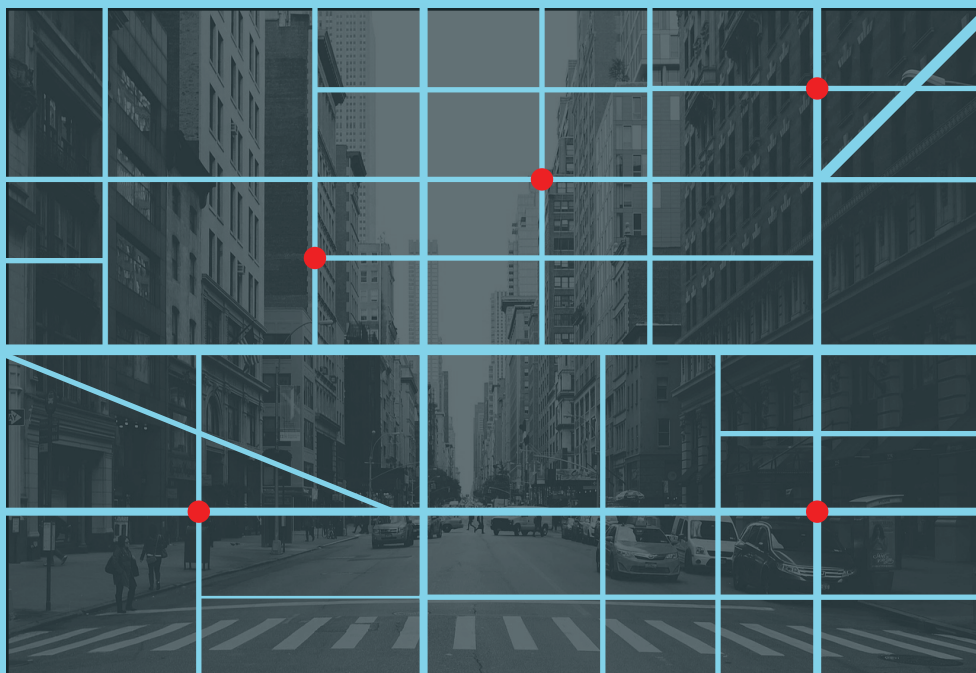


INTELLIGENT PARATRANSIT

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EXECUTIVE SUMMARY

As Americans aged 65 or older increase from fifteen to twenty percent of the population by 2030, cities across the United States will face a transportation crisis. Urban residents who are physically unable to use public transportation, including the disabled and mobility-impaired elderly, are offered paratransit services. These paratransit systems, required by an unfunded 1990 Americans with Disabilities Act mandate, are enormous, and growing annually in new applications and budget requirements.

Paratransit demand is growing nationwide and costs continually increase (now \$5.2 billion nationwide); the user experience is often reported as poor. To address efficiency and user experience, this report assesses the state of paratransit, analyzes innovative solutions in three cities and recommends potential technological solutions. Our Intelligent Paratransit Technological Upgrade Framework includes improvements in the areas of Onboarding, Reservations, Dispatch & Routing and User Experience.

Key technological recommendations include:

- Ride reservations should be available through multiple channels: phone, apps, SMS messaging, physical infrastructure on the street and wearable technology for riders.
- Paratransit agencies must collaborate with taxis and app-based car services, including Uber, Lyft, Via and SilverRide to integrate more efficient services.
- Services connecting riders to transit should feature real-time, in-vehicle data integration with transit services to optimize accessibility of trips.
- As cities grow in language diversity, paratransit vehicles should feature on-board translation apps and call-in numbers to better service all riders.

By applying new technological systems to a 26 year-old mandate, paratransit services can be made more efficient and provide a better customer experience. In New York City, these upgrades could save the agency up to \$133 million per year. Improving mobility solutions for the elderly and disabled is possible, necessary and urgent.

CONTENTS

INTRODUCTION.....	1
STATE OF PARATRANSIT.....	2
THE URGENT NEED FOR REFORM.....	3
A PARATRANSIT TECHNOLOGY FRAMEWORK.....	6
TAPPING INTO PRIVATE SECTOR TECHNOLOGY AND PUBLIC RESOURCES.....	15
TECHNOLOGY COST SAVINGS.....	16
COST SAVINGS FROM TECHNOLOGY SOLUTIONS FOR CBC RECOMMENDATIONS.....	16
TECHNOLOGY IMPLEMENTATION CHALLENGES.....	17
POLICY CHALLENGES.....	19
GLOBAL BEST PRACTICES IN MOBILITY FOR MULTI-STOP ROUTING.....	20
CASE STUDIES.....	22
FURTHER RESEARCH.....	28
CONCLUSION.....	29
ACKNOWLEDGMENTS.....	30
ADVISORY BOARD.....	30

INTRODUCTION

Residents of cities who are physically unable to use public transportation, including the disabled and mobility-impaired elderly, are offered car or van rides by paratransit services. Required by an unfunded 1990 Americans with Disabilities Act mandate¹, paratransit systems are enormous: in New York City, paratransit serves 144,000 subscribers at \$456 million per year; in the Chicago region, 50,000 subscribers are served at \$137 million per year; in Boston, 80,000 at \$75 million per year. These operations grow annually with new registrations and costs. Furthermore, their rides are reportedly poor experiences². Paratransit demands will grow as the population above 65 years increases to 20 percent of the nation's population by 2030³.

Current paratransit models cannot afford to scale to meet increasing demand. This report assesses the state of the paratransit market, analyzes innovative solutions in three cities and recommends several technology-based methods to improve paratransit:

- Tapping into app-based ridesharing companies
- Real-time integration with transit
- Deploying physical and wearable technologies to improve the hailing and ridership experience
- Right-size vehicle dispatch, including vehicles from private transportation providers like Uber and Lyft

By applying new technological methods to a 26 year-old mandate, paratransit services can provide a better customer experience. Improving mobility solutions for the elderly and disabled is possible, necessary and urgent.

1. 49 Code of Federal Regulations 37.21 - Transportation Services for Individuals with Disabilities (ADA) Applicability: General. (2016). LII / Legal Information Institute. available at <https://www.law.cornell.edu/cfr/text/49/37.21>

2. "The Current State of Transportation for People with Disabilities in the United States," National Council on Disability, June 2005.

3. "Profile on Older Americans," U.S. Department of Health and Human Services Administration on Aging, 2015.

STATE OF PARATRANSIT

THE PARATRANSIT TRIP

Paratransit provides shared-ride, door-to-door and transit feeder services for daily trips and non-emergency transport.

In most cities, paratransit trips must be reserved one to two days in advance. Typically, reservations are made by telephone, although some cities provide web-based reservation systems. In most cities, same-day paratransit trips are unavailable.

Passengers are assigned pickup times, typically with 30-minute windows; they must meet the vehicle within five minutes of arrival under penalty of marked as a “no-show.”

Trips are provided either door-to-door or to the nearest accessible transit service, depending on the user’s evaluation. The vehicle may pick up additional riders en-route for shared trips.

It is clear that day-before reservations and unpredictable travel times relegate paratransit users to travel during a time before the internet. As this report will discuss, opportunities abound to improve the reservations process, dispatch, routing and passenger information processes with technology.

A FEDERAL MANDATE

Paratransit services are required by the Americans with Disabilities Act of 1990. This unfunded mandate requires that municipalities provide accessible equivalent transportation service to disabled individuals where fixed-route systems are inaccessible. While paratransit systems serving disabled riders existed prior to the ADA mandate,

their growth and use has increased rapidly following the passage of this act. The ADA is intended to provide disabled Americans with the same or comparable public transit access as their peers, and must meet a minimum of service requirements, outlined in the chart below.

SUMMARY OF MINIMUM PARATRANSIT SERVICE REQUIREMENTS PER ADA MANDATE

Service requirement	Description
Service area	Includes area within $\frac{3}{4}$ mile of fixed-route bus and rail corridors as well as areas between these corridors.
Response time	Service must be provided in response to a request made the previous day. Reservations may be taken by reservation agents or by machine.
Fares	Service charges may not exceed 2x the full fare for a similar fixed-route trip. Guests accompanying ADA eligible riders are charged the same fare; a care attendant may ride without charge.
Service hours	Service hours should be the same as fixed-route services.
Trip restrictions	Providers may not restrict or prioritize trips based on purpose, nor may they restrict the number of trips an individual can make.
Capacity	Providers may not waitlist individuals. Services should monitor trip lengths, timeliness of pick-ups and drop-offs, and trip denials to ensure that adequate service is provided.

CONTINUOUS GROWTH

The demand for on-demand transit services is growing rapidly. According to the United States Government Accountability Office, 73 percent of U.S. transit agencies experienced an increase in ADA paratransit registrants between 2007 and 2010. The top ten transit agencies' registrants increased an average of 22 percent in that timeframe⁵. In

New York City, "paratransit trips have grown at an average annual rate of 8.4 percent, nearly five times the rate of growth of subway ridership" since 2002, according to the Citizens Budget Commission⁶. If paratransit is not made more efficient, its growth will be unsustainable in both cost and scale.

THE URGENT NEED FOR REFORM

Reforming paratransit systems' policy, management and operational models is urgent and essential. The systems are interfacing with aging, often inaccessible transit infrastructure, sitting on the

culsp of a sharp increase in the elderly population in cities across the United States and facing dramatically rising costs.

RISING COSTS

Growth in ridership on paratransit systems presents a major challenge to transportation agencies. Although paratransit serves a relatively small customer base within transit agencies, disproportionately high subsidies are required to operate and maintain the services. According to a recent Brookings analysis of American Public Transportation Association data, demand response services, also called paratransit or dial-a-ride services, cost \$5.2 billion dollars in 2013, about 12.2 percent of the total costs for transit

services (see chart below)⁷. This increased from 3.2 percent of costs in 1988, before the ADA paratransit mandate. A 2012 report issued by the US Government Accountability Office detailed that the average cost of an ADA paratransit trip was \$29.30, or about 3.5 times more expensive than the average cost of a fixed route trip (\$8.15)⁸. This report also found that the average cost of providing an ADA paratransit trip increased an alarming 10 percent from 2007 to 2010.

