SDOT
Seattle Department of Transportation

ITS STRATEGIC PLAN 2010-2020



March 2010

Seattle Department of Transportation

ITS STRATEGIC PLAN 2010–2020

March 2010

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TUKWILA
Rainier Beach

OVERVIEW

This plan provides a 10 year approach for implementing **Intelligent Transportation Systems (ITS)** in Seattle. ITS employ electronics and communications technologies on the street, and automated traffic systems, to enhance mobility for all modes by increasing the efficiency and safety of the transportation infrastructure.

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The Seattle Department of Transportation (SDOT) has been implementing ITS for many years, primarily to address multi-modal (car, pedestrian, bicycle, transit and freight) operations at traffic signals. Implementations have included:

- Enhancing operations by adding communications links, installing new traffic signal controllers with additional capabilities, and increasing the frequency of traffic signal timing updates.
- Using automated systems that detect congestion and change signal timing to speed traffic clearance from special event venues (Key Arena, Safeco Field, Seattle Center, Benaroya Hall), from bridge openings, ferry off-loading, and rail crossings.
- Improving traffic signal operations for all modes by adding detection for pedestrians, bicycles, and vehicles, and by installing improvements to vehicle and pedestrian signal displays, including audible displays for the visually impaired pedestrian.
- Installing and operating transit signal priority (TSP), and other transit systems for buses, streetcars, and light rail trains.
- Implementing traffic cameras citywide to improve the response to outages and incidents.
- Providing public access to traffic information by implementing a website that includes real-time congestion information, traffic advisories and images from traffic cameras.
- Deploying Dynamic Message Signs (DMS) to provide targeted traffic messages to drivers en route.

The investments and infrastructure in place provide a core set of services. This infrastructure must be maintained to ensure safe, reliable and efficient operations, and properly managed to realize a positive return on the investment. This Strategic Plan identifies this, the ITS "Core Infrastructure" as:

- Traffic signal controllers, cabinets, detection and displays
- The citywide ITS communications network
- Traffic cameras that enable staff to view operations and dynamically adjust traffic signal timing if needed
- DMS that provide on-street traveler information
- The traveler's website (*www.seattle.gov/travelers*) that includes congestion information, traffic advisories and traffic camera images
- The Traffic Management Center (TMC) that includes processing, monitoring, and communications equipment allowing staff to interact with the systems
- The staff that operate and maintain these assets

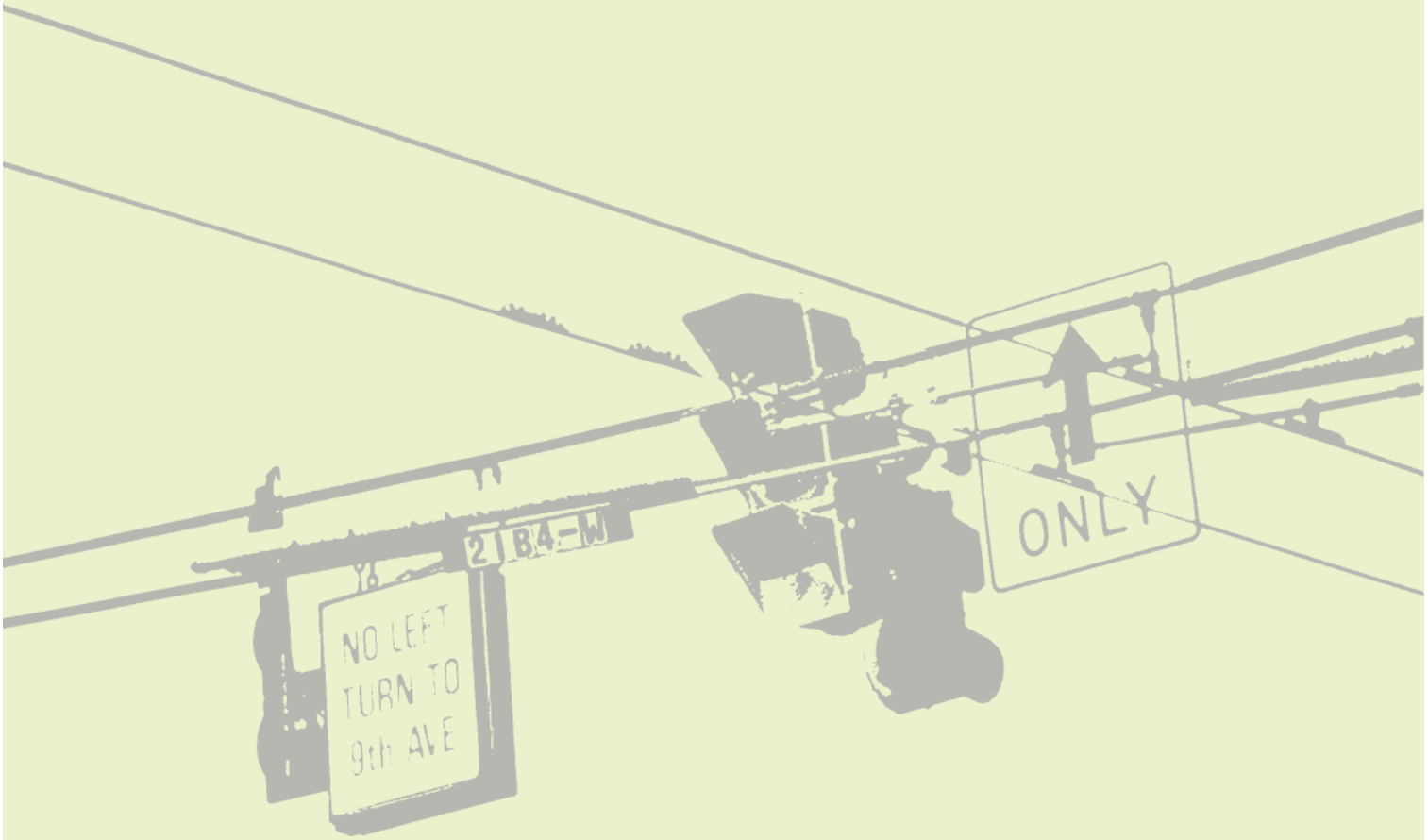
PLAN FOCUS

The focus of this **Strategic Plan** is to ensure the value of the existing ITS Core infrastructure is maximized by:

1st - *ensuring the ITS Core Infrastructure is maintained and preserved,*

2nd - *delivering the full value from the existing infrastructure,*

3rd - *to expand and leverage the ITS Core to provide additional geographic coverage and services to travelers, in support of SDOT's mission.*



SDOT MISSION

To deliver a safe, reliable, and efficient transportation system that enhances Seattle's environment and economic vitality.

ITS VISION

SDOT has developed an **ITS Vision Statement** that aligns with the department's mission and the citywide vision for the future of Seattle.

This vision provides guidance for implementation of the ITS Strategic Plan. ITS projects must meet the intent of the vision to be considered for deployment.

VISION STATEMENT

To support development of a sustainable transportation system, and to contribute to the City's economic vitality, by implementing, operating and maintaining the most appropriate technology to meet multimodal transportation safety and mobility needs.

Implementing the vision will result in protection of traffic safety, reduced environmental impacts of transportation, improved multi-modal mobility and enhanced efficiencies of the transportation network.


BUSES ONLY
ONE WAY
Madison St

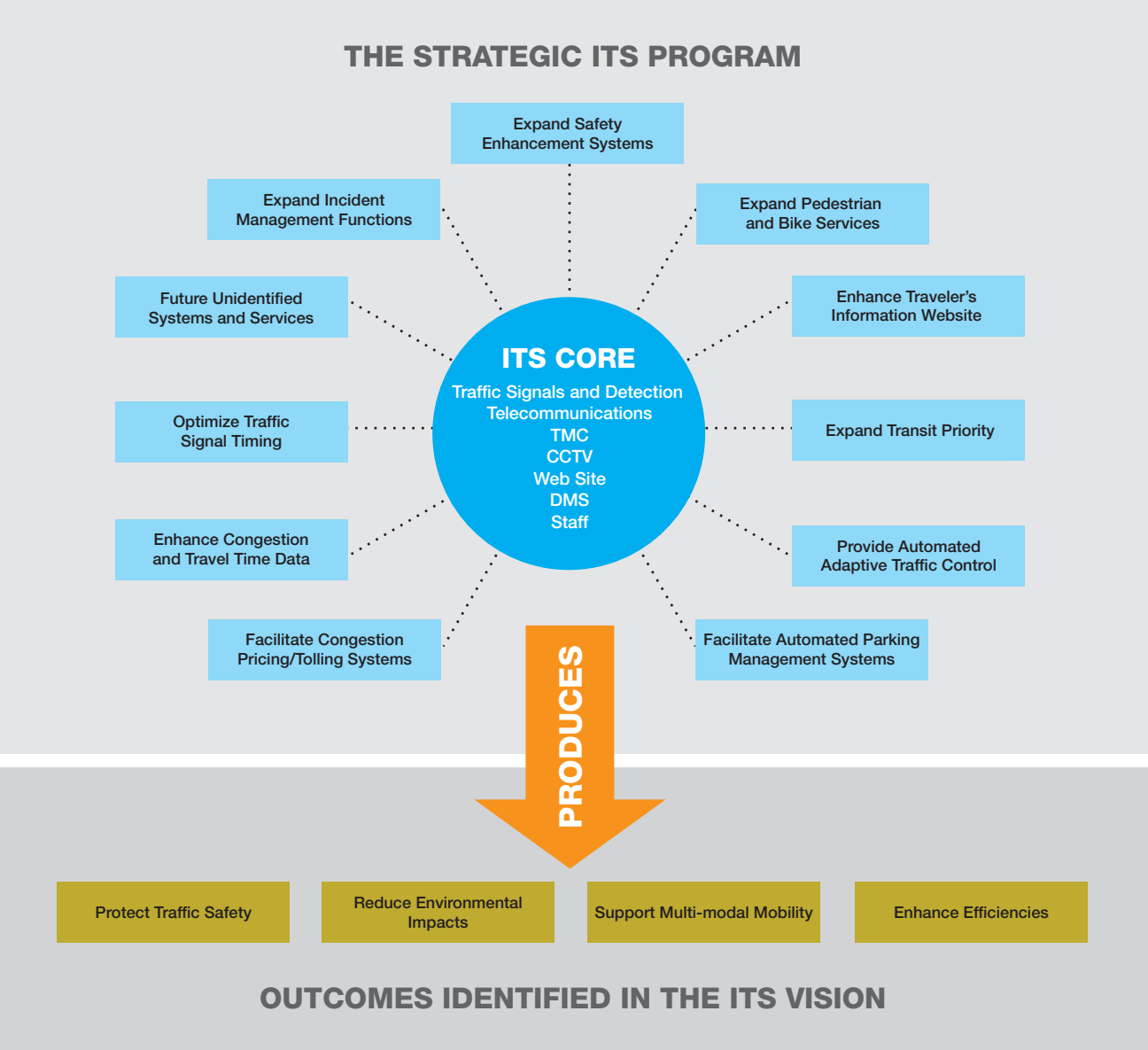
ITS IN SEATTLE

Intelligent Transportation Systems represent the next step in the evolution of the nation's transportation infrastructure.

