Maryland Transportation Authority

REPLACEMENT OF CANTON VIADUCT
I-895 OVER I-95 RAMPS, RAILROADS & CITY STS. AND
REHABILITATION OF BALTIMORE HARBOR TUNNEL & TUNNEL APPROACHES

CATEGORY 100
PRELIMINARY

SECTION 100-13 – TRAFFIC MANAGEMENT SYSTEM

100-13.01 DESCRIPTION. This work consists of furnishing, installing, relocating, operating, maintaining, and removing an automated portable Traffic Management System (TMS) for work zones during construction as stipulated herein.

The TMS shall consist, at a minimum, of the following:

- Portable Traffic Sensors (PTS) to monitor and record traffic data as stipulated herein.
- Portable Variable Message Signs (PVMS) to display real-time travel time messaging, alternate route messaging, and/or queue warning to the general road using public.

The Contractor shall furnish this TMS for Construction Stages 2, 3 and 4, including associated sub-stages, or as directed by the Engineer. The goal of the TMS is to monitor and collect traffic data along various roadways within this project's impact area and disseminate real-time travel time information and or alternate route messaging based on the data collected to the MDTA and the traveling public via field installed PVMS and a Contractor supplied and maintained software and website. It is anticipated that traffic conditions will deteriorate and travel times will increase due to reductions in roadway capacity, queuing caused by high traffic volumes, work zone vehicle interference, weather, grade changes, etc.

This project will require the vendor to supply the necessary equipment to monitor traffic, collect data, and provide real-time reporting and remote messaging via the Contractor supplied and maintained website due to these conditions. The Contractor shall furnish this TMS for measuring and delivering manually programmed and traffic condition-responsive messages for this Project's impact area as noted in the Contract Documents.

100-13.02 REQUIREMENTS

Traffic Management System. The TMS shall provide the following:

a. Monitor and collect traffic data along various roadways within this project's impact area and disseminate real-time travel time information based on the data collected to the MDTA on a Contractor supplied and maintained website and the traveling public via field installed PVMSs. The TMS software may be accessed via a web portal or utilizing Owner's system software. Should software installation be required for access, the Contractor shall install, configure, and troubleshoot the software required on any MDTA computer as necessary to access the full functionality of the system software.

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b. The TMS software shall be configured so that appropriate personnel at MDTA are notified by email in text format each time a malfunction has occurred and the malfunction has been corrected in the system and a malfunction record is made in the database. Configure the software so that all approved personnel with system access can be notified in this manner. The notification shall also display an error message for the device or devices affected. Please note that the TMS provider is responsible for this notification procedure. The TMS shall provide device outage alerts via email to MDTA for outages greater than 15 minutes. The email addresses for recipients of these outage alerts will be provided by MDTA. All equipment outages must be logged and easily accessible at any time by any TMS user level from the system database. This information shall also be easily graphed and exported in a comma delimited spreadsheet format. Any pay reductions as per the pro-rated schedule (see Section "Operational Performance") will be calculated from these outage summaries.

c. The TMS shall be capable of providing current operational and location status (i.e. current traffic data and messages, communications system, power, solar charging, signs and sensors, as well as latitude/longitude of all deployed devices) updated every 1 minute maximum via the Internet on a dedicated Contractor developed and maintained website established for the purpose of monitoring the corridor and monitoring and controlling the TMS equipment. The current status of all devices shall be able to be seen all at once in a List View or similar format without selecting individual devices to obtain this information.

d. The TMS shall be configured to assess, log, and provide notification of any type of malfunction that has occurred. This assessment includes but is not limited to communications disruption between any device in the system configuration, variable message board malfunctioning (in accordance with the latest NTCIP protocols), speed sensor malfunction, loss of power, low battery, etc. This malfunction information shall be sent via email in text format to MDTA for each occurrence. Access to all such log information shall be available from the website by approved users at any time. All logs shall be updated to the nearest minute.

e. To support incident or event management, the TMS shall be configured to allow approved users (Operators) to manually override motorist information messages on a single or multiple PVMSs for a user-specified start time duration, after which automatic operation will resume with display of messages appropriate to the prevailing traffic conditions. The system shall also allow the same type of users to end one or more overrides at any time. All devices that are in an override mode shall provide an obvious icon to indicate this state for each PVMS. The TMS shall log all message overrides with time and date (to document the starts and stops), message content and name of the user that performed the action. This log information shall be accessible to all system users directly from the TMS web interface at any time upon initiation. All logs shall be updated to the nearest minute.