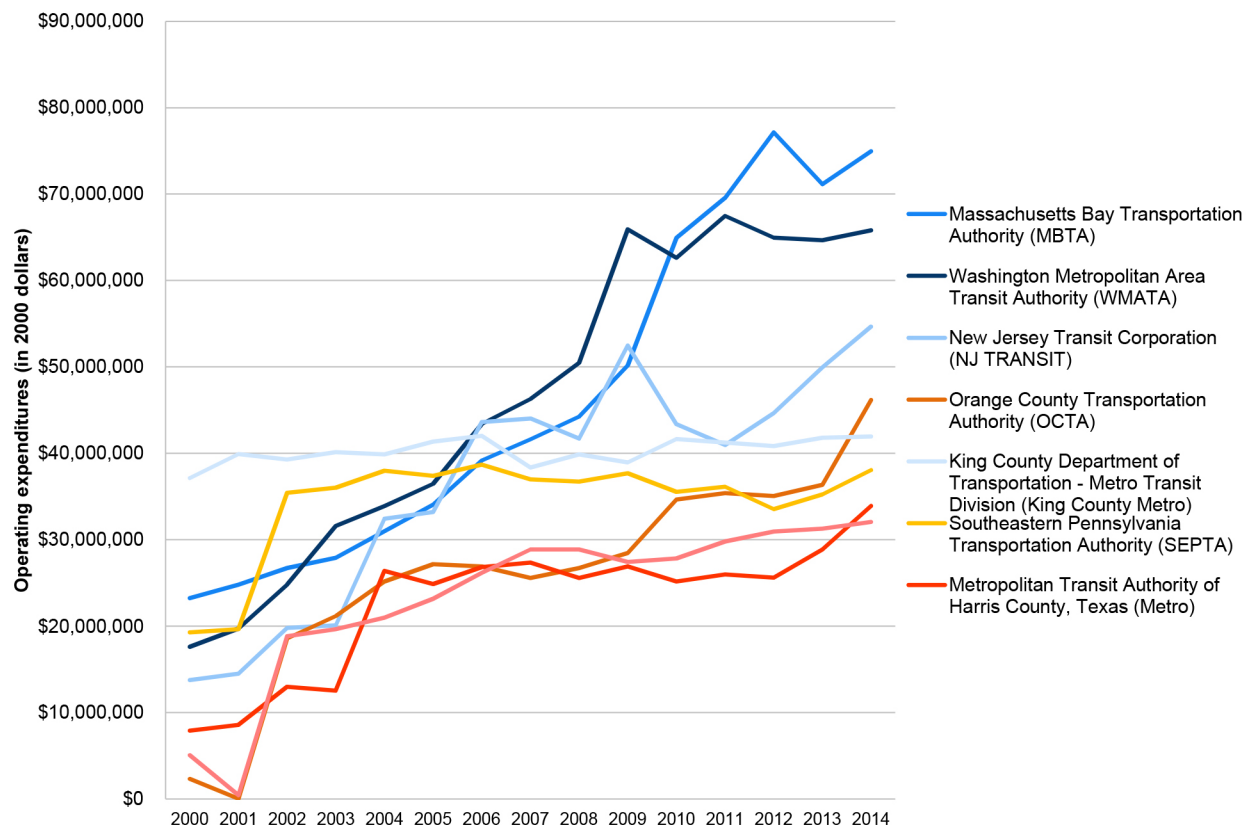
5. "ADA Paratransit Services: Demand Has Increased, but Little is Known about Compliance," United States Government Accountability Office, Report to the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, November 2012.

6. Citizens Budget Commission. "Access-A-Ride: Ways to Do the Right Thing More Efficiently," September 2016.

7. Kane, J., Tomer, A., & Puentes, R. (2016). How Lyft and Uber can improve transit agency budgets. The Brookings Institution. Retrieved 19 April 2016, from <http://www.brookings.edu/research/papers/2016/03/08-lyft-uber-transit-agency-budgets-kane-tomer-puentes>

8. United States Government Accountability Office. ADA PARATRANSIT SERVICES: Demand Has Increased, but Little Is Known about Compliance. November 15, 2012. Accessed April 4, 2016. <http://www.gao.gov/products/GAO-13-17>.

Operating expenditures for demand response services at selected transportation agencies 2000 to 2014



Source: Brookings analysis of National Transit Database (NTD) data

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Paratransit costs have increased in recent years due to growing enrollment and utilization. High vehicle costs, urban congestion and long trip lengths also play a role in high trip costs, according to a report issued by The Citizens Budget Commission⁹.

The disproportionate impact of these cost increases puts paratransit providers in a difficult position. Transportation agencies are disincentivized from increasing the quality of paratransit service, which would induce greater demand for services, resulting in cost increases. Agencies seeking cost reductions often focus on encouraging or incentivizing paratransit riders to opt for fixed-route services. Because the cost

of subsidizing a paratransit trip is so high, giving paratransit riders free taxi, bus or subway rides is an effective means to reducing overall costs. For example, in MetroAccess in Washington, DC, the cost of subsidizing the trip of one customer could instead be applied to moving 65 rail customers¹⁰. Of the agencies examined in the GAO survey, 55 percent utilize travel training and 62 percent have made accessibility improvements to their fixed-route systems since 2007 in an attempt to reduce future paratransit system costs. Seeking cost management tactics also pushes these agencies to reach outside of their own management and operations systems; 59 percent of agencies

<http://www.brookings.edu/research/papers/-08/03/2016lyft-uber-transit-agency-budgets-kane-tomer-puentes>

9. Citizens Budget Commission. "Access-A-Ride: Ways to Do the Right Thing More Efficiently," September 2016.

10. Holeywell, R. (2012). Transit Service for Disabled May Feel Weight of Seniors. Governing.com. Retrieved 19 April 2016, from <http://www.governing.com/generations/government-management/gov-transit-service-for-disabled-could-feel-weight-of-seniors.html>

responding to the survey were actively working with health or human services providers and 44 percent were working with other local transit agencies. Numerous other cost savings measures can be taken by paratransit providers, as

recommended by the Citizens Budget Commission report on this subject, including increasing the use of broker services, modifying subsidy policies and reorganizing the program organization¹¹.

ADVERSE CUSTOMER EXPERIENCE

Although compliance with service requirements are not measured on a national level, paratransit customers across the U.S. face difficult circumstances. In New York, the Comptroller found that Access-A-Ride did not meet timeliness or minimum customer service standards¹². Across the country, and particularly in Miami¹³, Dallas¹⁴ and Philadelphia¹⁵, paratransit is anecdotally

reported as providing adverse customer experiences, including late pickups, stranded passengers, sexual harassment by drivers, erratic driving, insensitive drivers, inaccessible vehicles and prolonged travel. Better service to customers, through route monitoring, driver behavior training and improved customer feedback mechanisms, is clearly necessary.

AGING POPULATION

Population growth projections based on U.S. Census data predict that the number of Americans in the 65-plus age bracket will double between 2010 and 2050, while the number of Americans who are 85 or older will more than quadruple¹⁶. As the senior population grows, their needs for accessible transit will also increase, carrying implications for accessibility in urban and transportation planning.

In New York City, 69 percent of Paratransit customers are 65 years of age and older¹⁷. The

burgeoning senior population (those who are currently age 55-64) is concentrated in areas largely lacking accessible subway stations. Although local buses are accessible, they are less convenient and carry fewer passengers. As the aging population rapidly grows and becomes physically unable to use inaccessible transit systems, current paratransit models must modernize to meet future demands.

11. Citizens Budget Commission. "Access-A-Ride: Ways to Do the Right Thing More Efficiently," September 2016.

12. Stringer, Scott M. "Audit Report of the Metropolitan Transportation Authority's Oversight of the Access-A-Ride Program," City of New York Office of the Comptroller, May 2016.

13. Pipitone, Tony. "Paratransit Firm in \$400,000 Dispute With Miami-Dade County Amid Lawsuits, Complaints," NBC 6, February 10, 2015.

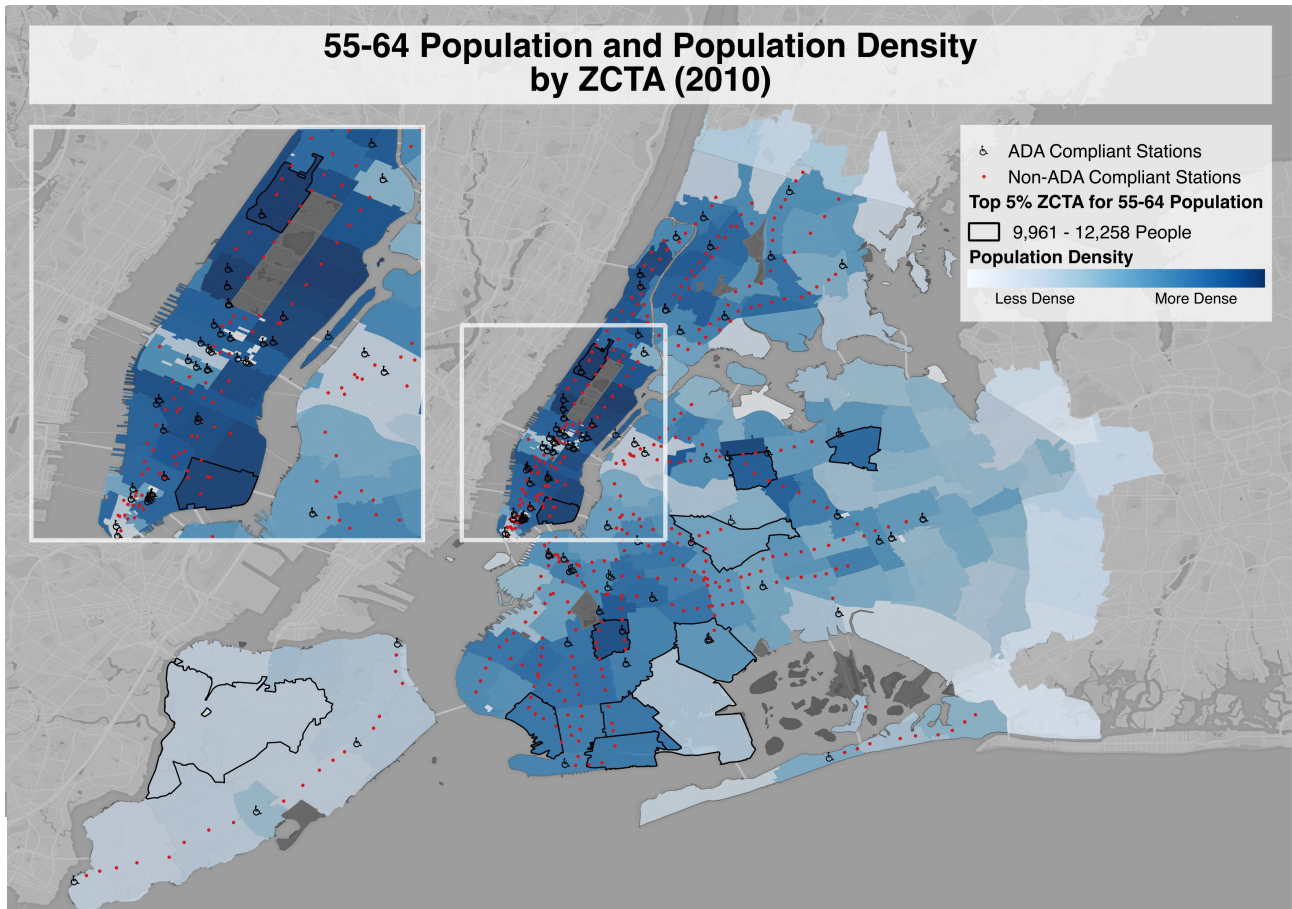
14. Lieber, Dave. "The Watchdog: 2,500 pages of DART paratransit complaints distressing," The Dallas Morning News, September 15, 2014.

15. Ubinas, Helen. "SEPTA transportation for seniors and disabled not working for many," The Philadelphia Inquirer, February 19, 2016.

16. Vincent, G. K., & Velkoff, V. A. (2010). The next four decades: The older population in the United States: 2010 to 2050. Washington, D.C.: U.S. Dept. of Commerce, Economics and Statistics Administration, U.S. Census Bureau.

17. MTA Paratransit Operations briefing, April 2016.

CONCENTRATION OF POPULATION AGED 64-55 AND ACCESSIBLE SUBWAY STATIONS BY NYC NEIGHBORHOOD¹⁸



As the aging population rapidly grows and becomes physically unable to use inaccessible transit systems, current paratransit models must modernize to meet future demands.

