New Travel Tool Links Commuters to Real-Time Traveler Information

Ann Brody Guy

Transit faces an ongoing crisis of confidence. Many commuters who might otherwise be eager to reduce their energy consumption, CO2 emissions, and stress levels by choosing transit have been so frustrated by late arrivals, mysterious mid-trip delays, and other time-wasting surprises that they prefer their cars — traffic jam or not.

If a perceived lack of reliability is the culprit for underutilization of transit, it begs the question: Can better information change traveler behavior? If seamless, highly accurate transit information across multiple modes of transportation were instantly accessible to travelers before and during their trips, would they make different decisions?

Researchers at the California Partners for Advanced Transit and Highways (PATH), are seeking to answer that question with the Networked Traveler project, a study launched this August that blankets the entire US 101 commute corridor with real-time transit information — that is, information based on the actual GPS-identified location of the transit vehicles, rather than schedule-based arrival times — updated vehicle counts at transit stations, and real-time traffic conditions.

Wei-bin Zhang is the Transit Program Lead at PATH Project Manager Wei-bin Zhang says the goals of the project are to reduce the wait time at stations (thus also reducing total trip time), eliminate the frustrations of passenger uncertainty, and assist travelers in choosing transit when the highway is congested. “At its core, this project is meant to be a congestion relief tool that will help balance demand across all dimensions of the transportation network,” Zhang said.

Informed Choices

The data-rich software tool features a trip planner that uses real-time bus and train arrival times to find the fastest routes. It compares those with drive times based on live traffic conditions, and, for shorter distances, biking times.

It functions much like Google’s trip planner, with a starting location and a destination, but the results page displays options for multiple modes in a simple-

The Networked Traveler project instrumented Caltrain with its first real-time train location and arrival information.

continued on next page
to-read grid while not-so-subtle color-coding uses green to show the relative CO2-emission savings among the various modes, and blue to show the option of gaining work and relaxation time, even if transit may take longer than driving.

The trip planner also provides potential Park-and-Ride commuters with “smart parking” information, displaying the real-time availability of parking spots at four busy Caltrain stations: Millbrae, Redwood City, Palo Alto, and Menlo Park.

For travelers who already know their routes, there is a comprehensive menu of next-bus/next-train arrivals for all transit agencies in the region, one of the Bay Area’s most clogged commute corridors.

**Along for the Ride**

PATH2Go, the project’s mobile application, has the transit features of the trip planner, and more importantly, includes a series of in-transit alerts that apprise travelers of up-to-the-minute arrival-time adjustments and trip milestones.

Users simply plan a trip on the website, then download it to their mobile phone to receive dynamically generated alerts. iPhones, Androids, and Windows-based smart phones are supported.

**Wake-Up Call**

PATH2Go in-transit services include regularly updated trip-duration times and alerts that tell travelers when their next train or bus is due and when their train is approaching the station, both where they are waiting and where they exit.

Alerts can be set to screen text, sound, or vibrate. “We designed the ‘Your stop is approaching’ ping as an aid for commuters who get absorbed in their work or music, as well as for people with hearing and vision disabilities and people traveling in unfamiliar territory,” Liping Zhang said.

For driver safety, “geofencing” technology is used to block the cell phone application while a driver is in a moving automobile.

**Options and More Options**

For shorter trips, entering an urban segment into the trip planner will yield a bicycle option with estimated times that users can compare to transit and driving.

Project Manager Wei-bin Zhang concedes that sometimes driving will be the best option — for example, when traffic is clear and a traveler is in a hurry. “The project’s larger purpose is to allow travelers to make informed choices,” Zhang said. The comparisons also include cost estimates.

The Networked Traveler project also provides help for drivers already on the road. The “smart parking” feature is linked to a freeway message sign at Millbrae Avenue on US 101 that displays the available parking at the Caltrain stations. Another linked sign shows a real-time comparison between staying on the freeway and exiting to take Caltrain.

