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U.S. Department of Transportation

Office of the Assistant Secretary for Research and Technology

Welcome

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A306a:
Understanding User Needs for Electrical and Lighting Management Systems (ELMS) Based on NTCIP 1213 Standard v03

Instructor

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Learning Objectives

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Identify **specific ELMS user needs**

Use the Protocol Requirements List (PRL) to **select the user needs and trace them to requirements**

Explain **how to use the ELMS PRL table** for the ELMS specification

Learning Objective 1

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Purpose and Selection of the NTCIP 1213 v03 Standard

What Is an ELMS?

An ELMS is defined as a system or device that:

- Senses and communicates near real-time data
- Focuses on electrical, lighting, Smart Grid, Connected Vehicle, and electric vehicle charging parameters
- Uses the NTCIP protocol

Purpose and Selection of the NTCIP 1213 v03 Standard

Why Should You Use an ELMS?

- User needs supported by the standard
  - Example: Implement Roadway Lighting Plan based on Time Schedule
- Functional requirements supported by the standard
  - Example: Control Roadway Lighting Levels based on Time of Day
- Supports interoperability
  - Example: By providing standardized functionality with NTCIP, ITS, and Smart Grid systems

CASE STUDY

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Image Source: Thinkstock USDOT

Purpose and Selection of the NTCIP 1213 v03 Standard

ELMS Case Study – Anytown, USA

- You're the public works manager responsible for:
  - Traffic signals
  - Roadway lighting
  - Other infrastructure

- Users
  - The finance director
  - Field staff

- You need to:
  - Deploy dimmable LED street lighting
  - Prepare for adaptive dynamic roadway lighting systems of the future
  - Minimize ground fault injuries

EXAMPLE

Purpose and Selection of the NTCIP 1213 v03 Standard

User Needs of Anytown, USA

- Energy use must be controllable
- Power outages must be communicated in near real-time
- Dimmable LED lighting must be deployed
- Adaptive control of lighting using vehicular and pedestrian traffic information must be deployed
- Ground fault conditions must be communicated in near real-time to the Traffic Management Center (TMC)

EXAMPLE

ELMS Case Study – Anytown, USA

- You've reviewed ELMS standards-based solutions
- You consider ELMS-based solutions very promising

You then ask yourself

- Can an ELMS system satisfy these five wide-ranging user needs?
- The answer is **YES**
- This course will provide the domain knowledge to achieve those goals

SUPPLEMENT

Purpose and Selection of the NTCIP 1213 v03 Standard

ELMS Case Study – Anytown, USA

The NTCIP 1213 ELMS v03 Standard:

- User needs supported by the standard
  - Example: Implement Roadway Lighting Plan based on Time Schedule
- Functional requirements supported by the standard
  - Example: Control Roadway Lighting Levels based on Time of Day
- Supports interoperability
  - Example: By providing standardized functionality with NTCIP, ITS, and Smart Grid systems

What Is Different in v03 Compared to v02 and v01

History of NTCIP 1213

- v01 was not published
- v02 was published in 2011; it includes support for:
  - Lighting fixtures (luminaires)
  - Branch circuits and electrical services
  - Scheduling and logical grouping of the above

What Is Different in v03 Compared to v02 and v01

v03 Supports All Features in v02 Plus

- Support for connected vehicles, as well as connected pedestrians (and bicyclists) for safety as well as for the development of adaptive roadway applications
- Standardized communications protocols for electric vehicle charging stations, also known as Electric Vehicle Service Equipment (EVSEs) to create new revenue streams for local, state, and federal governments

What Is Different in v03 Compared to v02 and v01

v03 Supports All Features in v02 Plus

- Electrical Demand Response support to facilitate greater integration to the intelligent electrical generation, distribution, and market efforts known informally as the “Smart Grid”
- This includes support for bidirectional communications needed to support Automated Demand Response activities by electric utilities as well as renewable electric such as wind- and solar-based photovoltaic distributed energy generation and storage

Components of the Standard

We Will Examine:

- ConOps: Concept of Operations
- Functional Requirements
- Dialogs
- MIB: Management Information Base
- PRL: Protocol Requirements List
- RTM: Requirements Traceability Matrix

Components of the Standard

User Needs and the Architecture

We will discuss:

- Location of user needs and standards on “Vee” diagram Life Cycle Process
- The generic architecture model

Components of the Standard

Sections within the Document

- Section 1: General
- Section 2: Concept of Operations
- Section 3: Functional Requirements
- Section 4: Dialog
- Section 5: Management Information Base
- Annex A: Requirements Traceability Matrix (RTM)
- Annex B: Object Tree
- Annex C: Test Procedures

Components of the Standard

Introduce Generic Architecture Model

- NTCIP (National Transportation Communications for ITS Protocols): a family of standards for the ITS industry
- Provides rules for communicating (called protocols)
- Provides the vocabulary (called objects) necessary to control and monitor ELMS field equipment such as:
  - Roadway Lighting
  - Ground Fault Equipment
  - Revenue Grade Power Metering

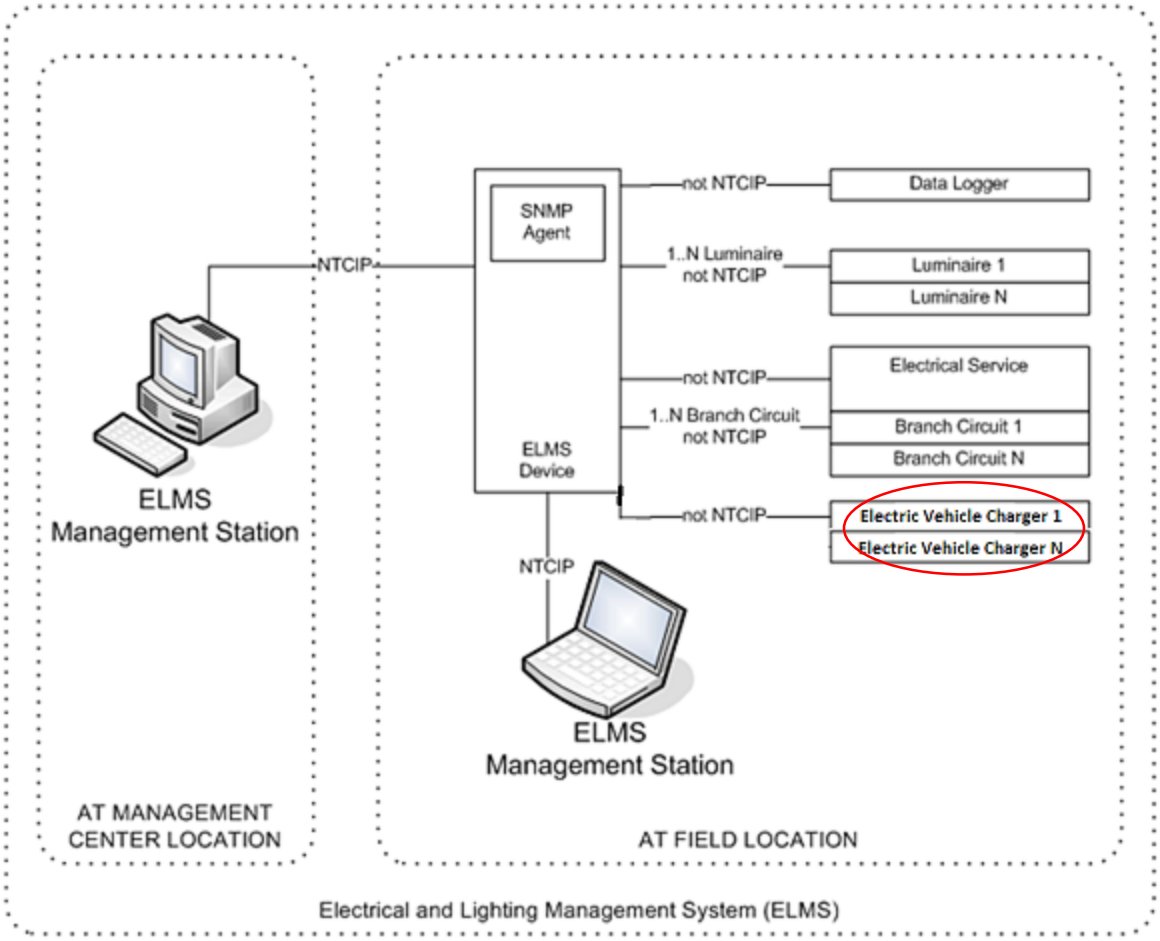
Components of the Standard

Generic Architecture Model

New in v03:

Provides the vocabulary (called objects) necessary to control and monitor ELMS field equipment such as:

- Adaptive Lighting Systems
- Smart Grid Demand Management Systems
- Electric Vehicle Chargers



Components of the Standard

NTCIP Family of Standards

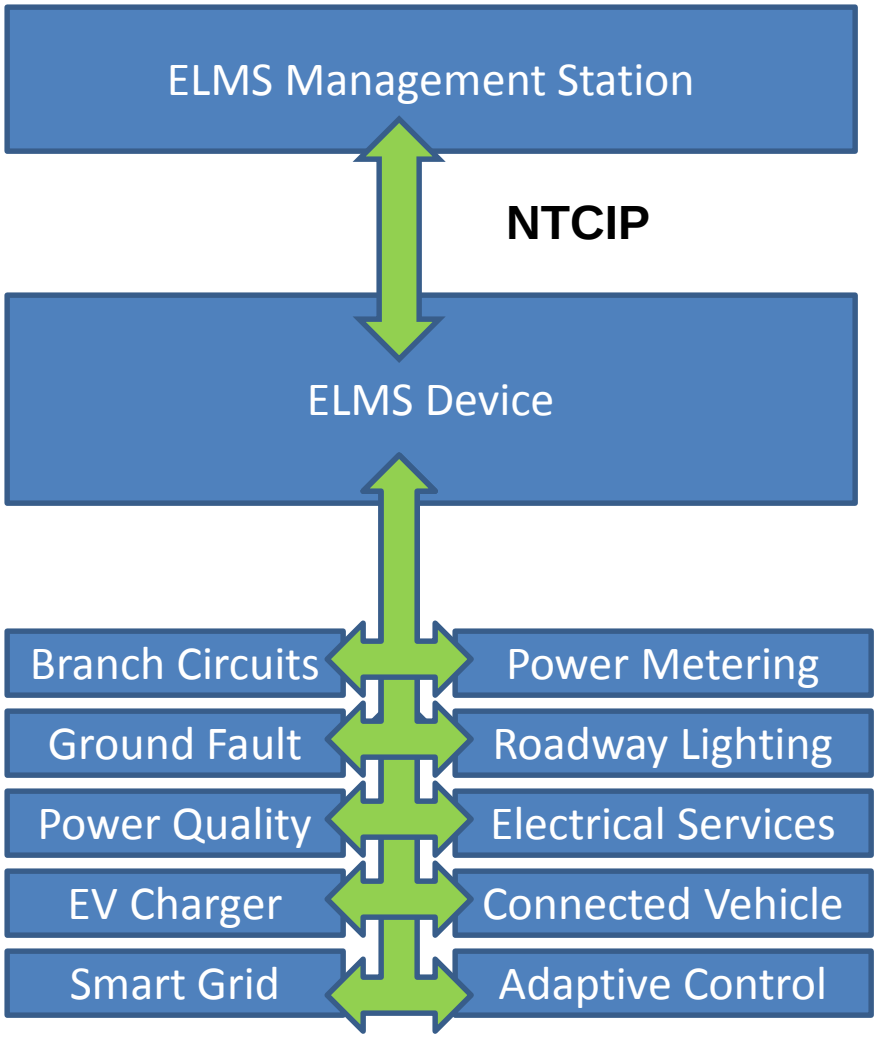
A family of standards for the ITS industry:

- Information profile standards are called “objects”
- Objects are aggregated in a data table known as a Management Information Base (MIB)
- Underlying communications standards are called “protocols”
- NTCIP 1213 is an Information Content Standard

Components of the Standard

What Is NTCIP 1213?

- Standardizes the communications interface
- Specifies the interface between the ELMS systems in the field and the host system



Components of the Standard

History of the ELMS NTCIP 1213 Standard

- NTCIP 1213 v01.03. February 2004 – Accepted as a User Comment Draft
- NTCIP 1213 v02.19. December 2005 – Accepted v02.19b as a Recommended Standard
- NTCIP 1213 v02.20. February 2011 – Published
- NTCIP 1213 v03 approved by NTCIP JC in May 2016

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Question

Which of the following statements is true?

Answer Choices

a) NTCIP 1213 is an Information Content standard

b) NTCIP 1213 is an Application Level standard

c) NTCIP 1213 is a Transport Level standard

d) NTCIP 1213 is a Plant Level standard

Review of Answers

a) NTCIP 1213 is an Information Content standard

Correct, because NTCIP 1213 addresses the Information Level of interoperability.

b) NTCIP 1213 is an Application Level standard

Incorrect, because NTCIP 1213 does not address the Application Level.

c) NTCIP 1213 is a Transport Level standard

Incorrect, because NTCIP 1213 does not address the Transport Level.

d) NTCIP 1213 is a Plant Level standard

Incorrect, because NTCIP 1213 does not address the Plant Level.

Components of the Standard

Major Benefits of ELMS NTCIP 1213

- Defines user needs supported by the standard, for example:
  - Monitor the Status of the ELMS Luminaire Switch Status Message
- Defines functional requirements supported by the ELMS standard, for example:
  - Monitor the ELMS Luminaire Current Status Message
- Requirements are traced to the user need “monitor the status of the ELMS message”

Components of the Standard

Advantages of ELMS NTCIP 1213

Enables solutions that are:

