METROPOLITAN TRANSIT AUTHORITY OF HARRIS COUNTY

RAIL SAFETY EXCELLENCE AWARDS: SMARTSYNC INTERSECTION SIGNALING COLLABORATION

CATEGORY III: 20 MILLION OR MORE PASSENGER TRIPS ANNUALLY

2019

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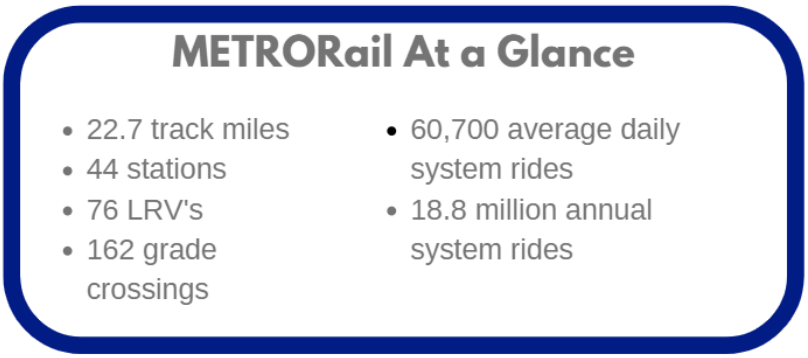
HOUSTON METRO SMARTSYNC INTERSECTION SIGNALING PARTNERSHIP
AMERICAN PUBLIC TRANSPORTATION ASSOCIATION
2019 RAIL SAFETY AWARDS

ABOUT HOUSTON METRO

The Metropolitan Transit Authority of Harris County, Texas (METRO) is the largest public transportation provider in the Houston metropolitan region, with a service area of 1,303 square miles. With more than 4,000 employees, it operates buses, light rail, paratransit, vanpool, and HOV/HOT lanes within a region of more than 6 million residents.

Through collaborative relations and innovative approaches, METRO is an industry leader in delivering timely and efficient service that is transformative by providing multimodal interactions for communities to connect to everyday work and life opportunities.



SAFETY PROGRAM/ PROJECT EFFECTIVENESS

The safety of passengers, the public, and employees is a top concern in the public transportation industry. Failure to prioritize safety will result in consequences that could be very costly – incidents or accidents that could lead to loss of life, property, and the public's trust in the system. METRO and its Board of Directors have made a commitment to take proactive, organization-wide approaches to improving safety.

Given Houston's auto-centric design and METRORail's in-street infrastructure, light-rail collisions rates are higher than the national average. More than 65 percent of crashes between LRVs and cars are the result of drivers making illegal left turn and running red lights. METRORail in collaboration with the City of Houston's Traffic Timing group embarked on *SmartSync*, a project to improve traffic/rail signaling at intersections within Houston's Central Business District (CBD) along METRO's Red Line, to enhance traffic safety and efficiency within the corridor. We believe the solutions we created are first of their kind in the U.S., and perhaps the world.

The goal of *SmartSync* is to allow LRVs to move smoothly through the CBD corridor, while also giving drivers, bicyclists and pedestrians additional time to cross at intersections—under the theory that increased efficiency improves safety. This also provided enough intersection capacity to run trains on exclusive phases, further reducing the potential for LRV/auto conflicts.

Located at each intersection is a traffic case which drives intersection signals — including the bar signals used by trains. A separate railway signal system detects the presence of trains. Ideally, both systems should communicate and work together, adjusting timing plans in response to changing traffic patterns. However, each system is based on radically different design conventions and philosophies. Until this project, these systems did not play well together. This failure of these systems to communicate and coordinate — the failure to play well with each other — meant one small variable change could lead to a domino effect of delays throughout the system. *(Exhibit A)*

Prior to implementation of *SmartSync*, LRV trips through the CBD were not smooth. Trains often experienced long waits at intersections, resulting in unnecessary delays between stations. Drivers and pedestrians would also incur long delays at intersections even when there was no cross-traffic. Often cars would wait a long time for trains. The sum effect of all of these led to unsafe behavior.

