University of Washington Subarea

Multimodal Integrated Corridor Mobility for All (MICMA)

VOLUME 1
TECHNICAL APPLICATION

Grant Application:

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative

NOFO 693JJ317NF0001

MAY 22, 2020 REVISION
AMENDMENT 1

Jenny Durkan, Mayor

Sam Zimbabwe, Director,
Seattle Department of Transportation

Seattle Department of Transportation

Project Name	Multimodal Integrated Corridor Mobility For All
Eligible Entity Applying to Receive Federal Funding	City of Seattle Department of Transportation
Total Project Cost (From All Sources)	$13,637,050
ATCMTD Request	$4,091,000
Are matching funds restricted to a specific component? If so, which one?	Cash matches from SDOT are not restricted. Cash match from WSDOT applies to work with the SR 520 Montlake project area. Software matches from private sector partners are restricted to their associated components as follows: • ***Siemens*** soft match is restricted to adaptive control support, software development, controller firmware development, and SiBike cyclist detection app. • ***Sensys*** soft match is restricted to GiveMeGreen cyclist X-to-I system and hardware. • ***IDAX*** soft match is restricted to MaaS services.
State in which the project is located	Washington
Is the project currently programmed in the: • Transportation Improvement Program (TIP) • Statewide Transportation Improvement Program (STIP) • MPO Long Range Transportation Plan • State Long Range Transportation Plan	The project and the WSDOT SR 520 (match) project are programmed in the: • TIP: Puget Sound Regional Council 2019-2022 TIP • WSDOT 2020-2023 STIP • MPO Long Range Plan: PSRC Transportation 2040 Long Range Plan • State Long Range Transportation Plan: Washington Transportation Plan 2035
Technologies Proposed to be deployed (briefly list)	• Traffic Signal system upgrades, detection, communications network, adaptive control, CCTV • Analytics platform for Advanced Traffic Signal Performance Measures (ATSPMs) • Passive pedestrian detection and pedestrian demand-based traffic signal timing • Cyclist detection (X-to-I) via mobile application (app), and traffic signal response • Green Wave via center-to-center system integration for emergency vehicles • Integrated Corridor Management solutions for freeway incidents including associated arterial DMS • Mobility-as-a- Service (MaaS) data standards development and API

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2 PROJECT DESCRIPTION

The following provides a description of the multimodal Integrated Corridor Mobility for All (MICMA) project, proposed for deployment in the University of Washington (UW) subarea of Seattle.

2.1 Introduction

The MIMCA project will create an urban arterial operations environment that is responsive to all modes, and all traveler, at all times.

The Challenge

The UW subarea is show in Figure 2 (page 8), and is characterized by:

- High pedestrian and cyclist volumes, and higher than average crash occurrence.
- Traffic and pedestrian surges due to University operations and events at the many venues at the UW, including the 72,500-person capacity Husky Stadium
- Traffic disruptions due to moveable bridge operations, and incidents on freeways that bound the west and south of the subarea.
- Pedestrian surges at rail stations.
- The presence of major employment, education, and health centers, with disadvantaged and disabled persons needing access.
- Two emergency rooms (ER), and increasing emergency medical responder travel time

The Texas Transportation Institute (TTI) ranks Seattle, in 2017, as the 5th worst in the US based on TTI;s travel time index. The cost of congestion is more than $1500 per commuter, with Seattle ranking 9th in the US.

The US Census in 2019 indicates that Seattle is ranked as #4 in population growth for large cities. The UW subarea reflects this growth with increased traffic for all modes, increased risks and conflicts and increased congestion. An array of mode choices has been introduced in the UW subarea, but there remains a need to better integrate and manage them - and this issue is not unique to Seattle.

MICMA – The Solution

The MICMA project will leverage and enhance Intelligent Transportation System (ITS) and Mobility-as-a-Service (MaaS) platforms to create a multimodal operations environment that responds to all users. As shown in Figure1, MICMA provide systems that:

- Allow traffic signals to respond, in real-time, to pedestrian volume demand.
- Allow traffic signals to respond, in real-time, to cyclists.
- Allow traffic signals to respond, in real-time, to fluctuations in traffic volumes.
- Improve emergency vehicle travel time to the two ERs in the subarea by implementing a Green Wave approach – setting signals to green downstream to clear traffic on the path to the ER.
- Integrate freeway data with arterial traffic signals to develop arterial timing plans that respond to freeway incidents, and integrating freeway and arterial travel time data to provide alternative route travel times to drivers.
- Enhance the MaaS data and Application Programming Interface (API) to include barriers to disabled persons (stairs, steep grades, etc.) and wheelchair-accessible taxi service in the MaaS trip planning service, enhancing disabled person's mobility. Additionally, work with other cities in the development of data standards for the MaaS API.

INSERT FIGURE 1

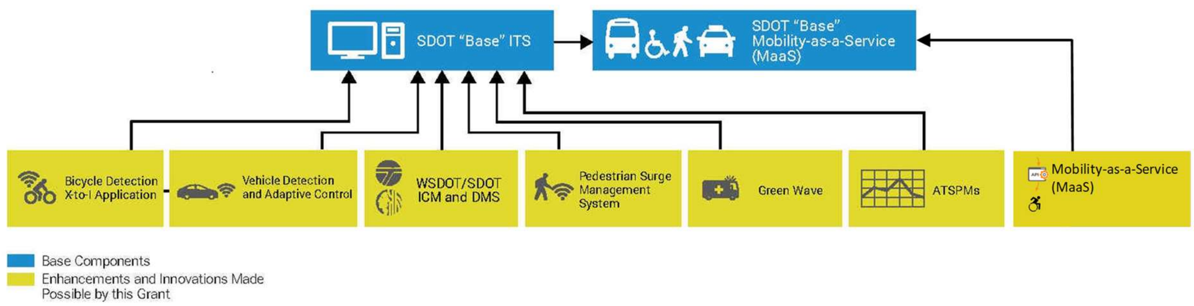
Why SDOT is Seeking This Grant

The MIMCA components illustrated in Figure 1, above, include two “base” elements shown in blue, and which support and enable the innovations proposed via this grant. These two base elements are planned for implementation under current SDOT funding sources. The grant funding is intended to enhance these two base elements, and to further provide innovative functions – including many “1st in the US” – needed in the UW subarea, across the City of Seattle, and across the US. These operations enhancements will enhance multimodal mobility and operations, including for underserved and disabled populations.

2.1.1 The MICMA Components

Base ITS and Base MaaS enable, and integrate with, the proposed innovative functions.

Figure 1: The MICMA Components



Base ITS. SDOT has programmed funds to install systems to address the major and unpredictable congestion in the UW subarea. Core systems to be installed as part of Base ITS include:

- Traffic signal system upgrades to include replacement of outdated traffic signal controllers and cabinets, detection for vehicles, bicycles (on designated corridors), and pedestrians (including Accessible Pedestrian Signals) at up to 40 intersections, and enhancements to previously installed Transit Signal Priority (TSP) for exclusive transit phases, queue jumps, and early green operations.
- Communications network to support remote management of traffic signals.
- CCTV cameras for operations management and incident monitoring and detection
- Bridge opening detection for the Montlake Bridge
- Travel time detection

This package of technologies is the basic set that SDOT implements across Seattle. Indeed, SDOT has been successfully implementing and operating all of these technologies for more than a decade. The UW subarea traffic signal equipment is the oldest in the city, with no remote communications capabilities, and these upgrades ranked highly in SDOT’s plans.

Elements of and Enhancements to Base ITS that the Grant Funding Will Support: If SDOT were to implement this work using only local funds, the project would be implemented using City forces, and the traffic signals would not be operated under adaptive control as the required detection would not be available. The Grant funding will support FHWA-compliant design and construction including installation of the additional traffic detection required for adaptive control, and services required to support development of adaptive control signal timing parameters. Note that SDOT is experienced in implementing and operating adaptive signal control, with successful implementation on the Mercer St corridor completed in February 2017.

Base MaaS. SDOT has programmed funds and developed a strategy for MaaS that supports private-sector provision of traveler and mobility services. The core of that strategy is to provide a rich data set, and creating standard API and data definitions. SDOT has been coordinating with other cities, including the City of Los Angeles, to develop the data standard. Several private sector mobility service providers will be engaged in this process. In early discussions, providers including Google and Citymapper have indicated they intend to use this data to provide improved mobility information, including for persons with disabilities. The work will result in:

- A Transportation API Strategy to further Seattle's acceptance and encouragement of MaaS data integration at a Department-wide level.
- Continue to work with national private and public sector partners (e.g. City of Los Angeles) to develop standards for data and data definitions, supporting a national standard for such data.

SDOT has funded two projects. The first is a Data Portal project that will provide the deliverables for the MaaS. The second is an Incident Management Software project that will provide important data to ingest to the MaaS data set.

The MaaS deliverables will be used in Seattle with the goal of being adopted by other cities and eventually becoming a standard for MaaS across the country and globe. Existing global standards and specifications will be reviewed before aligning an approach. SDOT will partner with private sector entities to build and evolve the open data specification to include accessibility markers, and to pilot this open data specification by creating a machine-readable API feed for third-party providers like Google Maps, City Mapper, Transit App and regional transit trip planning applications to incorporate into their wayfinding and trip planning applications.

Elements of and Enhancements to Base ITS that the Grant Funding Will Support: As part of the UW MICMA project, the work will include ingestion of data sets, including those that support mobility for disabled persons. SDOT's efforts will also include a focus on incorporating accessible wayfinding and associated data standards into the API strategy and data definitions.

MICMA Systems and Innovations

The grant funds will be used to enhance the Base ITS and Base MaaS technologies as noted above, and to provide innovative functions needed in the UW subarea, across the City of Seattle, and across the US. These innovations will deliver enhanced mobility and operations, including for underserved and disabled populations. Specifically, there are 6 proposed systems and innovations the grant will support.

▶ Automated Traffic Signal Performance Measures (ATSPMs).

SDOT will deploy an ATSPM tool, funded via private sector soft match, to support traffic signal operations management. The ATSPM will provide high-resolution data, including traffic signal operations status, to support objectives and performance-based operations and maintenance strategies aimed at improving multimodal mobility. An innovation of the ATSPM to be supplied by FLIR via soft match is that their business model will bundle the ATSPM tool with their other hardware and services. This project will accelerate FLIR in bringing this offering to market.

USDOT Focus Area: Infrastructure Maintenance, Monitoring, and Condition Assessment
Readiness: ATSPM tools are available on the marketplace today. FLIR will develop their own tool (through a soft match), which they will productize and offer in a unique manner to their customers.
Scalability/Portability: Fully scalable to unlimited number of intersections.
Measures of Effectiveness: • *Staff assessment of ATSPM impact on speed to assess and correct signal malfunctions* • *Staff assessment of ease of use of the ATSPM tool*

▶ Pedestrian Surge Management via Demand-based Detection and Signal Timing.

Install new passive pedestrian detection technology at locations where pedestrian surges occur – including at rail transit stations and near event venues. The technology proposed will not only detect pedestrians, but will count pedestrians. The traffic signal operations software will be modified to accept the pedestrian count input, and to allow for pedestrian crossing times to be adjusted to match the demand. This project will provide for a first in the US – treating pedestrians as we do vehicles, in that the timing will respond to volume-based demand.

