

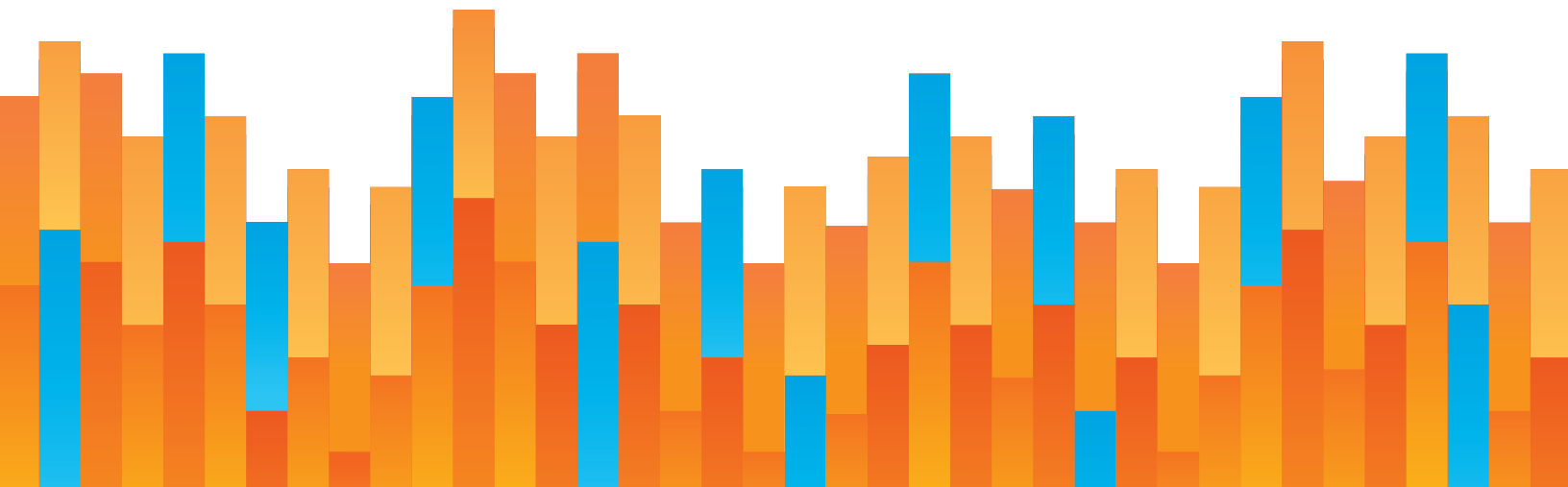


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TRANSIT OPERATIONS: RECOMMENDATIONS FOR POLICYMAKERS

by Neliann Rivera

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PART 1

INTRODUCTION

Whether people choose to use public transit often comes down to a simple question: how long will the trip take? In many U.S. cities, a 20-minute car trip can take an hour or more by transit because routes are indirect, service is infrequent, or buses and trains are delayed by traffic. These longer travel times help explain why transit accounts for only a small share of daily trips in most metropolitan areas. In 2024, about 3.7% of U.S. workers commuted by public transportation, according to the American Community Survey.¹

Yet focusing on commuting may overstate transit's current popularity. Transit carries a larger share of commute trips than of other travel. The 2022 National Household Travel Survey found that transit accounted for 2.5% of trips to and from work, compared with 1.4% of shopping and personal-errand trips and 0.8% of social and recreational trips.² Across all purposes, transit accounted for only about 1.5% of daily trips nation-wide.

Transit commuters are clustered in a limited number of metro areas. In 2019, about 70% of transit commuters living in U.S. metropolitan areas were concentrated in just seven transit-heavy metros: New York–Newark–Jersey City, Chicago–Naperville–Elgin, Washington–Arlington–Alexandria, Boston–Cambridge–Newton, Los Angeles–Long Beach–Anaheim,

¹ "United States Commuting at a Glance: American Community Survey 1-Year Estimates," U.S. Census Bureau, Census.gov, 22 Sept. 2025.
<https://www.census.gov/topics/employment/commuting/guidance/acs-1yr.html> (17 July 2026).

² S. Bricka et al., "Summary of Travel Trends: 2022 National Household Travel Survey," Federal Highway Administration, Jan. 2024. www.nhts.ornl.gov/assets/2022/pub/2022_NHTS_Summary_Travel_Trends.pdf (8 June 2026).

Philadelphia–Camden–Wilmington, and San Francisco–Oakland–Berkeley.³ In many other metropolitan areas, transit commute shares are around 2%–3%.⁴ Despite its limited popularity in many parts of the country, public transit remains a major focus of transportation policy and continues to receive substantial public funding. In order to ensure that transit serves as a practical transportation option in urban areas, agencies must provide service that is reliable, frequent, and useful for everyday travel.

Part of the answer lies in ensuring that transit serves today's transportation patterns. When many heavy- and light-rail networks were built, transit systems were designed primarily to move large numbers of commuters from residential areas to central city employment centers during rush hour.⁵ Today, jobs are often concentrated in several employment centers across a metropolitan area, while homes are spread over a much wider area.⁶ Remote work has also reduced the number of commuters who rely on traditional rush-hour transit. As travel patterns have become more dispersed and schedules more flexible, transit networks built around peak-hour downtown commuting often struggle to match current travel demand. Riders have fewer direct routes, more transfers, and less-predictable travel times.

These shifts in travel behavior help explain why many transit systems have struggled to maintain ridership. In the United States, transit ridership peaked in the mid-2010s and had already been declining before the COVID-19 pandemic, suggesting the decline reflects longer-term changes in travel habits rather than a temporary disruption.⁷ Lower ridership can also lead agencies to cut service frequency and routes, making transit less convenient and increasing wait times for passengers. Small and mid-sized transit systems are especially vulnerable because even slight drops in demand can raise operating costs per trip and trigger further service cuts.

³ Michael Burrows, Charlynn Burd, and Brian McKenzie, "Commuting by Public Transportation in the United States: 2019," U.S. Census Bureau, American Community Survey Report ACS-48, April 2021. <https://www.census.gov/content/dam/Census/library/publications/2021/acs/acs-48.pdf> (17 July 2026).

⁴ "Percent Commuting by Public Transportation in Metro Areas: 2010–2014," Bureau of Transportation Statistics, U.S. Department of Transportation, BTS.gov, www.bts.gov/content/percent-commuting-public-transportation-metro-areas-2010-2014 (13 Apr. 2026).

⁵ Baruch Feigenbaum, *21st Century Transit*, (Washington, D.C.: Reason Foundation, 2024).

⁶ Robert Manduca, "The Spatial Structure of US Metropolitan Employment: New Insights from Administrative Data," *Environment and Planning B: Urban Analytics and City Science* 48, no. 5 (2021). 1357–1372. <https://journals.sagepub.com/doi/10.1177/2399808320934821> (12 Aug. 2026).

⁷ William J. Mallett, "Public Transportation: An Overview," Congressional Research Service, 2023. www.congress.gov/crs-product/R47302 (13 Apr. 2026).

These changes suggest that transit performance depends not only on infrastructure but also on how service is designed and operated. Public discussions often focus on major capital projects such as rail expansions or new lines. Riders, however, evaluate transit based on how frequently and reliably it operates, how well its routes serve their destinations, and how long the trip takes.⁸ Decisions about technology, operations, route design, scheduling, and street management therefore play a central role in making transit competitive with other ways to travel.



Lower ridership can also lead agencies to cut service frequency and routes, making transit less convenient and increasing wait times for passengers.



This brief focuses on those operational choices. The central argument is that improving transit performance depends less on building new infrastructure than on aligning service technology, operating models, network design, and roadway management with the way people travel today.

The brief proceeds in seven parts. Part 2 examines how agencies can choose the right transit technology for different corridor types. Local bus service forms the backbone of most transit networks, with higher-capacity modes added as demand increases. In dense urban corridors, heavy rail (HRT) serves the highest-demand markets, followed by light rail (LRT) and bus rapid transit (BRT). In suburb-to-central-city markets, commuter rail generally serves denser corridors while express bus is often better suited to lower-density travel patterns. In low-density areas, microtransit and demand-response service (DRT) can provide more flexible coverage.

