CONNECTJXN

TRANSIT PLAN

Appendix D

Mobility On-Demand Technical Analysis

August 2021

1. Introduction

This report documents the findings and recommendations of a Mobility On-Demand (MOD) feasibility analysis performed for the JTRAN service area. ConnectJXN: Transit Plan consultant team member Via Strategies, the consulting arm of Via, an international leader in transit technology and on-demand service delivery, conducted this analysis. The following sections provide an overview of on-demand service and use cases, define potential on-demand zones in Jackson, and identify implementation strategies should JTRAN choose to offer this service in the future.

2. What is Mobility On-Demand?

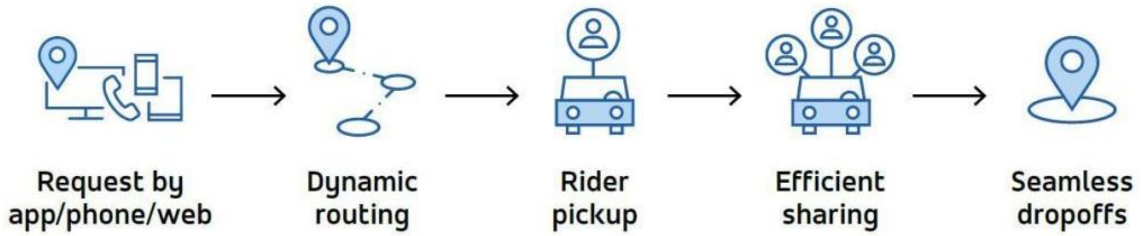
Mobility on Demand (MOD), also known as “microtransit” or “on-demand transit,” is similar to a conventional, fixed-route bus in that passengers are asked to walk to meet a vehicle at a ‘virtual bus stop’ that may be up to ¼ of a mile from their requested location. However, it is different from a bus in that there are no schedules or route maps. Instead, trips must start and end within service zones that fill gaps in the bus network.

Passengers can book a trip using a smartphone application (“app”), a website, or through a call center. To book a ride, a passenger starts by indicating the number of passengers in their party and their desired pickup and drop-off locations. When booking using the app, passengers will clearly see the geofenced zone in which service is offered. Requesting a trip beyond this zone is not possible, so passengers always know where the microtransit service is available. Once the passenger submits a trip request, they are given a proposal that tells them when the vehicle will arrive and where to meet it, usually at the nearest intersection and seldom farther than a 5-minute walk away. Typically, passengers must wait between 5 and 30 minutes for a trip, although this may vary depending on the level of demand and the number of vehicles available. Passengers can track the vehicle in real-time using the app. The passenger is provided with vehicle information—for example: license plate, driver name, driver photo, and vehicle ID number. Passengers can usually cancel a ride at any time before pickup, but as cancellations may negatively affect other passengers, a small fee is often charged to discourage cancellations.

Once the vehicle arrives, the driver confirms the passenger’s details using the driver app. Most on-demand transit providers take care to include payment options for people without credit cards or bank accounts to ensure that the service is accessible to all. Depending on service design, passengers can pay using credit and debit cards, transit passes, cash, vouchers, and more. The passenger is then taken to their destination. Along the way, the vehicle will pick up and drop off other passengers heading in the same direction, but care is taken to avoid lengthy detours for passengers already on board. The passenger can track their progress using the app. After each trip, passengers may be automatically emailed a receipt. Passengers may also be able to provide real-time and post-trip feedback through the app.

A typical workflow for MOD is shown in the graphic below:

Figure 1: MOD Workflow



There are several key differences between fixed-route bus, ADA paratransit, and on-demand transit service, which are summarized in **Table 1**, below:

Table 1: User Experience Between Modes

	Fixed-Route	Paratransit	On-Demand
Pick-up / Drop Off Locations	Bus Stop	Door-to-Door	"Virtual" stop at nearby intersection or at defined connection point to fixed-route network.[1]
Service Area	Trip must begin or end at fixed-route bus stop.	Trips must begin and end within ¾ mile of a fixed-route stop	Trips must begin and end within defined on-demand zone.
Trip Booking	N/A	Requires 24-hour advance booking	Same-day booking. Average wait time 15-25 minutes.
Eligibility	No restrictions	Requires approved application	No restrictions
Accessibility	Wheelchair accessible	Wheelchair accessible, with assistance provided in boarding and alighting	Wheelchair accessible

Use Cases

On-demand transit can serve a variety of use cases, rider groups, and trip types. The locally relevant mix of use cases in Jackson has significant bearing on key service design parameters, such as its hours of operation.

In Jackson, one of the more relevant use cases is **local transportation,** in areas where fixed-route service is either unavailable or unproductive, such as in lower-density or suburban areas of the city. It is especially apt if a zone has limited or no access to frequent and reliable fixed-route service. To serve this use case, on-demand transit provides access to any location within a specific zone, and customers are not required to transfer to fixed-route service (though many passengers will still do so to complete longer trips).

Another common use case for on-demand transit is to connect riders to the nearest transit hub or major station, also known as **first mile / last mile connections.** In this use case, customers book an end-to-end transit trip even if fixed-route service is not available within walking distance of their desired origin or destination by using on-demand to provide a connection to or from the bus. This multi-leg trip effectively expands the reach of the fixed-route system by allowing passengers to travel farther than the typical 10-minute walking radius to reach the nearest bus stop. The first mile / last mile connection use

[1] Passengers who indicate they have a disability, whether in the mobile app or to the dispatcher, are offered door-to-door service.

case is most suitable if the fixed-route service at the transfer point offers frequent service throughout the day, ideally every 15 minutes or better. While no current route in Jackson offers such a frequency, this use case is still relevant because of the imperative to connect on-demand transit passengers with fixed-route service wherever possible, as it should be considered a seamless extension of the overall public transit network.

Serving **off-peak travel demand** is another key use case for on-demand transit. Because JTRAN fixed-route service currently ends at 7:45 PM on weekday evenings and does not operate on Sundays, on-demand transit can potentially fill these temporal gaps. Because passenger travel demand is typically lower during these off-peak times, it is also possible that on-demand transit can operate at a lower cost-per-trip (using smaller, right-sized vehicles) compared to the cost of extending fixed-route service running on larger transit buses during the same hours.

Providing same-day service options to ADA paratransit customers is another common on-demand transit use case. Like most ADA paratransit services, JTRAN's Paratransit service requires passengers to book rides at least 24 hours in advance and provides passengers with a variable, 30-minute pickup window. These factors limit the efficacy of paratransit for many types of trips and do not allow for the spontaneity that many passengers need. By using smaller, right-sized vehicles and more efficient vehicle routing and trip assignment than most paratransit systems, on-demand transit can often provide ADA paratransit customers with same-day service to a greater extent than possible with older paratransit services. In an alternative approach used in some transit systems, ADA-compliant paratransit and mainstream on-demand transit services are integrated through a process called "commingling," in which vehicle fleets, driver shifts, and even individual passenger trips are shared between these two service types. Commingling offers transit agencies significant potential cost savings by allowing mainstream on-demand and ADA paratransit customer trips to be routed and shared more efficiently among fewer vehicles and vehicle-hours.