As information technologies and advances in electronics continue to revolutionize all aspects of our modern-day world, from our homes and offices to our schools and even our recreation, they are also being applied to our transportation network. These technologies include the latest in computers, electronics, and communications systems.

Within SDOT, ITS has grown from its original focus on safely and effectively managing traffic operations to include a range of equipment and functions that improve the multimodal travel experience. ***Figure 1*** provides a schematic depiction of the ITS systems in place and considered within the Strategic Plan.

Figure 1: *Building Off The ITS Core*



THE ITS CORE

As shown in ***Figure 1,*** the ITS Core is at the center of the ITS program. The ITS Core consists of:

- *Technologies including traffic (vehicle, pedestrian and bicycle) signals and associated vehicle, pedestrian and bicycle detection systems, transit signal priority, telecommunications, central control software, the TMC, and traffic cameras.*
- *The Travelers web site and DMS to provide important information to the public.*
- *Operations and maintenance staff resources that are essential to the implementation, operations and maintenance of the systems.*

This ITS Strategic Plan focuses first on:

- *Maintaining the ITS Core to ensure high availability and proper operations.*
- *Extracting full value from the ITS Core. For example, software that enables traffic responsive traffic signal operations is a one-time expenditure, but to ensure value is extracted from that expenditure, staff resources are needed to develop and implement the signal timing plans.*
- *Strengthening the ITS Core, in the form of providing added capacity and redundancy to key communications and systems that support important transportation services.*
- *Leveraging the ITS Core to expand the geographic coverage, service and benefits of ITS.*

SAMPLE BENEFITS OF CURRENT ITS DEPLOYMENTS

The following provides examples of how SDOT has implemented and leveraged the ITS Core to provide services and benefits to travelers.

Traveler Information

BENEFIT:

The power to make decisions regarding route, mode and trip departure time through web-based traveler information

NATIONAL EXPERIENCE:

The majority of workers surveyed in Seattle and Los Angeles indicated that they used the Internet to obtain traffic information for their commute trips. Results indicated that commuters tended to use information on the Internet more heavily during the afternoon commute versus the morning commute because they had greater flexibility at the end of their work day to modify their departure time and compensate for traffic conditions. Even more commuters reported that they used web-site traffic information to check traffic on alternate routes *(Federal Highway Administration (FHWA), United States Department of Transportation (USDOT), 2005).*

SDOT RESULT:

In 2009, SDOT implemented an innovative approach to providing City arterial congestion and traveler alert information on the Internet (*www.seattle.gov/travelers*). The site, shown in ***Figure 2,*** also includes traffic camera images. It replaces the site launched in 2001 that provided only traffic camera images. The city is transitioning from the old to the new site, and maintains both as of early 2010.

The number of people wishing to view traffic cameras increases greatly during major traffic incidents, game days and during weather events. For example, the old traffic cameras website was a critical service for the public during the major snow storms in 2008 and daily camera site activity was 200 to 300 times greater than average. ***Table 1*** provides usage data for the old traffic camera website through 2008, and camera usage on the new site in 2009.

Figure 2: *Traveler's Information Website*

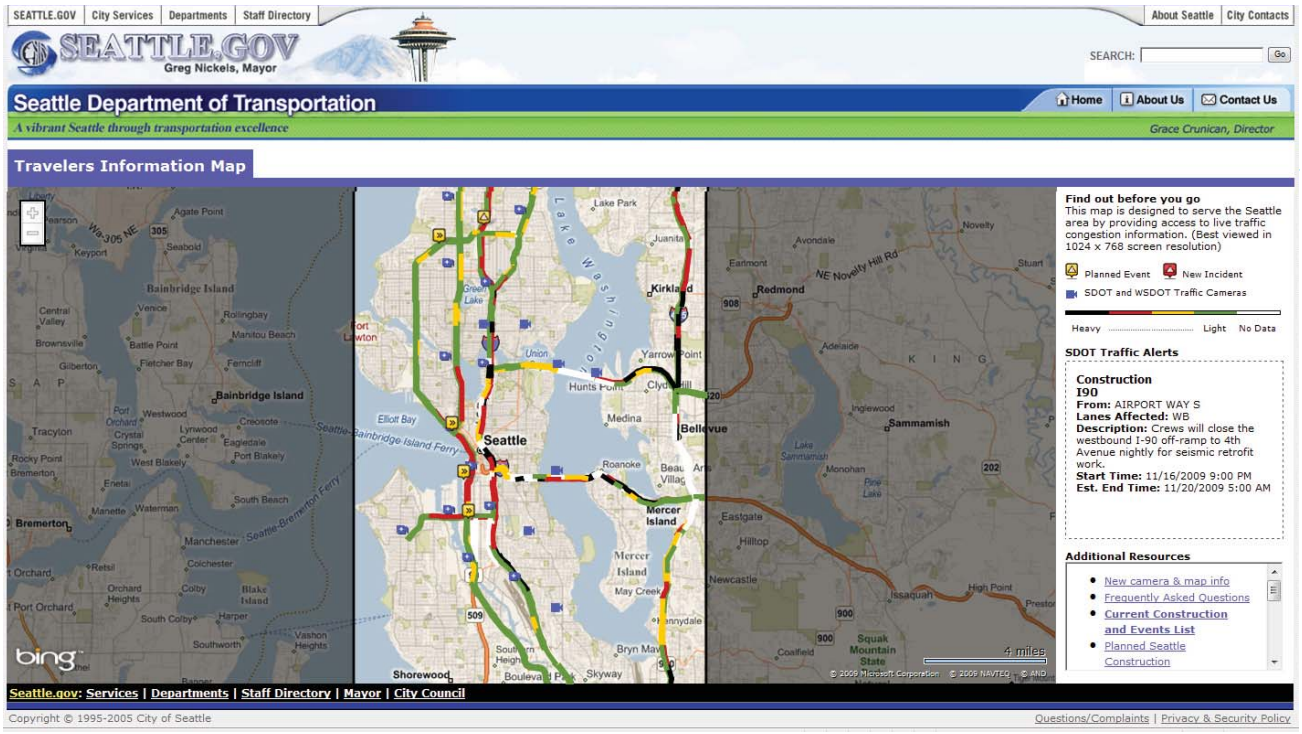


Table1: *Traffic Camera Website Usage*

YEAR	Camera Locations Available on the Web	Annual Website Hits (in millions)
2004	11	2.7
2005	28	2.9
2006	36	4.8
2007	41	7.3
2008	41	9.4
2009	73*	19.7**

** As of October 2009, 52 SDOT and 21 Washington State Department of Transportation (WSDOT) cameras were live on the City website.*

*** Data reflects traffic camera activity only*

Traffic Signal Timing Optimization

BENEFIT:

Fewer starts and stops, more reliable travel times, and reduced emissions due to improved traffic signal operations

NATIONAL EXPERIENCE:

Traffic signal retiming is one of the most cost-effective ways to improve traffic movement and make our streets safer. Comprehensive signal retiming programs have documented benefits of 7 to 13 percent reduction in overall travel time, 15 to 37percent reduction in delay and 6 to 9 percent fuel savings *(Institute of Transportation Engineers, 2009)*.

The FHWA estimates that the benefit-to-cost ratio of traffic signal timing optimization projects approaches 40 to 1. Improved traffic signal operations mean less stop-and-go traffic, which in turn means fewer rear-end accidents. Plus, fuel consumption (and associated emissions) is reduced *(USDOT/FHWA, 1996)*.

SDOT RESULT:

At 2009 staff levels, SDOT's goal is to optimize 150 traffic signals each year. SDOT's signal retiming experience matches the FHWA estimates of benefits, with recent retiming projects resulting in overall corridor delay reductions of 12 percent (off-peak) to 27 percent (PM peak), and emission reductions of 3 percent (off-peak) to 8 percent (PM peak). Plus, the retiming effort has reduced cycle times during off-peaks - greatly reducing delay for vehicles, pedestrians and bikes and reducing emissions during those off-peak periods.

Pedestrian and Bike Improvements

BENEFIT:

Mobility equity for bikes and pedestrians through improved detection and display technologies

Bicycle Detection at Traffic Signals

NATIONAL EXPERIENCE:

While there are no studies of the benefits of bicycle detection at traffic signals, they are generally viewed as mobility enhancement. Bicycles must follow the same rules of the road as motorized vehicles. It follows that traffic signals should respond similarly to bicycles and vehicles.

Addressing pedestrian mobility, pedestrian countdown timer indications were approved for use in the 2003 version of the Manual of Uniform Traffic Control Devices (MUTCD), the standard for signs, signals, and pavement markings in the United States. In 2009, the countdown indication was established by the MUTCD as a standard. A pilot study in San Francisco found that, at the pilot intersections, installation of countdown timers resulted in a reduction in pedestrian crossings on red from 14 to 9 percent. And, a study in Montgomery County, Maryland, confirmed that the installation of countdown timers reduced pedestrian-involved collisions *(Livable Streets Intiative)*.

SDOT RESULT:

SDOT has improved bicycle detection at traffic signals by adding bike-specific detection, fine-tuning existing detection, and placing pavement markings to help bikes locate the "hot spot" for detecting bikes at traffic signals.

The City has implemented a program, using "Bridging the Gap" funds, to replace standard pedestrian indications with LED countdown pedestrian indications citywide with about one-third of all locations changed out. Plus, SDOT has worked with the pedestrian and disabled populations to identify priority location for audible pedestrian signals to support the visually impaired.