Part 3 compares direct operation with contracted service and explains when each model is easier to define, monitor, and manage. It examines in-house operation, contracting, cost

⁸ Jessica Göransson and Henrik Andersson, “Factors That Make Public Transport Systems Attractive: A Review of Travel Preferences and Travel Mode Choices,” *European Transport Research Review* 15 (2023), article 32. <https://link.springer.com/article/10.1186/s12544-023-00609-x> (12 Aug. 2026).

analysis, service quality, contractor availability, and case studies involving Arlington and Foothill Transit.

Part 4 focuses on improved service operations, including route design, scheduling, real-time management, boarding delays, predictive maintenance, and artificial intelligence (AI). It explains how agencies can use measurable standards, observed operating data, and limited pilot projects to improve reliability without expanding tools that do not work.

Part 5 examines roadway and system operations, including queue jumps and intelligent transportation systems. It explains how agencies can reduce delay at intersections, use vehicle and passenger data, manage signal priority, and coordinate with traffic agencies so buses move more reliably through the street network.

Part 6 applies this brief's conclusions to craft useful recommendations for agency leaders.

PART 2

CHOOSE THE RIGHT TRANSIT TECHNOLOGY

Choosing a transit technology requires assessing the needs of a specific corridor or service area. This involves assessing expected passenger demand, determining if demand is steady enough to support permanent infrastructure such as rail lines or bus lanes, evaluating available space for those facilities, and considering whether trips follow a set route or are dispersed.

Part 2 uses this approach to compare transit options across three types of corridors. It begins with dense urban corridors, where the primary comparison is among heavy rail (HRT), light rail (LRT), and bus rapid transit (BRT), each suited to different levels of passenger demand and infrastructure investment. It then examines suburb-to-central-city corridors, where the choice is often between commuter rail and express bus for regional travel between suburbs and major employment centers. Next, it covers low-density, dispersed areas where fixed-route, high-capacity transit may be less effective and where services such as microtransit and demand-response can provide broader coverage and more-flexible access.

2.1

TRANSIT TECHNOLOGY OPTIONS FOR DENSE URBAN CORRIDORS

Public transit affects urban economies by shaping how many jobs workers can reach within a reasonable travel time, allowing labor markets to function more efficiently and employers to draw from a broader pool of workers. However, access to jobs by transit remains limited compared with driving. University of Minnesota estimates for 2024 show that, across the 50 largest U.S. metropolitan areas, the combined number of jobs reachable within 60 minutes was equal to approximately 94% of the areas' total jobs by automobile, compared with approximately 7% by public transit.⁹

“

However, access to jobs by transit remains limited compared with driving.

”

One reason for this gap is that metropolitan employment is often concentrated in multiple employment centers rather than primarily in a single downtown. Research using U.S. Census Bureau employment data found that, across the 100 largest metropolitan areas, approximately 75% of jobs were located on just 6.5% of developed land.¹⁰ Because these job centers are located throughout metropolitan areas, fixed-route transit networks must connect a wider range of origins and destinations.

Local bus service provides the basic coverage on which most transit networks depend. In 2024, local bus systems carried about 3.6 billion unlinked passenger trips (UPT), meaning the number of times passengers board a transit vehicle.¹¹ They also accounted for about

⁹ Andrew Owen, Shirley Shiqin Liu, and Eric Lind, “Access Across America: Transit 2024,” CTS 25-18, Center for Transportation Studies, University of Minnesota, Dec. 2025. <https://conservancy.umn.edu/items/2e99b09a-d081-4fe5-94cb-db60e18313f3> (12 Aug. 2026).; Andrew Owen, Shirley Shiqin Liu, and Eric Lind, “Access Across America: Auto 2024,” CTS 25-16, Center for Transportation Studies, University of Minnesota, Dec. 2025. <https://conservancy.umn.edu/items/5905f21c-ede4-439f-8df3-d9bdfd7f720a> (12 Aug. 2026).

¹⁰ Robert Manduca, “The Spatial Structure of U.S. Metropolitan Employment: New Insights from LODES Data,” U.S. Census Bureau Census Academy, 19 May 2021. Webinar. <https://www.census.gov/data/academy/webinars/2021/spatial-structure-of-us-metro.html> (12 Aug. 2026).

¹¹ “National Transit Summaries and Trends (NTST): 2024,” Federal Transit Administration, U.S. Department of Transportation, 17 April 2026.

12.5 billion passenger-miles and \$28.9 billion in operating expenses nation-wide.¹² Of this, around \$6.58 billion went to vehicle and facility maintenance, according to the Federal Transit Administration’s National Transit Database (NTD) operating expense categories.¹³

To provide faster service on high-demand routes, agencies may add limited-stop bus service alongside existing local service. By skipping some stops, these buses increase stop spacing and reduce the time passengers spend on the vehicle.¹⁴ The NTD does not classify limited-stop bus as a separate transit mode. Unlike BRT, limited-stop service can be introduced on an existing route without dedicated lanes or substantial new infrastructure.

To provide faster service on high-demand routes, agencies may add limited-stop bus service alongside existing local service.

As travel demand increases along certain bus routes, agencies often begin evaluating whether those travel patterns warrant greater investment along the corridor. A corridor is a travel path connecting common origins and destinations, typically along one or more major streets.¹⁵ Corridor planning focuses on whether existing bus service should remain relatively flexible or be upgraded with more-permanent infrastructure. To make that decision, agencies evaluate whether demand is high enough to support dedicated lanes or rail tracks, whether enough physical space exists to build them, and whether travel patterns are stable enough to justify long-term capital investment.

Agencies must determine which higher-capacity transit technology is most appropriate. In many cases, the primary decision is between BRT and LRT. Heavy rail systems, such as fully grade-separated metros, are generally reserved for the highest-density corridors in a small

www.transit.dot.gov/sites/fta.dot.gov/files/2024%20National%20Transit%20Summaries%20and%20Trends_1.2.pdf (22 Apr. 2026).

¹² Ibid., 153.

¹³ “2024 Annual Database Operating Expenses,” Federal Transit Administration, National Transit Database. www.transit.dot.gov/ntd/data-product/2024-annual-database-operating-expenses (11 May 2026).

¹⁴ Federal Transit Administration, “National Transit Summaries and Trends.”

¹⁵ Viggen Davidian, “A Comprehensive Guide to Transportation Planning,” Weblog post, Iteris Blog, Iteris, 9 Oct. 2024. www.iteris.com/blog/comprehensive-guide-transportation-planning (13 Apr. 2026).

number of large metropolitan areas, such as New York City and Chicago.¹⁶ LRT vehicles operate on rail tracks powered by overhead electric lines, while BRT systems use buses but incorporate features such as dedicated lanes, off-board fare collection, and signal priority to improve speed and reliability.

2.1.1 HEAVY RAIL (HRT)

HRT refers to metro or subway systems that operate on fully separated tracks. These systems use electric trains, exclusive rights-of-way, and centralized control systems to move passengers without interference from traffic.¹⁷

In dense urban areas, stations are spaced to balance walk access and travel speed, with many riders willing to walk about 0.5 miles to reach a station, while spacing increases in outer areas.¹⁸ Trains run frequently, often every 5 to 10 minutes during peak periods, allowing continuous passenger flow along busy corridors.¹⁹

A defining feature of HRT is right-of-way separation. Tracks run in tunnels, on elevated structures, or in exclusive corridors, eliminating conflicts with motor vehicles and intersections.

A defining feature of HRT is right-of-way separation. Tracks run in tunnels, on elevated structures, or in exclusive corridors, eliminating conflicts with motor vehicles and intersections.²⁰ This separation allows HRT systems to operate at high frequencies and

¹⁶ “Characteristics of Bus Rapid Transit for Decision-Making (CBRT),” Federal Transit Administration, U.S. Department of Transportation, Aug. 2004. www.transit.dot.gov/sites/fta.dot.gov/files/docs/CBRT.pdf (13 Apr. 2026).

