STRATEGIES FOR ITS INFRASTRUCTURE
NEXT GENERATION ITS

Prepared for:

SDOT
Seattle Department of Transportation

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WHAT TRANSPORTATION CAN BE.

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Next Generation Strategies for ITS Infrastructure

Introduction

Advancements in technology are shaping the way we interact with systems and share information. Technology applications enable agencies to gather information about transportation system operations, make the best use of existing infrastructure, and disseminate traveler information.

Total daily person trips in the Seattle area are forecast to increase 40 percent by 2040, and the City has already identified a number of ITS projects to accommodate the expected growth in travel and congestion. The strategies presented in this attachment are additional measures SDOT could take to use technology in ways that optimize capacity and efficiency on the transportation network.

As SDOT prepares for upcoming ITS design and project procurement packages, the strategies identified in this document serve as additional implementation strategies that are anticipated to result in significant benefits. The recommended strategies for ITS infrastructure are grouped into the following areas:

- **Mobility Options and Communication Tools:** Technologies that provide information on multimodal travel options and prepare for the next generation of future mobility options.
- **Strategic Partnerships:** Emerging technologies and resources from a range of partners that could be leveraged to improve existing infrastructure and traveler information.
- **Data Collection:** Existing and potential data sources for active transportation management and planning activities.

The strategies outlined in this report provide SDOT with additional means to develop accountable and transparent ways to be accommodating to residents and travelers throughout Seattle.

Strategies

While not a comprehensive list, these strategies are some of the most promising emerging tools to manage a complex transportation system. Each of these strategies requires an investment, but relies on resources, data, and crowd-sourcing that are readily available, or expected to be available.

Mobility Management and Communication

- Dynamic Lane Management System
- Software Developer Tools
- Puget Sound Bike Share

Strategic Partnerships

- Connected Vehicle
- Integrated Corridor Management (ICM)
- PacTrans University Transportation Center
- Private Partnerships

Data Collection

- Parking Enforcement Data Collection
- Mounted On-Street Parking Detection

Each strategy includes a summary, list of benefits, and a detailed description of the implementation process. The relative costs and level of effort to pursue each is also included to establish a framework for comparing the different strategies.

Estimated Cost

The following benchmarks describe estimated cost classes:

$	Low capital, operations or maintenance costs
$$	Moderate capital, operations and maintenance costs
$$$	High capital, operations, and maintenance costs

External factors such as advancement of particular technologies and cooperation with partners have a significant bearing on the actual cost of implementing each action item. This benchmark is intended to provide a means of providing relative cost comparison to other recommended strategies.

Level of Effort

The following benchmarks describe level of effort classes:

Low	Implementation has low cost implications and can be implemented at the TMC level.
Medium	Implementation has some cost implications and requires the coordination with other SDOT and City departments.
High	Implementation has some cost implications and requires coordination with a larger within the City departments, partnering agencies, and/or the public.

The level of effort is intended to provide a means of providing relative comparison to other recommended action items. This is an estimate of the amount of staff time and coordination with other agencies expected for each strategy.

Mobility Management and Communication

Image courtesy Montgomery County

Summary

Utilize a lane assignment system that can be changed over schedule time periods to dynamically provide travel in either direction.

Benefits

- Maximize the number of available lanes for peak travel flows
- Actively manage curbside parking and loading zones
- Adjust turn lane designations based on planned events

Level of Effort	HIGH
Cost	$$$

Dynamic Lane Management System

Description

To more effectively use existing roadway space, a Dynamic Lane Management (DLM) system updates lane assignments based on time-of-day (TOD) traffic operations. Travel lanes are reassigned during different time periods to provide additional capacity in peak travel directions for recurring traffic patterns. With fiber-optic communication, this technology allows changes to be made remotely from the TMC, and has the potential to be updated in the event of a roadway incident to accommodate diverted traffic flows.

Drivers are already familiar with this type of technology on local freeways, and adoption on arterial roadways has been effective in other cities. DLM may also be used on roadways with on-street parking to change restrictions based on TOD to increase capacity during peak periods, and allow parking during non-peak times. Dynamic Message Signs (DMS) in key locations would complement this technology by providing additional information to travelers during planned events or unexpected incidents.

