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Joint Program Office

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Ken Leonard, Director
ITS Joint Program Office
Ken.Leonard@dot.gov

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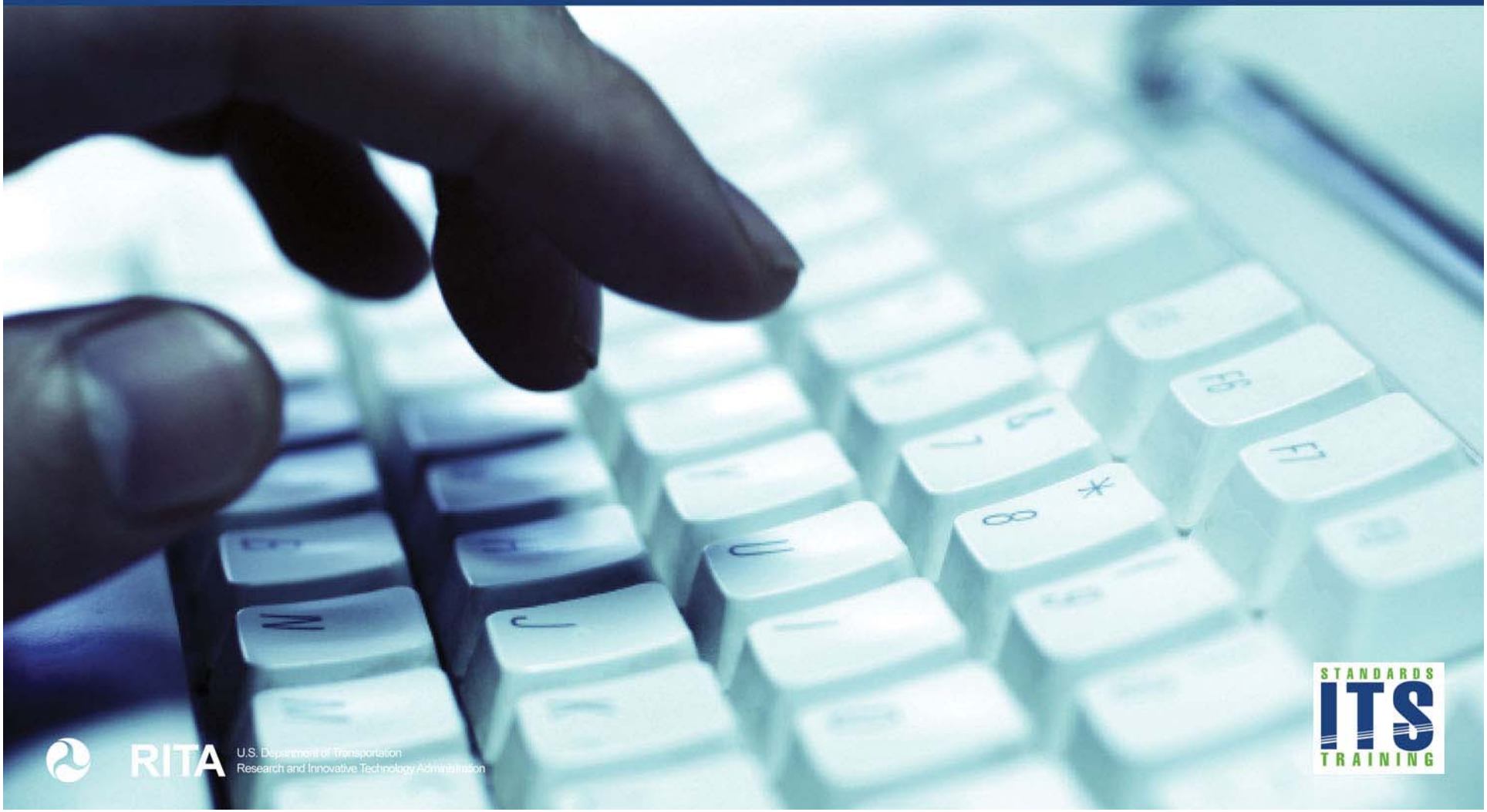

RITA U.S. Department of Transportation
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STANDARDS ITS TRAINING

A306b:
Specifying Requirements for Electrical and Lighting Management Systems (ELMS) Based on NTCIP 1213 Standard

Instructor

James J. Frazer
President
Gridaptive Technologies
Pompano Beach, Florida, USA

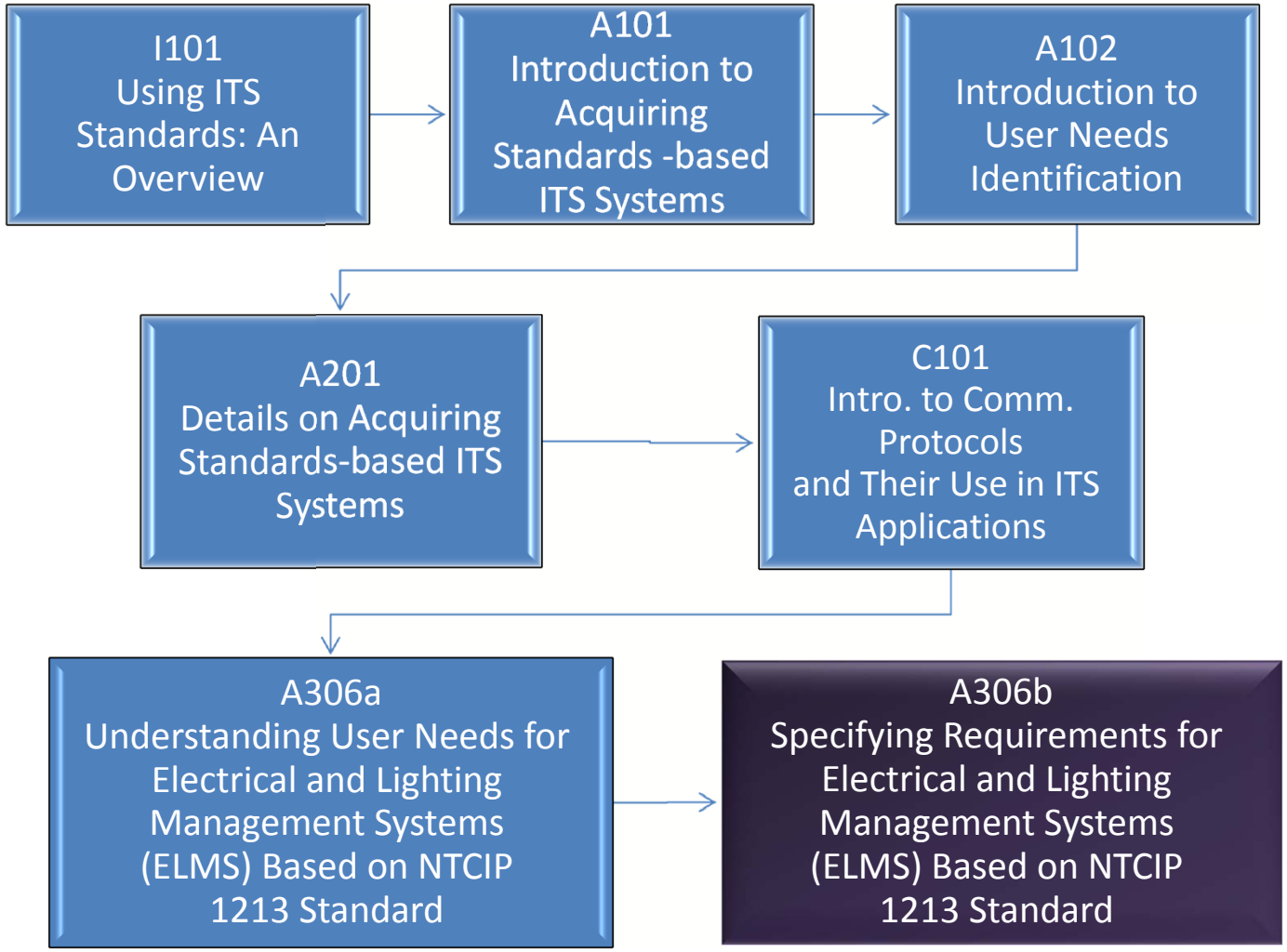
Target Audience

- Engineering staff
- Street lighting maintenance staff
- Traffic management center (TMC)/Operations staff
- System developers
- Private and public sectors 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
- A306a: Understanding User Needs for Electrical and Lighting Management Systems (ELMS) Based on NTCIP 1213 Standard

Curriculum Path (SEP)



Learning Objectives

1. Review the structure of the NTCIP 1213 v02 Standard
2. Use the Protocol Requirements List (PRL) to specify the standardized structure of requirements
3. Include the requirements from the PRL in the specification
4. Explain how interoperability is achieved through the Requirements Traceability Matrix
5. Examine the benefits of the SEP approach regarding verification and validation in the ELMS testing process
6. Explain conditions and context for extending the standard including specifying requirements not covered by standard

Learning Objective # 1 – Review the Structure of the NTCIP 1213 Standard

- Summarize NTCIP 1213 Capabilities
- Identify components of the standard, ConOps, Requirements, Dialogs, MIB, PRL, RTM
- Focus on Requirements
- State what this standard does not have (e.g., test cases)

Capabilities of NTCIP 1213 Systems

Control and monitoring of terminal devices for:

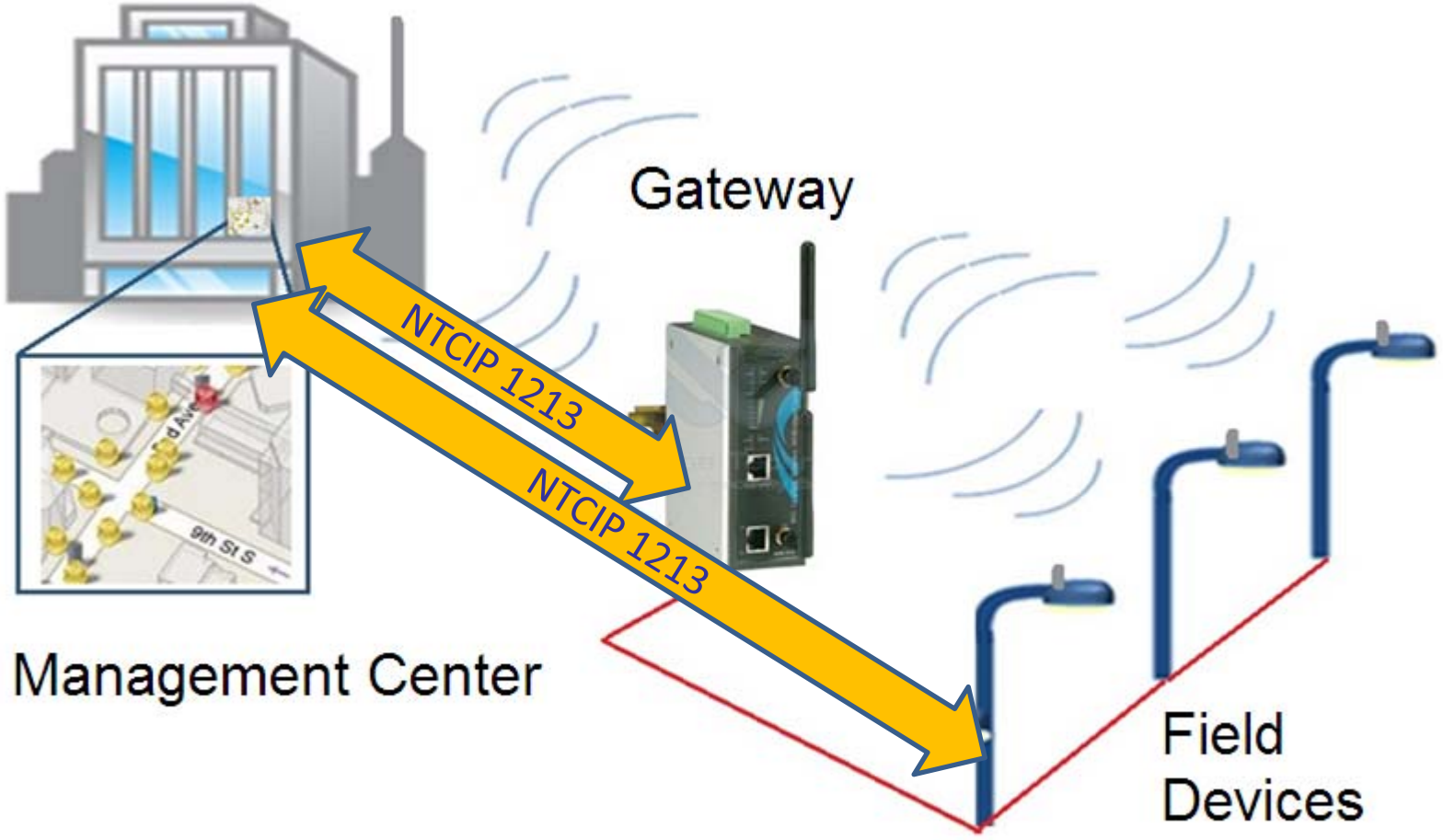
- Roadway lighting, including scheduling and zoning
- Safety: electrical leakage anomalies, including power quality and ground fault issues
- Revenue grade power metering

