

## **i-STOP Pilot Project: Experimenting the Solar Powered Bus Stops**

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### **ABSTRACT**

i-STOP, developed by Carmanah Technologies Corporation of British Columbia, is a solar powered stand-alone modular bus stop device designed to improve bus stop visibility, to enhance customer safety and security by increasing lighting levels at a bus stop, and to improve customer service by providing an illuminated schedule panel. The Greater Vancouver Transportation Authority, also known as TransLink, implemented an i-STOP pilot project by installing 17 i-STOPS in the Greater Vancouver area over a nine-month period from April 2004 to January 2005 to assess the benefits of the i-STOPS and to identify key factors for implementation in the Greater Vancouver area including location selection criteria, implementation and operation under different weather conditions and in different land use areas. The pilot project also included an user survey to evaluate customer and operator satisfaction and acceptance. This paper discusses the methodology of the pilot project, issues identified from implementation and operation, key findings from the user survey, and success factors for effective future deployment.

### **INTRODUCTION**

Public transportation is an important mode of travel in the Greater Vancouver Region in Canada. The Greater Vancouver Region has a highly developed and sophisticated transit system that offers a seamless and integrated network of service including SkyTrain, SeaBus, West Coast Express trains, buses, and community shuttle buses. This system is widely regarded as one of the best examples of a successfully integrated transit system in North America with a modal share of more than 11% or approximately 141 million transit trips annually. As all the bus trips start and end at a bus stop, improving passenger experience at bus stops has always been an important aspect of passenger facility design consideration to enhance customer service. In 2004, the Greater Vancouver Transportation Authority, also known as TransLink, implemented a pilot program to install 17 i-STOPS in the Greater Vancouver Area over a nine-month period from April 2004 to January 2005 to assess benefits of the i-STOPS and identify implementation issues to be considered for future expansion of i-STOPS in the region. This paper discusses the methodology of the pilot project, issues identified from implementation and operation, key findings from the user survey, and important success factors for effective future deployment.

### **METHODOLOGY**

There are two types of i-STOPS: three-functioned and two-functioned. The three-function i-STOPS have a security downlighting, a flashing beacon, and an illuminated schedule panel. The two-function i-STOPS have a security Downlighting and a flashing beacon. Figure 1 shows a three-function i-STOP.

The security Downlighting is a LED lighting feature that provides addition lighting to further enhance customer security and comfort at the bus stop. The flashing beacon can

be activated by a customer waiting at the bus stop to signal the bus driver to stop. The illuminated schedule panel is lit internally to improve the visibility of schedule information under poor lighting conditions

As an optional feature, the NexPole in octagonal shape can be used to improve bus stop identification for the visually impaired by providing a distinct feel of the pole.

A collaborative process was involved throughout the pilot project. Major tasks and key stakeholders involvement are outlined below:

- 1) Consultation and confirmation with the bus operating company and municipalities on selection of pilot locations – January 2004,
- 2) Installation of the i-STOPS by the bus operating company - April 2004,
- 3) Inspection/Maintenance by the bus operating company - April 2004 to January 2005,
- 4) User survey - November 2004,
- 5) Stakeholder feedback - January 2005.

The implementation of the pilot project was well publicized with media releases and on-board bus information to promote general public awareness of the pilot project.

