The Research Corporation of the University of Hawaii

V2X-Enabled Interconnected Traffic Control System Innovations on the Nimitz Highway and Ala Moana Boulevard Arterial

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ECONOLITE SYSTEMS

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2. Executive Summary

We live in a connected world and technology is converging to reveal new capabilities to more effectively manage our transportation system, improve public safety and include all roadway users in new meaningful ways. Econolite Systems, Inc. (ESI) will partner with the University of Hawaii (UH) and Hawaii Department of Transportation (HDOT) to fully embrace this convergence of technology, explore the possibilities, earn immediate and meaningful operational value, set the stage for future connected deployments and create a platform for academic research.

To accomplish these goals, we have proposed to deploy the following key elements:

UH Econolite Lab – Econolite will work with the College of Engineering to support parallel and related research activities and donate up to $50,000 of in-kind material and equipment to the University to create a UH Econolite Laboratory for the development and productization of mobile connected vehicle applications. The Lab and associated partnership through this project will facilitate independent verification and validation (IV&V) of results through research and analysis.

Centracs Advanced Transportation Management and Priority – We are not aware of any other ATMS application with nearly 300 systems under contract including licenses for over 50,000 intersections. Centracs Priority enhances signal performance, reduces emergency vehicle response time, and improves on time performance for the transit system.

Signal Performance Measures and Edaptive® – Dashboards to present metrics that matter including travel time improvements, environmental impacts, fuel consumption savings and safety improvements. In addition to powerful data analytics, we use the incredibly rich data streams from the advanced controllers to also create new timing plans in the background to dramatically reduce the high cost of expensive traffic studies and re-timing efforts. Of course we do this in real time, as well as allowing the system to dynamically adjust cycles, splits and offsets taking the human out of the loop and allowing the system to intelligently respond to dynamic demand.

Incident Management and Traveler Information – ESI has partnered with Waycare, a data science firm, who is shaping the future of mobility by enabling municipalities to take full control of their roads, harnessing in-vehicle information and municipal traffic data for predictive insights and proactive traffic management optimization. The data and predictive analytics that will be provided by Waycare is so powerful that we have developed several use cases where input from Waycare will be used to proactively modify timings not only for a specific incident (or capacity reducing event), but the surrounding area of impact as well.

Applied Information – Applied Information (AI) will provide 4G LTE connectivity to the field. This connectivity will not only allow for second-by-second command and control of the signalized intersections, but also push connected vehicle data to the cloud to connect drivers, cyclists and pedestrians through their TravelSafely™ mobile application. AI will also provide devices for DSRC communications to the vehicles equipped with an on-board device.

Controllers and Detection – We have proposed the Cobalt Advanced Transportation Controller with the EOS traffic application software and Vision Autoscope video detection system. The Cobalt controller with EOS and Vision detection are the most advanced platforms available on the market.

Cybersecurity – ESI has partnered with Mission Secure, Inc. (MSI), a cyber defense company to apply six points of action and awareness for critical infrastructure security to monitor, detect, inform, collect, correct and manage unauthorized use and cyber-attacks providing an unparalleled level of security for networks.

Moreover, Econolite is a one-stop shop and has extensive experience delivering turn-key solutions to our customers. We not only have deep understanding and knowledge of the hardware and software technologies proposed, but we know how to build it, integrate it, operate it, and maintain it. The solutions proposed, and our approach to partnering with UH and HDOT to create an operational and a research platform, will make this project the most technologically advanced connected system in the country.

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4. Problem Statement

ESI has prepared this proposal to address the very real issues noted in Sections 2.1, 2.2 and 2.3 of the RFP. Succinctly put, the emergence of connected vehicle technology and related advances in transportation technology will change absolutely everything about the way people, goods, and services are delivered across the islands over the next 50 years - similar to the way the creation of the National System changed everything about how business has been conducted over the past 50 years. The State of Hawaii and its partnering agencies and Universities must be prepared for this sea-changing event. Recognizing these trends, the Hawaii Department of Transportation (HDOT) has partnered with University of Hawaii (UH) to conduct a research program along a 5.25 mile stretch of Nimitz Highway and Ala Moana Boulevard, utilizing 36 traffic signals, to perform a study needed to fully evaluate the impacts and value of the technologies identified.

The research corridor is ideal for several reasons:

- It has the length and scope in included signals necessary to generate meaningful results from the research activity.
- The corridor extends through diverse zones, including industrial and retail.
- 36 signals in the corridor enable extensive study of technologies that optimize coordinated signal timing, including data-driven and “priority-driven” optimizations.
- The corridor presents a full array of traffic characteristics, with different demand profiles at various times of the day, as well as days of the week
- The corridor has a meaningful number of multimodal users, including cyclists and pedestrians, particularly at the south end of the corridor.
- The corridor supports transit vehicles in both directions.

Additionally, the research corridor extends to the location of the 2020 Western ITE Annual Conference and is proximate to both HDOT and the UH, providing an impetus and sense of urgency to expedite deployment, gain immediate operational value, and facilitate the research initiatives of the University.

ESI shares this vision and looks forward to bringing our own innovative talents and expertise to the table to deliver operational success, as may be measured through reductions in travel times and fuel consumption, while minimizing the environmental impact of the transportation system, and achieving measurable improvements in safety.

5. Objectives

Five project objectives are defined in Section 2.4 of the RFP. Accordingly, we have developed a comprehensive scope of work in ***Section 6 Project Plans and Tasks*** of this proposal to ensure each objective is accomplished during the project. The objectives are restated below along with the specific proposed Task where the objective will be addressed:

Table 1 - Project Objectives

Objective	Project Tasks
Update and install an innovative control system along the Nimitz Highway and Ala Moana Boulevard with the latest integrated traffic control and management technologies to improve traffic safety and mobility performance for all the travel modes	0, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18
Enable traffic control coordination and optimization as well as control performance measurement along the arterial.	0, 4, 5, 6, 7, 15, 16, 17, 18
Deploy V2X communications and emerging geolocation-based ATIS applications to connect pedestrians, cyclists, and other vulnerable roadway users to improve awareness and safety at intersections.	0, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19
Investigate and evaluate potential transportation improvements and benefits from a multi- faceted and well-integrated traffic management system.	0, 1, 5, 7, 11, 12, 13
Satisfy the FHWA’s SPaT challenge in the State of Hawaii.	0, 9, 10

6. Project Plans and Tasks

This section describes how the project objectives will be achieved through innovative deployment of the functional modules defined in Section 2.5 of the RFP and delivery of the major tasks defined in Section 2.6 to ensure the control system deployed along Nimitz Highway and Ala Moana Boulevard operates successfully. Details are provided in the form of a detailed scope of work including the steps necessary to accomplish the objectives. Table 2 summarizes the correlation to the requirements listed in the RFP.

Table 2 - Project Tasks

	Program Management	Transportation Management System	Servers and Network Infrastructure	Field Network Devices	Route Priority for Transit/Emergency Vehicles	Signal Performance Measures	Adaptive Signal Control	Incident Management	Cybersecurity	Connected Vehicle Infrastructure Deployment	Custom Development for CV Applications	Advanced Transportation Controller	Vehicle Detection Devices	Engineering and Design Services	Installation Services	Operations and Maintenance	Training	Testing	Warranty and Support	Connected and Automated Advisory Services
Task	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Expected Functional Modules																				
Adaptive signal control for traffic control coordination and optimization	✓	✓					✓							✓	✓	✓	✓	✓	✓	
CCTV-based video detection	✓												✓	✓	✓	✓	✓	✓	✓	
Incident management	✓	✓						✓						✓		✓	✓	✓	✓	
Connected vehicle infrastructure deployment	✓		✓	✓						✓				✓	✓	✓	✓	✓	✓	✓
Transit Signal Priority (TSP) and preemption	✓	✓			✓									✓		✓	✓	✓	✓	✓
Signal control performance measurement	✓					✓								✓		✓	✓	✓	✓	
V2X communication and customized connected vehicle applications	✓										✓			✓		✓	✓	✓	✓	✓
Real-time advanced traveler information system	✓							✓			✓			✓		✓	✓	✓	✓	
Control performance and traffic data visualization	✓					✓								✓		✓	✓	✓	✓	
Cybersecurity	✓		✓	✓					✓					✓		✓	✓	✓	✓	✓
Major Tasks and Deliverables																				
Install and Upgrade all the Advanced Transportation Controllers	✓											✓		✓	✓	✓	✓	✓	✓	
Install and Upgrade Traffic Detection Systems	✓												✓	✓	✓	✓	✓	✓	✓	
Arterial Control System Calibration and Coordination	✓	✓												✓		✓				
Initial Field Testing and Control Performance Evaluation	✓													✓		✓				
Initial V2X Applications	✓										✓			✓		✓	✓	✓	✓	✓
Periodic Field Testing and Control Performance Evaluation	✓													✓		✓				
Further V2X Application Testing	✓										✓			✓		✓	✓	✓	✓	✓
Arterial Control System Calibration, Performance Assessment, Re-Calibration, and Re-Assessment	✓	✓												✓		✓				
Functional Module Evaluation and Integration	✓	✓												✓		✓				
Control System Safety Performance Quantification	✓													✓		✓				
Technical Summary Report	✓													✓		✓				
On-going Maintenance Support	✓															✓			✓	

Task 0 – Program Management

Project management is a critical part of the deployment of any technology project, and especially to one of this size, scope, and aggressive timeline. We are therefore proposing the following project management services to ensure that the goals and expectations are understood and met throughout the project.

The project management activities include:

Project Plan

The Project Plan will document the following elements:

1. Project Scope – this document, plus modifications that may be required over the term of the contract.
2. Major Deliverables – also as documented in this proposal and any modifications that may be required over the term of the contract.
3. Risk Assessment – identifies major risk elements and mitigation actions.
4. Resource Requirements – includes team organization and responsibilities of stakeholders.
5. Project Schedule – Gantt chart periodically updated to reflect project progress.
6. Concept of Operations – Impacts to the Systems Engineering Concepts of Operations (ConOps) will be addressed in the Project Plan.

Status Reports

ESI will host weekly informal project meetings to keep the Stakeholders informed of project progress and upcoming activities for the first 12 months of the project. These meetings are structured as 'status only' and are intended to last not more than approximately 15-30 minutes. This time frame ensures regular stakeholder attendance and insists that more in-depth discussion to be taken offline. The agenda for these meetings will form two purposes: 1) to guide the discussion and 2) to function as a Status Report. These meetings will be limited to the following discussion points:

- Work performed in the prior week.
- Work anticipated in the ensuing week.
- Outstanding issues.

Following the first 12 months of the project, we will perform status meetings once per month until the project completion.

