| **System Requirement #** | **System Requirement Description** | **ConOps Section #** | **ConOps Statement** | **Requirement Met?** |
| --- | --- | --- | --- | --- |
| *3.1 - Network Characteristics* |
| 3.1.1 | The ASCT shall be able to control a minimum of 14 signals concurrently during Verona Road construction and at a minimum 21 signals after Verona Road construction.  | 4.2 | The system operator will need to implement adaptive control for 14 signals within the study area during construction. After construction, the adaptive system may need to adaptively control at a minimum 21 signals within the study area and up to 27 signals.  |  |
| 3.1.2 | The ASCT shall support groups of signals. | 4.2 | The system operator needs to be able to adaptively control several groups of signals that may vary based on spacing and coordination preferences. |  |
|  3.1.2a | The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user. |  |
|  3.1.2b | The size of a group shall range from 1 to at least 14 signals. |  |
|  3.1.2c | Each group shall operate independently. |  |
|  3.1.2d | The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to a time-of-day schedule, traffic conditions, or when commanded by the user.  |  |
| *3.2 - Type of Operation* |
| *3.2.1 - Mode of Operation* |
| 3.2.1.1 | The ASCT shall operate non-adaptively when adaptive control equipment fails.  | 4.14 | WisDOT and the City of Madison prefer the signals to fallback into actuated/coordinated signal mode. If fallback to actuated/coordinated is unavailable then the historic data for the isolated signal should be used. The failure and fallback mode options may vary depending on the intersection. |  |
|  3.2.1.1a | The ASCT shall operate non-adaptively when a user-specified detector fails. |  |
|  3.2.1.1b | The ASCT shall operate non-adaptively when the number of failed detectors connected to a signal controller exceeds a user-defined value. |  |
|  3.2.1.1c | The ASCT shall operate non-adaptively when the number of failed detectors in a group exceeds a user-defined value. |  |
|  3.2.1.1d | The ASCT shall operate non-adaptively when a user-defined communications link fails. |  |
|  3.2.1.1e | The ASCT shall be able to notify the operator via an external system for failures of items a-d above. | 4.12 | WisDOT and City of Madison staff would both prefer real time alerts as opposed to having to log into the system. |  |
|  3.2.1.1f | The ASCT shall notify the operator via an email for failures associated with items c and d above. |  |
| 3.2.1.2 | The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptively controlling a group of signals. | 4.7 | There are times where the system operator should have the ability to over-ride the adaptive system. |  |
| 3.2.1.3 | The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptive operation.  |  |
| 3.2.1.4 | 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. | 4.1.1 | Maximize the throughput on coordinated routes |  |
| 3.2.1.5 | When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers, preventing queues from exceeding the storage capacity at user-specified locations. | 4.1.4 | Manage the lengths of queues |  |
| 3.2.1.6 | When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers providing equitable distribution of green times.  | 4.1.3 | Distribute phase times in an equitable fashion |  |
| 3.2.1.7 | 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.  | 4.1.2 | Provide smooth flow along coordinated routes |  |
| 3.2.1.8 | 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.  | 4.1.4 | Manage the lengths of queues |  |
| 3.2.1.9 | The ASCT shall alter operations, to minimize repeated phase failures.  | 4.1.5 | Manage the locations of queues within the network |  |
| *3.2.2 - Allowable Phases* |
| 3.2.2.1 | The ASCT shall not prevent protected/permissive left turn phase operation.  | 4.9.14  | Protected/permissive phasing and alternate left turn phase sequences. |  |
| 3.2.2.2 | The ASCT shall not prevent the protected left turn phase to lead or lag the opposing through phase based upon user-specified conditions. |  |
| 3.2.2.3 | The ASCT shall prevent skipping a user-specified phase when the user-specified phase sequence is operating.  | 4.9.6 | Prevent one or more phases being skipped under certain traffic conditions or signal states. |  |
