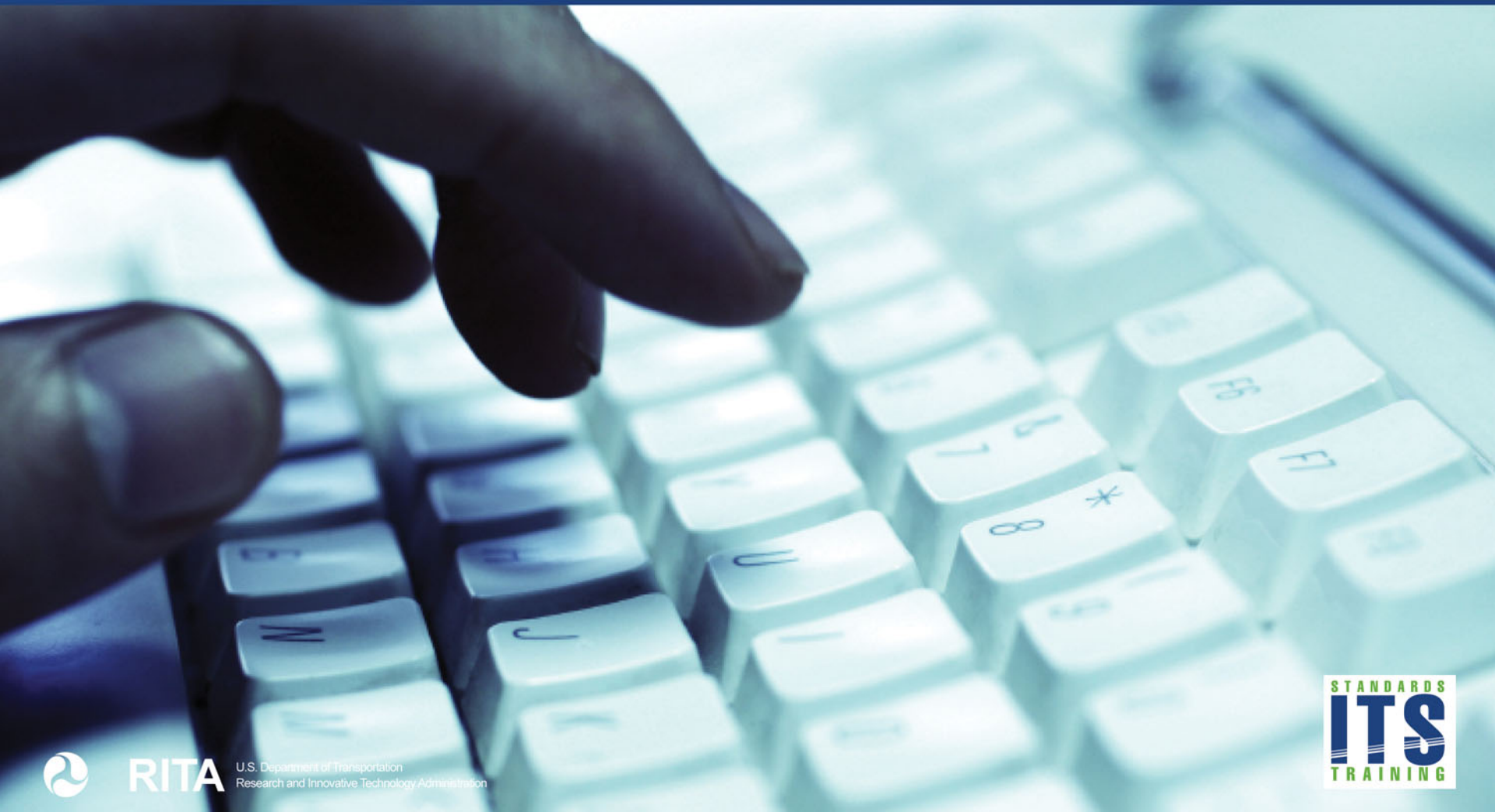
Annex A Requirements Traceability Matrix (RTM)

Annex B Object Tree

Annex C Test Procedures
(placeholder for the future)

Annex D Document Revisions

ACTIVITY



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What tool is used to show the relationship between requirements and dialogs within the standard?

Answer Choices

a) Object Tree
b) Protocol Requirements List (PRL)
c) Requirements Traceability Matrix (RTM)
d) Dialogs

Review of answers

a) Object Tree

Incorrect. The Object Tree shows the hierarchical organization of the objects in the MIB.

b) Protocol Requirements List (PRL)

Incorrect. The PRL shows the relationship of user needs to requirements.

c) Requirements Traceability Matrix (RTM)

Correct. The RTM shows requirements traced to the interface items (dialogs and objects).

d) Dialogs

Incorrect. Dialogs show the exchange of messages.

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
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		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

User Need – Configure Outputs

2.5.1.7 Configure Outputs

This feature allows the management station to configure the outputs to report the state of zones (e.g., assigning an output to a zone, conditioning of outputs to include delay and extension, assigning fail-safe/fail-secure mode of operation, force output on/off).

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Requirements for User Need Configure Outputs

3.4.1.6.1 Get Output Sensor Zone

The TSS shall allow a management station to determine the sensor zone assigned to an output.

3.4.1.6.2 Get Output Failsafe Mode

The TSS shall allow a management station to determine the last fail-safe mode command.

Requirements for User Need Configure Outputs

3.4.1.6.3 Get Output Mode Status

The TSS shall allow a management station to determine the current output mode status of an output.

3.4.1.6.4 Get Output Label

The TSS shall allow a management station to determine the label assigned to an output.

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	..	

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Use the PRL to Trace User Needs to Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.7	Configure Outputs			M	Yes	
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes / No	
		…	…	…	…	

Organization of Requirements

3.4.1 Manage the TSS Configuration

3.4.2 Monitor the Current Status

3.4.3 Collection of Sample Data

3.5 Multi-Version Interoperability

TSS Requirements Are "Well-Formed"

[Actor] [Action] [Target] [Constraint] [Localization]

Actor	Identifies who or what that does the action
Action	Identifies what is to happen
Target	Identifies who or what receives the action
Constraint	Identifies how to measure success or failure of the requirement
Localization	Identifies the circumstances under which the requirement applies

Localization and constraint portions are important but not all requirements will have both

Example TSS Requirement

[Actor] [Action] [Target] [Constraint] [Localization]

3.4.1.6.4 Get Output Label

The TSS shall allow a management station to determine the label assigned to an output.

