STANDARDS ITS TRAINING

WELCOME

U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Welcome

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

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A311b

Specifying Requirements for DMS Systems Based on NTCIP 1203 Standard v03
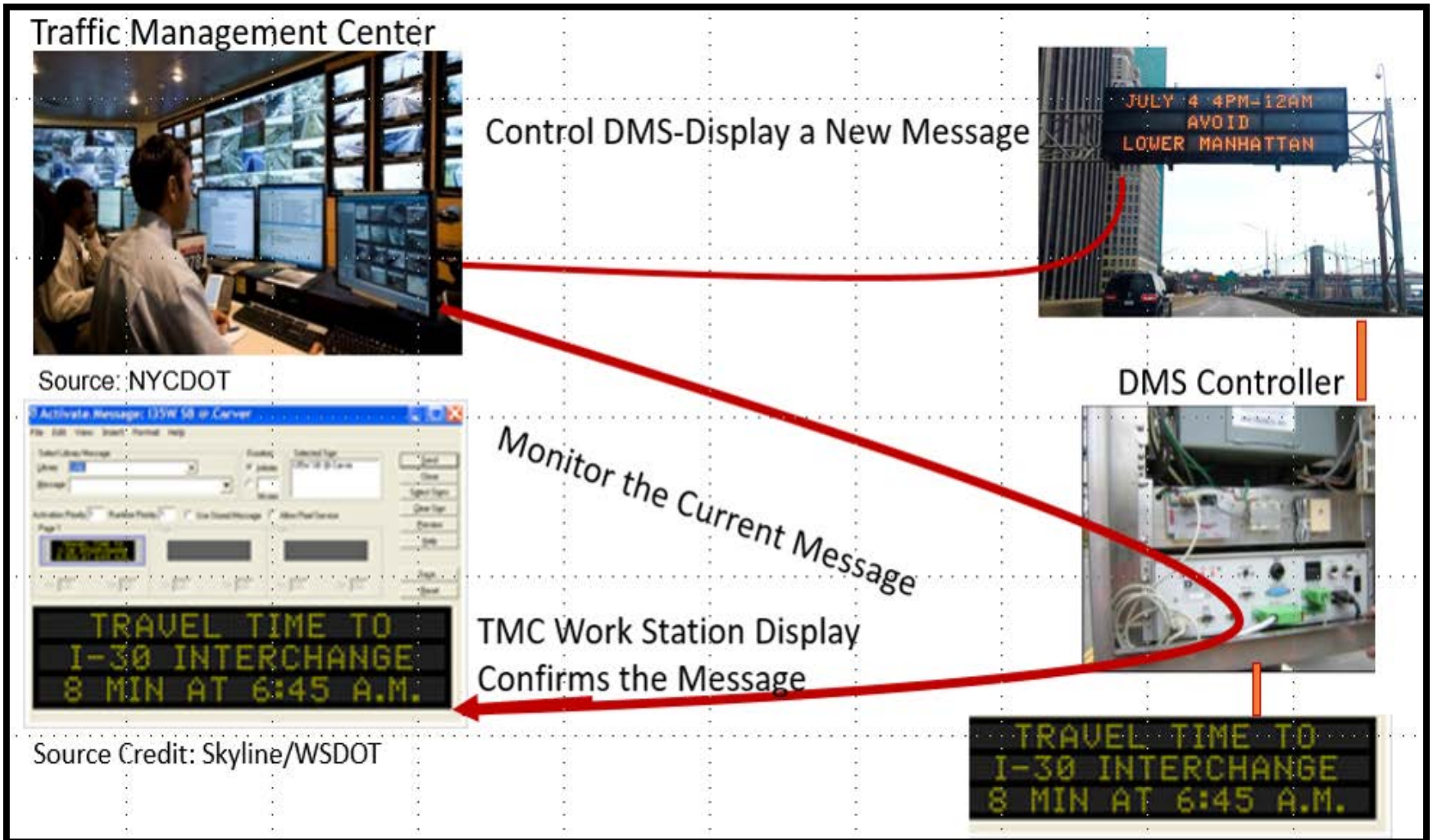
Instructor

Raman K. Patel, Ph.D.,P.E.

President
RK Patel Associates, Inc.
New York City, NY, USA

Learning Objectives

Briefly Review the **Structure** of the DMS Standard

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and Its Benefits

Prepare a **Project-Level RTM** with Standard-Supplied Requirements and Design Content (Concepts)

Prepare a DMS Specification (**Checklist**)

Learning Objective 1

Briefly Review the **Structure** of the Dynamic Message Sign (DMS) Standard

What Is NTCIP 1203 v03?

DMS Communications Interface Standard

✓ Provides DMS user needs, requirements, and design content.

✓ Using this information, we can prepare a specification to build a **Communications Interface.**

Comm Line between Sign Controller and Sign Housing (<u>NOT</u> covered by NTCIP)

Sign Housing

DMS

Subject of NTCIP

Management Station

Sign Controller
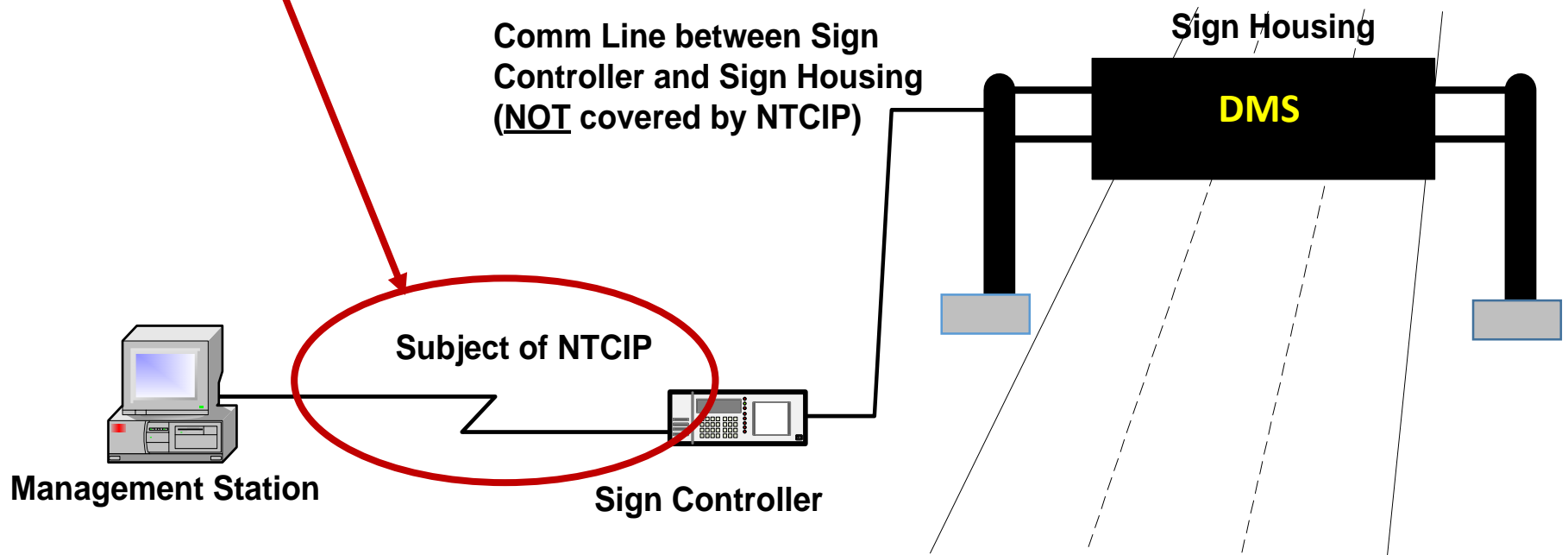
What Is NTCIP 1203 v03?