Benefits and Challenges of MOD

MOD offers transit agencies a range of potential benefits as well as risks and challenges that must be addressed. Some of the typical benefits of on-demand transit, compared to fixed-route service, include:

- Shorter average wait times, particularly compared to fixed-route bus corridors with existing frequencies of 30 minutes or worse, as in the JTRAN system
- Shorter typical walking distances for riders to access pickup and dropoff locations
- More flexible operations can provide greater geographic coverage without sacrificing quality of service
- No bus stop infrastructure required, with "Virtual Bus Stops"
- Lower insurance and driver training requirements due to smaller vehicles—in some cases, these may result in a lower cost-per-trip relative to underperforming fixed routes.

On-demand transit also carries several potential challenges and risks that should be addressed in service design and planning. Because on-demand service typically operates with smaller vehicles, it offers lower passenger capacity compared to fixed-route service. Likewise, on-demand offers a lower maximum productivity of service compared to the most productive fixed-route corridors because of the smaller vehicles used. Some on-demand passenger trips may require detours to pick up other passengers, though overall journey times are often shorter than comparable fixed-route trips, which are often slowed down by relatively high dwell time at stops during passenger boarding and alighting. As a newer, less familiar form of demand-response transportation, on-demand transit requires an upfront investment in marketing and community outreach to attract significant ridership. Successful marketing campaigns for new on-demand transit services often include distributing promotional materials at key activity centers (e.g. major bus transfer points, colleges, grocery stores, or community centers), posting announcements on bus stop signage, local news or social media advertising campaigns, and other strategies discussed in **Marketing New Services**.

Fixed-route service, on the other hand, carries its own significant drawbacks. Chief among them is the inherent tradeoff in a fixed-route service design between the capacity to provide comprehensive service coverage and the high service frequencies necessary to generate high ridership. Most fixed-route systems, being fiscally constrained, struggle to achieve either. Unless fixed-route service is frequent (typically defined as 15-minute headways throughout the day or better), the quality of service—measured by passenger wait times and walking distances—is typically poorer than on-demand transit. Additionally, the less flexible routing of fixed-route service, with embedded capital costs in bus stops, means that the network cannot easily adapt to changing travel demand patterns or new development, as seen in the westernmost neighborhoods in Jackson. Perceptions of safety can also negatively impact fixed-route service, as many riders may not feel safe walking to or waiting at bus stops, particularly late at night.

3. MOD Service Design Parameters

Service design for MOD is highly configurable and involves numerous trade-offs from key decisions made before the selection of specific on-demand transit zones. These decisions are essential to determining a suitable solution that optimizes both quality of service and cost-effectiveness, and they hinge on the following key variables:

Trip restrictions. In some on-demand zones, transit agencies restrict certain trips from being served by on-demand transit despite having an origin and destination falling within the overall service zone boundaries. Most commonly, these restrictions are implemented where there is a frequent and reliable fixed-route service operating within the zone (e.g. bus or train service) that could complete certain trips more cost-effectively. To avoid the displacement of fixed-route ridership to the on-demand service and ensure that trips connect to the broader fixed-route system, some on-demand zones require riders to select a designated transfer point or transit station as either their origin or destination. This effectively limits the on-demand service to fulfilling the first mile / last mile connection use case, described in the previous section, while precluding it from serving other types of trips. These trip restrictions are likely to marginally improve an on-demand service's productivity (passenger boardings per vehicle-hour) by ensuring that each trip is anchored by a key node of the fixed-route network, while discouraging travel on less commonly traveled routes. However, in lower-density cities like Jackson, where high-frequency fixed-route service is not available and the first mile / last mile connection use case is less salient, these trip restrictions are more likely to discourage ridership by making the on-demand service less useful to riders. As a result, **we advise against implementing trip restrictions here** at least until high-frequency fixed-route service is implemented within the zone.

Fare structure. Fares are an important determinant of ridership in many on-demand transit services. Unlike a taxi or ride-hailing service, on-demand transit is intended to be a fully integrated component of the public transit system, and the service's fare structure should reflect this. While some agencies offer fare-free on-demand services, a large majority charge flat fares equivalent to their existing one-way fares for fixed-route bus services, and a smaller number charge distance-based fares which reflect the higher cost of serving longer-distance trips. Because the on-demand services reviewed in the ConnectJXN Transit Plan are limited to the Jackson city limits and unlikely to serve large numbers of trips longer than 30 minutes in duration, we advise against distance-based fares. Instead, **we recommend that the on-demand fare match JTRAN's existing one-way transit fares** of $1.50 for the general public and $0.75 for students age 6-14, seniors age 60 or older, and people with disabilities. Because one of the primary use cases is first mile / last mile connections, we also **recommend that riders be granted a free transfer between JTRAN's fixed-route and on-demand**

services. These decisions will help to keep on-demand fares affordable to riders and encourage a sustained and robust ridership.

Passenger eligibility. Most on-demand services are open to the general public, while a significant minority are limited to specific populations with longstanding mobility needs, such as seniors, people with disabilities, qualified ADA paratransit customers, or students. For the purposes of this study, we assume that **on-demand transit service is available to the general public**.

Service model. On-demand transit operators provide two primary service models, dynamic or pre-booked. In either case, riders may request rides with a mobile app, web portal, or by calling a customer service center. Both service models also feature real-time vehicle tracking in the passenger mobile app as well as ETAs updated in real time throughout the trip.

- **Dynamic on-demand services** involve rides booked on a same-day basis at the time of need, with vehicles dispatched immediately following a trip request and passenger wait times of typically between 5 and 30 minutes. In a dynamic on-demand service, riders typically receive one or more ride proposals with different wait times and ETAs cited. This allows riders to plan for adequate time to make transfer connections to fixed-route service, if applicable. The rider then decides if they would like to confirm one of the proposed bookings and are charged an appropriate fare. This service model is generally preferable in urban or suburban areas with relatively short journey times (typically less than 30 minutes) and sufficient travel demand to justify a low-frequency, coverage-oriented fixed-route service. As a result, **this study evaluates on-demand transit using this dynamic service model.**
- **Pre-booked on-demand services** are similar to conventional demand-response services (also known as “dial-a-ride”) and enable customers to book rides between 2 hours to several weeks in advance as well as book recurring rides (also known as “subscription trips”). In a pre-booked on-demand service, riders receive a confirmation message (via phone call or text message) that their ride is booked accompanied by an approximate time window for pickup and arrival at their destination. This service model is generally preferable in rural areas with very low, diffuse travel demand or for services geared primarily towards passenger groups who may prefer booking their trips in advance (e.g. some ADA paratransit customers) or on a recurring basis (e.g. dialysis patients, people with disabilities attending day support programs).

