



Scott County Traffic Management System

Validation Plan

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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 concept of operations has been prepared to identify challenges with the current situation and to develop corresponding needs. The needs were identified by Scott County key stakeholders and documents relevant to the project. System requirements have also been developed to further identify how the stakeholder needs have been correlated with requirements that describe what the TMS must do as the basis for further design, procurement, installation, testing and operation. **This document now presents a validation plan that will be used during the design and construction stages of this project to confirm that the system is procured, installed and operating as specified by the system requirements.**

Testing is necessary to ensure system requirements are met. For this project, testing will be done on two levels. First, verification testing will be conducted on system components as they are identified for procurement and incorporated into design. This will confirm that available products meet specified requirements and it will be performed primarily through document review before the system is procured. Once procured and system integration is complete, additional testing verifies that the components have been successfully integrated before they are installed. Acceptance testing is the second level of validation for this project and it will take place after the initial system components are installed. System acceptance will confirm that the products fulfill their intended use and it will be completed when the system is in its operational environment to allow for demonstrations as the primary form of testing. Once the initial installation is accepted, all remaining installation may proceed.

Scott County will oversee all verification and acceptance testing, some of which will be led by the Design Contractor and others by the Construction Contractor(s). Five test cases are suggested for this project:

Verification Testing

1. Product Specification Review
2. Plan Set Review
3. Integration Demonstration

Acceptance Testing

4. Functional Demonstration (1-Day)
5. Reliability Demonstration (30-Day)

For each test case, a recommended test environment is noted. Test procedures and validation instructions then describe which system components will be inspected or demonstrated to verify the corresponding system requirements. The test procedures also identify who will lead and recommend who should participate in each test case. Some system components will be validated at more than one point and are noted as such in the validation instructions. Test log details are also included to use during

testing as formal documentation of whether the system passed or failed to meet requirements. Comments about each validation step should be entered in the log with enough detail for the Contractor(s) to make product, design or installation modifications as needed.

2. Verification Testing

Components for the TMS will be procured according to the system requirements and final design specifications approved by Scott County. Verification testing will occur as the components are identified for procurement to ensure requirements are met. Any items failed during verification testing will be corrected and then presented again to Scott County for final approval. Once this stage of testing is completed and approved by Scott County, procurement may proceed. Each product should also be accompanied by manufacturer documentation of successful Factory Acceptance Testing prior to shipping. The following tables present three test cases, environment, procedures, verification instructions, relevant system requirements and logs that will be used for verification testing.

Test Case 1: Product Specification Review			
Environment: Office or Factory / Warehouse			
Procedure: As system components are identified and assessed prior to procurement, the Design Contractor and Scott County will review product specifications for requirements verification and approval. Once approved, procurement may proceed. <i>Most steps described in the validation instructions below will be repeated during Test Case 4. The test log has been separated to reflect multiple instances of testing.</i>			
Participants: This test case will be led by the Design Contractor, with participation from Scott County.			
Validation Instructions	System Requirement	Test Log	
		Pass/Fail	Comments
1a. Confirm that control software is accessible via a standard Internet browser . <i>In Test Case 4, browser should be opened and software accessed via designated URL.</i>	1.1	Test Case 1 Results	
		Test Case 4 Results	
1b. Confirm that control software is a multi-user software . <i>In Test Case 4, five or more users should access the software simultaneously.</i>	1.2	Test Case 1 Results	
		Test Case 4 Results	
1c. Confirm that control software and databases are accessible to users 24/7/365 . <i>In Test Case 4, users should access software during a variety of times/days of the week.</i>	1.3	Test Case 1 Results	
		Test Case 4 Results	
1d. Confirm that control software is compatible with Red Hat Enterprise Linux .	1.4	Test Case 1 Results	

