Appendix J

New York State ITS Standards Specification Development Guide

Example New York State ITS Project

Dynamic Message Sign (DMS)

Information Level

NTCIP Communications Specification

Prepared for

New York State Department of Transportation

Prepared by

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Table of Contents

Revision History

Filename	Version	Date	Author	Comment
NYStateSpecGuide-ApJ.doc	0.1	10/08/06	P. Chan / M. Insignares	Initial Draft
NYStateSpecGuide-ApJ.doc	0.3	11/22/06	P. Chan / M. Insignares	Updated formatting of appendices in standards specification guide.
NYStateSpecGuide-ApJ.doc	0.4	1/16/07	P. Chan / M. Insignares	Updated specification to reflect V2 of the NTCIP 1203 DMS specification.

1 Introduction

1.1 Project Background

The New York State Department of Transportation (NYSDOT) has initiate a project to deploy an end-to-end communications system to improve transportation information dissemination to motorist and neighboring agencies. This deployment will result in the expansion of the NYSDOT ITS program, and work towards the deployment of transportation operations communications network.

This (Draft) NY State Dynamic Message Sign NTCIP Communications Specification has been developed through the consensus input of regional stakeholders to standardize the communication interfaces of DMS. Only the DMS interface (the way the sign communicates with a traffic management center) is being standardized, the DMS firmware and software, design, algorithms and methodologies that implement the interface, provided by numerous system integrators and vendors, are not covered by this specification.

1.2 Specification Development Approach

Following a Systems Engineering Methodology, a user-needs assessment and concept of operations (ConOps) were developed. Based on the ConOps, functional requirements and stakeholder agreement were developed. The figure below shows the application of the 'VEE' model to the development of the NY State C2C Interface Specification Development.
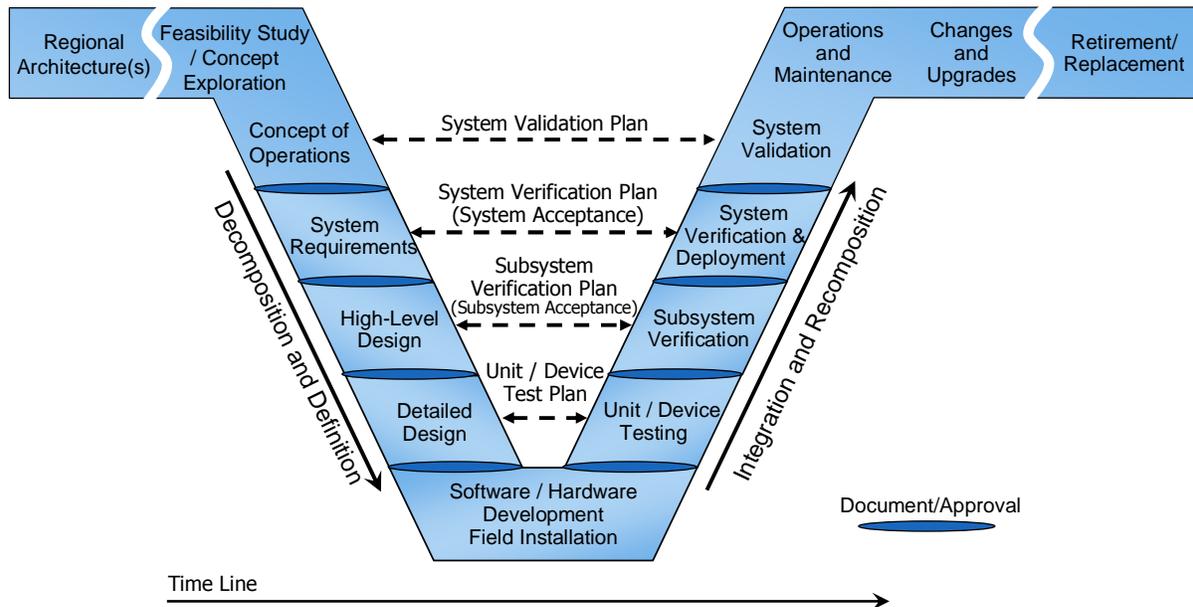
The system functional requirements for NY State DMS (Dynamic Message Sign) System are the basis for development of this technical specification.

Stepping from problem (requirements) to solution (design) a requirements traceability matrix (RTM) was developed to document how the analysis of requirements translates to the project-specific design of center interfaces.

1.3 Document Organization

This document is comprised of five Sections and three Appendices.

- Section 1 - Introduction. This section provides an overview of the document and introductory material.
- Section 2 - General Requirements. Contains a list of references to other documents, a conformance statement, and a glossary of terms.

2 DMS Specification Operations Plan

This document section contains detailed operational and functional specification for the Dynamic Message Sign (DMS) to be installed as part of this project.

The intent of this document is to present:

- the functions and capabilities available by the DMS to be procured by this project

- a discussion on how the DMS is envisioned to be controlled and monitored from the ATMS software, and

- the functions and capabilities accessible from the manufacturer-provided software

The document describes the behavior of the DMS under the various modes and conditions that the signs may experience. This concepts described in this document will be used to develop the Technical Specification for the DMS, to define the objects and ranges for the NTCIP standard, and to determine the test procedures for the DMS.

Variables that can be changed are provided in *italics*. These variables were selected based on the consultant's understanding from the Standards workshop conducted on *MM/DD/YYYY,* or are the consultant's recommendation. These values can be changed prior to completion of the Technical Specification. Variables are that require further discussion or a decision by the agency(ies) are in ***bold italics***. When reviewing this Concept of Operations, ASSUME that if the capability is NOT explicitly mentioned in this document, that the feature is not a requirement.

2.1 Normal Operations

2.1.1 Default Messages

Several default messages will be stored on the DMS Controller. These messages will be stored in non-volatile memory. These default messages can be changed using the manufacturer-provided software.

2.1.2 Sign Display Behavior After Bootup

When the DMS is first powered on, the DMS face shall remain blank during the power-up and boot-up cycle. Once the boot-up cycle is complete, the DMS will display a default message until a message is commanded.

The default message to be displayed can be a blank message, a specific defined message, or the last message commanded before the DMS was shut down. Note that a different default message may be displayed if the DMS controller was shut down due to a controller software reset command or a momentary power loss (see below). The duration of time which constitutes a momentary power loss is user-defined.

The default message to be displayed after a DMS Bootup is currently a ***blank*** message.

2.1.3   Sign Display After a Momentary Power Loss

If the elapsed time is less than the defined time duration, for example, one second, the DMS can be configured to display a default message. The default message to be displayed can be a blank message, a specific defined message, or the last message commanded before the DMS momentarily lost power.

The current default message to be displayed after a Momentary Power Loss shall remain the *current* message, and the defined time duration shall be *1 second*. The assumption is that if the DMS momentarily loses electrical power for less than 1 second, the message should not change from what is currently displayed before the momentary power loss.

2.1.4   Sign Display Behavior During Communications Loss

This parameter defines what message should be displayed on the DMS if the DMS controller has not received a valid poll from any source for a defined time period. The message to be displayed can be a blank message, the current message, or a specific defined message. This parameter does not apply if the DMS is in Local Mode.

A determinant of the defined time period will be how often the ATMS software polls the DMS. If the polling period is one hour (dialup modem), the defined time period should be longer than 1 hour, say, 121 minutes (2 hours, or 2 polling periods, + 1 minute). If the polling period is 15 minutes (direct-connect), the defined time period may be 46 minutes (45 minutes, or 3 polling periods, + 1 minute).

Assuming a *direct connection*, the DMS will be set to display *a blank message* is no valid communications with the AGENCY STATEWIDE TOC is detected within *46 minutes*. Once valid communications is received, the DMS will display the same message (in this case, the *blank message)* until a new message is commanded.

2.1.5   Sign Display After End Duration

Messages on the DMS can be activated for a fixed duration, either from a scheduler or manually (e.g., Display Message X for 30 minutes). If a message ends, and no other message has been assigned to replace the message, the DMS will display *a blank message*. The DMS will continue to display this message until a valid message is commanded.

2.1.6   Sign Display After Controller Reset

If the controller is reset (software), the DMS can be set to display a specific message after the reset. *This parameter is optional* and assumes that the DMS controller can differentiate between a power loss and controller reset. The default message to be displayed can be a blank message, a specific defined message, the last message commanded before the DMS was reset. The current default message to be displayed after a Controller Reset should be a *blank message*. The DMS will continue to display this message until a valid message is commanded.

ATMS Software
Under normal conditions, the DMS will be monitored and controlled from the AGENCY Operations Center, using the ATMS software.

The ATMS software provides the following functions:

- polls the DMS for operational status (errors) and checks the current message on a periodic basis (currently once per hour)

- selects a message to display from the center's library on the DMS based on current traffic conditions and incidents (subject to operator approval)

- once a message has been selected for display, the software downloads the message to the DMS and activates the message.

2.1.7 Polling

The ATMS software polls each DMS on a periodic basis for operational status and verifies the message currently displayed. The periodic basis is adjustable (by communications channel) and is currently set for once per hour. The one-hour period was selected because the communications media for a majority of the DMSs operated and monitored by AGENCY is on dial-up telephone lines. For DMSs that uses direct-connect serial lines for communications, such as optical fiber, a shorter polling period may be programmed, such as 15 minutes.

The ATMS software will poll each DMS for operational status, such as pixel failures, photocell failures, message failures, fan failures, module failures and communications failures. Certain types of failures are deemed to be severe, such as module failures and communication failures. If a severe failure is detected, the GUI will turn that DMS icon red.

The ATMS software cannot diagnose the severity, number, or exact location of any failure. For example, the ATMS software will note a pixel failure in its event logs, but cannot determine how many pixels or which pixels have failed.

