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The Future of DMS Messaging

FINAL REPORT

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16. Abstract <p>Transportation agencies at the state, provincial, and local levels receive many requests to display non-urgent messages on Dynamic Message Signs (DMS) regarding advertising, safety messages, and special events, for example. Agencies must decide how to respond to these requests. In addition to state, provincial, and local level policies and preferences about the use of DMS, federal design standards such as the Federal Highway Administration (FHWA) Manual of Uniform Traffic Control Devices (MUTCD) must also be considered when deciding which requests to approve.</p> <p>This project conducted an online search to gather state, provincial, local, and federal policies and guidelines for DMS messaging. The search also included documenting related DMS studies or efforts. Transportation agencies were also contacted to provide additional details on information gathered through the online search. In addition, ENTERPRISE members provided input throughout the duration of the project to enhance the search for DMS messaging related documents and guidelines. A survey was distributed to state, local, and provincial transportation agencies to gather additional details on the DMS message requests received by transportation agencies as well as the policy or process for handling DMS message requests. The project also researched the potential for public-private partnerships for DMS deployment and operations and documented a few potential future scenarios for connected and automated vehicle implications on DMS.</p>			
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Project Champion

Luke Biernbaum, Michigan DOT, was the ENTERPRISE Project Champion for this effort and served as the overall lead for the project.

Members

The ENTERPRISE Board consists of a representative from each of the following member entities of the program:

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- Illinois Department of Transportation
- Iowa Department of Transportation
- Kansas Department of Transportation
- Michigan Department of Transportation
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1.0 Introduction

Transportation agencies at the state, provincial, and local levels receive many requests to display non-urgent messages on Dynamic Message Signs (DMS), also referred to as Changeable Message Signs (CMS) and Variable Message Signs (VMS), regarding advertising, safety messages, and special events, for example. Agencies must decide how to respond to these requests. In addition to state, provincial, and local level policies and preferences about the use of DMS, federal design standards such as the Federal Highway Administration (FHWA) Manual of Uniform Traffic Control Devices (MUTCD) must also be considered when deciding which requests to approve.

Beyond the policy and guideline discussion, there are also technical issues with deploying certain types of messages on DMS. For example, sponsorship or wayfinding uses of DMS may demand flashing text, scrolling text, graphics, color, etc. Each of these poses both technical challenges for the signs, but also distraction and human factors related issues. This project recognized several key factors:

- Technologies for DMS are improving and the costs of DMS are decreasing;
- Requests for alternate messages to transportation agencies are increasing as are the requests for different display formats and features (e.g. flashing, scrolling, color, graphics, etc.);
- Transportation agencies have expanded uses for DMS with new and innovative traffic control strategies; and
- Various message formats may be limited by the DMS type deployed.

The objectives of this project were as follows:

Objective #1: To document the state, provincial, local, and federal rules of messages posted to DMS related to DMS requests (e.g. advertising, special events, graphics).

Objective #2: To research and document the requests by transportation agencies of messages to post on DMS and the foreseeable “demands” of DMS.

Objective #3: To research and document the potential for public-private partnerships for DMS deployment and operations.

Objective #4: To research and document potential connected and automated vehicle implications on DMS.

To accomplish the four objectives for this project, an online search was conducted to gather state, provincial, local, and federal policies and guidelines for DMS messaging. The search also included documenting related DMS studies or efforts. Transportation agencies were also contacted to provide additional details on information gathered through the online search. In addition, ENTERPRISE members provided input throughout the duration of the project to enhance the search for DMS messaging related documents and guidelines. A survey was distributed to state, local, and provincial transportation agencies to gather additional details on the DMS message requests received by transportation agencies as well as the policy or process for handling DMS message requests. The project also researched the

potential for public-private partnerships for DMS deployment and operations and documented a few potential future scenarios for connected and automated vehicle implications on DMS.

This report includes the following sections that document the information gathered for this project to accomplish the four project objectives.

- [2.0 DMS Messaging Approaches and Guidelines](#) – Provides an overview and examples of transportation agencies DMS messaging approaches and guidelines. Additionally, this section summarizes approved and prohibited uses of DMS from a review of transportation agency guidelines and federal DMS guidelines and highlights example guideline language for various DMS message requests.
- [3.0 DMS Related Studies](#) – Summarizes related DMS messaging studies.
- [4.0 Survey](#) – Presents a summary of responses received from a survey distributed to state, provincial, and local transportation agencies to gain insight about current and anticipated DMS message requests. The summary also documents the processes and guidelines regarding the handling and posting of these DMS message requests.
- [5.0 Potential for Public-Private Partnerships for DMS Deployment and Operations](#) – Describes the opportunity or potential for public-private partnerships for DMS deployment and operations.
- [6.0 Potential Implications of Connected and Automated Vehicles on DMS Messaging](#) – Discusses possible considerations that agencies may encounter as connected and automated vehicles emerge and become more prevalent on roadways.
- [7.0 Summary](#) – Provides highlights and a summary of information gathered in Sections 2.0 – 6.0 of this report.

2.0 DMS Messaging Approaches and Guidelines

An ongoing debate among transportation professionals is whether and how often to display non-urgent messages on DMS, which may relate to special events, Public Service Announcements (PSAs), safety messages, or air quality, for example. Many transportation agencies have developed guidelines, policies, or a process regarding which message types should be posted, uses or message types that are prohibited, and how message content is developed and approved. There is also guidance developed by FHWA and in the MUTCD on DMS messaging.

This section provides an overall summary of DMS message approaches as well as approved and prohibited uses of DMS messages from review of transportation agency guidelines and federal guidelines. It is important to note that this project reviewed 17 DMS guidelines from different transportation agencies, as listed in **Table 1** below. ENTERPRISE is aware that there are many other agencies that have DMS guidelines, however, the intent was not to provide a comprehensive list but to provide a list of examples. The guidelines were found through an online search or they were made available to the project by the sponsoring agency.

Table 1: DMS Policy/Guidelines

Agency	Policy/Guideline	Year
1 Caltrans	CMS Guidelines ¹	2013
2 Florida DOT (FDOT)	Displaying Messages on DMS Permanently Mounted on the State Highway System ²	2013
3 Illinois DOT (IDOT)	Permanent DMS Usage Policy	2014
4 Iowa DOT	Traffic and Safety Manual ³	2005
5 Maine DOT (MaineDOT)	Standard Operating Procedures for the Use of CMS ⁴	2007
6 Michigan DOT (MDOT)	Portable Changeable Message Sign Guidelines ⁵	2011
7 Minnesota DOT (MnDOT)	CMS Manual of Practice ⁶	2012
8 Missouri DOT (MoDOT)	DMS Policy ⁷	2014
9 New York State DOT (NYSDOT)	VMS Guidelines ⁸	2011
10 New York State (NYS) Thruway Authority	Guidelines for Use of VMS ⁹	2011
11 North Dakota DOT (NDDOT)	DMS Guidelines	2015
12 Oregon DOT (ODOT (Oregon))	Guidelines for the Operation of Permanent VMS ¹⁰	2013
13 Pennsylvania DOT (PennDOT)	DMS Operating Standards	2013
14 Texas DOT (TxDOT)	DMS Message Design and Display Manual ¹¹	2006
15 Washington State DOT (WSDOT)	VMS Policies, Guidance, Operations	2013
16 Wisconsin DOT (WisDOT)	Wisconsin DOT Traffic Guidelines Manual ¹²	2015
17 Ontario Ministry of Transportation (MTO)	DMS Policy and Guidelines	2015

2.1 DMS Messaging Approaches

Generally, agencies post messages on DMS that are transportation related. However, Ozone Action Day messages are common nationally and Missouri Department of Transportation (MoDOT) has posted messages referring to Amtrak as a travel option. Some states have posted messages that are even more general, such as DMS in California advising travelers to conserve water due to a drought. In some cases, requests from groups (e.g. governor’s office) for message requests may conflict with typical practices within the agency creating dilemmas.

In addition, agencies like MoDOT, Michigan DOT (MDOT), and Montana DOT (MDT) post messages on some DMS 24 hours per day, seven days per week so travelers know the sign is functional and may think the investment in the DMS is being more fully utilized. To assuage concerns of traveler fatigue of DMS messages, MoDOT posts “catchy” safety messages and PSAs like “Turn Signals...The Original Instant Message” and “Buckle Up, Windshields Hurt”, while also using Title Case in order to distinguish them from a higher priority message that is typically in ALL CAPS. Similarly, some agencies like MDOT default to posting travel time messages where that information is available in lieu of having a blank DMS.

Other agencies follow policies that are more restrictive on the types of messages and frequency with which they are displayed. This may involve only posting safety messages that are part of a national awareness campaign, e.g., National Work Zone Awareness week, or restricting safety messages to specific times as Iowa DOT does with “message Monday.” Some agencies will post non-urgent messages only during non-peak times, while others like Iowa DOT post messages during peak travel times. Some agencies do not post PSAs or safety messages at all so travelers will not become fatigued by DMS messages and will pay more attention when the DMS is showing a more urgent message.

The process for developing and approving the message content can also vary by state. For example, at MoDOT a special group meets regularly for developing and approving a set of PSAs and safety messages related to specific themes to be posted on DMS for each week. At other agencies this process may be overseen by a single individual.

Finally, the capabilities of each agency’s DMS may vary significantly based on the age and technology of their deployed DMS. The Illinois Tollway is currently undergoing a trial process with newer DMS technology, which includes a full color matrix for text and graphics. Rhode Island DOT (RIDOT) and the Minnesota DOT (MnDOT) (see **Figure 1**) have also deployed similar DMS.



Figure 1: MnDOT Full Color DMS

2.2 Approved Uses of DMS

This section summarizes approved uses of DMS from review of transportation agency guidelines and federal guidelines.

2.2.1 Transportation Agencies DMS Guidelines

From the review of the DMS guidelines in **Table 1**, each document provides information on approved DMS message types. Thirteen (13) of the agencies prioritize their message types. The prioritization assists a transportation agency when determining which message request overrides another message request. For example, an agency may post a general safety message such as “Buckle Up”, however if an incident occurs the message will be overridden due to the urgency of the second request.

Table 2 shows the prioritization for displaying messages on DMS based on their documented guidelines. Iowa DOT, Maine DOT (MaineDOT), New York State DOT (NYSDOT), and Texas DOT (TxDOT) provide a list of approved messages in their DMS guideline documents similar to those in the following table, however a priority is not noted.

Most of the agencies that prioritize DMS messages have incidents as a high priority. Safety messages are the lowest or closest to the lowest priority for many of the agencies that prioritize DMS messages.

It is important to note that the DMS guidelines reviewed may include additional approved DMS messages, however the on the following page only includes message types that were assigned a priority number.

