NATIONAL LABORATORY OF THE ROCKIES

On-Demand Transit: Features, Benefits, Challenges, Costs, and Evaluation

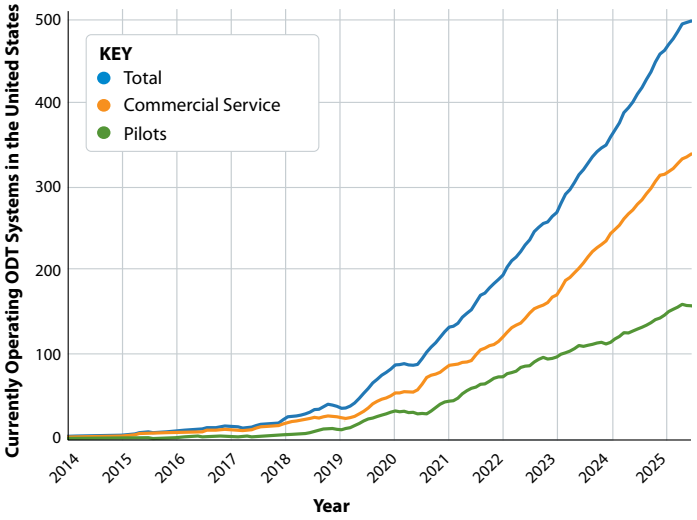
On-demand transit (ODT), also known as on-demand mobility or microtransit, is a flexible form of public mobility. Unlike traditional fixed-route transit, ODT adjusts where and when service is provided rather than following predetermined schedules and routes.

Having evolved from commercial ride-hailing business models, ODT leverages smartphone connectivity and real-time route optimization to provide highly responsive, dynamic, and efficient service. ODT trips, which are usually shared, can function as a stand-alone or first-mile/last-mile service connecting riders to other types of transit.

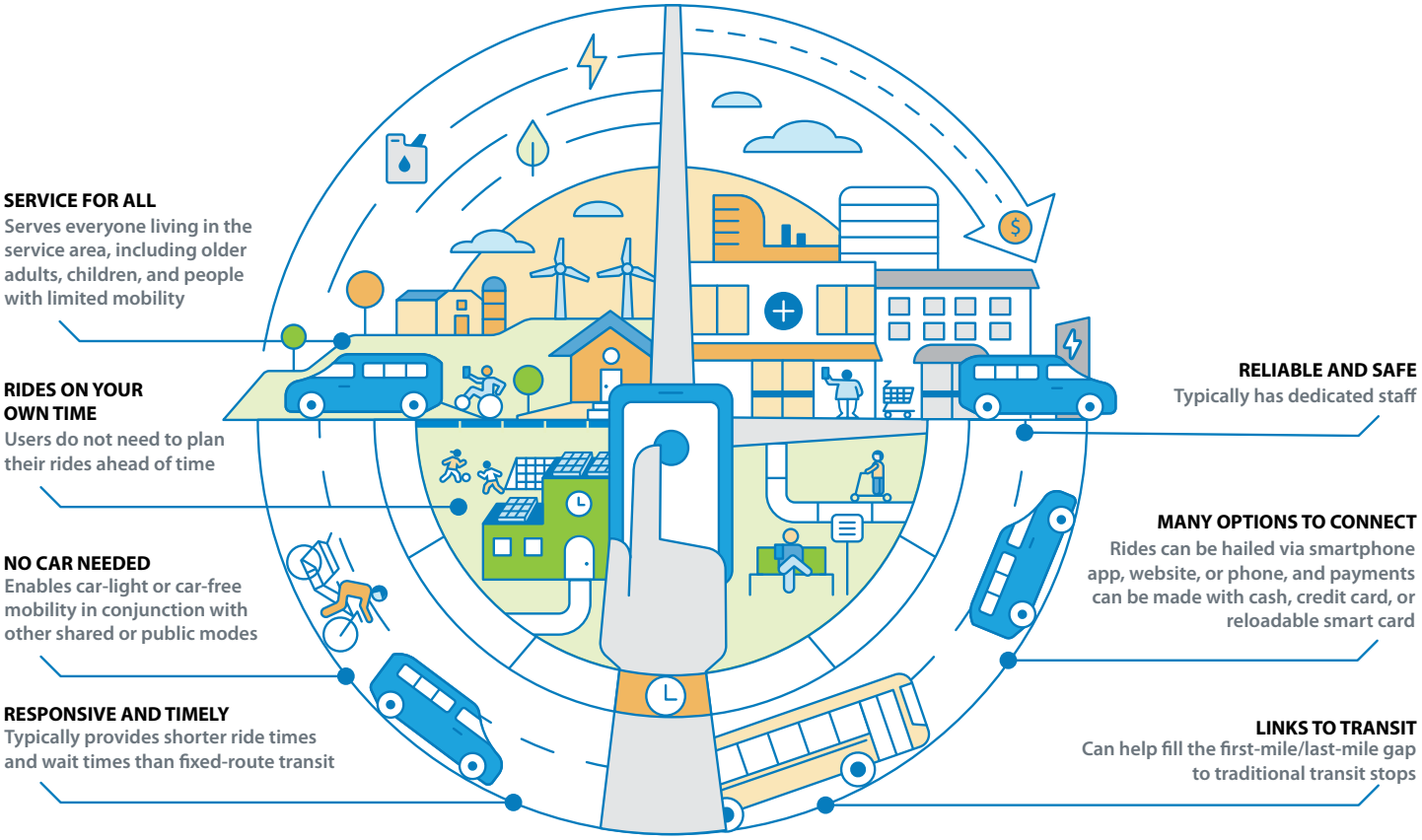
The U.S. Department of Energy's National Laboratory of the Rockies (NLR) works in partnership with communities and transit agencies across North America to support and evaluate customized ODT systems.

