Field Evaluation of Connected Vehicle – based Transit Signal Priority Control under Two Different Signal Plans

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Abstract

In 2017, a connected vehicle (CV) corridor utilizing dedicated short-range communication (DSRC) technology was built along Redwood Road, Salt Lake City, Utah. One main goal of this CV corridor is to implement transit signal priority (TSP) when the bus is behind its published schedule by a certain threshold.

For providing better signal coordination to buses, the signal plan for this CV corridor was retiming in October 2018. Data collected from 1) UTA transit operation system (SIRI) 2) DSRC communications; 3) Automated Traffic Signal Performance Measures (ATSPM) system were utilized to analyze the TSP performance before and after the signal retiming.

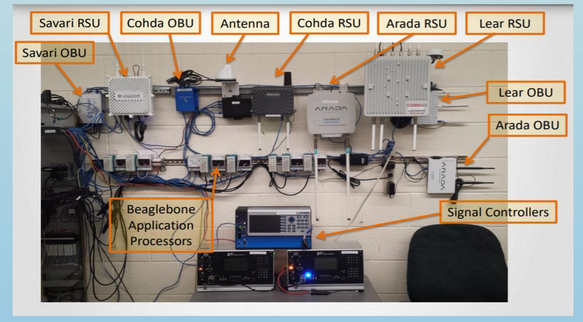
Deployment

Redwood Road in Salt Lake City, Utah

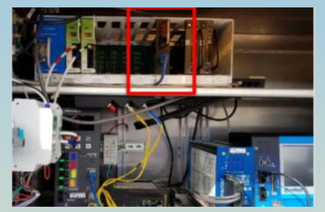
- State-owned north-south arterial
- 11 miles long
- 30 signalized intersections
- Varies from 5 to 7 lanes
- ADT : 18,000 to 40,000
  - 60,000 at I-215
  - Truck traffic: 24%
- Two light-rail crossings
- Demographic variety
  - Commercial / Retail
  - Residential
  - High School
  - Community College

DSRC-based connected vehicles system

- DSRC hardware
  - Four vendors : Savari, Arada, Cohda, and Lear
  - 24 of 30 Intersections with DSRC. Skipped freeway interchanges, CFIs, Reversible Lanes, TRAX



- Software
  - TSP application software is based on Multi-Modal Intelligent Traffic Signal System (MMITSS)
  - Software running on Linux processor



- RSU mounted on signal pole, mast arm, luminaire pole

- OBU mounted on roof of bus and inner bus

Priority Request Rules

UTA buses operate with a 30-minute headway during the early morning hours and late evening hours, a 60-minute headway after 9:00 PM, and a 15-minute headway during the rest time of the day.

Equipped buses on the corridor were allowed to request TSP when:

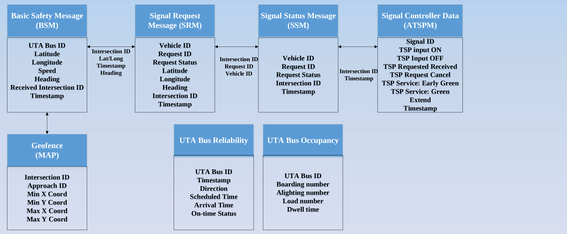
1) The bus was behind published schedule by a given threshold (e.g. 5 min)
2) The bus had at least 20% occupancy (9 passengers)

Data Description

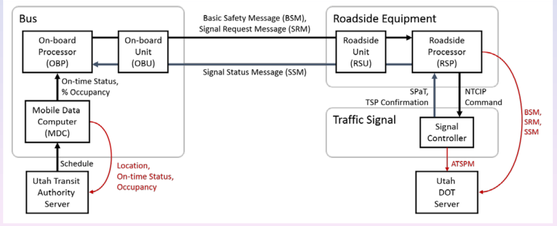
System operation Timeline for this study:

August, September, November, December in 2018

Data Source	Data
UTA SIRI Database	Bus reliability; bus occupancy
DSRC Database	Bus location; TSP requests
ATSPM Database	SPaT; TSP service

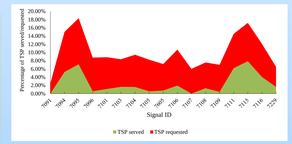


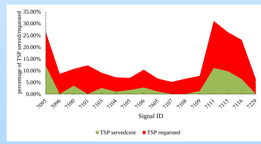
Available datasets diagram



MMITSS-Utah Diagram

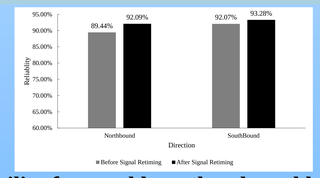
Result Analysis





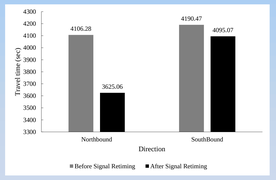
Rate of TSP requested and served before and after signal retiming

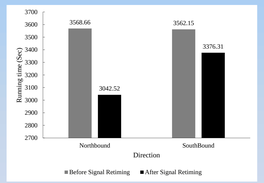
the average rate of TSP served before retiming is 33.13%, which is lower than that of 35.29% after retiming.



Bus reliability for northbound and southbound of route 217 before and after signal retiming

The average reliability for northbound and southbound before signal retiming are 89.44% and 92.09%. After signal retiming, they have been improved to 92.07% and 93.28%.





Bus travel time and running for northbound and southbound of route 217 before and after signal retiming

Conclusions

Results revealed that the TSP served rate after signal retiming is 35.29% which is higher that of 33.12% before signal retiming. As a result, the bus reliability for the northbound and southbound of the corridor improved by 2.65% and 1.21% respectively after signal retiming. Besides, the bus travel time and bus operation time all reduced after signal retiming.