Meeting Minutes

As dictated by project exigencies, formal project meetings (e.g. Project Kick-off) will be conducted and actions resulting from these meetings will be documented in Meeting Minutes. However, in our experience, the need and frequency for these types of meetings are mitigated by consistently performing the weekly project status report meetings discussed above.

Procurement Submittals

ESI will compile and provide product submittals for the following items:

- Transportation Management System
- Servers and Network Infrastructure
- Field Network Devices
- Cybersecurity
- Connected Vehicle Infrastructure Deployment
- Advanced Transportation Controllers
- Vehicle Detection Devices

The Stakeholders will review the submittals and return comments within five (5) working days.

Technical Report

ESI will prepare a technical report to summarize project activities and achievements. The technical report will facilitate research activities to be conducted by the University.

Local Project Facilities

ESI will establish a local project office in Honolulu or co-locate with an engineering partner. The local office will provide workspace for project staff as well as warehouse space to receive and inventory shipments and perform local testing as required.

Invoices

Invoices will be submitted by task in accordance with the Method of Payment.

Task 1 – Transportation Management System

ESI will provide the Centracs® Advanced Transportation Management System (ATMS). Centracs is a state-of-the-art ATMS platform that satisfies the immediate project requirements and is a powerful, groundbreaking system that is easy to deploy, easy to learn, and easy to use. The innovative features of Centracs are distinguished from the field of ATMS solutions in five key areas: innovative software technology, smart client architecture, the ability to easily add enhancements and expand the system, an intuitive user interface, and an incredibly rich feature set.

ESI will deploy Centracs licensed, for up to 50-intersections. Additionally, ESI will provide documentation and configuration services as defined in the following sections to meet the needs of the Showcase.

Documentation

The following project documentation shall be drafted soon after notice to proceed to guide the expansion program. The draft will be submitted for review and comment and finalized. The documents will include:

Migration Plan

ESI will prepare a Migration Plan in close coordination with the Stakeholders to describe the tasks, steps, milestones, responsibilities, and resources necessary for the installation of the system software, the upgrade of the system controllers to Econolite Cobalt ATCs with EOS software, network deployment, CCTV system considerations, and migration of the intersections onto the Centracs database.

The plan will also document functionality that may not be available during transition and will be structured so as to minimize any disruption in the street when the controllers are cut over to Centracs. This includes addressing the existing timing plans along the adjacent intersection corridors so that coordination can be maintained with those intersections and the existing QuicNet system.

Training Plan

ESI will prepare a Training Plan for the Centracs system, Cobalt ATCs with EOS software, and the network. The plan will focus on identifying specific knowledge gaps and tailoring the training objectives to fill these areas as well as targeted training on the new modules that will be added in the expansion. The plan will include a syllabus to guide the topics addressed, as well as identify logistical issues such as the appropriate timing for the training, location, number of attendees, IT needs, etc. Formal training will be performed under Task 15.

Test Plan

ESI will develop a Test Plan to focus on ensuring the intersections are integrated and configured to meet the Stakeholder's operational requirements as well as targeted testing modules that may be added. The plan will include detailed procedures and address logistical issues such as the appropriate timing for the testing, location, number of attendees, IT needs, etc. Formal testing will be performed under Task 16.

Configuration Services

ESI will configure all 36 intersections and build off the existing operational timing databases. To facilitate this configuration, the Stakeholders will provide the following information:

1. Geographic coordinates for each intersection, if available, including street names, and intersection number.
2. Current phase diagrams and timing/coordination databases for each intersection.

Following receipt of the above information, ESI will perform the following configuration tasks:

Intersection Graphics and Properties

ESI will develop intersection graphics for all 36 intersections based on a pre-approved template. The input for the graphic development will be the phase diagrams provided by the Stakeholders. It is assumed that GIS aerials or aerial images provided by Microsoft Bing will be made available by the Stakeholders for detailed intersection graphic views.

Intersection properties, including intersection name, main street, cross street, IP address, will also be configured by ESI.

Database Conversion and Bench Testing

The existing controller databases will be manually converted by ESI from their current format to EOS. The end result will be an electronic copy of the database ready to load into each controller. Following the conversions, ESI will install the converted databases on each controller and back it up to the data key. Each location will be bench tested to validate proper operation prior to installing the controller in the field.

Task 2 – Servers and Network Infrastructure

ESI will procure servers and network infrastructure necessary to host Centracs and provide real-time communications from the hosting site to the 36 traffic signals and all additional Showcase elements and connected vehicle devices. The servers may be cloud-based, physical, and/or virtual machines. Some services may be hosted entirely in the cloud, such as the Signal Performance Measures.

Servers, Installation and Configuration

ESI will coordinate with each Stakeholder's respective IT Department(s) to secure rack space to install the servers and assign appropriate IP addresses. Upon delivery, ESI will "rack-and-stack" the servers and reconfigure all software including the operating system, SQL, and Centracs Core. ESI will install Centracs client software on computer workstations provided by the Stakeholders.

The installation process will include the setup of the servers, verification and configuration of the operating system environment, and installation and configuration of the SQL Server database and other third-party COTS software required to establish the operating environment.

Once the operating environment is established, our engineers will install the appropriate components of the Centracs software application on the core and communications servers. We would expect that the existing Centracs installation will only be down for a total of a few hours and the work will be completed after normal operating hours.

All work on, or with the servers, will be closely coordinated with the IT Departments or other responsible parties to complete installation.

Centracs Failover

Servers will be configured for High-Availability for application level failover capabilities of the Centracs Core and Device Manager services. In the event there is a problem or shutdown of the primary Centracs services, a secondary instance will take over, providing significant reduction in down times and loss of data.

Other Network Infrastructure

ESI will work closely with the Stakeholders' IT Departments to leverage as much of the existing IT infrastructure, policies and administrative activities as is reasonable and possible given the short time frame of this project. As necessary, a security appliance to complete VPN tunneling will be procured, staged, configured, deployed and integrated to ensure connectivity from Centracs to the field intersections.

Task 3 – Field Network Devices

ESI will procure, stage, configure, install, and complete integration for the field network devices to complete a secure pipe to the servers defined in Task 2. While we understand there is some physical Layer 1 communication in place including twisted pair and fiber, it is not clear how this infrastructure is installed. As such, to meet this challenge and ensure timely delivery, we will leverage the 4G cell modem capabilities as provided by the AI-500-085 device from Applied Information.

Task 4 – Route Priority for Transit/Emergency Vehicles

Typically, both transit and emergency vehicles receive preferential treatment by enabling localized (intersection-by-intersection) detection. This type of control has historically been accomplished by placing infrastructure in the vehicle (a transmitter) and at the intersection (a receiver) on each approach. Upon receipt of the detection notice, a traffic signal controller will either provide the vehicle priority, as is the case for transit vehicles, or preemption, as is the case for emergency vehicles.
Centracs Priority provides an entirely new and innovative method for delivering intelligent signal control priority. Leveraging NTCIP 1211, Centracs Priority partners with the EOS controller to satisfy the following objectives through center-to-center interfaces:

- Minimize total time in transition due to pre-emption calls.
- Enhance transit on-time performance for vehicles exceeding a certain "behind-schedule" threshold.
- Improve response time for emergency services.

These objectives are accomplished without adding new infrastructure by providing estimated-time-of-arrival (ETA) based inputs and a view of the entire route including downstream intersections. When coupled with the EOS traffic application software, we are able to predict the controller state so that minor adjustments can be made while maintaining coordination and dramatically enhancing intersection performance.

The first phase will identify the AVL/CAD interfaces with the existing transit and emergency system providers and work directly with those entities in cooperation with the Stakeholders representatives. The interfaces will provide vehicle ID, class, speed, heading, direction, and route. This data is used by Centracs to calculate the vehicle's ETA and relay that information to the EOS controller. It is envisioned that the work in this task will leverage the interfaces already developed for the City of Charlotte, North Carolina transit and emergency system provided by Trapeze and TriTech respectively. If these existing systems are not used in Honolulu, we will either develop new interfaces or leverage an onboard vehicle monitoring unit such as provided by the AI-500-060 device from Applied Information.

The second phase will include any necessary software development and/or unit testing to build out any unique or custom aspects of the interfaces with the agencies' transit and emergency systems (or Applied Information). As such, this phase will ensure the required interfaces are enabled and operational.

The third phase will be the Implementation Phase and will consist of the deployment and testing of the operation in real world conditions with the ultimate goal to roll out the technology to all intersections under Centracs control.

Pricing includes a set-aside budget for the transit and emergency system providers to perform work on their side of the interface, or to modify the existing interface. However, should either one (or both) of these agencies not have an AVL system, or the interface is substantially different than what has already been developed by ESI elsewhere, or there is not sufficient time to complete an interface with their AVL/CAD vendors, we will implement the Applied Information, or similar solution.

In this case, transit routes will be obtained from GTFS data sources and emergency routes will be calculated by Centracs based on shortest distance. ESI will request permission to install the AI-500-060 device, or similar, on up to a total of ten transit and/or emergency vehicles.

ESI will prepare a Route Priority Deployment Strategy document outlining the methodology and deployment steps to implement Route Priority on the 36 intersections with the transit and emergency services agencies.

Task 5 – Signal Performance Measures

Centracs SPM is the next-generation Econolite analytics, reporting, and data management platform. This platform is designed based on FHWA's ATSPM approach and Purdue University's defined performance measures using high resolution data to provide a platform for performance-based management for traffic signal operations and maintenance.

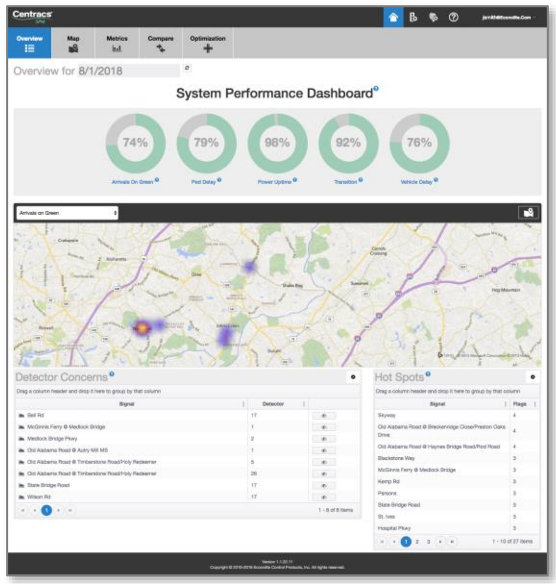

Figure 1 - Centracs SPM

However, what makes Centracs SPM stand out above other similar ATSPM tools is our unique method for optimizing traffic signal timings. As Centracs SPM continuously collects high resolution data, we run a link-pivot analysis to develop timing plans in the background. This means no more expensive retiming studies based on stale anecdotal data collected maybe once every five years. Rather, Centracs SPM provides new timing plans as often as once every week using current data collected at 1/10th-of-a-second intervals. Moreover, Centracs SPM holds itself accountable by providing users three critical pieces of information:

1. How the corridor is currently performing.
2. How the Link-Pivot analysis believes the corridor would perform if the new plan was deployed.
3. How the corridor actually performs once the timing plan is deployed.

