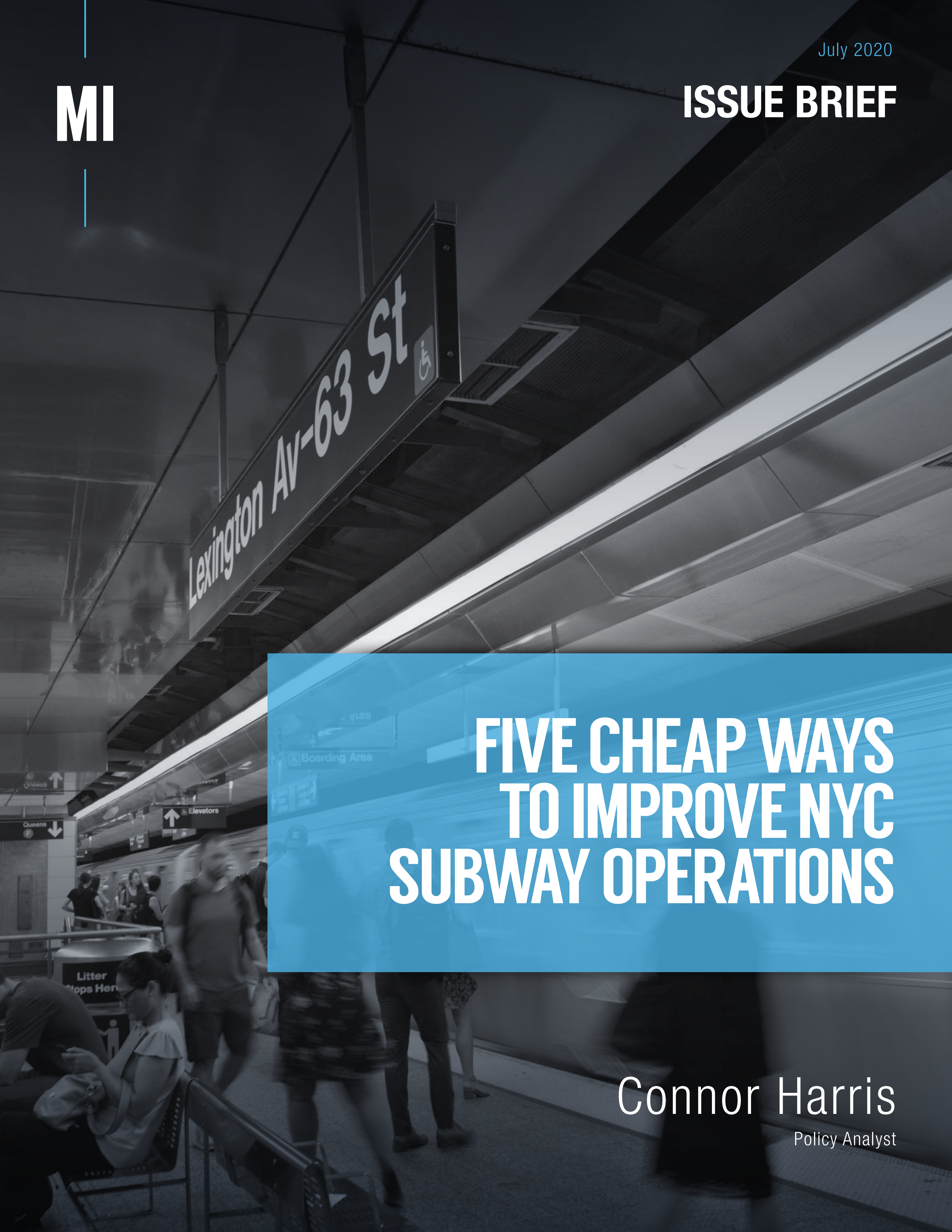


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ISSUE BRIEF

# FIVE CHEAP WAYS TO IMPROVE NYC SUBWAY OPERATIONS

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# Executive Summary

The COVID-19 pandemic has drastically affected MTA operations. Ridership fell to a tenth of its normal levels and has not yet recovered fully, and the city and state will lose massive amounts of tax revenue that previously went to subsidize operations. On May 6, 24/7 subway service even came to an unprecedented, though ostensibly temporary, end: the system now closes at nighttime to allow for the deep cleaning of subway cars. While this unprecedented crisis will exacerbate preexisting difficulties for the MTA, it will also offer opportunities to fix them.

