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The future of  
urban mobility

**Flexible, scalable, on-demand transit**

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# Introduction

Remember the images early in the pandemic featuring goats grazing in an otherwise deserted-looking town and near-empty cores of cities like London and New York? The streets were mostly void of their usual hum of humanity, as citizens took to their homes to avoid falling ill with COVID-19. A year and a half later, and it's clear the global pandemic will have a lasting impact on how a great number of people conduct their lives—and, in turn, on commuting and other urban travel. At the same time, commitment to climate-related initiatives means government support for transit agencies now requires they be more innovative, equitable, and sustainable.

Yet urban mobility was already evolving before the crisis, as digital and technical innovations enabled the emergence of alternatives to both mass transit and car ownership. The pandemic has accelerated this evolution, and today transit agencies around the world strive to address their financial and operational challenges while ushering in a new future for urban mobility. On-demand transit is staking a strong claim to be an integral part of that new future. In this report, Deloitte looks at the changing urban mobility landscape and how on-demand transit is allowing transit agencies to provide a better customer experience, reduce costs, operate more efficiently, improve environmental outcomes, and make smarter decisions.



The changing  
mobility  
landscape

Between the Great Recession of 2008-09 and the outbreak of COVID-19, a new paradigm for moving people and goods emerged. It was powered by rapid developments in technology, new business models, and shifting consumer and societal behaviours and expectations. Car-sharing, ride-sharing, autonomous vehicles, electric vehicles, and micro-mobility services—think of e-scooters—seemed to herald a future in which getting around town was more sustainable, equitable, efficient, and convenient.

During this time, transit users grew accustomed to personalized, responsive customer experiences through their interactions with online retailers and other businesses. They wanted to travel when, where, and how they wanted—while transit agencies still offered fixed stops, routes, and schedules. And while high-density areas are typically well-served, lower-density areas often have to make do with little to no service. If they could afford to, frustrated transit users turned to ride-sharing, which in certain instances worsened traffic congestion.<sup>1</sup> Transit agencies faced growing calls to adapt to changing customer needs and a new mobility norm.

Then the pandemic hit. In North America and around the globe, public transit and rail ridership fell 70–90% in the early months. Ride-sharing firms such as Uber and Lyft saw their gross bookings drop 75–80% in the immediate aftermath of the outbreak. Revenues plummeted. To reduce costs while maintaining some services, transit agencies laid off staff, reduced route frequency and capacity, or shut down routes entirely.<sup>2</sup>

Ridership and fare revenues have recovered slightly but remain well below pre-pandemic levels. Canadian transit operators' ridership had reached 40% of normal levels by December 2020, while billions of dollars in government aid enabled agencies to avoid devastating cuts and continue to provide approximately 87% of regular service levels.<sup>3</sup> Uber, meanwhile, saw gross bookings recover to US\$6.79 billion in the fourth quarter of 2020—up from US\$3.05 billion in the second quarter but well below the US\$13.51 billion reported in the last quarter of 2019.<sup>4</sup>

It's unclear whether revenues will return to pre-pandemic levels unless transit agencies and other mobility providers adjust to a changed world in which travel patterns and transportation needs are shifting. Remote working, virtual medicine, and e-learning have proven viable and are likely to be maintained in some form post-COVID-19.<sup>5</sup> Travel-heavy sectors, such as sales and professional services, may never return to pre-pandemic levels of movement. Consumers may rely on online shopping even after the pandemic ebbs.<sup>6</sup> This will mean fewer people travelling to and from work, school, doctors' offices, malls, and local shops. Traditional travel patterns into and out of central business districts and downtown cores will give way to more dispersed patterns as people travel between suburbs and to destinations closer to home. And transit agencies will need to adapt to these changing needs.



# What is on-demand transit?

On-demand transit—sometimes referred to as on-demand ride-pooling, a system in which small buses distributed throughout more distant zones feed into existing transit networks—isn't new. Flexible, shared mobility services have existed for years in many jurisdictions; think of jitney or shared-taxi services.<sup>7</sup> But this is quite different from a global routing optimization model that can handle an entire city as one service area. These modern versions include non-emergency medical transportation (NEMT) and paratransit services, both of which allow users to book their ride ahead of time; a bus is then dispatched to pick them up and deliver them to their destination in a shared ride.

Some of the on-demand ride-pooling services can be comparatively costly and be unable to move large numbers of people. Operating a paratransit vehicle, for example, is generally 10 times as costly as operating a normal bus, while the systems used to pool paratransit riders generally permit five or six trips per vehicle hour at most.<sup>8</sup> In addition, the customer experience can be cumbersome and even unpleasant. Bookings may require long lead times, customers may wait a long time to be picked up, and travel time itself may be quite lengthy.

Advances in technology have enabled a significant evolution in the capabilities of on-demand transit in recent years, however. Harnessing the power of mobile apps, the cloud, and powerful algorithms that optimize ride-pooling and routing, modern on-demand transit gives agencies the tools to provide riders with a better customer experience and demand-responsive service.

At the same time, such services provide vital intelligence that transit agencies can use to improve vehicle utilization, optimize routes, achieve cost and operational efficiencies, and better understand the travel patterns emerging across the cities they serve. In addition, the technology required is more easily implemented—and more scalable—than ever.

Cities worldwide are exploring on-demand transit in some form. By the end of 2020, nearly 400 such services had been rolled out around the globe, with 270 currently running. Interest hasn't been substantially dampened by the pandemic, either: over 130 projects were launched in 2020, compared to 150 in 2019.<sup>9</sup> While software companies such as Routematch (acquired by Uber in 2020<sup>10</sup>) and Trapeze have long helped transit agencies manage paratransit and other mobility-as-a-service offerings, new players have emerged to bring a broader vision of on-demand transit to life, including Spare Labs, Pantonium, ioki, Via, Padam, RideCo, and TransLoc, to name a few.

The market potential for on-demand transit could be considerable in a post-COVID-19 world. It seems unlikely that transit ridership will return to pre-pandemic levels. One Canadian transit agency, for example, anticipates that 25% of its ridership won't return to traditional buses and light rail.<sup>11</sup> New services will be needed to attract those riders back to transit—and on-demand services could be one answer.

CASE STUDY

## Spare Labs transforms on-demand transit in Dallas

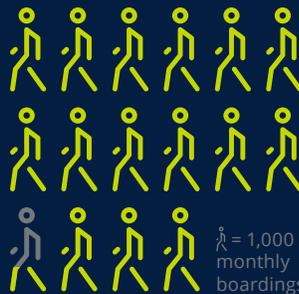
In Texas, Spare Labs worked with Dallas Area Rapid Transit (DART) and Unwire, a front-end smartphone app developer, to create the largest public on-demand transit service in North America.

DART serves metropolitan Dallas, a huge urban expanse that 7.5 million people call home. Connecting urban, suburban, and rural residents to city transit has long been a challenge. The first and last mile is a particular challenge: 28% of residents live more than a quarter mile from a transit stop, and 24% of all jobs are also a quarter-mile from a transit stop. A prior attempt at on-demand transit by a different developer had failed to deliver the desired results, in part because the software used wasn't integrated with DART's GoPass multimodal travel planner app.

Spare Labs brought to the table its Spare Open application programming interface (API), which allowed DART to seamlessly link its GoLink micro-transit service into its GoPass app. This enabled the transit agency to create a truly multimodal travel planner and ticketing solution across its entire transportation network. Spare Engine, Spare's flexible algorithm, also enables the ability to operate stop-based and door-to-door transit service as required.

Launched in January 2019, DART's GoLink has transformed how people travel across the Dallas metropolitan area, expanding to cover 24 zones.

The service averages **16,000 boardings a month** and enjoys a **95% rider satisfaction rate**



**GoLink's operational costs have fallen 26%** while continuing to maintain service excellence, and **riders per revenue hour has risen 14%**



Moreover, GoLink's success has reduced the burden on DART's paratransit service.

In addition, an analysis of DART's GoLink 2019 ridership data in four zones—a mix of commuter and residential areas—yielded useful. The analysis found that most on-demand requests occurred in areas with little to no public transit service, and that residential zones have noticeably more intra-zone travel than commuter zones. In addition, the analysis identified peak activity time for different kinds of travel (e.g., commuting vs. recreational) and areas where transit demand was most predictable. These data-driven insights could then be used to redesign the layout of transit routes overall.



# Why embrace on-demand transit?

On-demand transit enables transit agencies to respond to the changing—or unmet—needs of their ridership, improve service and the customer experience, and address the financial and operational challenges they are likely to face in both the near and long term. Moreover, for some agencies, on-demand transit could be a stepping stone toward a more agile, extended network comprising the assets of both agencies and an array of partners.

## Responding to changing or unmet transit needs

Traditional mass transit typically operates on a hub-and-spoke model and has shaped travel patterns: riders take a bus or train to a central hub, transferring to continue their journey as needed. With more people foregoing the usual commute and working from home at least some of the time, however, such travel patterns are being disrupted. New ones are emerging. Riders, used to the end-to-end convenience of ridesharing services, increasingly want to travel directly from where they are to where they want to go, on their terms. Over time, these mobility preferences will reshape the network.

It takes significant time and investment to build infrastructure, such as subways and light rail lines, for the traditional model. It also takes time to map out and establish new fixed bus routes or adjust existing routes to match changing demands, such as to new or expanded regional routes. And in some cases, ridership needs may have already changed by the time the new lines or routes open.

On-demand transit allows transit agencies to quickly scale up new services to meet emerging ridership demands. It also allows them to gather data that can be analyzed to determine whether new fixed routes are needed and where—and whether need is falling, in which case services can be scaled down equally fast.

In this way, on-demand transit can mitigate the risk of investing millions or billions in new transit infrastructure that proves to be underused and uneconomical. Pursuing an integrated model that combines traditional transit with new mobility alternatives maximizes the value of government investments in transportation infrastructure.

In addition, on-demand transit can enable more equitable transportation access to those whose needs don't necessarily align well with rigid traditional networks. Shift workers and parents or guardians managing childcare responsibilities, for example, are both rider groups that can benefit greatly from the flexibility. In some instances, on-demand transit options could even alleviate the need to provide full fixed-route service throughout the day. During the first year of the pandemic, for example, Ontario's Metrolinx discovered it couldn't sustain service reductions beyond a certain point because essential workers depended on the agency to get to and from work.<sup>12</sup> A more flexible alternative might have been able to bridge the gap.

**CASE STUDY**

## **BC ride-hailing company hits accelerator using Spare Labs technology**

**Whistle! is a ride-hailing company that launched in February 2020 to serve tourists and others in the communities of Tofino, Nanaimo, and Whistler in British Columbia.**

At first, the company it didn't have the necessary technology to support its business goals of providing a superior experience for both drivers and customers. Drivers couldn't accept back-to-back trips; they had to complete their current trip before accepting a new one. Potential customers had to download the company's app to book and pay for rides. Potential drivers weren't attracted. And the existing platform lacked a scalable back end, which hindered efforts to grow operations.

To address these challenges and support growth, Whistle! sought a ready-made technology solution that could be tailored to its needs, supported rider and driver apps, and provided the reporting tools required to meet government regulations.

Whistle! worked with Spare Labs, whose on-demand mobility platform allowed them to rapidly iterate a solution and develop the structure that fit the business's requirements. Whistle! established zones and fare structures that enabled it to accommodate different trip types, such as local trips or airport pickups; Spare's technology allows the company to adjust these zones and fare structures based on daily and weekly operational insights. The drivers can now accept new trips before their current trip has ended, and Spare's platform determines when the best match for a particular trip request is a vehicle already in service. As well, Spare's reporting system means that Whistle! can pay its drivers the same day their work is done, helping the company attract drivers in a tight labour market.

**Since adopting Spare's technology, Whistle! has experienced a 5% increase in ridership week over week, with a significant number of recurring passengers. By November 2020, the company had 1,500 unique riders.**



**The company is generating 30% more revenue**

because its drivers can accept new, efficiently routed trips while in service—leading to more trips per revenue hour.



## Improving the customer experience

Switching to on-demand transit enables transit agencies to serve the same ridership more responsively with fewer vehicles while it gives riders more choice and allows them to plan their trip around their needs. This will help agencies improve the rider experience while achieving better cost efficiencies and reducing wear and tear on vehicles. Pilots can be quickly established and tested in low-density or late-night service areas to gain quick wins. The network can be expanded based on customer demand, and ultimately integrated with traditional fixed-route services.

## Meeting sustainability and emissions goals

Governments at various levels across Canada, the United States, and other countries are making sustainability and carbon-emission reductions a central plank of their post-pandemic economic recovery plans. Investments in mass transit, including light rail and electric vehicles, play an important part in achieving these governments' long-term green objectives. On-demand transit can play a key part in the urban mobility mix, and can be implemented in a way that provides a flexible, responsive transit solution without putting more vehicles on streets unnecessarily.

## Improving equity and inclusion in cities

Public transit isn't going anywhere: no major city can function properly without providing an efficient transportation system for its citizens. And for many, it's an essential service—and a force for economic and social inclusion. People who ride to work are less likely to have the option to drive. In 2020, for instance, University of Toronto researchers found that low-income groups, visible minorities, and elderly people were the groups most likely to continue using transit despite pandemic-related risks. For them, transit is non-discretionary travel: there may be no alternative, or those that exist are more costly, less available, or less safe.<sup>13</sup>

However, as transit agencies deal with the financial impact of the pandemic and its aftermath, the pressure to reduce costs is likely to grow. This may involve reducing service levels in some areas. Such cuts can have a disproportionate impact on those citizens who rely on transit to get around, making travel increasingly burdensome and limiting opportunities for social and economic participation.

On-demand transit can help cities and transit agencies maintain—and even improve—equity and inclusion outcomes, even in challenging environments like a pandemic.

Moving low-density, fixed transit routes to an on-demand model ensures citizens in those areas continue to have access. It can also help transit agencies expand service in under served areas and eliminate so-called transit deserts, connecting more people to jobs, and other opportunities as well as transit networks. For workers in these areas, on-demand transit could mean it's no longer necessary to walk half an hour to a bus stop on a frigid winter night only to see the bus pull away, with the next one not due for another hour.

**CASE STUDY****Pantonium's on-demand solution brings unexpected benefits to Belleville**

Belleville Transit found that its late-night fixed routes often ran empty in long loops around the city, serving, on average, 43 riders per night. In late 2018, the agency began working with Pantonium to develop an on-demand transit solution for the small Ontario city. Pantonium provides transit agencies its proprietary algorithm to dynamically route buses in real time to meet riders' needs.

Belleville Transit's original goals were largely operational: replace the late-night routes with on-demand service, achieve more efficiency, and lower wear and tear on the vehicles. The organization was completely surprised by citizens' response to the new service: a 250-rider increase in two weeks, with ridership continuing to grow over a month until levelling off at a 300% increase. More buses were needed to meet the unexpected demand, and now five on-demand buses cover an area that once needed 13 fixed-route buses to serve.

Moreover, the overall service area has grown 70%—while vehicle mileage has dropped 30%. The city's transit authority attributes the increase in use to the fact that Pantonium's algorithm allows it to cover the entire city in one zone, enabling riders to travel between any two bus stops on a single bus, providing customer-controlled transit services that riders find easy to use.

The new service has helped employers almost eliminate transit-related absenteeism, because late-shift workers can now more easily travel to their workplace. It's also creating new social, tourism, educational, and economic development opportunities for the city, and has the potential to deliver important environmental benefits. According to a recent assessment, deploying Pantonium's on-demand transit technology in just 10% of Belleville's transit service time (i.e., the night service) could achieve important annual reductions in greenhouse gas emissions (-0.16kt) and air contamination from nitrogen oxide (-0.28t), sulfur oxides (-0.18t), volatile organic compounds (-0.25t), and particulate matter (-0.02t).



# Key considerations

On-demand transit has the potential to enable transit agencies to improve service levels and the rider experience, achieve important efficiencies, and support greater equity and inclusion among the people they serve. It can generally be divided into three categories:

1

#### **FIRST- AND LAST-MILE PROJECTS**

Connects people to and from busy fixed-route transit hubs

2

#### **TRADITIONAL ON-DEMAND TRANSIT PROJECTS**

Uses smaller vehicles in multiple smaller zones in areas of dense population

3

#### **FULL-CITY-ZONE ON-DEMAND TRANSIT**

Well suited to less dense areas and off-peak coverage for larger areas.

Before implementing any type of on-demand mobility services, however, agencies should consider some key factors:



### Asset management

On-demand transit allows agencies to optimize the size of their fleet. It may also drive them to bring in other, often smaller, vehicles. How will assets be repurposed once on-demand is implemented? Will on-demand allow for service expansion elsewhere in the network, or help lengthen the lifespan of existing assets? If the agency's fleet begins to comprise several types of vehicles, how can asset and maintenance costs be optimized? Several available technology platforms also offer scenario-modelling options, which allows transit agencies to consider various service options, model routes, and vehicle types on a map. This is helpful for planning in the early stages.



### Customer experience

How will the on-demand service be integrated with regular fixed-route transit operations? How will bookings and payments be handled? Will the on-demand service rely on existing stops, add virtual stops (which are marked only on an app), provide door-to-door service, or take a hybrid approach that combines all three, as some cities have explored? These decisions must be rooted in a solid understanding of the transit agency's customers, which in turn demands having the ability to capture and analyze rider data and to perform network modelling and dynamic optimization.



### Sustainability and emissions

As transit agencies transition from older, diesel vehicles to new low- or zero-emission ones, is there an opportunity to convert to assets better suited to delivering on-demand services? How will on-demand mobility affect agencies' ability to meet emissions targets, from carbon to air contaminants such as nitrogen dioxide? How will it impact traffic congestion on busy streets?



### Health and safety

Many people have avoided public transit during the pandemic out of concern for their health. The convenience of on-demand transit could lure riders back, but how will transit agencies ensure such services adhere to existing pandemic-driven standards for sanitation, ventilation, and physical distancing?



### Governance

How will on-demand transit services (or other mobility services) be governed? Will private companies simply contract with public transit agencies, or will they be managed as a public/private hybrid? Should autonomous vehicles reach the mainstream, what impact will that have on the governance of these services?



### Data collection, security, and usage

What customer data will be captured, and how will this data be stored, shared, and protected from cybersecurity threats? How will the data be used to improve on-demand and traditional transit offerings, and to help the agency stay on top of emerging client needs and behaviours?



### Digital integration

On-demand transit services typically use mobile and web apps to allow riders to book their trips. How will these new tools be integrated with existing fare systems so that customers can plan, book, and pay for their end-to-end journey? How can the tools be integrated with those of other partners serving the community, from scooter rental companies to grocery stores offering pickup? How will on-demand services facilitate integration with the city's future operational platforms or intelligent transport systems, which might control traffic patterns, signals, and more?



### Impact on employment

How will the adoption of on-demand transit affect those who currently work for travel authorities, and how will drivers' unions be involved in the change? The smaller vehicles that are often used for on-demand transit may not require the same licensing that traditional transit vehicles demand, and this can give agencies a larger talent pool from which to recruit drivers. At the same time, on-demand transit could lead to increased ridership and more sustainable employment for union drivers.



### Change management and communication

How will the introduction and impact of on-demand transit be communicated to drivers, other transit employees, and transit customers? An effective change management and communication program will be key to ensuring new services are rolled out smoothly and are well received by riders.



### Government funding

As federal, provincial, and state governments include transit funding into their post-pandemic recovery plans, how can transit agencies use it to reimagine the mobility mix in the areas they serve?

# Next steps

On-demand transit can be introduced much more quickly than most traditional alternatives, but transit agencies and governments should proceed with due care as they explore its applicability to their network.



**Start with the right model**

In selecting the type of on-demand model to offer (first and last mile, traditional on-demand, or full city zone on-demand), agencies should consider the size of the area being served, the population density of the area, and the level of service they wish to provide to clients.



**Focus on the customer**

Ensure that current key performance indicators and metrics are customer-focused. If they're not, adjust them so that they provide the data needed to measure, monitor, and improve the customer experience. It's vital to collect data about actual end-to-end customer journeys; on-demand transit pilots and proofs of concept can help capture this.



**Develop and validate the business case**

Transit agencies should consider all relevant factors in building the business case, including the total addressable population for any on-demand transit service; the current and potential locations of employment hubs and established transit hubs; asset life-cycle costs; known demand variabilities; available government funding; and financial, operational, sustainability, and equity goals or targets.



**Understand the future-state system configuration**

Agencies should map out how the transit system will be configured once on-demand services are introduced, and how this will work with the system in its current state. Areas to consider include service zones; fleet configurations; the impact on drivers, hours, and costs; and transfer and/or hand-off points. Simulation tools enable multiple scenarios to be defined and explored, and these scenarios can be used to provide decision-making process inputs, to validate the business case, and to allow for dynamic network optimization.



**Explore how technology can help manage the future-state transit system**

Consider what tools will be needed to monitor and manage a transit system combining fixed-route, on-demand, and other mobility services in real time. Digital twins or other simulation tools can be invaluable in understanding rider flows and anticipating demand or potential problems. Dashboards can be used to provide at-a-glance assessment of network status and key performance indicators.



**Embrace an agile approach in implementing**

On-demand services are ideally suited to an agile, test-and-learn approach to implementation. Launch the program with pilots in a small, defined area, and build on lessons to expand using a series of iterative, sprint-type rollouts. Where multiple stakeholders are involved, make sure that roles, responsibilities, and accountabilities are clearly defined and communicated.

Battered by the pandemic and facing an unprecedented need for change and optimization, public transit agencies around the world are searching for better ways to keep pace with technologically advanced new competitors, address their financial and operational challenges, and meet riders' needs as a new, hybrid work environment takes shape. On-demand transit has emerged as a viable way to achieve these objectives by transforming the transit mix. It can enable agencies to see where the needs are, improve route efficiency, and optimize vehicle utilization as they establish a revitalized network of fixed and on-demand services better suited to our new normal. However, as they explore the opportunities, transit agencies will also need to consider the mid- to long-term implications of this potentially significant change.

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