¹⁷ “National Transit Database (NTD) Glossary,” Federal Transit Administration, U.S. Department of Transportation, 7 Feb. 2025. www.transit.dot.gov/ntd/national-transit-database-ntd-glossary#H (22 Apr. 2026).

¹⁸ Erick Guerra and Robert Cervero, “Is a Half-Mile Circle the Right Standard for TODs?” ACCESS Magazine, Spring 2013. 15–19. www.accessmagazine.org/spring-2013/half-mile-circle-right-standard-tods/ (11 May 2026).

¹⁹ “Heavy Rail,” Texas A&M Transportation Institute, Texas A&M University System, <https://policy.tti.tamu.edu/strategy/heavy-rail/> (22 Apr. 2026).

²⁰ Ibid.

carry large passenger volumes. Depending on train length and loading, HRT systems can carry between 600 and 2,400 passengers per train during rush hour.²¹

These operating characteristics allow HRT systems to carry a large share of commuters in major metropolitan areas. In 2024, HRT systems carried approximately 2.8 billion UPT and accounted for about 11.5 billion passenger-miles traveled, according to the NTD.²²

Examples of heavy rail systems include:

- Metropolitan Transportation Authority (MTA), which operates the New York City Subway;
- Washington Metropolitan Area Transit Authority (WMATA), which operates Metrorail; and
- Chicago Transit Authority (CTA), which operates the "L."

Supporting this level of service requires completely exclusive guideways, large stations, dedicated power systems, specialized vehicles, and extensive signal and track infrastructure, making HRT one of the most expensive transit modes to construct and maintain.²³

To put these costs in perspective, the BART Silicon Valley–Berryessa Extension added 10 miles of heavy-rail service from Fremont into San José in the San Francisco Bay Area when it opened in 2020.²⁴ The project cost about \$2.3 billion, or roughly \$230 million per mile.²⁵ This is a typical cost for recent U.S. heavy-rail projects that are built at ground level or on elevated structures. HRT projects built underground are substantially more expensive to construct.²⁶

²¹ Ibid.

²² Federal Transit Administration, "National Transit Summaries and Trends," 106.

²³ Federal Highway Administration, "Federal Transit Administration (FTA) National Transit Database (NTD)," U.S. Department of Transportation, 2017. highways.dot.gov/safety/data-analysis-tools/rsdp/rsdp-tools/federal-transit-administration-fta-national-transit (11 May 2026).

²⁴ "Silicon Valley Berryessa Extension Project, San Jose, California," Federal Transit Administration, U.S. Department of Transportation, December 2016. www.transit.dot.gov/sites/fta.dot.gov/files/CA-San-Jose-Silicon-Valley-Berryessa-Extension-Project-FY-18-Profile.pdf (17 June 2026); "BART Silicon Valley Phase I," Santa Clara Valley Transportation Authority, VTA.org. www.vta.org/projects/bart-sv/phase-i (8 June 2026).

²⁵ Ibid.

²⁶ Philip Plotch, "Comparing the Costs of Transit Projects: New Report and Interactive Graphs," Weblog post, Eno Center for Transportation, 20 June 2025. www.enotrans.org/article/comparing-the-costs-of-transit-projects-new-report-and-interactive-graphs/ (8 June 2026); "Rail Transit: Federal Transit Administration

Operating and maintaining this type of infrastructure also requires significant ongoing spending. For context, the 2024 NTD reports that the New York City Transit HRT system spent approximately \$6.50 billion in total operating expenses, including about \$1.72 billion on vehicle operations, \$0.97 billion on vehicle maintenance, and \$2.32 billion on facility maintenance covering tunnels, stations, track, signals, and power systems.²⁷

Nationally, HRT systems incurred approximately \$12.27 billion in operating expenses in 2024.²⁸ This total consisted of approximately \$3.856 billion for vehicle operations, \$2.758 billion for general administration, \$1.888 billion for vehicle maintenance, and \$3.770 billion for facility maintenance, including stations, track, signals, and power systems.²⁹



HRT systems are in the densest corridors, and so they have some of the highest ridership. This high ridership spreads the operating costs to more riders, allowing heavy rail to move large numbers of passengers at a lower cost per mile.



HRT systems are in the densest corridors, and so they have some of the highest ridership. This high ridership spreads the operating costs to more riders, allowing heavy rail to move large numbers of passengers at a lower cost per mile. According to the Federal Transit Administration (FTA), HRT averages \$1.07 per passenger-mile compared with about \$1.88 for LRT and \$1.94 for BRT.³⁰ However, this operating efficiency comes with substantially higher construction costs. Therefore, agencies must weigh the tradeoff between higher upfront investment and lower long-term operating costs when selecting a transit technology.

Could Improve Information on Estimating Project Costs,” U.S. Government Accountability Office, 22 July 2019. www.gao.gov/products/gao-19-562 (8 June 2026).

²⁷ “2024 Annual Database Operating Expenses,” Federal Transit Administration, National Transit Database, U.S. Department of Transportation. www.transit.dot.gov/ntd/data-product/2024-annual-database-operating-expenses (11 May 2026).

²⁸ Federal Transit Administration, “National Transit Summaries and Trends,” 153.

²⁹ Federal Transit Administration, “2024 Annual Database Operating Expenses.”

³⁰ Ibid., 153.

Because of these infrastructure and operating requirements, HRT is typically used in corridors with ridership high enough to support its high capacity and high costs. Its fixed infrastructure also makes it difficult to modify once built, limiting flexibility compared with bus-based systems.

FIGURE 1: NEW YORK MTA HEAVY RAIL



Source: “MTA NYC Transit Increases Subway Speed Limits at 24 Locations,” *Railway Technology*, Jan. 2019; photo by MTAEnthusiast10.

2.1.2 LIGHT RAIL (LRT)

LRT is an electric rail service that operates on tracks powered by an overhead catenary system, which supplies electricity to the train through overhead wires.³¹ Unlike HRT, LRT is not necessarily on an exclusive right-of-way and can operate in a mix of environments, including streets, roadway medians, dedicated lanes, and exclusive transit corridors.³²

³¹ “What in the World Is Catenary? Understanding Catenary Systems and Their Impact on NJ TRANSIT Operations,” NJ TRANSIT, NJTransit.com, www.njtransit.com/catenary (22 Apr. 2026).

³² “Light Rail Transit,” Texas Transportation Institute, Texas A&M Transportation Policy Research Center, www.policy.tti.tamu.edu/strategy/light-rail-transit/ (22 Apr. 2026).

LRT systems can operate in partially separated environments and are typically used in corridors where bus service is no longer sufficient, but the cost and capacity of HRT are not justified.³³ Stops are typically spaced about 0.5 miles apart, wider than local bus stops but closer than heavy rail stations. Trains generally operate less frequently than HRT but more frequently than most local bus routes. According to the *Transit Capacity and Quality of Service Manual* (TCRP Report 165), LRT can operate with headways of 5 to 15 minutes in high-density corridors, while 15 minutes is typically the longest feasible off-peak headway that would justify LRT service.³⁴

In North America, these systems typically carry between 150 and 220 passengers per vehicle and can transport several thousand to more than 10,000 people per hour in each direction, depending on the size of the vehicles and the configuration of the trains.³⁵

While LRT represents a smaller share of total national transit ridership than bus or HRT, it plays an important role in the urban corridors it serves. In 2024, LRT systems carried approximately 343 million UPT and accounted for about 1.8 billion passenger-miles traveled, according to the 2024 NTD.³⁶

Examples of LRT include:

- Portland Tri-County Metropolitan Transportation District of Oregon (TriMet) MAX;
- Dallas Area Rapid Transit (DART); and
- Denver’s Regional Transportation District (RTD).

Providing this level of service still requires significant infrastructure, including rail tracks, stations, power systems, specialized vehicles, and signaling equipment. However, construction costs are usually lower than for HRT, since LRT can run in partly separated areas.