Transit Signal Priority

BENEFIT:

More predictable and speedier transit trips through transit signal priority

NATIONAL EXPERIENCE:

Transit signal priority (TSP) systems follow a number of different operating strategies that provide green signals to approaching transit vehicles. Experiences in 10 cities in the U.S. and abroad indicate up to 20 percent reductions in bus travel times with transit signal priority. Several studies show significant reduction in travel time variability, with a corresponding improvement in on-time performance. *(Chada, 2002)*.

SDOT RESULT:

Transit Signal Priority (TSP) is in place along Aurora Avenue N, Lake City Way NE, 1st Avenue S, Rainier Avenue S, and at other intersections in Seattle where transit can jump the queue at traffic signals. In addition, TSP systems for the Lake Union Streetcar and Sound Transit Light Rail on MLK are in place.

King County Metro estimates that these systems produce from 5 to 10 percent improvements in transit speed, and related reliability improvements.

Freight Movement Enhancements

BENEFIT:

Reduced delays to freight and other traffic through on-street information via DMS related to incidents, bridge opening delays, construction and special event advisories.

NATIONAL EXPERIENCE:

Simulation of the Advanced Warning to Avoid Railroad Delay (AWARD) system installed in San Antonio estimated that incorporation of information on rail crossing blockages on DMS resulted in 16 to19 percent decreases in travel time delay for affected motorists (United States. Joint Program Office for Intelligent Transportation Systems, 2001). The San Antonio evaluators also estimated that messages posted on arterial DMS for purposes such as congestion information, closures, and the like could support delay reductions by as much as 5 percent.

SDOT RESULT:

DMS have been installed in the SODO area to provide construction advisories (such as closures due to the Spokane Street viaduct reconstruction), for advanced warning of congestion-causing special events, for advice of bridge openings for the lower level Spokane Street Bridge, and other traffic advisories. In 2010, 20 new DMS will be operational across the City. These DMS will be used for incident management, bridge opening delay messages, and to warn of upcoming construction. Most of the new DMS were placed to mitigate impacts of the Alaskan Way Viaduct replacement project, and include freight corridors.

Automated Traffic Signal Responses

BENEFIT:

Automated traffic signal timing changes to respond to rail crossings, bridge openings, special events, reducing traffic clearance/recovery delay.

NATIONAL EXPERIENCE:

No documented US experience with this functionality was found.

SDOT RESULT:

SDOT has implemented innovative automated traffic signal timing plans, to help traffic recover after a disruption. Electronic integration has been accomplished with rail crossings in the SODO, and with the 1st Ave S Bridge that automatically change signal timing to clear long queues (if needed) after the rail crossing or bridge opening is complete. Plus, an automated system is in place at the Colman Dock to assist in the off-loading of ferry boats, resulting in substantial time savings to ferry operations. In addition, automated traffic signal timing response systems are used to address event traffic at Seattle Center, Safeco Field, Qwest Field and Benaroya Hall. Observations indicate that these systems are very effective at reducing delays and idling, providing associated reductions in emissions.

Safety Systems

BENEFIT:

Improved safety for peds, bikes and motorized vehicles through the implementation of red-light running enforcement cameras.

Red Light Running Enforcement Cameras

NATIONAL EXPERIENCE:

Evaluations in Fairfax, VA and Oxnard, CA showed that camera enforcement reduced red light running violations by about 40 percent. In addition to reducing red light running at camera-equipped sites, violation reductions in both communities carried over to signalized intersections not equipped with red light cameras *(Insurance Institute for Highway Safety, 2009)*.

Nationally, red light runners cause as many as 219,000 crashes each year, resulting in approximately 1,000 deaths and 181,000 injuries. About half of those killed in red light running crashes are pedestrians *(National Campaign to Stop Red Light Running, 2009)*.

SDOT RESULT:

In support of the Seattle Police Department-operated program, SDOT provides resources to enable the enforcement of a red light running camera program begun in 2007. 18 intersections were equipped by the end of 2008. Red light running was reduced by 44 percent at those locations in 2007 and 59 percent in 2008. SPD studies indicate that there has been no change in the total number of crashes, but injuries have been reduced.

Emergency Vehicle Pre-Emption

BENEFIT:

Emergency Vehicle Preemption (EVPE) systems provide green indications for approaching fire and emergency response vehicles.

NATIONAL EXPERIENCE:

The most commonly reported benefits of using EVPE include improved response time, improved safety, and cost savings. These benefits have been realized since the early deployments of EVPE and have been documented since the 1970s. For example, in Houston where EVPE was installed in 1992, a before-and-after study was conducted. After a year of operations, the average emergency vehicle travel time decreased 16 percent in one district and 23 percent in another *(FHWA JPO, January 2006)*.

Over the period from 1967 through 1976, the City of St. Paul deployed EVPE on 285 of 308 intersections. During this period, the number of emergency vehicle crashes decreased from the 1967 high of 8 to an average of 3.3 per year in the latter years of the study.

SDOT RESULT:

SDOT has implemented EVPE at more than 200 traffic signals in the City, with more being added each year. Working with the Seattle Fire Department, a schedule of high priority locations was developed to guide deployment. In some cases, EVPE has also been installed to mitigate construction impacts on adjacent corridors.

Speed Indicator Signs

BENEFIT:

Speed Indicator Signs that provide motorists with their speed consistently cause the fastest speeders

to reduce their speeds, resulting in localized safety benefits.

NATIONAL EXPERIENCE:

A study in Maryland showed that a reduction in the faster speeds (85th percentile speed) of 0 to 5 percent was found. In addition, the City of Bellevue experience with the signs installed to minimize arterial speeds showed a reduction in average speeds of 1 to 5 MPH and a similar reduction in 85th percentile speeds with most locations experiencing a 10 MPH reduction in 85th percentile speeds.

SDOT RESULT:

SDOT has implemented 16 speed indicator signs to support traffic calming efforts.

Maintenance Resources

BENEFIT:

Reductions in emissions from vehicles can be expected due to delay reductions directly associated with improved traffic signal maintenance.

NATIONAL EXPERIENCE:

Implementation of a traffic signal preventive maintenance program in DeKalb County, Ga (with 714 signals) resulted in a 35.6 reduction in trouble calls, an estimated reduction in congestion due to signal malfunctions of 1441 hours and associated reductions in emissions due to congestion *(Allen, 2009).*

SDOT RESULT:

SDOT has funded traffic signal preventative maintenance for many years. Based on maintenance staff input, SDOT's preventive maintenance program has reduced trouble calls for signal outages.


HOTEL
MAX

PREVIOUS PLAN: SUMMARY OF ACCOMPLISHMENTS AND REMAINING GAPS

The ITS systems and services described in the previous section have been implemented over several years, with many having been identified in the previous ITS Strategic Plan (2003 – 2008). This section summarizes the prior plan and the work done to achieve the plan's goals. The Appendix provides a more complete summary.

FOCUS OF THE PRIOR ITS STRATEGIC PLAN

The previous plan outlined a specific strategy for ITS improvements. The strategy recognized that while capital and operations/maintenance resources were limited, new technologies and systems were needed to meet the needs of the public. The focus of the prior strategic plan was two-fold:

1. to begin to fill critical gaps in important ITS operations and maintenance functions that had gone unmet for several years, AND
2. to strategically implement new ITS on the most highly traveled roads within the city to ensure that the most people experience the greatest benefits. These roads were dubbed the "ITS Key Arterial Network".

The plan identified critical gaps, field deployments and action items to meet the ITS Vision. Because of the lack of resources, SDOT recognized that they could not implement all of the desired ITS everywhere in the City. Therefore, the previous plan identified a subset of the City's arterial network where ITS would be focused. The "ITS Key Arterial Network" from that plan is shown in ***Figure 3***.

Figure 3 also provides a measure of progress in deployment on the ITS Key Arterial Network trough 2010. The map is color coded to indicate the level of instrumentation and robustness of the systems that make up the field elements of the ITS Core.

Red – *Nominal progress towards implementation. Additional investment required for detection, communications, traffic cameras, DMS, and controllers/cabinets.*

Yellow – *Significant progress towards implementation. Additional investment required for communications, detection, traffic cameras and DMS.*

Green – *Major progress towards implementation. Most hardware has been deployed. Spot improvements or enhancements required.*

SDOT was able to expand ITS implementations onto a significant amount of the ITS Key Arterial Network identified in the prior plan. This implementation was enabled by Federal Grants, including funds received as part of the Alaskan Way Viaduct Replacement Project mitigation agreement, and funds contributed by the Port of Seattle specifically for DMS on freight routes.

Figure 4 provides a map indicating the locations of SDOT's ITS field devices as of early 2010.

Figure 3: *ITS Deployment Progress on 2003-2008 ITS Key Arterial Network*

Figure 4: *Location of select ITS Devices Citywide (as of early 2010)*

SUMMARY OF REMAINING GAPS

Although a great deal was accomplished in the past 7 years, the funding sources limited and restricted deployment to particular areas and corridors, and to specific systems and services. In particular, Alaskan Way Viaduct Replacement Project mitigation funds focused on direct impacts from the Viaduct replacement project. Thus, SDOT was not able to fully address all ITS needs on the ITS Key Arterial Network, or citywide.

The most important gaps that remain from the prior plan are :

- **GAP:** Sufficient resources to operate and maintain the existing and planned systems, including maintenance, signal operations, and performing incident management functions on a 12 hour per day/5 day per week (12X5) basis.

- **GAP:** Completing implementation of ITS on, and expansion of, a redefined ITS Key Arterial Network. Suggested ITS equipment includes detection to enable advanced bicycle, pedestrian, transit and vehicle operations at intersections, traffic cameras, DMS, travel-time and congestion data collection, and the fiber-optic communication network. Particular focus of expansion of the ITS Key Arterial Network is on mitigating impacts of major construction, additional focus on freight and transit operations, enhancing east-west movement and alternative mode functionality.

- **GAP:** Expansion of the capabilities, data coverage, and information provided via the Travelers website.

Closing these gaps is the first priority of this plan.