- Easier to use
- Easier to specify
- Easier to test

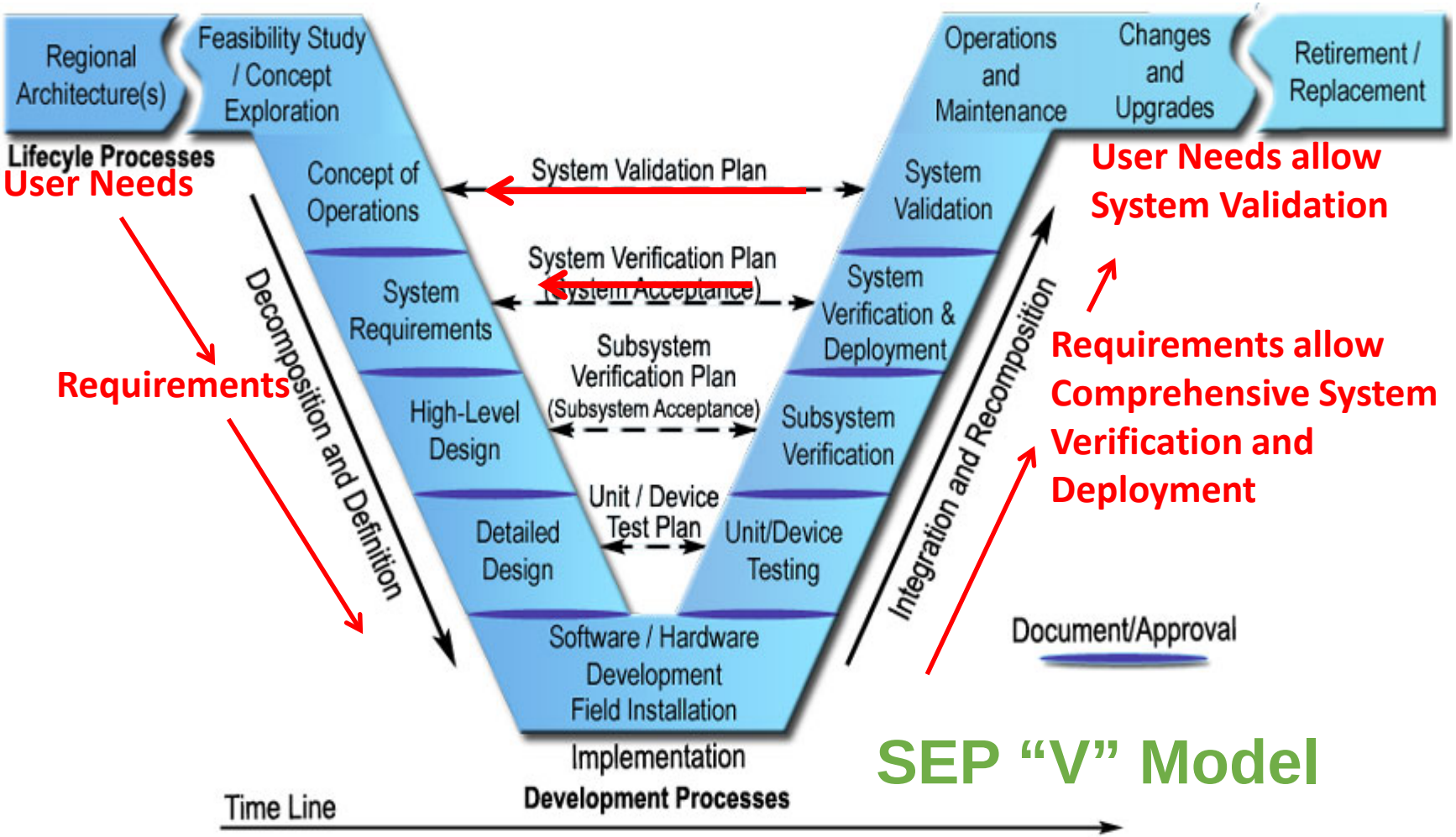
Components of the Standard

Advantages of SEP and ELMS NTCIP 1213

- Supports off-the-shelf interoperability
- Based on the requirements, the standard specifies the design, ensuring consistency between implementations
- Provides standardized user needs, requirements, and design content to fully support project engineering activities using the Systems Engineering Process (SEP)

Components of the Standard

ELMS NTCIP 1213 and the SE Life Cycle



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Question

Which of the following is not an advantage of using the systems engineering process for the ELMS NTCIP 1213 standard?

Answer Choices

a) Supports interoperability

b) Allows multiple designs for each requirement

c) Allows clear development of test procedures based on the requirements selected

d) Determines what user needs are supported

Review of Answers

a) Supports interoperability

True. NTCIP 1213 SEP process supports the Information Level of interoperability

b) Allows multiple designs for each requirement

False. NTCIP 1213 does define a unique design for each requirement

c) Allows clear development of test procedures based on the requirements selected

True. NTCIP 1213 describes clear test procedures

d) Determines what user needs are supported

True. NTCIP 1213 determines the user needs to be supported

Learning Objectives

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Identify **specific ELMS user needs**

Learning Objective 2

Identify **Specific ELMS User Needs**

CASE STUDY

U.S. Department of Transportation
ITS Joint Program Office
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What Are You Trying to Do as ELMS?

An Actual ELMS Case Study – Minneapolis, MN

User Needs

During a downtown reconstruction project, these user needs were identified:

- Lighting system attributes must be monitored
- Ground fault conditions must be communicated in near real-time
- Selected lighting fixtures must be turned off during nonpeak periods

Image © 2017 Jim Frazer

EXAMPLE

What Are You Trying to Do as ELMS?

ELMS Case Study – Minneapolis, MN

Results

- Roadway lighting system attributes are monitored
- Ground fault conditions are communicated in near real-time
- Selected lighting fixtures are turned off during nonpeak periods

Image © 2016 Gridaptive Technologies

What Are You Trying to Do as ELMS?

ELMS Case Study – Miami-Dade County, FL

User Needs

Due to severe and fatal injuries of people and animals, these user needs were recognized:

- Ground fault conditions must be communicated in near real-time
- Data must be logged
- Reports of alarms must be generated

Image © 2017 Jim Frazer

EXAMPLE

What Are You Trying to Do as ELMS?

ELMS Case Study – Miami-Dade County, FL

Results

- Ground fault conditions are communicated in near real-time
- Data are logged
- Reports of alarms are generated

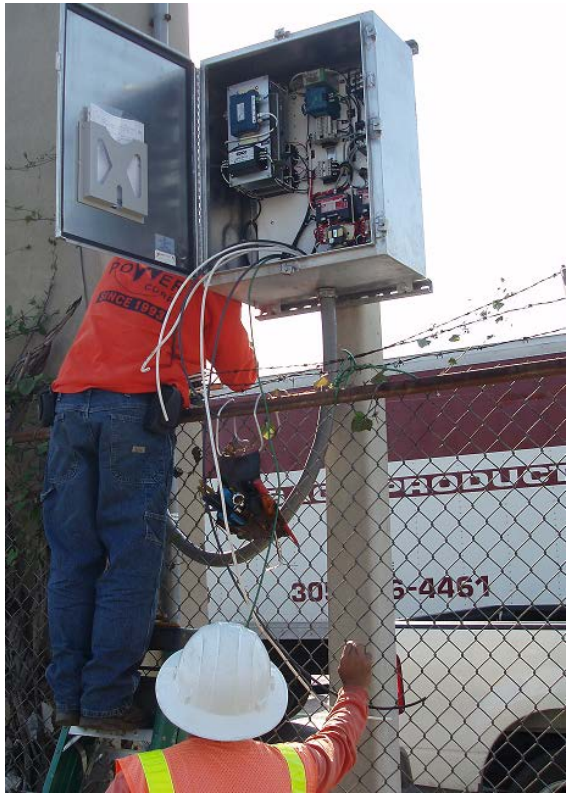


Image © 2017 Jim Frazer

SUPPLEMENT

What Are You Trying to Do as ELMS?

ELMS Case Study – Route 520 WSDOT

User Needs

During the Route 520 tunnel and bridge project from Seattle to Bellevue, these user needs were identified:

- Energy use must be controlled
- Power outages must be communicated in near real-time
- Adaptive control of lighting based on ambient light levels must be deployed

Image © 2012 Gridaptive Technologies

EXAMPLE

What Are You Trying to Do as ELMS?

ELMS Case Study – Washington State DOT

Results

- Energy use is controlled
- Power outages are communicated in near real-time
- Adaptive control of lighting based on ambient light levels is deployed

Image © 2012 Gridaptive Technologies

EXAMPLE

What Are You Trying to Do as ELMS?

ELMS NTCIP 1213 Concept of Operations

What is the Concept of Operations?

- Focus is on a system and its users
- Time frame is the life cycle of the system
- Defines the user needs supported by the standard
- Provides an operational context for the system

What Are You Trying to Do as ELMS?

Primary Uses of ELMS NTCIP 1213 Systems

ELMS is used for control and monitoring of:

- Roadway lighting, including scheduling and zoning
- Safety: electrical leakage anomalies
- Revenue grade power metering, i.e., “billable” metering
- Integration with other systems including:
  - Vehicle to Grid Infrastructure
  - The electrical distribution network (The Smart Grid)
  - Electric vehicle charging infrastructure, traffic signal power usage, DMS power usage, etc.

What Are You Trying to Do as ELMS?