18. Data: U.S. Census 2010; MTA.info

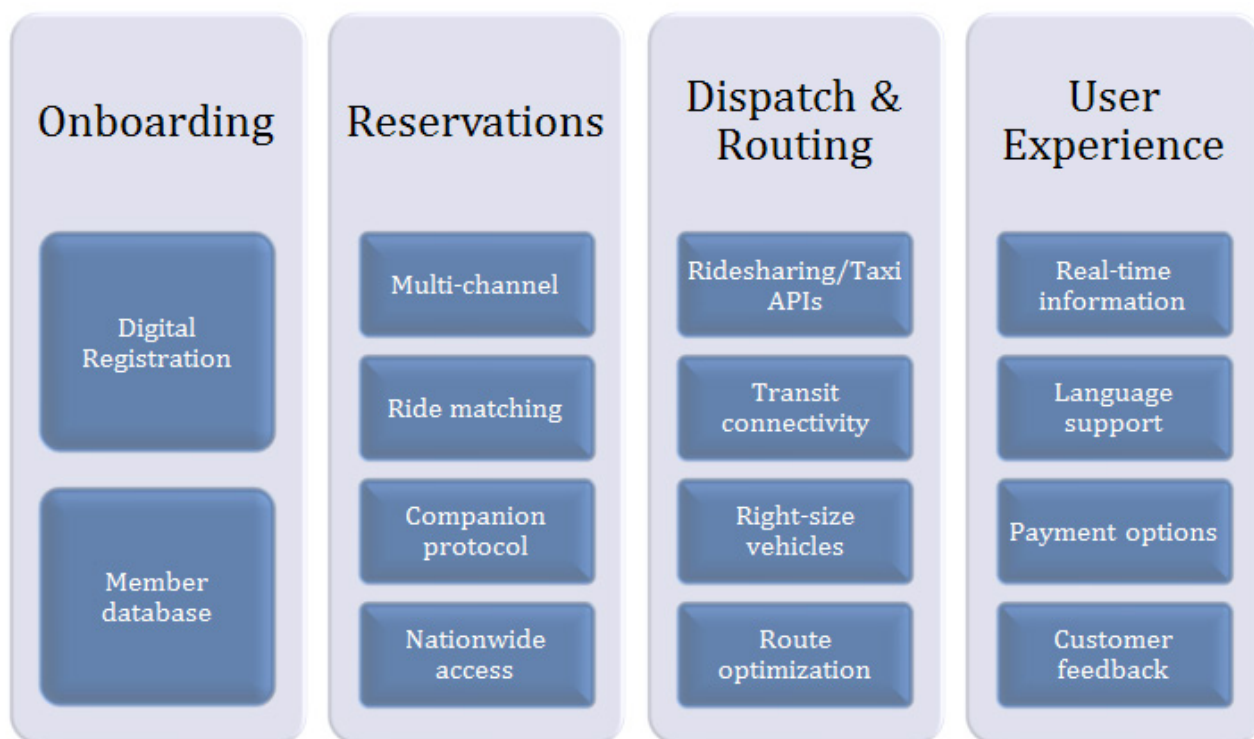
A PARATRANSIT TECHNOLOGY FRAMEWORK

From back-end technologies to ride execution, paratransit services must aim to implement technological solutions to reduce costs, improve efficiency and create a better customer experience. Most urgently, the areas of onboarding, reservations,

dispatch, routing and reservations technologies pose several actionable opportunities for improvement.

The following is a framework for technological upgrades to the paratransit environment.

INTELLIGENT PARATRANSIT: A TECHNOLOGY UPGRADE FRAMEWORK



This technology upgrade framework delineates a set of practical improvements to paratransit service delivery, focused on Onboarding, Reservations, Dispatch and Routing and User Experience.

ONBOARDING

Bringing new riders into the paratransit system is currently an onerous, paper-based process of filling out forms, providing medical proof of eligibility and undergoing disability assessments. The process could be vastly improved using several new tools:

Digital Registration

Registration should be electronic: Forms should be submitted digitally, with a secondary paper option where necessary. Physicians and insurance companies should be able to submit recommendations electronically, with direct integration with insurance providers' billing systems. There should be an option for paratransit assessments to occur remotely via video-conference at physicians' offices to avoid prolonged trips to remote offices for assessments.

Member Database

To optimize service delivery to passengers, member information must be retained in a robust database. Data points should be increased to contain at least the following:

- Home/frequent addresses
- Trip history
- Medical condition
- Service needs (walking support, wheelchair installation)
- Vehicle needs (wheelchair accessibility, low-floor entry)
- Authorized caretaker/companion list
- Automated renewal notification
- Health insurance
- Billing process and records
- Primary language spoken
- Emergency contacts

This database will power the back-end of member on-boarding, account maintenance and inform ride reservation needs. Large-scale member databases are already available from off-the-shelf products that do not require significant expense or software development. They are already used in retail, medical and security fields, and can be applied here as well.

RESERVATIONS

Opportunities abound in the improvement of paratransit ride reservations, which are typically conducted by phone and require one day's notice. To bring paratransit arrangements into the twenty-first century, several technological upgrades should be implemented:

Multi-Channel Reservations

Paratransit reservations are arranged by phone in 13 of the nation's 16 largest systems, and must be made a day in advance.¹⁹ However, modern information systems offer a variety of reservation tools, including phones, mobile apps and websites, which should be implemented in the paratransit environment. Paratransit users should be able to reserve on-demand, through multiple channels depending on their abilities and the situation: phone calls, SMS text messages, smartphone applications, and wearable devices, like emergency

alert necklaces. These tools are used across the globe among a variety of users and should be made possible in paratransit systems across the United States.²⁰

Lighter technologies should be harnessed for ride reservations. In addition to apps and websites, physical and wearable technologies present new, profound opportunities for the disabled:

- Seniors and the dependent disabled in Barcelona use the Telecare button, a wearable device that connects seniors wirelessly through a nearby landline or mobile phone. When a user presses the button on her necklace, she can call for emergency services, summon rides, or reach out for human contact. The city of Barcelona provides this service free to 70,000 seniors and disabled.²¹ Similar wearable devices could be distributed in the United States in partnership

19. Analysis of 16 top paratransit systems' websites

20. Boston's MBTA is in the RFP process for on-demand services that are expected to deliver paratransit rides within half an hour. More cities should follow suit. //Personal Interview with Michael Lambert, Deputy Administrator for Transit at MBTA21. Pipitone, Tony. "Paratransit Firm in \$400,000 Dispute With Miami-Dade County Amid Lawsuits, Complaints," NBC 6, February 10, 2015.

21. <http://smartcity.bcn.cat/en/telecare-service.html>

with social service agencies, with a paratransit ride summoning function, to incorporate travel with other medial and social needs. In the United States, Amazon sells a physical Dash button to allow customers replenish specific items, like paper towels. A version of Dash can be installed in users' homes to summon rides with the touch of a button.

- Information technology infrastructure should serve ride-summoning functions. The new LinkNYC units, with 7,500 planned throughout New York City, should be capable of summoning Access-A-Ride with member data input.²² Similar units, like On the Go kiosks in subways, and tourist information kiosks in other United States cities, can be similarly programmed. Tapping into physical infrastructure would reduce the need for smartphones, improve user location data and offer information about nearby alternatives, like taxis and buses.

- When paratransit riders are being picked up in crowded locations, they can be difficult to spot, resulting in missed connections between drivers and passengers. Installing beacons on paratransit vehicles would help to precisely locate passengers through smartphone sensing, reducing issues of miscommunication and missed rides.

In the nearer term, reservations should be made available through smartphone and web applications in addition to phones. Apps can give real-time feedback about ride timing and allow a user to request the best vehicle type for their current condition, which can change day-to-day for chronic illnesses. They can pay digitally, speeding up boarding and eliminating the need for drivers to carry cash, a safety issue. Finally, reservations apps can search and match riders to the most cost-effective option, offering a suite of ride options based on availability and out-of-pocket costs.

Recently, several app-based services have launched phone reservations in an attempt to reach a more diverse user base.²³ In these cases, these

companies can help shepherd more willing users to an app environment. In addition, users should experience cross-channel continuity; that is, if they start a reservation online and follow up by phone, their inputs should be retained.

Although some paratransit riders still require phone-based human consultation, a growing number are technologically savvy. In both New York and San Francisco, 30 percent of paratransit users own mobile phones. According to a City survey, 60 percent of New Yorkers over the age of 60 have smartphones and 7.5 percent regularly make smartphone-based payments; 74 percent of unbanked New Yorkers have smartphones.²⁴ With training and assistance, adoption of a reservations app and text message-based reservations and payments will grow quickly. In the next few years, the population of elderly riders with some smartphone experience will increase, while accessibility features on smartphones will continue to improve and costs of phones and data plans continue to decrease; more users will be equipped to book rides on smartphones. Now is the time to implement these not-so-new technologies.

Ride Matching

Shared rides are currently orchestrated manually in many paratransit organizations. Riders with somewhat nearby origins are matched through a manual calculation process, which likely does not produce an ideal output for destinations and timing. Riders should instead be matched automatically during the reservation phase, based on: origin, destination, timing requested, vehicle type need and presence of companion. Private companies, including Lyft, Via, Juno and Uber have developed robust technologies for this exact purpose. By leasing this software, paratransit agencies would save the costs associated with parallel trips and inefficient ride pairs.

To optimize ride sharing internally, paratransit agencies could use Lyft's modified geohashing algorithm.²⁵ In this method, urban geography is separated into distinct blocks; rides are matched by weighing a possible pickup by proximity to blocks along the first trip's route. Sharing is offered in the

22. <https://www.link.nyc/index.html>

23. Bliss, Laura. "A Florida Transit Agency Takes On the Digital Divide in a Partnership With Uber," Citylab, June 20, 2016.

24. "New York City Mobile Services Study," New York City Department of Consumer Affairs, November 2015.

25. Brown, Timothy. "Matchmaking in Lyft Line—Part 2," March 1, 2016. <https://eng.lyft.com/matchmaking-in-lyft-line-691a1a32a008#wzasymudu>

earlier portion of a trip to avoid re-routing close to the destination. Although shared trips may not initially present as optimized routes, when executed with optimal efficiency, trips may be marginally longer and the system will benefit as a whole.

By tapping into private companies' ride offerings for ambulatory paratransit users, ride sharing could be possible between mainstream and disabled riders. For example, two neighbors might travel together to a medical center, one as a patient and the other as a visitor; their rides are more efficiently shared than taken separately. Lyft Line enables dynamic ridesharing by offering discounts to passengers willing to share a ride with others, allowing the platform to aggregate demand, reduce costs, and simplify matching, especially in areas of high demand.²⁶ Paratransit users' trips could be aggregated at high-usage locations: medical centers, airports and shopping centers. Although they may make longer trips to the specific meetup point, their vehicle trips could be significantly shorter.

Systematic ride shares would make travel more efficient by sharing the costs of one trip between two travelers, presenting significant cost savings to paratransit agencies. In addition, matching mainstream and disabled riders can help remove them from the isolation that commonly accompanies limited mobility.

Companion Protocol

Paratransit users are offered the option to travel with a caretaker or companion at no cost to the rider. However, the companion travelers often do not take the ride; anecdotally, paratransit professionals note that some passengers reserve these spots to avoid sharing rides (and therefore indirect trips). Because the companions' seats are being reserved, they cannot be used for a secondary paratransit user, adding significant costs to the process. This practice should not continue without accountability; an app interface can track violations and automatically apply penalties.

Nationwide Access

Paratransit users traveling in the United States can struggle to access mobility services during travel to other cities. Because paratransit service operates under a federal mandate, a national database of paratransit users should be maintained. Riders should be able to travel without fear of isolation, and relocate to new cities without interruption of mobility services. In building smarter member databases, a federal data facility to share user names and service needs must also be built. Because many of the newer private mobility providers operate in multiple cities, data sharing between their networks and a federal database will be especially useful in offering these services. Although paratransit services and eligibility standards vary by region (paratransit in suburban areas serves differently than in cities), brief trips away from home cities should not mean interruptions in service.

