

Compliance with Functional Requirements Manufacturer List

Advanced Transportation Controller (ATC) _____

Advanced Transportation Controller Cabinet (ATCC) _____

Central Management System (CMS) _____

Signal Performance Measures (if not through CMS) _____

Dual Mode DSRC/C-V2X Connected Vehicle System _____

Adaptive Signal Control Technology / ASCT (Western Avenue) _____

ASCT - Civic Center Drive (if different than Western Avenue) _____

ASCT - Kennedy Memorial Drive (if different than above) _____

ASCT - Outer Main Street (if different than above) _____

Compliance with Functional Requirements Matrix

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
CONNECTED VEHICLE SYSTEM REQUIREMENTS				
Group 1: Manage Interface to SPaT Sources				
Requirements describing the functions of the SPaT Infrastructure System to interface with sources of SPaT data.				
3.1.1.	The SPaT Infrastructure System shall interface with the Traffic Signal Controller.			
3.1.1.1.	The SPaT Infrastructure System shall receive traffic signal data from the Traffic Signal Controller that is compliant with the standard NTCIP 1202 v3.			
3.1.1.2.	In locations where the SPaT Infrastructure System supports signal priority applications, the System shall receive Signal Control and Priority data compliant with the standard NTCIP 1211 v2.			
3.1.1.3.	In locations supporting Connected Vehicle enabled Pedestrian in Signalized Crosswalk Warning and/or Mobile Accessible Pedestrian Signal Systems (PED-SIG) applications, the SPaT Infrastructure System shall send or provide detector calls to the Traffic Signal System Interface compliant with the standard NTCIP 1202 v3.			
3.1.1.4.	In locations where the SPaT Infrastructure System supports Signal Preemption, the SPaT Infrastructure System shall receive preemption status from the Traffic Signal System compliant with the standard NTCIP 1202 v3 as defined in Exhibit A, the applicable Protocol Requirement List.			
3.1.1.5.	In locations where the SPaT Infrastructure System supports Signal Priority or Preemption, the SPaT Infrastructure System shall send or provide priority/preemption requests to the Traffic Signal System.			
3.1.1.6.	The SPaT Infrastructure System shall receive an updated data set from the Traffic Signal Controller on a schedule to be defined by the NTCIP 1202 v3 standard. At a minimum, the entire set of NTCIP objects shall be received each time there is a state change, and may be received as frequently as 10 Hz, regardless of whether there is a state change.			

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3.1.1.7.	In locations where the SPaT Infrastructure System aggregates BSM or PVD data, the SPaT Infrastructure System shall send detection reports to the Traffic Signal System compliant with the standard NTCIP 1202 v3.			
3.1.2.	The SPaT Infrastructure System shall interface with Central Signal Control System (CSCS).			
Group 2: Manage SPaT				
Requirements describing the functions of the SPaT Infrastructure to assemble the SPaT data into standard SPaT messages				
3.2.1.	The SPaT Infrastructure System shall assemble the content needed for standard SPaT messages.			
3.2.1.1.	The SPaT Infrastructure System shall process the message containing SPaT data obtained from the Traffic Signal System and generate a SPaT message.			
3.2.1.2.	The SPaT Infrastructure System shall combine the data received from the SPaT Data Source with additional data to complete the SPaT messages.			
3.2.1.3.	The SPaT Infrastructure System shall synchronize an internal system clock with Coordinated Universal Time (UTC) and be accurate within 10 milliseconds (ms) of UTC at all times.			
3.2.1.4.	The SPaT Infrastructure System shall convert all times obtained from the Traffic Signal Systems to UTC time and be accurate within 10 milliseconds in SPaT messages. The time sync reference shall be provided by the Dual Mode DSRC.			
3.2.1.5.	The SPaT Infrastructure System shall generate SPaT messages each time Traffic Signal System Data is received from the SPaT source.			
3.2.1.6.	The SPaT Infrastructure System shall have a maximum latency of 10 ms in generating SPaT messages from the time the System obtains Traffic Signal System data.			
3.2.1.7.	The SPaT Infrastructure System shall increment the Message Count whenever any data element in the message except the time stamp changes.			

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3.2.1.8.	The SPaT Infrastructure System shall use a point in time – also referred to as time marks (i.e. minutes and seconds of the year) as opposed to countdowns (e.g. “for the next 12 seconds”) to define start and end times.			
3.2.1.9.	Each SPaT message shall contain a current time stamp that is accurate to within 100 ms of UTC time (represented as minute of the year and milliseconds within the minute).			
3.2.1.10.	Each SPaT message shall contain the Intersection Status.			
3.2.1.10.1.	Each SPaT message shall uniquely identify the intersection for which it applies.			
3.2.1.10.2.	Intersection status shall include whether the intersection is operated as fixed time or actuated control.			
3.2.1.10.3.	Intersection status shall include whether the intersection is currently operating in preemption or priority.			
3.2.1.10.4.	Intersection status shall include whether the intersection is operating in failure flash.			
3.2.1.10.5.	Intersection status shall include which revocable lanes are currently enabled (if the MAP message has revocable lanes).			
3.2.1.11.	Each SPaT message shall contain Movement States. The number of Movement States shall correspond to the number of controller traffic and pedestrian phases that are currently in use at the intersection.			
3.2.1.11.1.	The Movement State shall describe the current interval for each movement.			
3.2.1.11.2.	The Movement State shall indicate when the current interval will end for each movement.			
3.2.1.11.3.	The Movement State shall indicate when that movement is estimated to next be green if it is not currently green.			
3.2.1.12.	Each SPaT message shall include a minimum end time defined to be the earliest time mark when the current phase will end (assuming no preemption or priority calls).			
3.2.1.13.	Each SPaT message shall contain a maximum end time defined to be the latest time mark when the current phase will end (assuming no preemption or priority calls).			

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3.2.1.14.	Each SPaT message shall contain a likely end time that is the most likely end time of the current phase.			
3.2.1.15.	When the maximum end time and likely end time are included in the data obtained from the Traffic Signal System, The SPaT Infrastructure System shall include these in the SPaT Message.			
3.2.1.16.	For fixed signal time, The SPaT Infrastructure System shall make the maximum end time equal to the minimum end time when maximum end time is included in the SPaT message.			
3.2.1.17.	Each SPaT message shall contain enabled lane data.			
3.2.1.18.	For locations where the ECO Departure application is implemented, each SPaT message shall include maneuver assist data.			
3.2.2.	The SPaT Infrastructure System shall assemble SPaT messages that conform to the SAE J2735 standard format.			
3.2.2.1.	The SPaT Infrastructure System shall use the SPaT data to create SPaT messages that conform to the SAE J2735 March 2016 standard format.			
3.2.3.	The SPaT Infrastructure System shall assemble SPaT messages that comply with other message formats in addition to SAE J2735.			
Group 3: Manage User Interface				
Requirements describing the functions of the SPaT Infrastructure System User Interface to manage functions of the SPaT Infrastructure System broadcast				
3.3.1.	The SPaT Infrastructure System shall include an interface for users to manage the SPaT Infrastructure System and its data.			
3.3.1.1.	The SPaT Infrastructure System User Interface shall be browser-based and provide access to authorized users for all management, configuration and support functionality as described in Groups 3 and 12.			
3.3.1.1.1.	The SPaT Infrastructure System User Interface shall be accessible via workstations on the agency network.			