New York City's subway is beset by operational problems. Trains frequently run late. Though on-time performance statistics have improved in the last few years, much of the apparent improvement is a result only of New York City Transit's (NYCT) adoption of more forgiving schedules.[1] A huge backlog of maintenance projects exists, as well.

NYCT also spends far more on operations than many peer systems. For example, in 2018, expenses for subway operations and maintenance in New York came to $14.55 per car-mile, while the system earned only $10.05 per car-mile in fare revenue.[2] The Chicago Transit Authority, by contrast, spent only $8.41 to move a car on the L one mile—little enough that if New York's subway had been as efficient as Chicago's, it would have turned a profit.

For New York to have a modern, reliable subway system, these problems need to be fixed. Furthermore, the MTA's precarious finances—worsened because of the COVID-19 epidemic—require that we identify subway improvements that can be done cheaply. Fortunately, many improvements could be made for little up-front cost, and some would even save money immediately.[3]


# Step 1: Use Nightly Shutdowns to Get Maintenance Costs Under Control

In the wake of the COVID-19 pandemic, Governor Andrew Cuomo ordered an end to nighttime subway service so that the cars could be deep-cleaned. This is probably not necessary. Other nations, notably in East Asia, keep train cars clean without nighttime shutdowns. For example, in Japan, a nation that prides itself on cleanliness, long-distance trains on the busy Shinkansen lines are completely cleaned within seven minutes.

But carefully planned suspensions of overnight subway service could solve another problem: New York's massively inflated track maintenance costs. Most subway systems around the world do not run around the clock; they shut down for several hours each night and schedule all track maintenance during these regular nighttime closures. (The Shanghai Metro, which has more than twice the ridership of the New York subway, closes entirely at 11 PM.) Late-night travelers can take special night buses, which can run much faster than daytime buses, thanks to reduced traffic congestion.

In New York, however, maintenance has to be scheduled while trains are still running, often during late evenings or weekends. Coordinating maintenance work with train service is difficult. First, taking tracks out of service reduces the number of possible trains, especially on two-track lines, where dispatchers have to schedule trains in opposite directions on a single track. Second, trains have to slow to walking speed whenever they approach work sites in order not to strike workers who may have wandered onto the wrong track.

Around-the-clock service also makes track maintenance less efficient. First, for safety reasons, work has to stop whenever a train passes, constantly interrupting workers and making them far less productive than they could be. Second, maintenance on an active track requires putting several workers on essentially unproductive "flagging" duty: standing at the edge of a work site and signaling passing trains to slow down. (Flagging is still necessary on closed tracks to protect work trains, but to a much lesser extent.) In Copenhagen's subway, one of the few others with 24/7 service, each line is a pair of physically separate parallel single-track tunnels. Trains can thus run bidirectionally on one track while maintenance workers on the other track work in complete safety.

As a result, NYCT spends $1.9 billion per year on track maintenance, four times as much per track-mile as any heavy rail system in the U.S. outside of New York.[4] Meanwhile, weekend subway riders have to put up with endless service disruptions and train reroutings for the sake of preserving nighttime service that serves far fewer users.

Ending 24/7 service is not a new idea. Under Joe Lhota's leadership, the MTA often closed individual lines at night for its FASTRACK accelerated repairs program, though it kept everyday service. The Regional Plan Association (RPA) also proposed closing individual lines at night in 2017.[5] The MTA's pressing fiscal needs make the idea all the more urgent. NYCT should consider closing lines overnight for maintenance beyond this current crisis, especially on lines with the largest maintenance backlogs. To help workers on night shifts who need to travel during times when the subway is closed, NYCT could instead run additional night buses, which could approach the typical speed of the subway, thanks to low traffic congestion.