The scale of these costs can be seen in the East Link Extension in the Seattle region, a 14-mile LRT project with 10 stations connecting Seattle’s International District to Judkins Park,

³³ Ibid.

³⁴ National Academies of Sciences, Engineering, and Medicine, *Transit Capacity and Quality of Service Manual, Third Edition*, (Washington, D.C.: The National Academies Press, 2013). 5-4–5-5. doi: 10.17226/24766. www.nationalacademies.org/read/24766/chapter/1 (11 May 2026).

³⁵ National Academies of Sciences, Engineering, and Medicine, *Transit Capacity and Quality of Service Manual*. 8-66.

³⁶ Federal Transit Administration, “National Transit Summaries and Trends.” 106, 154.

Mercer Island, South Bellevue, downtown Bellevue, and Redmond Technology Station via the I-90 corridor.³⁷ Sound Transit’s board increased the project’s baseline budget in January 2026 to approximately \$3.82 billion, or roughly \$273 million per mile, significantly lower than comparable HRT projects but still a significant public investment.³⁸ The U.S. Department of Transportation (DOT) contributed a \$1.33 billion Transportation Infrastructure Finance and Innovation Act (TIFIA) loan, \$74.7 million in FTA funds, and \$14 million in TIGER V funds toward the project.³⁹

Operating and maintaining this type of infrastructure also requires substantial ongoing spending. Because the East Link Extension operates as part of Sound Transit’s broader Link light rail network, line-specific operating costs are not reported. For context, the 2024 NTD reports that Sound Transit’s Link LRT system spent approximately \$329.6 million in total operating expenses.⁴⁰ Of that amount, about \$114.3 million went toward vehicle operations, \$36.7 million toward vehicle maintenance, \$90.6 million toward facility maintenance for stations, track, signals, and power systems, and another \$88.0 million toward general administration.⁴¹

Nationally, LRT systems had total operating expenses of approximately \$3.39 billion according to the 2024 NTD.⁴² Of this total, about \$2.12 billion was spent on vehicle operations (\$1.34B) and general administration (\$780M).⁴³ The remaining \$1.27 billion went to maintenance, including \$610 million for vehicle maintenance and \$660 million for facility maintenance, such as rail cars, tunnels, stations, tracks, signals, and power systems.⁴⁴

³⁷ “East Link Extension,” Sound Transit, Sound Transit. www.soundtransit.org/system-expansion/east-link-extension (11 May 2026).

³⁸ “Resolution No. R2026-01,” Sound Transit, 22 January 2026. 2. www.soundtransit.org/sites/default/files/documents/Resolution%20R2026-01.pdf (11 May 2026).

³⁹ “U.S. Department of Transportation Announces \$1.33 Billion Loan for Sound Transit’s Link Light Rail Extension from Seattle to Redmond,” U.S. Department of Transportation, Transportation.gov, 16 Jan. 2015. www.transportation.gov/briefing-room/us-department-transportation-announces-133-billion-loan-sound-transit%E2%80%99s-link-light (11 May 2026).

⁴⁰ Federal Highway Administration, “Federal Transit Administration (FTA) National Transit Database (NTD).”

⁴¹ Federal Transit Administration, “2024 Annual Database Operating Expenses.”

⁴² Federal Transit Administration, “National Transit Summaries and Trends.” 154.

⁴³ Federal Transit Administration, “2024 Annual Database Operating Expenses.”

⁴⁴ Ibid.

LRT averaged approximately \$1.88 in operating expenses per passenger-mile in 2024, compared with \$1.07 for HRT and \$1.94 for BRT.⁴⁵ Because its operating cost is much closer to BRT's than to HRT's, the case for LRT depends less on operating savings than on whether corridor demand justifies investing in rail infrastructure.

Because of its infrastructure requirements, LRT is typically used in corridors where ridership is too high for bus service to handle efficiently but not high enough to justify heavy rail. Like HRT, LRT relies on fixed infrastructure that is difficult to change once built, making service harder to adjust as travel patterns and development change.

FIGURE 2: GREEN LINE LRT IN ST. PAUL



Source: Corey Anderson, "A Tale of Two Green Lines...", MinnPost, 2024.

⁴⁵ Federal Transit Administration, "National Transit Summaries and Trends."

2.1.3 BUS RAPID TRANSIT (BRT)

BRT is a bus transit service that uses features commonly associated with rail systems to improve speed and reliability.⁴⁶ These features can include dedicated lanes, traffic signal priority, off-board fare collection, level boarding, and upgraded stations. Unlike rail systems, BRT uses buses that can operate on regular roads, in dedicated lanes, or on separate busways. It can therefore be implemented in corridors where local bus service is no longer sufficient, but the cost and permanence of rail may not be justified.⁴⁷ BRT has become one of the fastest-growing transit modes in the United States. Since 2016, approximately 317 miles of BRT lines have opened nation-wide.⁴⁸

BRT has become one of the fastest-growing transit modes in the United States.

Because BRT systems are built to move passengers faster than regular local buses, their stops are usually set farther apart. The distance between stops depends on the area. In dense urban neighborhoods where people walk to stations, stops are generally 0.25 to 0.33 miles apart.⁴⁹ In places where riders transfer from another bus to reach the BRT, stops are usually 0.5 to 1.0 miles apart.⁵⁰ In suburban areas where most people drive and park, stops can be up to 2.0 miles apart. When stops are spaced farther apart, buses can travel faster.⁵¹ The basic BRT all-stop service should operate every 5 to 10 minutes during peak times and every 12 to 15 minutes during off-peak times.⁵²

⁴⁶ “Bus Rapid Transit,” Federal Transit Administration, U.S. Department of Transportation, 26 Aug. 2024. www.transit.dot.gov/research-innovation/bus-rapid-transit (11 May 2026).

⁴⁷ Ibid.

⁴⁸ Ibid.

⁴⁹ National Academies of Sciences, Engineering, and Medicine, “Summary,” *Bus Rapid Transit, Volume 2: Implementation Guidelines*, (Washington, D.C.: The National Academies Press, 2003). 5–4. www.nationalacademies.org/read/21947/chapter/2 (12 May 2026).

⁵⁰ Ibid. 5–3.

⁵¹ Ibid. 5–3.

⁵² Ibid. 8-1.

In 2024, BRT systems carried approximately 70 million unlinked passenger trips and accounted for about 175.1 million passenger-miles traveled, according to the NTD.⁵³

Nation-wide, BRT systems had total operating expenses of approximately \$339.5 million according to the 2024 NTD.⁵⁴ Approximately \$260.8 million of that amount was spent on vehicle operations and administration, with \$182.0 million for vehicle operations and \$78.8 million for general administration.⁵⁵ The remaining \$78.7 million went to maintenance, including \$52.9 million for vehicle maintenance and \$25.8 million for facility maintenance, such as stations, shelters, and transit infrastructure along the corridor.⁵⁶

These operating characteristics allow BRT systems to serve corridors with strong but variable travel demand. BRT is not a single type of system, but a range of designs that generally fall into three categories: BRT Heavy, BRT Lite, and Freeway BRT.

BRT Heavy

BRT Heavy operates in exclusive lanes or fully separated busways, allowing buses to avoid regular traffic for much or all of the trip.⁵⁷ This separation from general traffic differentiates BRT Heavy from other BRT types and allows it to operate most similarly to rail in terms of speed and reliability along high-demand corridors.⁵⁸

BRT Heavy requires significant infrastructure, such as land purchases and the construction of dedicated lanes or busways, so it costs more and takes longer to set up than other BRT types.⁵⁹ Therefore, these systems work best in high ridership corridors with heavy traffic congestion, where mixed traffic is no longer practical.⁶⁰ According to Reason Foundation's *Bus Rapid Transit and Managed Lanes: Low-Cost, High-Quality Transportation Solutions for the*

⁵³ Federal Transit Administration, "National Transit Summaries and Trends." 153.

⁵⁴ Ibid., 153.

⁵⁵ Federal Transit Administration, "2024 Annual Database Operating Expenses."

⁵⁶ Ibid.