ACTOR

TARGET

LOCALIZATION

ACTION

3.4.1 Manage the TSS Configuration

3.4.1.1 Identify the TSS (7 reqs)

3.4.1.2 Determine the TSS Capabilities (10 reqs)

3.4.1.3 Control the TSS (14 reqs)

3.4.1.4 Manage Real-Time Clock (RTC) (4 reqs)

3.4.1.5 Manage Sensor Zones (57 reqs)

3.4.1.6 Manage Outputs (11 reqs)

3.4.1.7 Manage Camera (19 reqs)

3.4.2 Monitor the Current Status of the TSS

3.4.2.1 Get System Status (1 req)

3.4.2.2 TSS Sensor Status (11 reqs)

3.4.2.3 Monitor Output States (1 req)

3.4.3 Collection of Sample Data

3.4.3.1 Retrieve Historical Sample Data from the TSS (6 reqs)

3.4.3.2 Get Zone Class Label (1 req)

3.4.3.3 Get Number of Sample Data Entries (1 req)

3.4.3.4 Get Number of Sensor Zone Classes (1 req)

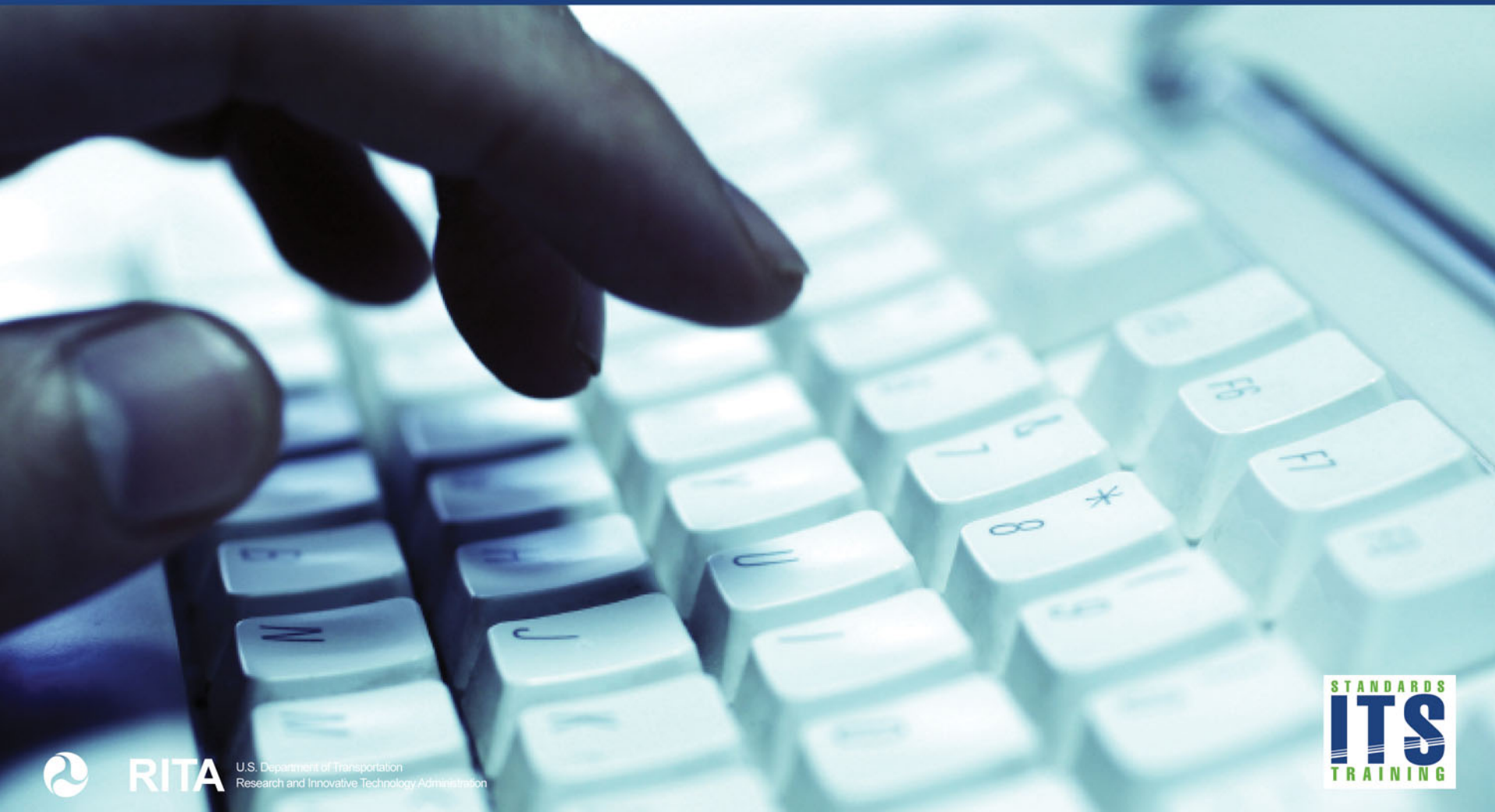
3.5 Multi-Version Interoperability (MVI – Backward Compatibility)

3.5.1 Retrieve Most Recent NTCIP 1209:2005 (v01) Conformant Data Sample Table (5 reqs)

3.5.2 Retrieve NTCIP 1209:2005 (v01) Conformant Historical Sample Data Table (5 reqs)

3.5.3 Loop Output Conditioning Table (12 reqs)

ACTIVITY



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Which of the following is not a major group of requirements in NTCIP 1209 v02?

Answer Choices

a) Manage the TSS configuration
b) Manage the camera
c) Collect sample data
d) Multi-version interoperability (backward compatibility)

Review of answers

a) Manage the TSS configuration

Incorrect. This major group of requirements covers Configuration and Control requirements of the TSS.

b) Manage the camera

Correct. Manage the camera is included in manage the TSS configuration so it is not its own major group. Monitor the TSS is the remaining major group.

c) Collect sample data

Incorrect. This major group of requirements refers to the collection of near real-time data.

d) Multi-version interoperability (backward compatibility)

Incorrect. This major group of requirements refers to the design of the standard in version NTCIP 1209 v01.