Back-of-the-envelope calculations show that even generous additional night bus service would cost only a small fraction of the potential savings. A bus route averaging 12 mph, with a bus every 10 minutes in each direction, requires one bus per mile; 12 mph is a high but achievable nighttime bus speed, and 10 minutes is a generous frequency. At this service level, it would take 1,225 bus-hours to duplicate the NYC subway, with it 245 route-miles, for a five-hour closure each night. NYCT buses cost $211/hour to run,[6] so a night bus system completely duplicating the subway for five hours every night would cost only $94.4 million per year. Even if drivers were given generous bonus payments for nighttime work, night buses would cost only a small fraction of the sum that could be saved with more efficient maintenance. Some of the remaining savings could go toward offsetting the impact of nighttime subway service losses in other ways, such as discounted fares for regular nighttime commuters.

In reality, things would be more complicated. Though most of the subway network runs along wide roads, some parts do not—especially the crossings of the East River, where some subway tunnels do not line up well with the road tunnels and bridges. It may be better to redesign night bus networks instead, in order to focus on a few central transfer hubs where many bus routes can be scheduled to arrive at once—thereby sparing passengers from a possibly dangerous nighttime wait. (London's night bus system, for example, has a large number of routes that terminate at a central transfer point in Trafalgar Square.)

Nighttime maintenance on elevated lines in residential areas, furthermore, creates noise bothersome to nearby residents, and walking on poorly illuminated elevated structures at night is hazardous to workers. These difficulties, though, could be ameliorated. For example, it may suffice only to do partial shutdowns of the subway for maintenance, with a few lines left open to pick up the slack from nearby lines. Not every mile of track would be guaranteed nightly attention during partial shutdowns, but routine maintenance would still be much easier and cheaper to schedule.

## Step 2: Platform Screen Doors

Most newly built subway systems around the world have Plexiglas barriers between the tracks and the platforms. The barriers have embedded doors that align with the doors on the train and open only when they are in the station. Full-height platform doors, stretching from the platform edge to the ceiling, can completely block passengers from going onto the tracks themselves or throwing objects onto them, but even "half-height" doors—which typically reach to about chest height for a person of average stature—can prevent accidental falls and block all but the most determined attempts to access the tracks.

Barriers are a greater benefit to operations than one might think. The New York subway sees about 900 intrusions onto the tracks every year, including about 40 suicides.[7] Each of these intrusions can cause extensive service delays, especially suicides (which, furthermore, are often traumatizing for train drivers). In May 2018, an ordinary month, track intruders on New York City's subway system directly caused 690 delayed trains.[8] Indirect train delays are likely even more numerous: after the deaths of two subway passengers who were shoved onto the tracks in 2013, the union for NYC subway workers told train drivers to reduce their speed to 10 mph whenever they entered a station and urged NYCT to change the official speed limit accordingly.[9]

Platform barriers could also eliminate—or, at the very least, significantly reduce—the 700 annual fires caused by trash on the train tracks, which can render tracks impassable and cause significant delays.[10] In May 2018, there were 726 delayed trains due to trash fires.[11] Finally, platform doors could allow running more frequent train service with the same number of staff. Currently, train conductors (a distinct position from train drivers) sit in the middle of the train to check that doors at each station have closed safely before the train departs; screen doors could obviate this position and allow conductors to be retrained as drivers of additional trains.

The MTA has considered plans to install screen doors for years. One rejected plan from 2012 estimated the cost of screen doors at more than $1 million per station.[12] In early 2018, the agency drew up plans to test half-height doors on the Third Avenue station on the L train, for a cost of $30 million, but ultimately decided to use the money for new elevators in other stations instead.[13]

The benefits of screen doors, however, are promising enough that the MTA should take another careful look. Stations with high levels of platform-level crowding, such as Times Square and Grand Central, would benefit from screen doors to prevent inadvertent falls. Some outdoor stations whose platforms can ice over or otherwise become slippery in inclement weather may also be useful targets. One contributor to the high cost estimates of screen doors is the difficulty of retrofitting stations to support additional weight—especially interchange stations with complex designs. Some older subway cars also have different arrangements of doors and would need to be retrofitted or replaced to work with platform screen doors, which must align with the doors on subway cars themselves.