Capabilities of NTCIP 1213 Systems

Integration with other systems including:

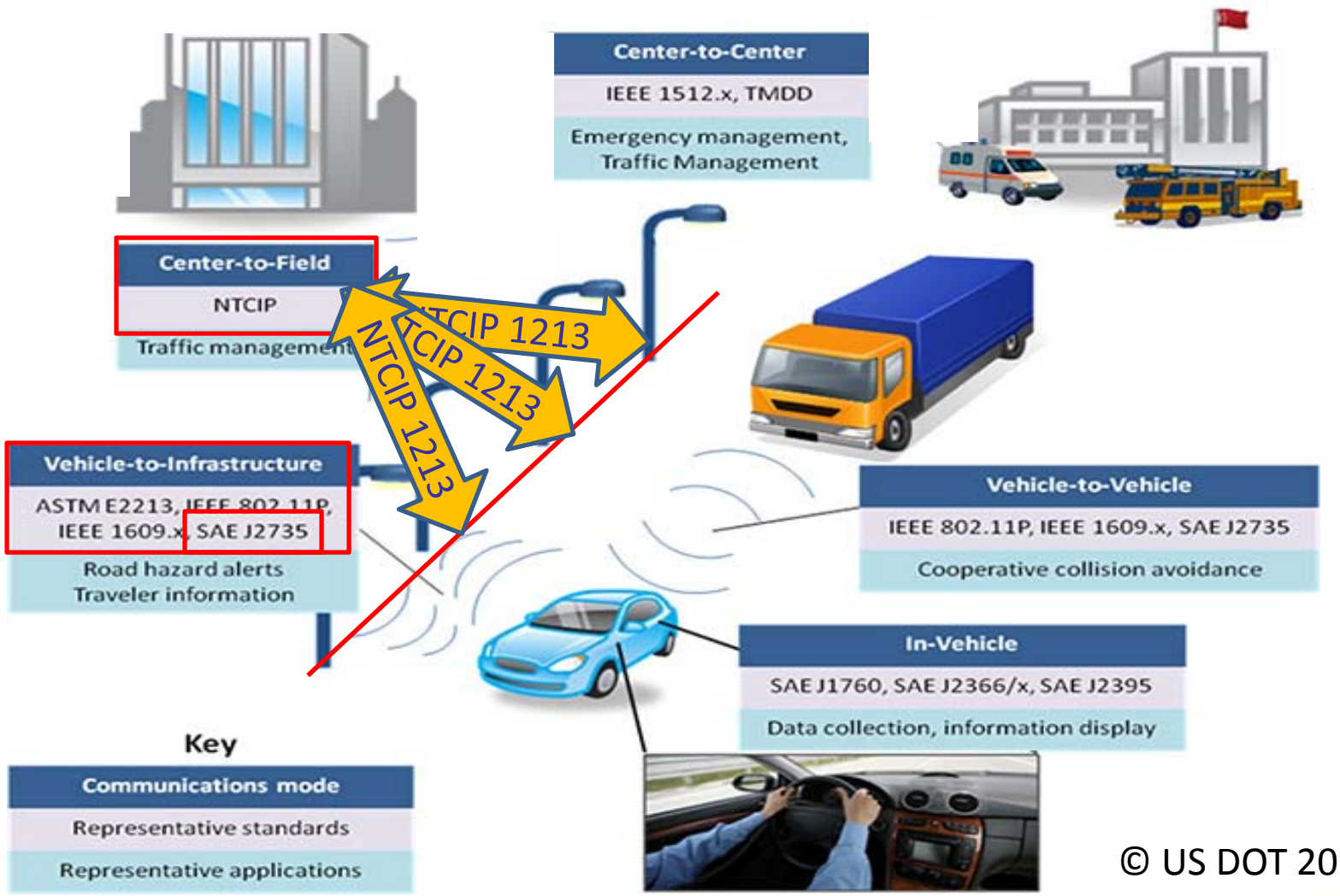
- Vehicle to Grid Infrastructure
- The electrical distribution network (The Smart Grid)
- Electric vehicle charging infrastructure

NTCIP 1213 System Configurations

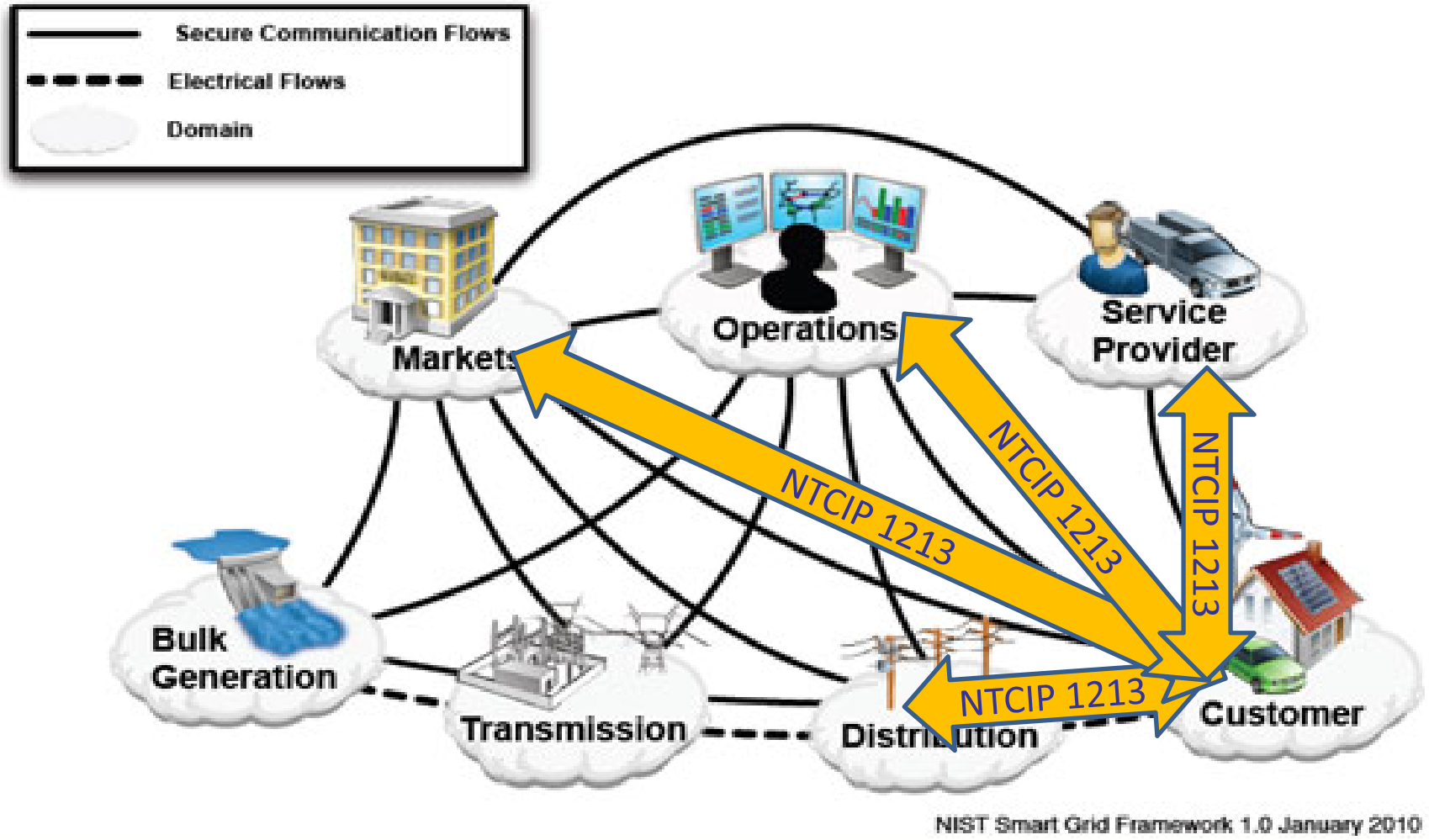


Graphics: Gridaptive Technologies

The USDOT Framework



The US Smart Grid Framework



NIST Smart Grid Framework 1.0 January 2010

Structure of the NTCIP 1213 Standard

Components of the Standard

- Section 1: General
- Section 2: Concept of Operations
- Section 3: Functional Requirements
- Section 4: Dialog Specifications
- Section 5: Electrical and Lighting Management System Master Object Definitions

Structure of the NTCIP 1213 Standard (Cont.)

Components of the Standard

- Annex A: Requirements Traceability Matrix (RTM)
- Annex B: Object Tree
- Annex C: Revised Object Definitions for Astronomical Clock

Missing Components of NTCIP 1213

Test Cases

- Does not include Test Cases
- Need to be produced for each project
- For more on testing, please examine:
  - T101: Introduction to ITS Standards Testing
  - T201: How to Write a Test Plan
  - T202 Overview of Test Design Specifications, Test Cases, and Test Procedures

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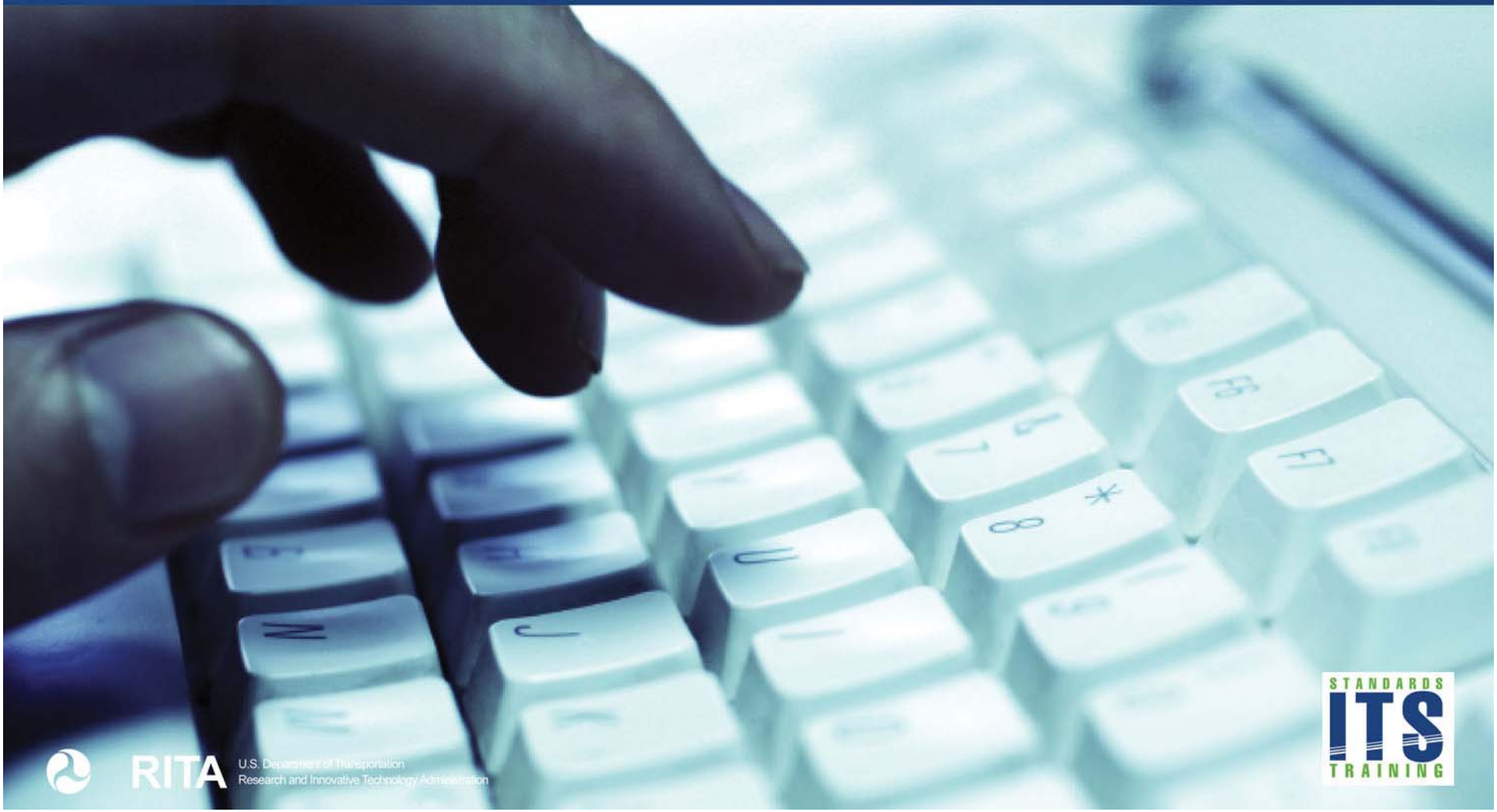