Summary of Learning Objective #1

Describe requirements included in the NTCIP 1209 v02 Standard

- Review components and structure of the NTCIP 1209 v02 Standard
- Use the PRL to trace the user needs to requirements
- Organization and decomposition of requirements of the NTCIP 1209 v02 Standard

Learning Objective #2 – Use the Protocol Requirements List (PRL) to specify an NTCIP TSS interface

- Specify performance criteria for functional requirements within the PRL
- Specify limits or ranges for functional requirements within the PRL
- Use Optional Requirements and Predicates within the PRL
- Use the PRL in a Specification

Specifying Performance Criteria for Functional Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.4.1	Retrieve In-Progress Sample Data			Sample:M Speed:M	Yes / N/A	
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes / N/A	
		3.4.3.1.2	Get Historical Sample Volume	Sample:M	Yes / N/A	
		3.4.3.1.3	Get Historical Sample Percent Occupancy	Sample:M	Yes / N/A	
		…	…	…	…	

Specifying Performance Criteria for Functional Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.4.1	Retrieve In-Progress Sample Data			Sample:M Speed:M	Yes / N/A	
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes / N/A	Message shall be sent once per second.
		3.4.3.1.2	Get Historical Sample Volume	Sample:M	Yes / N/A	Message shall be sent once per second.
		3.4.3.1.3	Get Historical Sample Percent Occupancy	Sample:M	Yes / N/A	Message shall be sent once per second.
		…	…	…	…	

Specifying Limits or Ranges on Requirements

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.1.2	Determine TSS Capabilities			M	Yes	
		3.4.1.2.1	Determine Maximum Number of Sensor Zones	M	Yes	
		3.4.1.2.2	Determine Maximum Number of Historical Data Entries per Sensor Zones	Sample:M	Yes / N/A	Max number of Historical Data Entries shall be 4.
		3.4.1.2.3	Determine Maximum Number of Outputs	M	Yes	
		…	…	…	…	

Using Optional Requirements and Predicates

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.2.5	Manage the Camera			Video:M	Yes / N/A	Video Predicate is Specified
		3.4.1.7.1	Set Disable Detection	Video: O	Yes / No / N/A	
		3.4.1.7.2	Get Disable Detection	Video: O	Yes / No / N/A	
		3.4.1.7.3	Set the Build Image Parameter	Video: O.2	Yes / No / N/A	
		3.4.1.7.4	Set Cancel Build In-Progress	Video: O.2	Yes / No / N/A	

Using the PRL in a Specification

- Shows relationship of user needs (features) to requirements
- Primary tool for specifying the NTCIP 1209 interface
- Completed PRL always included in NTCIP 1209 specification

Review of the Predicates Used in NTCIP 1209 v02

- Loop (Inductive Loop)
- Video (Machine Vision)
- RTC (Real-Time Clock)
- Speed
- Timing
- Sample
- Version1

Review of Conformance Status Used in NTCIP 1209 v02

Symbol	Conformance Status
M	Mandatory
O	Optional
O.#	Part of an "Option Group" where "#" indicates the group number (e.g., "O.2" means Option Group 2). If a requirement associated with a particular Option Group is to be supported, then all requirements in the standard that are associated with that Option Group must also be supported.
N/A	Not applicable (i.e., logically impossible in the scope of the standard)

Process for Using the PRL in NTCIP 1209 v02

1) Make a copy of the PRL table
2) Determine which predicates apply to your specification of the NTCIP 1209 v02
3) Step through each User Need in the PRL and indicate whether it is to be included
   a) Circle Yes for all User Needs indicated by an M
   b) Circle Yes or No for all User Needs indicated by an O

Process for Using the PRL in NTCIP 1209 v02 (cont.)

3) Step through each User Need in the PRL and indicate whether it is to be included (cont.)

   c) Circle Yes to all User Needs indicated by <Predicate>:M for the predicates determined in Step #2

   d) Circle Yes or No for all User Needs indicated by a <Predicate>:O and <Predicate>:O#

   e) Verify that all User Needs with a like <Predicate>:O# have a Yes circled

   f) Circle No or N/A as appropriate for all remaining User Needs

Process for Using the PRL in NTCIP 1209 v02 (cont.)

4) Step through each Requirement for each User Need in the PRL that has a circled Yes

   a) Circle Yes for all Requirements indicated by an M

   b) Circle Yes or No for all Requirements indicated by an O

   c) Circle Yes to all Requirements indicated by <Predicate>:M for the predicates determined in Step #2

   d) Circle Yes or No for all Requirements indicated by a <Predicate>:O and <Predicate>:O#

   e) Verify that all Requirements with a like <Predicate>:O# have a Yes circled

Process for Using the PRL in NTCIP 1209 v02 (cont.)

4) Step through each Requirement for each User Need in the PRL that has a circled Yes (cont.)
   f) Circle No or N/A as appropriate for all remaining Requirements
5) Enter any limits or ranges to be applied to any of the included requirements in the PRL
6) Enter any performance criteria for any of the included requirements in the PRL
7) Enter any other special instructions for any requirement in the PRL

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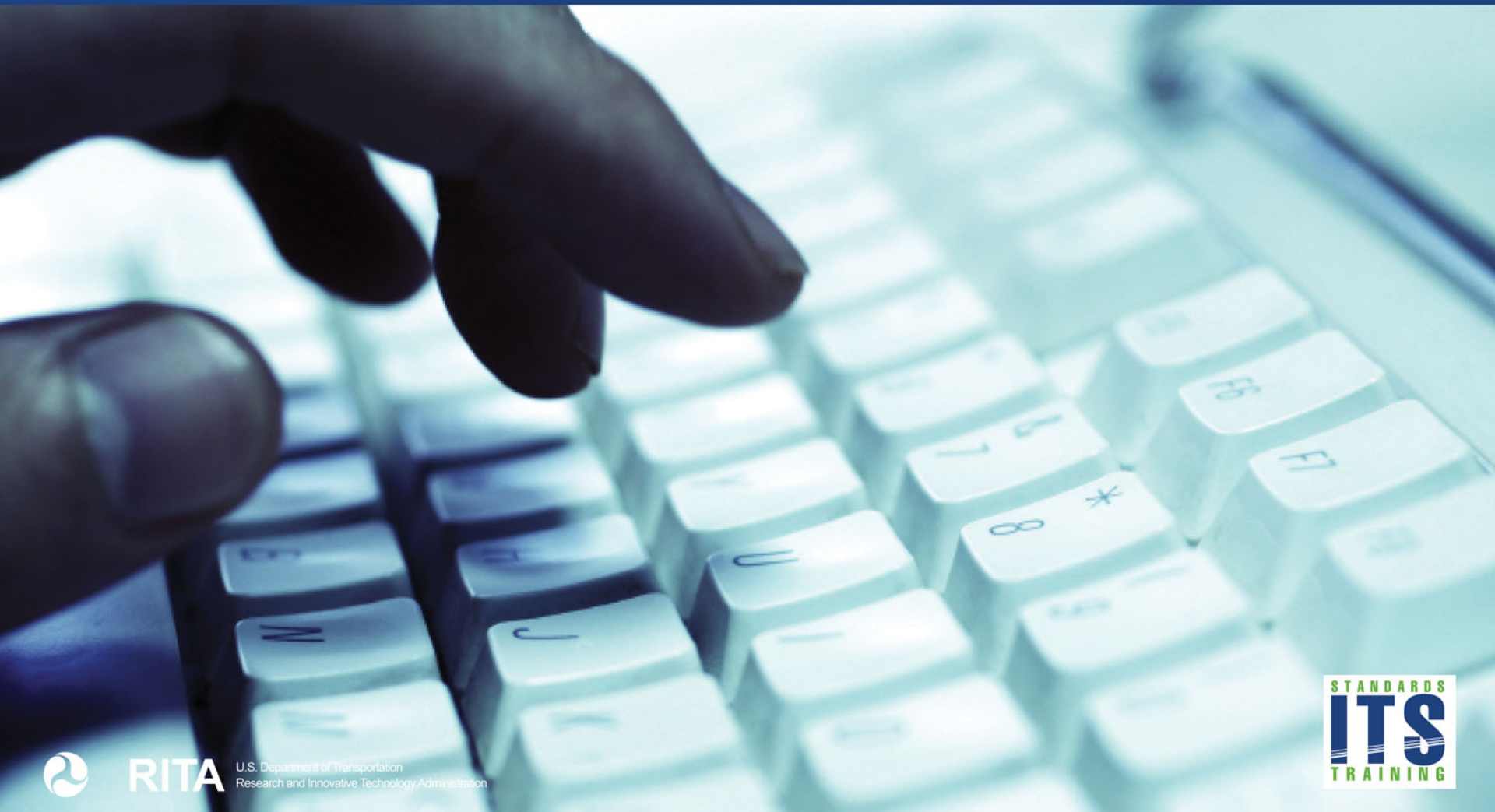

