OPTICOM™ | CASE STUDY

From pilot to priority: Faster bus service in New York City

A pioneering collaboration between the New York City Department of Transportation (NYCDOT) and Metropolitan Transportation Authority (MTA) has led to the implementation of an Opticom Transit Signal Priority (TSP) throughout some of New York City's busiest roadways, helping to address the issue of slow bus journeys caused by major traffic congestion.

Traditionally, TSP involves purpose-built hardware on the vehicle and at the intersection. But for the New York, the sheer volume of intersections and vehicles that needed to be equipped would have taken years to install. The decision to test and then implement a centralized, software-based TSP solution was critical to a successful deployment.

The innovative approach leveraged existing vehicle and citywide infrastructure, allowing the efficient rollout of TSP across nearly 6,000 buses and 12,700 intersections[1] in New York City. It will also allow the MTA to easily deploy updates and upgrades as technology improves, providing access to new features and refinements without requiring costly and time-consuming hardware maintenance.

As a result, New York City bus riders should see improved travel times and more reliable service as they use the country's largest bus network.

Moving Millions of People in a Megacity

New York City has the largest transit ridership in the United States. More than 2 million people use New York City buses every weekday.[2] Alongside rail and subway users, that makes for a total of 8.6 million transit passengers each weekday. But with high levels of congestion due to record numbers of city residents, workers and tourists, average bus speeds dropped steadily over the years to not much more than the typical speed of pedestrians in some areas. During the decade between 1996 and 2006, average travel times decreased by almost one mile per hour to 8.1mph, and the downward trend has continued over the following decade.

On busy bus routes in New York City, buses spend about 21 percent of their time stopped at traffic lights.[3] The result was a decrease in bus ridership at the very time that mobility needs were growing.

The NYCDOT and MTA have sought to address the issue through several initiatives, notably their partnership in the Select Bus Service program (See SBS info on page 2). An important element of the Select Bus Service was its trial and implementation of transit signal priority measures to reduce the time buses are required to stop at traffic lights along their route, and improve their travel times.

Solution Overview

PROBLEM

Bus travel times slow, and getting slower

- Route M15-SBS: 2nd highest passenger loads in city
- Congested, intermodal route
  - Heavy pedestrian, bicycle traffic
  - Unloading trucks
- Cross traffic coordination required
- Urban canyon reduced GPS effectiveness
- 13,000 traffic signals -- difficult to deploy hardware

SOLUTION

Deliver centralized transit signal priority control

- Leverage existing infrastructure, investments
- Undergo Sophisticated traffic engineering design

18%
Bus travel time reduction

Transit Signal Priority

One of the cornerstone elements of a rapid or select bus route is the use of transit signal priority.

TSP enables buses to travel faster by adjusting traffic signals along their route in real time to minimize delay. As a bus approaches an intersection, it sends a request for the traffic signal to extend a green light or truncate a red light.

Since 2012, the NYCDOT and MTA have been working to provide widespread implementation of transit signal priority (TSP). In New York, the NYCDOT is responsible for the traffic management center (TMC), roadways and traffic signals, while the MTA is responsible for bus on-board TSP components and their communications.[6]

The NYC implementation leveraged the NYC Wireless Network (NYCWiN) and new signal controllers already installed at each intersection. The TSP deployment was faster and more efficient, as no new signal hardware was required. On the vehicle side, the existing GPS technology on MTA buses was also used.[3]

In 2017, the MTA and NYCDOT agreed to enable transit signal priority on 6,000 buses and 1,000 intersections serving 20 bus routes by 2020. The deployment was the result of an agreement between the MTA, the NYCDOT, St. Paul, Minn.-based Global Traffic Technologies (GTT), makers of Opticom™ Transit Signal Priority, traffic engineering firm, Greenman-Pederson, Inc. (GPI) and technical and engineering services provider TransCore. The deal followed trials along several corridors, including a successful pilot program that ran through Manhattan's Financial District.

Multiple stakeholders: The SBS-M15 Pilot

In 2013 the stakeholders chose to test the Opticom TSP system on a 2.2 mile stretch of Select Bus Service Route M15 (SBS-M15), the second busiest bus route in New York City. The route extends from South Ferry terminal through the Financial District to East Harlem.

Travel time was critical along this route, because many riders need to catch the ferry as part of their commute. In addition, the route had abundant pedestrian traffic, heavy vehicular congestion and many areas where vehicles are double-parked.

One of the key aspects of the SBS-M15 Lower Manhattan route TSP trial was the necessary participation of multiple stakeholders. Coordination and cooperation were central to the success of the project and provided a model for the way deployments could be handled on a much wider basis.

The MTA contracted to work with GTT while the NYCDOT contracted with GPI. Also under separate contracts with the NYCDOT were TransCore and Peek Traffic. TransCore developed the traffic management center systems to support TSP field operations, while Peek Traffic provided the software to implement TSP at each intersection via the intersection traffic controllers.

