| Requirements Document Reference Number | System Requirements  USH 14 / STH 26 ADAPTIVE SIGNAL CONTROL SYSTEM  Janesville, WI | |
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| System Requirements Sample Requirements | Need Statement (Con Ops) |
| 1 | 1 Network Characteristics |  |
| 1.0-1 | The ASCT shall control a minimum of 25 signals concurrently | 4.2.0-1  The system operator needs to eventually adaptively control up to 25 signals, with the ability to communicate via Ethernet communications |
| 1.0-2 | *The ASCT shall support groups of signals.* | 4.2.0-2  The system operator needs to eventually adaptively control up to 25 signals, with the ability to communicate via Ethernet communications  4.2.0-3  The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions. |
| 1.0-2.0-1 | The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user. | 4.2.0-2  The system operator needs to eventually adaptively control up to 25 signals, with the ability to communicate via Ethernet communications |
| 1.0-2.0-2 | The ASCT shall control a minimum of 4 groups of signals. | 4.2.0-2  The system operator needs to eventually adaptively control up to 25 signals, with the ability to communicate via Ethernet communications |
| 1.0-2.0-3 | The size of a group shall range from 1 to 25 signals. | 4.2.0-3  The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions. |
| 1.0-2.0-4 | Each group shall operate independently | 4.2.0-2  The system operator needs to eventually adaptively control up to 25 signals, with the ability to communicate via Ethernet communications |
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| 1.0-2.0-5.0-2 | The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to the following traffic conditions:   1. Under normal operations, signals on USH 14 between Newville Road and Wright Road will operate in a coordinated fashion and signals on STH 26 between USH 14 and Kettering Street will operate in a coordinated fashion. 2. When the IH 39 alternate route follow USH 14 from south of the system to USH 51, signals on USH 14 between USH 51 and Wright Road will operate in a coordinated fashion. Signals on STH 26 will operate the same as scenario 1. 3. When the IH 39 alternate route follows USH 14 from IH 39 to USH 51, signals on USH 14 from IH 39 to USH 51 will operate in a coordinated fashion. Signals on STH 26 will operate the same as scenario 1.   When the USH 14 or STH 26 interchanges have ramp closures, pushing additional traffic onto USH 14 or STH 26, signals on USH 14 between IH 39 and STH 26 and signals on STH 26 between USH 14 and IH 39 will operate as one coordinated system.  The ASCT shall be capable of accepting changes to these scenarios and capable of handling the addition of scenarios. | 4.2.0-3  The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions. |
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| 2 | 2 Type of Operation |  |
| 2.1 | 2.1 General |  |
| 2.1.1 | 2.1.1 Mode of Operation |  |
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| 2.1.1.0-2 | *The ASCT shall operate non-adaptively when adaptive control equipment fails.* | 4.14.0-1  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. |
| 2.1.1.0-2.0-1 | The ASCT shall operate non-adaptively when a user-specified detector fails. | 4.14.0-1  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. |
| 2.1.1.0-2.0-2 | The ASCT shall operate non-adaptively when the number of failed detectors connected to a signal controller exceeds a user-defined value. | 4.14.0-1  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. |
| 2.1.1.0-2.0-3 | The ASCT shall operate non-adaptively when the number of failed detectors in a group exceeds a user-defined value. | 4.14.0-1  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. |
| 2.1.1.0-2.0-4 | The ASCT shall operate non-adaptively when a user-defined communications link fails. | 4.14.0-1  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. |
| 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. | 4.7.0-3  The system operator needs to over-ride adaptive operation. |
| 2.1.1.0-4 | The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptive operation. | 4.7.0-3  The system operator needs to over-ride adaptive operation. |
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| 2.1.1.0-7 | *The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions.* | 4.1.0-3  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. |
| 2.1.1.0-7.0-1 | When the coordinated phase associated with the IH 39 diversion route experiences cycle failure at the following locations on two consecutive cycles, the ASCT shall alter the state of the signal controllers, maximizing the throughput of the coordinated route:   1. STH 26 interchange ramp terminals 2. USH 14 interchange ramp terminals 3. USH 14 & USH 51 intersection 4. USH 14 & Wright Road intersection | 4.1.0-3  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. |
| 2.1.1.0-7.0-2 (1) | When queue spillback is detected from one signalized intersection to an adjacent signalized intersection on the mainline (STH 26 or USH 14), the ASCT shall alter the state of signal controllers, preventing queues from exceeding the storage capacity between signalized intersections. | 4.1.0-3  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. |
| 2.1.1.0-7.0-2 (2) | When a railroad preemption occurs, the ASCT shall alter the state of signal controllers, preventing queues from exceeding the storage capacity between the railroad crossing and the adjacent signalized intersection. | 4.1.0-3  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. |
