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U.S. Department of Transportation

Office of the Assistant Secretary for
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Module A315a

Understanding User Needs for Actuated Traffic Signal Controllers (ASC) Based on NTCIP 1202 v03 Standard

Instructor

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Learning Objectives

Review the Structure of the NTCIP 1202 v03 Standard

Identify Specific ASC Operational Needs

Describe the Purpose of the Protocol Requirements List (PRL) Matrix and Benefits

Discuss How to Prepare a Project Level PRL

Learning Objective 1

Review the Structure of the NTCIP 1202 v03 Standard

Review the Structure of the NTCIP 1202 v03 Standard

Overview

- Introduce the NTCIP Family of Standards
- Describe the relationship between NEMA TS2 and NTCIP 1202
- Introduce the structure of the NTCIP 1202 v03 standard, particularly the systems engineering content

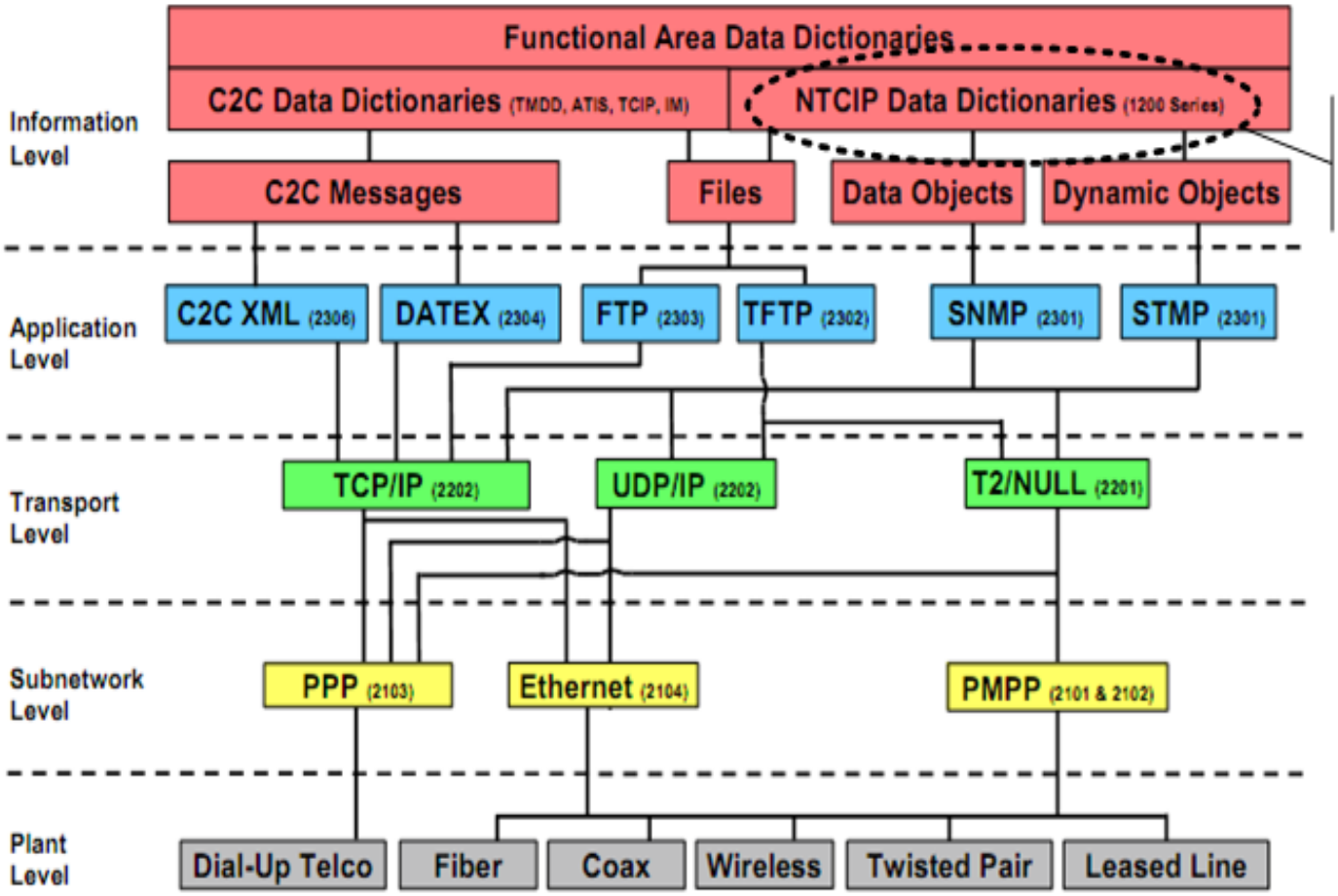
How This Standard Fit into the Family of NTCIP Standards

Source: New York City Department of Transportation

What is Actuated Signal Controller?

- A controller unit is that portion of a controller assembly devoted to the selection and timing of signal displays.

How This Standard Fit into the Family of NTCIP Standards



Source: NTCIP 9001 v04

How This Standard Fit into the Family of NTCIP Standards

What is NTCIP 1202?

- Defines aspects of a communications interface standard between an Actuated Traffic Signal Controller (ASC) and a “manager” (e.g., central, field master, maintenance laptop)

- Defines data elements (**object definitions**) used to monitor and control an ASC
  - References **NTCIP 1201 – Global Object (GO) Definitions** for generic data elements

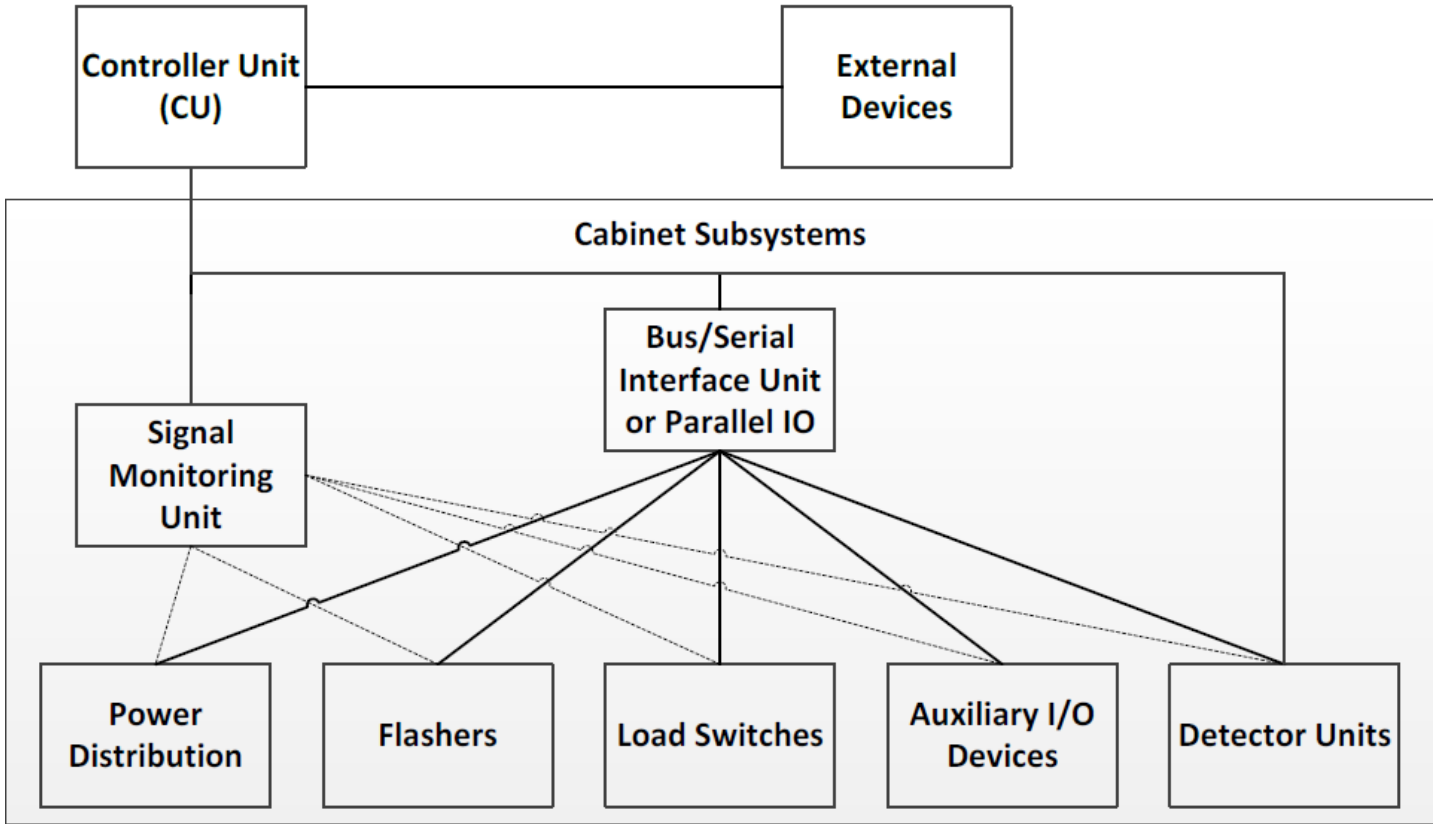
How This Standard Fit into the Family of NTCIP Standards