Exhibit A: Illustration of one of the Failure Modes We Corrected

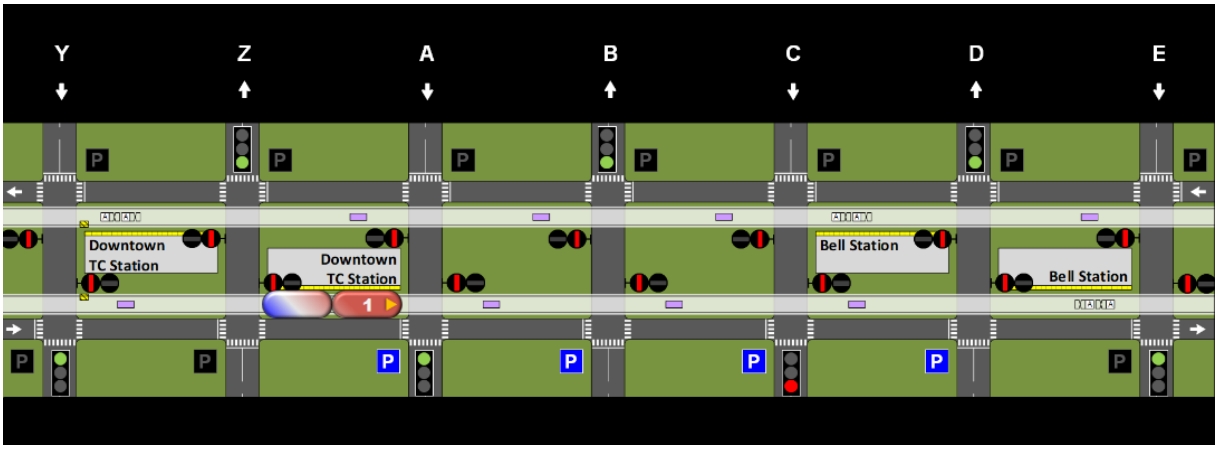


*Figure 1: Railway requests ("preempts") Intersections **A** thru **D** in order.*