1e. Confirm that control software is compatible with PostgreSQL database management.	1.5	Test Case 1 Results	
1f. Confirm that control software is accessible to users with authorized LAN access via desktop and portable computers. <i>In Test Case 4, users should access software from both desktop and portable computers.</i>	1.6, 1.7	Test Case 1 Results	
		Test Case 4 Results	
1g. Confirm that control software is accessible to authorized users via virtual private network (VPN) access. <i>In Test Case 4, users should access software from outside the Scott County firewall.</i>	1.8	Test Case 1 Results	
		Test Case 4 Results	
1h. Confirm that control software allows authorized users to perform concurrent operation. <i>In Test Case 4, two or more users should perform operations concurrently.</i>	1.9	Test Case 1 Results	
		Test Case 4 Results	
1i. Confirm that control software uses fiber to communicate with field devices. <i>In Test Case 4, control software should be connected to cameras and DMS via fiber.</i>	1.11, 2.7, 4.9	Test Case 1 Results	
		Test Case 4 Results	
1j. Confirm that control software uses cell modems to communicate with field devices. <i>No devices are currently planned for deployment with cell modem so this requirement will only be verified in Test Case 1.</i>	1.11	Test Case 1 Results	
1k. Confirm that control software, cameras and DMS use NTCIP center to field communication protocols to communicate with field devices.	1.12, 2.8, 4.10	Test Case 1 Results	
1l. Confirm that control software can simultaneously monitor a minimum of 75 field devices. <i>Reference product specifications to verify this.</i>	1.13	Test Case 1 Results	
1m. Confirm that control software allows the addition of field devices to accommodate future deployments. <i>In Test Case 4, step through process to adding a field device.</i>	1.14	Test Case 1 Results	
		Test Case 4 Results	
1n. Confirm that control software controls user access with individual	1.15	Test Case 1 Results	

<p>user identities and passwords. <i>In Test Case 4, a minimum of three user identities and passwords should be established across the three specified levels of user access.</i></p>		<p>Test Case 4 Results</p>
<p>1o. Confirm that control software maintains a record of access according to user identities for a minimum of 365 days.</p>	1.16	<p>Test Case 1 Results</p>
<p>1p. Confirm that control software allows for three levels of operating privileges to be established. <i>In Test Case 4, a minimum of three user identities and passwords should be established across the three specified levels of user access.</i></p>	1.17, 1.18, 1.19, 1.20	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1q. Confirm that control software displays field device locations in a tabular format.</p>	1.21	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1r. Confirm that control software displays field device operational status in table.</p>	1.22	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1s. Confirm that control software displays field device locations on a map.</p>	1.23	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1t. Confirm that control software displays field device operational status on a map.</p>	1.24	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1u. Confirm that cameras and related cabling are rated for outdoor use.</p>	2.3	<p>Test Case 1 Results</p>
<p>1v. Confirm that cameras 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.</p>	2.4	<p>Test Case 1 Results</p> <p>Test Case 4 Results</p>
<p>1w. Confirm that cameras allow users to pan, tilt and zoom remotely. <i>Test</i></p>	2.5	<p>Test Case 1 Results</p>

<i>Case 4 will verify the integration with control software to allow users to control pan, tilt and zoom remotely.</i>		Test Case 4 Results
1x. Confirm that cameras have day and night functionality to manage image quality . <i>In Test Case 4, check camera image quality during nighttime conditions.</i>	2.6	Test Case 1 Results
		Test Case 4 Results
1y. Confirm that cameras use fiber to communicate with control software . <i>In Test Case 4, cameras should be connected to control software via fiber.</i>	2.7	Test Case 1 Results
		Test Case 4 Results
1z. Confirm that cameras use cell modems to communicate with control software .	2.7	Test Case 1 Results
1aa. Confirm that cameras allow video to be transmitted over IP networks .	2.9	Test Case 1 Results
1bb. Confirm that cameras utilize MJPEG, MPEG4 or h.264 formats for video compression .	2.10	Test Case 1 Results
1cc. Confirm that cameras utilize a non-proprietary, common format (e.g. MPEG 4) for video storage .	2.13	Test Case 1 Results
		Test Case 4 Results
1dd. Confirm that control software automatically captures and temporarily stores for a minimum of 72 hours a digital video recording of Scott County-operated CCTV imagery without operator intervention .	2.14	Test Case 1 Results
1ee. Confirm that control software automatically overwrites digital video recording of CCTV imagery without operator intervention after 72 hours .	2.15	Test Case 1 Results
1ff. Confirm that control software automatically overwrites digital video recording of CCTV imagery without operator intervention after 72 hours .	2.15	Test Case 1 Results
1gg. Confirm that detection can detect traffic in a minimum of six (6) lanes . <i>In Test Case 4, verify that</i>	3.3	Test Case 1 Results
		Test Case 4 Results