26. Brown, Timothy. "Matchmaking in Lyft Line—Part 3," April 20, 2016. <https://eng.lyft.com/matchmaking-in-lyft-line-part-3-d8f9497c0e51#.uibdmz7vx>

DISPATCH AND ROUTING

Many paratransit agencies conduct at least some part of the dispatch and routing processes manually, including: vehicle type, pickup times, ride shares and routes. As a result, they can offer rides that must be arranged at least the day before and often wrongly-matched vehicles, such as wheelchair-accessible vans for ambulatory

passengers, extending the wait for passengers in wheelchairs. Because several technologies exist to streamline back-end planning and operations, this area of paratransit is the ripest for technological problem-solving. The areas of focus for dispatch and routing are:

For-Hire Vehicles and Taxi API Integration

As for-hire vehicle/app-based companies and taxi management agencies become more focused on open, robust data, they can produce Application Programming Interfaces, (APIs). APIs allow software to pull data from original sources to populate a single point of information. APIs power the appearance of Uber on Google Maps, for example. For paratransit, reservation software should integrate multiple APIs, resulting in a real-time, comprehensive list of services, including taxi and for-hire vehicle dispatches, social service agencies and community transport. When paratransit managers see the aggregated API data, they can choose the best option for ride requests based on availability, timing and cost. APIs can additionally power seamless booking and billing, reducing costs on nearly every trip.

Transit Connectivity

Many paratransit trips are actually “feeder service,” connecting riders to the nearest transit stop. These trips serve as first- or last-mile solutions, rather than door-to-door services. However, this is not always a workable solution: in the fall of 2015, 99 complaints were made to the MTA about bus drivers refusing to deploy the wheelchair lift or bypassing a wheelchair (44% of all bus-related complaints in that period). In addition, 56 complaints showed that subway stations and bus stops were inaccessible due to construction

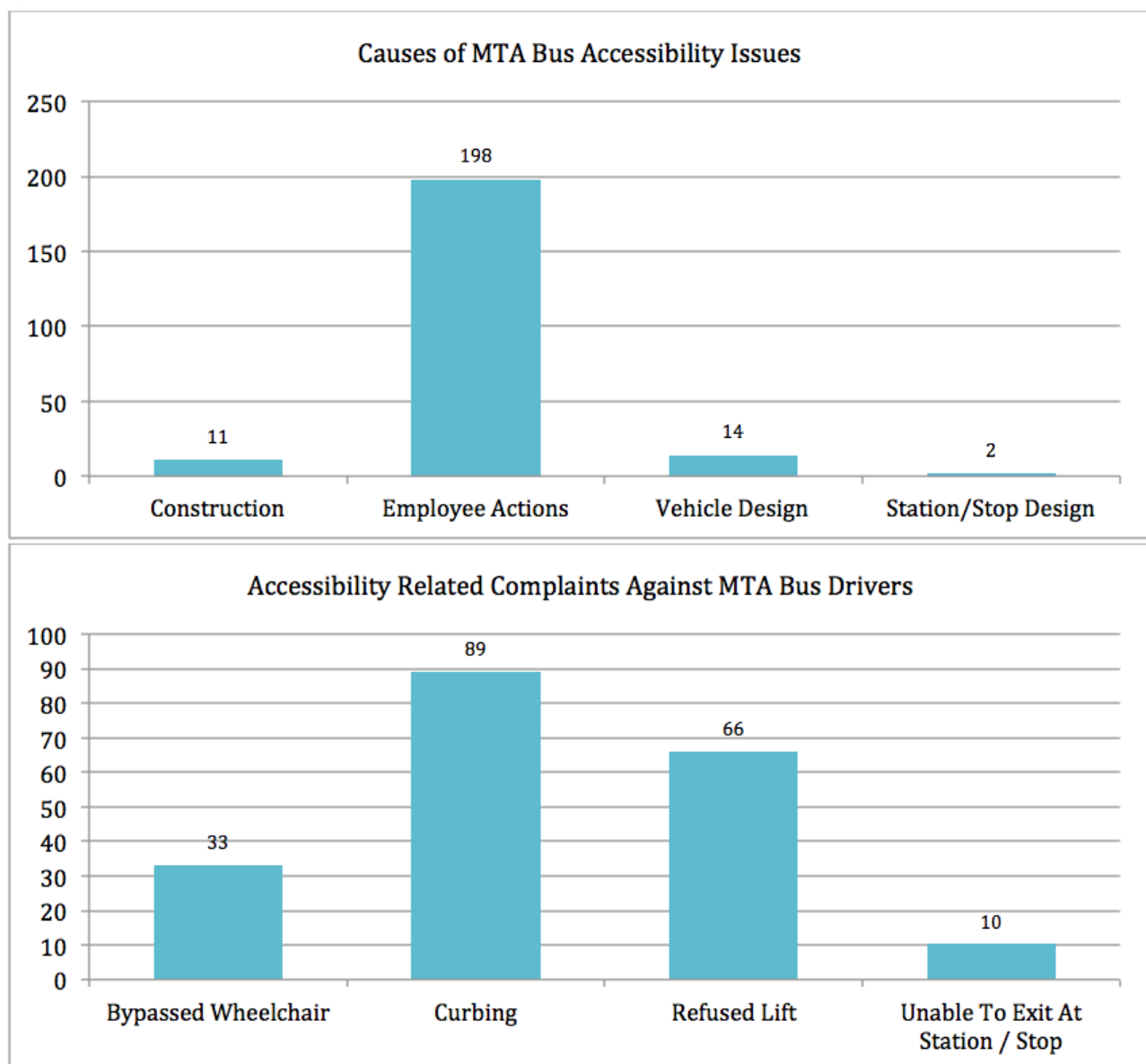
and station/stop design.²⁷ In New York City, these riders are connected to bus stops, not subways. The vast majority of subway stations in New York (88 percent) are not ADA-accessible, primarily due to the system’s age and the city’s space constraints.²⁸ Even those stations with elevators and ramps cannot be relied upon for paratransit connectivity, due to their inconsistent outages, and the lack of certainty that the subway will provide end-to-end service in accessible stations. Some experts propose a complete retrofit of the subway system to install and improve elevator services at every station; an entirely accessible subway would drastically reduce the demand on Access-A-Ride at the price of nearly \$2 billion (roughly four years of Access-A-Ride services).²⁹

Absent a major overhaul, technology can vastly improve the paratransit feeder service experience by incorporating real-time transit information into routing. A small in-vehicle screen should display nearby transit status information, including elevator outages at subway stations and bus arrival times. Driver-crowdsourced information can display and report bus stops that are unusable for disabled passengers, due to lack of snow shoveling, construction or other obstructions. Paratransit drivers should be empowered to act on the transit updates, re-routing accordingly or allowing riders to wait in vehicles for bus connections on frigid or extremely hot days.

27. MTA Commendations and Concerns data, Data from October 2015 - December 2015

28. Tangel, Andrew. “MTA Under Pressure to Add Elevators to More Subway Stations,” *The Wall Street Journal*, January 29, 2016.

29. Tangel, Andrew. “MTA Under Pressure to Add Elevators to More Subway Stations,” *The Wall Street Journal*, January 29, 2016.



MTA Complaint data, MTA.info. Curbing refers to when the bus operator fails to bring the bus close to the curb, which makes it more difficult to board.

Right-Sized Vehicles

The majority of paratransit users are ambulatory, which offers flexibility in vehicle selection. Using robust scheduling and routing software, right-sized vehicles should be selected on a trip-by-trip basis as they are arranged. Clustered ambulatory trips can be served with large vans making multiple stops; non-clustered ambulatory trips should be served with small vehicles – taxis or for-hire vehicles – offering door-to-door or feeder service. Because wheelchair-accessible vehicles are expensive to purchase, fit and maintain, they should be reserved for the trips that require them (in New York, 46 percent of trips are taken by the 14 percent of subscribers who use wheelchairs)³⁰. Ambulatory paratransit users can

be served by Transportation Network Companies, like Uber, Lyft, Juno and Via, which can provide rides from their local bases. Adjusting the dispatch system to include vehicle matching will reduce costs to agencies by assigning more fuel-efficient and lower-maintenance vehicles to appropriate trips.

For paratransit users in wheelchairs, paratransit systems should tap into hailing systems for accessible taxis and for-hire vehicles in addition to contracted paratransit companies. Matching right-size vehicles to the passengers is advantageous in cost savings and rider experience. Paratransit agencies must avoid selecting small buses and other non-flexible

30. MTA Paratransit Operations briefing, April 2016.

vehicles for service. These buses are prevented from using some roadways designated for passenger cars, extending the trip. When matching vehicles

to customers and routes, vehicle permissions must be considered.

Route Optimization

Paratransit trips are often manually routed, or use software based on static mapping data, and do not take into account road blockages, like traffic, construction or incidents. Routing should be conducted using GPS maps and incorporate historic traffic data and real-time information feeds, such as those from Waze, to allow drivers to re-route as needed. Routing must also be specific to vehicle type, as some larger paratransit vehicles are classified as buses, and not permitted on parkways.

Routing should consider obstructions en route to pickups, which result in “missed connections” between drivers and passengers. To navigate around road blockages, routing should be monitored for vehicles on call. When missed connections are unavoidable, app-based ride services should be summoned for immediate service; they often have more distributed bases and can reach riders more quickly.

USER EXPERIENCE

Progress on user experience in the private sector places pressure on the public sector to meet those rising expectations. However, modern technologies vastly simplify the improvement of user experience; the areas of focus in paratransit should be:

Real-Time Information

The greatest change in public transit in the last 20 years has been the provision of real-time information, which empowers travelers to optimize their mode and route decisions. However, these tools are typically unavailable for paratransit, leaving the users essentially in a previous century. Paratransit agencies must use their AVL systems to update riders in real-time with:

- Status of reservation requests
- Expected pickup time
- Delayed pickups
- Estimated arrival time
- Account status, such as penalties for no-shows
- Billing status
- Feedback mechanisms

This information is offered by nearly every mobility and technology service in 2016 and should be provided by paratransit as well.

On the back end, paratransit agencies must aggregate and analyze this data to measure:

- Actual (not estimated) demand
- On-time performance
- Over/underutilized vehicle assets
- Route effectiveness
- User experience feedback

The data should be anonymized, encrypted and released to the public in a machine-readable format for analysis and development. The information will help individuals weigh their travel options (paratransit vs taxi vs transit, based on historic and expected ride timing and cost). Just like taxi data in many U.S. cities, the public will analyze it to ensure accountability by paratransit organizations and recommend policy improvements.

Language Support

Twenty-one percent of the United States population speaks a language other than English at home.³¹ In many major U.S. cities, that percentage is significantly higher, including New York (38%), Chicago (29%) and Los Angeles (54%). These populations speak a hugely diverse set of languages: 192 languages are spoken in New York, 153 in Chicago and 185 in Los Angeles.³² With such high linguistic diversity, providing effective city services can be highly challenging. However, technology can help alleviate this need. First, by developing smartphone applications for reservations and account management in multiple languages, users can be serviced in their native tongues. The Google Translate app can help manage translation needs both in the cell center reservations process and using in-vehicle tablets, as is currently done in Nashua, New Hampshire's bus system.³³ For more extensive language needs, live translation services are available by placing an audio or video call to translation broker. If a driver and passenger are unable to communicate, a driver should be able to call an on-call translation provider. To reduce costs, cities can expand existing translation contracts for 311 and public hospitals.