“We are encouraging the public to consider using transit, even after they have begun their trip,” said Greg
BRT Performance Assessment
A Decision Support Tool for the Implementation of Bus Rapid Transit Systems

Mark A. Miller, California PATH
Aaron Golub, Arizona State University

Motivation and Introduction
Bus rapid transit (BRT) systems are commonly viewed as an alternative travel mode that helps make bus transit more attractive by enhancing customer service, with the ultimate goals of increasing ridership and contributing to the relief of traffic congestion. BRT is a maturing travel mode with proven operational experience in many parts of the world. It is widely accepted and can deliver services with features that normally are found only with rail service. Many systems have been evaluated in the U.S. and internationally.

The implementation of BRT in the U.S., and especially in California, has shown widespread cost-effectiveness and benefits. The California Department of Transportation (Caltrans) recently adopted a policy supporting the implementation of BRT that requires Caltrans to support BRT projects on the California State Highway System (SHS). However, Caltrans has been concerned about the impacts of implementing BRT strategies on the SHS, but it has lacked a decision support tool to help it understand the potential impacts – benefits and costs – of proposed BRT projects. To address this concern, Caltrans funded a research project that resulted in such a decision support tool, called the BRT Performance Assessment Guidebook or BRT PAG.

No single tool can evaluate all impacts of a BRT project for all relevant stakeholders because these projects depend on actual corridor conditions as well as proposed changes under a BRT scenario. Thus, the BRT PAG is a tool of tools that is best used in the early planning stages of the

Project partners include the Metropolitan Transportation Commission (MTC), San Mateo County Transit District (SamTrans), which operates Caltrain; Valley Transportation Authority, NAVTEQ, ParkingCarma, and SpeedInfo.

The Networked Traveler project equipped Caltrain cars and VTA and San Trans buses with GPS locators, and installed smart parking technology to count cars and transit data Caltrain Park and Ride lots. BART and Muni already generate real-time information that is accessible to third-party application developers; SamTrans provides its bus data to the project.

What’s Next
The field test is slated to continue throughout the fall. Researchers will analyze various sources of user input to learn which information is most likely to influence traveler behavior.

Lead developer Liping Zhang said the team will use website metrics, survey data, and data from interactive windows on PATH2GO that ask users “Did you find this useful?” to study how and when people use the services and which services were likely to influence user behavior. Zhang said, “We hope to learn whether providing information that is both comprehensive and accurate can improve mobility, decrease traveler stress, and ultimately, help to decrease congestion on the roadways.”

Larson, project manager at the California Department of Transportation (Caltrans), which is supporting the project with the aim of developing tools that will reduce traffic congestion and alleviate traveler stress.

Regional Partners
Wei-bin Zhang said that the study’s multi-agency cooperation was key to attaining real-time, region-wide data for multiple modes of transportation. “Getting data for all the parallel systems within this regional commute corridor was critical to providing the quality of information that can build traveler confidence in the network,” Zhang said.

iPad showing Carbon Emission savings using transit
BRT project development process. It compiles a wide array of discussions, and links tools and methods into a single structured environment that helps enable BRT implementers such as transit agencies and Caltrans to understand the various impacts of implementing BRT. Consequently, an agency can embark on a more specific and detailed evaluation along one or several of the impact threads discussed in the tool. BRT PAG can also assist agency staff to understand the required elements of an impact study, allowing them to develop detailed scopes of work for follow-on study.

The BRT PAG is based on a foundation of BRT system strategies and their impacts on affected stakeholders, methods used to assess these impacts, and quantitative estimates of benefits and costs associated with these impacts. Extensive material on BRT implementations and impacts were examined to determine which stakeholders, BRT strategies, and types of impacts we should include in the guidebook.
• Passenger information (stop/station and in-vehicle)

**Stakeholders**

A proposed BRT system can impact various stakeholders with their different perspectives and priorities. The BRT PAG considers the following stakeholders:

- Bus riders
- Bus operators
- Cities (local departments of transportation and revenue / finance)
- Businesses
- Pedestrians
- Cyclists
- Caltrans
- Drivers ("local" and through BRT corridor area)

**Impacts**

The impacts that individual BRT system strategies have on different stakeholders can be assessed according to specific measures of effectiveness such as travel time, service reliability, costs, and safety. For each relevant BRT strategy and stakeholder pair, there may be many impacts to consider.