Recap of Updated Module A311a

- Reviewed DMS Operational Needs and the Protocol Requirements List **(PRL)**, which outlined requirements

- Now we will discuss types of requirements

- Introduce Requirements Traceability Matrix **(RTM)** and how it is used

NTCIP 1203   version v03

National Transportation Communications for ITS Protocol

Object Definitions for Dynamic Message Signs (DMS)

v03.03   Part 1 plus Part 2 Annex C   April 2011

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NTCIP 1203 v03 Part 1, *use with Part 2 Annex C*

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Structure of Standard

Information Needed to Prepare a DMS Specification

NTCIP 1203 v03, Part 1

Concept of Operations
User Needs

Requirements

Design

Decomposition and Definition

Section 2 User Needs

Section 3 Functional Requirements

Section 4 Dialogs

Section 5 Management Information Base Objects
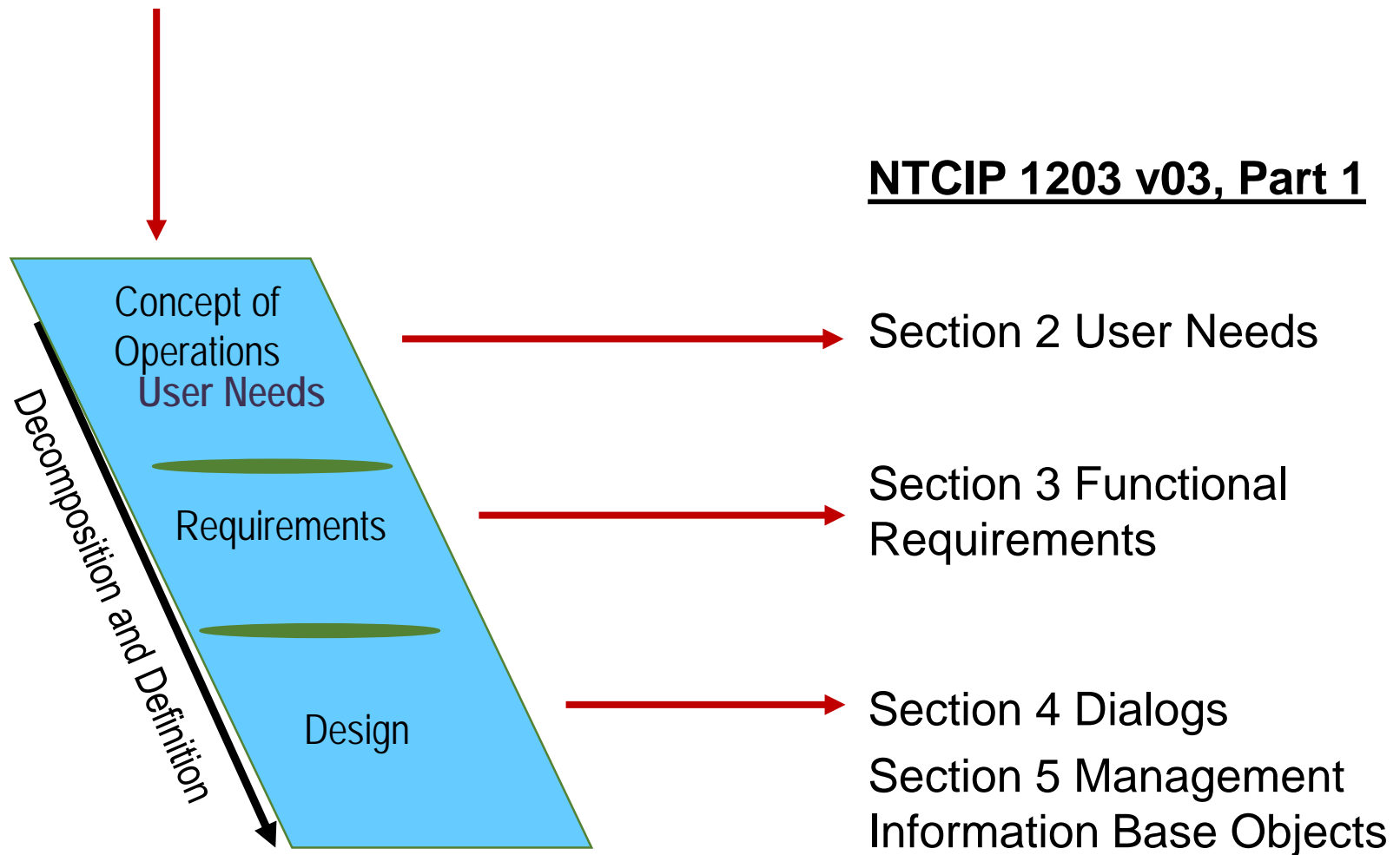
Structure of Standard

Specific Guidance from the NTCIP 1203 v03 Standard

Part 1: Provides Template for Selecting User Needs Called **Project Requirements List (PRL)**

Part 1: Annex A: Provides template for Design Dialogs, and Objects Called **Requirements Traceability Matrix (RTM)**

Part 2: Annex C: Outlines **Test Procedures** for a DMS Test Plan

What Is a Requirement?

"A statement that identifies a system, product, or process'

characteristic or constraint, which is unambiguous, clear, unique,

consistent, stand-alone (not grouped), and verifiable and is

deemed necessary for stakeholder acceptability."

- INCOSE Systems Engineering Handbook
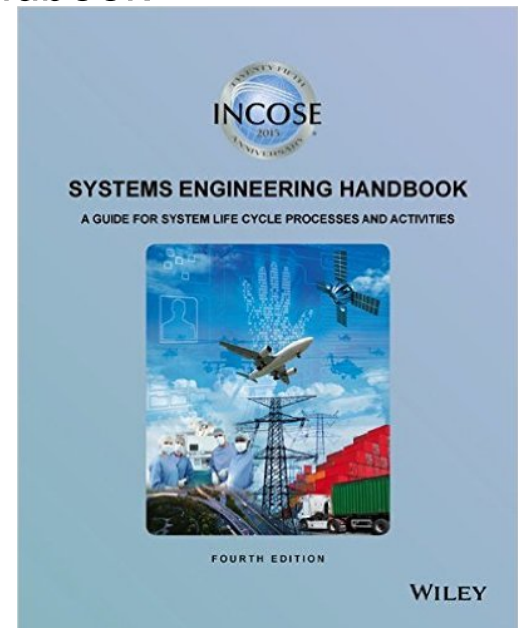
What Is a Requirement?

Definition of a Requirement

*"A requirement describes a condition or **capability** to which a **system must conform**; either derived directly from user needs, or stated in a contract, standard, specification, or other formally imposed document. A desired **feature**, property, or **behavior** of a system."* **NTCIP 1203 v03**

Example of a DMS Requirement

3.5.2.3.3 Define a Message

The DMS **shall allow** a management station to **download** a message for storage in the sign controller's message library.

Standard Structure

Types of DMS Requirements

3.4 Architectural Requirements

- Support Basic Communications

- Support Logged Data

- Manage Access

3.5 Data Exchange Requirements

- Manage the DMS Configuration

- Control the DMS

- Monitor the Status of the DMS

- Providing for Multi-Version Interoperability

3.6 Supplemental Non-Communications Requirements

Review Standard Structure

Architectural Requirements

Define the required behavior of the system in **exchanging data** across the communications interface

3.4 Architectural Requirements
- Support Basic Communications
- Support Logged Data
- Manage Access

Standard Structure

Architectural Requirements (Section 3.4)

3.4.2.3 Retrieve Logged Data

The DMS shall allow a management station **to retrieve** data from the event log.

3.4.2.4 Clear Log

The DMS shall allow the management station to **clear log entries** of a given event class that are less than or equal to a given time.

3.4.4.1 Determine Current Access Settings

The DMS shall allow the administrator at the management station to determine the current **access settings**.

