The Tide – The Evolution of Train Detection at Hampton Roads Transit

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Operating Characteristics in the Central Business District

- All train movement in the CBD is controlled by “line of sight” operations.
- Ten (10) minute headways during peak service, Fifteen (15) minute headways during mid-day and early evening and thirty (30) minute headways in early morning and late evening.
- During special events, headways drop to seven (7) minutes.
- In the CBD, the alignment intersects with several primary streets which are particularly important during daily traffic commute times.
- Throughout the CBD, trains merge in and out of shared lanes of automotive traffic.
- The rail alignment intersects with twelve (12) uncontrolled entry/exits, six (6) uncontrolled pedestrian crossings and one (1) uncontrolled bike crossing.
- The alignment has several very tight radius turns (82 ft.), which limits operating speeds.
The original design of the traffic control interface called for three (3) methods of train detection within the CBD:

- Five (5) imbedded induction loops
- One (1) “end of line” pushbutton
- Infrared detection system provided the vast majority of train detection.

The infrared system is similar to what is being used by fire, police and emergency medical services (EMS) vehicles in Norfolk. This system of detection has been used successfully in other light rail properties.

During the construction phase, concerns were raised that the alignment’s tight radius turns and their close proximity to intersections would limit system reliability and would cause inconsistent train movement.

Based information gathered with traffic modeling software, Norfolk opted to use three different methodologies for allowing train movement through an intersection.

- Pre-Eemption (13 intersections)
- Priority (5 intersections)
- Continuous Cycling (2 intersections)
Concerns with Infrared Train Detection

• During the construction phase, concerns were raised that Norfolk’s tight radius turns and their close proximity to intersections would limit system reliability and would cause inconsistent train movement.
• Emergency vehicles were observed within the CBD failing to gain a permissive aspect. While emergency vehicles would proceed with lights and sirens with little impact. Light rail vehicles would not have this option.
• Concerns prompted staff to review the design of the traffic management system and quickly realized that there had been no consideration given to the equipment needed to be installed on the LRV. Also, additional wayside sensors would be needed to augment the infrared design.
• Once the oversights had been identified, Hampton Roads Transit began to consider increased costs associated with modifying the system.
• Approximately eighteen (18) months to the start of revenue service, the infrared detection system was abandoned in favor of radar detection.
Radar Detection

- Setting aside the infrared detection system came when much of the civil work in the CDB was advanced beyond any serious modifications.
- LRVs were already physically present on Hampton Roads Transit property. Any changes would have to be installed retroactively.
- The project was facing severe budget restrictions, which required a minimalist approach to any design.
- Radar Detection was being used successfully in Minneapolis’ Hiawatha Light Rail System and enjoyed wide acceptance in many European rail systems.
- Radar Detection did not require vehicle modification, very little destructive work of embedded track and would fit in the remaining project budget ($160,000).
Radar Detection Implementation

- Radar detection system was installed and tested in the summer of 2011.
- It allowed twenty-four (24) minute trip times while allowing efficient signal coordination, queuing with minimal traffic impact to the city’s grid.
- Trains began moving through the CBD in early July.
- The system supported a regular schedule during operator training and the thirty (30) day pre-revenue testing phase.
- Periodically, staff was required to make detector alignment and sensitivity adjustments to maintain optimum performance.
- Going into revenue service, staff was very pleased with the performance of the radar detection system.
Technical Challenges with Radar Detection

- During the first month of operations, the radar detection system began showing signs of problems. The detection devices began experiencing a wide range of problems, including being overly sensitive, not sensitive enough or nonresponsive.
- Hampton Roads Transit worked with the manufacturer of the devices and solved many of the problems including the identification of a manufacturing error. The failures and false detections continued, but at a reduced rate.
- Further study revealed that delivery trucks encroaching onto or near the alignment were triggering the devices. Also, heavy rain could generate an echo recognized by the detector.
  - Detectors were repositioned to avoid false detection of trucks, but with mixed success.
  - No solution for heavy rain echo has been found.

![](chart.png)
Prototype Test - RF Tagging

- The number of unresolved traffic detection problems caused an unacceptable high number of requests for “stop and proceed” authorizations per day.
- Hampton Roads Transit and Norfolk worked together to find an acceptable alternative to radar detection.
- During the summer of 2012, Hampton Roads Transit turned to a prototype detection system using a radio frequency detector. The system is similar to those used by toll facilities around the country. The prototype test phase was a great success.
- RF Tagging proved itself immune from false triggering due to the close proximity of trucks and from heavy rains.
- Intersections outfitted with the prototype RF detection system were highly reliable with zero (0) false detections during the test phase.
Next Steps

- Hampton Roads Transit and Norfolk have decided to advance the RF Tagging approach to train detection in the CBD.
- The project will be advanced in phases to accommodate budget.
- Phase One will began in October 2012 and should be fully tested by mid-December.
- Phase One will address 50% of the intersection with the highest incidents of failure.
- As of this date, all of the phase one equipment, LRV and wayside, have been installed.
- City and staff are working together to “cut-in” and test system performance intersection by intersection until phase one is complete.
- Four intersections have been fully tested and are in service.
Questions?