

Seminole County - Advanced Traffic Management System (ATMS) Phase II

ASCT Verification & Traceability Matrix

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
Operation Needs	4			
Adaptive Strategies	4.1			
Maximize the throughput on coordinated routes	4.1.0-1.0-1	2.1.1.0-7	<i>The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions. (The required objectives are specified in Needs Statement</i>	Demonstration Through Simulation
		2.1.1.0-7.0-1	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of the signal controllers, maximizing the throughput of the coordinated route.	Demonstration Through Simulation
		2.1.1.0-10	The ASCT shall utilize the background TOD pattern for the order of phases at a user-specified intersection.	Demonstration Through Simulation
		2.2.0-4	<i>The ASCT shall calculate offsets to suit the current coordination strategy for the user-specified reference point for each signal controller along a coordinated route within a group.</i>	Demonstration Through Simulation
		2.2.0-4.0-1	The ASCT shall apply offsets for the user-specified reference point of each signal controller along a coordinated route.	Demonstration Through Simulation
		2.2.0-5	<i>The ASCT shall calculate a cycle length for each cycle based on its optimization objectives (as required elsewhere, e.g., progression, queue management, equitable distribution of green).</i>	Demonstration Through Simulation
		2.2.0-5.0-3	The ASCT shall calculate optimum cycle length according to the user-specified coordination strategy.	Demonstration Through Simulation
		2.2.0-5.0-1	The ASCT shall limit cycle lengths to user-specified values.	Demonstration Through Simulation
		2.2.0-5.0-2	The ASCT shall limit cycle lengths to a user-specified range.	Demonstration Through Simulation
		2.2.0-5.0-4	<i>The ASCT shall limit changes in cycle length to not exceed a user-specified value.</i>	Demonstration Through Simulation
Provide smooth flow along coordinated routes	4.1.0-1.0-2	2.1.1.0-7.0-4	When current measured traffic conditions meet user-defined criteria, the ASCT shall alter the state of signal controllers providing two-way progression on a coordinated route.	Demonstration Through Simulation
		2.1.1.0-10	The ASCT shall utilize the background TOD pattern for the order of phases at a user-specified intersection.	Demonstration Through Simulation
		2.2.0-4	<i>The ASCT shall calculate offsets to suit the current coordination strategy for the user-specified reference point for each signal controller along a coordinated route within a group.</i>	Demonstration Through Simulation
		2.2.0-4.0-1	The ASCT shall apply offsets for the user-specified reference point of each signal controller along a coordinated route.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		2.2.0-5	<i>The ASCT shall calculate a cycle length for each cycle based on its optimization objectives (as required elsewhere, e.g., progression, queue management, equitable distribution of green).</i>	Demonstration Through Simulation
		2.2.0-5.0-1	The ASCT shall limit cycle lengths to user-specified values.	Demonstration Through Simulation
		2.2.0-5.0-2	The ASCT shall limit cycle lengths to a user-specified range.	Demonstration Through Simulation
		2.2.0-5.0-3	The ASCT shall calculate optimum cycle length according to the user-specified coordination strategy.	Demonstration Through Simulation
		2.2.0-5.0-4	<i>The ASCT shall limit changes in cycle length to not exceed a user-specified value.</i>	Demonstration Through Simulation
Distribute phase times in an equitable fashion	4.1.0-1.0-3	2.1.1.0-7	<i>The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions. (The required objectives are specified in Needs Statement 4.1.0-1. Responding to this requirement demonstrates how the proposed system allows the user to define the conditions at which the objectives shift and their associated requirements are fulfilled.) (The alteration may be made by adjusting parameters or by directly controlling the state of signal controllers.)</i>	Demonstration Through Simulation
		2.1.1.0-7.0-3	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers providing equitable distribution of green times	Demonstration Through Simulation
		2.1.1.0-8	The ASCT shall provide maximum and minimum phase times	Demonstration Through Simulation
		2.1.1.0-8.0-1	<i>The ASCT shall provide a user-specified maximum value for each phase at each signal controller.</i>	Demonstration Through Simulation
		2.1.1.0-8.0-1.0-1	The ASCT shall not provide a phase length longer than the maximum value.	Demonstration Through Simulation
		2.1.1.0-8.0-2	<i>The ASCT shall provide a user-specified minimum value for each phase at each signal controller.</i>	Demonstration Through Simulation
		2.1.1.0-8.0-2.0-1	The ASCT shall not provide a phase length shorter than the minimum value.	Demonstration Through Simulation
		2.2.0-3	The ASCT shall calculate phase lengths for all phases at each signal controller to suit the current coordination strategy.	Demonstration Through Simulation
		2.2.0-5	<i>The ASCT shall calculate a cycle length for each cycle based on its optimization objectives (as required elsewhere, e.g., progression, queue management, equitable distribution of green).</i>	Demonstration Through Simulation
		2.2.0-5.0-1	The ASCT shall limit cycle lengths to user-specified values.	Demonstration Through Simulation