What Is a User Need?

Describes the major capability provided by a system to satisfy an operational need

- A system should not be procured or built without knowing what it is expected to do, such as:
  - Control roadway lighting
  - Monitor ground fault conditions
  - Monitor electrical power usage

What Are You Trying to Do as ELMS?

Who and What Can Generate User Needs?

User Needs describe the major capability provided by a system to satisfy an operational need

- People have User Needs
  - Travelers
  - TMC Operators
  - Maintenance Personnel

- In some contexts, a system may generate User Needs: "the management station may need to modify operational parameters..."

What Are You Trying to Do as ELMS?

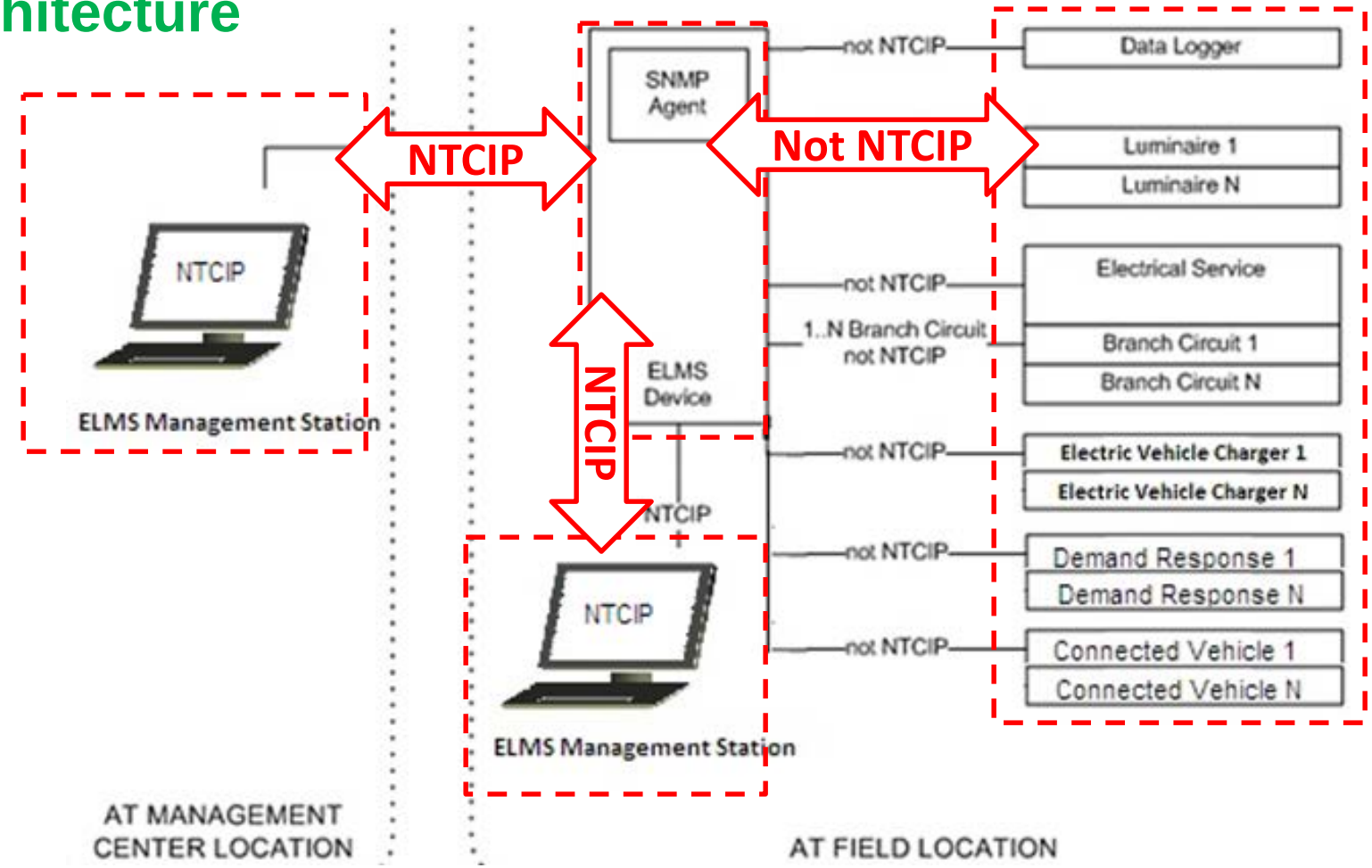
ELMS NTCIP 1213 User Needs

ELMS Problem Statement

- Need to manage generic information (e.g., device ID)
- Need to detect/sense device information from sensors in the field
- Need to control field sensor attributes
- Need to integrate to other ELMS systems, and other communications platforms