Table 2: Priority for Displaying Messages on DMS from DMS Policy/Guidelines

Agency	Policy/Guideline	Year	DMS Message Type																		
			Incidents	Lane Closures	Travel Times	Congestion Management	Work Zones	Future Work or Event	AMBER Alert	Weather / Road Conditions	Air Quality	Special Events	Safety Messages	Alternate Routes	Enforcement Actions	Emergency Message	Default or Test Messages	Travel Plaza Message	Automated ITS Message	Manual Message	Border Crossing Status
Caltrans	CMS Guidelines ¹³	2013	1	2	8		2	7	5	3	4	9		6	10						
FDOT	Displaying Messages on DMS Permanently Mounted on the State Highway System ¹⁴	2013	3	2	1		3		4	3	5										
IDOT	Permanent DMS Usage Policy	2014	2		6	3			5	7,8	4	10			1	9	11		12		
MDOT	Portable Changeable Message Sign Guidelines ¹⁵	2011	2	1	5		3				4	6	1								
MnDOT	CMS Manual of Practice ¹⁶	2012	1		3		2		6	4	5	7				8					
MoDOT	DMS Policy ¹⁷	2014	2	3	5	3	2	8	4,6	2	7	3	9,10	3	1						
NYS Thruway Authority	VMS Guidelines ¹⁸	2011	1			2	3			5	4	7	2	6							
NDDOT	DMS Guidelines	2015	2	1			2		4	3	5	5				6					
ODOT (Oregon)	Guidelines for the Operation of Permanent VMS ¹⁹	2013	2	1	8	3	5		6	4	9	7	10		1	11					
PennDOT	DMS Operating Standards	2013	2+	1		5		9	4	6		8	10		3	12	11	7			
WSDOT	VMS Policies, Guidance, Operations	2013	1		4			2	3						3						
WisDOT	Wisconsin DOT Traffic Guidelines Manual ²⁰	2015	1		5	4	3	7	2		6	8									
Ontario MTO	DMS Policy and Guidelines	2015	4	3	10	7,8	5	13	2,12	6,9			14	15		16			1	11	

+ Roadway restriction

2.2.2 Federal DMS Guidelines

Through the MUTCD and memorandums, FHWA has established guidance for transportation agencies regarding their use of DMS.

FHWA MUTCD Guidelines

In the [2009 MUTCD Section 2L.02.01 CMS, Applications of CMS](#)²¹, FHWA indicates that CMS have a large number of applications including, but not limited to, the following:

- Incident management and route diversion
- Warning of adverse weather conditions
- Special event applications associated with traffic control or conditions
- Control at crossing situations
- Lane, ramp, and roadway control
- Priced or other types of managed lanes
- Travel times
- Warning situations
- Traffic regulations
- Speed control
- Destination guidance

Additional approved CMS options for State and local highway agencies noted in [Section 2L.02.02 Applications of CMS](#)²² include:

- Safety messages
- Transportation-related messages
- Emergency homeland security messages
- America's Missing: Broadcast Emergency Response (AMBER) alert messages

FHWA Memorandum Guidelines

The following memorandum's have been issued by FHWA and include additional guidance on DMS use.

- [FHWA Memorandum 2001: Use of CMS](#)²³ notes "The appropriate use of a CMS and other types of real-time displays should be limited to managing travel, controlling and diverting traffic, identifying current and anticipated roadway conditions, or regulating access to specific lanes or the entire roadway."
- [FHWA Memorandum 2002: AMBER Alert – Use of CMS](#)²⁴ notes "If public agencies decide to display AMBER Alert or child abduction messages on a CMS, FHWA has determined that this application is acceptable only if (A) it is part of a well-established local AMBER Plan Program, and (B) public agencies have developed a formal policy that governs the operation and messages that are displayed on CMS."
- [FHWA Memorandum 2003: Use of CMS for Emergency Security Messages](#)²⁵ notes "If public agencies decide to display emergency or security alert messages on a CMS, FHWA has

determined that this application is acceptable if public agencies have developed policies and procedures that govern the messages that are displayed on CMS and their operation.”

- [FHWA Memorandum 2004: DMS Recommended Practice and Guidance](#)²⁶ notes “Providing travel time information is an excellent method of notifying motorists about current conditions in a manner that can be easily interpreted and understood.”

2.3 Prohibited Uses of DMS

Beyond congestion-related and emergency messages noted in [Section 2.2](#) to display on DMS, agency practices regarding what types of messages are allowed to be posted vary widely. This section summarizes uses of DMS prohibited by transportation agencies and from federal policy.

2.3.1 Transportation Agencies DMS Guidelines

Seventeen (17) transportation agency DMS policies or guidelines were reviewed to document prohibited uses of DMS. Prohibitions can vary widely between agency policies or guidelines. However, following is a list of common DMS message uses that were prohibited in the guidelines reviewed.

- Advertisements
- Flashing, animation, etc.
- General/vague/obvious information
- PSA
- Date, time
- General weather information
- Conflicting messages
- Normal recurrent congestion
- Graphics/symbols
- Static sign information
- Bilingual messages
- Weblinks, email, phone information

Table 3 indicates which agency prohibits each of the uses noted above from review of the DMS guideline documents. For example, 15 of the 17 guidelines reviewed noted advertisements are not a permitted DMS use.

In addition, there were other prohibited uses of DMS noted in the guidelines reviewed including:

- Political messages
- Arbitrary detours
- Directions for a specific user group
- Crime or criminal search information
- Repetitive messages
- Prefacing a message with a single word such as: Danger, Warning, or Caution
- Cause of any incident, closure, congestion, or any planned or unplanned traffic event

Table 3: Prohibited Use of DMS from Policy/Guidelines

Agency	Policy/Guideline	Year	Prohibited DMS Message Use											
			Advertisements	Flashing, animation, etc.	General/vague/obvious info	PSA	Date, Time	General Weather Info	Conflicting Messages	Normal Recurrent Congestion	Graphics / Symbols	Static Sign Information	Bilingual Messages	Weblinks, Email, Phone Info
Caltrans	CMS Guidelines ²⁷	2013	X	X	X	X				X	X	X		
FDOT	Displaying Messages on DMS Permanently Mounted on the State Highway System ²⁸	2013	X		X									
IDOT	Permanent DMS Usage Policy	2014	X			X+	X				X		X	X
Iowa DOT	Traffic and Safety Manual ²⁹	2005									X			
MaineDOT	Standard Operating Procedures for the Use of CMS ³⁰	2007	X		X	X	X						X	
MDOT	Portable Changeable Message Sign Guidelines ³¹	2011	X	X									X	
MnDOT	CMS Manual of Practice ³²	2012	X	X		X+								
MoDOT	DMS Policy ³³	2014	X	X									X	
NYSDOT	VMS Guidelines ³⁴	2011	X		X	X					X			X
NYS Thruway Authority	Guidelines for Use of VMS ³⁵	2011	X	X	X				X					
NDDOT	DMS Guidelines	2015											X	
ODOT (Oregon)	Guidelines for the Operation of Permanent VMS ³⁶	2013	X											
PennDOT	DMS Operating Standards	2013	X		X	X	X	X	X				X	X
TxDOT	DMS Message Design and Display Manual ³⁷	2006	X											
WSDOT	VMS Policies, Guidance, Operations	2013	X			X+								
WisDOT	Wisconsin DOT Traffic Guidelines Manual ³⁸	2015	X	X	X		X	X						
Ontario MTO	DMS Policy and Guidelines	2015	X	X									X*	X
Total			15	7	7	7	4	2	3	4	1	6	2	3

+ Not related to traffic safety information

* On same phase of a two-phase message

2.3.2 Federal DMS Guidelines

Through the MUTCD and memorandums, FHWA provides guidance on prohibited uses of DMS.

FHWA MUTCD Guidelines

FHWA MUTCD [Section 2L.02.05 Applications of CMS](#)³⁹ notes “A CMS should not be used to display a safety or transportation-related message if doing so would adversely affect respect for the sign. ‘CONGESTION AHEAD’ or other overly simplistic or vague messages should not be displayed alone. These messages should be supplemented with a message on the location or distance to the congestion or incident, delay and travel time, alternative route, or other similar messages.” According to MUTCD [Section 2L.04.01 Design Characteristics of CMS](#)⁴⁰, CMS shall not include:

- Advertising
- Animation
- Rapid flashing
- Fading
- Dissolving
- Exploding
- Scrolling text
- Other dynamic elements

[Section 2A. Design Signs](#)⁴¹ from the FHWA MUTCD also provides guidance on prohibited CMS use.

- Section 2A.06.14 (Standard) notes “Internet addresses and e-mail addresses, including domain names and uniform resource locators (URL), shall not be displayed on any sign, supplemental plaque, sign panel (including logo sign panels on Specific Service signs), or changeable message sign.”
- 2A.06.15 (Guidance) notes “telephone numbers of more than four characters should not be displayed on any sign, supplemental plaque, sign panel (including logo sign panels on specific service signs), or changeable message sign.”
- 2A.06.16 (Option) notes “Internet addresses, e-mail addresses, or telephone numbers with more than four characters may be displayed on signs, supplemental plaques, sign panels, and changeable message signs that are intended for viewing only by pedestrians, bicyclists, occupants of parked vehicles, or drivers of vehicles on low-speed roadways where engineering judgment indicates that an area is available for drivers to stop out of the traffic flow to read the message.”

FHWA Memorandum Guidelines

In addition, the following memorandums issued by FHWA provide additional guidance on prohibited DMS uses.

- [FHWA Memorandum 2001: Use of CMS](#)⁴² notes “The use of a CMS for the display of general public information or other nonessential messages is discouraged. Only essential messages should be displayed on a CMS.”

- [FHWA Memorandum 2002: AMBER Alert – Use of CMS](#)⁴³ notes “We continue to discourage the display of general public information or other nonessential messages on CMS.”
- [FHWA Memorandum 2003: Use of CMS for Emergency Security Messages](#)⁴⁴ notes “...general messages that are not related to transportation or specific emergency conditions requiring actions by motorists are discouraged. Additionally, it is unsafe to request motorists to write telephone numbers, websites, addresses, or other lengthy information while they are moving.”
- [FHWA Memorandum 2004: DMS Recommended Practice and Guidance](#)⁴⁵ notes “No new DMS should be installed in a major metropolitan area or along a heavily traveled route unless the operating agency and the jurisdiction have the capability to display travel time messages.”

2.4 DMS Guidance Language by Message Request

This section provides a table of example guidance language provided by transportation agency DMS guidelines and federal guidelines by type of message request (e.g. advertising, flashing). For example, as shown in **Table 4**, a request to post advertising on a DMS may be received by a Department of Transportation (DOT) and the MUTCD guidance indicates that “Advertising messages shall not be displayed on CMS or its supports or other equipment.” From a review of the 17 DMS policies or guidelines from this project, 15 policies prohibit advertising on DMS as documented in **Table 3** and an example of text from the MoDOT DMS Policy is noted which matches the guidance from the MUTCD. The purpose of this table is to provide examples of how other agencies approach or have documented how they handle different message requests to assist ENTERPRISE member agencies as they either develop or update DMS guidelines. Example guidance language is provided for the following DMS requests in **Table 4**.