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f.   The TMS shall be capable of calculating and having "real time" travel time information displayed on the PVMS. This "real time" information shall be calculated and displayed on the PVMS to the nearest minute along with the current time of day.

g.   The TMS shall be capable of detecting the presence of queued traffic on the Project roadways in the segments identified on the Contract Plans, and reporting via the TMS queue warning PVMS the distance from the PVMS to the detected back of queue within a ½ mile accuracy, but reported on the PVMS at 1 mile accuracy rounded up to the nearest mile. This "real time" queue location information shall be calculated and displayed on the applicable PVMS to the nearest minute.

h.   The TMS shall have the capability to notify MDTA personnel (by email and text) and the public via the PVMSs once the speed through the work zone decreases below threshold speeds in areas as shown on the Contract Documents. The PVMSs shall display alternative route messages as noted on the Contract Documents while the speeds are below the established threshold. The system shall notify MDTA once speeds return to above the alert speed thresholds. The system shall also notify MDTA once speeds drop below free flow conditions, and then once again once free flow conditions are met. These speed thresholds shall be able to be changed throughout the project and shall be configurable for different speeds for each sensor to accommodate changing speed limits and work zone speed limits. The TMS will be capable of transferring (each minute at a minimum) a snapshot of the real time data to the TMS website that is provided by and maintained by the Contractor. The TMS shall allow for all system users identified by MDTA to be notified via e-mail of these speed changes. Access to all sensor data shall be available from the software by all users at any time. All data shall be provided up to the nearest minute. The data shall be easily graphed and exported at any time by any users, with user defined parameters (time period, data intervals, data parameters (speed, occupancy, etc.).

i.   If so requested, the Contractor shall add up to 4 additional MDTA supplied PVMS to the TMS. MDTA will provide all communications information necessary to the Contractor to add the additional PVMS to the TMS.

j.   To allow for motorist information messages and data collection of high specificity, the TMS shall acquire traffic data of accurate speed measurement that includes the capability of detecting stopped traffic and counting traffic volume and lane occupancy at all data collection locations identified on the Contract Documents.

k.   The TMS shall provide 24/7 access to all system users for all message history, (including message overrides) with the associated date/time (stated in the local time zone), message posted by specific user or by automation, all sensor data and travel time route data (in the system increments of every minute and other selectable intervals such as 5, 15, 60 minutes intervals etc.). Traffic data and graphing shall be provided for the user defined parameters and also be exportable to a comma delimited spreadsheet format for further analysis and use directly from

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the software by the user. All information shall be updated to the nearest minute.

l. The system shall incorporate a means of secured communications between the central hosted server and all field devices. The method of securing the communications shall be a Virtual Private Network (VPN) that restricts any unauthorized parties from remotely accessing the field devices. The Contractor is responsible for furnishing and maintaining all VPN components that interact between the system server and the field devices. All TMS equipment shall be made secure from access (both physical and electronically) at both the local and remote levels. All TMS operator control functions shall be password protected. The Contractor shall also ensure the physical security of those devices and the Contractor:

- Shall configure the signs and modems with strong passwords;

- Disable any used programs, protocols/ports on the modems/signs; and

- Shall filter-out other internet addresses from reaching the modems/signs (except the vendor's network that the modems/signs are being managed from).

m. Full system functionality shall be provided using Internet Explorer Version 9 or higher.

n. The TMS shall operate continuously (24 hours, 7 days a week) when deployed on the project. The TMS shall always be collecting and storing data.

o. The TMS shall acquire the aforementioned data, develop travel times, locate queued traffic, and select motorist information messages automatically based on this information without operator intervention after system initialization.

p. The TMS shall automatically select default and advisory messages based on traffic conditions at a single traffic sensor point or at multiple traffic sensor points in combination.

q. MDTA users shall have the capacity to create, name, and save a library of up to 20 different default or automatic advisory messages for each PVMS. The library shall have the ability to be sorted by name for ease of use. The Contractor shall preprogram a set of override messages based on guidance contained herein and in the Contract Plans for each PVMS as a starting point and shall coordinate with MDTA for further refinement of the messages.

r. To provide for remote sign operation, the Website shall allow password-protected MDTA operators to manually override the automated messaging in order to display a message at any time. The operator shall be able to send a pre-programmed or custom message to one sign or multiple signs without sending the identical message to all PVMSs. The operator shall be able to cancel this manual override and initiate any and all of the systems automated messaging features at any time.

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s.   The default and advisory message content shall be programmable from the TMS website accessed by MDTA.

t.   The system devices and software shall autonomously restart and notify all required users in case of power failure for any field hardware or central software.

u.   The Contractor shall provide a XML data feed to MDTA for its use from all data collection sensors unless otherwise directed by MDTA. Contractor shall coordinate with the MDTA on how this data shall be provided prior to the start of Operational Field Testing.

