

The Successful Deployment of a Transit Signal Priority System; Sumner Avenue, Springfield, Massachusetts

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INTRODUCTION

The City of Springfield Massachusetts and the Pioneer Valley Transit Authority have installed a first-in-the region, in-vehicle Traffic Signal Priority (TSP) system for buses on one of the City's busiest routes. VHB/Vanasse Hangen Brustlin, Inc., the Pioneer Valley Transit Authority (PVTA) and the Pioneer Valley Planning Commission (PVPC) teamed up with the City of Springfield to implement this new system that had the potential to help increase on-time performance for the PVTA's bus fleet, decrease travel times for express bus routes during rush hour, attract and retain riders and reduce congestion related emissions by decreasing idling time by PVTA buses.

The system works through the use of optical-based transmitters (located on the buses), and receivers (located on the traffic signals). The transmitters emit both visible and infrared light. As the bus approaches an intersection (within approximately 400-feet), the receiver detects the optical transmission, and, based on status of the traffic signal sequence, either shortens the cross-street's green light, or extends the green light along the bus route.

In the past, bus-prioritization systems have proved less-than-ideal operation, because they disrupted the precisely coordinated timing of the traffic signal network along the prioritized route. The system installed in the City of Springfield avoids this problem, thanks to the new algorithm that governs the signal timing. A wireless GPS

system installed at each cabinet maintains an accurate time reference between intersections. The system also supports an emergency-vehicle pre-emption capability, which can detect approaching emergency vehicles, and give them a green light through the intersections. These two systems co-exist at each project location.

The Pioneer Valley Transit Authority serves 24 member communities in Western Massachusetts with the City of Springfield being PVTA's largest community. PVTA, through its four different fixed route operators, runs 175 buses on 44 different routes and carries nearly 10 million passengers per year. The Springfield Area Transit Company (SATCo) operates the Green Light Special for PVTA.

PROJECT OVERVIEW AND HISTORY

In 2001, the City of Springfield and PVTA were seeking to improve transit service in this corridor and applied for a Transportation Demand Management Grant from the Massachusetts Executive Office of Transportation (EOT). This competitive grant using Congestion and Air Quality Mitigation (CMAQ) funds sought to reduce auto trips and improve air quality. The Springfield Grant which was developed by the City's Planning and Public Works Departments, as well as PVTA and PVPC, sought to develop an express route with a Transit Signal Priority (TSP) system that would facilitate direct service from the outskirts of Springfield into downtown.

From the beginning, the project was structured around some innovative features which were expected to be replicated in other parts of the PVTA system. The final project focused on ITS applications that were simple and low cost.

PROJECT IMPLEMENTATION

System Design

In order to minimize construction costs, the system was designed to reuse as much of the existing traffic signal control infrastructure as possible. This included retaining traffic signal heads, supports, cabling as well as vehicle and pedestrian detection wherever possible. New traffic signal control cabinets, emergency vehicle preemption and bus priority systems were integrated into the existing system. To further reduce construction costs, the City of Springfield utilized its own staff to perform the installation of the system, along with technical support from VHB. In addition, the project specifications required that the system supplier provide on-site technical support during construction.

While the existing corridor contained a coordinated traffic signal system, there was no communication between intersections. Coordination was achieved through time-based coordination where the accurate time clock resident in each traffic controller provided the necessary time reference to maintain coordination. The new system installed as part of this project provides a GPS input directly into the traffic controller to maintain clock accuracy.

Signal Priority Control Equipment

While all of the traffic signal traffic controllers available on the market today have internal preemption capability, not all of them have the specific capability to support a bus priority system. Preemption for an emergency vehicle (high priority) involves an immediate termination of a conflicting movement or phase to provide a green indication for an approaching vehicle. This type of override of normal signal operation will cause the intersection to drop coordination and require that it re-synch over as many as five cycles before coordination is back in place. With bus preemption (low priority), the intent is to provide a preferential treatment for an approaching bus such that its headway is reduced without dropping the intersection out of coordination thus minimizing impacts to normal

signal operations. The project specifications contained functional requirements that the system needed to achieve so that the bus priority system would operate as required, maintain traffic signal coordination along the arterial and provide for as needed override of the system when an emergency vehicle preemption event occurred. The successful system bidder was required to demonstrate system capability prior to being approved for use on the project.

The traffic signal controller platform used was a NEMA TS-2, type 2 architecture, Naztec model 980 with transit priority firmware loaded into the unit. The transit detection system, as well as the emergency vehicle preemption system is a 3M Opticom system model 700 series.

Transit Signal Priority Integration

Unique to this project was the process in which the system was ultimately completed and fine tuned. Instead of the traditional method of providing plans and specifications to a contractor to construct the system and then performing an inspection, this project required that a team approach to final system integration be performed. In the course of the final stages of construction, representatives from the City, equipment suppliers, transit agency and the system designer worked together in the field to properly program the various control elements and fine tune as necessary.