In Seattle, potential applications include Alaskan Way near the Coleman Dock to improve efficiency during ferry loading and unloading. Overhead signs inform drivers of lane designations or turning restrictions based on demand. Dual turn lanes, for example, could be utilized to turn into the ferry loading area prior to ferry loading, then revert to allow additional capacity where ferries unload. Transit-only lane designations, loading zones, or parking restrictions could be also incorporated into a pilot deployment on Alaskan Way. A DLM plan is recommended on Alaskan Way with the following attributes:

- Analysis of travel delay for all modes due to lane designation changes at intersections and segments
- Initial assessment based on transit and ferry operations
- Compatibility with DMS at key locations to notify drivers of upcoming changes (i.e. stadium events, incidents)

Resources:
http://ops.fhwa.dot.gov/publications/fhwahop10031/sec3.htm
http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/2910-1.pdf

Mobility Management and Communication

Image courtesy Open Plans

Summary

Gather public input and provide traveler information through public and private software tools

Benefits

- Enhance public outreach and participation in planning studies using Web-based platforms
- Provide drivers with information on multimodal trips
- Develop relationships with application developers to disseminate public information

Level of Effort	LOW
Cost	$

Software Developer Tools

Description

A wide-range of Web-based mapping and outreach tools are available to gather and share information with residents. By working with open source data for developers, SDOT can use these tools to disseminate information on planned construction projects and traffic management incidents in real-time.

Multimodal trip planning applications are in development for several cities in the US. Many of these applications, created by both public and private software developers, use roadway information, transit schedules, and non-motorized networks provided by public agencies. One example in Portland, Oregon, was built on transit information provided by TriMet, the transit agency in the region. SDOT has the opportunity to advance a multimodal trip planner that utilizes data sources most up-to-date and ready for distribution to travelers.

Software applications can also be used to provide open dialogue for planning studies and provide off-the-shelf means for two-way communication with the public. The City of Chicago used Shareabouts, an application developed by Open Plans, to crowd-source locations for bike share stations. By engaging in public outreach and data sharing, SDOT and local software development efforts will both benefit.

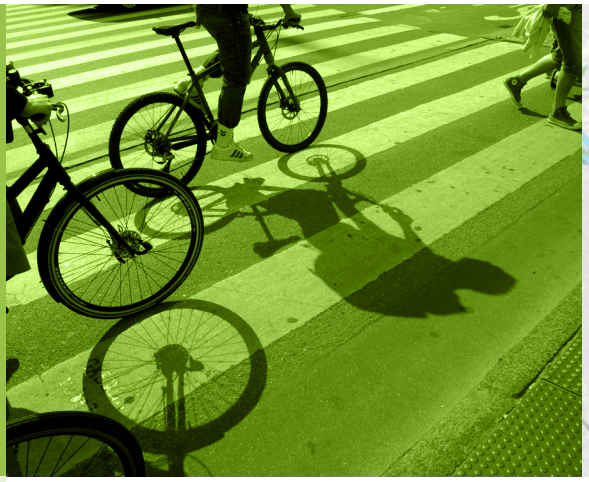
Making these applications available for residents is made possible through partnerships and open communication between agencies and software developers.

To enhance the availability and quality of public information tools, the following SDOT promotions are recommended:

- Host a developer workshop or Hackathon to determine how to best serve data to developers
- Provide open data at the granularity necessary for developers to create travel and notification tools for public consumption

Resources:
http://www.nimbler.com/,http://opentripplanner.com/
http://openplans.org/work/shareabouts/