The ATMS software will also verify the message being displayed. If the message currently displayed on the DMS does not match what the ATMS software believes it should be, the GUI will turn that DMS icon red.

2.1.7.1 Selecting Messages

The ATMS software suggests a message for display on each DMS from its central library based on current traffic conditions and any detected incidents. Operators must approve the suggested message before the command to display that message is sent to the DMS. Operators may also manually select a message from the central library to display on a DMS. The ATMS software assigns priorities to operators, so messages sent by an operator with a higher priority will "override" messages commanded by an operator with a lower priority.

The ATMS software provides tools for adding and editing messages in the central library. Users may create new messages that are to be displayed on the sign from the workstation. Messages may be text only and will support the basic ASCII character set (ASCII 30-126, inclusive), which includes all the characters on the full keyboard set. All messages are checked by the ATMS software for allowable words and that the message will fit on the DMS display (e.g., a 21-character line message on a DMS display that can only fit 20 characters per line).

Only one font is currently available for each DMS. The ATMS software can support multiple fonts for a DMS, but requires configuring the software.

The ATMS software currently limits all messages to two phases, but the limit can be adjusted. Each phase can be programmed with a different page duration (amount of time the phase appears before displaying the next phase). Each phase will be displayed for the user-defined duration before the next phase is displayed. Once all the phase has been displayed, phase 1 will be displayed again. The default page duration is *2.0 seconds.*

The ATMS software also defaults all messages to be center justified, both horizontal (left, center, right justify) and vertical (top, center, bottom).

2.1.8   Activate Messages

Upon an operator commanding a message to be displayed on a DMS, the ATMS software will download the message to the DMS controller, followed by a command to activate that message. The ATMS software downloads every commanded message to the exact same message table slot in the DMS controller and with the same priority. No other messages other than the commanded message are downloaded to the DMS controller. Thus, the "old" commanded message is always overwritten with the "new" commanded message.

2.2   Exception Operations

ATMS Software
Normally, the DMS will be monitored and controlled from the ATMS software at the AGENCY STATEWIDE TOC. On occasion, situations may occur that requires control of the DMS be transferred to some other party or software. These situations may include:

- For maintenance purposes – use of the manufacturer-provided software at the AGENCY STATEWIDE TOC or a laptop at DMS controller

- For emergency use, such as communications loss from AGENCY STATEWIDE TOC – use of the manufacturer-provided software at some other location, e.g., AGENCY, and through a dialup modem

It is expected that when control of the DMS is transferred from the ATMS software at the AGENCY STATEWIDE TOC to some other party or software, that proper operating procedures will be followed. This includes properly informing the AGENCY STATEWIDE TOC that the transfer of control is about to take effect, and when transfer of control is to be returned.

2.3   Control Modes

The DMS has three (3) modes of operation, Central, Local and Central Override. The mode of operation determines the source that the sign will accept commands from.

2.3.1   Central Mode

In Central mode, the DMS sign will display only those messages that originate through the CENTRAL communications port at the DMS controller. Commands through the CENTRAL

communications port will normally be from the ATMS software. However, it may also originate from the manufacturer-supplied software installed at the AGENCY STATEWIDE TOC. The DMS will normally operate in Central mode.

2.3.2   Local Mode

In Local mode, the DMS will display only those messages that are commanded through the LAPTOP communications port at the DMS controller. For maintenance purposes, the LAPTOP port may instead be connected to a laptop computer for monitoring, testing or maintenance purposes.

With the manufacturer-supplied software through the LAPTOP port, the laptop computer or AGENCY can perform diagnostics and monitor the operations of the DMS while the DMS is still in Central Mode.

However, the laptop computer or AGENCY can command the DMS into Local Mode, therefore taking control of the DMS, including commanding new messages and locking out control of the DMS from the AGENCY STATEWIDE TOC. This may be beneficial for testing the DMS on-site, if communications with the AGENCY STATEWIDE TOC is lost, or if the local user is aware of a field condition that may be temporary or the TMC is unaware of.

2.3.3   Central Override Mode

When a DMS is in Local mode, whether via a dialup modem or a local user, the user will normally release control of the DMS back to Central mode either by operating a switch or button at the DMS Controller, or by sending a command from the manufacturer-provided software. **While the DMS is in Local Mode, the Central (TMC) cannot control the DMS Sign!** The computer controlling the DMS via the LAPTOP port **MUST** release the computer back to Central Mode.

Unfortunately, the user may forget to release the sign from Local Mode when their work is complete. Thus, it may be necessary to send a Central Override command from the ATMS software or the manufacturer-provided software at the AGENCY STATEWIDE TOC. The DMS will then transition from Local Mode, temporarily to Central Override Mode, then back to Central Mode. (Note: verify that the ATMS software supports Central Override).

2.4   Monitoring

2.4.1   Monitoring Status

Regardless of which control mode the DMS sign is in, any computer connected to the CENTRAL communications port or the LAPTOP communications port, will be able to monitor the status of the DMS, whether using the ATMS software, or the manufacturer-provided software.

Monitoring the status of the DMS includes determining what message is currently displayed, and the source of the message. Monitoring also includes reporting error status of the DMS sign.

Errors reported include communications error, power error, photocell error, pixel error, message error, and controller error.

2.4.2   Event History

The DMS controller maintains an event history file. The event history file contains entries to indicate dates and times of any events or failures that occur. These events and failures include communications loss, sign doors opening, changes (and source) in the sign display. The Event History file can maintain a minimum of 256 entries. The Event History can be accessed using the manufacturer-provided software.

2.4.3   Diagnostics

There are several diagnostics and monitoring tools that will be provided with the DMS sign and can be accessed with the manufacturer-provided software. Diagnostic tools include:

- Specifically indicate what pixels are working and what pixels are not. Pixel testing of each pixel can also be commanded using the manufacturer-provided software. *Note: pixel exercises or pixel testing can be scheduled on a daily basis, but will require the scheduler functions*

- Controller resets (soft). This command will only restart the operating system and controller software.

- *Manually control brightness* of the DMS or to change the histeresis (algorithm for determining brightness based on the photocells).

- Fan tests

Monitoring tools include determining the temperature (control cabinet, sign housing, ambient temperature), and the status of the power supplies, communications, fans, photocells, and other equipment at the sign.

3 NTCIP Communications Specification

This portion of the specification defines the functional requirements and the detailed NTCIP requirements for the Dynamic Message Sign.

3.1 General NTCIP Requirements

3.1.1 Definitions

The following terms shall apply within the scope of this procurement specifications.

- Full, Standardized Object Range – Support for, and proper implementation of, all valid values of an object as defined within the object's OBJECT-TYPE macro in the subject NTCIP standard.

- Management System – A management system used to control a DMS. This includes any laptop software used for field control as well as the central control software.

- Dynamic Message Sign System – A Dynamic Message Sign, including the sign housing, the DMS controller, and the Management System.

3.1.2 References

The Dynamic Message Sign (DMS) System shall use NTCIP as its means of communications. The implementation of NTCIP for this DMS System shall conform to the following standards and versions:

- NTCIP 1201 – Global Objects Definition – NTCIP 1201:1996, version 01.10, including Amendment 1.

- NTCIP 1203 – Object Definitions for DMS – Version 1, with Amendment 1

- NTCIP 2101 - Point-to-Multi-Point Protocol over RS–232 Subnetwork Profile (SP-PMPP) – Version 2101:2001, dated November 26, 2001.

- NTCIP 2201 – NTCIP TP - Transportation Transport Profile (formerly TP-Null)

- NTCIP 2202 – NTCIP TP - Internet (TCP/IP and UDP/IP) Transport Profile (formerly TP-INTERNET)

- NTCIP 2301- Simple Transportation Management Framework (STMF) Application Profile

3.1.3 Conformance

To claim conformance with the above referenced standards, the implementation of NTCIP for the DMS System shall satisfy the mandatory requirements and objects as identified in the referenced standards.

Optional objects and requirements in the referenced standard(s) needed to satisfy a functional requirement in the Technical Specification, shall be conformant with the appropriate standard, and any standards it references (e.g., NTCIP 1201 and 1203).

3.1.4   Property Rights

If additional objects beyond the referenced standards are needed to support functionality required by this specification, the vendor shall inform the AGENCY, in writing and before factory acceptance testing, and clearly document the proposed object(s) including how the object is used, and all variables. The AGENCY must approval, in writing, each proposed additional object(s) prior to the Factory Acceptance Test. For any additional object(s) approved by the AGENCY, the AGENCY and its authorized parties shall have unlimited use of the object and all related documentation, at the time initially or in the future. This use of these objects and documentation shall extend to any systems integration purposes, regardless of what parties are involved.

3.2   Physical Features

3.2.1   Type of Sign

The Dynamic Message Sign shall be capable of displaying 3 lines of *460-mm* (18-inch) character text, and shall use LED technology. Each line shall be capable of displaying a minimum of 21 characters, 5-pixels wide per character, with 3 pixel spacing between characters.

The DMS will be a walk-in sign. It shall be possible for a maintainer to perform all maintenance on the sign, such as replacement of LEDs, display boards, environmental controls, etc…, within the walk-in enclosure.

3.2.2   LEDs

The DMS will be a single color sign, *amber*, with a peak wavelength of *590* mm ± *2* mm. All LEDs shall have a viewing angle of at least *23*˚ from the center axis or greater on the horizontal axis, but no greater than *30*˚. All LEDs shall have a half-angle of ±*y*˚ from the center axis or greater on the vertical axis. The currents through an LED shall be limited to the manufacturer's recommendation under any condition.