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STANDARDS ITS TRAINING

Which choice is not a capability of the NTCIP 1213 standard?

Answer Choices

a) Roadway lighting, including scheduling and zoning
b) Safety: electrical leakage anomalies, including power quality and ground fault issues
c) Revenue grade power metering
d) Wiring specifics

Review of answers

a) Roadway lighting, including scheduling and zoning

Incorrect. This is a core capability of NTCIP 1213.

b) Safety: electrical leakage anomalies, including power quality and ground fault issues

Incorrect. This is a core capability of NTCIP 1213.

c) Revenue grade power metering

Incorrect. This is a core capability of NTCIP 1213.

d) Wiring specifics

Correct. NTCIP 1213 does not support wiring specifics.

Summary of Learning Objective # 1

Review the Structure of the NTCIP 1213 Standard

- We summarized the capabilities of the NTCIP 1213 standard
- We identified the components of the standard
- We focused on requirements
- We stated what this standard does not have

Learning Objective # 2 – Use the Protocol Requirements List (PRL) to specify the standardized structure of requirements

- The PRL is a table that is a tool included in the standard for use by the system developers, agency specifiers, and producers of ELMS equipment

- Properly trace user needs to requirements

- Within a PRL, select a given range of a performance requirement

Use the PRL to Trace User Needs to Requirements

A Subset of the PRL Table

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Source: NTCIP 1213

Use the PRL to Trace User Needs to Requirements

User Need IDs in the PRL Table

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Use the PRL to Trace User Needs to Requirements

User Needs in the PRL Table

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

An Example User Need – Retrieve Luminaire Information

Examining User Need 2.4.2.1.1.1

2.4.2.1.1.1 Retrieve Luminaire Information

The system manager needs to be able to determine the capabilities of the ELMS. This manager may need to configure the ELMS luminaire to retrieve pole identifiers, locations, modes, zones, and vendor information for each luminaire.

Use the PRL to Trace User Needs to Requirements

The Functional Requirement Identifier

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Use the PRL to Trace User Needs to Requirements

The Functional Requirements Column

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Requirements for Retrieve Luminaire Information

Examining 3.4.1.1.1.1

3.4.1.1.1.1 Retrieve Luminaire Pole Identifier
A management station shall able to retrieve from the ELMS device the pole identifier to which a luminaire is attached.

Requirements for Retrieve Luminaire Information

3.4.1.1.1.2 Retrieve Luminaire Location - A management station shall be able to retrieve the location of the luminaire from the ELMS device. The location information shall be in one of the following forms:

3.4.1.1.1.2.1 Specify Location in Longitude/Latitude
3.4.1.1.1.2.2 Specify Location Information Using Textual Description of a Road/Street/Block Name/Number
3.4.1.1.1.2.3 Specify Location in Local Reference Coordinate Grid

Requirements for Retrieve Luminaire Information

3.4.1.1.1.3 Retrieve Luminaire Mode - A management station shall be able to retrieve the current operating mode of the luminaire from the ELMS device.

3.4.1.1.1.4 Retrieve Luminaire Zone - A management station shall be able to retrieve the zone identifier(s) for a luminaire from the ELMS device.

3.4.1.1.1.5 Retrieve Luminaire Vendor Information - A management station shall be able to retrieve the information on the version, make, and model of the luminaire from the ELMS device.

ELMS Requirements are "Well-formed"

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

Actor – Identifies who or what 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 of an ELMS Requirement

A management station shall be able to retrieve the location of the luminaire from the ELMS device

Actor - management station
Action - be able to retrieve
Target - the ELMS device
Constraint - location of the luminaire

Section 3 Functional Requirements

3.1 Tutorial [Informative]
3.2 Protocol Requirements List (PRL)
3.3 Operational Environment Requirements
3.4 Functional Requirements
3.5 Supplemental Requirements

Section 3.3 Operational Environment Requirements

3.3.1 Provide Live Data
3.3.2 Provide Off-Line Log Data
3.3.3 Monitor Exceptional Conditions

Section 3.4 Functional Requirements

3.4.1 Configure ELMS Device
3.4.2 Control Device
3.4.3 Monitor Device Status

Section 3.5 Supplemental Requirements

3.5.1 Supplemental Requirements for Scheduled Operations
3.5.2 Supplemental Requirements for Zones
3.5.3 Supplemental Requirements for Dim Levels
3.5.4 Supplemental Requirements for Event Logs
3.5.5 Supplemental Requirements for Live Data

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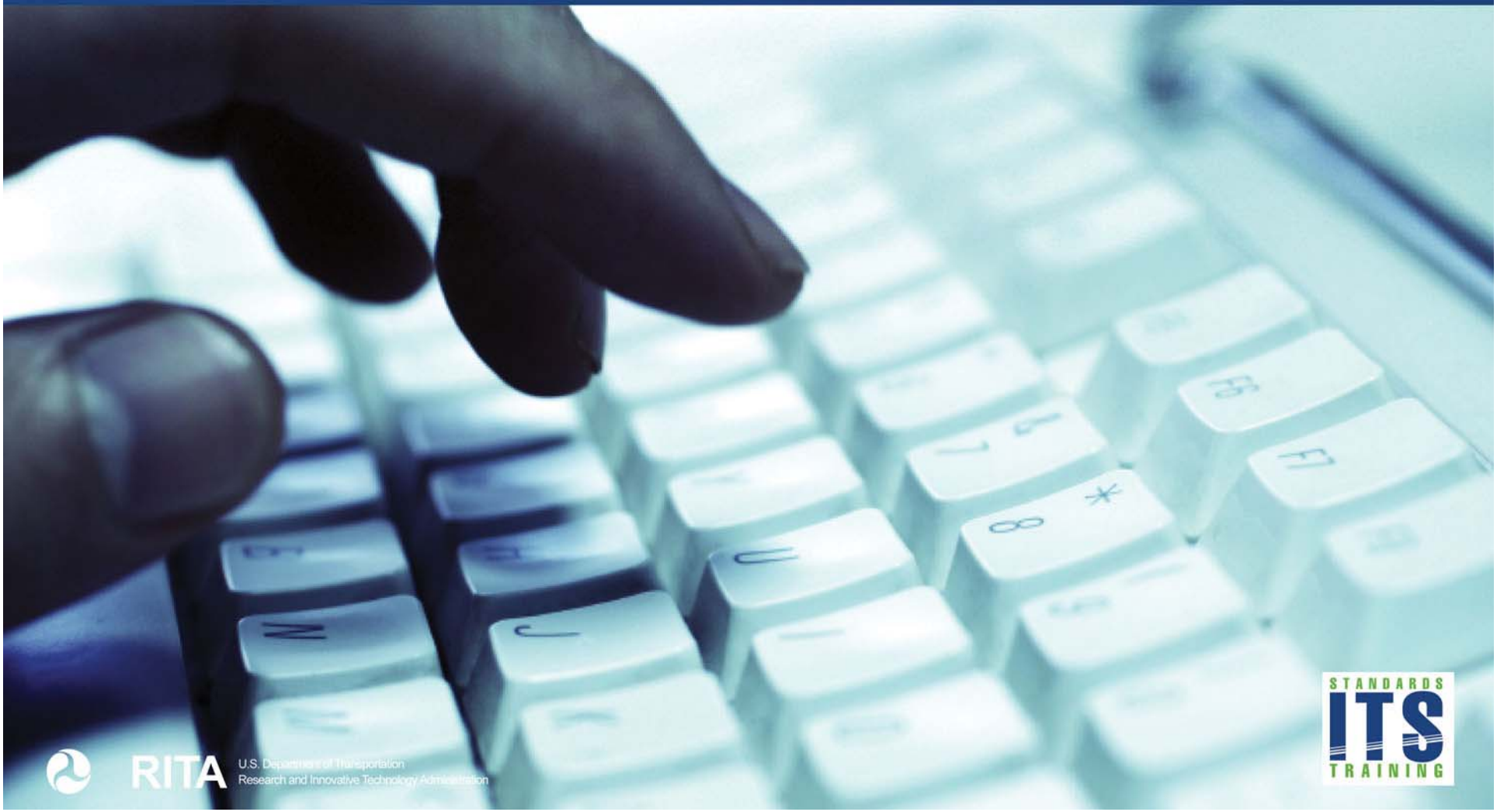

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Which of the following is not a major group of requirements in NTCIP 1213?

Answer Choices

a) Configure ELMS Device
b) Control Device
c) Monitor Device Status
d) Backwards Compatibility Requirements

Review of answers

a) Configure ELMS Device

Incorrect. These requirements provide for configuring ELMS field devices.

b) Control Device

Incorrect. These requirements provide for controlling the ELMS field device.

c) Monitor Device Status

Incorrect. These requirements provide for monitoring alarms and device status.

d) Backwards Compatibility Requirements

Correct. As the first published version of the standard, it does not have any backwards compatibility issues with which to deal.

Including PRL Requirements in the ELMS Specification:

Conformance

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Including PRL Requirements in the ELMS Specification:

Conformance

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
2.4.2.1.4	Configure for Scheduled Operation			O	Yes / No	
		3.4.1.4.1.	Configure Luminaire for Scheduled Operations	O.1 (1..*)	Yes / No	
		3.4.1.4.2	Configure Electrical Service for Scheduled Operations	O.2 (1..*)	Yes / No	
		3.4.1.4.3.	Configure Branch Circuit for Scheduled Operations	O.3 (1..*)	Yes / No	
		3.4.1.4.4.	Configure Devices in Zone for Scheduled Operations	O.4 (1..*)	Yes / No	

Including PRL Requirements in the ELMS Specification:

Project Requirements

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	
2.4.2	Features			M	Yes	
2.4.2.1	Configure ELMS Device			M	Yes	
2.4.2.1.1	Configure Luminaire			M	Yes	
2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Including PRL Requirements in the ELMS Specification:

Project Requirements

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
2.4.1	Operational User Needs			M	Yes	
2.4.1.1	Provide Live Data			M	Yes	
		3.3.1.1	Retrieve Data	M	Yes	
		3.3.1.2	Deliver Data	M	Yes	
		3.3.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
		3.5.5.1	Live Data Response Time	M	Yes	

Examining the PRL's Additional Project Requirements:

Performance Criteria

Supplemental Requirement ID	Supplemental Requirement	Conformance	Project Requirement	Additional Project Requirements
3.5.5	Supplemental Requirements for Live Data	M	Yes	
3.5.5.1	Live Data Response Time	M	Yes	The device shall initiate the transmission of the appropriate response (assuming that the device has permission to transmit) within 125 millisecond(s) of receiving the last byte of the request, plus 1 millisecond for each byte in the response variable-bindings field

Summary of Learning Objective #2

Use the Protocol Requirements List (PRL) to specify the standardized structure of requirements.