Mobility Management and Communication



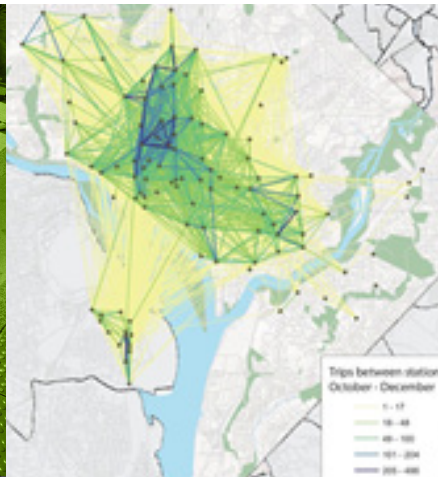


Image courtesy CommuterPageBlog

Summary

Use data from bike share participants to enhance bicycle and multimodal planning

Benefits

- Data for potentially large number of bicycle trips to supplement the limited information currently available on individual trips
- GPS units on bikes provide route choices, distance traveled, and origin-destination pairs
- Station data provides time-of-day utilization and mode transfer information

Level of Effort	LOW
Cost	$

Puget Sound Bike Share

Description

Puget Sound Bike Share is expected to launch in 2014 with 500 bicycles in stations throughout the downtown core, University District, and other inner neighborhoods. Bicycles will be equipped with GPS units for theft tracking purposes. The GPS units monitor the position of riders over time, which could be reduced to interpret speed, direction, and routes. Working with PSBS, GPS data would need to be organized and filtered to estimate origin-destination pairs for individual trips. A similar analysis has been completed for individual bike share trips between stations for Capitol Bike Share in Washington, DC.

Travel patterns from bike share participants would provide planners with a snapshot of bicycle travel in Seattle. However, routes will likely be dictated by designated bike sharing stations and may not be as comprehensive as other data sources. In order to fully leverage this data source, SDOT will need to work with PSBS to collect and analyze bike share trip data. Findings could be incorporated into future planning for bicycle routes, preferred bike facilities, and mode transfers – where riders switch to transit, walking, or other modes.

It is recommded that SDOT promote their relationship with PSBS and enhance the data available for bicycle planning through these steps:

- Develop a Memorandum of Understanding (MOU) with PSBS to utilize GPS and station data prior to bike share deployment
- Continue to coordinate with PSBS on the placement of stations and update based on future planning

Resources:
http://pugetsoundbikeshare.org/
http://greatergreaterwashington.org/post/13327/capital-bikeshare-releases-anonymous-trip-data/

Strategic Partnerships

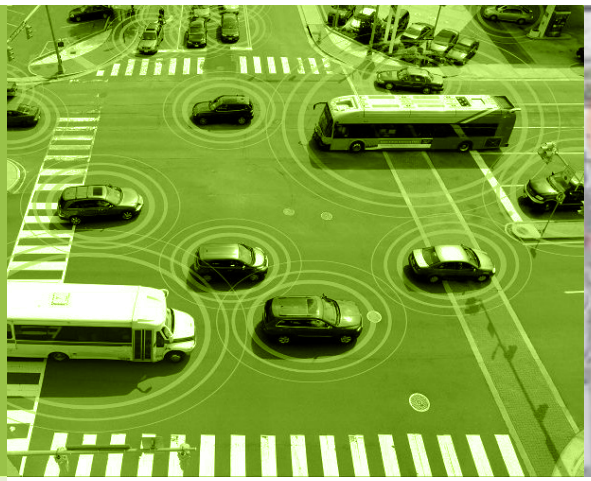


Image courtesy TruckTrend *Image courtesy CommuterPageBlog*

Summary

Initiate a plan for this emerging technology and create a test bed for future connected vehicle applications

Benefits

- With strategic partnering, this program will support local transportation academic research and private enterprises
- Transportation communication infrastructure augmentation
- Improved DOT messaging and public outreach
- Better positioning for federal grant funding
- Economic stimulus

Level of Effort	**MEDIUM**
Cost	**$**

Connected Vehicle Program

Description

The Connected Vehicle program is a research based initiative led by the ITS-Joint Program Office (ITS-JPO), under the USDOT Research and Innovative Technology Administration (RITA). The program examines a world where safety, mobility, and the environment can be improved through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity using advanced wireless technologies.