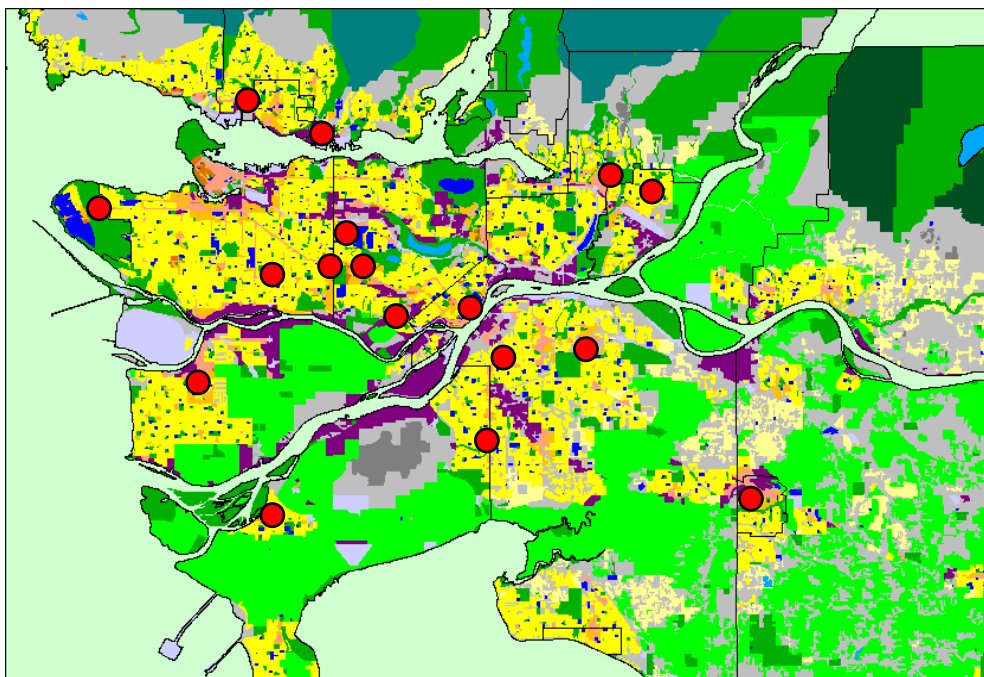
In order to test different features of the i-STOP units, the pilot locations were selected based on the following three criteria:

- 1) *Stops with high demand for schedule information.* The function of the illuminated schedule can be tested by placing the i-STOP at bus stops with high passenger activity such as a terminus in a transit exchange, transfer points, etc. This would also generate more awareness and exposure of the pilot i-STOPS.
- 2) *Stops with limited visibility due to geometric constraints.* The visibility of a bus stop is limited to bus drivers if the bus stop is behind a vertical or a horizontal curve of the roadway. The flashing beacon may help to caution the bus driver of waiting passengers at the bus stop, particularly in the dark.
- 3) *Stops with low lighting level.* Installation at bus stops with low lighting level provided opportunity to evaluate the effectiveness of the security lighting.



**Figure 1: i-STOP**

In addition to general coverage throughout the Greater Vancouver region, the location selection also considered different land use areas such as commercial, industrial, residential, and near schools. It should be noted that out of the 17 pilot units, six were three-function units, and eleven were two-function units. Octagonal shaped NexPoles were used at all 17 locations. Figure 2 provides a geographic distribution of the 17 pilot locations in the Greater Vancouver area.



**Figure 2: i-STOP Pilot Locations**

## **IMPLEMENTATION**

Installation and maintenance of the pilot i-STOPS were carried out by the bus operating company's bus stop maintenance crews. Schedule panel insert design and update were prepared by the marketing group. Sheet change information was provided by the bus operating company's customer information group. Some issues and logistics were identified through the pilot period for updating the inserts at the three-function i-STOPS.

### *Installation*

An adaptor was used to fit the NexPole into the existing 2 3/8" diameter sleeves. This proved to be cost effective for installation of the pilot units as it avoided removal of existing sleeves and installation of new sleeves to fit the NexPoles. If NexPoles are to be used for larger deployment, an inventory of NexPoles should be established. It should be noted that the i-STOP supplier is able to produce modules that can fit on existing round poles. Figure 3 shows an adaptor was fitted to the NexPole for the pilot installations.

### *Schedule Panel Inserts*

Customized schedule panel inserts were designed by TransLink's marketing group. The design was finalized based on comments received from stakeholders in terms of readability, font size, and color combinations. Figure 4 shows two layouts being used for the three-function i-STOPS.

Based on the feedback from the user survey, the panel insert design should be revisited if and when the i-STOP installations are expanded. It is suggested that a focus group be organized to test and select a new panel design in terms of color combinations, font size, amount of text, and user instructions.