**Measurement Methods**

Methodological approaches and the data used to assess – quantitatively and/or qualitatively – these impacts are included in the BRT PAG:

- Before-and-after travel time studies and surveys
- Analytical and micro-simulation models
- Analogy (an estimate based on a synthesis and analysis of actual or similar operating experience)

**Benefits and Costs**

The BRT PAG includes quantitative estimates of the benefits and costs to stakeholders of BRT system strategies.

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**Figure 1 - Main Matrix**

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<thead>
<tr>
<th>BRT SYSTEM STRATEGIES</th>
<th>Bus Riders</th>
<th>Bus Operators</th>
<th>Cities</th>
<th>Businesses</th>
<th>Pedestrians</th>
<th>Cyclists</th>
<th>Caltrans</th>
<th>Drivers (Local)</th>
<th>Drivers (Through)</th>
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**SECONDARY OR CO-BENEFITS**

- Emissions (local mobile-source and greenhouse gas pollutants)
- Ridership

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Review of Bus Rapid Transit Information Sources

Numerous reports and associated documentation from the transit/BRT and ITS fields were reviewed from the following subject matter areas:

- BRT benefits and costs
- BRT planning and deployment
- ITS
- Automatic vehicle location
- Collision warning and avoidance
- Lane assist and precision docking
- Passenger information
- Transit signal priority

Construction of Tool

The BRT PAG is a Web-based tool using Microsoft’s Visio program as a platform. Access to the tool is simple and best viewed via Microsoft’s Internet Explorer browser.

The Bus Rapid Transit Performance Assessment Guidebook

A User Guide explains how everything is steered from the Main Matrix (Figure 1), from which the various impacts of BRT strategies can be investigated. The Main Matrix uses a “button” icon that users click to highlight each BRT system strategy/stakeholder impact pair that has a corresponding flowchart information page. Secondary or co-benefits such as emissions, ridership, and land use and development are also included in the Main Matrix. Once users have clicked a button, they are taken to the corresponding flowchart page.

Future Tool Enhancements

The BRT PAG can be improved to assist Caltrans more effectively by:

- Filling existing information and data gaps in the Flowchart Pages’ “Resource and Documentation” component especially for ITS strategies, e.g., collision warning and precision docking, once such strategies achieve actual BRT revenue service operation and quantitative impacts are measured and documented.

- Conducting follow-on case studies in which the BRT PAG is applied to specific corridors considered by Caltrans and local area transit agencies for BRT systems implementation; enhancing the tool based on feedback and lessons learned from such case studies.

The final report for this research is available online at: http://www.path.berkeley.edu/PATH/Publications/PDF/PRR/2010/PRR-2010-37.pdf

Figure 2 provides a flowchart page template including:

- Page name: Identifies the BRT system strategy/stakeholder pair that is the page’s focus
- BRT System Strategy: Defines the individual BRT system strategy
- Impacts: Describes impacts that the BRT system strategy will have on the corresponding stakeholder group
- Measurement Methods: Outlines commonly used analysis tools to derive the impacts
- Resource Documentation: Describes documentation for and examples of existing quantitative benefits and costs of the corresponding BRT system strategy on the stakeholder group, along with additional links to resource documents and websites external to the tool.

Links back to the Main Matrix are provided at the top and bottom of each flowchart page.
Three-Truck Automated Platoon Testing

Steven Shladover

PATH researchers recently completed three weeks of testing of an automated platoon of tractor-trailer trucks on a remote section of highway in Nevada. These tests were designed to show that automated vehicle following in a platoon could be done using dedicated short range communications (DSRC) for vehicle-to-vehicle coordination at its standard update interval, and to measure the potential fuel consumption savings associated with aerodynamic drafting.