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3.3.1.1.2.	The SPaT Infrastructure System User Interface shall be accessible via remote portable devices through the Internet.			
3.3.1.2.	The SPaT Infrastructure System shall comply with the agency's security policy for remote access.			
3.3.2.	The SPaT Infrastructure System User Interface shall include security compliant with agency policy to limit user access.			
3.3.2.1.	The SPaT Infrastructure System User Interface shall only be accessible to authorized users.			
3.3.2.2.	The SPaT Infrastructure System shall have a mechanism for an administrator to configure user roles such that different users are limited to different subsets of functionalities.			
3.3.3.	The SPaT Infrastructure System User Interface shall display information to users.			
3.3.3.1.	The SPaT Infrastructure System shall provide a GIS-based digital map to geographically view the System and manage data.			
3.3.3.2.	The SPaT Infrastructure System User Interface shall display information to users on the operation, configuration and diagnostics of the System.			
3.3.3.3.	The SPaT Infrastructure System User Interface shall provide information to users in text and graphical formats as appropriate.			
3.3.3.4.	The SPaT Infrastructure System User Interface shall notify users of system alerts as defined in Group 12.			
Group 4: Manage Maps Requirements describing the functions of the SPaT Infrastructure to manage MAP data, use the correct MAP data for conditions and assemble standard MAP messages. <i>broadcast</i>				
3.4.1.	The SPaT Infrastructure System shall manage a MAP database.			
3.4.1.1.	The SPaT Infrastructure System shall include a database to store MAP data.			
3.4.1.2.	The SPaT Infrastructure System shall have a mechanism to configure the MAP data to be applied to the intersection associated with the SPaT Infrastructure System.			

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3.4.1.3.	The SPaT Infrastructure System shall store a unique MAP message for each SPaT intersection.			
3.4.2.	The SPaT Infrastructure System shall manage MAP dynamic features.			
3.4.2.1.	At intersections with reversible lanes, or movements restricted during selected periods (e.g. left turn not allowed during peak periods), the MAP messages shall designate these lanes as revocable.			
3.4.2.1.1.	In situations of reversible lanes, MAP messages shall define two lanes in the same location, one an ingress lane, and one an egress lane. Each lane shall be revocable.			
3.4.2.1.2.	In situations of turn restrictions (e.g. not permitting right turn on red or left turn allowed/not allowed), the MAP message shall define two lanes in the same location – one allowing the movement, the other not allowing the movement. Each lane shall be revocable.			
3.4.3.	The SPaT Infrastructure System shall assemble the content for standard MAP messages.			
3.4.3.1.	The Intersection Geometry shall be changed if and only if the map information is updated.			
3.4.3.2.	Each MAP message shall uniquely identify the intersection for which it applies.			
3.4.3.3.	The SPaT Infrastructure System shall increment the MAP message count whenever any data element in the message except the time stamp changes.			
3.4.3.4.	Each Map message shall identify each lane approaching and departing from the intersection and shall provide an intersection unique ID for the lane.			
3.4.3.5.	Each MAP message shall provide the directionality of each lane.			
3.4.3.6.	Each MAP messages shall identify all ingress and egress lanes.			
3.4.3.6.1.	Each ingress and egress lane shall be described by at least two node points that depict the center of the lane.			

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3.4.3.6.2.	Each MAP message shall separately identify each possible connection between ingress and egress lanes and provide an intersection unique ID for the connection.			
3.4.3.6.3.	Each MAP message shall include, for each connection, the lane, maneuver and signal group associated with the connection.			
3.4.3.6.4.	Each ingress and egress lane shall be depicted by enough nodes such that the distance between the actual curved lane center line and the straight line connecting nodes shall not be more than half of the lane width.			
3.4.3.6.5.	When a single connection between an ingress lane and an egress lane is controlled by more than one signal group, such as a protected/permissive left turn movement, the MAP message shall separately identify each signal group that controls the movement on that connection.			
3.4.3.7.	In locations where PED-SIG or Pedestrian Warning applications are deployed, MAP messages shall include crosswalk lane types.			
3.4.3.8.	MAP message shall define ingress lanes from the stop bar to a minimum of 300 meters before the stop bar.			
3.4.3.9.	When connecting to another intersection, each MAP message shall identify the remote intersection to be connected.			
3.4.4.	The SPaT Infrastructure System shall assemble MAP messages that conform to the SAE J2735 standard message format.			
3.4.4.1.	The SPaT Infrastructure System shall assemble the MAP messages that adhere to the SAE J2735 March 2016 standard.			
3.4.5.	The SPaT Infrastructure System shall assemble other standardized MAP messages, as needed.			
Group 5: Manage Position Correction Requirements describing the functions of the SPaT Infrastructure to obtain GPS correction data, configure the source of correction data and assemble standard GPS correction messages.				
3.5.1.	The SPaT Infrastructure System shall obtain position correction data.			

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3.5.1.1.	The SPaT Infrastructure System shall either calculate or obtain GPS position correction data in the RTCM 10403 Message Type 1001 format that corrects for the current atmospheric conditions in the area surrounding the intersection.			
3.5.1.2.	The SPaT Infrastructure System shall either generate or obtain the coordinates of the antenna reference point in the RTCM 10403 Message Type 1005 format.			
3.5.2.	The SPaT Infrastructure System shall assemble standard RTCM correction messages.			
3.5.2.1.	The SPaT Infrastructure System shall assemble standard RTCM correction messages for the following RTCM version 3.0 message types: - Message Type 1001 – GPS L1 observations - Message Type 1005 – Antenna Reference Point coordinates.			
3.5.2.2.	The SPaT Infrastructure System shall generate new RTCM Correction messages with the most current correction data at a minimum frequency of 5 Hz.			
3.5.2.3.	The SPaT Infrastructure System shall assemble RTCM correction messages that conform to the SAE J2735 standard message format.			
3.5.2.4.	The SPaT Infrastructure System shall assemble position correction messages that comply with additional standards, as needed.			
Group 6: Manage SPaT Vehicle System Interface				
Requirements describing the functions of the SPaT Infrastructure to broadcast and receive standard messages to/from SPaT Vehicle Systems.				
3.6.1.	The SPaT Infrastructure System shall broadcast standard 5.9 GHz DSRC messages.			
3.6.1.1.	The SPaT Infrastructure System broadcast of data shall be compliant with the USDOT's RSU Specification "DSRC Roadside Unit (RSU) Specification Document v4.1."			
3.6.1.2.	The SPaT Infrastructure System shall broadcast SPaT, MAP, and RTCM messages using Dedicated Short Range Communications (DSRC) on channel 172.			
3.6.1.3.	The SPaT Infrastructure shall broadcast the SPaT messages with a minimum frequency of 10 Hz.			