TMS Website

At a minimum, any system Website shall have the following:

a.   The Website shall be secure (https:// protocol) configured to provide a password protected link for approved personnel to have access to the operational characteristics of the system to manually override messages on the TMS PVMS.

b.   Each TMS device and data stream shall have a unique and descriptive (roadway, direction, device number, mile marker, etc.) device identifier. These identifiers shall be coordinated with and approved by MDTA at the beginning of the project and shall not change unless approved by MDTA.

c.   The website shall be configured to display current traffic conditions and real time speed at all locations to the nearest minute. Any "real time" travel time information displayed on the PVMS is updated every 1 minute minimum and the system software information is updated simultaneously with the travel time information displayed on the PVMS.

d.   The system shall be configured to support the scheduling of message overrides by the operator. Such scheduling shall allow the operator to set a message on a sign or group of signs simultaneously to turn on and to turn off at times set in the future and automatically return to the previous message automation without user intervention.

e.   Via the internet and the dedicated website, the system shall provide a full color map using Google Maps or equivalent depicting the project area with locations of PTSs and PVMSs. Using the defined color-coding scheme (specified herein), the map reflects the current average speed at each portable traffic sensor and displays the entire information message being shown by each PVMS either on the map or on another part of the website's main page. The map and all device data should be automatically refreshed a minimum of once every minute and GPS location verified a minimum of every 15 minutes (minimum) to automatically display any changes to PTSs and PVMSs.

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f. The system travel time and speed information is to be updated simultaneously with the traffic speed information recorded on the Portable Traffic Sensors. The system shall be capable of displaying traffic speeds using a three-tiered color coded logic. An example typically utilized would be green above 35 mph, yellow 34 –16 mph, and red below 15 mph. This logic is subject to modification by MDTA at any time during the project.

g. Provide immediate access to the historical and current real-time (up to the previous minute) traffic data (for speed, volume and occupancy), malfunction logs, login access, PVMS messages and overrides, and logs being recorded by the TMS as part of the project via the system interface. This data shall also be made available for a period of 6 months following acceptance of the data provided by the Contractor to MDTA.

h. Access to TMS website shall be via an external website portal or remote client software access. Full system functionality shall be provided using Internet Explorer Version 9 or higher.

i. The website shall allow MDTA's own website or project specific website to link to it.

TMS Submittals and Schedule Requirements

A maximum of 14 Days after Notice to Proceed (NTP), the Contractor shall submit the following information to the Engineer for review and approval:

1. The TMS Installer shall provide a qualifications package that details the following:

    a. TMS Installer shall provide documentation demonstrating experience in deployment, maintenance, and management of at least five (5) TMS projects similar in size, concept, and scope to the system proposed herein completed in the last 3 years. Experience should show work done by individuals who will be assigned to this project as well as that of the company. Projects referred to should be identified and provide the name of the customer, including the name, email addresses, and telephone number of the responsible official of the agency who may be contacted for verification.

    b. TMS Installer shall provide the number, and names where practical, of executive and professional personnel, programmers, consultants, etc., who will be engaged in the work on behalf of the Contractor. Show where these personnel will be physically located during the time they are engaged in the work. Include through a resume or similar document the education and experience in work zone ITS solutions for each individual. Indicate the responsibilities each will have in this project and how long each has been with the company. Identify subcontractors intended for use and the services they will perform. For this project, the Contractor must include at least the following roles: Project Manager, Local Systems Manager, Local Field Maintenance and Repair Personnel and Software Specialist. The Contractor shall be required to furnish a local system manager. The system manager must be

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experienced in maintaining this type of system, certified/trained on all equipment used as part of the system, shall be equipped with an internet connected laptop for mobile device maintenance and calibration, and shall be locally available to service and maintain system components, maintain the system software (or can immediately get in touch with someone who can), move portable devices as necessary and respond to emergency equipment situations. The system manager shall be responsible for coordinating the placement of devices in the project areas. The local system manager shall supply a phone number to the Resident Engineer to contact the system manager, and at least one alternate, at any time. The Contractor will be required to provide contact information for the local system manager and others responsible for maintenance of the system.

2. Upon Approval of the Qualifications package and a maximum of 45 Days after Notice to Proceed (NTP), TMS Installer shall submit the following information to MDTA for review and approval:

    a. The Contractor and TMS Installer shall meet with MDTA (in a manner approved by MDTA) and then propose the actual initial device layout to MDTA for approval. Contractor shall provide a plan at an appropriate scale and detail depicting the initial device layout. Said plan shall clearly identify the proposed location for all devices, proposed route segments and system logic, any third party data sources and uses, and PVMS messages based on the route segments and messaging specified in the Contract Documents and feedback from the initial meeting with MDTA. The minimum number of each type of device and the locations of the devices provided shall be as shown on the Contract Plans with the positions of the devices located as close as possible to the required locations unless otherwise approved by MDTA. Contractor may supplement this submission with a Google Earth KMZ file or similar commonly available and free format for ease of review.

    b. The TMS Installer shall submit all brochures and cut sheets on all the equipment to be used as part of the TMS, with details of how and which communications systems shall be used, and example of the software interface and detail on the software system and computer requirements.

    c. Contractor and TMS Installer shall provide a written request to MDTA for the names and email addresses of all system users. MDTA shall supply the information within 15 business days of receipt of the written request. MDTA shall also specify what permission level each user shall be allowed (Viewer, Operator, Administrator, etc.) and which shall receive automated system messaging as required herein. Contractor shall supply system user names and passwords a minimum of 7 days prior to the start of the operational field test period.