<i>traffic in six lanes is being detected.</i>			
1hh. Confirm that detection can detect traffic with 90% or higher accuracy . <i>In Test Case 4, verify that traffic is accurately detected when compared against another method of detection (e.g. traffic tubes).</i>	3.4	Test Case 1 Results	
		Test Case 4 Results	
1ii. Confirm that detection uses fiber to communicate with signal control software . <i>In Test Case 4, detection should be accessed via signal control software.</i>	3.5	Test Case 1 Results	
		Test Case 4 Results	
1jj. Confirm that detection uses cell modems to communicate with signal control software .	3.5	Test Case 1 Results	
1kk. Confirm that detection allows users the option to manage detection settings remotely . <i>This feature will not be used until Scott County deploys a centralized traffic signal control software.</i>	3.8	Test Case 1 Results	
1ll. Confirm that signal control software automatically captures and stores Scott County-operated detection data for a minimum of 365 days without operator intervention .	3.9	Test Case 1 Results	
1mm. Confirm that DMS 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 .	4.3	Test Case 1 Results	
		Test Case 4 Results	
1nn. Confirm that DMS 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 .	4.4	Test Case 1 Results	
		Test Case 4 Results	
1oo. Confirm that DMS utilize a full matrix display area .	4.5	Test Case 1 Results	
1pp. Confirm that DMS display full color .	4.6	Test Case 1 Results	
1qq. Confirm that DMS have a pixel pitch of 16 mm .	4.7	Test Case 1 Results	

1rr. Confirm that DMS use fiber to communicate with control software . <i>In Test Case 4, DMS should be connected to control software via fiber.</i>	4.9	Test Case 1 Results	
		Test Case 4 Results	
1ss. Confirm that DMS use cell modems to communicate with control software .	4.9	Test Case 1 Results	
1tt. Confirm that DMS allow users to post and remove DMS messages remotely .	4.13, 4.15	Test Case 1 Results	
		Test Case 4 Results	
1uu. Confirm that DMS allow users to preview messages before posting them to the sign .	4.14	Test Case 1 Results	
		Test Case 4 Results	
1vv. Confirm that DMS allow users to post pre-defined messages . <i>In Test Case 4, "TEST MESSAGE" should be added as a pre-defined message to verify this function.</i>	4.16	Test Case 1 Results	
		Test Case 4 Results	
1ww. Confirm that DMS allow users to post free-text messages . <i>In Test Case 4, "TEST MESSAGE" should be entered as a free-text message to verify this function.</i>	4.17	Test Case 1 Results	
		Test Case 4 Results	
1xx. Confirm that control software automatically captures and stores Scott County-operated DMS messages posted for a minimum of 365 days without operator intervention .	4.18	Test Case 1 Results	
1yy. Confirm that control software automatically pushes email alerts to user-defined distribution lists as operational plans are activated and deactivated .	6.1, 6.2	Test Case 1 Results	
		Test Case 4 Results	
1zz. Confirm that control software allows automatic push email alert feature to be turned on or off .	6.3	Test Case 1 Results	
		Test Case 4 Results	
1aaa. Confirm that control software allows manually pushed email alerts	6.4	Test Case 1 Results	

to user-defined distribution lists as needed.		Test Case 4 Results	
1bbb. Confirm that control software allows creation of user-defined distribution lists for push email alerts.	6.5	Test Case 1 Results	
		Test Case 4 Results	