3.2.3   Communications Ports

The DMS shall have a minimum of 2 ports for communications at the DMS controller.

One communications port shall be a serial EIA-232C port, labeled *CENTRAL,* and shall have a DB-9 connector configured as a DCE for communications with the AGENCY STATEWIDE TOC. It is the intent of the AGENCY to install an optical fiber network from the DMS for communications to the AGENCY STATEWIDE TOC.

A second communications port shall be a serial EIA-232C port, labeled *LAPTOP,* and shall have a DB-9 connector configured for communications with a portable maintenance computer, or to a dialup telephone modem.

Both communications port shall be capable NTCIP 2103 over a null-modem connection. Each port shall be able to communicate at the NTCIP 2103 mandatory bit rates as well as the optional bit rates of 28800, 38400, 57600, and 115200 bps. Each port shall minimally support NTCIP 2101 bit rates of 1200, 2400, 4800, and 9600 bps.

The physical layer shall conform to the EIA 232 interface defined in NEMA 3.2.1.1 and support the following command sets:

- Hayes AT - command set

- MNP5

- MNP10

- V.42bis

3.2.4 Fonts

All fonts for the DMS will be single stroke fonts, and 5x7 characters. Two permanent fonts will be provided with the DMS.

Font 1 shall a font to be supplied by the AGENCY. This shall be the default font.

Font 2 shall be a Standard font, as defined in Section 5.6 in the draft NEMA Standards Publication TS 4-2004, Draft –V1.30b, dated February 9. 2004.

The DMS shall be capable of supporting two additional downloadable fonts. These fonts can be created and downloaded to the DMS through the manufacturer-provided software.

3.2.5 Photosensors

The DMS sign contains 3 photosensors to measure ambient lighting around the DMS sign. The DMS controller will utilize stored tables or curves combine the readings into a single 'suggested light level'. The photosensors will be used to automatically set the brightness of the LEDs on the face of the DMS sign. The histeresis for determining the brightness values will be documented by the manufacturer and provided to the AGENCY.

4 Protocol Implementation Conformance Specification

The information in this section is based on Protocol Performance List (PRL) table contained in the NTCIP 1203 specification and identifies required features for the DMS System for this project. The DMS System shall support all of the requirements, dialogs, interfaces and object definition listed in this table. The column, Project Requirement, indicates the default value for the appropriate NTCIP object(s) supported by the functional requirement, or the minimum range that the NTCIP object(s) are required to support.

{ONLY A SUBSET OF THE PRL IS SHOWN IN THIS EXAMPLE}

The appropriate NTCIP object(s) to support these functional requirements shall be required. Unless it is stated otherwise, each appropriate, required object shall support the Full Standardized Object Range (FSOR) as defined by the standard.

4.1 Protocol Implementation Conformance Specification and Requirements

The table below is based on section 3.2.3 Protocol Requirements List (PRL) of the NTCIP 1203 v02.27, which contains a traceability of user needs to requirements. *{The information in this appendix represents only an example (partial) PRL}.*

4.1.1 Protocol Implementation Conformance Specification (PICS)

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.4.2	**Control the DMS**			**M**	**Yes**	
2.4.2.3	Control the Sign Face			M	Yes	
2.4.2.3.1	Activate and Display a Message			M	Yes	
		3.4.2.3.1	Activate a Message	M	Yes	
		3.4.2.3.10.5	Retrieve a Message	M	Yes	
		3.5.5	Supplemental Requirements for Message Activation Request	M	Yes	
		3.5.7	Supplemental Requirements for Locally Stored Messages	M	Yes	

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.4.3	**Monitor the Status of the DMS**			**M**	**Yes**	
2.4.3.2	Monitor the Current Message			M	Yes	
		3.4.3.2.1	Monitor Information about the Currently Displayed Message	M	Yes	

4.2 Functional Requirements

3.4.2.3.1 Activate a Message

The DMS shall allow a management station to display a message on the sign face, including:

1. Any permanent message supported by the sign

2. Any previously defined message

3. A blank message of any run-time priority

4. A message based on the scheduling logic, if a scheduler is supported by the sign.

3.4.2.3.3.5 Retrieve Message

The DMS shall allow a management station to upload any message definition from the sign contoller.

3.5.5 Supplemental Requirements for Message Activation Request

Supplemental requirements for activating a message for display on the sign face based on an external request are provided in the following subclauses.

3.5.5.1 Supplemental Requirements for Internal or External Message Activation

Supplemental requirements for activating a message for display on the sign face (whether generated by an internal or external request) are provided in the following subclauses.

3.5.5.1.1 Activate Any Message

The DMS shall allow the activation of any valid message that is stored in the sign controller.

3.5.5.1.2 Preserve Message Integrity

The DMS shall prohibit the display of a message that uses memory objects such as fonts or graphics that were altered after the message was composed and saved within the sign's local message library.

3.5.5.1.3 Ensure Proper Message Content

The DMS shall ensure that the contents of the message are the same as what the requester requests.

3.5.5.2 Indicate Message Display Duration

Each message activation shall be associated with a duration for the sign controller to display the

message. If the request is validated, the DMS shall display the associated message for the indicated duration.

3.5.5.3 Indicate Message Display Requester ID

Each message activation shall be associated with an indication of the entity that requested the display. The DMS shall store this information while the message is displayed.

3.5.5.4 Supplemental Requirements for Message Activation Priority

The DMS shall only activate the newly requested message if the activation priority is higher than the runtime

priority of the currently displayed message.

3.5.7 Supplemental Requirements for Locally Stored Messages

Supplemental requirements for storing local messages are provided in the following subclauses.

3.5.7.1 Support Permanent Messages

The DMS shall support the permanent message(s) as defined by the specification. If the procurement specification does not define the permanent messages, the DMS shall support at least one permanent message that can be used for testing the sign operation.

NOTE: A procurement specification should specify the minimum number of permanent messages that the DMS is required to support and their details (e.g., identification number, MULTI string including MULTI tags, beacon status, etc.).

3.5.7.2 Support Changeable Messages

The DMS shall support the number of changeable messages and amount of changeable memory as defined by the specification. If the specification does not define the number of changeable messages, the DMS shall support at least one changeable message. If the specification does not define the amount of changeable memory, the DMS shall support an amount of changeable memory that is at least the product of the number of messages multiplied by 100 bytes.

3.5.7.3 Support Volatile Messages

The DMS shall support the number of volatile messages and amount of volatile memory as defined by the specification. If the specification does not define the number of volatile messages, the DMS shall support

at least one volatile message. If the specification does not define the amount of volatile memory, the DMS shall support an amount of volatile memory that is at least the product of the number of volatile messages multiplied by 100 bytes.

Unless otherwise specified in a specification, the DMS may fulfill the requirements of this clause by providing additional changeable messages and additional changeable memory. If the DMS implements this option, the total number of changeable messages supported by the DMS shall be at least the sum of the required changeable messages and the required volatile messages; likewise, the total changeable memory supported by the DMS shall be at least the sum of the required changeable memory and the required volatile memory.

Note: Refer to the Glossary of Terms for the definition of Volatile Messages.

3.4.3.2.1 Monitor Information about the Currently Displayed Message

The DMS shall allow a management station to monitor details about the current message, including:

1. The message content

2. The stored message number used to activate the current message

3. The message display time remaining

4. The process or management station that activated the message

5. The current brightness level of the message, if brightness is supported by the DMS

6. The status of the beacons, if present

7. The status of pixel service, if supported by the DMS

4.2.1 Requirements Traceability Matrix

The table below is based on Appendix A Requirements Traceability Matrix (RTM) of the NTCIP 1203 v02.27, which contains a traceability of requirements to dialogs, interfaces, and objects. *{The information in this appendix represents only an example (partial) PRL}*.

FR ID	Functional Requirement	Interface ID	Interface	Dialog ID	Object ID	Object
3.4.2	**Control the DMS**					
3.4.2.3	Control the Sign Face					
3.4.2.3.1	Activate the Message			4.3.2.1		
		4.4.6.2.1	Message Activation Data	4.3.2.1		
				4.3.2.1	5.7.3	dmsActivateMessage
				4.3.2.1	5.7.17	dmsActivateMsgError
				4.3.2.1	5.7.26	dmsActivateErrorMsgCode
		4.4.6.2.3	MultiString Syntax Error Data	4.3.2.1		
				4.3.2.1	5.7.18	dmsMultiSyntaxError
				4.3.2.1	5.7.19	dmsMultiSyntaxErrorPosition
				4.3.2.1	5.7.20	dmsMultiOtherErrorDesctiption

FR ID	Functional Requirement	Interface ID	Interface	Dialog ID	Object ID	Object
3.4.3	**Monitor the Status of the DMS**					
3.4.3.2	Monitor the Current Message					
3.4.3.2.1	Monitor Information about the Currently Displayed Message			4.3.3.14		
		4.4.4.2.5	Illumination Status	4.3.3.14		
				4.3.3.14	5.8.5	dmsIllumBrightLevelStatus
				4.3.3.14	5.8.9	dmsIllumLightOutputStatus
		4.4.6.2.2.4.1	Message Identification	4.3.3.14		
				4.3.3.14	5.6.8.1	dmsMessageMemoryType
				4.3.3.14	5.6.8.2	dmsMessageNumber
		4.4.6.2.2.4.2	Basic Message Data	4.3.3.14		
				4.3.3.14	5.6.8.3	dmsMessageMultiString
				4.3.3.14	5.6.8.4	dmsMessageOwner
				4.3.3.14	5.6.8.8	dmsMessageRunTimePriority
		4.4.6.2.2.4.3	Pixel Service Flag	4.3.3.14		
				4.3.3.14	5.6.8.7	dmsMessagePixelService
		4.4.6.2.2.4.4	Beacon Flag	4.3.3.14		
				4.3.3.14	5.6.8.6	dmsMessageBeacon
		4.4.6.2.2.4.7	Message Name	4.3.3.14		

				4.3.3.14	5.6.8.10	dmsMessageName
		4.4.6.2.4	Current Message Information	4.3.3.14		
				4.3.3.14	5.7.4	dmsMessageTimeRemaining
				4.3.3.14	5.7.5	dmsMsgTableSource
				4.3.3.14	5.7.6	dmsMsgRequesterID
				4.3.3.14	5.7.7	dmsMsgSourceMode

4.3 Dialogs

The information below is based on Section 4 Dialogs of the NTCIP 1203 v02.27, which contains a description of the sequence of data communications exchanges, pre-conditions to the sequence (where applicable), and optionally a sequence diagram. *{The information in this appendix represents only an example (partial) PRL}.*

### 4.3.1 Dialog 4.3.2.1 Activate a Message

The standardized dialog for a management station to activate a message on the sign display shall be as follows:

1. (Precondition) The management station shall ensure that the desired message is supported by the DMS. This may entail downloading the desired message contents to the DMS. (See Clause 4.3.2.2)

2. The management station shall SET dmsActivateMessage.0 to the desired value. This will cause the controller to perform a consistency check on the message. (See Clause 4.4.6.4 for a description of this consistency check.)