If the weight is an obstacle, though, half-height or even waist-high barriers may provide many of the benefits of full barriers without the weight difficulties. The MTA could consider other innovations that would give many of the benefits of screen doors without any of the difficulties. For example, some mainline trains in South Korea use lightweight platform rope barriers—essentially, curtains of taut horizontal ropes strung along the platform edge and retracted when a train approaches. One manufacturer estimates that rope screen doors on a standard subway system could be installed for half the price of a standard screen door and in one-third the time.[14] In New York, rope doors have further benefits: they would not require renovating load-bearing parts of stations to support the additional weight or replacing large parts of the railcar fleet to homogenize door placement.

One slight but real drawback to platform screen doors is that checking for passengers trapped between the doors and the train can lengthen station stop times. One study found that the additional time per stop ranged from four to 15 seconds, with the higher figures found in Chinese systems where train drivers have to step out of the train to check.[15] Nevertheless, the study found, the other operational benefits far outweighed the additional dwell time.

## Step 3: De-interlining

New York's subway system has extensive reverse-branching, or interlining: trains that run on different trunk lines through central Manhattan combine onto the same branch in the outer boroughs. For example, in Queens, four lines—the E, F, M, and R—run together on the Queens Boulevard line. But in Manhattan, the trains split onto three lines: the E runs under Eighth Avenue, the F and M run under Sixth Avenue, and the R runs under Broadway.

Reverse-branching allows residents of the outer boroughs to travel to more locations in Manhattan with one-seat rides. But it has severe drawbacks, which is why most modern metro systems do not reverse-branch, and managers of legacy systems have invested in eliminating reverse-branching. The London Underground, for example, plans to end a complicated reverse branch on the Northern Line, now that an additional outer branch to the line is complete.

One problem with reverse-branching is that if one suburban branch reverse-branches into two core lines, the maximum service frequency of the core lines is half the capacity of the outer branch—even though the outer branches have lower passenger demand. Reverse-branching also amplifies the consequences of small delays in service. A delay on one trunk line on a reverse-branched system will require delays on all other trunk lines that feed into the same line in the suburbs, so that trains can still meet at the junction between the trunk lines without conflicting. On a system with ordinary branching, however, this sort of delay propagation between branches happens only on the outer parts of the system, which have lower traffic and where delays are less common, anyway.

In New York, subway lines are so interwoven that any disruption to one line can propagate to most of the network. Any disturbance to the numbered lines 2, 3, 4, and 5, for example, requires alterations to the other trains on the lines as well, as all four lines share tracks with the others at some point. So, too, any disruption on a lettered line (except the L, which has its own tracks) will propagate to the rest of the lettered network, which cannot be divided into smaller components that can be scheduled independently. Even under regular operations, coordinating complex merges between branches is difficult and sometimes requires deliberately running trains slower than their otherwise maximum speed.[16]

There are many ways that the subway network could be de-interlined such that all trains on a line in the outer boroughs feed the same line through Manhattan. A full plan would require new capital construction, but significant steps toward de-interlining could be taken without any new construction.

One possibility is at DeKalb Avenue, a six-track station that recombines trains from the Manhattan Bridge onto Brooklyn subway lines in a complex and delay-prone way. The Manhattan Bridge runs as two separate pairs of tracks: the northern pair carries the B and D lines, and the southern pair carries the N and Q. At the station, however, the D and N trains merge onto an inner pair of nonstop tracks that connects to the express tracks of the Fourth Avenue line through Brooklyn, while the B and Q stop and continue to the Brighton line. (The R train, which also stops at the station, has separate tracks connecting a dedicated Manhattan tunnel to the Fourth Avenue local tracks, as well as a non-revenue connection to the Brighton line.) The recombination is delay-prone and requires moving trains through a complex and therefore slow junction. By changing Brooklyn service to send the B and D down Fourth Avenue and the N and Q down Brighton, or vice versa, knock-on delays resulting from the junction could be eliminated. This service change would require no infrastructure investment and would also allow simplifying the track layout of the junction just north of DeKalb, allowing trains to travel over it faster. (The drawback, of course, is that some one-seat subway rides would be eliminated, but the B and D are only one block from the N and Q through core Manhattan, so most door-to-door subway trip times would not be affected.)[17]