A summary of the advantages and disadvantages of dynamic and pre-booked on-demand service models is shown in **Table 2** on the following page.

Table 2: Comparison of Dynamic On-Demand vs. Pre-Booked On-Demand Service Models

	Advantages	Disadvantages
Dynamic On-Demand	• Higher capacity for same-day bookings • Flexibility to book at time of need, adjusts easily to daily schedule • Simpler user experience • Automatic adjustments of supply without the need for dispatch intervention	• Rides cannot be booked in advance nor can recurring rides be booked • Selection of correct booking time is up to rider, and there is no automatic link to bus schedule
Pre-booked On-Demand	• Customers can book rides in advance and recurring rides • Higher level of guarantee that a ride is indeed booked (barring unforeseen circumstances) • Greater potential for trip aggregation, especially in very low-density areas	• Higher average wait times • In a hybrid system, lower capacity for same day bookings because seats are filled “in advance” • Worse experience for rider if a pre-booked ride is missed compared to on-demand • Significantly more complex to operate, especially when needing to adjust supply

Vehicle selection. On-demand transit is highly customizable with respect to the fleet vehicles used to operate service. Most software platforms are suitable for deployment on a range of vehicle types, from large transit buses to cutaways, minivans, and even passenger vehicles. However, ensuring a cost-effective on-demand service requires that transit agencies strike a balance between vehicle capacity (and therefore the service’s capacity) and its cost to operate. Typically, in lower-density areas expected to serve a lower ridership, on-demand services can be operated most cost-effectively with smaller minivans with a capacity of between 6 and 10 passengers. These vehicles are less expensive to operate than cutaways or shuttles and typically carry lower insurance and driver training requirements. For the purposes of simulations and modeling described in subsequent sections, **we assume an on-demand service operated with minivans with seated capacity of 6 passengers.**

Hours of operation. Many on-demand services share the same hours of operation as the fixed-route transit system to maximize both the service’s legibility and riders’ ability to make transfers between on-demand and fixed-route buses. Alternatively, an on-demand service can be designed to fill the temporal gaps in Jackson’s fixed-route service, such as on Sundays or on weekday or Saturday evenings between 8 PM and 5 AM. In the following section, we describe multiple service alternatives that explore each of these approaches.

4. MOD Service Analysis

This section presents the analysis that was conducted to identify potential MOD zones throughout JTRAN's service area.

Zone Identification and Demand Estimation

Findings from the Existing Conditions analysis were essential to identifying potential on-demand transit zones for further screening. Potential on-demand transit service zones were screened for further analysis based on their ability to facilitate any of a range of improvements to the transit system in Jackson, such as:

- Replacing fixed-route bus service in corridors where transit is currently unproductive, or serves very low ridership
- Providing first/last-mile connections to more productive fixed-route bus services;
- Facilitating short, locally-oriented trips for residents and employees living or working in the zone;
- Improving mobility for low-income residents;
- Enhancing access to medical facilities, shopping centers, and major employers; and
- Providing a same-day mobility option for ADA paratransit customers.

Characteristics of an ideal on-demand transit zone include the following:

- Multiple clearly defined, overlapping use cases to ensure an even distribution of demand throughout the day
- Major activity centers to generate ridership (e.g. shopping centers, hospitals, schools, social services, or universities)
- Demonstrated need for improved quality of service in the zone, which may be supported by:
  - Poor ridership or productivity on existing fixed-route bus services
  - Significant service gaps - either spatial or temporal
  - High-need or disadvantaged communities with higher propensity to ride transit
- Clear, legible boundaries (i.e. boundaries along major roadways or other natural barriers)
- Transfer opportunities to other fixed-route services

We estimate demand for on-demand transit in each zone by assuming a "capture rate" of the zone's total population and employment, as given by American Community Survey and LEHD datasets.[2] This capture rate is based on findings from Via's North American deployments, and it is expressed as a ratio between total population and employment and observed weekday ridership.

We considered, but ultimately recommend against advancing further, two potential on-demand transit zones in Jackson on the basis of low expected ridership and productivity, as well as high anticipated costs-per-passenger-trip. These deprecated zones include the following:

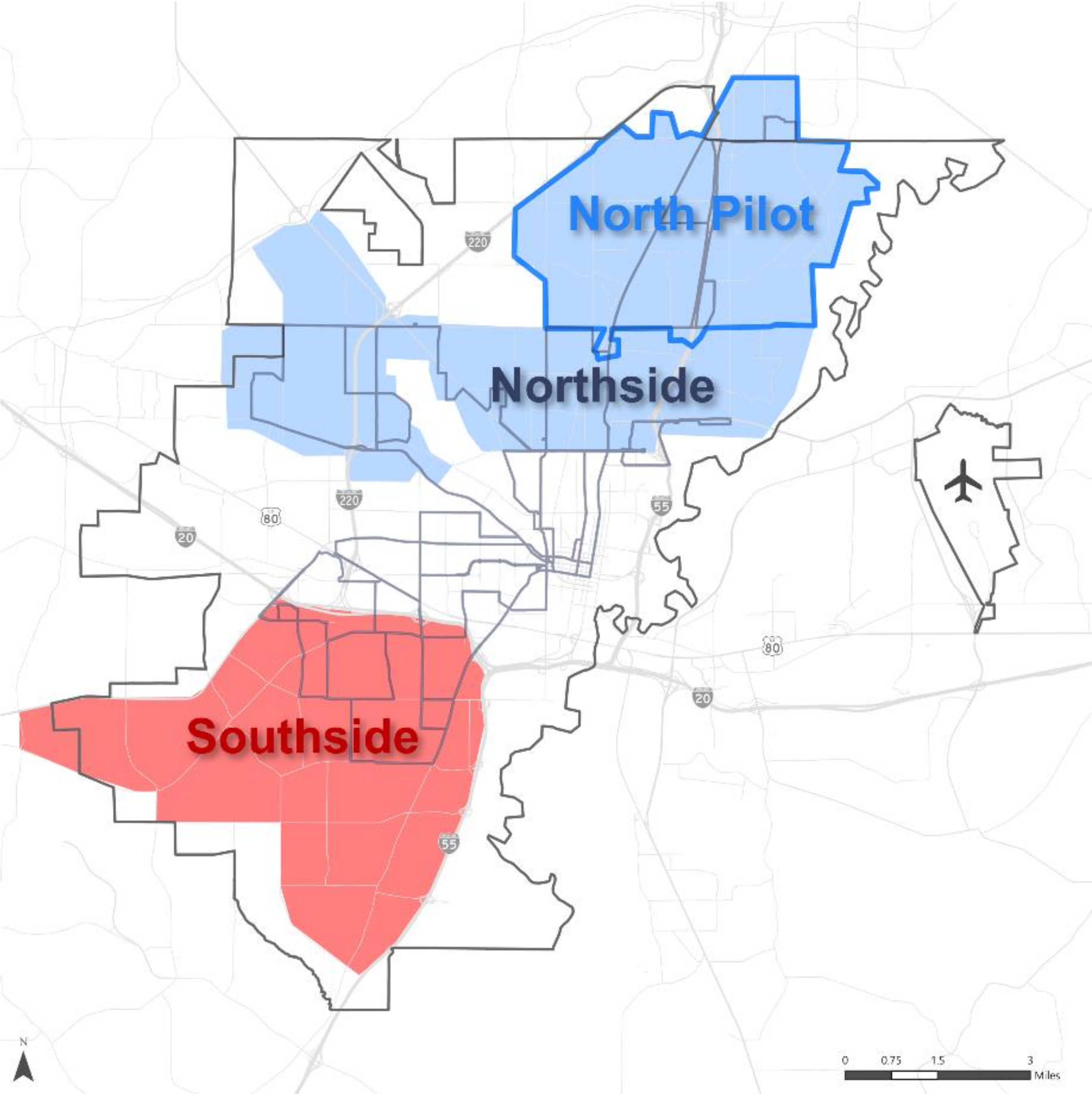
- **Presidential Hills/Westside Zone**, a zone which encompasses roughly the Presidential Hills, Magnolia Terrace, and Westchester Hills neighborhoods between I-220 and the western city limits of Jackson. This zone was forecast to carry fewer than 100 daily riders even under the highest-demand scenario, resulting in low passenger occupancy and high costs per trip.
- **Citywide on-demand transit service operating during late-night hours from 7 PM to 5 AM**, when JTRAN is not in service, within the Jackson city limits. While this service zone would fill an important temporal gap in service, we anticipate that such a zone would serve fewer than three

[2] Residents who both live and work within the same zone are subtracted from this total to avoid double-counting.

passengers per vehicle-hour, resulting in high costs per passenger-trip compared to other zones.

Two of the more promising on-demand transit zones, referred to hereafter as the Northside and Southside zones, were advanced for further analysis and simulation. These zones are shown in **Figure 2** and are profiled individually in the following section. As noted in the map, a subset of the Northside Zone, the North Pilot Zone, was identified as a suitable pilot project should JTRAN choose to implement a lower-cost MOD service with a smaller vehicle fleet in the future.

Figure 2: Proposed MOD Zones



On-Demand Zone Profiles

The proposed Northside and Southside Zones are profiled in the following section.

Northside Zone

The Northside zone is bounded by Jackson city limits to the east (near the Pearl River), Woodrow Wilson Avenue and Officer Thomas Catchings Drive to the south, John Hopkins Road and Magnolia Road to the west, and I-220 to the north. The zone contains many of Jackson's major medical, shopping, and employment centers along the I-55 corridor as well as the neighborhoods of Presidential Hills and Queens/Magnolia Terrace, which each have limited access to fixed-route transit. The Northside zone is currently home to about 36,000 residents and 57,000 jobs over 37 square miles, or about 1,000 residents and 1,600 jobs per square mile. This zone is dominated by big-box retailers along the I-55 corridor, the University of Mississippi Medical Center (UMC) and mixed-use development in the Fondren neighborhood along State Street, and a mix of industrial parks and low- to medium-density residential subdivisions in the western portion of the zone.

Some of the main activity centers likely to generate on-demand transit ridership in the zone include:

- UMC medical campus, including UMMC, Children's Hospital, Montgomery V.A. Hospital, and St. Dominic Hospital.
- Medical Mall, including adjacent Save A Lot
- Northpark Mall
- Meadowbrook shopping center
- Northwood shopping center
- Triangle Plaza shopping center
- Canton Mart shopping center
- Highland Village shopping center
- County Line Plaza shopping center
- Tougaloo College

Key transfer points to the existing fixed-route services in the zone include Food Depot, Triangle Plaza shopping center, Meadowbrook shopping center, County Line Plaza, and State Street & Stadium Drive, adjacent to the UMMC campus.

Southside Zone

The Southside zone is bounded by I-20 to the north, I-55 to the east, MS-18 to the west, and the Jackson city limits to the south (Forest Hill Road, McCluer Road, and Raymond Road). The zone is primarily low-density residential and has sparse fixed-route service coverage. It contains a major shopping center (Walmart Supercenter) at MS-18 & I-20, a small local health center (Merit Health Central), as well as several neighborhood shopping centers along McDowell Road. The Southside zone is currently home to about 18,000 residents and 6,000 jobs over 23 square miles, or about 770 residents and 240 jobs per square mile. Some of the main activity centers likely to generate on-demand transit ridership in the zone include:

- Walmart Supercenter
- Cash Saver (McDowell Road)
- Greenbriar shopping center (McDowell Road & Terry Road)
- Save A Lot (McDowell Road & Suncrest Drive)
- Merit Health Central

Each of these activity centers, with the exceptions of Merit Health Central and Cash Saver, also function as potential transfer points to other existing fixed-route services.

Simulation Setup and Parameters

Using the information gathered during the previous steps, we conduct on-demand transit simulations to determine the quality of service based on different fleet sizes and levels of demand. This technical exercise leverages Via's proprietary, agent-based simulation tool which allows us to predict how different zones and fleet configurations will perform as real flexible transit services. Below we outline the basic steps used to simulate the proposed on-demand transit zones:

1. **Upload on-demand service zone polygons.** The origins and destinations of all trips are limited to these zones.
2. **Generate underlying road map** by pulling data within the service zone boundaries from OpenStreetMap, including all roads categorized by functional classification, turn restrictions, directionality, and street walkability and drivability information.
3. **Determine traffic speeds** by querying Google's Maps APIs for traffic speeds specific to the time of day during which the service is being simulated. This ensures that wait times and trip times of the simulated service reflect real-world traffic data at the time of day for which service is being modeled.
4. **Set "terminals,"** to designate staging areas for vehicles that do not have active ride assignments. Terminals are safe parking areas that are distributed throughout the service zone, typical at transfer centers, park-and-ride facilities, or large shopping centers. When empty, vehicles will be routed to the terminal where the system has predicted demand. This ensures that each vehicle is used efficiently and that passengers will benefit from the shortest possible wait times.
5. **Generate "Virtual Bus Stops,"** to determine safe places for pickups and drop-offs. By default, Via's simulation tool generates Virtual Bus Stops throughout a zone, at points where vehicles can safely park. Via's simulation can be configured to assess curb-to-curb, corner-to-corner, or bus-stop-to-bus-stop service for riders. The simulations below assume a corner-to-corner model to improve the efficiency of the service by having passengers walk a short distance to the nearest Virtual Bus Stop, minimizing the number of vehicle detours necessary at pickup or dropoff. Typically, there are hundreds or thousands of Virtual Bus Stops in a zone. When setting up the zone, Virtual Bus Stop generation considers unique features of the zone, such as the pedestrian walking map, no parking/standing areas, and bus stops.
6. **Create demand scenario(s) to simulate the number and types of trip requests we expect to see in each zone.** Using information gathered in the demand analysis phase, combined with Via's fixed-route and on-demand transit experience, we can estimate travel patterns within the zone, and input them into the simulation tool.
7. **Set simulation parameters by determining the optimal configuration** for achieving JTRAN's service quality and passenger aggregation targets. These inputs — like fleet size, vehicle capacity, maximum wait times, and walk distances to/from Virtual Bus Stops — are those we adjust most frequently when creating and iterating upon a new service. After these variables are set, the scenario is ready to run. We perform many different simulations for each zone, demonstrating how adjusting service parameters will impact the quality of service, capacity, and efficiency.

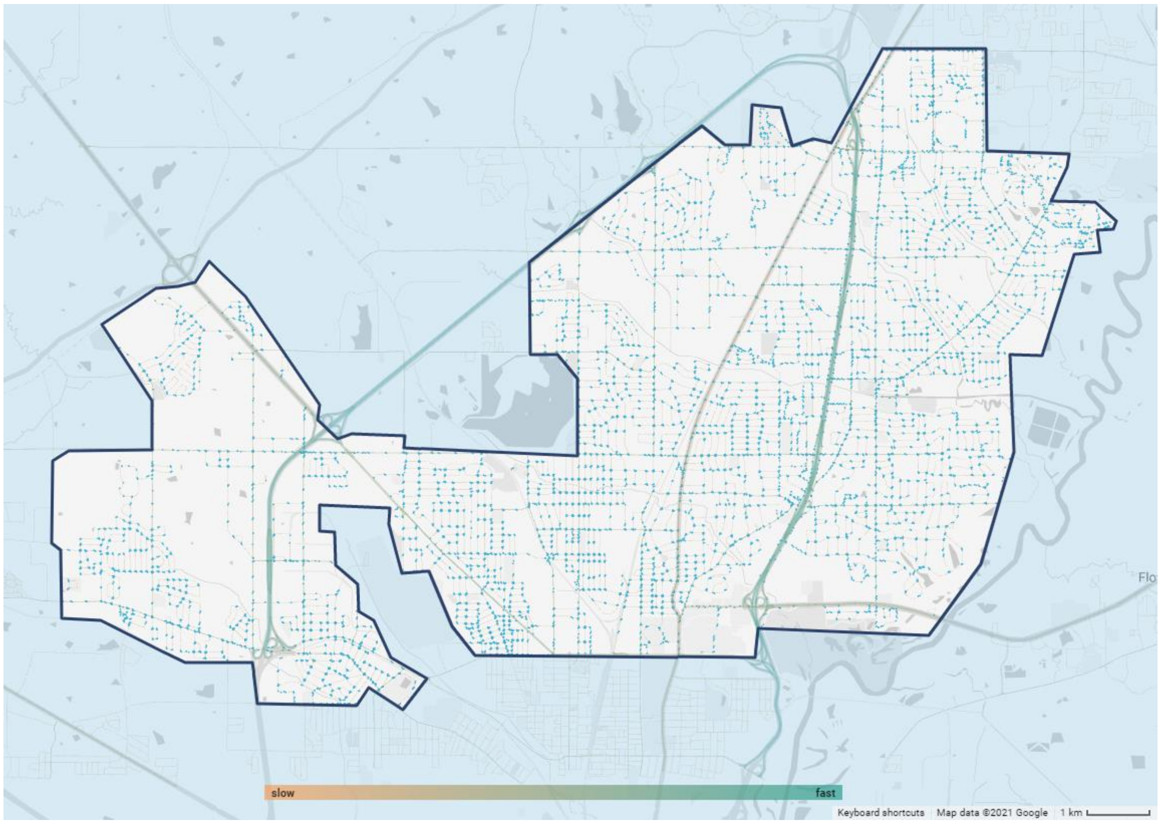
We established key simulation parameters with input from City staff, including:

- **Maximum pickup and dropoff walk (to or from Virtual Bus Stops):** ¼ mile (1,320 feet)[3]
- **Maximum wait times:** 45 minutes
- **Minimum seats per vehicle:** Six[4]
- **Service hours:** Weekdays 5:45 am to 7:45 pm, Saturdays 6:30 am to 6:30 pm

In practice, average walking distances passengers experience are typically 400 – 800 feet under these parameters. Likewise, average wait times are typically 15-25 minutes when the maximum wait time is set to 45 minutes.

Figure 3 is a screenshot of the simulation tool showing the Northside Zone with road segments and Virtual Bus Stops, shown as blue points within the service zone boundary shown in navy. A visualization of the simulation outputs is shown in **Figure 4**. Pickup locations are shown in blue, dropoff locations in orange, and black lines symbolize vehicles and their travel paths.

Figure 3: Northside Zone Simulation Inputs



[3] Previous research in the transit industry has found that most riders are unwilling to walk farther than ¼ mile to access local fixed-route bus service.

[4] However, any vehicle that accommodates six or more passengers could be used.

Figure 4: Northside Zone Simulation Outputs

Zone Simulation Results

Outputs from simulations are essential to determine both the quality of service riders are likely to experience in an on-demand zone and the size of the vehicle fleet necessary to satisfy all on-demand trip requests at peak times. These findings also help to determine the cost-effectiveness of various configurations of zone boundaries and fleet sizes in relation to their underlying ridership expected in the zone. The most important of its hundreds of outputs include:

- productivity of service (boardings per vehicle-hour)
- maximum fleet size necessary to serve all ride requests
- average passenger wait time
- average total walking distance at pickup and dropoff
- average trip duration
- shared-ride duration percentage, or the share of vehicle time in which multiple passengers are onboard.

The results of demand simulations in each of the proposed flexible transit service zones are shown in **Table 3** on the following page. Results are shown using low-demand, medium-demand, and high-demand scenarios to represent the uncertainty inherent in estimating travel behavior of an emerging mode; these scenarios are based on findings from Via's operating experience and research, with the "medium-demand" scenario reflecting the most likely performance outcome.

Table 3: Zone Simulation Results

North Pilot Zone			
	Low Demand	**Medium Demand**	**High Demand**
Estimated Daily Ridership	55 – 65	155 – 165	260 – 270
Rides per Hour (Peak)	5 – 6	12 – 14	20 – 24
Productivity (Rides per Vehicle-Hour, Peak)	5.0 – 5.9	4.6 – 5.4	5.6 – 6.6
Maximum Fleet Size	1	3	3
Average Wait Time (Minutes)	30	14	28
Average Walk Distance (Feet)	230 – 340	240 – 290	300 – 350
Average Trip Duration (Minutes)	11	12	14
Shared-Ride Duration Percentage	28%	42%	72%
Annual Vehicle-Hours	4,200	10,200	10,200
Northside Zone			
	Low Demand	**Medium Demand**	**High Demand**
Estimated Daily Ridership	120 - 130	330 - 350	540 - 570
Rides per Hour (Peak)	9 - 11	24 - 32	42 - 50
Productivity (Rides per Vehicle-Hour, Peak)	3.5 - 4.2	5.8 - 6.8	6.8 - 8.0
Maximum Fleet Size	3	5	7
Average Wait Time (Minutes)	18	26	27
Average Walk Distance (Feet)	370 - 400	380 - 420	400 - 450
Average Trip Duration (Minutes)	16	18	18
Shared-Ride Duration Percentage	45%	75%	80%
Annual Vehicle-Hours	10,200	16,900	23,000
Southside Zone			
	Low Demand	**Medium Demand**	**High Demand**
Estimated Daily Ridership	30 - 38	90 - 97	148 - 156
Rides per Hour (Peak)	3 – 4	8 – 9	12 - 14
Productivity (Rides per Vehicle-Hour, Peak)	2.9 - 3.4	4.0 - 4.7	6.5 - 7.6
Maximum Fleet Size	1	2	2
Average Wait Time (Minutes)	7	10	24
Average Walk Distance (Feet)	250 - 450	220 - 290	290 - 350
Average Trip Duration (Minutes)	9	9	11
Shared-Ride Duration Percentage	15%	13%	60%
Annual Vehicle-Hours	4,200	8,400	8,400

5. Implementation Plan

JTRAN seeks to understand what operating model would best suit the city's budget and other requirements. For the purposes of this report, Via has investigated two alternative service models:

Software as a Service (SaaS): In this model, JTRAN may prefer to provide on-demand transit services using the existing fleet, drivers, and operations team (or new vehicles and resources procured by JTRAN). Depending on the solution the JTRAN selects, ongoing service design and optimization, operational support, and customer service may be included. The advantages of this approach include the greatest continuity from existing fixed-route services and limiting the necessity to reallocate vehicles and drivers to other routes or services. The primary disadvantage of this approach is the need to adapt existing resources—including fleet, staff, operators—and procedures to implement a new and unfamiliar service, which may at least in the short-term lead to some inefficiencies and a higher cost-per-trip than the Transportation as a Service model described below. JTRAN would need to hire or retrain drivers to operate an on-demand service, and this may require additional expense. During the procurement of a technology platform under the SaaS model, we recommend that any platform solution include, at a minimum, the following components:

- Dynamic vehicle routing
- Passenger aggregation (shared-rides)
- Rider and driver mobile apps, with real-time vehicle tracking and live updated ETAs
- Support for booking by phone, as well as some form of cash payment for unbanked individuals
- Backend administrative tools, such as data dashboards to monitor performance
- Ongoing technical, operational, and marketing support

Transportation as a Service (TaaS): In this model, an on-demand transit vendor provides a bundled solution that includes on-demand transit technology, plus drivers, vehicles, and operations management. The advantages of a TaaS solution include potentially lower hourly per-vehicle costs than current operations,[5] as well as scalability. A service could be launched with current service hours and a given fleet size and, as ridership grows, JTRAN could evaluate whether to incrementally increase fleet size and/or extend operating hours. A bundled approach also ensures the operator and technology platform are interoperable and configured to work efficiently together. The primary disadvantage of this approach is the need to rely upon a vendor to operate and maintain the service, which may present administrative or labor-related challenges. Another potential drawback to TaaS is that JTRAN would have less direct control over specific operational decisions, such as the vehicle make/model, driver recruitment and wages/benefits, and vehicle maintenance processes, provided the vendor meets the terms of its service level agreement with JTRAN.

[5] Current demand-response service costs about $82 per revenue-hour according to JTRAN's 2018 reporting to the National Transit Database.

Table 4: Comparison of SaaS and TaaS Service Models

Service Model	Description	Benefits	Drawbacks
Software-as-a-Service (SaaS) *In-House Operations*	JTRAN provides service using own fleet, drivers, maintenance staff/facility, and management team JTRAN procures software/technology package for reservations/dispatch, customer-facing user interface (app), operational support, and customer service (optional)	• Provides continuity with existing services	• Requires need to adapt existing resources – including fleet, staff, operators – and procedures to implement a new and unfamiliar service • Potentially higher cost per trip
Transportation-as-a-Service (TaaS) *Turnkey Contract*	JTRAN procures turnkey contractor for software/technology, drivers, vehicles, maintenance, customer service, and operations management	• Faster deployment • Easily scalable based on ridership demand and desire to add new zones or expand existing zones • Potentially lower cost per trip compared to in-house operations	• Requires reliance on contractor, which may present administrative or labor-related challenges

MOD Cost Estimates

This section presents cost estimates for both the SaaS and TaaS service models for the proposed Northside and Southside MOD zones.

SaaS Model

The following model itemizes expected costs if JTRAN chooses to either purchase transportation and technology separately, or to operate on-demand transit in-house using JTRAN vehicles, drivers, and maintenance facilities. Upfront costs include one-time (or initial) expenses required to start the service. Ongoing operational costs include all recurring expenses throughout service delivery. As shown in the "Estimated Range" column of the Ongoing Operational Costs table, the attractiveness of this model is largely tied to the cost per vehicle hour of the contractor or JTRAN, if directly operated.

Table 5: Upfront Costs

Type of cost	US$ (one-time expenses)	Details of cost category
Vehicle acquisition	~$35,000 per van ~$50,000 per accessible van ~$125,000 - $250,000 per bus	Cost of acquiring vehicles for the service (assuming they are not already available). This may include vehicle registration costs, wraps (branding), retrofitting for accessibility, and more.
Driver acquisition	Depends on JTRAN recruiting process and requirements. Provided by a third-party operator if purchased transportation.	Cost to hire and train drivers for the service. Note that drivers providing ADA-compliant services may need additional, specialized training.
Hardware and data plans	$200 - $500 per tablet plus ongoing data plan subscription	Cost to purchase tablets, mounts, chargers, and dispatcher hardware (computer, phone, etc.) Each device will require an active data plan. A Mobile Device Management (MDM) plan may also be required to ensure tablets are only used for business purposes.
Software installation fees	$20,000 - $50,000	Software installation fees vary depending on the provider and the size of the deployment.
Marketing	$10,000 - $40,000	Cost to market the service prior to launch, ensuring riders are aware of any changes. This includes the cost of providing referral incentives (e.g., refer a friend and get $5).

Table 6: Ongoing Costs

<table>
<tr><th>Type of cost</th><th>US$ (ongoing expenses)</th><th>Details of cost category</th></tr>
<tr><td>Vehicle maintenance</td><td rowspan="3">According to the National Transit Database, JTRAN currently spends $82 per revenue-hour on its demand-response service and $95 per revenue-hour on its fixed-route bus services. These figures are inclusive of operations, maintenance, insurance, management, and dispatch/customer service functions.</td><td>JTRAN would either contract with a 3rd-party vehicle operator to manage ongoing vehicle maintenance, or would provide maintenance with its own staff.</td></tr>
<tr><td>Driver pay</td><td>Dependent on employment model, but typically uses salaried or hourly drivers employed by the municipality or public agency.</td></tr>
<tr><td>Operations management / customer service</td><td>A third-party contractor or JTRAN would manage the service. Usually this requires at least one person at all times. This individual would act as a dispatcher, receiving phone bookings, managing driver issues, and more.</td></tr>
<tr><td>Software licensing fees</td><td>$20,000 - $60,000 / year</td><td>Software installation fees vary depending on the provider and the number of vehicles needed to operate the on-demand service.</td></tr>
</table>

TaaS Model

This bundled service model may allow JTRAN to achieve lower operating costs per service-hour compared to the SaaS model. Variable costs are distilled into a fully loaded vehicle hour cost, which includes recurring technology fees, vehicle leases, driver pay, and customer service. Fixed costs include IT, local operations support, insurance, vehicle branding, etc.

Table 7: TaaS Fixed and Variable Costs

Fixed costs[6]	$225,000
Variable costs per hour	
Fully-loaded cost - 3 vehicles*	$80 - $100
Fully-loaded cost - 4 vehicles*	$70 - $90
Fully-loaded cost - 5-10 vehicles*	$60 - $80

Cost Summary

The table below summarizes the annual vehicle requirements, total vehicle-hours, and costs to operate on-demand services under both SaaS and fully-loaded TaaS models. The table also shows the cost per passenger trip as a measure of the service's relative cost-effectiveness. Values in the table below are shown as ranges corresponding to low-demand and high-demand scenarios discussed in the previous section. The low-demand scenario, marking the lower limit of the ranges below, requires fewer vehicles, and vehicle-hours, and is therefore less expensive to operate, but will have higher costs on a per-passenger-trip basis due its lower ridership. The high-demand scenario, marking the upper limit of the ranges below, requires a larger fleet and more vehicle-hours, raising overall operating costs, but is more cost-effective due to the higher ridership levels being served.

Table 8: Estimated O&M Costs for Proposed MOD Zones

	North Pilot Zone	Northside Zone	Southside Zone	Total (Northside & Southside Zones)
Vehicle Fleet Required	3	3 - 7	1 - 2	4 - 9
Annual Vehicle-Hours	10,200	11,000 – 23,000	4,200 - 8,400	15,200 - 31,400
SaaS Model	$1 million	$1 million – $2.4 million	$350,000 - $700,000	$1.35 million – $3.1 million
TaaS Model	$570,000	$570,000 – $1.3 million	$190,000 - $380,000	$750,000 – $1.7 million
Average Cost per Passenger Trip | SaaS Model	$23	$15 - $30	$16 - $36	$16 - $31
Average Cost per Passenger Trip | TaaS Model	$13	$8 - $16	$9 - $20	$8 - $17

Notes:

- Proposed JTRAN On-Demand Zones Modeled as corner-to-corner with Virtual Bus Stops
- SaaS model assumes JTRAN's hourly cost of demand-response operations from 2019, $82/rev-hour.
- SaaS model costs could be reduced if JTRAN is able to use more junior or less credentialed employees to operate On-Demand

[6] Costs based on Via operational experience and market research. Costs are representative and not fully inclusive of all fixed and variable line items (IT, local operations support, insurance, vehicle branding, etc.).

Modes of Rider Payment

On-demand transit technology platforms typically allow riders to pay for service directly through the app using a range of payment options, including credit/debit cards, transit passes (e.g. RFID-based smartcards), prepaid debit or stored value cards, vouchers, cash, and more.

Credit Cards. Riders scan credit card information automatically using their smartphones' built-in camera, or input manually. Credit cards can be used to pay per trip or to purchase fixed amounts of ride credit.

Stored Value Cards. To support unbanked riders, on-demand transit operators often accept other stored value cards or prepaid debit cards (which allows those without a bank account to add cash to an electronic account at local retailers, libraries, or government offices).

Cash. Some on-demand transit services allow riders to pay with cash onboard the vehicles, as they would on a fixed-route bus. However, if adopting the TaaS model, some operators may choose not to accept cash fare payment, as holding cash fareboxes onboard the vehicles raises their insurance risk.

Vouchers. Riders may have the option to buy ride credit in advance by purchasing a unique voucher code that they can input into the app (for example, a $20, $50, or $100 credit). JTRAN can offer this option to ensure unbanked customers can access the service even if cash payment is not accepted onboard the vehicles.

Marketing New Services

For any new transit service to be successful, it is critical to create a comprehensive marketing plan prior to the launch of the service. Marketing efforts for new services could include:

- Street marketing at fixed-route bus stops
- Parking branded service vehicles in high-traffic areas
- Canvassing or handouts at key points of interest
- Bus driver handouts
- Ads/notices on bus stop signage
- Producing a public service announcement (PSA) to be aired on local public television or the City's YouTube account
- Collecting footage and photos for the media
- Placing social media ads
- Participation in community events (e.g. farmers markets, sports tournaments, street fairs)
- Activation of key local influencers and community leaders
- Free ride promotions
- A launch event with local politicians, business leaders, and media present to promote the service

For on-demand services, the online booking platform may allow for additional targeting. To ensure intentional and measurable marketing efforts, we recommend a "Segment, Track, Test" approach consisting of the following steps:

Segment the target audience. When promoting a new service, it is important to understand the service's target use cases and the distinct rider cohorts in the community. These cohorts can form "segments" for whom marketing strategies can be customized according to their unique needs. For example, it is often useful to create different marketing plans for commuters, seniors, and riders with disabilities.

1. **Track rider behavior.** After launch, these cohorts can be further organized by activation date or week and the frequency with which they ride transit. With on-demand transit technology, JTRAN can track active riders on a daily, weekly, and monthly basis, and run campaigns to increase engagement. Via recommends sending inactive riders periodic reminders about the service, including fare promotions, to re-engage them before they become dormant.
2. **Test different approaches to iterate the best outcome.** As every service is unique, it is important to test different marketing approaches to gain insight into rider behavior and refine the marketing strategy over time. By experimenting with various campaigns, such as targeted trip discounts and email promotions, and monitoring the impact of each experiment, it is possible to determine the most effective strategy for different types of riders. For example, a simple test could be an email encouraging users to take evening rides. After the promotion, it is possible to compare the behavior of the segment of riders who received the email to the behavior of those who did not. Results from this experiment can be used to inform future communications.

Developing Local Partnerships. In addition to marketing to customers directly, local institutions are often excellent marketing partners who can help promote local transit services to their customers, employees, and, in the case of universities, students. The University of Mississippi Medical Center, St. Dominic Hospital, and Tougaloo College are each examples of institutions that could benefit from localized transit service improvements. Students who arrive on campus without private vehicles, or patients who need transportation assistance to medical appointments or following their discharge from a hospital are some examples of more targeted use cases relevant to these institutions.

The approach to these partnerships could also be replicated as services expand. For example, additional hospitals and health clinics, colleges and other educational institutions, and major employers throughout the county could be approached for service promotions. Moreover, those institutions that stand to benefit most from new transit services may be interested in financially supporting the operations of new services as a means of improving employee recruitment/retention or reducing parking demand on-site.

Funding

In addition to JTRAN's constrained operating resources, the following avenues could provide meaningful financial support for on-demand transit services:

Traditional Revenue Streams

State and Federal grants. Most on-demand transit operators will support public agencies in their applications for State and Federal grants. The FTA's RAISE and Accelerating Innovative Mobility (AIM) grant programs are two funds that are particularly suitable for on-demand transit.

Private financing. Private capital can defray the upfront costs of operating microtransit services, aligning the private provider and public partner's interest over the term of the contract. In some cases, private sources of funding have contributed sponsorships or matching funds to operate on-demand transit service. These private sources include major employers, retail and entertainment associations, universities, and other local institutions with a vested interest in ensuring the mobility needs of their communities are met, spurring economic development in the region, offering visitors convenient transportation.

Alternative Revenue Streams

Takeover advertising campaigns. Some on-demand transit services have recouped operational expenses by offering "takeover" advertising campaigns. These campaigns may include elements of advertising on vehicles, in-app affiliate marketing, and branded event promotions. Combined into a takeover campaign, these individual strategies have greater value to a potential advertiser. The unique qualities of an on-demand transit service – an app-based system with dedicated vehicles serving geographically-defined markets – make it particularly well suited for a takeover campaign strategy.

In-vehicle interactive tablets. Other on-demand transit operators have generated nominal revenue by installing interactive tablets in every vehicle. Passengers could use the tablets free of cost to play games, get trip information, read the news, and watch videos; the tablets generate revenue by showing advertisements periodically. The operator would partner with a hardware provider such as Surf, TripCam or Play Octopus, which would provide tablets and remit fees to the operator (whether JTRAN or a vendor) according to passenger use. Interactive tablets present an appealing option for revenue creation for their low cost and low effort to implement.

Implementation Steps & Phasing

As noted earlier in this report, JTRAN should consider implementing the North Pilot Zone prior to launching the larger Northside and Southside Zones. A smaller demonstration project will allow JTRAN to evaluate various service design parameters and make adjustments prior to scaling-up to larger service zones. The following next steps were identified to advance the implementation of on-demand service in Jackson.

1. **Planning & Fundraising**
    - Identify pilot project scope (zonal boundaries, service levels, service policies, fares)
    - Select service delivery model (TaaS vs. SaaS)
    - Identify and pursue grant funding opportunities and identify supplemental revenue sources
    - Initiate procurements (service contractor, vehicles, technology)
2. **Phase 1a Pilot Testing (6-12 months)**
    - Start-up activities
    - Marketing
    - Service launch
    - Service monitoring and evaluation
    - Refine service policies in advance of expansion
3. **Service Expansion**
    - Phase 1b: Northside Zone Expansion
    - Phase 2: Southside Zone

6. ADA Paratransit Considerations

Serving current ADA paratransit customers, particularly with same-day service options, is a primary objective of Mobility on Demand (MOD).[7] With the proposed redesign of JTRAN's fixed-route service, it is likely that a significant portion of current ADA paratransit customers will have their trip origins or destinations fall outside of the statutory ¾ mile buffer around the fixed-route network. However, JTRAN may choose to continue to serve these non-qualified trips. Areas of Jackson that would lose fixed-route service but continue to be served by MOD include portions of the Presidential Hills, Magnolia Terrace, Woodhaven, Tougaloo, and Eastover neighborhoods.

Currently, 11% of existing paratransit trips have either an origin or destination outside of the existing ¾ mile buffer service area and are therefore non-qualified trips. These non-qualified trips are mostly for medical purposes (61%) or employment (32%). Under the proposed Coverage Network and Moderate Frequency Network scenarios, 29% of current paratransit trips would become non-qualified by falling outside of the revised ¾ mile buffer of the fixed-route network. The Maximum Frequency Network, on the other hand, would result in a 45% reduction in annual qualified paratransit trips compared to the existing service area. The Northside and Southside on-demand transit zones are designed to offset these potential losses in the paratransit service area and minimize the disruption to passengers. By implementing both the Northside and Southside MOD zones, the forecast reductions in paratransit service area would shrink to 16% under the Coverage and Moderate Frequency Networks and to 22% in the Maximum Frequency Network.

On-demand transit may potentially offer JTRAN additional cost savings due to the significant share of ADA paratransit customers likely to shift a portion of their trips from ADA service to on-demand transit. This shift is significant because MOD is likely to be operated at a fraction of the cost of ADA paratransit - between $6 and $20 per trip - compared to the contracted ADA paratransit cost-per-trip of $56. Based on findings from other American MOD services, we find that areas with on-demand transit service generate levels of ADA paratransit ridership (normalized for underlying population) 31% lower than areas without on-demand transit service.[8] As a result, we estimate that 31% of the ADA trips that currently have an origin *and* destination within the Northside and Southside MOD zones will switch to MOD. If both Northside and Southside MOD zones are implemented, this modal shift from paratransit to MOD would result in annual cost savings to JTRAN of between $250,000 and $300,000, depending on the operating model.

[7] Currently, ADA paratransit customers must book trip reservations at least 24 hours but fewer than 14 days in advance.

[8] Khan et al. 2021. "Travel Behaviors of the Transportation-Disabled Population and Impacts of Alternate Transit Choices: A Trip Data Analysis of The Handitran Paratransit Service in Arlington, TX." p. 9. https://doi.org/10.1061/9780784483534.043.