		2.2.0-5.0-2	The ASCT shall limit cycle lengths to a user-specified range.	Demonstration Through Simulation
		2.2.0-5.0-3	The ASCT shall calculate optimum cycle length according to the user-specified coordination strategy.	Demonstration Through Simulation
		2.2.0-5.0-4	<i>The ASCT shall limit changes in cycle length to not exceed a user-specified value.</i>	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		2.4.0-3	The ASCT shall calculate optimum phase lengths, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	Demonstration Through Simulation
		2.4.0-3.0-1	The ASCT shall limit the difference between the length of a given phase and the length of the same phase during its next service to a user-specified value.	Demonstration Through Simulation
Manage the lengths of queues	4.1.0-1.0-4	2.2.0-4	<i>The ASCT shall calculate offsets to suit the current coordination strategy for the user-specified reference point for each signal controller along a coordinated route within a group.</i>	Demonstration Through Simulation
		2.2.0-4.0-1	The ASCT shall apply offsets for the user-specified reference point of each signal controller along a coordinated route.	Demonstration Through Simulation
		2.2.0-5.0-3	The ASCT shall calculate optimum cycle length according to the user-specified coordination strategy.	Demonstration Through Simulation
		2.2.0-5	<i>The ASCT shall calculate a cycle length for each cycle based on its optimization objectives (as required elsewhere, e.g., progression, queue management, equitable distribution of green).</i>	Demonstration Through Simulation
		2.2.0-5.0-1	The ASCT shall limit cycle lengths to user-specified values.	Demonstration Through Simulation
		2.2.0-5.0-2	The ASCT shall limit cycle lengths to a user-specified range.	Demonstration Through Simulation
		2.2.0-5.0-4	<i>The ASCT shall limit changes in cycle length to not exceed a user-specified value.</i>	Demonstration Through Simulation
		2.1.1.0-10	The ASCT shall utilize the background TOD pattern for the order of phases at a user-specified intersection.	Demonstration Through Simulation
Manage the locations of queues within the network	4.1.0-1.0-5	2.1.3.0-2	When queues are detected on the mainline at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	Demonstration Through Simulation
		2.2.0-3	The ASCT shall calculate phase lengths for all phases at each signal controller to suit the current coordination strategy.	Demonstration Through Simulation
		2.1.3.0-1	The ASCT shall detect the presence of queues on the mainline at pre-configured locations.	Demonstration Through Simulation
		2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Demonstration Through Simulation
At an isolated intersection, optimize operation with a minimum of phase failures (based on the optimization objectives).	4.1.0-1.0-6	2.4.0-2	The ASCT shall calculate a cycle length of a single intersection, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	Demonstration Through Simulation
		2.4.0-3	<i>The ASCT shall calculate optimum phase lengths, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)</i>	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		2.6.0-2	The ASCT shall limit the change in phase times between consecutive cycles to be less than a user-specified value. (This does not apply to early gap-out or actuated phase skipping.)	Demonstration Through Simulation
		2.4.0-4	The ASCT shall utilize the background TOD pattern for the order of phases at a user-specified intersection.	Demonstration Through Simulation
		2.1.1.0-8.0-1	<i>The ASCT shall provide a user-specified maximum value for each phase at each signal controller.</i>	Demonstration Through Simulation
		2.1.1.0-8.0-1.0-1	The ASCT shall not provide a phase length longer than the maximum value.	Demonstration Through Simulation
		2.1.1.0-8.0-2	<i>The ASCT shall provide a user-specified minimum value for each phase at each signal controller.</i>	Demonstration Through Simulation
		2.1.1.0-8.0-2.0-1	The ASCT shall not provide a phase length shorter than the minimum value.	Demonstration Through Simulation
		2.1.1.0-8	The ASCT shall provide maximum and minimum phase times.	Demonstration Through Simulation
The system operator needs to change the operational strategy (for example, from smooth flow to maximizing throughput or managing queues) based on changing traffic conditions.	4.1.0-3	2.1.1.0-7.0-3	When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers providing equitable distribution of green times.	Demonstration Through Simulation
		2.1.1.0-7.0-4	When current measured traffic conditions meet user-defined criteria, the ASCT shall alter the state of signal controllers providing two-way progression on a coordinated route.	Demonstration Through Simulation