Because of the substantial impact that V2V and V2I technology could have on safety, National Highway Traffic Safety Administration believes this technology warrants consideration for possible regulatory action. This regulatory action could result in new requirements on vehicle manufacturers such as the need to include equipment to support connected vehicle communications and applications. There will likely be a decision before the end of 2013 that could lead to regulatory action and specify a future date when these initiatives would need to be implemented. The NHTSA could also increase ongoing research efforts, or develop a government safety rating system for equipped vehicles.

States like California, Arizona, Michigan, Florida and Virginia have implemented connected vehicle programs to stay ahead of developing policies, while also realizing significant benefits in their test areas, and for the USDOT Connected Vehicle program.

Given the current activity and planned ITS strategy for SDOT, it is recommended that SDOT create a connected vehicle test bed with the following attributes:

- A small section of urban roadway that includes signalized, intersections with Ethernet connected controller cabinets
- Existing communication backhaul from one of the intersections to the TMC
- Proposed installation of dedicated short range communication (DSRC) radios on signal mast arms
- Interconnection of DSRC radios with controller cabinet network equipment

Resources:
Safety Pilot Model Deployment; University of Michigan Transportation Research Institute;
Local private software/hardware developers

Strategic Partnerships

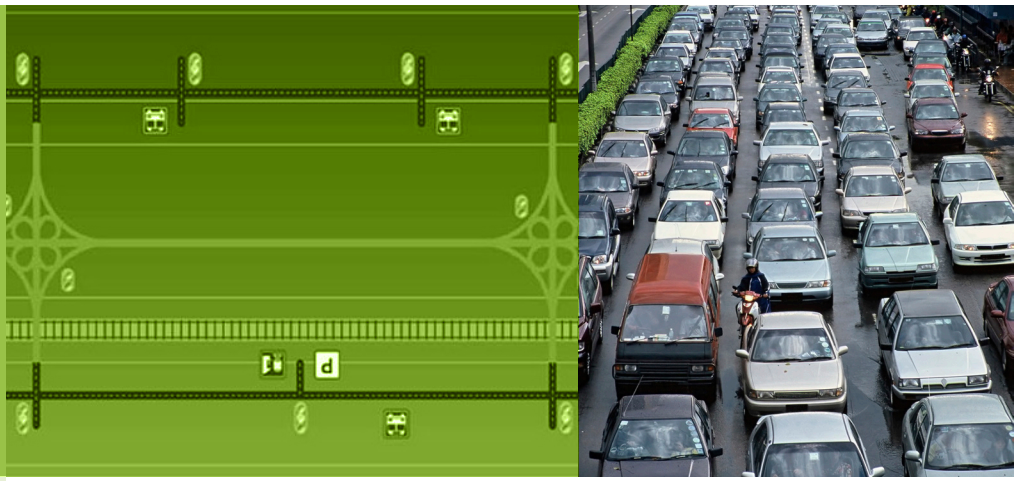


Image courtesy USDOT, RITA

Summary

Build on Seattle's Concept of Operations for ICM to include a pilot corridor for implementation

Benefits

- Combine applications to manage complete corridors to take advantage of unused capacity and resources
- Operate and optimize entire transportation system as opposed to individual networks
- Seattle has been part of the Federal ICM program as a pioneer site

Level of Effort	MEDIUM-HIGH
Cost	$$

Integrated Corridor Management

Description

Through a partnership with the Research and Innovative Technology Administration (RITA), Seattle has been among the eight pioneer cities for Integrated Corridor Management (ICM). WSDOT prepared a concept of operations for ICM in the Puget Sound region, and sites in two other cities were selected for initial demonstrations. Current deployments in San Diego and Dallas will continue through 2013, and the USDOT is expected to publish the results of those two programs.

Seattle's position as a pioneer site for ICM places the City in a unique position to demonstrate how operations strategies and ITS technologies could benefit local corridors. Seattle has locations with active traffic management, transit lines (bus and light rail), and freight available to showcase the role of future ICM deployments. Potential applications for ICM include parking management at park-and-rides, signal timing modifications, and incident management.

Working with WSDOT, it is recommended that SDOT conduct a study to implement ICM on arterials to smooth corridor progression and increase mobility options. This will position SDOT to apply for federal and local funding when it becomes available. A pilot deployment on a corridor in Seattle and expansion of the program would increase visibility and potential funding from USDOT.