- | | | |
|--------------------------------|------------------------------------|---|
| • Advertising | • Special Events | • Catchy Message |
| • Flashing | • Weather Related Messages | • Safety Messages on Portable DMS |
| • Scrolling Text | • Emergency or Evacuation Messages | • Prioritizing Display of One Message Type Over Another |
| • Animation | • Non-Transportation Messages | • Variable Speed Limits |
| • Graphics | • Missing Persons | • Displaying Speed of Passing Traffic |
| • Safety Messages | • Message in Color | |
| • Public Service Announcements | | |
| • Environmental Messages | | |

Table 4: Transportation Agency and FHWA DMS Messaging Guidance Example Language by Request

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
Advertising	<p>2L.01.03 "Advertising messages shall not be displayed on CMS or its supports or other equipment."</p> <p>2L.04.01 "Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements."</p>	<p>MoDOT DMS Policy</p> <p>"Advertising messages shall not be displayed on DMSs or its supports or other equipment."</p>
Flashing	<p>2L.04.01 "Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements."</p> <p>2L.05.05 "Techniques of message display such as fading, rapid flashing, exploding, dissolving, or moving messages shall not be used. The text of the message shall not scroll or travel horizontally or vertically across the face of the sign."</p>	<p>MoDOT DMS Policy</p> <p>"Techniques of message display such as fading, rapid flashing, exploding, dissolving or moving messages shall not be used."</p>
Scrolling Text	<p>2L.04.01 "Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements."</p> <p>2L.05.05 "Techniques of message display such as fading, rapid flashing, exploding, dissolving, or moving messages shall not be used. The text of the message shall not scroll or travel horizontally or vertically across the face of the sign."</p>	<p>MoDOT DMS Policy</p> <p>"Techniques of message display such as fading, rapid flashing, exploding, dissolving or moving messages shall not be used."</p>
Animation	<p>2L.04.01 "Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements."</p>	<p>MoDOT DMS Policy</p> <p>"Techniques of message display such as fading, rapid flashing, exploding, dissolving or moving messages shall not be used."</p>
Graphics	<p>2L.04.17-18 "Some CMS that employ newer technologies have the capability to display an exact duplicate of a standard sign or other sign legend using standard symbols,</p>	<p>ODOT (Oregon) DMS Guidelines</p> <p>"A single VMS phase may be used to display a standard static sign as allowed by the MUTCD. The image shall be a reasonable approximation of the standard MUTCD sign.</p>

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
	<p>the Standard Alphabets and letter forms, route shields, and other typical sign legend elements with no apparent loss of resolution or recognition to the road user when compared with a static version of the same sign legend. Such signs are of the full-matrix type and can typically display full-color legends. Use of such technologies for new CMS is encouraged for greater legibility of their displays and enhanced recognition of the message as it pertains to regulatory, warning, or guidance information.</p> <p>If used, the CMS described in the preceding paragraph should not display symbols or route shields unless they can do so in the appropriate color combinations.”</p>	<p>Text may be combined with an image of a standard MUTCD sign on a single VMS phase.”</p>
Safety Messages	<p>2L.02.02 "Changeable message signs may be used by State and local highway agencies to display safety messages..."</p> <p>2L.02.04 "Examples of safety messages include 'SEAT BELT BUCKLED?' and 'DON'T DRINK AND DRIVE.'"</p> <p>2L.02.05 "When a CMS is used to display a safety or transportation related message, the message should be simple, brief, legible, and clear. A CMS should not be used to display a safety or transportation-related message if doing so would adversely affect respect for the sign..."</p> <p>2L.02.06 "When a CMS is used to display a safety, transportation-related, emergency homeland security, or AMBER alert message, the display format shall not be of a type that could be considered similar to advertising displays."</p>	<p>FDOT DMS Policy</p> <p>"Public information messages that assist the Department in improving highway safety and reducing congestion may be used. These messages shall only be displayed when any of the following conditions are met: a) Display of the message will have a positive effect on highway safety and congestion in the area, b) The message is a supplement to a specific national or statewide highway safety media campaign on the same topic. The total duration of any such highway safety campaign message shall not exceed two hours per day, shall not be displayed during peak hour travel periods, shall not last more than two weeks in duration, and shall not exceed six events per year. The message display must be approved by the State Traffic Engineer prior to displaying the message."</p>

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
Public Service Announcements	2L.02.02 "Changeable message signs may be used by State and local highway agencies to display...transportation-related messages..."	<p>TxDOT DMS Policy includes two candidate policy statements for consideration at state and regional levels regarding PSAs.</p> <p>Policy #1 prohibits PSAs, stating "Messages designed to relay a PSA (e.g., ridesharing, enforcement actions, telephone hotlines, potential transit strike notices, etc.) are not permitted on DMSs, nor are messages designed to increase public awareness of a specific topic not associated with traffic or transportation."</p> <p>Policy #2 allows PSAs, stating "PSAs may be displayed on a limited and short-term basis. DMSs should only be used only randomly and sparingly for PSAs so that the primary purpose of the signs will not be degraded. PSAs shall not be displayed in urban areas during the peak periods, and the total duration of the display should not exceed [number] hours per day or more than [number] days per month at any permanent DMS location. PSAs shall not be displayed prior to the approval of the [title]. The text for PSA messages must be approved by the [title]."</p>
Environmental Messages	2L.02.04 "Examples of transportation-related messages include ... 'OZONE ALERT CODE RED—USE TRANSIT.'"	<p>ODOT (Oregon) DMS Guidelines</p> <p>"Messages related to air quality or alternative transportation options may be displayed during the 24-hour period preceding an air quality alert day as determined by the Region</p> <p>Traffic Engineer/Manager or designated representative in cooperation with the Department of Environmental Quality."</p>
Special Events	<p>2L.02.01 "Changeable message signs have a large number of applications including, but not limited to, the following:...Special event applications associated with traffic control or conditions"</p> <p>2L.02.04 "Examples of transportation-related messages include 'STADIUM EVENT SUNDAY,</p>	<p>MaineDOT CMS Standard Operating Procedures</p> <p>"Special Events - to advise motorists of impacts on travel due to major events (fairs, concerts, air shows, etc.). No reference to the specific event shall be permitted on the CMS, as this would be considered advertising. Messages shall be restricted to information that assists drivers in making decisions on how to avoid the potential</p>

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
	EXPECT DELAYS NOON TO 4 PM''	traffic impacts. Examples of acceptable messages are: Time of anticipated delay, Alternate routes, Availability of parking (shuttles), Travel lane selection, Time of day that event will impact traffic"
Weather Related Messages	2L.02.01 "Changeable message signs have a large number of applications including, but not limited to, the following:...Warning of adverse weather conditions"	Iowa DOT Traffic and Safety Manual A primary use of "permanently mounted CMSs" is for "Environmental problems – Caused by acts of nature such as fog, floods, ice, snow, etc."
Emergency or Evacuation Messages	2L.02.02 "Changeable message signs may be used by State and local highway agencies to display...emergency homeland security messages..."	FDOT DMS Policy The highest priority message is for "Conditions which require motorists to take action or alter their driving, such as emergency events including evacuations or closures required by FDOT, the State Emergency Operations Center, state and local law enforcement, the military, or the Department of Homeland Security."
Non-Transportation Messages	No specific allowance or prohibition stated.	WisDOT DMS Policy References a Memorandum of Understanding with the Wisconsin Department of Natural Resources that details the use of DMS for fire prevention purposes in high risk areas.
Missing Persons	2L.02.02 "Changeable message signs may be used by State and local highway agencies to display...America's Missing: Broadcast Emergency Response (AMBER) alert messages."	Iowa DOT Traffic and Safety Manual A secondary use of "permanently mounted CMSs" is for "AMBER Alerts – to supplement law enforcement efforts to recover abducted children."
Message in Color	2L.04.14-16 "The colors used for the legends and backgrounds on changeable message signs shall be as provided in Table 2A-5. If a black background is used, the color used for the legend on a changeable message sign should match the background color that would be used on a standard sign for that type of legend, such as white for regulatory, yellow for warning, orange for temporary traffic control, red for stop	ODOT (Oregon) DMS Guidelines "The colors used for the legends and backgrounds on VMS shall be as provided in the table of 'Common Uses of Sign Colors'. (See Table 2A-5 of the 2009 MUTCD, or equivalent table in superseding MUTCD)."

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
	<p>or yield, fluorescent pink for incident management, and fluorescent yellow-green for bicycle, pedestrian, and school warning. If a green background is used for a guide message on a CMS or if a blue background is used for a motorist services message on a CMS, the background color shall be provided by green or blue lighted pixels such that the entire CMS would be lighted, not just the white legend.</p> <p>2L.04.17-18 "Some CMS that employ newer technologies have the capability to display an exact duplicate of a standard sign or other sign legend using standard symbols, the Standard Alphabets and letter forms, route shields, and other typical sign legend elements with no apparent loss of resolution or recognition to the road user when compared with a static version of the same sign legend. Such signs are of the full-matrix type and can typically display full-color legends. Use of such technologies for new CMS is encouraged for greater legibility of their displays and enhanced recognition of the message as it pertains to regulatory, warning, or guidance information.</p> <p>If used, the CMS described in the preceding paragraph should not display symbols or route shields unless they can do so in the appropriate color combinations."</p>	
Catchy Message	2L.02.05 "When a CMS is used to display a safety or transportation related message, the message should be simple, brief, legible, and clear. A CMS should not be used to display a safety or transportation-related message if doing so would adversely affect respect for the sign..."	<p>MoDOT DMS Policy</p> <p>"MoDOT has developed an Electronic Message Boards Communications Plan to provide safety and public service information on all MoDOT DMSs... These messages will provide variety and guard against message boredom."</p>

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
Safety Messages on Portable DMS	<p>6F.60.01⁴⁶ "In most cases, portable changeable message signs follow the same provisions for design and application as those given for changeable message signs in Chapter 2L."</p> <p>6F.60.31⁴⁷ "When portable changeable message signs are used in TTC zones, they should display only TTC messages."</p>	<p>NYSDOT DMS Policy</p> <p>"The RTE may authorize the limited use of PVMS at the request of other public agencies to display general transportation or public safety information to the public..."</p>
Prioritizing display of one message type over another	<p>2L.02.03 "State and local highway agencies should develop and establish a policy regarding the display of [safety messages, transportation-related messages, emergency homeland security messages, and America's Missing: Broadcast Emergency Response (AMBER) alert messages]."</p>	<p>ODOT (Oregon) DMS Guidelines</p> <p>"Daily and seasonal occurrences or site specific operations objectives may alter the priority for displaying messages. The standard priority of displayed messages is the following:</p> <ol style="list-style-type: none"> 1. Drawbridge operations, road or ramp closures, and emergency situations; 2. Incident or crash; 3. Lane control or queue warning messages; 4. Adverse weather or environmental conditions and related regulations such as chain restriction information, icy conditions, and tsunami warnings; 5. Construction or maintenance operations; 6. AMBER Alert messages; 7. Traffic operations information associated with special events such as car shows or sports events; 8. Travel time information; 9. Air quality alerts as approved by the Region Traffic Engineer/designee; 10. Public Service Announcements approved by the State Traffic-Roadway Engineer; 11. Test messages."
Variable Speed Limits	<p>2L.02.01 "Changeable message signs have a large number of applications including, but not limited to, the following:...speed control"</p> <p>2B.13.18⁴⁸ "A changeable message sign that changes the speed limit for</p>	<p>TxDOT DMS Message Design and Display Manual</p> <p>"The DMS message can be displayed to supplement existing static speed limit signs. The DMS message is not enforceable and shall not be used in place of a static sign.</p>

Request is for...	MUTCD Guidance Language <i>See MUTCD Chapter 2L unless noted</i>	Example DMS Policy/Guideline Language <i>See Table 1 for DMS Policy/Guideline</i>
	traffic and ambient conditions may be installed provided that the appropriate speed limit is displayed at the proper times.”	However, the DMS can be used to display advisory speed limits without static advisory speed limit signs.”
Displaying speed of passing traffic	2L.02.01 "Changeable message signs have a large number of applications including, but not limited to, the following:...speed control" 2B.13.19 ⁴⁹ "A changeable message sign that displays to approaching drivers the speed at which they are traveling may be installed in conjunction with a Speed Limit sign.”	New York State (NYS) Thruway Authority Guidelines VMS Notes that this is "A special type of VMS not addressed in the Guidelines, except when used for other than their customary applications..."