History of NTCIP 1202

- **Version 1:** Approved in 1996 (Originally called TS3.5)
  - Provided basic monitoring and control of ASCs
  - Amendment 1: Drafted in 1999 but not published
- **Version 2:** Approved in 2005
  - Added block objects to be more bandwidth efficient and defined consistency checks
- **Version 3:** Published in 2019
  - Added systems engineering content
  - Added support for new user needs and requirements, including connected vehicles

Understand the Relationship Between NEMA TS2 and NTCIP 1202

What is NTCIP 1202?



Source: NTCIP 1202 v03

Understand the Relationship Between NEMA TS2 and NTCIP 1202

What is NTCIP 1202?

- Based on the NEMA TS2 standard
  - **Defines** the core functionality of American traffic signal controllers
  - NTCIP 1202 **supports** the functional requirements of NEMA TS2
- Supplements NEMA TS2 by **defining** data elements
  - Individual pieces of **data** exchanged between the signal controller and the monitoring system
  - An instance of a "data element" is called a "**parameter**."

Understand the Relationship Between NEMA TS2 and NTCIP 1202

Example:

- **NEMA TS2 Clause 3.5.3.2.5.a.** Following the Green interval of each phase the Controller Unit (CU) shall provide a Yellow Change interval which is timed according to the Yellow Change timing control for that phase."

- **NTCIP 1202 Clause 5.2.2.8.** Following the Green interval of each phase the CU shall provide a Yellow Change interval which is timed according to the Yellow Change parameter for that phase."
  - REFERENCE "NEMA TS2 Clause 3.5.3.1 and 3.5.3.2.5.a"

Understand the Relationship Between NEMA TS2 and NTCIP 1202

What is NTCIP 1202?

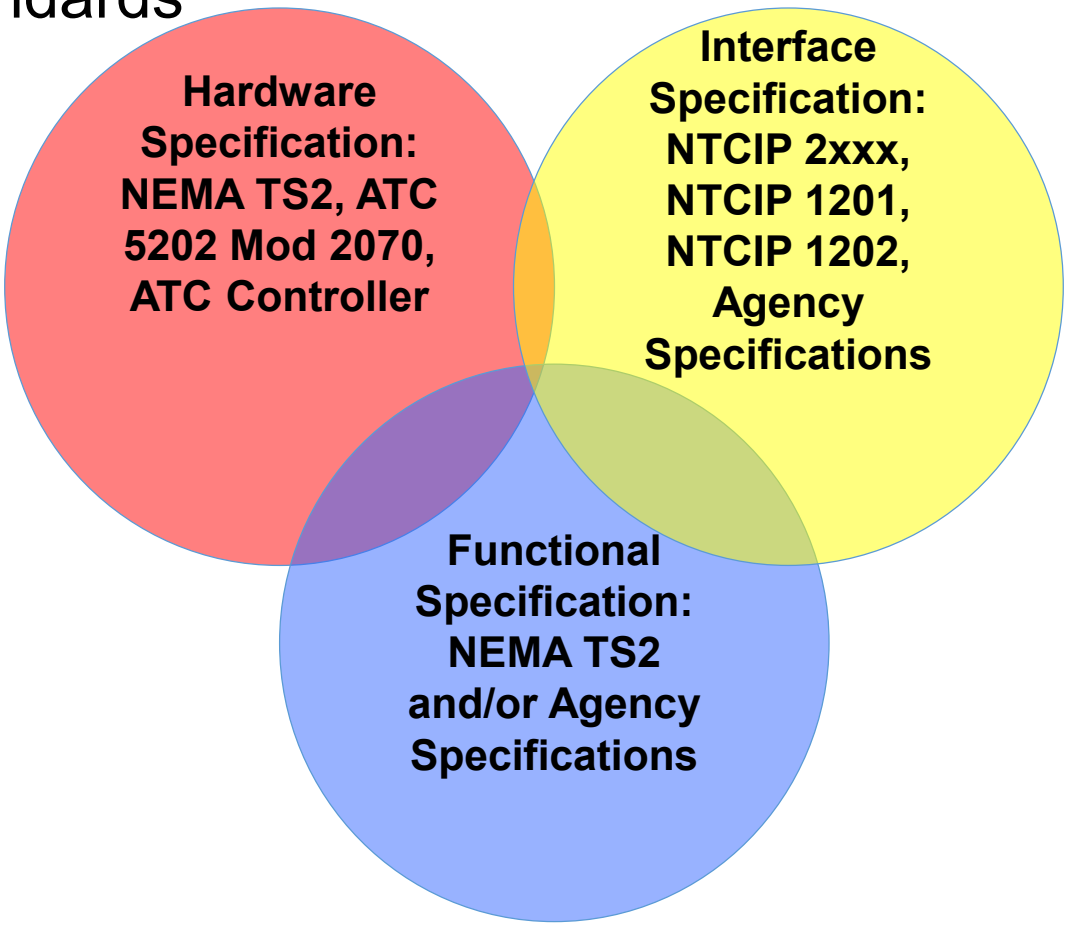
- **Example (Continued):**
  - NEMA TS2 Clause 3.5.3.1: Minimum Requirements
    - Function: Yellow Change
    - Minimum Range: 3-25.5 seconds
    - Maximum Increment: 0.1 second
  - NTCIP 1202 Clause 5.2.2.8
    - Parameter: phaseYellowChange
    - SYNTAX: INTEGER (0..255)
    - UNIT: tenth second

NEMA TS2 defines the range from 3 to 25.5 seconds but for encoding purposes, NTCIP 1202 allows 0 to 25.5 seconds

Understand the Relationship Between NEMA TS2 and NTCIP 1202

What is NTCIP 1202?

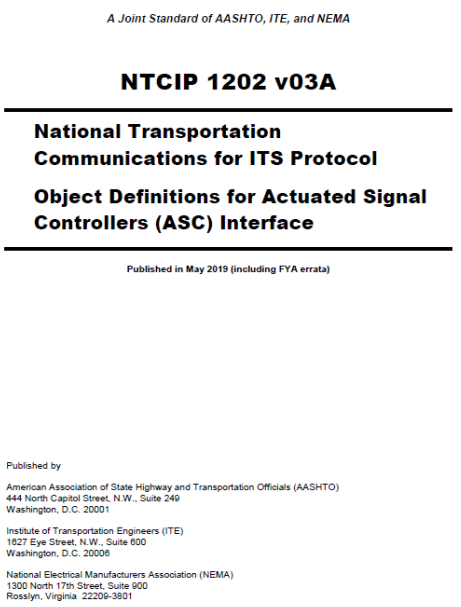
- Complements ASC hardware, functional specifications and standards



Review the Structure of NTCIP 1202 v03

NTCIP 1202 v03 Document Organization

- Section 1: General
- Section 2: Concept of Operations
- Section 3: Functional Requirements
- Section 4: Dialogs
- Section 5: Management Information Base (MIB)
- Section 6: Block Object Definitions
- Section 7: SAE/NTCIP Object Definitions



A Joint Standard of AASHTO, ITE, and NEMA

NTCIP 1202 v03A

National Transportation Communications for ITS Protocol

Object Definitions for Actuated Signal Controllers (ASC) Interface

Published in May 2019 (including FYA errata)

Published by

American Association of State Highway and Transportation Officials (AASHTO)
444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001

Institute of Transportation Engineers (ITE)
1627 Eye Street, N.W., Suite 600
Washington, D.C. 20006

National Electrical Manufacturers Association (NEMA)
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209-3801

Source: NTCIP 1202 v03

Review the Structure of NTCIP 1202 v03

NTCIP 1202 v03 Document Organization

- Annex A: Requirements Traceability Matrix
- Annex B: Object Tree
- Annex C: Test Procedures (placeholder)
- Annex D: Documentation of Revisions
- Annex E: User Requests
- Annex F: Generic Concepts and Definitions
- Annex G: SNMP Interface
- Annex H: Derived Functional Requirements and Dialogs
- Annex I: Communications Ports Protocols

Source: NTCIP 1202 v03

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Question

Which of the below is NOT a true statement about NTCIP 1202 v03?