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3.6.1.4.	The SPaT Infrastructure system shall broadcast MAP messages with a minimum frequency of 1 Hz.			
3.6.1.5.	The SPaT Infrastructure System shall broadcast RTCM Correction messages containing the most recent RTCM 10403 Message Type 1001 data with a minimum frequency of 5 Hz.			
3.6.1.6.	The SPaT Infrastructure System shall broadcast RTCM Correction messages containing the most recent RTCM 10403 Message Type 1005 data with a minimum frequency of 2 Hz.			
3.6.1.7.	In locations supporting preemption/priority applications, when there are active priority requests, the SPaT Infrastructure System shall broadcast Signal Status Messages (SSM) on Channel 182 with a minimum frequency of 10 Hz.			
3.6.1.8.	The SPaT Infrastructure System shall broadcast messages such that they can be received by DSRC on-board units in each lane approaching the intersection.			
3.6.1.9.	The SPaT Infrastructure System shall broadcast messages such that the data incurs no loss in fidelity to a distance of at least 300 meters upstream of the stop bar for each approaching lane.			
3.6.1.10.	The SPaT Infrastructure System shall sign outgoing broadcast messages with a valid security key.			
3.6.2.	The SPaT Infrastructure System shall validate received messages based on signed certificate associated with the messages.			
3.6.2.1.	In locations where BSM data is collected, the SPaT Infrastructure System shall receive and process all valid DSRC broadcasts of the Basic Safety Message (BSM) received by the DSRC radio on Channel 172 at the SPaT Infrastructure System.			
3.6.2.2.	In locations support signal priority and preemption, the SPaT Infrastructure System shall receive valid DSRC Signal Request Messages (SRM) received by the DSRC radio on Channel 182 at the SPaT Infrastructure System.			
3.6.2.3.	In locations where vehicle data is received, the SPaT Infrastructure System shall receive and process security credentials and digital signatures to be used to validate message received.			

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3.6.2.4.	In locations where probe data is being collected by the SPaT Infrastructure System, the SPaT Infrastructure System shall receive and process valid Probe Vehicle Data (PVD) data broadcast received by the DSRC radio at the SPaT Infrastructure System.			
3.6.2.5.	In locations supporting PED-SIG applications, the SPaT Infrastructure System shall receive valid Personal Safety Message (PSM) data broadcast by the Personal Information Device Systems within range of the SPaT Infrastructure System.			
3.6.3.	The SPaT Infrastructure System shall publish data over alternate communication mediums.			
3.6.4.	The SPaT Infrastructure System shall receive data over alternate communication mediums.			
Group 7: Manage Preemption / Priority Requirements describing the functions of the SPaT Infrastructure to monitor requests for preemption and priority, manage conflicting requests, generate requests from and responses to SPaT Vehicle Systems.				
3.7.1.	The SPaT Infrastructure System shall monitor for signal preemption and priority requests.			
3.7.1.1.	The SPaT Infrastructure System shall process Signal Request Messages (SRM) that adhere to the SAE J2735 March 2016 standard from SPaT Vehicle Systems as soon as they are received.			
3.7.1.2.	The SPaT Infrastructure System shall process preemption/priority request cancellations received from SPaT Vehicle Systems.			
3.7.2.	The SPaT Infrastructure System shall request preemption and priority.			
3.7.2.1.	The SPaT Infrastructure System shall assemble Signal Status Messages in other standard formats with a maximum latency of 10 ms from the time the System receives information from the Traffic Signal System.			
Group 8: Manage Vehicle & PID Data Requirements describing the functions of the SPaT Infrastructure to manage data received from vehicles and PIDs				
3.8.1.	The SPaT Infrastructure System shall monitor BSM, PVD, and PSM.			

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3.8.1.1.	The SPaT Infrastructure System shall receive BSM from vehicles.			
3.8.1.2.	The SPaT Infrastructure System shall receive PVD from vehicles.			
3.8.1.3.	The SPaT Infrastructure System shall receive PSM from Personal Information Devices (PIDs).			
3.8.2.	The SPaT Infrastructure System shall convert BSM and PSM to detector calls.			
3.8.2.1.	In locations where the intent is to convert BSMs to detector calls, the SPaT Infrastructure System shall have defined BSM geographic detection zones that define the geographic area assigned to each signal phase at each intersection detecting BSM.			
3.8.2.2.	In locations where the intent is to convert PSMs into detector calls, the SPaT Infrastructure System shall have defined PSM geographic detection zones that define the geographic area assigned to each signal pedestrian phase at each intersection detecting PSM.			
3.8.2.3.	The SPaT Infrastructure System shall convert the BSM and PSM messages received into detector calls for their corresponding detection zones.			
3.8.2.3.1.	When the SPaT Infrastructure System receives a BSM located within the respective detection zone, the SPaT Infrastructure System shall generate detector calls for the appropriate signal phase.			
3.8.2.3.2.	The SPaT Infrastructure System shall continue to generate detector calls whenever it receives BSM from one or more vehicles in a detection zone for BSM.			
3.8.2.4.	When the SPaT Infrastructure System receives a PSM located within the respective detection zone, the SPaT Infrastructure System shall convert each PSM that is requesting a WALK signal into a pedestrian crossing detector call for the signal pedestrian phase assigned to the PSM detection zone.			
3.8.2.4.1.	The SPaT Infrastructure System shall assemble pedestrian crossing detector calls to include the relevant crosswalk the pedestrian is requesting to access.			

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3.8.2.4.2.	When multiple PSM messages are received from more than one PID for a single WALK, the SPaT Infrastructure System shall generate no more than one detector call for a given phase within each cycle.			
3.8.2.5.	The SPaT Infrastructure System shall prepare actuation reports to be sent to the Traffic Signal System in compliance with NTCIP 1202 v3, at a minimum.			
3.8.3.	In locations where BSM and PVD data is collected, the SPaT Infrastructure System shall aggregate BSM and PVD data.			
Group 9: Manage Traffic Data System Interface Requirements describing the functions of the SPaT Infrastructure System to exchange data with the Traffic Data System.				
3.9.1.	The SPaT Infrastructure System shall exchange data with the Traffic Data System.			
3.9.1.1.	In locations where the Traffic Data System utilizes data from the SPaT Infrastructure System, the SPaT Infrastructure System shall send traffic data messages to the Traffic Data System.			
3.9.1.1.1.	The SPaT Infrastructure System shall exchange aggregated BSM data.			
3.9.1.1.2.	The SPaT Infrastructure System shall exchange aggregated PVD data.			
Group 10: Manage Security Requirements describing the functions of the SPaT Infrastructure to obtain and send security credentials, verify the credentials received and use that information to manage network access.				
3.10.1.	The SPaT Infrastructure System shall obtain valid security credentials.			
3.10.1.1.	The SPaT Infrastructure System shall comply with all security credentials, certification, and processes defined by the National Security Credentials Management System (SCMS), or another credential management system used by the SPaT Infrastructure System.			
3.10.1.1.1.	The SPaT Infrastructure System certification shall include all of the security credentials necessary to support each application.			