Test Case 2: Plan Set Review

Environment: Scott County (or City of Shakopee) Meeting Room

Procedure: After detailed design is complete, Scott County will review with the Design Contractor a completed plan set for the system installation to validate requirements and approve. Once approved, procurement may proceed. Review and approval of plan sets will occur in preparation for a bid letting that will procure equipment for the integration demonstration. This test case emphasizes the need for all plans to be reviewed and approved prior to field installation of equipment. *All of the validation steps in this test case will be repeated in Test Case 4. The test log has been separated to reflect both instances of testing.*

Participants: This test case will be led by the Design Contractor and should include, at a minimum, Scott County, City of Shakopee Public Works, Minnesota Department of Transportation (MnDOT), and Shakopee Mdewakanton Sioux Community (SMSC). Additional participants may include Shakopee Police Department, Canterbury Park, Mystic Lake Casino and Valleyfair.

Validation Instructions	System Requirement	Test Log	
		Pass/Fail	Comments
2a. Confirm that cameras operate on power over Ethernet or 120/240 Volts AC with a power drop from the local utility company. <i>In Test Case 2, power from local utility should be verified on plan set.</i>	2.11	Test Case 2 Results	
		Test Case 4 Results	
2b. Confirm that cameras are protected from degradation of power with voltage surge suppression.	2.12	Test Case 2 Results	
		Test Case 4 Results	
2c. Confirm that detection operates on 120/240 Volts AC with a power drop from the local utility company or on power provided by the signal control cabinet. <i>In Test Case 2, power from local utility should be verified on plan set.</i>	3.6	Test Case 2 Results	
		Test Case 4 Results	
2d. Confirm that detection is protected from degradation of power with voltage surge suppression.	3.7	Test Case 2 Results	
		Test Case 4 Results	
2e. Confirm that DMS are roadside or overhead mounted to accommodate installation site characteristics.	4.8	Test Case 2 Results	
		Test Case 4 Results	

2f. Confirm that DMS operate on 120/240 Volts AC with a power drop from the local utility company. <i>In Test Case 2, power from local utility should be verified on plan set.</i>	4.11	Test Case 2 Results	
		Test Case 4 Results	
2g. Confirm that DMS is protected from degradation of power with voltage surge suppression.	4.12	Test Case 2 Results	
		Test Case 4 Results	
2h. Confirm that static signs guide travelers in support of messages posted on DMS.	5.1	Test Case 2 Results	
		Test Case 4 Results	
2i. Confirm that static signs comply with Minnesota Manual on Uniform Traffic Control Devices, Part 2. Signs, Chapter 2M. Recreational and Cultural Interest Area Signs.	5.2	Test Case 2 Results	
		Test Case 4 Results	

Test Case 3: Integration Demonstration

Environment: Scott County (or City of Shakopee) Facility

Procedure: Once the system components have been procured and integrated, the Construction Contractor(s) will demonstrate the system integration for Scott County and Shakopee Police Department prior to initial installation. The demonstration will take place at a Scott County (or City of Shakopee) facility to simulate the installation environment. The Construction Contractor(s) will integrate at least one DMS, at least one CCTV and the corresponding control software. All system features (e.g. posting DMS messages, moving CCTV) should be activated and observed for requirements validation and approval during the demonstration. Once approved, the remaining integration may proceed. *All of the validation steps in this test case will be repeated in Test Case 4. The test log has been separated to reflect both instances of testing.*

Participants: This test case will be led by the Construction Contractor(s) and should include, at a minimum, Scott County, and Shakopee Police Department. Additional participants may include MnDOT, SMSC, Canterbury Park, Mystic Lake Casino and Valleyfair.