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If Video:O.2 is used in the conformance column of the TSS PRL, what does it mean?

Answer Choices

a) It's the second of 20 optional Video requirements in the standard

b) It identifies the second highest priority optional Video requirement

c) Says that if one Video:O.2 optional requirement is used in the project, all Video:O.2 requirements must be used

d) None of the above

Review of answers

a) It's the second of 20 optional Video requirements in the standard

Incorrect. There is no numbering of requirements in the conformance column of the PRL.

b) It identifies the second highest priority optional Video requirement

Incorrect. There is no priority of requirements indicated in the conformance column of the PRL.

c) Says that if one Video:O.2 optional requirement is used in the project, all Video:O.2 requirements must be used

Correct. This is the method used to identify an option group.

d) None of the above

Incorrect. There is a correct answer listed above.

Summary of Learning Objective #2

Use the Protocol Requirements List (PRL) to specify an NTCIP TSS interface

- Specify performance requirements within the PRL
- Specify limits or ranges on requirements within the PRL
- Use Optional Requirements and Predicates
- Use the PRL in a Specification

Learning Objective #3 – Achieve interoperability and interchangeability using the Requirements Traceability Matrix (RTM)

- How the RTM traces to a single design
- How to determine that a management station and device will be interoperable
- How to determine that two devices will be interchangeable

How the RTM traces to a single design

- Shows relationship of requirements to the specific design items of the interface (dialogs and data objects)
- Used by system software and TSS manufacturers implementing the standard
- Useful for identifying data objects within standard that may be subranged within the specification
- RTM information presented in the standard does not need to be repeated in an agency specification

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	**Get Zone Class Label**				
		4.3.3.5	**Retrieve Sensor Zone Class Labels**		
				5.2.4	**maxSensorZones**
				5.2.10	**functionalCapabilities**
				5.4.5.1	**zoneClassLabel**

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retrieve Sensor Zone Class Labels		
				5.2.4	maxSensorZones
				5.2.10	functionalCapabilities
				5.4.5.1	zoneClassLabel

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retrieve Sensor Zone Class Labels		
				5.2.4	maxSensorZones
				5.2.10	functionalCapabilities
				5.4.5.1	zoneClassLabel

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retrieve Sensor Zone Class Labels		
				5.2.4	maxSensorZones
				5.2.10	functionalCapabilities
				5.4.5.1	zoneClassLabel

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retrieve Sensor Zone Class Labels		
				5.2.4	maxSensorZones
				5.2.10	functionalCapabilities
				5.4.5.1	zoneClassLabel

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retriev e Sensor Z one Class Labels		
				5.2.4	maxSensorZones
				5.2.10	unctionalCapabilities
				5.4.5.1	zoneClassLabel

Using the Requirements Traceability Matrix

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.3.1.7	Get Zone Class Label				
		4.3.3.5	Retrieve Sensor Zone Class Labels		
				5.2.4	maxSensorZones
				5.2.10	functionalCapabilities
				5.4.5.1	zoneClassLabel

How to determine that a management station and device will be interoperable

Interoperability

- Ability of two or more devices to exchange information
- Ability to use the information that has been exchanged

How to determine that a management station and device will be interoperable

- RTM provides for interoperability by defining a specific design to fulfill a communications requirement
- PRL indicates which requirements are supported
- Comparison of the PRLs for the management station and field device allows a quick determination of interoperability

Can the management station and field device fulfill each requirement in a cooperative way?

How to determine that two devices will be interchangeable

Interchangeability

- Same functional and physical characteristics so as to be equivalent in performance and durability (subjective)
- Ability to exchange devices of the same type without alteration to the device or adjoining items (adjustments permitted, subjective)

