A NEW MODEL FOR TRANSIT

Transit/TNC Partnerships in Western Riverside County

University of California, Los Angeles, June 2018

A comprehensive project submitted in partial satisfaction of the requirements for the degree of Master of Urban and Regional Planning

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16. Abstract

The emergence of Transportation Network Companies (TNCs), e.g. Uber and Lyft, over the last decade has introduced a new form of on-demand mobility that has the potential to be a strong partner with transit agencies, providing lower-cost alternatives where traditional fixed-route transit is not sustainable. As an example, TNCs and transit agencies could partner to create designated zones where the agency agrees to subsidize a portion of all trips taken on TNCs within the zone, rather than providing traditional fixed-route service in that area. By partnering with TNCs, public transit agencies can switch from supply-driven to demand-driven mobility, only paying for drivers when there is demand for a trip. This has the potential to reduce transit agency operating costs, allowing agencies to reinvest resources into higher-performing areas of the network. This model may also allow agencies to merge fixed-route and complementary ADA/paratransit services under one on-demand service model.

This research analyzes the cost-savings potential for transit/TNC partnerships in five zones across the Riverside Transit Agency (RTA) service area in Western Riverside County: East Perris, Moreno Valley, Temescal Valley, Calimesa, and Temecula. Each of these zones has either low-performing fixed-route transit service or no fixed-route service at all. However, implementing a transit/TNC partnership is not as simple as switching out operators. RTA must consider factors such as geography, trip length, potential ridership, equitable fares and fare collection, vehicle/driver availability, and federal regulations (Americans with Disabilities Act and Title VI).

This research establishes a methodology for evaluating the cost-effectiveness of replacing traditional fixed-route transit services with partnerships with Transportation Network Companies (TNCs), e.g. Uber and Lyft. It evaluates five zones in Riverside Transit Agency's (RTA) service area that have either very low-performing fixed-route service or no fixed-route service at all. For each zone, the research estimates the average TNC fare for trips taken within a specified zone and compares this estimate to the current subsidy paid by RTA to provide fixed-route and Dial-a-Ride service in the same area. It leverages key lessons learned from five pilot partnerships around the country and provides recommendations for how to structure these partnerships to comply with existing federal regulations and generate ridership.

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Disclaimer

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Executive Summary

The emergence of Transportation Network Companies (TNCs), e.g. Uber and Lyft, over the last decade has introduced a new form of on-demand mobility that has the potential to be a strong partner with transit agencies, providing lower-cost alternatives where traditional fixed-route transit is not sustainable. As an example, TNCs and transit agencies could partner to create designated zones where the agency agrees to subsidize a portion of all trips taken on TNCs within the zone, rather than providing traditional fixed-route service in that area. By partnering with TNCs, public transit agencies can switch from supply-driven to demand-driven mobility, only paying for drivers when there is demand for a trip. This has the potential to reduce transit agency operating costs, allowing agencies to reinvest resources into higher-performing areas of the network. This model may also allow agencies to merge fixed-route and complementary ADA/paratransit services under one on-demand service model.

This research analyzes the cost-savings potential for transit/TNC partnerships in five zones across the Riverside Transit Agency (RTA) service area in Western Riverside County: East Perris, Moreno Valley, Temescal Valley, Calimesa, and Temecula. Each of these zones has either low-performing fixed-route transit service or no fixed-route service at all. However, implementing a transit/TNC partnership is not as simple as switching out operators. RTA must consider factors such as geography, trip length, potential ridership, equitable fares and fare collection, vehicle/driver availability, and federal regulations (Americans with Disabilities Act and Title VI).

These partnerships are new, and the industry has not yet established best practices for implementation. The main goal of this research is to develop a methodology for determining where transit agency/TNC partnerships can be cost-effective. The methodology in this report estimates ridership and average fares on TNCs and compares the current cost of providing fixed-route and complementary ADA/paratransit service to the potential cost of a TNC partnership. While this methodology is applied specifically to RTA, it can serve as a template for other transit agencies exploring similar partnerships. The methodology also incorporates key takeaways from interviews with agencies across the country who have already implemented pilot partnerships including: Pinellas-Suncoast Transportation Authority, City of Centennial, CO, Livermore Amador Valley Transit Authority, AC Transit, and Orange County Transportation Authority.

As shown in the table below, TNC partnerships in all five zones are estimated to generate considerable cost savings for RTA. This report recommends pursuing TNC partnerships in all five zones, prioritizing Moreno Valley, and also discusses a series of additional factors RTA should consider related to the costs, fare structure, and policies associated with these partnerships.

TNC Zone	Annual Ridership	TNC/Taxi Subsidy	Current Operating Subsidy	Net Savings	Percent Savings
East Perris	42,950	$211,312	$392,356	$181,043	46%
Moreno Valley	27,938	$169,026	$573,067	$404,041	71%
Temescal Valley	9,242	$52,680	$103,801	$51,121	49%
Calimesa	11,311	$130,344	$243,820	$113,476	47%
Temecula	88,485	$559,183	$1,052,511	$493,328	47%
Total	**179,937**	**$1,122,545**	**$2,365,554**	**$1,243,009**	**53%**

Introduction

Since 2014, transit agencies across the country have experienced a significant decline in ridership. Despite significant investments in transit restructuring projects, light rail, and service expansion, ridership continues to fall. Fewer riders means agencies have less fare revenue to fund service, and many have resorted to cutting service in order to remain financially sustainable. Agencies all over the country are seeking new and innovative ways to provide service more cost-effectively. At the same time, the emergence and popularity of shared mobility platforms such as carsharing, ridesourcing, bikesharing, etc., have transformed the definition of public mobility. In particular, the rise of Transportation Network Companies (TNCs) has introduced a new form of on-demand mobility that has implications for travel behavior, vehicle miles traveled, vehicle ownership, parking requirements, and -- most importantly for this research -- transit ridership and sustainability. TNCs (e.g. Uber and Lyft) are on-demand phone or computer applications that pair riders with drivers and offer door-to-door trips that are more private than public transit. They have the potential to draw passengers away from public transit by providing a more attractive alternative at an acceptable price. However, they also have potential to be strong partners with transit agencies, assisting transit systems in filling network gaps and providing lower-cost alternatives where traditional fixed-route transit is not sustainable.

By partnering with TNCs, public transit agencies can switch from supply-driven to demand-driven mobility, only paying for drivers when there is demand for a trip. By using ridesourcing technology, agencies can more effectively schedule trips and optimize use of existing drivers and vehicles in select areas. Both of these approaches have the potential to reduce transit agency operating costs, allowing agencies to reinvest resources into higher-performing areas of the network. These partnerships can be structured in a number of ways, but they commonly work by having the transit agency subsidize trips that riders take on TNCs rather than providing the trip themselves. Riders pay a subsidized fare, comparable to what they would have paid on fixed-route transit, while a transit agency pays a TNC the remaining fare, and the TNC receives payment for the full cost of the trip. Transit agencies and TNCs agree upon criteria for trips eligible to receive the subsidized fare, and the TNCs integrate these criteria into their online platforms.

Transit agencies have often struggled to find cost-effective ways to provide public mobility in low-density areas that do not generate ridership volumes capable of supporting traditional fixed-route service with a minimum cost recovery. Fixed-route service is most successful where high concentrations of origins and destinations clustered along a single walkable corridor generate a relatively high volume of rides. In low-density areas, origin/destination patterns are more dispersed, and auto-centric development limits walkability out to major corridors. Agencies may have transit service on major corridors, but these corridors may be a considerable walk from individual homes or businesses. Low ridership on many routes in suburban and rural areas leads agencies to operate these routes at lower frequencies, but such low-quality service further discourages ridership.

TNCs may provide an opportunity to address this age-old problem. With on-demand ridesourcing technology, TNCs can match riders to drivers who will take them exactly where they want to go at much closer to the exact time they want to travel, with a potentially shorter travel time.

Capacity expands and contracts based on demand, unlike fixed-route where the same resources are required to transport one passenger or forty passengers. These partnerships are most likely to be successful in areas where fixed-route is under-performing and the transit agency's subsidy per passenger with existing fixed route service is so high that it is more cost-effective for them to pay a subsidy for riders' individual Uber or Lyft trips than to operate a fixed-route service. Such partnerships have benefits and impacts to both riders and transit agencies:

Rider Benefits

- Service is "on-demand" with shorter wait times, a significant improvement over low-frequency service often experienced in lower-density areas.
- Service is "point-to-point," so riders do not have to worry about how they will get from their bus stop to their final destination, and their travel time will likely be shorter.

Transit Agency Benefits

- Considerable potential cost savings over fixed-route transit. Agencies only have to pay for service when there is demand, and operators are no longer paid to drive around empty buses.
- Cost savings can be reinvested as service improvements elsewhere in the network.
- Agencies can reduce their fleet and vehicle maintenance costs.

Rider Impacts

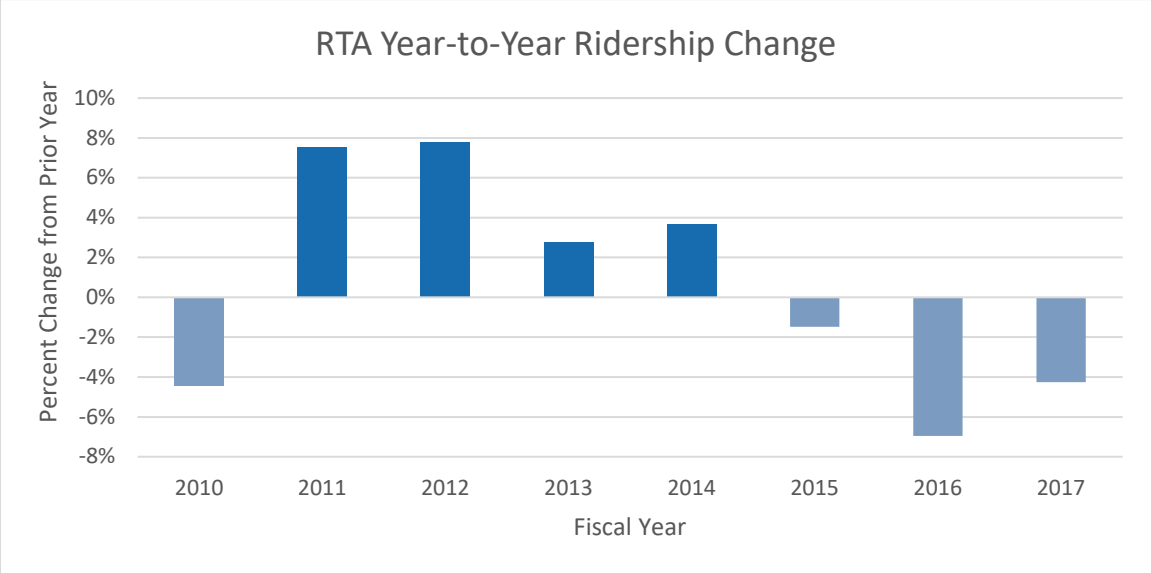
- Higher fares. While transit fares are typically flat, TNC/Taxi fares accrue based on time and distance, penalizing longer distance travel. Though transit agencies will subsidize a bulk of the fares, they are likely to be higher overall.
- Potential loss of one-seat rides from origin to final destination if parts of fixed-routes are discontinued and riders use the TNC to connect into the remaining fixed-route network.
- TNC users must overcome a technology barrier that requires having familiarity with the app or calling a call center to reserve a trip. Trip-making is no longer as simple as walking out and catching the next bus. However, this problem is likely to decline as the population becomes more familiar with smart technology.

Transit Agency Impacts

- TNCs could compete with fixed-route services for riders where quality and pricing are competitive.
- Since TNCs do not share rider information, transit agencies lose the ability to understand the trip patterns and characteristics of their riders.
- Dispersing fixed-route trips in one vehicle to multiple on-demand vehicles loses any economies of scale. The TNC model is less likely to produce savings as fixed-route usage increases, requiring a larger pool of "on-demand" vehicles to replace a single transit bus trip.

This research explores the potential for transit/TNC partnerships in Western Riverside County as a way to reduce operating costs in the face of declining ridership. Riverside Transit Agency (RTA) provides fixed-route and Dial-a-Ride service in Western Riverside County to over two million residents in a 2,752 square-mile service area.[1] Like the rest of California and the Southern California Association of Governments (SCAG) region, RTA has lost significant portions of its ridership since 2014 (Figure 1).[2]

Figure 1: RTA Ridership Percent Change 2010-2017



Source: Riverside Transit Agency. (2018). *Neighboring Agency Ridership Comparison* [Microsoft Excel]. Unpublished raw data.

This ridership loss came during a time of significant service expansion. Between 2013 and 2017, RTA expanded annual vehicle revenue hours on local bus service by 31 percent.[3] In August 2017, RTA launched the RapidLink Gold Line, an express route between Corona and UC Riverside along Magnolia and University Avenues, RTA's busiest bus corridor.[4] However, Figure 2 clearly demonstrates the financial impact resulting from combined service expansion and ridership loss. Fare revenue decreases as costs increase, creating a widening gap that RTA must fill with other revenue sources.

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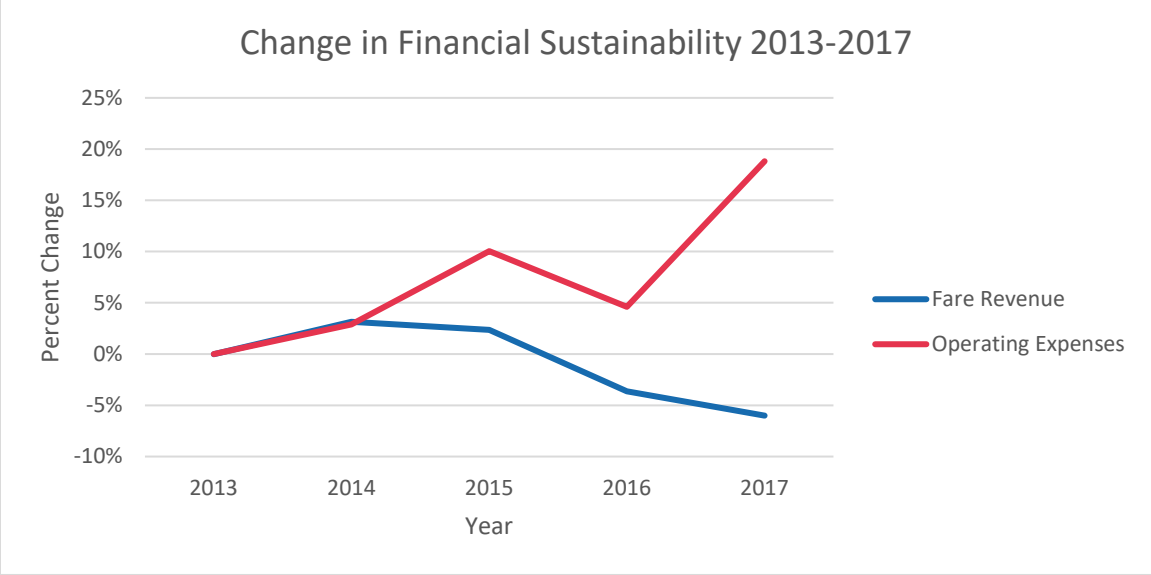
[1] National Transit Database. (2016). *Riverside Transit Agency: 2016 Annual Agency Profile.* Retrieved from: https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2016/90031.pdf.

[2] Riverside Transit Agency. (2018). *Neighboring Agency Ridership Comparison* [Microsoft Excel]. Unpublished raw data received through personal communications.

[3] National Transit Database. (2013-2016). *Riverside Transit Agency: Annual Agency Profile.* Retrieved from: https://www.transit.dot.gov/ntd/transit-agency-profiles/riverside-transit-agency.
Riverside Transit Agency. (2017). 90031 Riverside Transit Agency 2017 Original Submission to National Transit Database [Adobe PDF]. Unpublished raw data received through personal communications.

[4] Riverside Transit Agency. (August 21, 2017). *RTA to Kick Off New RapidLink Express Service.* Press Releases. Retrieved from: https://www.riversidetransit.com/index.php/news-a-publications/press-releases.

Figure 2: RTA Financial Sustainability 2013-2017



Source: National Transit Database for 2013-2016, Riverside Transit Agency for 2017.

Replacing low-performing fixed-route service and its complementary ADA paratransit/senior Dial-a-Ride service with TNC partnerships may be a viable way for RTA to reduce its overall operating costs. This research establishes a methodology for determining where in RTA's network partnering with TNCs can be a cost-effective alternative to providing traditional fixed-route and Dial-a-Ride service. The research identifies five potential partnership zones. This study starts with a Literature Review that examines current literature on TNCs, their impact on transit use, and pros/cons of partnerships. Following the Literature Review is a Case Studies section that summarizes key takeaways from five existing partnerships. These takeaways let RTA leverage lessons learned from some of the first projects of this kind: Direct Connect in Pinellas County, FL; Go Centennial in Centennial, CO; Go Dublin in Dublin, CA; ACFlex in Alameda County, CA, and SC Rides in San Clemente, CA. Next, the report summarizes the methodology I used to identify the TNC analysis zones and to determine the potential cost savings from replacing fixed-route and Dial-a-Ride service with a TNC partnership. Finally, the report concludes with additional factors RTA should consider if proceeding with these recommendations as well as overall key takeaways for ways to make these partnerships successful.

Literature Review

Since TNCs are less than a decade old, academic literature on partnerships with transit agencies and their impact on travel behavior is rather limited. What literature exists focuses primarily on changes in trip-making behavior and characteristics of people who use shared mobility options. Some literature discusses the great opportunity for transit agencies to partner with TNCs while a few document case studies of preliminary pilots noting persistent challenges in implementation. Recommendations are typically high-level, talking about general ways agencies can partner with TNCs without discussing operating specifics. This research will fill a gap in existing academic

literature by developing a methodology for selecting locations for TNC pilot projects and estimating costs and benefits to the agency.

Demographics of Ridesourcing Users

Understanding the demographic characteristics of TNC users is important to understanding where TNC/transit partnerships may be successful. TNCs do not share their rider data externally, so information on rider demographics must be gleaned from rider surveys. The Institute of Transportation Studies (ITS) at UC Davis and the Shared-Use Mobility Center at the American Public Transportation Association (APTA) both recently published surveys of shared mobility and ridesourcing users in seven major metropolitan areas. Both surveyed Boston, Chicago, Los Angeles, San Francisco, Seattle, and Washington, D.C. ITS surveyed New York as its seventh city[5] and APTA surveyed Austin.[6]

The ITS survey identified patterns in ridesourcing use by frequency, age, and income. The survey found that 21 percent of adults have used ridesourcing services, and of these users, 24 percent use the services on a weekly to daily basis. In urban areas, people use ridesourcing services to avoid drinking and driving, because parking is too difficult to find, and because parking is too expensive. In suburban areas the top two reasons are the same and the third is that riders use such services to go to the airport. The study summarizes the demographics of the typical ridesourcing rider but does not relate the characteristics back to the characteristics of the population as a whole. For example, the report states the average age of a ridesourcing rider is 37 with no information on whether or not this is older or younger than the average resident in these seven metropolitan areas. Overall, 36 percent of riders are between 18 and 29 years of age while only 4 percent of riders are over the age of 65. Finally, the study finds that ridesourcing use increases as income levels increase. Fifteen percent of people with annual household incomes of $35,000 or less used ridesourcing services, while this number more than doubled to 33 percent for people with annual household incomes of $150,000 or more.[7]

The APTA study evaluated "supersharers," people who have adopted a multi-modal lifestyle and frequently use a combination of transit, bikesharing, carsharing, and ridesourcing. The study found that the more people use shared modes, the fewer cars they own. Supersharer households own an average of 0.6 cars, while households who have only used transit, and not bikesharing, carsharing, or ridesourcing, own 1.5 cars.[8] The APTA study looked at top shared-use mode by income level. Ridesourcing ranges from 5-10 percent for each income level with no significant differences. Similarly, if top shared mode is not available, 5-8 percent of people turn to

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[5] Clewlow, R. & Mishra, G. (October 2017). *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States*. University of California, Davis Institute of Transportation Studies. Retrieved from http://usa.streetsblog.org/wp-content/uploads/sites/5/2017/10/2017_UCD-ITS-RR-17-07.pdf, p. 9.

[6] Shared-Use Mobility Center. (March 2016). *Shared Mobility and the Transformation of Public Transit*. American Public Transportation Association. TCRP J-11/Task 21. Retrieved from https://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf, p. 3.