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3.10.1.2.	The SPaT Infrastructure System shall have a mechanism for receiving updated security credential certification from the Security Back End System.			
3.10.1.3.	The SPaT Infrastructure System shall store security credential certifications for use in broadcasting messages to SPaT Vehicle Systems for their validation purposes.			
3.10.1.4.	The SPaT Infrastructure System shall request updated security credentials from the Security Back End System a configurable period of time in advance of when the current security credential expires.			
3.10.1.5.	The SPaT Infrastructure System shall receive updates from the Security Back End System regarding revoked security credentials.			
3.10.1.6.	The SPaT Infrastructure System shall store data regarding revoked security credentials.			
3.10.1.6.1.	The SPaT Infrastructure System shall ignore data received from SPaT Vehicle Systems whose security credentials have been revoked.			
3.10.1.6.2.	The SPaT Infrastructure System shall send data to the Security Back End System regarding invalid security credentials received from SPaT Vehicle Systems.			
3.10.2.	The SPaT Infrastructure System shall verify the credentials it receives.			
3.10.2.1.	The SPaT Infrastructure System shall have a mechanism for validating the security credentials received from SPaT Vehicle Systems.			
3.10.2.1.1.	The SPaT Infrastructure System shall check the security credentials of messages that include security credential data received from SPaT Vehicle Systems.			
3.10.2.1.2.	The SPaT Infrastructure System shall validate the security credentials of messages received from SPaT Vehicle Systems with valid credentials.			
3.10.2.1.3.	The SPaT Infrastructure System shall identify as revoked the security credentials of messages received from SPaT Vehicle Systems that match a revoked security credential.			

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3.10.2.1.4.	The SPaT Infrastructure System shall ignore messages received from SPaT Vehicle Systems without a valid security credential.			
3.10.3.	The SPaT Infrastructure System shall apply security credentials to broadcasts.			
3.10.3.1.	The SPaT Infrastructure System shall broadcast valid security credentials in the form of digital certificates signed by a trusted certificate authority for those messages broadcast with security credential information.			
3.10.3.2.	The SPaT Infrastructure System shall sign and validate DSRC messages using the IEEE 1609.2 security standard.			
3.10.4.	The SPaT Infrastructure System shall manage access to the system network.			
3.10.4.1.	The SPaT Infrastructure System shall comply with agency security policy to block malicious attempts, such as Distributed Denial of Service (DDOS) attacks, malware distribution, or other hacking efforts, to infiltrate the agency networks and systems.			
Group 11: Manage Security Back End Interface				
Requirements describing the functions of the SPaT Infrastructure to enable Traffic Engineering staff to configure the security interface				
3.11.1.	The SPaT Infrastructure System to provide a mechanism for users to configure data exchanges.			
3.11.1.1.	The SPaT Infrastructure System shall provide a mechanism for users to configure data exchanges between the SPaT Infrastructure System and the Security Back-End System that are compliant with agency security and network policies.			
3.11.1.2.	The SPaT Infrastructure System shall provide a mechanism for users to configure the Security Back-end System that are compliant with agency security and network policies.			
Group 12: Provide Support				
Requirements describing the functions of the SPaT Infrastructure to provide support to users to monitor status, activity and configure the system.				
3.12.1.	The SPaT Infrastructure System shall have a mechanism for managing logs of system activity.			

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3.12.1.1.	The SPaT Infrastructure System shall log and store records of data obtained by the System, including: <ul style="list-style-type: none"> - Traffic Signal System data. - GPS correction data. - MAP data. - Messages from SPaT Vehicle Systems and PIDs, including BSM, PVD, PSM and SRM. 			
3.12.1.2.	The SPaT Infrastructure System shall log and store the messages assembled by the System, including the content, time of generation and time of broadcast.			
3.12.1.2.1.	The SPaT Infrastructure System shall log and store the SPaT messages assembled by the System.			
3.12.1.2.2.	The SPaT Infrastructure System shall log and store the MAP messages assembled by the System.			
3.12.1.2.3.	The SPaT Infrastructure System shall log and store the RCTM messages assembled by the System.			
3.12.1.2.4.	The SPaT Infrastructure System shall log and store the SSM messages assembled by the System.			
3.12.1.3.	The SPaT Infrastructure System shall log and store the location of origin for all stored data, such as the location/intersection for each message broadcast and received.			
3.12.1.4.	The SPaT Infrastructure shall log and store user-initiated changes in System configuration, including the user, date and time, and configuration change.			
3.12.1.5.	The SPaT Infrastructure System shall log and store system errors and alerts, such as for loss of power, loss of connection to other systems, failure to process data and messages.			
3.12.1.6.	The SPaT Infrastructure System shall log and store user activity, including, at a minimum, the user and time of log in and log out for each session, and the time and location of failed login attempts.			
3.12.1.7.	The SPaT Infrastructure System shall have a mechanism for selecting stored data for deletion and then deleting that data.			

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3.12.1.8.	The SPaT Infrastructure System shall have a mechanism for configuring multiple logs to reflect: <ul style="list-style-type: none"> - log start and end times. - Data types and activities to be included in log. - Locations and/or devices to be included in log. 			
3.12.2.	The SPaT Infrastructure System shall provide a mechanism for users to configure the messages broadcast by the System.			
3.12.2.1.	The SPaT Infrastructure System shall provide a mechanism for users to select the appropriate standardized format(s) for messages to be broadcast.			
3.12.2.2.	The SPaT Infrastructure System shall have a mechanism for users to configure the data elements to include in: <ul style="list-style-type: none"> - SPaT Messages - MAP Messages - RTCM Messages - SSM - PSM 			
3.12.2.3.	The SPaT Infrastructure System shall have a mechanism for users to configure the frequency of broadcast for: <ul style="list-style-type: none"> - SPaT Messages - MAP Messages - RTCM Messages - SSM - PSM 			
3.12.3.	The SPaT Infrastructure System shall have a mechanism for managing MAP data.			
3.12.3.1.	The SPaT Infrastructure System shall have a mechanism for the user to select the format of MAP data to be imported from the SPaT Infrastructure System's usable formats, including: <ul style="list-style-type: none"> - XML - <to be defined> 			
3.12.3.2.	The SPaT Infrastructure System shall have a mechanism for the user to submit MAP data.			
3.12.3.2.1.	The SPaT Infrastructure System shall notify the user of successful MAP data submissions.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
3.12.3.2.2.	The SPaT Infrastructure System shall provide a mechanism for graphically displaying the location and layout of submitted MAP data.			
3.12.3.2.3.	The SPaT Infrastructure System shall notify the user of errors in the structure of the submitted data, such as missing required data in the wrong format, or data outside the range of allowable values.			
3.12.3.3.	The SPaT Infrastructure System shall have a mechanism for the user to create MAP data within the interface.			
3.12.3.3.1.	The SPaT Infrastructure System shall include a "wizard" environment for data entry that describes the type of data expected in each field. For example, the User Interface may inform the user of the number of digits of precision required for latitudes and longitudes.			
3.12.3.3.2.	The SPaT Infrastructure System shall have a mechanism for graphically displaying the location and layout of entered MAP data.			
3.12.3.3.3.	The SPaT Infrastructure System shall allow the user to name, copy, modify and delete MAP data of one or more configurations for each intersection.			
3.12.4.	The SPaT Infrastructure System shall have a mechanism for users to configure GPS correction.			
3.12.4.1.	The SPaT Infrastructure System shall have a mechanism for users to configure the source of GPS position correction data (e.g. define the source, define the polling mechanism and approach).			
3.12.4.2.	In locations where the source of position correction data is a regional or national source of data (e.g. Internet accessible data), the configuration shall include the location of the intersection to enable the acquisition of GPS correction data to obtain the correct values.			
3.12.5.	At locations where messages are received from SPaT Vehicle Systems and PIDS, the SPaT Infrastructure System shall have a mechanism for the user to manage the detection zones defined for receiving data from SPaT Vehicle Systems and PIDs.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
3.12.5.1.	The SPaT Infrastructure System shall have a mechanism for the user to create and modify detection zones and associate the detection zones to received message types and to vehicle and pedestrian movements at each intersection.			
3.12.5.2.	The SPaT Infrastructure System shall have a mechanism for the user to graphically define detection zones within a digital map environment.			
3.12.5.3.	The SPaT Infrastructure System shall have a mechanism to automatically identify when a vehicle or pedestrian movement does not have an associated detection zone and notify the user.			

