



W E L C O M E

**RITA** Intelligent Transportation Systems  
Joint Program Office

# Welcome



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The screenshot shows the RITA website with the following content:

- Header:** RITA RESEARCH AND INNOVATIVE TECHNOLOGY ADMINISTRATION INTELLIGENT TRANSPORTATION SYSTEMS
- Navigation:** About RITA, Communities of Interest, Contact Us, Press Room, RITA Offices, Site Map, Search
- Secondary Navigation:** About Us, T3 Webinars, ITS Peer-to-Peer, Resources, Local ITS PCB, Testimonials
- Updated:** June 3, 2011
- Main Title:** ITS Professional Capacity Building Program
- Sections:**
  - Welcome to ITS Professional Capacity Building:** The ITS Professional Capacity Building (PCB) Program provides comprehensive, accessible, and flexible ITS learning for the transportation industry. It helps public agencies build and sustain a capable and technically proficient ITS workforce, and transportation professionals develop their knowledge, skills, and abilities while furthering their career paths. A plan titled "ITS Professional Capacity Building: Setting Strategic Direction 2010-2014" describes the strategy.
  - ITS Technical Assistance:** Offers technical assistance resources to State and local transportation agencies, and to FHWA Field Offices. Includes links for the ITS Peer-to-Peer Program and the ITS Help Line.
  - Scheduled T3 Webinars:** Lists upcoming webinars on June 23, 2011 (1:00 PM - 2:30 PM ET) and June 29, 2011 (1:00 PM - 2:30 PM ET), with topics like "2011 Enhancements to the ITS Knowledge Resources Websites" and "Open Payments, Mobile Payments and Personal Identification Verification (PIV) Acceptance".
  - News:** Lists recent news items such as "Act Now! Fee Waived for June CITE Blended Course", "NTI Offering: Implementing Rural Transit Technology", and "T3 Webinar Archive Now Available" for various topics.

[WWW.PCB.ITS.DOT.GOV/STANDARDSTRAINING](http://WWW.PCB.ITS.DOT.GOV/STANDARDSTRAINING)





# A311a

## Understanding User Needs for DMS Systems Based on NTCIP 1203 Standard





# Target Audience

- Engineering staff
- TMC/Operations staff
- System developers
- Private and public sector users
- Other stakeholders





# Instructor



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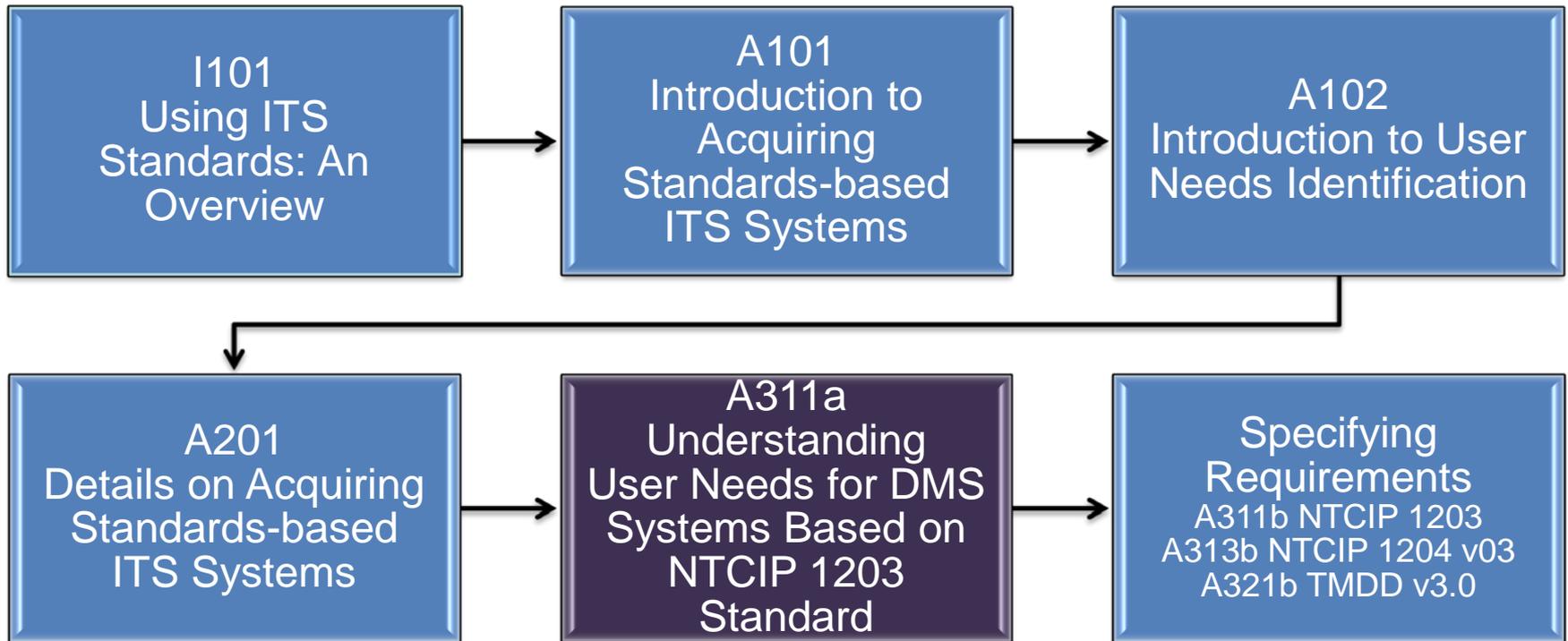