3.0 DMS Related Studies

Throughout the duration of this project, a number of related DMS message studies were found through a combination of an online search and input from ENTERPRISE members. This section provides a summary of the DMS related studies or efforts found.

- [Impact of Roadside Graphic Displays on Drivers](#)⁵⁰ (2016)
Caltrans District 4 requested approval from FHWA to post graphical images of routes on VMS associated with active traffic management system on I-80. FHWA rejected the request, indicating that research on this topic needs to be done before they can allow graphical images on the signs. This document provides examples of roadside graphic displays, a summary of survey results of state and international DOTs and a literature review. Conclusions from the document include:
 - VMS graphic signs are deployed, for example, in Ontario. They have found full color images and symbols enable drivers to easily recognize important road safety information, safely react to traffic conditions, and choose better routes, improving overall traffic flow.
 - From review of the document [“Use of Symbols and Graphics on DMS – Texas Transportation Institute \(2009\)”](#)⁵¹ it was derived that a graphic display improves the ability of drivers to identify the lanes available to drive in through a problem area.
 - As far as the distraction caused by the video displays, the studies that have been conducted show convincingly that roadside advertising is distracting and that it may lead to poorer vehicle control. However, the evidence is only suggestive of, although clearly consistent with, the notion that this could in turn result in crashes. Studies providing direct evidence that roadside advertising plays a significant role in these distraction-based crashes are currently not available.
- Full Color DMS Technology for the Iowa Council Bluffs Interstate System (CBIS) Program (2016)
This document summarizes the reconfiguration of I-80/I-29 to replace system interchanges with a dual-divided system consisting of express lanes and local lanes separated by median barriers. The original ITS Master Plan outlined the deployed technology components to establish the ITS system for the corridor including several traditional technologies such as fiber optic and wireless communications, road weather information systems, closed circuit television, vehicle detector units, and traditional amber DMS. Revisions to the CBIS Concept of Operations evaluated three solutions to meet the operational and traffic management needs of the future dual-divided freeway system and documented the operational needs and justification to select Full Color DMS technology. The Full Color DMS provides greater legibility and enhanced recognition as it pertains to regulatory, warning, or guidance information and provides the flexibility to do more and be clearer with messages as drivers approach the unique geometric configuration and complex static signing.

- [DMS Performance Measurement](#)⁵² (2015)

The effectiveness of DMS messages is typically based on performance metrics such as changes in vehicle speeds, driver diversion rates, secondary crash occurrence, and reliability of the displayed information. Accuracy of data displayed on DMS is critical if drivers are expected to trust the information enough to use it to make diversion decisions. Analysis of the performance of DMS systems may potentially provide operators with misleading performance measures unless the quality of the DMS message data is carefully considered. This document compares DMS message accuracy with the actual observed conditions on DOT interstate roadways. This research provides the framework for a data reduction procedure which will allow DMS operators to more effectively evaluate system performance. The research also suggests alternate measures that may be used to assess DMS performance where field data is not required.
- [Exploring Travelers' Behavior in Response to DMS Using a Driving Simulator](#)⁵³ (2013)

This research study reviews the effectiveness of a DMS using a driving simulator. Over 100 subjects from different socio-economic and age groups were recruited to drive the simulator under different traffic and driving conditions and various travel-related DMS messages. The subjects drove between a specified pair of origin and destination while choosing their own route in a network that included road signs, traffic signals, three-dimensional buildings and trees, and other roadside objects. Their driving behavior, including changes in driving speed, route choice and diversion, and travel time perception in the presence of a DMS were studied. In addition to the driving simulator experiment, a stated preference analysis was conducted through three sequential survey questionnaires to better understand drivers' perceptions of the efficiency-related attributes. The study concluded that a DMS is a safe device, since drivers did not reduce their speed significantly to read the DMS contents. Furthermore, quantitative information provided by the DMS affected drivers' route choice significantly and drivers were quite sensitive to travel time changes.
- [USDOT ITS Joint Program Office T3 Webinar: Effectiveness of Disseminating Traffic Messages on DMS](#)⁵⁴ (2014)

This webinar discusses how to design DMS messages effectively so they are easily understood by drivers. The discussion includes the effectiveness and safety of both traffic and non-traffic related messages displayed on DMS. In addition, how graphic-aid messages help drivers better understand the messages and how New Jersey Turnpike Authority uses full color/full matrix DMS to enhance its traveler information program is reviewed.
- [NCHRP Synthesis 383 Changeable Message Sign Displays During Non-Incident, Non-Roadwork Periods](#)⁵⁵ (2008)

Guidelines to design and display CMS messages during non-incident/non-roadwork periods were not readily available prior to this document. This synthesis summarizes the basic principles for effective CMS message design and display from a literature review and documents message design and display guidelines and policies and the survey results for displaying CMS messages

for non-incident/non-roadwork messages regarding congestion, speed, safety campaign, PSAs, traffic laws and ordinances, and AMBER alerts. In addition, experiences, lessons learned, concerns, and challenges for displaying CMS messages during non-incident/non-roadwork periods are summarized. The survey found that Traffic Management Center (TMC) decisions to display messages on CMS signs instead of leaving the signs blank was mainly a result of management preference, not objective research data. For example, there is a trend in urban areas to use travel time messages as an alternative to leaving the sign blank during non-incident/non-roadwork periods, however, there is little uniformity in message format and TMCs are experiencing difficulty accurately measuring and displaying travel times during rapidly deteriorating conditions. Also, few TMCs know the public's attitude about travel time messages.

- [AMBER, Emergency, and Travel Time Messaging Guidance for Transportation Agencies](#)⁵⁶ (2004)
Transportation agencies have developed various policies regarding the use of the CMS and the FHWA has provided policy guidance regarding appropriate uses of CMS, however, this guidance has been focused on acceptable uses rather than operational guidance. Consequently, operational practices across the nation vary, based on locally identified needs and procedures. This study assists and directs transportation officials in planning, designing, and providing traveler information using CMS. Specifically, these guidelines address messaging for travel time information, emergency or security warnings, and child abduction (AMBER) alerts.
- [Changeable Message Sign Operation and Messaging Handbook](#)⁵⁷ (2004)
This handbook is written for state, regional, and local transportation agency personnel who have responsibility for the operation and message design for large CMSs or portable CMSs. It is designed to help both new and experienced CMS users and provides specific information for entry-level personnel, reminders for experienced personnel, and high-level information for managers.

Studies conducted jointly by FHWA and the TMC Pooled Fund Study have explored the effectiveness of displaying non-traffic messages related to public service announcements and safety messages on DMS based on traveler survey responses, as described below. The studies summarized below may assist agencies considering the display of travel times, safety messages, and/or PSAs on DMS given the findings of this research.

- [Public Perception of Safety Messages and Public Service Announcements on Dynamic Message Signs in Rural Areas](#)⁵⁸ (2016)
This study provides insight regarding the usefulness and effectiveness of using DMS for safety and PSA messages. This study intercepted travelers on four rural interstate corridors in five states to ask travelers about public service announcements and safety messages posted on DMS upstream of the intercept location. Awareness, understanding, behavior change as a result of viewing the message, and traveler opinions on DMS messaging were examined. The analysis supports the display of PSAs and safety messages given 73 percent of surveyed travelers in rural areas support the use of DMS to display PSAs and safety-related information in general, and 73

percent also think DMS are the best way to communicate that information. Findings also imply that displaying safety messages and PSAs more often would not be detrimental since 23 percent of survey respondents reported behavior changes after reading the safety message on the DMS. Given high compliance rates, e.g., with seatbelt use, a low number would be expected, but even a small percentage of travelers changing behavior could have positive safety impacts. Further, respondents that did not change their behavior noted anecdotally that reading the safety message made them more conscious of driving in a safer manner.

- [Effectiveness of Safety and Public Service Announcement Messages on Dynamic Message Signs](#)⁵⁹ (2014)

This study examined the effectiveness of safety and PSA messages on DMS, but in urban areas, by surveying travelers in four cities. The majority of respondents said that safety and PSA messages on DMS are useful, with some noting that those messages are more effective on DMS as compared to other media. The majority of survey respondents indicated that more “threatening” messages, e.g., “Click it or ticket or get \$100 fine” or “100 deaths this year on Texas road,” would affect their driving behavior. Analysis showed that the messages were considered useful if the driver encountered them often.

- [Driver Use of Real-Time En-Route Travel Time Information](#)⁶⁰ (2009)

This study assessed the driver impacts of en route real-time travel time/delay/speed information on DMS, defined an effective way to provide en route real-time travel time information, and offered guidance to practitioners for delivering en route travel time information. The study examined what information should be disseminated and where, how this information should be formatted, and operational characteristics of the information delivery methods and systems.

4.0 Survey

A survey was conducted to add to the DMS messaging information gathered in the previous sections of this report. The purpose of the survey was to collect information on current and anticipated future requests that transportation agencies receive to post on DMS and the process or policy for accepting or rejecting a DMS request.

The survey was administered online via SurveyMonkey and was opened to respondents in October 2016. The survey was distributed to state, provincial, and local DOT representatives that included [TMC Pooled Fund Study Members](#)⁶¹.

The questions as presented on the survey and received responses are included in [Appendix A](#). The following information summarizes the survey responses.

In total, responses were obtained from the following 18 agencies.

- Arizona DOT (ADOT)
- Illinois IDOT (IDOT)
- Kansas DOT (KDOT)
- Michigan DOT (MDOT)
- Minnesota DOT (MnDOT)
- Missouri DOT (MoDOT)
- Montana DOT (MDT)
- Nevada DOT (NDOT)
- North Dakota DOT (NDDOT)
- Ohio DOT (ODOT (Ohio))
- Oklahoma DOT (ODOT (Oklahoma))
- Ontario Ministry of Transportation (MTO)
- Oregon DOT (ODOT (Oregon))
- Pennsylvania DOT (PennDOT)
- Regional Transportation Commission (RTC) of Southern Nevada/ Freeway and Arterial System of Transportation (FAST)
- Tennessee DOT (TDOT)
- Utah DOT (UDOT)
- Washington State DOT (WSDOT)

Respondents indicated that they receive message requests from many different entities. Based on the review of responses **most DMS requests are received from law enforcement (17 agencies), the governor's office (8 agencies), environmental agencies (8 agencies), neighboring states (6 agencies), or local agencies (6 agencies)**. Other entities that transportation agencies receive requests from included: special event groups, the public, trucking industry, National Weather Service (NWS), Canadian Border Patrol, U.S. Customs, transit groups, hospitals, charities, and Fish, Wildlife, and Parks (FWP).

Eleven (11) agencies noted an increase in the number of DMS requests in the past few years. A few agencies noted this increase of requests is due to more coordination with law enforcement. MDT noted that as the number of DMS deployments have increased, awareness of the ability to post messages has also increased. Six (6) agencies noted no difference in the number of DMS message requests received, **none of the agencies that responded indicated that they have been receiving a lower number of DMS requests in the past few years.** PennDOT noted that the number of DMS message requests has stayed consistent due to DMS operating standards.

Nine (9) agencies indicated that they have been receiving requests in the past few years from entities they had not previously. These included environmental agencies, sheriff's department, Secretary of State, National Weather Service, and the Department of National Resources (DNR). **Ten (10) agencies**

responded that they have not received requests in the past few years from any different agencies than in previous years.