Centracs SPM optimizes all signals within a corridor to reduce the number of traffic stops and delays based on the amount of time assigned to a phase (split), when the cycle starts (offset), or the length of the cycle to serve all phases (cycle length). The optimization process uses Purdue University's Link Pivot and GOR/ROR (Green Occupancy Ratio/ Red Occupancy Ratio) to optimize arterial-level parameters, including lead-lag sequencing.

ESI will model each intersection including intersection geometry, lane use, lane width, saturation flow, detection layout, etc. SPM will provide rich analytics with virtually any level of detection, but automatic timing plan development requires stop bar detection on all approaches and, minimally, advanced detection on the coordinated phases.

In parallel with the modeling exercise, ESI will create a subdomain on https://centracstraffic.com for secure use by the Stakeholders. Once the intersections are accurately modeled and data is uploaded to the cloud service, Centracs SPM will be ready for use.

Task 6 – Adaptive Signal Control

Building from the Centracs SPM cloud-based platform, Centracs Edaptive provides highly automated real-time signal adaptation. Target applications include corridors with highly variable traffic patterns, changing weather conditions, special events, high-priority corridors requiring maximum performance, and many other use cases.

The system works by having controllers start off collecting high resolution data. The data is evaluated, and several key calculations are run to determine the optimal values for adapting to changing traffic conditions. Two to three cycles' worth of data is needed for the algorithms to run. The new calculated values are then communicated to the controllers through a proprietary object that facilitates changes to the internal timings of the signal controller. Timing parameters are derived based on research developed by Purdue University through the NCHRP 3-79a and in cooperation with the Econolite engineering team as follows:

- **Cycle:** For cycle length optimization, the algorithm calculates the best cycle length to use that results in the lowest corridor V/C ratio.
- **Splits:** The splits adjustments that are generated in Edaptive are the result of the system using Red Occupancy Ratio (ROR) and Green Occupancy Ratio (GOR) to calculate the best combination of coordinated and side street phase splits.
- **Offsets:** For optimizing offsets, a link pivot algorithm is used. The algorithm works by stepping through possible offsets at each intersection, attempting to find the minimum delay.

Task 7 – Incident Management and Traveler Information

ESI will partner with Waycare, a data analytics firm that has a proven track record of using probe data to identify arterial based incidents far in advance of traditional infrastructure-based solutions. Through this partnership and resulting integration, we will deliver an incident management system with the following core capabilities:

1. **Incident Detection:** Rapid and accurate positive detection of incidents.
2. **Traffic Control Methods:** Traffic control methods that can quickly prepare for and adapt to the redirection of traffic around these incident locations.
3. **Traveler Information:** Roadway user notification of incidents, including suggested alternate routes to improve the dynamic route selection for those users not being navigated by on-board systems.

System Integration

The Centracs and Waycare system interfaces will be architected to exchange data between the Centracs SPM Cloud and Waycare Cloud via a two-way exchange of information as follows:

1. The Centracs system will receive notification of detected incidents from the Waycare system. Waycare will transmit the location of the incident as well as a likelihood/severity index so that the Centracs system can manage an appropriate response.
2. The Centracs system will be enhanced to incorporate the Waycare incident capabilities as native features within Centracs. The following enhanced capabilities will be provided:
    - Status indication of Waycare incident status as a new layer on the Centracs Map.
    - Incident inclusion into the Centracs Alerts/Triggers system for user notification and response plan enaction by the system.
    - Incident response plan selection based upon incident location and severity type.

This architecture allows the most efficient, extensible, and secure means of Center-to-Center (C2C) data exchange.

Use Case

An example, seven-step use case of the proposed solution will help illustrate how the systems will work together assuming an accident on South Nimitz Highway in the Southbound lanes and just north of the intersection at Fort Street.

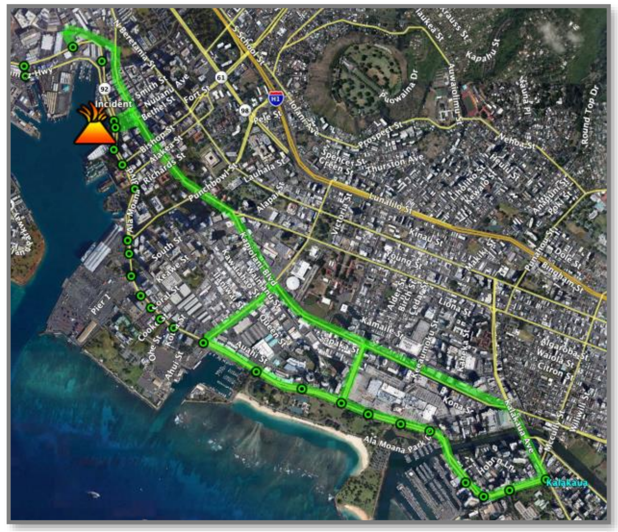

Figure 2 - Incident Management Use Case

1. Waycare will automatically detect this incident and prepare a severity index based on the current traffic flow on Nimitz and will factor in the expected projection of impact of this incident onto the parallel streets (i.e. King, H1, etc.).
2. When the Waycare system suspects an incident, a severity index of Level 1 will be transmitted to the Centracs system.
3. The Centracs system will have been pre-configured to create an alarm and provide notification to the selected operators. The operators would validate the incident. At this severity index, no action plan will be automatically invoked by Centracs. Upon observation or validation, the operator can observe the nature of the incident and automatically escalate the severity index as appropriate.
4. If the severity index increases to a Level 2 (from either Waycare analysis or Operator manual escalation), the Centracs system will jump into action and send out an action plan to the signals that belong to a predefined signal group.
5. The signals in this grouping will have been previously configured by the traffic engineer to be those impacted by an incident in this area. This group includes King Street which will reduce the split times for those turning onto Nimitz and increase split allocation in the NB/SB directions. This group was also set to include the signals on Beretania that will experience diversionary congestion as a result of the accident. Turning movement and side-street split times were programmed to be increased to facilitate alternate routing around the incident. Centracs will invoke an override to the normal time-of-day patterns for these signals and prepare their capacity for the impending re-routing.
6. The Centracs system will have the ability to automatically send alerts to any dynamic signs in the area, notifying drivers of the incident type, location, and suggested alternate routes. Waycare will send alerts to social media outlets including crowd-sourced navigation systems such as Waze.
7. The entire system will operate in this incident-response mode until the incident has been either manually cleared by the operator, a fixed time-out threshold has been fulfilled, or the Waycare system observes restoration of normal traffic flow patterns.

All traffic data and actions are recorded by the Centracs system for offline analysis of the event, enabling the traffic engineering team to modify the response plan based on observed behavior. As referenced in Task 5, Centracs SPM offers a background plan generator that can look at the traffic flows of this diversionary pattern and provide an optimized set of cycle/offset/splits to be applied the next time this diversionary plan is triggered.

Response Plans

Response plans will be developed based on input from an Event/Scenario matrix. An Event will be defined as any issue that triggers a severity index in the Waycare system. A Scenario is then defined as the location of the event and impact it will have on the signal timing. ESI will develop the Event/Scenario matrix and partner with the University to populate appropriate Response Plans by leveraging the learning capabilities of the Background Plan generator in SPM or more manually through a VISSIM modeling exercise. It is anticipated that through their research efforts, the University will create the vast majority of Response Plans using either one of these two methods, particularly as surrounding arterials may be impacted.

Pricing Consideration

Waycare provides an annual subscription-based service. This service is covered for the first year of this contract. The one-year term should be more than adequate for the University to perform necessary analysis and research. Additional years can be added through a change order or separate contract mechanism. Additional one-year terms can be added for approximately $125,000 per year.

Task 8 – Cybersecurity

ESI will furnish, install, and integrate a cybersecurity solution for the ITS/ATMS network. We have partnered with Mission Secure, Inc. (MSi), a cyber defense company that provides an unparalleled level of security for Operational Technologies (OT) networks. The MSi patented platform rigorously applies the US DoD Information Systems Agency (DISA) Security Technical Implementation Guide through six points of action and awareness for critical infrastructure security to monitor, detect, inform, collect, correct, and manage unauthorized use and cyber-attacks. MSi has a fully functional and vetted version of their security offering working with the Econolite Cobalt controllers in Tampa, Florida. This technology will be applied to the 36 intersections in this project and is a combination of platform and in-field devices.

ESI will provide documentation or certification from a third party that it meets cybersecurity requirements such as the Arizona Cyber Warfare Range, US DOD Information Systems Agency (DISA), or comprehensive PEN testers.

Task 9 – Connected Vehicle Infrastructure Deployment

ESI will deploy Connected Vehicle Infrastructure at each intersection and fully satisfy the SPaT Challenge. However, while the SPaT Challenge simply requires infrastructure to be deployed and payload packets evaluated, we propose to take this Task much further, and move the connected vehicle deployment far closer to meaningful operational and consumer value than has been accomplished previously. Specifically, we propose a turn-key solution comprised of hardware, central cloud-based software, and a public facing V2X smartphone application. The solution includes devices provided by Applied Information, the Glance Smart City Supervisory System, and the TravelSafely™ mobile application. Further, the solution supports both DSRC and cellular network communications, creating a far deeper penetration into the vehicle market, extending well beyond ten (10) equipped vehicles with a DSRC on-board unit, to anyone with a smart phone. The proposed deployment architecture is shown in Figure 3.