A maximum of 75 Days after Notice to Proceed (NTP), Contractor and/or TMS Installer shall submit the following information to MDTA for review and approval:

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1. Final device layout plan: A final device layout plan to specify the location of each device with proposed coordinates in a plan view format at a sufficient viewable scale and detail to clearly convey the proposed location. Contractor shall label each device or data stream with a unique identifier. Contractor may supplement this submission with a Google Earth KMZ file or similar commonly available and free format for ease of review.

2. Cross-Sectional Layout and Detail Plans: A cross-sectional photo view of each proposed device location. The photo view shall show the proposed device location marked in the field. Said plan shall clearly identify the clear zone required, proposed offset from edge of traveled way to the closest edge of the device, any site modifications (leveling pads drainage mods etc.) needed for installation, the layout of any temporary traffic control protection required, and the placement and support design for the project branding signage. Site modifications and protection layouts will require a site plan depicting the location, materials and slopes needed to complete the installation in accordance with MDTA standards.

3. Provide all installation manuals for each traffic sensor type to be utilized on the project for review purposes.

4. Intended system testing procedures for review and approval.

5. Sample malfunction email message format for review and approval.

6. Verification in writing that communications signal strength and solar requirements have been verified for each device location.

See TMS Deployment (Field Installation) and Operational Field Test under the CONSTRUCTION section for additional scheduling requirements.

100-13.03 MATERIALS

Equipment Requirements

The TMS shall consist of the following equipment as a minimum:

a. Portable Traffic Sensors (PTS)

b. Portable Variable Message Signs (PVMS)

c. Communication equipment for all above pieces including wireless data networks, base stations, cell phone data interfaces, Ethernet network interfaces and internet interfaces.

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d. Customized and secure (https:// protocol) webpage integrated with the TMS such that all TMS devices may be monitored or modified via the TMS by MDTA.

e. Software package customized for this particular project's needs or equivalent.

f. In addition to the above specified equipment, the following requirements shall be met for each Traffic Management System, PTS and PVMS:

   1. Each shall be individually mounted trailer units with solar and battery power sources (non-motorized). Multiple devices may be co-located on a single trailer unit. If multiple devices are co-located on a single trailer unit, battery and power supply shall be provided to meet the minimum requirements of this special provision for all devices on each platform.

   2. Each shall have a minimum of 3 leveling jacks to stabilize and level the overall unit. All units shall be installed level to the adjacent roadway surface.

   3. Each shall be equipped with digital modems or wireless data interfaces for use with multiple bandwidths as required.

   4. Each shall be linked to the TMS and accessible to MDTA. (See system requirements for security requirements)

   5. Each device shall have all components secured with locked compartments to prevent unauthorized access.

   6. Each PVMS device shall be NTCIP compliant and PTS shall be NTCIP compatible and meet all other applicable specifications within the Contract Documents.

   7. Local operation of each device shall be password protected to restrict unauthorized access.

   8. Each device shall be installed such that it cannot be removed or relocated by unauthorized personnel.

   9. Contractor shall verify that adequate communication signal strength is available at each device location to ensure all devices communicate at all times with system.

   10. Contractor shall ensure that all minimum power requirements are met with regard to each device as specified herein and able to be maintained at each device location.

Traffic Sensors (PTS)

The TMS Portable Traffic Sensors (PTS) at all data collection locations shall be such that the

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accuracy is not degraded by inclement weather and visibility conditions including precipitation, fog, darkness, excessive dust and road debris. These sensors shall be capable of acquiring bi-directional traffic data for up to 10 lanes of traffic on a lane-by-lane basis. The data acquired shall provide traffic volume, individual vehicle speed, and lane occupancy on a lane by lane basis at a minimum. Each sensor location shall record data for both directions of travel regardless of whether or not the data is needed for travel time reporting. This is required for data recording purposes only. If a singular device cannot accurately capture both directions of travel, a supplemental device shall be supplied to record data on the direction of travel that cannot be recorded by the singular device required for travel time reporting unless otherwise approved or directed by MDTA. Use of Doppler Radars, third party data streams (INRIX, etc.), Bluetooth, Wi-Fi or Bluetooth/Wi-Fi combo sensors and data on any project will require approval by MDTA prior to the start of the project. These devices shall not be used at any data collection location specified in the Contract Plans.

Each PTS shall communicate with the TMS to modify the appropriate PVMS messages depending on the prevailing traffic speed.

The PTS shall be capable of being installed along the roadway at a manufacturer recommended height and angle such that recording traffic data on each lane is not occluded by any of the adjacent travel lanes.

Portable Variable Message Signs (PVMS)

PVMSs, at a minimum, shall meet the requirements of Section 104.19 of the Specifications, where they do not conflict with the following criteria.

The signs shall be trailer mounted. The message panel shall be at least 7 feet above the pavement, present a level appearance, and be capable of displaying up to a minimum of eight characters in each of three lines at a time. Each PVMS to be used as part of the TMS shall be a NTCIP compliant LED display and shall conform to Section 6 of the MdMUTCD. All messages shall be as defined on plans, in this specification and as coordinated and approved by MDTA.