Subject of NTCIP

Management Station
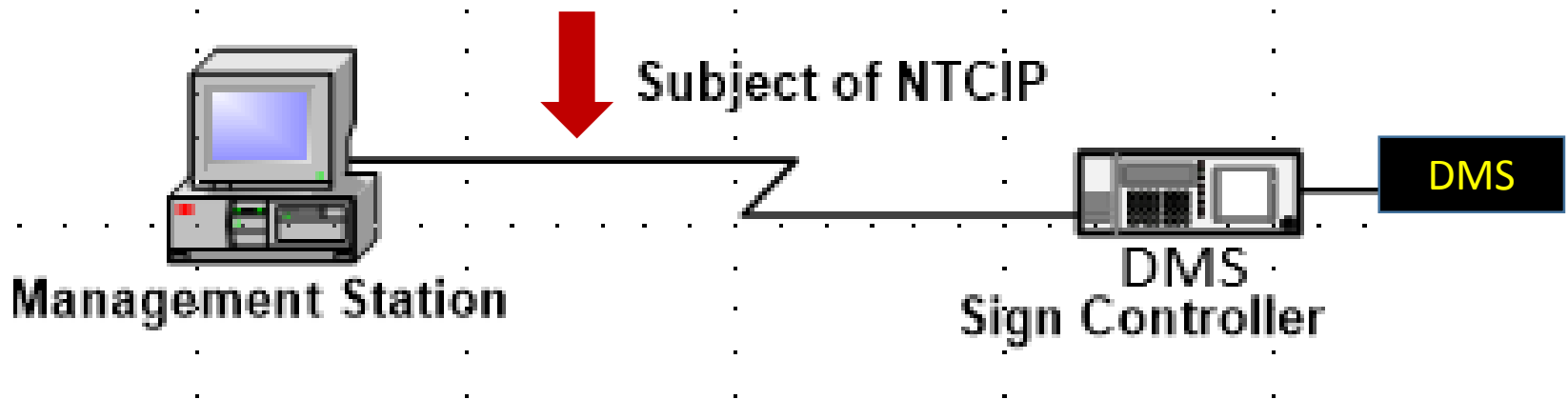
DMS Sign Controller
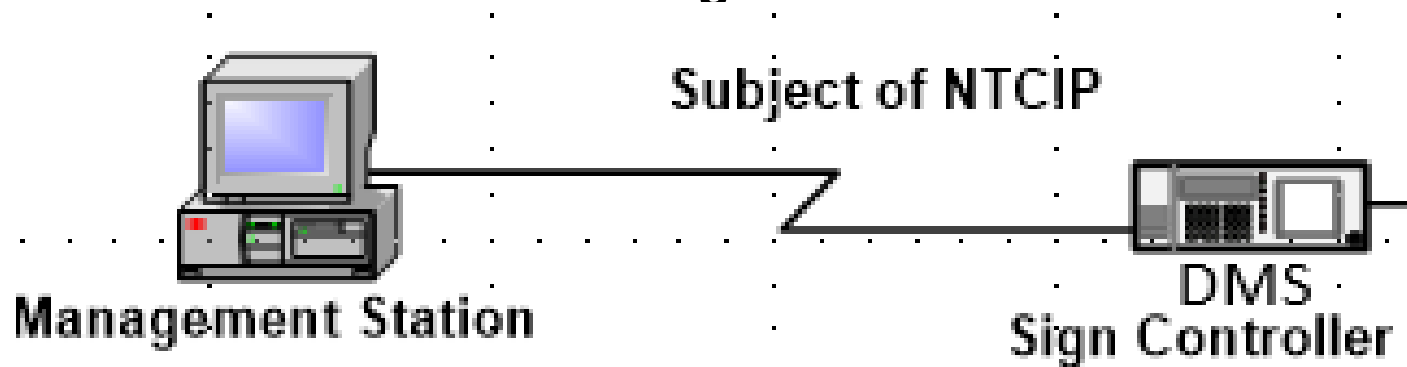
EXAMPLE

Standard Structure

Data Exchange Requirements (Section 3.5)

Define the required behavior of the system in **exchanging data** across the communications for three major areas:

3.5.1 Manage the DMS **Configuration**
3.5.2 **Control** the DMS
3.5.3 **Monitor** the Status of the DMS
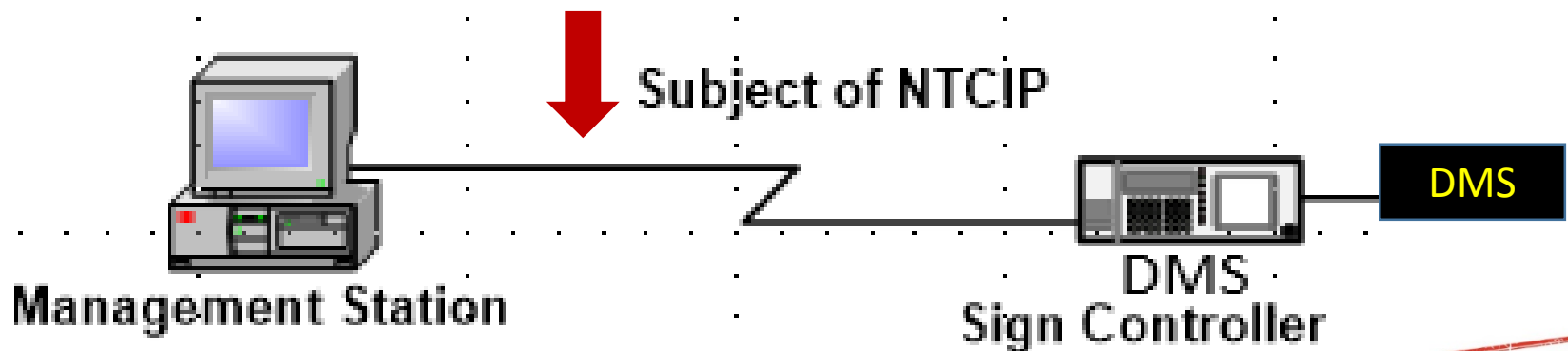
Standard Structure

Data Exchange Requirements (Section 3.5)

- **3.5.1 Managing Configuration**

  - Identify DMS – sign type and technology

- **3.5.1.1.1 Determine Sign Type and Technology**
  - The DMS shall allow a management station to determine its type and technology.

- **3.5.1.2 Determine message capabilities**

  - Determine basic message capabilities – size, beacons, access

  - Determine matrix capabilities – sign face size and character size in pixels, pixel spacing

EXAMPLE

Standard Structure

Examples of Data Exchange Requirement (Section 3.5)

3.5.1 Manage Configuration

- Determine VMS message display capabilities:
  - Maximum number of pages
  - Maximum message length
  - Supported color schemes
  - Message display capabilities

3.5.1.2.3.2 Determine Maximum Message Length   **Bytes**
The DMS shall allow a management station to determine the maximum length for a downloadable message.
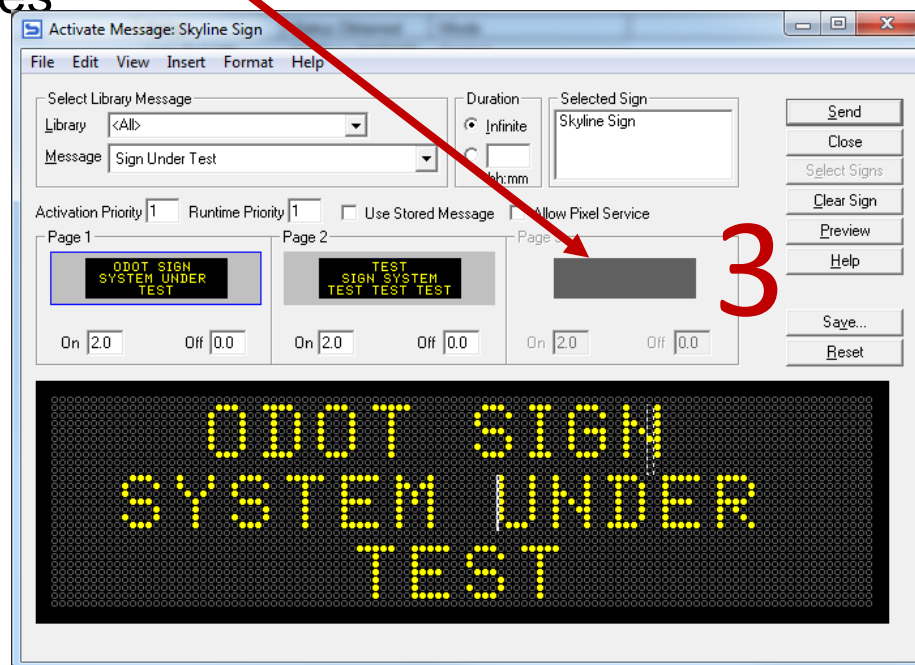
Standard Structure

Data Exchange Requirements (Section 3.5)

3.5.1 Manage Configuration

- **Manage Fonts** – Determine maximum number of:
    - Fonts supported
    - Character size
    - Characters per font
    - Retrieve a font definition
    - Configure a font, delete a font, validate a font
- **Manage Graphics Details** – Determine maximum number of graphics and their size and other details