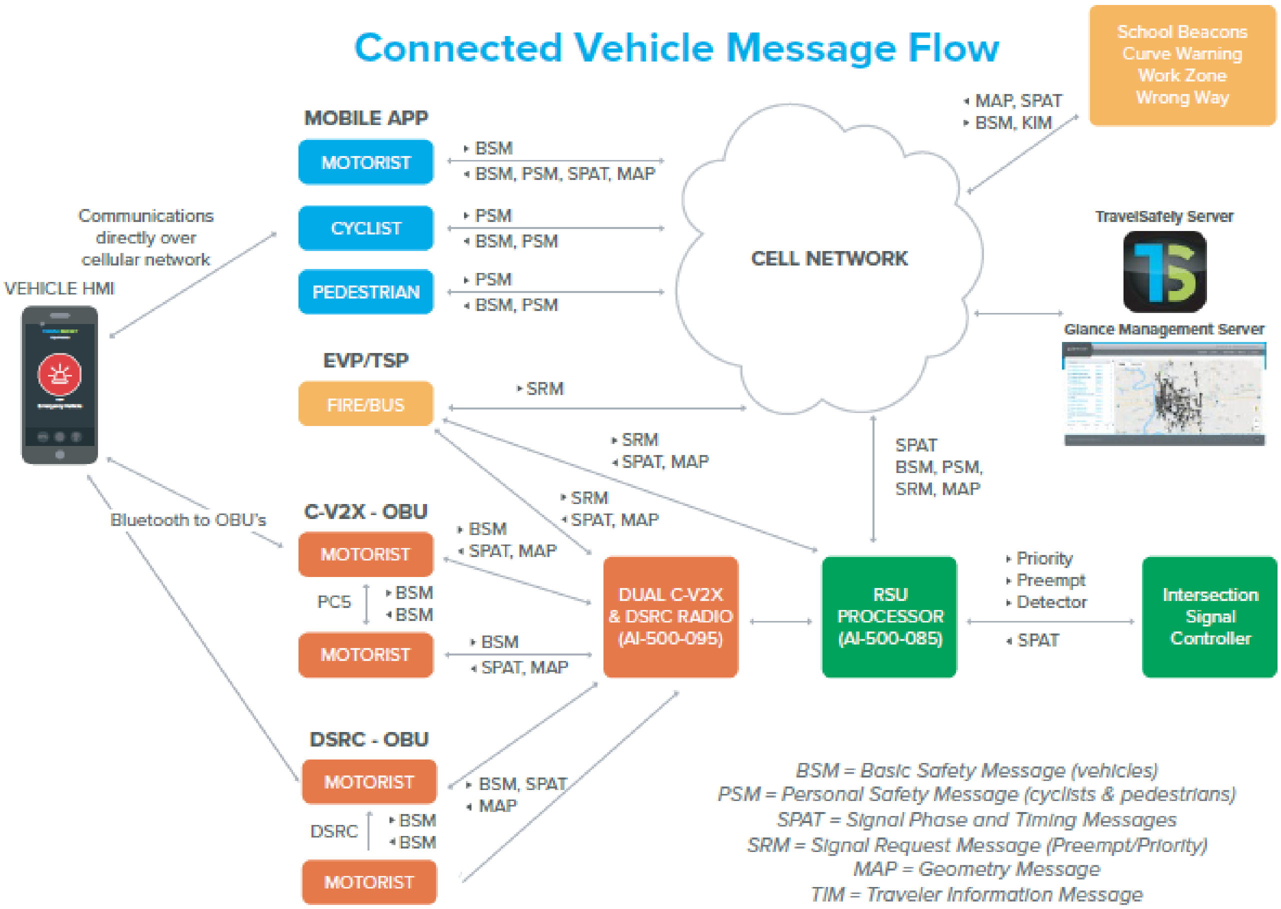

Figure 3 - Proposed CV Architecture

ESI, working with engineers from Applied Information, and their local distributor, Goldwings, will procure, stage, configure, install, and complete integration of the following items:

- **AI-500-095 Dual Mode DSRC & C-V2X System** –This Roadside Unit is equipped with the Qualcomm chipsets for both DSRC and C-V2X communication which assists in meeting the SPaT challenge criteria, while ultimately ensuring that intersections are equipped with both forms of communication.
- **AI-500-085-02 Field Monitoring Unit** – This device is installed in the cabinets to interface with the Cobalt controller to store and broadcast SPaT, BSM, PSM, and MAP data in the SAE J2735 format to ensure operability with all RSUs and OBUs.
- **Glance Smart City Supervisor** – Glance is a browser-based platform to which the above in-field hardware is connected. The platform connects all equipped infrastructure devices into a single application allowing HDOT and UH to monitor and manage all connected equipment, while also providing the University with a valuable tool to which enables them to extract and store pertinent data recorded from the equipped corridor.
- **On Board Units** – Up to ten (10) on-board units will be provided and installed as required by the RFP. These units will interface only with the DSRC side of the AI-500-095 device allowing the UH to assess the viability of cellular versus DSRC communications.

Task 10 –CV Applications

This Task ensure the infrastructure deployed in Task 9 performs a valuable operational function as well as providing commercial value to the motoring public. ESI will provide the TravelSafely™ mobile application developed by Applied Information. TravelSafely is available for free download from the respective application store (Apple or Android), providing a platform for the everyday road user to experience Connected Vehicle technology without the expense of aftermarket OBUs. The following applications will be provided:

- **Red-Light Warning** – As a vehicle approaches an intersection, the speed and GPS location (distance away from the intersection) of the vehicle, and the traffic controller signal timing is communicated to the in-field hardware. If red-light running is anticipated, the smartphone application will broadcast a warning message to alert the driver.
- **SPaT** – As a vehicle approaches a traffic intersection, SPaT information is abstracted from the traffic controller, transmitted via the C-V2X, DSRC and/or the cellular network, and broadcast to smartphones running the V2X app within a geofenced perimeter, providing the driver with timing information related to the current signal state. When a driver is stopped at an intersection, they will receive an audible alert that the traffic signal is about to turn green.
- **Forward Collision Warning** –Vehicles communicate speed, heading, and distance to one another, providing each TravelSafely user critical safety information to avoid collisions.
- **Pedestrian in Signalized Crosswalk** – TravelSafely detects pedestrians at signalized intersections and mid-block crossings (equipped with the Pedestrian Crossing Safety System), and alerts motorists within a geofenced perimeter if pedestrians are actively crossing the street.

In addition to the above applications, the following applications can also be provided.

- Intelligent School Beacons
- Motorist – Cyclist Communication
- Work Zone Warnings
- Curve Warning/Reduce Speed
- Virtual/Advance Traffic Detection

Task 11 – Advanced Transportation Controller (ATC)

ESI will supply an Advanced Transportation Controller (ATC) and the EOS traffic application firmware. The quantity of controllers to be supplied is shown on the pricing sheet. The controllers will be delivered and staged at the ESI facility. The ATC will be tagged as an asset and entered into the Maintenance Management System (MMS) for asset tracking.

Task 12 – Vehicle Detection Devices

ESI will supply the Autoscope Vision video detection devices to complement the detection that is already in place. Based on our assessment of the existing detection, we have estimated 100 new Autoscope Vision cameras will be required. If additional devices are required, a contract change may be necessary. Minimum detection requirements assume stop bar detection on all approaches and advanced detection on the coordinated phases.

Detection equipment will be delivered and staged at the ESI facility. All equipment will be tagged as an asset and entered into MMS for asset tracking.

Task 13 – Engineering and Design Services

To support the overall goals and objectives of the project, ESI will provide the following engineering design services:

- Prepare design documentation sufficient to allow for the efficient installation of the controllers, detection, and connected vehicle devices. The work will include development of base plans as possible, field surveys, and design drawings.
- Provide network support services to ensure the deployed technology and network function seamlessly.
- Perform an analysis of each corridor to assess the appropriate deployment of adaptive technology.
- Perform detection survey for adaptive deployment.
- Provide planning services to assess 'future-proof' opportunities that may guide the design services such that advances in near term technological enhancements in transportation are appropriately addressed.

Design drawings and details will be suitable for ESI installation crews or outsourced contractors to install the necessary equipment. It is assumed that formal plan submittal and reviews through the UH, Hawaii DOT, the County or the City, will not be required, but that ESI will work closely with the Stakeholders to ensure local installation guidelines are maintained and approval to move forward with installations are provided. It is further assumed that permits, Professional Engineering review or sign-off, etc. will not be required.

Task 14 – Installation Services

Installation work performed under this task will be considered a maintenance activity and not new construction. Prior to commencement of the installation work at each intersection, ESI will have performed a thorough Maintenance service at that location to verify intersection operation and identify any deficiencies or issues. Maintenance records will be provided to the Stakeholders, noting all issues detected and the recommended disposition. The dispositions will be annotated as follows:

- ESI repaired the recorded issue (examples may include minor repairs or other previously agreed upon issues that can be accomplished while the technician is onsite), or
- The defective or damaged equipment must be repaired or replaced. In this case, the Stakeholders may choose to self-perform the work, hire the work out to other contractors, or contract directly with ESI for the additional work. This work, as necessary, must be executed in a timely manner so as not to delay the project schedule.

ESI will provide installation services for the items described below:

Controller Installation

This work shall include the installation of new ATC traffic signal controllers in an existing cabinet. Database conversions, controller configuration, and burn-in are included in Task 1 and it is assumed that the controller has been made ready and is approved for installation prior to beginning this work.

This work includes the following tasks:

- Validate the results of the Bench Test performed in Task 1.
- Intersection will be placed into flash when traffic allows.
- Traffic signal controller wiring will be removed from unit that is to be replaced.
- Traffic signal controller that is to be replaced will be removed and returned to the Stakeholders.
- New programmed and tested traffic signal controller will be placed into traffic signal controller cabinet.
- New traffic signal controller will be powered on.
- Intersection will be taken out of flash when traffic allows.
- Intersection and traffic signal controller will be observed to ensure proper operation.

Detection Installation

This work shall include the installation of video or radar detection devices and associated supporting equipment on or within existing traffic signal infrastructure or approved existing street furniture as will be shown on the plans developed in Task 13. This work includes the following tasks:

- It is assumed that existing conduit paths, if required, will be used and no new conduit installed. Existing conduit paths will be investigated to determine proper route from traffic signal cabinet to the new camera location. Please note: if conduits are plugged, full, or damaged, additional work may be required.
- Detection cable will be installed from the traffic signal cabinet to the detector mounting location. Cables will be installed utilizing lubricant to prevent damage to existing wiring.
- Detection devices will be mounted at the locations determined on the plans developed in Task 13. Any holes drilled for mounts or for wire access will be sealed utilizing approved sealant.
- If traffic control is required to mount the detection devices, it will be done according to the latest MUTCD standards utilizing cones, warning signs, and arrow boards. City, State or County forces shall provide lane closures if required.
- Detection wire will be connected to the detectors utilizing manufacturer approved connectors.
- Detection cabinet equipment will be installed in an approved location within the cabinet. Wire will be routed neatly through the cabinet and terminated on the detection panel.
- Detection devices will be aimed, and detection zones developed according to plans developed in Task 13.
- Detection system operation will be observed to ensure proper operation.

Connected Vehicle Installation

Econolite Systems will provide turnkey installation of the Connected Vehicle deployment. Installation tasks are described below.