⁵⁷ Baruch Feigenbaum, "A Common Definition for BRT, Please," Surface Transportation News no. 177, Reason Foundation, 10 July 2018. <https://reason.org/transportation-news/surface-transportation-news-177/> (17 July 2026); "Bus Rapid Transit," Federal Transit Administration, Transit.dot.gov, 26 Aug. 2024. <https://www.transit.dot.gov/research-innovation/bus-rapid-transit> (17 July 2026).

⁵⁸ "Busways," Federal Transit Administration, Transit.dot.gov, 6 Dec. 2015. <https://www.transit.dot.gov/research-innovation/busways> (17 July 2026).

⁵⁹ Federal Transit Administration, "National Transit Summaries and Trends."

⁶⁰ Baruch Feigenbaum, "Bus Rapid Transit Provides Cost-Effective Mass Transit Options," Reason Foundation, 9 July 2021. www.reason.org/commentary/bus-rapid-transit-provides-cost-effective-mass-transit-options/ (12 May 2026).

21st Century, BRT Heavy is also most appropriate when bus headways fall below two minutes, or more than 30 buses per hour.⁶¹

BRT Heavy operates in exclusive lanes or fully separated busways, allowing buses to avoid regular traffic for much or all of the trip.

The Cleveland HealthLine on Euclid Avenue in Ohio is a good example of a BRT Heavy system. The 6.8-mile line opened in 2008 at a total project cost of approximately \$200 million.⁶² Of that amount, \$168.4 million was spent on the transit part of the project. Funding for the transit component included \$82.2 million from the FTA's New Starts program, \$50 million from the state of Ohio, \$17.6 million from the Greater Cleveland Regional Transit Authority, \$10 million from the Northeast Ohio Areawide Coordinating Agency, \$8 million from the city of Cleveland, and \$0.6 million from the FTA's Fixed Guideway Modernization program.⁶³

Cleveland had previously considered building a rail line in the same corridor, but that option would have cost nearly \$1 billion.⁶⁴ Instead, the HealthLine delivered similar service at about one-fifth of the cost. According to the FTA's 2012 Before and After Study, the line increased corridor transit service by 22% and reduced travel times by 21%.⁶⁵ Eighty percent of the time savings occurred along the 4.5 mile dedicated lane segment with traffic signal

⁶¹ Baruch Feigenbaum, "Bus Rapid Transit and Managed Lanes: Low-Cost, High-Quality Transportation Solutions for the 21st Century," Reason Foundation, Jan. 2014. www.reason.org/wp-content/uploads/files/bus_rapid_transit_and_managed_lanes.pdf (12 May 2026).

⁶² Jason Hellendrung, "HealthLine Drives Growth in Cleveland," Urban Land Magazine, 13 July 2012. urbanland.uli.org/economy-markets-trends/healthline-drives-growth-in-cleveland (12 May 2026).

⁶³ "Euclid Avenue BRT, Cleveland, OH," NACTO, 15 June 2015. www.nacto.org/latest/euclid-avenue-brt-cleveland-oh/ (12 May 2026).

⁶⁴ "The Cost-Effective Transit Solution That's Revitalizing Cleveland's 'Millionaires' Row,'" Weblog post, ICIC Blog, Initiative for a Competitive Inner City. www.icic.org/blog/cost-effective-transit-solution-thats-revitalizing-clevelands-millionaires-row/ (12 May 2026).

⁶⁵ Office of Planning and Environment, Federal Transit Administration, U.S. Department of Transportation, "Before-and-After Studies of New Starts Projects," Report to Congress, June 2012. 4. www.transit.dot.gov/sites/fta.dot.gov/files/docs/2012_Before_and_After_Studies_of_New_Starts_Projects.pdf (12 May 2026).

priority (TSP), which adjusts traffic signals to reduce delays for approaching buses.⁶⁶ Weekday ridership increased from about 8,900 daily trips on the previous Route 6 bus service to approximately 14,300 on the HealthLine.⁶⁷ Annual operating costs increased from \$7 million to \$8.2 million, but bus trips increased by 37% and faster run times reduced the cost per trip.⁶⁸ Unfortunately, annual ridership later declined from a peak of 5.1 million in 2014 to 1.7 million by 2023 following a 2017 court ruling that ended off-board fare collection and reduced its efficiency.⁶⁹ The HealthLine's experience shows that BRT Heavy delivers its strongest results when agencies maintain the service features that provide its speed and reliability.

BRT Lite

BRT Lite operates mainly in lanes shared with regular traffic and uses operational improvements rather than dedicated busways to improve service.⁷⁰ These improvements can include traffic signal priority (TSP), queue jumps at intersections, off-board fare collection, upgraded stations, and branded vehicles.⁷¹



Unlike BRT Heavy, BRT Lite typically does not require the construction of exclusive lanes or busways. This makes it less expensive and faster to implement than BRT Heavy, while still offering many of the same service improvements.



Unlike BRT Heavy, BRT Lite typically does not require the construction of exclusive lanes or busways. This makes it less expensive and faster to implement than BRT Heavy, while still

⁶⁶ Ibid.; “Signal Priority,” Federal Transit Administration, [Transit.dot.gov](https://www.transit.dot.gov), 6 Dec. 2015. www.transit.dot.gov/research-innovation/signal-priority (12 May 2026).

⁶⁷ Ibid. 5.

⁶⁸ Ibid. 5.

⁶⁹ Sam Allard, “Advocates Want HealthLine Improvements With Ridership Down,” *Axios Cleveland*, 28 Oct. 2024. www.axios.com/local/cleveland/2024/10/28/healthline-bus-rapid-transit-brt-ohio (12 May 2026).

⁷⁰ Feigenbaum, “Bus Rapid Transit and Managed Lanes,” 17.

⁷¹ “Appendix N – BRT Lite Option,” *Pierce Transit*, Jan. 2025. www.piercetransit.org/wp-content/uploads/2025/01/Appendix-N-BRT-Lite-Option.pdf (12 May 2026).

offering many of the same service improvements.⁷² Therefore, BRT Lite is most effective on routes with medium ridership and moderate congestion, where bus headways are two minutes or longer, meaning no more than 30 buses per hour.⁷³

Metro Transit's A Line along Snelling Avenue in the Minneapolis-Saint Paul region illustrates how BRT Lite can supplement rather than fully replace local bus service. When the A Line opened in 2016, it operated every 10 minutes for most of the day and stopped approximately every half mile.⁷⁴ Route 84 continued operating every 30 minutes to serve the more closely spaced stops between A Line stations.⁷⁵ This arrangement gave longer-distance riders faster service while preserving local access along the corridor.

The Omaha Rapid Bus Transit (ORBT) system runs along Dodge Street in Nebraska and is a good example of BRT Lite.⁷⁶ This eight-mile line opened on November 2020, replacing Metro Transit's Route 2.⁷⁷ The project cost roughly \$37 million, with a \$14.9 million federal Transportation Investment Generating Economic Recovery (TIGER) grant as its largest funding source.⁷⁸ ORBT includes TSP, off-board fare collection, level boarding, improved stations with real-time arrival information, and 60-foot articulated buses.⁷⁹ Most of the route runs in mixed traffic, except for dedicated bus lanes in the downtown area east of 30th Street.⁸⁰ Buses arrive every 10 minutes on weekdays.

Ridership increased quickly after opening. By January 2022, ORBT had surpassed 500,000 rides, with weekly ridership 83% higher than the previous Route 2 and weekend ridership doubling.⁸¹ Ridership continued to grow, reaching one million cumulative rides by March

⁷² Feigenbaum, "Bus Rapid Transit and Managed Lanes," 17.

⁷³ Ibid, 17.

Feigenbaum, "Bus Rapid Transit Provides Cost-Effective Mass Transit Options."

⁷⁴ "A Line Project FAQs," Metro Transit, MetroTransit.org. www.metrotransit.org/a-line-project-faqs (8 June 2026).

⁷⁵ Ibid.

⁷⁶ "Omaha Rapid Bus Transit (ORBT)," Metro Transit. www.ometro.com/rider-guide/orbt/ (12 May 2026).

