

ConOps Reference #	ConOps Sample Statement	System Requirements
4	User Needs	
4-1	This chapter describes the operational needs related to user interface, database management, monitoring, reporting, and maintenance activities. The main purposes of a traffic signal system are: to provide remote access to field infrastructure and signal timing databases, and to monitor and report system performance.	
4.1	System Configuration	
4.1.1	TSS Network Characteristics	
4.1.1.1	The TSS Operator needs to view and control up to XXX traffic signal controllers, at various locations within the (agency).	<p>3.1.3.1.1 The system shall control a minimum of XXX local signal controllers</p>
4.1.1.2	The TSS Operator needs to organize the traffic signals in two (or more) groups for coordination purposes.	<p>3.1.3.1.2 The system shall allow intersections to be included in a group.</p> <p>3.1.3.1.2.1 A group shall support up to XX signals.</p> <p>3.1.3.1.3 The system shall allow an intersection to be included in two or more groups.</p> <p>3.1.3.1.3.1 The system shall allow intersections to change grouping by time of day schedule.</p>

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		<p>3.1.3.1.3.2 The system shall allow intersections to change grouping by manual command.</p> <p>3.1.3.1.3.3 The system shall allow intersections to change grouping by (enter trigger).</p>
4.1.1.3	The TSS Operator needs to change intersection grouping by time of day or other trigger.	<p>3.1.3.1.2 The system shall allow intersections to be included in a group.</p> <p>3.1.3.1.3 The system shall allow an intersection to be included in two or more groups.</p> <p>3.1.3.1.3.1 The system shall allow intersections to change grouping by time of day schedule.</p> <p>3.1.3.1.3.2 The system shall allow intersections to change grouping by manual command.</p> <p>3.1.3.1.3.3 The system shall allow intersections to change grouping by (enter trigger).</p>
4.1.1.4	The TSS operator needs to receive current time from a source to ensure time synchronization between signals.	<p>3.1.8.1.1 The system shall receive the current time from a source:</p> <ul style="list-style-type: none"> * WWV radio * Network Time Protocol server * GPS time source * Neighboring traffic signal network
4.1.1.5	The TSS Operator needs to coordinate traffic signals managed by another system. Note: Cross-jurisdictional heading.	<p>3.1.3.1.2 The system shall allow intersections to be included in a group.</p> <p>3.1.3.1.3 The system shall allow an intersection to be included in two or more groups.</p>

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		<p>3.1.3.1.3.1 The system shall allow intersections to change grouping by time of day schedule.</p> <p>3.1.3.1.3.2 The system shall allow intersections to change grouping by manual command.</p> <p>3.1.8.1.2 The system shall re-sync the local controller time clock through a manual command.</p> <p>3.1.8.1.4 The system shall provide a time synch to each controller using:</p> <ul style="list-style-type: none"> * WWV radio * Network Time Protocol server * GPS time source * Neighboring traffic signal network
4.1.2	Adaptive Network Characteristics	
4.1.2.1	The TSS Operator needs to adaptively control up to XXX signals, up to XXX miles from the TMC (or specified location).	<p>3.1.3.2.1 The ASCT shall control a minimum of XX signals concurrently. Note: communications network characteristics based on mileage distance.</p>
4.1.2.2	The TSS Operator needs to be able to adaptively control up to XX independent groups of signals	<p>3.1.3.2.2 The ASCT shall support groups of signals.</p> <p>3.1.3.2.2.1 The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user.</p> <p>3.1.3.2.2.2</p>

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		<p>The ASCT shall control a minimum of XX groups of signals.</p> <p>3.1.3.2.2.4</p> <p>Each group shall operate independently</p>
4.1.2.3	<p>The TSS Operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.</p>	<p>3.1.3.2.2</p> <p>The ASCT shall support groups of signals.</p> <p>3.1.3.2.2.3</p> <p>The size of a group shall range from 1 to XX signals.</p> <p>3.1.3.2.2.5</p> <p>The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the ASCT system according to configured parameters.</p> <p>3.1.3.2.2.5.1</p> <p>The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to a time of day schedule. (For example: this may be achieved by assigning signals to different groups or by combining groups.)</p> <p>3.1.3.2.2.5.2</p> <p>The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to traffic conditions. (For example: this may be achieved by assigning signals to different groups or by combining groups.)</p> <p>3.1.3.2.2.5.3</p> <p>The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system when commanded by the user.</p>
4.1.3	<p>Traffic Performance Measurement Characteristics</p>	