USDOT Focus Area: Multimodal ICM
Readiness: Detection technology is fully tested and highly reliable. New aspect is the integration with traffic signal software/firmware.
Scalability/Portability: Fully scalable to unlimited number of intersections. Will be a portable "productized" technology upon completion.
Measures of Effectiveness: • *Reduction in pedestrian/vehicle conflicts and crashes* • *Cost:Benefit/ROI* • *Impact on vehicle delay and travel time*

▶ App-Based Bicycle Detection and Traffic Signal Communications and Response.

Two provider's cell phone mobile applications will be provided to bicyclists in the area. These apps enable X-to-I and I-to-X "smart bicycle" functionality. The systems will detect cyclists with the app loaded and active on their cell phones as they approach a signalized intersection, and will place a call to the controller while communicating that the call was received back to the cyclist.

USDOT Focus Area: Multimodal ICM, and Installation of Connected Vehicle Technologies at Intersections
Readiness: These apps are ready for early roll-out, and have been Beta tested at other locations in the US.
Scalability/Portability: Fully scalable to unlimited number of intersections.
Measures of Effectiveness:
• *Traffic signal responsiveness (green extension) provision for cyclists* • *Impact on cyclist travel time* • *Impact on vehicle delay and travel time*

▶ Green Wave EVPE.

This system will enable traffic signals to adjust, based on real-time congestion, to clear traffic in advance of approaching emergency vehicles. The system will rely on center-to-center communications between the Seattle Fire Department (SFD) CAD/AVL system and the SDOT central ITS software suite.

USDOT Focus Area: Multimodal ICM
Readiness: Both the SFD and SDOT software are enabled for integration, including the provision of open APIs. New aspect is applying Siemens CONCERT software to develop rules for clearing traffic (providing green signal) in advance of the emergency vehicle.
Scalability/Portability: Fully scalable to unlimited number of intersections. Portable to any other traffic signal management/control software with like capabilities.
Measures of Effectiveness:
• *Reduction in emergency vehicle travel time* • *Impact on vehicle delay and travel time*

Integrated Corridor Management.

SR 520 and I-5 bound the south and west of the subarea. A suite of services is proposed to include freeway incident detection integrated with arterial traffic signal timing changes, and real-time travel time/alternative route calculation and provision to drivers. DMS will be installed to provide drivers en route with alternative route information.

USDOT Focus Area: Multimodal ICM

Readiness: The needed systems are in place and ready to integrate data on incidents on freeways into traffic signal control software. Alternative route travel time capabilities also exist. This work supports the integration of freeway and arterial information specific to the UW subarea, and assess the effectiveness of such integration.

Scalability/Portability: Fully scalable to unlimited number of intersections. Portable to any other traffic signal management/control software with like capabilities.

Measures of Effectiveness:

- *Impact of alternative route and travel time messages on traffic patterns in the subarea*
- *Impact on vehicle delay and travel time, and total time the freeway and arterial network is congested due to the incident.*

MaaS.

SDOT's Base MaaS, including existing data sets and a new data and API standard, will be enhanced as part of this project. First, the MaaS data set will be enhanced to add mobility information directed at persons with disabilities (e.g. accessible walking paths, accessible taxi services), and other key data sets to support MaaS functions. Second, data from the Incident Management software purchased as part of this project will ingested to the MaaS and made available via the API. All work will be based on an open data standard, and be made available to the private sector for use in their transportation and mobility services offerings.

USDOT Focus Area: Technologies to Support Connected Communities, and Unified Fare Collection and Payment Systems Across Transportation Modes and Jurisdictions

Readiness: SDOT has a foundation of a MaaS API, which is fully ready and is already used by several private sector providers. The creation of a data standard and standard API definition, as well as the enhanced accessibility and incident data are added elements of this grant proposal.

Scalability/Portability: Fully scalable and portable to any other location in the US.

Measures of Effectiveness:

- *Number of private sector providers using the enhanced data streams, and functions supported*

2.2 The City of Seattle Department of Transportation (SDOT)

SDOT will act as the recipient of the federal award and be responsible for compliance with the regulatory and financial requirements associated with this project. SDOT has a long and proven track record of USDOT grant management.

2.2.1 Project Partners

A consortium of partners including Washington State Department of Transportation (WSDOT), Sensys Networks, Siemens, and Innovative Data Solutions, Inc. (IDAX), will deliver the project. A thoughtful program management structure with experienced and competent staff will enable the City to manage the multiple elements of the program in an effective and efficient manner.

2.2.2 Program Management Including Project Funding

SDOT has a successful record of ITS project and program management, with some $40M invested within the past decade. This project will benefit from the systems, processes and procedures in place for overall project management at SDOT. SDOT will use its proven dynamic project management system to standardize the entirety of project management and oversight. This system has woven-in accountability and real-time risk mitigation. The project funds will be allocated to subtasks in a work breakdown structure format, with each element being tracked for budget and schedule compliance individually.

Technical and project management will be led by SDOT’s Adiam Emery, who brings 25 years’ experience, exclusively in the SDOT ITS program. She provides proven strong project management and technical skills. She has managed projects using Federal funds, and is well aware of the compliance, reporting and other requirements of such projects. She will be supported by a consultant Program Management team to ensure proper oversight and tracking of the technical, schedule and funding progress. Adiam’s resume, along with those of SDOT key project staff are provided as an attachment.

2.3 The University of Washington (UW) Subarea

The UW subarea, shown in *Figure 2*, provides the ideal proving ground for new and innovative urban transportation solutions. The multimodal transportation network features transit priority/bus rapid transit (BRT) corridors, dedicated and shared bicycle streets, light rail and associated stations.

The UW subarea is the largest employment center in Seattle outside of downtown. A mix of land uses is found in the subarea, including low to high intensity residential and commercial uses, retail shopping, two hospitals/medical centers, as well as the University of Washington (UW) and its associated stadiums, recreation and event venues such as the Henry Art Gallery and Burke Museum. There are also acclaimed dance, theater and music performances at Meany Hall on the UW campus.

Figure 2: The UW Subarea

A number of converging factors result in transportation system challenges in the subarea:

- *Pedestrian and cyclist volumes are very high, typical of university districts and urban centers throughout the country. Some 31,000 undergraduate and 14,000 graduate students are enrolled at the UW Seattle campus. Crash occurrence is among the highest in the City of Seattle, as shown on Figures 5 and 6.*
- *The UW is the site of many special events and conferences held year-round, including major sporting and other events held at Husky Stadium (capacity 72,500), at Hec Edmundson Pavilion (capacity 10,000), or on campus.*
- *The Sound Transit U-Link light rail station, opened in 2016, as well as regular UW operations and events, produce frequent pedestrian surges*.
- *Two major hospitals, each with ERs, are located in the subarea, and intense congestion adds delay to emergency medical responders.*

- *The **UW Medical Center ER** provides specialized care in areas such as cardiology (Level I Cardiac Center), stroke (Level III Stroke Center), and high-risk pregnancy/neonatal (Level III neonatal intensive care) units.*
- ***Children's Seattle ER** serves babies, children and teens with life-threatening medical needs with specialty pediatric emergency services.*

- *The only access to the UW subarea from the south (the connection to SR 520) features a moveable bridge, the Montlake Bridge, which regularly creates delays in the surface street network as the bridge opens 2 to 12 times daily to allow maritime traffic to pass.*

Bicycle Network. Figure 2 also shows the bicycle network in the subarea, which includes dedicated bicycle lanes, sharrows, and the Burke-Gilman Trail, a separated bicycle/pedestrian shared use path.

Key Transit Features. In March 2016, Sound Transit opened the new University line of the Link light rail system, shown on Figure 3. The University line connects underserved and diverse populations from just south of SeaTac airport via Downtown Seattle to the UW subarea's employment, health, and education services. The ULink station is located adjacent to Husky Stadium, and is a major transportation anchor for the subarea. Ridership is at 60,000 per day. The U-District Station light rail station is planned to be opened in late summer 2021.

Also shown on Figure 2, the road network serves conventional bus transit, and includes transit priority corridors, and two bus transit hubs managed by King County Metro – with one hub on NE Campus Parkway and on NE 45th Street.

Figure 3: Sound Transit Light Rail Connects Diverse Neighborhoods in the Region to the UW Subarea

2.4 Issues and Challenges to be Addressed by the Technology

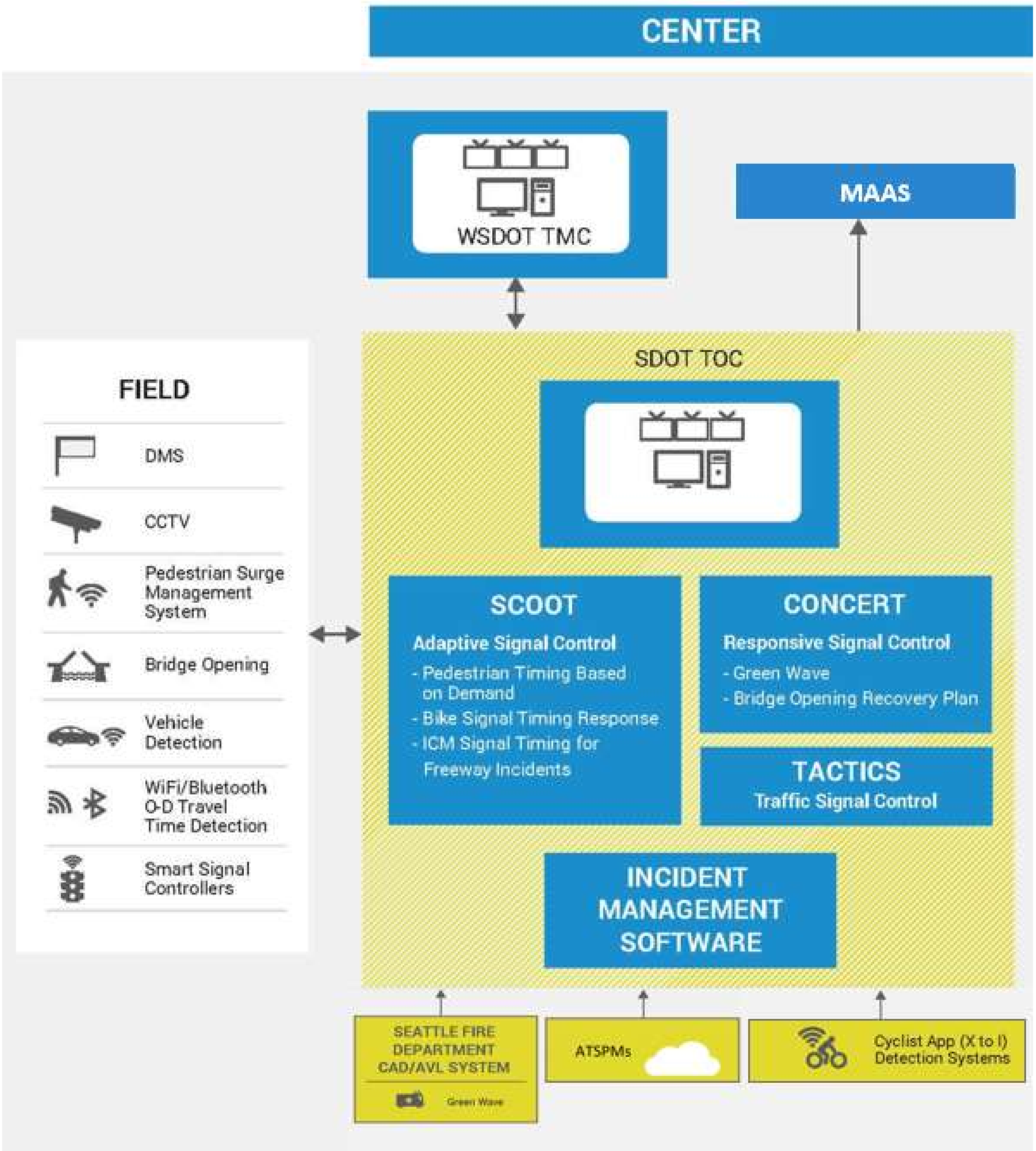
The overall challenge faced in the UW subarea is creating an arterial operations environment that is responsive to all modes, and all travelers. The following table presents the core issues and challenges to be directly addressed via this grant that, together, will meet this challenge.

