Rainier Transit ITS

by Joseph Couples, PE

Introduction

At no other time in the United States have transportation professionals held at hand the technology resources such as we have in the Intelligent Transportation System (ITS) field today, while simultaneously being confronted with diminished operational budgets. It is a unique paradigm and one that requires the engineer to think not only about the engineering functionality of an ITS system, but also consider new ways of partnering, and perhaps even new partners. The Rainier project was an ITS project envisioned to enhance a socioeconomic disadvantaged community in south Seattle, but also became an exploration in the advantages of partnering.

Like many urban regions the City Department of Transportation provides traffic management but does not operate the transit system. The transit network is operated by multiple entities including Sound Transit, Pierce Transit, Community Transit, and King County Metro Transit. Pierce and Community Transit offer intercity service, though primarily serve regions outside of Seattle. Sound Transit operates both Heavy and Light Rail as well as bus service within the Puget Sound Region with Seattle at the center of their service area. Within Seattle, most of the transit bus trips are on King County Metro busses and the Rainier Avenue corridor is Metros highest ridership corridor.

Rainier ITS was the final, almost crowning jewel, of a multi-phased, $12 million dollar project to improve the transit corridor travel time and attract new riders. This final phase of the program would install Transit Signal Priority and Real Time Information Signs along with the communications infrastructure to support the ITS elements. The preceding phases having installed the pedestrian signals and civil improvements including curb bulbs for bus stops, roadway cross-section revisions for queue jumps and revised parking for safety and traffic flow. While not explicitly stated in the project charter, not the least of the project objectives are to address social justice goals within the Rainier Valley and to be a prototype of sustainable transportation within Seattle.

The Rainier Valley is a center of rich, multiculturalism with emigrants from almost every continent of the world with over 40 languages spoken. The Rainier community also has the highest concentration of low income households and poverty in all of Seattle. The transit routes that provide service on Rainier Avenue have more than 10,000 weekday riders and over 3.6 million annual transit trips comprising the highest ridership in Seattle and King County. As part of the grant, with recognition of the community needs as well as the goal of sustainability through car free travel, an outreach campaign budget of $100,000 was set aside to get the message throughout the community.

Real Time Information Sign Deployment Considerations

While there are many cities that deploy traveler information for drivers using real time maps and dynamic message signs, the deployments of applications of transit rider information is not as prevalent. Even within relatively state-of-the practice King County, only Bus Rapid Transit lines (RapidRide) are afforded real time transit rider informational signs at bus zones. As such, there was not a great deal of information on how to select bus stop locations to receive the information signs. After discussions between the two agencies and with Tri-Met, a daily boarding minimum of 150 was established and this yielded 13 locations on the Rainier route.

Selecting specific Real Time Information Sign (RTIS) technology for the project between LCD and LED is not an insignificant issue, and both have favorable characteristics. Early in the process, the City and County concurred that the LED technology was probably the least cost in both deployment and life cycle. Furthermore, the two and four line LED signs could easily provide sufficient transit rider information for a forthcoming 30 minute period on one or two 'pages', even with the high number of busses used on the Rainier corridor.

Because of the limitations of their operational budget to encumber non-BRT informational signs as well as lack of agreement concerning operational costs, the city found itself in the new role of a provider of roadside transit rider information. This was an unexpected evolution of the project that meant that the city would have to design an alternative to the BRT developed real time signs called "Technology Pylons" so as not to necessitate the use of the County's proprietary system of transit bus data and licensing fees. If it were not for the knowledge and willingness of Brian Ferris and other associates at the University of Washington, the task of delivering real time information on Rainier would not have been practicable.

Real time transit rider information has been available in many cities for several years, but this history has largely been confined to PC's using the internet and over the past few years mobile devices as well. One such transit application was developed by the University of Washington (UW) and it is called "One Bus Away" (OBA). While the OBA system is now several years old, it remains a benchmark in its user interface and more transit riders in Puget Sound use it than all of the other systems combined. It was to the University of Washington that the Seattle team worked with to leverage the UW's bellwether OBA application, and it is to this OBA application that the Seattle RTIS can attribute the systems characteristic of extremely cost effective delivery of rider information.

If there was a short coming in the OBA application it was that it provided perhaps too much information for many, and certainly too much for a low cost LED display. After considerable evaluation of differing text abbreviations, symbology, and the use of color to provide bus information, it was determined simplicity was best. Once this was decided, the teams code writer began the task of using the Software Developer Kit to extract the core data from the OBA Application Programming Interface into a simplified output suitable for an LED sign. The simplified output came down to four key parameters: (1) route number, (2) route destination, (3) Predicted versus Scheduled status (useful if we have temporary failure in the wireless communication) and (4) minutes to arrival.

Why Real Time Information Signs?

Within the transit industry, there is a group that has become known as choice riders. These are persons whom have transportation options for their commute besides transit. While many persons choose transit because of commitment to the environment, or to save money, there are also many persons who will not select transit without other factors that will influence their choice. Studies suggest that these factors can be bus stop amenities, improved travel reliability, decreased travel time and also real time information analogous to traveler information maps.