In New York, language services were made available for printed and web materials, and by phone, following a 2014 lawsuit. As a result of non-English-speaker riders' complaints of missing appointments and inability to make telephone reservations, New York's Access-A-Ride must provide translation in more than 100 languages.³⁴ Translation information is not readily available in paratransit rider guides for Boston, Chicago or Los Angeles (which offers guides in English and Spanish). As United States cities grow increasingly diverse, paratransit providers must utilize translation technologies to ensure safe and useful services.

Payment Options

Although paratransit trips are subsidized by transit providers, riders must submit payment

equivalent to the transit fare. Most paratransit systems, including those in New York, San Francisco, Los Angeles and Chicago, require cash payments or paper trip vouchers upon vehicle boarding. In Los Angeles, users purchase paper voucher books online. In Boston, paratransit riders must pre-pay for rides on the digitized system. Users can add account funds by mailing checks, using credit cards online or by phone or by visiting a storefront payment center.³⁵

Cash and paper vouchers must be eliminated to protect drivers from loss or theft, to eliminate payment-related trip delays and to automate a time- and energy-intensive process of post-shift tallying.

Boston features the most advanced paratransit fare system, but is still lacking in true digitization. Paratransit fare payments should have at least one of these features:

- Integration into transit systems' existing fare payment systems, so users can swipe or tap their transit cards to pay
- Open-loop, accepting all major credit and debit cards (this can be carried out easily and without significant cost, using common tools like Square)
- Charged seamlessly in the background through a reservations app
- Bluetooth capabilities to accept payment through taps of cards or smart devices
- Coordination with health insurance, flex accounts and social services organizations, which may be assisting with fare payment

By upgrading the fare payment technologies, trips will become more efficient, safer for drivers and more accountable.

31. MTA Paratransit Operations briefing, April 2016.

32. United States Census Bureau. "Census Bureau Reports at Least 350 Languages Spoken in U.S. Homes," November 2013.

33. Siefer, Ted. "Nashua Buses Find New Way to Avoid Getting Lost -- in Translation," New Hampshire Public Radio, July 4, 2016.

34. "Transit Authority to Offer Translations Under Deal," The New York Law Journal, April 2016.

35. Agency paratransit websites

Customer Feedback

In nearly every service offering in 2016, customers are able to submit immediate feedback. After taking app-hailed rides, users can provide feedback instantaneously. However, most paratransit services lack feedback mechanisms to report especially strong or poor experiences, like extraordinarily helpful or erratic drivers. Although service providers tend to conduct annual surveys, real-time feedback is easier to evoke, more meaningful in content and richer when paired with GPS trip data. Just as app-based ride companies offer ratings following rides, users should be able to rate their trips and leave comments. Ratings could be conducted within an app, through an email or via text message.

Providing a better outlet for feedback and making user experiences known to paratransit companies is essential. Ratings can show the most and least helpful drivers, and those who drive smoothly or erratically. Analyzing ratings-based data will help paratransit providers identify unsafe drivers, reward exceptional drivers, identify and rank provider companies for future contracts,

pinpoint circumstances linked to bad ratings (like rush-hour traffic), and match customers with particular drivers' skill sets for future trips, where possible.

Ratings can be challenging to implement because an unfriendly driver is not necessarily an unsafe one, posing the question of what repercussions may be faced by a safe but less desirable driver. They would not be unfit to drive, but may be required to undergo sensitivity training.

It is essential for paratransit riders to have a feedback mechanism, and for the resulting data to be actionable by agencies. The data will help to optimize drivers for particular passengers, help in future route considerations and empower passengers. The data should be anonymized and aggregated for public release to improve the agencies' accountability. Paratransit agencies should consider partnering with academic institutions and other outside partners for assistance with robust data analysis.

TAPPING INTO PRIVATE SECTOR TECHNOLOGY AND PUBLIC RESOURCES

Paratransit technology is in need of an upgrade, and it is clear that significant opportunities are available from the private sector. Specific needs can be fulfilled by major players in high-tech ridesharing and for-hire vehicles:

- **Ride- and vehicle-matching:** Uber, which provides ridesharing through its UberPOOL system in 40 cities internationally, has completed more than 100 million ridesharing trips and offers wheelchair-accessible vehicle hailing in some locations.^{36,37}
- **Ridesharing and transit connectivity:** Lyft offers ridesharing through Lyft Line (in its largest cities, nearly half of Lyft rides are pooled with strangers) and has begun partnering with transit agencies to provide ridesharing solutions for the last-mile.³⁸
- **On-demand hailing software:** Via is an on-demand shared ride company in New York, Chicago and Washington D.C. with a robust ride-matching system.^{39,40} Via also offers agencies the ability to deploy its software directly into their existing rolling stock, institutionalizing mobility-on-demand capabilities.
- **Driver training:** SilverRide provides on-demand car services to seniors in San Francisco. Drivers provide physical assistance to riders and are informed about riders' specific needs before pickup. Paratransit agencies should tap into SilverRide's training curriculum and driver information services.

Because these transportation companies are eager to pursue the new business of paratransit, their technologies and fleets should be integrated into new policies concerning paratransit improvements.

In a mutually beneficial program for cities and paratransit providers, public taxis can fill many needs of paratransit providers. In New York City, taxis and Uber rides are offered as supplementary services when Access-A-Ride users are stranded. In a 2010-2015 pilot, 400 AAR registrants used yellow taxis to fulfill AAR trips, paying with a dedicated debit card; the pilot saved \$30-\$40 per trip.⁴¹ In addition, several taxi-hailing apps have been developed in recent years, and should be considered for incorporation into data aggregation software for hailing these rides. Wheelchair-accessible taxis are becoming more common: more than 1000 will be on New York City roads by end of 2016, and half of yellow taxis will be wheelchair-accessible by 2020. New York City already subsidizes 27 percent of Access-A-Ride service, and NYC taxpayers pay 14 percent additionally via the Urban Tax, real estate transfer taxes on selected commercial real estate.⁴² Utilizing already-available City taxis for paratransit service will present several benefits: less costly trips, a large fleet of accessible vehicles, making use of the large public utility of taxis, and streamlined taxi dispatch. New York is the leader in taxi accessibility in the United States; cities nationwide should follow suit in an accessible taxi-paratransit arrangement.

36. Manjoo, Farhad. "Car-Pooling Helps Uber Go the Extra Mile," The New York Times, March 30, 2016.

37. Uber input on report

38. Manjoo, Farhad.

39. de la Merced, Michael J. "Via Attracts Financing, Despite Silicon Valley's Nervousness About Ride Sharing," The New York Times, May 5, 2016.

40. Via input on report

41. New York City Taxi and Limousine Commission input on report

42. Citizens Budget Commission

TECHNOLOGY COST SAVINGS

Technological advances would reduce cost per trip by streamlining the reservations and routing processes and simplifying payments, translation and electronic hailing. A report put out by the Citizens Budget Commission, “Access-A-Ride:

Ways to Do the Right Thing More Efficiently,” identifies cost savings opportunities in New York City, where the \$72 cost per trip is the highest in the nation and the paratransit command center alone cost \$25.8 million in 2015:

COST SAVINGS FROM TECHNOLOGY SOLUTIONS FOR CBC RECOMMENDATIONS

CBC Recommended Improvement	Technology Recommendation	Estimated savings per year
Increasing the use of broker car services	API aggregation, and right-size vehicle matching	\$29 million to \$76 million ⁴³
Integrating taxi and for-hire vehicles	Dispatch integration, mainstream ride-sharing and vehicle matching	\$28 million to \$37 million ⁴⁴
Increase feeder service to the fixed-route system	Improve transit integration through service data displays	\$9 million to \$20 million ⁴⁵

The chart above shows potential cost savings through major improvements with relatively low investment in technology. Using technology-based improvements, Access-A-Ride could save up to \$133 million a year. Similar modifications in paratransit systems across the country could

potentially save millions of dollars. The CBC report is recommended for further reading about important paratransit cost-savings measures.

Clearly, serious benefits may be achieved through implementing new technologies.

43. Methodology by CBC: This range is dependent upon the number of trips requiring curb-to-curb service (and not door-to-door), which could be shifted to broker services (1.05 million ADA trips in 2015). Fuel savings average \$3.08 per trip.

44. Methodology by CBC: With an average taxicab trip of \$20.79 or rideshare cost of \$5, an estimated savings per trip of \$40.48 (including fuel savings) for approximately 700,000 trips in 2015.

45. Methodology by CBC: Assuming 2.5-5% of trips are feeder service, resulting in a 33% reduction in vehicle service hours.

TECHNOLOGY IMPLEMENTATION CHALLENGES

While technology may present smart solutions to paratransit systems' issues, several challenges may affect their implementation.

ADA STRUCTURE

The Americans with Disabilities Act was designed to duplicate fixed-route transit for people are unable to ride it. Pursuing the recommended technological changes would potentially conflict with the ADA mandate: by providing rides in services like Uber, public agencies would be perceived as far exceeding their requirements, or essentially subsidizing private car service rides. In addition, employing car service companies, which

provide curb-to-curb service, would not fulfill the ADA mandate of door-to-door service. This conflict should be resolved at the federal mandate level through a productive partnership with the Federal Transit Administration.

EXISTING LONG-TERM PARATRANSIT AND LABOR CONTRACTS

Current practices in the contracting of transportation service providers within the paratransit system present a monumental challenge to the consideration and implementation of tech solutions. Many paratransit service brokers are operating in 8 to 10 year contracts, limiting the timeframe for major changes. In addition, labor contracts would be affected by the shifting of rides to transportation network companies. Transit agencies may be unable to modify these contracts or existing practices. However, they may be able to implement performance incentives for current providers to ensure optimal efficiencies.

As new contracts are developed, paratransit agencies should be agile enough to make room for introduction of new technologies and processes. They must account for training of outside vendor labor providers. Finally, contract awards must incorporate data from user feedback about vendors, to ensure customer experience inclusion in awards.

INDUCED DEMAND

Improving the paratransit trip experience may lead to more users of the system and more trips taken by individual users. The increased demand would, in turn, create more expense despite efforts toward savings. Paratransit agencies may be required to implement regulations like ride quotas or rides only for specific trip purposes, where legally permissible.

In addition, fixed-route services should be made more accessible to help shift trips to other modes, where possible. These recommendations are fully explored in the Citizens Budget Commission report, "Access-A-Ride: Ways to Do the Right Thing More Efficiently."

INSTITUTIONAL CHANGES

Government agencies are typically late technology adopters. They may be averse to new tools that may be fleeting or unable to experiment in a public spotlight. Many agencies struggle with new technology procurement due to extensive requirements that subject them to arduous rules, taking years to procure new technologies. It is

essential to train paratransit agencies to critically evaluate new technologies, and to adjust technology procurement for more agile contracting processes. Several paratransit agencies are experimenting with new dispatch and payment systems (see the Case Studies in this report), demonstrating leadership in institutional change in this area.

DIGITAL DIVIDE

The digital divide persists among paratransit users, according to anecdotal reports by providers. Many riders have flip phones, but not smartphones, or no mobile phones at all. To manage the absence of mobile phone capabilities, including text messages and applications, paratransit providers must employ multiple channels for reservations, including voice calls, tapping into physical infrastructure like LinkNYC and maintaining connectivity to transit data in the vehicle.