RSU Installation

This work shall include the installation of radios and associated supporting equipment on or within existing traffic signal infrastructure or approved existing street furniture as will be shown on the design sketches. This work includes the following tasks:

- It is assumed that existing conduit paths, if required, will be used and no new conduit installed. Existing conduit paths will be investigated to determine proper route from traffic signal cabinet to the new DSRC radio location. Please note: if conduits are plugged, full, or damaged, additional work may be required.
- CAT 5 cable will be installed from the traffic signal cabinet to the DSRC radio mounting location. Cables will be installed utilizing lubricant to prevent damage to existing wiring.
- Radios will be mounted at the locations determined on the plan sketches. Any holes drilled for radio mounts or for wire access will be sealed utilizing approved sealant.
- If traffic control is required to mount the DSRC radios it will be done according to the latest MUTCD standards utilizing cones, warning signs, and arrow boards. City, State or County forces shall provide lane closures if required.
- Cabling will be connected to the Radios utilizing manufacturer approved connectors.
- Wire will be routed neatly through the cabinet and terminated at the port injector and existing network switch.
- DSRC Radios will be placed per manufacturer recommendations. One radio is assumed necessary at each intersection and will be mounted on the existing span wire poles.
- DSRC Radios are specified to provide a footprint for a 1-kilometer radius.
- DSRC Radio installations will be observed to ensure proper operation.

OBU installation

This work shall include the installation of up to ten On-Board Units and associated supporting equipment. Vehicles will be selected by the stakeholders from their existing fleet or other employee volunteers. Work will be completed in a neat and finished manner so as to be completely integrated into the vehicle similar to the existing radio or navigation system.

Dashboard equipment, to visualize application interfaces, may be facilitated through a separate interface panel integrated within the vehicle on the dashboard, or through a separate computing interface as may be available at the time of integration (e.g. smart phone, tablet or other device).

Cabinet Installation

To accommodate the project budget, new cabinets and installation is not proposed. ESI will make every effort to work within the available space in the existing cabinets. However, should additional space be required in the existing cabinets, cabinets and installation may be added through change order or a separate contract mechanism.

Task 15 – Operations and Maintenance

Operations

ESI will place a full-time Operations Engineer on-site for six months beginning after New Year's in 2020 and extending through June 2020 to assist the Stakeholders in transitioning the ATMS, controllers, detection communications and Connected Vehicle infrastructure. The Operations Engineer will be assigned to perform the following day-to-day duties:

- Provide formal and ad-hoc training for all project technologies.
- Document potential issues and identify root cause.
- Resolve issues and track to completion.
- Customize and configure Centracs and other technologies to meet operational objectives.
- Provide local testing of new databases and validate operations in the field.
- Perform testing and configuration services for all deployed technologies.
- Provide timing expertise and optimize adaptive settings.

The Operations Engineer will have a broad background in all of the technologies deployed in this project and be capable of immediately resolving most issues. They will work closely with the Econolite quality assurance and testing teams as necessary and participate in the project as a technical expert.

This Task will be for a six-month term with an expected outcome that the knowledge and expertise of the Operations Engineer will be transferred to staff designated by the Stakeholders. To measure the success of this knowledge transfer, the Operations Engineer will develop testing exercises. The designated staff will be asked to take and pass these exercises to provide assurance that staff has been competently and effectively trained. The Operations Engineer will provide monthly progress reports.

Following this initial six-month of on-site operations, we will check-ups every six months to assess the field infrastructure and evaluate performance over the following three years. The check-up will include analysis, re-calibration, and optimization of the traffic control performance. Additionally, we will check the status of the priority and incident management systems as well as the V2X user application modules and consider impacts from changes in driver behavior, travel demand, corridor management, and infrastructure network adaptability.

Maintenance

ESI will provide maintenance support including changeout of upgraded equipment or failures. Issues will be responded to within two hours. Should the issue be found to be unrelated to equipment or material installed as part of this contract, or is otherwise out of warranty, a service charge may be applied at an agreed upon rate plus any materials or equipment charges.

Additionally, ESI will perform routine maintenance for the 36 traffic signal locations for a six-month term following substantial completion of task 14. The work shall include the following activities:

- Display Equipment Inspection
  - Visually inspect signal and pedestrian displays and verify all indications are operational, note condition and alignment of all heads, note any deficiencies.
- Detector Verification
  - Verify proper operation of vehicle detectors, note any faults and reset.
  - Inspect condition of all loops and lead-ins; note sealant failures by street approach, lane and phase.
  - Verify proper operation of pedestrian pushbuttons on all approaches, note failures or other issues.
  - Check push button lamps, audio operation and direction, if applicable.
- Intersection Infrastructure Inspection
  - Check condition of pull-boxes; note size and number of any broken or missing lids, crushed boxes and buried boxes.
  - Perform ground-level visual inspection of metal poles for damage, rust, cracked welds, grounding & foundation damage.
  - Perform ground-level visual inspection of hand hole covers on steel poles; secure if necessary and note if missing.
  - Perform ground-level visual inspection of conduit risers; note any repairs needed.
- Cabinet Inspection
  - Inspect foundation and exterior for damage and vandalism.
  - Check door gaskets, anchor bolts, base extension bolts; reseal base if water is present.
  - Check for signal plans; verify signal heads are per plan; note any discrepancies.
  - Check/test interior cabinet lamps, fan and thermostat; replace any that are not working properly and note replacements.
  - Check physical condition of meter/service disconnect, line filter and surge arrestor.
  - Ensure all load switches and flashers have a tight and secure fit into the socket.
  - Check for and note any burned, pitted, corroded or discolored contacts and terminals.
  - Visually inspect condition of all relays and note if burned or full of ants; replace if necessary.
  - Ensure all terminal connections and harnesses have a tight and secure fit; check for frayed writing and note if any are found.
  - Visually check condition of all loading resistors.
- Cabinet Maintenance
  - Clean and vacuum cabinet; place insect, slug, and rodent control in cabinet, as needed.
  - Replace filter and, if needed, filter frame.
  - Lubricate hinges, lock, and lock cover on cabinet.
  - Remove graffiti, posters, stickers, etc., without damaging the surface of the cabinet.
- Power and Grounding Service
  - Measure and record service voltage.
  - Check ground resistance and bonding connections and conductors; record ground reading.
  - Note if control equipment is plugged into GFI.

- Controller Service
  - Verify date and time on isolated controllers, if any; note and correct any discrepancies.
  - Check operation of display and backlight on controller; note any issues.

- Conflict Monitor Service
  - Replace conflict monitor with a certified unit provided by the County and record conflict monitor identification in notes.

Maintenance records will be provided to the County, noting all issues detected and the recommended disposition. Dispositions will be managed as stated in Task 14.

Task 16 – Training

As set forth in the Project Schedule, and in accordance with the Training Plan developed in Task 1, ESI will deliver training for all project elements. Advanced Training content for Centracs is provided below as an example of the level of detailed training that will be provided. This content will be adjusted to best meet the Stakeholder needs.

- Introduction and Overview
- Windows Security
- Windows Event Logs
- Database Backups
- Software Installation Procedures
- The Centracs Server Suite
- Centracs System Configuration and Troubleshooting

Task 17 – Testing

Initial Acceptance Testing

Once all of the devices referenced herein are brought on-line, or are considered substantially complete, the Initial Acceptance Test can be conducted in accordance with the Test Plan developed in Task 1. Testing will be accomplished for each major component of the project.

If during this phase of testing an item is marked as "failed," ESI and Stakeholder staff will agree to a course of action, which may delay the start of the next phase of testing, the 30-day Trial Period. However, at the discretion of the Stakeholders and ESI with a valid corrective action plan, the 30-Day trial may commence even if one or more items above are marked as failed in order to maintain the project schedule.

30-Day Trial Period

Upon successful completion of the Initial Acceptance Test, the 30-day Trial Period will commence. During the Trial Period, various issues may arise. Typically, many of these are of a minor or trivial nature, which, although they will be addressed, do not constitute a system failure and do not warrant a restart of the Trial Period. A priority mechanism will be presented in the Test Plan to govern how these issues should be managed.

Task 18 – Warranty and Support

ESI will transfer all standard equipment warranties to the Stakeholders at the completion of work. Econolite equipment warranties are noted below:

- Controllers — One-year warranty from date of installation
- Detection Devices — One-year warranty from date of installation

In addition, a one-year warranty on Centracs will begin following successful completion of the 30-Day Trial period. The Centracs warranty covers all defects and bugs in the central system software and entitles the Stakeholders to free software updates. Third party hardware and software warranties will also be transferred to the Stakeholders. Following the Centracs warranty period, we will offer a Software Maintenance Agreement (SMA) that can be purchased on one-year terms.

Task 19 – Connected and Automated Advisory Services

ESI's CAV advisors, CAVita, will provide policy and technical services and support to UH and HDOT as needed.

- CAVita's Principals are international experts in Connected and Automated vehicle policy development including legislative and guidelines, technical standards, communications design and protocols.
- The Principals will dedicate 40 hours and 3 site visits.

7. Products

The following table summarizes all products and deliverables that will be provided for this project. The Scope of Work in ***Section 6*** of our proposal contains additional detail for each product.

Table 3 - Project Products

Task	Product/Deliverable
0. Program Management	Status Report Notes, Meeting Minutes, Procurement Submittals Invoices
1. Transportation Management System	Migration Plan, Training Plan, Test Plan Intersection Graphics and Properties Database Conversions and Bench Testing
2. Servers and Network Infrastructure	Servers, Installation, and Configuration Centracs Failover Other Network Infrastructure (Security Appliance)
3. Field Network Devices	4G Cell Modems
4. Route Priority for Transit/Emergency Vehicles	Route Priority Deployment Strategy document Centracs Priority and interfaces to third-party systems
5. Signal Performance Measures	Centracs SPM
6. Adaptive Signal Control	Centracs Edaptive
7. Incident Management	Waycare Incident Management subscription through the end of 2020 Centracs-Waycare integration and demonstration of Use Case
8. Cybersecurity	MSi Platform Remote monitoring through the end of 2020
9. Connected Vehicle Infrastructure Deployment	36 Roadside Units
10. Custom Development of CV Applications	Connected Vehicle Applications
11. Advanced Transportation Controller	Econolite Cobalt rack mounted controllers with graphic card and EOS pre-loaded.
12. Vehicle Detection Devices	Autoscope Vision video detectors
13. Engineering and Design Services	Installation sketches and details suitable for ESI or a local contractor to install the devices in the field in accordance with local practices
14. Installation Services	Installation of 36 ATC controllers Installation of up to 100 Autoscope Vision video detection devices Installation of 36 Roadside units, antennas and cabinet equipment Installation of ten (10) DSRC Onboard Units
15. Operations and Maintenance	Monthly Operational Progress Reports Maintenance Records
16. Training	Training Material Training Evaluation Forms
17. Testing	Testing Signoffs for each stage of testing
18. Warranty and Support	Warranty Cards
19. Connected and Automated Vehicle Advisory Services	Trip Reports

8. Control System Performance Testing and Benefits

The many project elements to be deployed as part of this effort along the Nimitz Highway will function together to enhance operations throughout the area, providing true and quantifiable benefits of reduced overall travel times, improved safety, and increased operational efficiency. The following areas of innovation are expected to provide directly measureable benefits:

- Signal Performance Measurement and Optimization
- Adaptive Control
- Priority Control
- Connected Vehicle Integration and Preparedness

Centracs SPM/Edaptive

The most immediate and significant benefit to UH and HDOT under this program will occur through the upgraded controller firmware to EOS, along with signal timing optimization offered within Centracs. As revealed in the National Transportation Operations Coalition (NTOC) Report Card, verifying and documenting effectiveness of signal timing can be a monumental and cost-prohibitive task, particularly with transportation agencies short of signal retiming resources. The combination of this real time cycle, offset and split optimization offers HDOT a well-researched optimization strategy, quite unlike other adaptive systems, one that maintains proper signal optimization even during periods of non-recurrent traffic demand.