**Figure 3: Adaptor to Fit the NexPole to Existing Sleeve**

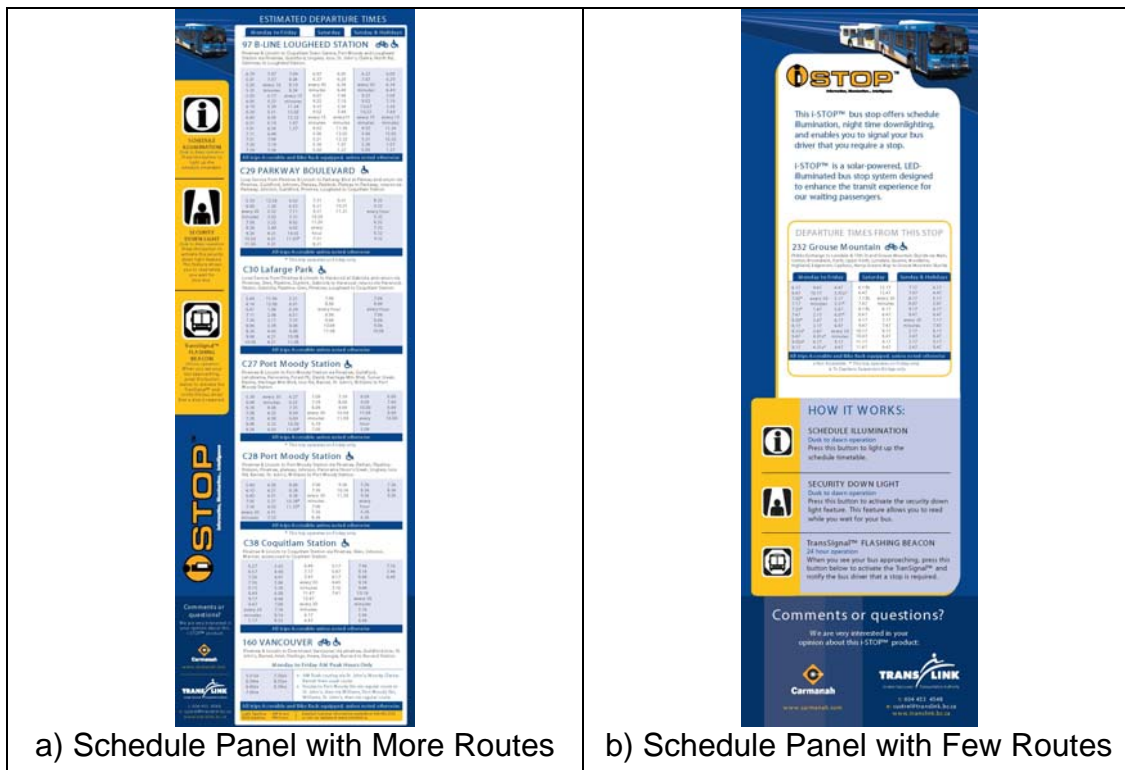
It should be noted that whether any instructions should be provided is also related to how self-explanatory the buttons are designed and labeled. For example, to reduce the number of buttons from three to two or even to one would reduce or eliminate the need for any new user to test to find out which button is for what feature especially during dark hours.

#### *Transit Schedule Update*

Transit schedules are adjusted four times a year. This is also referred as sheet changes. The pilot period covered all four sheet changes in April, June, September, and December. During each sheet change, schedule information was revised; this necessitated the revision of schedule panel inserts. The task of updating these inserts was accomplished with involvement of a number of internal groups. For future larger deployment, the schedule updating process should be streamlined to ensure accurate schedule information can be provided timely and efficiently.

#### *i-STOP Repairs and Replacements*

Most of the pilot units installed at relatively isolated suburban locations stayed intact through the pilot period. A couple of three-function i-STOPS installed in busy urban areas were vandalized and required repair or replacement.



**Figure 4: Schedule Panel Inserts for 3-Function i-STOPs**

## USER AND STAKEHOLDER FEEDBACK

### User Survey

TransLink retained Western Opinion Research Inc. to gather feedback on the i-STOP pilot project. Western Opinion Research Inc. commissioned a survey of 200 i-STOP users in November and December 2004. Interviews were also conducted with nine visually impaired i-STOP users, one totally blind user, three users with physical disabilities and five interviews with bus drivers. Key findings from the user survey are as follows:

1. i-STOP users were generally positive about the i-STOP program and rated i-STOP highly on a number of dimensions including overall satisfaction, improved schedule information, increased feelings of safety and security and an improved ability to signal drivers to stop.
2. The three-function i-STOPs were used more frequently as customers liked the schedule information at the bus stops. Two-function i-STOPs were used less frequently.
3. Most i-STOP users were supportive of more widespread use of i-STOP. However, greater consideration should be given to locating i-STOP in areas where they are most needed such as darker, more remote, less secure stops, or less visible stops. Higher traffic stops currently without a schedule would also benefit from the i-STOP schedule.