Issue/Challenge	System Proposed
Traffic volumes are highly variable in the UW subarea, and conventional or even traffic responsive traffic signal timing cannot respond well to these demands. Even if detection is implemented to support adaptive control, core analytics including Purdue data analytics, are not available to enable detailed, comprehensive performance monitoring and improvement.	**Base ITS, Adaptive Signal Operations and ATSPMs**
Pedestrian volumes surge due to normal university operations, events, and the new U-Link light rail station. Existing traffic signal timing is fixed for pedestrian crossings. Pedestrians commonly cross the intersection at the end of the pedestrian phase, seemingly feeling protected when there is a group of pedestrians doing the same. Ped crash occurrence is high in the subarea. SDOT's policy is to treat all modes in an equal manner to provide for true multimodal opportunity.	**Pedestrian Surge Management System**
Traffic signals provide timing in response to vehicle detection. Cyclists are not specifically detected, so the signal timing is not responsive to their travel. Cyclists are tempted to, and are often found to, enter the signal on yellow and even on red so they do not have to stop. This introduces additional crash risks. Cyclist crash occurrence is high in the subarea. SDOT's policy is to treat all modes in an equal manner to provide for true multimodal opportunity.	**Cyclist Detection Apps**
Congestion in the UW subarea is increasing, and emergency response vehicle travel time to incidents and emergency rooms is increasing. The current EVPE approach (Fire Lane Green) at traffic signals does not improve travel times in congested periods, as downstream congestion is not cleared.	**Green Wave**
Incidents on I-5 and SR 520 – two freeways that bound the west and south end of the UW subarea – create congestion in the subarea. Arterial users do not know the source of the congestion, and do not have information on alternative route travel times. The added congestion can impede incident response. In addition, the traffic signals are not responsive to freeway incident-caused congestion, resulting in increased time to clear incident congestion from the arterial and freeway network.	**ICM with WSDOT**
Data providers for Mobility-As-A-Service applications do not provide options tailored to disabled individual's needs. The lack of complete information for disabled individuals does not align with SDOT policy to provide mobility options for all users on a level playing field.	**MaaS**

2.5 Systems and Services Proposed

MICMA provides a fully integrated suite of systems and services, as shown in Figure 4 and described further on the subsequent pages.

Figure 4: MICMA Integrated Systems



2.5.1 ATSPMs

Systems and Technologies: SDOT will be delivered (as private sector soft match from FLIR) an ATSPM platform. The ATSPM analytics platform will provide for detailed analysis and performance monitoring of signal operations including:

- Optimized Signal Timing: The availability of historical 24x7 automatic turn movement counts enable signal timing optimization over multiple levels: (i) seasons (ii) days of the week (iii) Time-of-Day periods, and (iv) phase split-times. Today, only phase split-times optimization is feasible due to the manual and limited duration of the turn movement count data.
- Intersection Performance Measures: The ASTPM analytics solution will fuse detection data with traffic signal phase data to generate a wide variety of intersection performance and safety metrics including before/after comparison reports, Purdue Coordination Diagrams (PCDs), percentage arrivals on green/red, delays per approach, and traffic volumes. Corridor performance measures including travel time and delay will also be provided.

Outcome - Improve real-time management of traffic volumes always, including in response to unpredictable congestion-causing events (game or concert at Husky stadium), incidents and/or construction. Adaptive traffic signal management will allow quick response and recovery from the Pedestrian Surge Management and Green Wave Emergency Clearance systems proposed, maximizing the overall benefits of those two functions. The ATSPM will support assessment of these functions, as well as ongoing performance monitoring. Last, the ASTPM analytics tool will provide reporting in compliance with the FHWA Every Day Counts Automated Traffic Signal Performance Measures.

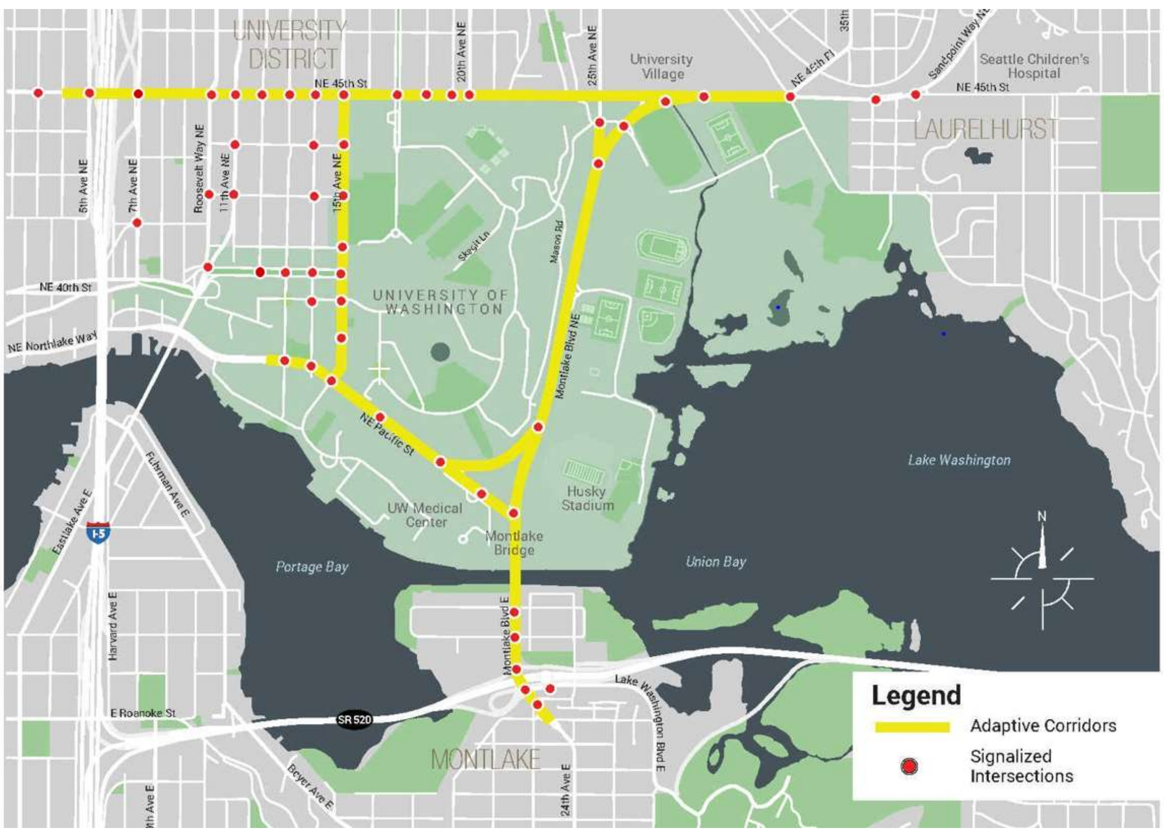


Figure 5: Signalized Intersections and Proposed Adaptive Corridors in the UW Subarea

Data: Today's UW subarea traffic management system is coordinated for progression on a time-of-day basis. This is sub-optimal given the fluctuations in traffic demand due to events, bridge openings, emergency vehicle pre-emption and SR520 construction. The system often takes several cycles to recover from individual incidents. Implementation of an ATSPM will also allow the project to create a baseline data. set and analytics for "Before" and "After" conditions analysis to assess adaptive control and the other functions proposed for MICMA.

2.5.2 Pedestrian Surge Management System

System and Technologies: The pedestrian surge management system consist of two elements:

- *Passive Pedestrian Counting/Detection. SDOT proposes to implement video image processing and cameras to provide pedestrian count detection at crossings and nearby approaches, at intersections serving the stadium and light rail station.*
- *Pedestrian Volume-Responsive Traffic Signal Control. SDOT (via Siemens) will modify traffic signal control software (in TACTICS/SCOOT), and traffic signal controller firmware (SEPAC) to enable the signal to respond to actual pedestrian demand.*

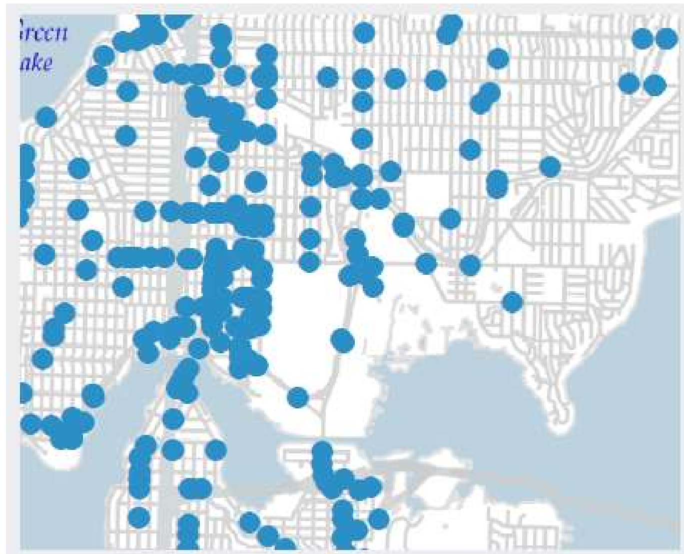


Figure 6: Pedestrian Crash Locations 2012-2016

Counting Pedestrians Using Video Image Processing Technology.

SDOT will competitively select a pedestrian counting technology that will deliver real-time pedestrian volumes. One potential technology that has been investigated is from Southwest Research Institute (SwRI), and demonstrates the feasibility of SDOT's approach. SwRI has developed a highly accurate video-image processing pedestrian detection technology that can be used with a large range of high-definition cameras. Originally created to support autonomous vehicle operation to avoid pedestrian crashes, the technology will be adapted to provide pedestrian count information. Because the processing software includes the travel vector of the pedestrian, the count data can be created to count pedestrians bound for specific crossings.