⁷⁷ "Meet ORBT," Metro Transit Omaha, Ometro.com. www.ometro.com/rider-guide/orbt/ (12 May 2026).

⁷⁸ "Rapid Transit Arrives in Omaha With Launch of ORBT," Mass Transit, 18 Nov. 2020. www.masstransitmag.com/bus/press-release/21163118/omaha-metro-rapid-transit-arrives-in-omaha-with-launch-of-orbt (12 May 2026).

⁷⁹ "ORBT Surpasses Half Million Rides," Metro Transit Omaha, Ometro.com, 31 Jan. 2022. www.ometro.com/metro-news/orbt-surpasses-half-million-rides/ (12 May 2026).

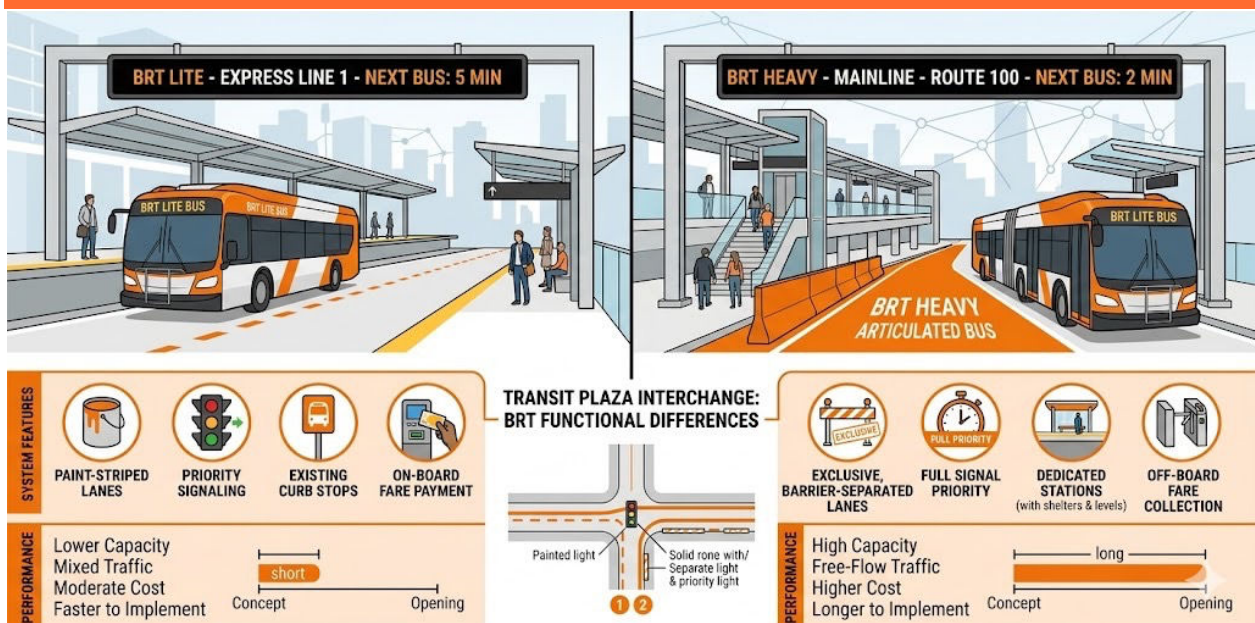
⁸⁰ Metro Transit Omaha, "Meet ORBT."

⁸¹ Metro Transit Omaha, "ORBT Surpasses Half Million Rides."

2023 and two million by November 2024.⁸² The city of Omaha also updated zoning rules in 2019 and 2020 to encourage development near ORBT stations and approximately \$119 million in new construction had occurred along the corridor by January 2022.⁸³ ORBT was also projected to generate \$450 million in economic impact.⁸⁴ These results suggest that BRT Lite performs best when strong service improvements are also paired with supportive land use policies.

ORBT shows that BRT Lite can improve frequency and ridership through targeted corridor upgrades without requiring the dedicated infrastructure of BRT Heavy.

FIGURE 3: COMPARING BRT LITE VS. BRT HEAVY SYSTEMS



Source: Federal Transit Administration, "National Transit Summaries and Trends."

⁸² Marlo Lundak, "Metro's ORBT Hits Millionth Ride, Officials Say Ridership Steadily Increasing," WOWT, 23 March 2023. www.wowt.com/2023/03/24/metros-orbt-hits-millionth-ride-officials-say-ridership-steadily-increasing/ (12 May 2026). "ORBT Celebrates Two Million Rides," Metro Transit Omaha, Ometro.com, 11 Sept. 2023. www.ometro.com/metro-news/orbt-celebrates-two-million-rides/ (12 May 2026).

⁸³ Metro Transit Omaha, "ORBT Surpasses Half Million Rides."

⁸⁴ "Metro Awarded \$15 Million TIGER Grant for BRT System," Metro Transit, OMetro.com, 15 Sept. 2014. <https://www.ometro.com/press-releases/metro-awarded-15-million-tiger-grant-for-brt-system/> (17 July 2026).

Freeway BRT

Freeway BRT operates on limited-access highways, where buses can travel in regular freeway traffic but perform best when managed lanes, High Occupancy Vehicle (HOV) lanes, or freeway shoulders are available to help them move faster and stay on schedule.⁸⁵ This service is meant for longer trips and stations are placed several miles apart to serve the region.

Minneapolis' METRO Orange Line on Interstate 35W is a great example. The 17-mile line serves 12 stations connecting downtown Minneapolis to Burnsville through Richfield and Bloomington.⁸⁶ The system includes off-board fare collection, real-time passenger information, branded articulated buses, and TSP.⁸⁷ The total project cost was \$150.7 million, funded through the FTA's Capital Investment Grants (CIG) program along with state and local sources.⁸⁸



Freeway BRT can be incorporated into larger highway and managed-lane projects, allowing some transit infrastructure costs to become part of a broader corridor investment.



Ridership increased steadily after opening. By March 2023, average weekday ridership reached 1,187, a 42% increase over the same month in 2022, and weekend service was

⁸⁵ American Public Transportation Association, *Designing Bus Rapid Transit Running Ways*, (Washington, D.C.: American Public Transportation Association, October 2010). www.apta.com/wp-content/uploads/Standards_Documents/APTA-BTS-BRT-RP-003-10.pdf (22 Apr. 2026).

⁸⁶ "U.S. Department of Transportation Announces \$74.1 Million for Orange Line Bus Rapid Transit Project in Minneapolis," Federal Transit Administration, U.S. Department of Transportation, 19 June 2019. www.transit.dot.gov/about/news/us-department-transportation-announces-741-million-orange-line-bus-rapid-transit-project (12 May 2026).

⁸⁷ "METRO Orange Line BRT: Minneapolis, Minnesota, Small Starts Project Development, Information Prepared November 2014," Federal Transit Administration, U.S. Department of Transportation. www.transit.dot.gov/sites/fta.dot.gov/files/docs/MN_Minneapolis_METRO_Orange_Line_BRT_Profile_FY17.pdf (12 May 2026).

⁸⁸ Federal Transit Administration, "U.S. Department of Transportation Announces \$74.1 Million for Orange Line Bus Rapid Transit Project."

added for the first time in the corridor.⁸⁹ Freeway BRT can be incorporated into larger highway and managed-lane projects, allowing some transit infrastructure costs to become part of a broader corridor investment. In the case of the Orange Line, its Lake Street station and managed lanes were included in a \$250 million multimodal reconstruction of the I-35W and I-94 interchange.⁹⁰

When comparing transit technologies, it is important to consider differences in scale, cost, and day-to-day use. Table 1 below summarizes national NTD data across major transit modes, including ridership, operating costs, and capital investment. Unlinked passenger trips (UPT) reflect total boardings, while passenger-miles traveled (PMT) measures the total distance that passengers travel.⁹¹

The table shows some important differences between transit systems. First, of the three modes shown, HRT systems carry the most passengers and have the lowest operating cost per passenger-mile, since high ridership spreads costs across many trips. However, HRT also had the highest national capital expenditures in 2024, at \$10.48 billion, compared with \$4.03 billion for LRT and \$311 million for BRT.⁹² Second, LRT falls between HRT and BRT in national ridership and annual capital expenditures. Third, BRT systems generally carry fewer passengers than HRT or LRT systems, while their operating cost per passenger-mile is similar to LRT's but higher than HRT's.

