



**PROCEDURAL GUIDELINES FOR IMPLEMENTING
TRAVEL TIME ON DMS IN CHART**



MARYLAND STATE HIGHWAY ADMINISTRATION
Office of CHART and ITSD
7491 Connelley Drive
Hanover, Maryland 21076

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LIST OF ACRONYMS

<u>Abbreviation</u>	<u>Full Text</u>
DMS	Dynamic Message Sign
ETL	Express Toll Lane
FHWA	Federal Highway Administration
HOV	High Occupancy Vehicle
ITS	Intelligent Transportation System
ITSD	ITS Development
MdTA	Maryland Transportation Authority
MSP	Maryland State Police
MUTCD	Manual on Uniform Traffic Control Devices
OOTS	Office of Traffic and Safety
R3B3	Release 3 – Build 3
SHA	State Highway Administration

PROCEDURAL GUIDELINES FOR IMPLEMENTING TRAVEL TIME ON DMS IN CHART

1 INTRODUCTION

Implementations of travel time messages on Dynamic Message Signs (DMS) have been a recent trend on the Nation's highways. Travel time messages provide a useful service to traveling motorists utilizing available DMS infrastructure. It has been well-received by the motorists and at the same time, has been encouraged by the Federal government.

The Maryland State Highway Administration's (SHA) Coordinated Highways Action Response Team (CHART) program has recently gained access to real-time travel-time information from INRIX®, a third party vendor, contracted by I-95 Corridor Coalition. INRIX® generates travel time data in real-time based on the vehicle probe information. In Maryland, INRIX® covers significant geographic areas that consist of routes along and parallel to I-95, and the Washington and Baltimore Beltways. The CHART program would like to disseminate this information to traveling motorists through its DMS infrastructure, by incorporating capabilities in the next Build of CHART software (i.e., Release 3 - Build 3 or R3B3) to display automated travel times on DMSs. It is also noted that SHA's sister organization, the Maryland Transportation Authority (MdTA) also owns DMS infrastructure that will display travel time information using the CHART system as well.

The CHART program initiated a study to develop a set of procedural guidelines for the travel time implementation, consistent with national practices and at the same time meeting the stakeholders' requirements. This document is the product of the study and represents procedural recommendations for launching the DMS travel time capability using the CHART software. This document specifically responds to a set of procedural issues (referred to as "study procedural issues" in this document). These are listed in the following section.

2 PROCEDURAL ISSUES

This section briefly discusses the procedural issues that are addressed in the document. The issues are divided into three main groups and are listed below:

1. Message display issues

- What will be the format of the travel time messages?
- Will the travel time message formats require a combination of left justification (say for the destinations) and right justification (say for the travel times) of different portions of the DMS message?
- Will multiple phases be used to display travel time and other information on DMS?
- Will some signs provide travel times for multiple destinations?

- How often will travel times be updated?
- Will the travel times be displayed in ranges, and if so, how will these ranges be calculated?
- 2. Display locations
 - Which DMSs will be used for travel time?
 - What destinations will travel times be provided for?
- 3. Logistical issues
 - Will travel times be shown that indicate speeds greater than the speed limit?
 - What constitutes "bad" data?
 - Where does travel time come in the hierarchy of DMS messages?
 - Do we need to display distance with the travel time data?
 - Should there be a minimal distance for travel time messages?
 - At what point should the travel time data obtained from INRIX® be deemed to be of not good enough quality to display travel time messages?

3 STUDY METHODOLOGY

The study methodology was as follows:

3.1 Collect and Review Information

The study focused on responses to the set of *study procedural issues*. Accordingly, the following information was gathered, reviewed and compiled:

1. Information on INRIX® data, including the raw data, processed information, frequency and geographic coverage (refer to Appendix A);
2. Statewide DMS locations for both SHA and MdTA;
3. DMS capabilities (number of characters and lines) by location.

3.2 Review Pertinent National and State Regulations and Guidance

The MUTCD guidelines were reviewed for DMS travel time implementations. Since DMS technologies are still evolving, much guidance was not available. The State of Maryland does have any relevant MUTCD supplements on DMS at this time.

FHWA directives and guidance were also reviewed with special attention to the *study procedural issues*. At this time, FHWA's position is as follows:

1. It has no specific policy or position on travel time messages on DMS; however, it offers best practices from various implementations throughout the United States.

