Scott County Traffic Management System

System Requirements

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1. Introduction

Scott County is developing a Traffic Management System (TMS) to address transportation safety and mobility challenges associated with event oriented traffic around the interchange of County Road (CR) 83 and US Highway (Hwy) 169 within the City of Shakopee. The management of traffic in this area involves transportation agencies at the city, county and state levels, as well as local law enforcement and businesses that generate traffic for large events. **The goal of this project is to actively manage traffic and provide real-time alternate route information to travelers in order to balance traffic in the project area during events, thus reducing safety and mobility issues.**

A general concept of operations was prepared to identify challenges with the current situation and develop corresponding needs. The needs were identified by Scott County key stakeholders and documents relevant to the project. This system requirements document has been developed to further identify how the stakeholder needs have been correlated with requirements. The document identifies how the envisioned TMS fits within the Minnesota ITS Architecture and it presents system requirements that describe what the TMS must do as the basis for further design, procurement, installation, testing and operation. The final section of the document outlines potential future needs and requirements which are not yet well-defined or are uncertain enough that they were not included in the scope of the initial TMS but are documented so that they may be monitored.

2. ITS Architecture Assessment

As an Intelligent Transportation System, it is necessary to assess where the TMS fits within the Minnesota ITS Architecture (Version 2014). As it is envisioned in the concept of operations, the TMS is part of the Advanced Traffic Management Systems Service Package Bundle (Volume 3). The TMS addresses the following needs identified in the architecture.

- TM05: Provide real-time incident and congestion information to travelers
- TM16: Identify alternate routes
- TM17: Provide travel information on special events
- TM24: Operate freeway/expressway/arterial DMS
- TM25: Operate CCTV cameras

It may be identified in this bundle as a series of existing elements within several service packages as described in Table 1 below.

Table 1 Scott County TMS in Minnesota ITS Architecture

System/Element	Service Package	Description
Automated Traffic Recorder Roadside Equipment	ATMS01: Network Surveillance	This element represents roadside equipment that collects data on traffic patterns and volumes. Data is communicated back to the central systems residing in TMCs. Data is also collected, processed, and archived by TMCs.
CCTV Roadside Equipment	ATMS01: Network Surveillance	This element represents CCTV cameras deployed along the roadside by various agencies and municipalities throughout Minnesota. Cameras are controlled and monitored by TMCs.

Dynamic Message Sign Roadside Equipment	ATMS06: Traffic Information Dissemination	This element represents portable and permanent DMS operated throughout the state used to convey driver information on special events, maintenance and construction activity, travel time, incident management, AMBER alerts, and transportation and national emergencies.
Local TMCs	ATMS01: Network Surveillance ATMS03: Traffic Signal Control ATMS06: Traffic Information Dissemination ATMS08: Traffic Incident Management	This element represents local centers that facilitate traffic management on a roadway network from a central location that provides roadway monitoring, signal system control, remote equipment control, and communications with field personnel and other agencies.
Traffic Signal Roadside Equipment	ATMS03: Traffic Signal Control	This element represents traffic signals in Minnesota that are controlled by TMCs. This element supports surface street control and arterial traffic management. It represents traffic signal systems ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests.

Based on the references noted here, it is confirmed that the TMS is adequately addressed in the Minnesota ITS Architecture.

3. System Requirements for TMS

System requirements are verifiable details that define what the TMS will do, how well they will perform or what conditions they must perform under. The requirements presented in this section are defined in relation to the needs that were identified in the concept of operations for the TMS. The needs are listed below for reference purposes.

Needs for Scott County TMS

1. Travelers need to know in real-time the safest, most efficient transportation access to major event venues during events generating more than 4,500 visitors.
2. Event venues, Shakopee Mdewakanton Sioux Community (SMSC), Shakopee, Scott County and MnDOT need to dynamically direct Travelers to the safest, most efficient transportation access to major event venues during events generating more than 4,500 visitors.
3. Event venues, SMSC, Shakopee, Scott County and MnDOT need to be able to monitor and dynamically direct Travelers 24/7/365.
4. Travelers need directional signing – both static and dynamic – that is credible and assertive to guide them to alternate access points.
5. During events, event venues, SMSC, Shakopee, Scott County and MnDOT need to

dynamically direct arriving Travelers to alternate routes via CR 101, CR 21 and CR 17.

