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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
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

What is Actuated Signal Controller?

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

Source: New York City Department of Transportation
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

![Diagram showing the relationship between NEMA TS2, NTCIP 1202, and Agency Specifications]

- Hardware Specification: NEMA TS2, ATC 5202 Mod 2070, ATC Controller
- Functional Specification: NEMA TS2 and/or Agency Specifications
- Interface Specification: NTCIP 2xxx, NTCIP 1201, NTCIP 1202, Agency Specifications
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

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
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
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
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.
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
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
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
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
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**
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
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
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
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
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
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
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
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
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
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
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
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:

- Signal Phase and Timing (SPaT) Message
- Basic Safety Message (BSM)
- Personal Safety Message (PSM)

Source: NTCIP 1202 v03
Manage Connected Vehicles (CV) Interface:
Management Station – ASC Process Interface

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

Source: New York City Department of Transportation
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
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
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
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
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
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
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
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

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<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
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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

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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)

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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

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<td></td>
</tr>
<tr>
<td>3.5.2.1.9.1.3</td>
<td>Configure Preempt Control - Preempt</td>
<td>D.16 (1..*)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Override Priority</td>
<td></td>
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<td>3.5.2.1.9.1.4</td>
<td>Configure Preempt Control - Flash</td>
<td>D.16 (1..*)</td>
<td></td>
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<tr>
<td></td>
<td>Dwell</td>
<td></td>
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<td>3.5.2.1.9.1.5</td>
<td>Configure Preempt Link</td>
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<td>3.5.2.1.9.1.6</td>
<td>Configure Preempt Delay</td>
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<tr>
<td>3.5.2.1.9.1.7</td>
<td>Configure Preempt Minimum Duration</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

---

The table above lists the various functional requirements associated with a PRL, along with their respective sections, descriptions, conformance levels, support, and additional specifications.
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

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2</td>
<td>Manage Signal Operations</td>
<td></td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2.5.2.1</td>
<td>Manage Signal Configuration</td>
<td></td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2.5.2.1.1</td>
<td>Manage Controller Startup Functions</td>
<td></td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.1.1</td>
<td>Configure Startup All-Red Flash Mode</td>
<td></td>
<td></td>
<td>O</td>
<td>Yes / No</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.1.2</td>
<td>Configure Startup Flash Time</td>
<td></td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
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

---

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
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<th>Support</th>
<th>Additional Specifications</th>
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<tr>
<td>2.3</td>
<td>Reference Physical Architecture [Informative]</td>
<td></td>
<td></td>
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<td>2.3.1</td>
<td>ASC Characteristics – Cabinet Specifications</td>
<td></td>
<td></td>
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<tr>
<td>2.3.1.a (332)</td>
<td>Model 332 Cabinet</td>
<td></td>
<td></td>
<td>O.1 (1)</td>
<td></td>
<td></td>
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<tr>
<td>2.3.1.b (TS1)</td>
<td>NEMA TS 1 Cabinet</td>
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<td></td>
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<tr>
<td>2.3.1.c (TS2-2)</td>
<td>NEMA TS 2 Type 2 Cabinet</td>
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<tr>
<td>2.3.1.d (TS2-1)</td>
<td>NEMA TS 2 Type 1 Cabinet</td>
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<tr>
<td>2.3.1.e (ITS)</td>
<td>ITS Cabinet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conformance

- **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)

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2.1.9</td>
<td>Manage Preempt Configurations</td>
<td></td>
<td>O</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>

---

### Protocol Requirements List (PRL)

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<tr>
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<th>Additional Specifications</th>
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<tbody>
<tr>
<td>2.5.2.2.8</td>
<td>Monitor Preempt Input State</td>
<td></td>
<td>Preempt:M</td>
<td>Yes/NA</td>
<td></td>
<td></td>
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<tr>
<td>3.5.2.2.8.1</td>
<td>Monitor Currently Active Preempt</td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.2.8.2</td>
<td>Monitor Current Preempt Inputs</td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
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<tr>
<td>2.5.2.2.9</td>
<td>Monitor Preempt State</td>
<td></td>
<td>Preempt:O</td>
<td>Yes/NA</td>
<td></td>
<td></td>
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<tr>
<td>3.5.2.2.8.3</td>
<td>Monitor Current Preempt State</td>
<td></td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
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<tr>
<td>3.5.2.2.8.4</td>
<td>Monitor Current Gate Status</td>
<td></td>
<td>O</td>
<td>Yes/No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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**

<table>
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<tbody>
<tr>
<td>2.5.2.1.4</td>
<td>Manage Timing Patterns</td>
<td></td>
<td></td>
<td>Coord:M</td>
<td>Yes / NA</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.1</td>
<td>Configure Pattern Cycle Time</td>
<td>M</td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.2</td>
<td>Configure Pattern Offset Time</td>
<td>M</td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.3</td>
<td>Configure Pattern Split Association</td>
<td>M</td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.4</td>
<td>Configure Pattern Sequence Association</td>
<td>M</td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.5</td>
<td>Configure Pattern Maximum Mode</td>
<td>O</td>
<td></td>
<td></td>
<td>Yes / No</td>
<td></td>
</tr>
</tbody>
</table>
### 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.