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4.1.3.1	The TSS Operator needs to configure performance measurement operations.	<p>3.1.3.3.1 The Performance Measurement Server shall configure how the high-resolution data is handled from local traffic signal controllers. [This requires the agency to provide traffic signal controllers that store the high-resolution data, which are not covered by these Model Documents.]</p> <p>3.1.3.3.1.1 High-resolution data shall include all enumerated events as described in Sturdevant, et. al., Indiana High Resolution Data Logger Enumerations, November, 2012, or later document as developed under Pooled Fund Study TPF-5(377).</p> <p>3.1.3.3.1.2 High-resolution data interface is defined by (Specify latest interface control document, if available—Pooled Fund Study TPF-5(377), currently underway, will: Update the data logger specification to provide secure file transfer, incorporate new enumerations that have emerged, and logging new connected vehicle messages.</p> <p>3.1.3.3.1.3 The Performance Measurement Server shall be a separate server, independent of the TSS or ASCT.</p> <p>3.1.3.3.1.3.1 The Performance Measurement Server shall run ATSPM version 4.0 (or more recent version) available from the FHWA Open Source Application Development Portal.</p> <p>3.1.3.3.1.3.2 The Performance Measurement Server shall be co-located with the TSS. (In such cases, it shall be owned by the TSS System Manager.) [This requirement is exclusive of 3.1.3.3.1.3.3—choose one or the other]</p> <p>3.1.3.3.1.3.3</p>

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		<p>The Performance Measurement Server shall be located at an alternative location [specify] and managed and maintained by a separate entity [specify]. [This requirement allows the server to be shared by multiple agencies but managed by one of them, or provided as a service by a private-sector provider. Please specify in this requirement. This requirement is exclusive of 3.1.3.3.1.3.2]</p> <p>3.1.3.3.1.3.4</p> <p>The Performance Measurement Server shall be integrated into the TSS (ASCT).</p> <p>3.1.3.3.1.3.4.1</p> <p>The Performance Measurement Server shall run ATSPM version 4.0 (or more recent version) available from the FHWA Open Source Application Development Portal. The open-source software may be revised to facilitate integration, or to exte⁹ to additional features that may be required herein.</p>
4.1.4	System Access and Security	
4.1.4.1	<p>The TSS Operator needs to manage the system database from the following locations: (EDIT TO SUIT YOUR SITUATION)</p> <ul style="list-style-type: none"> * Multiple workstations in the TMC * Multiple networked workstations on the City's LAN or WAN located at (USER SPECIFY) * Workstations at other Agencies' TMC (USER SPECIFY) 	<p>3.1.1.1</p> <p>The system shall provide monitoring and control access from the following locations.</p> <ul style="list-style-type: none"> * Agency TMC * Agency LAN or WAN * Other agency TMC (SPECIFY) * Local controller cabinets (hard wire) * Local controller cabinets (wireless) * Remote location via internet <p>3.1.1.2</p> <p>The system shall allow remote access using a secure Virtual Private Network (VPN).</p>

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	<ul style="list-style-type: none"> * At the local controller cabinet using a hard wire connection * At the local controller cabinet using a wireless connection * Remote locations connected to the internet (USER SPECIFY, such as employee's home, maintenance vehicle, etc.) 	
4.1.4.2	Multiple system TSS Operators need to log on to the system simultaneously in order to do independent functions at different intersections or to view the same intersection.	<p>3.1.1.3 The system shall allow operators from different agencies to view/edit traffic signal databases owned by other agencies, subject to assigned privilege level.</p> <p>3.1.1.4 The system shall allow XX number of users to log on to the system simultaneously.</p> <p>3.1.1.5 The system shall allow multiple operators to access an intersection database simultaneously.</p> <p>3.1.1.6 The system shall allow multiple TSS Operators to view the status of an intersection or group of intersections simultaneously.</p> <p>3.1.1.7 The system shall restrict control of each intersection database to a single user at a time.</p>