- To properly trace user needs to requirement
- Within a PRL, to select a given range of a performance

Learning Objective # 3 – How to Include the Requirements from the PRL in the Specification

- How to compare and contrast vendor PRLs for off-the-shelf interoperability analysis
- Explain how it fits into the big picture
- Explain how ELMS fits in the smart grid infrastructure
- Properly tracing User Needs to Requirements
- Creating a Specification, Overview, Contents, and Considerations

Using the PRL to Build a Specification: Washington State DOT Case Study

In preparing the communications interface specification for a large bridge and tunnel project, many user needs were identified.

Using the PRL to Build a Specification: Washington State DOT Case Study

These Needs Included the Ability to:

- Control lighting system lumen output by current ambient light level (adaptive lighting)
- Control lighting fixtures by zones of branch circuits
- Configure branch circuits into alternate zones
- Configure, control, and monitor branch circuits
- Configure schedules for branch circuit zones
- Report exceptional conditions in a near real-time basis
- Override schedules as required

Using the PRL to Build a Specification: Washington State DOT Case Study

These Needs Do Not Include the Ability to:

- Configure, control, or monitor
  - Luminaires
  - Electrical services
  - Ground fault equipment
  - Arc fault equipment
- Provide Smart Grid information to the local electric utility

Photo: Gridaptive Technologies

Building Project Specifications Using the PRL

Provide Live Data

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Project Requirement	Additional Project Requirements
2.4.1	Operational User Needs			M	Yes	
2.4.1.1	Provide Live Data			M	Yes	
		3.3.1.1	Retrieve Data	M	Yes	
		3.3.1.2	Deliver Data	M	Yes	
		3.3.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
		3.5.5.1	Live Data Response Time	M	Yes	

Building Project Specifications Using the PRL

Provide Off-Line Log Data

2.4.1.2	Provide Off-line Log Data			O	Yes / No	
		3.3.2.1	Retrieve Configuration of Logging service	M	Yes	
		3.3.2.2	Configure Logging Service	M	Yes	
		3.3.2.4	Clear Log	M	Yes	
		3.3.2.5	Retrieve Capabilities of Event Logging Services	M	Yes	
		3.3.2.6	Retrieve Number of Events Currently Logged	M	Yes	
		3.3.2.7	Set Time	M	Yes	
		3.3.2.8	Retrieve Current Time	M	Yes	
		3.3.2.9	Set Daylight Saving Time Mode	M	Yes	
		3.3.2.10	ELMS Pre-defined Event Configurations	M	Yes	
		3.3.2.10.1	Supported Event Classes	M	Yes	
		3.5.4	Supplemental Requirements for Event Logs	M	Yes	

Building Project Specifications Using the PRL

Provide Luminaire Switch State Logging

2.4.1.2.1	Provide Luminaire Switch State Logging			O	Yes / No	
		3.3.2.10.2	Luminaire Switch State Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Luminaire Lamp Condition Logging

2.4.1.2.2	Provide Luminaire Lamp Condition Logging			O	Yes / No	
		3.3.2.10.3	Luminaire Lamp Condition Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Luminaire Burn Condition Logging

2.4.1.2.3	Provide Luminaire Burn Condition Logging			O	Yes / No	
		3.3.2.10.4	Luminaire Burn Condition Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Periodic Luminaire Burn Time Logging

2.4.1.2.4	Provide Periodic Luminaire Burn Time Logging			O	Yes / No	
		3.3.2.10.5	Periodic Luminaire Burn Time Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Periodic Luminaire Temperature Logging

2.4.1.2.5	Provide Luminaire Temperature Logging			O	Yes / No	
		3.3.2.10.6	Luminaire Temperature Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Periodic Luminaire Pole Condition Logging

2.4.1.2.6	Provide Luminaire Pole Condition Logging			O	Yes / No	
		3.3.2.10.7	Luminaire Pole Condition Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Relay Switch State Logging

2.4.1.2.7	Provide Relay Switch State Logging			O	Yes / No	
		3.3.2.10.8	Relay Switch State Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Power Meter Switch State Logging

2.4.1.2.8	Provide Power Meter Switch State Logging			O	Yes / No	
		3.3.2.10.9	Power Meter Switch State Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Periodic Power Meter Measurement Logging

2.4.1.2.9	Provide Periodic Power Meter Measurement Logging			O	Yes / No	
		3.3.2.10.10	Periodic Power Meter Measurement Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Power Meter Condition Logging

2.4.1.2.10	Provide Power Meter Condition Logging			O	Yes / No	
		3.3.2.10.11	Power Meter Condition Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Ground Fault Switch State Logging

2.4.1.2.11	Provide Ground Fault Switch State Logging			O	Yes / No	
		3.3.2.10.12	Ground Fault Switch State Log	O	Yes / No	

Building Project Specifications Using the PRL

Provide Periodic Ground Fault Measurement Logging

2.4.1.2.12	Provide Periodic Ground Fault Measurement Logging			O	Yes / No	
		3.3.2.10.13	Periodic Ground Fault Measurement Log	O	Yes / No	

Building Project Specifications Using the PRL

Retrieve Logged Data

2.4.1.2.13	Retrieve Logged Data			M	Yes	
		3.3.2.3	Retrieve Logged Data	M	Yes	

Building Project Specifications Using the PRL

Monitor Exceptional Conditions

2.4.1.3	Monitor Exceptional Conditions			O	Yes / No	
		3.3.3.1	Retrieve Current Configuration of Exception Reporting Service	M	Yes	
		3.3.3.2	Configure Events	M	Yes	
		3.3.3.3	Provide Automatic Reporting of Events (SNMP Traps)	M	Yes	
		3.3.3.4	Manage Exception Reporting	M	Yes	
		3.3.3.5	Retrieve Capabilities of Exception Reporting Service	M	Yes	
		3.3.3.6	Retrieve Current Number of Exception Events	M	Yes	
		3.3.3.7	Record and Timestamp Events	M	Yes	

Building Project Specifications Using the PRL

Features

2.4.2	Features	M	Yes	

Building Project Specifications Using the PRL

Configure ELMS Device

2.4.2.1	Configure ELMS Device	M	Yes	

Building Project Specifications Using the PRL

Configure Luminaire

2.4.2.1.1	Configure Luminaire	M	Yes	

Building Project Specifications Using the PRL

Retrieve Luminaire Information

2.4.2.1.1.1	Retrieve Luminaire Information			M	Yes	
		3.4.1.1.1.1	Retrieve Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.1.2	Retrieve Luminaire Location	M	Yes	
		3.4.1.1.1.3	Retrieve Luminaire Mode	M	Yes	
		3.4.1.1.1.4	Retrieve Luminaire Zone	O	Yes / No	
		3.4.1.1.1.5	Retrieve Luminaire Vendor Information	M	Yes	

Building Project Specifications Using the PRL

Configure Luminaire Identification Information

2.4.2.1.1.2	Configure Luminaire Identification Information			M	Yes	
		3.4.1.1.1.2.1	Specify Location in Longitude/Latitude Coordinates	O	Yes / No	
		3.4.1.1.1.2.2	Specify Location Information Using Textual Description of a Road/Street/Block Name/Number	M	Yes	The ELMS device shall support a location name of at leas 255 (8..255) Characters.
		3.4.1.1.1.2.3	Specify Location in local reference coordinate grid	O	Yes / No	
		3.4.1.1.2.1	Configure Luminaire Pole Identifier	O	Yes / No	
		3.4.1.1.2.2	Configure Luminaire Location	M	Yes	

Building Project Specifications Using the PRL

Configure Luminaire Mode

2.4.2.1.1.3	Configure Luminaire Mode			M	Yes	
		3.4.1.1.3	Configure Luminaire Mode	M	Yes	

Building Project Specifications Using the PRL

Configure Electrical Service

2.4.2.1.2	Configure Electrical Service	O	Yes / No	

Building Project Specifications Using the PRL

Retrieve Electrical Service Information

2.4.2.1.2.1	Retrieve Electrical Service Information			O	Yes / No	
		3.4.1.2.1.1	Retrieve Electrical Service Location	M	Yes	
		3.4.1.2.1.2	Retrieve Electrical Service Zone	O	Yes / No	
		3.4.1.2.1.3	Retrieve Electrical Service Pole Identifier	O	Yes / No	
		3.4.1.2.2.1	Configure Electrical Service Location	M	Yes	
		3.4.1.2.2.2	Configure Electrical Service Pole Identifier	O	Yes / No	

Building Project Specifications Using the PRL

Configure for Light-Activated Operation

2.4.2.1.3	Configure for Light-Activated Operation			O	Yes / No	
		3.4.1.3.1	Configure Luminaire for Light Activated Operations	M	Yes	
		3.4.1.3.2	Configure Electrical Service for Light Activated Operations	O	Yes / No	
		3.4.1.3.3	Configure Branch Circuit for Light Activated Operations	O	Yes / No	
		3.4.1.3.4	Configure Devices in Zone for Light Activated Operations	O	Yes / No	

Building Project Specifications Using the PRL

Configure for Scheduled Operation

2.4.2.1.4	Configure for Scheduled Operation			O	Yes / No	
		3.4.1.4.1.	Configure Luminaire for Scheduled Operations	O.1 (1..*)	Yes / No	
		3.4.1.4.2	Configure Electrical Service for Scheduled Operations	O.2 (1..*)	Yes / No	
		3.4.1.4.3.	Configure Branch Circuit for Scheduled Operations	O.3 (1..*)	Yes / No	
		3.4.1.4.4.	Configure Devices in Zone for Scheduled Operations	O.4 (1..*)	Yes / No	
		3.4.1.4.5	Schedule ELMS Device Event	M	Yes	
		3.4.1.4.6	Retrieve a Schedule	M	Yes	
		3.5.1	Supplemental Requirements for Scheduled Operations	M	Yes	

Building Project Specifications Using the PRL

Configure Zones

2.4.2.1.5	Configure Zones			O	Yes / No	
		3.4.1.5.1	Configure Luminaire Zone	M	Yes	
		3.4.1.5.2	Configure Electrical Service Zone	O	Yes / No	
		3.4.1.5.3	Configure Branch Circuit Zone	O	Yes / No	
		3.4.1.5.4	Define Zones	M	Yes	
		3.5.2	Supplemental Requirements for Zones	M	Yes	

Building Project Specifications Using the PRL

Configure for Manual Operation

2.4.2.1.6	Configure for Manual Operation			M	Yes	
		3.4.1.8.1	Configure Luminaire for Manual Operation	M	Yes	
		3.4.1.8.2	Configure Electrical Service for Manual Operations	O	Yes / No	
		3.4.1.8.3	Configure Branch Circuit for Manual Operations	O	Yes / No	
		3.4.1.8.4	Configure Devices in Zone for Manual Operations	O	Yes / No	

Building Project Specifications Using the PRL

Configure Stagger Interval

2.4.2.1.7	Configure Stagger Interval			O	Yes / No	
		3.4.1.6.1	Configure Luminaire Stagger Interval	M	Yes	The ELMS device shall support a stagger interval with a maximum value of _____ (0..255) seconds.
		3.4.1.6.2	Configure Branch Circuit Stagger Interval	O	Yes / No	The ELMS device shall support a stagger interval with a maximum value of _____ (0..255) seconds.