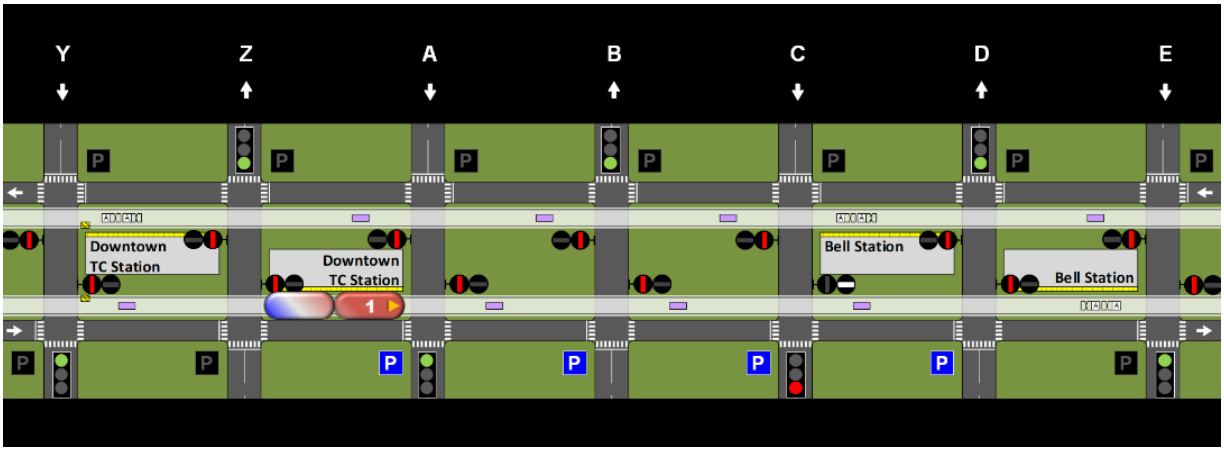


*Figure 2: We requested **C** third; but it upgrades first.*

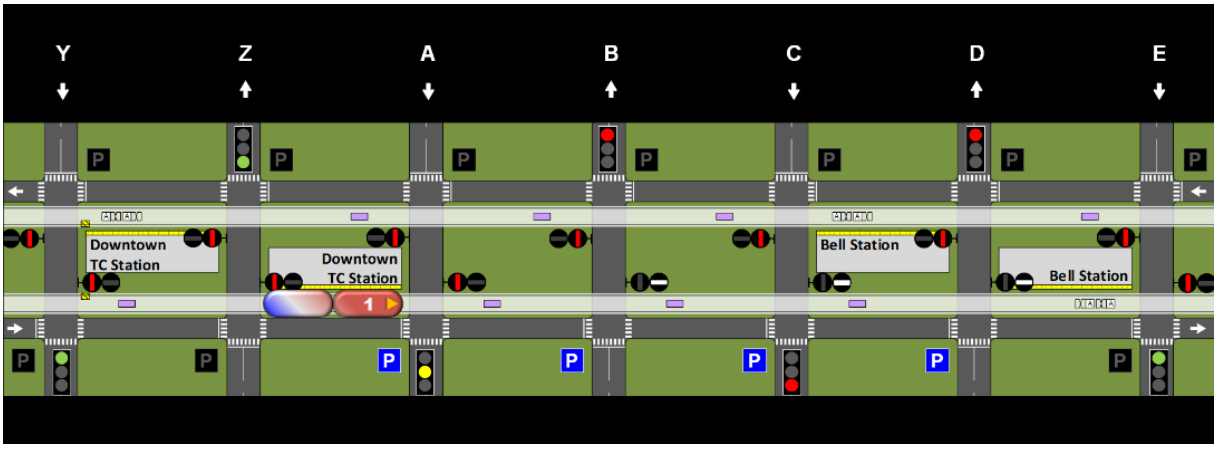


*Figure 3: We requested **A** first, but it upgrades last. **Why?** Each intersection formerly tried to serve the train as-soon-as-possible; but each intersection will be at different points in the cycle when preempted. **C** had been in an all-red buffer phase and thus serves the train immediately. **A** had just started a cross street walk and needs to run a 7 second MinWalk + 16 second countdown (flashing hand) + 4 second yellow clearance + 2 second red buffer = 29 seconds total, before it can serve the train.*

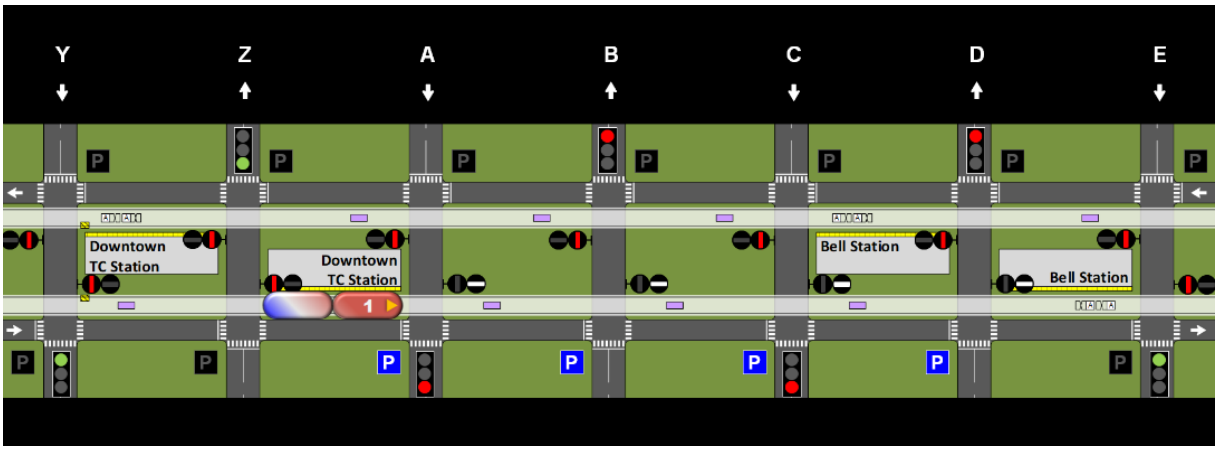


*Figure 4: 29 seconds after **C** upgrades, train is finally allowed to leave **A**.*

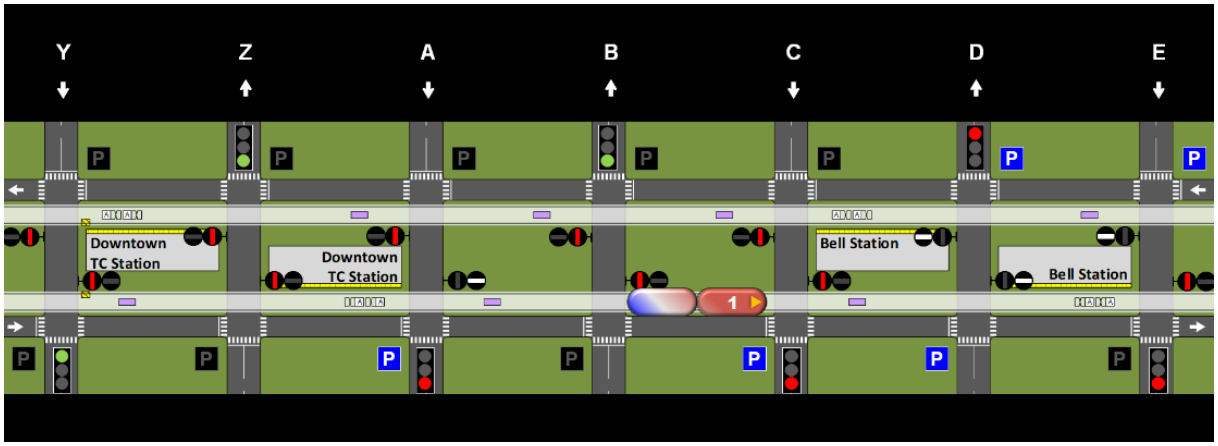


*Figure 5: Previously, each intersection had a 60-second timeout. By the time Train 1 reaches **C**, unless it was quick on the throttle leaving **A**, **C** will have timed out. This results in cars and pedestrians at **C** waiting a full minute for a train that is not moving. The ultimate lose-lose!*