Answer Choices

a) Part of the NTCIP Family of Standards

b) Contains systems engineering content

c) Describes the hardware functionality of a traffic controller

d) Contains user needs to manage a traffic controller

Review of Answers

a) Part of the NTCIP Family of Standards

Incorrect. NTCIP 1202 v03 is an information standard in the NTCIP family of standards.

b) Contains systems engineering content

Incorrect. NTCIP 1202 v03 contains systems engineering content.

c) Describes the hardware functionality of a traffic controller

Correct! NTCIP 1202 v03 does not describe the hardware functionality, but other standards such as NEMA TS 2 do.

d) Contains user needs to manage a traffic controller

Incorrect. NTCIP 1202 v03 contains user needs.

Learning Objective 2

Identify Specific ASC Operational Needs

Identify Specific ASC Operational Needs

Overview

- How the NTCIP 1202 v03 Standard satisfies operational and maintenance needs?
- Recognize how TS2 and NTCIP 1202 are intertwined.
- Understand constraints that will impact cost-benefit/trade-offs
- Identifying user needs not addressed by the NTCIP 1202 v03 Standard

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

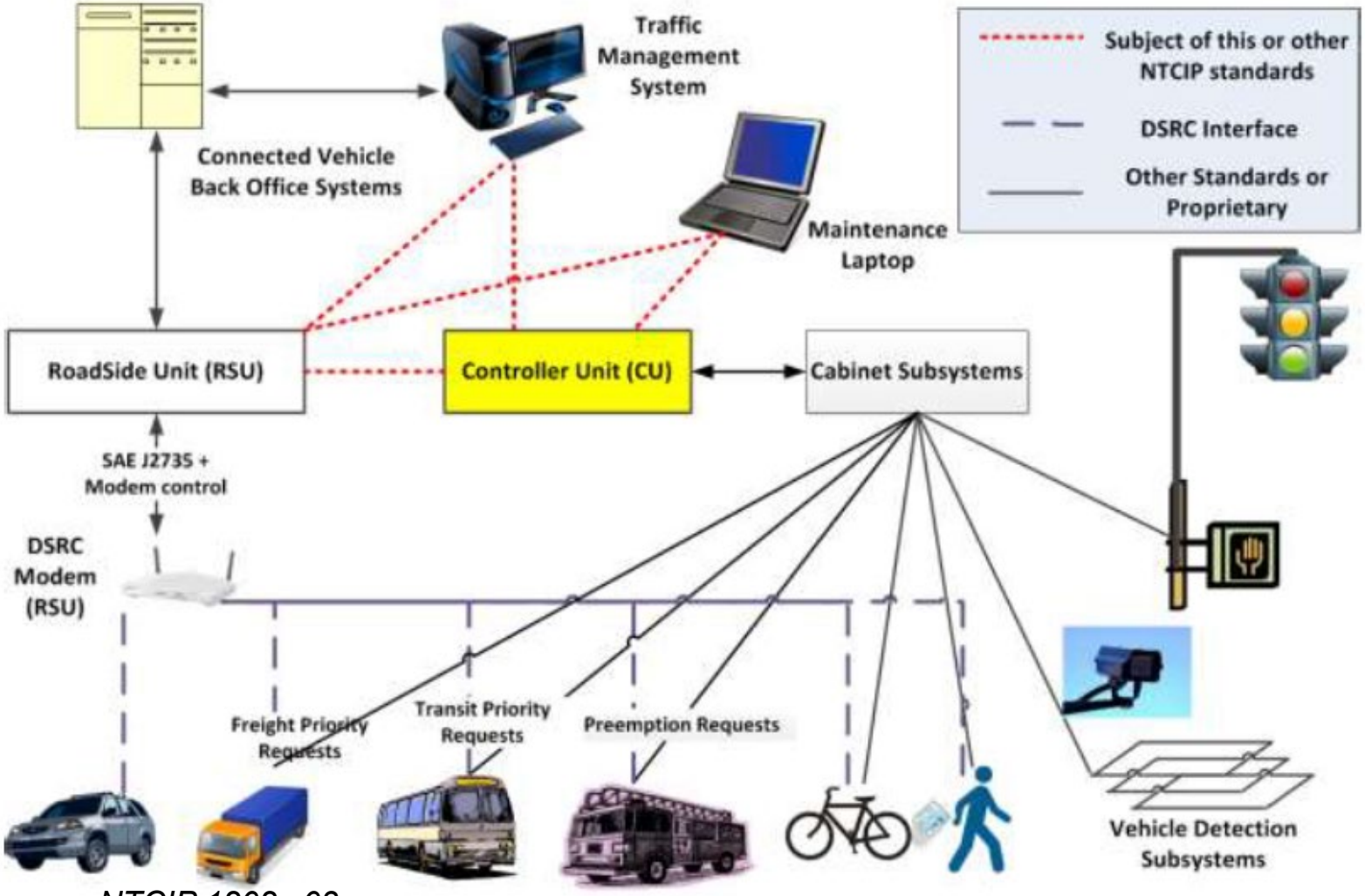
Concept of Operations (ConOps)

- Communicates user needs and expectations for the proposed ASC system
- Provides the operational context of an ASC system

> Transportation system managers use ASCs to control traffic operations on a roadway. ASCs allow different conflicting movements to travel across a roadway in a safe, orderly manner. In a roadway network, ASCs can be coordinated to improve mobility of certain movements, such as along a major arterial.
>
> *- NTCIP 1202 v03*

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Operational Context of NTCIP 1202 v03



Source: NTCIP 1202 v03

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Current Situation, Problem Statement

- Conflicting movements at intersections must be managed to prevent collisions
- Signals located near one another can impact each other's operations and should be coordinated
- Agencies wish to manage signals remotely to reduce maintenance and operations costs
- There was no industry standard for remote communications, only proprietary solutions

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

What are User Needs?

- Standardized statements that describe what a manager needs the ASC to do (**features/functions**)
- Every user need has a Unique ID, provides a Major Desired Capability (MDC), has a rationale and is solution-free

Source: New York City Department of Transportation

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Illustration of an ASC User Need

- **2.5.2.1.1 Manage Controller Startup Functions**
- A manager needs to retrieve and configure the startup capabilities and functions of the ASC. This feature allows the manager to define the startup times upon powerup, set the backup time, set the minimum clearance times for the ASC.