NOTE: dmsActivateMessage.0 is a structure that contains the following information: message type (permanent, changeable, blank, etc.), message number, duration, activation priority, a CRC of the message contents, and a network address of the requester.

3. If the response indicates 'noError', the message has been activated and the management station shall GET shortErrorStatus.0 in order to ensure that there are no errors preventing the display of the message (e.g. a 'criticalTemperature' alarm). The management station may then exit the process.

4. If the response from Step 2 indicates an error, the message was not activated. The management station shall GET dmsActivateMsgError.0 and dmsActivateErrorMsgCode.0 to determine the type of error.

5. If dmsActivateMsgError equals 'syntaxMULTI' then the management station shall GET the following data to determine the error details:

a. dmsMultiSyntaxError.0

b. dmsMultiSyntaxErrorPosition.0

6. If dmsActivateMessageError equals "syntaxMULTI(8)" and dmsMultiSyntaxError equals "other(1)" then the management station shall GET dmsMultiOtherErrorDescription.0 to determine the vendor specific error.

This process is depicted in the figure below.
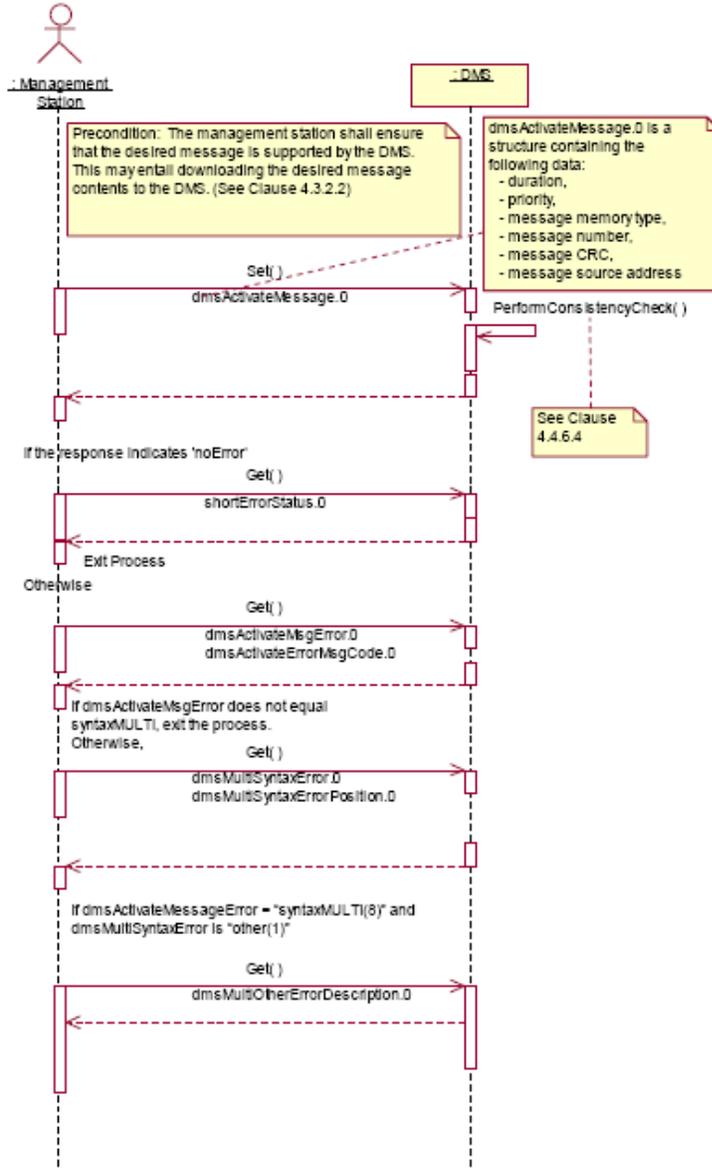
4.3.2   Dialog 4.3.3.14 Monitor the Current Message

1. The management station shall GET dmsMsgTableSource.0 to determine the message number,

message type, and message CRC of the currently displayed message.

2. The management station shall GET dmsMessageTimeRemaining.0.

3. The management station shall GET dmsMsgRequesterID.0 to determine the source address of

the controller that activated the currently displayed message.

4. The management station shall GET dmsMsgSourceMode.0 to determine the source from which

the message was generated (e.g., default message, communications port, scheduler, etc.).

5. The management station shall GET the following data:

a. dmsMessageMultiString.5.1

b. dmsMessageOwner.5.1

c. dmsMessageRunTimePriority.5.1

NOTE: Instance "5.1" is the currentBuffer row of the Message Table.

6. The management station shall GET dmsMesagePixelService.5.1.

NOTE: The response to this request may be a noSuchName error, indicating that the DMS does not support this optional feature. This error will not affect the sequence of this dialog, but the management station should be aware that the CRC will be calculated with this value defaulted to zero (0).

7. The management station shall GET dmsMessageBeacon.5.1.

NOTE: The response to this request may be a noSuchName error, indicating that the DMS does not support this optional feature. This error will not affect the sequence of this dialog, but the management station should be aware that the CRC will be calculated with this value defaulted to zero (0).

8. The management station shall GET dmsMessageName.5.1.

NOTE: The response to this request may be a noSuchName error, indicating that the DMS does not support this optional feature. This error will not affect the sequence of this dialog.

9. The management station shall GET the following data:

a. dmsIllumBrightLevelStatus.0

b. dmsIllumLightOutputStatus.0

4.4   DMS Object Definitions

The information below is based on Section 5 DMS Object Definitions of the NTCIP 1203 v02.27, which contains a description of the data content of a communications packet (also known as NTCIP Objects). *{The information in this appendix represents only an example (partial) PRL}.*

4.4.1   Object 5.6.8.1 Message Memory Type Parameter

dmsMessageMemoryType OBJECT-TYPE

SYNTAX INTEGER {

--other (1), -deprecated

permanent (2),

changeable (3),

volatile (4),

currentBuffer (5),

schedule (6),

blank (7)}

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates the memory-type used to store a message. Also provides access to current message (currentBuffer) and currently scheduled message (schedule). The rows associated with the 'currentBuffer', 'schedule', and 'blank' message types cannot be written into, because these are either filled in by the controller (currentBuffer and schedule) or predefined and not modifiable (blank).

The definitions of the enumerated values are:

other - any other type of memory type that is not listed within one of the values below, refer to device manual;

permanent - non-volatile and non-changeable;

changeable - non-volatile and changeable;

volatile - volatile and changeable;

currentBuffer - contains the information regarding the currently displayed message. Only one entry in the table can have the value of currentBuffer and the value of the dmsMessageNumber object shall be one (1). The content of the dmsMessageMultiString object shall be the currently displayed message (including a scheduled message), not the content of a failed message activation attempt;

schedule - this entry contains information regarding the currently scheduled message as determined by the time-base scheduler (if present). Only one entry in the table can have the value of 'schedule' and the value of dmsMessageNumber for this entry shall be 1. Displaying a message through this table row shall set the

dmsMsgSourceMode object value to 'timebasedScheduler'. When no message is currently active based upon the schedule or if the schedule currently does not point to any message within the message table, the schedule entry shall contain a copy of dmsMessageType 7 (blank) with a dmsMessageNumber value of 1.

blank - there shall be 255 (message numbers 1 through 255)

pre-defined, static rows with this message type. These rows are defined so that message codes (i.e., objects with SYNTAX of either MessageIDCode or MessageActivationCode) can blank the sign at a stated run-time priority. The run-time priority of the blank message is equal to the message number (i.e., blank message number 1 has a run time priority of 1 and so on). The dmsMessageCRC for all messages of this type shall be 0x0000 and the dmsMultiString shall be an OCTET STRING with a length of zero (0). The activation priority shall be determined from the activation priority of the MessageActivationCode.

<DescriptiveName>Message.memoryType:code

<DataConceptType>Data Element"

::= { dmsMessageEntry 1 }

4.4.2   5.6.8.2 Message Number Parameter

dmsMessageNumber OBJECT-TYPE

SYNTAX INTEGER (1..65535)

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Enumerated listing of row entries within the value of the primary index to this table (dmsMessageMemoryType -object). When the primary index is 'currentBuffer' or 'schedule', then this value must be one (1). When the primary index is 'blank', this value shall be from 1 through 255 and all compliant devices must support all 255 of these 'blank' rows.