Validation Instructions	System Requirement	Test Log	
		Pass/Fail	Comments
3a. Confirm that control software allows authorized user access to field devices operated by Scott County. <i>Access to DMS and cameras should be demonstrated.</i>	1.10	Test Case 3 Results	
		Test Case 4 Results	
3b. Confirm that control software displays field device locations in a tabular format.	1.21	Test Case 3 Results	
		Test Case 4 Results	
3c. Confirm that control software displays field device operational status in table.	1.22	Test Case 3 Results	
		Test Case 4 Results	
3d. Confirm that control software displays field device locations on a map.	1.23	Test Case 3 Results	
		Test Case 4 Results	
3e. Confirm that control software displays field device operational status on a map.	1.24	Test Case 3 Results	
		Test Case 4 Results	
3f. Confirm that control software allows map pan and zoom capabilities.	1.25	Test Case 3 Results	

		Test Case 4 Results
3g. Confirm that control software allows users to define view preferences by geography and zoom level.	1.26	Test Case 3 Results
		Test Case 4 Results
3h. Confirm that control software identifies device locations on a map with unique icons representing the type of device.	1.27	Test Case 3 Results
		Test Case 4 Results
3i. Confirm that control software allows user to search and view by device type (e.g. all DMS).	1.28	Test Case 3 Results
		Test Case 4 Results
3j. Confirm that control software displays the following details when a user clicks on a device: <ul style="list-style-type: none"> • 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 	1.29	Test Case 3 Results
		Test Case 4 Results
3k. Confirm that control software allows users with the first and second highest levels of operating privileges to click on a device to access its control functions.	1.30	Test Case 3 Results
		Test Case 4 Results
3l. Confirm that control software allows 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.	1.31	Test Case 3 Results
		Test Case 4 Results
3m. Confirm that control software allows users with the first highest level of operating privileges to create, modify, activate and deactivate operational plans.	1.32, 1.33, 1.34, 1.35	Test Case 3 Results
		Test Case 4 Results
3n. Confirm that control software	1.36	Test Case 3 Results

<p>maintains a record of operational plan activations and deactivations according to user identities for a minimum of 365 days.</p> <p><i>Activate/deactivate a series of operational plans to confirm that a record is created and check for settings associated with how long records are retained.</i></p>			
		Test Case 4 Results	
<p>3o. Confirm that control software interfaces with MnDOT IRIS to display snapshot images, in view-only mode, from MnDOT-operated CCTV.</p>	2.1, 2.2	Test Case 3 Results	
		Test Case 4 Results	
<p>3p. Confirm that control software interfaces with MnDOT IRIS to display messages, in view-only mode, posted on MnDOT-operated DMS.</p>	4.1, 4.2	Test Case 3 Results	
		Test Case 4 Results	

3. Acceptance Testing

This stage of testing will include a functional (1-day) test and a reliability (30-day) test to be conducted at the initial installation. The functional test will be conducted to demonstrate that all system requirements are adequately met. For the remaining installation, reliability tests will be conducted to validate that the systems are properly installed and operate as required. The following tables present two test cases, environment, procedures, validation instructions, relevant system requirements and log that will be used for system acceptance testing.