NTCIP 1213 Scope

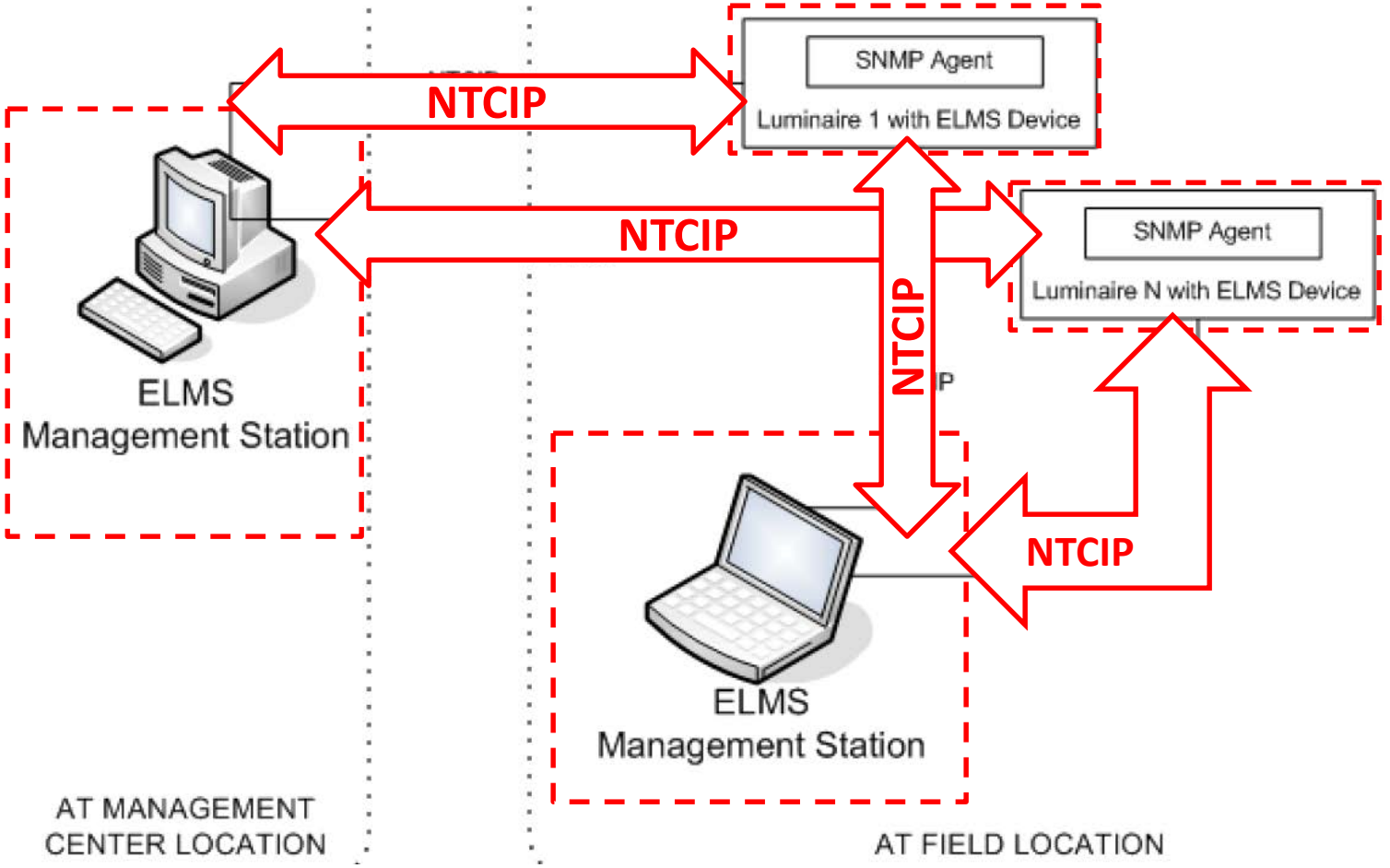
Simple Architecture



Source: Figure 1, Page 9, NTCIP 1213 Standard

NTCIP 1213 Scope

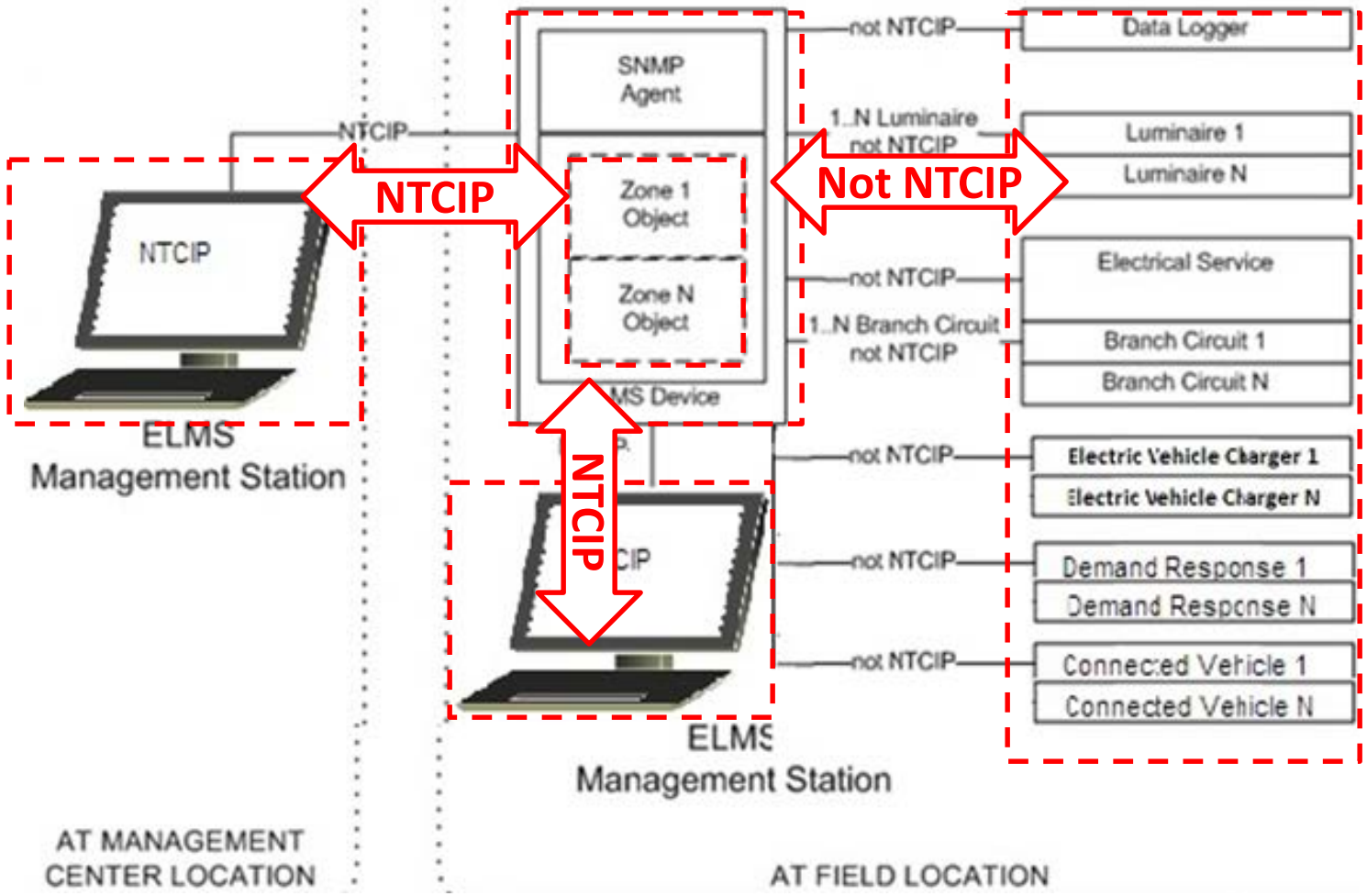
Alternate Architecture: ELMS within a Luminaire



Source: Figure 1 , Page 9, NTCIP 1213 Standard

NTCIP 1213 Scope

Alternate Architectures – Logical Zoning



What Are You Trying to Do as ELMS?

ELMS NTCIP 1213 User Needs in Detail

- Section 2.5 describes the major user needs that are related to the definition of the interface between the management station and an ELMS field device

- The user needs are considered to be the “high level” capabilities for NTCIP 1213 v03, and form the basis for defining the detailed functional requirements of the interface

What Are You Trying to Do as ELMS?

ELMS NTCIP 1213 User Needs in Detail

The user needs are organized as follows:

- Operational—defining the basic modes of operation for communication between the management station and field devices
- Features—describing essential data communication functions and message elements to be supported by the interface

What Are You Trying to Do as ELMS?

ELMS NTCIP 1213 Operational User Needs

Provide Live Data (mandatory)

2.5.1.1 Provide Live Data

One operational environment allows the management system to monitor and control the device by issuing requests (e.g., requests to access information, alter information, or control the device). In this environment, the device responds to requests from the management station immediately (e.g., through the provision of live data, success/failure notice of information alteration, or success/failure of the command).

What Are You Trying to Do as ELMS?

ELMS NTCIP 1213 Operational User Needs

Provide Off-Line Logged Data

2.5.1.2 Provide Off-Line Log Data

Some operational environments do not have always-on connections (e.g., dial-up links). In such environments, a transportation system operator may wish to define conditions under which data are placed into a log, which can then be uploaded at a later time. For example, the operator may wish to manage the ELMS device so that it autonomously maintains a log of whenever a specific luminaire is turned on or off.

ELMS NTCIP 1213 Features

Relate to the informational needs of the users – control, monitor, and manage:

- Electrical power, metering
- Electrical safety/ground faults
- Electric vehicle charging
- Smart Grid demand management operations
- Connected vehicle driven adaptive lighting

SUPPLEMENT

Manage Roadway Lighting

Managing Roadway Lighting includes several subneeds:

- Implement Lighting Plan Based on Ambient Light Level
- Implement Lighting Plan Based on Time Base Schedule
- Create Zone
- Configure Zone

ELMS NTCIP 1213 Features

Manage Roadway Lighting

Managing Roadway Lighting includes several subneeds:

- Configure Schedule
- Apply Schedule to Zone
- Configure Roadway Lighting Dim Level

ELMS NTCIP 1213 Features

Manage Roadway Lighting

Managing Roadway Lighting also includes luminaire subneeds:

- Configuration of Luminaire Switch State Logging
- Configuration of Luminaire Lamp Condition Logging
- Configuration of Luminaire Burn Condition Logging
- Configuration of Luminaire Pole Condition Logging

Manage Roadway Lighting

Managing Roadway Lighting also includes luminaire subneeds:

- Configuration of Luminaire Switch State
- Configuration of Luminaire Identification
- Configuration of Luminaire Dim Level
- Control of Luminaire