[7] Clewlow, R. & Mishra, G, pp. 13-14.

[8] Shared-Use Mobility Center, p. 7.

ridesourcing, which is slightly higher for lower-income groups than higher-income groups who are more likely to drive a car.[9]

Impacts of Ridesourcing on Transit Use

Transit/TNC partnerships have the potential to reduce ridership on mass transit vehicles if people switch to using TNCs to reach their final destinations. Multiple studies have examined ridesourcing's impact on transit use and travel behavior.

The ITS study finds that TNC use decreases transit use and increases vehicle miles traveled (VMT), but their methodology is somewhat questionable. The survey asked respondents, "Since you started using on-demand mobility services such as Uber and Lyft, do you find that you use the following transportation options more or less?" Of people who changed their behavior, the number of people who used transit less was 6 percentage points higher than the number of people who used transit more often. The report interprets this as a 6 percent reduction in transit use; however, this information cannot actually provide any insight into aggregate changes in travel behavior. The report also states that the majority of respondents indicated no change in behavior, so the 6 percentage points themselves may be overstating changes in transit use. The number one reason ITS survey respondents who use transit substitute ridesourcing services is that transit services are too slow. A close second is that the person travels at times when no transit services are available, indicating the potential of ridesourcing services to fill gaps in transit networks by providing late-night service.[10]

The ITS study also found that mode substitution also likely results in increased VMT. Survey respondents were asked "If Uber or Lyft were unavailable, which transportation alternatives would you use for the trips that you make using Uber or Lyft?" Twenty-two percent said they would make fewer trips, 17 percent would walk, 7 percent would bike, and 15 percent would take rail. This is a total of 61 percent of trips that would not have been made by car that added to citywide VMT. One important note is that the question did not seem to include "Bus" or "Other" as an answer choice. The only transit option was "Rail," and the lack of a complete range of responses may have affected how people responded.[11]

On the other hand, the APTA study found that ridesourcing complements transit use. Fifty-four percent of survey respondents indicated they used ridesourcing for social or recreational trips while only 21 percent used it for commute trips. Ridesourcing is most commonly used on weekends and after 8 pm, times when transit service is also less available. Unlike the ITS study, the APTA study found that people using ridesourcing services are most often substituting for private auto trips or carsharing and therefore not adding to overall VMT.[12]

Alejandro Henao conducted a third survey as part of his doctoral dissertation at the University of Colorado. He temporarily became an Uber and Lyft driver in order to collect original data on both the driver and rider side of TNC operations. He collected 311 surveys from passengers and asked

[9] Ibid, pp. 22-23.
[10] Clewlow, R. & Mishra, G, pp. 24-25.
[11] Ibid, p. 26.
[12] Shared-Use Mobility Center, pp. 11-16.

them how they would have completed their trip if Uber/Lyft were not available, shown in Table 1 below. He estimated how each substitution mode affected VMT and calculated that through the use of TNCs, VMT increased by 85 percent. The VMT increase was from both new trips that would not otherwise have been made or by replacing trips on other modes with zero marginal VMT such as public transit, bicycling, or walking.[13]

Table 1: For This Trip, How Would You Have Traveled if Lyft/Uber Was Not an Option?

Travel Mode	Percent of Respondents
Public Transportation	22.2%
Drive Alone	19.0%
Wouldn't Have Traveled	12.2%
Bike or Walk	11.9%
Taxi	9.6%
Carpool	9.3%
Other Ridesourcing	5.5%
Get a Ride	4.5%
Car Rental	4.2%
Other	1.6%

Overall, the literature disagrees on ridesourcing's impact on travel. The APTA study argues TNC trips replace driving trips while both the ITS and Henao studies suggest that TNC trips increase overall VMT.

Partnerships with TNCs

The rise of TNCs has opened up a wide range of new ways to provide public mobility service. Partnerships can take on a wide variety of structures from first/last-mile gaps to/from existing transit stations (Pinellas Suncoast Transit Authority, Centennial Colorado, Dayton Ohio); late night service as a lifeline option when transit is no longer operating (Pinellas Suncoast Transit Authority); mobile ticketing integration (Dallas Area Rapid Transit); dedicated senior mobility service (Gainesville, Florida); general public transit zones (Livermore Amador Valley Transit Authority) and paratransit service (Massachusetts Bay Transportation Authority, Washington Metro).[14] [15]

[13] Henao, A. (2017). *Impacts of Ridesourcing – Lyft and Uber – On Transportation Including VMT, Mode Replacement, Parking, and Travel Behavior* (Doctoral dissertation). ProQuest No. 10265243. Retrieved from https://search.proquest.com/docview/1899208739?pq-origsite=gscholar, pp. 59-63.

[14] Blodgett, M., Alireza, K., Negoescu, D., & Benjaafar, S. (August 2017). *Public/Private Partnerships in Transit: Case Studies and Analysis.* Minnesota Council on Transportation Access. Retrieved from: http://www.coordinatemntransit.org/MCOTA/meetings/documents/2017august/MCOTA_P3s_2017.pdf.

[15] *NYPTA White Paper on Transportation Network Company (TNC) Issues.* New York Public Transit Association, Inc. Retrieved from: https://nytransit.org/images/NYPTA_TNC_issues_White_Paper.pdf.

There is great potential for TNCs to replace traditional demand-response and paratransit services that currently offer curb-to-curb mobility options for riders.[16] These services are very expensive for agencies to operate, and both costs and demand for such service continue to increase. Between 1999 and 2012, the national annual number of paratransit trips increased from 68 to 106 million, and the average cost per trip increased from $14 to $33. Cost per trip increased 138 percent compared to an 82 percent cost increase in fixed-route bus service. Agencies could either harness TNC technology to better schedule trips and optimize use of resources or have TNCs operate paratransit services directly.[17]

Partnerships can take on a variety of payment structures with public transit agencies subsidizing a portion or all of riders' trip costs, with a range of examples shown below in Table 2.

Table 2: Overview of Partnership Fare Structures

City	Program Structure	Fare Structure	Agency Subsidy
Orange County, CA	Pick up at former transit stops[18]	Flat capped fare	$9.00
Pinellas Park, FL	To/from designated transit stops		$5.00
Boston, MA	Paratransit service		$13.00
Alamonte Springs, FL	Within city limits	Percent of trip cost	20% within city limits 25% to/from stations
Philadelphia, PA	To/from rail stations[19]		40% trip cost, $10 cap
Dublin, CA	Within city limits		50% trip cost, $5 cap
Centennial, CO	To/from light rail station	Full trip cost	100%
Summit, NJ	To/from rail station[20]	Riders pay flat fare	All costs after first $2
Miami-Dade, FL	To/from rail station[21]		All costs after first $3
Gainesville, FL	Senior mobility	Ability to pay	Up to $5.00

Source: Blodgett et al., 2017 unless otherwise noted

[16] Kane, J., Tomer, A., & Puentes, R. (March 8, 2016). *How Lyft and Uber Can Improve Transit Agency Budgets.* The Brookings Institution. Retrieved from http://www.brookings.edu/research/how-lyft-and-uber-can-improve-transit-agency-budgets/.

[17] Shared-Use Mobility Center, p. 25.

[18] Swegles, F. (October 5, 2016). *San Clemente Partners with Lyft to Fill Gaps after 2 OCTA Bus Routes End*. OC Register. Retrieved from: https://www.ocregister.com/2016/10/05/san-clemente-partners-with-lyft-to-fill-gaps-after-2-octa-bus-routes-end/.

[19] SEPTA Media Relations. (May 25, 2016). *SEPTA and Uber Announce Transit Partnership*. ISEPTAPHILLY Blog. Retrieved from: http://www.iseptaphilly.com/blog/Uber.

[20] Elliott, G. (June 10, 2017). *City of Summit Partners with Uber on Commuter Ridesharing Initiative*. TAPinto.net. Retrieved from: https://www.tapinto.net/towns/plainfield/articles/city-of-summit-partners-with-uber-on-commuter-rid-2.

[21] Del Busto, Carolina. (August 29, 2016). *Miami-Dade Transit and Uber Join Forces for Easier, Quicker Commute*. Miami-Dade County. Retrieved from: http://www.miamidade.gov/releases/2016-8-29-dtpw-uber-collab-release.asp.

Challenges to Implementation

Although multiple agencies have begun exploring opportunities to partner with TNCs, a number of regulatory, funding, and behavioral obstacles remain that may limit the potential of such partnerships. Being aware of these obstacles will help RTA anticipate potential setbacks as well as design a program that complies with state and federal mandates.

Title VI Compliance: Public transit agencies are required by federal legislation to provide equitable access to mobility services for all persons while TNCs are operated by private contractors not funded by government agencies and therefore not obligated to uphold those values. Title VI of the Civil Rights Act of 1964 requires agencies to provide equitable access to persons with low incomes, limited English proficiency, and identifying as a minority in order to receive federal funding. Because TNCs require both smartphone and credit cards for use, they are often inaccessible to persons with low incomes, the unbanked, and persons with limited English proficiency.[22] The APTA study found that there was no significant difference across income groups when it comes to using public transit agency-provided apps or websites to view transit schedules,[23] but it is still likely that any partnership with a TNC using current TNC operating practices would violate Title VI regulations if these issues were not addressed.

ADA Compliance: The Americans with Disabilities Act (ADA) established a mandate for transit agencies to provide complementary paratransit service within three-quarters of a mile of fixed-route during all service hours for persons with disabilities who cannot use traditional fixed-route service. Compliance with ADA requires that persons with disabilities have access to comparable service which extends to wait times for trips. Having a TNC partnership where riders can get a ride in under 10 minutes means the transit agency would be legally required to guarantee a comparable level of service for persons with disabilities. Because TNCs are operated by independent contractors using their own private vehicles, trips on wheelchair-accessible vehicles (at least within a reasonable response time) cannot be guaranteed without intervention.[24]

Federal Funding Requirements: TNC drivers also currently cannot be subject to certain employment conditions which need to be met for agencies to fund the partnerships with federal dollars. Spending federal dollars requires compliance with FTA-required drug and alcohol testing, liability and occupational safety training for loading/unloading passengers in wheelchairs, requirements for providing accessible rides for persons in wheelchairs or with service animals, and heightened vehicle safety and inspection requirements. In addition to employment regulations, vehicle requirements such as accessibility accommodations and "Buy America"

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[22] The National Academies of Sciences, Engineering, and Medicine. (2015). *Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services.* Transportation Research Board Special Report 319. Retrieved from: https://www.nap.edu/download/21875#, pp. 83-91.

[23] Shared-Use Mobility Center, p. 20.

[24] Foxx, A. (December 5, 2016). Dear Colleague Letter from Secretary Foxx on Transportation Network Company Obligations [open letter]. United States of America Department of Transportation. Retrieved from https://www.transit.dot.gov/sites/fta.dot.gov/files/Dear%20Colleague%20Letter%20re%20Shared%20Mobility.pdf.

provisions would place restrictions on the vehicles ridesourcing drivers could use to operate service.[25]

Guaranteeing Rides: A more general issue is that TNC drivers tend to go where demand is highest – urban areas with concentrations of destinations. Relying on TNCs to provide mobility in lower density areas where fixed-route transit is not effective requires guaranteeing that TNC service will be readily available in those areas. If demand is low, trip wait times may be long, reducing the effectiveness of the service.[26]

Resistance to Using TNCs: Finally, many potential users, primarily older adults, hesitate to use TNCs. A Transportation Research Board study interviewed seniors about their reasons for not using TNCs. These reasons included: confusion about how to use the services, risk averseness, fear of riding with unknown drivers, mistrust with online financial transactions, and inability to use the technology.[27] Gainesville, FL implemented a senior mobility partnership with Uber and found technology to be the biggest barrier to the program's success.[28] As the country's population ages, the issue of senior mobility will become more prevalent. Any new solution for senior mobility must address the barriers noted above in order to be successful, though within a number of generations this problem may be eliminated as this technology becomes the norm.

Non-TNC Operating Models

TNC partnerships are not the only effective shared mobility solution in areas not suited for fixed-route transit. Call-n-Ride or Flex zones can be preferable to fixed-route in lower-density areas with dispersed origins and destinations. Unlike fixed-route, these zones provide service access for all residents in the zone, not just those within walking distance of a transit stop.

Denver's Regional Transportation District (RTD) operates 21 Call-n-Ride (CnR) zones that supplement the fixed-route network and carry an average total of 2,228 riders each weekday. Riders can travel anywhere within the designated zone for a flat fare of $2.25, the same as RTD's fixed-route fare. In "Operating Experience with General Public Demand Responsive Transit," RTD evaluated the performance of the agency's 21 CnR zones. They found that ridership was most directly correlated with in-service hours and senior, youth, and total population density. The study found that CnR riders and bus riders have similar demographic characteristics in terms of age, gender, and frequency of use. Household income is skewed higher on CnR, possibly because the service focuses on suburban residential areas and the reverse commute. RTD differentiates between two types of services, feeder and non-feeder services, depending on whether the service directly feeds riders into a higher-frequency transit service. The study found that feeder services

[25] Shared-Use Mobility Center, pp. 26-27.
[26] The National Academy of Sciences, Engineering, and Medicine, pp. 83-91.
[27] Shirgaokar, M. (November 15, 2016). *Which Barriers Prevent Seniors from Accessing Transportation Network Company (TNC) Services? Identifying Ways Forward for a Gendered Policy Approach (#17-04291)*. Transportation Research Board 96th Annual Meeting. Retrieved from http://docs.trb.org/prp/17-04921.pdf, pp. 11-14.
[28] Blodgett et al., p. 12.

have higher productivities, carrying a range of 3.3 to 8.5 passengers per hour. Non-feeder services carry 2.2 to 4.8 passengers per hour.[29]

Orange County Transportation Authority (OCTA) developed a white paper for a pilot program called OCFlex which is now set to launch in Spring 2018. OCTA will partner with TransLoc, a MicroTransit company that provides agencies with the technology to operate on-demand service.[30] OCTA chose not to pursue a partnership with TNCs due to the following issues: lack of accessible vehicles, legal risk, and unwillingness of TNCs to provide desired data.[31] The agency also believed that in-house operations have a few advantages over other shared-mobility providers including: driver background checks and drug/alcohol testing, fully wheelchair-accessible vehicles, discounted fares for OCTA pass holders, and service availability for all ages, not just 18 and older.[32] OCTA identified seven potential zones based on areas where fixed-route had been eliminated or where the agency had frequently received requests for new service. OCTA then ranked these seven zones based on the following criteria: population density, employment density, low-income population density, traffic density, intersection density, number of connecting bus routes, number of transit nodes, bus ridership, and ACCESS (ADA) ridership. OCTA advanced the two highest-scoring zones to become part of the pilot.[33] OCTA estimates the annual operating cost of the program to be $1,200,000. Four vans will operate each day at a cost of $50 per hour for an annual cost of $1,150,000. Additional costs are $25,000 for software and $25,000 for marketing and materials. Rather than estimate ridership, OCTA estimates the program will carry 6 passengers per hour and uses this estimate to reverse engineer annual ridership.[34] OCTA takes a unique approach to pricing. Service on OCFlex must be paid for using an OCTA or Metrolink pass. The service is free for riders who already have a day or monthly pass. Those who do not have a pass can purchase a day pass online for $4.50 or on the bus for $5.00. Once purchased, the pass can be used on most other OCTA routes through the end of the day. This pricing structure limits pilot use to those with an interest in associating themselves with OCTA. It also encourages additional use of the OCTA network.[35] OCTA conducted a survey of potential riders and found that the average maximum fare respondents would be willing to pay for a single trip was $5.37, which is consistent with the proposed pricing structure.[36]

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[29] Becker, J., Teal, R., & Mossige, R. (2013). *Operating Experience with General Public Demand Responsive Transit in a Metropolitan Transit Agency's Service Portfolio*. Transportation Research Board. TRB Paper #13-4441. Retrieved from http://amonline.trb.org/13-4441-1.2515090?qr=1, pp. 3-9.

[30] Orange County Transportation Authority. (October 2017). *OCFlex: Pilot Project White Paper*. Orange County Transportation Authority. Retrieved from https://octa.legistar.com/LegislationDetail.aspx?ID=3189741& GUID=D6A01F98-5F03-410D-9D71-FE7769FAEE61, p. 21.

[31] Ibid, p. 4.

[32] Ibid, p. 17.

[33] Ibid, pp. 13-14.

[34] Ibid, p. 23.

[35] Ibid, p. 16.

[36] Ibid, p. 10.

Conclusion

While there is great potential for public transit agencies to partner with TNCs, there is still much to be learned about the success of these partnerships. Academic literature on this topic is growing, but to date most focuses on ridesourcing's impact on travel behavior. While many agencies have begun to partner with TNCs, these partnerships remain in their infancy, and data on their operations is limited. Finally, there are a number of barriers to implementation, most of which stem from working to integrate private companies with public services. This research seeks to fill this gap in existing academic literature by providing a methodology for estimating the costs and benefits of a TNC partnership. The next section builds on this literature review by examining five pilot programs in depth.

Case Studies

Pilot TNC partnerships and on-demand services around the country provide critical insight into how RTA should go about structuring such a program. This case study review examines five pilot programs implemented by public transit agencies across the country. These programs have completely different operating structures, fare structures, challenges, and mobility solutions. Information for this case study review came from interviews with agency representatives as well as white papers, reports, and websites about the programs. While these sources provided a lot of great information on the strengths/weaknesses of different partnership structures, rider data remains rather limited. Data-sharing agreements with TNCs such as Uber and Lyft restrict the level of information available to public agencies, often including the number of rides taken, specific origin/destination patterns, and rider demographics.

The following sections examine the following five pilot programs: Direct Connect in Pinellas County, Fl; Go Centennial in Centennial, CO; Go Dublin in Dublin, CA; AC Flex in Alameda County, CA; and SC Rides in Orange County, CA. Each section includes project context, program overview, information on program performance, and a summary of challenges and lessons learned.

Table 3: Summary of Case Studies

Pilot Programs	Purpose	Service Area Size (sq. mi.)	Fare Structure	Providers	Daily Ridership
Go Centennial	First/last mile to light rail station	3.75	Free	Lyft, Via	10
Direct Connect	Replaced fixed-route, first/last mile	Original - 14.5 Current - countywide	Original - 50% up to $3.00 Current - $5.00 subsidy	Uber, United Taxi, Care Ride	66
Go Dublin	Replaced fixed-route, first/last mile	15.23	50% up to $5.00	Uber, Lyft, DeSoto Cab	50
AC Flex	First/last mile to BART stations	Newark – 5.5 Castro Valley - 4	$2.25	AC Transit	125
SC Rides	To/from former fixed-route bus stops	Former fixed-route stops	$2.00 flat fare, up to $9.00 subsidy	Lyft	70

Program #1: Direct Connect

Project Context

In 2016, Pinellas Suncoast Transportation Authority (PSTA) in Pinellas County, FL implemented Direct Connect, a pilot program with Uber to provide first/last mile connections into the fixed-route transit network.[37] A failed tax referendum in November 2014 left PSTA with a budget deficit, prompting recommendations to discontinue low-performing fixed-route services. Direct Connect was an effort to show the PSTA Board alternative models to fixed-route transit that could still provide needed first/last mile mobility.[38]

Program Overview

The program started with two Direct Connect zones, one in Pinellas Park and the other in East Lake. Pinellas Park is served by Route 444, the lowest-performing route in the PSTA network, providing only 244 trips per month.[39] East Lake is served by the East Lake Shuttle which requires day-ahead trip reservations.[40] The original Direct Connect program subsidized 50% of fares up to $3.00 on trips taken to/from one of two designated transit stops within the zone. PSTA chose the $3.00 subsidy value based on data received from Uber on average fares in Pinellas Park and to limit cost exposure for PSTA.[41]

On January 19, 2017 PSTA expanded the program countywide to eight different zones. The fare structure changed with the program expansion to $5.00 off each ride. Uber has a minimum fare (regardless of time or distance) in Pinellas County that was just under $6.00 at the start of 2017. PSTA chose $5.00 as the program's subsidy so that fares could be as low as $1.00. However, since the program started, Uber increased the minimum fare in Pinellas County to $6.70, so the lowest Direct Connect fare is now $1.70. Riders can choose between three different transportation providers to complete their Direct Connect trip – Uber, United Taxi, or Wheelchair Transport. All three options are required to satisfy Title VI and ADA requirements. United Taxi is available for riders without access to a smartphone or credit card while Wheelchair Transport is available for riders who require wheelchair-equipped vehicles. Although Demand Response Transportation (PSTA's paratransit

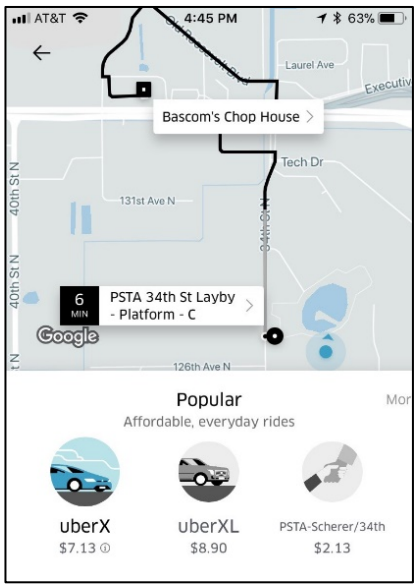

Figure 3: Example of Direct Connect Integration on Uber App

[37] Pinellas Suncoast Transportation Authority. (2016). "PSTA Wins Future of the Region Award for Direct Connect." Retrieved from: https://www.psta.net/about-psta/press-releases/2016/psta-wins-future-of-the-region-award-for-direct-connect/.