# Recommended Prerequisites

- I101 – Using ITS Standards: An Overview
- A101 – Introduction to Acquiring Standards-based ITS Systems
- A102 – Introduction to User Needs Identification
- A201 – Details on Acquiring Standards-based ITS Systems



# Curriculum Path (SEP)





# Value of a DMS Sequence

- Module 311a – Dynamic Message Signs (DMS) User Needs is part of a group of Professional Capacity Building (PCB) modules
- Group consists of:
  - A311a – Understanding User Needs for DMS Systems Based on NTCIP 1203 Standard
  - A311b – Specifying Requirements for DMS Systems Based on NTCIP 1203 Standard
  - T311 – Applying your Test Plan to the NTCIP 1203 v03 DMS Standard





# Learning Objectives

1. Discuss the structure of the DMS standard
2. Identify specific DMS operational needs
3. Use the Protocol Requirements List (PRL) to select the user needs and link to requirements
4. Explain how the PRL fits into the DMS Specification



# Review of the DMS Standard

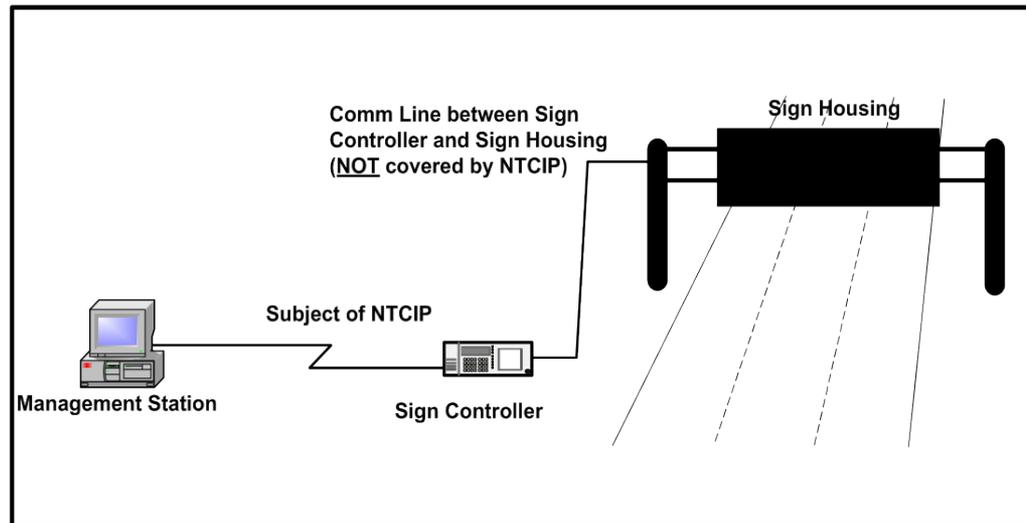
## NTCIP Family

- 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 traffic field equipment.
- NTCIP 1203
  - Information Content standard



# Review of the DMS Standard

## What is NTCIP 1203?



- Standardizes the communications interface
- Specifies the interface between the dynamic message signs in the field and the host systems that control them

# Review of the DMS Standard

## History of NTCIP 1203

- NTCIP v01 was published in 1999
- NTCIP 1203 Amendment 1 was approved in 2001
- NTCIP 1203 v02 – accepted in 2010
  - Adds new functionality
  - Uses a systems engineering approach
- NTCIP 1203 v03 (Recommended Standard 2011)
  - Adds test procedures



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# On-line Poll

**Please indicate if your agency has deployed dynamic message signs using standards before.**

1. Using NTCIP 1203 v01 DMS Standard
2. Using NTCIP 1203 v02 DMS Standard
3. Not using any DMS Standard
4. Not sure



# Review of the DMS Standard

## Comparison of NTCIP 1203 v01 and v02

### NTCIP 1203 v01

- Section 1 General
- Section 2 DMS Object Definitions
- Section 3 MULTI
- Section 4 Group Definitions
- Section 5 Conformance Statements

### NTCIP 1203 v02

- Section 1 General
- Section 2 Concept of Operations
- Section 3 DMS Functional Requirements
- Section 4 Dialogs
- Section 5 Management Information Base
- Section 6 MULTI
- Annex A Requirements Traceability Matrix
- Annex D Documentation of Revisions



# Advantages of NTCIP 1203 v02

## NTCIP 1203 v02

- Defines user needs supported by the standard
  - E.g., Monitor the Status of the Message
- Defines functional requirements supported by the standard
  - E.g., Monitor the Current Message
  - Traced to the user need “monitor the status of the message”
- Defines a single design for each requirement
  - Supports interoperability



# Advantages of NTCIP 1203 v02

## NTCIP 1203 v02

- Result:
  - Easier to use - Agencies and specification writers can easily determine what user needs and requirements the standard supports
  - Easier to specify - Agencies and specification writers can easily specify their requirements for the proposed implementation
  - Easier to test - Based on the requirements selected, the standard provides the definition of the design, thus agencies can consistently test for conformance

# Advantages of NTCIP 1203 v02

## NTCIP 1203 v02

- Result:
  - Supports off-the-shelf interoperability - Based on the requirements, the standard specifies the design, ensuring consistency between implementation
  - Provides drop-in user needs, requirements and design content to fully support project systems engineering activities



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# Exercise #1 – Systems Engineering Process

Which of the following is not an advantage of using the systems engineering process for the ITS standards?