The growing number of ODT systems reflects the need for more effective, flexible, and scalable public transit solutions that can adapt to real-world demands. Many of these ODT systems began as pilot projects and continue to operate today as commercial services.

Growing Number of ODT Systems in the United States



Data source: Lukas Foljanty On-Demand Ridepooling World Map (August 2025)



ODT offers a customizable, cost-effective mobility solution. *Graphic by Cameron Nelson, National Laboratory of the Rockies (NLR)*

Benefits

ODT technologies and operations continue to mature, and adoption is increasing in part due to the benefits they offer relative to fixed-route transit. These benefits include:

Quality of Service

Riders may experience a higher quality of service with ODT compared to fixed-route services in terms of flexibility, real-time requests, wait times, and ride times.

- **Greater flexibility in pickup and drop-off locations** within the service area.
- **Requires little to no advance scheduling,** whereas traditional paratransit services typically request 24–48 hours' notice. Although ODT trips may be scheduled in advance, they are typically requested in real time, similar to commercial ride-hailing services.
- **Reduced wait times** compared to fixed-route transit, averaging about 10 minutes.
- Can function as a stand-alone service with **shorter ride times** or as a first-mile/last-mile service connecting riders to other types of transit.

Safety

ODT systems typically have a dedicated staff of drivers, real-time vehicle tracking via mobile apps, and late-night door-to-door services, providing enhanced safety compared with fixed-route transit.

Rich Data Streams

ODT provides rich data streams, such as heat maps of the top pickup and drop-off locations. Such data can be used to optimize service areas, times of operation, or vehicle and fleet sizes.

Accessibility and Coverage

ODT systems serve everyone within the service area, including seniors, people with disabilities, and those without access to private vehicles. Trips can be booked via smartphone app, website, or phone, and payments can be integrated or made with cash, credit card, or reloadable smart card.

Energy Consumption

Vehicles that are "rightsized" to demand (e.g., minivans versus full-sized buses) tend to be more energy efficient, reducing fuel consumption and overall energy use. Smaller vehicles can also be more financially feasible for communities, lowering both capital investments and operating expenses.

Challenges

ODT also faces some challenges, including:

Scaling Up and Servicing Peak Times

ODT systems can quickly see increased ridership in general and/or specifically during peak hours of operation. Such increases may require additional vehicles and drivers to maintain service quality, which can be financially challenging.

Schedule Uncertainty

A non-fixed schedule may work well for non-time-sensitive tasks such as grocery shopping, but it can be challenging for commuters—though some ODT systems do allow pre-scheduled trips.

Safety

Some riders may feel uncomfortable sitting in close proximity to other riders in smaller vehicles.

Integration With Nearby Transit Systems

Riders may use ODT to connect to fixed-route transit (bus or rail) when their final destination is outside of the ODT service area. Integrating real-time information (schedules and stops) for the full trip into the mobile app can be challenging due to the various data streams and transit agencies involved.

Smartphone Dependency

While riders without smartphones can call to schedule a ride, they will not be able to track the vehicle's location. In addition, downloading an app and setting up an account may deter some potential riders.

Service Designs

Transit agencies partnering with companies for ODT system service can follow various business models:

- Subsidize ride-hailing trips.
- Hire a software-as-a-service company for dispatch and operations, with the transit agency owning the fleet.
- Use turnkey solutions, where a company is hired for the software as well as the vehicles and drivers.