Background

PATH has been researching truck automation for more than 10 years, and did a series of carefully controlled tests of fuel savings for a two-truck platoon in 2003. The current research is part of the Federal Highway Administration (FHWA) Exploratory Advanced Research Program (EARP) project, “Development and Evaluation of Selected Mobility Applications of V2I.”

In this project, which is funded by FHWA with Caltrans’s cost share, the PATH research team is working on three distinct applications that can enhance mobility through use of vehicle-vehicle and/or vehicle-roadside wireless communications using DSRC. In addition to the automated truck platoon, the other applications are cooperative adaptive cruise control and variable speed limits to avert traffic flow breakdowns. These applications can enhance mobility by increasing highway capacity and smoothing traffic flow disturbances, with resulting benefits in reduced fuel consumption and, potentially, emissions as well.

For the 2003 truck platoon tests, Caltrans purchased three Freightliner Century Class-8 truck tractors and...
PATH equipped two of them for automated driving, with an emphasis on close vehicle-to-vehicle coordination for vehicle following at short gaps. These trucks were tested on an unused runway at the former Crows Landing Naval Air Station in the California Central Valley near Patterson, California. The runway length of only 2.2 km limited the duration of each test run that could be done while cruising at highway speed. Despite this limitation, a good set of test data was obtained for trucks driving individually and in a two-truck platoon at gaps of 10, 8, 6, 4 and 3 meters. These results showed that during steady cruising at 90 km/h the lead truck could save up to 10% of its fuel consumption and the following truck could save up to 13%.

The new truck platooning research was needed to demonstrate that string stability can be achieved with a three-truck platoon, in spite of the technical performance limitations of the trucks, and within the default DSRC communication update rate of 10 Hz. There have been some claims in recent years that this communication update rate is insufficient to support string-stable platooning, so it was important to prove those claims wrong. The third Freightliner truck from the 2003 project was equipped with the same automation capabilities as the other two trucks, and all three were supplied with new DSRC radios operating in the 5.9 GHz band, with the prescribed 10 Hz update rates. A schematic view of one of the fully-equipped trucks is shown on page 7.

Support from Nevada DOT

The basic debugging and low-speed testing of the trucks was conducted on the short test track at the Richmond Field Station, but it was not possible to test the trucks with trailers or at speeds above 40 km/h because of the limited track length. The Crows
Landing site was no longer available for use, and we searched hard, but ultimately in vain, for comparable sites in California that could be used for truck testing at highway speeds.

Fortunately, Nevada DOT (NDOT) is interested in truck automation and is supporting a case study of truck automation for I-80 between the general areas of Reno and Salt Lake City. NDOT was sufficiently interested in the truck platooning technology that they offered use of a section of lightly traveled highway for testing the trucks, shown in a Google Earth view on page 8.

This section of Nevada State Route 722 (SR-722) to the west of Austin is straight and flat, and has an average daily traffic volume of only 60 vehicles, so NDOT was willing to provide traffic control to temporarily close the highway while the trucks were on their test runs, for intervals of up to ten minutes at a time.

NDOT’s Austin maintenance station provided three flaggers to close the highway during testing periods lasting up to ten hours per day, four days a week, and the University of Nevada, Reno, provided student flaggers for an additional two days a week so that the testing could continue outside the normal NDOT work hours.

The truck test scenario consisted of starting up from a stop, accelerating to a cruise speed of 87 km/h, and then decelerating to a stop at the end of the test section. The cruise speed level was chosen to avoid complications from inconsistent transmission gear shift speeds among the test trucks when they exceeded this speed, a temporary practical constraint rather than an inherent limitation of the general technical approach.

The testing began at gaps of 10 m between trucks and continued at that gap throughout extensive debugging. Only after the performance was consistent and reliable at the 10 m gap did the research team attempt shorter gaps. By the end of the three-week test period, we had data for vehicle following at gaps of 8 m and 6 m as well, so that we can compare the fuel consumption savings at these different gaps.

Additional highway-speed testing of the three-truck platoon is planned for next spring, providing opportunities for testing some other gaps, as well as operations including speed and grade changes and platoon join and split maneuvers.

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