6. During events, event venues, SMSC, Shakopee, Scott County and MnDOT need to smooth traffic arriving via CR 83.
7. Event venues, SMSC, Shakopee, Scott County and MnDOT need to know when traffic volumes on CR 101 make it an undesirable alternate route for accessing major event venues.
8. Event venues, SMSC, Shakopee, Scott County and MnDOT need to know in real-time when train traffic impacts on CR 101 make it an undesirable alternate route for accessing the major event venues during events.
9. Event venues, SMSC, Shakopee, Scott County and MnDOT need a permanent solution that allows them to dynamically manage traffic during events and incidents.
10. Event venues, SMSC, Shakopee, Scott County and MnDOT need a process for exchanging event information in advance to prepare for traffic management.
11. Event venues, SMSC, Shakopee, Scott County and MnDOT need to dynamically direct departing Travelers to alternate routes via CR 101, CR 21 and CR 17.
12. Event venues, SMSC, Shakopee, Scott County and MnDOT need to smooth traffic departing via CR 83.
13. Event venues, SMSC, Shakopee, Scott County and MnDOT need existing static signs to support any additional signing that may be used to dynamically direct Travelers to and from the major venues.
14. Event venues, SMSC, Shakopee, Scott County and MnDOT need to monitor in real-time traffic at key locations during events to understand traffic impacts.
15. Event venues, SMSC, Shakopee, Scott County and MnDOT need to anticipate future traffic impacts that may be caused by new businesses operating in the area.
16. Event venues, SMSC, Shakopee, Scott County and MnDOT need other traffic generators (e.g. MVTA, large employers) in the area to be aware of events so that, when possible, operations (e.g. routes, employee shifts, deliveries) can be modified.

Scott County has also explored several software solutions to identify a preferred direction for the system requirements. All of the solutions that were considered by the County are described below along with assessments for each as they relate to the TMS.

1. Partner agency owns, operates and maintains all control software through a partnership agreement with and funding from Scott County. Partner also operates and maintains all hardware (e.g. databases, services, field devices) associated with the TMS. Scott County considers this a partner-managed solution.

   Assessment: The potential partner agencies for this option were limited to MnDOT and the City of Bloomington; both of which operate IRIS as their TMS control software. IRIS is an open-source software developed by MnDOT. MnDOT is not currently structured to provide additional support to other agencies in relation to IRIS. The City of Bloomington is just beginning to use IRIS so their experience and abilities are limited and as such they are unable to provide support to other agencies.

2. Scott County owns control software but it is housed along with associated databases and servers within a partner agency. Scott County owns field devices. Operations and maintenance roles are negotiated between the partner agency and Scott County.

   Assessment: As with the partner-managed solution above, partner agencies were still limited to MnDOT and the City of Bloomington; both of which are not structured to provide hosting support to other agencies for this purpose.

3. Scott County licenses Cloud-based control software provided by a vendor. Scott County owns and operates field devices. Maintenance roles are negotiated with a vendor. Scott County considers this arrangement to be the provision of software as a service.

   Assessment: Although some vendors of control software offer Cloud-based services, they are primarily offered to private industry clients. Public agency clients prefer to purchase and host software within their own network to allow more direct control and access to the software. Most control software vendors do support virtual server environments. These vendors include, but not limited to, Econolite, Transcore, Kimley-Horn (KITS), and Intelight. These vendors provide Traffic Signal Management Systems with optional modules for DMS and CCTV control. Of these vendors, Econolite, Transcore, and Kimley-Horn truly integrate DMS and CCTV control into their software. Intelight currently uses hyperlinks to allow users to pull up third party software to control DMS and CCTV. Intelight is currently working on fully integrating DMS and CCTV into their software. None of these vendors manufacture or sells DMS or CCTVs or currently provides services on field devices.

4. Scott County licenses control software provided by a vendor on a private traffic ring provisioned within the Scott County network. Scott County owns and operates field devices. Maintenance roles are negotiated with a vendor.