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| 2.1.1.0-7.0-4 | Under normal traffic conditions, the ASCT shall alter the state of signal controllers providing two-way progression on a coordinated route. | 4.1.0-3  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. |
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| 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.) | 4.1.0-4  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. |
| 2.1.1.0-9.0-1 | The ASCT shall alter operations, to minimize repeated phase failures. | 4.1.0-4  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. |
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| 2.1.1.0-11 | *The ASCT shall provide coordination along a route.* | 4.1.0-8  The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy. |
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| 2.1.1.0-11.0-2 | The ASCT shall determine the coordinated route based on traffic conditions. | 4.1.0-8  The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy. |
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| 2.1.2 | 2.1.2 Allowable Phases |  |
| 2.1.2.0-1 | The ASCT shall not prevent protected/permissive left turn phase operation. | 4.9.0-1.0-14   * Protected/permissive phasing and alternate left turn phase sequences. |
| 2.1.2.0-2 | The ASCT shall not prevent the protected left turn phase to lead or lag the opposing through phase at any time. | 4.9.0-1.0-14   * Protected/permissive phasing and alternate left turn phase sequences. |
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| 2.1.2.0-7 | The ASCT shall omit protected left turn phases at signals with protected/permitted left turn phasing if cycle failure is detected for the opposing through movement in two consecutive phases and queues in the left turn lane do not exceed the left turn storage capacity. | 4.9.0-1.0-5   * Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states. |
| 2.1.2.0-8 | The ASCT shall omit a user-specified phase during railroad preemption and recovery from railroad preemption. | 4.9.0-1.0-5   * Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states. |
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| 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:   * next phase; * next coordinated phase;   user-specified phase. | 4.9.0-1.0-10   * Allow the operator to specify which phase receives unused time from a preceding phase |
| 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:   * previous phase; * next phase; * next coordinated phase;   user-specified phase. | 4.9.0-1.0-10   * Allow the operator to specify which phase receives unused time from a preceding phase |
| 2.1.2.0-12 | The ASCT shall not alter the order of phases at the STH 26 interchange ramp signals or the USH 14 interchange ramp signals. | 4.1.0-7  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. |
| 2.1.3 | 2.1.3 Oversaturation |  |
| 2.1.3.0-1 | The ASCT shall detect the presence of queues on every lane of every approach at every signalized intersection. The ASCT shall detect queues that spillback from signalized intersections to adjacent signalized intersections and queues that exceed storage capacity of left turn lanes. | 4.1.0-4  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.  4.5.0-2  The system operator needs to detect queues within the system's boundaries and modify the ASCT operation to accommodate the queuing. |
| 2.1.3.0-2 | When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode. | 4.1.0-4  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. |
| 2.1.3.0-3 | When queues are detected that spill back from a signalized intersection to an adjacent signalized intersection, the ASCT shall execute the “maximize throughput” adaptive operation strategy. | 4.1.0-4  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.  4.5.0-2  The system operator needs to detect queues within the system's boundaries and modify the ASCT operation to accommodate the queuing. |
| 2.1.3.0-4 | When queues are detected that spill back from a signalized intersection to an adjacent signalized intersection, queues in the opposing left turn lane do not exceed the left turn storage capacity, and the left turn phasing is protected/permitted, the ASCT shall omit the associated protected left turn phase. | 4.1.0-4  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. |
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| 2.2 | 2.2 Sequence-based Adaptive Coordination |  |
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| 2.2.0-5.0-5 | **(Sequence-based only)** 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. | 4.1.0-5  The system operator needs to minimize the chance that a queue forms at a specified location.  ***Note to user when selecting these requirements:***  ***Select from requirements in the 2.2 group when sequence-based systems are allowed (sequence-based systems explicitly calculate cycle, offset, and split).***  ***Select from requirements in the 2.3 group when non-sequence-based systems are allowed (non-sequence-based systems do not explicitly calculate cycle, offset, and split).***  ***Select from requirements in the 2.5 group when phase-based systems are allowed (phase-based systems do not explicitly calculate cycle, offset and split at all intersections).***  ***(Select requirements from two or all three groups when the vendor is given the choice of supplying the type of adaptive operation.)*** |
| 2.3 | 2.3 Non-sequence-based adaptive coordination |  |