ELMS NTCIP 1213 Features

Manage Electrical Power

Managing Electrical Power includes several subneeds:

- Configure and Monitor Power Meter Switch State
- Configure and Monitor Power Meter Switch State Logging
- Configure and Monitor Power Meter Condition Logging
- Configure and Monitor Power Meter Periodic Measurement Logging

Manage Electrical Safety

Managing Electrical Safety includes several subneeds:

- Configure and Monitor Ground Fault Switch State Logging
- Configure and Monitor Periodic Ground Fault Measurement Logging
- Configure and Monitor Electrical Service

Manage Electrical Safety

Managing Electrical Safety includes several additional subneeds:

- Configure and Monitor Circuit
- Monitor Circuit Breaker
- Monitor Arc Fault Status

ELMS NTCIP 1213 Features

Manage Electric Vehicle (EV) Charging

A management station may need to retrieve information from the ELMS device, such as:

- Electric Vehicle Charger Ground Fault Current Status
- Electric Vehicle Charger Charge Current
- Electric Vehicle Charger Proximity Resistance
- Electric Vehicle Charger Temperature
- Electric Vehicle Charger Activation
- Electric Vehicle Charger Operational Status

ELMS NTCIP 1213 Features

Manage Smart Grid Demand Management

A management station may need to retrieve information from the ELMS device, such as

- Electricity Price
- Energy Price
- Demand Charge
- Bid Price
- Bid Load
- Bid Energy
- Load Dispatch
- Load Control Capacity
- Load Control Offset
- Load Control Setpoints
- Load Control Percent Offset

ELMS NTCIP 1213 Features

Manage Connected Vehicle Support

A management station may need to configure objects within the ELMS device, such as:

- Connected Vehicle Speed Setpoint
- Connected Vehicle Direction Setpoint
- Connected Vehicle Location Setpoint
- Connected Vehicle Ambient Light Level Setpoint
- Connected Vehicle Headlight Status Setpoint
- Connected Vehicle Road Friction Setpoint

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Question

Which of the following user needs cannot be satisfied by an ELMS system?

Answer Choices

a) Need to inform TMC manager of electrical leakage

b) Need to control traffic flow at an intersection

c) Need to inform TMC manager of energy usage

d) Need to control lighting levels by dimming

Review of Answers

a) Need to inform TMC manager of electrical leakage
Incorrect. NTCIP 1213 supports the communications of electrical leakage information

b) Need to control traffic flow at an intersection
Correct. NTCIP 1213 does not support traffic flow

c) Need to inform TMC manager of energy usage
Incorrect. NTCIP 1213 supports the communications of energy usage information

d) Need to control lighting levels by dimming.
Incorrect. NTCIP 1213 supports the communications of dimming information

Learning Objectives

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Identify **specific ELMS user needs**

Use the Protocol Requirements List (PRL) to **select the user needs and trace them to requirements**

Learning Objective 3

Use the Protocol Requirements List (PRL) to **select the user needs and trace them to requirements**

Requirements to Be Implemented in a Project-Specific Implementation

PRL as a Tool

- Understand the parts of the PRL
- Use the PRL as a tool for project-specific implementations
- Reduce the risk of failure

Requirements to Be Implemented in a Project-Specific Implementation

ELMS NTCIP 1213 Functional Requirements

Section 3 of the ELMS standard defines the requirements based on the user needs identified in Section 2, and the interrelationship of user needs and functional requirements.

- Protocol Requirements List (PRL)
- Operational environment requirements
- Functional requirements
- Supplemental requirements

Requirements to Be Implemented in a Project-Specific Implementation

Purpose of the ELMS Protocol Requirements List

The PRL's purpose is:

- To be a table that maps the user needs to the requirements
- Must be part of the agency's specification
- References the standard to define the communication interface
- Designed to help define what you want the interface to do
- Used to identify what requirements will be selected to address a specific set of user needs.

Requirements to Be Implemented in a Project-Specific Implementation

Purpose of the ELMS Protocol Requirements List

3.3.3 Protocol Requirements List (PRL) Table

Protocol Requirements List (PRL) Table						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.1	Operational User Needs			M	Yes	
2.5.1.1	Provide Live Data			M	Yes	
		3.5.1.1	Retrieve Data	M	Yes	
		3.5.1.2	Deliver Data	M	Yes	
		3.5.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
		3.5.1.4	Live Data Response Time	M	Yes	
2.5.1.2	Provide Off-Line Log Data			O	Yes / No	
		3.5.2.1	Retrieve Configuration of Logging Service	M	Yes	
		3.5.2.2	Configure Logging Service	M	Yes	
		3.5.2.2.1	Configure Number of Events in Event Log	M	Yes / No	The ELMS device shall support at least _____ (1..255) events.
		3.5.2.2.2	Configure Number of Event Classes	M	Yes / No	The ELMS device shall support at least _____ (1..255) classes.
		3.5.2.2.3	Configure Number of Event Types	M	Yes / No	The ELMS device shall support at least _____ (1..255) event types.
		3.5.2.3	Retrieve Logged Data			
		3.5.2.4	Clear Log	M	Yes	
		3.5.2.5	Retrieve Capabilities of Event Logging Services	M	Yes	
		3.5.2.6	Retrieve Number of Events Currently Logged	M	Yes	
		3.5.2.7	Set Time	M	Yes	

SUPPLEMENT

Requirements to Be Implemented in a Project-Specific Implementation

ELMS User Needs in the PRL

3.3.3 Protocol Requirements List (PRL) Table

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Requirements to Be Implemented in a Project-Specific Implementation

ELMS Functional Requirements in the PRL

3.3.3 Protocol Requirements List (PRL) Table

Protocol Requirements List (PRL) Table

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		3.5.2.1	Retrieve Configuration of Logging Service	M	Yes	
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		3.5.2.7	Set Time	M	Yes	

Requirements to Be Implemented in a Project-Specific Implementation

ELMS Conformance in the PRL

3.3.3 Protocol Requirements List (PRL) Table

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		3.5.1.2	Deliver Data	M	Yes	
		3.5.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
		3.5.1.4	Live Data Response Time	M	Yes	
2.5.1.2	Provide Off-Line Log Data			O	Yes / No	
		3.5.2.1	Retrieve Configuration of Logging Service	M	Yes	
		3.5.2.2	Configure Logging Service	M	Yes	
		3.5.2.2.1	Configure Number of Events in Event Log	M	Yes / No	The ELMS device shall support at least _____ (1..255) events.
		3.5.2.2.2	Configure Number of Event Classes	M	Yes / No	The ELMS device shall support at least _____ (1..255) classes.
		3.5.2.2.3	Configure Number of Event Types	M	Yes / No	The ELMS device shall support at least _____ (1..255) event types.
		3.5.2.3	Retrieve Logged Data			
		3.5.2.4	Clear Log	M	Yes	
		3.5.2.5	Retrieve Capabilities of Event Logging Services	M	Yes	
		3.5.2.6	Retrieve Number of Events Currently Logged	M	Yes	
		3.5.2.7	Set Time	M	Yes	