   Assessment: This is a feasible option as it is a more prevalent offering among vendors of control software.

5. Scott County owns control software and houses all associated databases and servers within the Scott County network. Scott County owns and operated field devices. Maintenance is provided by Scott County. This is considered an on premise solution by Scott County.

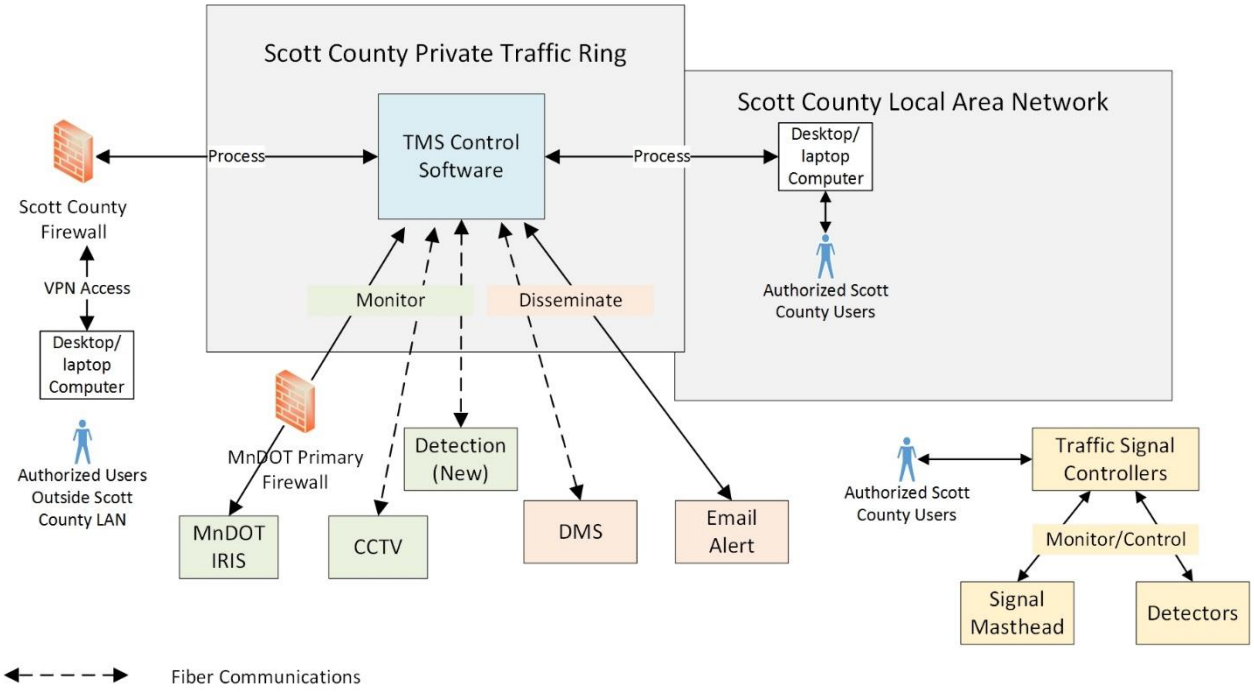
   Assessment: This is the most feasible option as it is currently the most prevalent offering among vendors of control software. Most, if not all, software vendors offer services that includes the maintenance of the software databases and provide updates to the software remotely. Typically, it is the agency's responsibility to maintain the associated server(s). There are two known consultants that currently provide support and maintenance of IRIS. SRF is currently under contract with the Nebraska Department of Roads to assist with the deployment of IRIS and provide support and ongoing maintenance of IRIS. Iteris is currently assisting the deployment of IRIS for the Wyoming DOT. They are providing the integration support and will continue to provide 24x7 IRIS support and enhancements for WYDOT. In both instances, IRIS is installed on a server that resides within the agency's network. It should

also be noted that Iteris currently hosts MnDOT iPEMS software on a cloud-hosted server. Iteris may be able to provide a cloud-hosted solution for IRIS.