Standard Structure

Examples of Data Exchange Requirements (Section 3.5)

3.5.2 Control the DMS

3.5.2.1 Manage Control Source
A DMS shall allow the user to switch between the **local and central** control modes.

DMS

Subject of NTCIP

Management Station

DMS
Sign Controller

Local Computer
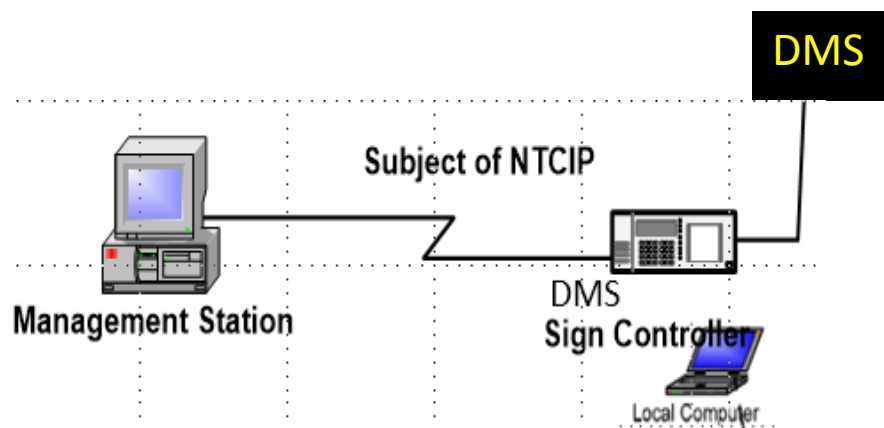
- **Reset the sign controller**
- **Control the sign face**:
  - ✓ Activate a message
  - ✓ Manage default message display parameters
  - ✓ Manage message library, schedule messages for display, configure event-based message activation

Standard Structure

Example of a Requirement for Scheduling a Message

3.5.2.3.4.1 Retrieve a Schedule: The DMS shall allow a management station to retrieve the schedule as stored within the sign controller.
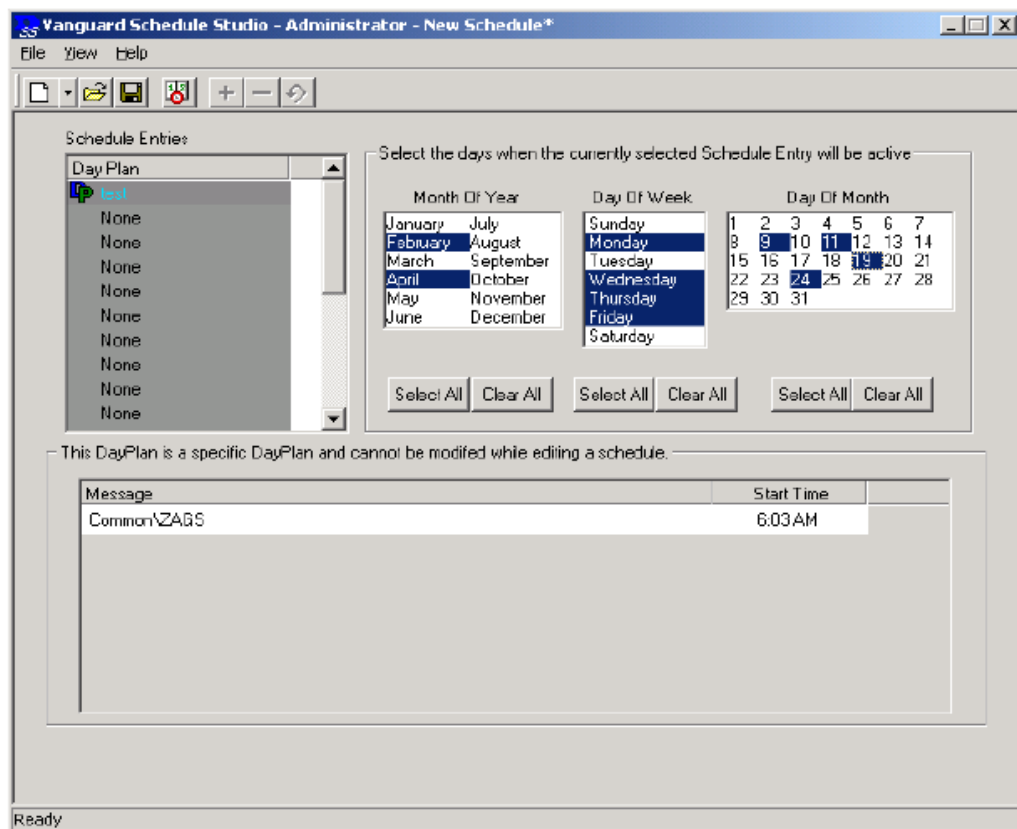
Management Station

If an event is known in advance, a message can be scheduled to run between a set time and date.

Sign Controller

Source: WSDOT

Standard Structure

Examples of Data Exchange Requirements (Section 3.5)

3.5.3 Monitor the Status of the DMS

- Perform diagnostics:

  - Test operational status of DMS components

  - Provide general DMS error status information

  - Identify problem subsystems

  - Monitor subsystems status details such as pixel errors, light **sensor errors**

- Monitor the current message – Monitor information about the current message

- Monitor status of DMS control functions

Standard Structure

Monitor the Status of the Current Message

TMC

DMS Controller

Source: NYCDOT-WSDOT

Management Station

Monitor the Current Message

TMC Work Station Display
Confirms the Message

TRAVEL TIME TO
I-30 INTERCHANGE
8 MIN AT 6:45 A.M.

TRAVEL TIME TO
I-30 INTERCHANGE
8 MIN AT 6:45 A.M.

Standard Structure

Support for Maintenance Requirements

Source: WSDOT

Standard Structure

Supplemental Requirements (Section 3.6)

Supplemental Requirements are additional requirements not covered by the other two categories (Architectural/Data exchange).

Example: Include range capabilities of the DMS:

✓ How many messages a VMS is required to support?

EXAMPLE

Standard Structure

Types of DMS Requirements Supported (Section 3.6)

Standard Structure

Illustration of a Supplemental Requirement

Ray Engel, NYS Thruway

3.6.1.1 Support for a Number of Fonts

The DMS shall support the **number of fonts** as defined by the specification. If the specification does not define the number of fonts, the DMS shall support at least **one font.**

3.3.4 Protocol Requirements List – Supplemental Table

Req ID	Requirement	Req ID	Requirement	Conformance	Support	Additional Specifications
	Supplemental Requirements					
3.6.1	Supplemental Requirements for Fonts					
		3.6.1.1	Support for a Number of Fonts	M	Yes	The DMS shall support at least ____ fonts (1..255). NOTE: The specification may optionally specify the fonts to be stored in the sign controller upon initial delivery by using an additional attached sheet to define the desired pixel-by-pixel bitmaps of each character of each font.

Standard Structure

Types of Standardized Dialogs Used to Manage DMSs (Section 4)

Dialogs are sequence of data exchanges that fulfill various requirements to communicate to a DMS system:

G.1   Generic SNMP **GET** Interface to **retrieve data** from DMS

G.2   Generic SNMP **GET-NEXT** Interface defines a process by which a management station can **explore data** within a device to fulfill the requirements

G.3   Generic SNMP **SET** Interface defines a generic process by which a management station can **send data** to a device