[38] Epstein, B. (November 8, 2017). *PSTA as a Mobility Manager*. Presentation at the California Transit Association Conference, Riverside, CA.

[39] Epstein, B. (January 10, 2018). Phone Interview.

[40] Pinellas Suncoast Transportation Authority. (July 21, 2017). "East Lake Shuttle." Retrieved from: https://www.psta.net/riding-psta/schedulesmap/east-lake-shuttle/.

[41] Epstein, B. (January 10, 2018). Phone Interview.

provider) still operates in the service areas, the partnership with Wheelchair Transport is required to guarantee riders a same-day trip with a comparable wait time to Uber or United Taxi. The $5.00 subsidy uniformly applies to all providers. While taxis are typically more expensive than TNCs, short trips taken on United Taxi can actually be cheaper than Uber trips because they are not subject to the high minimum fare. PSTA estimates the average fare on United Taxi is $6.00-$6.25 before the $5.00 promotion is applied. Unfortunately, PSTA cannot track average fare information on Uber rides because Uber just sends them an invoice for $5.00 times the number of trips provided, with no individual trip information.[42]

As shown in Figure 3, Direct Connect works as an option embedded in the Uber app that shows up as an Uber option such as uberX or uberXL (trip options based on size of vehicle required). If a trip planned starts or ends at a Direct Connect stop, the PSTA partnership icon will appear as an option, automatically applying $5.00 off the uberX fare. To receive the trip subsidy, riders simply select the PSTA trip option.[43]

Pilot Performance

Direct Connect carried an average of 661 riders per month between February and November 2017. PSTA estimates that riders completed 90 percent of trips on Uber and 10 percent on United Taxi. To date no trips have been requested on Wheelchair Transport. At $5.00 per trip, the cost to PSTA was approximately $39,648 for the entire county in 2017. In comparison, Route 444 costs over $50 per passenger trip with an annual cost of around $190,000.[44] This program demonstrates tremendous potential for significant cost savings by switching to an on-demand-based approach to replace unproductive fixed-route service. PSTA operated both Route 444 and DART paratransit in the original Pinellas Park Direct Connect pilot zone, so it is impossible to know how the program would have responded if those services were not in operation. It is possible that travelers did not request rides from Wheelchair Transport simply because DART paratransit service was still available in the area.

Challenges and Lessons Learned

Connecting to Fixed-Route: It is difficult for PSTA to know whether riders are using the program to access the fixed-route transit network. Because major ridership stops are often at key destinations, riders could simply be using Direct Connect to travel to their final destination rather than to connect into fixed-route transit. However, to overcome this problem, PSTA carefully selected Direct Connect stops that were at convenient transfer locations but not adjacent to major destinations.

Data Sharing: PSTA's primary challenge has been data sharing. Uber does not provide the agency with data on individual rider trips or the number of trips taken within each Direct Connect zone. They also do not share information on rider demographics, travel patterns, trip distance, or

[42] Ibid.
[43] Ibid.
[44] Ibid.

average fare. Without more detailed information on riders and trips, it is difficult for PSTA to evaluate the success and evolution of the program.[45]

Program #2: Go Centennial

Project Context

Centennial, Colorado lies 15 miles southeast of downtown Denver and is home to 109,000 residents. The City is served by the Dry Creek light rail station with direct connections into downtown Denver. However, the station has no fixed-route bus connections. Commuters who want to access fixed-route transit must use the Dry Creek Call-n-Ride which costs $2.60 per one-way trip and operates weekdays between 5:30 AM and 7:00 PM. Commuters can then transfer for free to light rail at Dry Creek Station.[46] The existing four square-mile Call-n-Ride zone provides service that is expensive for Regional Transportation District (RTD), Denver's public transit provider, to provide because it must operate all day regardless of demand. It is also not ideal for riders to use as reservations for the service must be made at least one hour in advance, limiting trip flexibility.[47] The service carries an average of 3.9 boardings per revenue hour and has an average subsidy per boarding of $18.54.[48]

Program Overview

The Go Centennial pilot program emerged as a way to reduce single-occupancy vehicle travel to/from Dry Creek Station and to encourage additional light rail ridership. For a six-month period, riders could travel for free within the service area to/from Dry Creek Station. The pilot program operated between August 17th, 2016 and February 17th, 2017 between 5:30 AM and 7:00 PM on weekdays to match the service hours of the existing Call-n-Ride, which was also still in operation. The City of Centennial chose to make the program free for riders because current Call-n-Ride users receive a free transfer to/from light rail stations. The Go Centennial pilot was embedded in RTD's Go Denver app which allowed users to book trips online. Riders launching the Go Centennial app could choose either Lyft or Via as their service provider. Lyft rides were available as Lyft Line rides only, Lyft's shared-ride platform.[49] Lyft invested in driver recruitment events to help ensure enough drivers would be available in the area to provide trips within a reasonable wait time.[50] Via provided wheelchair-accessible rides, and at least one driver was present in the service area at all times to ensure comparable wait times for riders requesting Via trips.[51] Riders without access to a smartphone or a credit card could call the Centennial Citizen Response Center to book rides and could pay in cash on Via.[52] For those who were not exposed to Go Centennial through the Go

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[45] Ibid.

[46] Centennial Innovation Team and Fehr & Peers. (June 2017). *Go Centennial Final Report*. City of Centennial, CO. Retrieved from: http://go.centennialco.gov/, pp. 6-8.

[47] Regional Transportation District. (2018). "Call-n-Ride." Retrieved from: http://www.rtd-denver.com/callNRide.shtml#drycreek.

[48] *Go Centennial Final Report*, p. 8.

[49] Ibid, pp. 11-22.

[50] Morgan, M. (July 13, 2017). *Go Centennial Q&A Webinar* [Video webinar]. Transportation for America Smart Cities Collaborative. Retrieved from: http://go.centennialco.gov/.

[51] *Go Centennial Final Report*, p. 15.

[52] Ibid, p. 16.

Denver app, the City of Centennial also marketed the program on news channels, transportation blogs, and the City website. Representatives positioned at Dry Creek station informed light rail riders about the program and help them download the app.[53]

Pilot Performance

The Go Centennial pilot program provided 1,302 trips to 127 unique users over the six-month period.[54] Twenty of these trips were taken on Via.[55] The program averaged about 10 riders a day, while the Call-n-Ride operating in the service area provided about 50 rides a day. The two programs had the same operating hours, but the RTD Call-n-Ride does not limit trip origins/destinations to Dry Creek Station. RTD did not see significant changes in Call-n-Ride ridership while Go Centennial was in operation, so it is possible the program attracted new riders. One benefit of the TNC model is that capacity can expand or contract based on demand at any given time. The Call-n-Ride has fixed capacity and often cannot accommodate everyone who wants a trip at a certain time, decreasing the likelihood those riders denied a trip will opt to use transit in the future.[56] The City of Centennial conducted a rider survey and found that 15 percent of trips taken on Go Centennial were previously made by driving, 35 percent used the park-n-ride at Dry Creek Station, and 50 percent used the Dry Creek Call-n-Ride. Sixty-eight percent of riders had never used a Call-n-Ride service before, indicating they were new to such transit services.[57] Additionally, 36 percent had never used Lyft before.[58]

The Go Centennial pilot program realized significant cost savings over traditional Call-n-Ride and RTD Access-a-Ride services. The average Lyft Line trip cost the City $4.70, with costs ranging between $2.56 and $16.24. This represents a significant cost reduction compared to the Call-n-Ride subsidy per passenger of $18.54. Via service was considerably more expensive, since the City paid $26.50 per hour to have a wheelchair-accessible vehicle in the service area at all times. Individual Via trips incurred an average cost of $6.82. Assuming 30-minute trips, Via trips were subsidized at an average of $20.07 ($13.25 for half the hourly cost and $6.82 for the mileage of the trip). This subsidy is still less than half the subsidy of traditional RTD Access-a-Ride services of $42.96 per ride.[59]

Challenges and Lessons Learned

Providing ADA Service: Providing complementary wheelchair-accessible service proved to be one of the program's primary challenges. Total operating costs for the pilot were $60,770. Via service cost $45,760, three-quarters of the total program cost. Due to low ridership and because the vehicle could only be hired for Go Centennial Access trips, the vehicle sat empty most of the day, incurring hourly costs of $26.50.[60] Because the service area was only 3.75 square miles, accessible

[53] Morgan, M. (January 10, 2018). Phone Interview.
[54] *Go Centennial Final Report,* p. 21.
[55] *Go Centennial Q&A Webinar.*
[56] Morgan, M. (January 10, 2018). Phone Interview.
[57] *Go Centennial Final Report,* pp. 24-25.
[58] *Go Centennial Q&A Webinar.*
[59] *Go Centennial Final Report*, pp. 28-29.
[60] Ibid, pp. 41, 51.

demand within the service area is low, and much of it is likely already accommodated by existing Call-n-Ride service. It was also difficult for the City to estimate the demand for wheelchair-accessible rides because RTD does not track that information on its Call-n-Ride service. Expanding Via's service area to other Call-n-Ride areas could have increased demand without degrading service for residents in Dry Creek.[61]

Clearly Defining Boundaries: A second challenge was communicating service area boundaries and pick-up/drop-off locations for participants and Lyft drivers. Many residents who lived just outside of the service area complained they could not participate in the program. The City recommended clearly defining pick-up and drop-off locations at Dry Creek Station to reduce confusion for Lyft drivers unfamiliar with the station. The City also recommended using major streets or highways to define service area boundaries so they are easily communicated and easy to understand.

Program Duration: The City also felt limited by the program's short duration. It took them two months to collect the first round of data from the pilot, and by that point the pilot was already one-third of the way through. By the time the City recognized that adjustments needed to be made and decided on the nature of those adjustments, the pilot had almost ended. Therefore, the City recommended allowing a least a year for pilot program duration and to develop action plans ahead of implementation.[62]

Generating Ridership: Finally, ridership was lower than the City anticipated, especially given the widespread attention the program received from transportation planning professionals. The City recommends using a larger service area to attract more riders and to leverage targeted marketing. Because the biggest complaint was from residents living just beyond the service area boundaries, a larger service area would have generated additional ridership. The project team found it difficult to advertise on social media because their targeted marketing applies to larger geographic areas. Finding a way to specifically target residents within the limited service area proved challenging.[63]

Program #3: Go Dublin

Project Context

The City of Dublin, CA lies within the service area of the Livermore Amador Valley Transit Authority (LAVTA) in northern California. The agency conducted a Comprehensive Operations Analysis (COA) in 2015 that led to elimination of Route 3 within the City of Dublin in an effort to reorient resource investment towards more productive services. At the time of the study, Routes 2 and 3 carried an average of 5 to 6 passengers per revenue hour with a subsidy of $15 to $20 per passenger trip.[64] LAVTA introduced the Go Dublin pilot in January 2017 to provide on-demand mobility service to replace lost fixed-route service.

[61] Morgan, M. (January 10, 2018). Phone Interview.
[62] Ibid.
[63] *Go Centennial Final Report*, p. 49.
[64] Livermore Amador Valley Transit Authority. (February 2017). *Go Dublin Pilot White Paper*, pp. 1-2. Received through personal communications.

Program Overview

The pilot offers subsidies for rides that start and end within the City of Dublin. LAVTA chose the city boundaries for its study area for ease of marketing and implementation and to make it easy for riders to understand.[65] The pilot is a partnership between the agency and three providers – Uber, Lyft, and DeSoto Cab. Rides taken on the partnership must be completed through the agencies' ridesharing platform – Uber Pool, Lyft Line, or DeSoto Share, in order to qualify. Riders choose which provider to use, book their trips through the app, and apply the GODUBLIN promo code to their trip in order to receive the LAVTA discount. The promotion can be used 24/7, representing a considerable expansion in local service hours.[66] Each provider created a geo-fence (geographic boundary embedded within the app) on their mobile apps to ensure the promo code can only be used for trips that start/end within the designated Go Dublin area.[67] To ensure equal opportunity for riders without access to smartphones or credit cards, trips can be booked on the phone for DeSoto cab and paid for with cash. The DeSoto cab option is also available for riders requiring a wheelchair-accessible vehicle.[68] The Promotion Agreement between LAVTA and DeSoto Cab stated that DeSoto would ensure the availability of a wheelchair-accessible vehicle within 20 minutes of a request.[69]

LAVTA subsidizes 50% of rides up to $5.00 and chose this structure carefully to balance costs to both the customer and the agency. Setting a cap at $5.00 limits financial exposure for the agency and protects against TNC surge pricing. The BART station, the most popular destination for Go Dublin trips, is centrally-located in the service area, minimizing the number of long-distance trips. Overall, the service area is about seven square miles, and its compact size limits long-distance travel. On average, passengers pay around $3.00 per ride, and LAVTA's subsidy per ride is also about $3.00, for a total trip cost around $6.00.[70]

Pilot Performance

Ridership on Go Dublin is about half that of previous Routes 2 and 3. Go Dublin carries about 1,500 riders per month. The LAVTA COA reported that Route 3 carried an average of 65 riders on weekdays and Route 2 carried 44 riders.[71] Cost per passenger trip on Routes 2 and 3 was $15-$20 and Go Dublin costs are around $3 per passenger, a significant cost saving.[72] Most trips taken on Go Dublin are to/from the BART station during peak periods.[73]

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[65] Wegener, C. (January 2, 2018). Phone Interview.
[66] *Go Dublin Pilot White Paper*, p. 3.
[67] Livermore Amador Valley Transit Authority. (December 2016). *DeSoto Cab and Livermore Amador Valley Transit Authority Promotion Agreement.* Received through personal communications.
[68] *Go Dublin Pilot White Paper,* p. 3.
[69] *DeSoto Cab and Livermore Amador Valley Transit Authority Promotion Agreement.*
[70] Wegener, C. (January 2, 2018). Phone Interview.
[71] Nelson Nygaard Consulting Associates Inc. (October 2015). *LAVTA Comprehensive Operational Analysis: Existing Conditions Report*. Retrieved from: http://www.wheelsbus.com/wp-content/uploads/2016/02/LAVTA-Existing-Conditions-Final.pdf, pp. 4-6.
[72] *Go Dublin Report White Paper*, p. 2.
[73] Wegener, C. (January 2, 2018). Phone Interview.

Challenges and Lessons Learned

Competition with Fixed-Route: LAVTA stressed not wanting to create a product that directly competes with fixed-route transit. They did not want to provide subsidies so that riders could complete trips on Uber that they previously took on a bus. The goal of the promotion was to provide connections to the fixed-route transit network. They recommend restricting the service area to exclude corridors with frequent transit service.

Tracking Riders: LAVTA also wished they had required participants to register with the agency in order to use the promotion code. Registration would allow the agency to assemble a database of riders they could survey about their use of service. It would also increase the chances that the people using the promotion code were previous riders of the fixed-route service.

Providing ADA Service: Finally, providing wheelchair-accessible trips was a big implementation challenge. Go Dublin would not have been possible without the Desoto cab partnership.[74]

Program #4: AC Flex

Program Context

The Alameda Contra Costa Transit District (AC Transit) is located in the East Bay Area. It launched its Flex program in July 2016 to provide an alternative to fixed-route service in Newark and Castro Valley modeled after Denver's Call-n-Ride program (see Literature Review). Newark had the lowest-performing service in the network and Castro Valley had no fixed-route transit service.[75] AC Transit ridership declined 6 percent since 2014 despite a 12 percent investment in revenue hours, challenging the agency to remain financially sustainable. The goal of the AC Flex program was to improve service in low-demand areas while responding to changing customer expectations associated with the rise of TNCs and on-demand mobility. AC Transit also wanted to ensure that the program enhanced equity and access to transit service.[76]

Program Overview

AC Flex is operated in-house by AC Transit, but it provides a more on-demand experience for riders than fixed-route service. AC Flex trips leave from the Union City BART station every 30 minutes and pick-up/drop-off riders at designated stops (shown in Figure 4).[77] Riders boarding at the BART station simply tell their driver where they want to be dropped off. Otherwise, riders must reserve a trip online or over the phone and can travel between any of the zone's designated stops. Upon booking a reservation, riders receive a 10-minute pick-up window during which their trip could arrive at the designated stop. This allows AC Transit some flexibility in trip scheduling and also lets riders know exactly when to expect the bus. The scheduling software uses algorithms to determine routing for each trip, and drivers must reference the software to know their pick-up

[74] Ibid.
[75] Urgo, J. (January 5, 2018). Phone Interview.
[76] Urgo, J. (May 31, 2017). *AC Transit Flex Program*. Presentation at the Southern California Association of Governments Meeting of the Regional Transit Technical Advisory Committee. Los Angeles, CA. Received through personal communications.
[77] AC Transit. (2018). "AC Transit Flex." Retrieved from: http://www.actransit.org/wp-content/uploads/NW_475-aug16-TT1.pdf.

and drop-off locations. AC Transit recommends scheduling trips at least 30 minutes in advance. The program also allows subscription trips where riders commit to recurring trips. Subscription trips take up a lot of the vehicles' capacity and dictate schedules throughout the day. Because of the high number of subscription trips and the commitment to leave the BART station every half hour, the average wait time for on-demand trips is about 30 minutes.[78]

Service is available on weekdays between 6:00AM-8:00PM, and the fare is AC Transit's base fare of $2.25.[79] The Newark Flex and Castro Valley routes operate every 30 minutes whereas the former fixed-route Route 275 only operated every 45 minutes. AC Transit leveraged former infrastructure investment to set up the AC Flex program by repurposing stops from previously discontinued services.

Figure 4: AC Flex Stops in Newark

Since all AC Flex vehicles are wheelchair-equipped and the program provides point-to-point mobility, the service does not require complementary ADA paratransit service. However, AC Transit chooses to still operate ADA paratransit service in the AC Flex service areas, as removing this service would force transfers for riders making longer trips. AC Transit estimates that about three percent of AC Flex riders use a wheelchair and know of at least one ADA-qualified rider who has switched from paratransit to AC Flex.[80] There are no Title VI implications because there were no fare changes, the drivers accept cash payments, and reservations can be made over the phone.

Pilot Performance

The Flex program service has been resource-neutral for AC Transit to operate. Both Route 275 and the Newark Flex require two vehicles. Route 275 used 30-ft buses while the Newark Flex uses smaller, less expensive 26-foot cutaway vans. However, the cost savings from using smaller vehicles is used up by the additional technology costs of providing on-demand service.[81] Because the service is operated in-house, AC Transit does not realize any operator cost savings.