Table 1 shows that BRT's operating cost is about \$1.94 per passenger-mile, which is slightly higher than LRT's \$1.88 and HRT's \$1.07.⁹³ BRT's main financial advantage is that it can require less capital investment than rail where its service characteristics match corridor demand.

⁸⁹ "Rapid Connection," HNTB, 2023. www.hntb.com/designer/rapid-connection/ (12 May 2026).

⁹⁰ "Multimodal Project Improves Downtown Minneapolis Traffic Flow," SEH. www.sehinc.com/portfolio/35w94interchange/ (12 May 2026).

⁹¹ "National Transit Database (NTD) Glossary," Federal Transit Administration, U.S. Department of Transportation, [Transit.dot.gov](https://www.transit.dot.gov), <https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary#U> (22 Apr. 2026).

⁹² Federal Transit Administration, "National Transit Summaries and Trends."

⁹³ Ibid.

TABLE 1: NATIONAL TRANSIT MODE COMPARISON: RIDERSHIP, OPERATING COSTS, AND CAPITAL INVESTMENT

Mode	National Ridership/Use	Operating Expense	Operating Expense per Passenger-Mile	Annual Capital Expenditures	Planning Implication
BRT	70 million UPT; 175.1 million PMT	\$339.5 million	\$1.94	\$311 million	Cost-effective upgrade for stronger corridors
LRT	343 million UPT; 1.8 billion PMT	\$3.39 billion	\$1.88	\$4.03 billion	Appropriate where demand justifies fixed rail infrastructure
HRT	2.8 billion UPT; 11.5 billion PMT	\$12.3 billion	\$1.07	\$10.48 billion	Reserved for the highest-density corridors with sustained demand

Source: Federal Transit Administration, National Transit Database: 2024 National Transit Summaries and Trends; and TS2.1—Service Data and Operating Expenses Time Series by Mode.

2.2

SUBURB-TO-CENTRAL-CITY CORRIDORS: COMMUTER RAIL VERSUS EXPRESS BUS

Corridors connecting suburbs to central cities differ from dense urban corridors in three keyways:

- Trips are longer,
- Demand is concentrated during peak commuting hours, and
- Travel is typically directed toward a small number of central job areas.

As a result, the goal in these corridors is not frequent, all-day service but moving large numbers of passengers efficiently over longer distances during rush hours.

A key part of doing this effectively is understanding travel patterns. This means identifying where riders are going, when they travel, and whether trips are concentrated along a single route or spread across multiple destinations. It also includes whether these patterns are stable over time, which helps determine whether a fixed system like rail is appropriate or if a more flexible service is better suited. In these corridors, the primary comparison is between commuter rail and express bus.

2.2.1 COMMUTER RAIL

Commuter rail is a train service that connects suburbs to a central city using railroad tracks.⁹⁴ These trains travel long distances, with stops spaced several miles apart, and primarily serve peak-hour commuters.⁹⁵ For example, the Long Island Rail Road (LIRR) connects Long Island suburbs to Manhattan, with many commuters traveling 30 to 60 miles from mid-island hubs into the city.⁹⁶ This type of service works best when a large number of riders travel from similar suburban areas to the same central destination at roughly the same time each day.



Projects using an existing corridor may still require stations, vehicles, maintenance facilities, and upgrades to track, signals, communications, and safety systems.



However, commuter rail depends on maintaining high ridership. When fewer people use the system, costs are spread across fewer passengers, increasing the cost per rider and requiring more subsidy. In 2024, commuter-rail systems carried approximately 364 million unlinked passenger trips and accounted for about 8.66 billion passenger-miles traveled, according to the NTD.⁹⁷

Capital costs differ substantially depending on whether usable railroad infrastructure is already available. Projects using an existing corridor may still require stations, vehicles, maintenance facilities, and upgrades to track, signals, communications, and safety systems. The proposed 11.5-mile Broward Commuter Rail South project illustrates this type of

⁹⁴ “National Transit Database Glossary,” Federal Transit Administration, U.S. Department of Transportation, <https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary#C> (22 Apr. 2026).

⁹⁵ “TCRP Report 78 Glossary,” Transportation Research Board, 2002.

www.onlinepubs.trb.org/onlinepubs/tcrp/tcrp78/glossary/all.htm (22 Apr. 2026).

“Commuter Rail Passenger Transportation,” 49 U.S. Code § 5302, Legal Information Institute, Cornell Law School, www.law.cornell.edu/definitions/uscode.php?def_id=49-USC-1034416376-1968110647 (22 Apr. 2026).

⁹⁶ “Long Island Rail Road,” Metropolitan Transportation Authority, MTA.info, www.mta.info/agency/long-island-rail-road (22 Apr. 2026).

⁹⁷ Federal Transit Administration, “National Transit Summaries and Trends.”

investment. It would operate along the existing Florida East Coast Railway, and as of December 2024, the Federal Transit Administration (FTA) estimated its capital cost at \$297 million.⁹⁸ Projects that cannot use an existing corridor must also pay to acquire right-of-way and construct new rail infrastructure.

According to the 2024 National Transit Annual Database, commuter-rail agencies reported approximately \$5.55 billion in capital expenditures, including about \$3.03 billion for guideway, \$1.01 billion for passenger stations, and \$780 million for revenue vehicles.⁹⁹ The spending breakdown shows that commuter rail's largest capital costs are tied to fixed infrastructure rather than vehicles, making the availability of an existing corridor a major factor in the project's total cost.

For operating costs, in 2024, the nation's 28 commuter rail agencies spent about \$8.90 billion operating their systems.¹⁰⁰ This included \$3.46 billion for vehicle operations, \$1.93 billion for vehicle maintenance, \$1.78 billion for facility maintenance, and \$1.74 billion for general administration.¹⁰¹



Commuter rail is...best suited to corridors where demand is high, concentrated, and likely to remain stable, particularly when an existing rail corridor can reduce the need for new infrastructure.



Commuter rail costs about \$1.03 per passenger-mile. Because its guideway, stations, and other infrastructure are fixed, routes are difficult to modify after construction. Commuter rail is therefore best suited to corridors where demand is high, concentrated, and likely to remain stable, particularly when an existing rail corridor can reduce the need for new infrastructure.

⁹⁸ "Broward Commuter Rail South: Broward County, Florida, New Starts Project Development," Federal Transit Administration, [Transit.dot.gov](https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-12/FL-Broward-BCRS-NS-PD-Profile-12-04-2024.pdf), 4 Dec. 2024. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-12/FL-Broward-BCRS-NS-PD-Profile-12-04-2024.pdf> (17 July 2026).

⁹⁹ "2024 Annual Database Capital Use," Federal Transit Administration, [Transit.dot.gov](https://www.transit.dot.gov/ntd/data-product/2024-annual-database-capital-use), n.d. <https://www.transit.dot.gov/ntd/data-product/2024-annual-database-capital-use> (17 July 2026).

¹⁰⁰ Ibid.

¹⁰¹ Ibid.

2.2.2 EXPRESS BUS

The express bus service discussed here falls within the National Transit Database’s commuter-bus category. Express bus service carries passengers from park-and-ride lots or suburban transit centers to downtown areas and other major employment centers with limited stops, often using highways and HOV or managed lanes to reduce delays from congestion.¹⁰² Because it operates on existing roads rather than fixed rail infrastructure, agencies can adjust routes and frequencies as demand changes. For example, Georgia Xpress Route 411 connects the Buford and Sugarloaf Mills park-and-ride lots to downtown Atlanta during weekday commuting periods.¹⁰³

In 2024, commuter bus systems carried approximately 40 million unlinked passenger trips and accounted for about 1.01 billion passenger-miles traveled, according to the NTD.¹⁰⁴

Express bus service has much lower upfront capital costs since it uses existing roads rather than building and/or maintaining rail lines. The 2024 NTD shows that commuter bus agencies reported approximately \$125 million in capital expenditures, including \$44 million for revenue vehicles, \$10 million for passenger stations, and \$2 million for guideway infrastructure.¹⁰⁵



Because it operates on existing roads rather than fixed rail infrastructure, agencies can adjust routes and frequencies as demand changes.