Approximately half of the respondents (8) indicated that they anticipate receiving DMS requests from agencies that do not currently make requests. Respondents indicated that there is always a group or someone that wants their venue or campaign out to the public. Also, as transportation agencies expand their use of DMS, others may see this is an opportunity to request a message.

Almost all agencies (17) that responded to the survey have a policy or process that is followed for accepting, rejecting, and/or prioritizing DMS message requests. In addition, ***most of the agencies have a prioritized list of how to address conflicting DMS message requests.*** See [Section 2.2.1](#) for additional information on prioritizing DMS message requests. Most of the responding agencies also indicated that they have a team or committee to review the request and then approve or reject the request. For example, each request at MoDOT is evaluated individually by a team including the Statewide Traffic Department, Communication Division, and the TMC manager. MnDOT responded that all messages that are traffic safety related are approved by the Regional TMC Manager and Traffic Safety staff. MnDOT received a request from the Bureau of Criminal Apprehension to expand the AMBER Alert policy for missing children to include Silver Alerts for missing adults. There was a mutual decision to not expand the program to include Silver Alerts from MnDOT.

Thirteen (13) of the respondents also noted that they have a process or policy for developing or approving the content of messages that are posted on a DMS. A team or committee in most agencies approves the message content and reviews policies for message standards and formats. As an example, a team meets monthly to discuss PSA message content at MoDOT.

Ten (10) agencies indicated that they have an official DMS policy or guidelines. See [Section 2.0](#) for a list of DMS policies and guidelines reviewed as part of this study. A benefit noted by several agencies for having a policy or guidelines is statewide consistency in DMS messaging as well as a strong foundation for staff decision making. However, one agency noted a challenge in keeping the guidelines or policy document up-to-date.

Seven (7) of the respondents noted that they have developed performance measures on DMS usage or they have collected data to measure the effectiveness of DMS messages. ADOT distributed a survey and the results indicated that DMS are very effective, especially travel time messages. MDOT collects monthly DMS usage information but does not measure effectiveness. MnDOT logs all permanent DMS messages, however performance measures or reports are not available. Ohio has utilized the [FHWA Tool for Operations Benefit Cost Analysis \(TOPS-BC\)](#)⁶² for DMS.

Eight (8) agencies noted that they have not been approached to post advertising on DMS, while 7 agencies noted that they have been approached. These requests were not approved by the agencies. The MUTCD prohibits advertising on DMS and as noted in Table 3 fifteen (15) transportation agencies also prohibit advertising as documented in their DMS guidelines.

DMS displays are guided by the MUTCD and in-vehicle displays in connected vehicles may not be guided by the MUTCD, therefore, conflicts may arise. **Most of the agencies (11 respondents) indicated they are not planning for connected vehicle conflicts with DMS.** However, a few agencies indicated that they are aware of the issues and are monitoring it. See [Section 6.0](#) for additional information on potential implications of connected and automated vehicles with DMS messaging.

Eleven (11) of the respondents indicated that they have not changed their approach to deploying or replacing DMS with changes in the industry (e.g. connected vehicles, the increased use of web-enabled cell phones, or the increased use of in-vehicle navigation systems with real-time information). MoDOT indicated that rather than attempting to replace all DMS at the end of life cycle, retrofitting the DMS by replacing the electronic components while keeping the structures has been investigated. This is a lower cost method that may extend the life until DMS are no longer needed. WSDOT is taking advantage of social media where they do not have DMS coverage.

Seven (7) of the agencies indicated that their agency is encouraged to increase utilization of DMS (such as posting PSAs) when time critical messages (e.g. alerts of crashes, delays, travel times, detours) are not needed. Some agencies noted executive leadership will encourage display of traffic safety messages so DMS are not blank. ODOT (Oregon) limits PSAs in terms of how many hours a day they can be displayed, however travel times are displayed 24 hours. MDT's intention is to provide messages on a continual basis for deployed signs. If signs are not displaying incident, work zone, or condition information, MDT posts PSAs associated with national campaigns or state focused initiatives such as Vision Zero (reduce fatalities and serious crashes). **Eight (8) agencies indicated that they limit sign use for concern that traffic messages might become less effective and travelers will ignore the messages.**

5.0 Potential for Public-Private Partnerships for DMS Deployment and Operations

As transportation agencies face funding constraints among many competing priorities, opportunities may exist for public-private partnerships. For example, some state DOTs have partnered with private companies to sponsor 511 systems and traveler information websites (e.g. ODOT (Ohio) and WSDOT), rest areas (e.g., Virginia DOT (VDOT) partners with Geico Insurance), and freeway safety patrols (e.g. ODOT (Ohio) and 11 other states partner with State Farm Insurance). These sponsorships are generally advertised directly on DOT traveler information websites, static roadside signage, or service vehicles, as shown in **Figure 2**. This may include the name of the sponsoring entity on static roadside signs, on the traveler information website, and/or in messages. As noted in [Section 4.0](#), State DOTs that are approached about the possibility of advertising on their deployed DMS typically reject those requests, citing their agency DMS policy or the MUTCD; specifically, the [MUTCD Section 2L.01.03](#)⁶³ states "Advertising messages shall not be displayed on changeable message signs or its supports or other equipment."

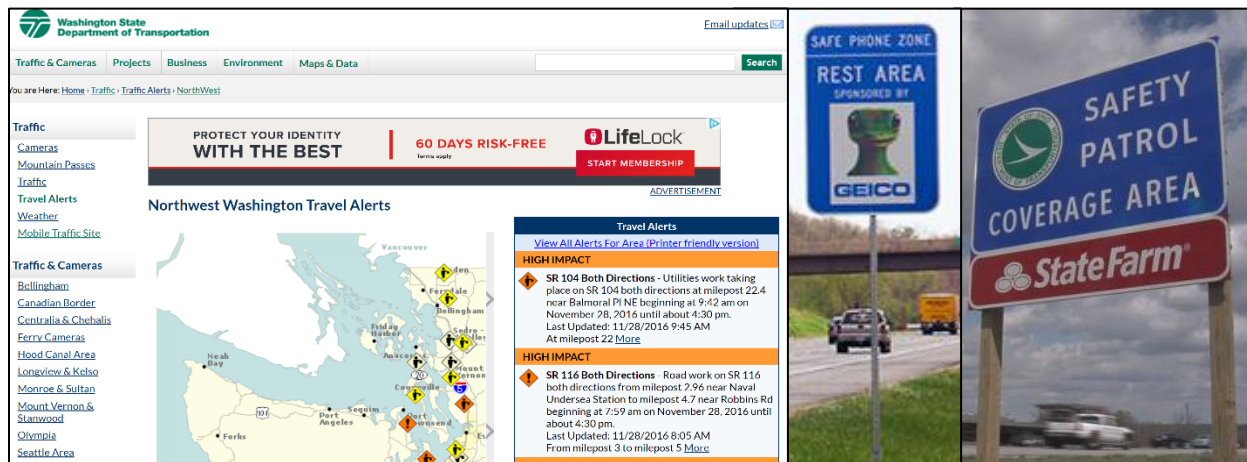


Figure 2. Examples of advertising private sponsors of a DOT traveler information website (WSDOT, left), rest areas (VDOT, center), and safety patrol (ODOT (Ohio), right)

TxDOT, however, has received a more unique proposition from the private sector, in which the private sector company is willing to fund the installation of 400 color/full matrix DMS in exchange for the provision of corporate logo sponsorships on a portion of the display. Given the potential for deploying additional signs to assist travelers than the agency would be able to do otherwise, TxDOT has applied to FHWA for a request to experiment. This request to experiment was approved and is examining the potential tradeoffs of providing traveler information alongside sponsorship logos via new DMS that would not have otherwise been possible, versus the possibility that the sponsorship logos will distract drivers or diminish the value of information displayed on DMS.

Certainly, the findings of this experiment could have wide-ranging implications for other agencies, particularly if it resulted in a modification of the MUTCD to allow for advertising under certain conditions. Agencies might then be pressured to display advertisements as a new funding source, which

may require upgrades of DMS and then compete for space to display traffic messages or require more brevity in message content. That said, one could argue that the roadside already contains many advertisements both outside the right-of-way in the form of billboards, and in the right-of-way with sponsors for “Adopt A Highway” litter campaigns, 511 systems, rest areas, and services at exits. Further, without regulations, connected and automated vehicles could contain in-vehicle displays for advertising alongside other safety or traffic-related messages.

Finally, although agencies have been increasingly involved in public-private partnerships, the importance of contracts should be re-emphasized. The DOT must be certain to fairly prioritize its needs against those of the private sector given the different goals each entity has. As noted in Chapter 5 of the FHWA report, [Next Generation Traveler Information System \(NGTIS\): A Five Year Outlook](#)⁶⁴, “public sector entities should be very clear on the roles they wish to play, and the goals that they are seeking to meet, when performing vendor selection assessments and negotiations.” Contract detail is also particularly important, especially if the private sector is providing the up-front costs for DMS since operational conditions or policies could change before the conclusion of a contract, for example.

6.0 Potential Implications of Connected and Automated Vehicles on DMS Messaging

Given the evolution for providing traveler information as technology advances, particularly for connected and automated vehicles, transportation agencies may at some point want to examine the utility of DMS messages as an information dissemination mechanism. Eventually, in-vehicle messages or use of smart phone applications may become a more efficient and less costly way to provide more detailed traveler information and other messages discussed in this study to travelers than DMS. This chapter discusses possible considerations that agencies may encounter as connected and automated vehicles emerge and become more prevalent on roadways.

6.1 Potential for Connected and Automated Vehicle In-Vehicle Messaging

Connected and automated vehicles are widely expected to revolutionize travel as new and enhanced features, applications, and vehicles that provide better data continue to be deployed. Already, smart phones are providing in-vehicle traveler information to drivers in a similar fashion as may occur in connected and automated vehicle systems.

It can be assumed that connected and automated vehicles will increasingly be equipped and evolve toward ingesting information from numerous sources in order to make more informed recommendations and decisions for drivers. This is likely to include information related to work zones, weather, incidents, special events, road closures, congestion, and travel times which might be gathered from a variety of sources besides a transportation agency's traveler information system.

Travelers in a vehicle requiring some form of driver engagement will require more traveler information than those in a more automated vehicle that simply takes passengers to a destination; an automated vehicle will simply use available data and information and not necessarily need to inform the passenger. In either case, the vehicle may access data either from the DOT or from other traveler information sources which may simply duplicate information that is posted on a DMS. Recognizing the benefits of other traveler information applications, some state DOTs have already partnered with applications such as WAZE to exchange information that could result in improved traveler information to drivers. Connected and automated vehicles are likely to access this type and perhaps even more detailed traveler information which would allow far broader geographic coverage for traveler information dissemination than a more limited network of DMS.

Additionally, connected and automated vehicles are expected to use vehicle-to-vehicle (V2V) communications. These exchanges could be used to automatically detect slowdowns and stopped traffic. On-board connected vehicle safety applications may provide alerts and warnings to drivers and possibly even utilize automatic braking capabilities for crash-imminent situations.

The exact nature of whether and how connected and automated vehicles will provide in-vehicle information to travelers is not certain and will not necessarily be uniform. Some connected vehicle systems may only provide audible, haptic, or graphical alerts and warnings. Other systems may be able to display or project all images, text, and graphics which would allow for the provision of many types of more detailed information.