2. It encourages following the MUTCD.
3. It encourages each state to develop its own standard.

The note-worthy FHWA references are as follows:

1. Jeffrey Paniati, FHWA Policy Memorandum, *Information and Action, Dynamic Message Signs (DMS) Recommended Practice and Guidance*, July 16, 2004.
2. Bob Rupert, *Travel Times on Dynamic Message Signs*, Presentation to I-95 Coalitions, IMTI Program Track Committee, June 14, 2005.
3. Travel Time Research Project, *Deliverable #1 – Travel Time Best Practices Manual*, Final report, The ENTERPRISE Pooled Fund Program, April 3, 2007.

The findings are presented in Appendix B.

3.3 Review State-of-the-Practice

A number of jurisdictions have already implemented travel time dissemination through DMS. An FHWA publication cited 42 implementations as of August-2008; however, this study identified several more.

State-of-the-practices information relevant to the *study procedural issues* identified above was reviewed. Information sources primarily included: 1) Internet, 2) FHWA state-of-the-practice, and 3) a scan tour report authored by several Maryland ITS professionals.

The findings are presented in Appendix C.

3.4 Interview Stakeholders

A series of stakeholder interviews were conducted to understand requirements and directions regarding the *study procedural issues*. The stakeholders represented the following groups:

1. CHART Systems Integrations
2. CHART Operations
3. CHART ITS Development (ITSD)
4. Office of Traffic and Safety (OOTS)
5. MdTA¹

The interview summaries are presented in Appendix D in matrix format. The matrix provides a full traceability of the issues, stakeholders' opinions, national guidance, and the state of practice.

¹ MdTA was contacted for coordination purposes so that travel time displays are all uniform statewide.

Outreach was also made to FHWA and the Maryland State Police (MSP) for input on various procedural issues.

3.5 Develop Procedural Guidelines

A set of procedural guidelines was derived from the matrix (refer to Appendix D, rightmost column). The goal for each recommendation was to ensure compliance with MUTCD, while at the same time ensuring the various stakeholder needs were captured. In most cases, a consensus was achieved on the various Procedural Guidelines. Where a full consensus could not be achieved, an assessment was made from a Traffic Engineering point-of-view. This assessment was factored into the final recommendation. The state-of-the-practice and lessons learned from other states provided a critical role in the development of these recommendations. The next section discusses the findings.

4 PROCEDURAL GUIDELINES

This section discusses the set of procedural guidelines developed for the travel time display on CHART DMSs. It is important to note that these procedural guidelines are intended for the initiation of the program only. It is believed that the guidelines will evolve over time based on:

1. Lessons learned;
2. Modifications in MUTCD guidance and its Maryland supplement;
3. Enhancements in technologies (e.g., probe information, DMS technologies, etc.).

Recommendations for each individual issue are presented below.

4.1 Message Display Issues

What will be the format of the travel time messages?

The basics are as follows:

- Justification: Centered (horizontally within the line)
- Message contents:
 - a) Message heading (i.e., **TRAVEL TIME TO**)
 - b) Destination
 - c) Distance (preferred, provided there is space for it)
 - d) Travel Time

The sample illustrations are provided with the next issue.

While being displayed, the travel time message should remain up on a continuous basis. For a single-phase message, the text should be continuously displayed; for a two-phase message, the full cycle should be displayed continuously, with each phase displayed long enough for motorists to read the text twice, while traveling at the posted speed limit.

Will the travel time message formats require a combination of left justification (say for the destinations) and right justification (say for the travel times) of different portions of the DMS message?

As long as the texts are horizontally centered, it meets MUTCD requirements. Therefore, both the following ways are acceptable:

1. Text fully-centered
2. Left element - left justified and right element - right justified (within a line)

Figure 1 shows an illustration of single destination travel time. There are two candidate methods to display this message. For the second alternative, the distance information is dropped since its inclusion makes the individual line crowded and confusing. For brevity and consistency, MILE has been abbreviated as MI and MINUTE has been abbreviated as MIN. It is also consistent with other state practices.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			T	R	A	V	E	L		T	I	M	E		T	O				
		I	-	8	9	5		1	0		M	I		A	H	E	A	D		
								1	0	-	1	5		M	I	N				

Alternative 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
			T	R	A	V	E	L		T	I	M	E		T	O					
		I	-	8	9	5							1	0	-	1	5		M	I	N