SwRI's existing current object detection approach uses state-of-the-art deep learning algorithms employing neural network designs such as Convolutional Neural Network s (CNN), Resnet50, and Single Shot Detection. Key technology features include:

- *Intelligent Single Shot camera-based algorithms that accurately detect high-pose objects such as bicycles, people, and animals in cluttered environments*
- *>99.95% accuracy*
- *Detection, classification, and tracking algorithms use a custom convolutional neural network algorithm to increase performance in cluttered environments*
- *Semantic segmentation of desired object*
- *Detected objects include, but are not limited to, partially occluded bicycles, humans, vehicles, road signs, and work zone objects (cones, barrels, etc.)*

The selected passive pedestrian counting technology will be tailored to be specific to pedestrian counting for traffic signal operations.

Outcome: Decrease pedestrian conflicts and crashes.

Data: The UW subarea sees some of the highest volumes of traffic related pedestrian injuries outside of downtown Seattle. In 2012-2016, the UW subarea saw seven pedestrian fatalities; in the last three years, the UW subarea saw 62 pedestrian collisions (see Figure 5). The Seattle Pedestrian Master Plan identifies many roadways in the UW subarea as being “high need”, due to their volume of crashes, speeds, and other criteria.

2.5.3 Cyclist Detection Apps (X-to-I and I-to X)

System and Technologies: Two private sector providers - Sensys Networks and Siemens - will provide a platform that sends infrastructure-based information to travelers and relevant traveler information to the infrastructure in unique and valuable ways. The solution leverages communications capabilities available with existing smartphones, and will be adapted by cyclists. The Sensys Networks GiveMeGreen, and Siemens SiBike cell phone apps will be fielded and tested. These apps are loaded on the cyclists’ cell phone, and use the phone’s GPS positioning to determine if a cyclist is approaching a traffic signals, and place a call to the traffic signal. The call will be treated the same as vehicle calls, with green extension and other detection parameters available. The green extension may be modified to accommodate the average speed of cyclists.

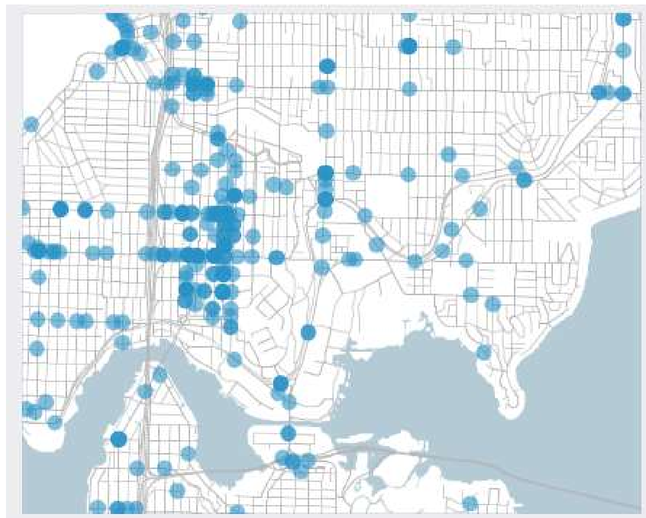


Figure 7: Cyclist Crash Locations 2012-2016

The main difference between these two systems is that the SiBike is a centralized platform, and can be pushed to any traffic signal controller with the proper firmware and connected to TACTICS version 5.2.2 (both of which are being implemented by SDOT) The Sensys system is decentralized and includes hardware to be installed at the controller – and will be placed at only one location. There are advantages to each approach, and these will be assessed. The Sensys system will be assessed system reliability and accuracy. The Siemens system will be assessed for both system reliability and accuracy, and the user experience.

Outcome: Reduce the number of cyclists stops, improving cyclist travel time and minimizing cyclist/vehicle conflicts.

Data: The UW Subarea sees some of the highest cyclist volumes in Seattle (with an associated higher crash occurrence rate) as shown on Figure 6.

2.5.4 Green Wave Emergency Vehicle Clearance System

System and Technologies: The Green Wave clearance system will develop an algorithm that will reside in SDOT’s CONCERT responsive traffic signal system. The algorithm will assign green traffic signal display to sets of traffic signals, based on real-time congestion levels, to clear back-ups that impede emergency vehicle access to destinations. Responding vehicle location and destination data from the SFD CAD/AVL will be ingested into CONCERT, as will network congestion data. The algorithm will, when needed, change traffic signals to green well in advance of the approaching SFD responding vehicle to clear any downstream congestion. The system will also provide a Green Wave of traffic signal indications to support the responding vehicle path.

Outcome: Decreased emergency responder delays by providing a clear path for emergency vehicles to access hospitals. Congestion in the area creates delays beyond the capability of existing emergency vehicle preemption systems (EVPE) which clear one intersection at a time. Currently if traffic is grid-locked, no clearance is achieved. The Green Wave Emergency Clearance system overcomes existing challenges by clearing congestion well in advance of the emergency vehicle, with plans implemented based on measured real-time congestion.

Data: The Seattle Fire Department (SFD) provides a portion of the 6,000 ambulance trips in the area, with many of the most critical patient needs. SFD provided 592 patient transports to UW Hospital and 124 patient transports to Seattle Children's hospital in 2015. Peak hours for SFD emergency medical service trips tend to be in the late afternoon to early evening – periods of peak traffic congestion.

2.5.5 Integrated Corridor Management (ICM)

System and Technology: WSDOT and SDOT already have a digital data-sharing system in place. This work will integrate data from WSDOT's traffic sensors with the SDOT central traffic signal control system. The project will identify the freeway incident "triggers," and design signal timing plans for various incident scenarios. In addition, travel time algorithms that fuse WSDOT freeway and SDOT arterial data will be developed to calculate travel times to key destinations. Alternative route travel times will be posted on arterial DMS (to be installed as part of this project) and via the Traveler's website, plus via private-sector ISPs, and integrated with MaaS.

Outcome: Linking the State highway and the city arterial network using live streaming data will provide seamless optimized operation between the state highway and city arterial network. Providing users with alternate routes that will leverage both facilities, and better manage the congestion and/or incidents. With respect to freeway incident management, better managing the demand on arterials bound for freeways should improve overall incident-created congestion clearance times.

Data: Blocking Incidents on I-5 and SR 520 in the UW environs occur approximately 50 times per year. In addition, closures due to weather events on SR 520 occur as often as 5 days per year, and maintenance activity occurs with a similar frequency.

2.5.6 Mobility-As-A-Service Data and API

Systems and Technology: SDOT will implement two systems to support provision of historical and real-time data streams to the MaaS API. The ***Data Portal*** project is directed towards development of a standard and open API and populating that API, to include enhancing existing open data specifications and endpoints for

- construction data (work zone data in collaboration with US DOT's recent initiative)
- special event data
- parking data
- traffic congestion and other "base" traffic data including travel times and traffic volumes
- incident data
- transit delay

SDOT will deliver these enhancements in the form of the real-time and historical data APIs.

SDOT will also procure ***Incident Management Software***. This module will replace current data gathering systems, and integrate and automate incident data input for Traffic Operations Center operators charged with supporting incident management, and will include integration of Seattle Safety Patrol (service patrol) dispatch, fire CAD/AVL system data and potentially Seattle Police Department (SPD) data feeds related to traffic-impacting incidents. The Incident Management software will include an open API, which will be used to populate the MaaS data API.

SDOT proposes to build upon and enhance previous work in the Mobility as a Service (MaaS) sphere related to open source and open data standards. Past and current efforts include pushing out real-time construction event and congestion information into APIs, as well as bridge and railroad openings and road closures. SDOT continue to build out the Transportation API strategy to inform all development of real-time and two-way data sharing between public and private entities, and to support standards development at a national level.

With regard to accessibility and movement for all people, as presented in the grant proposal, SDOT has created a Digital Wayfinding Strategy and Roadmap that will guide the Department in city wayfinding planning, design, and information sharing. In order to sustain seamless wayfinding, a systematic approach to data management is needed. Diverse authorities, ranging from cities, transit providers, local attractions, and property owners, design and implement their own separate wayfinding systems in their pockets of jurisdiction. This, for the user, results in:

- Inconsistent units (i.e. distance displayed in blocks, yards, or minutes)
- Inconsistent visual languages (i.e. color schemes, iconography etc.)
- Inconsistent hierarchy (i.e. landmarks, routes of importance etc.)
- Inconsistent naming (i.e. place and boundaries)
- Inconsistant priorities (i.e. accessibility, tourism etc.)

All these combined, create confusion and inaccessibility across the City, leaving a bad experience for residents and visitors alike. When produced as touchpoints, these different approaches also compete for space and attention; creating visual, physical, and content clutter.

SDOT will provide the following to address these issues:

- Support the development of a Transportation API Strategy to further Seattle's acceptance and encouragement of MaaS integration at a Department-wide level. Deliverable will be an API roadmap for priority information and data feeds that Department should prioritize for MaaS adoption. Included in this API roadmap will be accessible wayfinding and data standards, addressed as deliverables in the following sections.
- Produce an open data specification for accessible city wayfinding that can be used in Seattle but adopted by other cities across the country and globe. Will first review existing global standards and specifications before aligning on approach. Work with national public sector partners (e.g. City of Los Angeles) to develop standards for data and data definitions, supporting a national standard for such data. SDOT will partner with public and private sector entities to build and evolve the open data specification to include accessibility markers such as:
    - Real-time information on hazards, such as street works, damaged sidewalks, etc.
    - Curb cuts and tactile paving
    - Gradients and cross falls
    - Presence or absence of sidewalk
    - Crossing point
    - Parking