TO FERRIES
Vashon
Southworth
Bremerton
Bainbridge
RIGHT LANE
14' MAX HEIGHT
PAST ROYAL
BROUGHAM
NORTH
519
SAFECO FIELD
QWEST FIELD
14
OVERSIZED
TRUCK
DETOUR

2010-2020 ITS PROGRAM PLAN

The actions described below will enable the City to satisfy the ITS vision as described in this plan.

They are designed to maintain, geographically expand, and strengthen the ITS Core, which is vital to the continuing success of the ITS program and, by extension, to the smooth functioning of the City's transportation network. Budget and resources permitting, leveraging the ITS Core to provide expanded ITS systems and services may be accomplished as well.

ITS CORE ACTIONS

The following describes, at a programatic level, actions that address maintaining, strengthening, expanding, and leveraging of the ITS Core.

ITS CORE ACTIONS

Program	Description
Continue Controller/Cabinet and Equipment Upgrades	SDOT must complete phase-out of older controllers/cabinets and associated equipment to enable improved traffic signal operations including additional vehicle, pedestrian and bicycle detection, transit signal priority, and the ability to communicate with the central control system. Controller technologies are continually evolving, and change-outs will be a necessary and ongoing part of the ITS program.
Expand Deployment of Detection at Traffic Signals	Additional traffic detection is required to assist the Department in improving the operations of the traffic signals to reduce delays and associated vehicle emissions. Detection will be implemented to support bicycles, to provide system detection (which supports automated traffic signal timing changes based on traffic volumes), to enable improved signal operations, to support incident detection, and to gather data on overall system operation and performance. Highest priority is assigned to locations which would experience impacts from major construction projects such as the SR 520 Bridge, Spokane Street Viaduct and the Alaskan Way Viaduct replacement projects.
Expand Deployment of the Fiber optic Communications Network	Fiber optic communications media is required to provide highly reliable communications to all ITS devices. Not only does a fiber network provide robust service to signals and ITS devices, it reduces maintenance calls. Some locations in the City are served by copper communications, and some locations have no communications for ITS. More fiber optic cable will be needed in the long-term to serve ITS deployments. Some of this fiber will be required to replace older copper communications media. Highest priority is assigned to locations which would experience impacts from major construction projects such as SR 520 Bridge, Spokane Street Viaduct and the Alaskan Way Viaduct replacement projects. Fiber optic resources also support transit signal priority and real-time transit arrival time systems.

Program	Description
Implement Systems That Increase the Reliability of the ITS Core	SDOT plans to implement the following systems to increase the reliability and robustness of ITS: • **Battery back-up for traffic signals**. SDOT plans to implement battery back-up power for traffic signals at major intersections. Battery back-up will allow signals to operate during power outages, such as those caused by windstorms. • **IP-based communications network.** SDOT has begun the process of migrating to an IP-based communications network from the existing serial network. This change enables additional communications capacity using the same number of fibers; provides a ring-based network that can withstand a major break in the fiber; and readies the City for the next wave of ITS equipment, which is moving toward becoming exclusively IP-based. • **Satellite TMC.** SDOT plans to implement a secondary satellite TMC at the maintenance yard. The Satellite TMC will provide remote access to traffic signals and other ITS assets for the maintenance crews, saving them the trip to the primary TMC. In addition, if the primary TMC loses power or is inaccessible for any reason, the satellite TMC will serve as a redundant back-up ensuring traffic signals and ITS functions can be managed even in case of such emergencies.
Maintain and/or Upgrade Existing and Implement New Systems at the TMC	The TMC houses the central processing and communications systems for the ITS program, and is where operators monitor and manage traffic signals, traffic cameras, DMS and other ITS devices. The TMC systems also provide video images to City agencies and others that use them in emergency and incident management, as well as the Travelers website. Software and technologies implemented for these functions must be maintained and upgraded from time to time as technology progresses and systems age. In addition, adding new functionality to the ITS program will require new systems to manage them at the TMC. Examples of future systems not currently implemented at the TMC include multi-modal trip planning for the web, the proposed Highway Advisory Radio (HAR) system, parking management systems and systems related to tolling or congestion pricing.
Continue Deployment of ITS Equipment on the ITS Key Arterial Network	The ITS Key Arterial Network is not fully instrumented to provide the desired ITS systems and services. The devices deployed will depend upon the state of equipment already in place, and the specific needs of each corridor and subarea. Deployment will include a mixture of technologies including communications, controllers/cabinets, detection, traffic cameras, DMS, and License Plate Readers (LPRs) or other travel time technology. Highest priority is assigned to locations which would experience impacts from major construction projects such as the SR 520 Bridge Replacement Project, the Alaskan Way Viaduct Replacement Project, and the Spokane Street viaduct reconstruction project.

Provide Resources to Enable Active Traffic and Incident Management

The TMC currently provides pro-active monitoring and response to incidents that affect traffic from 7 AM to 9 AM and from 4 PM to 6 PM weekdays. TMC staff also respond to major incidents as part of the City's emergency response plans. With the addition of several DMS, more traffic cameras, and more traffic signals connected to the central system, the capabilities of the TMC to pro-actively monitor for and respond to incidents is enhanced. In addition, investments are being made to coordinate operations with SDOT, WSDOT and King County Metro by electronically integrating the control centers for each of these agencies. This "center-to-center" integration enables data sharing so that staff can manage corridors across the three agencies (Integrated Corridor Management). However, additional resources are required to take advantage of the potential of these investments.

A first step is to expand coverage to 12 hours per day, 5 days per week (weekdays) currently planned to begin in April 2010. This will allow pro-active incident monitoring, response to incidents via signal retiming or posting DMS messages and web messages as appropriate. In addition, the City's Travelers website would be monitored and maintained to ensure accurate and reliable information is provided. And, additional staff time can be assigned to coordinate with WSDOT and Metro for improved network operations.

Provide Resources to Maintain and Preserve Existing ITS Investments

Current maintenance resource allocations allow for ground-level visual reviews of traffic signal hardware such as poles, mounting and support hardware, back plates, and signal and pedestrian indications twice per year, and associated maintenance of any discovered issues. ITS devices currently receive only responsive maintenance, and are not currently included in the preventative maintenance program. Many new ITS devices, including 20 DMS, 62 traffic cameras, and 34 license plate readers, will be operational by summer 2010. Additional devices are being added to the ITS inventory including in-pavement flashers at crosswalks, radar speed signs, and parking guidance system components for which no maintenance funding has been identified. Providing preventative maintenance of these devices is, therefore, not feasible under current funding. Without additional resources, these devices will receive responsive maintenance, at best, when required.

Additional maintenance funding is needed to increase preventive maintenance (which will reduce responsive maintenance trouble calls), resulting in devices being more available and more reliable. The added resources would specifically allow:

- preventative maintenance of all ITS devices.
- additional preventative maintenance of traffic signals including detailed inspection of traffic signals from above ground to detect potential hardware failures, and inspection of grounding and bonding to ensure safe functioning of traffic signals.
- Improving traffic signal operations for all modes (including addressing interconnect cable malfunctions), and enhancing detection for bicycles and pedestrians.

Program	Description
Increase Coverage and Functionality of Traveler Information Services	SDOT recently launched the Travelers website, providing traffic conditions on City streets and traffic camera images. As the ITS Key Arterial Network is instrumented, more information will become available, including congestion and travel time information on more City streets, and more traffic camera images. This information will need to be added to the website. In addition, new services can be provided via the web. Personalized traffic alerts are an example of a fairly common service provided by traveler information websites in the US. SDOT may also be able to integrate with WSDOT and King County Metro to provide comparisons of travel times by route and mode.
Increase Resources Assigned to Traffic Signal Timing Optimization	The current levels of signal optimization resources enable SDOT to retime approximately 150 traffic signals per year, and to retime an additional approximately 50 traffic signals for construction and detours. The staff also respond to public inquiries regarding traffic signal timing and operations, including field investigation of customer complaints – of which some 150 were logged in 2008. The City manages signals within the Downtown in a different manner from other signals as they operate on a compact grid, and support heavy transit and pedestrian traffic. Therefore, the Downtown traffic signals (240 signals) are optimized in a different manner and on a different schedule – currently targeted at once every 5 years. For the remaining signals, at current resource levels, traffic signals will be retimed on average every 5 years. Given the pace of traffic growth and changes in Seattle, this means that many locations that could benefit significantly from retiming would not be addressed in a timely manner. SDOT has installed hardware and software to implement traffic responsive signal timing, which will enable traffic signal timing to change based on traffic volumes, rather than on preset times of day. This approach will be particularly effective in locations where traffic volumes fluctuate regularly such as in the SODO area, and Northgate. However, additional resources are needed to implement these plans, as they require more complex analysis and monitoring. Without additional resources, this means that fewer signals will be retimed per year as staff implement the traffic responsive functions. Adding signal optimization resources will result in more effective traffic signal operations, resulting in reduced delays to all modes, and reduced vehicle emissions. The plan goal is to reduce the citywide retiming cycle to about 3 years (excluding the Downtown), ensuring traffic signal timings would be reasonably current across the City.
Implement Specialized Technologies in Support of Pedestrians and Bicycles	SDOT will continue its deployment of systems to support alternate modes of transportation. This will include bicycle detection at intersections, and continued deployment of pedestrian-friendly countdown indications at selected intersections.

Improve Regional Corridor Management	SDOT coordinates with regional traffic operations partners on an ongoing basis to develop plans for improving regional operations. To date, these efforts have resulted in improved communications between the regional partners, and spurred the proposed Integrated Corridor Management project, which partners WSDOT, King County Metro and SDOT in managing traffic in the south end of Seattle. Future efforts will focus on regional normal and incident operations, and sharing data on websites.
Deploy Systems to Support Freight Movement	Freight corridors benefit from the ITS treatments implemented to benefit all traffic. Additional systems can be deployed to support freight traffic. For example, the strategic placement of DMS on major freight routes supports freight terminal operations.
Support Improved Transit Operations	As the Rapid Ride program is implemented, and Sound Transit rail expands, SDOT will continue to support their operations by implementing TSP, providing communications resources to enable the TSP and real-time bus arrival signs; and managing the traffic signal systems to ensure buses, streetcars and rail transit are well served.
Support Congestion Pricing/ Tolling Implementations	As regional toll projects and congestion pricing concepts come to fruition in the region, SDOT may be charged with implementing, operating and maintaining these systems.
Support Parking Management Systems Expansion	The downtown Parking Management System will be evaluated during the first years of this plan. If the system is proven effective, it will expand in the downtown, and may be considered for implementation in other locations such as Seattle Center.