Centracs Edaptive is the next-generation in adaptive signal control, optimizing cycle, offset, and splits by using high-fidelity 1/10th-second resolution data. Data is the name of the game. Better data yields better results, and with Econolite's Centracs SPM at its foundation, Centracs Edaptive is making timing changes based on the best possible data. Centracs Edaptive is web-based and offers deep analytical capabilities through Centracs SPM, allowing users to quickly and easily ensure maximum performance of their signal control system.

This will ensure all signals are automatically re-optimized and remain running optimized timing patterns. Traditional retiming methods would cost Hawaii approximately $5,000 per signal, totaling $180,000 of traffic engineering services, for what historically would only offer an immediate benefit that degrades over the next 3-7 years. Centracs SPM performs all this optimization automatically and maintains the system in an optimized state indefinitely.

Centracs Route-Based Priority

Econolite has also developed and deployed a comprehensive Route Priority system (Centracs Priority) for Transit and Emergency Vehicles that we are proposing to deploy for HDOT. Not only can this system use a combination of Transit Signal Priority and Preemption to accommodate priority service requests, but new Signal Control Priority Standards are also available.

As reference, Centracs Priority is currently integrated with Miami-Dade County's Clever Transit Management System and Charlotte, North Carolina's Trapeze and TriTech systems, and is actively providing priority to numerous transit routes. As an indication of potential benefits, travel times have been improved from 67 minutes to 50 minutes on Miami's Route 34, revealing the significant improvements that can be made with the Centracs Priority.

Connected Vehicle Infrastructure

As CV-equipped vehicles continue to proliferate among the traveling public fleet, we will be able to begin using this information to make more intelligent decisions for operations. We will also be able to enhance the safety of the corridor by notifying users on roadway conditions as well as pedestrians near intersections. This will have a dramatic effect on the overall safety of the corridor and will continue to provide improvements through improved travel times, reduced delay, and a decrease in emissions.

9. Time Schedule

Our initial review of the schedule is represented in the Work Breakdown Structure presented on the following page. This is an accelerated timeline structured to meet dependencies to get the bulk of the work accomplished by March 31, 2020, in order to allow the University some initial time prior to the Western ITE conference in June to engage in preliminary analysis and research. The schedule is highly dependent on early approval of submittals and material lead times and assumes a Notice to Proceed no later than December 15, 2019.

Several specific milestone dates were identified in Section 2.6 of the RFP. Those milestones and dates are represented in the table below and include the date our preliminary WBS indicates we can deliver them.

Table 4 - Key Project Milestones

Milestone from Section 2.6	Required Delivery	Proposed Delivery
ATC Controllers Installed	March 31, 2020	February 7, 2020
Video Detection Installed	March 31, 2020	June 19, 2020
Traffic Management System Available	June 30, 2020	March 10, 2020
Testing Availability	December 31, 2020	September 14, 2020
Connected Vehicle Deployment	September 30, 2020	July 3, 2020

Our proposed schedule, shown in Figure 4, reflects early delivery of every milestone with the exception of the video detection. The working assumption in this milestone is a single three-man crew. If we double the crews, we can complete on April 6, 2020, but will still be a few days late. The amount of work to complete these installations is substantial and consideration for available resources may be a limiting factor. This milestone will be assessed as a critical path element and every effort will be made to accelerate installation.

Task Name	Duration	Start	Finish	Predecessors
Task 00 - Program Management	1044.938d	12/09/19	12/08/23	
NTP	0	12/15/19	12/15/19	
Project Plan	5d	12/09/19	12/13/19	2FS -5d
Status Reports	1034.938d	12/23/19	12/08/23	
Procurement Submittals	32d	12/09/19	01/21/20	
Technical Report	40d	10/13/23	12/08/23	93FF
Local Project Facilities	10d	12/16/19	12/27/19	2
Task 01 - Transportation Management System	67d	12/09/19	03/10/20	
Documentation	17d	12/16/19	01/07/20	
Configuration Services	35d	12/09/19	01/24/20	
Move Database to Hawaii Servers	5d	01/29/20	02/04/20	123, 134
Bring Online	20d	02/12/20	03/10/20	129, 138, 166
Task 02 - Servers and Network Infrastructure	5d	01/22/20	01/28/20	
Server Installation and Configuration	5d	01/22/20	01/28/20	100
Centracs Failover	5d	01/22/20	01/28/20	132SS
Other Network Infrastrucutre	5d	01/22/20	01/28/20	133SS
Task 03 - Field Network Devices	15d	01/22/20	02/11/20	
Task 04 - Route Priority for Transit/Emergency Vehicles	67d	12/16/19	03/17/20	
Task 05 - Signal Performance Metrics	145d	12/30/19	07/17/20	
Task 06 - Adaptive Signal Control	20d	07/13/20	08/07/20	
Task 07 - Incident Management	50d	12/16/19	02/21/20	
Task 08 - Cybersecurity	20d	01/21/20	02/18/20	
Task 09 - Connected Vehicle Infrastructure Deployment	88d	02/18/20	06/19/20	
Task 10 - CV Applications	10d	06/22/20	07/03/20	
Task 11 - Advanced Transportation Controller (ATC)	5d	01/21/20	01/28/20	
Task 12 - Vehicle Detection Devices	0	01/21/20	01/21/20	
Task 13 - Engineering and Design Services	60d	12/16/19	03/06/20	
Task 14 - Installation Services	108d	01/22/20	06/19/20	
Task 15 - Operations and Maintenance	1031d	01/06/20	12/18/23	
Six Month Initial Operations	131d	01/06/20	07/06/20	2FS +15d
Checkups	785d	12/15/20	12/18/23	
Task 16 - Training	16d	07/27/20	08/17/20	
Task 17 - Testing	26d	08/10/20	09/14/20	
Initial Acceptance Tresting	5d	08/10/20	08/14/20	130, 139, 145, 149, 151, 154, 15
30 Day Burn-In	21d	08/17/20	09/14/20	190
Task 18 - Warranty and Support	859d	09/15/20	12/29/23	191
Task 19 - Connected and Automated Advisory Services	201d	12/16/19	09/21/20	

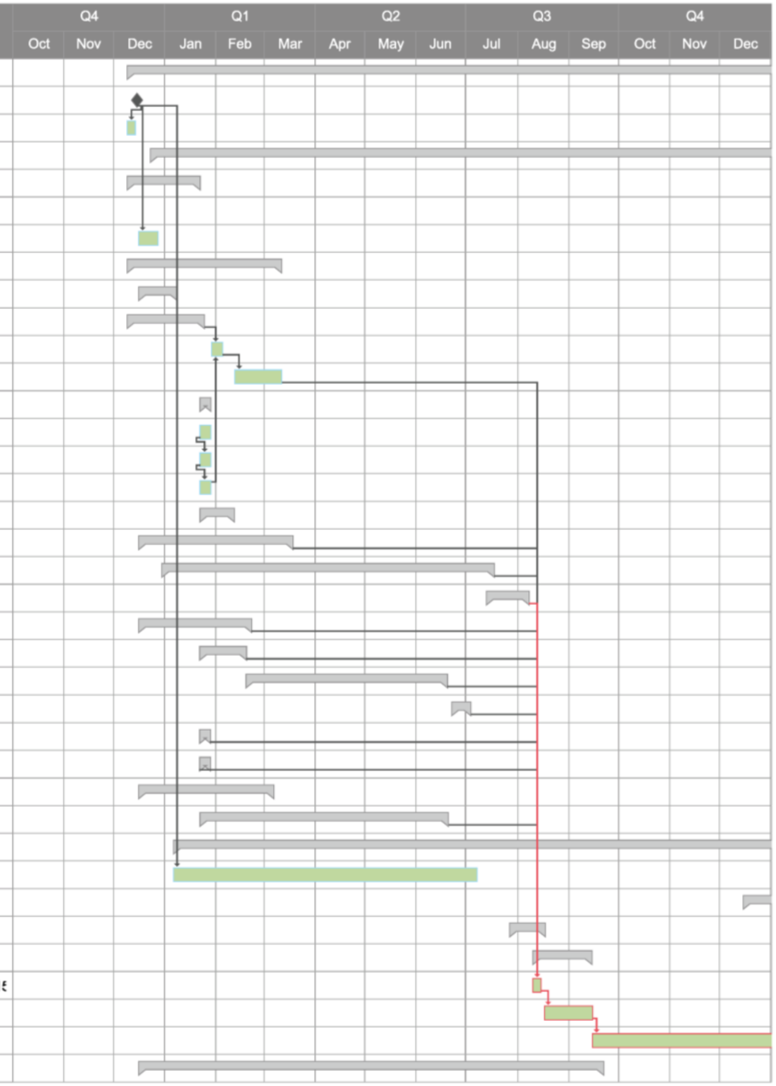

Figure 4 - Project Schedule

10. Staffing and Facilities

Econolite began in 1933, with a single unique product innovation, a stop sign with a flashing beacon that turned off during the daytime, extending bulb life and reducing power consumption. That product shared its name with the company, “ECONOLITE.” Econolite never stopped innovating and is now one of the largest, one-stop-shop providers of traffic control products, technology, systems, and support in the industry.

Today, the Econolite family includes our product group, Econolite Control Products, Inc. and Econolite Canada, our services group, Econolite Systems, Inc. (ESI), and world-class expertise in Connected and Automated Vehicles provided by CAVita. Together, the Econolite family employs approximately 800 people throughout North America. Econolite is headquartered in Anaheim, California, with offices throughout the US and Canada.

We are pleased to include a local partner on our team. ***Wilson Okamoto Company***'s (WOC) traffic and civil engineering design team is comprised of engineers with decades of experience in traffic and transportation analysis and design. WOC's Traffic and Transportation Engineering Group (TTEG) includes personnel with experience in preparation of traffic impact studies, intersection and traffic signal design, transportation master planning, transportation modeling and simulation, signal timing plans and various traffic related studies.

Applied Information (AI) is an industry-leading developer of connected, intelligent transportation systems (ITS) solutions designed to improve safety, reliability, and mobility. Formed in 2011 and based in Atlanta, GA, the AI team is armed with decades of technical and business experience. Creating unique, easy-to-use, and reliable solutions, Applied Information is at the forefront of delivering next generation advances in CV systems.