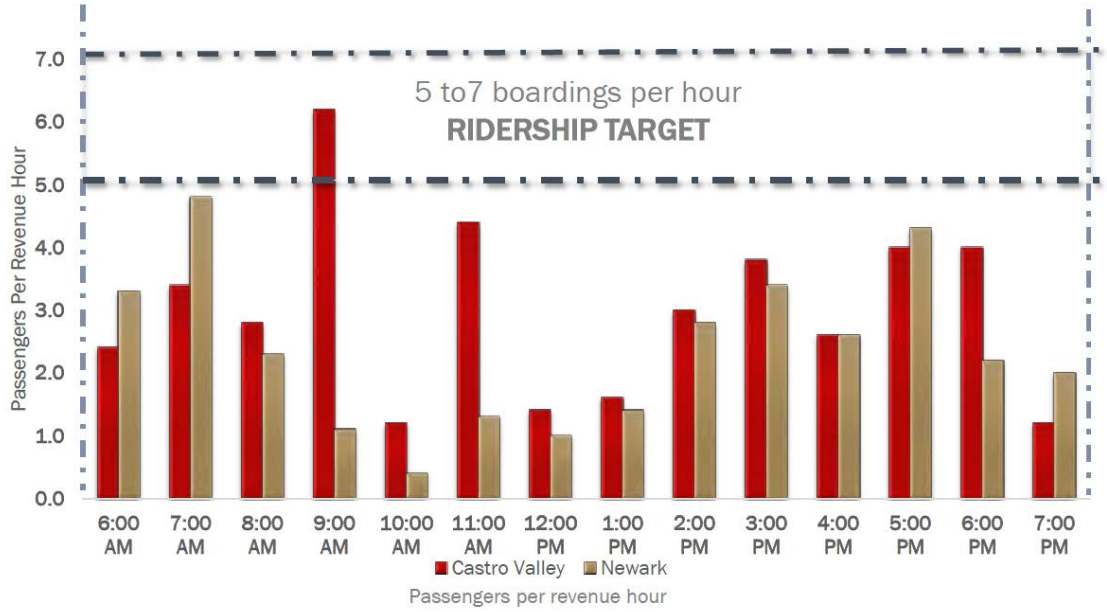
Both ridership and productivity in terms of passengers per revenue hour is about half of what it was on Route 275. AC Transit estimates that 40 percent of Route 275 riders switched to Flex service, 40 percent switched to other fixed-routes, and 20 percent stopped riding AC Transit, as part of the agency's overall ridership decline. AC Transit also believes that the program has

[78] Urgo, J. (January 5, 2018). Phone Interview.
[79] "AC Transit Flex."
[80] Ibid.
[81] Urgo, J. (May 31, 2017). *AC Transit Flex Program*.

generated some new ridership, but this is difficult to measure. Most riders travel to/from the BART station. There is some bi-directional demand in Newark with people traveling both into and out of Union City Station in peak periods.

Ridership in Castro Valley is primarily seniors.[82] Ridership has grown considerably since the service started, averaging about 1,200 rides in August 2016 and 2,500 rides in April 2017. About 68 percent of riders are repeat customers. Forty-five percent of riders book their trips online, 38 percent show up spontaneously at the BART stop, and 17 percent reserve their trips over the phone.[83] As shown in Figure 5 below, both services fall below the target performance of 5 to 7 passengers per revenue hour. For Newark, productivity is limited by service to the BART station. The service area is 5.5 square miles, and the BART station lies two miles outside the service area, eating up a lot of time and reducing the number of passengers that can be picked up along the way.[84]

Figure 5: AC Flex Passengers per Revenue Hour



Source: Urgo, J. (May 31, 2017). *AC Transit Flex Program.*

Challenges and Lessons Learned

Operator Training: AC Transit's biggest challenge was operator training. Implementing the program required working with drivers and teaching them how to use the technology and getting them used to checking the tablet for updated routing instead of following a fixed alignment each trip.

Marketing: Another challenge was marketing, notifying current riders of changes and attracting a new ridership base. AC Transit is currently working on having riders register to use the program.

[82] Urgo, J. (January 5, 2018). Phone Interview.
[83] Urgo, J. (May 31, 2017). *AC Transit Flex Program*.
[84] Urgo, J. (January 5, 2018). Phone Interview.

This process would allow them to do more tailored marketing to interested riders and to identify exactly who is using the program. In the future, it will make it easier for AC Transit to survey riders and get their feedback on the service.

Service Area Size: Finally, the agency learned that given the resources available, the program is best suited to a 5 to 7 square mile service area and is not expected to carry more than 7 passengers per revenue hour. This service size is large enough to reach a number of potential riders, but small enough to limit demand. Capacity on the vehicles is limited, and drivers can only pick up about 7 passengers per hour and still meet the scheduled departures from the BART stations.[85]

Program #5: SC Rides

Project Context

In October 2016, Orange County Transportation Authority (OCTA) discontinued bus Routes 191 and 193 in San Clemente as part of a systemwide network restructuring. To fill in the resulting network gaps, the City of San Clemente contracted with Lyft to provide an alternative for riders who previously used Routes 191 and 193. The program is still in beta testing, and San Clemente is planning a full launch in Spring 2018. Since the program has only been in soft launch, ridership and performance data is limited, but its unique structure provides a contrast to the other four programs evaluated in this section.

Program Overview

The program, known as SC Rides, subsidizes trips for riders whose trips start and end along the previous bus route, as shown in Figure 6. Rides must start and end at previous fixed-route stops to be eligible for the program. Riders pay $2.00 and OCTA subsidizes the remainder of the trip, up to $9.00. Riders are then responsible for paying additional costs for trips that exceed $11.00. Riders apply the "SCRIDES" discount code in the Lyft app in order to receive the subsidy.[86] Program funding and current fare structure directly influenced the fare structure. Funding for the program comes from OCTA Measure M2 Project V funds which subsidizes community-based circulators up to $9.00 per passenger.[87] OCTA's base fare for fixed-route transit is $2.00.[88]

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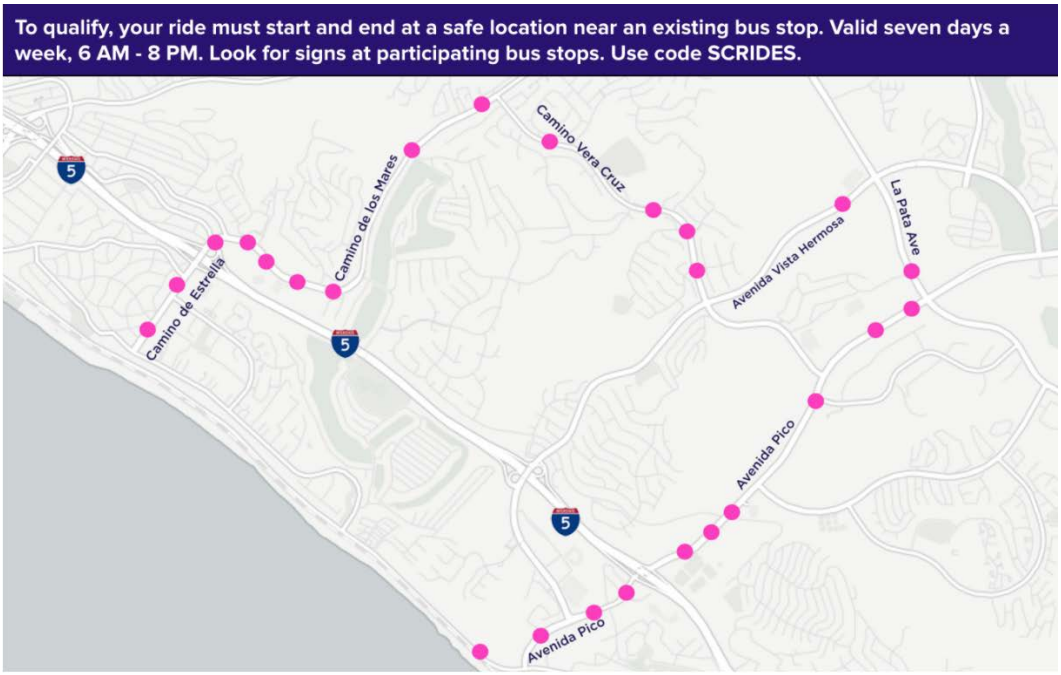
[85] Ibid.

[86] Lyft. (October 10, 2016). "Reimagining Public Transit in San Clemente." Lyft Blog. Retrieved from: https://blog.lyft.com/posts/reimagining-public-transit-in-san-clemente.

[87] Orange County Transportation Authority. (March 12, 2018). *Comprehensive Transportation Funding Program Guidelines: 2018 Call for Projects.* Retrieved from: http://www.octa.net/pdf/CTFPGuidelines2018.pdf.

[88] Orange County Transportation Authority. (2018). "Fares and Passes: Overview." Retrieved from: http://www.octa.net/Bus/Fares-and-Passes/Overview/.

Figure 6: Map of SC Rides Bus Stops

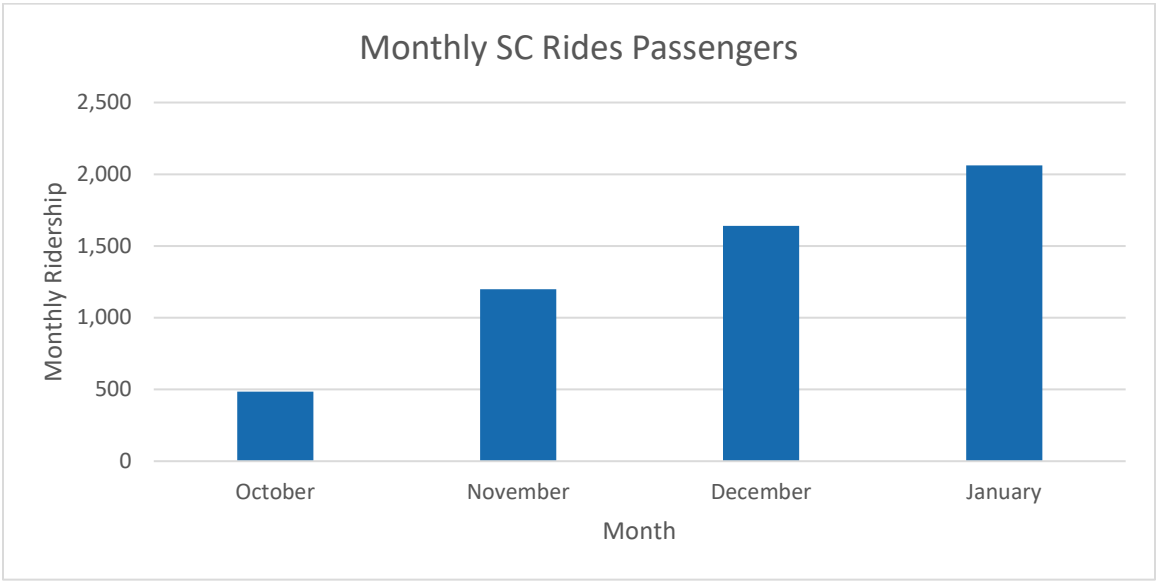


Source: Lyft. (October 10, 2016). "Reimagining Public Transit in San Clemente."

Program Performance

SC Rides beta test program has carried an average of 70 riders per day. Ridership grew considerably over the first four months of the program, as shown in Figure 7.[89]

Figure 7: SC Rides Monthly Ridership



Source: Frank, T. (November 29, 2017). *City of San Clemente Rideshare Beta Test Rider Program* [Presentation].

[89] Frank, T. (November 29, 2017). *City of San Clemente Rideshare Beta Test Rider Program* [Presentation]. Received through personal communications.

Challenges to Implementation

The original SC Rides program did not include options for people to call-in reservations and to have access to wheelchair-accessible vehicles. In order to be compliant with Title VI and ADA regulations, the SC Rides program must include these options. Once these options are operable, the City of San Clemente will formally launch the SC Rides program.[90]

Key Takeaways

Though these pilot programs are still in their infancy, there are a few emerging themes about "lessons learned" in pilot implementation.

1. Clearly Define the Service Area: The size and boundaries of the service area can greatly influence its success. Residents do not intuitively know where city boundaries are or when they are within three-quarters of a mile of a fixed-route service. Multiple interviewees recommended using major streets or natural boundaries that people are familiar with to clearly define service area boundaries, so they can be easily communicated to prospective riders.

2. Service Area Size Is Important to Success: The size of the service area matters depending on the operating and fare structures. Service areas that are too small serve a limited number of potential riders and make marketing difficult. Service areas that are too large could incur significant trip costs for both the agency and the passenger and may produce long response times. For TNCs, capacity constraints are not a consideration since capacity can adjust to meet demand. For in-house operations like AC Flex, the service area must be correctly sized to match the capacity of the dedicated vehicles.

3. Meet Title VI and ADA Requirements: In order to satisfy Title VI requirements, public transit agencies must provide a mechanism for riders to pay with cash and reserve trips over the phone. This option requires partnering with a transportation provider such as a taxi company, operating the service in-house, or establishing a call center where staff can book TNC rides for riders electronically. To satisfy ADA requirements, public transit agencies must provide wheelchair-accessible rides with comparable response times to TNCs, unless this service is guaranteed by the TNCs themselves. For most agencies this means expanding beyond their in-house paratransit services which often require day-ahead reservations. Two models exist for meeting this requirement, both of which require partnering with a third-party transportation provider. The first is to dedicate a vehicle to the service area, ensuring that wheelchair-accessible rides are readily available. However, this approach is expensive because drivers are paid whether or not rides are requested, and there may be a low demand for wheelchair-equipped vehicles. The second option is to reimburse the transportation provider on a per trip basis. This approach is more cost-effective but means that riders may have to wait longer to get a trip. However, agencies could work out arrangements with the transportation provider to guarantee a certain response time.

4. Choose the Right Fare Structure: The right fare structure strikes a careful balance between cost to riders and cost to the transit agency. Fares significantly higher than fixed-route fares may place

[90] Ibid.

a financial burden on fixed-route riders with limited income or discourage other travelers from using the service. Fares that are too low may expose the transit agency to high costs, limiting the cost savings they are able to realize through replacing fixed-route. To achieve this balance, many programs provide low initial fares but then cap the subsidy at a certain amount.

5. Marketing: Almost all interviewees mentioned marketing as a major factor limiting ridership potential. Tailored marketing is difficult in undefined service areas and when the agency cannot clearly identify their riders. Multiple agencies found that people living within the pilot's service area were not aware of the program. When service areas do not follow clear jurisdictional boundaries, it can be hard to conduct effective marketing campaigns. Most advertising channels market to a wider population than just those living within a relatively small service area. TNCs also do not readily share information about their riders; therefore, agencies typically do not receive data on the demographics of riders using the TNC programs. Requiring riders to register with the agency to use the program allows agencies to maintain a database of riders that can be used for targeted outreach and future data collection efforts.

These key takeaways were incorporated into the five TNC zone pilot models explored in the following sections.

Data and Methodology

This section outlines my methodology for determining places in RTA's service area where TNC partnerships may be cost-effective as well as for estimating potential cost savings.

Identifying the Partnership Structure

As discussed in the Literature Review and Case Studies sections, TNC/transit partnerships can take on a variety of forms. Many partnerships limit subsidies to trips taken to/from designated transit stops as a way to help ensure that riders are connecting into the larger transit network to complete their trip. However, I chose to structure these partnerships under the parameter that riders could travel anywhere within the zone and still receive a subsidy. I made this decision to preserve the use of public transportation for local community travel. Since this study focuses on replacing fixed-route, restricting subsidies to rides that started or ended at designated stops would cause many riders to lose access to service. First/last mile connections into fixed-route transit work well in areas that extend transit's current coverage area but are less ideal for replacing entire fixed-route services.

The Literature Review and Case Studies sections showed that TNC partnerships can only be successful if agencies also provide riders with a range of reservation, payment, and accessibility options. Riders must have the option to pay in cash, phone-in a reservation, and ride in a wheelchair-equipped vehicle. While there are a number of private transportation companies RTA could partner with, I selected Taxis as a provider that can meet all three of these requirements.

Identifying the TNC Analysis Zones

Through conversations with RTA staff, I determined the five analysis zones included in this study. We selected two zones based on analysis of current transit system performance, and the other

three zones are neighborhoods/areas that are not well served by the current transit network that have been continuous sources of discussion for RTA. To select the first two zones, I gathered data provided by RTA on route-level ridership, productivity (passengers per revenue hour), the farebox recovery ratio, and the subsidy per passenger boarding. Using these data, I identified routes with the lowest performance. I took the bottom five routes in each category which yielded eight unique routes, as shown in Table 4 below.

Table 4: Summary of Lowest-Performing RTA Local Routes

Route	Weekday Frequency (min)[91]	Average Trip Length (mi.)[92]	Annual Ridership[93]	Productivity	Farebox Recovery	Subsidy per Passenger
Route 3 – Corona, Eastvale	50	5.2	162,380	7.5	6.5%	($11.46)
Route 23 - Murrieta	60	7.5	95,163	6.2	7.6%	($11.84)
Route 24 - Temecula	80	7.8	63,395	6.7	8.9%	($10.68)
Route 26 – Moreno Valley Metrolink	50	N/A[94]	20,684	2.6	2.8%	($29.41)
Route 30 – Perris	70	3.9	56,988	6.1	7.7%	($11.92)
Route 33 – Hemet	75	3.6	39,299	7.8	8.9%	($9.07)
Route 40 – Canyon Lake	100	7.8	17,587	4.9	6.6%	($15.08)
Route 61 – Sun City/Menifee	70	11.0	81,211	4.9	6.7%	($15.32)

Route 26 has by far the lowest performance out of all the routes, carrying fewer than 100 passengers a day. It is one of RTA's newest local shuttle routes, starting after the Perris Valley Metrolink rail line opened in June 2016.[95] One primary takeaway from the interviews was the importance of service area size. With respect to TNC trips, trip length is a huge factor. RTA charges a flat fare regardless of how far passengers travel. With TNCs, costs accrue based on time and distance. In order to balance cost to RTA and cost to the passenger, it is important to minimize overall TNC trip costs, so shorter trips are better suited for such partnerships. As explained further in the Fare Structure section, three-mile trips achieve this balance. For this reason, I pursued Routes 30 and 33 for further consideration. Out of these two, Route 30 in Perris has lower productivity, farebox recovery, and higher subsidy per boarding. Therefore, I selected Routes 26 and 30 for this study.

[91] Riverside Transit Agency. (2018). "Maps & Schedules." Retrieved from: https://www.riversidetransit.com/index.php/riding-the-bus/maps-schedules.

[92] Transportation Management & Design, Inc. (2013). *SAS Passenger Activity by Time Period*. Unpublished raw data.

[93] Riverside Transit Agency. (2017). *RTA Quarterly Comprehensive Route Performance Report July 1, 2016 to June 30, 2017*. Received through personal communications.

[94] Average trip length data came from a ridecheck conducted in 2013 before RTA implemented Route 26.

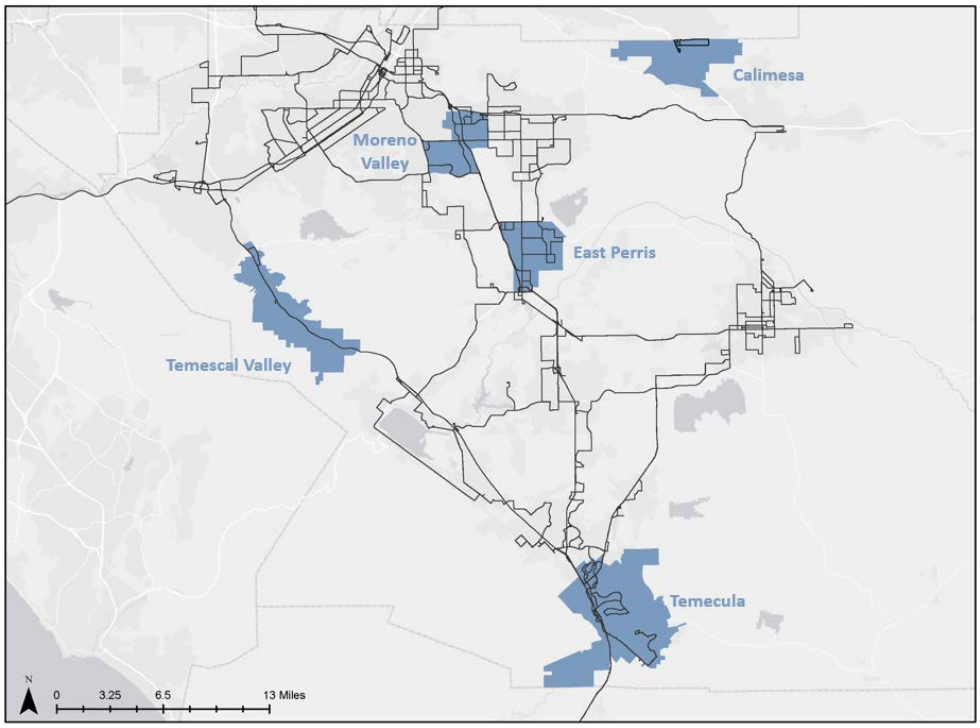
[95] Riverside Transit Agency. (2016). "Buses Connect with New 91/Perris Valley Line Metrolink Service." Retrieved from: https://www.riversidetransit.com/index.php/news-a-publications/latest-news/item/748-buses-to-connect-with-new-91-perris-valley-line-metrolink-service.