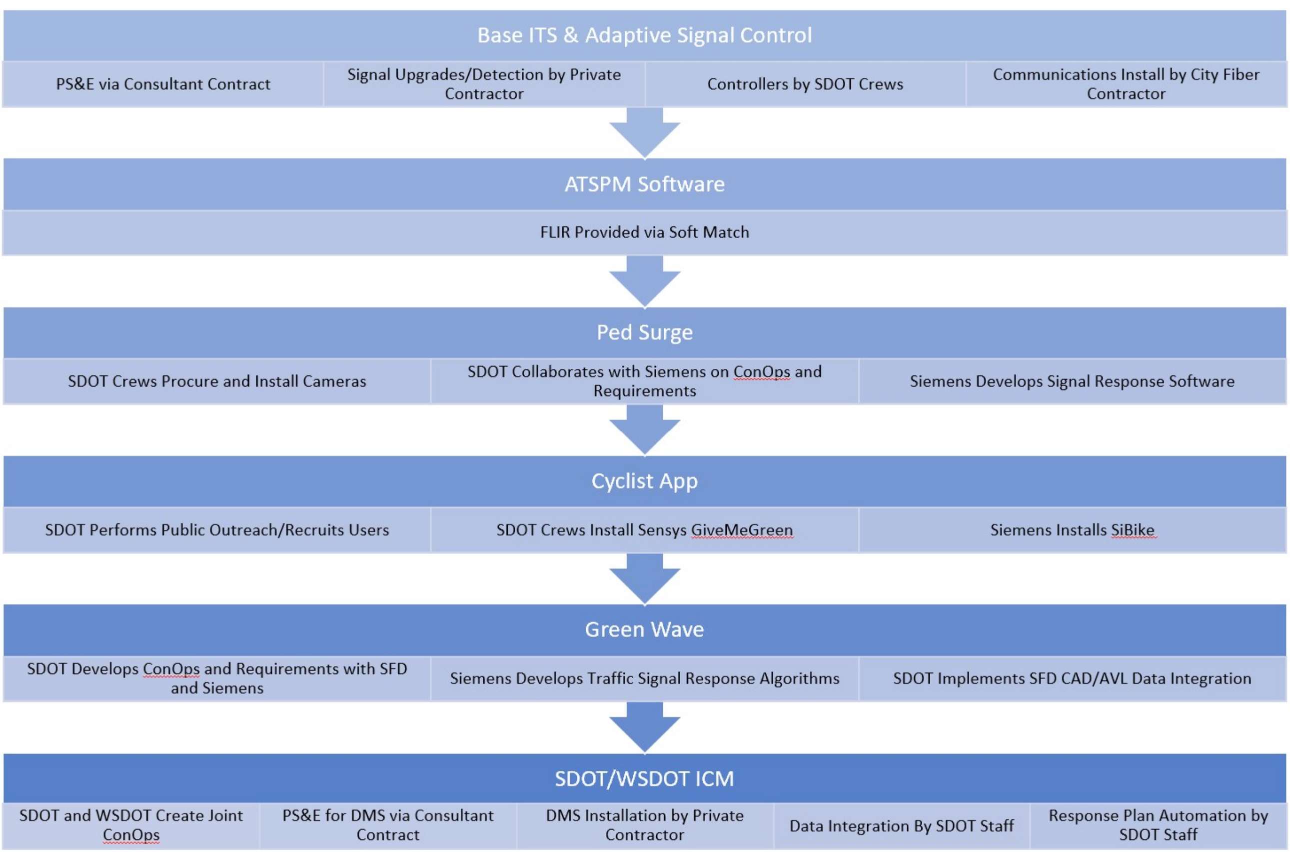
  - Washrooms
  - Clear width
  - Elevators and tunnels (and their operating hours)
  - Shuttles
  - Lighting
- Pilot this open data specification by creating a machine-readable API feed for third-party providers like Google Maps, City Mapper, Transit App and regional transit trip planning applications to incorporate into their wayfinding and trip planning applications.

Outcome: Studies have shown that integrated digital mobility platforms have the potential to increase the use of shared mobility assets (including transit), while reducing SOV trips, car ownership, and customer transportation costs. Additionally, the MaaS will increase access to employment, education, and health care for economically disadvantaged and disabled persons.

Data: This technology should help all people, but especially disadvantaged and disabled populations, in planning their trips and reaching their destination on time with fewer incidents and at a lower cost, greatly improving disabled persons mobility.

2.6 Deployment Plan Including Ongoing Operations, Maintenance, Monitoring and Improvements

The deployment plan encompasses the phases as shown in the figures below, and is designed as a stepwise approach. New functions will be added, step-by-step on top of existing functions as a risk management measure, and to support the project evaluation of the individual project elements. The project schedule in section 2.13 reflects this approach. Information on how the project components will be managed and



delivered is shown in the figures below. MaaS Implementation is shown separately, and will proceed at the same time as the remaining project elements.

Figure 8: Project Deployment Plan (Excluding MaaS)

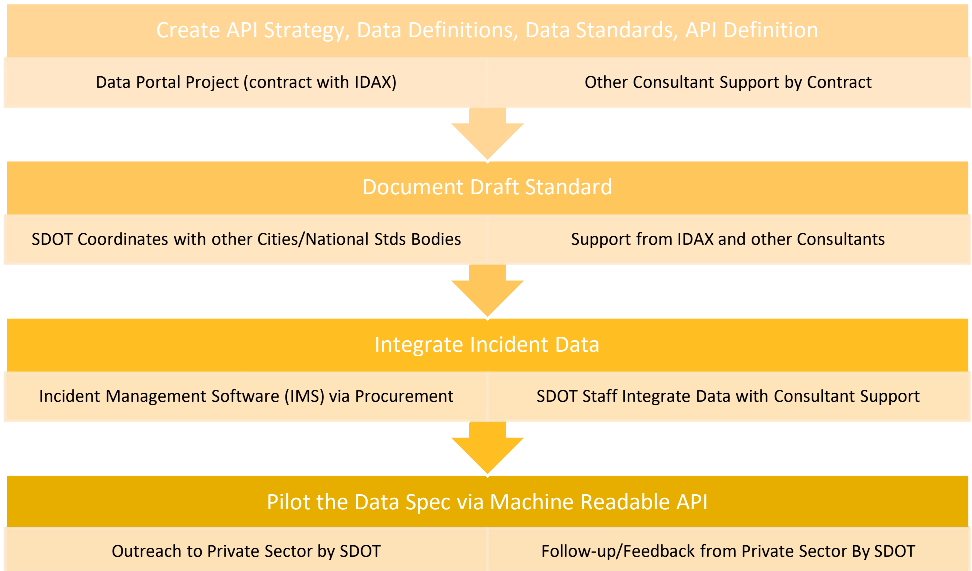


Figure 9: MaaS Deployment Plan

2.6.1 Ongoing Operations, Maintenance, Monitoring and Improvements

The City of Seattle's commitment to arterial operations is reflected in SDOT's history of ongoing budget support for ITS initiatives and staffing. SDOT has programmed ongoing operations and maintenance in their budgets to ensure the systems installed in this project provide lasting value.

- SDOT has programmed over $18.9 million annually for ITS maintenance in 2017 and 2018. The budget planning requests for future out years include annual escalation through 2023.
- SDOT has funded the current ITS TOD staff positions through 2018, and the budget plan includes escalation and planning for additional positions through 2023.
- SDOT has currently programmed $169,000 in 2018 for ongoing operations and maintenance of the MaaS, with ongoing operations and maintenance budget requests, including annual escalation, included in the capital budget request through 2023.

Monitoring of traffic signal operations will be facilitated via the ATSPM tool being delivered as part of this project.

2.7 Challenges

SDOT does not anticipate any significant regulatory, legislative, or institutional challenges will arise to impede this project. In our review of potential challenges, the following were identified, and a mitigation approach developed.

1. Public Information Privacy

   SDOT has reviewed all relevant public privacy concerns with respect to data sharing, WiFi-Bluetooth readers, video-based detection, and the cyclist detection systems proposed. All comply with current City law and policy.

2. Public and Private Sector Partners

   SDOT has long-standing partnerships with the entities included in this grant proposal, and does not anticipate any institutional issues. SDOT has additionally advised our private sector partners to acknowledge their understanding of and compliance with FHWA grant requirements in their commitment letters, to avoid any potential issues down the road. Letters of commitment or support (attached to this proposal).

   Our history with our partners includes:

- SDOT and WSDOT already partner for data sharing and are currently working on a regional incident management improvement initiative to better integrate freeway and arterial operations during incidents.
- SDOT has worked with Sensys Networks for ten years, having been one of the initial deployment sites for their technologies.
- SDOT has worked with Siemens ITS for more than fifteen years and has existing contracts and relationships with Siemens ITS. The history includes software development/modification experience, such as proposed on this project. Siemens has identified Seattle as a "Center of Excellence" in their corporate planning, and is committed to SDOT's success.
- SDOT has worked with FLIR/Acyclica for more than four years, and has deployed their Data-As-A-Service solution across the City.
- SDOT has contracted with IDAX for data and cloud services for more than two years. IDAX has consistently shown their commitment to SDOT's success.

3. COVID19

   A key challenge will be operating under the COVID19 restrictions now in place, and under an uncertain future. The impacts of COVID19 on the marketplace, on SDOT, and Contractors is unknown. Possible impacts of COVID19 include:

- Shortages of materials, equipment and systems resulting in schedule delays.
- Increase in cost of materials, equipment and systems.
- Delays in bid date due to staff required to review PS&E package and put out the bid being unavailable.
- Delays due to possible agency staff reductions post-COVID.
- Due to changed vehicle, cyclist and pedestrian traffic levels, inability to complete a full evaluation for the project.

   SDOT has incorporated cost contingencies of up to 15% into the project budget. As far as schedule impacts, the project schedule includes float, and SDOT is confident that the project can be completed within the agreement term, even if SDOT staff reductions occur. SDOT can add consultant support, to a limit imposed by the project budget, for some functions if needed. A key staff resource for this project is SDOT Crew support, which cannot be replaced. In the event of staff reductions, SDOT will work with the Crews to ensure UW MICMA work is prioritized. In addition, WSDOT suspended work in late March on nearly all of its construction projects statewide, in compliance with the Governor's Stay Home Stay Healthy order, including the SR 520 Montlake Project. Construction is expected to resume by July 2020, and this delay is incorporated in the project schedule's float.

2.7.1 Commitment to Project Evaluation and Ongoing Performance Monitoring

SDOT is a data-driven organization, and is already applying evaluation/performance monitoring to manage and continuously improve traffic incident management, traffic signal operations and maintenance, and other core functions of the TOD. For example, the infographic in *Figure 11* is produced weekly for the Mercer corridor project.

2.8 System Performance Improvements

The system performance measures for the UW subarea relate to the interconnected challenges being addressed by the project. SDOT will enhance their data set using detection installed as part of this grant. Analysis will be conducted using data from continuous measuring collected by traffic and WiFi/Bluetooth sensors connected in real time to the SDOT TOC, and can be combined with other data for analysis. The ATSPM system will also provide the capability of granular evaluation of system performance. Systems performance improvements will be measured before and after analyses to assess how well the project improves travel for all modes. Quantifiable measures related to the project improvements include overall sub-area and street-specific:

- Reductions in vehicle travel time by time-of-day – using WiFi/Bluetooth reader data
- Vehicle delay reduction by time-of-day – using WiFi/Bluetooth reader data and ATSPMs
- Reduction in vehicle and bicycle stops - using ATSPMs
- Vehicle travel time reliability - using WiFi/Bluetooth reader data and ATSPMs
- Transit travel time – using transit AVL/CAD data
- Reduction in pedestrian delay – using video-based observations
- Reduction in pedestrian crashes – based on police crash reports input to the TDC
- Reduction in bicycle crashes – based on police crash reports input to the TDC
- Reduction in medical emergency responder travel time to emergency rooms and to SFD-dispatched incidents – based on SFD AVL/CAD data
- All of the above during major events
- All of the above during freeway incidents, plus time to clear incident-related congestion

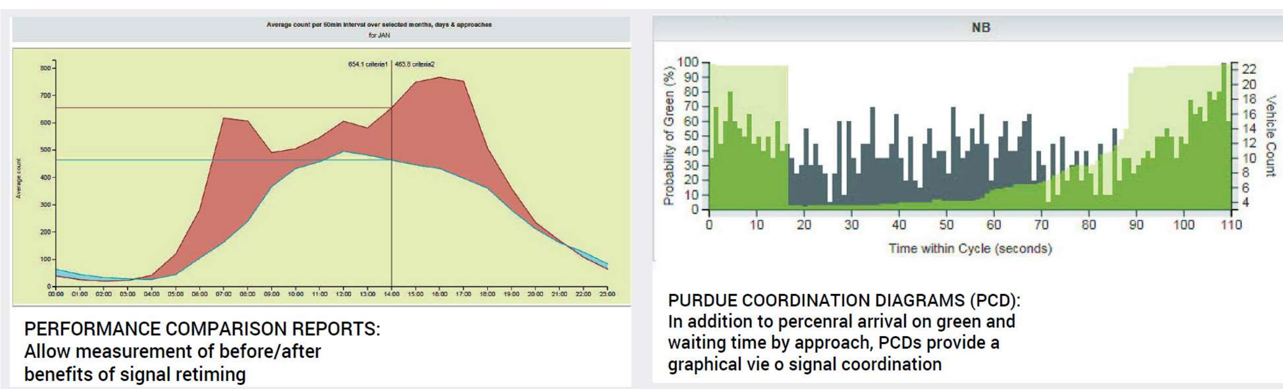


Figure 10: ATSPMs Will Provide Analytics to Support the MICMA Evaluation and Ongoing Performance Monitoring

- How the MaaS improves access for all to transportation services, with a specific focus on the disabled community.
  - Data fields added to the MaaS
  - Number of private-sector users of the MaaS data.