Requirements to Be Implemented in a Project-Specific Implementation

ELMS Project Requirements in the PRL

3.3.3 Protocol Requirements List (PRL) Table

Protocol Requirements List (PRL) Table

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.1	Operational User Needs			M	Yes	
2.5.1.1	Provide Live Data			M	Yes	
		3.5.1.1	Retrieve Data	M	Yes	
		3.5.1.2	Deliver Data	M	Yes	
		3.5.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
		3.5.1.4	Live Data Response Time	M	Yes	
2.5.1.2	Provide Off-Line Log Data			O	Yes / No	
		3.5.2.1	Retrieve Configuration of Logging Service	M	Yes	
		3.5.2.2	Configure Logging Service	M	Yes	
		3.5.2.2.1	Configure Number of Events in Event Log	M	Yes / No	The ELMS device shall support at least _____ (1..255) events.
		3.5.2.2.2	Configure Number of Event Classes	M	Yes / No	The ELMS device shall support at least _____ (1..255) classes.
		3.5.2.2.3	Configure Number of Event Types	M	Yes / No	The ELMS device shall support at least _____ (1..255) event types.
		3.5.2.3	Retrieve Logged Data			
		3.5.2.4	Clear Log	M	Yes	
		3.5.2.5	Retrieve Capabilities of Event Logging Services	M	Yes	
		3.5.2.6	Retrieve Number of Events Currently Logged	M	Yes	
		3.5.2.7	Set Time	M	Yes	

Requirements to Be Implemented in a Project-Specific Implementation

Other User Needs Not in the PRL

Other Operational Needs:
User Needs Not Supported by NTCIP 1213

- The standard, like the entire suite of NTCIP protocols, allows for extensions
- Proprietary extensions are not desired (interoperability problems), but are sometimes necessary
- Extensions might become part of a future version of the standard
- The standard supports interoperability for all contained features

Agency Use of the ELMS PRL

The ELMS PRL can be used by:

- A user or agency specification writer to indicate which requirements are to be implemented in a project-specific implementation

- The protocol implementer, as a checklist to reduce the risk of failure to conform to NTCIP 1213

Supplier and User Use of the ELMS PRL

The ELMS PRL can also be used by:

- The supplier and user, as a detailed indication of the capabilities of the implementation
- The user, as a basis for initially checking potential interoperability with another implementation

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Question

Which of the following is a true statement?

Answer Choices

a) ELMS User Needs do not describe what features the device needs to support and why

b) ELMS Functional Requirements are not specifications

c) Within the ELMS PRL, the relationships between User Needs and Functional Requirements are not standardized

d) The ELMS PRL promotes Interoperability

Review of Answers

a) User Needs do not describe what features the device needs to support and why

Incorrect. User Needs do describe supported features.

b) Functional Requirements are not specifications

Incorrect. Functional Requirements do not support specifications.

c) Within the PRL, the relationships between User Needs and Functional Requirements are not standardized

Incorrect. Relationships between User Needs and Functional Requirements are standardized.

d) The PRL promotes Interoperability

Correct. The PRL does support Interoperability.

Capabilities of the Implementation

Selecting User Needs through the PRL

Using the ELMS User Need ID number 2.5.2.2.2, the corresponding text allows determination if the User Need "Control Electrical Service" is desired in your system.

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.2	Control Electrical Service			O	Yes / No	
		3.5.5.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.5.5.2.2	Control Electrical Service by Transitory Override	O	Yes / No	
		3.5.5.2.3	Control Electrical Service by Timed Override	O	Yes / No	
		3.5.5.2.4	Control Electrical Service in Stagger Mode	O	Yes / No	
		3.5.5.2.5	Control Electrical Service by Photocell	O	Yes / No	
		3.5.5.2.6	Control Electrical Service by Adaptive Means	O	Yes / No	

Selecting User Needs through the PRL

ELMS User Need 2.5.2.2.2 “Control Electrical Service” is defined in the ELMS standard as:

Control Electrical Service
A management station may need to control an electrical service directly or by enabling/disabling the staggered operation for branch circuits served by the electrical service. A management station may need to control the electrical service to allow or disallow the schedule control by one of four states:

1. **Continuous control**
2. **Transitory control**
3. **Timed control**
4. **Adaptive control**

ELMS PRL and Conformance

Conformance Mandatory vs. Optional

- Examine the “Conformance” column
- Conformance – Identifies if the user need (or requirement) is mandatory or optional

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.2	Control Electrical Service			O	Yes / No	
		3.5.5.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.5.5.2.2	Control Electrical Service by Transitory Override	O	Yes / No	
		3.5.5.2.3	Control Electrical Service by Timed Override	O	Yes / No	
		3.5.5.2.4	Control Electrical Service in Stagger Mode	O	Yes / No	
		3.5.5.2.5	Control Electrical Service by Photocell	O	Yes / No	
		3.5.5.2.6	Control Electrical Service by Adaptive Means	O	Yes / No	

ELMS PRL and Conformance

Conformance Mandatory vs. Optional

- Conformance – Identifies if the user need (or requirement) is mandatory or optional
- Thus, if User Need 2.5.2.2.2 “Control Electrical Service” is required, 3.5.5.2.1 is mandatory, others are optional

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.2	Control Electrical Service			O	Yes / No	
		3.5.5.2.1	Control Electrical Service by Permanent/Continuous Override	M	Yes	
		3.5.5.2.2	Control Electrical Service by Transitory Override	O	Yes / No	
		3.5.5.2.3	Control Electrical Service by Timed Override	O	Yes / No	
		3.5.5.2.4	Control Electrical Service in Stagger Mode	O	Yes / No	
		3.5.5.2.5	Control Electrical Service by Photocell	O	Yes / No	
		3.5.5.2.6	Control Electrical Service by Adaptive Means	O	Yes / No	

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Question

Which of the following descriptions of the PRL is a false statement?

Answer Choices

a) Options for Conformance are Mandatory or Optional

b) Options for Project Requirements are Yes or No

c) Optional User Needs are dependent on Project Requirements

d) Optional Functional Requirements are not dependent on Project Requirements

Review of Answers

a) Options for Conformance are Mandatory or Optional

True statement. The only valid entries for Conformance are Mandatory and Optional.

b) Options for Project Requirements are Yes or No

True statement. The only valid entries for Project Requirements are Yes and No.

c) Optional User Needs are dependent on Project Requirements

True statement. Selection of Project Requirements drives the inclusion/exclusion of optional User Needs.

d) Optional Functional Requirements are not dependent on Project Requirements

False. Selection of Project Requirements drives the inclusion/exclusion of optional FRs.

Capabilities of the Implementation

ELMS User Needs Hierarchical Relationship

- User Need 2.5.1.2 is Optional. Thus, if the project definition requires this user need, then
- Dependent Requirements are Mandatory

2.5.1.2	Provide Off-Line Log Data		O	Yes / No	
	3.5.2.1	Retrieve Configuration of Logging Service	M	Yes	
	3.5.2.2	Configure Logging Service	M	Yes	
	3.5.2.2.1	Configure Number of Events in Event Log	M	Yes / No	The ELMS device shall support at least _____ (1..255) events.
	3.5.2.2.2	Configure Number of Event Classes	M	Yes / No	The ELMS device shall support at least _____ (1..255) classes.
	3.5.2.2.3	Configure Number of Event Types	M	Yes / No	The ELMS device shall support at least _____ (1..255) event types.
	3.5.2.3	Retrieve Logged Data			
	3.5.2.4	Clear Log	M	Yes	
	3.5.2.5	Retrieve Capabilities of Event Logging Services	M	Yes	
	3.5.2.6	Retrieve Number of Events Currently Logged	M	Yes	
	3.5.2.7	Set Time	M	Yes	

Capabilities of the Implementation

ELMS PRL User Needs: Project Requirements Relationship

Agency/Specifier to circle **Yes** or **No** to indicate the agency's user needs for the proposed implementation

2.5.2.1.21	Configure ELMS Device for Adaptive Operation			O	Yes / No
		3.5.4.23	Configure ELMS Device for Adaptive Operation	O	Yes / No
		3.5.4.23.1	Configure Connected Vehicle Speed Setpoint	O	Yes / No
		3.5.4.23.2	Configure Connected Vehicle Direction Setpoint	O	Yes / No
		3.5.4.23.3	Configure Connected Vehicle Location Setpoint	O	Yes / No
		3.5.4.23.4	Configure Connected Vehicle Ambient Light Level Setpoint	O	Yes / No
		3.5.4.23.5	Configure Connected Vehicle Headlight Status Setpoint	O	Yes / No
		3.5.4.23.6	Configure Connected Vehicle Road Friction Setpoint	O	Yes / No