<DescriptiveName>Message.number:identifier

<DataConceptType>Data Element"

::= { dmsMessageEntry 2 }

4.4.3   Object 5.6.8.3 Message MULTI String Parameter

dmsMessageMultiString OBJECT-TYPE

SYNTAX OCTET STRING

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Contains the message written in MULTI-language as defined in Section 6 and as subranged by the restrictions defined by vmsMaxMultiStringLength and dmsSupportedMultiTags. When the primary index is 'schedule', 'blank', 'currentBuffer' or 'permanent', this object shall return a genErr to any SET-request. When the primary index is 'schedule', the object shall return the MULTI string of the currently scheduled message in response

to a GET-request (regardless whether this message is actually being displayed). The value of the MULTI string is not allowed to have any null character.

<DescriptiveName>Message.multiString:text

<DataConceptType>Data Element"

::= { dmsMessageEntry 3 }

4.4.4   Object 5.6.8.4 Message Owner Parameter

dmsMessageOwner OBJECT-TYPE

SYNTAX OwnerString

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates the owner or author of this row.

<DescriptiveName>Message.owner:text

<DataConceptType>Data Element"

::= { dmsMessageEntry 4 }

4.4.5   Object 5.6.8.6 Message Beacon Parameter

dmsMessageBeacon OBJECT-TYPE

SYNTAX INTEGER (0..1)

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates if connected beacon(s) are to be activated when the associated message is displayed. Zero (0) = Beacon(s) are Disabled ; one (1) = Beacon(s) are Enabled. When the primary index is 'schedule', 'blank', 'currentBuffer', or 'permanent', this object shall return a genErr to any SET-request. When the primary index is 'schedule', the object shall return the dmsMessageBeacon setting of the currently scheduled message in response to a GET-request (regardless whether this message is actually being displayed).

<DescriptiveName>Message.beacon:code

<DataConceptType>Data Element"

DEFVAL {0}

::= { dmsMessageEntry 6 }

4.4.6   5.6.8.7 Message Pixel Service Parameter

dmsMessagePixelService OBJECT-TYPE

SYNTAX INTEGER (0..1)

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates whether pixel service shall be enabled (1) or disabled (0) while this message is active. When the primary index is 'schedule', 'blank', 'currentBuffer', or 'permanent', this object shall return a genErr to any SET-request. When the primary index is 'schedule', the object shall return the dmsMessagePixelService setting of the currently scheduled message in response to a GET-request (regardless whether this message is actually being displayed).

<DescriptiveName>Message.pixelService:code

<DataConceptType>Data Element"

DEFVAL {0}

::= { dmsMessageEntry 7 }

4.4.7   Object 5.6.8.8 Message Run Time Priority Parameter

dmsMessageRunTimePriority OBJECT-TYPE

SYNTAX INTEGER (1..255)

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates the run time priority assigned to a particular message. The value of 1 indicates the lowest level, the value of 255 indicates the highest level. When the dmsMessageMemoryType is 'schedule,' the value set in this object (i.e. dmsMessageRunTimePriority.6.1) shall override the run-time priority of the scheduled message. When the dmsMessageMemoryType is 'currentBuffer' the value returned shall be determined from the dmsMessageRunTimePriority of the message referenced in the dmsMessageTableSource object. When the dmsMessageMemoryType is 'blank', the value returned shall be equal to the dmsMessageNumber of that particular

message.

<DescriptiveName>Message.runTimePriority:quantity

<DataConceptType>Data Element"

::= { dmsMessageEntry 8 }

4.4.8   Object 5.6.8.10 Message Name Parameter

dmsMessageName OBJECT-TYPE

SYNTAX DisplayString (SIZE (0..64))

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates the name of the message.

<DescriptiveName>Message.name:text

<DataConceptType>Data Element"

::= { dmsMessageEntry 10 }

4.4.9 Object 5.7.3 Activate Message Parameter

dmsActivateMessage OBJECT-TYPE

SYNTAX MessageActivationCode

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> A code indicating the active message. The value of this object may be SET by a management station or modified by logic internal to the DMS (e.g., activation of the end duration message, etc.). When modified by internal logic with a reference to a message ID code, the duration will indicate 65535 (infinite), the activate priority will indicate 255, and the source address will indicate the an address of 127.0.0.1. If a GET is performed on this object, the DMS shall respond with the value for the last message that was successfully activated. The dmsActivateMsgError object shall be updated appropriately upon any attempt to update the value of this object, whether from an internal or external source. If a message activation error occurs (i.e., dmsActivateMsgError is updated to a value other than 'none'), the new message shall not be activated and if the activation request originated from a SET request, a GenErr shall be returned. A management station should then GET dmsActivateMsgError as soon as possible to minimize the chance of additional activation attempts from overwriting the dmsActivateMsgError. A 'criticalTemperature' alarm shall have no affect on the 'activation' of a message, it will only affect the display of the active message. Thus, a message activation may occur during a 'criticalTemperature' alarm and the sign controller will behave as if the message is displayed. However, the shortErrorStatus will indicate a criticalTemperature alarm and the sign face illumination will be off. As soon as the DMS determines that the 'criticalTemperature' alarm is no longer present, the DMS shall display the message stored in the currentBuffer.

<DescriptiveName>DMS.activateMessage:code

<DataConceptType>Data Element"

::= { signControl 3 }

4.4.10 Object 5.7.4 Message Display Time Remaining Parameter

dmsMessageTimeRemaining OBJECT-TYPE

SYNTAX INTEGER (0..65535)

ACCESS read-write

STATUS optional

DESCRIPTION

"<Definition> Indicates the amount of remaining time in minutes that the current message shall be active. The time shall be accurate to the nearest second and rounded up to the next full minute. For example, a value of 2 shall indicate that the time remaining is between 1minute and 0.5 seconds and 2 minutes. When a new message is activated with a minute-based duration, or this object is directly SET, the minute-based duration value shall be multiplied by 60 to determine the number of seconds that the message shall be active. Thus, if a message activation is for 2 minutes, the DMS will be assured to display the message for 120 seconds; if an event trigger message is activated for 5 seconds, the sign will be assured to activate the message for 5 seconds. The value 65535 indicates an infinite duration. A value of zero (0) shall indicate that the current message display duration has expired. A SET operation on this object shall allow a Central Computer to extend or shorten the duration of the message. Setting this object to zero (0) shall result in the immediate display of the dmsEndDurationMessage.

<DescriptiveName>DMS.messageTimeRemaining:quantity

<DataConceptType>Data Element

<Unit>minute"

DEFVAL {65535}

::= { signControl 4 }

4.4.11 Object 5.7.5 Message Table Source Parameter

dmsMsgTableSource OBJECT-TYPE

SYNTAX MessageIDCode

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Identifies the message number used to generate the currently displayed message. This object is written to by the device when the new message is loaded into the currentBuffer of the MessageTable. The currently displayed message is stored in the currentBuffer, but the information regarding which message number generated the current message would be lost if not indicated through this object.

<DescriptiveName>DMS.msgTableSource:code

<DataConceptType>Data Element"

::= { signControl 5 }

4.4.12 Object 5.7.6 Message Requester ID Parameter

dmsMsgRequesterID OBJECT-TYPE

SYNTAX IpAddress

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> A copy of the source-address field from the dmsActivateMessageobject used to activate the current message. If the current message was not activated by the dmsActivateMessage-object, then the value of this object shall be zero (0).

<DescriptiveName>DMS.msgRequesterID:identifier

<DataConceptType>Data Element"

REFERENCE "RFC 1155, May 1990"

::= { signControl 6 }

4.4.13 Object 5.7.7 Message Source Mode Parameter

dmsMsgSourceMode OBJECT-TYPE

SYNTAX INTEGER {

other (1),

local (2),

external (3),

--otherCom1(4), -deprecated

--otherCom2 (5), -deprecated

--otherCom3 (6), -deprecated

--otherCom4 (7), -deprecated

central (8),

timebasedScheduler (9),

powerRecovery (10),

reset (11),

commLoss (12),

powerLoss (13),

endDuration (14),

event (15) }

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates the source that initiated the currently displayed message. The enumerations are defined as:

other (1) - the currently displayed message was activated based on a condition other than the ones defined below.

local (2) - the currently displayed message was activated at the sign controller using an onboard terminal.

external (3) - the currently displayed message was activated from a locally connected device using serial (or other type of) connection to the sign controller such as a laptop or a PDA. This mode shall only be used, if the sign controller is capable of distinguishing between a local input (see definition of 'local (2)') and a serial connection.

central (8) - the currently displayed message was activated from the central computer.

timebasedScheduler (9) - the currently displayed message was activated from the timebased scheduler as configured within the sign controller.

powerRecovery (10) - the currently displayed message was activated based on the settings within the dmsLongPowerRecoveryMessage, dmsShortPowerRecoveryMessage, and the dmsShortPowerLossTime objects.

reset (11) - the currently displayed message was activated based on the settings within the dmsResetMessage object.

commLoss (12) - the currently displayed message was activated based on the settings within the dmsCommunicationsLossMessage object.

powerLoss (13) - the currently displayed message was activated based on the settings within the dmsPowerLossMessage object. Note: it may not be possible to point to this message depending on the technology, i.e. it may not be possible to display a message on pure LED or Fiberoptic signs DURING power loss.

endDuration (14) - the currently displayed message was activated based on the settings within the dmsEndDurationMessage object.

event (15) - the currently displayed message was activated based on an event defined in the event trigger table.