Due to spatial constraints within the Right of Way (ROW) in some project areas, smaller sized PVMSs may be required. It shall be the Contractor's responsibility to ascertain if sufficient space is available at all proposed PVMS locations, outside of those identified on the Contract Documents, to accommodate a full-size PVM. If a full-size PVMS cannot be accommodated due to spatial constraints within the ROW, an urban or intermediate size PVMS, meeting the criteria detailed in this special provision and having a minimum display size of 36 inches x 72 inches shall be provided, with approval of the Engineer.

The PVMS shall be compliant with the latest approved NTCIP Protocol.

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Visibility

PVMS messages shall be visible within a distance range of 1200 feet from the VMS display face under the following conditions:

When the PVMS is mounted so its bottom side is positioned between five feet and 20 feet above a level roadway surface.

24 hours per day and in most normally encountered weather conditions experienced in Maryland.

During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the PVMS.

When viewed by motorists and travelers that have 20-20 corrected vision.

When the motorist eye level is 3 feet to 12 feet above the roadway surface.

Legibility

At horizontal viewing angles up to 45 degrees from the display, the characters shall be legible from 800 feet.

At extreme horizontal viewing angles of up to 82 degrees from the display, the characters shall be legible from 140 feet.

The sign shall include automatic dimming for night-time operations.

The message sign shall provide for remote sign operation via the TMS allowing operators to manually override the automated messaging in order to display a message at any time. The operator shall be able to cancel this override and initiate the systems automated messaging feature. Each message sign shall be capable of password protected manual local operation via a hard-wired keyboard control.

All messages are to be center-justified.

Messages to be displayed shall have the capability to be modified autonomously at various times of the day and days of the week.

Any request to change the messages on the PVMSs shall be approved by MDTA.

The TMS shall display and record message board solar charge and the battery capacity.

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The message board shall utilize a hydraulic lift to raise and lower the sign panel to display height and a locking mechanism to prevent rotation.

Solar panel array shall be sized to provide continuous operation at all times at the proposed field location.

The battery bank shall have adequate amp-hr capacity to operate the message board continuously in the absence of solar recharge for a minimum of 14 days.

Branding

The TMS PVMSs shall have branding signing installed to associate the PVMSs specifically with the project. The branding signing messages and sizes shall be coordinated with and meet the minimum requirements established by MDTA. Generally, branding signs shall be the width of the PVMS they are located with. The Contractor shall be responsible for designing the appropriate placement and support for the branding signs, which may vary from location to location based on site conditions. Branding signs shall be installed so that it is immediately and obviously associated with the PVMS to all approaching. Options for branding sign installation include, but are not limited to: direct mounting of the sign to the PVMS and mounting the sign on independent supports directly behind and directly above the PVMS. All sign placement and supports shall be submitted to MDTA for review and approval with the brochure and cut sheet submittal outlined above.

Operational Requirements

System Communications – The Contractor shall ensure that the TMS communications meet the following requirements:

The Contractor performs the required configuration of the TMS's communications system during system initialization.

Included in the operational responsibilities is the assumption of all communication and power costs such as FCC licensing, cellular telephone, wireless data networks, satellite and Internet subscription charges, solar system support and battery charging and maintenance. In addition to these requirements, the Contractor shall assume all responsibility for any damaged TMS equipment due to crashes, vandalism, adverse weather, etc. that may occur during the system's deployment.

Communications between the server and any individual PVMS and PTS are independent through the full range of deployed locations and do not rely upon communications with any other PVMS or PTS except when co-located on the same piece of equipment.

The TMS's communications system incorporates an error detection, correction & notification mechanism to ensure the integrity of all traffic condition data and motorist information messages.

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Data Requirements

The following data acquisition requirements are to be met:

All traffic data acquired by the TMS including but not limited to calculated data fields shall be archived in a log file with time and date stamps for the duration of the project. During the project, MDTA shall have the ability to immediately access any archived data from the TMS website.

The TMS vendor shall provide MDTA all project archive data on a monthly basis unless otherwise approved by MDTA. This logged information will be in a comma delimited spreadsheet format for all traffic data and log information. All data shall be provided in 15 minute intervals reported by device labeled with the approved unique device or data stream identifier. Said intervals shall be provided on a lane by lane arrangement by device/data stream. The Contractor shall coordinate with MDTA on appropriate method of delivery for all project data (DVD, portable media device, external website posting, FTP etc.). The Contractor shall also supply a map displaying the locations of all equipment with its unique device identifier used as part of the TMS. Accompanying this map shall be a detailed description of where each device was installed (shoulder, median, overhead structure location), what lanes the devices were collecting data on (if applicable), how lanes relate to the device and data fields recorded as well as latitude and longitude coordinates for each device.

All system log information shall be provided in chronological order by event (malfunction, overrides, speed alert etc.)