Building Project Specifications Using the PRL

Configure Dim Levels

2.4.2.1.8	Configure Dim Levels			O	Yes / No	
		3.4.1.7.1	Configure Luminaire Dim Level	M	Yes	
		3.4.1.7.2	Configure Electrical Service Dim Level	O	Yes / No	
		3.4.1.7.3	Configure Branch Circuit Dim Level	O	Yes / No	
		3.4.1.7.4	Configure Dim Level for Devices in Zone	O	Yes / No	
		3.5.3	Supplemental Requirements for Dim Levels	M	Yes	

Building Project Specifications Using the PRL

Configure Electrical Service Monitoring and Metering Equipment

2.4.2.1.9	Configure Electrical Service Monitoring and Metering Equipment			O	Yes / No	
		3.4.1.9.1	Configure Branch Circuit Ground Fault Detector	O	Yes / No	
		3.4.1.9.2	Configure Branch Circuit Power Meter	O	Yes / No	
		3.4.1.9.3	Configure Branch Circuit Arc Fault Detector	O	Yes / No	

Building Project Specifications Using the PRL

Configure Branch Circuit

2.4.2.1.10	Configure Branch Circuit	O	Yes / No	

Building Project Specifications Using the PRL

Retrieve Branch Circuit Information

2.4.2.1.10.1	Retrieve Branch Circuit Information			O	Yes / No	
		3.4.1.10.1.1	Retrieve Branch Circuit Zone	O	Yes / No	
		3.4.1.10.1.2	Retrieve Branch Circuit Location	O	Yes / No	
		3.4.1.10.1.3	Retrieve Branch Circuit Pole Identifier	O	Yes / No	

Building Project Specifications Using the PRL

Configure Branch Circuit

2.4.2.1.10.2	Configure Branch Circuit			O	Yes / No	
		3.4.1.10.2.1	Configure Branch Circuit Location	O	Yes / No	
		3.4.1.10.2.2	Configure Branch Circuit Pole Identifier	O	Yes / No	

Building Project Specifications Using the PRL

Control Device

2.4.2.2	Control Device	M	Yes	

Building Project Specifications Using the PRL

Control Luminaire

2.4.2.2.1	Control Luminaire			M	Yes	
		3.4.2.1.1	Control Luminaire by Permanent/Continuous Override	M	Yes	
		3.4.2.1.2	Control Luminaire by Transitory Override	O	Yes / No	
		3.4.2.1.3	Control Luminaire by Timed Override	O	Yes / No	
		3.4.2.1.4	Control Luminaire in Stagger Mode	O	Yes / No	

Building Project Specifications Using the PRL

Control Electrical Service

2.4.2.2.2	Control Electrical Service			O	Yes / No	
		3.4.2.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.4.2.2.2	Control Electrical Service by Transitory Override	O	Yes / No	
		3.4.2.2.3	Control Electrical Service by Timed Override	O	Yes / No	
		3.4.2.3.4	Control Electrical Service in Stagger Mode	O	Yes / No	

Building Project Specifications Using the PRL

Control Branch Circuit

2.4.2.2.3	Control Branch Circuit			O	Yes / No	
		3.4.2.3.1	Control Branch Circuit by Permanent/Continuous Override	M	Yes	
		3.4.2.3.2	Control Branch Circuit by Transitory Override	O	Yes / No	
		3.4.2.3.3	Control Branch Circuit by Timed Override	O	Yes / No	
		3.4.2.3.4	Control Branch Circuit in Stagger Mode	O	Yes / No	

Building Project Specifications Using the PRL

Control Devices By Zone

2.4.2.3	Control Devices by Zone			O	Yes / No	
		3.4.2.4.1	Control Devices in Zone by Permanent/Continuous Override	M	Yes	
		3.4.2.4.2	Control Devices in Zone by Transitory Override	O	Yes / No	
		3.4.2.4.3	Control Devices in Zone by Timed Override	O	Yes / No	

Building Project Specifications Using the PRL

Monitor Device Status

2.4.2.4	Monitor Device Status	M	Yes	

Building Project Specifications Using the PRL

Monitor Luminaire

2.4.2.4.1	Monitor Luminaire			M	Yes	
		3.4.3.1.1	Retrieve Luminaire Switch Status	M	Yes	
		3.4.3.1.2	Retrieve Luminaire Temperature	O	Yes / No	Units are in tenths of degrees Celsius
		3.4.3.1.3	Retrieve Luminaire Burn Time Statistics	O	Yes / No	
		3.4.3.1.4	Retrieve Luminaire Pole Status	O	Yes / No	
		3.4.3.1.5	Retrieve Luminaire Dimming Level Output	O	Yes / No	
		3.4.3.1.6	Retrieve Luminaire Lamp Status	O	Yes / No	
		3.4.3.1.7	Retrieve Luminaire Power Usage Statistics	O	Yes / No	
		3.4.3.1.8	Retrieve Luminaire Ballast Status	O	Yes / No	
		3.4.3.1.9	Retrieve Luminaire Starter Status	O	Yes / No	

Building Project Specifications Using the PRL

Monitor Electrical Service

2.4.2.4.2	Monitor Electrical Service			O	Yes / No	
		3.4.3.2.1	Retrieve Electrical Service Ground Fault Status	O	Yes / No	
		3.4.3.2.2	Retrieve Electrical Service Hours	O	Yes / No	
		3.4.3.2.3	Retrieve Electrical Service Operational Status	M	Yes	
		3.4.3.2.4	Retrieve Electrical Service Power Readings	O	Yes / No	
		3.4.3.2.5	Retrieve Electrical Service Main Breaker Status	O	Yes / No	
		3.4.3.2.6	Retrieve Electrical Service Arc Fault Status	O	Yes / No	

Building Project Specifications Using the PRL

Monitor Branch Circuit

2.4.2.4.3	Monitor Branch Circuit			O	Yes / No	
		3.4.3.3.1	Retrieve Branch Circuit Power Readings	O	Yes / No	
		3.4.3.3.2	Retrieve Branch Circuit Arc Fault Status	O	Yes / No	
		3.4.3.3.3	Retrieve Branch Circuit Breaker Status	O	Yes / No	
		3.4.3.3.4	Retrieve Branch Circuit Operational Status	M	Yes	
		3.4.3.3.5	Retrieve Branch Circuit Hours	O	Yes / No	
		3.4.3.3.6	Retrieve Branch Circuit Ground Fault Status	O	Yes / No	

Building Project Specifications Using the PRL

Supplemental Requirements

Supplemental Requirement ID	Supplemental Requirement	Conformance	Project Requirement	Additional Project Requirements
3.5	Supplemental Requirements	M	Yes	

Building Project Specifications Using the PRL

Supplemental Requirements for Scheduled Operations

3.5.1	Supplemental Requirements for Scheduled Operations	M	Yes	
3.5.1.1	Support a Number of Actions	M	Yes	The ELMS Device shall support at least **255** (1..255) Actions.
3.5.1.2	Support a Number of Day Plans	M	Yes	The ELMS Device shall support at least **255** (1..255) Day Plans.
3.5.1.3	Perform Action at Scheduled Time	M	Yes	

Building Project Specifications Using the PRL

Supplemental Requirements for Zones

3.5.2	Supplemental Requirements for Zones	M	Yes	
3.5.2.1	Define Number of Zones Supported by an ELMS Device	O	Yes / No	The ELMS Device shall support at least **999** (0..65535) Zones.
3.5.2.2	Define Number of ELMS Devices for a Zone	O	Yes / No	At least **100** (0..65535) ELMS devices shall be able to be assigned to a single zone.

Building Project Specifications Using the PRL

Supplemental Requirements for Dim Levels

3.5.3	Supplemental Requirements for Dim Levels	M	Yes	
3.5.3.1	Define Dim Levels as a percentage of maximum brightness	O	Yes / No	

Building Project Specifications Using the PRL

Supplemental Requirements for Event Logs

3.5.4	Supplemental Requirements for Event Logs	M	Yes	
3.5.4.1	Configure Number of Events in Event Log	O	Yes / No	The ELMS device shall support at least **255** (1..255) events.
3.5.4.2	Configure Number of Event Classes	O	Yes / No	The ELMS device shall support at least **255** (1..255) classes.
3.5.4.3	Configure Number of Event Types	O	Yes / No	The ELMS device shall support at least **255** (1..255) event types.

Building Project Specifications Using the PRL

Supplemental Requirements for Live Data

3.5.5	Supplemental Requirements for Live Data	M	Yes	
3.5.5.1	Live Data Response Time	M	Yes	The device shall initiate the transmission of the appropriate response (assuming that the device has permission to transmit) within 152 millisecond(s) of receiving the last byte of the request, plus 1 millisecond for each byte in the response variable-bindings field

Using the PRL in a Specification

As Part of the Interface Specification

- A completed PRL defines the requirements for the NTCIP interface

- A deployment may need multiple interface specifications
  - Management systems that support multiple devices
  - May need support for legacy protocol

Using the PRL in a Specification

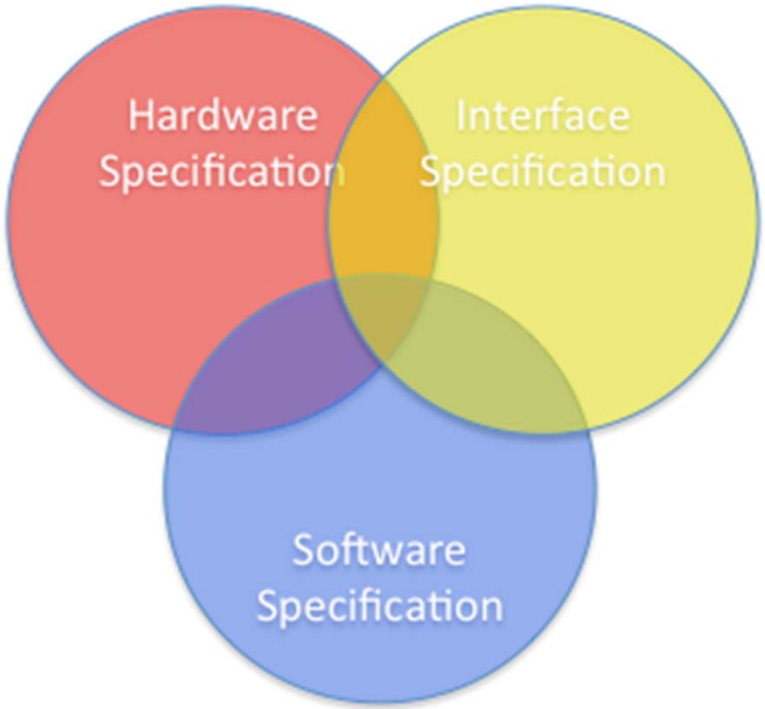
Compare and contrast vendor PRLs for off-the-shelf interoperability analysis

- Once your project specific PRL is complete, you can use it to determine:
  - If off-the-shelf solutions are available
  - Which vendor's product fits your application best
  - Whether custom development is required
  - Which vendor's products are interoperable, and exactly which features are interoperable

Using the PRL in a Specification

Consistency

- The interface specification must be consistent with the remainder of the specification