- If the private sector will participate, we will request aggregated user data from them to understand the types of services accessed by their users.

2.9 Benefit Projections

The project summary included proposed measures of effectiveness for the project elements. The following provides those measures, and the estimated benefits, when such estimate is available. It is noted that modeling has not been completed to estimate benefits, and any estimates are based on comparison to other locations and sketch-level planning.

2.9.1 Estimated Benefits:

"Base" SDOT ITS Elements

- Reduced vehicle delay - estimated at 20%[1]
- Reduced travel time - estimated at 25%[1]
- Maintain transit travel time – no change to transit travel time[2]
- Improved travel time reliability – no estimate available
- Reduced vehicle emissions - estimated at 4%[3]
- Reduced fuel consumption – estimated at 6%[3]

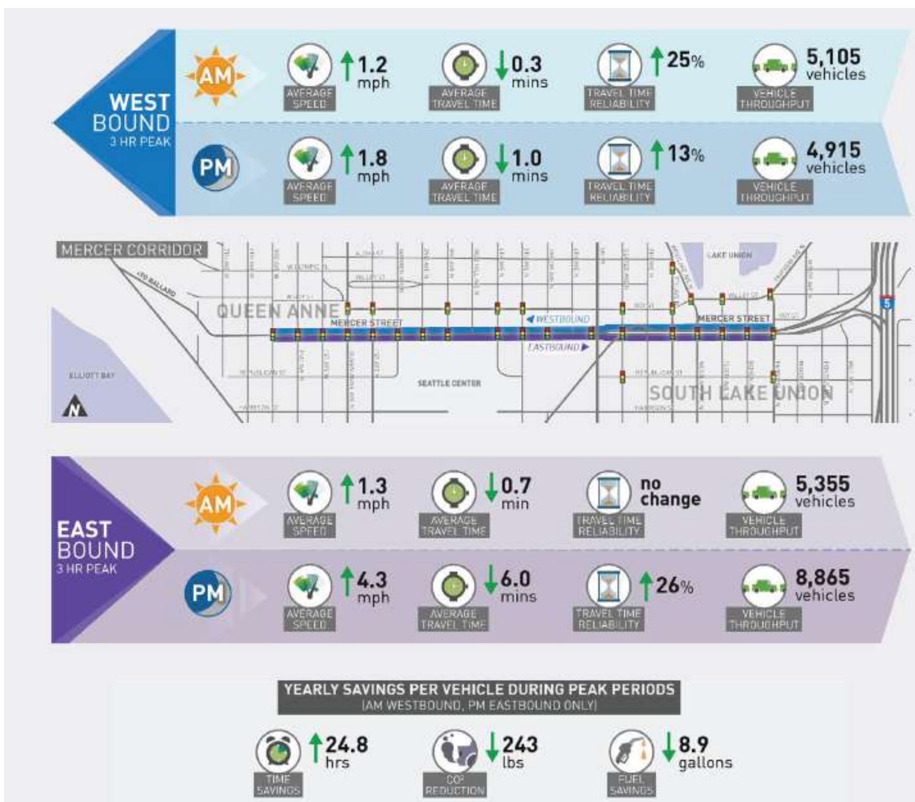


Figure 11: Adaptive Control Measured Improvements in the Mercer Corridor

1 *Based on a combination of SDOT measurement of benefits in the Mercer Corridor, and Siemens' reporting of average benefits from all SCOOT installations*
2 *Based on SDOT measured experience in the Mercer Corridor*
3 *Based on Siemens' reporting of average benefits from all SCOOT locations*

Pedestrian Demand-Based Detection and Signal Timing

At locations where the system is installed:

- Reduction in pedestrian/vehicle conflicts – estimated at 5% during peak periods[4]
- Reduction in pedestrian/vehicle crashes – no estimate available
- Increase in vehicle delay – no estimate available
- Increase in travel time – no estimate available

Cyclist Detection Apps

- Traffic signal provision of green extension – estimated at 100% when within timing parameters
- Reduction in bicycle stops – no estimate available
- Reduction in bicycle travel time – estimated at 5%[5]
- Increase in vehicle delay – estimated at 0%[6]
- Increase in vehicle travel time – estimated at 0%[6]

Green Wave

- Reduction in SFD responder travel time to incidents in the UW subarea and to the two ERs in the subarea -estimated at 30 seconds (average)[7]
- Increase in vehicle delay – no estimate available
- Increase in vehicle travel time – no estimate available

ICM

- Vehicle delay reduction – no estimate available
- Vehicle travel time reduction – no estimate available
- Reduction in total time freeway and arterial network is congested due to incident – estimated at 10%[8]

4 Based on estimated number of extended pedestrian phases to be provided
5 Based on reducing travel delay by one 90 second signal cycle on key corridors
6 Based on performance of SCOOT, added green extensions for bidycles should not affect overall vehicle delay or travel time
7 Based on congested versus uncongested travel time for emergency responder to UW ER
8 Based on estimate of available capacity on alternative routes

2.10 Vision, Goals, and Objectives

SDOT is invested in deploying leading-edge ITS systems and services because they produce results. SDOT's 2010 ITS Strategic Plan establishes the vision for ITS in Seattle.

The SDOT ITS Vision

To support development of a sustainable transportation system, and to contribute to the City's economic vitality by implementing, operations and maintaining the most appropriate technology to meet multimodal transportation safety and mobility needs. Implementing this vison will result in protection of traffic safety, reduced environmental impacts of transportation, improved multimodal mobility and enhanced efficiencies of the transportation network.

Since the 2010 adoption of SDOT's ITS Vision, SDOT has completed a nearly $40 million ITS work program, and invested more than $20 million in high-priority ITS projects that optimize the city's very constrained road capacity. Part of that investment has been in the deployment and maintenance of core systems that will support the expansion of services across the City including:

- SCOOT traffic adaptive control
- CONCERT central traffic responsive control
- Upgrading the ITS communications network to a layer 3 topology support added systems and improve resiliency
- Travelers ATIS web site and mobile applications
- Upgrading the SDOT Transportation Operation Center and increasing staffing, coverage, and functions

The MICMA goals and objectives flow from the ITS Vision and are:

Goals	Objectives
Improve access to jobs, health care, and education for all travelers.	• Provide access to mobility choice information that improves accessibility for all users including disabled persons.
Treat all modes equally while reducing delay to each.	• Increase travel time reliability. • Maximize throughput. • Provide traffic signal timing based on demand of vehicles, transit, cyclists and pedestrians. • Manage queues. • Change objectives as required to meet special demands. • Reduce SFD travel times in the UW subarea. • Reduce vehicle emissions.
Reduce crash risks for all modes.	• Time traffic signals for pedestrian demand at high pedestrian volume locations, and respond to cyclists at traffic signals.

2.11 Partnering Plan

SDOT has a history of establishing and maintaining true partnerships with public and private sector entities. For SDOT, the meaning of "true" partnerships is that each partner receives benefits. In this proposal, SDOT's partners' goals align with SDOT's, which each deriving benefit.

Partner	Systems/Services Provided	Partner Funding Contribution	Benefit to Partner	Benefit to SDOT
Siemens ITS	SiBike Pedestrian Surge Management System GreenWave	$174,000 (soft match) for controller firmware and central control software development, and provision of SiBike and app.	Provides a real-world deployment to further test and refine product.	Reduce delays to SFD responders, provide pedestrian surge management and provides improved flow for cyclists, with signals responsive to approaching bikes.
Sensys Networks	Cyclist detection	$8,250 (soft match) for equipment needed to provide GiveMeGreen app	Provides a real-world deployment to further test and refine product.	Provides improved flow for cyclists, with signals responsive to approaching bikes
FLIR	ATSPM tool	$225,149 (soft match)	Provides a real-world deployment of the ATSPM that integrates Acyclica data with traffic signal controller data.	Provides analytics to support ongoing operations and performance monitoring in the UW subarea.
IDAX	MaaS Data Strategy, Data/API Definitions	$175,000 (soft match)	Provides IDAX with in-depth understanding of data and API standard, enhancing their ability to efficiently create products using this data.	Enhanced data and API plus standard for these elements to provide to multiple private sector partners.
WSDOT	Funds are tied to SR 520 reconstruction project, and will support upgrades to WSDOT ATIS and traffic management.	$3,500,000 (in-kind match)	Improved arterial/freeway multimodal operations. Minimization of disruptions due to construction and incidents.	Improved arterial/ freeway multimodal operations. Minimization of disruptions due to construction and incidents.

Contractual arrangements will be made with our partners detailing each party's commitments and responsibilities. Letters of commitment are provided as an attachment to this grant proposal.