SAFETY PROGRAM/ PROJECT BENEFIT LEVEL

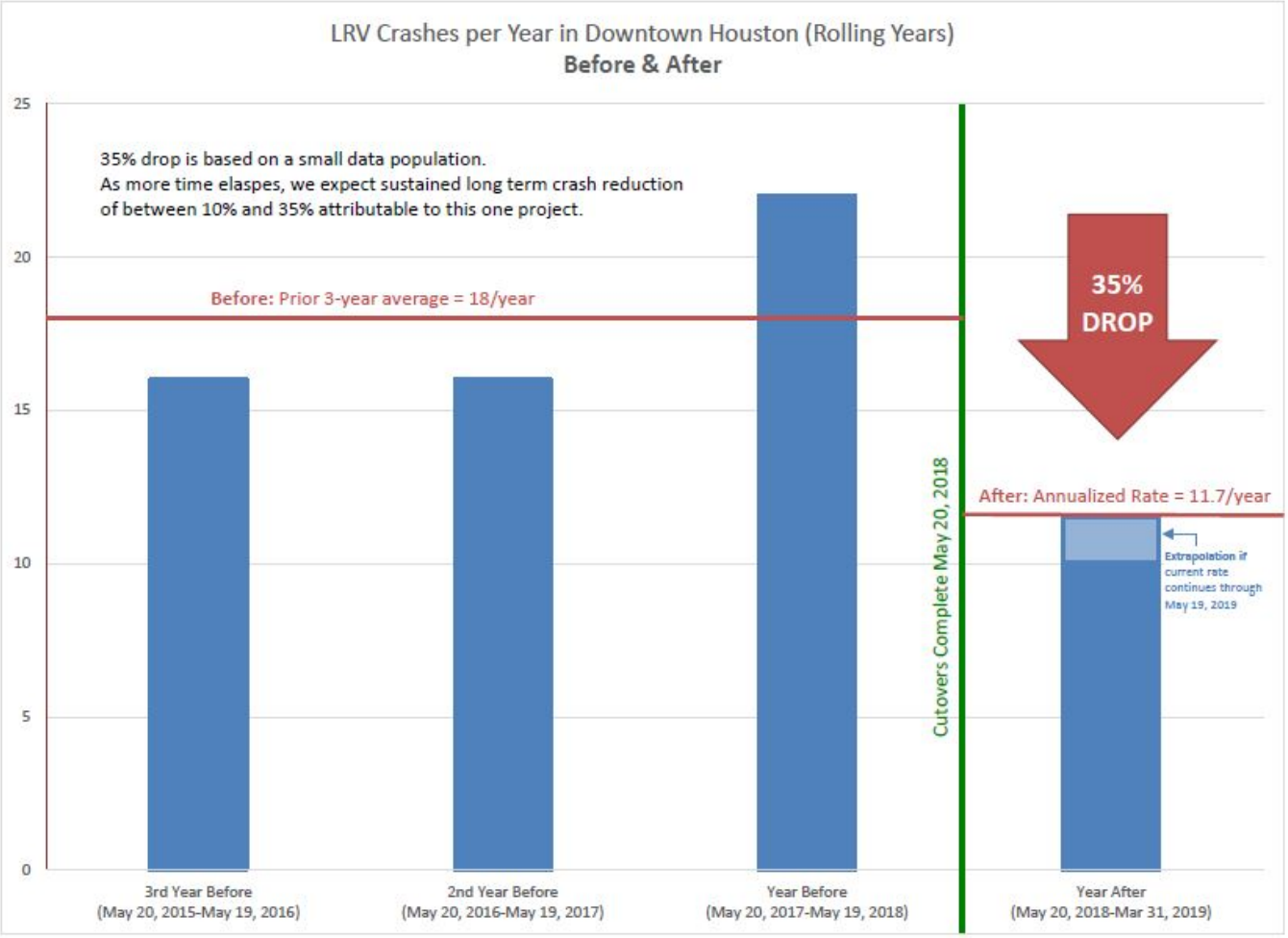
The SmartSync project area included 23 intersections located along a 1.75 mile segment of Main Street, between Commerce and McGowen streets.