## Step 4: Improve Passenger Flow in Stations

One source of subway users' frustration is overcrowding in the stations themselves. Many key subway stations have narrow platforms and staircases more appropriate to a system with much lower ridership. Platform crowding is hazardous for passengers and creates a risk of falling onto the tracks. The MTA must repurpose conductors as platform agents during peak travel hours solely for crowd control. Overcrowding also generates in-station congestion that adds time to riders' door-to-door journeys and reduces the overall capacity of the system. There is some evidence that extra time in stations can have an outsize effect on ridership; one review, for example, finds that passengers value walking and waiting time about 1.8 times as much as in-vehicle time, and circumstances such as "waiting in crowded conditions" carry an even larger penalty.[18]

Fixing this problem entirely would require extensive reconstruction: for example, widening some narrow platforms may require excavating additional space in stations and moving the tracks as well. Conditions on platforms, however, could be improved without heavy construction. RPA's Fourth Regional Plan, for example, pointed out that many subway platforms are cluttered with nonnecessities such as newsstands that could be very cheaply removed.[19] Other stations, principally in outer regions, have entrances that are unnecessarily closed; reopening these would cut some time from many nearby residents' street-to-platform walking time. The MTA might also reevaluate the placement of benches, electronic displays, and other impediments to passenger flow.

Furthermore, while structural station renovations may be difficult, they are not impossible. In the early 2000s, a renovation of the station at Amsterdam Avenue and 72nd Street included platform expansions.[20] The MTA's proposals for renovations of stations on the L train, as well as in East Midtown,[21] have included staircase widenings. Whole station renovations, which can include wider staircases, along with other structural improvements, typically cost millions of dollars. But the MTA will have to renovate many subway stations in the near future to comply with ADA requirements for wheelchair access. If the unavoidable disruptions from ADA work are large enough, additional improvements for nondisabled passengers, such as wider staircases, could be carried out without further impact.

# Step 5: Reevaluate Speed Restrictions

In the last few decades, the subway has become slower, largely in response to accidents. In 1995, for example, a fatigued train driver nearing the end of an overnight shift overran a faulty red-light signal on the Williamsburg Bridge and collided with a train stopped at a station. In response, the MTA lowered speed limits throughout the system from 55 mph to 50 mph and severely cut fleet acceleration standards, reducing the de facto speed limit even further, to about 40 mph. Some key portions of track have even lower speed limits; for example, many nonstop tracks in stations on three- or four-track lines are limited to 15 mph, and the Williamsburg Bridge—a long, nonstop segment where lowered top speeds have a large effect on trip times—is limited to 20 mph.

These lowered speed limits are exacerbated by subpar equipment. Many segments of subway track have devices called "signal timers," which trip the emergency brakes on any train that travels faster than the speed limit. These devices are often faulty and impose excessively low speed limits; because train drivers who trip a signal timer can be severely disciplined, most of them travel much slower than the official speed limit on track segments controlled by signal timers.

NYCT could also profitably reevaluate its assumptions on brake maintenance and trains' braking standards. Subway braking rates are set very conservatively, based on tests of braking performance on rails covered in propylene glycol. These tests simulate hazards such as fallen leaves that apply only to portions of the network; braking distances are then padded an additional 35% for extra safety.[22] A survey of New York subway drivers also found that many of them drive even more slowly because they do not trust the performance of subway brakes.[23] It would be worthwhile to investigate drivers' complaints of faulty train brakes to see if they have any validity, and, if so, to make brake inspections more frequent. Speed limits and signal timing in underground portions of the subway network, meanwhile, could be reevaluated for more aggressive braking than currently conducted.

Andy Byford's Save Safe Seconds program had already begun reexamining many of these speed restrictions, such as by recalibrating hundreds of faulty signal timers. After his departure, the next manager of NYCT should continue his work. Special attention should be given to high-ridership nonstop segments such as the East River bridges or the A express tracks under Central Park West. Trains on these segments run near top speed for long intervals, unlike elsewhere in the network, where more time is taken up by braking and pauses at stations. So even small increases to top speed there would have an outsize effect on overall system performance.