6.2 Potential for Connected and Automated Vehicle Impacts on DMS Messaging

The following two sections discuss 1) how connected and automated vehicles could reduce the need for DMS while also presenting a case for continuing DMS operations, and 2) the potential for conflicts between DMS and in-vehicle messaging.

6.2.1 Potential for Connected and Automated Vehicle Impacts on the Need for DMS

Future DMS operations might initially seem less needed with the spread of connected and automated vehicles but may still be necessary. Most of the information currently provided to travelers via DMS becomes less necessary as the vehicle, and other applications used by drivers, evolve to make recommendations and decisions. For instance, in a fully automated vehicle state, DMS are presumably unnecessary as the vehicles would likely be able to receive information from the DOT via other means of communication and, with no drivers, will process available data to safely transport passengers to their destination in what is calculated to be the most efficient way. Passengers in automated vehicles may still have an interest in some types of information that is currently posted to DMS, but this information could again be communicated to travelers via other means and may come from sources other than the DOT. Even today, much of the information posted on DMS is already available via smart phone applications. The continued evolution of vehicle and smart phone technologies would seem to indicate the DMS could be phased out as a redundant provider of en route information. Through partnerships with applications like WAZE, agencies already have a mechanism for pushing DOT information about incidents, road work, congestion, and special events to vehicles via smart phone applications, as shown in **Table 5**. There is no reason to believe that connected and automated vehicles could not similarly receive, process, and display this information, as necessary.

Table 5: DMS Messaging Type and Availability to Travelers by Other Current and Future Means

DMS Message Type	Current State		Potential Future State with DOT Input		
	DOT and Private Smart Phone Applications	DOT and Commercial Radio Broadcasts	Future Smart Phone Applications	In-Vehicle Connected Vehicle Applications	Built-in Automated Vehicle Functions
Congestion / Queues	X	X	X	X	X
Travel Times	X	X	X	X	X
Incidents	X	X	X	X	X
Special Events		X	X	X	X
Work Zones	X	X	X	X	X
Diversion Routes	X	X	X	X	X
Road Closures	X	X	X	X	X
Variable Speed Limits			X	X	X
Weather Events	X	X	X	X	X
Safety Messages			X	X	X
Public Service Announcements			X	X	X
AMBER/Silver/Blue Alerts		X	X	X	X

There are a few major reasons that agencies would wish to continue DMS operations for the foreseeable future. First, DMS are one of the few mechanisms that agencies can control the message given to travelers. Smart phone applications and in-vehicle systems do not necessarily prioritize or disseminate the same information to travelers that is deemed most important by agencies. Connected and automated vehicle penetration rates can be expected to be relatively low for some time. Therefore, in the near-term, the more appropriate limiting factor for maintaining DMS operations will be the number of traditional vehicles that are not equipped with aftermarket devices or smart phone applications that can reliably communicate the types of information currently displayed on DMS. The availability of the information does not directly mean all travelers will use or be able to access it. A logical question is “What connected and automated vehicle penetration rate might be necessary to render DMS unnecessary?” and “Can or will drivers of unequipped vehicles access and use smart phone applications that duplicate the functions of DMS?” Ultimately, one can argue that it is the responsibility of the DOT to support all travelers, and an agency would want to be comfortable that all travelers have access to traveler information via other means before phasing out DMS operations. To that end, the FHWA report [Next Generation Traveler Information System \(NGTIS\): A Five Year Outlook](#)⁶⁵ acknowledges explosive growth in new technologies while noting that more traditional means of en route information remains most popular, with radio and DMS being the first and second leading sources for travelers and mobile sites and smart phone applications coming in third place.

While the possibility exists for message types displayed on DMS to reach travelers on an in-vehicle display that is either a smart phone or part of the vehicle, some message types may be lost in transition. Public service announcements and safety messages are examples of message types that could be lost without DMS. A similar concern exists for AMBER, Silver, and Blue Alerts, however some smart phones now automatically receive push notifications for some of these instances. Other message types will require direct DOT communication to in-vehicle systems, such as variable speed limit messaging; in these operational scenarios, it is unlikely that signs used for that purpose can be removed for many years.

6.2.2 Potential for Conflicts Between DMS and In-Vehicle Messaging

The connected vehicle has the potential to have more data available to it, using information from the DOT as supplemental. This provides greater opportunities to have more detailed messages that are more specific for their connected vehicle operating characteristics. However, an area of potential concern in a connected vehicle environment where messages are displayed on the roadside and also broadcast for in-vehicle messaging is the possibility of conflicting messages. In this instance, the connected vehicle might provide the driver with vehicle-specific information that could conflict with roadside static or dynamic signage. For example, the safe speed of a vehicle traversing a curve is different for a large tractor trailer and a sports car; however, the infrastructure generally provides the lower safe speed. As such, the content of message posted on DMS and in-vehicle messaging may have to be presented in a way that reduces driver confusion.

Even when the roadside and in-vehicle message to the driver is the same, differences in vehicle capabilities for presenting information to drivers could cause inconsistencies and confusion that create a conflict or distraction to drivers. For example, in advance of a left curve, a standard MUTCD advanced

warning sign is a yellow background with a left curving arrow; however, a connected vehicle may present this information differently. Some connected vehicles, lacking a display could present audio messages, e.g., “road curves to the left”, which could be an unnecessary distraction to a driver, given the presence of a static sign. Other connected vehicles could visually warn the driver with either a primitive warning light indicating a left curve ahead or a more sophisticated graphic on a display screen. Even with capabilities to present drivers with a sophisticated graphic, it is not clear that warnings for a curve would match with MUTCD signing standards. In summary, the differences in how information is presented to the driver on the roadside via static signs or DMS versus in the vehicle could create conflicts even when the same basic information is being communicated.

6.3 Assessing the Viability of Renewing and Expanding Systems

As new technologies emerge and existing systems evolve, it is productive to examine the viability and usefulness of legacy systems. In this case, as in-vehicle messaging and automated vehicles emerge to process new, available data for en-route traveler information, when will the costs of new deployments, operations, and maintenance for DMS outweigh the benefits? Chapter 5 of the FHWA report, [Next Generation Traveler Information System \(NGTIS\): A Five Year Outlook⁶⁶](#), presents an overview of various frameworks and processes for agencies to examine their business practices and approaches to providing traveler information.

As vehicles evolve to generate and consume more data and information from non-DOT sources, agencies may have to re-assess their role in providing traveler information, including DMS messaging. The FHWA NGTIS report argues that adaptability is the key for agencies moving forward. Given that change is inevitable, operations must be designed to evolve and support routine reviews in order to make the right decisions at the right time based on customer and agency needs. The potentially rapid rollout of connected and automated vehicles reinforce the need for agencies to routinely reassess their needs and core business functions. Strategy management and road mapping provide two business planning models for agencies to determine if and when to phase out current systems like DMS, by providing a broader context and systematic approach to the decision. For example, knowing the goals of an agency, the role of DMS in supporting those goals should be regularly examined to assess their overall effectiveness. Numerous resources like the FHWA Systems Engineering for Intelligent Transportation Systems are available to provide specific information for system replacement and phase-out. These analyses can help determine whether to continue providing ongoing funding and investment for DMS operations.

Conceivably, numerous scenarios are possible for the future of deploying and operating DMS. The future decisions for deploying and operating DMS are likely to vary by agency and possibly within each agency. Three general, potential future scenarios are presented below that could be adopted statewide, within specific districts or regions (e.g., urban areas or rural areas), or even in some combination based on the needs of the area.

6.3.1 Scenario 1 – Continued Expansion

As connected and automated vehicle penetration rates increase, coupled with the increasing availability of enhanced traveler information via various mobile applications, some DOTs continue to opt to expand

DMS operations. These DOTs maintain the importance of disseminating traveler information to all travelers. Despite relatively high penetration rates of connected and automated vehicles, in this scenario a high percentage of travelers in these areas use DMS, preferring DMS as a more reliable source of en-route information than smart phone applications, for example. As such, DMS continues to be more widely deployed at strategic locations, in both urban and rural areas. DMS operations continue, but more specific messages are now posted given the availability of more detailed information since connected vehicle data is received and processed at the TMC. These DMS messages inform travelers that do not have connected vehicles or utilize smart phone applications and also allow DOTs to provide safety messages, public service announcements, and other important messages to all travelers.

Note that some DOTs may only apply this approach in specific districts or areas where few DMS had previously been deployed and were warranted in advance of strategic locations, e.g., in rural areas for weather messaging. Other DOTs could opt for this approach statewide.

6.3.2 Scenario 2 – Operate and Maintain

As connected and automated vehicle penetration rates increase, coupled with the increasing availability of enhanced traveler information via various mobile applications, some DOTs opt to stop deploying new DMS and simply operate, maintain, and replace DMS in the strategic locations where they have already been deployed. While these DOTs recognize the importance of DMS for insuring that traveler information is disseminated to all travelers, it is recognized that other en-route sources of information are available. In this scenario, a minority of travelers use DMS as their primary source of en-route information, finding comparable information via smart phone or connected vehicle applications. As a result, these DOTs invest in other technologies in lieu of deploying new DMS while continuing to utilize and maintain the existing DMS, posting more specific messages now given the availability of more detailed information from the connected vehicle data that is received and processed at the TMC. These DMS messages inform the minority of travelers that do not have connected vehicles or utilize smart phone applications and also allow DOTs to provide consistent safety messages, public service announcements, and other important messages to all travelers.

Note that some DOTs may only apply this approach in specific districts or areas where a full network of DMS had previously been deployed, e.g., in urban areas for incident-related messaging to recommend diversion upstream of major intersections. Other DOTs could opt for this approach statewide.

6.3.3 Scenario 3 – Scale Back and Transition DMS Operations

As connected and automated vehicle penetration rates increase, coupled with the increasing availability of enhanced traveler information via various mobile applications, some DOTs opt to stop deploying new DMS. As existing DMS reach the end of their lifecycle, these DOTs choose to either remove or replace them with less costly static signage containing automated dynamic elements, e.g., to display travel times on various routes. In this scenario a relatively low percentage of travelers use DMS as their primary source of en-route information, finding comparable and reliable information via commercial radio or smart phone or connected vehicle applications. As a result, these DOTs chose to streamline DMS operations, recognizing the importance of DMS for insuring that traveler information is disseminated to all travelers, while also directing travelers to other en-route sources of information. Static roadside

signage guides travelers in traditional vehicles to commercial radio and smart phone applications. Sometimes these static signs are accompanied by flashing beacons to advise travelers in traditional vehicles to seek these other sources of information for a pertinent traffic message that cannot be displayed on the new static signage with dynamic elements.

Note that some DOTs may only apply this approach in specific districts or areas, or possibly selectively in conjunction with a previously described scenario. Other DOTs could opt for this approach statewide.

7.0 Summary

The following bullets highlight the information gathered for this project.