1. Supports interoperability
2. Provides a variety of potential designs to fulfill a requirement
3. Allows clear development of test procedures based on the requirements selected
4. Determines what user needs are supported



# Review of User Needs

- User need - Describes the major capability desired (from a system)
- Only people have needs
  - Travelers
  - TMC Operators
  - Maintenance Personnel
- A transportation system does not have needs
- A TMC does not have needs



# What User Needs Might a DMS System Satisfy?

- Need to convey information to the traveling public
  - Advisory information
  - Regulatory information
- Need to manage the information, possibly from multiple locations or by multiple agencies
- Can be stationary deployments (e.g., roadside, transit platforms) or portable on moveable vehicles.



# Concept of Operations

## NTCIP 1203 v02 Concept of Operations

- The user (operational) needs supported by the standard can be found in the Concept of Operations section
  - Communicates the user's needs and expectations for the proposed system
- Provides an operational context for the system elements of a DMS system



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## Exercise #2 – User Needs

Which of the following two user needs may be satisfied by a DMS system?

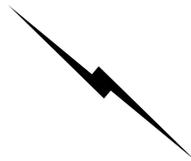
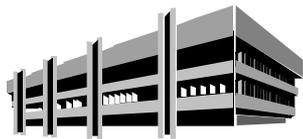
1. Need to inform motorist about an alternate route
2. Need to control traffic flow at an intersection
3. Need to warn travelers about expected delays
4. Need to monitor a traffic incident on the roads



# Operational Needs Addressed by NTCIP 1203 v02

## Operational Environment Supported

- Provide Live Data Exchange
  - Need to allow a management station to issue requests for status and issue control commands to a DMS.
  - E.g., request status information, issue commands



# Operational Needs Addressed by NTCIP

## 1203 v02

### Operational Environment Supported

- Logged Data Exchange
  - Addressing operational environments without always-on connections (e.g., dial-up links)
  - Define conditions to place data into a log
    - Uploaded at a later time
    - E.g., maintain a log of opened cabinet door
  - Logging is important for situations without communications or when recording field information

# Operational Needs Addressed by NTCIP 1203 v02

## Operational Needs (Features) Supported

- Manage the DMS Configuration
  - Determine the DMS Identity
  - Determine Sign Display Capabilities
  - Manage Fonts
  - Manage Graphics
  - Manage Brightness
  - Address Backwards Compatibility



# Operational Needs Addressed by NTCIP 1203 v02

## Operational Needs (Features) Supported

- Control the DMS
  - Control a DMS from more than one Location
  - Remotely Reset the Sign Controller
  - Control the Sign Face
  - Control External Devices
  - Control the Brightness Outputs
  - Perform Preventative Maintenance



# Operational Needs Addressed by NTCIP 1203 v02

## Operational Needs (Features) Supported



- Monitor the Status of the DMS
  - Perform Diagnostics
  - Monitor the Current Message

# Operational Needs Addressed by NTCIP 1203 v02

## Operational Needs (Features) Supported

- May depend on the type of DMS
  - Blank Out Sign (BOS)
  - Changeable Message Sign (CMS)
  - Variable Message Sign (VMS)
- Also may depend on the technology(ies) used
  - Fiber Optic
  - Light Emitting Diode (LED)
  - Flip Disk or shutter
  - Lamp Matrix
  - Drum (rotating)