CMS / ASCT SYSTEM REQUIREMENTS

4.1.	Adaptive Strategies			
4.1.1.	The ASCT system shall alter the timing of signal controllers, when current measured traffic conditions meet user-specified criteria, providing adequate capacity to meet demand.			
4.1.2.	The ASCT system shall alter the timing of signal controllers, when current measured traffic conditions meet user-specified criteria, preventing queues from exceeding the storage capacity between intersections at specified locations.			
4.1.3.	The ASCT system shall alter the timing of signal controllers, when current measured traffic conditions meet user-specified criteria, providing equitable distribution of green times.			
4.1.4.	The ASCT system shall alter the timing of signal controllers, when current measured traffic conditions meet user-specified criteria, providing two-way progression on coordinated route(s).			
4.1.5.	The ASCT system shall alter the state of signal controllers, when current measured traffic conditions meet user-specified criteria, provide for non-coordinated operation (free) at one or more system locations.			
4.1.6.	The ASCT system shall respond in real time when user defined levels of traffic demand are detected by the system.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.1.7.	The ASCT system shall limit the change in consecutive cycle lengths to be less than a user defined value.			
4.1.8.	The ASCT system shall limit the change in phase times between consecutive cycles to be less than a user defined value.			
4.1.9.	The ASCT system shall limit the frequency of change in coordinated phase(s) based on a user defined value.			
4.1.10.	The ASCT system shall support Connected Autonomous Vehicle (CAV) operations.			
4.1.11.	The ASCT system shall operate non-adaptively in accordance with a user-defined time of day schedule to accommodate scheduled special events. During these times, pre-defined traffic coordination patterns will be active providing signal coordination for designated routes to facilitate radial outbound flow from area traffic generators.			
4.1.12.	The ASCT system shall operate non-adaptively when the system operator manually commands the system to cease adaptive operation.			
4.1.13.	The ASCT system shall provide user-settable maximum and minimum phase times. Multiple maximum times shall be available by Time of Day or via manual selection.			
4.1.14.	The ASCT system shall not prevent the signal controller from servicing the next sequential phase when there is vehicle or pedestrian demand for that phase.			
4.1.15.	The ASCT system shall provide a user-defined maximum value for each phase at each controller.			
4.1.16.	The ASCT system shall not provide a phase length longer than a user-defined maximum value.			
4.1.17.	The ASCT system shall not allow a phase length shorter than the minimum allowed from the summation of fixed interval settings (vehicle and pedestrian fixed interval timings).			
4.1.18.	The ASCT system shall provide coordination along user defined routes.			
4.1.19.	The ASCT system shall determine the coordinated route(s) based on traffic conditions.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.1.20.	The ASCT system shall determine the coordinated route(s) based on a user-defined schedule.			
4.1.21.	The ASCT system shall select a stored coordinated route(s) based on a user-defined schedule.			
4.1.22.	The ASCT system shall be capable of implementing a stored coordinated route(s) by operator command.			
4.1.23.	The ASCT system shall support FYA and FRA operation.			
4.1.24.	The ASCT system shall not omit phases containing a valid vehicle or pedestrian call.			
4.1.25.	The ASCT system shall assign unused time from preceding phases that terminate early to a user-specified phase as follows: <ul style="list-style-type: none"> ▪ Next phase ▪ Next coordinated phase ▪ User specified non-coordinated phase 			
4.1.26.	The ASCT system shall be capable of selecting a cycle length range based on a time of day schedule.			
4.1.27.	The ASCT system shall be capable of dynamically calculating a phase length (split) for all phases at each location based on the current coordination strategy and system detector data.			
4.1.28.	The ASCT system shall calculate offsets to suit the current coordination strategy along a coordinated route(s) within the system.			
4.1.29.	The ASCT system shall calculate a cycle length for each cycle based on user-defined optimization objectives and system detector data.			
4.1.30.	The ASCT system shall detect the presence of queues at pre-defined locations.			
4.1.31.	When user-defined levels of change in traffic conditions are detected; the ASCT system shall respond in real time.			
4.1.32.	The ASCT system shall not alter the order of phases at any location. Phases without active detection may be skipped.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.1.33.	When queues are detected at pre-defined locations, the ASCT system shall automatically adjust signal timings at signalized locations in proximity to the queueing condition, execute a user-defined timing plan or user-defined operational mode.			
4.1.34.	The ASCT system shall allow the operator to specify which phase, or phases, receives unused time from a preceding phase.			
4.1.35.	The ASCT system shall allow flexible timing of non-coordinated phases while maintaining coordination.			
4.1.36.	The ASCT shall provide coordination provisions to fully support existing signal sequencing and operations. This includes supporting the number of phases, overlaps, and rings currently in place at all existing project locations.			
4.1.37.	The ASCT system shall allow any phase(s) to be designated as the coordinated phase(s), changeable by time of day or coordination pattern. This feature shall only be in effect during adaptive control.			
4.1.38.	The system shall be capable of supporting new technologies as they become available.			
4.1.39.	The CMS/ATCS system shall have the ability to communicate with traffic signal controllers from different manufacturers.			
4.2. Network Characteristics				
4.2.1.	The CMS system shall be capable of supporting a minimum of 1000 signalized intersections.			
4.2.2.	The Cloud based infrastructure system shall contain the CMS software, the ASCT system control software, and the SPM management software.			
4.2.3.	The CMS/ASCT system shall log user accesses to system controller units including, but not limited to, username, date and time.			
4.2.4.	The CMS/ASCT system shall be capable of being accessed from any web enabled device, including computers, tablets, and smart phones as limited based on security requirements.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.2.5.	The CMS/ASCT system shall be capable of uploading the entire controller database and download user selectable parameters such as controller timing data.			
4.2.6.	The CMS/ASCT system shall be capable of providing a means for labeling traffic controller alarms and displaying the user defined name when the alarm is active.			
4.2.7.	The CMS/ASCT system shall be capable of providing a system-wide map to support common GIS map navigation, ability to incorporate standard ESRI vector/image files and support user selectable levels.			
4.2.8.	The CMS/ASCT system shall be capable of displaying the operational and alarm status of each system controller, system link and/or detector status as well as displaying intersection name, and operational status. It shall also be possible for the system-wide failure status map to be displayed on both user workstations and on a map to be displayed on the existing MaineDOT video wall.			
4.2.9.	The CMS/ ASCT system shall be capable of displaying real time status of system traffic controllers including phase output status, pedestrian status and overlap status.			
4.2.10.	The CMS/ASCT system shall be capable of displaying time space diagrams, in real time, including green band progression and design speed.			
4.2.11.	The CMS/ASCT system shall be capable of supporting system reports and event logging functions. Reports shall be recorded to disk, viewable on workstations or printed as selected by the user.			
4.2.12.	The CMS/ASCT system shall be capable of supporting central scheduler functions including traffic controller/group time operations, device log collection, collection of traffic data, email notifications and reports, date/time broadcast to all controllers and timing parameter audit reports.			
4.2.13.	The CMS/ASCT system shall be capable of providing system security functions including username and password for each user and access level restrictions settable by the system administrator. The CMS/ASCT shall allow for unlimited simultaneous user logins to the system with no impact to ops.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.2.14.	The CMS/ASCT system shall be a full production, fully tested and certified product (certified to be compliant with all standards with which it is required to be compliant), with a minimum of 25 identical production units in continuous operation, running intersections within the United States.			
4.2.15.	The CMS/ASCT system shall be supplied and installed with adaptive control software contained in user programmable configuration database format. Adaptive control software supplied with script only level software will not be accepted.			
4.2.16.	The CMS/ASCT system shall allow the operators to configure groups of intersections that operate in a coordinated manner.			
4.2.17.	The CMS/ASCT system shall provide database upload and download capability to all intersection controller units under its control. The controller shall remain on stop and go during upload/download operations.			
4.2.18.	The CMS/ASCT system shall have a graphical user interface that is consistent with the Windows™ operating system. The system software shall be designed so that additional signalized locations may be added to the map display by agency personnel.			
4.2.19.	The CMS/ASCT system shall provide real time intersection maps for each intersection in the system.			
4.2.20.	The CMS/ASCT system shall be programmed such that all intersection related documentation is loaded into the cloud-based system and available for remote user access. This includes cabinet wiring diagrams, a digital photo of each cabinet and as-built plans for each intersection.			
4.2.21.	The ASCT system shall include a user programmable scheduler that shall allow scheduled operations to take place, including but not limited to controller unit operations and device log retrieval.			
4.2.22.	The ASCT system shall provide multi-level user authentication that prevents unauthorized users from logging on to the cloud-based system software.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.2.23.	The ASCT system shall log all user accesses, including but not limited to username, date, and time.			
4.2.24.	The video detection system portion of the ASCT system shall have the capability of remotely displaying live video streams from all video detection units installed at intersections. The setup of video detection zones shall be available via remote access including from the TMC. The system shall log which user made any changes to the detection zone configurations.			
4.2.25.	The Detection system shall be connected to the Ethernet Switch and/or the FMU in each Controller Cabinet.			
4.2.26.	It shall be possible to view live streaming MPEG-4/H.264 video from proposed video detection cameras at the TMC or any web enabled device from every camera assembly in project.			
4.2.27.	The ASCT system shall be capable of viewing live streaming video from proposed video detection cameras up to the maximum system capacity of 1000 intersections.			
4.2.28.	The ATSC system shall be capable of simultaneous viewing of live streaming video from all proposed video detection cameras.			
4.2.29	Shall be supplied and installed with the ability of being accessed from any web enabled device, including computers, tablets, and smart phones as limited based on security requirements.			