Source: NTCIP 1202 v03

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

User Needs Organization

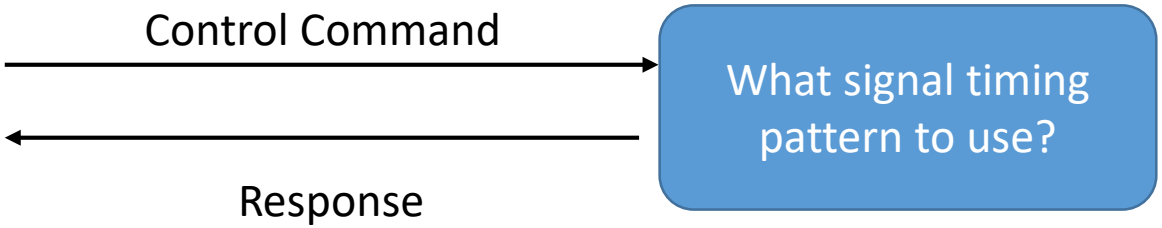
- 2.4 Architectural Needs
  - 2.4.1 Provide Live Data
  - 2.4.2 Provide Dynamic Object Data
  - 2.4.3 Provide Block Data
  - 2.4.4 Provide for Log Data Local Storage and Retrieval
  - 2.4.5 Provide for Database Management
  - 2.4.6 Condition-based Exception Reporting

Source: NTCIP 1202 v03

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Provide Live Data

- Environment allows a management station to monitor and control the ASC by issuing requests:
  - To **access** information
  - To **alter** information (to configure / control the ASC)
- ASC responds to requests from management station
  - Through provision of live data
  - **Success/failure** of information alteration (command)



Source: New York City Department of Transportation

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Provide Dynamic Object Data

- Dynamic objects allow **grouping data sets** together
  - More efficient transmission over data network
- For environments with limited data capacity
- **Users** often have capabilities to **configure dynamic objects** with any functions
  - **Provides flexibility**

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Provide Block Data

- Each block data object **groups sets of data** together
  - More efficient transmission over data network
- For environments with limited data capacity
- Each **group** is statically **defined by the standard** based on functional areas
  - **Requires less processing power**

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Provide for Log Data Local Storage and Retrieval

- ASC provides **logged data** to management station
  - **Diagnostic purposes**
  - Operational environments **without always-on connections** (e.g. loss of communications)
- Each logged event is timestamped and can **capture transient events**

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Provide for Database Management

- ASC must check downloaded inter-related data for **consistency before committing changes**
  - Must be able to **report** the source of the inconsistency (error)
  - For example, check that the ring and splits are properly defined before saving a signal timing pattern

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Condition-based Exception Reporting

- ASC can automatically transmit data to management station when **certain conditions** occur
- Example scenarios
  - Cabinet door is opened
  - ASC goes into error flash condition
  - Phase becomes active
- Can be programmed to cause transmission of alarm objects

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Summary of User Needs Supported

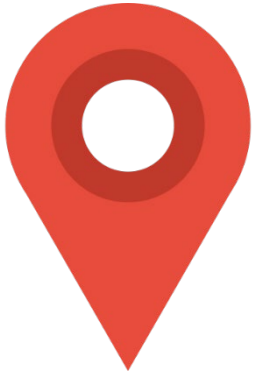
- 2.5 Features
  - 2.5.1 Manage the ASC Configuration
  - 2.5.2 Manage Signal Operations
  - 2.5.3 Manage Detectors
  - 2.5.4 Manage Connected Vehicles Interface
  - 2.5.5 Backward Compatibility Features

Source: NTCIP 1202 v03

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage the ASC Configuration: Retrieve Device Identity

- **Location** (latitude and longitude)
- Make, model, and version of device components
  - Hardware, software, or firmware components
  - Physical or logical entity



How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage the ASC Configuration: Manage Communications

- Enable or disable communications ports
- Configure and retrieve port addresses

- Allows for disabling unused communications ports for security

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage the ASC Configuration: Monitor Cabinet Environment

- Monitor for unsafe operating environments
  - Open controller cabinet door
  - High cabinet temperatures
  - Indication that the cabinet fan has turned on

Manage the ASC Configuration: Monitor Power

- Determine whether power sources for cabinet are suspect and need maintenance

Source: https://upload.wikimedia.org/wikipedia/commons/f/fd/TrafficControlBox.JPG

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage the ASC Configuration: Retrieve Operational Performance Data

- Analysis of signal timing and efficiency
- View the temporal relationship between signal indications and traveler arrivals
  - Progression of traffic along arterials
  - Measuring the amount of unused green time during a cycle
- Monitor data or store in log for later retrieval

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage the ASC Configuration: Manage Auxiliary External Inputs/Outputs

- Activate external devices or functions tied to other transportation operational needs

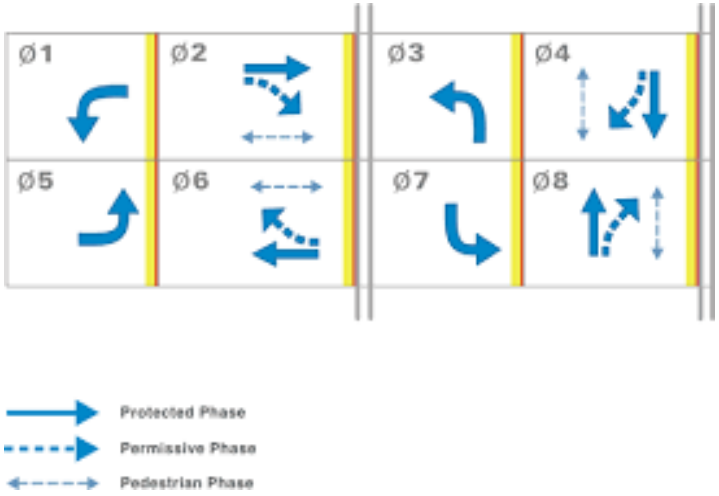
Manage the ASC Configuration: Manage Database

- Manage configuration and version of database

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Signal Operations: Manage Signal Configuration

- Manage Controller Startup Functions
- Manage Phase Configurations
- Manage Coordination Configurations
- Manage Timing Patterns
- Manage Splits Configurations
- Manage Ring Configurations
- Manage Channel Configurations



Source:
https://ops.fhwa.dot.gov/publications/publications.htm

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

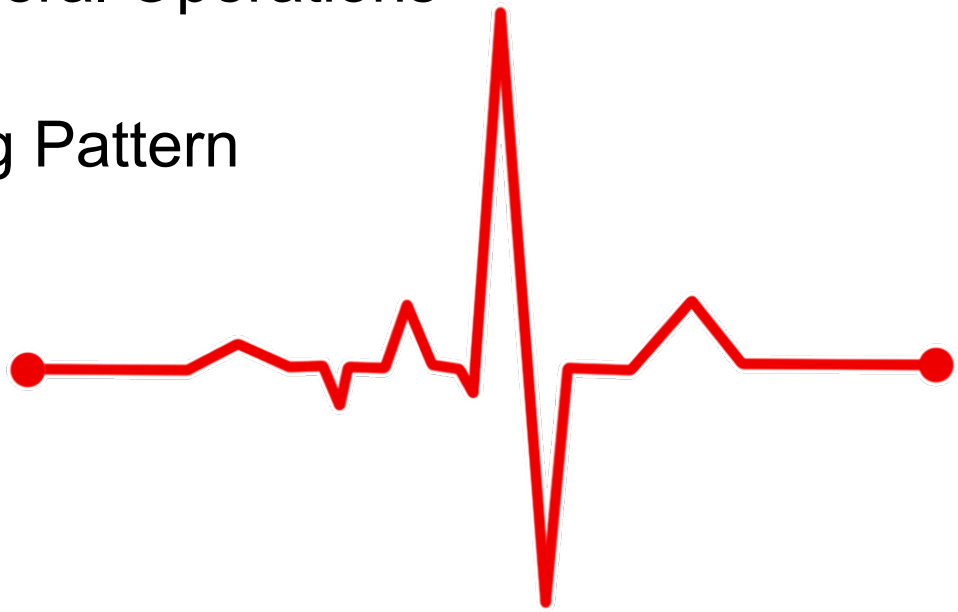
Manage Signal Operations: Manage Signal Configuration

- Manage Overlap Configurations
- Manage Preempt Configurations
- Manage Timing Pattern Scheduler
- Manage Action Scheduler
- Manage I/O Mapping
- Manage Intra-Cabinet Communications Configuration
- Manage ADA Support

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Signal Operations: Monitor Signal Operations Status

- Determine Controller Health
- Determine Mode of Operation
  - Monitor Unit-wide General Operations
  - Monitor Flashing
  - Monitor Current Timing Pattern
  - Monitor Current Cycle
- Monitor Signal Indication
- Monitor Phase Status



How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Signal Operations: Monitor Signal Operations Status

- Monitor Ring Status
- Monitor Channel Status
- Monitor Overlap Status
- Monitor Preempt Input State
- Monitor Preempt State
- Monitor Special Function Outputs
- Monitor Timebase Action status
- Monitor Intra-Cabinet Communications Configuration

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Signal Operations: Control Signal Operations

- Control ASC-wide General Operations
- Command Timing Pattern
- Phase Requests
- Activate Preempt
- Control Ring Operations