Given the ongoing work at the state and federal level with ICM, SDOT should explore a study to recommend a pilot corridor with the following attributes:

- A small section of urban roadway that includes vehicle, transit, and freight modes
- Develop a plan for a phased approach to implementing ICM based on findings from national demonstration sites

Resources:
http://www.its.dot.gov/icms/, http://www.its.dot.gov/icms/pioneer_seattl.htm

Strategic Partnerships

Image courtesy PacTrans

Summary

Collaborate with researchers and students at the PacTrans University Transportation Center (UTC) at University of Washington on future innovative strategies

Benefits

- Contact with cutting-edge research and future engineers
- Potential for low cost and new technologies

Level of Effort	LOW
Cost	$

PacTrans University Transportation Center

Description

The University Transportation Center (UTC) at University of Washington is continually developing projects that progress the state of the practice for ITS applications. Researchers and students are currently working on a range of federal and local projects, such as origin-destination studies using Bluetooth technology, and video detection methods by travel mode to accurately count pedestrians, cyclists, and vehicles.

To supplement the studies already underway, a connected vehicle program that encourages the potential for public-private and public-public partnerships is recommended. The visions co-developed in these shared pursuits increases opportunities to obtain resources (personnel), equipment, software and new funding sources (grants).

SDOT can establish and solidify a relationship through the following steps:

- Promote a SDOT and UTC workshop or forum to exchange current and upcoming ideas and information
- Designate an SDOT point person to meet regularly with PacTrans researchers to develop research needs statements and stay up-to-date on ITS applications

Resources:
http://depts.washington.edu/pactrans/

Strategic Partnerships

Image courtesy theblogaboutcars

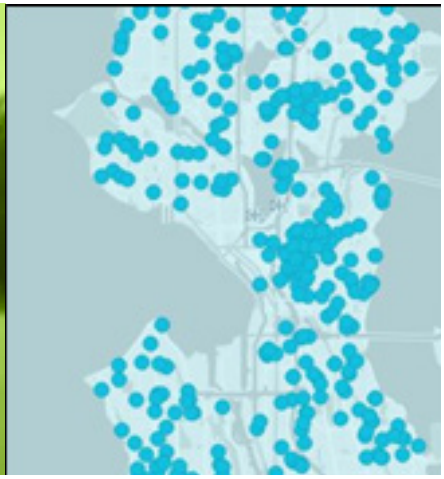


Image courtesy Disposable Cars

Summary

Work with private partners to utilize traveler information and data in the development of transportation plans

Benefits

- Potential for large data sources that are readily available for analysis
- Coordination of upcoming transportation technologies that impact travel habits

Level of Effort	**MEDIUM**
Cost	**$$**

Private Partnerships

Description

Innovative applications and research are underway in private industry to develop technologies that influence transportation systems. Projects such as Google's unmanned vehicles and the Microsoft/Ford in-vehicle DSRC radios are potential partnerships that could keep Seattle on the leading edge of transportation technologies.

Car2Go services could provide data sources to develop a system used in the event of transit delays and planned events. Carpooling match services, such as Avego, could provide additional data sources for travel patterns and origin-destination pairs on heavily traveled routes.

Public-private partnerships benefit from the additional resources provided by both parties. Private entities are willing to provide investment capital into projects that will benefit travelers with the potential for profit. SDOT can leverage the data and outcomes from these projects to gather more information about the City's transportation system.

SDOT can promote these relationships to gather existing data on travel habits and maintain an edge on the development of future technologies by taking the following steps:

- Develop relationships with point-persons at private companies that are able to share data for planning purposes
- Conduct exploratory studies with data from Car2Go and Avego on existing travel patterns

Resources:
http://sacks.io/disposable-cars/

Data Collection

Image courtesy ParkMe

Summary

Parking enforcement vehicles equipped with LPR provide parking turnover and count information

Benefits

- Data from parking enforcement vehicles that are already on roadways
- Potential for real-time applications for travelers to reduce number of circulating vehicles

Level of Effort	**LOW - MEDIUM**
Cost	**$$$**

Parking Enforcement Data Collection

Description

License Plate Readers (LPR) are a reliable technology used in several cities across the US. By outfitting parking enforcement vehicles with this technology, SDOT could gather parking occupancy and turnover information in real time, and information could be provided to the public for on-street space availability. This strategy would require parking enforcement vehicles to circulate the area consistently and more frequently in order to get accurate information.