Standard Structure

Illustration of a Generic SET Dialog

G.3   GENERIC SNMP SET INTERFACE

SNMP defines a generic process by which a management station can send data to a device. This process consists of a Set request and a GetResponse (sic) as depicted in Figure 14. Both the Set request and the GetResponse messages contain a list of objects as defined by the varBindingList structure (see Annex G.4).
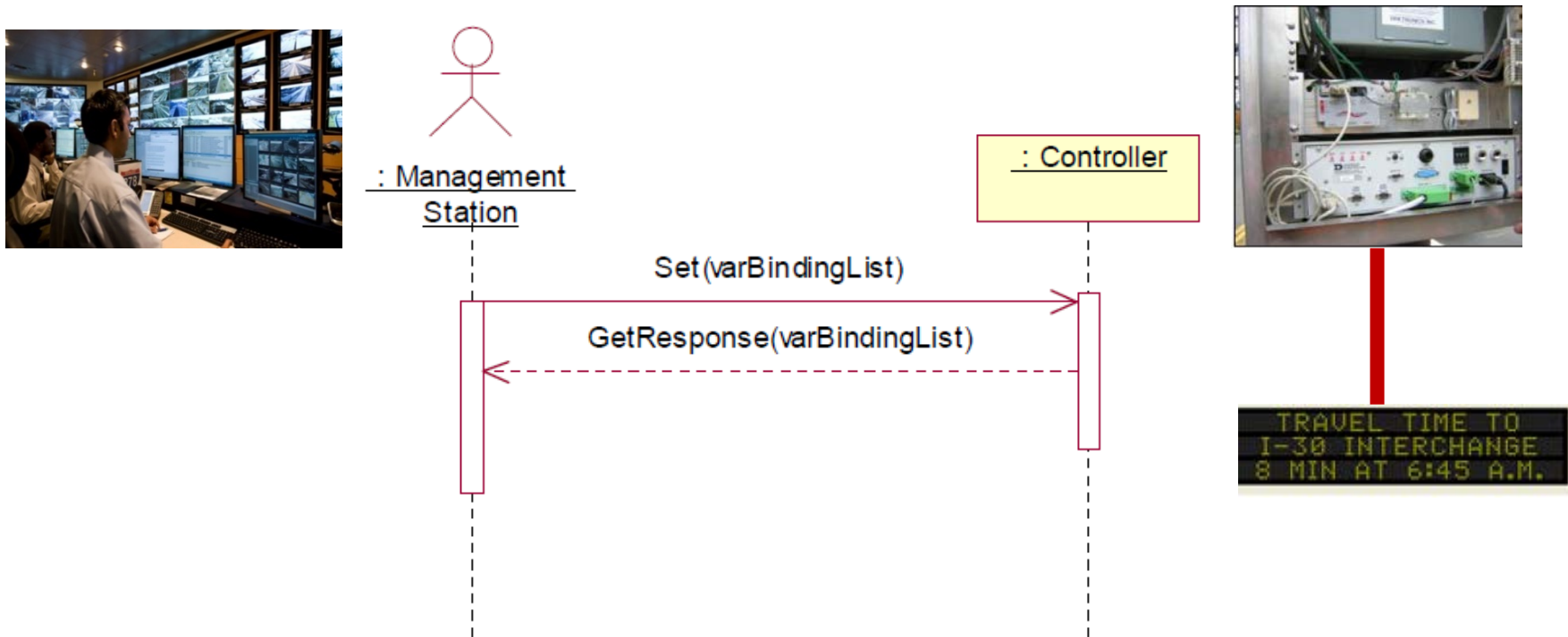
Figure 14 SNMP Set Interface

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Question

Which of the following is a FALSE statement related to the DMS Standard?

Answer Choices

a) Supports configuration, control, and monitoring of DMS functions

b) Supplemental requirements directly involve communications between the management station and the DMS

c) Supports remote communications to the DMS Controller

d) Standardized dialogs carry messages between two ends

Review of Answers

b) Supplemental requirements directly involve communications between the management station and the DMS

False statement. Supplemental requirements cover range values such as message line justification shown below.

3.6.13.2 Support Center Line Justification
The DMS shall support center line justification.

Ray Engel, NYS Thruway

SPEED MONITORED
BY LASER AND RADAR

3.6.13.1 Support Left Line Justification
The DMS shall support left line justification.

RIGHT LANE CLOSED
MERGE LEFT

Review of Answers

a) Supports configuration, control and monitoring of DMS functions

Correct statement. These are core functions of the DMS standard.

c) Supports remote communications to DMS Controller

Correct statement. This statement is true. The standard supports the DMS communications interface.

d) Standardized dialogs carry messages between two ends

Correct statement. This statement is true. DMS has three dialogs: G.1, G.2, and G.3 to facilitate remote conversations.

Learning Objectives

Briefly Review the **Structure** of the DMS Standard

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and Its Benefits

Learning Objective 2

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and Its Benefits

What Is an RTM?

Revisiting Protocol Requirements List (PRL): Module A311a

PRL table traces User Needs to Requirements

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5	Features			M	Yes	
2.5.1	Manage the DMS Configuration			M	Yes	
2.5.1.1	Determine the DMS Identity			M	Yes	
		3.5.1.1.1	Determine Sign Type and Technology	M	Yes	
		H.2.1	Determine Device Component Information	M	Yes	
		H.2.4	Determine Supported Standards	M	Yes	
2.5.1.2	Determine Sign Display Capabilities			O	Yes / No	
		3.5.1.2.1.1	Determine the Size of the Sign Face	M	Yes	

Standardized DMS user needs are provided in Section 2 and requirements in Section 3 of v03 standard.

What Is an RTM?

Terminology

- **Traceability** is defined as the ability to follow or study the logical progression among the **needs, requirements, and design** details in a step-by-step fashion

- **Requirements Traceability Matrix (RTM)** is a table that provides a complete **design** (dialogs and objects) for each requirement. The user has no role

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.1.1	Identify DMS				

NTCIP 1203 v03 Annex A, Page 233

What Is an RTM?

Example of a DMS Requirement

"*Determine Sign Type and Technology*" is **traced** to dialog G.1 and associated design objects – 5.2.2 and 5.2.3

Traceability

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.1.1	Identify DMS				
3.5.1.1.1	Determine Sign Type and Technology	G.1			
			5.2.2	dmsSignType	
			5.2.9	dmsSignTechnology	

What Is an RTM?

Value of Design Content Provided by the RTM

- RTM presents the standardized **Design** content to build the *DMS Communications Interface*

Subject of NTCIP

Management Station

DMS
Sign Controller

DMS
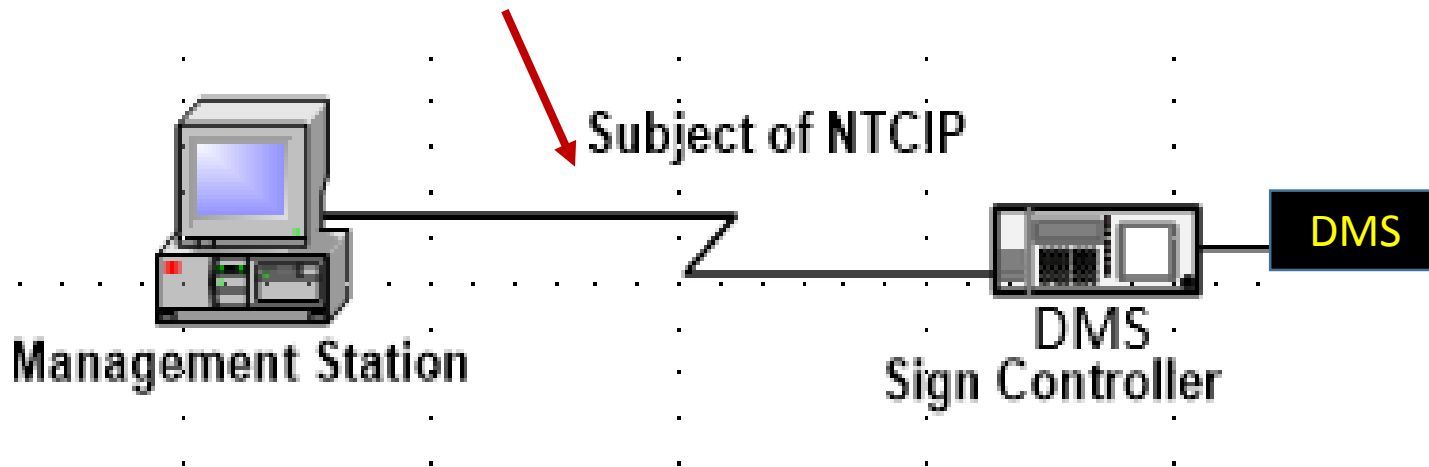
- Interface will be **conformant** to standard ONLY if:

1. Each functional requirement is implemented with all Objects and Dialogs traced from that requirement given by the RTM.