Capabilities of the Implementation

Importance of the ELMS PRL's User Needs and Functional Requirements Relationship

- User Needs describe required features
- Functional Requirements refine the user needs into detailed specifications
- Within the PRL, the relationships between User Needs and Functional Requirements are standardized
- Use of the PRL's User Needs and dependent Functional Requirements promotes interoperability

ELMS PRL's User Needs/Functional Requirements Relationship in Detail

- Functional Requirement Identifier (FR ID) – Section Number of the Functional Requirement
- Functional Requirement (FR) – Title (description of the functional requirement)

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.1.22	Retrieve ELMS Device Adaptive	Operation Configuration		O	Yes / No	
		3.5.4.24	Retrieve ELMS Device Adaptive Operation Configuration	O	Yes / No	
		3.5.4.24.1	Retrieve Connected Vehicle Speed Setpoint	O		
		3.5.4.24.2	Retrieve Connected Vehicle Direction Setpoint	O		
		3.5.4.24.3	Retrieve Connected Vehicle Location Setpoint	O		
		3.5.4.24.4	Retrieve Connected Vehicle Ambient Light Level Setpoint	O		
		3.5.4.24.5	Retrieve Connected Vehicle Headlight Status Setpoint	O		

Capabilities of the Implementation

ELMS PRL's User Needs/Functional Requirements Relationship in Detail

- Requirements associated with a User Need are found under that User Need
- Each user need will have at least one requirement associated with it
- Each requirement in the standard is associated with at least one user need
- Result: The standard has no unnecessary requirement, and all user needs are satisfied by at least one requirement

ELMS PRL's User Needs/Functional Requirements Relationship in Detail

Mandatory vs. Optional

- A "mandatory" requirement is only mandatory if an associated user need is selected
- If an optional User Need is not selected, its associated requirements are not necessary, unless they are required by another user need selection
- Example: "3.5.4.4.4 – Configure Devices in Zone for Light Activated Operation"

ELMS PRL's User Needs/Functional Requirements Relationship in Detail

Additional Project Requirements Column

Used to provide further details about the implementation

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.1.22	Retrieve ELMS Device Adaptive Operation Configuration			O	Yes / No	
		3.5.4.24	Retrieve ELMS Device Adaptive Operation Configuration	O	Yes / No	
		3.5.4.24.1	Retrieve Connected Vehicle Speed Setpoint	O		
		3.5.4.24.2	Retrieve Connected Vehicle Direction Setpoint	O		
		3.5.4.24.3	Retrieve Connected Vehicle Location Setpoint	O		
		3.5.4.24.4	Retrieve Connected Vehicle Ambient Light Level Setpoint	O		
		3.5.4.24.5	Retrieve Connected Vehicle Headlight Status Setpoint	O		

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Question

Which of the following is a false statement?

Answer Choices

a) User Needs describe what features the device needs to support

b) Functional Requirements refine the user needs into specifications

c) Relationships between User Needs and Functional Requirements are standardized

d) The ELMS PRL does not promote interoperability

Review of Answers

a) User Needs describe what features the device needs to support

True statement. User Needs describe what features are required.

b) Functional Requirements refine the user needs into specifications

True statement. Functional Requirements do refine user needs into detailed, measurable specifications.

c) Relationships between User Needs and Functional Requirements are standardized

True statement. The PRL defines standardized relationships.

d) The PRL does not promote interoperability

False. The PRL does promote interoperability.

Using the ELMS PRL to Check Interoperability

Use of the ELMS PRL supports interoperability of selected attributes with:

- The ITS Management Center
- Other ELMS systems, on site or remote
- Smart Grid systems for automated demand management
- Connected vehicle and connected pedestrians for true adaptive roadway lighting
- Electric vehicle charging stations

Benefits of PRL

What Does Use of the PRL Achieve?

- Each Requirement has a need
- No Needs are unmet
- Extraneous requirements are avoided.

Learning Objectives

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Identify **specific ELMS user needs**

Use the Protocol Requirements List (PRL) to **select the user needs and trace them to requirements**

Explain **how to use the ELMS PRL table** for the ELMS specification

Learning Objective 4

How to use the PRL table for the ELMS Specification

User Needs-Requirements Link

Integrating the ELMS PRL into an ELMS Specification

From an agency's perspective:

- A completed PRL must become part of the overall specification
- A completed PRL indicates the requirements for the communications interface
- Agency provides language in the specification that all selected requirements must be implemented as per the standard in order to support off-the-shelf interoperability

SUPPLEMENT

User Needs-Requirements Link

Integrating the ELMS PRL into an ELMS Specification

From a vendor's perspective:

- Even if a user need and resulting requirement(s) is not mandatory, a vendor may optionally fulfill the user need and provide the feature
- Vendors can provide a PRL for their standard products to show what user needs they support

User Needs-Requirements Link

Integrating the ELMS PRL into an ELMS Specification

ELMS Contract Documents:

A completed ELMS PRL is part of the overall project specification, in addition to the hardware and software specifications

Contract Documents

Product Specifications		
Hardware Specifications	**Software Specifications**	**Communications Interface Specifications**
Functional Requirements	Functional Requirements	Functional Requirements
Performance Requirements	Performance Requirements	Performance Requirements
Structural Requirements		Protocol Requirements
Mechanical Requirements		
Electrical Requirements		
Environmental Requirements		

User Needs-Requirements Link

Integrating the ELMS PRL into an ELMS Specification – Conformance vs. Compliance

- Conformance:
  - Meets a specified standard
- Compliance
  - Meets a specification (e.g., for a specific project)

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Question

Which of the following is a false statement?

Answer Choices

a) Vendors can provide an ELMS PRL for their standard products to show what user needs they support

b) A completed ELMS PRL must become part of the overall specification

c) A completed ELMS PRL indicates the requirements for the communications interface

d) A completed ELMS PRL describes the entire project specification

Review of Answers

a) Vendors can provide an ELMS PRL for their standard products to show what user needs they support.

True statement. Products can be evaluated for standardization.

b) A completed ELMS PRL must become part of the overall specification

True statement. Project specifications includes communications, hardware, and software specifications.

c) A completed ELMS PRL indicates the requirements for the communications interface

True statement. The PRL defines the communications interface.

d) A completed ELMS PRL describes the entire project specification

False. It only describes the communications interface.

Module Summary

Understand the structure of the NTCIP 1213 v03 Standard for Electrical and Lighting Management Systems (ELMS)

Identify specific ELMS user needs

Use the Protocol Requirements List (PRL) to select the user needs and trace them to requirements

Explain how to use the ELMS PRL table for the ELMS specification

We Have Now Completed A306a in the ELMS Curriculum

Module A306a: Understanding **User Needs** for Electrical and Lighting Management Systems Based on NTCIP 1213 ELMS Standard v03

Module A306b: Specifying **Requirements** for Electrical and Lighting Management Systems Based on NTCIP 1213 ELMS Standard v03

Module T306: Applying Your **Test Plan** to the Electrical and Lighting Management Systems based on NTCIP 1213 ELMS Standard v03

Next Course Module

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

Concepts taught in next module (Learning Objectives):

1) Review the structure of the NTCIP 1213 v03 Standard
2) Use the PRL and then the RTM to specify the standardized structure of requirements
3) Include the requirements from the PRL and RTM in the ELMS Communications Interface specification
4) Explain conditions and context for extending the standard

Thank you for completing this module.

Feedback

Please use the Feedback link below to provide us with your thoughts and comments about the value of the training.

Thank you!