| 3.2.2.4 | The ASCT shall prevent skipping a user-specified phase based on the state of a user-specified external input.  |  |
| 3.2.2.5 | The ASCT shall prevent skipping a user-specified phase according to a time-of-day schedule.  |  |
| 3.2.2.6 | The ASCT shall omit a user-specified phase when the cycle length is below a user-specified value.  | 4.9.5 | Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states. |  |
| 3.2.2.7 | The ASCT shall omit a user-specified phase based on measured traffic conditions.  |  |
| 3.2.2.8 | The ASCT shall omit a user-specified phase based on the state of a user-specified external input.  |  |
| 3.2.2.9 | The ASCT shall omit a user-specified phase according to a time-of-day schedule.  |  |
| 3.2.2.10 | The ASCT shall assign unused time from a preceding phase that terminates early to a user-specified phase as follows:  | 4.9.10 | Allow the operator to specify which phase receives unused time from a preceding phase |  |
|  3.2.2.10a | User-specified phase |
| 3.2.2.11 | The ASCT shall assign unused time from a preceding phase that is skipped to a user-specified phase as follows:  |  |
|  3.2.2.11a | User-specified phase |
| 3.2.2.12 | The ASCT shall not alter the order of phases at a user-specified intersection.  | 4.1.8 | 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 the Beltline interchange signals. |  |
| *3.2.3 - Oversaturation* |
| 3.2.3.1 | The ASCT shall detect the presence of queues at pre-configured locations.  | 4.1.4 | Manage the lengths of queues |  |
| 3.2.3.2 | When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.  | 4.1.4 | Manage the lengths of queues |  |
| 3.2.3.3 | The ASCT shall prioritize preventing queues at interchange ramp terminal intersections from spilling back to the Beltline highway. | 4.5 | The stakeholders indicated that the ramp terminal intersections should not back up to the Beltline at the three interchanges within the study area.  |  |
| *3.2.4 - Sequence Based Adaptive Coordination* |
| 3.2.4.1 | The ASCT shall select cycle length based on a time-of-day schedule or traffic responsive means based on user-specified thresholds. | 4.1.1-4.1.5  | Maximize the throughput on coordinated routesProvide smooth flow along coordinated routesDistribute phase times in an equitable fashion Manage the lengths of queuesManage the locations of queues within the network |  |
| 3.2.4.2 | 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). |
|  3.2.4.2a | The ASCT shall limit cycle lengths to user-specified values. |
| *3.2.5 - Responsiveness* |
| 3.2.5.1 | The ASCT shall limit the change in consecutive cycle lengths to be less than a user-specified value. | 4.1.10 | The system operator needs to set signal timing parameters (such as minimum green, maximum green and extension time) to comply with agency policies. If there is no set policy (such as for transitions between cycle lengths), engineering judgment of the system operator should be used. |  |
| 3.2.5.2 | 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.) |  |
| 3.2.5.3 | The ASCT shall limit the changes in the direction of primary coordination to a user-specified frequency. |  |
| 3.2.5.4 | When a large change in traffic demand is detected, the ASCT shall respond in fewer transitions than normal user-specified adaptive operation, subject to user-specified limits.  |  |
| 3.2.5.5 | The ASCT shall select cycle length from a list of user-defined cycle lengths.  | 4.8.2 | The system operator needs to constrain the selection of cycle lengths to those that provide acceptable operations, such as when resonant progression solutions are desired.  |  |
| *3.3 - External Interfaces* |
| 3.3.1 | The ASCT shall send the following to a central ATMS | 4.11 | The performance reporting measures that are preferable to be included are as follows:1. The agency needs to define the communications support that is needed to be able to monitor the ASCT system automatically.
2. The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.
3. The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.
4. The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to a defined external system.
5. The system operator needs to report performance data in real time to a defined external system.
6. 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.
7. Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.
 |  |
|  3.3.1a | Operational data |  |
|  3.3.1b | Control data  |  |
|  3.3.1c | Monitoring data  |  |
|  3.3.1d | Coordination data |  |
|  3.3.1e | Performance data |  |
| 3.3.2 | Monitoring of the data listed in requirement 3.3.1 shall be allowed for the following networks: |  |
|  3.3.2a | City of Madison internal network |  |
|  3.3.2b | WisDOT internal network |  |
| 3.3.3 | For the data listed in requirement 3.3.1, the ASCT system shall be able to: |  |
|  3.3.2a | Share data |  |
|  3.3.2b | Export data |  |
|  3.3.2c | Utilize an open data source that can be queried by other data sources. |  |
| 3.3.4 | The ASCT shall receive commands from the central ATMS. |  |
| 3.3.5 | The ASCT shall implement the following commands from the central ATMS when commanded: |  |
|  3.3.5a | Specified cycle length |  |
|  3.3.5b | Specified direction of progression |  |
|  3.3.5c | Specified adaptive strategy |  |
|  3.3.5d | Manual override of ASCT |  |
|  3.3.5e | Disabling of ASCT |  |
|  3.3.5f | Modification of controller databases |  |
| *3.4 - Crossing Arterials and Boundaries* |
| 3.4.1 | The ASCT shall support adaptive coordination on crossing routes.  | 4.3 | The system operator needs to adaptively coordinate signals on two crossing routes simultaneously if coordination is desired on two crossing routes.  |  |
| *3.5 - Access and Security* |
| 3.5.1 | The ASCT shall provide monitoring and control access at the following locations: | 4.10 | The preference for monitoring and control is from remote locations. The City of Madison has an operations center that currently has a television that cycles through the signals that they operate and/or maintain.  |  |
|  3.5.1a | Remote locations via internet via internet utilizing virtual private network (VPN) |  |
|  3.5.1b | City of Madison Operations/Maintenance Office |  |
| 3.5.2 | Policies (IT, security, and others as needed) will be negotiated between the City of Madison and WisDOT.  | 4.4 | WisDOT SW Region prefers to be the administrator at least for their own signals. If the WisDOT SW Region is not the administrator during construction, they would prefer the City of Madison to be.The City of Madison prefers to be the administrator of the system for the signals they typically maintain and operate.  |  |
| 3.5.3 | The ASCT shall not prevent access to the local signal controller database, monitoring or reporting functions by any installed signal management system.  | 4.15.4  | An adaptive system should not change the access that maintenance staff and operators currently have to the signal controller and the controller’s functions. |  |
| *3.6 - Data Log* |
| 3.6.1  | The ASCT shall log the following events with time-stamps: | 4.11 | The performance reporting measures that are preferable to be included are as follows:1. The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.
2. The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.
3. The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to a defined external system.
4. The system operator needs to report performance data in real time to a defined external system.
5. 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.
6. Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.
 |  |
|  3.6.1a | Vehicle phase calls |  |
|  3.6.1b | Pedestrian phase calls |  |
|  3.6.1c | Emergency vehicle preemption calls |  |
|  3.6.1d | Transit priority calls (capability does not exist now, but may in future) |  |
|  3.6.1e | Start and end of each phase |  |
|  3.6.1f | Controller interval changes |  |
|  3.6.1g | Start and end of each transition to a new timing plan |  |
|  3.6.1h | System failures |  |
|  3.6.1i | Loop failures |  |
|  3.6.1j | Communications failures |  |
| 3.6.2 | The ASCT shall be able to export its systems log in one or more of the following formats:  |  |
|  3.6.2a | Microsoft Excel |  |
|  3.6.2b | Text or CSV |  |
|  3.6.2c | Microsoft Access |  |
| 3.6.3 | The ASCT shall store the event log for a user-specified duration.  |  |
| 3.6.4 | The ASCT shall store results of all signal timing parameter calculations for a user-specified duration. |  |
| 3.6.5 | The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a user-specified duration: |  |
|  3.6.5a | Volume |  |
|  3.6.5b | Occupancy |  |
|  3.6.5c | Queue length |  |
|  3.6.5d | Phase utilization |  |
|  3.6.5e | Arrivals in green |  |
|  3.6.5f | Green band efficiency |  |
| 3.6.6 | The ASCT system shall archive all data automatically after a user-specified period. |  |