<DescriptiveName>DMS.msgSourceMode:code

<DataConceptType>Data Element"

::= { signControl 7 }

4.4.14 Object 5.7.17 Activate Message Error Parameter

dmsActivateMsgError OBJECT-TYPE

SYNTAX INTEGER {

other (1),

none (2),

priority (3),

messageStatus (4),

memoryType (5),

messageNumber (6),

messageCRC (7),

syntaxMULTI (8),

localMode (9),

centralMode (10),

centralOverrideMode (11) }

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> This is an error code used to identify why a message was not displayed. Even if multiple errors occur, only one error will be indicated.

other (1): any error not defined below.

none (2): no error.

priority(3): the activation priority in the MessageActivationCode is less than the run time priority of the currently displayed message. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

messageStatus(4): the 'dmsMessageStatus' of the message to be activated is not 'valid'. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

NOTE: In the 1997 version of this standard, this bit was assigned the name of 'underValidation'. It has been renamed to better reflect the fact that this bit can be set due to the message being in a number of different states, not just the 'validating' state.

messageType(5): the message memory type in the MessageActivationCode is not supported by the device. If this

error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

messageNumber(6): the message number in the MessageActivationCode is not supported or is not defined (populated) by the device. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

messageCRC(7): the checksum in the MessageActivationCode is different than the CRC value contained in the 'dmsMessageCRC'. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

syntaxMULTI(8): a MULTI syntax error was detected during message activation. The error is further detailed in the

'dmsMultiSyntaxError', 'dmsMultiSyntaxErrorPosition', and 'dmsMultiOtherErrorDescription' objects. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

localMode(9): the central system attempted to activate a message while the 'dmsControlMode' object is 'local'. This error shall NOT be set if the value of the 'dmsControlMode' is set to 'central', or 'centralOverride'. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set.

centralMode (10): a locally connected system attempted to activate a message while the 'dmsControlMode' object is 'central' or 'centralOverride'. This error shall NOT be set if the value of the 'dmsControlMode' is set to 'local'. If this error occurs, the corresponding bit (message error) within the 'shortErrorStatus' object shall be set. A 'criticalTemperature' alarm shall have no affect on the 'activation' of a message, it will only affect the display of the active message. Thus, a message activation may occur during a 'criticalTemperature' alarm and the sign controller will behave as if the message is displayed. However, the shortErrorStatus will indicate a criticalTemperature alarm and the sign face illumination will be off. As soon as the DMS determines that the 'criticalTemperature' alarm is no longer present, the DMS shall display the message stored in the currentBuffer.

<DescriptiveName>DMS.activateMsgError:code

<DataConceptType>Data Element"

::= { signControl 17 }

4.4.15 Object 5.7.18 MULTI Syntax Error Parameter

dmsMultiSyntaxError OBJECT-TYPE

SYNTAX INTEGER {

other (1),

none (2),

unsupportedTag (3),

unsupportedTagValue (4),

textTooBig (5),

fontNotDefined (6),

characterNotDefined (7),

fieldDeviceNotExist (8),

fieldDeviceError (9),

flashRegionError (10),

tagConflict (11),

tooManyPages (12),

fontVersionID (13),

graphicVersionID (14),

graphicNotDefined (15) }

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> This is an error code used to identify the first detected syntax error within the MULTI message.

other (1): An error other than one of those listed.

none (2): No error detected.

unsupportedTag (3): The tag is not supported by this device.

unsupportedTagValue (4): The tag value is not supported by this device.

textTooBig (5): Too many characters on a line, too many lines for a page, or font is too large for the display.

fontNotDefined (6): The font is not defined in this device.

characterNotDefined (7): The character is not defined in the selected font.

fieldDeviceNotExist (8): The field device does not exist / is not connected to this device.

fieldDeviceError (9): This device is not receiving input from the referenced field device and/or the field device has a fault.

flashRegionError (10): The flashing region cannot be flashed by this device.

tagConflict (11): The message cannot be displayed with the combination of tags and/or tag implementation cannot be resolved.

tooManyPages (12): Too many pages of text exists in the message.

fontVersionID (13): The fontVersionID contained in the MULTI tag [fox,cccc] does not match the fontVersionID for the fontNumber indicated.

graphicVersionID (14): The graphicVersionID contained in the MULTI tag [gx,cccc] does not match the graphicVersionID for the graphicIndex indicated.

graphicNotDefined (15): The graphic is not defined in this device.

<DescriptiveName>DMS.multiSyntaxError:code

<DataConceptType>Data Element"

::= { signControl 18 }

4.4.16 Object 5.7.19 Position of MULTI Syntax Error Parameter

dmsMultiSyntaxErrorPosition OBJECT-TYPE

SYNTAX INTEGER (0..65535)

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> This is the offset from the first character (i.e. first character has offset 0, second is 1, etc.) of the MULTI string where the SYNTAX error occurred.

<DescriptiveName>DMS.multiSyntaxErrorPosition:quantity

<DataConceptType>Data Element

<Unit>character"

::= { signControl 19 }

4.4.17 Object 5.7.20 Other MULTI Error Parameter

dmsMultiOtherErrorDescription OBJECT-TYPE

SYNTAX DisplayString (SIZE (0..50))

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates vendor-specified error message descriptions. Associated errors occurred due to vendor-specific MULTI-tag responses. The value of this object is valid only if dmsValidateMessageError has a value of "syntaxMULTI(5)" or dmsActivateMessageError has a value of "syntaxMULTI(8)" and dmsMultiSyntaxError is "other(1)".

<DescriptiveName>DMS.multiOtherErrorDescription:text

<DataConceptType>Data Element"

::= { signControl 20 }

4.4.18 Object 5.7.19 Position of MULTI Syntax Error Parameter

dmsMultiSyntaxErrorPosition OBJECT-TYPE

SYNTAX INTEGER (0..65535)

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> This is the offset from the first character (i.e. first character has offset 0, second is 1, etc.) of the MULTI string where the SYNTAX error occurred.

<DescriptiveName>DMS.multiSyntaxErrorPosition:quantity

<DataConceptType>Data Element

<Unit>character"

::= { signControl 19 }

4.4.19 Object 5.7.20 Other MULTI Error Parameter

dmsMultiOtherErrorDescription OBJECT-TYPE

SYNTAX DisplayString (SIZE (0..50))

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates vendor-specified error message descriptions. Associated errors occurred due to vendor-specific MULTI-tag responses. The value of this object is valid only if dmsValidateMessageError has a value of "syntaxMULTI(5)" or dmsActivateMessageError has a value of "syntaxMULTI(8)" and dmsMultiSyntaxError is "other(1)".

<DescriptiveName>DMS.multiOtherErrorDescription:text

<DataConceptType>Data Element"

::= { signControl 20 }

4.4.20 Object 5.7.26 Activate Message State

dmsActivateMessageState OBJECT-TYPE

SYNTAX INTEGER {

fastActivationSign(1),

slowActivatedOK(2),

slowActivatedError(3),

slowActivating(4) }

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Signs that are able to change their message with fast activation always return 'fastActivationSign(1)'. This allows a central to use this object to determine whether or not the sign does fast activation (that is, whether the sign can immediately change the display). Signs that do slow activation (such as a rotary drum sign) shall set this object to 'slowActivating(4)' during the changing of the display and when the message change has completed shall change it to 'slowActivatedOK(2)' if successful or 'slowActivatedError(3)' if an error occurred during the display change. A sign with fast activation uses this object only to indicate that it is a fast activation sign. Such a sign shows an immediate response to a SET of dmsActivateMessage that is either noError or a genErr. In the case of a genErr the specific error is found in dmsActivateMsgError. With a slow activation sign there are two opportunities to detect an error. The first comes when the SET of dmsActivateMessage is performed, just as in the fast activation sign. It could be a bad message number or other error. If such an error is received, it should be assumed that the message change does not occur and therefore this object can be ignored. If the SET of dmsActivateMessage succeeds, then the central must wait for either slowActivatedOK or slowActivatedError in this object. If the sign detects an error, it should set this object to slowActivatedError and set the "message error" bit in the shortErrorStatus object. When a central receives slowActivatedError it should examine other status objects specific to the sign, such as the rotary drum status objects, to determine the precise error.

<DescriptiveName>DMS.activateMessageState:code

<DataConceptType>Data Element"

::= { signControl 27 }

4.4.21 Object 5.8.5 Status of Illumination Brightness Level Parameter

dmsIllumBrightLevelStatus OBJECT-TYPE

SYNTAX INTEGER (0..255)

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates the current Brightness Level of the device, ranging from 0 (OFF) to the maximum value given by the dmsIllumNumBrightLevelsobject (Brightest).

<DescriptiveName>DMS.illumBrightLevelStatus:quantity

<DataConceptType>Data Element"

::= { illum 5 }

4.4.22 Object 5.8.9 Status of Illumination Light Output Parameter

dmsIllumLightOutputStatus OBJECT-TYPE

SYNTAX INTEGER (0..65535)

ACCESS read-only

STATUS optional

DESCRIPTION

"<Definition> Indicates the current physical light output value ranging from 0 (darkest) to 65535 (maximum output).

<DescriptiveName>DMS.illumLightOutputStatus:quantity

<DataConceptType>Data Element"

::= { illum 9 }

5 Software and Integration Support

It is expected that the DMS will be controlled and monitored from the ATMS software, provided by another Systems Integrator, under normal conditions. However, the functions and capabilities from the ATMS is limited to basic operations and monitoring, and supports only a subset of the NTCIP Standards.

5.1.1 Software

The manufacturer is to provide software supporting all the functional requirements listed above. The software will be used to support maintenance activities and to configure the DMS. The software shall be installed on the workstations and maintenance laptop computers to be provided.