The digital divide issue is likely to subside in the coming decade. The penetration of smartphones

in cities is relatively high, and growing. According to a survey by the New York City Department of Consumer Affairs, 60 percent of New Yorkers over the age of 60 have smartphones⁴⁶ and 7.5 percent regularly make smartphone-based payments; 74 percent of unbanked New Yorkers have smartphones. In addition, older Americans are increasingly technologically-adept: 27 percent of ridesharing service Via's users are over 55, and ten percent are over 65.⁴⁷

PERSONAL SERVICE

While this report has focused primarily on the more technical aspects of providing paratransit service, it is important to note the significance of the more human aspects of the service. Many of the policy recommendations made in this paper focus on improving the paratransit system by reducing costs in both time and money by integrating new technological improvements, but do not acknowledge the role of many of the more human-oriented pieces of the paratransit system at play in promoting the mobility and wellness of paratransit system users, as mobility impairments can be isolating. Paratransit systems must maintain focus on these areas while exploring new technologies:

- Driver sensitivity training
- Phone support and reservations
- Multiple language support
- Potential for matching riders with requested drivers

Although technology challenges are evident, it remains essential that paratransit agencies explore new methods for streamlining paratransit services. The new technologies recommended will make rides more efficient, less costly and a better experience for users.

46. "New York City Mobile Services Study," New York City Department of Consumer Affairs, November 2015.

47. Schwartzberg, Lauren. "Early-Adopter Seniors Have Totally Taken Over the Ride-Sharing App Via," New York, December 16, 2015.

POLICY CHALLENGES

Paratransit is a highly regulated, costly resource across the United States. Several universal challenges exist in most cities, including local and

federal policies and requirements and growing costs.

Federal Policy Challenges

The greatest challenge resulting from the federal ADA mandate is a lack of sustainability of the current model: door-to-door service is overwhelmingly costly and in high demand for most paratransit agencies. Without dedicated funding for this policy, local systems are forced to carry the burden of a one-size-fits-all mandate that leaves little room for customization to suit their local needs.

Though the purpose of the ADA mandate – providing accessible transit service to the disabled – is unquestionably important and vital to the mobility of the disabled population, it is also important to recognize the cost burden that this places on transit systems whose fixed-route services lack basic accessibility measures. In cities like New York, retrofitting subway stations with accessible infrastructure would be a viable long-term solution, but the costs remain prohibitive in terms of funding, time and the already-outdated subway infrastructure.

Many cost-saving measures that a transit agency could make to limit service are explicitly forbidden by ADA guidelines. Agencies could develop cost-efficient policies around limiting the number of trips by a particular rider or prioritizing trips by purpose, like medical appointments. It is time to revisit these policies.

A further challenge is that the ADA mandate requires service to be “comparable” to fixed-route services. As such, there is little to no motivation for a transit agency to provide exceptionally beneficial paratransit services or to go above and beyond for

clients. For clients who can afford to use taxis or app-based ride services, the competition is more alluring. In addition, every new paratransit rider contributes to rising costs, due to heavy subsidies. As a result, many paratransit systems find it beneficial to expend resources on travel training programs with multiple service providers that aim to shift users away from using paratransit services.

Finally, fraudulent use of the system is pervasive, according to industry leaders, and difficult to prevent. As some users exaggerate medical needs or use non-existent companions to avoid sharing rides, agencies are less financially able to improve paratransit services.

In conclusion, the ADA federal policy mandates the provision of a service that, despite its critical importance socially, is growing to be cost-prohibitive to the agencies that provide it. One clear solution is providing accessible fixed-route services and further encouraging their use. But, for older systems with significant challenges and costs associated with making capital improvements, providing accessible fixed-route services is not feasible. The policies of this unfunded mandate must be revisited to consider growing costs, new innovations in efficiency and improved local focus of regulations.

In addition to federal policies, many paratransit agencies must navigate additional city and state level-regulations. To explore these issues, New York and New Jersey regulations are considered in this section.

LOCAL NEW YORK AND NEW JERSEY REGULATIONS

State and municipal regulatory environments can provide additional layers of complication to federal ADA requirements. Those in the New York City metropolitan area provide an interesting example. Access-A-Ride, New York City's ADA-compliant paratransit service, must also comply with regulations put in place by New York City and State. For example, the Rules of the City of New York, Title 34, Chapter 5, Sections 1-7, provides additional regulation for Access-A-Ride beyond ADA requirements. These include sections on Subscription and Advance-Reservation Trips, Cancellations, Participant Obligations For Pick-Up, an outline of positions and responsibilities for an Eligibility Review Board and guidelines for Participant Behavior. Additionally, the Rules of the City of New York, Title 35, Chapter 56, Sections 1-27 provides the Taxi and Limousine Commission's rules codifying "procedures for the licensing and supervision of Paratransit Drivers who operate for hire in the City of New York,

operating rules to protect the customers and the public, and appropriate penalties for the violation of these Rules."⁴⁸ Taxi and Limousine Commission rules refer back to state rules, such as the New York State Department of Motor Vehicles' Vehicle and Traffic Law Article 19-A giving stipulations for bus driver qualifications.

Many of these regulations present important requirements for the safety and quality of paratransit services, but they also present challenges. The bureaucratic and fragmentary nature of additional regulations on paratransit systems complicate the environment in which these services operate, and variability between regulations at the local level makes it more difficult to develop nationwide solutions. The complicated nature of paratransit mandates and funding must be revised to adapt to a twenty-first century urban environment: new technologies and policies must be considered in the federal mandate.

GLOBAL BEST PRACTICES IN MOBILITY FOR MULTI-STOP ROUTING

The modern transit landscape focuses on dynamic, multi-stop routing, a model that specifically lends itself to paratransit systems. Developments of note in this area include:

Mobility As a Service

Globally, the urban public is shifting toward mobility as a service, where trips are conducted from a selection of modes, rather than the use of an owned car or bicycle.⁴⁹ Many new ride-sharing, car-sharing, bike-sharing, e-hailing and on-demand innovations offer mobility as a service, helping to shift how individuals view their transportation

and commute decisions. For example, when users enter destinations into the Whim app in Finland, all available transportation options – buses, trains, cars and other services – are listed. Regardless of mode, users pay for trips through Whim's monthly subscription packages.⁵⁰ Similar apps in Sweden⁵¹ and elsewhere are altering public expectations

48. Section 56-01: Scope of this Chapter. | NYC Rules. (2016). Rules.cityofnewyork.us. Retrieved 9 May 2016, from <http://rules.cityofnewyork.us/content/section-56-01-scope-chapter>

49. R. Giesecke, T. Surakka and M. Hakonen, "Conceptualizing Mobility as a Service," 2016 Eleventh International Conference on Ecological Vehicles and Renewable Energies (EVER), Monte Carlo, 2016, pp. 1-11.

50. Kwang, Tan Wee. "Mobility-as-a-Service: The digital transformation of transportation," eGov Innovation, September 10, 2016.

51. J. Sochor, H. Strömberg and I. M. Karlsson. "Implementing Mobility as a Service: Challenges in Integrating User, Commercial, and Societal Perspectives" Transportation Research Record: Journal of the Transportation Research Board, pp. 1-9, 2015.

for what a trip or mode should offer them in ownership, convenience and amenities.

As a transportation service, paratransit systems have the potential to work with and benefit from the growth in on-demand ride-sharing services seen around the world in the past several years. Paratransit agencies can use this innovation to offer their users a selection of trips, and mutually select a cost-effective and convenient solution.

Filling the Gap

Where transportation is needed for the ambulatory disabled, many social service agencies and private companies take the lead.

- Some public agencies fulfill specific mobility needs for disabled users:

- o Departments for the Aging provide buses for senior center field trips, taxi fare payment cards for seniors with mobility issues and transportation for community service organizations.⁵²

- o NYC's Office of Emergency Management helps to warn residents with mobility issues about impending evacuations, assisting in their preparations for emergencies.⁵³

- o Veterans' Affairs offices across the United States offer transportation to individuals visiting VA health care facilities.⁵⁴

- Community-based organizations, including neighborhood-based and religious institutions, provide transportation to their elderly members. Hyde Shuttles in Seattle, for example provides free, donation-based rides to seniors. Like many community groups' or religious institutions' services, availability is limited to small geographic areas and volunteer drivers.⁵⁵

- Several private companies offer services specifically to fill the needs of mobility-impaired users; non-emergency medical transport is estimated to be a \$5 billion industry. Silver Ride, based in San Francisco, provides car service trips to seniors, catering rides to meet specific physical issues.⁵⁶ Veyo, newly launched in San Diego, offers e-hailing services to Medicaid users traveling to doctor's appointments.⁵⁷

Kutsuplus

Helsinki's innovative bus service, Kutsuplus, made headlines in 2013 when it began providing the Finnish public with a service that acted as a hybrid between city bus and taxi.⁵⁸ Kutsuplus, Finnish for "call plus," was an attempt to provide on-demand, dynamically-routed transit service. Kutsuplus service closed on December 31, 2015 due to high costs to taxpayers, but the software persists in the Washington, D.C.-based ride-sharing service, Split, which recently garnered attention for being "crazy enough to take on Uber and Lyft."^{59,60} Despite Kutsuplus' inability to succeed as a service, the pilot program provides a valuable lesson regarding the feasibility of providing an on-demand, door-to-door, shared-ride transit service and how people interact

with and use such a service.⁶¹ Namely, Kutsuplus demonstrated that dynamically-routed transit is technically feasible and that users are willing to adopt new transit mechanisms. The system failed due to its inability to achieve economies of scale, or to reduce the subsidies necessary to fund the service, both familiar problems to paratransit agencies; the 17 Euro per-trip cost to taxpayers was controversial.⁶² The Kutsuplus experience is nonetheless a valuable lesson for paratransit agencies in the United States; agencies seeking to improve efficiency through technology can apply Kutsuplus' software and strategy to their already large ridership and subsidized programs.

52. "Mobility Management Resource Guide," NYC Department of Transportation, 2015.

53. "Mobility Management Resource Guide," NYC Department of Transportation, 2015.

54. U.S. Department of Veterans Affairs. http://www.va.gov/HEALTHBENEFITS/vtp/veterans_transportation_service.asp

55. Hyde Shuttles, <http://www.seniorservices.org/transportation/hydeshuttles.aspx>

56. <http://www.silverride.com/>

57. Freeman, Mike. "Veyo brings ride-hailing tech to health care," The San Diego Union-Tribune, July 13, 2016.

58. Barry, K. (2016). "New Helsinki Bus Line Lets You Choose Your Own Route." WIRED. Retrieved 2 May 2016, from <http://www.wired.com/2013/10/on-demand-public-transit/>

59. Finnish Transportation Revolution Goes International: Ajelo Acquired by Split Technologies | ArcticStartup. (2014). ArcticStartup. Retrieved 9 May 2016, from <http://arcticstartup.com/article/finnish-transportation-revolution-goes-international-ajelo-acquired-by-split-technologies/>

60. The D.C. start-up that's crazy enough to take on Uber and Lyft. (2016). Washington Post. Retrieved 12 May 2016, from <https://www.washingtonpost.com/news/innovations/wp/2016/05/10/the-d-c-start-up-thats-crazy-enough-to-take-on-uber-and-lyft/>

61. Why Helsinki's innovative on-demand bus service failed. (2016). Citiscope.org. Retrieved 2 May 2016, from <http://citiscope.org/story/2016/why-helsinki-innovative-demand-bus-service-failed>

62. Citiscope.org.

CASE STUDIES

While analyzing paratransit in the United States, the NYU Rudin Center looked more closely at three cities' paratransit improvements through innovative technologies and policies. The programs in Boston, San Francisco and Seattle, three leaders in transit innovation, demonstrate common challenges and new approaches.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY, BOSTON, MASSACHUSETTS

Exploring the frontier of meshing paratransit with on-demand services

Overview

The Massachusetts Bay Transportation Authority (MBTA) provides public transit for nearly 4.7 million people living in the more than 3,200 square miles surrounding and including the City of Boston.