<table>
<thead>
<tr>
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<td>Manage Timing Patterns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.1</td>
<td>Configure Pattern Cycle Time</td>
<td>M</td>
<td>Coord:M</td>
<td>Yes / NA</td>
<td></td>
<td>The ASC shall support at least timing patterns.</td>
</tr>
<tr>
<td>3.5.2.1.4.1.2</td>
<td>Configure Pattern Offset Time</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.3</td>
<td>Configure Pattern Split Association</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.4</td>
<td>Configure Pattern Sequence Association</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1.5</td>
<td>Configure Pattern Maximum Mode</td>
<td>O</td>
<td>Yes / No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.2.1</td>
<td>Determine Maximum Number of Phase-based Timing Pattern</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td>The ASC shall support one of the following types of signal patterns (Select one only):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>____ Each pattern is unique</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>____ Each pattern consists of a plan with 3 different offsets</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>____ Each pattern consists of a plan with 5 different offsets</td>
</tr>
</tbody>
</table>
### What is a PRL?

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

### Protocol Requirements List (PRL)

<table>
<thead>
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<th>User Need ID</th>
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<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2.1.11.2.1</td>
<td>Retrieve Maximum Number of I/O Maps</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.11.2.2</td>
<td>Retrieve Maximum Number of I/O Map Inputs</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.11.2.3</td>
<td>Retrieve Maximum Number of I/O Map Outputs</td>
<td>M</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 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
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
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
Which of the following is a benefit of the PRL table?

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

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
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<th>Additional Specifications</th>
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<tbody>
<tr>
<td>2.5.2.1.4</td>
<td>Manage Timing Patterns</td>
<td></td>
<td></td>
<td>Coord:M</td>
<td>Yes/NA</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.1</td>
<td>Configure Pattern Cycle Time</td>
<td>3.5.2.1.4.1.1</td>
<td>Configure Pattern Cycle Time</td>
<td>M</td>
<td>Yes</td>
<td></td>
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<tr>
<td>3.5.2.1.4.2</td>
<td>Configure Pattern Offset Time</td>
<td>3.5.2.1.4.1.2</td>
<td>Configure Pattern Offset Time</td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.3</td>
<td>Configure Pattern Split Association</td>
<td>3.5.2.1.4.1.3</td>
<td>Configure Pattern Split Association</td>
<td>M</td>
<td>Yes</td>
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<td>3.5.2.1.4.4</td>
<td>Configure Pattern Sequence Association</td>
<td>3.5.2.1.4.1.4</td>
<td>Configure Pattern Sequence Association</td>
<td>M</td>
<td>Yes</td>
<td></td>
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<tr>
<td>3.5.2.1.4.5</td>
<td>Configure Pattern Maximum Mode</td>
<td>3.5.2.1.4.1.5</td>
<td>Configure Pattern Maximum Mode</td>
<td>O</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.4.2</td>
<td>Determine Maximum Number of</td>
<td>3.5.2.1.4.2.1</td>
<td>Determine Maximum Number of Phase-based</td>
<td>M</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phase-based Timing Pattern</td>
<td></td>
<td>Timing Pattern</td>
<td></td>
<td></td>
<td>The ASC shall support at least 5 timing patterns.</td>
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<td>3.5.2.1.4.2</td>
<td>Determine Phase-based Timing Pattern</td>
<td>3.5.2.1.4.2.2</td>
<td>Determine Phase-based Timing Pattern Type</td>
<td>M</td>
<td>Yes</td>
<td>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</td>
</tr>
</tbody>
</table>

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**]

<table>
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<tr>
<th>User Need ID</th>
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</thead>
<tbody>
<tr>
<td>3.5.2.1.3.6.1</td>
<td>Configure Coordination Point - First Phase Green Begin</td>
<td>O.10 (1..*)</td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
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<tr>
<td>3.5.2.1.3.6.2</td>
<td>Configure Coordination Point - Last Phase Green Begin</td>
<td>O.10 (1..*)</td>
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<td>No</td>
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<tr>
<td>3.5.2.1.3.6.3</td>
<td>Configure Coordination Point - First Phase Green End</td>
<td>O.10 (1..*)</td>
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<td>No</td>
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<td>3.5.2.1.3.6.4</td>
<td>Configure Coordination Point - Last Phase Green End</td>
<td>O.10 (1..*)</td>
<td></td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>3.5.2.1.3.6.5</td>
<td>Configure Coordination Point - First Phase Yellow End</td>
<td>O.10 (1..*)</td>
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<td>No</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.3.6.6</td>
<td>Configure Coordination Point - Last Phase Yellow End</td>
<td>O.10 (1..*)</td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
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.**

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<tr>
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<td>2.5.2.1</td>
<td>Manage Signal Configuration</td>
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<td>2.5.2.1.1</td>
<td>Manage Controller Startup Functions</td>
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<td></td>
</tr>
<tr>
<td>3.5.2.1.1.1.1</td>
<td>Configure Startup All-Red Flash Mode</td>
<td>M</td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>3.5.2.1.1.1.3</td>
<td>Enable/Disable Automatic Pedestrian Clearance Setting</td>
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<tr>
<td>3.5.2.1.1.2</td>
<td>Configure Backup Time</td>
<td>M</td>
<td></td>
<td>Yes</td>
<td></td>
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</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Hardware Specifications</th>
<th>Software Specifications</th>
<th>Communications Interface Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Req.</td>
<td>Functional Req.</td>
<td>Project PRL, Requirements</td>
</tr>
<tr>
<td>Performance Req.</td>
<td>Performance Req.</td>
<td>Traceability Matrix, Testing Documentation</td>
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<td>Structural Req.</td>
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<td>Electrical Req.</td>
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<tr>
<td>Environmental Req.</td>
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</tbody>
</table>

Contractual requirements during

System Development

Testing

Deployment/Integration

Operations/Maintenance

Project Management
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.
ACTIVITY
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!