		2.1.1.0-7	<i>The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions. (The required objectives are specified in Needs Statement 4.1.0-1. Responding to this requirement demonstrates how the proposed system allows the user to define the conditions at which the objectives shift and their associated requirements are fulfilled.) (The alteration may be made by adjusting parameters or by directly controlling the state of signal controllers.)</i>	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to detect repeated phase failures and control signal timing to prevent phase failures building up queues. The operator in this case is trying to prevent a routine queue from forming where it will block another movement in the cycle unnecessarily. For example, the operator may need to prevent a queue resulting from the trailing end of the through green from blocking the storage needed by an entering side-street left turn in the subsequent phase. An overall queue management strategy, particularly when congestion is present, is covered under 4.1.0-1.0-5.	4.1.0-4	2.1.1.0-9	The ASCT shall detect repeated phases that do not serve all waiting vehicles. (These phase failures may be inferred, such as by detecting repeated max-out.)	Demonstration Through Simulation
		2.1.1.0-9.0-1	The ASCT shall alter operations, to minimize repeated phase failures.	Demonstration Through Simulation
The system operator needs to minimize the chance that a queue forms at a specified location.	4.1.0-5	2.2.0-5.0-5	The ASCT shall adjust offsets to minimize the chance of stopping vehicles approaching a signal that have been served by a user-specified phase at an upstream signal.	Demonstration Through Simulation
The system operator needs to modify the sequence of phases to support the various operational strategies.	4.1.0-6	7.0-6	<i>The ASCT shall utilize all of the available phase sequences provided by the controller.</i>	Demonstration Through Simulation
		7.0-6.0-1	Each permissible phase sequence shall be user-assignable to any signal timing plan.	Demonstration Through Simulation
		7.0-6.0-2	Each permissible phase sequence shall be executable by a time of day schedule.	Demonstration Through Simulation
		7.0-7	The ASCT shall not prevent a phase/overlap output by time-of-day.	Demonstration Through Simulation
		7.0-8	The ASCT shall not prevent a phase/overlap output based on an external input.	Demonstration Through Simulation
		7.0-9	The ASCT shall not prevent the following phases to be designated as coordinated phases. (User to list all required phases.)	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to fix the sequence of phases at any specified location. For example, the operator may need to fix the phase order at a diamond interchange.	4.1.0-7	2.1.2.0-12	The ASCT shall not alter the order of phases at a user-specified intersection.	Demonstration Through Simulation
The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy.	4.1.0-8	2.1.1.0-11	<i>The ASCT shall provide coordination along a route.</i>	Demonstration Through Simulation
		2.1.1.0-11.0-1	The ASCT shall coordinate along a user-defined route	Demonstration Through Simulation
		2.1.1.0-11.0-3	The ASCT shall determine the coordinated route based on a user-defined schedule.	Demonstration Through Simulation
		2.1.1.0-11.0-4	<i>The ASCT shall store at least 4 or more user-defined coordination routes.</i>	Demonstration Through Simulation
		2.1.1.0-11.0-4.0-1	The ASCT shall implement a stored coordinated route by operator command.	Demonstration Through Simulation
		2.1.1.0-11.0-4.0-3	The ASCT shall implement a stored coordinated route based on a user-defined schedule.	Demonstration Through Simulation
The system operator needs to set signal timing	4.1.0-9	2.1.1.0-12	The ASCT shall not prevent the use of phase timings in the local controller set by agency policy.	Demonstration Through Simulation
Network Characteristics	4.2			
The system operator needs to eventually adaptively control up to 300 signals, up to 30 miles from the TMC.	4.2.0-1	1.0-1	The ASCT shall control a minimum of 300 signals concurrently	Demonstration Through Simulation
The system operator needs to be able to adaptively control up to 50 independent groups of signals	4.2.0-2	1.0-2	<i>The ASCT shall support groups of signals.</i>	Demonstration Through Simulation
		1.0-2.0-2	The ASCT shall control a minimum of 50 groups of signals.	Demonstration Through Simulation
		1.0-2.0-4	Each group shall operate independently	Demonstration Through Simulation
		1.0-2.0-1	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user.	Demonstration Through Simulation
The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.	4.2.0-3	1.0-2	<i>The ASCT shall support groups of signals.</i>	Demonstration Through Simulation
		1.0-2.0-3	The size of a group shall range from 1 to 50 signals.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		1.0-2.0-5.0-1	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.)	Demonstration Through Simulation
		1.0-2.0-5.0-3	The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system when commanded by the user.	Demonstration Through Simulation
Coordination Across Boundaries	4.3			
The system operator needs to adaptively coordinate signals on two crossing routes simultaneously. (Include signals on crossing arterials within the boundaries of the adaptive systems mapped in Chapter 3.)	4.3.0-3	4.0-1.0-4	The ASCT shall support adaptive coordination on crossing routes.	Demonstration Through Simulation
The system operator needs to constrain the adaptive system to operate a cycle length compatible with the crossing arterial.	4.3.0-5	4.0-1.0-2	The ASCT shall operate a fixed cycle length to match the cycle length of an adjacent system.	Demonstration Through Simulation
Security	4.4			
The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.	4.4.0-1	5.0-1	The ASCT shall be implemented with a security policy that addresses the following selected elements:	Demonstration Through Simulation