5.1.2 Integration Support

The manufacturer shall support the AGENCY's systems integrator in troubleshooting and verifying proper monitoring and operations of the DMS using the ATMS software.

During the Factory Acceptance Tests (see Section xxx), the manufacturer shall assist the Systems Integrator with testing the implementation of DMS with the ATMS software. The Systems Integrator will use its software or its NTCIP exerciser to perform basic communications and control of the DMS.

During the Integration Test (see Section xxx), the Systems Integrator will transfer monitoring and control of the DMS to the ATMS software for a 30-day demonstration period. During this period, the manufacturer shall assist the Systems Integrator with troubleshooting any problems or events that may occur.

The ATMS software is expected to exercise the following NTCIP 1203 objects when monitoring and controlling the DMS. These are the most common objects expected to be exercised by ATMS software, and is by no means limited to these objects.

- dmsMessageTable
    - dmsMessageNumber
    - dmsMessageMultiString
    - dmsMessageOwner
    - dmsMessageCRC
    - dmsMessageBeacon
    - dmsMessagePixelService
    - dmsMessageRunTimePriority
    - dmsMessageStatus
- dmsValidateMessageError

- dmsControlMode

- dmsActivateMessage

- dmsActivateMsgError

- shortErrorStatus

6 Installation and Testing

Upon the installation of the DMS, the functionality of the DMS will be exercised locally at the DMS control cabinet. This demonstration and exercising of the DMS locally will be called the Startup Tests. The purpose of the Startup Test is to demonstrate that the basic capabilities of the DMS are functioning properly (LEDs, climate controls, uploading/downloading), and that the proper default values have been properly set up (fonts, default messages, device address). A laptop computer will be connected to the DMS's LAPTOP port. Basic control and monitoring of the DMS will be demonstrated using the DMS manufacturer-supplied software, which will be loaded on the laptop computer.

Upon satisfactory completion of the Startup tests, the functionality of the DMS will be exercised at the local workstation provided by the manufacturer, using the manufacturer-supplied software; and using the ATMS software. This demonstration and exercising of the DMS from the AGENCY STATEWIDE TOC will be called the Operational Tests. The purpose of the Operational Test is to demonstrate proper monitoring, control, and exercising of all the DMS's functionality, as required in the Technical Specifications. The Operational Test will be a 60-day test, 30-days of which will be using the manufacturer-supplied software and 30-days using the ATMS software. *Note: we are assuming that the initial and final location of the workstation will be at AGENCY.*

Upon satisfactory completion of the initial 30-day Operational Test using the manufacturer-supplied software, the monitoring and control of the DMS will be transferred from the local workstation to the ATMS software. The transfer and verification of monitoring and control of the DMS using the ATMS software will be called the Integration Tests. The Integration Test will be performed by the AGENCY and other contractors, however, a qualified representative of the DMS manufacturer will be present to assist the AGENCY and its contractors on any issues that may occur during the integration test.

The CONTRACTOR shall perform the Factory Acceptance Tests, Visual Inspection Test, Startup Tests, Stand-alone Tests, Operational Tests, and Integration Tests on the Dynamic Message Sign (DMS) System.

- The Factory Acceptance Test (FAT) shall include all labor and material necessary to verify conformance of the field equipment with the performance, mechanical, electrical and environmental requirements specified.

- The Visual Inspection Test shall include all labor and material necessary to perform a visual inspection after the complete installation of the DMS equipment to check for manufacturing and installation defects.

- The Startup Tests shall include all labor and material necessary to verify the setup and configuration of the DMS.

- The Stand-alone Tests shall include all labor and material necessary to demonstrate that the required functionality and capabilities of the DMS are functioning properly, including

subsystem check tests on all installed equipment and operation and monitoring of the DMS.

- The Operational Tests shall include all labor and material necessary to support the AGENCY over a 60-day period during which the DMS System will be utilized by the AGENCY in daily operations.

- The Integration Tests shall include all labor and material necessary to transfer control and monitoring of the DMS from the manufacturer-supplied software to the ATMS software.

The Visual Inspection, Startup and Stand-alone Test may be performed on the same day, subject to AGENCY approval. However, the tests must be performed and completed in the proper sequence, as defined in the technical specifications.

For each test, the CONTRACTOR shall provide written notice of the proposed test date to the AGENCY at least two (2) weeks in advance to allow the AGENCY to make arrangements to be present during the tests. All tests shall be performed as specified in the presence of the AGENCY, or its representative. The CONTRACTOR, and a qualified representative from the DMS manufacturer shall be designated to be present as well.

The AGENCY will review the test results for conformance with the requirements of the CONTRACT DOCUMENTS. If the DMS System fails any part of the test, at the option of the AGENCY, the entire test shall be repeated, and/or the AGENCY will consider other contractual options.

6.1.1 Factory Tests

Prior to delivery, the DMS System shall be subject to a Factory Acceptance Test. This test shall verify that the field equipment properly meets or exceeds the performance, electrical and environmental requirements specified. The Contractor shall provide all test equipment, test facilities, and personnel required for the performance of the Factory Acceptance Test. All costs incurred for the conduct of the laboratory tests shall be paid for by the Contractor.

The Factory Acceptance Tests shall be performed at the manufacturer's facilities or at an independent testing laboratory.

The CONTRACTOR shall submit a Factory Acceptance Test procedure for AGENCY review and approval, no less than eight (8) weeks prior to the proposed Factory Acceptance Test date. The AGENCY shall have no less than three (3) weeks to review the proposed Test procedure and provide comments back to the CONTRACTOR. The Factory Test Procedure must be approved, in writing, by the AGENCY before the Factory Tests are performed.

At a minimum, the Factory Acceptance Tests shall include the following:

- space on the checklist for each item for the AGENCY's or its representative's initials

- Environmental Testing – The environmental tests shall use the environmental test procedures (Chapter 2) outlined in the draft NEMA Standards Publication TS 4-2004, Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements, Draft –V1.30b, dated February 9. 2004. Environmental tests may include the temperature, transient, voltage, humidity, power interruption, shock (impact) and vibration tests, as required by the Technical Specifications.

- NTCIP Testing – The NTCIP tests shall demonstrate proper use and conformance of the appropriate referenced standards. The test shall include verification that any manufacturer-specific objects used have been properly documented. Tools that may be used by the AGENCY for the performance of the NTCIP tests include the FHWA NTCIP Exerciser software, Version 3.3b7a; and DeviceTester for NTCIP from Intelligent Devices, Inc.

- Display Testing – The display tests shall use the display test procedures (Chapter 5) outlined in the draft NEMA Standards Publication TS 4-2004, Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements, Draft –V1.30b, dated February 9. 2004. Display tests may include contrast ratio, cone of vision, and luminance intensity.

- Compatibility Testing – The compatibility tests shall demonstrate proper control and monitoring of the DMS with the ATMS software or systems integrator exerciser. The test procedures for the compatibility test shall be provided by others, and will be provided to the CONTRACTOR prior to the Factory Acceptance Test.

The Factory Acceptance Test Plans must be completed, dated, and signed by the CONTRACTOR and the AGENCY or its representative. The completed test plans are to be submitted to the Engineer, or his appointed representative, no less than 10 business days after completing the Factory Acceptance Test, regardless of pass or fail.

6.1.2   Visual Inspection Test

Upon the installation of the DMS, a visual inspection of the DMS will be performed, and shall be called the Visual Inspection Test. The purpose of the Visual Inspection is to verify that the DMS has been properly installed according to Contract Documents and to check for manufacturing and installation defects.

The CONTRACTOR shall submit a visual inspection checklist for AGENCY review and approval, no less than six (6) weeks prior to the proposed Visual Inspection Test date. The AGENCY shall have no less than three (3) weeks to review the proposed visual inspection checklist and provide comments back to the CONTRACTOR. The visual inspection checklist must be approved, in writing, by the AGENCY before the Visual Inspection Test is performed.

The visual inspection checklist shall include, at a minimum:

- space on the checklist for each item for the AGENCY's or its representative's initials

- check for manufacturing and installation defects prior to connecting the DMS System to the power feed. Any deficiencies found during this inspection must be corrected prior to the Startup Test.

- check the wiring diagrams from the manufacturer and compare to the actual wiring at the DMS site. Ensure that the wiring diagrams are on-site during the Visual Inspection Tests.

- proper grounding

- correct wiring of sensors and alarms to the controller's inputs.

A visual inspection checklist must be completed, dated, and signed by the CONTRACTOR and the AGENCY or its representative. Checklists are to be submitted to the Engineer, or his appointed representative, no less than 5 business days after completing the Visual Inspection Test, regardless of pass or fail.

6.1.3   Startup Tests

Upon satisfactory completion of the Visual Inspection Test of the DMS, the setup and configuration of the DMS will be verified locally at the DMS control cabinet. This verification of the DMS locally will be called the Startup Tests. The purpose of the Startup Test is to demonstrate that the proper default values have been properly set up (sign configuration, fonts, default messages, device address).

During the Startup Tests, a laptop computer will be connected to the DMS's LAPTOP port. Basic control and monitoring of the DMS will be demonstrated using the DMS manufacturer-supplied software, which will be loaded on the laptop computer.

The CONTRACTOR shall submit a Startup Test Plan for AGENCY review and approval, no less than six (6) weeks prior to the proposed Startup Test date. The AGENCY shall have no less than three (3) weeks to review the proposed Startup Test Plan and provide comments back to the CONTRACTOR. The Startup Test Plan must be approved, in writing, by the AGENCY before the Startup Test is performed.