4.3.	Security
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4.3.1.	The Controller Unit shall include configurable security features that limit local and remote access to authorized users only.			
4.3.2.	The ASCT system shall manage/restrict remote access to the system, i.e., any user access from locations other than the MaineDOT TMC, shall be via secure VPN only.			
4.3.3.	The configurable security features shall be changeable by the System Administrator at any time, including complete denial of system access.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.3.4.	The configurable security features shall provide different levels of access to the system and its components for different types of users.			
4.3.5.	The communications system shall be a secured point to point VPN between the intersections and the cloud-based system. All remote connections to the cloud-based system shall require two factor authentications.			
4.3.6.	The ASCT system shall comply with all existing security policies and requirements of MaineDOT.			
4.4.	Pedestrians			
4.4.1.	<p>The CMS/ASCT system shall accommodate the following custom pedestrian features:</p> <ul style="list-style-type: none"> ▪ Exclusive pedestrian operation ▪ Concurrent pedestrian operation ▪ Overlapping phase pedestrian operation ▪ Leading pedestrian interval (LPI) operation ▪ Pedestrian APS systems ▪ Support passive pedestrian detection technology 			
4.5.	Bicycles			
4.5.1.	The CMS/ASCT system shall be provided with the ability to fully support MaineDOT's policies regarding bicycle accommodation at signalized intersections.			
4.6.	Freight and Snowplow Operations			
4.6.1.	The CMS/ASCT shall be provided with the ability to configure local and system level controls to facilitate freight and snowplow movement through the intersections.			
4.7.	Non-Adaptive Situations			
4.7.1.	The CMS/ASCT system shall revert to a central monitoring and control system when the adaptive control portion of the system is no longer operating.			

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4.7.2.	The CMS/ASCT system shall automatically revert to a time-based coordination system under the conditions when ASCT system operation is active.			
4.7.3.	The CMS/ASCT shall be provided with the ability to allow the system operator to manually override adaptive operation control system-wide or on an individual intersection basis, or by user defined intersection groupings.			
4.8.	System Responsiveness			
4.8.1.	The ASCT system shall be provided with the ability for the system operator to adjust the level of responsiveness.			
4.8.2.	The ASCT system shall be provided with the ability to limit the frequency of cycle changes and provide limits for minimum and maximum cycle lengths based on time of day/day of week and seasonal programming.			
4.8.3.	The ASCT system shall monitor traffic conditions in the areas adjacent to the project and adjust signal timings to minimize queueing and congestion. Reports shall be available which track daily AM/PM peak congestion levels by corridor and can automatically generate weekday, weekend and monthly averages for these corridors and ASCT systemwide.			
4.8.4.	The ASCT system shall be programable to provide user selectable strategies to support one or two-way progression, cross arterial coordination, queue management and critical intersection accommodation based on manual override or automatically based on real time traffic conditions.			
4.9.	Complex Coordination and Controller Features			
4.9.1.	The Controller Cabinet supplied under this project shall be an Advanced Transportation Controller Cabinet (ATCC) compliant with ATC 5301 v02.			
4.9.2.	The Controller Unit supplied under this project shall be an Advanced Transportation Controller compliant with ATC 5201 v06.			
4.9.3.	The Controller Unit shall be a full production, fully tested and certified to be compliant with all applicable standards.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.9.4.	The Controller Unit shall be designed to operate in the following environmental conditions: <ul style="list-style-type: none"> -40°C to 74°C operating temperature range -40°C to 85°C storage temperature range 10% to 95% relative humidity (non-condensing) 89 VAC to 135 VAC, 60 Hz 			
4.9.5.	The Controller Unit shall include a Linux-based real-time operating system.			
4.9.6.	The controller unit shall have an expected useful product life of ten years, minimum.			
4.9.7.	The Controller Unit shall have connectors for all external input/output functions that are rigidly defined by the governing national standard.			
4.9.8.	The Controller Unit's connectors for external input/output functions shall be identical in quantity, size, type, configuration, and pinout for all manufacturer's units used in the system.			
4.9.9.	The Controller Unit shall include a minimum of two 10/100 BaseT Ethernet connector that provides system communications functions.			
4.9.10.	The Controller Unit shall take specific user specified actions when it detects the failure of system communications.			
4.9.11.	The Controller Unit software shall meet the functional requirements of the NEMA TS-2, 2016 Standard, including all amendments.			
4.9.12.	The Controller Unit shall support Connected Autonomous Vehicle (CAV) operations.			
4.9.13.	The Controller Unit shall include 2 USB 3.0 ports, at a minimum.			
4.9.14.	The Controller Unit shall contain real-time context sensitive HELP screens.			
4.9.15.	The Controller Unit shall include a time-of-day, day-of-week, week-of-year scheduler.			