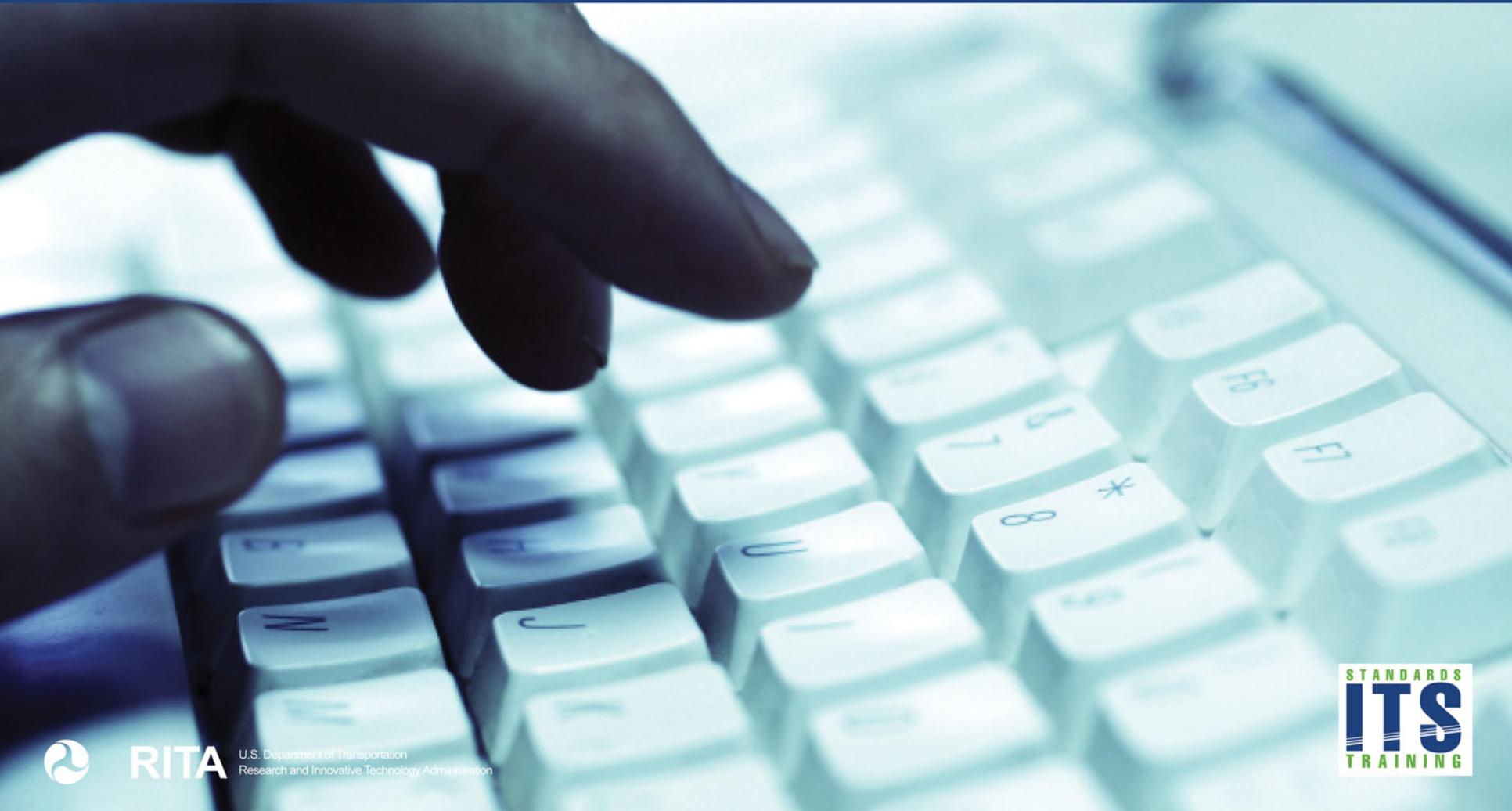
# Other Operational Needs

## User Needs Not Supported by NTCIP 1203 v02

- The standard, like the entire suite of NTCIP protocols, allows for extensions
- Proprietary extensions are not desired (interoperability problems), but are sometimes necessary



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# Other Operational Needs

## User Needs Not Supported by NTCIP 1203 v02

- Can anyone identify a proprietary extension that may be necessary or have been created for a DMS?
  - Support for triggers
  - Support for legibility



# Other Operational Needs

## User Needs Not Supported by NTCIP 1203 v02

- E.g., a user need is for a sign face to blank when the message is not legible.
  - Legibility on the sign face is not supported by the standard or the message is distorted.
  - A user (or agency) may create a new object to support this new user need.

**THIS IS A TEST MESSAGE**



# Protocol Requirements List (PRL)

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5.3.1.5 (Environment)	Monitor Sign Environment			O	Yes / No	
		3.5.3.1.4.7	Monitor Sign Housing Temperatures	M	Yes	
		3.5.3.1.4.8	Monitor Sign Housing Humidity	O	Yes / No	
		3.5.3.1.4.9	Monitor Control Cabinet Temperatures	O	Yes / No	
		3.5.3.1.4.10	Monitor Control Cabinet Humidity	O	Yes / No	
		3.5.3.1.7	Monitor Ambient Environment	Temp:M	Yes / NA	

- Maps the user needs of the standard to its associated requirements
- Specifies the standard - defines the communications interface and what the interface will do
- Designed to be part of an agency's specification

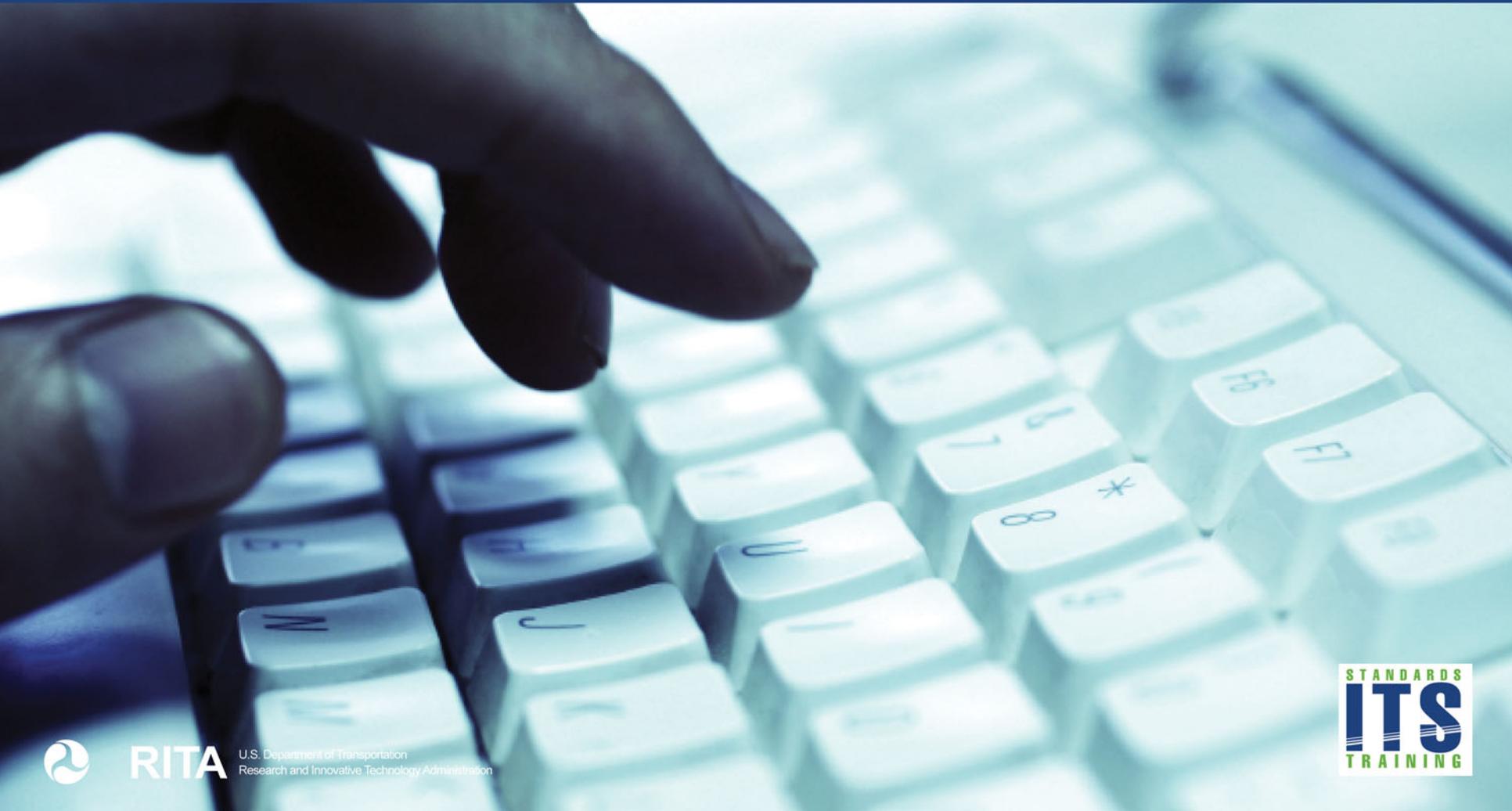
# Protocol Requirements List (PRL)

