Connected Temporary Traffic Signal Deployment Plan

Prepared for the Iowa DOT by

DRAFT March 24, 2021

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Introduction

Timely and accurate information on work zones is becoming increasingly important, not only to road authorities, but to other public and private stakeholders involved with managing road construction and maintenance activities.

Several problems in providing this information are:

- Collecting and reporting timely information is time consuming for staff and competes with other project administration duties.
- Road construction and maintenance activities on two lane roads that require lane closures are not always reported to operations staff resulting in inaccurate or no dissemination to traveler information systems and the traveling public.
- Stakeholders desire more detailed records on the start time, end time, and location of lane closures for improved post work zone analysis of the transportation management plan (TMP) and performance measurement.

Given anticipated deployment of connected vehicles, driver notifications of work zone-related lane closures via in-vehicle displays offer opportunities for increased safety, but also increases the need for accurate information about active lane closures.

Solution

Temporary Traffic Signals, both span wire and trailer mounted designs, are routinely used to control two-way traffic in a single lane when lane closures are needed on two lane highways. Application of available technology could report the location and operation of these temporary traffic signals without requiring significant time of agency staff.

Purpose

This plan provides a guide for the development of communication standards for and deployment of real time connected temporary traffic signals on all Iowa DOT construction and maintenance projects on two-lane highways.

Scope

This plan focuses on developing a system that provides real-time reporting from connected temporary and portable traffic signals used for construction and maintenance operations to determine the status of lane closures. This does not include temporary traffic signals used to control traffic at an intersection or for haul road applications. This plan does not include post processing of this data for applications such as traveler information, project management, project performance, or analysis.

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General Needs

All Connected Temporary Traffic Signals must meet the requirements found in the Manual on Uniform Traffic Control Devices (MUTCD), 2009, Standard Road Plans TC-215, TC-216, TC-217, and TC-271. Temporary signals currently used on construction projects must also meet Iowa DOT Specification Article 2528.03.H and be included on the Approved Products are listed in the Materials Approved Products Listing Enterprise (MAPLE) All traffic signal controllers in Iowa are required to meet NEMA TS5 specifications.

Detailed needs and requirements are included in Attachment 1 of this implementation plan. There are two options of the Smart Arrow Board Protocol:

1. Option 1 – Smart Arrow Board Protocol – JSON (Attachment 2) which receives data from an intermediary server, and
2. Option 2 – Smart Arrow Board Protocol (Attachment 3) where data is polled directly from the arrow board.

Manufacturers and suppliers are allowed to select either of these protocols for the systems provided on Iowa DOT projects.

Maintenance Operations

Maintenance equipment is not required to be included on the MAPLE approved projects list and is not required to meet the same specifications as construction contract devices. It is critical to coordinate with INTRANS to ensure that maintenance deployed CTTS provides data that is compatible with the WZDI. Two options for consideration are:

- Using existing Automated Vehicle Location (AVL) capabilities and SkyHawk Telematics. The major disadvantage is that CTTS are not equipped with the AVL capabilities capable of reporting WZDI data.
- Using the protocol and specifications used for contract operations.

A revised schedule for deployment may be needed to allow for identification of equipment needs and procurement of equipment. This includes:

- Does existing equipment meet operational requirements?
- Can existing equipment be retrofitted to ensure compliance?
- Is replacement of all existing equipment necessary?
- Is funding available to purchase or lease the necessary equipment?

Future Needs

The implementation of smart arrow boards and Connected Temporary Traffic Signals are only the first steps in providing automated data for work zones. There are other technologies and needs, that need to be addressed to provide more complete work zone data.

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Proposed Project Schedule

Year		2021												2022												2023
Month		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
1	Establish Needs																									
2	Research Current Methods																									
3	Develop Architecture																									
4	ATSSA Chapter																									
5	Manufacturers																									
6	Manufacturers Comments																									
7	Select Manufacturers																									
8	Midwest Round Table																									
9	Evaluation																									
10	Construction Specifications																									
11	Supplemental Specifications																									
12	Establish MAPLE																									
13	Two Lane Deployment																									

Key for color code on schedule:

	Activity Period		Planned Completion

1. Present schedule and high-level needs to WZMTO Committee January 21, 2021 meeting. Present needs March 2021 meeting.
2. Interview the six manufacturers to establish the method used to communicate with existing temporary signals.
3. Present architecture and high-level requirements to meet needs and receive agreement from WZMTO Committee March 2021 meeting.
4. Provide Iowa DOT with a plan to present to the Iowa ATSSA Chapter members.
5. Conduct interviews with manufacturers to determine their needs prior to making final recommendations. Provide Iowa DOT with information to share with portable traffic signal manufacturers. This should include an invitation to provide portable traffic signals, at no cost to the DOT, for evaluation and approval.
6. Review manufacturers comments and make recommendations to Iowa DOT.
7. Select manufacturer(s) for evaluation. Based on response to invitation in task 5.
8. Provide information to Iowa DOT for presentation at Midwest Work Zone Roundtable.
9. Conduct field evaluation for system approval.
10. Develop smart portable traffic signal specifications for construction contracts and present to the Iowa DOT Specification Committee.