- Transportation agencies vary in their approach to posting messages on DMS. Some agencies post messages 24 hours/day, while other agencies follow stricter policies that are more restrictive on the types of messages and frequency with which they are displayed.
- The process for approving a message request, as well as developing content of approved messages can also vary by state. Some agencies have a team or committee that reviews requests and determines message content. At other agencies, this process may be overseen by a single individual.
- Most external requests for messages to be displayed on DMS are received from law enforcement, the governor's office, environmental agencies, neighboring states, or local agencies. The increase in requests from law enforcement is due to more coordination between transportation agencies and law enforcement. In addition, as transportation agencies expand their use of DMS, others may see this as an opportunity to request a message.
- Based on the review of 17 DMS policies or guidelines, 13 transportation agencies prioritize message requests. The prioritization assists a transportation agency when determining which message request overrides another message request. For example, an agency may post a general safety message such as "Buckle Up", however if an incident occurs the message will be overridden due to the urgency of the second request. Most of the agencies that prioritize DMS messages have incidents as a high priority. Safety messages are the lowest or closest to the lowest priority for many of the agencies that prioritize DMS messages.
- All 17 DMS policies or guidelines reviewed indicate some prohibited uses of DMS. Common prohibited uses of DMS include:
 - Advertisements
 - Flashing, animation, etc.
 - General/vague/obvious information
 - PSA
 - Date, time
 - General weather information
 - Conflicting messages
 - Normal recurrent congestion
 - Graphics/symbols
 - Static sign information
 - Bilingual messages
 - Weblinks, email, phone information

- FHWA provides guidance on both approved and prohibited uses of DMS. Guidance is provided in the MUTCD [Section 2A. Design Signs](#)⁶⁷ and [Section 2L. Changeable Message Signs](#).⁶⁸ In addition, the following memorandums provide additional guidance on both approved and prohibited uses of DMS.
 - [FHWA Memorandum 2001: Use of CMS](#)⁶⁹
 - [FHWA Memorandum 2002: AMBER Alert – Use of CMS](#)⁷⁰
 - [FHWA Memorandum 2003: Use of CMS for Emergency Security Messages](#)⁷¹
 - [FHWA Memorandum 2004: DMS Recommended Practice and Guidance](#)⁷²

- Typically, the language addressing approved or prohibited uses of DMS in transportation agency policies or guidelines matches or closely matches the language in the MUTCD.

- As transportation agencies face funding constraints among many competing priorities, opportunities may exist for public-private partnerships. However, state DOTs that have been approached about the possibility of advertising on their deployed DMS typically reject those requests, citing their agency DMS policy or the MUTCD; specifically, the [MUTCD Section 2L.01.03](#)⁷³ states "Advertising messages shall not be displayed on changeable message signs or its supports or other equipment."

- As connected and automated vehicles advance, transportation agencies may be able to leverage new data sources for more detailed messages. In the longer term, agencies may want to consider whether to continue using DMS messages as an information dissemination mechanism, examining the utility of deploying new DMS, continuing to maintain and replace existing DMS, or ceasing DMS operations completely, for example.

Appendix A – Survey Questions and Responses

Survey Question and Responses

ENTERPRISE: The Future of DMS Messaging

Following are the questions and responses to the survey distributed by ENTERPRISE to approximately 45 individuals from provincial, state, and local agencies in October 2016.

The ENTERPRISE Pooled Fund Study is conducting this survey to collect information on current and anticipated future message requests for DOTs to post on Dynamic Message Signs (DMS) (or Changeable Message Signs (CMS)). The survey is also collecting information on your agency's process or policy for accepting or rejecting a DMS request. The information gathered from this survey will be used in a final report that will summarize anticipated DMS message demands and in-place policies/processes.

Question 1: Please provide your name and agency.

	Name	Agency
1	Reza Karimvand	Arizona DOT
2	Kevin Price	Illinois DOT
3	Shari Hilliard	Kansas DOT
4	Hilary Owen	Michigan DOT
	Suzette Peplinski	
5	Brian Kary	Minnesota DOT
6	Alex Wassman	Missouri DOT
7	Brandi Hamilton	Montana DOT
8	Seth Daniels	Nevada DOT
9	Brandon Beise	North Dakota DOT
10	John MacAdam	Ohio DOT
11	Jared Schwennesen	Oklahoma DOT
12	David Tsui	Ontario Ministry of Transportation
13	Dennis Mitchell	Oregon DOT
14	Leslie McCoy	Pennsylvania DOT
	Mark Kopko	
15	Brian Hoeft	Regional Transportation Commission (RTC) of Southern Nevada/ Freeway and Arterial System of Transportation (FAST)
16	Donald Gedge	Tennessee DOT
17	Lisa Miller	Utah DOT
18	Vinh Q. Dang, PE	Washington State DOT

Question 2: From what entities do you typically receive DMS Messages? Select all that apply.

Entities	Response Count
Law Enforcement	17 responses
Governor’s Office	8 responses
Environmental Agency	8 responses
Other “DOT Offices” or “Other” Entities (please specify)	
<ul style="list-style-type: none"> • Other DOT: traffic safety, neighboring states, Illinois Tollway Other: Municipalities, event communication coordinators • Fish Wildlife and Park (FWP), Department of National Resources and Conservation (DNRC), Department of Justice (DOJ) • Other DOT Offices: Coordination with neighboring states on work zone and incident impact messaging Other: Organizers of special events, or customers stuck in traffic due to special events, sometimes contact us to request messaging. We will message for the traffic impact caused by events but will not message for the event specifically. • Local TMC and local traffic operation offices (Cities, Counties). Canadian Border Patrol and US custom for the border crossing activities. • Local Jurisdictions • Michigan Secretary of State, Special interest groups, such as ROAR (road rage), SMARTER (motorcyclist safety), trucking industry. Special event groups: festival or event coordinators or a city representative from area the festival is in. • Other DOT: Regional and municipal government transportation agencies Other: Motoring public submitting their comments/ideas through our website • NDDOT works with law enforcement on road weather warnings. NDDOT posts safety messages fairly frequently. Local groups and organizations have requested messages, but those are usually denied because they don't fit within the NDDOT DMS Guidelines. • Neighboring states with incidents close to the border or closures that effect interstate corridors. Also city and county officials for specific events. • Charities, other transit groups, hospitals, etc. • We will receive requests from the public as well as surrounding states and local governments. • Other DOTs - if there is a major closure over the state boarder, we will display warning messages at key decision points so a driver can take an alternative route prior to encountering the closure in the neighboring state. Other - We receive PSA requests from numerous safety groups and the general public. • MnDOT Regional Transportation Management Center • Safety, Communications, NWS 	

Question 3: In the past few years, have you experienced changes in the number of DMS message requests from the entities selected above? (e.g. If you have experienced higher or lower DMS requests, please indicate the requesting agency(ies) and identify/describe the reason for the change.)

Responses	
1	Law Enforcement and Gov Office for Safety
2	Higher due to more coordination with law enforcement.
3	Most messaging is in house for known events. Outside requests have been and continue to be rare.
4	About the same over the last few years. Environmental Agency has requested Air Quality Alert messages. Law Enforcement, Department of Public Safety and internal Traffic Safety staff have requested more PSA messages related to traffic safety. Law Enforcement (Bureau of Criminal Apprehension) requested Silver Alerts for missing adults.
5	No
6	Yes, requests have increased as the number of sign deployments increased and the awareness of the ability to post messages
7	Slight increase due to enhanced focus on transportation and safety campaigns.
8	Yes, as more people see the benefit of roadside messaging, more requests are made. The NWS would like to see more weather warnings used on the DMS.
9	Higher interest in weather related and safety related messages
10	higher from the Department of Public Safety and from within ODOT media and public relations group
11	Yes, but the requests are mostly from internal due to the Pan Am / ParaPan Am games in Toronto in 2015. Other requests are pretty much the same in terms of quantity.
12	no
13	Not really, Amber Alerts The number of requests has stayed consistent. We credit this to having DMS Operating Standards.
14	No
15	No
16	Yes, higher
17	Higher DMS request from Law enforcement offices. Prominently the alert program growing from the initial Amber alert to Blue and Silver alert. Higher DMS request from environmental agencies for air quality and fire danger.

Question 4: In the past few years, are you receiving requests from agencies you did not previously?

No or Yes	Response Count
No	10 responses
Yes	8 responses

Please list the agency(ies) and describe the requests.

- Environmental Agencies. "NO BURN DAY" msgs
- Getting more requests from Sheriff's Department
- Secretary of State, motorcycle safety; National Weather Service (NWS), weather messaging; Department of Natural Resources (DNR), fire danger
- Environmental Agency requesting Air Quality Alerts was a new request.
- Primarily local agencies
- We have received a few requests for holiday or event messages from local government entities.
- Zero Fatalities related
- Department of Natural Resource, DNR, Fire danger, Do not throw cigarette out, Camping caution, etc. ...

Question 5: Do you anticipate receiving DMS requests from agencies that do not currently make requests?

No or Yes	Response Count
No	8 responses
Yes	9 responses

Please list the agency(ies) and describe the reason you anticipate the future request.

- There is always someone out there with an idea. We have a process to screen requests for relevance.
- With more PSA messages being displayed, I would anticipate other requests for traffic related PSAs and well as non-traffic related PSAs. We have gotten requests in the past from Department of Natural Resources about PSAs related to hauling firewood, and from our State Fire Marshall's Office requesting PSA's related to changing smoke detector batteries. Both of these requests were denied.
- As more partnerships with counties and other local municipalities occur, they will likely request input on messaging.
- I'm sure the possibility of additional requests is likely
- Always a group, public or otherwise, that wants to get their campaign / event / venue out to the public
- In the last year we have expanded our use of the DMS and I see other agencies wanting to capitalize on their success.
- Transit agency (GO Train) is requesting message that can help initiate transportation mode shift amongst motoring public
- Yes, I think that will happen

Question 6: Does your agency have a policy or a process that is followed for accepting, rejecting, and/or prioritizing DMS message requests.

No or Yes	Response Count
No	1 response
Yes	17 responses

Please describe your agency's policy or process for handling DMS message requests.

Accepting or rejecting DMS message requests

- As long as is transportation related we'll accept it otherwise it will be rejected.
- Requests are reviewed by a sign message committee
- A team reviews, final decision is regional
- Local region screens requests. If they wish to pursue, for "Safety Messages" there is a statewide group set up to discuss and approve. For special event messages, it is normally left to the region, if within policy guidelines.
- Our process is that all messages are traffic safety related and are approved by RTMC Manager and Traffic Safety staff at MnDOT.
- Each request is evaluated individually by a team including the Statewide Traffic Department, Communication Division, and the TMC manager.
- If it is related to transportation, safety, or other acceptable criteria we will work to create and display messages. If a message does not fit within our guidelines or acceptable messages/use we will reject the request.
- We have a committee made up of state traffic engineers and district traffic engineers.
- Traffic / Event messages are filtered through acceptable TMC language for posting
- Must be relevant to motorists' immediate driving tasks or overall transportation network operational efficiency.
- Messages must be related to traffic, air quality or amber alert
- We have a committee that evaluates requests
- Committee for selection
- Accepting/Participating in Alert request and Public Service Announcement. Rejecting Fire danger request
- Emergency messages are coordinated with central office and Illinois Emergency Management Agency (IEMA). AMBER Alerts are coordinated between central office and Illinois State Police (ISP). No crime related messages, instead post if road is closed and not the reason. Special event messages should use generic terms and limit messages to traffic oriented terms, except where the legitimate name of a facility or event helps with clarity. No advertising of any product, service, event or political party. No PSA other than traffic safety related. Other messages need to be reviewed by a local district supervisor for approval. If in doubt, direct request to District Traffic Engineer or District TMC Manager who in turn may contact Central Office Operations for further interpretation.