IMPLEMENTATION APPROACH AND FUTURE PROJECTS

SDOT has identified a set of arterials that are considered the ITS Key Arterial Network.

These arterials are identified as streets that:

- **Are designated as Principal arterials OR as Freight Streets**
- **Carry the highest volumes in the City**
- **Are capable of supporting diversion routes for major incidents and special events**

In addition, three Districts were identified where special events or seasonal needs place extra demands on the transportation network. The three districts, where all streets may be candidates for ITS are:

- **University Stadium**
- **Central Business District** (CBD)
- **South of Downtown** (SODO)

The implementation approach addresses the ITS Key Arterial Network by sub-area citywide. ***Figure 5*** shows the sub-area boundaries, with implementation plans described below. The subareas overlap somewhat, to ensure connectivity between them. Depending upon funding availability, the sub-areas projects may be divided into a number of implementation phases.

SDOT includes ITS as part of the initial scope of corridor capital improvement projects to ensure that ITS is considered in the project definition, especially for work affecting a facility identified as part of the ITS Key Arterial Network.

Figure 5 also presents the ITS Key Arterial Network. The ITS Key Arterial Network has been expanded from the previous plan to add east-west linkages that are crucial when developing diversion routes to respond to incidents and blockages.

Also shown on ***Figure 5*** are the Puget Sound Regional Council (PSRC) defined Regional ITS Facilities. These roads are the focus of transportation management and associated ITS to cooperatively manage traffic regionally.

In addition to sub-area ITS deployments, 13 projects with citywide implications are included in the implementation approach.

The infrastructure planned for the ITS Key Arterial network depends upon local and regional needs and budget constraints, but generally includes:

- *Upgrading signal controllers/cabinets, as needed, to allow for a coordinated system, transit priority, and advanced intersection operations.*
- *Communication links as needed to connect signalized intersections to the TMC and the Central Signal System, and to improve communications network reliability and redundancy.*
- *Traffic Cameras for monitoring conditions and providing images to SDOT's website (for traveler information) and associated TMC equipment.*
- *Dynamic Message Signs, as needed, to provide timely information to motorists.*
- *Data Stations for collecting traffic data which may be used to provide a real-time traffic conditions flow map and incident detection. Data may also be used for planning and performance measure purposes.*
- *Detection for efficient multimodal operation of traffic signals. Detection would be used for time-of-day, traffic responsive, or traffic adaptive operations.*
- *Transit Signal Priority, where appropriate, to provide travel time and reliability advantages for transit. Queue jumps also will be considered.*
- *Emergency Vehicle Priority, at all signalized intersections, to assist in timely delivery of emergency services.*
- *Accessible Pedestrian Push Buttons, Pedestrian Countdown Indications and other advanced pedestrian detection devices, as appropriate.*
- *Bicycle detection enhancements, as appropriate.*
- *Battery back-up for major arterial intersection traffic signals to ensure operations even in time of power outages.*
- *Higher levels of Operations & Maintenance support.*

Figure 5: *ITS Key Arterial Network, ITS Districts & Deployment Subareas*



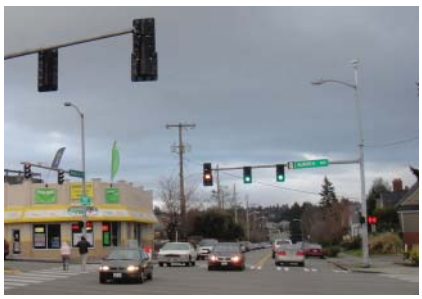







CROSSWALK

SOUNDTRANSIT



CROSSWALK

SUB-AREA DEPLOYMENTS

The following Table describes the sub-area ITS deployments (***Figure 6*** shows the subareas), including information on the base ITS components to be implemented on the ITS Key Arterial Network, and any emphasis particular to the subarea.

Figure 6: *ITS Districts & Deployment Subareas*

Subarea	Estimated Cost	ITS Key Arterial Network Impacted Streets	Base ITS Components	Sub-Area Targeted ITS Components
Northeast Seattle ITS	$8.1 million	• 145th St • 125th St • Northgate Way • Lake City Way*	Some ITS systems have been installed on NE Northgate Way and Lake City Way. These corridors will be upgraded to provide additional CCTV, detection for traffic signal operations, congestion and travel time detection, and selected pedestrian and bicycle improvements. DMS will be provided (estimated at 6) to provide incident advisories and travel times in coordination with WSDOT.	ITS systems and operational coordination with City of Shoreline, City of Lake Forest Park and WSDOT. Coordination with WSDOT to develop travel time advisories from Bothell to I-5 via Lake City Way (SR522/SR527 corridor).
Montlake ITS	$9.1 million	• NE 45th St/NE 50th St Corridor • NE Sandpoint Way • Montlake • Pacific • University of Washington Stadium District	ITS implementations focused on improving multi-modal arterial traffic management are proposed including detection and communications to support traffic responsive operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and providing additional DMS (estimated at 8) to support incident advisories, Montlake Bridge raising delays, and travel times. Cabinet replacement will be required on many streets.	Area includes the University Stadium District, which encompasses all roadways within the District as potential targets for event-related systems to manage traffic around highly congested areas. Additionally, the subarea is impacted by the upcoming SR520 reconstruction, and systems to manage traffic due to incidents and construction are included.
Northwest Seattle ITS	$11.3 million	• 145th St • 130th St • Holman Road/105th/ Northgate Way • 85th St • 45th/50th corridor • Leary/Pacific Way • Elliott Way/15th/ Greenwood Ave N* • Aurora Ave* • Greenwood Ave N of 105th	Multi-modal ITS implementations on Elliott/15th and SR99 are substantially complete. Emphasis will be on instrumentation and detection for east-west connections for improved signal operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and providing additional DMS (estimated at 6) to support incident advisories and travel times in coordination with WSDOT. Cabinet replacement will be required on many east-west streets.	ITS systems and operational coordination with City of Shoreline and WSDOT. Subarea includes the Leary/Pacific Way freight route. ITS deployments on this route would be directed toward freight movement.

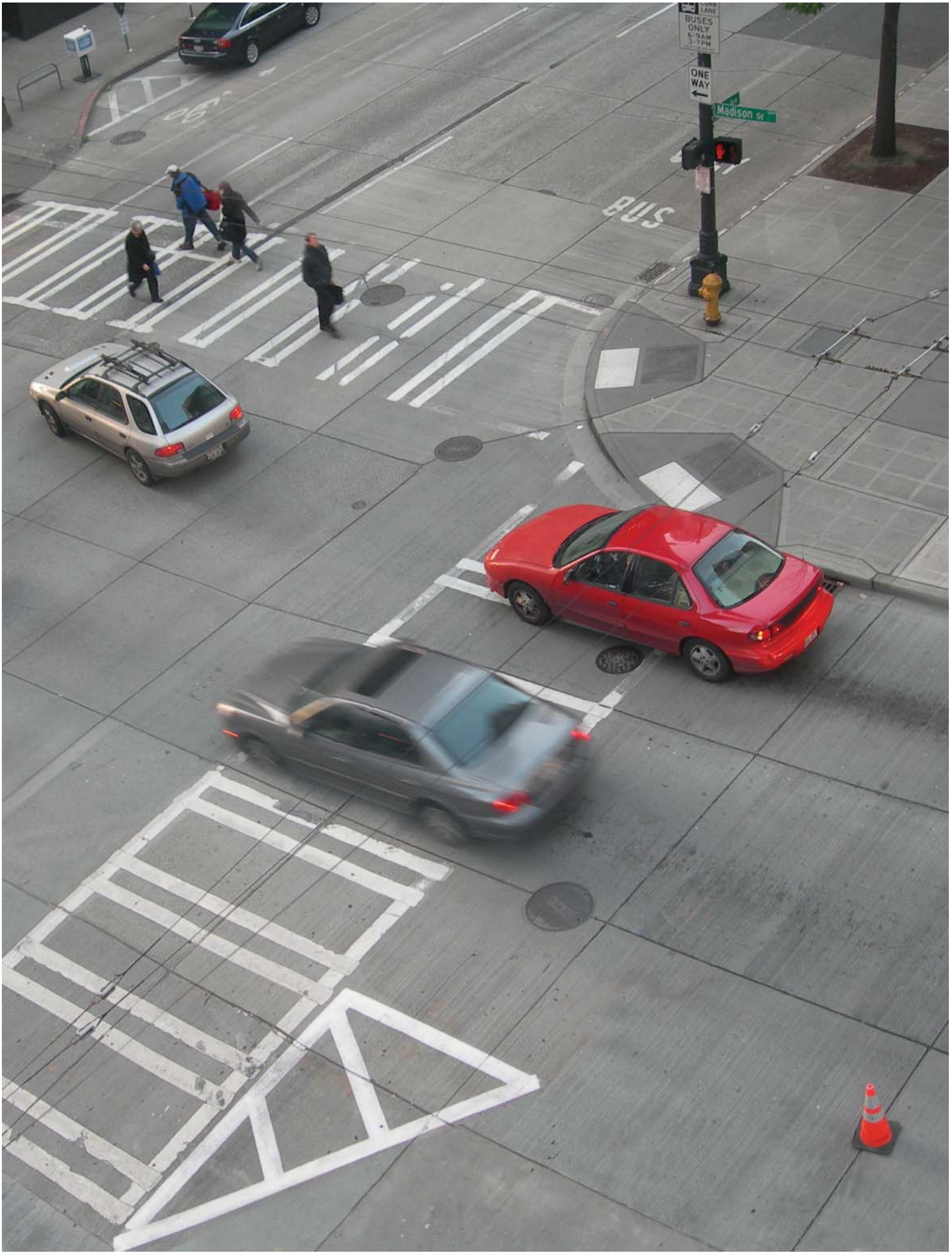
** Puget Sound Regional Council designated Regional ITS Facility*