## User Needs

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5.1.2	Determine Sign Display Capabilities			0	Yes / No	

- 1st line are the headings of the PRL Table
- 2nd line is an example of a user need
- UN Section Number – Section number of the user need.
- User Need (UN) – Title (description of the user need).
- Using the User Need Section Number, look up the user need to determine if this user need is desired for your implementation

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## Exercise #3 – User Needs

When would this user need be required (for the agency)?

The operator needs to be able to define and edit the appearance of the fonts used to display messages on the sign face.

**Hint: Consider the type of sign!**





# Exercise #3 – User Needs

## 2.5.1.3 Manage Fonts

This feature allows the operator to define and edit the appearance of the fonts used to display messages on the sign face. This helps an operator ensure that messages have a consistent appearance across many DMS in a large system despite the use of different manufacturers, etc. It allows the operator to manage the height and width of the font, and the color of the font. It allows the operator to edit or delete existing fonts, and to create new fonts in a controller. It also allows an operator to determine the existing configuration of fonts.

Each font supported by the DMS should support a common set of characters (e.g., ASCII codes) to improve interoperability, including letters numbers and various special characters that are frequently used on DMS.

When might this user need not be needed (for the agency)?



# Protocol Requirements List (PRL)

## User Needs

### 2.5.1.2 Determine Sign Display Capabilities

This feature allows the operator to retrieve the necessary information to produce a rendering of a suggested or active message. This feature also allows the system to ensure that a message can be displayed on the DMS. The feature allows the operator to determine the detailed physical limitations of the DMS as well as details regarding the current fonts and any graphics that are stored.

- Is this a User Need for you?
  - May be desired for central systems that provide a graphical rendering of how a DMS sign face may look like
  - May not be desired for a simple blank out sign

# Protocol Requirements List (PRL)

## Conformance

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5.1.2	Determine Sign Display Capabilities			O	Yes / No	

- Identifies if the user need (or requirement) is mandatory (M) or optional (O)
  - Some user needs are basic needs related to a DMS. These user needs are considered mandatory
  - E.g., Activate and Display a Message is a basic user need for a DMS
  - Result: There is a basic set of user needs that must be satisfied by all implementations

# Protocol Requirements List (PRL)

## Conformance

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.3.2.3	DMS Display Matrix Configuration			M	Yes	The DMS shall be ___ millimeters wide (0..65535) and ___ millimeters high (0..65535), inclusive of borders.  The Sign's Border shall be at least ___ millimeters wide (0..65535) and ___ millimeters high (0..65535).
2.3.2.3.1	Non-Matrix			O.2 (1)	Yes / No	
2.3.2.3.2 (Matrix)	Matrix			O.2 (1)	Yes / No	The pitch between pixels shall be at least ___ millimeters (0..255).

- The designation “O.2 (1)” means
  - This user need is optional (indicated by the “O”)
  - The user need is one of several under the higher-level User Need (2.3.2.3 – DMS Display Matrix Configuration) (indicated by the “.2”)
  - One of the user needs selected under the higher-level user need must be selected (indicated by the (1))

# Protocol Requirements List (PRL)

## Conformance

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.5.1.3 (Fonts)	Manage Fonts			VMS:O	Yes / No / NA	

- Predicate - <predicate>: Indicates whether this user need is mandatory, optional or not applicable, and is dependent on a condition or another feature is supported.
  - E.g., For Manage Fonts, VMS:O indicates if the DMS is a variable message sign, the user need is optional.
  - Other conditions or features include type of DMS (BOS, CMS, VMS); type of technology (fiber, LED, flip/shutter, lamp, drum); if Graphics is supported; and the type of display (matrix, character matrix).

# Protocol Requirements List (PRL)

## Support / Project Requirement

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.5.1.3 (Fonts)	Manage Fonts			VMS:O	Yes / No / NA	

- Agency/Specifier to circle Yes, No, or NA to indicate the agency's user needs for the proposed implementation.
- If the Conformance statement for the User Need is Mandatory, circle Yes.
- If the Conformance statement is not applicable for your implementation, circle NA.