The other three zones were agreed upon through collaboration with RTA staff. They are locations where RTA receives frequent requests for service but are not well-suited for fixed-route transit. The first zone is the City of Temecula. TransLoc already completed a Mobility On Demand analysis for RTA that I leveraged as part of this study. The second zone is in Temescal Valley, an unincorporated community located south of the City of Corona and north of the City of Lake Elsinore along the I-15 freeway, that is served by one RTA CommuterLink express route but no local fixed-route service.

The third zone is in the City of Calimesa. Calimesa is a member of the RTA Joint Powers Agreement (JPA) and has a seat on the RTA board. However, RTA has not operated service in the City since 2009 when it discontinued an under-performing Route 36. Pass Transit, a co-operation between the City of Beaumont and the City of Banning, provides local fixed-route transit service in the San Gorgonio Pass area. The Beaumont Pass Transit agency (operated by the City of Beaumont) introduced Route 136 in Calimesa in August 2016. However, Pass Transit is running into the same problems RTA did when it operated Route 36 – very low ridership and farebox recovery, and Route 136 service is proposed to end in mid-2018. RTA is interested in evaluating a TNC solution in the area because of the City's history of not being able to sustain local fixed-route service.[96]

In a final step, I established the boundaries of the TNC analysis zones, as shown in Figure 8. In collaboration with RTA staff, we determined the final boundaries to ensure that all local transit needs would be met by the zones, relying primarily on major streets or jurisdictional boundaries.

Figure 8: Map of TNC Analysis Zones



[96] Forgiarini, J. (February 26, 2018). "Re: Route 136." Message to Melissa Sather. Email.

Estimating Pilot Ridership

There are three types of riders who could use the TNC pilot programs: current fixed-route riders, current Dial-a-Ride riders, and new riders.

Current Fixed-Route Riders: When AC Transit implemented AC Flex, the agency estimated that 40 percent of riders switched to the AC Flex system, 40 percent switched to using other fixed routes, and 20 percent stopped riding transit altogether. However, AC Transit has a more robust fixed-route transit program than RTA with more transit alternatives for riders. It is also important to over-estimate the cost of providing the pilot program so there are no surprises for RTA. Since RTA has fewer alternatives, I assumed that 80 percent of current riders would switch to the pilot program and 20 percent would switch to other fixed-routes or stop riding altogether. RTA staff provided average stop-level ridership for October 2017 – December 2017. I divided monthly ridership by the number of weekdays, Saturdays, and Sundays in each month to determine daily estimated ridership.

Dial-a-Ride Riders: RTA provided systemwide Dial-a-Ride data for the month of October 2017. I filtered this dataset to include only the cities in each TNC zone, then geo-coded the origin addresses to determine how many trips started within the zone. Then I took this filtered list and geo-coded the destination addresses to determine how many trips started and ended within the zone.

I assumed that 100 percent of Dial-a-Ride trips starting and ending within the TNC zone would switch over to the pilot program for three reasons:

1. Pilot program with on-demand service provides a much higher level of service than having to schedule a trip a day in advance.

2. Due to potential cost savings, it is beneficial to RTA to work with current riders and teach them how to use the pilot program.

3. Dial-a-Ride service would no longer be required to operate within three-quarters of a mile of the discontinued fixed-route. However, it would still be available in much of the service area due to the proximity of other fixed-route services.

New Riders: The traditional economic principle of elasticity of demand states that when the price of most service decreases, demand for it increases, so introducing a TNC subsidy should induce new ridership. TNCs can estimate price elasticity of demand for how demand changes in response to price changes, but this requires knowing how many people in the zone currently use TNCs. Since this data is not available, I based induced ridership estimates off the nearest comparable program – Corona's public Dial-a-Ride service.

The City of Corona, just west of the City of Riverside and north of Temescal Valley, operated a public Dial-a-Ride service within the City boundaries. Ridership trends on this service can be used as a proxy to estimate TNC partnership demand. However, it is not a perfect proxy because Dial-a-Ride service requires day-ahead phone reservations while TNCs are on-demand and scheduled

through an app. Annual ridership on the Corona Dial-a-Ride for FY2017 is shown in Table 5 below.[97]

Table 5: Corona Dial-a-Ride Ridership by Category

Category	Annual Riders
Regular	4,833
Disabled	25,813
ADA	17,701
Senior	6,288
Total	54,635

Next, I calculated what percent of the population used the Dial-a-Ride service on a daily basis using data from the American Community Survey 2016 1-Year Estimates.[98] Since "Senior" and "Disabled" are not mutually exclusive categories, I included any seniors over the age of 65 with a disability in the "Disabled" category. Additionally, because the number of ADA-eligible persons in each zone is unknown, I put the riders from the ADA category into the Disabled category. I then applied these percentages to the TNC zone population to estimate daily ridership numbers.

Table 6: Percent of Corona Population Using Dial-a-Ride Service

Rider Category	Annual Dial-a-Ride Trips	Average Daily Trips[99]	Total Corona Population	Percent of Population Using the Service
Regular	4,833	19.0	140,497	0.01%
Disabled	43,514	170.6	14,521	1.18%
Senior	6,288	24.7	11,756	0.21%
Total	54,635	214.3	166,774	0.13%

Estimating Pilot TNC/Taxi Cost

Estimating costs of a pilot program requires having information on trip length and duration for potential trips. RTA has some high-level trip length information for fixed-route transit at the route-level. However, the Dial-a-Ride dataset contains trip distance and duration details for individual trips. This provides information on individual travel patterns from which TNC or Taxi costs can be directly estimated. However, there are still two limitations with using this data.

1. Dial-a-Ride trip patterns are not necessarily representative of fixed-route trip patterns. In cases where there are too few Dial-a-Ride trips within the service area to appear representative of all fixed-route trips, average trip distances, I extrapolated average trip distances from average stop-level ridership reports and previous RTA ridership analyses.

[97] Paul, S. (January 25, 2018). "Re: RTA TNC Analysis." Message to Melissa Sather. Email.
[98] Census Reporter. (2016). *Corona, CA Community Profile.* American Community Survey 2016 1-Year Estimates. Retrieved from: https://censusreporter.org/profiles/16000US0616350-corona-ca/.
[99] Assumed 255 weekdays.

2. On trips with multiple passengers, the travel time in the dataset includes the time taken to pickup and drop-off other passengers, which can greatly increase travel times. The increased time is similar to what would occur on UberPool or LyftLine, but these programs do not operate in the study area. There is nothing in the data set that indicates when this is occurring, so it is not possible to extract these trips. However, using longer travel times will over-estimate the cost of providing a trip, resulting in a more conservative estimate of TNC/Taxi cost.

I calculated both TNC and Taxi fares for each Dial-a-Ride trip with complete information based on the fare drivers discussed in "Identifying the Fare Structures." I inputted the minimum fare of $6.80 to replace TNC values that fell below the minimum. Findings from the Peer Review suggest a 90-10 split between TNC and Taxi trips, even if a higher percentage of Taxi trips is optimal from a cost perspective. The convenience of booking a trip using an app and being able to track drivers and trip progress in real time are advantages TNCs have over Taxis that make them more attractive. I assumed that trips that had lower TNC than Taxi fares would remain as TNC trips. Then I determined how many trips needed to be taken on Taxis to reach 10 percent of all trips and ordered the trips from lowest cost to highest cost. Finally, depending on how many Taxi trips there were, I extracted trips at even intervals and assigned them as Taxi trips. For example, if there were 40 optimal Taxi trips but only 10 were required to meet the 10 percent threshold, I assigned every fourth trip as a Taxi trip. Finally, once all trips were assigned as TNC or Taxi trips, I took the associated fare to calculate an average fare per trip. I then multiplied the average fare by the estimated annual ridership to generate annual cost.

Estimating TNC/Taxi Revenue

Setting the right fare structure is critical to balancing the cost to riders and cost to RTA. While fixed-route fares are flat, TNC fares accrue based on time and distance. This increases potential costs to both the rider and RTA and inserts an unknown factor for both parties. Having defined zones limits potential costs since trips are limited to a certain distance. This analysis estimates fares based on known Uber, Lyft, and Taxi rates. Many of the pilot programs examined in the Peer Review require use of UberPool or LyftLine options to receive subsidies, but neither option is available in the TNC analysis zones. Therefore, all fares are based on UberX and regular Lyft rates.

The minimum fares imposed by the TNCs play a significant part in determining the ideal fare structure. Uber and Lyft have the same fare structures in the RTA service area. Both have a $2.80 booking/processing fee and a $4.00 minimum fare, for a total minimum fare of $6.80.[100] [101] The goal of the minimum fare is to guarantee drivers a certain amount of revenue per trip, but it also limits TNCs' feasibility for short-distance travel; $6.80 is a steep price to pay for a mile-long trip when the same trip can be made for $1.50 on RTA. However, having RTA absorb some of this cost and keeping the cost low for riders can make it an attractive mobility option for residents. The minimum fare of $6.80 covers about a 3-mile trip. In the RTA service area, TNCs charge $1.01 per

[100] Lyft. (May 2018). "Lyft Fare Estimator." Retrieved from: https://www.lyft.com/fare-estimate.
[101] Uber Technologies, Inc. (May 2018). "Uber Fare Estimate." Retrieved from: https://www.uber.com/fare-estimate/.

mile and $0.15 per minute. Assuming travel speeds of 20 mph, a 3-mile trip would take 9 minutes and cost $7.33. Because of the minimum fares, all trips under about 3 miles will cost the same.

While taxis are often considered more expensive than TNCs, they can be more cost-effective for short-distance travel. Yellow Cab in the RTA service area has a $3.00 hailing fee and charges $2.70.[102] Based on this fare structure, trips less than 1.5 miles are cheaper to take on taxis than on TNCs, assuming 20 mph travel speeds.

RTA's current base fare for fixed-route service is $1.50. CommuterLink express routes and Dial-a-Ride trips which provide a premium service cost the passenger $3.00.[103] Since point-to-point mobility provided through TNC partnerships is a premium service compared to traditional fixed-route, it is reasonable that RTA would charge a higher fare for trips taken through this program. For each zone I multiplied the number of annual passengers by each average fare to determine total estimated annual revenue. I examined four fare structures in this analysis, shown in Table 7.

Table 7: Overview of Fare Structures

Fare Structure	Reasoning	Pros	Cons
Rider pays $1.50	Same as RTA fixed-route fare	Minimizes cost to riders	Higher costs for RTA
Rider pays $3.00	Same as RTA Dial-a-Ride fare	Reflects higher quality of service provided by on-demand curb-to-curb service	More expensive for riders than current fixed-route option
RTA pays $5.00	$5.30 would make minimum TNC fare $1.50 for riders, simplified to $5.00	Minimizes cost exposure for RTA from long-distance trips and discourages riders from using the program for longer distances	Potentially high cost for riders
RTA and Riders each pay 50%	Splits cost burden between both parties	Same as above	Same as above

Estimating Current Operating Costs

Current Fixed-Route Cost: I took current annual fixed-route costs directly from RTA's Quarterly Comprehensive Route Performance Report July 1, 2016 – June 30, 2017. I included only Operations/ Maintenance costs as Administrative costs will not necessarily decrease with a reduction in service.

Current Dial-a-Ride Cost: The same Quarterly Comprehensive Route Performance Report includes a total Dial-a-Ride cost (without Taxi overflow). The total Operations/Maintenance cost (excludes Administration) was $10,862,802. I divided this total by the annual number of passengers, 415,236, to generate an average cost of $26.16 per trip. I then multiplied this cost per trip by the number of Dial-a-Ride trips within each zone to determine an annual cost of providing Dial-a-Ride service.

[102] The Yellow Cab Company. (2018). "Rates." Retrieved from: http://www.theyellowcab.com/rates/.
[103] Riverside Transit Agency. (2018). "Fares & Passes." Retrieved from: https://www.riversidetransit.com/index.php/riding-the-bus/fares-a-passes.

Estimating Current Fare Revenue

Current Fixed-Route Revenue: The Quarterly Comprehensive Route Performance Report contains data on annual passenger revenue on a route-level. For zones that did not replace entire routes I took the annual passenger revenue and divided it by the number of annual passengers to yield average revenue per passenger. I then multiplied this by the number of passengers estimated to lose service.

Current Dial-a-Ride Revenue: Dial-a-Ride fares are $3.00 per passenger boarding. I multiplied this rate by the number of annual Dial-a-Ride passengers impacted.

Estimating Net Savings

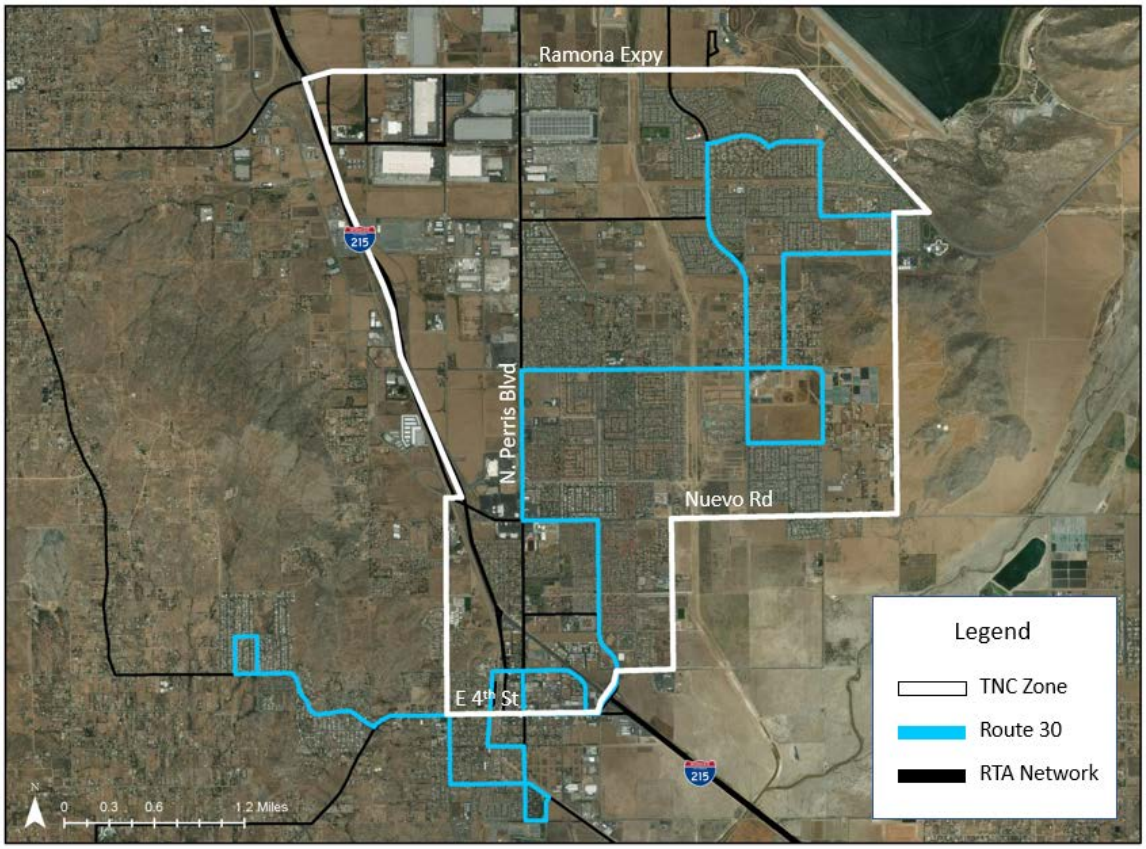
I subtracted the pilot subsidy from the current operating subsidy in order to estimate net savings.

Zone Analysis

Zone 1: Route 30 – East Perris

Route 30 operates as a community circulator within the City of Perris, providing local community travel as well as connections to Metrolink trains and other RTA buses at the Perris Station Transit Center. It operates as two separate loops (West Loop and East Loop) originating from the Perris Station Transit Center, each with 70-minute frequency.

Figure 9: Map of East Perris Analysis Zone



Service is provided between 4:00 AM and 7:30 PM on weekdays and 8:30 AM to 6:30 PM on Saturdays. There is no Sunday service.[104] In FY2017, this route averaged 6.1 passengers per revenue hour, less than half RTA's average of 14.0.[105] The TNC zone includes only the territory of the East Loop and covers 11.8 square miles.

Estimated Daily Pilot Ridership

Between October and December 2017, Route 30 carried an average of 228 boardings on weekdays, 170 on the East Loop and 58 on the West Loop.[106] In October 2017, Route 30 carried 395 passengers on Saturdays, an average of 99 boardings per day.[107] Assuming the same ratio of East to West Loop boardings take place on Saturdays, the East Loop generates an average of 74 boardings each Saturday. The TNC zone only includes the East Loop portion of the route. Many current riders board at stops near other fixed-route services and may continue using fixed-route rather than switching to the TNC pilot program. Route 19 operates in the heart of the TNC zone north/south on Perris Blvd every 15 minutes on weekdays and 30 minutes on weekends with connections into Perris Station Transit Center, providing an alternative for riders who do not wish to use the TNC program.[108] If 80 percent of current East Loop riders switch to the TNC program, the program would generate 136 boardings on weekdays and 59 boardings on Saturdays.

Evaluating October 2017 Dial-a-Ride ridership data generated the following number of Dial-a-Ride trips starting and ending within the service area. Since Route 30 does not operate on Sundays, the Sunday trip was excluded from analysis. Figure 10 shows which Dial-a-Ride trip origin locations fall within the TNC zone boundary and were included as part of this analysis.

Table 8: East Perris Zone Dial-a-Ride Boardings

Total Perris Trips	Origins in TNC Zone	Destinations in TNC Zone	Weekday Boardings	Saturday Boardings	Sunday Boardings
1,711	827	381	354	26	1

Fixed-route and Dial-a-Ride combined projected ridership is shown in Table 9 below.

Table 9: East Perris Zone Ridership Projections

Day Type	Daily Fixed-Route	Daily Dial-a-Ride	Total Daily Ridership	Days per Year	Annual Ridership
Weekdays	136	16	152	260	39,544
Saturdays	59	7	66	52	3,406

Total annual ridership is projected to be 42,950.

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[104] Riverside Transit Agency. (January 14, 2018). "Ride Guide – Route 30." Retrieved from: https://www.riversidetransit.com/images/stories/DOWNLOADS/ROUTES/030.pdf.

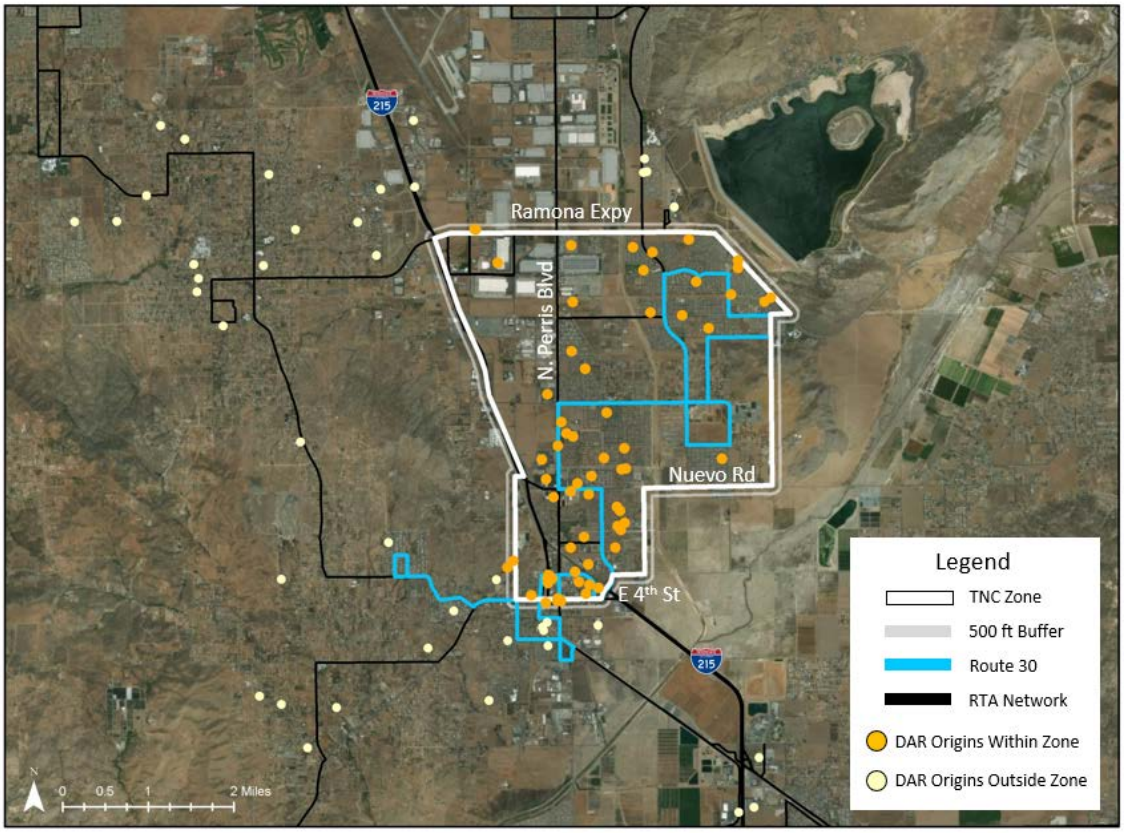
[105] Riverside Transit Agency. (2017). *RTA Quarterly Comprehensive Route Performance Report July 1, 2016 to June 30, 2017*. Received through personal communications.