| 2.3.0-1 | **Use this section if non-sequence-based adaptive coordination is likely to provide acceptable operation in your situation.** |  |
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| 2.3.0-5 | **(Non-sequence-based only)** The ASCT shall adjust signal timing so that vehicles approaching a signal that have been served during a user-specified phase at an upstream signal do not stop. | 4.1.0-5  The system operator needs to minimize the chance that a queue forms at a specified location. |
| 2.4 | 2.4 Single intersection adaptive operation |  |
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| 2.5.0-7 | **(Phase-based only)** The ASCT shall adjust the state of the signal controller so that vehicles approaching a signal that have been served during a user-specified phase at an upstream signal do not stop. | 4.1.0-5  The system operator needs to minimize the chance that a queue forms at a specified location. |
| 2.6 | 2.6 Responsiveness |  |
| 2.6.0-1 | The ASCT shall limit the change in consecutive cycle lengths to be less than 20% of the cycle length. | 4.8.0-1  The system operator needs to modify the ASCT operation to closely follow changes in traffic conditions. |
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| 2.6.0-3 | The ASCT shall limit the changes in the direction of primary coordination to no more than four times per hour. | 4.8.0-1  The system operator needs to modify the ASCT operation to closely follow changes in traffic conditions.  4.8.0-2  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. |
| 2.6.0-4 | When a large change in traffic demand is detected, the ASCT shall allow changes in the length of consecutive cycle length of up to 50% of the cycle length. | 4.8.0-3  The system operator needs to respond quickly to sudden large shifts in traffic conditions. |
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| 3 | 3 External/Internal Interfaces |  |
| 3.0-1 | The ASCT system shall be capable of integrating Siemens and\or Econolite traffic signal systems. | 4.3.0-1  The system operator needs to adaptively control signals operated by WisDOT and the City of Janesville.  4.11.0-5  The system operator needs to report performance data in real time to the Southwest Region via the ITSNet. |
| 3.0-1.0-1 | The ASCT shall send operational data to the Southwest Region via the ITSNet | 4.11.0-5  The system operator needs to report performance data in real time to the Southwest Region via the ITSNet. |
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| 3.0-1.0-5 | The ASCT shall send performance data to the Southwest Region via the ITSNet | 4.11.0-5  The system operator needs to report performance data in real time to the Southwest Region via the ITSNet. |
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| 4 | 4 Crossing Arterials and Boundaries |  |
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| 4.0-1.0-4 | The ASCT shall support adaptive coordination on crossing routes. | 4.3.0-3  The system operator needs to adaptively coordinate signals on two crossing routes simultaneously. |
| 5 | 5 Access and Security |  |
| 5.0-1 | The ASCT shall be implemented with a security policy that addresses the following selected elements: | 4.4.0-1  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. |
| 5.0-1.0-1 | * Local access to the ASCT. | 4.4.0-1  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. |
| 5.0-1.0-2 | * Remote access to the ASCT. | 4.4.0-1  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. |
| 5.0-1.0-3 | * System monitoring. | 4.4.0-1  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. |
| 5.0-1.0-4 | * System manual override. | 4.4.0-1  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. |
| 5.0-1.0-5 | * Development | 4.4.0-1  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. |
| 5.0-1.0-6 | * Operations | 4.4.0-1  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. |
| 5.0-1.0-7 | * User login | 4.4.0-1  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. |
| 5.0-1.0-8 | * User password | 4.4.0-1  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. |
| 5.0-1.0-9 | * Administration of the system | 4.4.0-1  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. |
| 5.0-1.0-10 | * Signal controller group access | 4.4.0-1  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. |
| 5.0-1.0-11 | * Access to classes of equipment | 4.4.0-1  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. |
| 5.0-1.0-12 | * Access to equipment by jurisdiction | 4.4.0-1  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. |
| 5.0-1.0-13 | * Output activation | 4.4.0-1  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. |
| 5.0-1.0-14 | * System parameters | 4.4.0-1  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. |
| 5.0-1.0-15 | * Report generation | 4.4.0-1  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. |
| 5.0-1.0-16 | * Configuration | 4.4.0-1  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. |
| 5.0-1.0-17 | * Security alerts | 4.4.0-1  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. |
| 5.0-1.0-18 | * Security logging | 4.4.0-1  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. |
| 5.0-1.0-19 | * Security reporting | 4.4.0-1  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. |
| 5.0-1.0-20 | * Database | 4.4.0-1  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. |
| 5.0-1.0-21 | * Signal controller | 4.4.0-1  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. |