The vendor shall only modify the format of the data to be provided upon approval from MDTA. Each TMS device or data stream shall have a unique device/data stream identifier. These identifiers shall be coordinated with MDTA and approved by MDTA at the beginning of the project and shall not change unless approved by MDTA.

TMS Motorist Information Messages

The following messaging requirements are to be met:

The Traffic Management System PVMSs shall be capable of providing speed, delay, length of traffic queue, travel time, or lane closure advisories as well as time of day messages to motorists as directed by MDTA.

The TMS shall have capacity to preset up to 20 different override messages for use with each PVMS.

Vendor/Manufacturer Equipment Demonstration

Prior to acceptance of the TMS for use on the project and prior to installation in the field, MDTA

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reserves the right to require a local demonstration under actual working conditions, of equipment bid under this item on local roadways (within 50 miles of the project location).

Vendors who have had previous successful and similar projects with MDTA may be excluded from this process at the discretion of MDTA.

The demonstration will be performed and incidental to the cost of the Traffic Management System item, by the Vendor/Manufacturer at a mutually acceptable time and location to MDTA. The field location of equipment shall be coordinated and approved by MDTA.

It is the responsibility of the Vendor/Manufacturer to provide manuals, notes, and other materials for up to twenty (20) attendees at the demonstration.

The Vendor/Manufacturer is responsible for providing programming and setting up all local field equipment necessary for the demonstration.

If requested, the Vendor/Manufacturer should be prepared to demonstrate the equipment within 30 days after notification.

MDTA will reject any equipment which, in MDTA's judgment, does not adequately provide a TMS as required in these special provisions. During the demonstration the operational field test requirements shall be demonstrated to ensure the system proposed will meet the specifications. Refer to the Operational Field Test Section for additional information.

100-13.04 CONSTRUCTION

Security

a) Lock all trailer control cabinets when not attended by an Authority employee or Contractors' employee, whether being stored, in transport, or deployed and activated.
b) Do not store or maintain any passwords on any trailers or equipment.
c) Remove any password attached or inscribed on any trailers or equipment.
d) Do not leave Owner/Instruction manuals in the trailer control cabinets. Manuals should be copied and made available to personnel responsible for deploying the PVMSs and Traffic Sensors
e) Construction Inspectors will ensure Contractor compliance.

TMS Deployment (Field Installation)

Field deployment of the Traffic Management System shall begin no earlier than October 1, 2018, or nine weeks prior to the Contractor's anticipated start of Construction Stage 2. During the field deployment period, the PVMSs and branding signing shall be covered or rotated so they are not

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visible to roadway users. PVMSs and branding signing shall only be made visible as required for the Operational Field Testing, then recovered or obscured.

The PVMSs and PTSs of the TMS shall be installed in close proximity to the locations identified in the Contract Documents.

PTS units for data collection shall be located as close as possible to the locations specified in the contract plans unless otherwise approved or directed by MDTA.

The Contractor shall coordinate with and stake-out/mark in the field all proposed equipment locations with MDTA prior to final device layout plan submission.

The Contractor shall coordinate all proposed equipment field installations with MDTA.

The Contractor shall prepare the locations to receive the equipment in accordance with the equipment manufacturer's requirements. Location preparation shall include but is not limited to site grading modifications, temporary drainage modifications and selective tree trimming. Any site or drainage modifications necessary to install equipment shall be designed by the Contractor and submitted to MDTA for review and approval prior to construction in the field.

The Contractor shall install each component of the TMS in accordance with the manufacturer's recommendations in compliance with all industry standards and codes such that the TMS is fully operational and can be operated and controlled from a website portal provided for MDTA's use as detailed herein.

The Contractor shall coordinate the work with other contractors as designated by MDTA to complete installation and integration of all equipment for all system types. The Contractor shall furnish and install all necessary materials and equipment for the TMS to provide a complete operational system that can be viewed and operated from the website interface by MDTA or other approved parties as detailed herein.

All equipment shall be located within the public way. Any device placed within the public way must meet Maryland State Highway Administration (SHA) clear zone requirements, unless specified on the plans or as otherwise directed by MDTA. If the device is located within the clear zone it shall be protected in accordance with SHA and AASHTO requirements. Any such protection necessary shall be considered incidental to the item and no separate payment will be made for providing such protection.

Contractor shall assume that device locations may be required to be relocated over the course of the project for MDTA purposes and coordination with other projects. Such relocations shall be included in the contract price bid and no additional compensation will be provided for this work.

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The decision to add, relocate, or remove individual devices or the entire TMS shall be at the discretion of MDTA.

Operational Field Test

Once the TMS is fully installed, it shall undergo a 7-day operational field test. The Contractor shall develop and submit to MDTA for review and approval an operational field test procedure and intended schedule for testing to verify all the system requirements outlined below and included in this specification.

The operational field test shall include a test of the system in operation during normal traffic conditions, as well as during a lane closure(s) at the discretion of MDTA, to ensure that all TMS equipment (including the PVMSs, PTSs, central computer, communication devices and website) is operating in a fully functional manner in conformance with the Contract Documents and this special provision for a duration of at least seven (7) calendar days.