DSRC is a potential tool for quick communication with LPR-equipped enforcement vehicles. A deployment of DSRC could complement expansion for a future connected vehicle program. Vendors of this technology, such as Codha and Savari, may provide a demonstration of DSR antennas and devices to determine their effectiveness in this application.

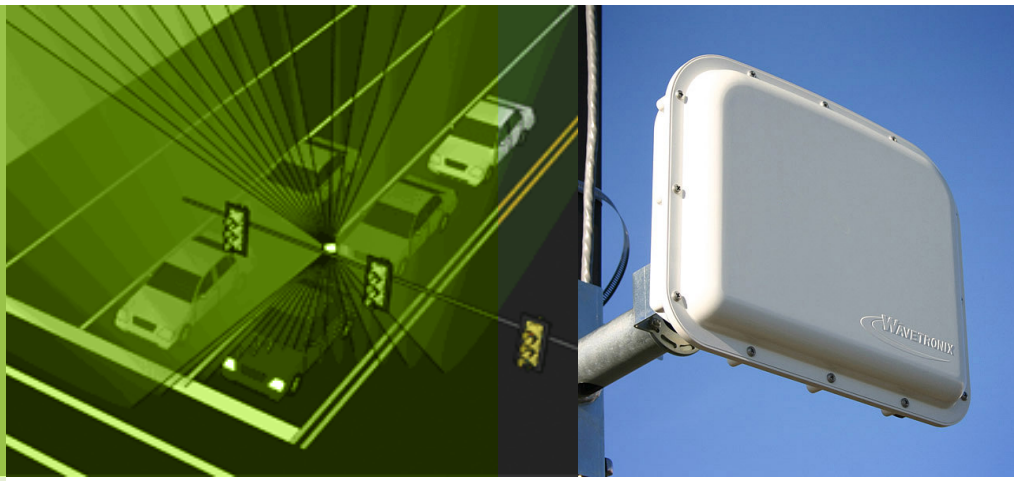
The information from circulating parking enforcement vehicles could be transferred to a mobile or Web application that would show parking availability in real time. Apps such as San Francisco's ParkMe improve parking utilization and reduce circulation when searching for parking. Business owners can feature the optimum parking locations near their businesses, and parking operators can map out lot locations. Parking occupancy and turnover information could be logged and archived for use in updates to parking rates, programs, and other studies.

SDOT could enhance the availability and quality of parking information by taking the following steps:

- Coordinate potential parking enforcement routes that would complement a data collection effort for on-street parking turnover and occupancy
- Explore DSRC as a potential tool for communication by working with vendors on a pilot demonstration

Resources:
http://www.parkme.com/operators-cities

Data Collection



Images courtesy Wavetronix

Summary

On-street parking counts using mounted detection devices

Benefits

- Pilot effort could be conducted with minimal cost
- Data stream readily available with minimal effort after infrastructure installed

Level of Effort	**MEDIUM**
Cost	**$**

Mounted On-Street Parking Detection

Description

Advanced stop-bar detection technology may soon be capable of monitoring on-street parking occupancy on city streets. This strategy would use vehicle detection infrastructure mounted on mast-arms and utility poles to count parked vehicles in real time.

The potential for this technology lies with private companies such as Wavetronix that already specialize in this type of technology. The installation of this next generation device could provide SDOT with parking occupancy, turnover, and enforcement capabilities that could be used for future studies and parking availability maps for public consumption.

SDOT could promote this relationship to enhance the availability and quality of parking information by taking the following steps:

- Select one or two block segments for a pilot deployment by Wavetronix or other private vendor with this technology
- Pilot deployment should include blocks with heavy parking turnover

Resources:
http://www.wavetronix.com/en