

LYT.speed™ is a cloud-based, AI-powered transit signal priority (TSP) system that utilizes preexisting bus-fleet tracking sensors and city communication networks to dynamically adjust the phase and timing of traffic signals to provide sufficient green clearance time while minimally impacting cross traffic. The Santa Clara Valley Transportation Authority (VTA) in partnership with the City of San José piloted LYT.speed on 17 intersections in East San Jose. TSP was provided to 98 buses daily from July to December 2019. Because it leverages pre-existing infrastructure, it required no additional hardware installations inside traffic cabinets or buses. Unlike the traditional, location-based check-in and check-out TSP solutions, LYT.speed processes live bus location information through machine learning models. The result is priority calls based on estimated times of arrival. LYT.speed's effect on VTA's route 77 was an overall 18 to 20 percent travel time improvement equating to a five to six-minute reduction in signal delay.

1. Introduction

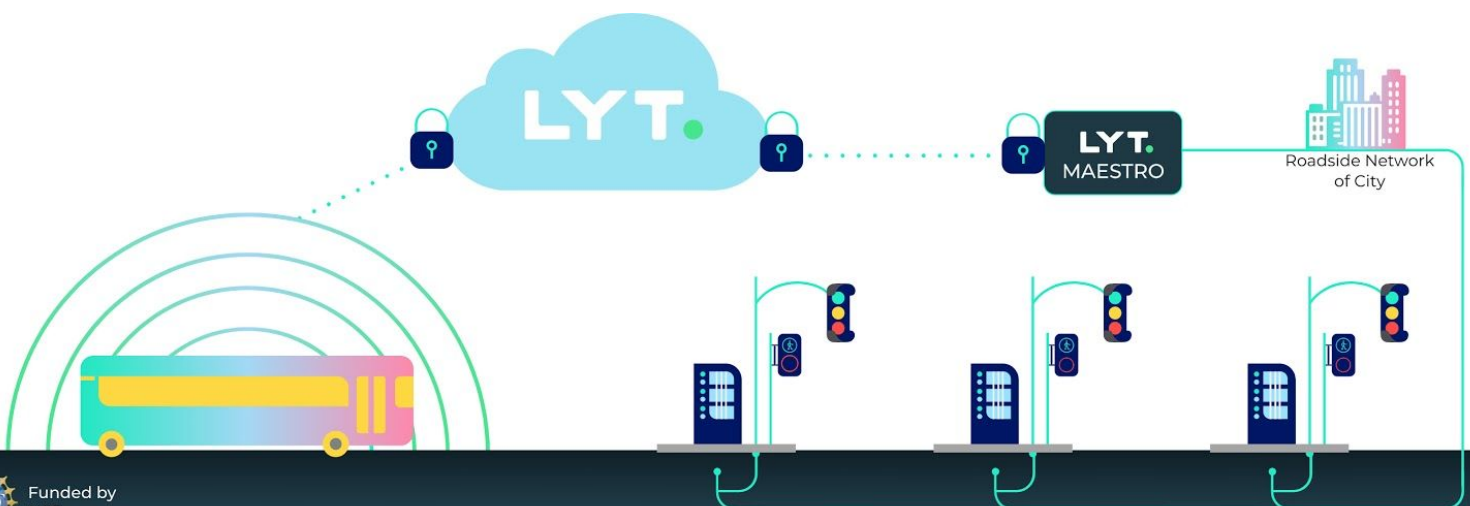
The average speed of the VTA bus fleet has declined by 5.4 mph since 1995. This makes it harder to achieve on-time performance and makes the service less appealing to riders. This degraded route operation results in higher costs as more vehicles are needed to maintain the frequency of service. This is especially concerning on VTA's highest ridership routes, which are among the slowest in VTA's system. An example of this can be seen on the VTA's route 22 where an additional seven buses are required to maintain the 15-minute service.

Many cities have installed transit signal priority systems to ensure that transit vehicles have a higher probability of getting green lights, thereby partially mitigating these problems. However, these solutions are suboptimal, relying exclusively on geofenced areas known as bounding boxes. Bounding boxes disregard real-time traffic and other parameters such as bus stop dwell times, which result in suboptimal improvements while also disrupting cross traffic. Furthermore, traditional TSP systems use additional hardware or unreliable communication mediums like infrared or DSRC, contributing to suboptimal improvements.

LYT's cloud-based TSP system, LYT.speed, therefore takes the global picture of a route into account and uses machine learning to predict the optimal time to grant the green light to transit vehicles at just the right time. It minimizes the interference with crisscrossing routes and simultaneously maximizes the probability of a continuous drive.

2. LYT.speed Architecture

LYT.speed allows cities to build upon current investments in infrastructure to deploy city-wide TSP. To enable safe and secure connections with traffic signals, each city receives just one device, called LYT.Maestro. It is a computer that resides at the "edge" and serves as the secret link between city traffic signals and the LYT platform. It is designed to securely manage the information exchange between traffic lights and our cloud platform. It is the only additional hardware necessary for LYT.speed. Depending on the existing city network configuration, LYT's cloud may receive vehicular data directly or via the city's network using secure connections.