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		<p>3.1.1.7.1 The system shall release lock of intersection database after a user-specified period of inactivity.</p> <p>3.1.1.7.2 The system shall allow access to a traffic signal database on a first come, first served basis.</p> <p>3.1.1.7.3 The system shall allow administrator to terminate intersection control by other users with lesser user rights.</p> <p>3.1.1.8 The system shall allow access to a traffic signal database based on user privileges.</p> <p>3.1.2.6 The system shall show operators/administrator who is logged in to the system at a given time.</p>
4.1.4.3	The TSS Operator needs to make changes to an intersection database, disabling the ability of other TSS Operators to simultaneously make changes to the same intersection database.	<p>3.1.1.4 The system shall allow XX number of users to log on to the system simultaneously.</p> <p>3.1.1.7 The system shall restrict control of each intersection database to a single user at a time.</p> <p>3.1.1.7.1 The system shall release lock of intersection database after a user-specified period of inactivity.</p> <p>3.1.1.7.3 The system shall allow administrator to terminate intersection control by other users with lesser user rights.</p>

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4.1.4.4	The TSS Operator needs to view the status of an intersection or group of intersections even when another TSS Operator is editing the intersection database.	<p>3.1.1.3 The system shall allow operators from different agencies to view/edit traffic signal databases owned by other agencies, subject to assigned privilege level.</p> <p>3.1.1.4 The system shall allow XX number of users to log on to the system simultaneously.</p> <p>3.1.1.5 The system shall allow multiple operators to access an intersection database simultaneously.</p> <p>3.1.1.6 The system shall allow multiple TSS Operators to view the status of an intersection or group of intersections simultaneously.</p> <p>3.1.1.7 The system shall restrict control of each intersection database to a single user at a time.</p> <p>3.1.1.7.2 The system shall allow access to a traffic signal database on a first come, first served basis.</p> <p>3.1.1.7.3 The system shall allow administrator to terminate intersection control by other users with lesser user rights.</p> <p>3.1.1.8 The system shall allow access to a traffic signal database based on user privileges.</p>
4.1.4.5	The TSS Operator needs to view the status of multiple agency signals, edit the	<p>3.1.1.3 The system shall allow operators from different agencies to view/edit traffic signal databases owned by other agencies, subject to assigned privilege level.</p>

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	<p>intersection databases, and/or create reports, as allowed by permission.</p>	<p>3.1.2.1 The system shall provide the ability to control and limit user access via user privileges (allowing for different levels of user access to system features and functions).</p> <ul style="list-style-type: none"> * Local access to the system * Remote access to the system * System monitoring * System manual override * Database * Administration of the system * Signal controller group access * Access to classes of equipment * Access to equipment by jurisdiction * System parameters * Report generation * Configuration * Security alerts <p>3.1.2.5 The system shall provide full access to the administrator.</p>
4.1.4.6	<p>The TSS Operator needs secure access to the system consistent with the existing agency network policies.</p>	<p>3.1.2.4 The system shall comply with the agency's security policy as described in (specify appropriate policy document)</p> <p>3.1.2.5 The system shall provide full access to the administrator.</p>

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4.1.4.7	The TSS Manager needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by a TSS Manager, and conform to the agency's access and network infrastructure security policies.	<p>3.1.2.2 The system shall provide user privileges definable for the following:</p> <p>3.1.2.2.1 Geographic area</p> <p>3.1.2.2.2 Time of Day</p> <p>3.1.2.2.3 Device ownership</p> <p>3.1.2.3 The system shall provide user privileges definable on a functional level:</p> <p>3.1.2.3.1 TSS Manager</p> <p>3.1.2.3.2 TSS Operator</p> <p>3.1.2.3.3 External System</p> <p>3.1.2.3.4 TSS Maintainer</p> <p>3.1.2.7 For Adaptive Systems, the ASCT shall be implemented with a security policy that addresses the following selected elements:</p> <ul style="list-style-type: none"> * Local access to the ASCT * Remote access to the ASCT * System monitoring * System manual override * Development

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		<ul style="list-style-type: none"> * Operations * User login * User password * Administration of the system * Signal controller group access * Access to classes of equipment * Access to equipment by jurisdiction * Output activation * System parameters * Report generation * Configuration * Security alerts * Security logging * Security reporting * Database * Signal controller <p>3.1.2.9 The ASCT shall comply with the agency's security policy as described in (specify appropriate policy document).</p>
4.1.5	Overall Architecture	
4.1.5.1	The TSS Operator needs to operate the system with the following architecture (EDIT TO SUIT YOUR SITUATION):	<p>3.1.3.4.5 The system shall work with the existing communications architecture (DEFINE characteristics, specifications and layout of system).</p> <p>3.1.3.4.5.1 The system shall operate on a stand alone server located at (SPECIFY LOCATION)</p>