2.3 million bus trips daily[4]

12,700+ traffic signals

5,700 MTA buses

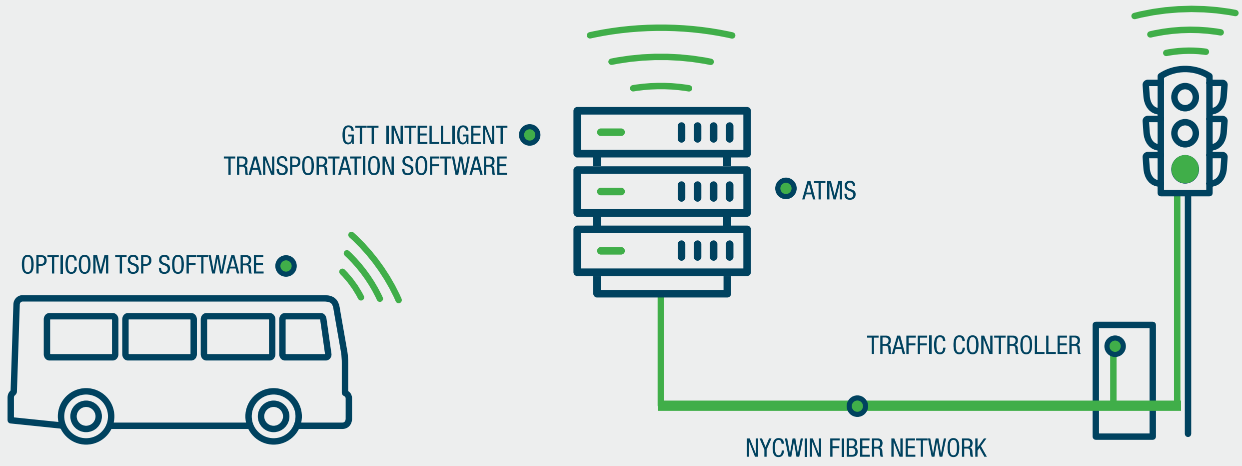
2,800 miles of routes

New york City's Select Bus Service

Select Bus Service is New York City's version of Bus Rapid Transit: an improved bus service that offers fast, frequent, and reliable service on high-ridership bus routes.[5] Completed in much less time and at much lower cost than subways—which take years to construct and require expensive up-front infrastructure and equipment—Select Bus Service offers a more immediate improvement to New York City's transit network benefitting the entire city through improved mobility, cleaner air, reduced greenhouse gas emissions, and reduced congestion.

Designed to provide rail-like service, Select Bus Service uses techniques and technologies such as dedicated bus lanes, off-board fare collection and transit signal priority to improve the quality and performance of transit and, in turn, to improve mobility and access in the neighborhoods that it serves.

Select Bus Service projects are also designed to make bus service easier to use, through features like bus bulbs, and high quality passenger information and overall attention to pedestrian and vehicular safety. Select Bus Service features can also be applied individually in locations not appropriate for the full Select Bus Service treatment.



HOW IT WORKS: Opticom software on the bus sends a TSP request via cellular connection to an Opticom server at the MTA. Requests are validated and passed to the NYCDOT transportation management center and the city's advanced traffic management system (ATMS),The ATMS then pushes the request out to the intersection via the city's broadband network connection (NYCWiN). The result is a green light, if it's warranted.

GTT and the other partners worked closely with individuals in each organization to overcome the challenges of differing schedules, procurement processes, budget constraints and staffing limitations. An agreement was put in place to develop a centralized TSP system based on rigorous traffic engineering studies that leveraged existing hardware, proven software and citywide network communications, leveraging existing computer hardware on buses and fiber network connections to the intersections.

Leveraging Infrastructure

New York had one crucial advantage when it came to implementing Transit Signal Priority: its existing communications and traffic controller infrastructure. In previous years investments had been made in providing TSP-capable advanced solid-state traffic controllers (ASTC) at almost every signalized intersection. Using the dedicated, secure broadband network known as NYCWiN, which supports public safety and city operations, and the MTA could wirelessly transmit TSP requests from the vehicle computers on its buses to a central server and onto the ATSC controllers anywhere in the city.

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Because of these earlier investments, both the MTA and the NYCDOT could get almost the entire city street network and bus fleet ready for TSP with minimal investment in hardware. Implementing a software-based TSP solution also dramatically reduced the amount of time it took to install the system.

Still, one major challenge was to figure out how to improve bus operations while avoiding negative effects for all other traffic operations. GPI traffic engineers needed to eliminate the potential for chaos if 5,700 buses requested simultaneous adjustments at signals throughout the city.

GPI set out to answer those types of questions with a thorough analysis and modeling of traffic operations at each intersection where TSP was proposed along the pilot route.

For GTT, the biggest challenge was complex technical integration with a variety of vendors and stakeholders. GTT developers figured out how best to ensure the various systems involved would seamlessly work together. This had implications not just for the trial project, but for the potential citywide rollout of TSP in future.