Goldwings Supply Service, Inc. is a Native Hawaiian 8(a), WOSB, EDWOSB, UDBE and H UBZone certified technical solutions provider with over 30 years industry experience. Started in 1987, their clients include private, commercial,military and government agencies spanning the US & Abroad.

Shah & Associates will support maintenance and warranty service for the the project. Econolite is also in discussion with contractors for installation elements of the project and will be adding a local C-13 or C-15 Licensed Contractor to our team.

Team members' qualifications and estimated project involvement are summarized in Table 5. Biographies of key staff have been included in ***Appendix B*** of our proposal.

Table 5 - Project Staffing

Name, Title & Company	Role on Project	Experience & Qualifications	Estimated Hours
[redacted]	Project Manager Engineer, Design, Documentation Lead	30-years of experience. B.S., Civil Engineering, [redacted]	440
[redacted]	Senior Advisor CAV Advisor	33-years of experience. B.S., Civil Engineering [redacted]	200
[redacted]	Senior Advisor CAV Advisor	20-years'of experience. [redacted]	100
[redacted]	Senior Advisor Procurement	22-years of experience. MBA, [redacted]	100

Name, Title & Company	Role on Project	Experience & Qualifications	Estimated Hours
[redacted]	Engineer, Design, Documentation CAV Advisor	22-years of experience. M.S. Civil Engineering, [redacted]	200
[redacted]	Engineer, Design, Documentation	35-years of experience. [redacted]	100
[redacted]	Engineer, Design, Documentation System Configuration Testing	30-years of experience. B.S. Computer Science and Math[redacted]	160
[redacted]	Engineer, Design, Documentation System Configuration	30-years of experience. IMSA Certified Level I, II, and III Traffic Signal Technician; Journeyman Electrician.	450
[redacted]	System Installation & Configuration Lead Training	27-years of experience[redacted], IMSA Traffic Signal and Fiber Optic Level II.	200
[redacted]	System Configuration	10-years of experience. B.S. Network Administration & Comm, [redacted]	400
[redacted]	System Configuration Testing	10-years of experience. B.S. Civil Engineering, [redacted]	600
[redacted]	Operations, Maintenance, Warranty Lead	5-years of experience. B.S. Mechanical Engineering, [redacted]	1,000
[redacted]	Training	3-years of experience. B.S. Civil Engineering, [redacted]	240
[redacted]	Training	3-years of experience. B.S. Electrical Engineering, [redacted]	240
[redacted]	CAV Advisor Lead	38-years of experience. M.S. Engineering, [redacted]e, B.S. [redacted]	88

Our proposed project team organization is summarized in Figure 5.

[redacted]

Figure 5 - Project Organization Chart

11. Quality Management Plan

Our Quality Management Plan has three main components: quality planning, quality assurance (QA), and quality control (QC).

Figure 6 - Quality Control Process

Quality planning performed early in the project cycle will have a tremendous positive impact on overall cost control through the project's lifecycle. It is an important step that must be made at the onset of a project to be effective. It is essential that all project participants hold a shared vision for the delivery of quality products. Our quality plan provides a framework for quality management for four areas of program implementation:

- Program Activities
- Implementation Plan
- Detailed Design
- System and Field Integration

This Quality Plan provides identification of appropriate quality standards relevant to the project, formal acceptance and determination of means to satisfy them.

The second and third components of our Quality Management Plan are QA and QC. QA is the evaluation of overall performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards. While QC is the monitoring of specific results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

Our Team's Quality Management process (See Figure 6) emphasizes the development and use of the Project Plan, which will also provide an overview, detailed scope, schedule, budgets, personnel assigned to the project, communication guidelines, risks of the project, procurement management, and project closeout. All Econolite Team members will be involved in the Project Plan development as appropriate, which helps keep everyone on the same page.

The Econolite Team will be responsible for the professional quality, technical accuracy and coordination of all design, development, implementation, field integration and other services under this contract, notwithstanding any reviews or inspections by or on behalf of UH. We fully understand the importance of adherence to QA/QC standards. Econolite is ISO 9001:2015 certified, and we are proud of the hard work that our employees have undertaken to obtain and maintain this important and prestigious certification. ISO 9001:2015 is an internationally recognized certification that is achieved when stringent requirements of the International Standards Organization (ISO) for procedures and documentation necessary to assure the highest level of quality and customer satisfaction are achieved.

All project activities and deliverables will be checked for conformance with project requirements and applicable standards to ensure that a quality product is delivered to UH. Our Team's QA/QC process assumes that at least two qualified individuals agree on the correctness of each work product before it is released as a deliverable. This requires specific activities be performed for QC reviews and QA verification on every deliverable as noted:

- Our Project Manager is responsible for QC for the project and will lead the preparation of a Design Quality Management Plan (DQMP) that will expand on this initial Quality Management Plan.

- The DQMP and the QC Plan will identify the Lead Technical Professionals (LTPs) and the Quality Control Reviewers (QCRs), as well as the QC reviews identified as specific tasks within the project schedule.
- Our Project Manager will ensure appropriate communication is completed with the proper members of the Team prior to commencement of work activities, usually through a project kick-off meeting.
- During deliverable production, the QCRs must be independent of the members of the team. The LTPs are responsible for the quality of their individual deliverables.
- At the end of each sub-task, the LTP compiles the documents to be used for the QC reviews and submits them to the Project Manager who distributes them to the QCR associated with the work.
- The QCR performs the review in accordance with the QC procedures outlined in the DQMP and provides the document back to the Project Manager.
- The QC and QA documentation developed will be properly recorded in the files to show that project requirements were met.

The Econolite Team stresses that all employees are responsible for their own work. To assure that the work is accurate, it is done in pairs. One team member checks the other's work and brings any discrepancies to the attention of the other team member and the Project Manager. The Project Manager also checks the project for the purpose of documenting the accuracy and assuring that the intermediate double checks have been performed.

The Econolite Team has assigned two senior staff members to ensure the quality of the project. These people include [redacted]

A signed Statement with each submittal that the documents have undergone a QC review will be submitted. All members of the Econolite Team will be held to the same quality standard and will be adhering to the approved DQMPs.

12. Data Management Plan

Data Management is important aspect of any project undertaken by ESI, as we strive to enhance our systems both from an operations and security perspective. As part of the initial deliverables, ESI plans to prepare a complete Data Management Plan (DMP) which will expand on the elements below.

Roles and responsibilities

The roles of each agency will be key in the overall performance of the project. ESI will be responsible for complete deployment of the overall system as well as operations and maintenance of the deployed devices and systems. For example, Centracs and 2070 controllers will be deployed at each intersection, as well as other elements such as video detection, Roadside Units (connected vehicle technology), and route-based Priority. Hawaii DOT will responsible for its maintenance (contracted to the City & County of Honolulu) after the project's timeline (4 years). UH's role will be to utilize the data for both research and development as well as review of the overall project.

Costs

Cost for the deployment, operations and maintenance, as well as the collection and storage of data from all systems are included in the project. However, should the UH or other project entity desire to store historic data for research and development of other use, the cost will be outside of the project.

Types of data

There are several sources of data as part of this project, they include:

- **Centracs** – Signal information is stored within SQL databases and can be accessed through the incorporated SQL reporting tools, or it can be accessed directly via SQL.
- **Video detection** – the actual count or recognition of vehicles as part of signal operations will be part of Centracs. The actual video stream will be accessible for viewing only. No storage of video is included within this project. However, should one of the agencies wish to store recorded video for research and development or teaching aids that can be done.
- **Centracs SPM/Edaptive** – this is a cloud hosted environment, so no physical servers are on premise. The users will have full access to the reporting tools and capabilities through web interaction.
- **Roadside Units** – this data will be stored outside of Centracs in SQL tables, but as development progresses for use in signal operations, it too will be accessible through Centracs.
- **Applied Information** (AI) – AI is a cloud hosted environment, so no physical servers are on premise. The users will have full access to the reporting tools and capabilities through web interaction.

Standards for Data and Metadata

Econolite staff either interact or sit on each major standards committee associated with the transportations industry, and we are typically one of the first vendors to apply those standards to our products. As an example, following are just a few of the several standards that we incorporate and are actively following:

- NTCIP – The National Transportation Communications for Intelligent System Protocol.
- J2735 – An SAE standard which defines the format and structure of message, data frames, and data exchange between V2V and V2I. (Dedicated Short Range Communications or DSRC).
- ATC – Advanced Transportation Controller Standards to provide an open architecture hardware and software platform.
- NCHRP 03-127 – National Cooperative Highway Research Program – specific to Cybersecurity.

Access, Sharing and Privacy

ESI will furnish, install, and integrate a cybersecurity solution for the ITS/ATMS network. We have partnered with Mission Secure, Inc. (MSi), a cyber defense company that provides an unparalleled level of security for Operational Technologies (OT) networks. The MSi patented platform rigorously applies the US DoD Information Systems Agency (DISA) Security Technical Implementation Guide through six points of action and awareness for critical infrastructure security to monitor, detect, inform, collect, correct, and manage unauthorized use and cyber-attacks. MSi has a fully functional and vetted version of their security offering working with the Econolite Cobalt controllers in Tampa, Florida. This technology will be applied to the 36 intersections in this project.

The ATMS is considered critical infrastructure. Therefore, the ATMS must be able to remain resilient and remain protected from all threats and vulnerabilities. The cybersecurity solution shall contain an overview software system to provide operators situational awareness of the Operational Technologies (OT) network, from the Human Machine Interface (HMI) down to Level 0 through the cybersecurity devices. This acts as an intrusion detection system to provide passive, continuous monitoring of OT network traffic, and an inline cyber protection tool to safeguard field ITS devices.

Policies and Provisions for Reuse and Redistribution

As stated earlier, ESI will work closely with UH to develop a concise plan outlining the policies for data reuse and redistribution. Econolite understands that a corridor of this nature can be a great learning tool for the UH as well as other agencies such as HDOT and the City & County of Honolulu, by allowing the open use of data by the local agencies, if desired.

Data Storage and Preservation

Data storage will be done either on premise for Centracs, or within hosted web services for SPM and Edaptive for 1-year increments. Should the need arise to store longer periods of data that can either be off-loaded to UH servers or ESI can expand its storage capacity. As identified, no video is expected to be stored as part of this contract.

Backups

Typically, Econolite recommends daily backups of the local SQL database and works with the local Agency's IT department to utilize existing local (ex: tape library) or offsite storage contracts to store backups, for example, weekly. The Data Management Plan will identify the available resources and, in coordination with the local Agency, identify the storage retention policies that apply and document a backup and local/offsite storage and recovery plan. This contract provides for local storage sufficient to store 10 to 14 days of regular daily backups.

13. Budget

Our estimated project budget is shown in the budget form included on the following page.