Using the PRL in a Specification

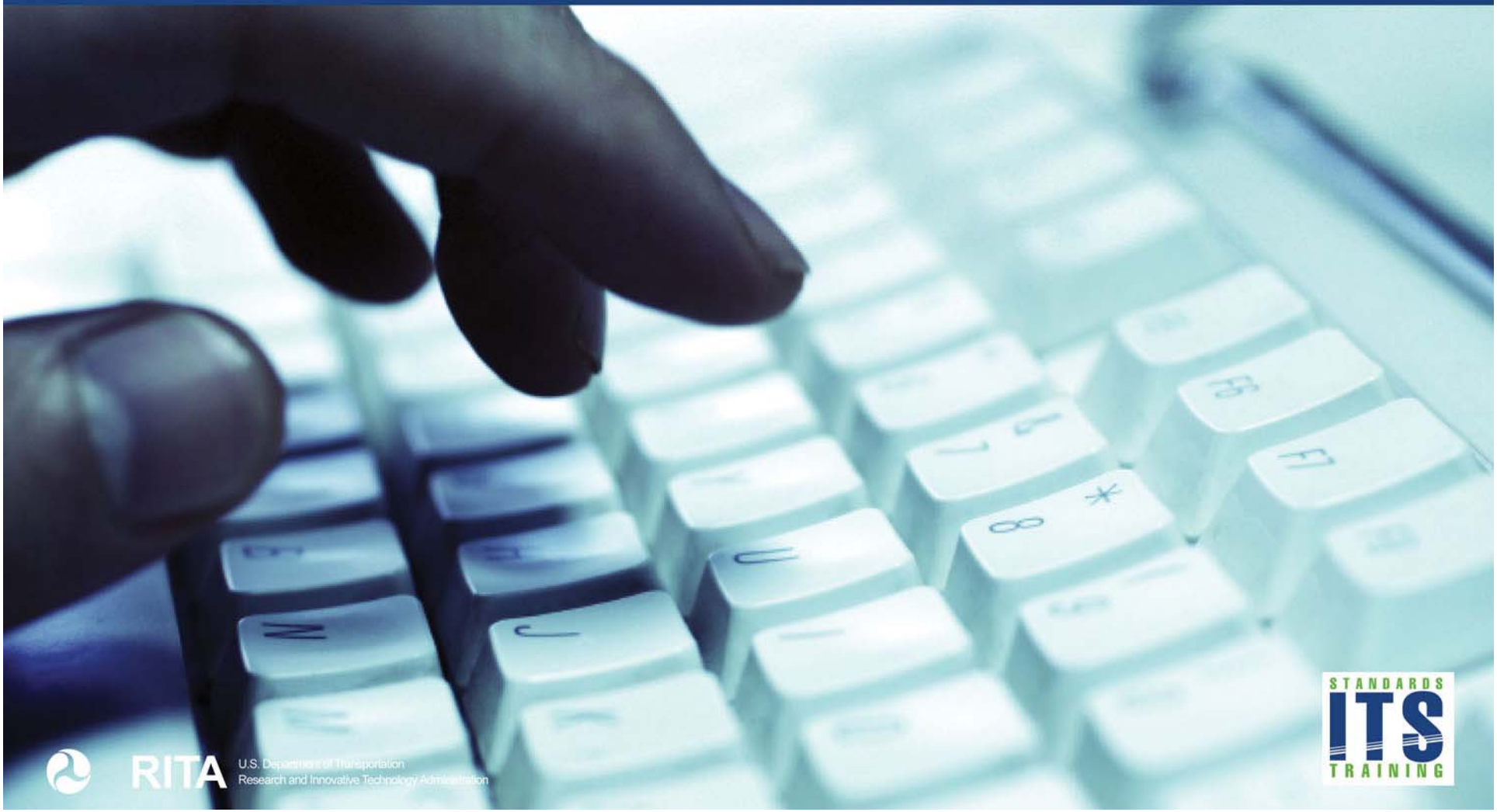
Sample Text for Use in a Specification

- The PRL should be properly introduced within the specification.

- A copyright disclaimer should appear with the PRL.

- Refer to the student supplement for guidance on wording used to introduce the PRL.

ACTIVITY



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Which choice is not a functional requirement contained in the NTCIP 1213 PRL?

Answer Choices

a) Retrieve luminaire location
b) Configure luminaire mode
c) Configure branch circuit zone
d) Retrieve wiring particulars

Review of answers

a) Retrieve luminaire location

Incorrect. This is a functional requirement of NTCIP 1213.

b) Configure luminaire mode

Incorrect. This is a functional requirement of NTCIP 1213.

c) Configure branch circuit zone

Incorrect. This is a functional requirement of NTCIP 1213.

d) Retrieve wiring particulars

Correct. NTCIP 1213 does not support retrieval of wiring particulars.

Summary of Learning Objective # 3

How to include the requirements from the PRL in the specification

- We demonstrated how to compare and contrast vendor PRLs for off-the-shelf interoperability analysis.
- We explained how ELMS fits in the smart grid infrastructure architecture.
- We properly traced user needs to requirements.
- We created a specification, overview, contents, and considerations.

Learning Objective # 4 – Explain How Interoperability is Achieved through the Requirements Traceability Matrix

- Explain source requirement and how it is selected in RTM
- Explain link to dialogs, objects, and block objects
- Learn how dialogs and messages in RTM are communicated to the field device using SNMP
- Provide complete description of how a specification is to be created to support the complete end-to-end example
- Provide example of how monitoring of ELMSs work

Using the Requirements Traceability Matrix (RTM)

Achieving Interoperability and Interchangeability

- How the RTM traces to a single design
  - Annex A contains the RTM
  - The RTM maps requirements to a specific design
- How to compare for interoperability
- How to compare for interchangeability

Using the Requirements Traceability Matrix (RTM)

The Requirement ID Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.3	Operational Environment Requirements				
3.3.1	Provide Live Data				
3.3.1.1	Retrieve Data				
		4.2.1	Generic SNMP Get Interface		
3.3.1.2	Deliver Data				
		4.2.3	Generic SNMP Set Interface		
3.3.1.3	Data Retrieval and Data Delivery Action Performance				
		4.2.1	Generic SNMP Get Interface		
		4.2.2	Generic SNMP Get-Next Interface		
		4.2.3	Generic SNMP Set Interface		
3.3.2	Provide Off-line Log Data				
3.3.2.1	Retrieve Configuration of Logging service				
		4.2.1	Generic SNMP Get Interface		

Using the Requirements Traceability Matrix (RTM)

The Requirement Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval
3.4.1.3.2	Configure Electrical Service for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.5.1.6	electricalserviceMode
				5.5.1.19	electricalserviceLightThreshold
				5.5.1.20	electricalserviceHoldInterval
				5.5.1.21	electricalserviceLightHysteresis
				5.5.1.22	electricalserviceDelayInterval

Using the Requirements Traceability Matrix (RTM)

The Dialog ID Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval
3.4.1.3.2	Configure Electrical Service for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.5.1.6	electricalserviceMode
				5.5.1.19	electricalserviceLightThreshold
				5.5.1.20	electricalserviceHoldInterval
				5.5.1.21	electricalserviceLightHysteresis
				5.5.1.22	electricalserviceDelayInterval

Using the Requirements Traceability Matrix (RTM)

The Dialog Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval
3.4.1.3.2	Configure Electrical Service for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.5.1.6	electricalserviceMode
				5.5.1.19	electricalserviceLightThreshold
				5.5.1.20	electricalserviceHoldInterval
				5.5.1.21	electricalserviceLightHysteresis
				5.5.1.22	electricalserviceDelayInterval

Using the Requirements Traceability Matrix (RTM)

The Object ID Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval
3.4.1.3.2	Configure Electrical Service for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.5.1.6	electricalserviceMode
				5.5.1.19	electricalserviceLightThreshold
				5.5.1.20	electricalserviceHoldInterval
				5.5.1.21	electricalserviceLightHysteresis
				5.5.1.22	electricalserviceDelayInterval

Using the Requirements Traceability Matrix (RTM)

The Object Column

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval
3.4.1.3.2	Configure Electrical Service for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.5.1.6	electricalserviceMode
				5.5.1.19	electricalserviceLightThreshold
				5.5.1.20	electricalserviceHoldInterval
				5.5.1.21	electricalserviceLightHysteresis
				5.5.1.22	electricalserviceDelayInterval

Using the Requirements Traceability Matrix (RTM)

Summarizing the RTM

The RTM

- Maps each requirement to one specific design
- Is a precise dialog
- Is a precise list of objects
- All of the objects must be supported if the requirement is supported

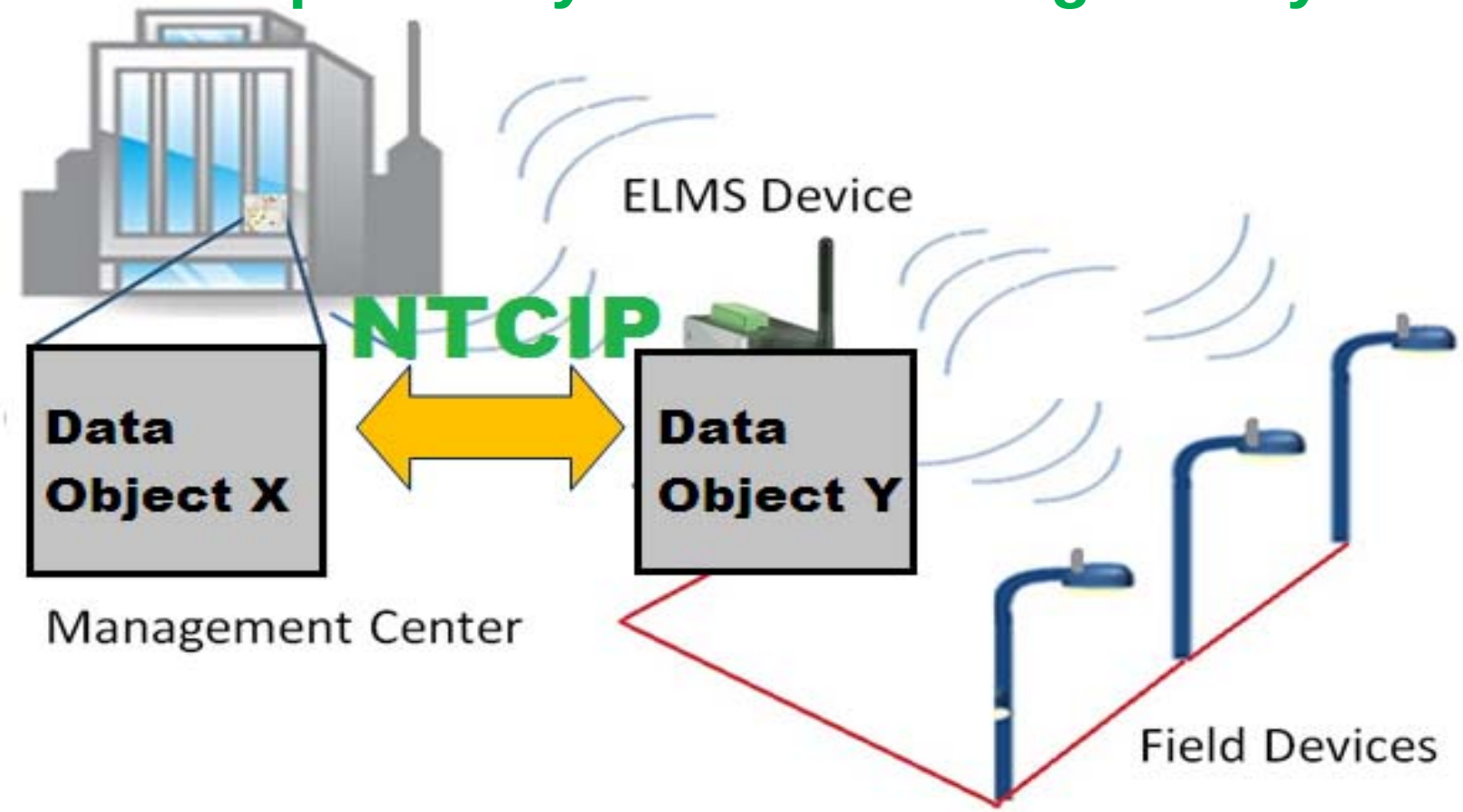
Using the Requirements Traceability Matrix (RTM)

How to Compare for Interoperability

- The RTM provides interoperability of requirements
- The PRL indicates which requirements are supported
- Comparison of PRLs allow quick determination of interoperability