| 3.6.7 | The ASCT shall provide data storage for a system size of at least 21 signal controllers. The data to be stored shall include the following:  |  |
|  3.6.7a | Controller state data |  |
|  3.6.7b | Reports |  |
|  3.6.7c | Log data |  |
|  3.6.7d | Security data |  |
|  3.6.7e | ASCT parameters |  |
|  3.6.7f | Detector status data |  |
|  3.6.7g | Volume data |  |
|  3.6.7h | Loop data |  |
| 3.6.8 | The ASCT shall calculate and report relative data quality including:  |  |
|  3.6.8a | The extent data is affected by detector faults |  |
|  3.6.8b | Any other applicable items |  |
| 3.6.9 | The ASCT shall report comparisons of logged data when requested by the user: |  |
|  3.6.9a | Day to day |  |
|  3.6.9b | Hour to hour |  |
|  3.6.9c | Hour of day to hour of day |  |
|  3.6.9d | Hour of week to hour of week |  |
|  3.6.9e | Day of week to day of week |  |
|  3.6.9f | Day of year to day of year |  |
| 3.6.10 | The ASCT shall store data logs in a standard database.  |  |
| 3.6.11 | The ASCT shall report stored data in a form suitable to provide explanations of system behavior to public and politicians and to troubleshoot the system. |  |
| 3.6.12 | The ASCT shall store the following data in customizable increments that range from at least 5 minute to 60 minutes: |  |
|  3.6.12a | Volume |  |
|  3.6.12b | Occupancy |  |
| *3.7 - Advanced Controller Operation* |
| 3.7.1 | When specified by the user, the ASCT shall serve a vehicle phase more than once for each time the coordinated phase is served. | 4.9.1 | Service a phase more than once per cycle |  |
| 3.7.2 | The ASCT shall support NEMA phasing. | 4.9.3 | Allow for a defined maximum number of rings and phases at each signal |  |
| 3.7.3 | The ASCT shall not prevent a phase/overlap output by time-of-day. | 4.9.4 | Permit different phase sequences under different traffic conditions |  |
| 3.7.4 | The ASCT shall not prevent a phase/overlap output based on an external input. |  |
| 3.7.5 | The ASCT shall not prevent user-specified phases to be designated as coordinated phases.  | 4.9.9 | Allow any phase to be designated as the coordinated phase |  |
| 3.7.6 | 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. | 4.9.12 | Allow the coordinated phase to terminate early under prescribed traffic conditions |  |
| 3.7.7 | The ASCT shall not prevent the controller from displaying flashing yellow arrow left turn or right turn.  | 4.9.15 | Use flashing yellow arrow to control permissive left turns and right turns |  |
| 3.7.8 | The ASCT shall not prevent the local signal controller from performing actuated phase control using extension/passage timers as assigned to user-specified vehicle detector input channels in the local controller. | 4.9.11 | Allow the controller to respond independently to individual lanes of an approach. This may be implemented in the signal controller using a defined amount of extension/passage timers, which may be assignable to each vehicle detector input channel. This may allow the adaptive operation to be based on data from a specific detector, or by excluding specific detectors. |  |
|  3.7.8a | The ASCT shall operate adaptively using user-specified detector channels. |  |
| 3.7.9 | When adaptive operation is used in conjunction with normal coordination, the ASCT shall not prevent a controller serving a cycle length different from the cycles used at adjacent intersections. | 4.1.10 | The system operator needs to set signal timing parameters (such as minimum green, maximum green and extension time) to comply with agency policies. If there is no set policy (such as for transitions between cycle lengths), engineering judgment of the system operator should be used. |  |
| *3.8 - Pedestrians* |
| 3.8.1 | When a pedestrian phase is called, the ASCT shall execute pedestrian phases up to a user-specified time before the vehicle green of the related vehicle phase. | 4.6 | For the mitigation routes, lower volume pedestrian crossings should use overrides. The higher volume pedestrian crossings may be built into the signal timing.How the signal system handles pedestrian crossings with adaptive control should be reviewed and adjusted after observing operations of the system. |  |
| 3.8.2 | When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times during adaptive operations. |  |
| 3.8.3 | When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times then resume adaptive operation. |  |
| 3.8.4 | The ASCT shall execute user-specified exclusive pedestrian phases during adaptive operation. |  |