# Protocol Requirements List (PRL)

## Additional Project Requirements

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.3.2.2	DMS Technology			M	Yes	NOTE—Certain combinations of the following technologies might not be supported by any product.
2.3.2.2.1 (Fiber)	Fiber			O	Yes / No	
2.3.2.2.2 (LED)	LED			O	Yes / No	
2.3.2.2.3 (Flip/Shutter)	Flip/Shutter			O	Yes / No	
2.3.2.2.4 (Lamp)	Lamp			O	Yes / No	
2.3.2.2.5 (Drum)	Drum			O	Yes / No	
2.3.2.3	DMS Display Matrix Configuration			M	Yes	The DMS shall be ___ millimeters wide (0..65535) and ___ millimeters high (0..65535), inclusive of borders.  The Sign's Border shall be at least ___ millimeters wide (0..65535) and ___ millimeters high (0..65535).

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

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# Exercise #4 – Selecting User Needs

Using the Information (pages 7 and 8) in the Supplemental Material, assume you are procuring an LED full-matrix sign. Which of the following is not a mandatory user need for this procurement?

1. Define a Message (2.5.2.3.3)
2. Control the Brightness Output (2.5.2.5)
3. Manage Graphics (2.5.1.4)
4. Determine the DMS Identity (2.5.1.1)



# Completing the PRL

## User Need – Requirement Relationship

- User Needs define the “Why” and “What” of a desired feature - The selection of the user need leads to the refinement of associated requirements
- Functional Requirements define how a desired User Need is satisfied
- Within the PRL, the relationship of User Need to one or more Functional Requirements is standardized
- Ensures Interoperability

# Completing the PRL

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5.3.1.5 (Environment)	Monitor Sign Environment			<input type="radio"/>	<input checked="" type="radio"/> Yes <input type="radio"/> No	
		3.5.3.1.4.7	Monitor Sign Housing Temperatures	M	Yes	
		3.5.3.1.4.8	Monitor Sign Housing Humidity	<input type="radio"/>	Yes / No	
		3.5.3.1.4.9	Monitor Control Cabinet Temperatures	<input type="radio"/>	Yes / No	
		3.5.3.1.4.10	Monitor Control Cabinet Humidity	<input type="radio"/>	Yes / No	
		3.5.3.1.7	Monitor Ambient Environment	Temp:M	Yes / NA	

- For each user need, under the Support/Project Requirement column, indicate if the user need is required for the agency/project implementation
- If the user need is selected, the PRL identifies the requirements associated with that user need
- Also complete any notes or information under the Additional Project Requirements column

# Completing the PRL

## Functional Requirements

UN Section Number	User Need (UN)	FR Section Number	Functional Requirement (FR)	Conformance	Support / Project Requirement	Additional Project Requirements
2.5.2.3.1	Activate and Display a Message			M	Yes	
		3.5.2.3.1	Activate a Message	M	Yes	
		3.5.2.3.3.5	Retrieve Message	M	Yes	
		3.5.2.3.6	Activate a Message with Status	Drum:M	Yes / NA	

- FR Section Number – Section number of the Functional Requirement
- Functional Requirement (FR) – Title/description of the functional requirement

# Completing the PRL

## User Need – Requirement Relationship

- Requirements associated with a User Need are found under that User Need
- Each user need will have at least one associated requirement
- 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

# Completing the PRL

## Tips

- Do NOT select all user needs – Select only those operational needs relevant to you.
  - Can be very expensive to procure and test



# Using the PRL

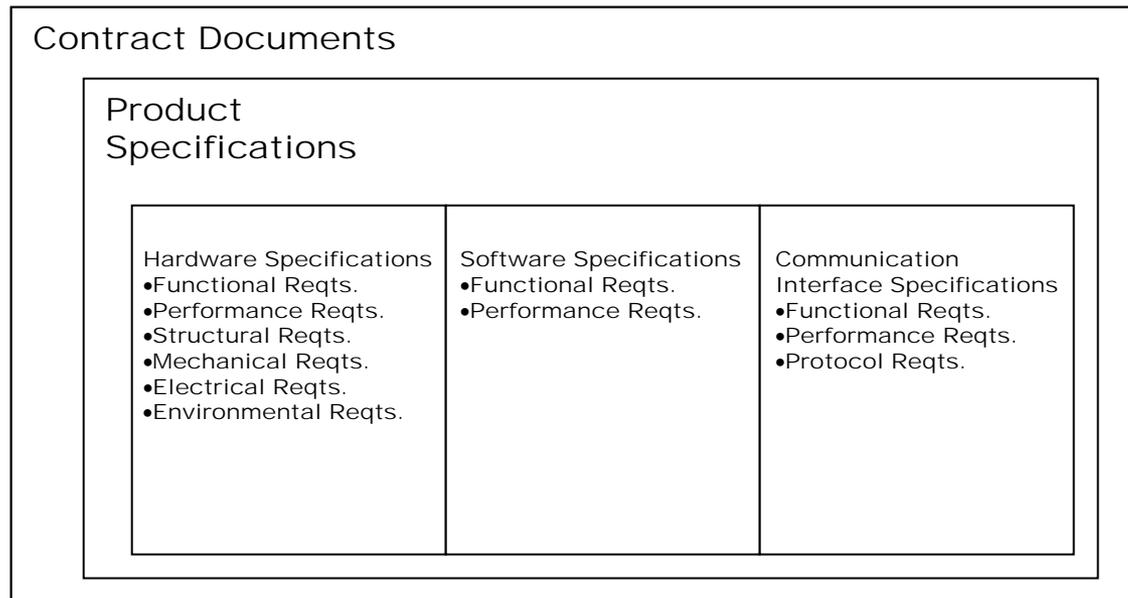
## Agency's Perspective

- The PRL makes it easier to specify what the interface is to do
- A completed PRL indicates the requirements for the communications interface, and, by extension, the user needs (and functional requirements) the DMS must support



# Using the PRL

## As Part of A Procurement Specification



- A completed PRL can become part of the overall specification, in addition to the performance specifications pertaining to the hardware

# Using the PRL

## As Part of A Procurement Specification

- The completed PRL has to 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.