2. Management Station implements all Dialogs traced from the functional requirement.

Parts of RTM with DMS Examples

Parts of RTM Table

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5	Data Exchange and Operational Environment Requirements				
3.5.1	Manage the DMS Configuration				
3.5.1.1	Identify DMS				
3.5.1.1.1	Determine Sign Type and Technology	G.1			
			5.2.2	dmsSignType	
			5.2.9	dmsSignTechnology	

- First lines are the headings of the RTM
- FR ID – Section number of the functional requirement (FR)
- Functional Requirement - Title (description of the FR)
- Dialog ID – Section number of the dialog associated with this FR

Parts of RTM with DMS Examples

Parts of RTM Table

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5	Data Exchange and Operational Environment Requirements				
3.5.1	Manage the DMS Configuration				
3.5.1.1	Identify DMS				
3.5.1.1.1	Determine Sign Type and Technology	G.1			
			5.2.2	dmsSignType	
			5.2.9	dmsSignTechnology	

- Object ID – Section number of the object(s) that will fulfill this FR
- Object Name – Name of the object(s) that will fulfill this FR
- Additional Specifications – Provides additional notes on how the design can be implemented to fulfill the requirement

Parts of RTM with DMS Examples

Single Message Dialogs: G.1, G.2, G.3

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5	Data Exchange and Operational Environment Requirements				
3.5.1	Manage the DMS Configuration				
3.5.1.1	Identify DMS				
3.5.1.1.1	Determine Sign Type and Technology	G.1			
			5.2.2	dmsSignType	
			5.2.9	dmsSignTechnology	

Management Station wants to determine:
Is it a BOS, CMS, or Line Matrix ?

Is it an LED, FLIP DISK, Fiber Optics?

Parts of RTM with DMS Examples

More Complicated Data Exchange Requires Specified Dialogs (Section 4)

Example: Activate a Message

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5.2.3	Control the Sign Face				
3.5.2.3.1	Activate a Message	4.2.3.1			
			5.7.3	dmsActivateMessage	
			5.11.2.1.1	shortErrorStatus	
			5.7.17	dmsActivateMsgError	
			5.7.24	dmsActivateErrorMsgCode	
			5.7.18	dmsMultiSyntaxError	
			5.7.19	dmsMultiSyntaxErrorPosition	
			5.7.20	dmsMultiOtherErrorDescription	

Dialog **4.2.3.1** fulfils the requirement using these objects

SUPPLEMENT

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Parts of an RTM with DMS Examples

Special Note on Importance of Dialogs Order

- Data exchange **order** is important, unless the dialogs state otherwise

- Interoperability may be compromised if the **sequence** of data exchanges is changed

- Conformance to standard may **not** be realized

> If you are a system developer, these issues are bound to come up in your work.

Benefits of RTM to Shareholders

Beneficiary of RTM Uses

1. Procuring Agency-DMS Specification

2. Traffic Management Center-Operations

3. System Developers-Implementers

4. DMS Manufacturers/Vendors

5. Conformance Testers

What?

Management Station

DMS

DMS Sign Controller

Why?

Are we missing something?

Will the interface support operations?

Do I have to do it all over again?

How do I know what their requirements are?

What do I test for conformance and why?
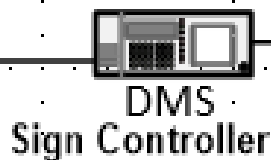
Benefits of RTM to Shareholders

Benefits of RTM to Agency Procurement-Specification Preparation

- **Standardized** design is provided to users

- RTM will enable DMS **Testing Process** at later stage

- RTM enables interoperability, **conformity,** and incremental procurement

- Brings all parties to a **common understanding**, removes ambiguities

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Benefits of RTM to Shareholders

Benefits of RTM to System Developers/Implementers

- RTM **reduces** design work

- RTM's powerful traceability maintains order for **interoperability**, makes it easier to build a **central** system

- The protocol implementer uses RTM as a **checklist** to reduce the risk of failure to **conform** to NTCIP 1203 v03 through oversight

Benefits of RTM to Shareholders

Benefits of RTM to DMS Vendors

- Vendor knows unambiguously what the **users'** requirements are, details of capabilities desired

- RTM ensures in-house product functionality testing **prior** to shipping to client

- Overall, legal **disputes** can be further avoided knowing what clients desire

Benefits of RTM to Shareholders

The Market Place

- ✓ Multiple Vendors
- ✓ Multiple Agencies
- ✓ Range of Products

Source: WSDOT
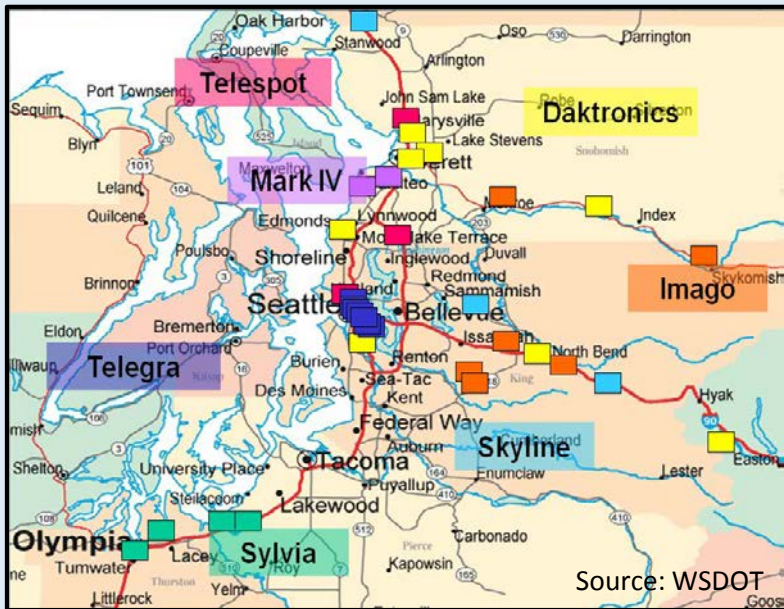
- ✓ One National DMS Standard
- ✓ Supports Multiple Messages
- ✓ Multiple Applications

Travel Times on DMS Status

Total, as of October 30, 2015

🟠 = Provide Travel Times (76)
🟡 = Plan to Provide Travel Times (8)

Accessed: 12/05/16

Source: FHWA

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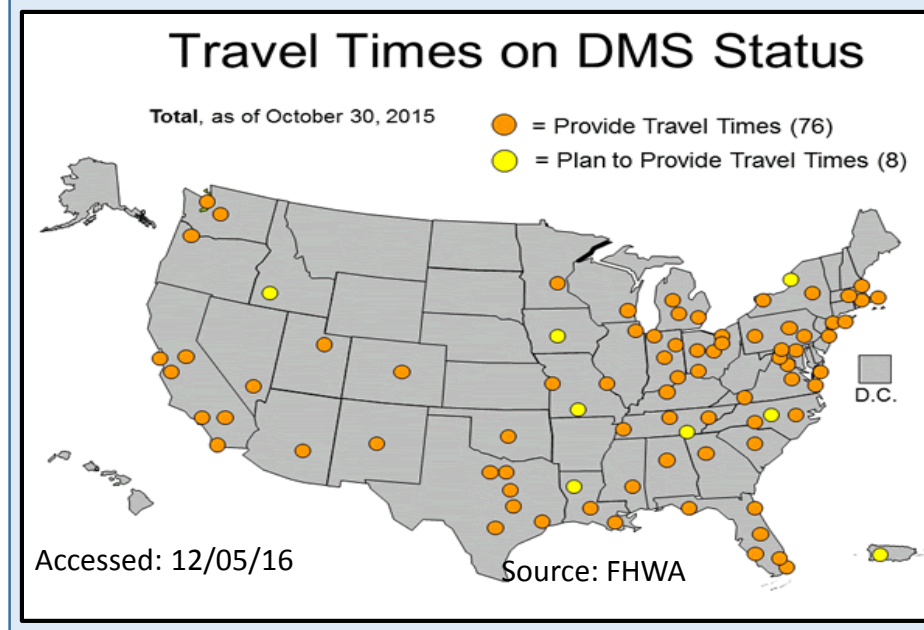
Question

Which of the following is a FALSE statement as it is applied to DMS?