[106] Riverside Transit Agency. (2017). *Ridership by Route and Stop Routes 26 and 30 weekdays Oct – Dec 2017 average* [Excel spreadsheet]. Unpublished raw data received through personal communications.

[107] Riverside Transit Agency. (2017). *Ridership Detail Report 2017-10-v1* [Excel spreadsheet]. Unpublished raw data received through personal communications.

[108] Riverside Transit Agency. (January 14, 2018). "Ride Guide – Route 19." Retrieved from: https://www.riversidetransit.com/images/stories/DOWNLOADS/ROUTES/019.pdf.

Figure 10: Map of October 2017 Dial-a-Ride Origins in East Perris Zone



Estimated TNC and Taxi Cost

I estimated average TNC and Taxi cost to be $7.92 using the methodology discussed in "Data and Methodology." TNC fares were lower than Taxi fares for 56 percent of trips.

Table 10: East Perris Zone Average Trip Characteristics

Average Trip Distance	Average Trip Duration	Average TNC/Taxi Cost
2.2 miles	16.3 minutes	$7.92

If annual ridership is 42,950 passengers, total pre-revenue TNC/Taxi cost is estimated to be $340,161.

Estimated TNC/Taxi Revenue

Table 11 below shows the estimated annual fare revenue and operating subsidy for each of the four fare structures based on an average trip cost of $7.92.

Table 11: East Perris Zone Estimated Fare Revenue

Fare Structure	Cost to Riders	Cost to RTA	Annual Revenue	Annual Cost	Annual Subsidy
Riders pay $1.50	$1.50	$6.42	$64,424	$340,161	$275,737
Riders pay $3.00	$3.00	$4.92	$128,849	$340,161	$211,312
RTA pays $5.00	$2.92	$5.00	$125,413	$340,161	$214,748
RTA pays 50%	$3.96	$3.96	$170,081	$340,161	$170,081

Estimated Fixed-Route and Dial-a-Ride Cost

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 30 cost $663,375 to operate. The route uses two vehicles, so discontinuing the East Loop would save one vehicle, reducing the cost by half to $331,687. RTA average cost per Dial-a-Ride trip is $26.16. Multiplying average daily October ridership by 260 yields an annual Dial-a-Ride cost of $118,286.

Table 12: East Perris Zone Dial-a-Ride Cost

Day Type	October 2017 Ridership	Annual Ridership	Annual Cost
Weekdays	354	4,184	$109,444
Saturdays	26	338	$8,842
Total	381	4,522	$118,286

Together, total cost of providing service in East Perris is $449,974.

Estimated Fixed-Route and Dial-a-Ride Revenue

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 30 generated $52,924 in fare revenue. The route carried 56,988 passengers to yield average revenue per passenger of $0.93. Assuming RTA operated 256 weekdays and 52 Saturdays and that the East Loop carries 170 passengers on weekdays and 74 passengers on Saturdays, an annual total of 47,368 riders would be impacted from discontinuing the East Loop.[109] These 47,368 riders pay estimated annual fare revenue of $44,052.

RTA Dial-a-Ride base fare is $3.00 per trip. Multiplying annual ridership of 4,522 by $3.00 yields annual Dial-a-Ride revenue of $13,566.

Together, total revenue generated by Route 30 and intra-zone Dial-a-Ride service is $57,618. Operating subsidy (cost minus revenue) is $392,356.

Estimated Cost Savings

All four scenarios generate considerable cost savings for RTA. While it is difficult to estimate general public induced demand from less expensive TNC trips, I calculated how many more riders this pilot could serve before incurring additional costs. Assuming the most expensive option for RTA, riders pay $1.50, this program could provide an additional 18,142 annual trips, or 58 daily trips, with the current cost savings.

Table 13: East Perris Zone Estimated Net Savings

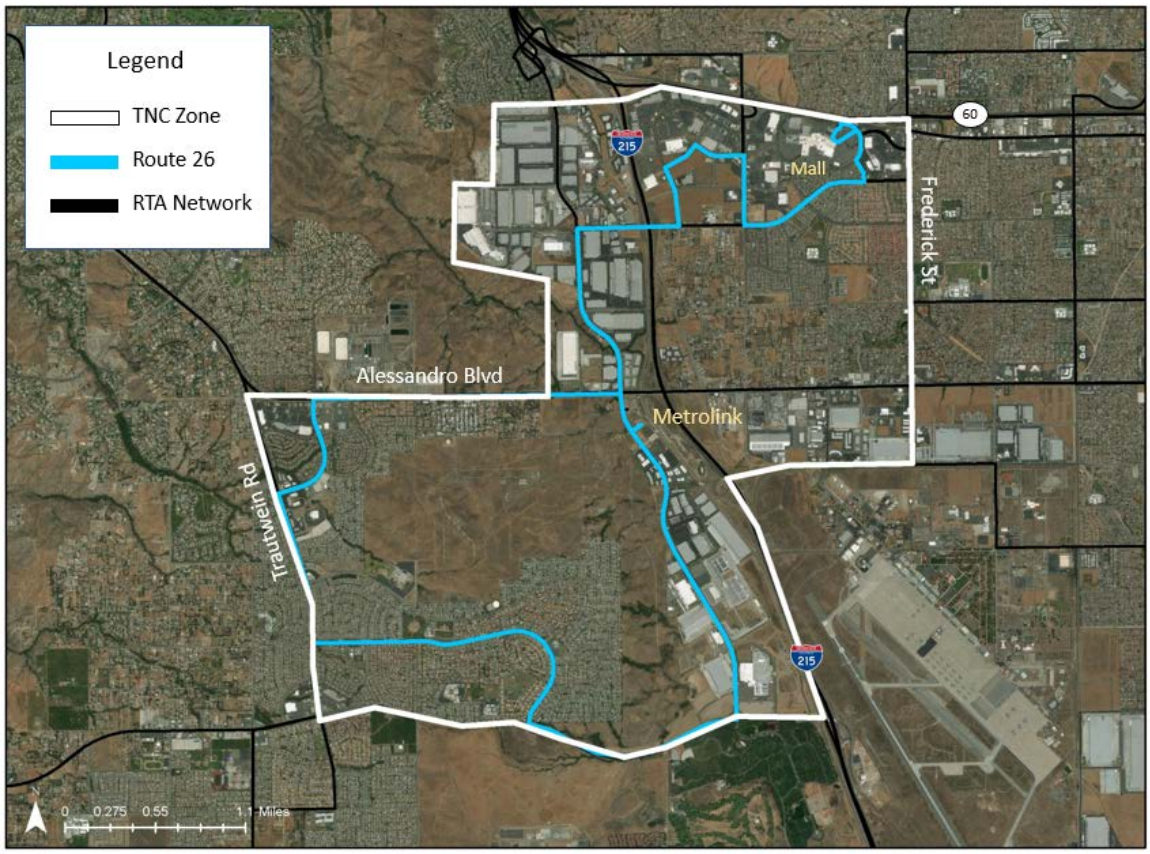
TNC/Taxi Pilot Program				Current RTA Service			Net Savings
Fare Structure	Fare Revenue	Operating Cost	Operating Subsidy	Fare Revenue	Operating Cost	Operating Subsidy	
Riders pay $1.50	$64,424	$340,161	$275,737	$57,618	$449,974	$392,356	**$116,619**
Riders pay $3.00	$128,849	$340,161	$211,312	$57,618	$449,974	$392,356	**$181,043**
RTA pays $5.00	$125,413	$340,161	$214,748	$57,618	$449,974	$392,356	**$177,607**
RTA pays 50%	$170,081	$340,161	$170,081	$57,618	$449,974	$392,356	**$222,275**

[109] Riverside Transit Agency. (2018). *FY2018 Performance Statistics* [Excel spreadsheet]. Unpublished raw data received through personal communications.

Zone 2: Route 26 – March Air Force Base Metrolink Station

This zone includes the entirety of Route 26 with key destinations including the Moreno Valley/March Field Metrolink Station and Moreno Valley Mall. The zone is 10.8 square miles.

Figure 11: Map of Moreno Valley Zone

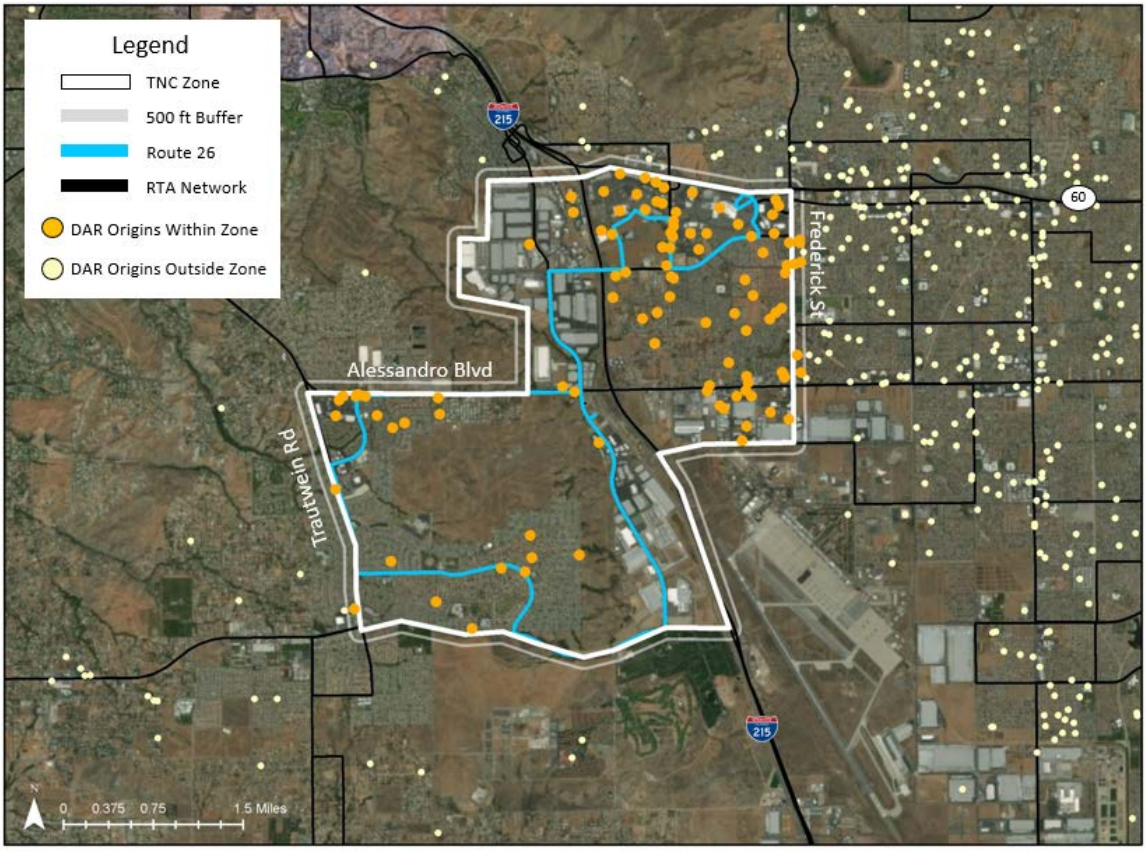


Estimated Daily Pilot Ridership

Between October and December 2017, Route 26 carried an average of 129 boardings on weekdays. If 80 percent of current Route 26 riders switch to the TNC program, the program would generate 103 boardings on weekdays, or 26,000 riders annually.

A total of 9,394 weekday Dial-a-Ride October trips fell within these jurisdictions. Of these trips, 1,273 originated within a 500-foot buffer of the study area (shown in Figure 12), but only 98 both started and ended within the study area. Only four of these trips ended west of I-215.

Figure 12: Map of October 2017 Dial-a-Ride Origins in Moreno Valley Zone



Fixed-route and ADA combined projected ridership is shown in Table 14 below.

Table 14: Moreno Valley Zone Estimated Ridership

Day Type	Daily Fixed-Route	Daily Dial-a-Ride	Total Daily Ridership	Days per Year	Annual Ridership
Weekdays	103	4.5	108	260	27,938

Total annual ridership is projected to be 27,938.

Estimated TNC and Taxi Cost

For the Perris zone, I assumed Dial-a-Ride travel patterns were representative of general public travel patterns. The same assumption cannot be made for the Moreno Valley zone because of the limited sample of Dial-a-Ride trips that take place within the zone each month. Only four trips each month end west of I-215. I therefore used Route 26 stop-level ridership data to interpolate rider travel patterns. Relying on stop-level ridership generally is not ideal because there is no way to link individual boardings and alightings to represent a single trip. However, data from Route 26 shows clear ridership patterns.

Like Route 30, Route 26 is split into an East Loop and a West Loop. The East Loop operates between Moreno Valley/March Field Metrolink Station and Moreno Valley Mall. On the bus, this

is a 5.5-mile trip that takes 22 minutes. Driving, this is a 3-mile trip that takes about 10 minutes.[110] Of the 79 daily boardings on the East Loop, 41 take place at these two stops. This is the longest trip that can be made on the East Loop, so to be conservative, I assumed that all East Loop trips will travel between the Metrolink Station and Moreno Valley Mall, using a 3-mile trip distance and 10-minute trip time. Assuming 90 percent of trips are taken on TNCs and 10 percent are taken on taxis, the average fare for East Loop trips is $7.71.

The West Loop operates between the Metrolink Station and the U.S. Social Security Administration building, a 2.9 and 5.9-mile trip depending on direction. Assuming the 5.9-mile distance and a 12-minute travel time, average fare for West Loop trips is $11.40.[111]

The average trip distance of the 98 October Dial-a-Ride trips is 1.42 miles, and the average trip duration is 11.65 minutes. I estimated taxi and TNC fares for each of the 98 weekday trips. For 73 percent of trips, taxi fares were lower than the TNC fare. This is due to the prevalence of short-distance trips. Assuming each rider picks the travel option that results in the lowest overall trip cost, the average trip cost would be $6.58. Assuming 90 percent of trips take place on TNCs, average cost would be $7.06.

Table 15: Moreno Valley Zone Estimated TNC/Taxi Cost

Rider Type	Daily Riders	Annual Riders	Cost per Trip	Annual Cost
East Loop	63	16,380	$7.71	$126,241
West Loop	40	10,400	$11.40	$118,519
Dial-a-Ride	4.5	1,158	$7.06	$8,175
Total	108	27,938	$9.05	$252,936

If annual ridership is 27,938 passengers, total TNC/Taxi cost is estimated to be $252,936.

Estimated TNC/Taxi Revenue

Table 16 below shows the estimated annual fare revenue and operating subsidy for each of the four fare structures based on an average trip cost of $9.05.

Table 16: Moreno Valley Zone Estimated TNC/Taxi Revenue

Fare Structure	Cost to Riders	Cost to RTA	Fare Revenue	Annual Cost	Annual Subsidy
Riders pay $1.50	$1.50	$7.55	$41,907	$252,936	$211,029
Riders pay $3.00	$3.00	$6.05	$83,814	$252,936	$169,122
RTA pays $5.00	$4.05	$5.00	$113,149	$252,936	$139,787
RTA pays 50%	$4.525	$4.525	$126,468	$252,936	$126,468

[110] Google. (March 2018). [Google Maps driving directions from Moreno Valley/March Field Metrolink Station and Moreno Valley Mall]. Retrieved from: https://www.google.com/maps/dir/.
[111] Google. (March 2018). [Google Maps driving directions from Moreno Valley/March Field Metrolink Station and U.S. Social Security Administration Moreno Valley]. Retrieved from: https://www.google.com/maps/dir/.

Estimated Fixed-Route and Dial-a-Ride Cost

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 26 cost $564,027 to operate. RTA average cost per Dial-a-Ride trip is $26.16. Multiplying average daily ridership in October by 260 yields an annual Dial-a-Ride cost of $30,298. ***Together, total cost of providing Route 26 and intra-zone Dial-a-Ride service is $594,325.***

Estimated Fixed-Route and Dial-a-Ride Revenue

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 26 generated $17,784 in fare revenue.

RTA Dial-a-Ride base fare is $3.00 per trip. Multiplying annual ridership of 1,158 by $3.00 yields annual Dial-a-Ride revenue of $3,474.

Together, total revenue generated by Route 26 and intra-zone Dial-a-Ride service is $21,258. Operating subsidy (cost minus revenue) is $573,067.

Estimated Cost Savings

All four scenarios generate considerable cost savings for RTA. Assuming the most expensive option for RTA, RTA could carry an additional 184 passengers each weekday without incurring additional cost.

Table 17: Moreno Valley Zone Estimated Net Savings

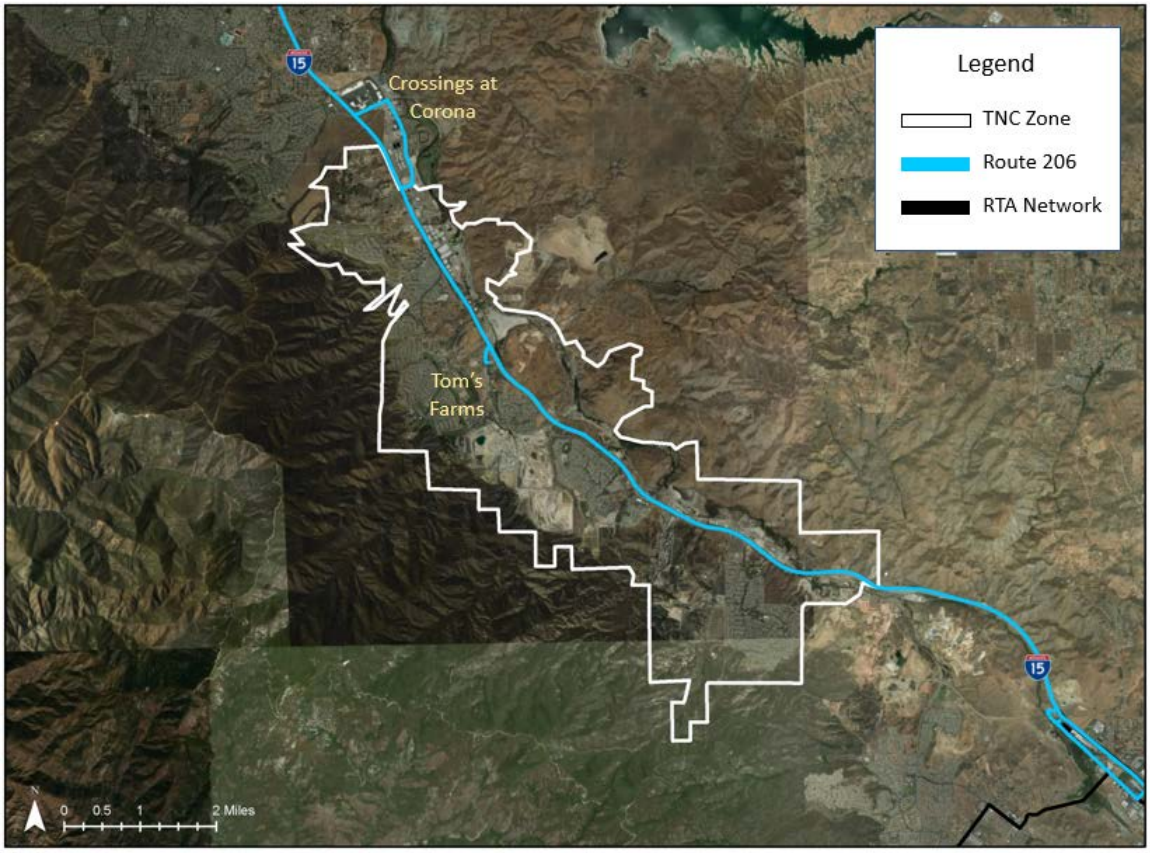
TNC/Taxi Pilot Program				Current RTA Service			Net Savings
Fare Structure	Fare Revenue	Operating Cost	Operating Subsidy	Fare Revenue	Operating Cost	Operating Subsidy	
Riders pay $1.50	$41,907	$252,841	$210,933	$21,258	$594,325	$573,067	**$362,134**
Riders pay $3.00	$83,815	$252,841	$169,026	$21,258	$594,325	$573,067	**$404,041**
RTA pays $5.00	$113,150	$252,841	$139,691	$21,258	$594,325	$573,067	**$433,376**
RTA pays 50%	$126,420	$252,841	$126,420	$21,258	$594,325	$573,067	**$446,647**

Zone 3: Temescal Valley

Temescal Valley lies just south of Corona and primarily consists of subdivisions developed off of I-15. The entire area covers 19.3 square miles and is home to 24,654 residents. The TNC analysis zone includes this entire area as well as the Crossings at Corona shopping center and North Main Corona Metrolink Station as an isolated point to provide connections into Metrolink and frequent fixed-route service. RTA currently operates CommuterLink Routes 205 and 206 in Temescal Valley with connections into Temecula, Corona, and Orange County. However, service operates weekday peak periods only. Tom's Farms is served by eight northbound and ten southbound trips on weekdays with no service between 8:00 AM and 4:00 PM. On average, RTA boards 13 riders per day in Temescal Valley.[112]

[112] Forgiarini, J. (March 5, 2018). "Re: Additional Data Question." Message to Melissa Sather. Email.