# Using the PRL

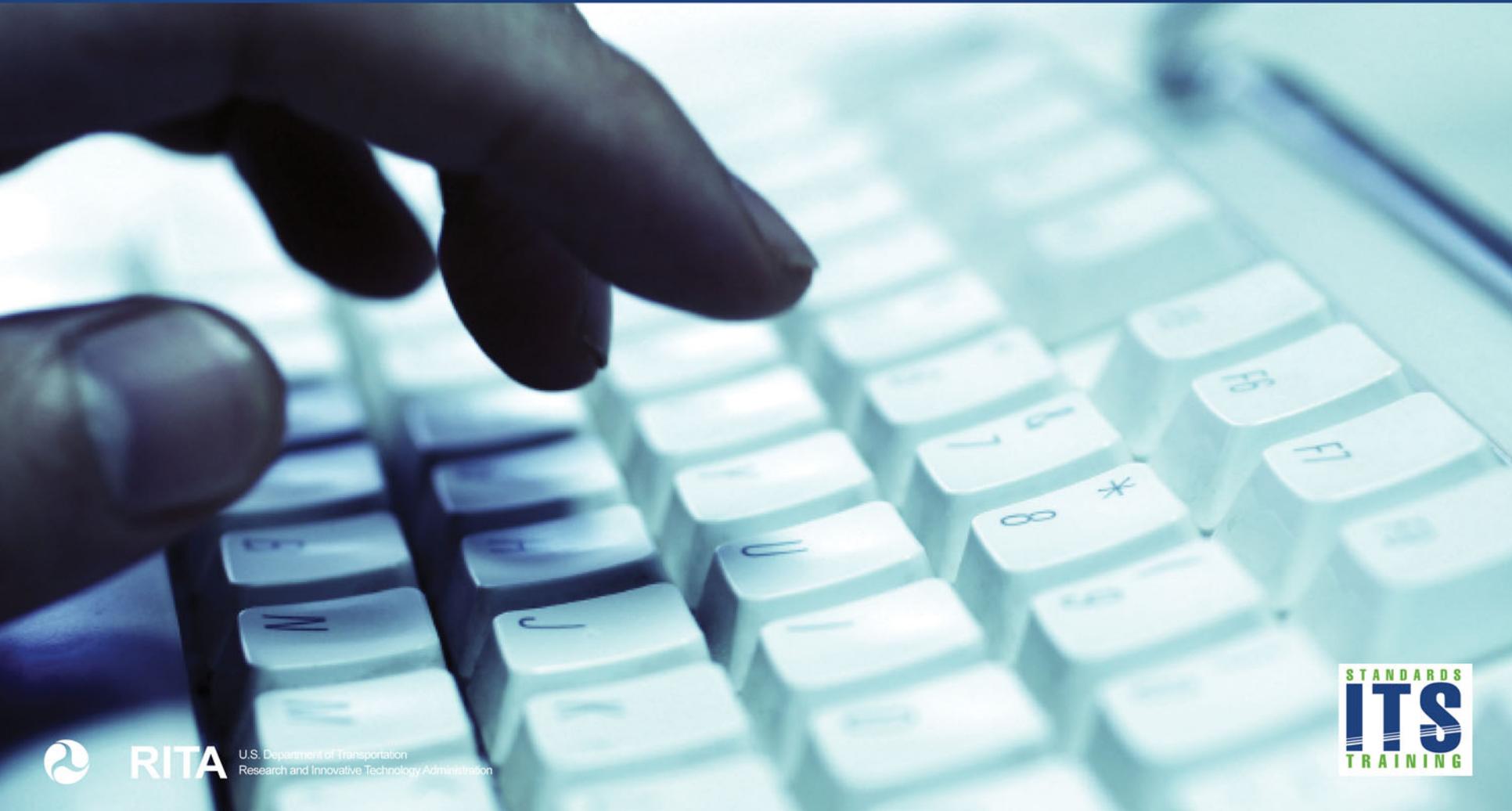
## Conformance versus Compliance

- Conformance:
  - Meets a specified standard
  - To claim "Conformance" to NTCIP 1203 v02, the vendor shall minimally satisfy the mandatory requirements selected
  - Vendors providing features beyond the completed PRL are conformant if those features conform with the requirements of NTCIP 1203 v02 and its normative references.
- Compliance
  - Meets a specification





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# Exercise #5 – Conformance versus Compliance

- An engineer writing a specification to purchase a variable message sign. Would an implementation providing for variable message signs be conformant or compliant?  
*Compliant. An implementation is compliant to a specification, and conformant to a standard.*
- A dynamic message sign supports a feature that the sign will automatically blank when the message is no longer legible. Is that conformant with the standard?  
*No – A legibility function is not defined in the standard.*
- Would an implementation that does not support the DMS device ID be conformant with NTCIP 1203 v02?  
*No – Every DMS must support the identification of the device.*

# Using the PRL

## 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 that feature.
- Vendors can provide a PRL for their standard products to show what user needs they support.