| 5.0-2 | *The ASCT shall provide monitoring and control access at the following locations:* | 4.10.0-1  The system operator needs to monitor and control all required features of adaptive operation from the following locations: (Edit and select as appropriate to suit your situation.) |
| 5.0-2.0-1 | Monitor and Control:   * WisDOT SW Region Office   Monitor Only:   * Statewide Traffic Operations Center * IH 39 Field Office * City of Janesville | 4.10.0-1.0-1  Monitor and Control:   * WisDOT SW Region Office   Monitor Only:   * Statewide Traffic Operations Center * IH 39 Field Office * City of Janesville |
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| 5.0-2.0-5 | * Local controller cabinets | 4.10.0-1.0-5   * Local controller cabinets |
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| 5.0-3 | The ASCT shall comply with the agency's security policy as prescribed by WisDOT IT Enterprise Support. | 4.4.0-1  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. |
| 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. | 4.10.0-2  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. |
| 6 | 6 Data Log |  |
| 6.0-1 | *The ASCT shall log the following events:* | 4.11.0-6  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. |
| 6.0-1.0-1 | Time-stamped vehicle phase calls  ***(This was not included in the most recent ConOps)*** | 4.11.0-6  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. |
| 6.0-1.0-2 | Time-stamped pedestrian phase calls  ***(This was not included in the most recent ConOps)*** | 4.11.0-6  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. |
| 6.0-1.0-3 | Time-stamped emergency vehicle preemption calls | 4.11.0-6  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. |
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| 6.0-1.0-5 | Time-stamped railroad preemption calls | 4.11.0-6  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. |
| 6.0-1.0-6 | Time-stamped start and end of each phase  ***(This was not included in the most recent ConOps)*** | 4.11.0-6  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. |
| 6.0-1.0-7 | Time-stamped controller interval changes  ***(This was not included in the most recent ConOps)*** | 4.11.0-6  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. |
| 6.0-1.0-8 | Time-stamped start and end of each transition to a new timing plan  ***(This was not included in the most recent ConOps)*** | 4.11.0-6  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. |
| 6.0-2 | * The ASCT shall export its systems log in the following format: * CSV | 4.11.0-4  The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the system server. |
| 6.0-3 | The ASCT shall store the event log for a minimum of 90 days.  ***(This was increased from 10 days in previous ConOps)*** | 4.11.0-4  The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the system server. |
| 6.0-4 | The ASCT shall store results of all signal timing parameter calculations for a minimum of 90 days.  ***(This was increased from 10 days in previous ConOps)*** | 4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.  4.11.0-3  The system operator needs to store and report data that can be used to measure traffic performance under adaptive control. |
| 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 90 days:   * volume * occupancy * queue information * phase utilization * arrivals in green * green band efficiency   ***(This was increased from 10 days in previous ConOps)*** | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.  4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.  4.11.0-3  The system operator needs to store and report data that can be used to measure traffic performance under adaptive control. |
| 6.0-6 | The ASCT system shall archive all data automatically after a user-specified period not less than 90 days.  ***(This was increased from 10 days in previous ConOps)*** | 4.11.0-4  The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the system server. |
| 6.0-7 | The ASCT shall provide data storage for a system size of 25 signal controllers. The data to be stored shall include the following:   * Controller state data * Reports * Log data * Security data * ASCT parameters * Detector status data | 4.11.0-4  The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the system server. |
| 6.0-8 | The ASCT shall calculate and report relative data quality including:   * The extent data is affected by detector faults * Other applicable items | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 6.0-9 | The ASCT shall report comparisons of logged data when requested by the user:   Day to day,   Hour to hour   Hour of day to hour of day   Hour of week to hour of week   day of week to day week  \* Day of year to day of year | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 6.0-10 | The ASCT shall store data logs in a standard database . | 4.11.0-4  The system operator needs to store all operational data and signal timing parameters calculated by the adaptive system, and export selected data to the system server. |
| 6.0-11 | 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. | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 6.0-12 | The ASCT shall store the following data in 15 minute increments:   * volume * occupancy * queue length | 4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.  4.11.0-3  The system operator needs to store and report data that can be used to measure traffic performance under adaptive control. |
| 7 | 7 Advanced Controller Operation |  |
| 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. | 4.9.0-1.0-1   * Service a phase more than once per cycle |