Alternative 2

Figure 1. Two Alternative Single Destination Messages on 21x3 DMS

Figure 2 illustrates multiple destination travel time display. For this case also, the distance information is dropped since its inclusion makes the individual lines crowded and confusing. It is noted that these illustrations are applicable to a full size 21x3 (i.e., 21 characters x 3 lines) DMS

display. For other sizes, the message can be tweaked; for example, the distance information can be skipped. A suggested comprehensive set of illustrations is provided in Appendix E.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			T	R	A	V	E	L		T	I	M	E		T	O				
I	-	8	9	5								1	0	-	1	5		M	I	N
I	-	3	9	5								2	0	-	2	5		M	I	N

Figure 2. Multiple Destination Message on 21x3 DMS

In the event that a third line is necessary to display additional information (e.g., a third travel destination), the "Travel Time to" heading of the message can be dropped and the additional information can be displayed (refer to Figure 3).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
I	-	8	9	5								1	0	-	1	5		M	I	N
I	-	6	9	5								1	3	-	1	8		M	I	N
I	-	3	9	5								2	0	-	2	5		M	I	N

Figure 3. Three Destinations on 21x3 DMS

Will multiple phases be used to display travel time and other information on DMS?

The following guidelines apply:

1. Travel Time messages themselves should only be single phase.
2. During incidents, a 2nd phase with travel time information can be displayed for a value up to 10x (where x is the travel time corresponding to the posted speed limit). [Note: In future when feasible, a 2nd phase with travel time information (for a value up to 10x) can be displayed along with alternate routes.]

Will some signs provide travel times for multiple destinations?

Yes. Depending on the sign size, location and feasible destinations, multiple destinations should be provided.

How often will travel times be updated?

It depends on the provider's update frequency. Nominally, a 5-minute update cycle should be provided to keep travel times accurate.

Will the travel times be displayed in ranges, and if so, how will these ranges be calculated?

A range should be used for travel time display (consistent with other state practices). The range will vary on a graduated scale, i.e., narrower range at a lower value and wider range at a higher value. The range will be capped at a higher value (30 minutes and above). Table 1 presents the suggest travel time ranges.

Table 1. Travel Time Display Range

Reported Travel Time, Min	Suggested Range	Example*
0-10	+/- 1	5 will be shown as 4-6
11-20	+/- 2	15 will be shown as 13-17
>20**	+/- 3	25 will be shown as 22-28

* The lower value of the range shall not be less than the speed limit derivative.

** In future, for travel time > 30 minutes, consideration can be given to rounding the number to the nearest 5 minute interval, i.e., 30, 35, 40, 45, 50, 55, 60 minutes, etc.

4.2 Display Locations

Which DMSs will be used for travel time?

It depends on individual DMSs based on several location-specific criteria. It must -- a) be within travel time coverage area, b) have minimum space necessary for the display, and c) offers worthy destination(s). A list of usable DMSs is provided in Appendix F.

What destinations will travel times be provided for?

Travel times can be displayed for the following type of destinations:

1. Interstates
2. Major state routes
3. Major landmarks (e.g., bridges and tunnels)
4. Major sinks along the route during special events (e.g., Redskins Stadium, Camden Yards)

Appendix F presents the candidate destinations associated with specific DMSs. Two lists are provided in the appendix – 1) a preliminary list with one or two significant candidate

destinations per DMS (for launching the program), and 2) a list with a number of possible candidate destinations for each DMS site.

4.3 Logistical Issues

Will travel times be shown that indicate speeds greater than the speed limit?

No. The lower threshold of the travel time displayed should be constrained by the speed limit derivative (i.e., the travel time displayed should not represent a speed higher than the posted speed limit).²

The CHART software needs to have the flexibility to support changes in procedures in future. Furthermore, this flexibility is also necessary to accommodate any difference in needs of MdTA (which also uses CHART software for their DMS display).

What constitutes "bad" data?

At a travel time 4x, the software should alert the operator (where "4" is configurable, and x is the travel time corresponding to the posted speed limit)

At a travel time 10x, the display should switch to "Blank" or other appropriate messages, such as "Stop and Go" or "Congestion Ahead" (where 10 is configurable, and x is the travel time corresponding to the posted speed limit).

Where does travel time come in the hierarchy of DMS messages?