Subarea	Estimated Cost	ITS Key Arterial Network Impacted Streets	Base ITS Components	Sub-Area Targeted ITS Components
South Lake Union/ Seattle Center	$5.3 million	• Denny Way • Mercer St • Elliott Way* • Aurora Ave*	Emphasis will be on instrumentation and detection for east-west connections for improved signal operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and providing additional DMS (estimated at 4) to support incident advisories and travel times in coordination with WSDOT.	The sub-area is impacted by the north portal of the proposed Alaskan Way Tunnel project. ITS to mitigate construction and post-construction impacts are included.
Center City ITS	$21.7 million	• Denny Way • Jackson Street* • E Madison Street • 24th Ave E • Boren Ave • Rainier Ave* • Airport Way* • 4th Ave* • 1st Ave* • SR 99* • Alaskan Way* • CBD District • SODO District	Investments in ITS are substantially complete on SR 99, 1st Ave, 4th Ave and Airport Way. The focus of improvements in this sub-area will be on multi-modal needs to improve the connection from the CBD to the Montlake area, and east-west movements on Jackson Street, connecting to Rainier and Boren. Components will improve multi-modal arterial traffic management including detection and communications to support traffic responsive operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and providing additional DMS (estimated at 8) to support incident advisories and travel times. Upgrading aging communications infrastructure in the CBD is also included.	ITS field elements associated with the Alaska Way Surface Street project associated with the Alaskan Way Viaduct project are addressed in this subarea. Additionally, the subarea is impacted by the upcoming SR 520 reconstruction, and systems to manage traffic due to incidents and construction are included.
Southeast Seattle ITS	$9.6 million	• Rainier Ave • Martin Luther King Way • S Columbian Way	This subarea has partial ITS implementation, in particular on Martin Luther King Way as part of the light rail transit corridor project. Additional focus on Rainier Ave S to improve multi-modal arterial traffic management including detection and communications to support traffic responsive operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and providing additional DMS (estimated at 4) to support incident advisories and travel times.	Regional ITS corridors Rainier Ave and Martin Luther King Avenue will receive additional focus to manage regional multi-modal traffic.

** Puget Sound Regional Council designated Regional ITS Facility*

Subarea	Estimated Cost	ITS Key Arterial Network Impacted Streets	Base ITS Components	Sub-Area Targeted ITS Components
Duwamish ITS	$5.0 million	• Airport Way* • 4th Ave* • 1st Ave* • SR 99* • East Marginal Way S* • S Spokane St/Viaduct/ West Seattle Bridge • Ellis Ave S • S Michigan St	Multi-modal ITS implementations are substantially complete in this subarea. Emphasis will be on instrumentation and detection to complete 4th Ave S regional ITS corridor implementation from Spokane St to E Marginal Way S.	The subarea is the focus of coordination with WSDOT and neighboring cities to the south to support implementation of integrated corridor management on north/ south facilities including I-5 and Regional ITS corridors in the area to better manage all modes of traffic south of downtown. Additionally, freight movements are a core focus in the subarea, and additional freight improvements may be developed in the future.
West Seattle ITS	$7.8 million	• Fauntleroy • West Seattle Bridge • 35th • Roxbury/Olson Pl/ Cloverdale • 14th Ave S	ITS implementations for multi-modal corridor management are substantially complete on the Fauntleroy Way/West Seattle Bridge Corridor. The focus on improvements will be on alternate routes to the West Seattle Bridge important to transit, freight and all other traffic. Components will improve multi-modal arterial traffic management including detection and communications to support traffic responsive operations, congestion and travel time data collection, CCTV, completing communications infrastructure, and additional DMS (estimated at 4) to support incident advisories and travel times.	Mitigation related to Fauntleroy Ferry traffic such as automated speed detection.

** Puget Sound Regional Council designated Regional ITS Facility*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CITYWIDE ITS PROJECTS

Project	Estimated Cost	Base ITS Components
Traveler Information	**$1.5 M**	This project will expand coverage and enhance the services of the Traveler's Website, which features real time arterial traffic congestion information, and incident and event advisories. As roads are instrumented for congestion and travel time measurement via the subarea ITS projects, this information will be integrated into the website. The project also explores ways to display HOV and bus traffic flow, which may be different (better) than general traffic lanes. Other services may include personalized traffic alerts and information, and mode choice tools
Traffic Management Center Upgrades	**$1.0 M**	The TMC houses several electronic, computer and software systems that require ongoing upgrades and replacement to ensure a high level of reliability and performance, and to manage the expanding number of field devices. And, as with most electronics, systems become obsolete, can no longer be maintained, and must be replaced. Major components slated for upgrade include the video display wall, and the electronics serving the camera and communications systems. Also, SDOT's current video management system requires upgrades to increase the number of video feeds that can be shared, and the number of video recipients - the existing system is at capacity and no new video images or new users can be added. The system is an important tool for departments at the City in the management of emergencies and incidents, enabling remote video views of impacts and response.
Transit Systems	**$13.6M**	The ITS Program has supported implementation and operation of all forms of transit – bus, light rail, Bus Rapid Transit, and streetcars (including the Lake Union Streetcar). Technologies implemented include transit signal priority to improve transit speed and reliability, transit queue jumps, special signal phasing, operation of light rail transit signals and recovery plans. Staff resources have been assigned to retime traffic signals for all forms of transit. SDOT has also shared telecommunications infrastructure with transit providers to support their operations. The shared fiber optic infrastructure has and will be used by transit providers to support transit signal priority, real-time bus arrival displays at stops and stations, and overall transit operations. The ITS Strategic Plan includes costs to continue supporting transit operations via transit signal priority and supportive telecommunications infrastructure. The costs included in this plan are outside of funds proposed for initiatives such as light rail transit and the Rapid Ride program, which have their own funding sources. The costs in this plan are intended to support the City's Urban Village Transit Network Corridors.
Regional ITS Corridors Traffic and Incident Management Operations	**$2.5M**	This regional project covering King County would address normal and emergency/incident traffic operations. It would coordinate information posted on websites operated by the various agencies. It would establish response plans for predictable major incidents such as a crash blocking a freeway or major arterial. Plans would be developed to manage the incidents, provide common traffic control systems, establish communication links, and seek agreements for regional operations during these types of incidents. Key components are; • Incidents centered around the freeway and highway system. • Develop scenarios. • Dynamic Message Signs as needed. • Develop plans to manage incidents. • Build in the ability to deploy plans. • Develop public communications plan. • Build partnerships which result in signed agreements for operations.

Project	Estimated Cost	Base ITS Components
Citywide Travel Time on Arterials	$2.5 M	This project would implement travel-time data collection technologies Citywide, rather than on a sub-area basis. It would additionally implement data processing as required to post travel time to the Travelers website, and potentially to DMS.
Parking Guidance System (PGS)	$6.0 M	This project results in a system of changeable message signs which displays real-time parking availability for parking lots and garages in the Seattle Center Area, as an expansion of the concept applied in the CBD and SODO Stadium areas. Motorists, seeking parking nearby the Seattle Center, frequently are turned back as the parking areas are already full. PGS signs would inform motorists, before they pass key decision points, about parking availability. The result will be less circulating traffic, less congestion, and reduced conflicts between motorists and pedestrians. The PGS will be similar to those found throughout Europe.
Satellite TMC	$750K	The Signal Operations group currently operates a TMC on the 37th floor of the Seattle Municipal Tower. The primary focus of the TMC is the daily operations of traffic signals including coordinating with maintenance on malfunctions, CCTV cameras and video feeds, incident management, the travelers web page, and DMS operations. Supporting the Signal Operations group are the electricians and electronics technicians of the Traffic Maintenance Group. These staff input signal timing plans, perform troubleshooting and diagnose problems with traffic signals, traffic cameras, DMS and other electronic equipment associated with traffic operations. This group currently has limited remote access to the traffic operations assets in the field from their worksite located at 4200 Airport Way SE (commonly known as Sunny Jim). The primary purpose of the Satellite TMC is to support improvements in daily maintenance operations. Implementing a Satellite TMC also enables this site to function as a back-up TMC in the event that the main TMC is inaccessible to staff, or becomes inoperable. Providing a back-up TMC ensures that traffic signal, traffic camera and DMS operations are maintained even if the main TMC is inaccessible or inoperable.
Highway Advisory Radio System Expansion	$500K	This project is an expansion of the currently planned Highway Advisory Radio (HAR) project. A feasibility study to implement HAR is being conducted (late 2009). HAR is planned to be implemented to advise drivers of major transportation issues such as complete road closures, or closures of an area of the City. The system broadcasts a radio message providing drivers with more information than can be supplied via DMS.
Bicycle ITS	$2.9M	The ITS Program also supports the efforts outlined in the Seattle Bicycle Master Plan to increase bicycling and improve cyclist safety. SDOT will continue to implement bicycle only traffic signals, improved bicycle detection at traffic signals, modified signal timing for bicycles, and modified traffic signals to support implementation of bicycle lanes and sharrows. The ITS Program will continue to identify technology and operational needs on bike trails and other bike facilities that are appropriate to ITS solutions. This ITS Strategic Plan provides a cost estimate to create a funding pool for bicycle ITS based on costs to implement bicycle detection for the city wide sharrow facilities noted in the Bicycle Plan. While specific bicycle projects come with their own funding, the costs outlined in this plan are for activities outside of any funded bicycle projects. The ITS Strategic Plan is targeted towards technology and operational improvements that positively affect bicycle ridership and safety, and that may arise over the course of the plan based on citizen input, changes due to construction projects, or other unforeseen needs. . This includes needs that arise due to the availability unforeseen new technologies that support the bicycle mobility goals of the City.