4. A number of suggestions for improvement of the i-STOP were provided, and in this regard consideration should be given to:
  - Revising the i-STOP instructions to ensure the language is simple and clear;
  - Clarifying the reason and purpose of the security light to convey the message that it is not an emergency feature to alert authorities;
  - Increasing the size of lettering in the schedule information;
  - Informing users that the schedule and security down light only work at night but that the light to alert the driver works at all times; and
  - Ensuring i-STOP button-activated features are working properly at all times.
  
5. Visually impaired or physically disabled people were less satisfied with i-STOP because many of the features were less accessible to them, and require adaptation to be beneficial. In this respect consideration should be given to:
  - Increasing the size of the printed information including the buttons, schedule and instructions;
  - Providing tactile (Braille) or audible instructions that allow visually impaired users to identify the button functions and to determine if the buttons have been activated;
  - Lowering the height of the stop information so that it is more accessible to those in wheelchairs; and
  - Providing colour contrasting on the i-STOP poles and the buttons.

#### *Bus Drivers' Feedback*

Bus drivers who operated at the pilot stops indicated that properly placed i-STOPS in locations with limited visibility would be an advantage. Operators surveyed indicated that the flashing beacon was effective in being highly visible from a distance, which helped to reduce pass-ups and to inform the driver, in advance, of the intent of the customer to board the bus. It should be noted that the flashing beacon is an enhancement to the existing operating procedure that a bus driver is required to stop for a waiting passenger even if the passenger does not activate the flashing beacon.

#### *Municipal Staff Feedback*

The 17 pilot i-STOPS were installed in 12 municipalities. Most comments received from municipalities related to how much additional lighting the i-STOP units provided at the bus stop, and i-STOPS should be used at stops with less frequent bus service and low lighting levels. It should be noted that provision of street lighting is under the responsibility of the roadway owners. Municipal staff also made comments on the use of the NexPole as an important feature for bus stop identification by visually impaired customers.

#### *The Supplier's Next Generation of the i-STOP*

In response to user feedback, the supplier has developed a new generation of three-function i-STOPS which includes self-illuminating buttons with Braille labels for visually challenged users. Figure 5 shows a new generation three-function i-STOP.



**Figure 5: i-STOP Next Generation**

### **KEY SUCCESS FACTORS**

Through the 9-month pilot period from April 2004 to January 2005, much knowledge was gained on issues including the product functionality, implementation and maintenance, and the user survey. Key success factors for future deployment are discussed in terms of the product functionality and deployment considerations.

#### *Product Functionality*

- Three-function i-STOPS are preferred for future deployment based on user survey that the use of the i-STOP mainly involves usage of the schedule information;
- Lighting level of the Security Downlighting should be suitable to the lighting level requirement at bus stops;
- The number of buttons to activate the i-STOP features should be reduced to simplify its use. This is to minimize testing by new users, and reduce or eliminate the need to provide instructions; and
- The product should be made more reliable, durable, and vandalproof.

#### *Deployment Considerations*

- For use at isolated bus stops, a warrant system should be developed to consistently identify suitable locations. The warrant system should include factors such as ambient lighting level, bus service frequency, poor sight line, and limited sight distance to a bus stop;
- i-STOPS can also be used to mark a specific type of service such as an express route or a dial-a-ride service by using the schedule panels to indicate the types of service;

- Schedule panel design should take into consideration of font size, color combination for ease of reading; and
- The process of updating schedules should be streamlined to ensure correct information is provided at bus stops timely and effectively.

## **CONCLUSIONS**

The solar powered i-STOP bus stops provide potential to improve transit customer services by an illuminated schedule, a security down light and a flasher beacon to signal operators to stop. The results from the user survey indicate a general user support to a more widespread application of the i-STOPS at appropriate locations. The findings from the pilot project provide important considerations for improvement to the product and provide key input on design a program for a more widespread implementation.

## **REFERENCES**

1. Greater Vancouver Transportation Authority. 2005 – 2007 Three-Year Plan and Ten-Year Outlook, February 2004.
2. Western Opinion Research. i-STOP Pilot Study User Survey, January 26, 2005.