# Endnotes


[1] Clayton Guse, “The MTA Tweaked Subway Train Schedules—Then Its On-Time Performance Metric Shot Up,” *New York Daily News*, Mar. 9, 2020.

[2] Federal Transit Administration, “MTA New York City Transit: 2018 Annual Agency Profile.”

[3] While precise estimates of cost savings are not clear, the impacts will likely be sizable and will lower service costs at the margin. This also underscores the need for greater MTA transparency with data.

[4] Figures from the 2018 National Transit Database.

[5] Dan Rivoli, “Transit Experts Propose Ending NYC’s 24/7 Subway System,” *New York Daily News*, Nov. 30, 2017.

[6] Federal Transit Administration, “MTA New York City Transit: 2018 Annual Agency Profile.”

[7] Emma G. Fitzsimmons, “Yet Another Worrisome Subway Statistic: More People Are Going on the Tracks,” *New York Times*, Sept. 17, 2018.

[8] Dan Rivoli, “MTA Holds Off on Testing Platform Door on L Line,” *New York Daily News*, June 26, 2018.

[9] Matt Flegenheimer, “Union of Subway Drivers Urges Slower Train Speeds,” *New York Times*, Jan. 14, 2013.

[10] Ginia Bellafante, “Subway Delays and the Power of Shame,” *New York Times*, July 21, 2017.

[11] Rivoli, “MTA Holds Off on Testing Platform Door on L Line.”

[12] Alex Davies, “Why New York City Can’t Save People from Being Hit by Subways,” *Business Insider*, Jan. 2, 2013.

[13] Rivoli, “MTA Holds Off on Testing Platform Door on L Line.”

[14] Rope-barrier systems appear to cost about half of what a sliding-door system would cost, according to the manufacturer and reports from trials around the globe. See, e.g., “Wire Ropes as Platform Screens,” *Railway Gazette*, Apr. 28, 2015; Komachine, “Rope Screen Door,” https://www.komachine.com/en/companies/skd-hi-tec/products/100047-Rope-Screen-Door. That does not include any potential savings from reduced platform disruption during installation.

[15] Alexander Barron et al., “Operational Impacts of Platform Doors in Metros,” *Transportation Research Record* 2672, no. 8 (June 2018): 266–74.

[16] A320Lga, Twitter post, Dec. 22, 2019, https://twitter.com/A320Lga/status/1208773904510177282.

[17] See Alon Levy, “Fix DeKalb Avenue, Pedestrian Observations (blog), Nov. 3, 2017, for a fuller discussion of DeKalb de-interlining.

[18] Hiroyuki Iseki, Brian D. Taylor, and Mark Miller, “The Effects of Out-of-Vehicle Time on Travel Behavior: Implications for Transit Transfers,” Tool Development to Evaluate the Performance of Intermodal Connectivity (EPIC) to Improve Public Transportation, Jan. 18, 2006.

[19] Regional Plan Association, “The Fourth Regional Plan,” 2017, Modernize and Refurbish New York City’s Subway Stations.

[20] Metropolitan Transportation Authority (MTA), press release, “New Headhouse Opens at West 72nd Street,” Oct. 29, 2002.

[21] MTA, “L Project Proposal,” Mar. 20, 2019; New York City Department of City Planning, “East Midtown Subdistrict,” Aug. 29, 2013.

[22] Kenneth A. Mooney and N. N. Ghaly, “Communications-Based Train Control at MTA New York City Transit Program: Background and Update,” Proceedings of the 1998 ASME/IEEE Joint Railroad Conference (1998), pp. 177–188; Metropolitan Transportation Authority, “Final Report: MTA NYCT Subway Speed and Capacity Review,” Dec. 31, 2019.

[23] Clayton Guse, “Higher Subway Speeds Worry NYC Train Operators—and New Report Explains Why,” New York Daily News, Oct. 14, 2019.