PROJECT OPERATION

Transit Operations

Prior to the implementation of the Sumner Avenue Green Light Special bus route, PVTA operated only a fixed route along Sumner Avenue and Main Street in Springfield with extended service into the adjacent City of Chicopee. This route, the Green 1, as typical with urban transit routes, serviced many stops along the route located at nearly every other street corner. Service is provided approximately every 15 minutes in the peak hours (5:00 AM to 9:00 AM and 2:00 PM to 6:00 PM); 20 minute headways are provided the rest of the operational day. Travel time for this route from the outskirts of Springfield, at the Five Town Plaza, which is near the intersection of Allen Street/Cooley Street, to downtown could take over 45 minutes.

The new express route, the Green Light Special, provides service along the Sumner

Avenue corridor traveling from the Five Town Plaza to Baystate Medical Center during the weekday mornings between the hours of 7:00 AM and 9:30 AM and 3:30 PM and 6:00 PM. During the weekday afternoon, service starts at Mercy Hospital. Figure 1 illustrates the Green Light Special bus route.

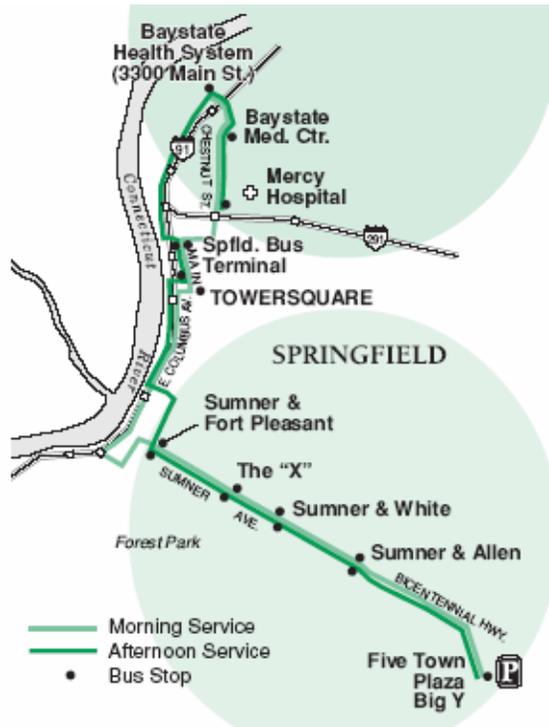


Figure 1: Green Light Special Bus Route

The bus stop locations for inbound and outbound routes do not include every stop that is included in the fixed route along Sumner Avenue or Main Street. The more frequently used stops were evaluated and included as the primary stops for the express bus route. It was determined that stops on the far side of a traffic signal work better with this application. The following stops were included:

- Five Town Plaza (Allen/Cooley)
- Sumner & White
- The "X"
- Sumner & Fort Pleasant
- Main & Harrison
- Baystate Hospital
- 3300 Main Street

Emitters

Currently the PVTA has 175 buses in its fleet, of which, only nine currently have priority signal emitters. In the initial project concept, the emitters would be turned on/off with the bus sign; however, the current buses did not have the capability to operate this way. Therefore, all of the buses were wired with manual on/off switches for the drivers to manually use the emitters. PVTA instructed drivers to make sure the manual switches are turned off when the bus is not in service as an Express Bus on the Sumner Avenue corridor. This was an important component to ensuring that the system operated efficiently. The emitters needed to be off when buses were "dead heading" to the park & ride lot at Five Town Plaza. Also as part of this process, the City requested that PVTA inform them of the routes that the out of service buses use. This was also important because the City has approximately 40 intersections with high priority (preemption) capabilities and did not want to disable any low priority capabilities at any of the locations, other than Sumner Avenue, that may have low priority enabled.

Transit Improvement

In order to measure the effectiveness of this system, PVTA and PVPC collected data at three specific time periods relative to the project implementation. The data collection included:

- Before implementation of traffic signal coordination;
- After implementation of traffic signal coordination; and
- After implementation of transit/bus priority.

This data collection was required to satisfy the requirements of the grant funding focusing on the comparison of before and after data. This collection of data provides a measure for the overall effectiveness of the implementation of both traffic signal coordination and transit/bus priority. Once the data collection process was completed for the "before traffic signal coordination", the system was turned on at all locations prior to the official start of the Express Bus Service.

Travel Time Improvements

The Green Light Special service has reduced travel time across the entire route by nearly 15

minutes; from 45 minutes to 30 minutes. This time savings is a combination of the route's limited stop and I-91 express operations, more efficient routing and the Transit Signal Priority System.

Ridership on the route has ranged between 7 and 15 passengers per hour, with an average of 11 passengers during the route's first four months. The performance is in line with PVTA's other express routes which have 15 passengers per hour, but below PVTA's target of 20 passengers per hour. However, the ridership of the existing Green 1 route is up 8% for October 2006 when compared to October 2005 indicating that the express service is creating new riders and trips to the PVTA System.