Short-Term Recommendation: The travel time message should be displayed before or in lieu of congestion messages. *(This recommendation is consistent with other State practices).*

The suggested priority is as follows:

1. Urgent Messages
2. Incident Messages
3. Planned Roadway Closure Messages
4. Toll Rate Messages
5. Travel Time Messages
6. Congestion Messages
7. Shazam Messages
8. Weather Messages
9. Special Messages
10. Action Messages
11. Safety Messages

² Maryland State Police (MSP) was contacted on this issue. MSP also offered a similar position, i.e., not to display any travel times that imply traffic is moving above the posted speed limit.

The following additional guidance is provided:

- A. **For the Toll Rate Signs** (e.g., express toll lanes or ETL) – these signs are specially built for toll operations and will be used to display toll rate and travel time information only. No other information can be displayed on these signs. CHART will configure the system so that these signs cannot be used for any other purpose and will be locked down for MdTA use only. The CHART DMS arbitration queue is not relevant for these signs.
- B. **For Shared Signs** – these signs are near a toll roadway and could possibly display incident messages, travel time messages or toll rate messages (e.g., signs on I-695 near the I-95 interchange). The term “shared” is a notion that these signs can be used for incident management purposes or toll management purposes. In other words, it involves a shared function of the sign, and not who owns the sign. There were different priorities from SHA and MdTA in regard to where toll rate belonged in the hierarchy. Therefore, for a shared sign, the hierarchy can be adjusted to have toll rate messages be displayed after travel times and vice versa on a case-by-case basis. Thus, the system should allow this type of adjustments. This capability requires an arbitration queue that can be set on a per-DMS basis.
- C. **For Incident Management Signs not Near a Toll Roadway** – these signs would most likely never display toll rate, but could display travel time. Travel time messages should be after urgent, incident, and planned roadwork messages.

Long-Term Recommendation: During non-peak travel, the travel time message should come after Safety. (Scan from other States supports it indirectly; many states turn off travel time during off-peak time).

Do we need to display distance with the travel time data?

If space is available on the sign, distance should be displayed along with location and travel time. Distance, in association with travel time, offers a sense of level of congestion to the motorists. If space on the DMS does not permit, distance can be omitted.

Should there be a minimal distance for travel time messages?

The decision depends on the specific location and Appendix F presents recommendations on a site-by-site basis.

At what point should the travel time data obtained from INRIX® be deemed to be of not good enough quality to display travel time messages?

Any destination comprising of at least one link with a score³ of 10 should not be displayed. The historic data can be highly inaccurate. The use of historical data in travel time computations is

³ INRIX® assigns a quality indicator to each link in the form of a score of 10, 20, or 30. A score of 30 indicates the link data is good. A score of 20 means link data is only available from surrounding links. A score of 10 means the data is based solely on historical data and no real-time probe data is available.

risky since it may not accurately reflect real-time conditions, could be erroneous, and may reduce the traveling public's confidence in the system.

5 SUMMARY AND NEXT STEPS

In summary, these procedural guidelines provide a basis for launching the travel time display program on CHART DMSs. The guidelines have been established based on national policies, stakeholder inputs and a scan of other states' implementations. It is expected that the procedural guidelines will be necessary to be modified over time to suit the needs of the motorists, technology evolution and any changes in national or state guidance.

Several other relevant notes (DOs, DON'Ts and future considerations) are listed below:

- No display techniques (fading, exploding, etc), nor animation, dynamic elements, etc. shall be used (per MUTCD).
- Each phase should convey a single thought (per MUTCD).
- The message should be readable 2 times by a motorist (per MUTCD).
- The message should be limited to 3 lines and 21 characters per line (Note: MUTCD actually has set forth 3 lines x 20 characters as non-mandatory guidance; however, the current industry-standard is 21 characters).
- The letter size should be 18" (desired), 10.6" (min) (per MUTCD).
- Public awareness is necessary for the upcoming program. It can be done via -- a) media campaign and b) DMS display "Travel Time Coming in XX days" (per MUTCD). Public feedback is also needed (per FHWA).
- Travel time display should be fully automated (per FHWA).
- Travel time must be dynamic (per FHWA).
- Travel time display needs to be treated differently than emergency messages. It should be well designed so that motorists become familiar quickly and can read the message faster (per FHWA).
- The same sign should not be used for travel time for high occupancy vehicle (HOV) and general purpose lanes. It will be too much information. If needed, the time savings between the two can be displayed (Note: it may apply to ETLs or managed lanes).
- In the future, consideration should be given to the following items based on lessons learned:
 - DMSs may be blanked out during the off peak time (many states follow this procedure).
 - Destinations may be changed based on the time of day to signify the predominant destination (several states implemented this feature).