2.12 Leveraging Other Systems

This project will leverage and optimize many existing technology investments including:

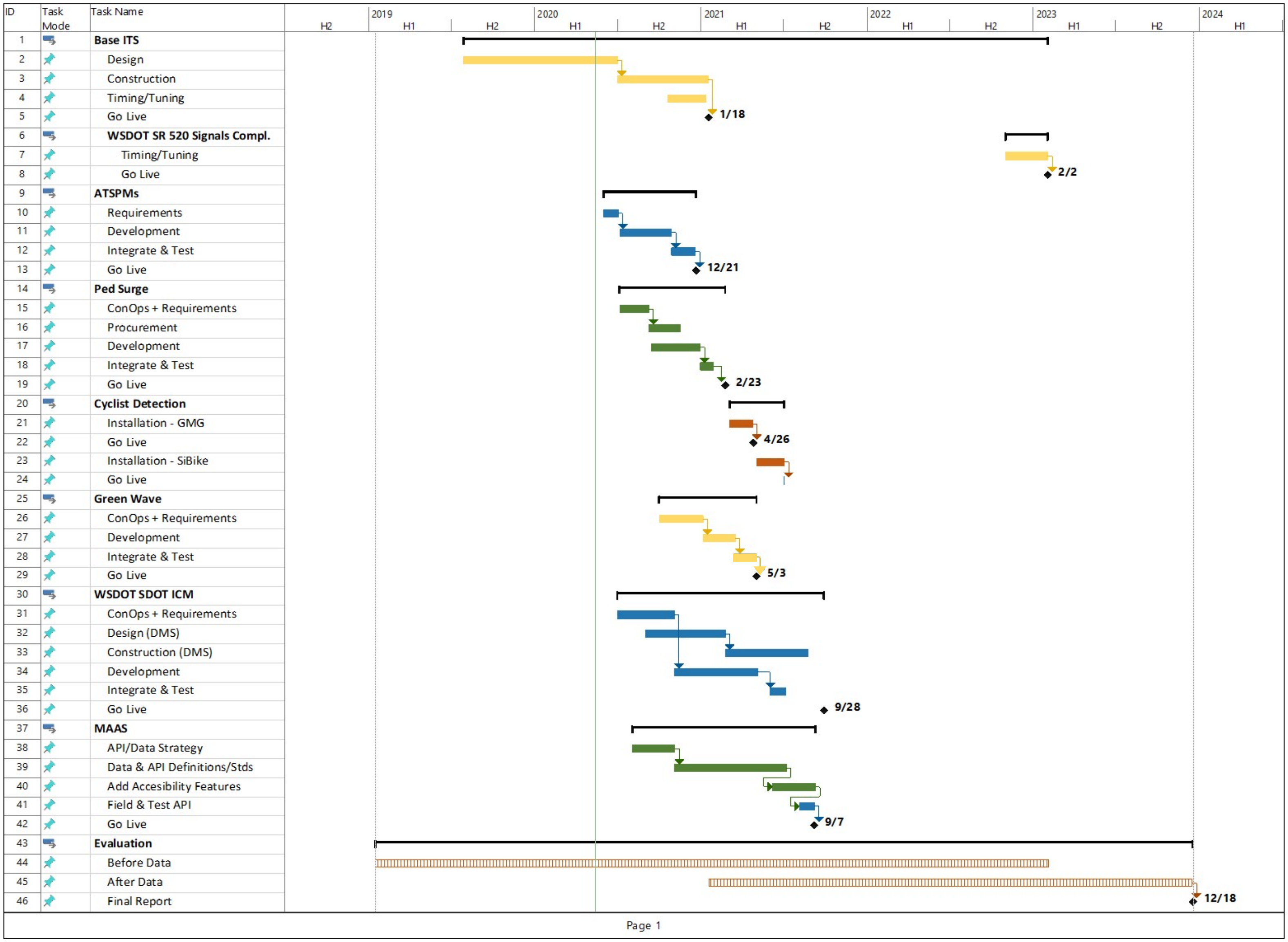
- SDOT has deployed ITS infrastructure across the City, with some ITS already in place in the UW subarea. The prior investment in the UW subarea includes existing traffic detection, CCTV cameras, DMS, traffic signal infrastructure, and communications infrastructure and is estimated at $10 million. This project will optimize this existing investment through system, detection, and communications upgrades.
- $1.75 million investment in advanced, central traffic signal control platforms – SCOOT for adaptive control and CONCERT for responsive control. SDOT has also invested in TACTICS (central traffic signal control software) and associated upgrades for 15 years.
- $1.5 million invested in the Travelers ATIS web site and mobile app. These systems will be enhanced with the data gathered in the UW subarea, increasing geographic coverage and accuracy.
- WSDOT brings their highly sophisticated advanced freeway traffic management software and systems. This project will leverage their existing travel time algorithms and data systems.

It is SDOT's plan to expand the systems and services provided in this proposal city-wide.

2.13 Schedule

The project technology deployments are anticipated to be complete within 4 years of NTP, which was January 16, 2019. WSDOT's construction schedule plans completion of their portion of the field ITS in late 2022/early 2023. Evaluation, which is planned to assess operations during Husky Football season, will require additional time to ensure a full set of data is provided (capturing the Fall 2023 Husky Football season), for a total of 5 years from NTP. "Before" data collection may be somewhat delayed due to COVID19, but much of the data has already been collected, and any delays can be incorporated into the current schedule.

In developing the schedule, care was taken to minimize overlap in the technology deployment phases. It was designed so that no more than 2 items will be in final (field) testing at the same time. This was done to ensure that each element can be evaluated separately, to minimize conflicts among technologies, and to allow for a more graceful roll out of the new technologies. Consideration of potential known schedule risks is also incorporated in the schedule.


ID
Task Mode
Task Name
2019
2020
2021
2022
2023
2024
H1
H2
1 Base ITS
2 Design
3 Construction
4 Timing/Tuning
5 Go Live
1/18
6 WSDOT SR 520 Signals Compl.
7 Timing/Tuning
8 Go Live
2/2
9 ATSPMs
10 Requirements
11 Development
12 Integrate & Test
13 Go Live
12/21
14 Ped Surge
15 ConOps + Requirements
16 Procurement
17 Development
18 Integrate & Test
19 Go Live
2/23
20 Cyclist Detection
21 Installation - GMG
22 Go Live
4/26
23 Installation - SiBike
24 Go Live
25 Green Wave
26 ConOps + Requirements
27 Development
28 Integrate & Test
29 Go Live
5/3
30 WSDOT SDOT ICM
31 ConOps + Requirements
32 Design (DMS)
33 Construction (DMS)
34 Development
35 Integrate & Test
36 Go Live
9/28
37 MAAS
38 API/Data Strategy
39 Data & API Definitions/Stds
40 Add Accesibility Features
41 Field & Test API
42 Go Live
9/7
43 Evaluation
44 Before Data
45 After Data
46 Final Report
12/18
Page 1

2.14 Connecting to USDOT Initiatives

SDOT is committed to support the USDOT in advancing ITS initiatives. The following table connects this grant proposal with the Program Categories identified in the JPO's ITS 2015-2019 Strategic Plan:

U.S. DOT Program Area	How This Project Supports the Program Area
Connected Vehicles	The cyclist apps are X-to-I systems that can inform the program in the area of "other CV technologies and communications media", and the interaction of these media with traffic signal control.
Emerging Capabilities	With two innovations proposed in this project, an understanding of the path to market of the products can help inform U.S. DOT's Emerging Capabilities Program Area.
Enterprise Data	Through the MaaS/Data Portal project, SDOT will be providing public and private sector access to SDOT's data in a seamless manner.
Interoperability	SDOT will be developing data standards for MaaS data, improving accessibility to any other users in the US. SDOT will also apply any existing U.S. DOT data standards.
Accelerating Deployment	This project will accelerate deployment of new products and services in the arterial traffic operations arena. The project can help U.S. DOT assess the impact of the program on product development, launch, and subsequent product phases.

The project evaluation can be designed to gather findings important to advancing the U.S. DOT's ITS Program Areas.

3 STAFFING

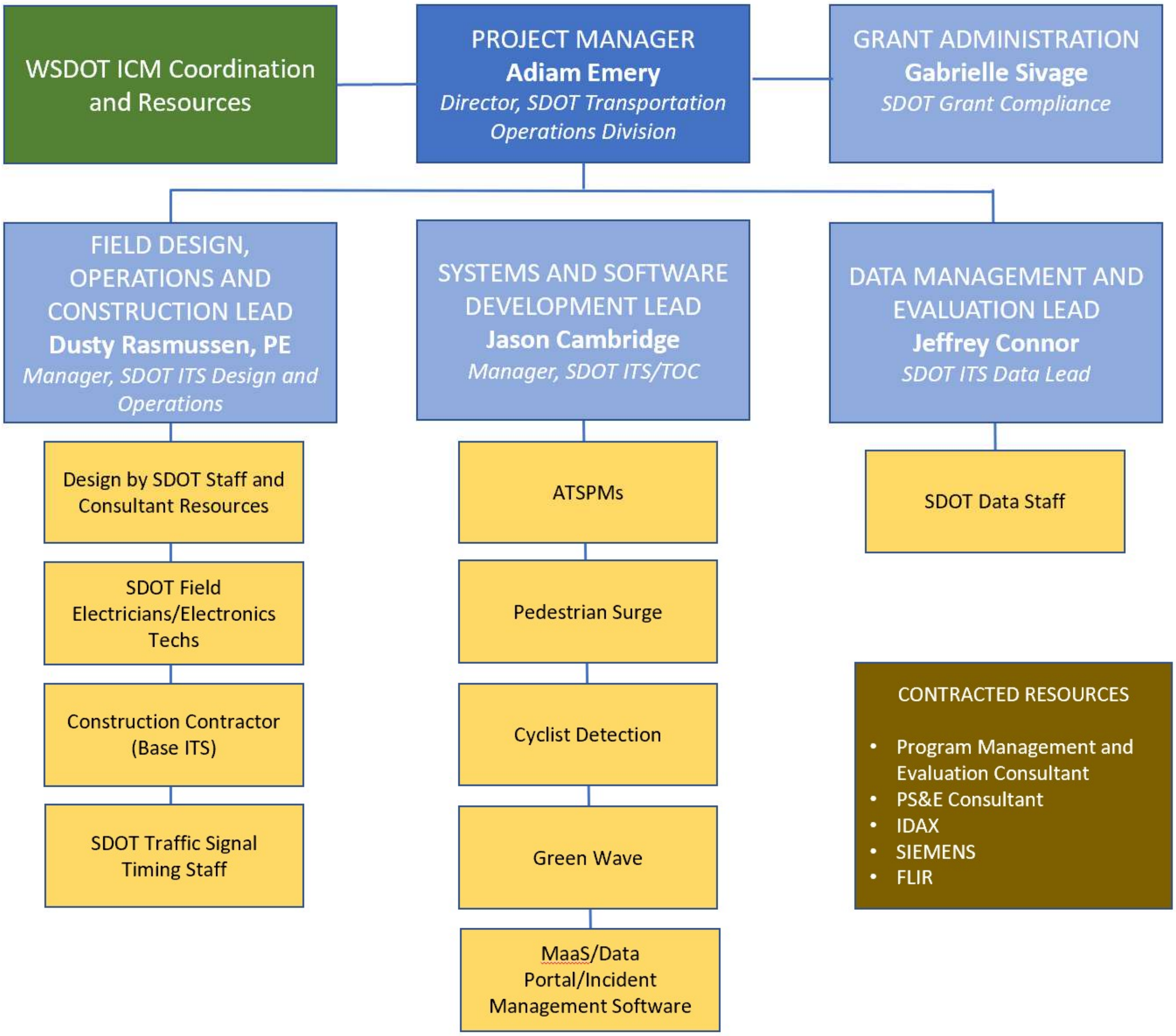
SDOT brings its top ITS staff to this project, each with significant and extensive depth of knowledge, skills and abilities to ensure success. Additionally, SDOT has supplemented their staff through on-call services contracts (already in place) to support ITS design, systems engineering and program management.