How to determine that two devices will be interchangeable

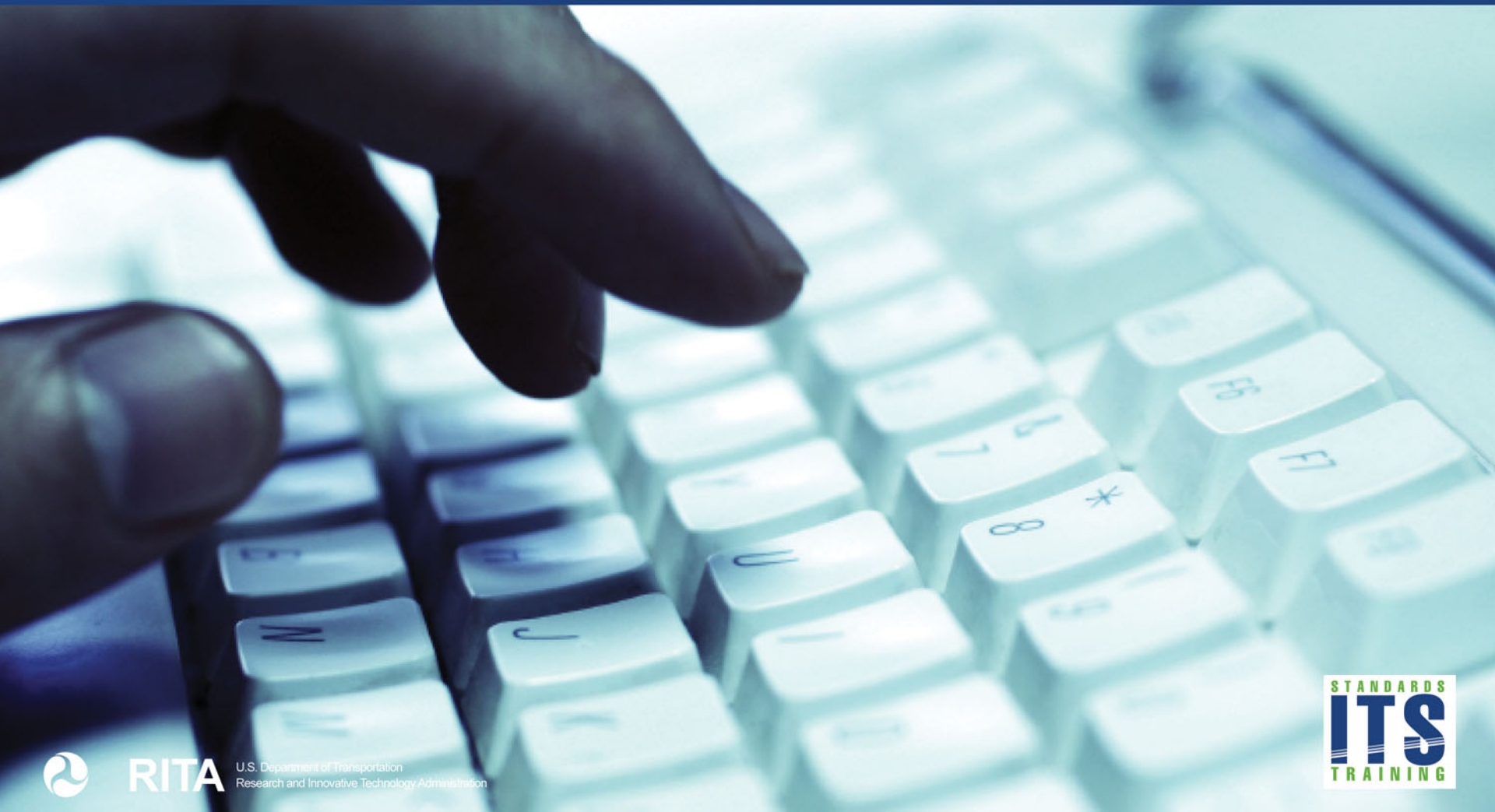
- Must be interoperable in same system
- Compatible on same communications channel
- Standard functions provide same results
- Subjective measures important to the agency (accuracy, maintenance, etc.)

Is it close enough for you?

Off-the-Shelf Interoperability and Interchangeability

- Systems using only standardized requirements, data objects, and dialogs facilitates interoperability and makes interchangeability a possibility
- Systems using requirements, data objects, and dialogs not in the standard make interoperability and interchangeability difficult

ACTIVITY



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Which statement is TRUE in regards to achieving interchangeability for TSS equipment using NTCIP 1209 v02?

Answer Choices

a) Using user needs from the standard guarantees interchangeability

b) Using only requirements, data elements, and dialogs from the standard guarantees interchangeability

c) Adding communications data elements that are not in the standard makes interchangeability impossible

d) Using only requirements, data elements, and dialogs from the standard makes interchangeability a possibility

Review of answers

a) Using user needs from the standard guarantees interchangeability

Incorrect. User needs (features) identified in the standard are at a high level that, by themselves, are not explicit enough for interchangeability.

b) Using only requirements, data elements, and dialogs from the standard guarantees interchangeability

Incorrect. Interchangeability may be affected by other aspects of the TSS device – not just communications.

c) Adding communications data elements that are not in the standard makes interchangeability impossible

Incorrect. Using data elements not in the standard may limit choices of manufacturers willing or able to provide support for those data elements but interchangeability is not impossible technically.

d) Using only requirements, data elements, and dialogs from the standard makes interchangeability a possibility

Correct. Using only the standardized interface items provides the best opportunity for interchangeability.

Which statement is TRUE in regards to the RTM in NTCIP 1209 v02?

Answer Choices

a) Shows relationship of requirements to the specific design items of the TSS interface

b) Shows relationship of user needs to the specific design items of the TSS interface

c) Should always be included in an agency specification

d) Not used until integration of the system and the TSS device

Review of answers

a) Shows relationship of requirements to the specific design items of the TSS interface

Correct. The design items include the data objects and dialogs.

b) Shows relationship of user needs to the specific design items of the TSS interface

Incorrect. User needs are found in the Protocol Requirements List.

c) Should always be included in an agency specification

Incorrect. RTM information is only needed in an agency specification if there is something different from the standard.

d) Not used until integration of the system and the TSS device

Incorrect. The RTM is used by system software and TSS manufacturers implementing the standard.

Summary of Learning Objective #3

Achieve interoperability and interchangeability using the Requirements Traceability Matrix (RTM)

- How the RTM traces to a single design
- How to determine that a management station and device will be interoperable
- How to determine that two devices will be interchangeable

Learning Objective #4 – Incorporate requirements not covered by the standard

- Conditions and context for extending the NTCIP 1209 v02 Standard
- Example of Extending the NTCIP 1209 v02 Standard

Conditions and context for extending the NTCIP 1209 v02 Standard

- Consider the warnings in the previous learning objective
  - Using only standardized requirements, data objects, and dialogs facilitates interoperability and interchangeability
  - Using requirements, data objects, and dialogs not in the standard make interoperability and interchangeability difficult
- If extending the standard, the extensions should be documented and made available to anyone

Conditions and context for extending the NTCIP 1209 v02 Standard (cont.)

- Extending or adding to the TSS Standard can make sense to provide for:
  - Control features and requirements that are specific to certain sensor technologies
  - Data available in sensor technologies not yet covered in the standard

Sensor Technologies That May Have Technology-Specific Features

- **Loop ***
- **Video ***
- **Microwave Radar**
- **Magnetometer**
- **Acoustic**
- **Ultrasonic**
- **Infrared**
- **Laser**
- **Piezoelectric**
- **Pneumatic**
- **Light-Sensitive**

*** – Technology-specific features included in NTCIP 1209 v02**

Example of Extending the NTCIP 1209 v02 Standard

85th Percentile Speed

A speed at or below which 85 percent of people drive at any given location under good weather and visibility conditions may be considered as the maximum safe speed for that location.