# Backwards Compatibility

- NTCIP 1203 v02 is mostly backwards compatible with NTCIP 1203 v01.
  - NTCIP 1203 v02 adds new features and defines dialogs to enforce interoperability
  - Certain features were modified in NTCIP 1203 v02 (fan failures, simulation mode)
- NTCIP 1203 v02 also supports a need to require backwards compatibility with v01.



# Backwards Compatibility

- Since NTCIP 1203 v01 did not define dialogs, v01 implementations may not be fully “interoperable” with each other or with v02 implementations.
  - E.g., A DMS central system conformant with NTCIP 1203 v01 may need some modifications to manage and control a v01 DMS from different vendors if each vendor’s dialogs are different.
  - Note: the risk is low, but possible.





# Summary

- Discuss the structure of the DMS Standard (NTCIP 1203 v02)
  - Supports additional functionality
  - Includes the systems engineering process
    - User Needs
    - Functional Requirements
    - Protocol Requirements List (PRL)
    - Design
  - Addresses Backwards Compatibility





# Summary

- Identify specific DMS operational needs:
  - Manage the DMS Configuration
  - Control the DMS
  - Monitor the Status of the DMS





# Summary

- Use the Protocol Requirements List (PRL) to select the user needs and link to requirements:
  - Links the user needs with the requirements
  - Allows specifiers to select their user needs and requirements, making procurements easier
  - Defines the user needs that are mandatory for conformance
- Explain how the PRL fits into the DMS Specification
  - Include the completed PRL in the specification
  - Defines the communications interface

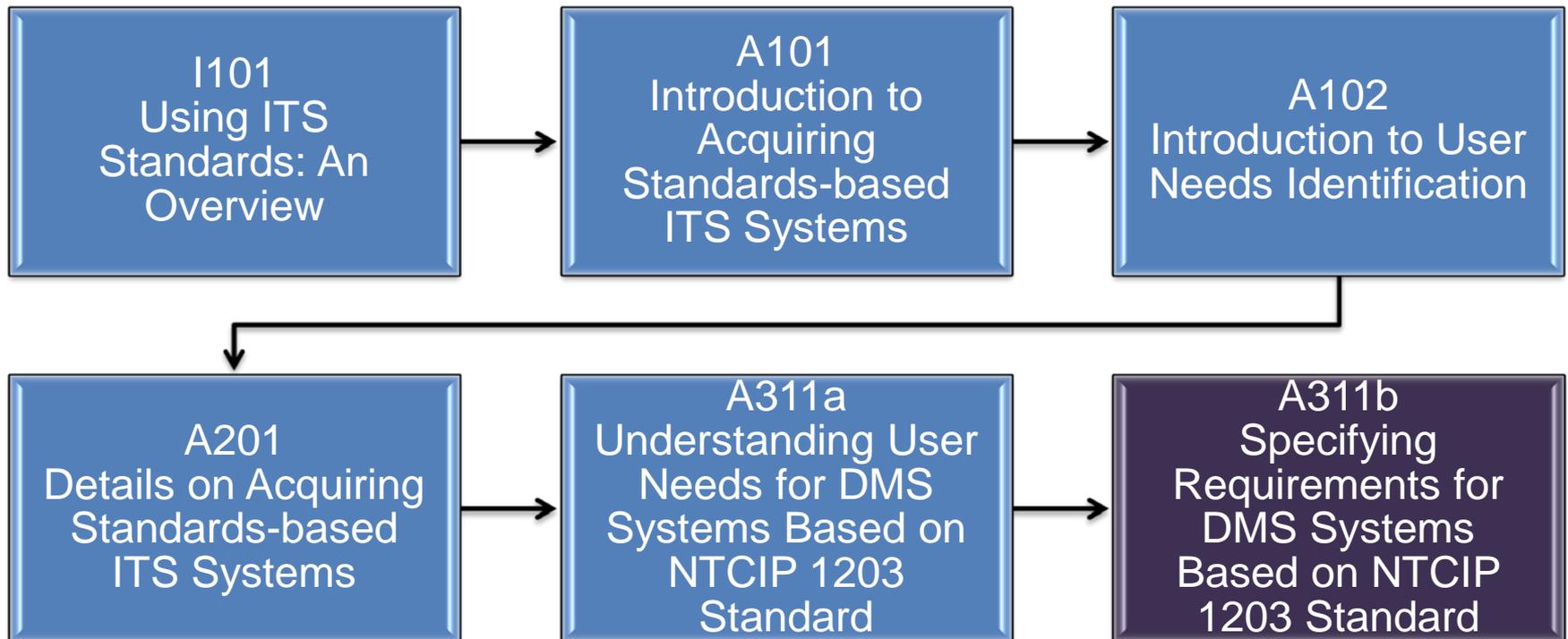


# Resources

- NTCIP 1203 v02.039b, Object Definitions for Dynamic Message Signs – [www.ntcip.org](http://www.ntcip.org)
- NTCIP 9001 v04 – The NTCIP Guide – [www.ntcip.org](http://www.ntcip.org)
- IEEE 1362 - IEEE Guide for Information Technology and System Definition Concept of Operations (ConOps) Document



# Next Steps





# Next Steps

- Module A311b – Specifying Requirements for DMS Systems Based on NTCIP 1203 Standard
  - Reviews the requirements supported by the standard.
  - Shows the relationship between the requirements and the design that satisfies those requirements.
  - Shows how to select and refine requirements that supports the User Needs selected in the PRL



# QUESTIONS?



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