Air Quality Improvements

All of Western Massachusetts is designated as a non-attainment area for ozone, and the City Metropolitan area is designated a non-attainment area for carbon monoxide. The project will provide both PVTA and the City with an opportunity to reduce vehicle miles traveled and poor air quality while offering a viable alternative to single occupant commuter vehicles. The project includes upgrades to existing signals and new timing plans along with coordination to facilitate intermodal traffic flow enhance motorist safety while improving the efficiency of the Sumner Avenue corridor

FUTURE BUS PRIORITY

The Project's Future

PVTA expects to make some changes to the schedule in April which should make it more convenient for passengers to use the service. During the longer term PVTA expects to analyze the Express service in conjunction with regular G1 service to determine the correct overall level of service in the corridor.

PVTA is seeking to implement additional transit Signal Priority systems in other appropriate corridors in Western Massachusetts. Routes include the State Street Corridor in Springfield as well as the Route 9 Corridor between Northampton and Amherst.

Lessons Learned

This project began with the City and PVTA's desire to increase transit ridership in the corridor, and why not provide something new

and innovated for transit riders. This innovated system also provided the City of Springfield with the ability to try something new, which would be covered by a grant.

The initial conversation with the Department of Public Works made it clear that the signals in the corridor would need to be updated to allow for transit priority, but this too could be funded as part of the grant application.

For ITS projects to be successful relationships between different entities need to be fostered. From the beginning PVTA and the City of Springfield had a positive relationship over a project with mutual benefit. PVTA brought to the table resources to make traffic signal improvement possible and, in exchange received the ability to use the Transit Signal Priority System. PVTA and the City's agreement formed the basis for the first interagency agreement under the Regional ITS Architecture for the Pioneer Valley. As PVTA moves forward to implement additional Transit Signal Priority (TSP) systems in other area corridors, evidence of a successfully working relationship will be very useful in moving these innovated techniques forward.

Funding

Federal funds in Transit and Congestion Mitigation Air Quality Programs (CMAQ) are eligible to be used for projects that benefit transit. In this case CMAQ funds were transferred from the Federal Highway Administration to the Federal Transit Administration and then granted to PVTA. PVTA was the recipient of the funds and reimbursed the City for a portion of the expenses for the signal improvements.

CONCLUSION

This project developed from "a what if" conversation between PVTA and the City of Springfield. PVTA has received a number of TDM grants from the Executive Office of Transportation before this project, and sought out partnership opportunities from member communities to promote new transit services that also include using innovated ITS applications.

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REPUBLICAN NEWSPAPER ARTICLE
By Jack Flynn, October 5, 2006

But behind the wheel of Pioneer Valley Transit Authority bus 1151, McCarthy does something every few minutes that most people will never do. By using an electronic signal, McCarthy stops red lights before they stop his bus and snarl traffic along Sumner Avenue, one of the city's busiest commuting routes.

"It's like a new toy," McCarthy said yesterday, approaching a green light at Sumner and Fort Pleasant avenues. Once the bus rolls within 400 feet of the traffic signal, a transmitter instructs the light to stay green, allowing the bus to cruise through another intersection.

"That's nice," said Darcelle Pharms, a student at American International College on her way to a class.

Besides shaving minutes off the daily commute, the traffic light zapping system offers a glimpse of the future of bus service in Greater Springfield and other traffic-clogged urban areas.

Combining a wireless transmitter on the bus with receivers on traffic lights, the \$460,000 program was unveiled here last month in a federally funded campaign to speed up bus service and reduce traffic congestion.

In New England, Springfield is one of a few cities participating in the experiment. The system does not eliminate red lights entirely. If a bus is more than 400 feet away, the signal does not work. And only one bus route, the Sumner Avenue route from Five Town Plaza to downtown and Baystate Medical Center, is part of the Greenlight Special project.

Still, the reviews have been positive, especially from coffee cup-clutching commuters gathering every morning in the Five Town Plaza parking lot. By using the green light extender along with limited stops and a quick excursion onto Interstate 91, the Greenlight Special runs between 15 and 20 minutes shorter than the non-express service.

Not every attempt at traffic-light zapping has gone so well. Past experiments have wrought havoc with emergency vehicles and tangled traffic patterns. The new system, according to designer VHB/Vanasse Hangen Brustlin, Inc.,

works better because it is based on "a new algorithm."

No transit official could elaborate yesterday, other than to say the Greenlight Special is running smoothly.

So smoothly, in fact, that some drivers wish they had similar devices in their own vehicles, and PVTA officials from other communities are, well, green with envy.

"I hope we get one out here in Palmer," said James St. Amand, who represents the town on the PVTA's advisory board. "I think we should be next."

Next up for the Greenlight Special treatment will probably be Main and State streets in Springfield. The PVTA's acting administrator, Richard J. Kos, said the agency eventually hopes to install electronic scheduling boards showing location and arrival times at each bus shelter.

The idea, Kos said, is to make bus commuting as convenient and hassle-free as possible.

On her ride from Five Town Plaza to the downtown terminal yesterday, Pharms had no complaints: 15 minutes, no red lights, no traffic backups.

"I'm on time," said Pharms, who takes a connecting bus to her college. "That's always good."