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4.9.16.	The Controller Unit shall include dedicated phase detection inputs, pedestrian detection inputs, and system detection inputs.			
4.9.17.	The Controller Unit shall be capable of receiving database downloads and sending database uploads from/to a computer via USB or Ethernet cable.			
4.9.18.	The ATC controller and cabinet shall support Flashing Yellow Arrow (FYA) and Flashing Red Arrow (FRA) operation with the ability to provide a minimum of 6 flashing pairs.			
4.9.19.	It shall be possible to alter the controller unit's internal database using a built-in front panel keyboard, using a computer connected to the controller unit with a USB cable or an Ethernet cable, and remotely using the central management system application. In addition, a remote access system shall be provided using Telnet and/or HTTPS.			
4.9.20.	The Controller Unit shall be configured for controlling the operation of the traffic signals as indicated on the phase sequence and timing charts on the plans.			
4.9.21.	The controller unit shall include an internal database which stores all configurable parameters, including but not limited to phase timings, phase sequencing, overlaps, coordination parameters, preemption and priority parameters, time base parameters, communications parameters, detection parameters, flashing operation, and security parameters.			
4.9.22.	The Controller Cabinet shall be compliant with an existing, approved, national standard.			
4.9.23.	The Controller Cabinet shall be compliant with Advanced Transportation Controller Cabinet (ATCC) 5301 v02.			
4.9.24.	All equipment installed within the Controller cabinet shall be compliant with existing, approved, national standards.			
4.9.25.	All equipment installed within the control cabinet shall be designed to operate in the following environmental conditions: <ul style="list-style-type: none"> -40°C to 74°C operating temperature range -40°C to 85°C storage temperature range 10% to 95% relative humidity (non-condensing) 			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.9.26.	The controller cabinet shall be designed, constructed and installed with all the necessary provisions to comply with the NFPA 70E requirements. The controller cabinet shall include a bypass electric meter trough mounted on the exterior upper right-side wall of the cabinet. The type, model and wiring of the meter trough shall be in full compliance with all relevant MaineDOT and local electric utility requirements.			
4.9.27.	The Controller Cabinet shall include a communications interface device that is compatible with the communications network.			
4.9.28.	All Controller Cabinets shall be electrically bonded and grounded and meet existing MaineDOT, NEC and NESC requirements for cabinet grounding and bonding. The cabinet shall be NFPA-70E compliant.			
4.9.29.	Detection shall consist of IP based video detection equipment at all project intersections, as shown in the Plans.			
4.9.30.	Video detection shall consist of an IP camera assembly and a video detection system that allows for a per camera IP address.			
4.9.31.	The video detection system shall be connected to the in-cabinet high speed communications bus within the Controller Cabinet.			
4.9.32.	Detection data shall be passed to the Controller Unit via the in-cabinet high speed communications bus within the Controller Cabinet.			
4.9.33.	The traffic signal controller shall be supplied and installed to include user defined alarms and alerts.			
4.10.	Monitoring and Control			
4.10.1.	The CMS/ACST system shall be resident on a cloud-based system and configured to allow for secure, remote monitoring and control of the system for operators and staff as designated by MaineDOT.			
4.10.2.	Monitoring and control capabilities of the CMS/ASCT system shall be limited only by virtue of the user privileges assigned to specific users by the System Administrator, not by location (i.e., TMC vs remote) of the users.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.10.3.	The CMS/ASCT system shall be capable of being accessed from any web enabled device, including computers, tablets, and smart phones as limited based on security requirements.			
4.11.	Performance Reporting			
4.11.1.	The controller unit shall be supplied and installed with the ability to collect, store, and report various measures of effectiveness (MOE's).			
4.11.2.	The controller unit shall collect and process all 255 high resolution enumerations as defined in the report "Indiana Traffic Signal Hi Resolution Data Enumerations" July 2019.			
4.11.3.	The CMS/ATCS shall collect high resolution data from each system controller unit and automatically download that data to the server based on a user defined schedule. The amount of data downloaded, and the level of data transmitted shall be user programmable.			
4.11.4.	The CMS/ASCT system shall store and report data used to calculate signal timings and have the data available for subsequent analysis.			
4.11.5.	The CMS/ASCT system shall store and report Automated Traffic Signal Performance Measures (ATSPM) data used to quantify system operation under adaptive control. This data shall be collected on separate cloud-based instance to be supplied as part of the project.			
4.11.6.	The CMS/ASCT system shall store all operational data and signal timing parameters calculated by the adaptive system and export selected data in an agency usable format.			
4.11.7.	The CMS/ASCT system shall report and display signal performance data in real time.			
4.11.8.	The CMS/ASCT system shall have the capability to generate historic and real-time reports that effectively support operations, maintenance and reporting of system performance and traffic conditions. These historic reports shall be available in 15 minute or hourly increments for user selected sensors and be available by the day, week or month.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.12.	Failure Notifications			
4.12.1.	The CMS/ASCT system shall immediately notify maintenance and operations staff of alarms and alerts. Alarms and alerts shall be user programmable by the system operator. User adjustable/programmable audible alarms shall be available to supplement visual displays for critical alarms such as conflict flash.			
4.12.2.	The CMS/ASCT system shall maintain a complete log of all alarms and failure alerts.			
4.12.3.	The CMS/ASCT system shall automatically pass alarms and alerts to the MaineDOT control center.			
4.13.	Preemption and Priority			
4.13.1.	The Controller Unit shall be capable of twelve control inputs. Connections for these inputs shall be provided in the traffic cabinet.			
4.13.2.	The Controller Unit shall be capable of twelve emergency vehicle preemption inputs. Connections for these inputs shall be provided in the traffic cabinet.			
4.13.3.	The Controller Unit shall be capable of railroad preemption.			
4.13.4.	The CMS/ASCT system shall record and provide time/date stamped data on related priority activities including priority requests, cancellations, approvals, etc. This data shall be available to all of the agencies to be able to monitor priority operation and to aid in troubleshooting problems as they occur.			
4.13.5.	The CMS/ASCT system shall be provided with an ATC controller, user-programmable priority operation which will allow the system operator to configure each priority approach with specific control and timing parameters.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.14.	Failure and Fallback			
4.14.1.	The ASCT system shall operate under CMS control when adaptive control equipment required to support system operation fails. If communication to the central system is unavailable, coordinated time base operation shall provide AM peak, PM peak and off-peak timings.			
4.14.2.	The ASCT system shall operate non-adaptively when a user specified system detector(s) fails.			
4.14.3.	The ASCT system shall operate non-adaptively when the number of failed system detectors exceeds a user-defined number.			
4.14.4.	The ASCT system shall operate non-adaptively when a user-defined communications link(s) fails.			
4.14.5.	The controller unit shall include detector failure algorithms that take user defined actions when certain user defined criteria are met.			
4.14.6.	The ASCT system shall have the ability to provide a fall back state that allows for signal coordination to continue in the event of a system level failure such as loss of communications or a malfunction at the central control station.			
4.14.7.	The ASCT system shall have the ability to provide a fall back state that allows for signal coordination to continue in the event of a cabinet level failure such as a defective vehicle/pedestrian detector.			
4.14.8.	Fall back operation will support system wide as well as user defined sub-grouping of coordination based on a common cycle length as well as supporting multiple cycles, splits and offsets suitable for use during AM peak, PM peak and off-peak periods.			
4.14.9.	The CMS/ASCT system shall have the ability to immediately notify designated staff of alarms and alerts. Alarms at MaineDOT's TMC shall include an audible option for selected alarms. The volume and tone type shall be user selectable. A single audible alarm shall be provided for an alarm which re-occurs within a user defined period.			