3. AI and LYT.speed

Unlike existing TSP solutions, LYT.speed does not instruct a signal to turn green as soon as a transit vehicle enters a bounding box. These suboptimal solutions result in performance degradation due to factors such as bus stops within the bounding box, heavy traffic, and road capacity. Many of these factors also vary with time. Existing TSP solutions can generate traffic network disruptions as they treat each intersection individually. LYT.speed captures these variable factors in a machine learning-based system to accurately predict the exact time the bus will arrive at the intersection, activating a green light to occur precisely at that moment. This results in minimal change in signal phases with negligible effects on cross traffic. LYT.speed also frequently updates these models so that its TSP is always learning, resulting in predictions that get better with time.

4. Deployment of LYT.speed

The LYT.speed demonstration took place on 17 signalized intersections on a section of VTA route 77 in East San Jose, which transports commuters between the Eastridge Transit Center in the South to the Great Mall Transit Center in the North and vice-versa. VTA classifies this route as a frequent line; this means that bus service runs at a minimum frequency of 15 minutes on weekdays during peak travel times. Unlike a Bus Rapid Transit (BRT) line, buses on this route can service any other VTA bus route. Over the duration of the pilot, 277 of the 443 buses in the VTA fleet serviced this line. By using the bus fleet's existing onboard tracking units, each bus identified to be servicing route 77 was granted priority. LYT's software-based solution **saved VTA ~\$1,385,000** of upfront bus equipment costs.

Route 77 operates along a sequence of mostly two-lane roads containing 42 signalized intersections. The pilot section of this route contained 17 of these intersections. Four of these 17 intersections cause more than 80 percent of this section's signal delays, resulting in up to six minutes of travel delay. The roads at these four intersections also happen to run coordinated east-west timing plans, one of which is coordinated by Kimley-Horn's Kadence system. The crossroad of one of the other four intersections also has dedicated center bus lanes and DSRC-based, conventional TSP for its BRT line.

LYT's software-based solution **saved VTA ~\$255,000** in upfront traffic signal equipment installation and configuration costs.

5. Pilot Performance Results

LYT considers a priority call successful when the receiving bus clears the intersection at a speed of 5 mph or greater. LYT.speed achieved a 90 percent or better success rate at 12 of the 17 intersections in the pilot section. Furthermore, it increased the arrival-on-green rate of a bus by approximately 60 percent at each of the four most congested intersections mentioned in section four, and all 17 signals in the pilot saw a minimum increase of 15 percent in bus arrival-on-green rates.

VTA conducted its own independent evaluation of the performance of LYT.speed on route 77. As shown in Figure 1, it concluded that LYT.speed **improved bus speed by 4 to 15 mph**, resulting in a **15 to 20 percent on-time performance increase** in the pilot section of the route. VTA further stated that the pilot section's enhanced traffic flow ended up improving the performance of the entire route by a total of 18 to 20 percent.

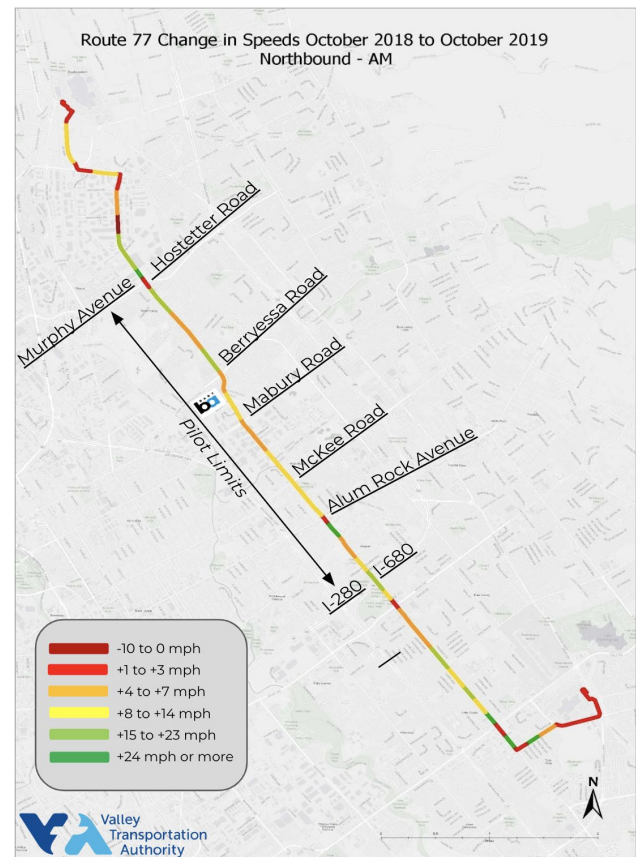


Figure 1: Change in Average Bus Speed After LYT.speed Deployment (Source: VTA). The intersections at Alum Rock Avenue, McKee Road, Berryessa Road, and Murphy Avenue are historically the most delay-prone on this section of route.