		5.0-1.0-1	· Local access to the ASCT.	Demonstration Through Simulation
		5.0-1.0-2	· Remote access to the ASCT.	Demonstration Through Simulation
		5.0-1.0-3	· System monitoring.	Demonstration Through Simulation
		5.0-1.0-4	· System manual override.	Demonstration Through Simulation
		5.0-1.0-5	· Development	Demonstration Through Simulation
		5.0-1.0-6	· Operations	Demonstration Through Simulation
		5.0-1.0-7	· User login	Demonstration Through Simulation
		5.0-1.0-8	· User password	Demonstration Through Simulation
		5.0-1.0-9	· Administration of the system	Demonstration Through Simulation
		5.0-1.0-10	· Signal controller group access	Demonstration Through Simulation
		5.0-1.0-11	· Access to classes of equipment	Demonstration Through Simulation
5.0-1.0-12	· Access to equipment by jurisdiction	Demonstration Through Simulation		

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		5.0-1.0-13	· Output activation	Demonstration Through Simulation
		5.0-1.0-14	· System parameters	Demonstration Through Simulation
		5.0-1.0-15	· Report generation	Demonstration Through Simulation
		5.0-1.0-16	· Configuration	Demonstration Through Simulation
		5.0-1.0-17	· Security alerts	Demonstration Through Simulation
		5.0-1.0-18	· Security logging	Demonstration Through Simulation
		5.0-1.0-19	· Security reporting	Demonstration Through Simulation
		5.0-1.0-20	· Database	Demonstration Through Simulation
		5.0-1.0-21	· Signal controller	Demonstration Through Simulation
Queuing Interaction	4.5			
The system operator needs to detect queues from outside the system and modify the ASCT operation to accommodate the queuing.	4.5.0-1	2.1.3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	Demonstration Through Simulation
		2.1.3.0-1	The ASCT shall detect the presence of queues on the mainline at pre-configured locations.	Demonstration Through Simulation
		2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Demonstration Through Simulation
The system operator needs to detect queues within the system's boundaries and modify the ASCT operation to accommodate the queuing.	4.5.0-2	2.1.3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	Demonstration Through Simulation
		2.1.3.0-1	The ASCT shall detect the presence of queues on the mainline at pre-configured locations.	Demonstration Through Simulation
		2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Demonstration Through Simulation
The system operator needs to detect queues propagating outside its boundaries from within the ASCT boundaries, and modify its operation to accommodate the queuing.	4.5.0-3	2.1.3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	Demonstration Through Simulation
		2.1.3.0-1	The ASCT shall detect the presence of queues at pre-configured locations.	Demonstration Through Simulation
		2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to store queues in locations where they can be accommodated without adversely affecting adaptive operation.	4.5.0-4	2.1.3.0-2	When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode.	Demonstration Through Simulation
		2.1.3.0-1	The ASCT shall detect the presence of queues at pre-configured locations.	Demonstration Through Simulation
		2.1.3.0-3	When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Demonstration Through Simulation
Pedestrians	4.6			
The system operator needs to accommodate infrequent pedestrian operation while maintaining adaptive operation. (This is appropriate for pedestrian calls that are common but not so frequent that they drive the operational needs.)	4.6.0-2	8.0-2	When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times during adaptive operations.	Demonstration Through Simulation
The system operator needs to accommodate the following custom pedestrian features. (Describe custom features in this need and then create appropriate requirements.)	4.6.0-4		SCTE is in the process of requesting a cycling crazy ped that would allow 2 separate conflicting overlaps to cycle through the ped time. The ASCT shall not prevent this operation.	Demonstration Through Simulation
The system operator needs to accommodate early start of walk and exclusive pedestrian phases.	4.6.0-5	8.0-1	When a pedestrian phase is called, the ASCT shall execute pedestrian phases up to XX the programmed amount of time before the vehicle green of the related vehicle phase.	Demonstration Through Simulation
		8.0-4	The ASCT shall execute user-specified exclusive pedestrian phases during adaptive operation.	Demonstration Through Simulation
Non-Adaptive Situations	4.7			
The system operator needs to detect traffic conditions during which adaptive control is not the preferred operation, and implement some pre-defined operation while that condition is present.	4.7.0-1	2.1.1.0-1	The ASCT shall operate non-adaptively during the presence of a defined condition.	Demonstration Through Simulation
The system operator needs to schedule pre-determined operation by time of day.	4.7.0-2	2.1.1.0-5	The ASCT shall operate non-adaptively in accordance with a user-defined time-of-day schedule.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to override adaptive operation.	4.7.0-3	2.1.1.0-3	The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptively controlling a group of signals.	Demonstration Through Simulation