If queue detection and warning is required as part of the system, a separate queue detection and warning test shall be required. The Contractor shall develop a test procedure utilizing a police rolling road block to slow and then stop traffic to test the system. Said procedure shall identify the starting and stopping points for the test, intended duration (3 minutes of stopped traffic), methodology for observing website and field PVMS reporting and eventual release to normal traffic operations and submit to MDTA for review and approval.

During this time the messages displayed on the TMS PVMS shall be determined by MDTA.

Upon initiation of the 7-day test period, the Vendor shall demonstrate all specified and functional items of the system are in compliance with the specifications including but not limited to the following:

- Demonstrate ability to email/text alerts for :
  o Low power
  o Loss of communications for > 15 minutes
  o Restoration of communications = normal
  o Speed Alerts (Low Speed Alert… threshold adjustable) & (Normal/Free Flow Speed Alert… threshold adjustable)

- Demonstrate device GPS on map view

- Demonstrate using Vendor website to obtain all data such as message history, traffic data history, device malfunction history, current device voltages, communications status etc.

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- Demonstrate that all data is available and easily graphed and exported at any time by MDTA authorized users and includes any defined time/date/interval (1 minute, 5 minutes, 15 minutes, 1 hour, 1 day, etc.) periods.

- Demonstrate that all data is available at any time by individual sensor and group of sensors by MDTA authorized users for the current time up to the previous minute.

- Demonstrate that data can be exported by MDTA authorized users from software to common spreadsheet file from the website for all historical data up to the latest minute.

- Demonstrate NTCIP Protocol compliance thru detection of PVMS malfunctions (i.e. Pixel error, controller error, etc.)

- Demonstrate two way communications with PVMS and message verification.

- Test by removing one display card on live board and see system detect issue.

- Demonstrate detection and status of no traffic data for more than 15 minutes.

- Demonstrate ability to conduct manual override for a singular and multiple PVMSs by any authorized operator for a specified duration (by setting specified start time/date and end time/date). Also demonstrate that the PVMS returns to previous message upon expiration of manual override.

- Demonstrate logging visibility to users of when overrides occurred, what the message was and who created the action to verify it is in compliance with the specifications.

- Demonstrate the ability to utilize different font sizes and graphics for PVMS messages via the TMS website and verify messages are displayed correctly in the field (FULL MATRIX LED PVMS ONLY).

The Contractor shall provide for complete operations support from the vendor during the operational field test (including all manpower, equipment and materials required), and the Contractor shall provide verification, utilizing a method approved by MDTA, that the reported system/PVMS drive time through the work zone accurately reflects actual field conditions (if required). The Contractor shall also provide verification utilizing a Contractor supplied handheld speed reader radar unit, that the system is recording speeds in close proximity to what the system is recording at any location(s) specified by MDTA.

The Contractor shall maintain accurate records of equipment stoppages and resumptions during the 7-day operational field test for submission to MDTA for approval. In the event that ten percent or

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more of the time similar malfunctions occur that affect the proper operation of the TMS, MDTA may declare a system component defective and require replacement of the equipment at no additional cost. When a TMS component defect is declared, the Contractor shall provide field testing and sufficient data to demonstrate that the deficiency has been corrected and the system is operating in accordance with this special provision.

The Contractor shall submit a report to MDTA detailing the daily activity of the TMS during the operational field test. The report shall indicate the date and time of any activity necessary to maintain operation of the TMS during the operational field test period. Each entry shall include the following information:

- Identity of the equipment on which work was performed.
- Cause of equipment malfunction (if known).
- A description of the type of work performed.
- Time required to repair the equipment malfunction.

Once the operational field test report is received and approved by MDTA, the TMS will be considered operational ready and the system will be accepted for use. The system shall become operational (live) on December 3, 2018, or the Contractor's scheduled start of Construction Stage 2, when permanent lane closures are implemented. The TMS shall be accepted for use (operational ready) a minimum of 14 days prior to the beginning of the operational period. If the system is not accepted for use 14 days prior to the operational period, MDTA may at its sole discretion delay the start of Construction Stage 2 until such a time that the TMS is fully accepted.

Training and Support

The following personnel, training and support shall be required:

Contractor shall ensure that the TMS is furnished, installed and maintained by personnel who are experienced in this type of work. Deploying firm/personnel must have a minimum of five similar deployments.

Training will be provided to project staff on the use and operation of the TMS Software.

The Contractor shall provide training of up to eight (8) hours for MDTA personnel and their agents on the use and operation of both the physical field hardware and the TMS software. The Contractor is to coordinate with MDTA as to the exact location and time of the training.

Training shall be completed upon installation of all TMS devices in the field but prior to the operational field test period or as directed by MDTA. It is the responsibility of the Contractor to provide training manuals, class notes, and other instructional materials for up to twenty (20) attendees at the training session. No training shall begin unless and until, in the opinion of MDTA

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that, the TMS is sufficiently complete and operational such that the training would be useful.