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	<ul style="list-style-type: none"> * Standalone server located at XX * Virtual server * On-street masters * Center to center (multiple servers) * Integrated with an Advanced Traffic Management System * Cloud based <p>Note: These interfaces are beyond the scope of the Model Systems Engineering documents, and responding to these needs will require additional systems engineering activities to develop needs and requirements related to these interfaces.</p>	<p>3.1.3.4.5.2 The system shall operate as cloud based.</p> <p>3.1.3.4.5.3 The system shall operate with center to center capabilities.</p> <p>3.1.3.4.5.4 The system shall be integrated with an Advance Traffic Management System (SPECIFY)</p> <p>3.1.3.4.5.5 The system shall operate with on-street masters.</p>
4.1.5.2	The TSS Operator needs to access the system at all times to view status or manage the system.	<p>3.1.7.1.1 The system shall update the status of all traffic signal controller connected to the system every (XX) seconds.</p> <p>3.1.7.1.2 The system shall update the status of all traffic signal controllers connected to the system 24 hours a day, 7 days a week.</p>
4.1.5.3	The TSS Operator needs to fully operate the system within	3.1.3.4.1

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	a communications bandwidth limit of XXX Mbps. (SPECIFY APPLICABLE LIMITS)	<p>The system shall fully satisfy all requirements when connected to XX local controllers (SPECIFY local controller type)</p> <p>3.1.3.4.1.3</p> <p>Communications media and protocols (list applicable equipment)</p> <p>3.1.3.4.1.3.1</p> <p>AB3418E</p> <p>3.1.3.4.1.3.2</p> <p>NTCIP (SPECIFY relevant items)</p> <p>3.1.3.4.4</p> <p>The system shall fulfill requirements within a communications bandwidth limit of XX Mbps (specify applicable limits).</p> <p>3.1.3.4.6</p> <p>The system shall use the following communications protocols with traffic signal controllers (SPECIFY as appropriate)</p> <p>3.1.3.4.6.1</p> <p>Ethernet</p> <p>3.1.3.4.6.2</p> <p>Serial</p> <p>3.1.3.4.6.3</p> <p>Other [Specify]</p>
4.1.6	TSS Failure and Fallback Mode	
4.1.6.1	The TSS Operator needs the local traffic signal controllers to fall back to local control without causing disruption to traffic flow, in the event of	<p>3.1.6.2.1</p> <p>The TSS shall execute user-specified actions when communications to one or more signal controllers fails within a group. (SELECT THE APPROPRIATE ACTION)</p> <p>3.1.6.2.1.1</p>

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	equipment, communications, or software failure.	<p>In the event of loss of communication to a user-specified signal controller, the TSS shall release control of all signal controllers within a user-specified group to local control.</p> <p>3.1.6.2.1.2</p> <p>The TSS shall switch to the alternate operation in real time without operator intervention.</p> <p>3.1.8.2.2</p> <p>The system shall allow the traffic signals to operate according to local control in case of communications failure.</p> <p>3.1.8.2.3</p> <p>The system shall allow the traffic signals to operate according to local control in case of TSS failure.</p> <p>3.1.9.1.1.2</p> <p>The ASCT shall operate non-adaptively when adaptive control equipment fails.</p> <p>3.1.9.1.1.2.1</p> <p>The ASCT shall operate non-adaptively when a user-specified detector fails.</p> <p>3.1.9.1.1.2.2</p> <p>The ASCT shall operate non-adaptively when the number of failed detectors connected to a signal controller exceeds a user-defined value.</p> <p>3.1.9.1.1.2.3</p> <p>The ASCT shall operate non-adaptively when the number of failed detectors in a group exceeds a user-defined value.</p> <p>3.1.9.1.1.2.4</p> <p>The ASCT shall operate non-adaptively when a user-defined communications link fails.</p>

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4.1.6.2	The TSS Operator needs to maintain a complete log of alarms and failure events.	<p>3.1.6.1.4 In the event of a failure, the TSS/ASCT shall log details of the failure in a permanent log.</p> <p>3.1.6.1.5 The permanent failure log shall be searchable, archivable and exportable.</p> <p>3.1.6.2.7 In the event of a communications failure, the TSS/ASCT shall log details of the failure in a permanent log.</p> <p>3.1.6.2.8 The permanent failure log shall be searchable, archivable and exportable.</p>