11. Work with Specification Committee to have Supplemental Specifications approved and published.
12. Establish temporary and portable traffic signal MAPLE list.
13. Allows contractors and traffic control providers to begin conversion of their inventory to real-time arrow boards and begin deployment. This deployment will be mandatory on two lane projects in 2023. The RCE should determine the need for a change order on previously let projects with consultation with Traffic Safety Engineer in Construction and Materials.

Portable Signal Manufacturers

Horizon Signal
Horizonsignal.com
800-852-8796

John Thomas Inc.
Jtitraffic.com
888-447-7263

OMJC Signal
Omjcsignal.com
403 Chestnut Street
Waterloo, IA 50703

North America Traffic
Northamericantraffic.com
877-352-4626
7 Petersburg Circle
Port Colborne, Ontario

Ver-Mac
Ver-mac.com
888-488-7446
4590 Scott Trail, Suite 209
Eagan, MN 55122 USA

iCone Products
iconeproducts.com
3279 Cottrell Rd
Cato, NY 13033

Superior Traffic Services
Superiortrafficservices.com
8404 El Way
Missoula, MT 59808

Attachment 1

Connected Temporary Traffic Signals Needs and Requirements

Needs/Requirements Analysis

Iowa DOT Temporary Traffic Signal Protocol

Version 1.0

Iowa DOT

SRF Consulting Group, Inc. | Engineers Planners Designers

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Definitions

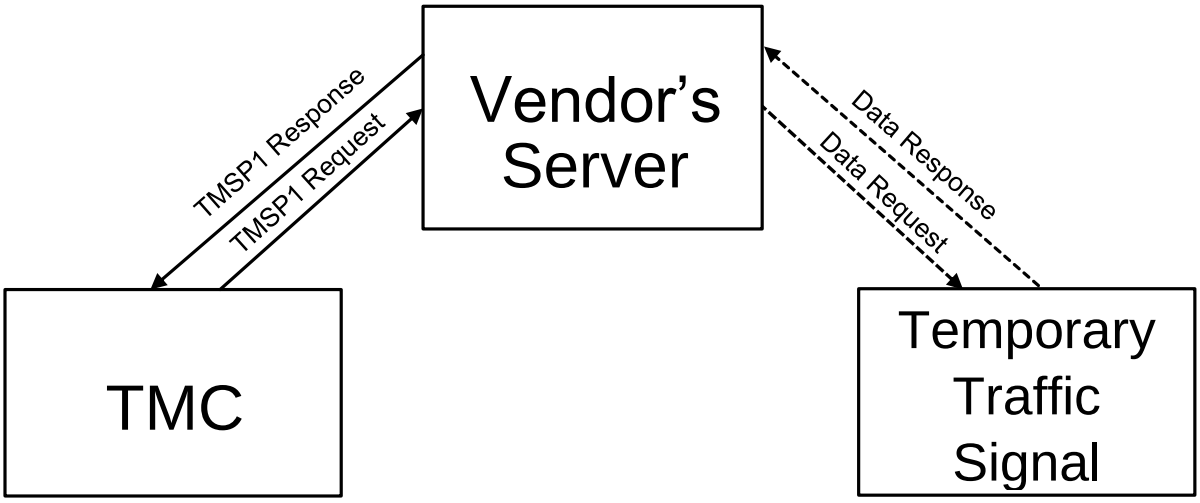
For brevity, for the remainder of this document: “display” will mean “temporary traffic signal display”. “Controller” will mean “traffic signal controller”. And “central software” will mean “central traffic management software”.

Acronyms

ASCII – American Standard Code for Information Interchange
GPS – Global Positioning System
IP – Internet Protocol
TCP – Transmission Control Protocol
UTC – Coordinated Universal Time

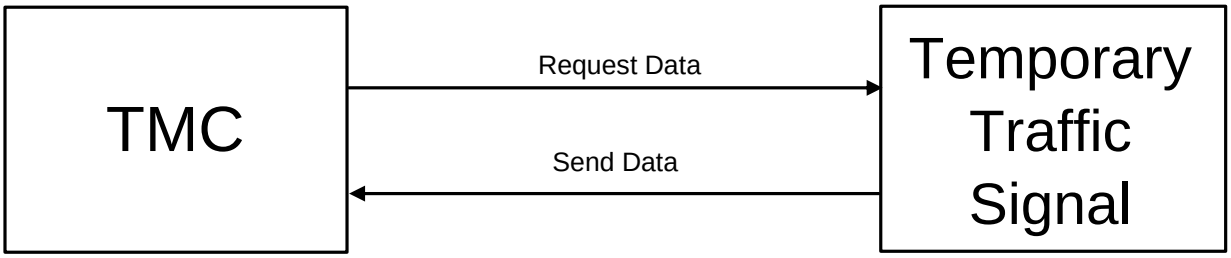
System Architecture

Retrieving Data from an Intermediary Server



(Solid arrow lines show TSMP1 protocol exchange. Dotted lines are manufacturer specified protocol.)