The SDOT Traffic Operations Division contains 123 staff. The Transportation Operations Center and ITS Program (27 staff), and the Signal Design and Field Operations (55 staff) groups reside within the TOD, and are leading this project. Key to this project are the following numbers of staff resources within these two groups:

- **12** Traffic data specialists
- **3** ITS engineers
- **9** Traffic signal timing/arterial operations engineers
- **6** Traffic signal/ITS design engineers
- **30** ITS/Signal electricians and electronics staff
- **4** IT/Network engineers

3.1 Project Organization

The following organizational chart provides the overall structure of the project staff assigned to this work, and identifies the key personnel. Key personnel resumes follow the organizational chart. As indicated in the organizational chart, responsibilities for design and construction, for software and systems development, and data management/project evaluation and ongoing performance monitoring are clearly matched with the appropriate key personnel with the proper skills needed to accomplish the work.



In addition to the key staff, the project partners and consultants are shown. This project is important to our private sector partners. To demonstrate their commitment, they have assigned their own key leadership staff to manage their efforts:

- From **Siemens, Glenn Massarano**, Principal System Engineer, is assigned to lead the work. Mr. Massarano is responsible for the customer success of Siemens' advanced software systems nationwide, providing technical expertise, systems engineering and quality control for implementations of our advanced transportation management systems and central traffic signal systems.
- From **Innovative Data Acquisitions (IDAX), Scott Lee, PE**, CEO, is assigned as lead for this effort. Mr. Lee is the CEO and a founding member of IDAX, a company that provides data solutions for transportation planning, management, and operations. Scott is responsible for data acquisition, integration, and summary across a multitude of data feeds to help bring a systematic approach, user-friendly access, and intentional visualizations for transportation decision making.
- From **FLIR Systems, Inc. (FLIR), Daniel Benhamou**, FLIR's Senior Director of ITS, Software and Solutions will lead the development of the ATSPM tool.

3.2 POINT OF CONTACT

The point of contact for this proposal is **Adiam Emery**.

Her contact information is:

E-mail: adiam.emery@seattle.gov

Phone: 206-384-5677

Cell Phone: 206-290-0495

Mailing Address: Seattle Department of Transportation
P.O. Box 34996
700 Fifth Avenue, Suite 3800
Seattle, WA 98124-4996

RESUMES

Adiam Emery SDOT Director of Transportation Operations	Project Role: **Project Manager**
Years' Experience: 25	Education: BSCE University of Washington

Adiam Emery brings her depth of project management, traffic operations and technology expertise to this project. She has supervised the SDOT traffic signal operations group, led the program that implemented ITS City-wide in Seattle, and managed the implementation of the current SDOT Traffic Operations Center – one of the only City-based TOCs in the US with fulltime operators, and which includes traffic incident management and traveler information in their mission and functions. She is responsible for the overall ITS and TOC program including policy, design, implementation, and operations as well as performance monitoring. As Director of the Transportation Operations Division, she has overall responsibility for all aspects of the UW MICMA project.

Relevant Experience

Project Manager – Implementation of Siemens SCOOT Adaptive Traffic Signal Software.

Managed all aspects of the successful Mercer Corridor SCOOT implementation from requirements to procurement, implementation, test and acceptance.

Project Manager – Data Exchange with Private Sector Provider.

Managed the development and deployment of data sharing of traffic signal real-time data with a private-sector developer that provides real-time traffic signal information to private partners (Audi, BMW) for their use in driver information and autonomous vehicle application development.

Project Manager – SDOT TOC and Video Display System.

Managed the full remodel of SDOT's TOC including reconfiguration of the space, implementing new operator console station and systems, and implementing a new video wall and associated software.

Project Manager – NextGen ITS Program.

Managed the deployment of $10 million of ITS systems and software across the city, including new WiFi/Bluetooth detection technology and associated analytics that provide travel time information which is posted on DMS and to SDOT's Travelers ATIS website.

Project Manager – Seattle CBD Signal Timing.

Managed the planning, modeling and implementation of new zone-based, traffic responsive, traffic signal coordination/timing plans at 260 intersections in Seattle's CBD, including the City's first use of Siemens CONCERT for "normal" and incident conditions.

Project Manager – Travelers Web Site.

Managed the development of requirements, coding, testing and launch of SDOT's Award-winning Travelers web site that features arterial congestion, incidents and travel times.

Key Accomplishments

- Founded SDOT ITS program and procured first $20M in federal funding as start-up capital investment.
- First in the US to implement arterial travel time system based on license plate readers, including posting travel times on DMS.
- Spearheaded the City's Incident Management Task Force. This task force provides a forum and agenda to improve arterial incident response, and to advance integrated freeway/arterial management with respect to incidents.
- Implemented 24/7 TOC staffing, and policies and procedures to reduce incident-related disruption and delay, and to improve public information provision regarding construction, incidents, events, and "normal" congestion.

Dusty Rasmussen, PE, PTOE **SDOT Manager of Signal Design and Field Operations**	Project Role: **Field Design, Construction and Operations Lead**
Years' Experience: 12	Education: MSCE University of Washington BA, Applied Physics, Whitworth College

Dusty leads SDOT's teams responsible for traffic signal and ITS design, traffic signal operations, and traffic signal/ITS field maintenance and construction. He brings comprehensive, hands-on experience implementing and operating traffic signals and ITS across Seattle. His knowledge of traffic and ITS engineering principles, standards, law and regulations are applied daily as he serves as divisional reviewer of final plans, specifications and estimates. His background includes modeling and implementing complex traffic signal operations.

Relevant Experience

Project Manager – Montlake Triangle Bus Station Restructure Project.

Managed and performed design, and construction oversight and oversaw operations analysis for this project that reconfigured transit operations to support the new Link Light Rail Station. Work including real-time information DMS, upgrading network communications, implementation of ADA-standard curb ramps and APS, and traffic signal reconstruction. Extensive coordination with the University of Washington, Sound Transit, and King County Metro resulted in a successful project, ready to support opening day of the light rail station.

Project Manager – Annual Traffic Signal Rebuild Projects (2004 to date).

Manages a team of engineers and field crews that perform redesign and upgrade of 5 traffic signals annually. Ensures the work meets all current standards (e.g. AASHTO, NACTO, MUTCD, PROWAG) and serves the required modal balance with projects including Protected Bike Lanes, transit enhancements, and pedestrian signal phasing. Provides oversight of complex upgrades to signal timing plans to serve all modes.

Project Manager – Citywide Pedestrian Enhancement Projects

Project manager responsible for design, implementation and coordination of APS upgrades, and Rectangular Rapid Flashing Beacons (RRFBs) across the city including associated civil works to support ADA compliance.

Key Accomplishments

- Developed and implemented method to calculate pole loading to ensure traffic signal rebuilds meet current modern design requirements.
- Oversaw staff performing successful delivery of SDOT's first adaptive traffic signal operations project.
- Successful deployment of $18.5 million in ITS improvements and maintenance over the past 2 years, installing hundreds of ITS devices (including advanced traffic signal controllers, CCTV cameras, detection, fiber optic cable and network devices, wireless communications) across the City.
- Budget and schedule requirements for the 60-person staff of electricians, electronics technicians and systems experts consistently met.

Jason Cambridge **Manager of Data Analytics and ITS**	Project Role: **Systems and Software Development Lead**
Years' Experience: 15	Education: BS Information Systems, City University

Certifications:

•• Comp TIA Network+ Certification (2008)
•• Master Certificate in IS/IT Project Management – Villanova University (2012)
MTA Certificate in Windows Server Administration Fundamentals (2014)
•• Cisco Certified Network Administrator – Routing and Switching (2017)
Cisco Certified Network Administrator – Security (2017)

Jason leads the SDOT Transportation Operations Division technology selection and maintenance program. He leads a team of engineers responsible for designing and managing the ITS communications network and IT infrastructure, as we as the specific ITS technologies deployed. He manages servers, workstations, custom, and off-the-shelf applications used by the City and the public, including the SDOT web based ATIS known as Travelers. He manages the selection, development, integration and testing of all systems and software under his management, including ITS field devices. Additionally, he is responsible for analyzing and maintaining IT system security, in compliance with City IT policies and requirements.

Relevant Experience

Project Manager - SDOT ITS Communications Network Upgrade.

Managed the planning, design and implementation/migration to upgrade SDOT's city-wide ITS communications network to a Layer 3 topology, providing for needed capacity, as well as greatly improved resilience and security.

Project Manager – Network Resiliency Plan

Managed a consultant team to evaluate and make recommendations for improving ITS communications network resiliency.

Project Manager – SDOT Travelers ATIS Web Site.

Managed the update of SDOT's public-facing ATIS web site to provide additional real-time traffic information and to integrate new third-party data providers. The upgrade also provided multi-platform public mobile user interfaces. Jason developed requirements and oversaw software development for all aspects of the upgrade.

Project Manager – One Bus Away Digital Signing.

Managed the design and implementation of digital signage at transit stops displaying when the next bus is predicted to arrive. Work included developing requirements, and overseeing testing and acceptance, including requirements for the API to transform the data to an NTCIP-compliant interface.

Key Accomplishments

- Reduced system down time due to network failures.
- Implemented a streaming media server solution to provide traffic camera control to emergency responders, the Seattle Police and Fire Departments, the Mayor's office, and other City personnel.
- Successfully planned and migrated the TOD's mission-critical operations systems from a downtown high-rise to data centers to minimize single-point failure risk. The work required re-architecting a 450-node communications network spanning the City, and developing and implementing a continuity of operations plan.

Jeffrey Conor **SDOT Data Analyst**	Project Role: **Data Management and Evaluation Lead**
Years' Experience: 13	Education: MSCE University of Washington MS Math Education, Brooklyn College BA Economics, Oberlin College

Jeffrey brings a diverse range of mathematical modeling and analytical skills to SDOT. He is also experienced with a range of data gathering and storage systems, enabling him to ensure data quality, and to perform deep data dives to support project performance and evaluation needs. Having served two years as an operator in SDOT's TOC, his understanding of arterial operations and incident management is a core skill supporting his work.

Relevant Experience

Project Lead – SDOT Non-Intrusive Detection Testing.

Jeffrey is responsible for the evaluation design data collection, and analysis of SDOT's program to test non-intrusive vehicle, cyclist and pedestrian detection. Performance metrics include traffic counting and traffic signal detection functions across a range of environmental and implementation conditions.

Project Lead Analyst – How Seattle Bikes

Created a bike collision exposure metric using diverse data sets (crash, road geometric and other features, volumes), and statistical analysis methods.

SDOT Senior ITS Engineer, Specialist

Responsible for a range of project performance metrics including for Mercer Corridor Adaptive Signal operations, West Seattle Bridge Closure, and the "big squeeze" of the SR 99 closure. Lead in mining and gathering required data, evaluating the data for errors, cleaning the data, performing the analysis, and creating public-friendly presentations of the results.

Key Accomplishments

- Overseeing SDOT's first data storage and analytics contractor in the delivery of daily and weekly arterial operations performance monitoring reports
- Created a model in Arcview GIS to analyze new camera placements in support of long-term ITS plans.
- Streamlined the TOC Incident Response and Inventory databases and reports to collect and report more meaningful metrics. .