Project	Estimated Cost	Base ITS Components
Pedestrian ITS	**$8.0 M**	The City of Seattle has identified the pedestrian plan mission to become the "most walkable city" in the US. Elements of the ITS Strategic Plan which support that mission include: • Implementing pedestrian count-down indications that show the number of seconds left to cross. SDOT has begun retrofitting pedestrian indications, with about one-third of the existing indications already changed out as of early 2010. • Providing new traffic signals for pedestrians where warranted. Since 1985, SDOT has installed 125 traffic signals to primarily serve pedestrians, which represents more than half of all traffic signals installed during that time frame. • Adopting a new walking speed standard of 3 ½ feet per second (fps). This is slower than the current standard of 4 fps and will accommodate a broader range of pedestrians. Traffic signal timing will be modified to include the new speed. The Central Business District traffic signal system timing plans will require special attention to support modified pedestrian walking speeds. • Retiming traffic signals to meet location-specific pedestrian walking or pedestrian volume needs. • Providing audible pedestrian crossing signals to support the visually impaired pedestrian at locations indentified by the disabled community that meet SDOT policy. Working with the disabled community, a list of high-priority locations for audible indications was developed. SDOT has begun installing more audible pedestrian signals. • Installing school beacons. SDOT will continue to install and maintain school beacons as part of the Safe Routes to Schools initiative. In addition, whenever traffic signals are rebuilt or newly installed, the pedestrian hardware and operations implemented will meet pedestrian needs specific to the location. This ITS Strategic Plan identifies improvements, with associated costs, to continue with the actions noted herein. While specific pedestrian projects come with their own funding, the costs outlined in this plan are for activities outside of the funded pedestrian projects. The ITS Strategic Plan costs are targeted towards technology and operational improvements that align with the pedestrian plan goals, and that may arise over the course of the plan based on citizen input, changes due to construction projects, changes in technology and operational needs, or other unforeseen needs.
Traffic Signal Timing/ Optimization	**$1.0M Annually**	Additional resources are needed for citywide traffic signal timing plan development to ensure the benefits of the existing investment in signal timing infrastructure can be realized. The resources would enable implementation of traffic responsive operations, and help ensure that signal timing is optimized on a 3 year cycle.
Downtown Traffic Signal Timing/ Optimization	**$1.0M**	The Downtown Traffic Signal system includes 240 traffic signals. It requires a different optimization approach and retiming cycle than other traffic signal systems in the City, It is thus presented as a separate project with a retiming cycle of 5 years. This project supports two retiming cycles over the 10 year term of this ITS Strategic Plan.
ITS Maintenance	**$2.0M Annually**	As noted in the previous section on gaps, SDOT requires additional resources to preserve and maintain ITS and traffic signal assets. Many systems have been implemented without associated maintenance resources.
Active Traffic and Incident Management	**$300K Annually**	These resources would allow SDOT to manage its streets more actively, and manage DMS, the Travelers website and overall operations on a proactive basis, including responding to incidents on a 12X5 basis (currently planned to begin in April 2010).

TEN YEAR PROGRAM PLAN COST SUMMARY AND PRIORITIZATION

ITS is driven by new technologies. While the plan discusses various specific technologies, as innovations are developed SDOT will evaluate and implement them as appropriate.

In addition, external changes, such as the recent updates to the FHWA's Manual on Uniform Traffic Control Devices (MUTCD), may require technology changes including implementation of count-down pedestrian signals, and retiming traffic signals to accommodate a new, slower walking speed for pedestrians.

PRIORITIZATION OF PROJECTS IN THE TEN-YEAR ITS PROGRAM PLAN

The prioritization of project in the ten-year ITS Program Plan is based on the following:

- *Ensuring ITS already in place functions with high reliability (less than 2 percent outages).*
- *Extracting the maximum benefit and geographic and functional coverage from existing ITS systems.*
- *Supporting pedestrian, bicycle and transit modes.*
- *Keeping systems that are direct links to the public reliable, accurate and technically up-to-date to preserve a high level of usage, user confidence and functionality.*
- *Addressing critical major project mitigation such as for the upcoming SR520 and Alaskan Way Tunnel projects.*

A final criteria is to expand the geographic coverage of ITS devices so that the same level of operations and functionality is provided citywide. However, these expansions are at a lower priority, as the plan emphasis is to get the most out of the existing investments.

The prioritization criteria are further influenced by the fact that all projects depend upon receipt of funding. Some ITS projects can benefit from grants and other funding directed at Capital Improvement Projects grants, and other local, State and Federal grants that can be used to support ITS implementation.

The following ***Table 2*** provides the prioritization of the ITS projects described in this Plan, summarizing the estimated funding needs over the ten years.

Table2: *Prioritized ITS Projects and Estimated Costs*

Rank	Project	Estimated Cost
1	Active Traffic and Incident Management	$ 3,000,000.00
2	TMC Upgrades	$ 1,000,000.00
3	ITS Maintenance	$ 20,000,000.00
4	Montlake ITS	$ 9,147,375.00
5	Pedestrian ITS	$ 7,950,000.00
6	Downtown Retiming/Optimization	$ 1,000,000.00
7	Traffic Signal Optimization	$ 10,000,000.00
8	Bicycle ITS	$ 2,875,000.00
9	Satellite TMC	$ 750,000.00
10	South Lake Union/Seattle Center ITS	$ 5,323,500.00
11	Transit ITS	$ 13,636,625.00
12	Traveler Information System	$ 1,500,000.00
13	Regional ITS Corridor Operations	$ 2,500,000.00
14	Citywide Travel Time on Arterials	$ 2,500,000.00
15	Parking Guidance System	$ 6,000,000.00
16	Southeast Seattle ITS	$ 9,578,875.00
17	Northeast Seattle ITS	$ 8,080,750.00
18	Northwest Seattle ITS	$ 11,318,250.00
19	West Seattle ITS	$ 7,823,250.00
20	Center City ITS	$ 21,709,500.00
21	HAR Expansion	$ 500,000.00
22	Duwamish ITS	$ 5,048,500.00
	Total	**$ 151,268,625.00**

FUNDING APPROACH

The combined cost identified for the ITS projects identified in this plan is substantial and is difficult to fund without some guidance.

This section highlights some of the most significant funding needs, and indicates potential funding opportunities that are known today. Other opportunities may currently exist or arise in the future. This section is not intended to be a comprehensive listing of funding sources for the ITS program. It suggests ideas to address the funding needs.

ENTIRE PLAN

In the past, ITS projects outside of those funded from City dollars have typically been funding using various Federal and State grants. These grants were either specific to ITS or provided to support ITS activities as mitigation for another funded project. Recently, Bridging-The-Gap (BTG) funds have also been used to support some ITS activities.

This Strategic Plan divides the City into subareas for ITS deployments. The costs to deploy ITS across the subareas are significant, and will likely require multiple funding sources over several years to accomplish. Currently, grants are typically provided in the range of $2,000,000 to $4,000,000. Several funding sources would be needed to fully deploy ITS as envisioned in this plan city-wide. An individual grant could address a portion of a subarea, or be focused on a particular corridor.

ITS deployments would be designed to address the particular needs presented by the location. The projects would include:

- ***Systems to improve arterial operations and provide Active Traffic Management (ATM) for all modes.*** *Project elements may include traffic signal controller upgrades (to support advanced signal operations and optimization), traffic, bicycle and pedestrian detection, transit signal priority, communications links, DMS to inform drivers of incidents and CCTV cameras to monitor operations. Per the Institute of Traffic Engineers, these measures can reduce traffic delays by 15 to 40 percent. Congestion relief reduces greenhouse gas emissions up to 22%, and also reduces fuel consumption by up to 10%.*

- ***Systems to improve emergency operations.*** *Adding redundant communications links, a back-up TMC and battery back-up at traffic signals help ensure operations continuity. The benefit is based on a reduction of outages so that safe arterial operations can be maintained. A reduction in traveler delay (and associated congestion and emissions), and crashes due to power outages can be anticipated from such systems.*

- ***Implementation of systems and data integration to enrich information provided on the Travelers web site.*** *Systems that support provision of congestion and travel time data, and CCTV camera implementations to provide video images can all be integrated with the City's Traveler's web site. The current site does not provide comprehensive information coverage of congestion, travel times or video images across the city. By increasing the data coverage, more users would benefit from pre-trip information on their planned route. Studies have shown that this information leads to changes in behavior including changing their departure time or travel mode. Both types of changes help reduce traffic congestion and associated vehicle emissions.*

Costs for the entire plan or substantial portions should be included in future initiatives that are introduced to voters. Specifically a next version of Bridging the Gap and a Seattle Rail funding package (that includes Bike & Pedestrian improvements) are being considered. Funding for the ITS Plan should be included in those initiatives.

APPROACH FOR SPECIFIC ITS PROGRAM PROJECTS

Staffing to Provide Active Traffic Management (ATM):

With the rich deployment of ITS devices in the last couple of years SDOT has enough tools to make a difference by actively managing the street network on a daily basis. Where ATM is in place, traffic flows are monitored by vehicle detectors, traffic cameras, license plate readers, bridge monitoring equipment, and railroad monitoring equipment. The data is returned, via high speed fiber optics, to the Seattle Traffic Management Center (TMC), where it is used by staff, and also feeds automated and advanced traffic systems. Active Traffic Management (ATM) and Intelligent Transportation Systems (ITS) can reduce traffic delays by up to 40 percent. Congestion relief reduces greenhouse gas emissions up to 5%, and also reduces fuel consumption. Staffing is needed for TMC. **The annual cost is $300,000 and this should be funded by local dollars and contributions from major capital project dollars as part of mitigation for those projects.**

TMC Upgrade:

A number of systems have reached or are reaching the end of their useful life. The video distribution system is 100% maxed out. The reliability of that system is marginal. It needs to be replaced. Video is shared among several City departments to support their incident and emergency operations including the Police and the Emergency Operations Center. Major components of the video wall are beyond their expected life and will fail before too long. Other computer servers are in need of replacement and components need to be changed to move from analog systems to digital. **A Federal Homeland Security Urban Areas Security Initiative (UASI) grant should be pursued to replace the video distribution system and possibly address other key components. Other grant or local funds should be sought for the remainder. Total cost is $1,000,000.**

ITS Maintenance:

This proposal is to add staff and materials for Intelligent Transportation Systems (ITS) maintenance needs. The request addresses needs associated with numerous new devices installed as part of ITS improvements in the last two years. SDOT has made $20M in capital investment in ITS in the last two years. These devices are used to address safety and efficiency needs. Proper maintenance of these devices is necessary to keep them working as intended. **The annual cost is $1,000,000 and this should be funded by local dollars.**

SR 520 Construction Mitigation and the Montlake and City Center ITS Programs:

Replacement of the SR 520 bridge is expected to increase congestion and delays in the Montlake/24th corridor. This corridor is heavily congested during normal peak hours, and when incidents occur on SR 520, or when large events take place at the University of Washington traffic congestion can become severe. SR 520 construction will compound the existing congestion, which, in addition to affecting general purpose traffic and increasing greenhouse gas emissions, increases travel times for transit and emergency vehicles.