Daily ridership: 1.3 million passengers daily on heavy and light rail transit, buses, commuter lines, ferries, and in paratransit vehicles.⁶³

Paratransit: The RIDE, which is the MBTA's Americans with Disabilities Act (ADA) required paratransit service, provided 1.8 million trips to 80,000 registered customers in 2015. MBTA exceeds the ADA requirement of providing service within 3/4-mile of fixed route corridors, serving instead a 712-square mile area with a total population of 2.5 million.⁶⁴

Contractors: Greater Lynn Senior Services provides paratransit in the North Area, Veterans Transportation Services provides paratransit in the West Area, and National Express provides paratransit in the South Area. The MBTA provides approximately 80% of the 949-vehicle fleet, but each contractor is responsible for reservations and scheduling, dispatching, service operations, and vehicle inspection, maintenance, and storage.

Budget: The FY 2015 budget for The Ride was \$105,373,056.⁶⁵

Fare: Paratransit customers pay \$3.00 for a one-way trip within the ADA required service area and \$5.00 for a one-way trip that is not within 3/4-mile of a fixed route corridor.⁶⁶

Paratransit Innovations

On-Demand rides: MBTA has selected Uber and Lyft in a groundbreaking pilot to begin in the fall of 2016. For six months, this pilot will test new processes and technologies to improve The RIDE's response time, provide a less expensive service option for customers, improve mobility management, create an on-demand individualized service using non-dedicated vehicles and reduce strain on the existing ADA program. In this pilot service, paratransit passengers will pay \$2 per trip on Uber and Lyft and MBTA will subsidize trips up to \$13. To account for users without smartphones, Lyft will offer phone-based reservations and Uber may supply smartphones to some users. The companies are required to spread vehicles across the service area to ensure rapid response times. As with current contractors, the selected respondents are expected to serve as the primary point of contact for customers, and are also responsible for service provision and data collection.

Cost savings with taxis: In early November 2015, the MBTA began a pilot program to allow eligible paratransit riders to use accessible taxis at a

63. Capital Investment Program: FY 2016. Available at: http://www.mbta.com/uploadedfiles/About_the_T/Financials/FY16CIP.pdf

64. Focus 40 – State of the System Report: The RIDE. Available at: <http://www.mbta.com/uploadedfiles/Documents/Focus40/Focus40TheRIDE.pdf>.

65. MBTA Operating and Capital Budget: Governor's Special Panel to Review the MBTA. Available at: http://www.mbta.com/uploadedfiles/About_the_T/Panel/MBTACapitalandOperatingBudgets.pdf

66. Ridership and Service Statistics: Fourteenth Edition 2014. Available at: <http://www.mbta.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition.pdf>

subsidized rate. Riders are given debit cards that can only be used to pay for taxi rides; for every \$2 a passenger loads onto the card, the T matches with \$13. The agency is currently analyzing the cost impacts of this program.

Improved payment management: In addition, the MBTA established a centralized fare account for each registered customer in 2012. Passengers can add funds to their account online, via the phone, by mail, or in person. All three paratransit contractors allow passengers to request trips, view past trips, cancel trips, and check the status of current trips via an online portal.

Program Impacts

As of FY 2015, the cost of one trip on The RIDE was \$31. Subsidized taxi trips are capped at \$13, which represents a savings of \$18 per trip. However, because the MBTA cannot know whether each taxi trip is a direct substitute for a trip on The RIDE, there is no way to know exactly what the cost savings are from the taxi program. The new on-demand pilot is expected to cost the MBTA \$13 per ride.

SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY (SFMTA), SAN FRANCISCO, CALIFORNIA

Leading in app development and taxi integration

Overview

The San Francisco Municipal Transportation Agency (SFMTA) operates Muni, the largest transit system in the Bay Area.

Daily ridership: 707,478 weekday trips⁶⁷

Paratransit: Paratransit services are overseen by SFMTA's Taxi and Accessible Services Division. The agency provides nearly 800,000 paratransit passenger trips yearly, approximately 500,000 of which take place on 128 SFMTA-owned paratransit vehicles, and approximately 300,000 of which are provided by privately-owned taxi companies.⁶⁸

The SFMTA contracts out paratransit services to a broker, which is responsible for managing subcontracts with paratransit service providers (including taxi providers), monitoring service quality, administering client eligibility, managing the sale of fare instruments and acting as the principal customer service representative. The current paratransit broker is Transdev. Non-taxi paratransit services in San Francisco are subcontracted by the broker to multiple service

providers, including Transdev, Baymed Express, Centro Latino, Self Help for the Elderly, and Kimochi.

San Francisco Paratransit offers five key services:

- **SF Access** is a fully American with Disabilities Act (ADA) compliant service that provides shared-ride, pre-scheduled, door-to-door van transportation. Passengers must request a pick-up one to seven days in advance.
- **SF Taxi** is a typical curb-to-curb, on-demand service, but can be paid for using a San Francisco Paratransit Debit Card issued to eligible users. Taxi services do not necessarily fully comply with ADA standards and are considered supplemental to San Francisco's other paratransit programs.
- **Group Van Services** are pre-scheduled and provide door-to-door transportation to groups of eligible customers who are traveling to specific sites, such as adult day health care, senior centers, or work.

67. San Francisco Municipal Railway (MUNI) 2014 Agency Profile. National Transit Database.

68. San Francisco Paratransit, SFParatransit.com

- Shop-a-Round** is a specialized program that uses vans and taxis to transport eligible paratransit riders to and from grocery stores.

- Van Gogh** shuttles provide transportation to and from social and cultural events for eligible riders.⁶⁹

Budget: The Taxi and Accessible Services Division of the SFMTA has a FY 2017 budget of \$30.5 million. The FY 2017 budget for the SF Paratransit contract is \$25.8 million.

Fare: Paratransit riders pay \$2.25 per trip and in FY 2016 paratransit fare revenues totaled approximately \$1.2 million. The remainder of the annual costs is paid for with a mix of federal, state and local funds.⁷⁰

Ongoing Paratransit Innovations

Integrating taxis: The San Francisco Paratransit taxi program provides an opportunity for eligible disabled or senior riders to take a taxi instead of the traditional paratransit vans or fixed route transit. Although the taxi program is not an ADA service, it often better serves the transportation needs of ADA-certified transit riders. All taxi companies in San Francisco are required to participate in the program in accordance with city ordinance. There are currently 100 ramp-equipped taxis (ramp taxis) throughout the city that can accommodate wheelchairs. Improving payment systems: Eligible riders are issued an SF Paratransit debit card and photo ID that can be used to pay for paratransit taxi services. For every \$5.50 a certified rider loads into their account, SF Paratransit adds \$30 of value to the debit card up to a preset monthly allotment. Implementing the debit card system in 2009 required SF Paratransit to equip all taxis with in-vehicle systems for processing payments.⁷¹

Planned Paratransit Innovations

SFMTA is developing several innovative paratransit programs:

Payment cards: The Paratransit Debit Card Patron Portal, currently in development, will allow SF Paratransit taxi riders to load value on their taxi debit cards, view balances, and review prior taxi trips online.

App-based ride hailing: The agency is partnering with Flywheel, a mobile application that allows passengers to electronically hail taxi rides on demand, to develop a customized version for SF Paratransit taxi riders. The application will allow paratransit riders to electronically hail a taxi using their smartphone or tablet, mimicking many of the features found in the mobile applications for Transportation Network Companies (TNCs), like Uber and Lyft. Paratransit riders will also be able to filter by vehicle type, which will allow wheelchair users to display and electronically hail only wheelchair-accessible taxis.

Community transport: Finally, SFMTA is implementing a Peer Escort Program, in which senior volunteers accompany and provide extra assistance to “attendant required” (ATR) paratransit riders who attend day programs at social service agencies and are transported through the SF Paratransit Group Van service. The agency plans to use grant funds to provide the senior volunteers with a stipend.⁷²

Program impacts

Using taxi services to substitute for some SF Paratransit trips results in a significant savings in per trip costs. Because SFMTA cannot determine whether every paratransit taxi trip is a trip that the customer would have otherwise taken on the

69. “Short Range Transit Plan: Fiscal Year 2015 – Fiscal Year 2030,” SFMTA, June 2015.

70. “SFMTA: FY 2015 and FY 2016 Adopted Operating Budget,” SFMTA.

71. “TCRP Synthesis 119: Use of Taxis in Public Transportation for People with Disabilities and Older Adults,” Transit Cooperative Research Program, Transportation Research Board, January, 2016. p 37-40

72. TCRP Synthesis 119

regular paratransit van service, the exact total cost savings per year are indeterminate. However, according to SFMTA's FY15 NTD report, the cost per passenger trip was \$37.66 with SF Access or a Group Van, while the cost per passenger trip for taxis was \$14.98. In total, the operating cost for the 487,108 passenger trips on SF Access and in Group Vans was \$18.3 million (averaging \$37.56 per trip), while the operating cost for the 306,096 passenger trips using the pilot taxi program was \$4.6 million (averaging \$15 per trip).

SFMTA has reported several advantages to using a debit card payment system for taxis. First, using an electronic system simplifies ride monitoring and payment. As a result, enforcement for riders and drivers is more easily carried out, resulting in decreased misuse and fraud. Additionally, having an electronic payment system allows passengers to give a tip to their drivers and allows for payments to be made to taxi companies more regularly. Finally, the number of trips outside of the designated service area has decreased because the system prevents users from paying with their debit cards if the taxi crosses the service area line.

Beyond the direct benefits to SFMTA, customers report high levels of satisfaction with all of the SF Paratransit services, including paratransit taxi. According to a 2015 customer satisfaction survey, 89 percent of paratransit taxi users said they were satisfied with the service (up from 86 percent in 2013) and 84 percent of Ramp Taxi users were satisfied (up from 81% in 2013). Further, many paratransit customers find that the taxi service better meets their transportation needs because it is available 24 hours a day, seven days a week, and can be reserved and used in the same day.⁷³

KING COUNTY METRO TRANSIT, KING COUNTY, WA

Demonstrating the value of strategic partnerships

Overview

King County Metro Transit provides 532,013 weekday bus and trolley trips for the 2 million residents living in the 2,000 square miles that comprise King County, including the city of Seattle.⁷⁴

Ridership increase: Between 2005 and 2014, transit ridership rose from 99,000,000 to 121,000,000 and paratransit ridership rose from 1,275,000 to 1,500,000.⁷⁵

Paratransit: King County Metro offers several options for ADA eligible riders:

- Access is King County's Americans with Disabilities Act (ADA) compliant curb-to-curb paratransit service. It operates within ¾ mile of the fixed route service area and can be requested between one and three days in advance.⁷⁶
- Community Access Transportation (CAT) serves as a complement to the Access program and is a joint operation between King County Metro and partner organizations.
- Hyde Shuttle is a free group shuttle program that brings senior and disabled citizens to

73. TCRP Synthesis 119

74. King County Metro, 2014 Agency Profile, National Transit Database

75. King County Metro Accountability Center. Available at: <http://metro.kingcounty.gov/am/reports/annual-measures/ridership.html#paratransit-boardings>.