Answer Choices

a) RTM provides the standardized design content

b) Generic Dialogs are used for single message to and from a DMS Controller

c) Testing process uses RTM to verify each DMS requirement

d) RTM does not reference dialog

Review of Answers

a) RTM provides the standardized design content

Correct statement. It reflects what RTM is about. For each requirement, a full design is provided.

b) Generic Dialogs are used for single message to and from a DMS Controller

Correct statement. G.1, G.2 and G.3 generic dialogs are meant for simple-single conversations between two ends.

c) Testing process uses RTM to verify each DMS requirement

Correct statement. RTM is used in preparing Test Cases during testing process to test a requirement.

d) RTM does not reference dialog

False statement. RTM specifies the order in which dialogs must be implemented in order to make error-free communications possible and to achieve interoperability.

Learning Objectives

Briefly Review the **Structure** of the DMS Standard

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and its Benefits

Prepare a **Project-Level RTM** with Standard-Supplied Requirements and Design Content (Concepts)

Learning Objective 3

Prepare a **Project-Level RTM** with Standard-Supplied Requirements and Design Content (Concepts)

Refer to a Project-Level PRL for Supported Requirements

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.5	Features			M	Yes	
2.5.1	Manage the DMS Configuration			M	Yes	
2.5.1.1	Determine the DMS Identity			M	Yes	
		3.5.1.1.1	Determine Sign Type and Technology	M	Yes	
		H.2.1	Determine Device Component Information	M	Yes	
		H.2.4	Determine Supported Standards	M	Yes	
2.5.1.2	Determine Sign Display Capabilities			O	Yes / No	
		3.5.1.2.1.1	Determine the Size of the Sign Face	M	Yes	

See Student Supplement for Module A311a for a Project PRL Example

SUPPLEMENT

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Complete Project RTM with Entries (Populating Table) for Dialogs/Design Concepts

RTM Provides the Design for Each Supported Requirement

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.1.1	Identify DMS				
3.5.1.1.1	Determine Sign Type and Technology	G.1			
			5.2.2	dmsSignType	
			5.2.9	dmsSignTechnology	

I   AM
A
Blank Out Sign

I   AM
LED
TECHNOLGY

Examples of RTM

Message Display Capabilities-Manage Configuration (3.5.1)

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.1.2.3	Determine VMS Message Display Capabilities				
3.5.1.2.3.1	Determine Maximum Number of Pages	G.1			
			5.5.24	dmsMaxNumberPages	
3.5.1.2.3.2	Determine Maximum Message Length	G.1			
			5.5.25	dmsMaxMultiStringLength	
3.5.1.2.3.3	Determine Supported Color Schemes	G.1			
			5.5.22	dmsColorScheme	
			5.3.7	monochromeColor	
3.5.1.2.3.4	Determine Message Display Capabilities	G.1			
			5.5.23	dmsSupportedMultiTags	
3.5.1.2.4	Delete All Messages of a Message Type with One Command	G.3			
			5.7.16	dmsMemoryMgmt	

Examples of RTM

Display Capabilities Requirements Are Fulfilled

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.1.2.3	Determine VMS Message Display Capabilities				
3.5.1.2.3.1	Determine Maximum Number of Pages				
3.5.1.2.3.2	Determine Maximum Message Length				
3.5.1.2.3.3	Determine Supported Color Schemes				
3.5.1.2.3.4	Determine Message Display Capabilities				
3.5.1.2.4	Delete All Messages of a Message Type with One Command				

Examples of RTM

Reset the Sign Controller-Manage Control (3.5.2)

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.2.2	Reset the Sign Controller	G.3			
			5.7.2	dmsSWReset	

3.5.2.2 Reset the Sign Controller
The DMS shall allow a management station **to reset** the sign controller.

Management Station

EXAMPLE

Examples of RTM

Monitor Status-Manage Control (3.5.3)

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5.3	Monitor the Status of the DMS				
3.5.3.1	Perform Diagnostics				
3.5.3.1.1	Test Operational Status of DMS Components				
3.5.3.1.1.1	Execute Lamp Testing	4.2.4.1			
			5.11.2.5.3	lampTestActivation	
3.5.3.1.1.2	Activate Pixel Testing	4.2.4.2			
			5.11.2.4.3	pixelTestActivation	

Module/Driver Failure

EXAMPLE

Examples of RTM

Monitor Status-Manage Control (3.5.3)

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.11.2.6.2	dmsDrumNumRows	
3.5.3.1.3.10	Monitor Door Status	G.1			
			5.11.1.6	dmsStatDoorOpen	

3.5.3.1.3.10 Monitor Door Status

The DMS shall allow a management system to determine which doors of the DMS are open or closed.

EXAMPLE

Monitor Current Status of a Message-Manage Control

FR Section Number	Functional Requirement	Dialog ID	Object Section Number	Object	Additional Specifications
3.5.3.2	Monitor the Current Message				
3.5.3.2.1	Monitor Information about the Currently Displayed Message	4.2.4.14			
			5.8.5	dmsIllumBrightLevelStatus	
			5.8.9	dmsIllumLightOutputStatus	
			5.6.8.1	dmsMessageMemoryType	Value of '5' only
			5.6.8.2	dmsMessageNumber	Value of '1' only

Monitoring the Status of the DMS

TMC
Source: NYCDOT

DMS Controller

Monitor the Current Message

TMC Work Station Display Confirms the Message [50]

Source Credit: Skyline

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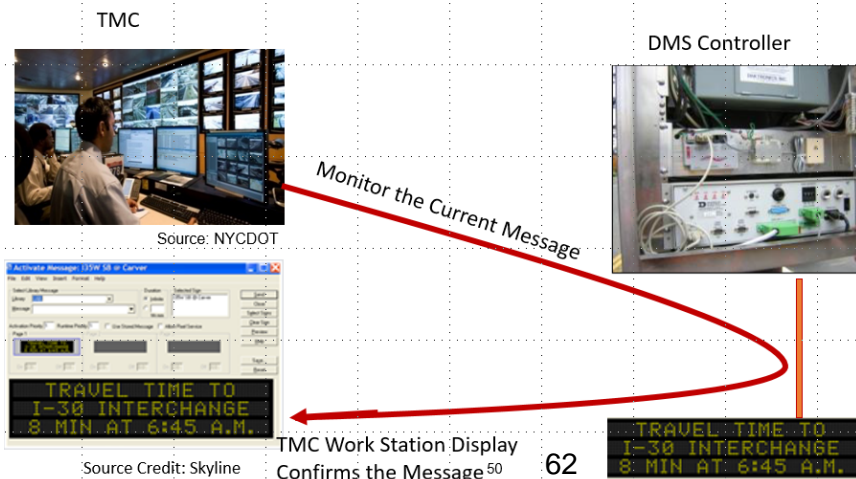
Architectural Requirements (3.4.2)

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.4.2.3	Retrieve Logged Data	H.3.1.3			
			1103 v02 A.7.3.5	eventClassNumRowsInLog	
			1103 v02 A.7.3.6	eventClassNumEvents	
			1103 v02 A.7.7.1	eventLogClass	
			1103 v02 A.7.7.2	eventLogNumber	
			1103 v02 A.7.7.3	eventLogID	
			1103 v02 A.7.7.4	eventLogTime	
			1103 v02 A.7.7.5	eventLogValue	
3.4.2.4	Clear Log	G.3			
			1103 v02 A.7.3.3	eventClassClearTime	

Support Operational Environment with Logged-Data

- **When Connection is Broken or Using Dial-UP Connection:**
  Logged-Data is retrieved at later time when a broken connection is restored.

LOG.txt - Notepad
File Edit Format View Help
.LOG

✓ Controller door was opened at 2 am
✓ Power on at 3:15 am
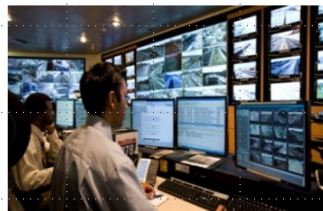
Source: NYCDOT

EXAMPLE

ACTIVITY

STANDARDS
ITS
TRAINING

U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Question

Which of the following statements does NOT apply to RTM?