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

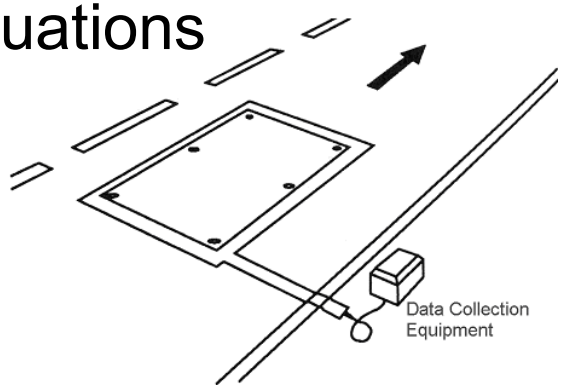
Manage Signal Operations: Control Signal Operations

- Activate Special Function Output
- Control Frame 40
- Activate Action Plan
- Remote Manual Control

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Detectors: Manage Detector Configuration

- Define travel mode detected
  - Vehicle, pedestrian, transit, and bicycle
- Select phase assignments
- Define capabilities
- Define criteria for detector faults
  - Amount of time between detector actuations
  - Amount of time with continuous actuations



Source: https://www.fhwa.dot.gov/publications

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Detectors: Monitor Detector Status

- Determine presence of vehicles, pedestrians, or other travelers

Manage Detectors: Monitor Detector Health

- Determine if detectors are operating correctly
- Detect faults

Manage Detectors: Control Detectors

- Clear a detector fault and place detectors back in service

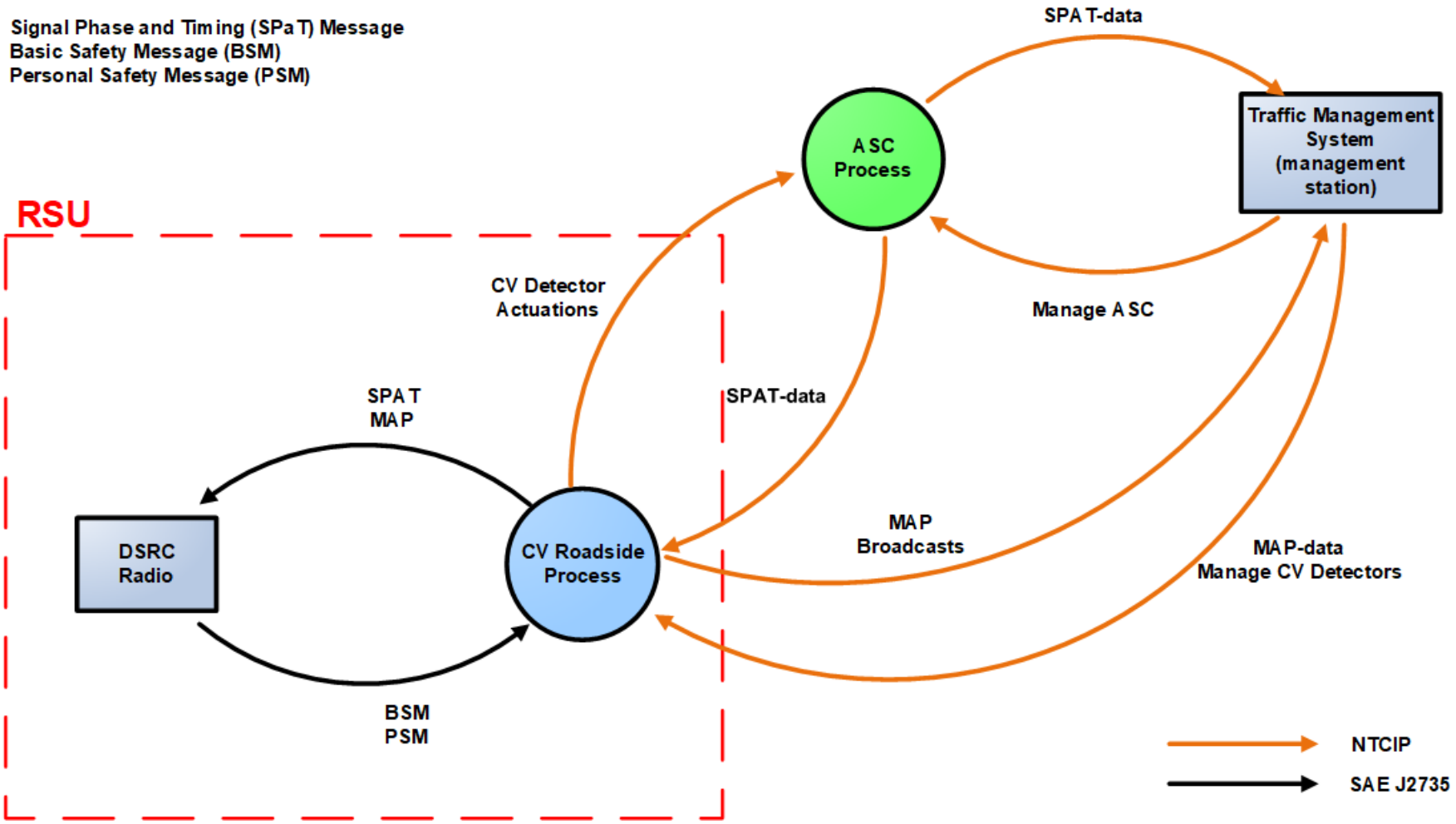
How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Detectors: Manage Detector Data

- Retrieve reports from ASC on data measured by detectors
  - Volumes, occupancies, and speeds

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Connected Vehicles (CV) Interface:

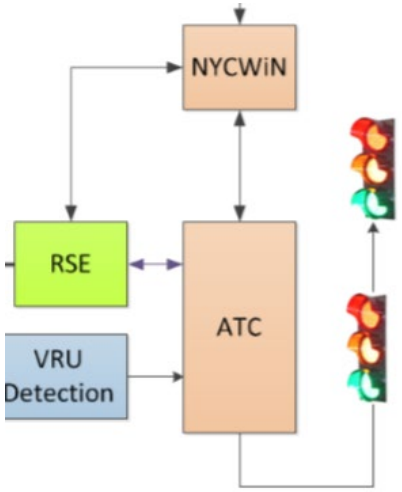


Source: NTCIP 1202 v03

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Connected Vehicles (CV) Interface: Management Station – ASC Process Interface

- Manage RSU Interface
- Manage RSU Interface Watchdog
- Manage Signal Phase and Timing Data



Advanced Solid-State Traffic Controller (ASTC)

Note: Ethernet ports available for connection to CV units

Source: New York City Department of Transportation

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Connected Vehicles Interface:

Management Station – CV Roadside Process Interface

- Manage Roadway Geometrics Information
- Manage Movement Configuration for Connected Devices
- Manage Collection of Connected Devices Data
- Monitor Broadcasted MAP Messages
- Monitor Broadcasted SPaT Messages

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Connected Vehicles Interface:

ASC - CV Roadside Process Interface

- Exchange Current and Next Movement Information
- Exchange Next Occurrences of a Movement
- Exchange Presence of Connected Devices
- Exchange Roadway Geometrics Information

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

Manage Connected Vehicles Interface:

ASC - CV Roadside Process Interface

- Define which is the manager and which is the agent?
  - Manager (management station) polls, agent responds

How NTCIP 1202 v03 Standard Satisfies Operational and Maintenance Needs

User Needs Organization

- 2.6 Security
  - 2.6.1 Manage Authentication
  - 2.6.2 Manage Accessibility
  - 2.6.3 Manage Users
  - 2.6.4 Log User Access

Source: NTCIP 1202 v03

Recognize how TS2 and 1202 are Intertwined

- **NEMA TS2 defines functionality** for traffic signal controllers
  - Functional aspects of standard provides the logical model used by virtually all North American controller deployments
- NTCIP 1201 and NTCIP 1202
  - NTCIP 1202 defines the data elements to **support this functionality**
  - 1201 defines generic data and 1202 defines ASC-specific data

Understand constraints that will impact cost-benefit/trade-offs

Benefit / Cost Considerations

- Need to live within **budget constraints**
  - How many phases do you really **need** or **will need**?
- NEMA TS2 provides a **baseline** of what industry typically supports
  - Number of phases, detectors, etc.
  - Which standardized features are mandatory
- **Interoperability requires significant agency specifications**
  - *degree to which two or more systems, products or components can exchange information and use the information that has been exchanged*