| 3.8.5 | The ASCT shall execute pedestrian recall on user-defined phases in accordance with a time-of-day schedule. |  |
| 3.8.6 | The ASCT shall begin a non-coordinated phase later than its normal starting point within the cycle when all of the following conditions exist:  | 4.9.13 | Allow flexible timing of non-coordinated phases (such as late start of a phase) while maintaining coordination |  |
|  3.8.6a | The user enables this feature |  |
|  3.8.6b | 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 |  |
|  3.8.6c | The phase is called after its normal start time |  |
|  3.8.6d | The associated pedestrian phase is not called |  |
| 3.8.7 | When specified by the user, the ASCT shall execute pedestrian recall on pedestrian phase adjacent to coordinated phases. | 4.6 | For the mitigation routes, lower volume pedestrian crossings should use overrides. The higher volume pedestrian crossings may be built into the signal timing.How the signal system handles pedestrian crossings with adaptive control should be reviewed and adjusted after observing operations of the system. |  |
| 3.8.8 | When the pedestrian phases are on recall, the ASCT shall accommodate pedestrian timing during adaptive operation. |  |
| 3.8.9 | The ASCT shall not inhibit negative vehicle and pedestrian phase timing during overlap phases.  | 4.9.17 | Use negative pedestrian phasing to prevent an overlap conflicting with a pedestrian walk/don't walk |  |
| *3.9 - Special Functions* |
| 3.9.1 | The ASCT shall set a specific state for each special function output based on the occupancy on a user-specified detector.  | 4.9.7-8 | Allow detector logic at an intersection to be varied depending on local signal statesAccommodate custom features used by defined agency |  |
| 3.9.2 | The ASCT shall set a specific state for each special function output based on the current cycle length.  |  |
| 3.9.3 | The ASCT shall set a specific state for each special function output based on a time-of-day schedule. |  |
| 3.9.4 | The ASCT shall be compatible with Origin-Destination travel time technology | 4.3 | It is desirable for the ASC to be compatible with Origin-Destination travel time technology.  |  |
| *3.10 - Detection* |
| 3.10.1 | The ASCT shall be compatible with the following types of controllers:  | 4.15.5 | The system should be compatible with TS-1 and TS-2 controllers and detection technologies that are compatible with these controllers. |  |
|  3.10.1a | TS-1 |  |
|  3.10.1b | TS-2 |  |
| 3.10.2 | The ASCT shall be compatible with detection technologies that are compatible with the controllers listed in requirement 3.10.1. |  |
| 3.10.3 | The ASCT shall be able to operate within the existing cabinet environments. | 4.15.5 | The system should operate within the existing cabinet environments. |  |
| *3.11 - Railroad and Emergency Preemption* |
| 3.11.1 | The ASCT shall maintain adaptive operation at non-preempted intersections during railroad preemption. | 4.13.3 | Railroad preemption is not a factor in signal operations within the study area. However, if the adaptive system is expanded in the future, features relating to railroad preemption and communication should not be precluded. |  |
| 3.11.2 | The ASCT shall maintain adaptive operation at non-preempted intersections during EVP. | 4.13.2 | Emergency vehicles should be accommodated at existing locations. Directly after emergency vehicle preemption, the current practice for WisDOT is to run the mainline first and then call every phase. For the City of Madison, the typical operation after emergency vehicle preemption is to place calls on the non-served phases during preemption. |  |
| 3.11.3 | The ASCT shall resume adaptive control of signal controllers when preemptions are released. |  |
| 3.11.4 | The ASCT shall execute user-specified actions at non-preempted signal controllers during preemption. (E.g., inhibit a phase, activate a sign, display a message on a DMS) |  |
| 3.11.5 | 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.) |  |
| 3.11.6 | The ASCT shall release user-specified signal controllers to local control when one signal in a group is preempted. |  |
| 3.11.7 | The ASCT shall not prevent the local signal controller from operating in normally detected limited-service actuated mode during preemption. |  |
| *3.12.1 - Transit Priority* |
| 3.12.1 | The ASCT shall have the ability to accommodate transit priority in the future.  | 4.13.1 | Bus preemption, or TSP, in the adaptive system may be considered in the future and should not be precluded by the technology selection.  |  |