The Startup Test plan shall include the following tests, at a minimum:

- space on the checklist for each item for the AGENCY's or its representative's initials

- verify that all global objects values have been properly set (Configuration, Database Management, Time Management, Report, STMF, and PMPP Conformance Groups), and record the information.

- verify that all dmsSignCfg and vmsCfg values have been properly set (Sign Configuration, GUI Appearance, and DMS Sign Configuration Conformance Groups) and record the information.

- verify that the MULTI default values have been properly set (MULTI Configuration Conformance Group) and record the information.

- verify that all default messages have been properly set (Default Message Conformance Group) and record the information.

- verify that the required fonts have been properly loaded and set (Font Definition Conformance Group).

Note that the Startup Tests do not require the display of a message on the DMS.

The Startup Test Plan must be completed, dated, and signed by the CONTRACTOR and the AGENCY or its representative. Checklists are to be submitted to the Engineer, or his appointed representative, no less than 5 business days after completing the Startup Tests, regardless of pass or fail.

6.1.4   Stand-alone Tests

Upon satisfactory completion of the Stand-Alone Test of the DMS, the functionality of the DMS will be demonstrated locally at the DMS control cabinet. This exercise will be called the Stand-alone Tests. The purpose of the Stand-alone Test is to demonstrate that the basic capabilities of the DMS are functioning properly, including subsystem check tests on all installed equipment (communications equipment, LEDs, climate controls), and activating, uploading and downloading messages.

The CONTRACTOR shall submit a Stand-alone Test Plan for AGENCY review and approval, no less than six (6) weeks prior to the proposed Stand-alone Test date. The AGENCY shall have no less than three (3) weeks to review the proposed Stand-alone Test and provide comments back to the CONTRACTOR. The Stand-alone Test must be approved, in writing, by the AGENCY before the Stand-alone Test is performed.

The hardware portion of the Stand-alone Test plan shall include the following tests, at a minimum:

- space on the checklist for each item for the AGENCY's or its representative's initials

- conduct of subsystem check tests on all installed equipment, including communications equipment. Include equipment checkout tests for each system component, including provisions for testing all internal and external system interfaces.

- Proper operation of every pixel, including uniform brightness at all brightness levels and proper current consumption.

- Proper wiring of the display modules, checked by displaying a test message that identifies the modules' proper row and column positions.

- Appropriate brightness of the DMS for day and night conditions, including when the sun is directly in front of or behind DMS.

- Test for absence of leaks. This can be demonstrated by operating the blowers with the doors and exhaust vents closed to pressurize the sign enclosure, and checking for air bypassing the door and window gaskets.

- Proper aiming of the display modules.

- Proper operation of the temperature sensors, blowers, defogging system, and lights.

Using these hardware tests, demonstrate that the equipment installed at each location is installed properly and that all functions are in conformance with the Contract Documents. The field equipment tests include non-central functional tests of the locally installed equipment. Any deficiencies found during Stand-alone Tests must be corrected prior to conducting the Operational Test.

The software portion of the Stand-alone Test plan shall include the following tests, at a minimum:

- space on the checklist for each item for the AGENCY's or its representative's initials

- connect a laptop computer loaded with the manufacturer's software to the LAPTOP port located on the VSLS controller. Proper control and monitoring of the DMS, as will be demonstrated using the DMS manufacturer-supplied software.

- upload, download and activate a message.

- use of all required and supported MULT tags.

- Proper reporting of the sign status reporting objects, such as shortErrorStatus (Sign Status Conformance Group, and all applicable subconformance groups).

- perform all diagnostic routines provided by the manufacturer and as required by the Contract Documents. This includes exercising the pixel service functions

- verify and record the histeresis for determining the brightness of the LEDs.

The Stand-alone Test Plan must be completed, dated, and signed by the CONTRACTOR and the AGENCY or its representative. Checklists are to be submitted to the Engineer, or his appointed representative, no less than 5 business days after completing the Stand-alone Tests, regardless of pass or fail.

6.1.5   Operational Tests

After all equipment and software provided under this Contract has successfully completed the Stand-alone Tests and system training has been completed, an Operational Test period will begin. The purpose of the Operational Test is to demonstrate that the system has been properly installed and integrated, performs properly, and complies with the Contract Documents. The Operational Test shall consist of a 60-day demonstration period and will serve to evaluate full-scale operation of the system under normal conditions. The AGENCY STATEWIDE TOC will be responsible for operating the system during this period. For the Operational Test, the

functionality of the DMS will be exercised at the AGENCY STATEWIDE TOC, and will communicate with the DMS through the DMS's CENTRAL port.

The first 30 days of the 60-day demonstration period, monitoring and control of the DMS will be from the local workstation provided by the manufacturer using the manufacturer-supplied software. The last 30 days of the 60-day demonstration period, monitoring and control of the DMS will be from the ATMS software currently in use at the AGENCY STATEWIDE TOC, after completion of the Integration Tests.

Submit the following procedures and documentation to the AGENCY for review and approval before the start of the Operational Tests:

- procedures for notification and failure reporting to the CONTRACTOR and/or the DMS System manufacturer. Procedures shall include a log for recording failures or comments, and a 24-hour, either a toll-free or local telephone number, to contact the CONTRACTOR for maintenance or assistance.

- a preventative maintenance schedule for the DMS System. The schedule shall indicate maintenance procedures and a list of tools required to perform the maintenance.

The following conditions apply during the observation period:

- During the entire period, the system will monitor and control the signs, and perform all the other functions described in these Specifications.

- If any hardware item that is part of the DMS System fails (with the exception of expendable items such as printer cartridges), the items will repaired at no addition cost to AGENCY. The observation period for the failed item will restart for the full 60-day duration.

- Any system problems discovered during this demonstration period, will result in the suspension of the observation period until the problem is resolved. Once the problem has been eliminated, the observation period will resume. The CONTRACTOR shall carefully record the problem and report to the AGENCY how the problem was resolved. The CONTRACTOR may be required to demonstrate that any corrections or modifications made are valid, that the problems which restricted system operation have been corrected, and no new problems have resulted from the changes.

- Total system "down time" may not exceed 36 hours during the entire period. Down time is a condition caused by failure of the central equipment, central software, which causes the system to cease normal operation. If total system "down time" exceeds 36 hours, a full 60-day observation period will begin again.

- Intermittent communications problems shall not count towards the total system "down time" if the CONTRACTOR shows that the communications problem is caused by problems unrelated to the DMS System. It is incumbent on the CONTRACTOR to provide proof to the agency.

- If 10 percent of the total quantity of a particular hardware item fails during the observation period, that item or unit will be replaced at no additional cost to AGENCY. The replacement units shall be new and unused. The observation period will start over after that item has been completely replaced.

Within five (5) business days of the completion of the 60-day demonstration period, the CONTRACTOR submit a final maintenance report summarizing the nature and time of all maintenance or repairs performed during the demonstration period and list the equipment and spare parts used in this effort. The report shall contain the following information as a minimum:

- tasks performed and man-hours required to perform them

- numbers and types of components repaired and the extent of repairs needed

- number and types of components replaced by new equipment

- numbers and types of components recommended as additional spare parts

Upon successful completion of the observation period, the AGENCY will accept the DMS System, in writing, providing that all corrections in documentation have been rendered and all other requirements of the Contract Documents have been met.

Integration Tests
Upon satisfactory completion of the initial 30 days of the 60-day Operational Tests, the monitoring and control of the DMS will be transferred from the local workstation to the ATMS software. The initial demonstration and exercising of monitoring and control of the DMS using the ATMS software will be called the Integration Tests. The Integration Test will be performed by the AGENCY and other contractors, however, a qualified representative of the DMS manufacturer will be available to assist the AGENCY and its contractors on any issues that may occur during the integration test.

If an integration issue arises, the DMS manufacturer may be asked to analyze the issue and shall submit a proposed solution in writing. *Note: Implementation of proposed solution is not discussed.*

6.2 Workstation

Under the project, a workstation will be supplied with the DMS manufacturer's software to allow users to monitor the status of and control the signs on the facility. The purpose of the workstation is to test the DMS upon initial installation of the DMS sign, and to serve as a backup in the event of a failure of the main ATMS software.

Each workstation will be provided with a *Microsoft Windows 2000* or *Microsoft Windows XP* operating system, and an archival media, such as a *CD-ROM burner* or *tape backup* for storing log files and event messages. *An Uninterruptible Power Supply* will be provided with each

workstation to protect the workstation in the event of a power failure for at least *15* minutes. *A laser printer* will be provided with each workstation to allow printing of reports and logs.

A *technician's laptop computer* will be provided with the sign. The technician's laptop computer will be used to maintain or control the DMS sign at the DMS cabinet for maintenance purposes or in the event there is no communications between the traffic management center and the DMS sign. The technician's laptop computer shall be environmentally hardened. The laptop computer shall be provided with the manufacturer's software, *Microsoft Windows* operating system, and the necessary cables to connect to the DMS sign's laptop *RS-232* port.

7 Documentation

The component shall be supplied with full documentation, including 3.5" floppy disk(s) and a CD-ROM containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.

- If the device does not support the full range of any given object within a Standard MIB Module, a manufacturer-specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro shall be provided. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension ".man".

- A MIB Module in ASN.1 format containing any and all manufacturer-specific (or agency-specific) objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.

- A MIB containing any other objects supported by the device.

Warranties
In addition, the developer shall provide free software upgrades for a period of 12 months from successful acceptance of the DMS System.

Interpretation Resolution
If the State, State's representative, or manufacturer discovers an ambiguous statement in the standards referenced by this procurement specification, the issue shall be submitted to the NTCIP Working Group for resolution. If the Working Group fails to respond within 90 days, the project shall develop an interpretation of the specification.