Scenario:
We are an agency that wishes to include 85th Pecentile Speed in our TSS Specification

Example of Extending the NTCIP 1209 v02 Standard (cont.)

Assume our specification is arranged as follows -

- **Sections 1-5** cover requirements and specifications identified for the majority of our TSS device
- **Section 6** covers extensions to NTCIP 1209 v02
- **Section 6.1** has some introductory information
- **Section 6.2** identifies needs/features
- **Section 6.3** states requirements
- **Section 6.4** describes dialogs
- **Section 6.5** provides object definitions

Example of Extending the NTCIP 1209 v02 Standard (cont.)

Need / Feature

6.2.1 85th Percentile Speed

This feature allows the management station to obtain the 85th percentile speed from the TSS.

Example of Extending the NTCIP 1209 v02 Standard (cont.)

Requirements

6.3.1 Get 85th Percentile Speed

The TSS shall allow a management station to retrieve the 85th percentile speed for each zone.

6.3.2 Reset 85th Percentile Speed

The TSS shall allow a management station to reset the 85th percentile speed.

Example of Extending the NTCIP 1209 v02 Standard (cont.)

PRL

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
6.2.1	85th Percentile Speed			M	Yes	
		6.3.1	Get 85th Percentile Speed	M	Yes	
		6.3.2	Reset 85th Percentile Speed	M	Yes	

Example of Extending the NTCIP 1209 v02 Standard (cont.)

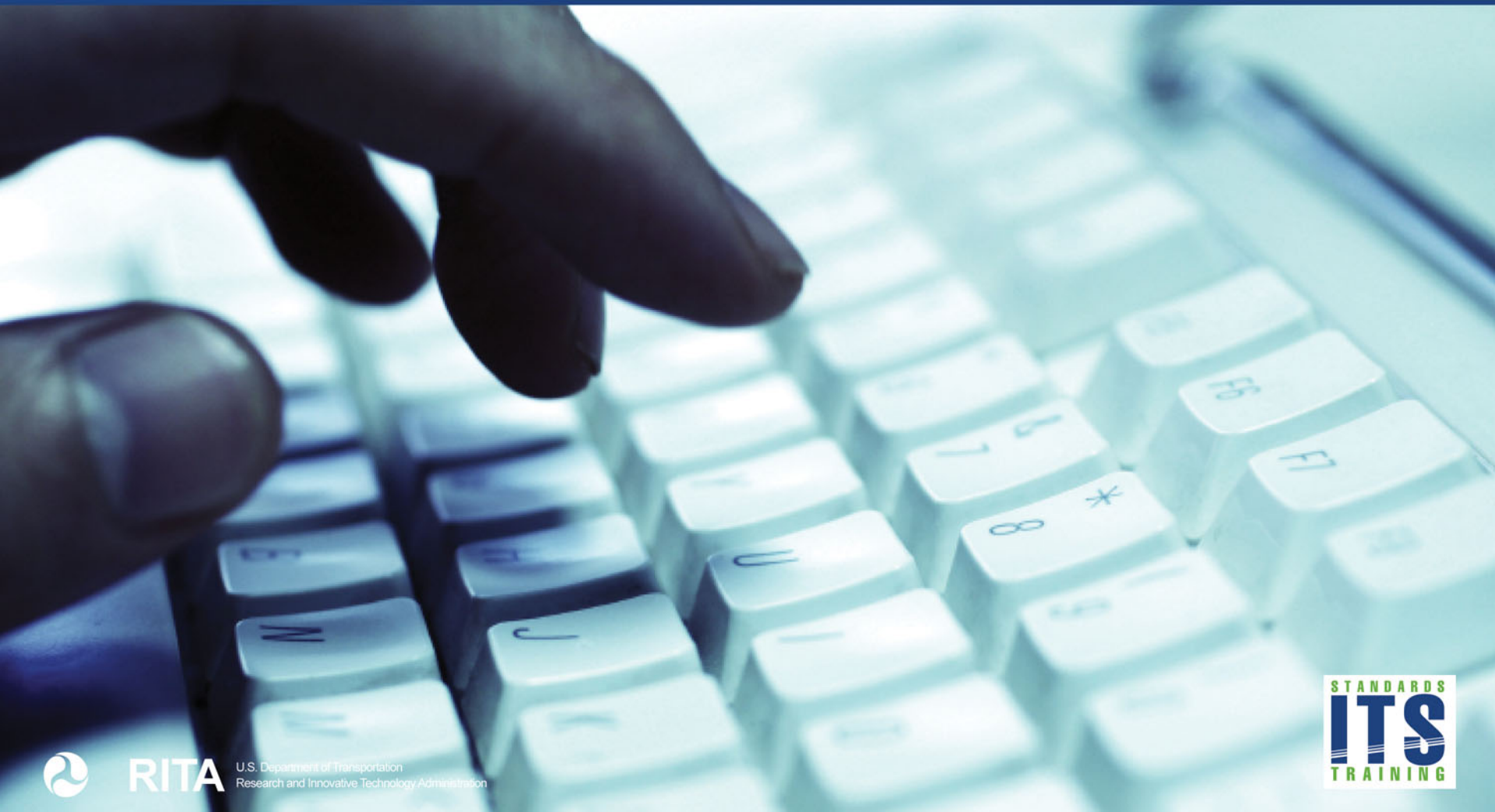
RTM

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
6.3.1	Get 85th Percentile Speed				
		6.4.1	Retrieve 85th Percentile Speed		
				6.5.1	zoneEightyFifthPCTLSpeed
6.3.2	Reset 85th Percentile Speed				
		6.4.2	Initialize 85th Percentile Speed		
				6.5.2	resetZoneEightyFifthPCTLSpeed

Example of Extending the NTCIP 1209 v02 Standard (cont.)

```
zoneEightyFifthPCTLSpeed OBJECT-TYPE
  SYNTAX  INTEGER (1..2550)
  ACCESS  read-only
  STATUS  mandatory
  DESCRIPTION
  "<Definition> Indicates the
  85th percentile speed for a zone.
  <Unit> tenths of km/h
  <Object Identifier>
  1.3.6.1.4.1.1206.4.2.4.3.6.1.1"
  ::= { zoneSpeedDataEntry 1 }
```

ACTIVITY



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Which of the following is justification for extending the standard with a new feature?