These assessments were internally reviewed by Scott County and a hybrid of options 4 and 5 was selected to reflect the decision to use IRIS as the TMS control software. Under this hybrid option, Scott County would own IRIS such that the software is hosted at a vendor location and a vendor would also provide integration services, ongoing support and maintenance of the central control software. It is also possible that Scott County could host the software on premise and a vendor would still provide support services. Finally, Scott County could also contract with a local vendor to provide maintenance for the field devices under this solution.

Based on the selected software solution, Figure 1 illustrates the envisioned TMS architecture. Figure 1 also shows users and several components that will perform specific functions as part of the overall system. The requirements are presented in relation to the function that they serve and the components that serve a particular function. The primary TMS functions include processing, monitoring and dissemination. Processing primarily consists of the commands issued by users through the control software to operate the TMS. Monitoring is made up of the components that will interact with the TMS control software to support user monitoring activities. Dissemination is comprised of the components that will interact with the TMS control software to support users disseminating information.

Figure 1 Envisioned TMS Architecture



The TMS requirements are included in Table 2. The number references in the requirements table allow for traceability back to needs and forward for design and testing. The first identification number will be used as a requirement reference number and it will be used to track requirements through design and testing. The second series of numbers refers to the stakeholder needs as they are presented above and in the concept of operations.

Table 2 TMS System Requirements

Requirement The TMS shall…		Need
1. Processing-Control Software		
1.1.	Be accessible via a standard Internet browser.	2, 3, 9
1.2.	Be a multi-user software.	2, 9
1.3.	Consist of software and databases for users to access 24/7/365.	2, 3, 9
1.4.	Be able to be added to a private traffic ring established by Scott County using Red Hat Enterprise Linux.	2, 9
1.5.	Be compliant with PostgreSQL database management systems.	2, 9
1.6.	Enable user access from desktop and portable computers with Scott County LAN connections to the server.	2, 9
1.7.	Include the ability to provide access from desktop and portable computers for authorized users outside the Scott County LAN.	2, 9
1.8.	Support access for authorized users through the Scott County firewall using virtual private network (VPN) access.	2, 9
1.9.	Enable computers connected via authorized users access to perform concurrent operation.	2, 9
1.10.	Have the capability for computers connected via authorized user access to communicate with field devices (e.g. detection, CCTV, DMS) operated by Scott County.	2, 9
1.11.	Communicate via fiber (first preference) and cell modem (second preference) with field devices operated by Scott County.	2, 5, 7, 8, 9, 11, 14
1.12.	Use National Transportation Communications for ITS Protocol (NTCIP) center to field communications protocols to interface with field devices operated by Scott County.	2, 5, 7, 8, 9, 11, 14
1.13.	Be capable of simultaneously monitoring a minimum of 75 field devices.	2, 5, 7, 8, 9, 11, 14
1.14.	Be capable of adding field devices to accommodate future deployments.	2, 5, 7, 8, 9, 11, 14, 15
1.15.	Control user access with individual user identities and passwords.	2, 9
1.16.	Maintain a record of access to the system according to user identities for a minimum of 365 days.	2, 9
1.17.	Allow for three levels of operating privileges based on types of user access.	2, 9
1.18.	Provide the first highest level of operating privileges for users who will perform administrative functions associated with maintaining the software.	2, 9
1.19.	Provide the second highest level of operating privileges for users who will use the software to operate the TMS.	2, 9
1.20.	Provide the third highest level of operating privileges for users who will only use the software to view information in the TMS.	2, 9
1.21.	Display device locations in a tabular format.	2, 9
1.22.	Display device operational status in a table.	2, 9
1.23.	Display device locations on a map.	2, 9
1.24.	Display device operational status on a map.	2, 9
1.25.	Include map pan and zoom capabilities.	2, 9
1.26.	Allow users to define view preferences by geography and zoom level.	2, 9
1.27.	Identify device locations on the map with unique icons representing the type	2, 5, 7, 8, 9, 11,