Source: ISO/IEC 25010:2011

Identifying User Needs not Addressed by the NTCIP 1202 v03 Standard

User Needs Not Addressed in NTCIP 1202 v03

- Interval Based Controllers
- Non-Persistent Timing Patterns
- Traffic Adaptive Algorithm
- Peer-to-Peer
- Additional Support for ADA
- Programmable Logic Gates and Functions
- Advanced Preempt Inputs
- Conflict Monitoring Unit and Channel Support

Identifying User Needs not Addressed by the NTCIP 1202 v03 Standard

What if a User Need is NOT Found in NTCIP 1202 v03

- The standard allows for **extensions**
- Proprietary extensions are not desired but **exist**
- Interoperability is **inhibited** if:
  - A solution (design) is not well documented and provided to the agency
  - The agency cannot distribute the design to other parties (e.g., another vendor or the central system)
  - The costs to implement the design is too costly for a third party

Identifying User Needs not Addressed by the NTCIP 1202 v03 Standard

What if a User Need is NOT Found in NTCIP 1202 v03

- Consider whether any non-standard capabilities are really needed - likely a custom/proprietary solution
- Determine if there are alternatives that stakeholders will consider
- If still needed, fully document the user need in the Concept of Operations
- Consider cost implications of extended features
  - Specification
  - Testing
  - Maintenance of proprietary solution

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Question

Which of the below is a benefit of extensions?

Answer Choices

a) Addresses a user need that is not supported by the standard

b) Addresses interoperability

c) Changes the cost for testing and maintenance

d) Requires additions to the agency specification

Review of Answers

a) Addresses a user need that is not supported by the standard

Correct! Extensions are used to support user needs not addressed by the standard.

b) Addresses interoperability

Incorrect. Extensions can lead to proprietary solutions that inhibits interoperability.

c) Changes the costs for testing and maintenance

Incorrect. Extensions lead to additional costs for testing and maintenance.

d) Requires additions to the agency specification

Incorrect. The agency specification needs to include the definition and description of the extensions.

Learning Objective 3

Describe the Purpose of the Protocol Requirements List (PRL Matrix and Benefits)

Describe the Purpose of the Protocol Requirements List (PRL Matrix and Benefits)

Overview

- What is a PRL?
- Explain benefits of PRL to stakeholders
- Explain the relationship of needs to requirements
- Evaluating conformance to the NTCIP 1202 v03 Standard

What is a PRL?

Protocol Requirements List (PRL)

- Defines the **standardized relationship** between user needs and their requirements
- **Specifies the standard** - designed to be part of an agency's specification
- Defines **conformance** to the standard

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2	Manage Signal Operations			M	Yes	
2.5.2.1	Manage Signal Configuration			M	Yes	
2.5.2.1.1	Manage Controller Startup Functions			M	Yes	
		3.5.2.1.1.1.1	Configure Startup All-Red Flash Mode	O	Yes / No	
		3.5.2.1.1.1.2	Configure Startup Flash Time	M	Yes	
		3.5.2.1.1.1.3	Enable/Disable Automatic Pedestrian Clearance Setting	M	Yes	
		3.5.2.1.1.2	Configure Backup Time	M	Yes	

What is a PRL?

Protocol Requirements List (PRL)

The PRL provides guidance

- **Guides agency** to select project user needs
- Agency **fills out the PRL** by selecting the applicable user needs and associated requirements

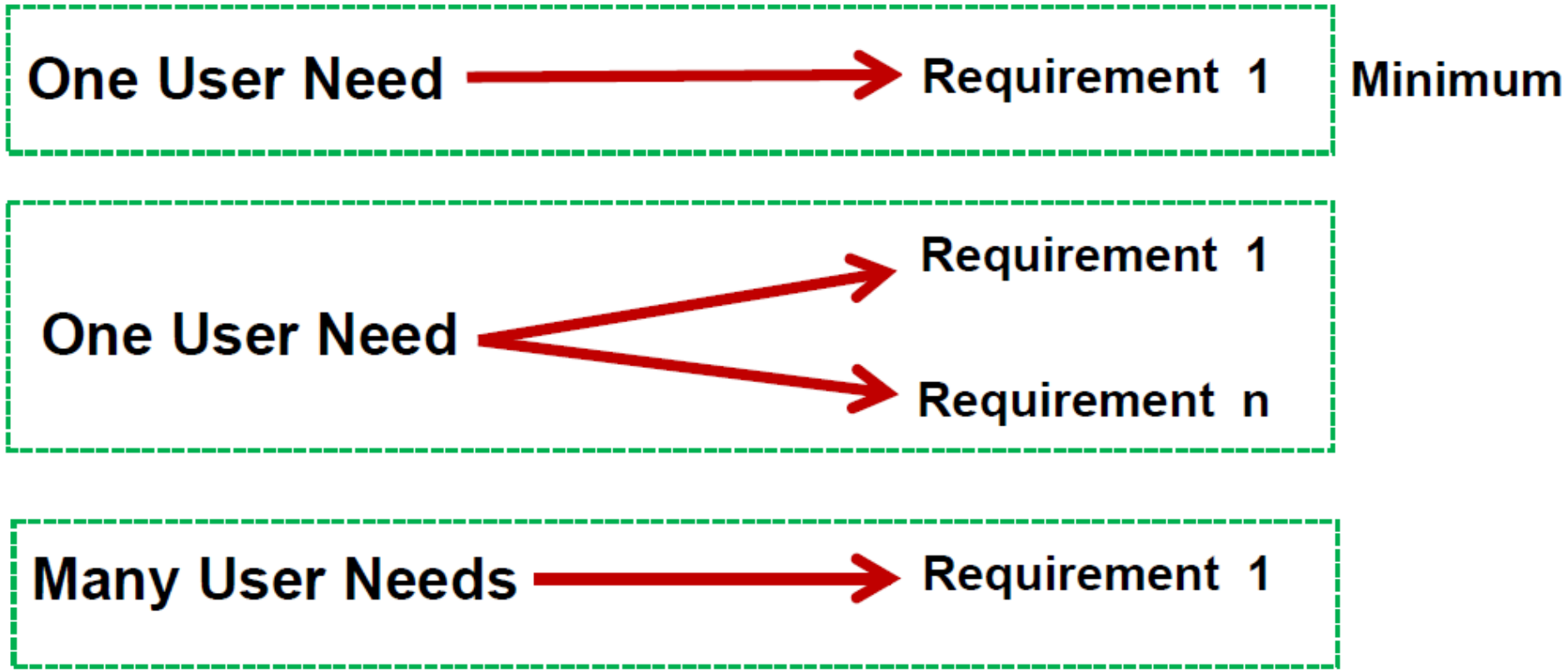
Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2	Manage Signal Operations			M	Yes	
2.5.2.1	Manage Signal Configuration			M	Yes	
2.5.2.1.1	Manage Controller Startup Functions			M	Yes	
		3.5.2.1.1.1.1	Configure Startup All-Red Flash Mode	O	Yes / No	
		3.5.2.1.1.1.2	Configure Startup Flash Time	M	Yes	
		3.5.2.1.1.1.3	Enable/Disable Automatic Pedestrian Clearance Setting	M	Yes	
		3.5.2.1.1.2	Configure Backup Time	M	Yes	

What is a PRL?

User Need – Requirement Relationship

- User Needs define the "**Why**" and "**What**" of a desired feature
  - The selection of the user need guides the **selection** of functional requirements
- Functional Requirements are **measurable** and **enforceable** statements
- The PRL **standardizes** the relationship of a user need to one or more functional requirements
- Supports **interoperability**

What is a PRL?



Result: The PRL is a check that the standard has no unnecessary requirement, and **all** user needs are satisfied by at least one requirement

What is a PRL?

User Need

- **User Need ID.** Section number of the user need
- **User Need.** A short description of the user need
- Using the User Need ID, look up the user need to determine if this user need is applicable for your implementation

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2.1.9 (Preempt)	Manage Preempt Configurations			O	Yes / No	
		3.5.2.1.9.1.1	Enable/Disable Preempt Inputs	O	Yes / No	
		3.5.2.1.9.1.2.1	Configure Preempt Control - Non-Locking Memory	O.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.2	Configure Preempt Control - Preempt Override Flash	O.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.3	Configure Preempt Control - Preempt Override Priority	O.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.4	Configure Preempt Control - Flash Dwell	O.16 (1..*)	Yes / No	
		3.5.2.1.9.1.3	Configure Preempt Link	M	Yes	
		3.5.2.1.9.1.4	Configure Preempt Delay	M	Yes	

What is a PRL?