The SR 520 Mitigation project will provide travelers with real-time traffic information, which will allow them to make better travel choices. They may plan a new route, or they may reschedule their trip to avoid congestion. This will help mitigate construction impacts, as well as reduce overall congestion in the area. The project will upgrade signals to improve

traffic and transit flow, pedestrian safety and emergency vehicle access. The systems contemplated in this effort include ITS specific to construction mitigation. The ITS system costs estimated for the Montlake and Center City ITS Programs can be offset by the SR 520 Mitigation funding. However, additional geographic coverage for these two subareas, for telecommunications and pedestrian ITS (considered city-wide programs) are also included in this plan.

The total SR 520 Mitigation project cost is estimated to be just over $10 million, including design, construction and contingency. The estimated time to complete the project is 2 years, which includes design and construction. The State DOT should provide $7M for this project and SDOT $3M to cover local match needs. Grant opportunities should be considered for the SDOT portion.

Pedestrian Countdown Indications:

The vision of the Pedestrian Master Plan is to make Seattle the most walkable city in the nation, and the plan includes installing pedestrian countdown signal heads to increase safety for pedestrian at signalized intersection. Currently, the only source of funding to install the countdown pedestrian indications has been BTG. The current rate of deployment, which is $95,000 per year, results in 40 intersections of new countdown indications a year. At that pace it would take 17 years for full deployment of countdown indications. **The rate of spending from BTG should be increased to $500,000/year. Any initiative related to walk, bike, ride or Seattle Rail should include pedestrian countdown indications funded at $3 million.**

Bicycle ITS :

As the city Bicycle Master Plan presents ideas that increases the capacity for bike related facilities on the existing roadway network, ITS will work to increase the bike operation efficiently at signalized intersections. **Funds used for deployment of the Bicycle Master Plan need to include design and installation of bike detection at signalized intersections. It is estimated that the sharrows identified in the Bicycle Master Plan would required $2.9 million if all were implemented city wide. Also, any initiative that relates to walking, bicycle riding or Seattle Rail needs to consider the improvements of detection goes hand in hand with the related facilities.**

Satelite TMC:

Over the last few years, and continuing in 2009 and 2010, the reliance upon systems in the TMC has grown substantially. Efficient control of traffic and delivery of information has made the TMC an integral part of SDOT's mission to keep Seattle moving. If a server were to fail, the function it provides would either fail or not work properly. Given the reliance upon these systems, duplicate servers are needed to address risk and vulnerabilities of having no back up. The impact of a major disruption to traffic would be significant. These servers will reside in a Satellite TMC. **The cost is estimated at $750,000. The funding recommendation is to seek a UASI grant.**


YOUR
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SPEED
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TIME

PERFORMANCE MEASURES

The only way to assess whether this plan is a success is to measure the City's performance in connection with the plan.

SDOT will track all of the planned implementations and other activities in this plan and report on them annually.

- **The number of visits to the web pages**

  Both the Travelers and camera images web pages hits will be reported. Increases in hits can be interpreted as customer satisfaction with the services provided.

- **The number of incident messages processed by the TMC**

  When staffed, TMC operators log incident messages posted on DMS, to the website, and to the public information office.

- **Number of hours traffic responsive signals are placed in plans outside normal plan hours**

  When the traffic responsive signal system is implemented, the time a signal plan is implemented based on traffic volumes, rather than time-of-day inputs will be logged. This is a measure of the effectiveness of the traffic responsive approach.

- **Arterials optimized and optimization outcome**

  Both travel delay improvements and emissions reductions are the goals of the optimization program.

- **Transit operations improvements due to signal priority**

  METRO transit measures before and after travel times on routes when new transit signal priority systems are implemented.

- **Number of automated events – DMS messages, Quick Response, traffic responsive plans**

  Each automated event is one where staff interaction with the systems are minimized, and the ITS systems are providing just-in-time responsiveness, producing greater efficiencies.

- **Mobility Enhancements**

  The spread of ITS devices including detection, DMS, cameras, pedestrian and bike treatments, and the like will be tracked.

- **User satisfaction with the web page (as shown by a survey)**

  A survey will be developed and posted for optional response by web users to gauge their satisfaction with the web services related to traffic.

- **Reduction in trouble calls for traffic signals**

  As the maintenance management system is implemented, the ability to log trouble calls will be provided and these will be tracked.

APPENDIX

PREVIOUS PLAN:
SUMMARY OF ACCOMPLISHMENTS AND REMAINING GAPS


CROSSWALK

APPENDIX

PREVIOUS PLAN: SUMMARY OF ACCOMPLISHMENTS AND REMAINING GAPS

The ITS systems and services described in the previous section have been implemented over several years, with many having been identified in the previous ITS Strategic Plan (2003 – 2008).

FOCUS OF THE PRIOR ITS STRATEGIC PLAN

The previous plan outlined a specific strategy for ITS improvements. The strategy recognized that while capital and operations/maintenance resources were limited, new technologies and systems were needed to meet the needs of the public. The focus of the prior strategic plan was, thus, two-fold:

1. to begin to fill critical gaps in important ITS operations and maintenance functions that had gone unmet for several years, AND
2. to strategically implement new ITS on the most highly traveled roads within the city to ensure that the most people experience the greatest benefits. These roads were dubbed the "Strategic ITS Network".

The plan identified critical gaps, field deployments and action items to meet the ITS Vision.

Accomplishments Since the Prior Plan – Critical Gaps

- **The 2003-2008 ITS Strategic Plan identified four critical gaps in operations and maintenance. These gaps compromised the functionality, capability and reliability of the ITS Core.**

  GAP: Inadequate staff numbers to perform required ITS preventative maintenance .

- **In 2003, the SDOT ITS maintenance staffing level (electricians) was 16 persons below Federal guidance and industry standards.**

  PROGRESS: Since 2003, 3 ITS maintenance staff (electricians) were added to the maintenance crews (one short of the 5-year plan target). SDOT remains 13 ITS maintenance staff below industry standards. In addition, technology is being deployed by several SDOT programs, for example parking management systems and radar speed signs, for which no dedicated maintenance funding was identified. These deployments place additional burden on the maintenance staff with no commensurate resource increase.

  GAP: Inadequate staff to perform traffic signal timing and optimization.

- **In 2003, SDOT was staffed at 3 - 7 persons below Federal guidance and industry standard to perform signal timing and optimization. The staff were able to retime approximately 90 traffic signals per year, resulting in a 10-year cycle for traffic signal retiming citywide,**

  PROGRESS: Since 2003, 2 staff were added to the operations program, leaving SDOT at 5 staff below industry standards. Approximately 150 traffic signals can be retimed each year at the increased staff level, resulting in a 7-year citywide retiming cycle.

  GAP: Lack of an ITS asset/work management system

- **In 2003, there were no electronic systems to support inventory, asset management and work order generation and tracking for ITS.**

  PROGRESS: Since 2003, SDOT implemented an asset/work management system department-wide. SDOT completed the inventory and condition

assessment of traffic signals required for data input to that system. The data has yet to be input to the system, and ITS assets remain uninventoried. In addition, the system features to track and manage maintenance work orders have not been implemented. SDOT will soon input this data to the system.

GAP: Traffic signal controllers/cabinets and associated equipment were outdated and unable to provide desired functionality.

In 2003, approximately one-third of the traffic signal controllers/cabinets and equipment did not enable connection to the central system software, or interconnect, or added system detection, or additional signal phases.

Over the past 5 years, SDOT was able to replace more than 300 outdated traffic signal controllers and cabinets in the City using funds from the Voter-approved Bridging The Gap referendum, as outlined in the previous plan. Approximately 20 percent of the controllers/cabinets and equipment must still be addressed.

Accomplishments Since the Prior Plan – Action Items

The following describes the actions identified in the prior plan and the progress since 2003:

- **Connect every traffic signal in the City to the central system at the TMC**

  In 2003, approximately one-half of all traffic signals were connected to central. SDOT currently operates 1040 traffic signals, of which approximately two-thirds are directly connected to the central system at the TMC. This is significant progress towards the goal, yet one-third of signals remain to be connected.

- **Operate all signals at peak efficiency**

  In 2003, staff levels allowed retiming of approximately 90 traffic signals annually. With the staff additions, the target has reached 150 traffic signals each year. The number that can be retimed depends upon the complexity of the timing plans, and the number of additional staff assignments, such as retiming for construction detours which have been a major activity since 2003. Notably, in 2008, staff were able to retime almost 400 traffic signals, including 258 in the central business district.

- **Provide accurate and timely information to motorists**

  SDOT implemented a website in 2004 that provided images from traffic cameras. The table, below, shows the growth in activity at that website.

YEAR	Camera Locations Available on the Web	Annual Website Hits (in millions)
2004	11	2.7
2005	28	2.9
2006	36	4.8
2007	41	7.3
2008	41	9.4

  In 2009, the Traveler's website was launched (*www.seattle.gov/travelers)*, which supplements the camera images with real-time arterial congestion information gathered from sensors on selected arterials, and traffic alerts for incidents and planned events.

- **Implement technologies that reduce the maintenance burden and improve operations**

  Since 2003, SDOT has replaced approximately 3650 incandescent and neon light sources for vehicle and pedestrian signal indications with low-power consuming, long-life LED light sources.

  Connecting traffic signals to central and implementing traffic cameras reduces trips to the field to investigate problems. Traffic signals connected to central increased from 50 to 66 percent, and 30 cameras have been added since 2003.

  The controller change-out program has resulted in

a reduction of the required controller inventory, streamlining maintenance and reducing inventory costs.

SDOT has implemented wireless sensors that replace or augment traffic detection loops. The replacement costs for this technology is lower than that for detection loops.

- **Ensure that every ITS component is maintained in excellent working order**

  SDOT increased funding for preventive maintenance at traffic signals in 2007, enabling twice-annual inspection and maintenance of every traffic signal. This was made possible by voter-approved Bridging The Gap funding. Additional ITS components including traffic cameras, DMS, communications network equipment and other systems are yet to be added to the regular preventive maintenance program.

- **Report on system performance at least annually**

  SDOT has reported annually on performance in 2007 and 2008, the years when new ITS funding was available.

ITS STRATEGIC PLAN 2010–2020

March 2010

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