Answer Choices

a) When you are not worried about interoperability or interchangeability

b) After you have weighed the risk of making interoperability and interchangeability more difficult against the benefit of the feature

c) When you want to disqualify a second vendor because you have done business with another in the past

d) When a proprietary method to accomplish a feature is more familiar over the method used in the standard

Review of answers

a) When you are not worried about interoperability or interchangeability

Incorrect. If not concerned with interoperability or interchangeability, why use NTCIP at all?

b) After you have weighed the risk of making interoperability and interchangeability more difficult against the benefit of the feature

Correct. It should be a significant enhancement.

c) When you want to disqualify a second vendor because you have done business with another in the past

Incorrect. You may find yourself trapped into one vendor in the future even if they perform poorly.

d) When a proprietary method to accomplish a feature is more familiar over the method used in the standard

Incorrect. If there is a standard method to accomplish the same feature, it is best to use it.

Summary of Learning Objective #4

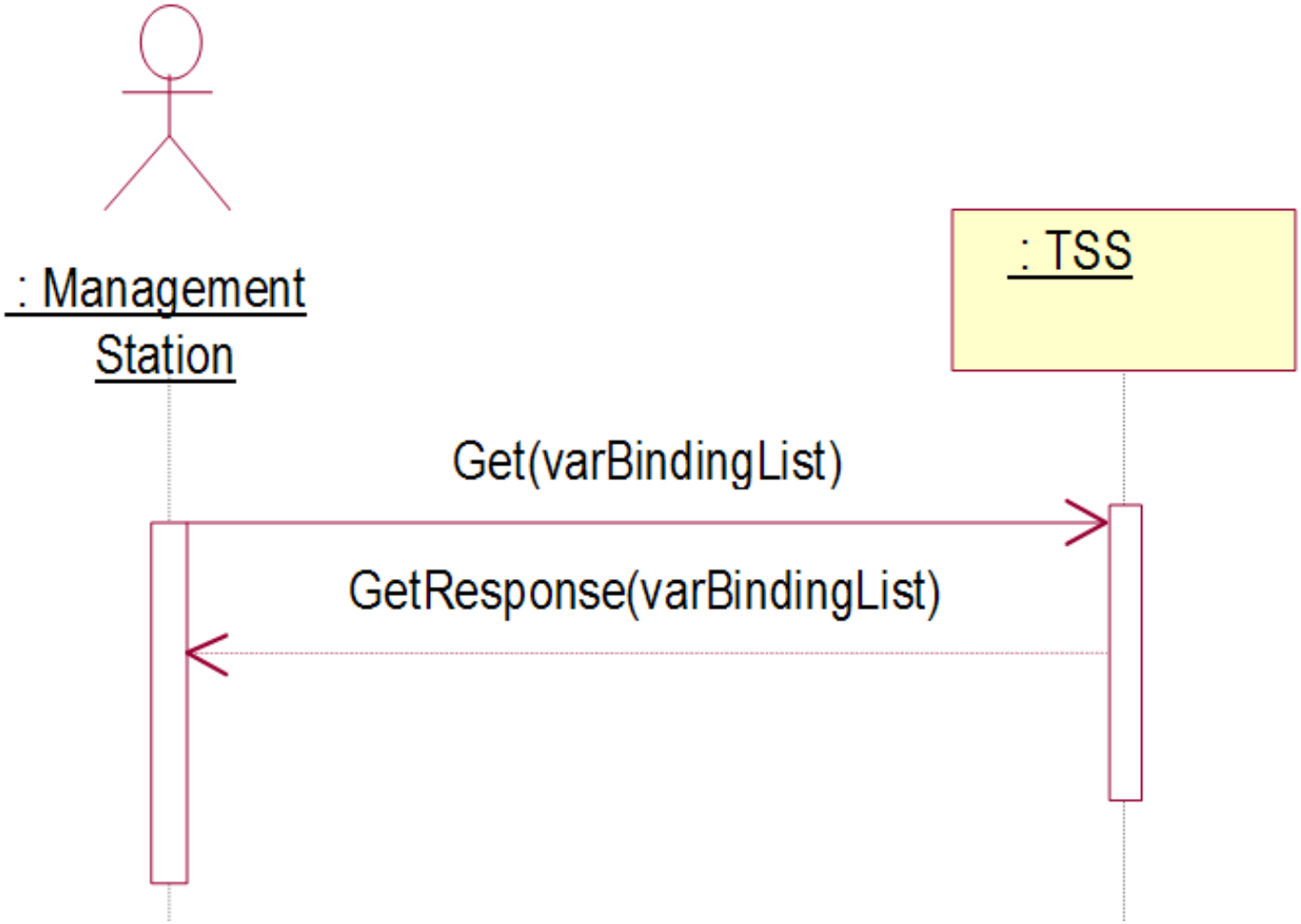
Incorporate Requirements Not Covered by the Standard

- Conditions and context for extending the NTCIP 1209 v02 Standard
- Example of Extending the NTCIP 1209 v02 Standard

Learning Objective #5 – Explain the TSS SNMP Interface and Dialogs

- Example dialogs from NTCIP 1209 v02
- Example of a dialog extension to the standard

A Standard SNMP Get Dialog



Example From NTCIP 1209 v02 – Retrieve Sensor Zone Class Labels Dialog

- Retrieve all of the Class Labels for a given Zone of a TSS device
- MIB defines data structures for storing Zone and Class information within the TSS device
- Management Station knows about these structures and how to reference them to get the desired data
- For this dialog, the Management Station must:

  1) Retrieve the Number of Classes for the Zone
  2) Loop through retrieving the Class Label for each Class of the Zone

Example Data Structures

zoneSequenceTableEntry

Zone Index	# of Sample Data Entries	# of Classes
1	4	3
2	4	3
3	4	3
n	…	…

Example Data Structures (cont.)

zoneClassTableEntry

Zone Index	Class Index	Class Label
1	1	Motorcycle
	2	Sedan
	3	Truck
2	1	Motorcycle
	2	Sedan
	3	Truck
…	…	…

Retrieve Sensor Zone Class Labels Dialog

Where: x = sensorZoneNumber; y = sampleZoneClass

a) (Precondition) The management station shall determine that the sensorZoneNumber is less than or equal to the maxSensorZones. The TSS supports sampling features

b) The management station shall GET zoneSequenceTableEntry:numSensorZoneClass.x

c) sampleZoneClass = zoneSequenceTableEntry:numSensorZoneClass.x from Step b

Retrieve Sensor Zone Class Labels Dialog (cont.)