		2.1.1.0-4	The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptive operation.	Demonstration Through Simulation
		2.1.1.0-5	The ASCT shall operate non-adaptively in accordance with a user-defined time-of-day schedule.	Demonstration Through Simulation
System Responsiveness	4.8			
The system operator needs to modify the ASCT operation to closely follow changes in traffic conditions	4.8.0-1	2.6.0-2	The ASCT shall limit the change in phase times between consecutive cycles to be less than a user-specified value. (This does not apply to early gap-out or actuated phase skipping.)	Demonstration Through Simulation
Complex Coordination and Controller Features	4.9			
The system operator needs to implement the following advanced controller features while maintaining adaptive operation:	4.9.0-1			Demonstration Through Simulation
Service a phase more than once per cycle	4.9.0-1.0-1	7.0-1	When specified by the user, the ASCT shall serve a vehicle phase more than once for each time the coordinated phase is served.	Demonstration Through Simulation
Operate at least 8 phases	4.9.0-1.0-2	7.0-2	The ASCT shall provide a minimum of 8 phases.	Demonstration Through Simulation
Permit different phase sequences under different traffic conditions	4.9.0-1.0-4	7.0-6	<i>The ASCT shall provide a minimum of 16 different user-defined phase sequences for each signal.</i>	Demonstration Through Simulation
		7.0-6.0-1	Each permissible phase sequence shall be user-assignable to any signal timing plan.	Demonstration Through Simulation
		7.0-6.0-2	Each permissible phase sequence shall be executable by a time of day schedule.	Demonstration Through Simulation
Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states.	4.9.0-1.0-5	2.1.2.0-9	The ASCT shall omit a user-specified phase according to a time of day schedule using I/O logic and or special functions from the ASCT system.	Demonstration Through Simulation
		2.1.2.0-8	The ASCT shall omit a user-specified phase based on the state of a user-specified external input.	Demonstration Through Simulation
Allow any phase to be designated as the coordinated phase	4.9.0-1.0-9	7.0-9	The ASCT shall not prevent any phases from being designated as coordinated phases. (User to list all required phases.)	Demonstration Through Simulation

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Allow the operator to specify which phase receives unused time from a preceding phase	4.9.0-1.0-10	2.1.2.0-10	The ASCT shall assign unused time from a preceding phase that terminates early to a user-specified phase as follows <ul style="list-style-type: none"> • Fixed or floating force offs • next phase; • next coordinated phase; • user-specified phase (Storage phases) 	Demonstration Through Simulation
		2.1.2.0-11	The ASCT shall assign unused time from a preceding phase that is skipped to a user-specified phase as follows: <ul style="list-style-type: none"> · Fixed or floating force offs · next phase; · next coordinated phase; · user-specified phase (Storage phases) 	Demonstration Through Simulation
Allow the coordinated phase to terminate early under prescribed traffic conditions	4.9.0-1.0-12	7.0-10	The ASCT shall have the option for a coordinated phase to be released early based on a user-definable point in the phase or cycle. (User select phase or cycle.)	Demonstration Through Simulation
Allow flexible timing of non-coordinated phases (such as late start of a phase) while maintaining coordination	4.9.0-1.0-13	8.0-6	The ASCT shall begin a non-coordinated phase later than its normal starting point within the cycle when all of the following conditions exist: <ul style="list-style-type: none"> · The user enables this feature · Sufficient time in the cycle remains to serve the minimum green times for the phase and the subsequent non-coordinated phases before the beginning of the coordinated phase · The phase is called after its normal start time · The associated pedestrian phase is not called The associated pedestrian phase is not called 	Demonstration Through Simulation
Protected/permissive phasing and alternate left turn phase sequences.	4.9.0-1.0-14	2.1.2.0-1	The ASCT shall not prevent protected/permissive left turn phase operation.	Demonstration Through Simulation
		2.1.2.0-2	The ASCT shall not prevent the protected left turn phase to lead or lag the opposing through phase based upon user-specified conditions.	Demonstration Through Simulation
Use flashing yellow arrow to control permissive left turns and right turns.	4.9.0-1.0-15	7.0-11	The ASCT shall not prevent the controller from displaying flashing yellow arrow left turn or right turn. (SELECT AS APPLICABLE)	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
Service side streets and pedestrian phases at minor locations more often than at adjacent signals when this can be done without compromising the quality of the coordination. (E.g., double-cycle mid-block pedestrian crossing signals.)	4.9.0-1.0-16	7.0-13	When adaptive operation is used in conjunction with normal coordination, the ASCT shall not prevent adjacent signal controllers from serving phases multiple times within the cycle serving a cycle length different from the cycles used at adjacent intersections.	Demonstration Through Simulation