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| 7.0-6.0-4 | The ASCT shall dynamically choose the best phase to serve based on measured traffic conditions in real time. | * Permit different phase sequences under different traffic conditions. |
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| 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. | 4.9.0-1.0-12   * Allow the coordinated phase to terminate early under prescribed traffic conditions |
| 7.0-11 | The ASCT shall not prevent the controller from displaying flashing yellow arrow left turn or right turn. | 4.9.0-1.0-15   * Use flashing yellow arrow to control permissive left turns and right turns. |
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| 7.0-13 | 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. | 4.9.0-1.0-16   * 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.) |
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| 8 | 8 Pedestrians |  |
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| 8.0-2 | When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times during adaptive operations. | 4.6.0-2  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.) |
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| 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:   * 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 | 4.9.0-1.0-13   * Allow flexible timing of non-coordinated phases (such as late start of a phase) while maintaining coordination |
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| 9 | 9 Special Functions |  |
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| 10 | 10 Detection |  |
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| 11 | 11 Railroad and EV Preemption |  |
| 11.0-1 | The ASCT shall maintain adaptive operation at non-preempted intersections during railroad preemption. | 4.13.0-1  The system operator needs to accommodate railroad preemption at the USH 14 & Kennedy Drive and USH 14 & Newville Road intersections. |
| 11.0-2 | The ASCT shall maintain adaptive operation at non-preempted intersections during emergency vehicle preemption. | 4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
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| 11.0-4 | The ASCT shall resume adaptive control of signal controllers when preemptions are released. | 4.13.0-1  The system operator needs to accommodate railroad preemption at the USH 14 & Kennedy Drive and USH 14 & Newville Road intersections.  4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
| 11.0-5 | The ASCT shall execute the following actions at non-preempted signal controllers during railroad preemption:   1. Omit phases 2. Dwell on certain phases 3. Activate blank-out signs 4. Activate fixed-message warning signs | 4.13.0-1  The system operator needs to accommodate railroad preemption at the USH 14 & Kennedy Drive and USH 14 & Newville Road intersections.  4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
| 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.) | 4.13.0-1  The system operator needs to accommodate railroad preemption at the USH 14 & Kennedy Drive and USH 14 & Newville Road intersections.  4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
| 11.0-7 | The ASCT shall release user-specified signal controllers to local control when one signal in a group is preempted. | 4.13.0-1  The system operator needs to accommodate railroad and light rail preemption (explain further)  4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
| 11.0-8 | The ASCT shall not prevent the local signal controller from operating in normally detected limited-service actuated mode during preemption. | 4.13.0-1  The system operator needs to accommodate railroad preemption at the USH 14 & Kennedy Drive and USH 14 & Newville Road intersections.  4.13.0-2  The system operator needs to accommodate emergency vehicle preemption (explain further) |
| 12 | 12 Transit Priority |  |
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| 13 | 13 Failure Events and Fallback |  |
| 13.1 | 13.1 Detector Failure |  |
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| 13.1.0-3 | In the event of a detector failure, the ASCT shall issue an alarm to the STOC | 4.12.0-1  The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.  4.12.0-2  The system operator needs to immediately and automatically pass alarms and alerts to the Statewide Traffic Operations Center (STOC). |
| 13.1.0-4 | In the event of a failure, the ASCT shall log details of the failure in a permanent log. | 4.12.0-3  The system operator needs to maintain a complete log of alarms and failure events. |
| 13.1.0-5 | The permanent failure log shall be searchable, archivable and exportable. | 4.12.0-3  The system operator needs to maintain a complete log of alarms and failure events. |
| 13.2 | 13.2 Communications Failure |  |
| 13.2-1 | *The ASCT shall execute user-specified actions when communications to one or more signal controllers fails within a group.* | 4.14.0-1  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. |
| 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. | 4.14.0-1  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. |
| 13.2-1.0-2 | The ASCT shall switch to the alternate operation in real time without operator intervention. | 4.14.0-1  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. |
| 13.2-2 | In the event of communications failure, the ASCT shall issue an alarm to the Statewide Traffic Operations Center (STOC). | 4.12.0-1  The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.  4.12.0-2  The system operator needs to immediately and automatically pass alarms and alerts to the STOC. |