Requirement The TMS shall…		Need
	of device (e.g. CCTV, detector, DMS).	14
1.28.	Allow users to search and view by device type.	2, 5, 7, 8, 9, 11, 14
1.29.	Allow users to click on a device and view the following details: • Device identification number • Geographic location of device by latitude and longitude • Date and time stamp of last TMS communication with device • Device operational status according to active operational plan	2, 5, 7, 8, 9, 11, 14
1.30.	Allow users with the first and second highest levels of operating privileges to click on a device to access its control functions. Control functions are specified for each device below.	2, 5, 7, 8, 9, 11, 14
1.31.	Allow creation of operational plans that specify device actions (e.g. messages posted to DMS, email alerts, signal timing plans) based on conditions that warrant use of the system.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
1.32.	Allow users with the first highest level of operating privileges to create operational plans.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
1.33.	Allow users with the first highest level of operating privileges to modify operational plans.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
1.34.	Allow users with the first and second highest levels of operating privileges to activate operational plans.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
1.35.	Allow users with the first and second highest levels of operating privileges to deactivate operational plans.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
1.36.	Maintain a record of operational plan activations and deactivations according to user identities for a minimum of 365 days.	2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16
2. Monitoring-CCTV		
2.1.	Interface with MnDOT IRIS to access snapshot images from MnDOT-operated CCTV.	2, 14
2.2.	Display CCTV images from MnDOT IRIS as view only information.	2, 14
2.3.	Include CCTV and related cabling rated for outdoor use.	2, 6, 8, 14
2.4.	Include CCTV that provide at least three individually configurable full resolution video streams at 30 frames per second (NTSC) in all resolutions up to 704 x 480 pixels or 25 frames per second (PAL) in all resolutions up to 704 x 576 pixels.	2, 7, 8, 14
2.5.	Include CCTV that allow users to pan, tilt and zoom CCTV control remotely.	2, 7, 8, 14
2.6.	Include CCTV with day and night functionality to manage image quality.	2, 7, 8, 14
2.7.	Include CCTV capable of communicating via fiber (first preference) or cell modem (second preference).	2, 7, 8, 14
2.8.	Include CCTV that utilize NTCIP field to center communication protocols.	2, 7, 8, 14
2.9.	Include CCTV that allow video to be transmitted over IP networks.	2, 7, 8, 14
2.10.	Include CCTV that utilize MJPEG, MPEG4 or h.264 formats for video compression.	2, 7, 8, 14

Requirement The TMS shall…		Need
2.11.	Include CCTV that operate on power over Ethernet or 120/240 Volts AC with a power drop from the local utility company.	2, 7, 8, 14
2.12.	Include CCTV that are protected from degradation of power with voltage surge suppression.	2, 7, 8, 14
2.13.	Utilize a non-proprietary, common format (e.g. MPEG 4) for video storage.	2, 7, 8, 14
2.14.	Automatically capture and temporarily store for a minimum of 72 hours a digital video recording of Scott County-operated CCTV imagery without operator intervention.	2, 7, 8, 14
2.15.	After 72 hours, automatically overwrite digital video recording of CCTV imagery without operator intervention.	2, 7, 8, 14
3. Monitoring-Detection		
3.1.		
3.2.		
3.3.	Include detection capable of detecting traffic in a minimum of six (6) lanes.	2, 7, 8, 15
3.4.	Include detection capable of detecting traffic with 90% or higher accuracy.	2, 7, 8, 15
3.5.	Include detection capable of communicating via fiber (first preference) or cell modem (second preference).	2, 7, 8, 15
3.6.	Include detection that operates on 120/240 Volts AC with a power drop from the local utility company or on power provided by the signal control cabinet.	2, 7, 8, 15
3.7.	Include detection that is protected from degradation of power with voltage surge suppression.	2, 7, 8, 15
3.8.	Include detection that allows users the option to manage detection settings remotely.	2, 7, 8, 15
3.9.	Automatically capture and store Scott County-operated detection data for a minimum of 365 days without operator intervention.	2, 7, 8, 15
4. Disseminating-DMS		
4.1.	Interface with MnDOT IRIS to access messages posted on MnDOT-operated DMS.	2, 5, 11
4.2.	Display DMS messages from MnDOT IRIS as view only information.	2, 5, 11
4.3.	Include DMS that comply with Minnesota Manual on Uniform Traffic Control Devices, Part 2. Signs, Chapter 2L. Changeable Message Signs, Section 2L.3. Legibility and Visibility of Changeable Message Signs.	1, 2, 4, 5, 11
4.4.	Include DMS that comply with Minnesota Manual on Uniform Traffic Control Devices, Part 2. Signs, Chapter 2L. Changeable Message Signs, Section 2L. 4. Design Characteristics of Changeable Message Signs.	1, 2, 4, 5, 11
4.5.	Include DMS that utilize a full matrix display area.	2, 4, 5, 11
4.6.	Include DMS that display full color.	2, 4, 5, 11
4.7.	Include DMS with a pixel pitch of 16mm.	2, 4, 5, 11
4.8.	Include DMS that will be roadside or overhead mounted to accommodate installation site characteristics.	2, 4, 5, 11
4.9.	Include DMS capable of communicating intermittently via fiber (first preference) or cell modem (second preference).	2, 4, 5, 11
4.10.	Include DMS that utilize NTCIP field to center communication protocols.	2, 4, 5, 11
4.11.	Include DMS that operate on 120/240 Volts AC with a power drop from the local utility company.	2, 4, 5, 11
4.12.	Include DMS that are protected from degradation of power with voltage	2, 4, 5, 11