Comparison of PRLs

For Interoperability and Interchangeability



Comparison of PRLs

For Interoperability

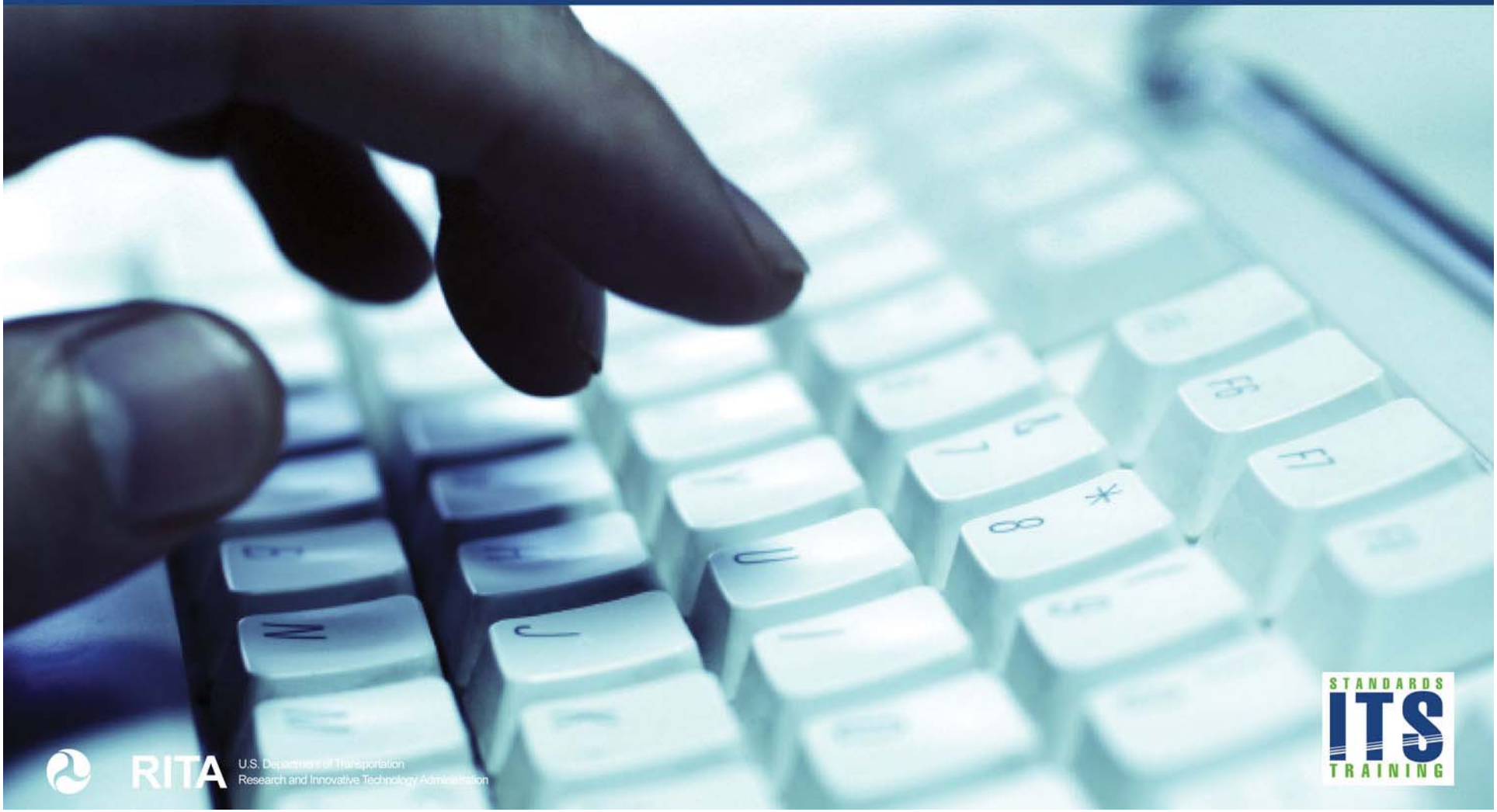
- If both the TMS and the ELMS support a feature
  - Interoperability is provided
- If the TMS supports, but ELMS does not
  - TMS can still use other features (typically)
  - TMS can still interoperate with feature with other devices
- If ELMS supports, but TMS does not
  - Feature could be used by other/future TMS
  - Feature can potentially be used manually

Comparison of PRLs

For Interchangeability

- Both support a feature
  - Equipment is interchangeable for feature
- New equipment supports; old one does not
  - New equipment is interchangeable (meets or exceeds)
- Old equipment supports; new ones do not
  - Feature will not be supported
  - Is feature needed?

ACTIVITY



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What does the following table mean?

Requirement ID	Requirement	Dialog ID	Dialog	Object ID	Object
3.4.1.3.1	Configure Luminaire for Light Activated Operations				
		4.2.3	Generic SNMP Set Interface		
				5.4.1.3	luminaireMode
				5.4.1.15	luminaireLightThreshold
				5.4.1.16	luminaireHoldInterval
				5.4.1.17	luminaireLightHysteresis
				5.4.1.18	luminaireDelayInterval

Answer Choices

a) All of the objects must be supported

b) At least one of the objects must be supported

c) All of the objects must be supported if the requirement is supported

d) At least one of the objects must be supported if the requirement is supported

Review of answers

a) All of the objects must be supported

Incorrect. They only need to be supported if the requirement has been selected in the PRL.

b) At least one of the objects must be supported

Incorrect. If the requirement is selected, all of the objects must be supported.

c) All of the objects must be supported if the requirement is supported

Correct.

d) At least one of the objects must be supported if the requirement is supported

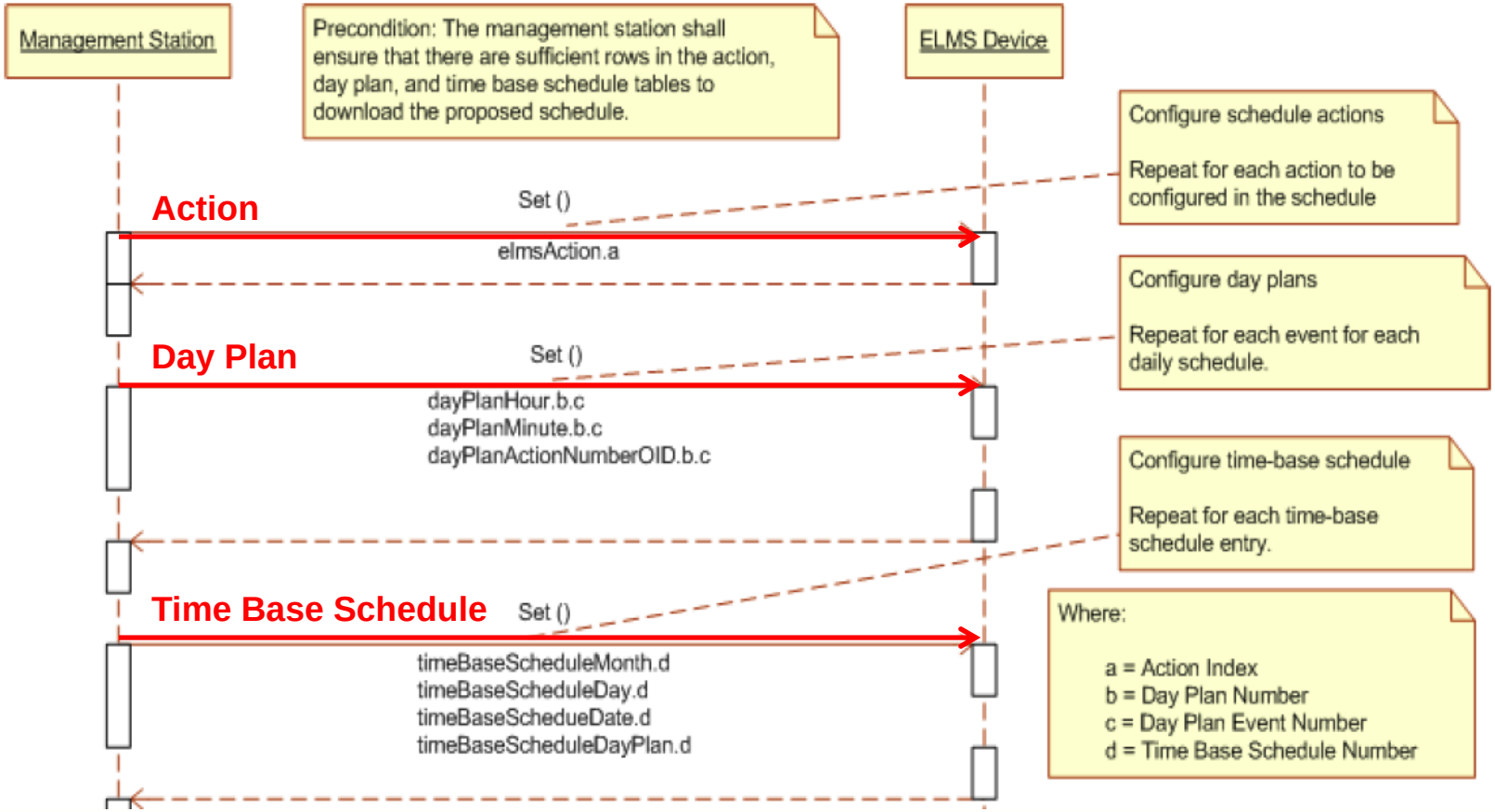
Incorrect. If the requirement is supported, all of the objects must be supported.

NTCIP 1213 Dialogs

A Basic Dialog between the TMS and the ELMS

NTCIP 1213 Dialogs

Dialog Example: Configuring a Schedule



Source: NTICP 1213

NTCIP 1213 Dialogs

All Dialog Objects Are Listed in the RTM

3.4.1.4	Configure for Scheduled Operation				
3.4.1.4.1	Configure Luminaire for Scheduled Operations				
		4.3.1	Configure Luminaire for Scheduled Operations		
				5.4.1.4	luminaireSwitchMode
3.4.1.4.2	Configure Electrical Service for Scheduled Operations				
		4.3.2	Configure Electrical Service for Scheduled Operations		
				5.5.1.7	electricalserviceSwitchMode
3.4.1.4.3	Configure Branch Circuit for Scheduled Operations				
		4.3.3	Configure Branch Circuit for Scheduled Operations		
				5.6.1.7	branchcircuitSwitchMode
3.4.1.4.4	Configure Devices in Zone for Scheduled Operations				
		4.3.4	Configure Devices in Zone for Scheduled Operations		
				5.7.1.6	zoneSwitchMode
3.4.1.4.5	Schedule ELMS Device Event				
		4.3.5	Schedule ELMS Device Event		
				5.3.4.1	scheduleActionIndex
				5.3.4.2	scheduleAction
				5.3.4.3	scheduleActionType
				5.3.4.4	scheduleActionNumber
				5.3.4.5	scheduleActionParameter

Summary of Learning Objective #4

Explaining Interoperability and the RTM

- We explained source requirements and how they are selected in the RTM.
- We examined links to dialogs, objects, and block objects.
- We described how a specification is created to support the complete end-to-end example, from user need to dialog on the wire.
- We discussed how monitoring of ELMS is accomplished.