| *3.13 - Failure Events and Fallback* |
| *3.13.1 - Detector Failure* |
| 3.13.1.1 | The ASCT shall take user-specified action in the absence of valid detector data from a user-specified number of vehicle detectors within a group. | 4.14 | WisDOT and the City of Madison prefer the signals to fallback into actuated/coordinated signal mode. If fallback to actuated/coordinated is unavailable then the historic data for the isolated signal should be used. The failure and fallback mode options may vary depending on the intersection. |  |
|  3.13.1.1a | The ASCT shall release control to central system control. |  |
|  3.13.1.1b | The ASCT shall release control to local operations to operate under its own time-of-day schedule.  |  |
| 3.13.1.2 | The ASCT shall use the following alternate data sources for operations in the absence of the real-time data from a detector: |  |
|  3.13.1.2a | Data from a user-specified alternate detector. |  |
|  3.13.1.2b | Stored historical data from the failed detector. |  |
|  3.13.1.2c | The ASCT shall switch to the alternate source in real time without operator intervention. |  |
| 3.13.1.3 | In the event of a detector failure, the ASCT shall issue an alarm to the following: |  |
|  3.13.1.3a | User specified recipients via email |  |
|  3.13.1.3b | Central ATMS system |  |
| 3.13.1.4 | In the event of a failure, the ASCT shall log details of the failure in a permanent log. |  |
| 3.13.1.5 | The permanent failure log shall be searchable, archivable and exportable. |  |
| *3.13.2 - Communications Failure* |
| 3.13.2.1 | The ASCT shall execute user-specified actions when communications to one or more signal controllers fails within a group. | 4.14 | WisDOT and the City of Madison prefer the signals to fallback into actuated/coordinated signal mode. If fallback to actuated/coordinated is unavailable then the historic data for the isolated signal should be used. The failure and fallback mode options may vary depending on the intersection. |  |
|  3.13.2.1a | 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. |  |
|  3.13.2.1b | The ASCT shall switch to the alternate operation in real time without operator intervention. |  |
| 3.13.2.2 | In the event of communications failure, the ASCT shall issue an alarm to the following: |  |
|  3.13.2.2a | User specified recipients via email |  |
|  3.13.2.2b | Central ATMS system |  |
| 3.13.2.3 | The ASCT shall issue an alarm within a user-specified period for detection of a failure. |  |
| 3.13.2.4 | In the event of a communications failure, the ASCT shall log details of the failure in a permanent log. |  |
| 3.13.2.5 | The permanent failure log shall be searchable, archivable and exportable.  |  |
| *3.13.3 - Adaptive Processor Failure* |
| 3.13.3.1 | The ASCT shall execute user-specified actions when adaptive control fails: | 4.14 | WisDOT and the City of Madison prefer the signals to fallback into actuated/coordinated signal mode. If fallback to actuated/coordinated is unavailable then the historic data for the isolated signal should be used. The failure and fallback mode options may vary depending on the intersection. |  |
|  3.13.3.1a | The ASCT shall release control to central system control. |  |
|  3.13.3.1b | The ASCT shall release control to local operations to operate under its own time-of-day schedule. |  |
| 3.13.3.2 | In the event of adaptive processor failure, the ASCT shall issue an alarm to the following: |  |
|  3.13.3.2a | User specified recipients via email |  |
|  3.13.3.2b | Central ATMS system |  |
| 3.13.3.3 | The permanent failure log shall be searchable, archivable and exportable.  |  |
| 3.13.3.4 | During adaptive processor failure, the ASCT shall provide all local detector inputs to the local controller. |  |
| *3.14 - Software* |
| 3.14.1 | The vendor's adaptive software shall be fully operational within the Windows-PC platform. | 4.15.5 | WisDOT prefers Econolite TS-2 controllers and microwave detection that has presence detection. The City of Madison prefers Econolite hardware for their traffic signals. The signals within Dane County that are operated and maintained by the City of Madison all use Econolite equipment. The preferred type of software to use if an adaptive control system would be compatible with Econolite hardware.  |  |
| 3.14.2 | The ASCT shall fully satisfy all requirements when connected with detectors used by the City of Madison and WisDOT. |  |
| 3.14.3 | The ASCT shall fully satisfy all requirements when connected with controllers used by the City of Madison and WisDOT. |  |