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4.14.10.	The ASCT system shall maintain adaptive coordination operation in the background at the controlling intersection during an active priority event. This will minimize the time needed for the controller to return to active operation at the conclusion of a priority event.			
4.14.11.	The Controller Unit alarms and alerts shall be user defined.			
4.15.	Constraints			
4.15.1.	All proposed equipment to be supplied under this project must be compliant with ATC standards.			
4.16.	Training and Support			
4.16.1	The manufacturer's representative or distributor shall be located within New England. References shall be supplied which will document the availability and expertise of local support for the traffic signal control equipment to be utilized.			
4.17.	Communications			
4.17.1.	The Communications System shall be compliant with an existing, approved, national standard.			
4.17.2.	The communications system shall be a fiber optic infrastructure and cellular back haul communications network.			
4.17.2.1.	The Communications System shall consist of single mode fiber optic cable of the quantity, type, number of strands, and installation methods as shown in the Plans and Specifications as well as a cellular back haul communications network.			
4.17.2.2.	The Communications System shall include 1 Gbps Managed Layer 2 Ethernet switches in each Controller Cabinet, as shown in the Plans and Specifications.			
4.17.3.	The communications system shall include a secure Internet connection as detailed in the Specifications.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.17.3.1.	The Internet connection shall be made to the cloud-based system via a secure VPN tunnel.			
4.17.3.2,	The Internet connection shall provide secure VPN connectivity to a cloud-based system, to the selected CMS/ASCT vendor's system.			
4.17.4.	The communications system shall support real time streaming video from each project cabinet. It shall provide sufficient bandwidth to transport all IP camera video streams from each project cabinet simultaneously, at 720p resolution, 15 frames per second, H.264 compression.			
4.17.5.	The communications system shall support the ability to monitor the status of all IP addressable devices within the entire system with tools such as network management systems.			
4.17.6.	The communications system shall connect to existing fiber optic cable as shown in the Plans for the connection to the cloud-based system.			
4.17.6.1.	The wireless communications links shall provide the requisite data capacity to meet all required functionality.			
4.17.6.2.	The wireless communications links shall provide TCP/IP communications to the project locations.			
4.18.	Maintenance			
4.18.1.	At any time that operating software updates are released by the Controller Unit manufacturer, whether routine enhancement updates, releases to fix software issues, or a combination of both, it shall be possible for personnel from MaineDOT to update the software in all its controller units without any assistance or supervision from any other agency, firm, or persons. The controller shall log which user installed the updates and provide a "rollback feature to go back to the previous version in the event the update is not compatible with other system elements. The controller cabinet door open function shall be logged by the MaineDOT cloud-based software.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.18.2.	At any time that operating software updates are released by the Controller Unit manufacturer, they shall be made available to MaineDOT immediately upon release to the distributor by the manufacturer, including the release notes of the new firmware.			
4.18.3.	Software updates by the Controller Unit manufacturer shall be made available to the agencies for the operating life of the original Controller Unit product at no additional cost to the agencies, except as expressly identified in the Contract documents.			
4.18.4.	At any time that operating software updates are released by the manufacturer of the traffic signal system control software portion of the cloud-based Software, whether routine enhancement updates, releases to fix software issues, or a combination of both, it shall be possible for personnel from the agencies to update the software on all of its cloud-based systems without any assistance or supervision from any other agency, firm, or persons. The system supplier shall provide phone based technical support to agency personnel installing software updates.			
4.18.5.	At any time that operating software updates are released by the manufacturer of the traffic signal system control software portion of the cloud-based system, they shall be made available to MaineDOT immediately upon release to the distributor by the manufacturer, including the release notes of the new firmware.			
4.18.6.	Software updates by the manufacturer shall be made available to the agencies for the operating life of the original system product at no additional cost to the agencies, except as expressly identified in the Contract documents.			
4.18.7.	The cloud-based system software shall operate under the Windows™ operating system, current version available at the time of installation. In addition, during the support period, the system supplier shall provide updates to the ASCT software to allow continued operation with a new windows version when the current Windows™ version no longer receives support from Microsoft.			

Requirement Number	System Requirement	Existing System Complies with Requirement (Yes/No)	Existing System to be Modified to Comply with Requirement (Yes/No)	Explanation for Non-Compliance or Description of Proposed Modification
4.18.8.	Prior to system acceptance the vendor shall be responsible for all system maintenance.			
4.18.9.	After system acceptance the manufacturer and supplier shall be responsible for all system operations and maintenance for a period of three years.			
4.18.10.	The manufacturer and supplier shall warrant the system to be free of defects for a period of one year, except that some system elements shall have a warranty of greater than one year, as shown in the Special Provisions.			
4.18.11.	If a unit is found to be defective during this warranty period, it will be the responsibility of the manufacturer and/or representative to assume the cost of shipping the unit to and from the factory, supplying parts and making repairs at no cost to the agencies.			
4.18.12.	During this period the vendor shall provide a unit of the same type to make the intersection operational per the traffic signal timing plan.			
4.18.13.	Each piece of equipment shall carry its own individual warranty from the equipment manufacturer and the supplier.			
4.18.14.	Standard practices and standards compliance shall be adhered to as set forth in the contract documents.			
4.18.15.	In the absence of a defining standard or code, all work shall be conducted using the highest standards of care and methodology normally associated with the specific activity.			