Figure 13: Map of Temescal Valley TNC Zone



Estimated Daily TNC Pilot Ridership

RTA currently provides trips to 13 riders each weekday, for an annual ridership of 3,380. To be conservative, I counted these riders in the daily ridership estimates. However, because Routes 205 and 206 would continue to operate even with the partnership in place, it is likely that riders not destined for Corona would continue using this service.

Table 18: Temescal Valley Zone Estimated Ridership

Rider Category	Total Temescal Valley Population[113]	Percent of Population Using the Service	Average Daily Trips	Annual TNC Pilot Trips
Regular	20,387	0.01%	2	530
Disabled	1,980	1.18%	23	6075
Senior	2,430	0.21%	5	1327
Total	**24,797**	**0.13%**	**30**	**7,931**

[113] Census Reporter. (2016). *Temescal Valley, CA Community Profile.* American Community Survey 2016 1-Year Estimates. Retrieved from: https://censusreporter.org/profiles/16000US0678138-temescal-valley-ca/.

To estimate additional ridership, I applied the ridership percentages from the Corona public Dial-a-Ride to the population of Temescal Valley, as discussed in the "Data and Methodology" section. Expanding the TNC zone to the entire City is expected to generate an additional 7,931 annual passenger trips.

Total annual TNC pilot ridership is projected to be 11,311.

Estimated TNC/Taxi Cost

Actual travel pattern data is not available for Temescal Valley. Without knowing where people would travel to, it is difficult to estimate their TNC fares. In this case, it is best to overestimate costs so RTA allocates enough operating resources to provide the service. This TNC zone includes three major destinations: Tom's Farms grocery and shopping center, Crossings at Corona shopping mall, and the North Main Corona Metrolink Station. I assumed that half the trips would be from Tom's Farms to Crossings at Corona and the other trips would be from Tom's Farms to North Main Corona Metrolink Station. Since both the Crossings and the Metrolink station are outside of Temescal Valley, this assumption should be conservative and capture internal trips within Temescal Valley.

A trip from Tom's Farms to the North Main Corona Metrolink Station is 10.3 miles and can take 16 to 30 minutes during morning rush hour. A trip from Tom's Farms to the Crossings at Corona is 4.4 miles takes around 15 minutes.[114] This generates the following TNC and Taxi costs, for an average trip cost of $14.52.

Table 19: Temescal Valley Zone Estimated TNC/Taxi Cost

Trip Origin-Destination	Distance	Duration	TNC Fare	Taxi Fare
Tom's Farms to Crossings at Corona	4.4 miles	15 minutes	$9.49	$14.88
Tom's Farms to Metrolink Station	10.3 miles	30 minutes	$17.70	$30.81

If annual ridership is 11,311 passengers, annual TNC/Taxi cost is estimated to be $164,278.

Estimated TNC/Taxi Revenue

Table 20 below shows the estimated annual fare revenue and operating subsidy for each of the four fare structures based on an average trip cost of $14.52.

Table 20: Temescal Valley Zone Estimated TNC/Taxi Revenue

Fare Structure	Cost to Riders	Cost to RTA	Fare Revenue	Annual Cost	Annual Subsidy
Riders pay $1.50	$1.50	$13.02	$16,967	$164,278	$147,311
Riders pay $3.00	$3.00	$11.52	$33,934	$164,278	$130,344
RTA pays $5.00	$9.52	$5.00	$107,685	$164,278	$56,593
RTA pays 50%	$7.26	$7.26	$82,139	$164,278	$82,139

[114] Google. (March 2018). [Google Maps driving directions from Tom's Farms to Crossings at Corona]. Retrieved from: https://www.google.com/maps/dir/.

Estimated Fixed-Route Cost

Since RTA would not discontinue any service in this area, it would not realize any cost savings. However, this information can help RTA argue that implementing a TNC partnership would be more cost-effective than implementing fixed-route service when confronted with requests for additional bus service.

Route 40 operates in a suburban/rural environment similar to Temescal Valley. It uses one vehicle and operates between 5:30 AM and 7:30 PM on weekdays.[115] Routes 40 costs $255,923 to operate on an annual basis, and this number can serve as the baseline for what a similar fixed-route service would cost to operate in Temescal Valley.[116]

Total operating costs of a fixed-route service in Temescal Valley is estimated to be $255,923.

Estimated Fixed-Route Revenue

Route 40 generates average revenue of $1.07 per passenger boarding.[117] Applying this to the estimated 11,311 annual ridership yields annual revenue of $12,103.

Annual revenue generated by a fixed-route service is estimated to be $12,103. Estimated operating subsidy (cost minus revenue) is $243,820.

Estimated Cost Savings

All four scenarios generate considerable cost savings for RTA. It is also important to note that this net savings estimate is conservative and does not account for Dial-a-Ride service that RTA would be required to provide if it chose to introduce fixed-route service. This scenario assumes all TNC partnership riders would use the fixed-route service which is unlikely given that a large percentage of the riders have disabilities and may not be able to use fixed-route. If some of these riders used Dial-a-Ride rather than fixed-route, RTA's net savings from using a TNC partnership over fixed-route would increase.

Table 21: Temescal Valley Zone Estimated Net Savings

TNC/Taxi Pilot Program				Current Pass Transit Service			Net Savings
Fare Structure	Fare Revenue	Operating Cost	Operating Subsidy	Fare Revenue	Operating Cost	Operating Subsidy	
Riders pay $1.50	$16,967	$164,278	$147,311	$12,103	$255,923	$243,820	**$96,509**
Riders pay $3.00	$33,934	$164,278	$130,344	$12,103	$255,923	$243,820	**$113,476**
RTA pays $5.00	$107,685	$164,278	$56,593	$12,103	$255,923	$243,820	**$187,227**
RTA pays 50%	$82,139	$164,278	$82,139	$12,103	$255,923	$243,820	**$161,681**

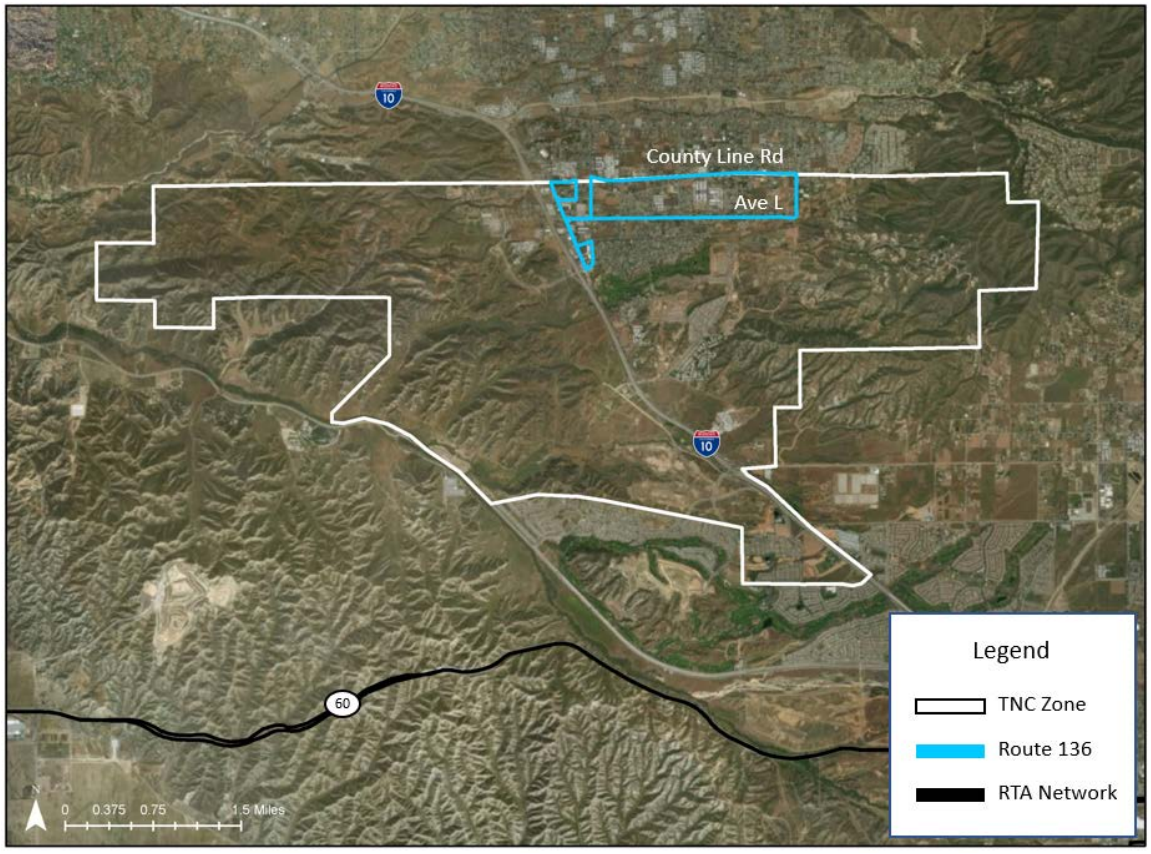
[115] Riverside Transit Agency. (January 14, 2018). "Ride Guide – Route 40." Retrieved from: https://www.riversidetransit.com/images/stories/DOWNLOADS/ROUTES/040.pdf.
[116] RTA Quarterly Comprehensive Route Performance Report July 1, 2016 to June 30, 2017.
[117] Ibid.

Zone 4: Calimesa

Fixed-route service has historically been unsuccessful within the City of Calimesa. RTA discontinued Route 36 due to low ridership in 2009. Current Route 136 operated by Pass Transit is also considerably under-performing.[118] The route connects City Hall, Calimesa Library, Mesa Grande Academy, and the Stater Brothers shopping center, operating 20 trips on weekdays only, with two supplementary school trips.[119]

The City of Calimesa is 14.8 square miles and home to 8,269 residents. The median age is 51.4, and 30.3 percent of residents are over the age of 65. This is considerably higher than the Riverside-San Bernardino-Ontario Metropolitan Area average of 11.5 percent.[120] As of 2013, 74.1 percent of the land was vacant, 14.2 percent was residential, and only 4.6 percent was commercial.[121] This means there are a limited number of potential transit trip generators within the City.

Figure 14: Map of Calimesa Zone



[118] Forgiarini, J. (February 26, 2018). "Re: Route 136." Message to Melissa Sather. Email.
[119] Pass Transit. (December 1, 2017). "Route 136." Retrieved from: https://passtransit.com/bus-route-information/route-136/.
[120] Census Reporter. (2016). *Calimesa, CA Community Profile.* American Community Survey 2016 1-Year Estimates. Retrieved from: https://censusreporter.org/profiles/16000US0609864-calimesa-ca/.
[121] City of Calimesa. (August 4, 2014). *City of Calimesa General 2014 Plan.* Retrieved from: http://www.cityofcalimesa.net/Forms/Calimesa%20General%20Plan.pdf, pp. 2-3.

Estimated Daily TNC Pilot Ridership

Between July 2017 and January 2018 Route 136 carried 1,958 passengers, an average of 13.5 per day. Assuming this ridership trend continues, the route is expected to carry an average of 3,357 passengers per year.[122] There are no ADA-registered residents living within three-quarters of a mile of the route who require supplementary ADA service.[123]

To estimate additional ridership, I applied the ridership percentages from the Corona public Dial-a-Ride to the population of Calimesa. Expanding the TNC zone to the entire City is expected to generate an additional annual 5,885 passenger trips. This methodology may overestimate ridership by double-counting riders already using Route 136, leading to a more conservative estimate of anticipated TNC costs.

Table 22: Calimesa Zone Estimated Ridership

Rider Category	Total Calimesa Population[124]	Percent of Population Using the Service	Average Daily Trips	Annual TNC Pilot Trips
Regular	5,096	0.01%	0.5	133
Disabled	1,594	1.18%	18.8	4,890
Senior	1,579	0.21%	3.3	862
Total	8,269	0.13%	22.6	5,885

Total annual TNC pilot ridership is estimated to be 9,242.

Estimated TNC/Taxi Cost

Actual travel pattern data is not available for Route 136. A trip from Mesa Grande Academy to Stater Bros. shopping center is 2.5 miles and takes about 8 minutes to drive.[125] This represents about the farthest a rider can travel on Route 136. To be conservative, I assumed that all riders make this trip. Even when the zone is applied to the entire City, this trip represents one of the longer possible trips that can be made within the developed territory due to geographic limitations. This generates a TNC cost of $6.53 ($6.80 once the maximum is applied) and Taxi cost of $9.75. Assuming 90 percent of riders use TNCs and 10 percent use Taxis, the average TNC/Taxi cost is $6.85.

If annual ridership is 9,242 passengers, annual TNC/Taxi cost is estimated to be $63,308.

Estimated TNC/Taxi Revenue

Table 23 below shows the estimated annual fare revenue and operating subsidy for each of the four fare structures based on an average trip cost of $6.85. Fare structures for this scenario vary

[122] Pass Transit. (2018). *FY 2017-2018 Route 136 Only* [Excel spreadsheet]. Unpublished raw data received through personal communications.
[123] Cabrera, C. (February 12, 2018). "Re: Route 136." Message to K. Warsinski. Email.
[124] Census Reporter. (2016). *Calimesa, CA Community Profile.* American Community Survey 2016 1-Year Estimates. Retrieved from: https://censusreporter.org/profiles/16000US0609864-calimesa-ca/.
[125] Google. (March 2018). [Google Maps driving directions from Mesa Grande Academy to Stater Bros]. Retrieved from: https://www.google.com/maps/dir/.

from the previous RTA scenarios. Pass Transit's base fare is $1.15, and its discounted Senior/Disabled fare is $0.65.[126] Since 27 percent of Route 136 riders pay with a Senior/Disabled fare, it made sense to leave in this fare option.[127]

Table 23: Calimesa Zone Estimated TNC/Taxi Revenue

Fare Structure	Cost to Riders	Cost to Pass Transit	Annual Revenue	Annual Cost	Annual Subsidy
Riders pay $0.65	$0.65	$6.20	$6,007	$63,308	$57,301
Riders pay $1.15	$1.15	$5.70	$10,628	$63,308	$52,680
Pass Transit pays $5.00	$1.85	$5.00	$17,098	$63,308	$46,210
Pass Transit pays 50%	$3.425	$3.425	$31,654	$63,308	$31,654

Estimated Fixed-Route Cost

Total cost of providing Route 136 service is $107,208.[128]

Estimated Fixed-Route Revenue

I estimated Route 136 fixed-route revenue from Pass Transit's base fare. Pass Transit charges $1.15 per one-way trip and provides a $0.65 for seniors and persons with disabilities. Since 27 percent of Route 136 riders pay a Senior/Disabled fare, I estimate the average fare to be $1.015. Multiplying annual ridership of 3,357 by $1.015 yields annual revenue of $3,407.

Annual revenue generated by Route 136 is service is $3,407. Operating subsidy (cost minus revenue) is $103,801.

Estimated Cost Savings

All four scenarios are estimated to generate considerable cost savings for Pass Transit.

Table 24: Calimesa Zone Estimated Net Savings

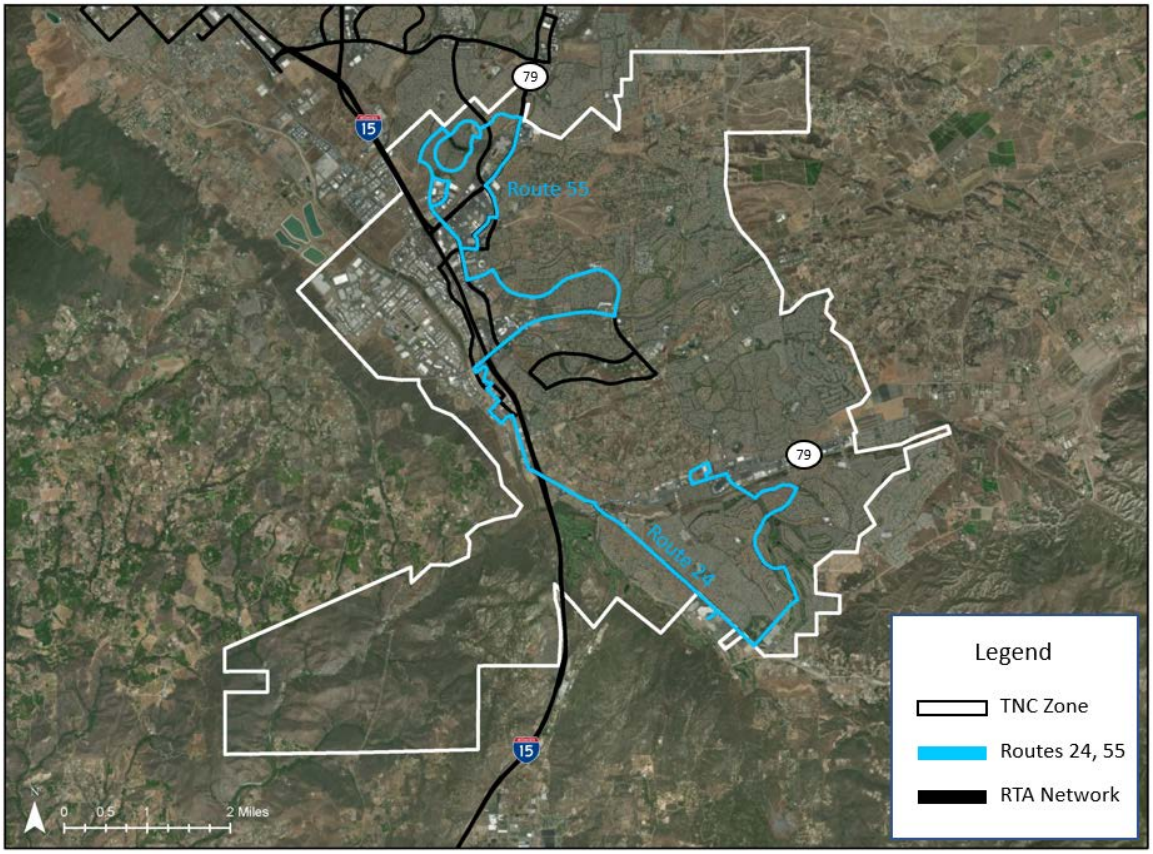
TNC/Taxi Pilot Program				Current Pass Transit Service			Net Savings
Fare Structure	Fare Revenue	Operating Cost	Operating Subsidy	Fare Revenue	Operating Cost	Operating Subsidy	
Riders pay $0.65	$6,007	$63,308	$57,301	$3,407	$107,208	$103,801	**$46,500**
Riders pay $1.15	$10,628	$63,308	$52,680	$3,407	$107,208	$103,801	**$51,121**
Pass Transit pays $5	$17,098	$63,308	$46,210	$3,407	$107,208	$103,801	**$57,591**
Pass Transit pays 50%	$31,654	$63,308	$31,654	$3,407	$107,208	$103,801	**$72,147**

[126] Pass Transit. (2018). "Fares & Passes." Retrieved from: https://passtransit.com/fare-passes/.
[127] Pass Transit. (2018). *FY 2017-2018 Route 136 Only* [Excel spreadsheet]. Unpublished raw data received through personal communications.
[128] Cabrera, C. (February 12, 2018). "Re: Route 136." Message to K. Warsinski. Email.