User Need

2.5.2.1.9 Manage Preempt Configurations

A manager may need to retrieve and configure the preempts in the ASC. Preempts are used to service special needs at an intersection, such as for a railroad crossing or emergency vehicles responding to an incident. This feature allows the manager to retrieve and configure the minimum durations, phase settings, outputs and clearance times whenever a preempt signal is detected, how the controller enters into and exits out of preemption and to define the priority of different preempt inputs into the ASC. This feature also allows a manager to configure the ASC to enable or disable the preempt under certain conditions, such as time-of-day, or to configure the ASC to select alternate exit strategies based on input conditions.

- User needs are also called **Features**
- Is **Manage Preempt Configurations** a User Need for you?
- May not be a need, but the vendor may provide anyway

What is a PRL?

Functional Requirements

- **FR ID.** Section number of the functional requirement
- **Functional Requirement.** Short description of the requirement

Protocol Requirements List (PRL)						
User Need ID	**User Nee**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2.1.9 (Preempt)	Manage Pr	empt Configuratio	s	D	Yes / No	
		3.5.2.1.9.1.1	Enable/Disable Preempt Inputs	D	Yes / No	
		3.5.2.1.9.1.2.1	Configure Preempt Control - Non-Locking Memory	D.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.2	Configure Preempt Control - Preempt Override Flash	D.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.3	Configure Preempt Control - Preempt Override Priority	D.16 (1..*)	Yes / No	
		3.5.2.1.9.1.2.4	Configure Preempt Control - Flash Dwell	D.16 (1..*)	Yes / No	
		3.5.2.1.9.1.3	Configure Preempt Link	M	Yes	
		3.5.2.1.9.1.4	Configure Preempt Delay	M	Yes	
		3.5.2.1.9.1.5	Configure Preempt Minimum Duration	M	Yes	

What is a PRL?

Conformance

- Identifies if the user need (or requirement) is mandatory (M) or optional (O)
- Certain basic user needs are considered **Mandatory** and must be selected **Yes** for conformance
  - E.g. Manage Controller Startup Functions is a basic user need
- There is a basic set of user needs that must be satisfied to conform to the standard

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2	Manage Signal Operations			M	Yes	
2.5.2.1	Manage Signal Configuration			M	Yes	
2.5.2.1.1	Manage Controller Startup Functions			M	Yes	
		3.5.2.1.1.1.1	Configure Startup All-Red Flash Mode	O	Yes / No	
		3.5.2.1.1.1.2	Configure Startup Flash Time	M	Yes	

What is a PRL?

Conformance

- The designation “O.1 (1)” means
  - This user need is optional (indicated by the “O”)
  - The user need is one of several options in **option group** 1 (indicated by the “.1”)
  - **One and only one** user need in the option group must be selected (indicated by (1))
    - If (1..*), one **or** multiple **or** all may be selected

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.3	Reference Physical Architecture [Informative]					
2.3.1	ASC Characteristics – Cabinet Specifications			M	Yes	
2.3.1.a (332)	Model 332 Cabinet			O.1 (1)	Yes / No	
2.3.1.b (TS1)	NEMA TS 1 Cabinet			O.1 (1)	Yes / No	
2.3.1.c (TS2-2)	NEMA TS 2 Type 2 Cabinet			O.1 (1)	Yes / No	
2.3.1.d (TS2-1)	NEMA TS 2 Type 1 Cabinet			O.1 (1)	Yes / No	
2.3.1.e (ITS)	ITS Cabinet			O.1 (1)	Yes / No	

What is a PRL?

Conformance

- **Predicate.** <predicate>: Whether this user need is mandatory, optional or not applicable, is **dependent** on a condition or if another feature is supported
  - E.g., Preempt:M. If preempt is supported, Monitor Preempt Input State is **mandatory** to support
  - E.g., Preempt:O. If preempt is supported, Monitor Preempt State is **optional** to support

Protocol Requirements List (PRL)					
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support
2.5.2.1.9 (Preempt)	Manage Preempt Configurations			O	Yes / No

Protocol Requirements List (PRL)						
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.2.8	Monitor Preempt Input State			Preempt:M	Yes / NA	
		3.5.2.2.8.1	Monitor Currently Active Preempt	M	Yes	
		3.5.2.2.8.2	Monitor Current Preempt Inputs	M	Yes	
2.5.2.2.9	Monitor Preempt State			Preempt:O	Yes / NA	
		3.5.2.2.8.3	Monitor Current Preempt State	M	Yes	
		3.5.2.2.8.4	Monitor Current Gate Status	O	Yes / No	

What is a PRL?

Support Column

- Agency/Specifier to circle **Yes**, **No**, or **NA** to indicate if it a user need for the agency
- If the Conformance for the User Need is Mandatory, circle **Yes**
- If the Conformance is Not Applicable for your implementation, circle **NA**

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2.1.4	Manage Timing Patterns			Coord:M	Yes / NA	
		3.5.2.1.4.1.1	Configure Pattern Cycle Time	M	Yes	
		3.5.2.1.4.1.2	Configure Pattern Offset Time	M	Yes	
		3.5.2.1.4.1.3	Configure Pattern Split Association	M	Yes	
		3.5.2.1.4.1.4	Configure Pattern Sequence Association	M	Yes	
		3.5.2.1.4.1.5	Configure Pattern Maximum Mode	O	Yes / No	

What is a PRL?

Additional Specifications Column

- Provides additional notes or requirements for the product to be procured or to provide any additional details about the implementation.

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2.1.4	Manage Timing Patterns			Coord:M	Yes / NA	
		3.5.2.1.4.1.1	Configure Pattern Cycle Time	M	Yes	
		3.5.2.1.4.1.2	Configure Pattern Offset Time	M	Yes	
		3.5.2.1.4.1.3	Configure Pattern Split Association	M	Yes	
		3.5.2.1.4.1.4	Configure Pattern Sequence Association	M	Yes	
		3.5.2.1.4.1.5	Configure Pattern Maximum Mode	O	Yes / No	
		3.5.2.1.4.2.1	Determine Maximum Number of Phase-based Timing Pattern	M	Yes	The ASC shall support at least _____ timing patterns.
		3.5.2.1.4.2.2	Determine Phase-based Timing Pattern Type	M	Yes	The ASC shall support one of the following types of signal patterns (Select one only): _____ Each pattern is unique _____ Each pattern consists of a plan with 3 different offsets _____ Each pattern consists of a plan with 5 different offsets

What is a PRL?

Additional Specifications Column

- Another example of other types of information that may be requested under Additional Specifications.

Protocol Requirements List (PRL)						
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
		3.5.2.1.11.2.1	Retrieve Maximum Number of I/O Maps	M	Yes	
		3.5.2.1.11.2.2	Retrieve Maximum Number of I/O Map Inputs	M	Yes	
		3.5.2.1.11.2.3	Retrieve Maximum Number of I/O Map Outputs	M	Yes	
		3.5.2.1.11.2.4	Retrieve I/O Mapping Activate Conditions	M	Yes	The following conditions shall be satisfied before a new I/O map can be activated: ___ Cabinet Door Open ___ in any flash state ___ programmed all red flash ___ in CVM flash ___ ASC restart

Explain the Benefits of PRL to Stakeholders

Project PRL: Agency Perspective

- Can be **obtained** from NTCIP or **copied** for completion
- "Communicates" the scope of the desired ASC communication interface
  - **What** the interface is to do
  - **What** user needs (and functional requirements) the ASC must support
  - A "**checklist**" to validate the built system - Did the vendor build the **RIGHT** system?
  - Aids in achieving interoperability

Explain the Benefits of PRL to Stakeholders

Project PRL: Vendor/System Developers Perspective

- Standardizes format of procurement specifications
  - Everyone is on the same page
  - Eliminates "**ambiguity**" - reduces risks
  - Vendors "confirms" ASC **functionality** + offer optional features
- With a **completed PRL**, the agency, vendors and system developers, **all parties** know what is expected from the ASC implementation.