In consideration of the UH's Q&A Response 3, we would like to propose a milestone payment schedule based on the tasks and deliverables identified in our proposed Scope of Work detailed in ***Section 6***. This payment milestone schedule would be designated at contract negotiations to be consistent with UH cashflow considerations.

DETAILED BUDGET ESTIMATE

Federal Fiscal Year 2020

COST CATEGORY	Total	Task 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A. Personnel Costs																					
Employee Salaries and Benefits																					
Position Title(s) and Full-Time/Part-Time Yearly Salary:																					
Director	42,935	-	2,872	419	629	6,665	1,012	-	5,896	839	3,507	1,456	-	-	5,610	839	10,160	1,398	1,631	-	-
Project Manager	44,655	-	6,117	-	-	-	-	-	-	-	-	-	-	-	38,538	-	-	-	-	-	-
Senior Associate	64,932	-	3,495	-	-	27,520	2,545	-	-	-	12,933	-	-	-	14,943	-	-	-	3,495	-	-
Principal	11,797	-	-	-	-	-	-	-	-	-	-	-	-	-	6,554	5,243	-	-	-	-	-
Senior Engineer	63,099	-	-	-	-	-	880	-	-	8,389	11,768	-	-	-	5,243	4,195	32,624	-	-	-	-
Engineer	43,907	-	10,530	1,573	1,573	-	3,360	-	-	-	3,146	-	-	-	2,753	-	-	10,486	10,486	-	-
Senior Technican	19,272	-	1,981	1,783	3,565	-	2,138	-	-	-	8,913	-	-	-	891	-	-	-	-	-	-
Technician	3,525	-	1,165	-	-	-	-	-	-	-	-	-	-	-	2,359	-	-	-	-	-	-
Developmment	87,911	-	-	-	-	-	-	-	70,434	-	-	17,477	-	-	-	-	-	-	-	-	-
Software SQA	14,914	-	-	-	-	-	-	-	12,001	-	-	2,913	-	-	-	-	-	-	-	-	-
CAVita Principal	10,253	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,253
Operations Support Engineer	60,588	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60,588	-	-	-	-
Electrical Apprentice	3,565	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,565	-	-	-	-
Laborer	2,097	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,097	-	-	-	-
Fringe Benefit Rate: _____________%	710,177	-	39,241	5,663	8,651	51,278	- 14,902	-	132,496	13,842	60,402	32,770	-	-	115,338	15,415	163,553	17,827	23,420	-	15,380
Time to be spent on project: 7309 hours																					
Category Sub-Total	1,183,629	-	65,402	9,438	14,419	85,463	24,837	-	220,827	23,070	100,670	54,617	-	-	192,229	25,692	272,589	29,712	39,033	-	25,633
B. Travel Expenses																					
Out-of-State																					
Event/Conference: Project Related Travel																					
Number of Travelers: Various																					
Air Travel: To: Honolulu From: Various	84,414	-	4,751	1,144	2,096	6,235	1,588	-	-	3,812	14,029	6,618	-	-	5,599	1,906	20,753	6,353	6,353	-	3,176
Surface Travel: Shuttle/Taxi Car Rental (daily rate, # of days, fuel, taxes, etc.) Private Car: (__________miles @ __________ per mile)	25,468	-	2,112	-	-	3,429	874	-	-	-	-	-	-	-	2,488	847	9,224	2,824	2,824	-	847
Excess Lodging: __________ nights @ $__________ per night	52,141	-	4,224	-	-	7,482	1,906	-	-	-	-	-	-	-	4,976	1,694	18,447	5,647	5,647	-	2,118
Per Diem: __________ days @ $__________ per day	24,849	-	1,980	-	-	3,991	1,016	-	-	-	-	-	-	-	2,333	794	8,647	2,647	2,647	-	794
Baggage Fee:																					
Tuition, Course, Registration and Miscellaneous Fees: Individual cost: __________ x No. of attendees: ________																					
Category Sub-Total	186,871	-	13,067	1,144	2,096	21,138	5,384	-	-	3,812	14,029	6,618	-	-	15,396	5,241	57,071	17,471	17,471	-	6,935
C. Contractual/Consultant Services																					
Installation Contractor	686,118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	686,118	-	-	-	-	-
Category Sub-Total	686,118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	686,118	-	-	-	-	-
D. Equipment																					
3rd Party Material	1,021,839	-	7,832	45,426	260,786	182,763	7,584	-	109,412	144,412	212,262	-	-	-	-	11,551	39,812	-	-	-	-
Econolite Material (Controllers, Video Detection)	783,898	-	-	-	-	-	-	-	-	-	-	-	113,400	670,498	-	-	-	-	-	-	-
Freight	48,243	-	235	1,363	7,824	4,660	193	-	3,282	4,332	6,368	-	2,668	15,776	-	347	1,194	-	-	-	-
Taxes	81,258	-	352	2,044	11,735	8,224	341	-	4,924	6,499	9,552	-	5,103	30,172	-	520	1,792	-	-	-	-
Category Sub-Total	1,935,238	-	8,420	48,833	280,345	195,648	8,119	-	117,618	155,243	228,182	-	121,171	716,446	-	12,417	42,798	-	-	-	-
E. Other Direct Costs																					
PM - Other/Misc	38,824	-	-	3,529	5,882	-	-	-	-	-	-	-	-	-	17,647	-	11,765	-	-	-	-
Software Licenses	266,407	-	45,000	-	-	172,855	48,552	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Indirect Costs and Project Risk	202,914	-	8,156	3,512	14,782	7,750	2,687	-	26,321	9,567	21,121	5,751	-	-	21,070	35,978	33,691	4,308	5,193	-	3,025
Category Sub-Total	508,144	-	53,156	7,041	20,665	180,605	51,239	-	26,321	9,567	21,121	5,751	-	-	38,717	35,978	45,456	4,308	5,193	-	3,025
GRANT TOTAL	4,500,000	-	140,045	66,455	317,525	482,853	89,579	-	364,766	191,692	364,002	66,986	121,171	716,446	246,343	765,446	417,913	51,490	61,697	-	35,593

Appendix A – Proposal Letter

Appendix A

PROPOSAL LETTER TO THE RESEARCH CORPORATION OF THE UNIVERSITY OF HAWAII

We propose to provide services for the Research Corporation of the University of Hawaii, for the benefit of the College of Engineering of the University of Hawaii.

It is understood that this proposal constitutes an offer.

It is understood and agreed that we have read the Research Corporation of the University of Hawaii's specifications described in the RFP and this proposal is made in accordance with the provisions of such specifications. By signing this proposal, we guarantee and certify all items included in this proposal meet or exceed any and all such specifications, and agree to the terms and conditions in all of the documents described in Section 4.5 of the RFP, including Attachments.

If selected, we agree to deliver goods and services which meet or exceed the specifications.

Respectfully submitted,

Authorized Signature	October 31, 2019 Date
Kirk T. Steudle, P.E. Printed Name	
Senior Vice President Title	
KSteudle@econolite.com Email Address	517-376-1486 Telephone
Econolite Systems, Inc. If contract is awarded, the purchase order/payment should be made to	27-0206675 Federal EIN
Dept LA 24173 Remittance Address	
Pasadena, CA 91185-4713 City, State, Zip Code	

*Attach to this page: Evidence of authority of the above officer to submit an offer on behalf of the company, giving also, the names and addresses of the other officers of the company.

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ECONOLITE

Attachment to Appendix A, Proposal Letter to the Research Corporation of the University of Hawaii

AUTHORITY OF KIRK STEUDLE TO SUBMIT AN OFFER ON BEHALF OF ECONOLITE SYSTEMS, INC.

This is to confirm that in accordance with the Delegation of Authority adopted by the Board of Directors of Econolite Systems, Inc., Mr. Kirk Steudle, Senior Vice President Systems & CAVita, has the authority to submit the offer herein on behalf of Econolite Systems, Inc.

The following is a list of the names and addresses of all of the officers of Econolite Systems, Inc.:

[redacted]

ECONOLITE SYSTEMS

Appendix B – Offeror's Profile

Appendix B

OFFEROR PROFILE
(All items must be provided to be considered)

Company Name Econolite Systems, Inc.
Type of Company Corporation

Address 1250 N. Tustin Avenue
Anaheim, CA 92807

Total # Full Time Employees 136

Phone Number 714-630-3700

Email KSteudle@econolite.com

Federal ID # 27-0206675

Company Start Date 2009

State ID # 3199366

Project Manager / Principal Contact (Attach Bio) [redacted]

Assigned Employees (Attach Bios) Bios for our Project Manager and Task Leads are attached:

[redacted]

(Attach Additional Listings)

Signature [signature]
Date October 31, 2019

Position/Title Senior Vice President

***Attach to this page: Resumes for all project team members.**

Page **17** of **34**

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendix C – References

Name of Firm & Address	**City of Charlotte** 600 East Fourth Street, Charlotte, NC 28202
Contact Name, Position, Telephone and Email	[redacted]
Description and Date of Services Provided	• Date of Services: 2011 - Present ATMS deployment, including controller upgrades to EOS for 750 intersections • Integration of 500 CCTV cameras into Centracs • Deployment of Centracs Priority for TSP and EV Preemption at all 750 intersections.

Name of Firm & Address	**North Carolina DOT Connected Vehicle Deployment Program** 750 N. Greenfield Parkway, Garner, NC 27529
Contact Name, Position, Telephone and Email	[redacted]
Description and Date of Services Provided	• Date of Services: June 2017 - October 2017 • Deployed and integrated connected vehicle technology along 20 intersection corridor that met the requirements of the SPAT challenge. • The goal of this project was thorough assessment of interoperability and vendor technology, setting the stage for all connected vehicle deployments in the State • Provided complete Turn-Key solution including hardware procurement, installation, integration, training, and testing.

Name of Firm & Address	**SMARTCenter Traffic Control System, Transportation Research Center, Inc.** 10820 State Route 347, East Liberty, Ohio 43319-0367
Contact Name, Position, Telephone and Email	[redacted]
Description and Date of Services Provided	• Date of Services: September 2018 – Present • Design/build of private intersection, with custom RSU software and OBU integration. The project will install 8 RSUs and 4 OBUs. • The project also includes sending SPaT messages from controllers to RSUs to test reaction of CV to conflicting messages. • This project introduces the use of DSRC and V2X infrastructures to TRC's large testing environment along with a high-speed intersection.

Name of Firm & Address	**Harris County, Texas** 1001 Preston, 7th Floor, Houston, TX 77002
Contact Name, Position, Telephone and Email	[redacted]
Description and Date of Services Provided	• Date of Services: July 2016 – Present • Centracs ATMS deployment at 900 intersections, includes MMS module. • Centracs SPM deployment at 600 intersections running EOS controller software. • Centracs Edaptive deployment at 300 intersections.