Agenda

• RBRC Program
• Project Background
• Concept of Operations
• Design Process
• Design Challenges
• Status
RBRC Program

• Roberts Bank Rail Corridor Program
  » An integrated package of nine road-rail improvement projects and a railway crossing information system (RCIS)
  » a $307 million investment funded by an unprecedented collaboration of 12 partners
  » Will improve the safety and add efficiencies to the road and rail networks in four municipalities
RCIS

- Initiated by Port Metro Vancouver
- Significant potential benefits to the region
  - Travel time improvements
  - Environmental benefits
  - Infrastructure capacity improvements
  - Transparency in rail community activity
Problem Definition: Increased rail traffic significantly impacts vehicle traffic

- Average train length = 2200m (7200’)
- Max train speed = 56km/h (35 mph) [16m/s]
- Corridor length = 4.4 km
- Average rail transits through corridor = 22/day
  (Approximately 1 event/hr, 6:00am – 6:00pm)

Based on RBRC study, by 2021:

- Train length predicted to increase approx. 10%
- Number of transits predicted to increase by 40%
Traffic Impact

- Based on 200th St traffic signal pre-emption data
  - Crossing currently occupied between 1-4 minutes
- Significant queuing can occur at all crossings, with 200th St. southbound often the worst
- Can take 10 minutes or more to clear the resultant queues and congestion
- City of Langley’s rule of thumb – 5:1 ratio
  - 3 minute blockage = 15 minutes of congestion/disruption
Project Objective

- To mitigate the impact of increased rail traffic by providing information that encourages timely diversion of motor vehicle traffic to grade-separated overpasses

- **Solution**: implement **Rail Crossing Information System (RCIS)** to detect trains and notify motorists of crossing status
Project Scope

Scope

» Four major at-grade crossings
» 7 Train Detector (TD) stations
» 9 Motorist Advisory Signs (MAS)
» No Left Turn signs
» Central control system

Design

» Concept of operations
» Traffic modelling and sign priority analysis
» Detector functionality and pilot project
» MAS human factors analysis
Key Plan
Detect Train
- Detect train
- Track the train through the rail corridor
- Identify length of train
- Predict the time and duration of intersection blockages for each train

Activate Signs
- Activate motorist advisory signs to provide advance notice to drivers who are approaching the at-grade rail crossings
- Activate temporary turn restriction signs as part of applicable rail event timing plans

De-activate Signs
- Confirm when the train has cleared the at-grade crossings
- Have capability to keep the motorist advisory signs active for a configurable period of time to advise drivers of any residual traffic congestion
Concept of Operations

- Train detection
  - Detectors located along RBRC corridor
  - Provide data on train speed, direction, and length
  - Positioned in advance of crossings to provide sufficient notification, taking into account train lengths and advance notification to users of pending closures
  - Located off rail ROW
Prediction algorithm

- Train movement tracked along corridor
- Based on train speed, direction, and length data, the following are calculated:
  - Train arrival time at each crossing
  - Estimated crossing blockage duration
- Train position confirmed using:
  - Mid-corridor train detectors
  - Crossing pre-emption signals, where available
- Data will be collected for all key inputs
Concept of Operations

- **Sign Activation**
  - Motorist advisory signs activated to provide notification to drivers
  - Temporary turn restriction signs activated as part of the applicable rail event (by rail pre-emption)
  - Status of signs set based on data provided by detectors and calculated by algorithm
  - Status of signs updated at regular intervals, based on progression of train along corridor
Concept of Operations

Activation Point
(60s +20s) x 15m/s = 1224m from crossing

Current Location
1200m from crossing

Driving Time = 60s

Eastbound Train

Railway Crossing Status
56 Ave  Fraser  200 St

TRAIN TRAIN TRAIN

PBX Engineering Ltd.
ITS 2014
Concept of Operations

- Driver Diversion
  - Drivers respond to sign status information and make appropriate route decisions
  - Appropriate messaging content is critical to guiding driver behavior
  - 10% diversion required to achieve project cost-benefit threshold
Central Control System

» Utilizes ATMS at MoTI’s RTMC

» Control and monitoring of all sub-systems
  • PLC
  • Detection sensors
  • CCTV

» Will operate largely autonomously
Sign Location Analysis

- Conceptual design report looked at travel times and route diversions
- VISSUM macro-simulation model to assess diversion potential and number of cars served for each sign
- Sign locations re-evaluated during design phase to assess cost-benefit, develop optional cost items, and respond to budget constraints
Accurate and reliable train detection information is pivotal for project operation.

A number of candidate technologies were investigated during the preliminary design phase.

Pilot test was recommended due to unknown performance of candidate technologies when used for train detection.

Off-ROW train detection is a difficult problem:
- Non-contact measurement
- Varying length, speed, and direction
- Varying car configurations
- Use of siding tracks
Train Detector Testing

- Simple radar detector configuration has proven to reliably detect trains
- System will use pair of radar units per TD
- Approximate accuracy is as follows:
  - Presence: near 100%
  - Speed: +/- 3-9%
  - Direction: near 100%
  - Length: +/- 3-9%
Train Detector Station

- TD station configuration
  - 4 x presence radar
  - 1 x speed radar
  - 3 x digital cameras
  - Control cabinet
Motorist Advisory Sign Design

- Message purpose
  - Notify drivers of rail crossing status to inform route choice
  - Clear messaging is critical to effective system operation

- Design Assumption
  - Target audience is a motorist who is familiar with the area and knows the route options (location of overpasses)
Motorist Advisory Sign Design

- Extensive design exercise to develop and refine the sign and messaging
  - Technical committee workshops
  - Public consultation
  - Message comprehension survey. Results showed high comprehension and rated the messaging as “very effective” → these were first time users
  - Human factors analysis
Motorist Advisory Sign Design

- Layout
  - Static and dynamic graphical elements
  - All signs will display 3 crossings, except Sign #1
  - Crossing order is specific to the sign location
Design Challenges

- Detector technology
  - Unique requirements necessitated extensive research and field testing
- Budget constraints
  - Necessitated prioritization of signs
- Construction in an evolving urban environment
  - Utility conflicts
  - Property constraints
  - Impact to visual appearance of roadway
Status

- Construction tender closed.
- Tender evaluation in progress.
- Working with stakeholders to finalize agreements and permitting.
- Project completion date: September 2015