Conformance versus Compliance

- **Conformance**
  - Meets a specified standard
  - To claim "Conformance" to NTCIP 1202 v03, the vendor shall minimally fulfill the mandatory requirements selected
  - Vendors providing features beyond the completed PRL are conformant if those features conform with the requirements of NTCIP 1202 v03 and its normative references.
- **Compliance**
  - Meets a specification

Evaluating the Conformance to the NTCIP 1202 v03 Standard

Conformance versus Compliance

- A device may support data that has not been defined by NTCIP 1202 v03, however the data shall be properly registered with a valid **Object Identifier** (OID)
- To “claim” conformance, an ASC shall be provided with a **Management Information Base** (MIB) that contains all non-NTCIP-standardized object and block definitions
- To “claim” conformance, an ASC device shall use the NTCIP 1202 v03 **standardized objects** to manage NTCIP 1202 v03 functionality

Source: NTCIP 1202 v03

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Question

Which of the following is a benefit of the PRL table?

Answer Choices

a) Maps needs to requirements

b) Provides a list of features supported by the standard

c) Provides a convenient checklist during deployment

d) All of the above

Review of Answers

a) Maps needs to requirements

This is one of the key benefits of the PRL table.

b) Provides a list of features supported by the standard

The PRL lists all of the user needs supported by the standard.

c) Provides a convenient checklist during deployment

The PRL can be used as a checklist for testing.

d) All of the above

Correct! All of the above statements are true.

Learning Objective 4

Discuss How to Prepare a Project Level PRL

Discuss How to Prepare a Project Level PRL

Overview

- Review steps (tailoring) to select user needs and associated requirements
- Complete project PRL with entries
- Discuss examples of commonly used ASC user needs in PRL
- Explain how the PRL fits into the ASC Specification

Review Steps (Tailoring) to Select User Needs and Associated Requirements

Key Points for Completing a Project PRL

- Your ASC Specification must have a fully completed PRL
- PRL must be based on the NTCIP 1202 v03 with SNMP Interface

Protocol Requirements List (PRL)

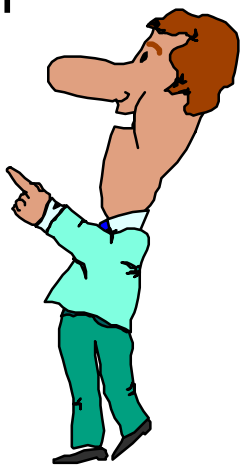
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.5.2.1.4	Manage Timing Patterns			Coord:M	Yes / NA	
		3.5.2.1.4.1.1	Configure Pattern Cycle Time	M	Yes	
		3.5.2.1.4.1.2	Configure Pattern Offset Time	M	Yes	
		3.5.2.1.4.1.3	Configure Pattern Split Association	M	Yes	
		3.5.2.1.4.1.4	Configure Pattern Sequence Association	M	Yes	
		3.5.2.1.4.1.5	Configure Pattern Maximum Mode	O	Yes / No	
		3.5.2.1.4.2.1	Determine Maximum Number of Phase-based Timing Pattern	M	Yes	The ASC shall support at least 5 timing patterns.
		3.5.2.1.4.2.2	Determine Phase-based Timing Pattern Type	M	Yes	The ASC shall support one of the following types of signal patterns (Select one only): ☑ Each pattern is unique ____ Each pattern consists of a plan with 3 different offsets ____ Each pattern consists of a plan with 5 different offsets

Source: NTCIP 1202 v03

Review Steps (Tailoring) to Select User Needs and Associated Requirements

Key Points for Completing a Project PRL

- Do NOT select all user needs – select only those operational needs relevant to you.
  - Can be very expensive to procure and test
- PRL must be **consistent** with the hardware specification. Example: cabinet type, number of channels supported



Review Steps (Tailoring) to Select User Needs and Associated Requirements

Fill-in PRL with User Needs/Requirements

- Use the Support column to indicate if the user need is required for the implementation
- If the user need is selected, indicate if the associated requirements is required [YES or NO]

Protocol Requirements List (PRL)						
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
		3.5.2.1.3.6.1	Configure Coordination Point - First Phase Green Begin	O.10 (1..*)	Yes / No	
		3.5.2.1.3.6.2	Configure Coordination Point - Last Phase Green Begin	O.10 (1..*)	Yes / No	
		3.5.2.1.3.6.3	Configure Coordination Point - First Phase Green End	O.10 (1..*)	Yes / No	
		3.5.2.1.3.6.4	Configure Coordination Point - Last Phase Green End	O.10 (1..*)	Yes / No	
		3.5.2.1.3.6.5	Configure Coordination Point - First Phase Yellow End	O.10 (1..*)	Yes / No	
		3.5.2.1.3.6.6	Configure Coordination Point - Last Phase Yellow End	O.10 (1..*)	Yes / No	

Review Steps (Tailoring) to Select User Needs and Associated Requirements

Fill-in PRL with User Needs/Requirements

- Specification **SHOULD** select [YES] to mandatory User Needs and associated Requirements; **First Step to Achieving Interoperability.**

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2	Manage Signal Operations			M	Yes	
2.5.2.1	Manage Signal Configuration			M	Yes	
2.5.2.1.1	Manage Controller Startup Functions			M	Yes	
		3.5.2.1.1.1.1	Configure Startup All-Red Flash Mode	O	Yes / No	
		3.5.2.1.1.1.2	Configure Startup Flash Time	M	Yes	
		3.5.2.1.1.1.3	Enable/Disable Automatic Pedestrian Clearance Setting	M	Yes	
		3.5.2.1.1.2	Configure Backup Time	M	Yes	

In summary, the **PRL** has all the user needs and associated requirements in **ONE** place, together with a solid relationship.

Review Steps (Tailoring) to Select User Needs and Associated Requirements

Extensions

- If an agency defines **extensions**, those user needs and their associated requirements should be **added** to the PRL
- The PRL also should indicate if **Conformance** is mandatory or optional (or any predicates) for each extension

Discuss Example of Commonly Used ASC User Needs in a PRL

Procurement Contract Specifications

Hardware Specifications
Functional Req.
Performance Req.
Structural Req.
Electrical Req.
Environmental Req.

Software Specifications
Functional Req.
Performance. Req.

Communications Interface Specifications
Project PRL,
Requirements Traceability Matrix,
Testing Documentation

Contractual requirements during
System Development
Testing
Deployment/Integration
Operations/Maintenance
Project Management

Discuss Example of Commonly Used ASC User Needs in a PRL

Procurement Contract Specifications

- The completed PRL must be **consistent** with the hardware specification
- The completed PRL **shows the intent.** Interested vendors can view the PRL and understand the intent of the requirements.

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Question

Which of the following is a FALSE statement related to an ASC specification?

Answer Choices

a) An ASC specification should include a project PRL

b) Conformance requires satisfying all mandatory user needs

c) Vendor must comply with the project PRL in the agency specification

d) Compliance requires only satisfying the user needs in the standard and not the specification

Review of Answers

a) An ASC specification should include a project PRL

True. The ASC specification should include a PRL to describe the interface.

b) Conformance requires satisfying all mandatory user needs

True. All mandatory user needs must be satisfied to claim conformance.

c) Vendor must comply with the project PRL in the agency specification.

True. The vendor should use the project PRL to indicate which requirements it will fulfill.

d) Compliance requires only satisfying mandatory user needs in the standard and the specification

Correct. The vendor must satisfy the mandatory user needs and all selected optional user needs in the specifications.

Module Summary

Review the Structure of the NTCIP 1202 v03 Standard

Identify Specific ASC Operational Needs

Describe the Purpose of the Protocol Requirements List (PRL) Matrix and Benefits

Discuss How to Prepare a Project Level PRL

Next Course Modules:

A315b, Part 1 of 2: Understanding Requirements for Actuated Traffic Signal Controllers (ASC) Based on NTCIP 1202 v03 Standard

- Identify NTCIP 1202 v03 Standard Requirements
- Explain the Purpose and Benefits of the Requirements Traceability Matrix (RTM)
- Prepare a Project-Level RTM
- Prepare an ASC Specification

Next Course Modules:

- **A315b, Part 2 of 2:** Understanding Requirements for Actuated Traffic Signal Controllers (ASC) Based on NTCIP 1202 v03 Standard
- **T315:** Applying Your Test Plan to the NTCIP 1202 v03 ASC 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!