76. King County Metro Access Transportation Overview. Available at: <http://metro.kingcounty.gov/tops/accessible/programs/access.html>.

specific locations, including hot meal programs, medical appointments, senior centers, and grocery stores. No ADA eligibility requirement is necessary to use the Hyde Shuttle, which is staffed by volunteers.⁷⁷

- Taxi Scrip is a program that allows low-income disabled residents between the ages of 18 and 64 or low-income residents over the age of 65 to purchase “taxi scrip” ride certificates at a 50 percent discount and use them to pay for on-demand taxi rides. The Taxi Scrip program is subsidized by non-operations Public Transportation Fund revenues.⁷⁹
- Demand Area Response Transit is one of King County Metro’s fixed route transit offerings, but is fully ADA-accessible and can perform a small number of off-route deviations upon request.⁸¹

Budget: In 2012, the cost of running the Access program was \$58,084,037 and the service revenue was \$2,528,440.⁸¹ King County Metro also receives funding from the FTA, Washington State agencies, King County, and the City of Seattle.

The Community Access Transportation program is cost-effective for King County Metro because the agency enters into partnerships, rather than subcontracts, with non-profit organizations. In exchange for funding and other resources from the transit agency, the partners commit to providing a certain number of ADA-eligible rides, which otherwise would have been taken through the Access program.

Ongoing Paratransit Innovations

King County Metro is commonly known as one of the most innovative transit agencies in the country. Like most transit agencies, it is faced with the high costs of delivering transit alternatives to disabled and elderly riders in an efficient and financially sustainable manner. The agency’s creative

Community Access Transportation Program (CAT) is an alternative to traditional ADA service provision and fills gaps in the agency’s accessibility program.⁸² Under the CAT program, King County Metro strategically partners with social service agencies and community organizations that coordinate the operation of mobility services for their clients. In exchange, King County Metro provides resources such as vehicles, insurance payments, and driver training. Two types of CAT partnerships exist in King County:

- **Advantage** partnerships work with non-profit organizations whose clients are elderly and disabled. King County Metro provides accessible vans, van maintenance, and driver training. The non-profits provide drivers and insurance, and are required to provide at least 150 one-way van trips for ADA eligible riders each month.
- **Vanworks** partnerships work with non-profit organizations that provide transportation for senior or disabled citizens to work or training facilities. King County Metro provides the vanpool vehicles, van maintenance, gasoline, and comprehensive/collision insurance. The non-profits provide one driver, one back-up driver, and one bookkeeper per van, liability insurance, and are required to provide at least 50 one-way van trips for ADA eligible riders each month.⁸³

A wide range of public and non-profit organizations collaborate with King County Metro under the CAT Program. Partner agencies include supportive living facilities, senior centers, adult day care organizations, medical centers, community centers, organizations that serve clients with special needs, and even one small town outside of Seattle. In 2015, the average number of total monthly boardings was nearly 29,000.

77. Sound Generations Website. Available at: <http://seniorservices.org/transportation/HydeShuttles.aspx>.

78. King County Metro Taxi Scrip Overview. Available at: <http://metro.kingcounty.gov/tops/accessible/programs/taxi.scrip.html>.

79. King County Metro Transit 2012 Annual Management Report. <http://metro.kingcounty.gov/am/accountability/performance.html#annual-reports>.

80. King County Metro DART Overview. Available at: <http://metro.kingcounty.gov/tops/bus/dart/>.

81. King County Metro Transit 2012 Annual Management Report. Available at <http://metro.kingcounty.gov/am/accountability/performance.html#annual-reports>

82. APTA 2012 Meeting Presentation: King County Metro’s Community Access Transportation Program. Available at: <http://metro.kingcounty.gov/tops/bus/dart/>.

83. Of the CAT partner organizations, only one is using the Vanworks model since the grant funds used to partially pay for the service are no longer available.

The program includes three additional services:

- **Solid Ground Circulator**, which provides free rides to low-income passengers and others who are accessing health and human services in downtown Seattle;
- **Domestic Violence Emergency Transportation Program**, which provides emergency taxi rides for low-income victims in domestic violence situations; and
- **Getting There Transportation Resource Center**, which is a one stop information center for people with limited transportation options.

Planned Paratransit Innovations

Fleet optimization: King County Metro is investigating potential ideas to utilize transit vans that sit idle for most of the day. Under such a program, the agency may tap into the regular transit fleet in areas that only use transit on a limited basis, and use the vans during non-peak hours to make paratransit trips. In addition, the agency may work with CAT partners to increase the number of hours that the shuttles or vans are in use throughout the day. Regardless of the agency's direction moving forward, King County Metro will be sure to select cost-effective programs, and those that fill gaps to better service Metro passengers.

Web-based services: King County Metro is developing an online booking platform, but has not yet made the service available to riders. In addition, while the agency currently uses taxis for overflow service, they are investigating the development of a pilot program with Transportation Network Companies such as Uber and Lyft.

Program Impacts

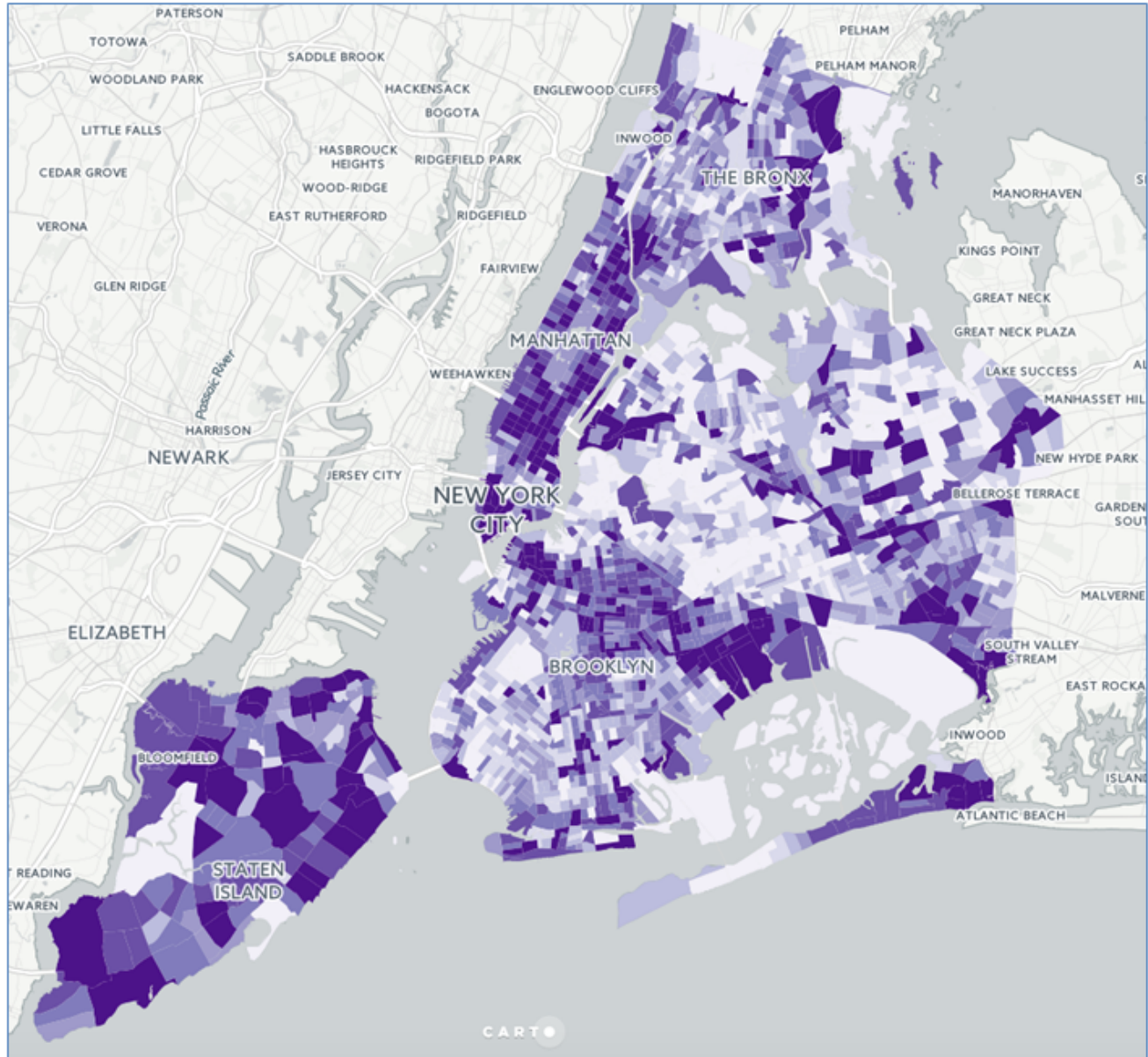
Twenty-six partnerships were in place between Metro and non-profits in 2015, an increase from 20 in 2007. CAT rides as a share of total paratransit rides rose from 11 percent in 2007 to more than 24 percent in 2015. King County estimates that there were 347,919 CAT Program boardings in 2015, half of which were presumed to be ADA-eligible passengers.

Although the cost per CAT ride rose from \$5.00 to \$6.52 between 2007 and 2015, the cost per Access boarding has stayed steady at around \$35.50, more than five times the cost of the average CAT boarding. The increased share of CAT ridership contributed to \$3.9 million in savings for King County Metro in 2015.

In addition to the monetary benefits that the CAT program provides to the agency, it is less expensive and more convenient for the ADA-eligible riders who are able to take advantage of the program. Most CAT services do not charge any fare, and the most expensive service is \$1 per ride. The CAT program also provides more adaptable service to ADA-eligible riders so that their needs are better met. In a 2014 CAT Agency Profile report, customers reported satisfaction with the program, citing the benefit of having the same drivers and co-passengers every day, and the importance of on-time pick-ups and drop-offs.

FURTHER RESEARCH

To develop a greater understanding of MTA services, systematic data analysis should be conducted about paratransit operations. In New York, the NYU Rudin Center has begun to map out every paratransit ride in 2015; a sampling of the map below features paratransit pickup and dropoff numbers by census tract using the MTA's own data (darker shades indicate more paratransit usage).



By analyzing this data, we can identify potential location-based improvements, such as:

- Subway stations to target for accessibility improvements based on clusters of paratransit ridership
- Frequent paratransit origins and destinations located near for-hire vehicle bases, which could improve the handoff of rides to these services

- Key bus stops for accessibility improvements and priority snow clearing
- Route clusters and potential ridesharing possibilities

The NYU Rudin Center aims to further the data analysis to identify new innovations that can improve paratransit and the fixed-route systems.

CONCLUSION

Paratransit is an essential service in cities, but is not currently scalable to meet the increasing needs of riders. Policymakers should consider new policies and technological innovations that will make paratransit more efficient and sustainable.

The federal paratransit mandate and its implementation at the state and local levels must be revised to account for the current state of the market. State and local leaders should put paratransit at the forefront of policy and transit discussions, rather than treat it as a low priority. Furthermore, paratransit for suburban and rural regions, which is an entirely different operation, warrants serious analysis and research.

More importantly, paratransit agencies should begin to implement technological changes for both their back-end and customer-facing work. Incorporating new technologies should begin now, before demand intervenes. As more vehicles are subsumed by autonomous vehicles, paratransit may stand out as the major human-assisted mobility function. Paratransit drivers may not control the vehicle, but they will provide the same sensitivity services they do now, augmented by technologies. To reach a future where technology is assistive rather than uncontrollable, paratransit agencies should start to work closely with the technological tools under development.

Paratransit agencies should implement technological improvements in the areas of onboarding, reservations, dispatch and routing and user experience. The adoption of new systems for riders, dispatchers and drivers will fundamentally improve the ride experience and cost controls. Improving paratransit with new technological systems is necessary, urgent and possible.

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