Where: x = sensorZoneNumber; y = sampleZoneClass

d) The management station shall GET zoneClassLabel.y.x

e) If zoneClassEntry is greater than 0, then zoneClassEntry = zoneClassEntry - 1 and go to Step d

f) Retrieval of class labels for this sensor zone is complete

Retrieve 85th Percentile Speed Dialog

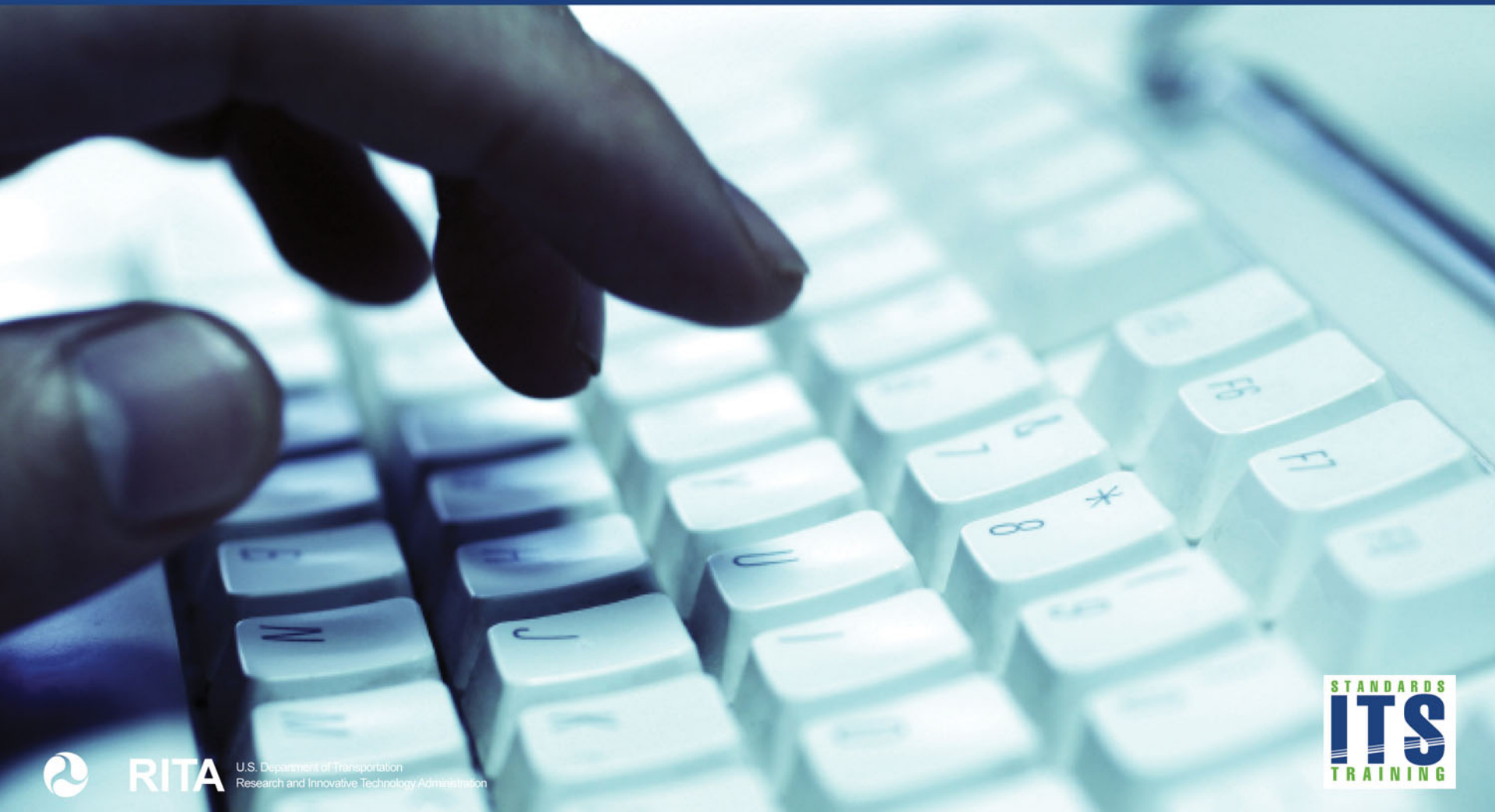
Where: x = sensorZoneNumber

a) (Precondition) The management station shall determine that the sensorZoneNumber is less than or equal to the maxSensorZones.

b) The management station shall GET zoneSpeedDataEntry:zoneEightyFifthPCTLSpeed.x

c) Retrieval of 85th Percentile Speed for this sensorZoneNumber is complete

ACTIVITY



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Which statement is TRUE concerning Dialogs used in defining a TSS interface?

Answer Choices

a) A Dialog is best defined by graphical pictures

b) A Dialog is not necessary when adding features outside of the standard

c) A Dialog is only necessary if there are several exchanges of messages

d) A Dialog is important to defining the exchange of messages to accomplish a requirement

Review of answers

a) A Dialog is best defined by graphical pictures

Incorrect. There are multiple ways to define a Dialog.

b) A Dialog is not necessary when adding features outside of the standard

Incorrect. Requirements for features that are outside of the standard require dialogs also.

c) A Dialog is only necessary if there are several exchanges of messages

Incorrect. Every exchange of data has a dialog, even if it is only a standard SNMP SET, GET, or GET NEXT operation.

d) A Dialog is important to defining the exchange of messages to accomplish a requirement

Correct. This is critical for software developers to implement the interface.

Summary of Learning Objective #5

Explain the TSS SNMP Interface and Dialogs

- Example dialogs from NTCIP 1209 v02
- Example of a dialog extension to the standard

What We Have Learned

1. Describe ***requirements*** included in the NTCIP 1209 v02 Standard
2. Use the ***Protocol Requirements List (PRL)*** to specify an NTCIP TSS interface
3. Achieve interoperability and interchangeability using the ***Requirements Traceability Matrix (RTM)***
4. Incorporate requirements ***not covered*** by the standard
5. Explain the TSS SNMP interface and ***dialogs***

Resources

- *Systems Engineering Guidebook for Intelligent Transportation Systems Version 3.0*
- *IEEE 830-1988 Recommended Practice for Software Requirements Specifications*
- *National Transportation Communications for ITS Protocol Object Definitions for Transportation Sensor Systems (TSS) Version 02*
- *ITS PCB Training http://www.pcb.its.dot.gov*

QUESTIONS?

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