GTT's Opticom software was required to work with the TransCore traffic management system at the NYCDOT center, and to interface successfully with the existing onboard vehicle systems.

Ensuring those systems could communicate and exchange data was key to providing access to the crucial location and route information held by the vehicles' bus hardware subsystems. GTT's engineers tailored the Opticom system to meet these project requirements, allowing Opticom to act as the central hub connecting and enabling all of the varied elements of the TSP system.

12,700+ INTERSECTIONS IN NEW YORK CITY

That's roughly equivalent to all the traffic signals in Los Angeles, Chicago, Houston, Atlanta and Detroit combined[6]

TSP Implementation Decisions

In its planning work prior to implementation of the TSP project, traffic engineering firm GPI looked at several crucial questions:

- Which intersections can successfully provide TSP benefits to buses without impacting pedestrian safety and unduly disrupting cross-street traffic?
- Which signal phases should be adjusted at these intersections?
- How long can these phases be extended or shortened?
- When should the system act to adjust the signals for an approaching bus? (Start too soon and the bus may be too far back from the intersection and squander an entire extended green before it reaches the intersection. Start too late and the bus can be delayed longer than necessary by a red signal.)
- Where are queue jumps warranted and feasible?
- How should the system handle conflicting calls for TSP service?[6]

These questions were further complicated as conditions varied from intersection to intersection and by time of day.

Because of this complexity, GPI used Aimsun Next software to perform microscopic traffic simulation analyses, tailored precisely to NYC requirements. These requirements were defined by the NYCDOT and MTA at the project outset for citywide implementation.

The software helps prepare simulation models of existing conditions, calibrated and validated with field observations, and used to answer the aforementioned implementation questions. The result is that the models can identify the potential time-travel savings using Opticom TSP at each intersection in the corridor.

GPI's analyses helped determine how effective both active and passive TSP improvements would be at each intersection along the test route. Active TSP refers to altering the signal phase with a request from the bus, whereas passive TSP improvements include lane re-striping, parking restrictions and bus station placement. When combined, both active and passive TSP lead to faster, more reliable bus service.

Test results

GPI's simulations predicted a 13 percent reduction in travel time. But the actual results in the real-world across both the SBS-15 pilot and the other subsequent projects were even more impressive.

According to NYCDOT, on average TSP has reduced bus travel times about 14 percent during weekday peak morning and evening commuting periods. Results vary by corridor and time of day, but can range from 0.7 percent to a 25 percent reduction in travel times.[3] The SBS-M15 results showed reductions of between 4.7 percent (at midday) and 18.2 percent during morning peak travel. The same report says "general traffic flow has also improved due to better signal coordination." Peak hour delays for all traffic – side street and along the corridor – dropped between 8.3 and 11.9 percent.

NYCDOT Goals

- Provide safe, efficient, and environmentally responsible movement of pedestrians, goods, and vehicular traffic on the streets, highways, bridges, and waterways of the City's transportation network
  - Improve traffic mobility and reduce congestion throughout the City
  - Rehabilitate and maintain the City's infrastructure, including bridges, tunnels, streets, sidewalks, and highways
  - Encourage the use of mass transit and sustainable modes of transportation and conduct traffic safety educational programs[1]

NYC MTA Project Highlights

- Collaborative pilot-to-procurement project with multiple stakeholders
- Leveraged existing investments in network communications
- Accelerated deployment via cellular/software-based solution
- Sophisticated TSP analysis to reduce impact on traffic flow

Citywide Rollout

Public entities – like the MTA and the NYCDOT – are expected to be good stewards of public funds. That often means that technological advancements outpace procurement timelines. The lifecycle of a NYC bus is around 12 years,[7] while the pace of technology change is significantly faster. Therefore the TSP implementation had to offer long-term value, and provide the ability to add features and upgrades as they are developed.

As of 2018, Opticom Transit Signal Priority was operational at approximately 500 intersections along 10 different bus routes on major congested corridors in all five boroughs of New York. Together these corridors serve over 300,000 riders each day and include high and moderate urban density as well as suburban-like conditions. Plans call for coverage at 1,000 intersections serving 20 bus routes by 2020.

The success on SBS-MB15 was encouraging, but deploying TSP throughout NYC via conventional means would have been a logistical challenge.

Traditionally, TSP involves purpose-built hardware on the vehicle and at the intersection. But for the New York, the sheer volume of intersections and vehicles that needed to be equipped would have taken years to install. The decision to test and then implement a centralized, software-based TSP solution was critical to a successful deployment.

The benefits of a software-based approach extend beyond deployment time. The decision to use existing technology and communications in this centralized system also gives New York City an advantage as technology improves, allowing software updates and upgrades to be the means of adding features and refinements remotely.

Ultimately, the New York City software-based transit signal priority system is a groundbreaking advancement in public transportation technology. The success of this system in the United States' most densely-populated city shows a clear path to smarter and safer mobility.

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Sources

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