Prioritizing DMS message requests

- We have 9 different levels: L-1,2,3 and 4: Closures and anything related to the closures (i.e. fatal, injuries), L-5:Traffic related to football, Golf,...However, all these msgs alternate with Travel time posted all day.
- Guidelines, currently in draft form. Final decision is regional.

- Regions generally prioritize DMS messaging, but if there is a conflict, it is taken to statewide group. There are sometimes "mandatory statewide safety messages" that take priority.
- Requested PSA messages are lower priority than incident messages, road work messages, and travel times. Amber Alerts are lower than incident and roadwork messages but can override travel times and PSAs.
- Message priorities can be found in our policy.
- Incident, roadway messages are first priority. Safety messages and AMBER Alerts next, then PSA type messages
- Current DMS policy list priority by message type.
- Safety related / scheduled "campaigns" are prioritized by a committee.
- Usually based on their impact on improving traffic safety and traffic flow quality
- A priority list is provided in our guidelines.
- Control room policy
- Traffic incident and ATIS 1st, Travel Time 2nd, Alert 3rd and at strategic locations. PSA 4th at strategic locations
- Prioritization of messages as they relate to how the message/event may affect traffic. Message priority is summarized as follows: 1. Incident management, 2. congestion, 3. special event, 4. AMBER alert, 5. travel times, 6. weather alert/warning, 7. safety message.

Question 7: Please describe any DMS message requests your agency has received that are not documented in your policy or process for accepting/rejecting or prioritizing message requests.

9 Responses

1	None Transportation related
2	N/A
3	Specific requests are not in policy, only procedure to review/approve
4	If they are not within existing use or policy, then there is a process for review/approval (see other responses).
5	As noted earlier, we have gotten requests in the past from Department of Natural Resources about PSAs related to hauling firewood, and from our State Fire Marshall's Office requesting PSA's related to changing smoke detector batteries. Both of these requests were denied. The Bureau of Criminal Apprehension requested expanding the Amber Alert policy for missing children to include Silver Alerts for missing adults. Mutual decision was to not expand program to include Silver Alerts.
6	One example is a planned power outage for a particular area.
7	N/A
8	Very rare. Maybe some special message requests tied to political influences.
9	none

Question 8: Does your agency have a policy or process for developing or approving the content of messages that are posted on a DMS?

No or Yes	Response Count
No	0 responses
Yes	13 responses

Please describe the policy or process.

- The policy is described in our Operation Manual
- Process is not iron clad and has gray areas, but it is a team decision, with final decision being regional unless it is dictated at the Director level. Standard Operating Procedures (SOP's) for message content. For Safety messages (non-traffic impact messages), there is a statewide group that reviews and approves.
- Generally most messages are approved by the Regional Transportation Management Center (RTMC) Engineer for DMS in the Twin Cities Metro. Messages displayed statewide will be vetted through the District Traffic Engineers.
- A team meets monthly to discuss PSA message content. General messages are designed using the standards in the MoDOT Engineering Policy Guide.
- We have developed guidelines for sign use, message format, acceptable messages, etc. The approval process of content is not specific only that review and approval is required. MDT does not have an official policy only guidelines related to use however, it serves somewhat as a policy
- Our DMS policy contains guidelines for different message types. New messages are sent through the above mentioned DMS committee for approval or rejection. We also maintain a list of approved messages.
- Committee that filters requests for safety campaigns. Trying to generate buzz without being offensive.
- The policy prescribes message formats for the various sign types used for all approved messaging strategies such as event management, traffic flow management, and road safety messages.
- Standard message content already developed. new reviewed against policy related to length of message, priority, etc.
- Included in our guidelines.
- Committee
- The policy define VMS purpose, uses, deployment criteria, priorities, authority. The policy also provides guidance on message content, message format, standardization.
- Examples are described in policy document which follow FHWA guidelines.

Question 9: Does your agency have an official DMS policy?

No or Yes	Response Count
No	3 responses
Yes	10 responses

Please describe the benefits, issues, or challenges with a formal DMS policy.

- It provides strong foundation to staff for decision making process.
- We have an SOP that describes what type of messages that should be used and how they should be formatted.
- For Michigan, it is hard to write a comprehensive messaging policy that fits all of our regions. We have some heavy metro areas, a lot of mid-size cities areas, a lot of very rural areas, and a lot of variety in both traffic volumes and types of traffic (commuter, freight, tourist, schools/colleges, etc.)
- I need to clarify this is a DMS guidelines manual and not a policy. Benefits are to have consistent messages statewide. Issues and challenges have been keeping the manual up-to-date and have the manual restrictive enough to prohibit some messages will still being open enough to allow districts to have some level of flexibility.
- MoDOT has a formal DMS policy, but it will not be referenced when there is a unique incident that requires immediate action. We depend upon our operators and their supervisors to be familiar with the policy and use their best judgment when creating a message. Due to the real-time demands, the policy is used more of a foundation to build off of than a concrete set of rules which cannot be broken. ATMS has helped the uniformity of messages greatly by suggesting message sets based on the incident, but there will always be unique situations that are not covered.
- It is a good tool to balance DMS usage. Too much content can cause the signs to be ignored, causing drivers to miss information requiring their immediate attention. Being a public agency, our policy has to be able to provide some flexibility as there are no absolutes in a changing environment.
- Standard message templates to ensure consistent use of language to describe similar events. Eliminate unnecessary learning curve in terms of message comprehension by motorists. Policy needs to be updated frequently to address new needs and challenges
- Consistency
- Our policy help manage the request for non-traffic related deployment. It also help us deliver advance traveler information effectively. Within the ICM corridor, VMS at strategic locations can be used very effectively to promote route choice/load balancing.

Question 10: Has your agency developed any performance measures on DMS usage or collected any data to measure effectiveness of DMS messages?

No or Yes	Response Count
No	8 responses
Yes	7 responses

Please describe your agency's performance measures or data collected to measure DMS effectiveness.

- 1) Up time 2) Survey that we send out. The Survey indicates they are very effective, specially Travel time.
- We have in our Wichita metro area.
- See TOC performance measures documents online. We have some to measure usage, but nothing to measure effectiveness. Studies have been done. Our TOC's collect monthly DMS usage data.
- No performance measures or reports available, however, we do log all DMS deployments for permanent DMS.
- We participated in a multistate research project for the effectiveness of DMS in rural areas - completed in 2016 and posted the FHWA website.
- We utilized an FHWA tool to (TOPS B/C) calculate Operations b/c. One feature was DMS.
- Monitoring drivers response to route diversion messages.

Question 11: Has your agency been approached to post advertising on DMS?

No or Yes	Response Count
No	8 responses
Yes	7 responses

Please describe your agency's experience.

- Our answer was a NO.
- All requests for advertising have been denied per MUTCD.
- We have been asked if it was a possibility and informed the party of our policy.
- In a way, with a new casino opening or otherwise. Not necessarily direct marketing.
- Our policy prohibits commercial advertising messages

Question 12: Is your agency planning for connected vehicle conflicts with DMS? (e.g. DMS displays are guided by the MUTCD and in-vehicle displays in connected vehicles will not be guided by the MUTCD; therefore, conflicts may arise.)

No or Yes	Response Count
No	12 responses
Yes	3 responses

Please elaborate.

- We will provide the best information we can with the tools we have while following all federal and state regulations.
- We have not discussed this at this point
- We are aware of and monitoring the issue.
- Not that I am aware of but we eventually will have to consider this
- We provide all traffic info to third party that currently provides data for in-vehicle navigation.
- Mainly be aware of the potential for conflicts and be engaged in the V2X initiatives, development and discussion.

Question 13: Have changes in the industry (e.g., connected vehicles, the increased use of web-enabled cell phones, or the increased use of in-vehicle navigation systems with real-time information) influenced your agency’s approach to deploying or replacing DMS?

No or Yes	Response Count
No	11 responses
Yes	4 responses

Please elaborate.

- We'll be evaluating this issue in the future.
- It has been discussed, but our policy has not changed yet. MDOT is working on an ITS strategic plan update that will likely include this.
- Although we've discussed that the need for DMS will diminish as the industry changes, we have not changed our approach to DMS deployment as we feel these changes will take time to become widespread across all motorists.
- Rather than attempting to replace all DMS at the end of life cycle, retrofitting the DMS by replacing the electronic components while keeping the structures has been investigated. This is a lower cost method that may extend the life until DMS are no longer needed.
- Increased availability of traveler information has refocused us on provided more critical information requiring immediate driver attention.
- Kind of... we know that with smartphones we can provide traveler information via our OHGO mobile app (a message board in every pocket?!) but we still need to replace / prioritize DMS locations
- We have considered changes but no decisions have been made.
- No so much for deploying or replacing DMS, but more for taking advantage of using social media where we do not have VMS coverage. The message format for social media is less stringent.
- It has come up for discussion on if there is still a need to expand DMS deployment. However we have decided that the lifespan of DMS installed today will still make them effective even as new technologies are starting to be explored.

Question 14: Does your agency encourage increased utilization of DMS and have a policy to post messages such as public service announcements on the DMS when time critical messages to travelers (e.g. alerts of crashes, delays, travel times, or detours) are not needed?

No or Yes	Response Count
No	8 responses
Yes	7 responses

Please describe the benefits, issues, or challenges with displaying messages frequently.

- We do four week long safety campaigns each, other than that we do not post any other PSA, unless approved by DMS Committee. Those are reviewed on a case by case basis.
- Rural regions are generally more likely to use public service announcements than urban regions. Certain statewide initiative do use DMS statewide, but the use of PSA's statewide is limited due to fear of desensitizing the drivers. West Michigan region does not continuously post PSA type messages, only a few keys ones per year. Our dwell message is generally travel times. West Michigan believes that continuous safety messages dilute the effectiveness of time-critical messages when they are needed.
- We limit the use of PSA messages to just a few days out of the year and we only use our message signs for traffic-safety related messages. We are concerned that over using these signs for other messages might make them less effective for what we most need them to do - give roadway users real-time traffic advisory messages and route guidance.
- The benefit is to share important information with customers at all times. The challenges are message fatigue and ignoring the messages, and capturing the attention of drivers by keeping messages fresh and interesting.
- MDT has worked diligently to provide relevant information on our VMS. Currently our intention is to provide messages on a continual basis for deployed signs. If signs are not displaying incident, work zone, or condition information we post PSA's associated with national campaign time periods or state focused initiatives such as Vision Zero (reduce fatalities and serious crashes).
- Feedback and experience tells us that overuse my cause critical messages to be overlooked or ignored. The same problem occurs if inaccurate messages are posted including untimely messages not being removed.
- Not an official policy but our ATMS does set priorities (Traffic over weather over safety etc.)
- We have recently started a work zone Wednesday message campaign to bring awareness to work zone safety but have no data to prove it is helping other than Facebook likes.
- PSAs are limited in terms of how many hours a day they can be displayed. other than crash and detours, etc. we are displaying travel time 24 hours a day
- Zero fatalities messaging
- We would participate in PSA but strongly believe the DMS will be more visible and have more impact if only used for traffic related messages. PSA messages tend to be static, provide much less value to the user with the driving task at hand. DMS position is very intruding, directly above the lane and right in front of the driver. Commanding driver attention with PSA message in this manner can be detrimental to the effectiveness of the DMS when the true need (to command attention) arise.
- From time to time executive leadership encourage increased utilization of DMS (so they just don't sit blank). This has led to the displaying of traffic safety related messages.

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