Requirement The TMS shall…		Need
	surge suppression.	
4.13.	Include DMS that allow users to post DMS messages remotely.	2, 4, 5, 11
4.14.	Include DMS that allow users to preview messages before posting them to the sign.	2, 4, 5, 11
4.15.	Include DMS that allow users to remove DMS messages remotely.	2, 4, 5, 11
4.16.	Include DMS that allow users to post pre-defined DMS messages.	2, 4, 5, 11
4.17.	Include DMS that allow users to post free-text DMS messages.	2, 4, 5, 11
4.18.	Automatically capture and store Scott County-operated DMS messages posted for a minimum of 365 days without operator intervention.	2, 4, 5, 11
5.	**Disseminating-Static Signs**	
5.1.	Include static signs guide travelers in support of messages posted on DMS.	1, 4, 13
5.2.	Include static signs that comply with Minnesota Manual on Uniform Traffic Control Devices, Part 2. Signs, Chapter 2M. Recreational and Cultural Interest Area Signs.	1, 4, 13
6.	**Disseminating-Email Alert**	
6.1.	Automatically push email alerts to user-defined distribution lists as operational plans are activated.	16
6.2.	Automatically push email alerts to user-defined distribution lists as operational plans are deactivated.	16
6.3.	Allow automatic push email alert feature to be turned on or off.	16
6.4.	Allow manually pushed email alerts to user-defined distribution lists as needed.	16
6.5.	Allow the creation of user-defined distribution lists for push email alerts.	16

4. Potential Future Needs and Requirements

In addition to the immediate needs and requirements identified for the TMS in this document and the concept of operations, Scott County and the stakeholders involved in the development of the TMS foresee some potential future needs and requirements for the system. These needs and requirements are not yet well-defined or are uncertain enough that they were not included in the scope of the initial TMS. They are, however, documented here so that they may be monitored and considered if or when more information is known.

- Signal control is recognized as a part of the overall TMS operation in the sense that signal timing plans may be developed and activated in relation to operational plans for managing events. However, Scott County's existing signal network does not allow for central control. Control is limited to dial-up access (for MnDOT-operated signals intersecting Scott County roads) and modifications in the field at individual signal controllers (for signals operated by Scott County). Future signal control software could be centralized but would likely remain separate from the TMS control software.
- Canterbury Park, Mystic Lake Casino and Valleyfair are part of an area marketing group called RiverSouth. All traveler information for the TMS is currently envisioned for dissemination at the roadside via DMS. It is possible, however, the RiverSouth or one of the event venues could

develop a website or app to display information from the TMS for travelers to receive in a pre-trip fashion.

- MVTA will begin 24/7 operations on select routes in the next year and they currently operate two park and ride facilities in the area – one off CR 17 and the other off CR 21. Although they do not currently provide charter service for events, it is possible that Scott County or the City of Shakopee could contract them for such activities in the future and the TMS could potentially be used to support those services.
- Finally, it is possible that the TMS could be expanded to other corridors in the future.