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| 13.2-4 | In the event of a communications failure, the ASCT shall log details of the failure in a permanent log. | 4.12.0-3  The system operator needs to maintain a complete log of alarms and failure events. |
| 13.2-5 | The permanent failure log shall be searchable, archivable and exportable. | 4.12.0-3  The system operator needs to maintain a complete log of alarms and failure events. |
| 13.3 | 13.3 Adaptive Processor Failure |  |
| 13.3-1 | *The ASCT shall execute user-specified actions when adaptive control fails:* | 4.14.0-1  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. |
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| 13.3-1.0-2 | The ASCT shall release control to local operations to operate under its own time-of-day schedule. | 4.14.0-1  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. |
| 13.3-2 | In the event of adaptive processor failure, the ASCT shall issue an alarm to the STOC. | 4.12.0-1  The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.  4.12.0-2  The system operator needs to immediately and automatically pass alarms and alerts to the STOC. |
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| 14 | 14 Software |  |
| 14.0-1 | The vendor's adaptive software shall be fully operational within the following platform:   * Windows-PC, | 4.15.0-2  The system operator needs to use equipment and software acceptable under current agency IT policies and procedures. |
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| 14.0-3 | The ASCT shall fully satisfy all requirements when connected with EPAC and/or Econolite controllers. | 4.15.0-1.0-1   * Controller type (list acceptable equipment) |
| 14.0-4 | The ASCT shall fully satisfy all requirements when connected with fiber optic, wireless, and/or radio communication systems with Ethernet connections. | 4.15.0-1.0-3   * -Communication system |
| 15 | 15 Training |  |
| 15.0-1 | *The vendor shall provide the following training.* | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-1 | The vendor shall provide training on the operations of the adaptive system. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-2 | The vendor shall provide training on troubleshooting the system. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-3 | The vendor shall provide training on preventive maintenance and repair of equipment. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-4 | The vendor shall provide training on system configuration. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-5 | The vendor shall provide training on administration of the system. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-6 | The vendor shall provide training on system calibration. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-7 | The vendor's training delivery shall include: printed course materials and references, electronic copies of presentations and references. | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
| 15.0-1.0-8 | The vendor's training shall be delivered at a WisDOT Southwest Region Facility | 4.16.0-1  The agency needs all staff involved in operation and maintenance to receive appropriate training. |
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| 16 | 16 Maintenance, Support and Warranty |  |
| 16.0-1 | The STOC shall provide maintenance via a separate maintenance contract managed by the STOC. 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. | 4.16.0-2  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. |
| 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. | 4.16.0-4  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. |
| 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. | 4.16.0-3  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. |
| 17 | 17 Schedule |  |
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| 18 | 18 Performance Measurement, Monitoring and Reporting |  |
| 18.0-1 | The ASCT shall report measures of current traffic conditions on which it bases signal state alterations. | 4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. |
| 18.0-2 | The ASCT shall report all intermediate calculated values that are affected by calibration parameters. | 4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. |
| 18.0-3 | *The ASCT shall maintain a log of all signal state alterations directed by the ASCT.* | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.  4.11.0-2  The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis. |
| 18.0-3.0-1 | The ASCT log shall include all events directed by the external inputs. | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 18.0-3.0-2 | The ASCT log shall include all external output state changes. | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 18.0-3.0-3 | The ASCT log shall include all actual parameter values that are subject to user-specified values. | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 18.0-3.0-4 | The ASCT shall maintain the records in this ASCT log for 90 days.  ***(This was increased from 10 days in the ConOps)*** | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |
| 18.0-3.0-5 | The ASCT shall archive the ASCT log in the following manner:   1. The ASCT log shall be archived before data is deleted from the system. 2. The ASCT log shall be archived every 90 days. 3. The ASCT log shall be in CSV format. 4. All ASCT log entries shall be time stamped with the date and time, accurate to the nearest second. | 4.11.0-7  Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions. |