Use leading pedestrian intervals to prevent an overlap conflicting with a pedestrian walk/don't walk	4.9.0-1.0-17	8.0-9	The ASCT shall not inhibit leading pedestrian intervals phase timing.	Demonstration Through Simulation
Monitoring and Control	4.10			
The system operator needs to monitor and control all required features of adaptive operation from the following locations:	4.10.0-1	5.0-2	<i>The ASCT shall provide monitoring and control access at the following locations:</i>	Demonstration Through Simulation
Agency TMC	4.10.0-1.0-1	5.0-2.0-1	Agency TMC	Demonstration Through Simulation
Maintenance facility	4.10.0-1.0-2	5.0-2.0-2	Maintenance facility	Demonstration Through Simulation
Workstations anywhere on the agency LAN or WAN	4.10.0-1.0-3	5.0-2.0-3	Agency LAN or WAN	Demonstration Through Simulation
Local controller cabinets	4.10.0-1.0-5	5.0-2.0-5	Local controller cabinets	Demonstration Through Simulation
Maintenance vehicles	4.10.0-1.0-6	5.0-2.0-6	Maintenance vehicles	Demonstration Through Simulation
Remote locations (e.g., smart phones, etc.)	4.10.0-1.0-7	5.0-2.0-7	Remote locations via internet	Demonstration Through Simulation
The operator needs to access to the database management, monitoring and reporting features and functions of the signal controllers and any related signal management system from the access points defined for those system components.	4.10.0-2	5.0-4	The ASCT shall not prevent access to the local signal controller database, monitoring or reporting functions by any installed signal management system.	Demonstration Through Simulation
Performance Reporting	4.11			
The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.	4.11.0-2	6.0-4	The ASCT shall store results of all signal timing parameter calculations for a minimum of 2 years.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		6.0-5	The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a minimum of 2 years: · volume · occupancy	Demonstration Through Simulation
		18.0-1	The ASCT shall report measures of current traffic conditions on which it bases signal state alterations.	Demonstration Through Simulation
		18.0-2	The ASCT shall report all intermediate calculated values that are affected by calibration parameters.	Demonstration Through Simulation
		18.0-3	<i>The ASCT shall maintain a log of all signal state alterations directed by the ASCT.</i>	Demonstration Through Simulation
The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.	4.11.0-3	6.0-4	The ASCT shall store results of all signal timing parameter calculations for a minimum of 2 years.	Demonstration Through Simulation
		6.0-5	The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a minimum of 2 years: · volume · occupancy	Demonstration Through Simulation
The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to.	4.11.0-4	6.0-2	The ASCT shall export its systems log in the following formats: (edit as appropriate) · MS Excel · Text · CSV · Open source SQL database	Demonstration Through Simulation
		6.0-3	The ASCT shall store the event log for a minimum of 720 days	Demonstration Through Simulation
		6.0-6	The ASCT system shall archive all data automatically after a user-specified period not less than 2 years.	Demonstration Through Simulation
		6.0-7	The ASCT shall provide data storage for a system size of 500 signal controllers. The data to be stored shall include the following: · Controller state data · Reports · Log data · Security data · ASCT parameters · Detector status data	Demonstration Through Simulation
		6.0-10	The ASCT shall store data logs in a standard database (specify as appropriate).	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.	4.11.0-6	6.0-1	<i>The ASCT and/or system software shall log the following events: (edit as appropriate)</i>	Demonstration Through Simulation
		6.0-1.0-3	Time-stamped emergency vehicle preemption calls	Demonstration Through Simulation
		6.0-1.0-4	Time-stamped transit priority calls	Demonstration Through Simulation
		6.0-1.0-5	Time-stamped railroad preemption calls	Demonstration Through Simulation
		6.0-1.0-6	Time-stamped start and end of each phase	Demonstration Through Simulation
		6.0-1.0-7	Time-stamped controller interval changes	Demonstration Through Simulation
		6.0-1.0-8	Time-stamped start and end of each transition to a new timing plan	Demonstration Through Simulation
Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.	4.11.0-7	6.0-5	The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a minimum of 720 days: (edit as appropriate) · Occupancy during effective green Recommended splits · Actual splits · Progression bandwidth	Demonstration Through Simulation
		18.0-3	<i>The ASCT shall maintain a log of all signal state alterations directed by the ASCT.</i>	Demonstration Through Simulation
		18.0-3.0-4	The ASCT shall maintain the records in this ASCT log for a 2 year period.	Demonstration Through Simulation
Failure Notification	4.12			
The system operator needs to immediately notify maintenance and operations staff of alarms and alerts	4.12.0-1	13.1.0-3	In the event of a detector failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.	Demonstration Through Simulation
		13.2-2	In the event of communications failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.	Demonstration Through Simulation
		13.3-2	In the event of adaptive processor failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.	Demonstration Through Simulation