Retrieving Data Directly form a Temporary Traffic Signal



System Needs and Requirements

This document presents the system needs and high level-requirements. These are organized as a hierarchy with needs at the highest level and successive levels of requirements providing additional detail under each.

System needs describe the end goals the system is intended to achieve, or, put another way, the reason a system is being considered.

System requirements describe what a system should do to meet the needs articulated. Requirements are distinct from system specifications, which describe the materials, construction techniques and other details related to a design.

1. **Standardize communication between central software and displays using industry standard communications hardware and methods.**
   - 1.1. The controller shall accept a Transmission Control Protocol (TCP)/ Internet Protocol (IP) connection initiated by central software.
   - 1.2. The default TCP/IP port used for this communication shall be 23 (telnet). Note: The controller does <u>not</u> need to implement a full "telnet client". A raw TCP/IP port will suffice.
   - 1.3. A protocol shall be defined to communicate between central software and a controller using this port.
   - 1.4. All communication via this protocol shall be conveyed via 8-bit American Standard Code for Information Interchange (ASCII) text.
   - 1.5. The controller shall not echo command data.
   - 1.6. The controller shall provide a response to every protocol command.
2. **Permit remote monitoring of display's location, orientation, and traffic signal mode.**
   - 2.1. The protocol shall allow retrieving the display's:
     - 2.1.1. Latitude
     - 2.1.2. Longitude
     - 2.1.3. GPS-lock status
     - 2.1.4. Display orientation expressed as an azimuth (compass heading)
     - 2.1.5. Traffic signal mode currently being displayed
       - 2.1.5.1. No communication available to the temporary signal set
       - 2.1.5.2. Powered on, but not displaying
       - 2.1.5.3. Using a timed cycle
       - 2.1.5.4. Using a manual trigger
       - 2.1.5.5. Using some other external trigger
       - 2.1.5.6. Disabled due to an error

Discussion on extensibility – plan is for these to have structure for how you describe more things, future version have defined structure i.e. 1=actuated, 2= fixed, 3=…future items can be integrated into ATMS. i.e. can add other to each mode.

Follow syntax of SAB, easier and easier to integrate into ATMS

2.1.6. UTC timestamp
2.1.7. Age of latest GPS info
2.1.8.Traffic Signal position (up or down) for trailer mounted design.

3. **The protocol shall allow service technician to perform on-site configuration and diagnostics without the need for custom software.**
   3.1. A service tech may initiate a communication session from a personal computer to a controller using a TCP/IP terminal program in raw mode.
   3.2. All protocol commands shall be defined so that they can be generated from a standard ASCII keyboard.
   3.3. All protocol responses shall be formatted to be human readable.
      3.3.1. Responses shall be formatted as ASCII text.
      3.3.2. Responses shall be descriptive.
   3.4. All TCP/IP communication sessions shall be automatically disconnected, by the controller, after 60 seconds of no communication.
   3.5. The protocol shall allow manual overriding of the reported location and/or orientation information where use of a GPS or a digital compass (parked in a tunnel or installed at a fixed location) isn't appropriate.
   3.6. The protocol shall allow resuming normal reporting of location and/or orientation.
4. **The controller shall allow the TCP communication port used to communicate with the controller to be configured after manufacture.**
   4.1. The protocol shall allow changing the TCP/IP port used for communicating with the controller. This change shall take effect automatically at the end of the communication session that initiates the change.
5. **Allow retrieving/monitoring display maintenance information.**
   5.1. If a sign display controller is used, the protocol shall allow retrieving the display's:
      5.1.1. Controller hardware version.
      5.1.2. Controller software version.
      5.1.3. Photocell data.
      5.1.4. Current display brightness.
      5.1.5. Functional status (*normal*, *locked on*, *locked off*, or *other error*) of each display element.
      5.1.6. Power status (where applicable)
         5.1.6.1. Battery voltage
         5.1.6.2. Solar panel output voltage
         5.1.6.3. Generator or vehicle power supply voltage
         5.1.6.4. AC power voltage
6. **Allow storing/retrieving secondary information about the display.**
   6.1. The protocol shall allow storing and retrieving a list of other hardware and/or project specific attributes.

6.1.1. <example optional attributes TBD with input from temporary traffic signal manufacturers>