| 3.14.4 | The ASCT shall be fully capable of sending the following from one single system: |  |
|  3.14.4a | Adaptive control commands |  |
|  3.14.4b | Controller database data |  |
| *3.15 - Training* |
| 3.15.1 | The vendor shall provide the following training to City of Madison and WisDOT staff: | 4.15.3 | The City of Madison and WisDOT desire to have adaptive signal system training for their respective engineers and electricians. |  |
|  3.15.1a | Operations of the adaptive system |  |
|  3.15.1b | Troubleshooting the system |  |
|  3.15.1c | Preventive maintenance and repair of equipment |  |
|  3.15.1d | System configuration |  |
|  3.15.1e | Administration of the system |  |
|  3.15.1f | System calibration |  |
|  3.15.1g | The vendor's training shall be delivered at a location to be determined. |  |
|  3.15.1h | The training shall be at a location where those being trained can interactively work with the system. |  |
|  3.15.1i | The vendor shall provide training to a minimum of 8 staff for an amount of time to be determined. |  |
|  3.15.1j | The vendor shall provide a minimum of 2 training sessions. |  |
| *3.16 - Maintenance, Support, and Warranty* |
| 3.16.1  | If desired, 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. | 6.1 | During construction, the City of Madison and WisDOT will handle maintenance of the signal system as they do today. Separate contracts with vendors are not expected to be needed. |  |
| 3.16.2 | The Vendor shall provide routine updates to the software and software environment necessary to preserve the fulfillment of requirements for a minimum of 2 years and up to 7 years. Preservation of requirements fulfillment especially includes all IT management requirements as previously identified. | 6.2 | The agency expects updates to the software and software environment as necessary for a minimum of two (2) years and up to seven (7) years. This will be included in the purchase price.  |  |
| 3.16.3 | The Vendor shall warrant the system to be free of defects in materials and workmanship for a minimum 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. | 6.3 | Replacement or repair of defective or failed equipment will be covered for a minimum of two (2) years by the manufacturers' warranties. The labor cost of replacement during this period will be included in the purchase price.  |  |
| *3.17 - Schedule* |
| 3.17.1  | The ASCT shall set the state of external input/output states according to a time-of-day schedule. | 4.1.6 | Change the operational strategy (for example, from smooth flow to maximizing throughput or managing queues) based on changing traffic conditions. |  |
| 3.17.2 | The ASCT output states shall be settable according to a time-of-day schedule |  |
| 3.17.3 | The ASCT operational parameters shall be settable according to a time-of-day schedule | 4.1.10 | The system operator needs to set signal timing parameters (such as minimum green, maximum green and extension time) to comply with agency policies. If there is no set policy (such as for transitions between cycle lengths), engineering judgment of the system operator should be used. |  |
| *3.18 - Performance Measurement, Monitoring, and Reporting* |
| 3.18.1 | The ASCT shall report measures of current traffic conditions on which it bases signal state alterations. | 4.11.2-7 | The performance reporting measures that are preferable to be included are as follows:1. The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.
2. The system operator needs to store and report data that can be used to measure traffic performance under adaptive control.
3. The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to a defined external system.
4. The system operator needs to report performance data in real time to a defined external system.
5. 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.
6. Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.
 |  |
| 3.18.2 | The ASCT shall report all intermediate calculated values that are affected by calibration parameters. |  |
| 3.18.3 | The ASCT shall maintain a log of all signal state alterations directed by the ASCT. |  |
|  3.18.3a | The ASCT log shall include all events directed by the external inputs. |  |
|  3.18.3b | The ASCT log shall include all external output state changes. |  |
|  3.18.3c | The ASCT log shall include all actual parameter values that are subject to user-specified values. |  |
|  3.18.3d | The ASCT shall maintain the records in this ASCT log as long as specified by the user. |  |