We invented a traffic case function called Preempt Service Delay (PSD). Formerly each intersection served the train "as-soon-as-possible" based on the current status of each intersection in isolation. This new and innovative function created a "just-in-time" system. Intersections now serve trains only at a time a train can benefit from it — never early, never late. PSD is a major component of the *SmartSync* system. Although implementing it in real traffic cabinets led to the creation of some of the most complex traffic timing files in the city, the functions we invented are now being built into the operating system of at least one vendor's traffic timing product. This means other cities/agencies will not have to go through the process of manually inserting it into traffic cabinets.

Current results indicate:

- ✓ LRV crashes in Houston's CBD have decreased by **35 percent** since May 2018. *(See Exhibit B)*
- ✓ The project has resulted in smoother traffic flow and a drastic reduction in wait times for vehicles. Decreased wait times resulted in less cars running red lights.
- ✓ Increased efficiency allowed LRVs to proceed on a separate phase from cars in parallel lanes. This resulted in substantial reduction in illegal-left-turn crashes. LRVs no longer follow a queue-jump strategy. Instead, trains have a proceed signal only when parallel cars have a red light. Even when a car does make an illegal turn, the train is not there to get hit.
- ✓ The project has resulted in a reduction in wait times at intersections for pedestrians. Decreased wait times result in fewer pedestrians violating the walk/don't walk signals.
- ✓ Positive and measurable safety and traffic flow results from the project have given METRO the credibility and traction to implement additional safety projects in other corridors. When METRO recently proposed a demonstration safety project to convert a lane shared with trains and automobiles into a dedicated train lane along a three-block stretch of the Green & Purple lines in downtown, for example, key stakeholders requested we consider all 32 blocks instead. A similar dedicated train lane project will soon be presented to the Texas Medical Center (TMC). Our crash data suggests these two projects taken together would result in a system-wide 30% reduction in our crash rate**. This was a huge accomplishment for METRO as stakeholders were, at one time, uniformly opposed to the removal of any shared lanes in the corridor.** Decreased running time. Efficiency gained from *SmartSync* allowed METRO to run the same six-minute service using one fewer train. This translates into a **future capital cost saving of up to $7 million and an annual operating cost savings of $250k.**
- ✓ Increased customer satisfaction and overall rider experience.

Exhibit B: Collision Analysis Before-After



SAFETY PROGRAM/PROJECT INNOVATION

METRORail's safety project is an innovative and multi-faceted program that focuses on enhancing the safety of our system in several ways.

- ✓ **Collaborative Approach:** Houston METRO controls LRV station areas, operations of vehicles, and budgets for items like gate arm crossings and flashing signs, however, surrounding environments, streets, and traffic signalization are controlled by other stakeholders including city, county and state agencies. This jurisdictional overlap can add to the complexity of successfully implementing safety improvements. SmartSync was achievable because of a collaborative partnership between Houston METRO and the City of Houston's Traffic Signal Timing group.

- ✓ **Outside-the Box Solutions:** The project aimed to maximize the potential of existing assets with limited funding. The development of SmartSync began with a handshake between two agencies and, together, METRO and the City of Houston invented a brand-new traffic timing function, Preempt Service Delay. This bottom-up approach is not a common in government, but it allowed us to remain flexible, open to experimentation and implement improvements quickly, with minimal risk.

- ✓ **User Design Considerations:** Urban environments are unpredictable. Clear rules, combined with enforcement and education, encourage compliance and lead to safer streets. However, it is also important to recognize the value of engineering that considers and/or channels human behavior. Lengthy wait times at crosswalk signals, for example, can result in frustrated pedestrians crossing streets against a "don't walk" signal, which creates a safety hazard. SmartSync took these types of considerations into account.

SAFETY PROGRAM/PROJECT TRANSFERABILITY

This project can be reasonably replicated and implemented by other rail agencies, however, cooperation between the Rail Transit Agency (RTA) and other stakeholders is crucial. This project would not have been possible without the partnership and participation of both METRO and the City of Houston. Both agencies donated staff time, totaling approximately $250k. Hardware cost for the project was roughly $35k**.**

Although *SmartSync* is a relatively new initiative, the current 35% collision reduction rate we see is very encouraging. This period has experienced a lull in collisions, not a peak, and the crash rate is clearly lower than previous years. Our current projections predict a 10% to 35% permanent reduction in crashes along this corridor solely because of this project.