		13.2-3	The ASCT shall issue an alarm within 2 minutes of a detection failure.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to maintain a complete log of alarms and failure events.	4.12.0-3	13.1.0-4	In the event of a failure, the ASCT shall log details of the failure in a permanent log.	Demonstration Through Simulation
		13.1.0-5	The permanent failure log shall be searchable, archivable and exportable.	Demonstration Through Simulation
		13.2-4	In the event of a communications failure, the ASCT shall log details of the failure in a permanent log.	Demonstration Through Simulation
		13.2-5	The permanent failure log shall be searchable, archivable and exportable.	Demonstration Through Simulation
Preemption and Priority	4.13			
The system operator needs to accommodate railroad and light rail preemption.	4.13.0-1	11.0-1	The ASCT shall maintain adaptive operation at non-preempted intersections during railroad preemption.	Demonstration Through Simulation
		11.0-4	The ASCT shall resume adaptive control of signal controllers when preemptions are released.	Demonstration Through Simulation
		11.0-6	The ASCT shall operate normally at non-preempted signal controllers when special functions are engaged by a preemption event. (Examples of such special functions are a phase omit, a phase maximum recall or a fire route.)	Demonstration Through Simulation
		11.0-8	The ASCT shall not prevent the local signal controller from operating in normally detected limited-service actuated mode during preemption.	Demonstration Through Simulation
		11.0-3	The ASCT shall maintain adaptive operation at non-preempted intersections during Light Rail Transit preemption.	Demonstration Through Simulation
The system operator needs to accommodate emergency vehicle preemption.	4.13.0-2	11.0-4	The ASCT shall resume adaptive control of signal controllers when preemptions are released.	Demonstration Through Simulation
		11.0-6	The ASCT shall operate normally at non-preempted signal controllers when special functions are engaged by a preemption event. (Examples of such special functions are a phase omit, a phase maximum recall or a fire route.)	Demonstration Through Simulation
		11.0-8	The ASCT shall not prevent the local signal controller from operating in normally detected limited-service actuated mode during preemption.	Demonstration Through Simulation
		11.0-2	The ASCT shall maintain adaptive operation at non-preempted intersections during emergency vehicle preemption.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
The system operator needs to accommodate bus and light rail transit signal priority.	4.13.0-3	12.0-1	The ASCT shall continue adaptive operations of a group when one of its signal controllers has a transit priority call	Demonstration Through Simulation
		12.0-2	<i>The ASCT shall advance the start of a user-specified green phase in response to a transit priority call.</i>	Demonstration Through Simulation
		12.0-3	<i>The ASCT shall delay the end of a green phase, in response to a priority call.</i>	Demonstration Through Simulation
		12.0-2.0-1	The advance of start of green phase shall be user-defined.	Demonstration Through Simulation
		12.0-2.0-2	Adaptive operations shall continue during the advance of the start of green phase.	Demonstration Through Simulation
		12.0-3.0-1	The delay of end of green phase shall be user-defined.	Demonstration Through Simulation
		12.0-3.0-2	Adaptive operations shall continue during the delay of the end of green phase.	Demonstration Through Simulation
		12.0-8	The ASCT shall accept a transit priority call from: · a signal controller/transit vehicle detector; · an external system	Demonstration Through Simulation
Failure and Fallback	4.14			
The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.	4.14.0-1	13.1.0-2	<i>The ASCT shall use the following alternate data sources for operations in the absence of the real-time data from a detector:</i>	Demonstration Through Simulation
		13.1.0-2.0-3	The ASCT shall switch to the alternate source in real time without operator intervention.	Demonstration Through Simulation
		13.1.0-1	<i>The ASCT shall take user-specified action in the absence of valid detector data from XX vehicle detectors within a group. (SELECT THE APPROPRIATE ACTION.)</i>	Demonstration Through Simulation
		13.1.0-1.0-1	The ASCT shall release control to central system control.	Demonstration Through Simulation
		13.2-1	<i>The ASCT shall execute user-specified actions when communications to one or more signal controllers fails within a group. (SELECT THE APPROPRIATE ACTION)</i>	Demonstration Through Simulation
		13.2-1.0-1	In the event of loss of communication to a user-specified signal controller, the ASCT shall release control of all signal controllers within a user-specified group to local control.	Demonstration Through Simulation
		13.3-1	<i>The ASCT shall execute user-specified actions when adaptive control fails:</i>	Demonstration Through Simulation
		13.3-1.0-1	The ASCT shall release control to local controller.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		2.1.1.0-2	<i>The ASCT shall operate non-adaptively when adaptive control equipment fails.</i>	Demonstration Through Simulation
		2.1.1.0-2.0-4	The ASCT shall operate non-adaptively when a user-defined communications link fails.	Demonstration Through Simulation