Zone 5: City of Temecula

The methodology for the City of Temecula zone is different from the other four. In Fall 2017, TransLoc, a microtransit software company, developed a Microtransit Simulator model for RTA using the City of Temecula data as a test simulation. TransLoc uses an OnDemand Dispatch System with scheduling algorithms to implement on-demand transit service in cities throughout the country. TransLoc works by efficiently scheduling and routing trips, while the vehicles are still operated by the transit agency or a third-party transportation provider. Different from TNCs, TransLoc provides the technology but not the vehicles or the drivers.[129] For this zone, I analyzed whether implementing the TransLoc partnership in Temecula would be more cost-effective than maintaining current RTA fixed-route and Dial-a-Ride service.

Figure 15: Map of Temecula TNC Zone



RTA operates two transit routes entirely within the City of Temecula: Route 24 which offers service approximately every 70 minutes between the Promenade Mall and Pechanga Resort & Casino,[130] and Route 55 which operates approximately every 20 minutes during peak periods as a

[129] TransLoc, Inc. (2018). "TransLoc: Deliver the Ultimate Rider Experience." Retrieved from: https://transloc.com/.

[130] Riverside Transit Agency. (January 14, 2018). "Ride Guide – Route 24." Retrieved from: https://www.riversidetransit.com/images/stories/DOWNLOADS/ROUTES/024.pdf.

short-distance community circulator.[131] AllTransit™, operated by the Center for Neighborhood Technology, estimates that 59 percent of Temecula residents live within a half mile of a transit stop and that only 0.41 percent of commuters take transit to work.[132] However, the city is also difficult to serve effectively with fixed-route transit, due to its low-density development, long block lengths, and auto-centric development patterns. This is shown by the fact that I identified Route 24 as one of the lowest-performing routes in the network. RTA has struggled to find a way to cost-effectively provide transit access to Temecula residents.

The TransLoc Microtransit Simulator estimates trip costs based on different combinations of ridership levels and available vehicles. It modeled 15 different scenarios based on 50, 100, and 300 trips per day and 2, 4, 6, and 10 vehicles available for service with the top six results shown in Table 25. TransLoc calculated trip costs using an input cost of $65 per vehicle hour, comparable to RTA DAR operating cost per hour. The model assumed vehicles had 7-passenger capacity, and it randomly selected pick up times throughout the day. Finally, the model randomly generated trip origins and weighted them by population density.[133]

Table 25: TransLoc Microtransit Simulator Results

Trips	Vehicles	Hours of Service	Rides per Hour per Vehicle	Average Wait Time (min)	Average Ride Time (min)	Cost per Trip ($)	Ride Pooling (%)
50	2	11	2.3	2	17	28	25
100	2	11	4.5	10	24	14	41
100	4	11	2.3	2	15	28	20
100	6	11	1.5	0	15	43	15
300	6	11	4.5	8	23	14	40
300	10	11	2.7	2	16	24	25

Because drivers would need to be paid at $65 per hour for the full 11 hours of service, the TransLoc model does not realize savings over fixed-route transit. Currently, RTA pays $1.2 million per year to provide service to 101,279 passengers, an average marginal cost of $11.73 per trip.[134][135]

[131] Riverside Transit Agency. (January 14, 2018). "Ride Guide – Route 55." Retrieved from: https://www.riversidetransit.com/images/stories/DOWNLOADS/ROUTES/055.pdf.
[132] AllTransit™. (2018). "AllTransit™ Metrics: Temecula, CA." Retrieved from: https://alltransit.cnt.org/metrics/?mapL=248,-117.14836479999997,33.4936391,12,place,2146.
[133] TransLoc, Inc. (2017). *The Microtransit Simulator: Real Answers for the Future of Modern Transportation*. Received through personal communications, pp. 4-5.
[134] Riverside Transit Agency. (2017). *RTA Quarterly Comprehensive Route Performance Report July 1, 2016 to June 30, 2017.* Received through personal communications.
[135] Riverside Transit Agency. (2017). *DAR Origins to Destinations Trips Oct 2017* [Microsoft Excel]. Unpublished raw data received through personal communications.

Table 26: Temecula Zone Current RTA Operating Cost

Service	Annual Ridership	Annual Operating Cost
Route 24	63,395	$669,642
Route 55	21,208	$82,589
ADA Trips	16,676	$436,245
Total	101,279	$1,188,476

The fifth TransLoc scenario provides trips to 300 people a day at $14.30 per trip. Operating service 365 days a year would cost $1,565,850, a 32 percent cost increase. Ridership trends from Route 24 suggest that ridership falls by half on weekends.[136] Applying this same ratio to the TransLoc scenario generates an estimated annual ridership of 93,750. In conclusion, implementing the most cost-effective TransLoc scenario would cost more than current service and serve fewer riders.

However, switching to TransLoc does have some benefits:

- All Temecula residents have access to the program, compared to 59 percent of the population that lives within a half mile of a transit stop.
- Average wait time ranges from 0 to 10 minutes, a significant improvement over current fixed route service frequencies. Route 24 operates approximately every 70 minutes, and Dial-a-Ride passengers must schedule their trips 24 hours in advance.
- TransLoc trips provide point-to-point service for riders getting them exactly where they need to go. Riders no longer have to worry about how they will get from the bus stop to their final destination.

The next section evaluates what a TNC partnership would cost that covered the entire City of Temecula.

Estimated Daily Pilot Ridership

In FY2017, Route 24 carried 63,395 riders and Route 55 carried 21,208 riders. Assuming 80 percent of current riders switch to the TNC program, the program would generate an annual total of 67,682 riders.

In October 2017, 1,413 Dial-a-Ride trips started and ended within the City of Temecula. Multiplying average daily ridership by the number of days in a year yields an annual ridership estimate of 16,676.

Finally, because only 59 percent of Temecula's population is within a half mile of a transit stop, expanding service to the whole city is likely to induce additional ridership. Here, I decided to apply the Corona Dial-a-Ride "Regular" percentage of 0.01 percent to the entire Temecula population. It is likely that those who would use the "Senior" or "Disabled" fare are already using RTA, but applying this ratio to the entire population provides a conservative estimate. Using this 0.01

[136] Riverside Transit Agency. (2017). *FY 2018 Performance Statistics (OCT)* [Microsoft Excel]. Unpublished raw data received through personal communications.

percent ratio on Temecula's population of 113,062 generates an additional 11 riders per day, or 4,127 annually.

Total annual ridership is projected to be 88,485.

Estimated TNC and Taxi Cost

I estimated average TNC and Taxi cost using the methodology discussed in "Data and Methodology." TNC fares were lower than Taxi fares for 71 percent of trips.

Table 27: Temecula Zone Estimated TNC and Taxi Cost

Average Trip Distance	Average Trip Duration	Average TNC/Taxi Cost
3.1 miles	21.6 minutes	$9.32

If annual ridership is 88,485 passengers, total pre-revenue TNC/Taxi cost is estimated to be $824,638.

Estimated TNC/Taxi Revenue

Table 28 below shows the estimated annual fare revenue and operating subsidy for each of the four fare structures based on an average trip cost of $9.32.

Table 28: Temecula Zone Estimated TNC/Taxi Revenue

Fare Structure	Cost to Riders	Cost to RTA	Annual Revenue	Annual Cost	Annual Subsidy
Riders pay $1.50	$1.50	$7.82	$132,728	$824,638	$691,911
Riders pay $3.00	$3.00	$6.32	$265,456	$824,638	$559,183
RTA pays $5.00	$4.32	$5.00	$382,256	$824,638	$442,382
RTA pays 50%	$4.66	$4.66	$412,319	$824,638	$412,319

Estimated Fixed-Route and Dial-a-Ride Cost

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 24 cost $669,642 and Route 55 cost $82,589.

RTA average cost per Dial-a-Ride trip is $26.16. Multiplying annual ridership of 16,676 by $26.16 yields an annual Dial-a-Ride cost of $436,245.

Together, total cost of providing service in Temecula is $1,188,476.

Estimated Fixed-Route and Dial-a-Ride Revenue

According to RTA's Route Performance Report for July 1, 2016-June 30, 2017, Route 24 generated $66,446 while Route 55 generated $19,491.

RTA Dial-a-Ride base fare is $3.00 per trip. Multiplying annual ridership of 16,676 by $3.00 yields annual Dial-a-Ride revenue of $50,028.

Together, total revenue generated by Route 24, Route 55 and intra-zone Dial-a-Ride service is $135,965. Operating subsidy (cost minus revenue) is $1,052,511.

Estimated Cost Savings

All four scenarios are estimated to generate considerable cost savings for RTA, with three of the four scenarios saving over half the operating cost. It all comes down to the fact that TNCs significantly lower the cost per trip. As stated earlier, RTA's average cost per trip in Temecula is $11.73. TransLoc estimated its average cost would be $14.30. The TNC trips cost an average of $9.32, immediately saving almost $2.50 per boarding. With the TNC partnerships, riders are also responsible for paying a larger portion of the trip's cost which reduces RTA's operating subsidy. The TNC model also estimates lower annual ridership than both the TransLoc estimate and current RTA ridership because it assumes that 20 percent of current fixed-route riders stop using the service.

Table 29: Temecula Zone Estimated Net Savings

TNC/Taxi Pilot Program				Current RTA Service			Net Savings
Fare Structure	Fare Revenue	Operating Cost	Operating Subsidy	Fare Revenue	Operating Cost	Operating Subsidy	
Riders pay $1.50	$132,728	$824,638	$691,911	$135,965	$1,188,476	$1,052,511	**$360,600**
Riders pay $3.00	$265,456	$824,638	$559,183	$135,965	$1,188,476	$1,052,511	**$493,328**
RTA pays $5.00	$382,256	$824,638	$442,382	$135,965	$1,188,476	$1,052,511	**$610,129**
RTA pays 50%	$412,319	$824,638	$412,319	$135,965	$1,188,476	$1,052,511	**$640,192**

Planning Recommendations

The analysis above suggests that replacing low-performing fixed-routes with TNCs may result in cost savings for public transit agencies as long as the subsidy they provide on a per passenger and total basis are lower on TNCs than on a fixed-route service they replace. This will not always be the case, meaning that TNC partnerships are not appropriate in all situations. Instead, partnerships should adhere to the following guidelines when designing TNC pilot zones:

- Subsidized TNC trips must meet certain eligibility criteria. It is not the role of the transit agency to subsidize TNC trips for all residents. This generally requires limiting trips to within a certain geographic zone or to/from certain transit stops, as well as requiring rides to be shared where multiple trips can be matched efficiently
- Because TNC fares accrue based on time and distance, long-distance trips can be prohibitively expensive. TNC trips are best suited for short-distance travel, or long-distance trips that are completed on fixed-route transit. This approach limits cost exposure for both riders and transit agencies. Limiting trip distance can be achieved either through setting a defined geographic zone or by capping the transit agency's subsidy per trip. Capping the subsidy allows riders to take TNCs for long distances but places the cost burden on the rider and not the transit agency.
- TNC partnerships make sense in lower-density areas where a single fixed-route cannot meet travel needs. Origins and destinations are likely dispersed throughout the area or are located significant distances from major corridors. This can apply to areas of existing low-performing routes or in new expansion areas to existing networks.

TNC partnerships represent a radical departure from traditional fixed-route transit. While the industry is still trying to figure out "best practices" in implementation, there are already a few known steps transit agencies must take to make such partnerships successful.

- Include options to meet both Title VI and ADA requirements. This requires partnering with a transportation provider that can guarantee wheelchair-accessible vehicles with a comparable response time to a TNC trip as well as provider that can accept cash payments. This also requires operating a call center so riders without access to a smart phone can make a reservation.
- Require riders to register with the transit agency in order to use the program. This ensures that use of the program is limited to those who need it most, or at the very least have some interest in associating themselves with a transit agency. It also allows the agency to know who its riders are which is integral for targeted marketing or surveying efforts.
- Engage in targeted marketing efforts with the community and current riders. Getting riders familiar with the new technology is critical to generating ridership. It is also important that the zone boundaries are clearly communicated. People do not intuitively know jurisdictional boundaries or recognize boundaries on maps. Zones should follow major arterials or natural barriers so riders can easily understand their travel options.

- Encourage TNCs to conduct driver recruitment near pilot zones. Having enough drivers is critical to reduce wait times and provide an "on-demand" experience. TNC partnerships are most cost-effective in lower-density areas, areas also more likely to have fewer TNC drivers.

All five TNC analysis zones reviewed could yield considerable cost savings for RTA or Pass Transit with any of the proposed fare structures. Because the TNC partnership provides a higher quality of service than fixed-route service, it is fair for RTA to charge a higher fare. TNC partnerships provide passengers with on-demand rides that take them more directly to their final destination. For this reason, I recommend selecting a $3.00 flat fare ($1.15 for Pass Transit). This would double the fare for current fixed-route passengers but would result in no fare change for current Dial-a-Ride passengers. Table 30 summarizes all five TNC zones. If RTA implemented all four zones within its service area, it could save $1.1 million, or 53 percent, of operating costs. Pass Transit could save 47 percent of its costs.

Table 30: Summary of TNC Analysis Zones

TNC Zone	Annual Ridership	TNC/Taxi Subsidy	Current Operating Subsidy	Net Savings	Percent Savings
East Perris	42,950	$211,312	$392,356	$181,043	46%
Moreno Valley	27,938	$169,026	$573,067	$404,041	71%
Temescal Valley	9,242	$52,680	$103,801	$51,121	49%
Calimesa	11,311	$130,344	$243,820	$113,476	47%
Temecula	88,485	$559,183	$1,052,511	$493,328	47%
Total	**179,937**	**$1,122,545**	**$2,365,554**	$**1,243,009**	**53%**

If RTA has to pick just one pilot to start with, I recommend pursuing a TNC partnership in the Moreno Valley zone. Route 26 is the lowest-performing route in the RTA network, and a TNC partnership in this area could realize the largest cost savings for RTA. The Perris Valley Line Metrolink Station and Moreno Valley Mall serve as key anchor stops and connections into the larger fixed-route network.

Additional Considerations

Marketing and Technology Costs

Some of the cost savings from the pilot programs will need to be invested in marketing and technology. Since TNC partnerships represent such a drastic deviation from fixed-route service, RTA will need to embark on significant marketing efforts to inform riders and the general public of the new service. This will be particularly important for current Dial-a-Ride riders, as switching as many of those riders as possible to TNC partnerships will have the greatest cost benefit for RTA. The agency should consider having staff on the ground at major transit stops in the TNC zones to work with current riders and educate them on how to use the new service.

The two main sources of technology costs are trip-planning software and travel planning apps. Only the TransLoc partnerships or an operation such as AC Flex would require RTA to purchase new technology. RTA partners with a number of trip planning apps and would likely need to

update the information in these apps to include the new program. The City of Centennial spent $26,000 to embed the Go Centennial program into the Go Denver trip planning app.[137]

Fare Increases

The analysis in this report was based on TNC fare structures as of January 2018. Any subsequent increase in booking fees, minimum fares, cost per mile, and cost per hour will affect the results of this analysis. In the case of a cost increase, RTA would need to evaluate whether or not to increase its subsidy per trip or charge riders a higher fare. Since TNCs are privately-owned, there is no existing mechanism for RTA to guard against potential cost increases, and this uncertainty may play a role in RTA's decision to pursue such partnerships.

Transit Passes

In these scenarios I assumed that riders using TNC partnerships would pay the full fare each trip. With fixed-route service, frequent riders rarely pay the full fare each trip because they take advantage of pass options that reduce their cost per trip. This is why RTA's average fares per route are so much lower than their base fares. RTA could choose to integrate the TNC partnerships into their existing fare structures, allowing riders to use RTA passes to pay for their TNC rides. This would likely increase RTA's subsidy per trip as well as ridership.

Reduced Fares

The Federal Transit Act 49 U.S.C. Section 5307(d)(1)(D) mandates that transit agencies cannot charge seniors, persons with disabilities, or Medicare cardholders more than half of the peak-hour fare during off-peak hours on fixed-route transit. This is a requirement for any agency that receives Section 5307 funding for transit operations.[138] Currently, this requirement only applies to fixed-route services that operate during peak and off-peak periods and does not include demand-responsive service.[139] However, it is conceivable that in the absence of fixed-route service, the Federal Transit Administration may look to apply this requirement to TNC partnerships. If this happens, RTA would see considerably less passenger revenue from TNC partnerships as a large portion of the ridership is estimated to be generated by previous ADA passengers.

Long Pick Up Fees

In December 2017, Uber introduced "Long Pickup Fees" that incentivize drivers to pick up passengers that are far away. Previously, Uber did not pay drivers for their deadhead (hours and miles spent driving between trips), encouraging them to only accept trips that originated nearby. This made it difficult for riders in less urban areas to secure rides. With the introduction of Long Pickup Fees, drivers start accruing time and mileage cost after they have surpassed their individual driving threshold. For example, if a driver's threshold is 10 minutes and he drives 15 minutes to

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[137] Centennial Innovation Team and Fehr & Peers. (June 2017). *Go Centennial Final Report*. City of Centennial, CO. Retrieved from: http://go.centennialco.gov/, p. 41.

[138] Federal Transit Administration. (2018). "Civil Rights/ADA: Frequently Asked Questions." Retrieved from: https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/frequently-asked-questions.

[139] Federal Transit Administration (2011). *Half-Fare Triennial Guidance for Fiscal Year 2011.* Retrieved from: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/14_Half_Fare_TriennialGuidance_FY2011.pdf.

pick up a passenger, the passenger fare includes an extra 5 minutes of time/mileage. The rates are the same as in-revenue rates.[140] The maximum Long Pickup Fee in any city is $20. Depending on vehicle available in Temescal Valley and Calimesa, the introduction of this new fee could make Uber trips prohibitively expensive in these areas.[141]

Conclusion

In conclusion, the methodology established and used in this report shows that transit/TNC partnerships present a cost-effective alternative to fixed-route transit in situations where subsidies per boarding are extremely high. By adjusting capacity to meet demand, TNCs optimize use of resources, limiting the cost of providing shared mobility. Replacing under-performing fixed-route transit service with point-to-point TNC trips can reduce subsidies per passenger boarding and free up resources that can be reinvested elsewhere in transit networks. These partnerships work best in clearly-defined geographic zones that limit maximum trip length, minimizing cost exposure for both the agency and passengers. They are successful in areas with dispersed origins and destinations that cannot be efficiently connected by a single fixed line.

However, while these partnerships are attractive from a cost-savings perspective, there are a number of additional considerations that must be factored in when evaluating their feasibility. As privately-owned companies, TNCs do not follow the same mandates as public agencies. They do not guarantee rides, low fares, or short wait time, and they do not adhere to federal regulations for driver training and background checks. Public agencies must also satisfy ADA and Title VI requirements, and this requires extending options beyond traditional TNC services. Riders must overcome a technology barrier and learn to incorporate mobile apps into their trip-making rather than just walking out and catching the next bus.

Despite these factors, it is critical that transit agencies adapt to new technologies as rider preferences change and on-demand shared mobility options become more popular. Instead of seeing these barriers as obstacles, transit agencies should work with one another to share viable solutions and learn how on-demand platforms can be integrated into traditional transit service. Transit agencies should view TNCs not as competitors, but as potential partners who can extend the reach of their transit networks.

[140] Campbell, Harry. (October 2017). "Uber Increasing Waits on Long Pickups and Wait Time." The Rideshare Guy: A Blog and Podcast for Rideshare Drivers. Retrieved from: https://therideshareguy.com/uber-increasing-rates-on-long-pickups-and-wait-time/.

[141] Uber Technologies, Inc. (2018). "How are Long Pickup Fees Calculated?" Uber Help. Retrieved from: https://help.uber.com/h/20d33df7-7317-4f86-aa38-5db09a219c27.

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