Learning Objective # 5 – Examine the benefits of the SEP approach

- Benefits in developing a test plan
- Benefits of testing using SEP
- Benefits to agencies
- Benefits to vendors

Examine the benefits of the SEP approach

The Benefits in Developing a Test Plan

- Verify that requirements are fulfilled
- Reduce the risk of misinterpretation between agency and manufacturers
- Reduce the risk of financial mismanagement
- Reduce the risk of perceived lack of oversight
- Ensure interoperability to allow system expansion

Examine the benefits of the SEP approach

The Benefits of Testing Using SEP

- **Validation:** Making sure a system, when placed in operation, will support agency needs
- **Verification:** Making sure a design complies with requirements and that the systems (as proposed and delivered) comply with both design and requirements
- **Traceability:** A tool to help determine if the agency's requirements are fulfilled by the design and that implementation was done correctly
- Used for unit, subsystem, and system testing

Examine the benefits of the SEP approach

The Benefits of Testing Using SEP

- Unit/Device Testing
  - Focuses on comparing an implementation against the standards and specified options
  - May be performed by inspecting the code to use "proven" software to send test messages to the device

- Subsystem Testing
  - Consists of connecting two or more devices together and exchanging data
  - Assumes devices and components have passed a designed unit test plan

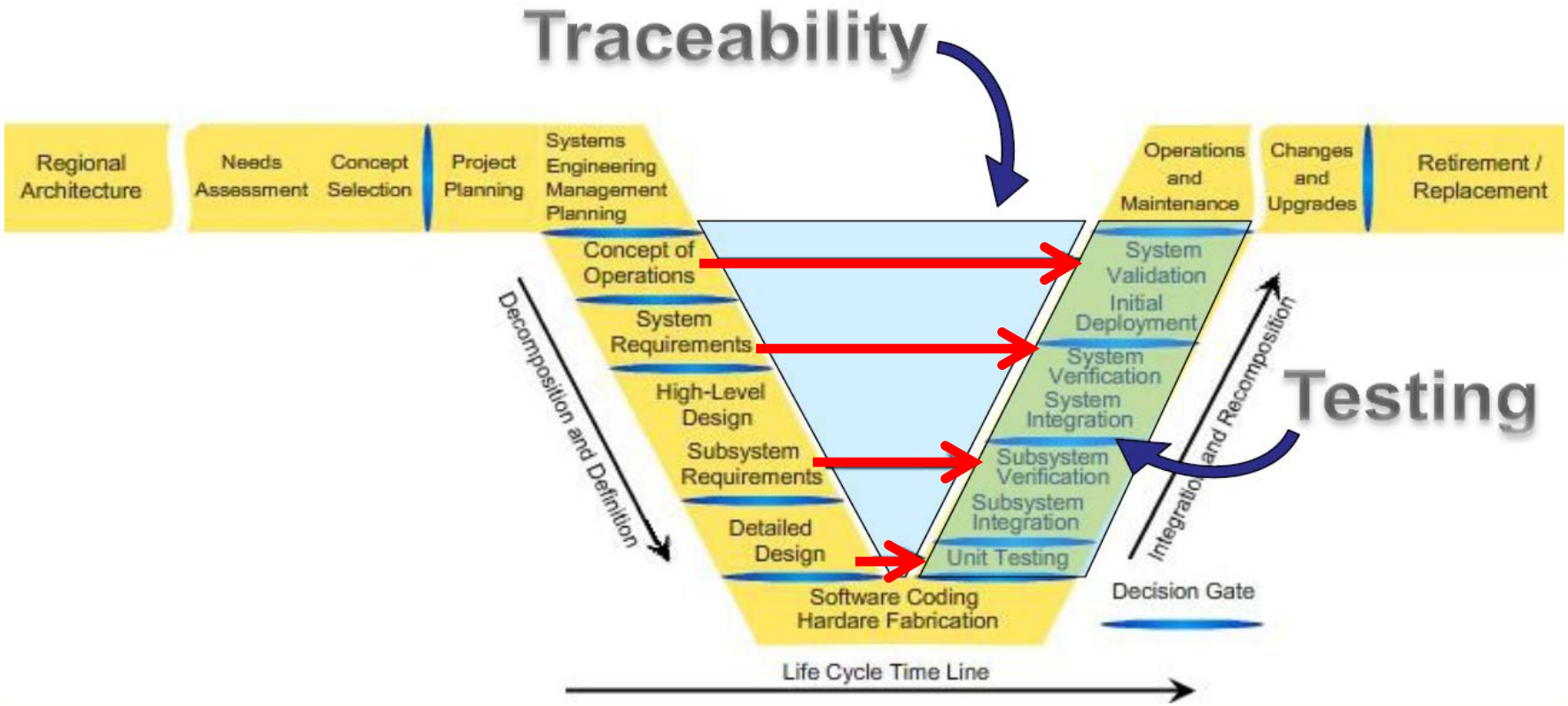
Examine the benefits of the SEP approach

The Benefits of Testing Using SEP

- System Testing
  - Highest level of testing
  - Performed after all lower level testing is successfully completed
  - Performed in an operational environment
  - Includes acceptance testing

Examine the benefits of the SEP approach

The Benefits of Testing Using SEP



Examine the benefits of the SEP approach

The Benefits of Testing Using SEP

- Provides the framework and process to verify that the system meets the user needs
- Improves stakeholder participation
- Results in more adaptable, resilient systems
- Verifies functionality and fewer defects
- Results in higher level of reuse in future projects
- Results in better documentation

Examine the benefits of the SEP approach

The Benefits to Agencies

- Users including transportation and electric utility specification developers can use testing results to confirm which requirements have been delivered in a project specific implementation

- The protocol implementer can use testing results to confirm conformance to NTCIP 1213

Examine the benefits of the SEP approach

The Benefits to Vendors

- The supplier can supply testing data as a detailed indication of the capabilities of the implementation

- The user can use this vendor supplied test data, as a basis for checking interoperability with another implementation

Summary of Learning Objective #5

Benefits of the SEP Approach

- We discussed the importance of the SEP.
- We examined the benefits in developing a test plan.
- We reviewed the benefits to agencies including Transportation and electricity specification developers.
- We reviewed the benefits to vendors.

Learning Objective #6 – Extending the Standard

- Conditions and context for extending the standard
- Specify requirements not covered by the standard
  - Adding missing requirements identified through best practices
  - Emphasize user needs-requirements link

Extending the Standard

Complicates interoperability and interchangeability

- Not achievable unless all design details are known
- Extensions are relatively custom solutions, resulting in:
  - Increased specification costs
  - Increased development costs
  - Increased testing costs
  - Increased integration costs
  - Longer deployment timeframe
  - Increased maintenance costs

Extending the Standard

Extensions should only be considered when:

- NTCIP features are inadequate to meet need
- Benefits of extension outweigh added costs

Extending the Standard

Extended equipment should be designed to:

- Appropriately integrate with NTCIP-only deployments
- Minimize added complexity

Extending the Standard Using a Custom User Need

X.1 Custom Needs

X.1.1 Plan Selection Based on Astronomical Clock (Annex C)

A TMS operator needs the ELMS to switch luminaires, circuits and electrical services based on the sunrise and sunset time as calculated by day of year, and latitude/longitude.

This feature allows ELMS to ensure these conditions are managed daily.

Extending the Standard Using a Custom User Need

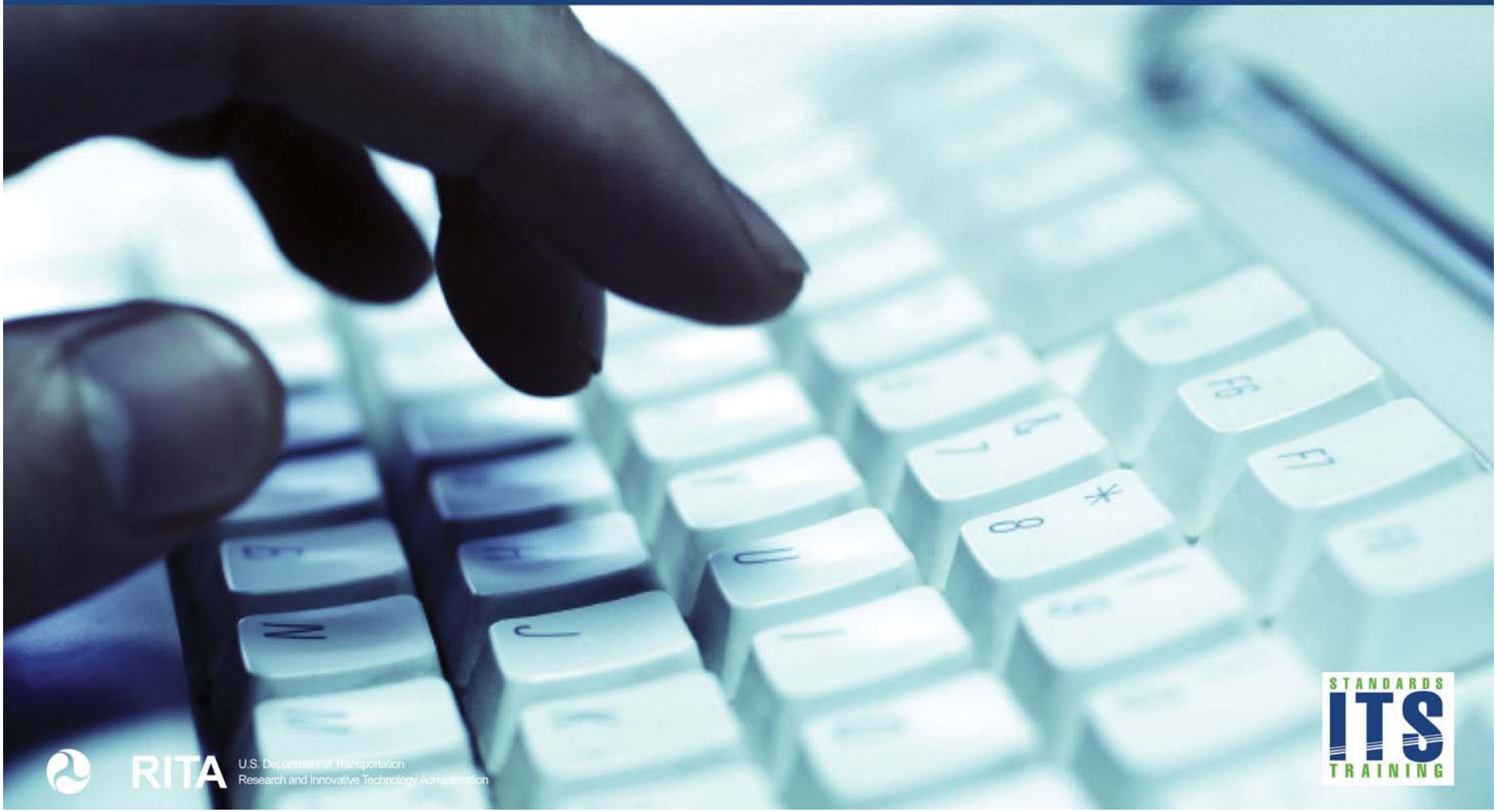
X.2 Requirements
X.2.1 Configure Astronomical Control

The ELMS shall allow the TMS to configure schedule mode to enable astronomical control

X.2.2 Monitor Astronomical Control

The ELMS shall allow the TMS to monitor astronomical control.

ACTIVITY



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Which of the following is the best reason to extend the NTCIP 1213 standard?

Answer Choices

a) There is an unmet need that justifies the added cost
b) The existing system uses a non-standard method
c) You want to use your specification to favor a specific vendor
d) When the standardized solution is overly complex for your simple needs

Review of answers

a) There is an unmet need that justifies the added cost

Correct. Sometimes you just have to accept the added cost.

b) The existing system uses a non-standard method

Incorrect. Doing this will prolong the expensive customized approach for another generation.

c) You want to use your specification to favor a specific vendor

Incorrect. This can trap you into a proprietary solution.

d) When the standardized solution is overly complex

Incorrect. Some NTCIP features are complex to allow flexibility, but costs of custom solutions far outweigh any costs due to added complexity.

Summary of Learning Objective #6

Explain conditions and context for extending the Standard

- We discussed specifying requirements that are that are not included in the standard:
  - By adding missing requirements identified through best practices
  - By emphasizing the user need/requirements link

What We Have Learned

1) Components of the standards: User Needs, *Requirements*, Dialogs, the *PRL* and the RTM.

2) *Dialogs* and messages in the *RTM* are communicated to the field device using *SNMP*.

3) The protocol implementer can use testing results to confirm *conformance* to NTCIP 1213 as a benefit to agencies.

4) The RTM traces requirement to a *single* design solution, thereby providing *interoperability*

Resources

- *Systems Engineering Handbook,* Version 3.2, International Council on Systems Engineering, January 2010
- *Systems Engineering Guidebook for Intelligent Transportation Systems,* Version 3.0, United States Department of Transportation, November 2009
- *The NTCIP Guide*, Version 04, NTCIP 9001, 2009
- *Object Definitions for Electrical and Lighting Management Systems,* Version 2.20b, NTCIP March 2011
- A306b Participant Student Supplement

QUESTIONS?

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