		13.1.0-1.0-2	The ASCT shall release control to local operations to operate under its own time-of-day schedule.	Demonstration Through Simulation
		13.2-1.0-2	The ASCT shall switch to the alternate operation in real time without operator intervention.	Demonstration Through Simulation
		13.3-1.0-2	The ASCT shall release control to local operations to operate under its own time-of-day schedule.	Demonstration Through Simulation
Constraints	4.15			
<i>The system operator is constrained to use the following equipment:</i>	4.15.0-1			Demonstration Through Simulation
Controller type (list acceptable equipment)	4.15.0-1.0-1	14.0-3	The ASCT shall fully satisfy all requirements when connected with Naztec ATC controllers (specify controller types).	Demonstration Through Simulation
Detector type (list acceptable equipment)	4.15.0-1.0-2	14.0-2	The ASCT shall fully satisfy all requirements when connected with detectors from manufacturer Video Detection (Traficon with IR cameras) Inductive loops Radar (Matrix by WaveTronix)	Demonstration Through Simulation
Communication system	4.15.0-1.0-3		Ethernet	Demonstration Through Simulation
Cabinet type and size	4.15.0-1.0-4		Naztec ts2 68 inch type 6 cabinet	Demonstration Through Simulation
Signal management system	4.15.0-1.0-5		Naztec's ATMS.now	Demonstration Through Simulation
The system operator needs to use equipment and software acceptable under current agency IT policies and procedures.	4.15.0-3	14.0-1	The vendor's adaptive software shall be fully operational within the following platform: · Windows-PC	
Training and Support	4.16			
The agency needs all staff involved in operation and maintenance to receive appropriate training.	4.16.0-1	15.0-1.0-1	The vendor shall provide training on the operations of the adaptive system.	Demonstration Through Simulation
		15.0-1.0-9	The vendor shall provide a minimum of 16 hours of training to a minimum of 10 staff members.	Demonstration Through Simulation
		15.0-1	<i>The vendor shall provide the following training.</i>	Demonstration Through Simulation
		15.0-1.0-2	The vendor shall provide training on trouble-shooting the system.	Demonstration Through Simulation
		15.0-1.0-3	The vendor shall provide training on preventive maintenance and repair of equipment.	Demonstration Through Simulation
		15.0-1.0-4	The vendor shall provide training on system configuration.	Demonstration Through Simulation
		5.0-1.0-5	The vendor shall provide training on administration of the system.	Demonstration Through Simulation
		15.0-1.0-6	The vendor shall provide training on system calibration.	Demonstration Through Simulation

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
		15.0-1.0-7	The vendor's training delivery shall include: printed course materials and references, electronic copies of presentations and references.	Demonstration Through Simulation
		15.0-1.0-8	The vendor's training shall be delivered at SCTE Signal Maintenance shop.	Demonstration Through Simulation
		15.0-1.0-10	The vendor shall provide a minimum of 2 training sessions.	Demonstration Through Simulation
The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to be maintained to repair faults that are not defects in materials and workmanship.	4.16.0-2	16.0-1	The Maintenance Vendor shall provide maintenance according to a separate maintenance contract. That contract should identify repairs necessary to preserve requirements fulfillment, responsiveness in effecting those repairs, and all requirements on the maintenance provider while performing the repairs.	Demonstration Through Simulation
The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to remain free of defects in materials and workmanship that result in requirements no longer being fulfilled.	4.16.0-3	16.0-3	The Vendor shall warrant the system to be free of defects in materials and workmanship for a period of 2 years. Warranty is defined as correcting defects in materials and workmanship (subject to other language included in the purchase documents). Defect is defined as any circumstance in which the material does not perform according to its specification.	Demonstration Through Simulation
The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs support to keep software and software environment updated as necessary to prevent requirements no longer being fulfilled.	4.16.0-4	16.0-2	The Vendor shall provide routine updates to the software and software environment necessary to preserve the fulfillment of requirements for a period of 2 years. Preservation of requirements fulfillment especially includes all IT management requirements as previously identified.	Demonstration Through Simulation
External Interfaces	4.17			

Concepts of Operation User Needs	Concepts of Operation Section	Satisfied by User Requirements	User Requirement Description	Verification Method
Maintenance	4.18			
Each maintaining agency needs all applicable equipment to be readily accessible with the following support.	4.18.0-1			
		6.0-17	SCTE expects maintenance of all adaptive system software for a period of 2 year will be included in the purchase price	
		6.0-18	SCTE expects to operate this system using the latest software for the life of the system through maintenance fees.	
		6.0-19	SCTE will seek technical support from the vendor for assistance in using the adaptive software for the life of the system through maintenance fees.	