Contractor shall ensure that a Local Systems Manager or other vendor equipment certified on-site maintenance specialist, who is capable of troubleshooting and correcting any issues with all the TMS equipment and software is locally available 24 hours a day, 7 days a week to maintain the system components. Said activity may require movement of portable devices deployed as part of the TMS as necessary to respond to emergency situations within 4 hours. The specialist shall be equipped with sufficient resources and commonly needed spare equipment (i.e. modem, PTS, PVMS, etc.) to make needed corrections of deficiencies within 8 hours of written/email notification. The Local Systems Manager shall also attend the MDTA training session and be introduced and available to MDTA project personnel.

System Operational Performance

The following operational performance requirements shall be met:

To ensure a prompt response to incidents involving the integrity of the TMS devices, the Contractor shall be required to make all necessary corrections to any and all of the components of the TMS (with the exception of MDTA supplied devices) within 12 hours of notification by MDTA. If all corrections are made within this 12-hour period and the system is brought back on-line, no pay reduction will occur. If the 12-hour timeframe expires and the components of the system are not fully restored to proper working order, payment deductions for the system will be made for that day and daily until such time as the entire system is brought back on-line at the discretion of MDTA. The payment deduction will be determined as follows:

1 day = $2,500.00	6 days = $15,000.00
2 days = $5,000.00	7 days = $17,500.00
3 days = $7,500.00	8 days = $20,000.00
4 days = $10,000.00	9 days = $22,500.00
5 days = $12,500.00	10 days = $25,000.00

Each 24 hour period in excess of the initial 12 hour period during which the TMS is not working will be measured as one (1) day.

If the components of the TMS are down for more than 10 total days in a month whether they are consecutive or cumulative, then MDTA reserves the right to require removal of the TMS at this time and replacement with a different system. The Contractor shall continue to be penalized at the payment deduction of $5,000.00 per day for each day, after the initial 10 day penalty that the system is out of compliance with this specification. Any pay deductions in excess of any payment owed to the Contractor shall be paid to the Authority by the Contractor.

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MDTA reserves the right to remove any TMS component at any time if it determines the system is not performing in accordance with this specification, at which time no further payment shall be made.

If the system is not fully approved for use prior to the beginning of the operational period, a pay reduction as detailed above shall occur until the system is approved by MDTA.

The TMS shall perform with no major malfunctions throughout the entire contract unless MDTA requests the system to be removed. Malfunctions include, but are not limited to, the inability of the equipment to provide accurate-real time travel time information, inability to withstand a construction roadside environment or normal weather conditions, etc. MDTA reserves the right to terminate this item at any time if it determines this TMS is not performing in accordance with this specification.

100-13.05 MEASUREMENT AND PAYMENT
The Traffic Management System will not be measured, but will be paid for at the Contract Lump Sum price bid. The price shall include all labor, materials, equipment, tools, and incidentals required to complete the work.

Payment for the TMS will be as follows:

1. 15% of the Contract Lump Sum price will be paid when all TMS equipment is delivered to the job site.
2. 15% of the Contract Lump Sum price will be paid when MDTA approves completion of the 7-day operational field test.
3. 60% of the Contract lump sum price will be prorated and paid in equal amounts on each monthly estimate. The number of months used for prorating will be the number estimated to complete the remainder of the work (Construction Stages 2, 3 and 4).
4. The final 10% of the Contract Lump Sum price will be paid once the entire system has been removed from the project area, all areas have to been restored to original conditions to the satisfaction of the Engineer, and all historical data has been provided to and approved by MDTA.

The TMS shall be removed as stipulated herein or earlier as directed by MDTA. Removal of the TMS and it components shall be considered incidental and no further compensation will be allowed.

Should communications with any device become unreliable or unavailable at any time while in use, the Contractor shall correct by any means necessary (relocate device if possible, switch cellular provider, switch equipment etc.) at no additional cost.

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Contractor shall ensure that all devices have adequate power in accordance with the requirements of this special provision at all times by any means necessary (provide alternate power source etc.) at no additional cost.

Mobilization, installation, relocation, or removal of the TMS, or any of its components, from the project shall be considered incidental and no further compensation will be allowed.

PTSs (including any Doppler radar units, Bluetooth, Wi-Fi, Bluetooth/Wi-Fi combo readers) utilized as part of the TMS and PVMSs (regardless of size utilized as part of the TMS) shall be considered incidental and no further compensation will be allowed.

Acquisition of any third-party data utilized as part of the TMS shall be the Contractor's responsibility and considered incidental and no additional compensation will be allowed.

Any type of permits, Engineered site plans, temporary traffic control, equipment, removal or installation of guardrail, concrete barrier, impact attenuators or traffic control devices, site work, grading or material placement to complete the installation of any of the TMS equipment shall be considered incidental and no further compensation will be allowed.

The TMS operational costs shall be considered incidental and no further compensation will be allowed