Test Case 4: Functional Demonstration (1-Day)
<p>Environment: Installation Sites</p> <p>Procedure: Once the installation is complete, the Construction Contractor(s) will schedule 1-day functional demonstration to allow for Scott County observation under dawn/dusk lighting and peak/off-peak traffic conditions. The demonstration will require at least one vehicle to drive around the installation sites and observe component activations for requirements validation and approval. Authorized access from computers at Scott County, Shakopee Police Department and MnDOT will be required to operate and observe control software performance for validation and approval. Authorized access from computers at SMSC, Canterbury Park, Mystic Lake Casino and Valleyfair will also be required to confirm observational access to control software. <i>All of the validation steps in this test case will be conducted first in Test Case 1, Test Case 2 or Test Case 3. The instructions and test log have been included in the previous test cases respectively to reflect the multiple instances of testing.</i></p> <p>Participants: This test case will be led by the Construction Contractor(s) and should include Scott County, City of Shakopee Public Works, Shakopee Police Department, SMSC, MnDOT, Canterbury Park, Mystic Lake Casino, and Valleyfair.</p>
Validation Instructions
4a. Repeat validation steps 1a-1c, 1f-1i, 1m-1n, 1p-1t, 1v-1y, 1cc, 1gg-1ii, 1mm-1nn, 1rr, 1tt-1ww, and 1yy-1bbb as described in Test Case 1. Record results in test log also provided under Test Case 1.
4b. Repeat ALL validation steps as described in Test Case 2. Record results in test log also provided under Test Case 2.
4c. Repeat ALL validation steps as described in Test Case 3. Record results in test log also provided under Test Case 3.

Test Case 5: Reliability Demonstration (30-Day)

Environment: Installation Sites

Procedure: Following completion of Test Case 4, Scott County and Shakopee Police Department will continue operation of the system for another 30 days to demonstrate reliability and validate the associated requirements. During this period, signs may be covered and unavailable for driver interaction. Each day Scott County and Shakopee Police Department will validate default operation of all DMS, all CCTV and the corresponding control software. Scott County and Shakopee Police Department will also activate at least one operational plan to validate the prescribed operation of all DMS, all CCTV and the corresponding control software. *All of the validation steps in this test case have been conducted in previous test cases. Because these steps must be completed each day for 30 days, the instructions and test log entries are provided to accommodate documentation of pass/fail status for each day.*

Participants: This test case will be led by Scott County with participation from Shakopee Police Department, MnDOT and the Construction Contractor(s). Scott County may lead testing during routine business hour and Shakopee Police Department may lead in the off hours.

Validation Instructions		System Requirement
5a. Confirm that control software allows users with the first highest level of operating privileges to create, modify, activate and deactivate operational plans.		1.32, 1.33, 1.34, 1.35
Test Log		
	Day 1	Day 2
	Day 3	Day 4
	Day 5	Day 6
	Day 7	Day 8
	Day 9	Day 10
	Day 11	Day 12
	Day 13	Day 14
	Day 15	Day 16
	Day 17	Day 18
	Day 19	Day 20
	Day 21	Day 22
	Day 23	Day 24
	Day 25	Day 26
	Day 27	Day 28
	Day 29	Day 30
Pass/Fail		
Comments		

Validation Instructions		System Requirement
5b. Confirm that control software allows users to pan, tilt and zoom cameras remotely.		2.5
Test Log		
	Day 1	
	Day 2	
	Day 3	
	Day 4	
	Day 5	
	Day 6	
	Day 7	
	Day 8	
	Day 9	
	Day 10	
	Day 11	
	Day 12	
	Day 13	
	Day 14	
	Day 15	
	Day 16	
	Day 17	
	Day 18	
	Day 19	
	Day 20	
	Day 21	
	Day 22	
	Day 23	
	Day 24	
	Day 25	
	Day 26	
	Day 27	
	Day 28	
	Day 29	
	Day 30	
Pass/Fail	Comments	

Validation Instructions		System Requirement
5c. Confirm that control software allows users to post and remove DMS messages remotely.		4.13, 4.15
Test Log		
	Day 1	
	Day 2	
	Day 3	
	Day 4	
	Day 5	
	Day 6	
	Day 7	
	Day 8	
	Day 9	
	Day 10	
	Day 11	
	Day 12	
	Day 13	
	Day 14	
	Day 15	
	Day 16	
	Day 17	
	Day 18	
	Day 19	
	Day 20	
	Day 21	
	Day 22	
	Day 23	
	Day 24	
	Day 25	
	Day 26	
	Day 27	
	Day 28	
	Day 29	
	Day 30	
Pass/Fail	Comments	