Many choice riders will choose to drive rather than take transit in order to remain in control of their travel. This is an understandable human factor. When we take transit, we are subject to unknowns that affect our trip. Delays, route changes due to events or incidents, and confusion about schedules are among the issues faced by transit riders. The USDOT identifies that "After 3 minutes, a passenger waiting for a bus that is not coming expects more information and begins to consider alternatives..." Real Time Information Signs puts a degree of control back in the hands of the awaiting transit rider so that they may make informed decisions.

While choice riders may be enticed to ride transit by such information, there are many whom are transit dependent and information for them is perhaps even more important. According to the 2005 US census approximately 50 million Americans have mental or physical disabilities. For the disabled, decision making information is even more meaningful and is consistent with the intent of the ADA in supporting the goal of mobility for all persons.

Much like Europe and Asia, we in the US are an increasingly mobile-technology society, and for many of the fortunate, mobile devices (smart phones, etc) often provide all of the real time information without any roadside assets. But this mobile technology should not be considered unilaterally to be an answer to attracting more transit riders, it can be inefficient in dense urban areas, and more importantly, this assertion would be inconsistent with the goals of social justice and the mobility for all persons.

Even with the growth of communications and the internet, the US Commerce Department has estimated that more than 40% of homes do not have internet access, and further, that internet use is least among low-income and older persons. A remarkably similar paradigm, though for very different reason exists for choice riders, whom while internet savvy also tend to be less familiar with the transit system. Thus, for very different reasons, transit rider information is a benefit to a range of transit riders, but for very different reasons.

The core of ITS systems is communications

The core of all Intelligent Transportation Systems is communication and the Rainier project includes fiber optic and wireless communication technologies. The project installed a fiber optic backbone from the Traffic Management Center through the corridor and to each of the traffic signal cabinets. From the traffic signal locations, wireless Access Points (AP's) are used to communicate to the RTIS 2.4/4.9 GHz client. In the present architecture, all of the AP's are root AP's that are connected to fiber switches, but the design allows for future expansion to include mesh AP's.

Microwave wireless has been used in many applications including popular WiFi, and for the project, 4.9 GHz Public Safety band was selected as the technology for the wireless with the vision of a wireless cloud available to all governmental entities. Unlike our transit partner whom pioneered the transit application of 4.9 GHz radios, the Seattle 4.9 GHz uses Open Standards rather than proprietary protocol. This, along with the superior bandwidth of 20 MHz channels as opposed to 5 MHz channels facilitates the interest of major partners such as the Seattle Police Department. These characteristics allowed for partnering opportunities and expansion capabilities that are the benchmark in state-of-the-practice ITS communications.

All of the projects AP's not only communicate the One Bus Away information to the Real Time Information Signs, but are also envisioned to have an expanded role in the future. Sometime after 2013 our transit partner will migrate to open standards Wireless Mobile Interface Cards and 20 MHz channels allowing them to take advantage of the wireless cloud for transit signal priority, communication of the GPS as well as other information from the bus On Board Systems. Other future possibilities that the wireless network will support include surveillance cameras, traffic signal interconnect, mobile clients, wireless metering for electrical power, and electronic parking systems.

Summary

Real Time Information Signs are one of the most significant tools available to those of us in the ITS field for increasing transit ridership by attracting choice riders and for delivering traveler information for those whom already use our transit network. RTIS empowers awaiting riders by giving them decision making information that they can use to adjust their trip plan to an alternate bus or take other actions. And while many persons may have mobile devices that provide real time transit information, this is not generally the expectation on the Rainier corridor.

The project was unique from the outset in that the partners were substantially broader then traditional ITS projects and included the Port of Seattle, King County Transit, Seattle Police, Fire, and Seattle DOT. Partnering on any large scale endeavor is sometimes an institutional hurdle, and initially one of our partners opposed any user other than themselves using the wireless cloud, but the cumulative strength in partnering quickly overcame any institutional tendency for unilateralism. In the end, all of the partners benefited beyond what any one of the entities could accomplish on their own.

The Rainier RTIS goals were attained at costs that far exceeded expectations. Beyond the cost benefits in partnering, leveraging from the open source OBA software from the University of Washington made the project not only possible, but at a cost that the project team had not imagined possible. The overall system cost was conservatively reduced by hundreds of thousands of dollars, from that of developing a traditional system. At this time, others, including researchers from Georgia Tech and the University of Washington are awaiting funding for expanded research of One Bus Away while additionally other cities are exploring the possibilities of applying OBA software to provide user friendly, real time transit information.

The number of wireless 4.9 GHz Public Safety band deployments have been quite limited. If there is one take away from the Seattle experience it is to apply the practice of creating a thoroughly vetted Request For Proposals, and include validation. While the Seattle deployment was an unqualified success, our capability to communicate with our transit partner was compromised by their application of a proprietary Wireless Mobile Interface Card protocol within their bus fleet. This was unknown at the time of the project, and at present precludes Transit Signal Priority along the corridor.

The present generation of ITS technology has approached saturation and there are to a degree, the first evidence of diminishing returns. The next sector for ITS development is that of multi-modal and connected vehicle technology. A recent poll of ITS practitioners in the US showed that 81% believe connected vehicles will likely, or perhaps even very likely become realized within the next 15 years. Projects such as the Rainier Transit ITS, by connecting mobile clients to roadside wireless, are a step toward achieving the connected vehicle concept as well as supporting alternative modes of transportation.

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