Answer Choices

a) RTM includes Architectural Requirements to communicate with sign controller

b) Includes DMS user needs

c) Includes dialogs and objects

d) RTM lists requirements for retrieving data from a remote DMS

Review of Answers

a) RTM includes Architectural requirements to communicate with sign controller

Incorrect answer. The statement is valid. Architectural requirements make interface operational.

b) Includes DMS user needs

Correct! This statement does not apply to RTM since user needs are part of only PRL.

c) Includes dialogs and objects

Incorrect answer. Dialogs and objects for each requirement are provided in RTM.

d) RTM lists requirements for retrieving data from a remote DMS

Incorrect answer. Retrieving data from a DMS is a data exchange function which is included in the RTM.

Learning Objectives

Briefly Review the **Structure** of the DMS Standard

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and Its Benefits

Prepare a **Project-Level RTM** with Standard-Supplied Requirements and Design Content (Concepts)

Prepare a DMS Specification (**Checklist**)

Learning Objective 4

Prepare a DMS Specification
(**Checklist**)

DMS Specification Communications Interface Specification (NTCIP)

Procurement Contract Specifications

1

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

2

Software Specifications

Functional Req.
Performance Req.

3

Communications Interface Specifications
User Needs
Functional Req.
Project PRL, RTM
Testing Documentation

Contractual requirements during:
- ✓ System development
- ✓ Testing
- ✓ Deployment/integration
- ✓ Operations/maintenance
- ✓ Project management

DMS Communications Interface Specification

NTCIP

DMS Specification Communications Interface Specification (NTCIP)

Building Communications Interface Specifications

What the Standard Provides

- Section 2 Description of User Needs
- Section 3 Description of Functional Requirements
- Annex C Test Procedures

Communications Interface Specifications
User Needs
Functional Req.

Project PRL, RTM
Testing Documentation

What the User Provides

- Prepare the Project-Level PRL
- Prepare the Project-Level RTM
- Prepare DMS Testing Documentation

Integrate PRL and RTM into a Specification: Interoperability–Coordination Needs

Checklist of Key Elements That Must Be Present

1. Address Interoperability

2. Integrate Project PRL and RTM in the Specification

3. Maintain consistency with DMS product specification

4. Specific Performance Requirements

5. Coordination Requirements

1. Address Interoperability

Why

- DMSs are deployed over **wide area** and often procured from **multiple vendors** over **time**
- Signs are often **shared** by **multiple agencies** from different centers
- These objectives require a capability to allow **sharing/control** of DMSs

How

- Agencies seeking interoperability must have same user needs, requirements, design objects in their Project PRL and RTM
- Must use same protocol – SNMP with other applicable standards

Integrate PRL and RTM into a Specification: Interoperability–Coordination Needs

2. Integrate PRL and RTM in the Project Specification

- A project PRL defines data exchange requirements for the communications interface

- A project RTM provides standardized design content for each requirement

- Underlying communications standards need to be specified too (protocols at various levels)

- Reference to interface standards must be specific to the version and publication date

- Include the completed PRL/RTM with object value ranges for all the objects to clarify parameters

"Give me everything you have" should be avoided.
ONLY specify in the project PRL what you need.

3. Maintain Consistency with DMS Product Specification

- The requirements for the communications interface must be consistent with the hardware specification

    - For example, the communications interface should not require support for requirements specific to beacons if the DMS does not include beacons.

4. Performance Requirements

- Performance requirements for the system not covered by the NTCIP standards, except response times

  - For example, number of devices on a channel, time lag when polling a device, polling rate, etc.

  - Response times addressed in NTCIP 1103 (see below), unless specified otherwise in the data standard.

G.5.5 Performance
The DMS shall process the Get, GetNext, or Set request in accordance with all of the rules of NTCIP 1103 v02, including updating the value in the database and initiating the transmission of the appropriate response (assuming that the DMS has permission to transmit) within 1 second of receiving the last byte of the request.

5. Coordination Requirements

- Include statement to use standardized design solutions, as specified in the project RTM

- Include a completed copy of the PRL plus the RTM as a source for the design of the system and the test plan

- Specify coordination needs with:

  - Vendors/developers/maintenance staff

Compliance and Conformance Requirements

Conformance Versus Compliance

- **Conformance:** Meets a specified standard

  - To claim "Conformance" to NTCIP 1203 v03, the vendor shall minimally satisfy the **mandatory** requirements selected

  - Vendors that provide additional features beyond the completed PRL are still conformant as long as they conform with the requirements of NTCIP 1203 v03 and its normative references

- **Compliance:** Meets an agency specification

Backward Compatibility Issues

Backward Compatibility Issues

- NTCIP 1203 v03 standard has made adjustments in defining objects to provide functionality consistency with v01/v02

- Interoperability may be an issue in some legacy-based central systems that used v01 and v02 interfaces

- Use PRL last column
  to indicate compatibility needs

ADDITIONAL PROJECT REQUIREMENTS

associated objects were deprecated and replaced by newer objects that have a wider scope or that have been changed to ease implementation.
Pay close attention to the implementation and interoperability of these objects.

Place a checkmark below, if the DMS is NOT required to support the major version that is checked."
Version v01_____
Version v02_____

Specifying Requirements Not Covered by the Standard (Extensions)

Support for Extensions

- The NTCIP standards support extensions

  - For user needs not supported by the standard:

    - May result in user-specific requirements

    - Specification must include the **dialogs and objects** to fulfill the user-specific requirements

    - Specification May NOT define **new dialogs or objects** for requirements **already supported** by the standard

- **Benefits:** Allows procurers to use the NTCIP family of standards to meet operational needs

Drawbacks/Consequences

- Interoperability may be compromised

  - Other management stations that do not support the new objects will be **unable to exercise** the new capabilities

  - If the agency is **not consistent** on defining how the requirement is fulfilled for all DMSs, interoperability cannot be achieved

  - Other agencies with the same requirement must have the same design if **sharing control** of devices

- Test plans need to be expanded to support the new requirements

- Additional costs

Specifying Requirements Not Covered by the Standard (Extensions)

Rules for Extensions

1. Dialog definitions and particularly object definitions must follow the **same configuration** as contained in the standard for those dialogs and object definitions contained in it

2. Dialogs and object definitions are NOT allowed to be **redefined** or replaced

3. All extended work must be **published** to other parties affected by the DMS operations

ACTIVITY

Question

Which of the following is a <u>FALSE</u> statement related to a DMS specification?

Answer Choices

a) Specification includes PRL-identified user needs

b) Project RTM provides project-based design content

c) To achieve interoperability either PRL or RTM is required

d) Extended standard is not conformant to the DMS standard

Review of Answers

a) Specification includes PRL-identified user needs.

Incorrect answer. The statement is true. PRL must be in every DMS specification because it has user needs and requirements.

b) Project RTM provides project-based design content.

Incorrect answer. The statement is true. RTM is the complete source of DMS design content.

c) To achieve interoperability either PRL or RTM is required.

Correct! The statement is only <u>False</u>. To ensure interoperability, we need both PRL and RTM and SNMP in specification.

d) Extended standard is not conformant to the DMS standard.

Incorrect answer. The statement is true. Vendor-specific design will not be conformant to the standard, even with properly done extensions.

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Module Summary

Briefly Review the **Structure** of the DMS Standard

Explain the **Purpose** of a Requirements Traceability Matrix (RTM) and Its Benefits

Prepare a **Project-Level RTM** with Standard-Supplied Requirements and Design Content (Concepts)

Prepare a DMS Specification (**Checklist**)

We Have Now Completed A311a and A311b in the DMS Curriculum

Module A311a: Understanding **User Needs** for DMS Systems based on NTCIP 1203 Standard v03

Module A311b: Specifying **Requirements** for DMS Systems based on NTCIP 1203 Standard v03

Module T311: Applying Your **Test Plan** to the NTCIP 1203 v03 DMS Standard

Next Course Module

Module T311: Applying Your Test Plan to the NTCIP 1203 v03 DMS Standard

Concepts taught in next module (Learning Objectives):

1) Describe within the context of a testing lifecycle the **role of a test plan** and the testing to be undertaken for DMS

2) Identify the **key elements** of NTCIP 1203 v03 relevant to the test plan

3) Describe the **application** of a good test plan to a DMS system being procured

4) Describe a **process** of adapting a test plan based on the selected user needs and requirements

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!

U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology