Welcome

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

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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 (NOT covered by NTCIP)
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
Structure of Standard Information Needed to Prepare a DMS Specification

NTCIP 1203 v03, Part 1

- 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

3.5.2.3.3.3 Define a Message

The DMS shall allow a management station to download a message for storage in the sign controller’s message library.
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
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
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.
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
Data Exchange Requirements (Section 3.5)

- **3.5.1 Managing Configuration**
  - Identify DMS – sign type and technology

- **3.5.1.1 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
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

The DMS shall allow a management station to determine the maximum length for a downloadable message.
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
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.

- 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
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.

If an event is known in advance, a message can be scheduled to run between a set time and date.
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
Monitor the Status of the Current Message

TMC

Source: NYCDOT-WSDOT

DMS Controller

Management Station

TMC Work Station Display Confirms the Message

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

These include:
- Light Sensor readings
- Temp Sensor readings
- Power Supply Pass/Fail readings
- Pixel/Lamp Tests
- Test Messages
- Comm. Failure messages
- Beacon Status
- Fan Status

Source: WSDOT
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?
3.6 Supplemental non-communications Requirements

3.6.1 Supplemental Requirements for Fonts.

3.6.2 Supplemental Requirements for General Illumination Brightness.

3.6.3 Supplemental Requirements for Automatic Brightness Control.

3.6.4 Supplemental Requirements for Control Modes.

3.6.5 Supplemental Requirements for Message Activation Request.

3.6.6 Supplemental Requirements for Message Definition.

3.6.7 Supplemental Requirements for Locally Stored Messages.

3.6.8 Supplemental Requirements for Color Scheme.

3.6.9 Supplemental Requirements for Monitoring Subsystems.

3.6.10 Supplemental Requirements for Scheduling.

3.6.11 Supplemental Requirements for Graphics.

3.6.12 Supplemental Requirements for Page Justification.

3.6.13 Supplemental Requirements for Line Justification.
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.

<table>
<thead>
<tr>
<th>Req ID</th>
<th>Requirement</th>
<th>Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
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<td>3.6.1</td>
<td>Supplemental Requirements for Fonts</td>
<td>Support for a Number of Fonts</td>
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<td>Yes</td>
<td>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.</td>
</tr>
</tbody>
</table>
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
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
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
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.

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

<table>
<thead>
<tr>
<th>USER NEED SECTION NUMBER</th>
<th>USER NEED</th>
<th>USER SECTION NUMBER</th>
<th>FR SECTION NUMBER</th>
<th>FUNCTIONAL REQUIREMENT</th>
<th>CONFORMANCE</th>
<th>SUPPORT / PROJECT REQUIREMENT</th>
<th>ADDITIONAL PROJECT REQUIREMENTS</th>
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<td>Determine the DMS Identity</td>
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<td>O</td>
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<td>M</td>
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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.

<table>
<thead>
<tr>
<th>FR Section Number</th>
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<th>Object Section Number</th>
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</tbody>
</table>

NTCIP 1203 v03 Annex A, Page 233
Determine Sign Type and Technology” is traced to dialog G.1 and associated design objects – 5.2.2 and 5.2.3
What Is an RTM?

Value of Design Content Provided by the RTM

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

- 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 Table

<table>
<thead>
<tr>
<th>FR ID</th>
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<td>5.2.9</td>
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</tr>
</tbody>
</table>

- 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

<table>
<thead>
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<td></td>
<td></td>
<td>5.2.9</td>
<td>dmsSignTechnology</td>
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</table>

- **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
### Single Message Dialogs: G.1, G.2, G.3

<table>
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<td></td>
<td>5.2.9</td>
<td>dmsSignTechnology</td>
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</table>

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

**Is it an LED, FLIP DISK, Fiber Optics?**
More Complicated Data Exchange Requires Specified Dialogs (Section 4)

Example: Activate a Message

<table>
<thead>
<tr>
<th>FR ID</th>
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<th>Object ID</th>
<th>Object Name</th>
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<td>4.2.3.1</td>
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</table>

- 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
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

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

Source: NYCDOT-Patel
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

- One National DMS Standard
- Supports Multiple Messages
- Multiple Applications

Travel Times on DMS Status

Total, as of October 30, 2015

- Orange = Provide Travel Times (76)
- Yellow = Plan to Provide Travel Times (8)

Accessed: 12/05/16

Source: WSDOT

Source: FHWA
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

<table>
<thead>
<tr>
<th>USER NEED SECTION NUMBER</th>
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<th>FR SECTION NUMBER</th>
<th>FUNCTIONAL REQUIREMENT</th>
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<td>Determine Device Component Information</td>
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<tr>
<td></td>
<td>3.5.1.2.1.1</td>
<td>Determine the Size of the Sign Face</td>
<td>M</td>
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</tbody>
</table>

See Student Supplement for Module A311a for a Project PRL Example
Complete Project RTM with Entries (Populating Table) for Dialogs/Design Concepts

RTM Provides the Design for Each Supported Requirement

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</tbody>
</table>
### Examples of RTM

#### Message Display Capabilities - Manage Configuration (3.5.1)

<table>
<thead>
<tr>
<th>FR Section Number</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object Section Number</th>
<th>Object</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1.2.3</td>
<td>Determine VMS Message Display Capabilities</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>3.5.1.2.3.1</td>
<td>Determine Maximum Number of Pages</td>
<td>G.1</td>
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<td></td>
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<tr>
<td>3.5.1.2.3.2</td>
<td>Determine Maximum Message Length</td>
<td>G.1</td>
<td>5.5.24</td>
<td>dmsMaxNumberOfPages</td>
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<tr>
<td>3.5.1.2.3.3</td>
<td>Determine Supported Color Schemes</td>
<td>G.1</td>
<td>5.5.22</td>
<td>dmsColorScheme</td>
<td></td>
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<tr>
<td>3.5.1.2.3.3</td>
<td>Determine Message Display Capabilities</td>
<td>G.1</td>
<td>5.3.7</td>
<td>monochromeColor</td>
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<tr>
<td>3.5.1.2.3.4</td>
<td>Determine Message Display Capabilities</td>
<td>G.1</td>
<td>5.5.23</td>
<td>dmsSupportedMultiTags</td>
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<tr>
<td>3.5.1.2.4</td>
<td>Delete All Messages of a Message Type with One Command</td>
<td>G.3</td>
<td>5.7.16</td>
<td>dmsMemoryMgmt</td>
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</table>
### Examples of RTM

#### Display Capabilities Requirements Are Fulfilled

<table>
<thead>
<tr>
<th>FR Section Number</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object Section Number</th>
<th>Object</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1.2.3</td>
<td>Determine VMS Message Display Capabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.3.1</td>
<td>Determine Maximum Number of Pages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.3.2</td>
<td>Determine Maximum Message Length</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.3.3</td>
<td>Determine Supported Color Schemes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.4</td>
<td>Determine Message Display Capabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delete All Messages of a Message Type with One Command</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Image of software interface](image-url)
Examples of RTM

Reset the Sign Controller-Manage Control (3.5.2)

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)

<table>
<thead>
<tr>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object ID</th>
<th>Object Name</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.3</td>
<td>Monitor the Status of the DMS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3.5.3.1</td>
<td>Perform Diagnostics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.3.1.1</td>
<td>Test Operational Status of DMS Components</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3.5.3.1.1.1</td>
<td>Execute Lamp Testing</td>
<td>4.2.4.1</td>
<td>5.11.2.5.3</td>
<td>lampTestActivation</td>
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<tr>
<td>3.5.3.1.1.2</td>
<td>Activate Pixel Testing</td>
<td>4.2.4.2</td>
<td>5.11.2.4.3</td>
<td>pixelTestActivation</td>
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</tbody>
</table>

### Module/Driver Failure

- **BAD WEATHER CONDITIONS**
- **SLC**
Examples of RTM

Monitor Status-Manage Control (3.5.3)

<table>
<thead>
<tr>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object ID</th>
<th>Object Name</th>
<th>Additional Specifications</th>
</tr>
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<tbody>
<tr>
<td>3.5.3.1.3.10</td>
<td>Monitor Door Status</td>
<td>G.1</td>
<td>5.11.2.6.2</td>
<td>dmsDrumNumRows</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5.11.1.6</td>
<td>dmsStatDoorOpen</td>
<td></td>
</tr>
</tbody>
</table>

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.
Examples of RTM

Monitor Current Status of a Message-Manage Control

<table>
<thead>
<tr>
<th>FR Section Number</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object Section Number</th>
<th>Object</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.3.2</td>
<td>Monitor the Current Message</td>
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<tr>
<td>3.5.3.2.1</td>
<td>Monitor Information about the Currently Displayed Message</td>
<td>4.2.4.14</td>
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<tr>
<td>5.8.5</td>
<td>dmsIllumBrightLevelStatus</td>
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<td>5.8.9</td>
<td>dmsIllumLightOutputStatus</td>
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<tr>
<td>5.6.8.1</td>
<td>dmsMessageMemoryType</td>
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<td></td>
<td></td>
<td>Value of ‘5’ only</td>
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<tr>
<td>5.6.8.2</td>
<td>dmsMessageNumber</td>
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<td></td>
<td></td>
<td>Value of ‘1’ only</td>
</tr>
</tbody>
</table>

Monitoring the Status of the DMS

Source: NYC DOT

Monitor the Current Message

Source Credit: Skyline

TMC Work Station Display

Source: Skyline

Example
### Examples of RTM

#### Architectural Requirements (3.4.2)

<table>
<thead>
<tr>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Dialog ID</th>
<th>Object ID</th>
<th>Object Name</th>
<th>Additional Specifications</th>
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<tbody>
<tr>
<td>3.4.2.3</td>
<td>Retrieve Logged Data</td>
<td>H.3.1.3</td>
<td>1103 v02 A.7.3.5</td>
<td>eventClassNumRowsInLog</td>
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<td>1103 v02 A.7.3.6</td>
<td>eventClassNumEvents</td>
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<td>1103 v02 A.7.7.1</td>
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<td>1103 v02 A.7.7.2</td>
<td>eventLogNumber</td>
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<td>1103 v02 A.7.7.3</td>
<td>eventLogID</td>
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<td>1103 v02 A.7.7.4</td>
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<td>1103 v02 A.7.7.5</td>
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<td>3.4.2.4</td>
<td>Clear Log</td>
<td>G.3</td>
<td>1103 v02 A.7.3.3</td>
<td>eventClassClearTime</td>
<td></td>
</tr>
</tbody>
</table>

#### 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.

  ![Logged-Data retrieval](source:NyCDot)

  - Controller door was opened at 2 am
  - Power on at 3:15 am
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)
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
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
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
Integrate PRL and RTM into a Specification: Interoperability–Coordination Needs

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

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

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.
Integrate PRL and RTM into a Specification: Interoperability—Coordination Needs

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
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

- 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___
```
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
Specifying Requirements Not Covered by the Standard (Extensions)

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
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.
Which of the following is a FALSE 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
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 False. 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.
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!