Service designs can include predefined pickup and drop-off locations—typically within one or two blocks of a user's destination where safe loading and unloading areas exist. This is known as corner-to-corner service, versus door-to-door service. Geofencing technology enables dynamic shifts between these service types as well as service boundary adjustments by time of day. Service designs can also be set up to integrate with existing fixed-route transit.

ODT systems can use a variety of vehicles—such as shuttle buses, minivans, or small low-speed vehicles—powered by electricity, hybrid systems, gasoline, or diesel. Many implementations primarily use shuttle buses or minivans.

Communities and researchers are also looking into the feasibility of using autonomous vehicles, as the technology has advanced in recent years with robotaxi companies such as Waymo, Tesla, and other emerging operators.

Although autonomous vehicles are primarily used for private ride-hailing, they have also been piloted in public ODT systems. For example, a four-year pilot in Arlington, Texas, used partially autonomous minivans operated by Via and May Mobility, and an ongoing pilot in Chandler, Arizona, uses autonomous passenger vehicles operated by Waymo to supplement its ODT fleet during peak periods. Additionally, Zoox and other companies are piloting autonomous vehicles designed for shared, multiparty use. Recent NLR interviews with ODT fleet managers show some interest in automation, but emphasize the need for greater clarity around the risks and benefits as the technology and public acceptance continue to evolve.

System Costs

ODT systems typically charge passenger fares comparable to fixed-route services ($1–$5 per ride), particularly in rural and small communities. The per-ride cost to provide ODT service is also on par with traditional transit, often requiring community subsidies. ODT more efficiently serves sparse demand because it is not constrained to given routes. In addition, "rightsized" vehicles help reduce capital, fuel, and maintenance costs.

Framework for Evaluating ODT Systems

NLR has identified key criteria for researchers or transit agencies to track and measure for evaluating the effectiveness of ODT systems.

Minimum criteria required for evaluation:

- **System operation** – Dispatch and route planning, hours of operation, and annual budget.
- **Vehicle fleet** – Fleet composition, origin-destination pairs, vehicle miles traveled, and energy use.
- **Ridership** – Ridership numbers, passenger wait and travel times, demographics, and passenger satisfaction.

Arlington, Texas, and other communities with populations spread out over large areas are turning to ODT models that allow residents to hail rides using smartphones. *Photo by Anna Squires, NLR 104427*

Additional criteria for more holistic evaluation:

- **System operational efficiency** – Percentage of shared rides, trip cancellation rates, passenger throughput per day per vehicle, and trip denial rate. Trip denial rate represents the percentage of ODT trips where a potential rider requests service but is not assigned a driver due to high demand at that time. In such cases, the requester is prompted to try again later.

NLR Case Studies and Additional Resources

NLR has evaluated ODT systems in communities of varying densities.

Rural Case Studies

Fort Erie On-Demand Transit Case Study (doi.org/10.2172/1908698), *NLR Technical Report (2023)*

Sustainability, Scalability, and Resiliency of the Town of Innisfil Mobility-on-Demand Experiment: Preliminary Results, Analyses, and Lessons Learned (doi.org/10.1061/9780784484340.022), *NLR Conference Paper (2022)*

Suburban Case Studies

Insights Into On-Demand Transit: A Case Study of Houston METRO's curb2curb Transit Services (docs.nlr.gov/docs/fy25osti/93137.pdf), *NLR Conference Paper (2025)*

Mobility Energy Productivity Evaluation of On-Demand Transit: A Case Study in Arlington, Texas (doi.org/10.1177/03611981241234901), *Transportation Research Record (2024)*

Urban Case Study

Community Public Mobility Using On-Demand, Low-Speed Electric Vehicles: A Case Study in Downtown St. Louis, Missouri (doi.org/10.1177/03611981241262306), *Transportation Research Record (2024)*

Additional Resources

How To Fund On-Demand Public Transportation and Microtransit in 2026 (ridewithvia.com/resources/creative-ways-to-fund-on-demand-public-transportation-and-microtransit-in-2026), *Via webpage (2026)*

On-Demand Transit Toolkit: A Resource Guide for Service Implementation (cutaactu.ca/wp-content/uploads/2022/06/CUTA-On-demand-transit-toolkit.pdf), *Canadian Urban Transit Association Report (2022)*

Demand Response Transit/Microtransit: A Guide for Implementing Flexible Transportation Services (www.arlingtontransit.com/sites/art/assets/File/Arlington_County_Guide_for_Flexible_Transit_reduced2019.pdf), *Arlington County, Virginia, and Metropolitan Washington Council of Governments Report (2019)*

Learn More

Visit **www.nlr.gov/transportation/on-demand-transit** to learn more about NLR's on-demand transit research and partnerships.

Cover image: *Photo by Anna Squires, NLR 104428*

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