¹⁰² “Express Bus Service,” Texas Transportation Institute, Texas A&M University, www.static.tti.tamu.edu/tti.tamu.edu/documents/policy/congestion-mitigation/express-bus-service.pdf (22 Apr. 2026). Feigenbaum, “Bus Rapid Transit Provides Cost-Effective Mass Transit Options.”

¹⁰³ “411 – Buford / Sugarloaf Mills to Downtown,” Xpress GA, Georgia Regional Transportation Authority, www.xpressga.com/routes/411/ (22 Apr. 2026).

¹⁰⁴ Federal Transit Administration, “National Transit Summaries and Trends.”

¹⁰⁵ Ibid., 135.

For operating costs, in 2024, commuter bus agencies reported approximately \$993.4 million to operate their systems.¹⁰⁶ This included about \$538.7 million for vehicle operations, \$168.0 million for vehicle maintenance, \$55.7 million for facility maintenance, and \$231.0 million for general administration.

Because express buses use existing roads rather than fixed rail lines, agencies can change routes, schedules, and service levels as demand shifts. This flexibility makes express bus a good option for areas where demand is increasing but does not yet support a permanent rail line.

This flexibility becomes important when travel patterns change. In Atlanta, for example, the Xpress commuter bus system redesigned its network after ridership fell to about 30% of pre-pandemic levels.¹⁰⁷ The agency modified routes, closed some park-and-ride locations, and restructured service, with some routes ending at Metropolitan Atlanta Rapid Transit Authority (MARTA) rail stations to correspond with current demand.¹⁰⁸ These changes aligned service with current demand and improved efficiency. Making similar changes to a rail system would be far more difficult because routes and infrastructure are fixed.

Express bus and commuter rail have similar operating costs. Express bus costs about \$0.99 per passenger-mile, while commuter rail costs about \$1.03 per passenger-mile.¹⁰⁹ The key difference is not operating cost, but the cost to build the system and how easily service can be adjusted over time.

The choice between commuter rail and express bus depends on whether conditions justify the higher cost and fixed nature of rail. Even when commuter rail can carry large numbers of passengers, the key question is whether the additional cost and long-term commitment provide enough benefit compared with a bus system that can serve the same trips more flexibly.

¹⁰⁶ Ibid., 153.

¹⁰⁷ “Xpress 2.0: Xpress Service Changes Begin June 16, 2025,” Xpress GA, Atlanta-region Transit Link Authority, www.xpressga.com/redefining-the-ride-xpress-2-0/ (22 Apr. 2026).

¹⁰⁸ Ibid.

¹⁰⁹ Federal Transit Administration, “National Transit Summaries and Trends,” 153.

In most suburb-to-central-city corridors, express bus is the more practical starting point because it can provide similar service with lower upfront cost and greater flexibility. Commuter rail becomes appropriate only when demand is very high, strongly concentrated, and supported by an existing rail corridor.

2.3

LOW-DENSITY, DISPERSED, AND COVERAGE-ORIENTED AREAS: MICROTRANSIT AND DEMAND-RESPONSE

Fixed-route transit is most effective when many riders travel along the same corridor at the same time. In low-density and dispersed areas where homes, jobs, stores, and services are spread out, this pattern does not exist. Trip demand varies by direction and time of day, so buses often run with few passengers while still incurring the full cost of scheduled service.

Data from the FTA show the impact. In 2024, local bus service averaged about 7.3 passenger-miles per vehicle revenue-mile, with an average operating cost of \$2 per passenger-mile.¹¹⁰ In comparison, demand-response service averaged only 1.1 passenger-miles per vehicle revenue-mile and cost about \$6.80 per passenger-mile.¹¹¹ In 2024, demand-response service accounted for about 804.3 million passenger-miles traveled, 738.1 million vehicle revenue-miles, and \$5.47 billion in operating expenses nationwide.¹¹²

Because fixed routes perform poorly under these conditions, agencies often turn to flexible services instead of adding more-traditional bus routes. The two main types are microtransit and demand-response transit (DRT).

2.3.1 MICROTRANSIT

Microtransit allows riders to request trips in real time or with short notice through an app, website, or call center.¹¹³ Instead of following a fixed route, vehicles are routed by software

¹¹⁰ Ibid.

¹¹¹ Ibid.

¹¹² Ibid.

¹¹³ Justin Slosky, Fred Silver, Jared Schnader, Ryan Schuchard, and Dan Welch, "Microtransit Definitions, Trends, and Applications," CALSTART, January 2022. 1–2. www.calstart.org/wp-content/uploads/2022/01/CALSTART-Microtransit-Overview.pdf (22 Apr. 2026).

that adjusts trips dynamically within a defined service area, grouping riders traveling in similar directions.¹¹⁴

Service is typically provided using small transit vehicles such as passenger vans or shuttle buses that carry about 6 to 15 passengers.¹¹⁵ Riders are often picked up at nearby corners or designated locations rather than fixed bus stops to reduce travel time.¹¹⁶ These services operate as shared rides, meaning multiple passengers are served in the same vehicle along a flexible route.¹¹⁷ Microtransit is most appropriate in areas where trips are too dispersed to support a productive fixed route but where riders still need access to nearby destinations, transit stations, jobs, stores, and services.

Operating costs vary by service model. Agency planning documents usually estimate costs at around \$80 per vehicle-hour when modeling microtransit services.¹¹⁸ In comparison, fully contracted turnkey services, where vendors supply vehicles, drivers, and technology, typically cost between \$65 and \$90 per vehicle hour.¹¹⁹ Costs vary depending on service hours, wait time targets, demand levels, and how efficiently riders can be grouped.



Microtransit is most appropriate in areas where trips are too dispersed to support a productive fixed route but where riders still need access to nearby destinations, transit stations, jobs, stores, and services.



The Dallas Area Rapid Transit (DART) GoLink program is one example of this model. It is an on-demand microtransit service that offers shared rides within defined zones, helping

¹¹⁴ Ibid., 1-2.

¹¹⁵ “Microtransit,” Transdev North America, TransdevNA.com, www.transdevna.com/services-and-modes/microtransit/ (22 Apr. 2026).

¹¹⁶ “Shared Mobility Definitions,” Federal Transit Administration, U.S. Department of Transportation, www.transit.dot.gov/regulations-and-guidance/shared-mobility-definitions (22 Apr. 2026).

¹¹⁷ Ibid.

¹¹⁸ “BRITE Microtransit Feasibility Study Final Report,” BRITE Bus Transit, July 2025. 54. www.britebus.org/wp-content/uploads/2025/10/20251001_BRITE-Microtransit-Feasibility-Study_Final-Report.pdf (22 Apr. 2026).

¹¹⁹ Ibid.

people reach nearby rail stations and other destinations.¹²⁰ Riders can book trips through the GoPass app or by phone, and trips are planned in real time rather than following fixed routes or schedules.¹²¹ DART also works with Lyft and Uber to provide some rides.¹²² Since contractors or private drivers own and operate the vehicles, GoLink needs little direct investment from DART and is mainly an operating expense.

Based on 2024 NTD data, GoLink's operating cost was approximately \$22.1 million in FY2024, including \$8.7 million for non-ADA purchased demand-response service and \$13.4 million for rides provided by companies such as Uber and Lyft.¹²³ DART's FY2025 adopted budget sets GoLink operating costs at \$31.5 million.¹²⁴ GoLink ridership grew rapidly, with quarterly trips rising from about 315,000 in FY2024 Q1 to over 570,000 in FY2026 Q1.¹²⁵ DART evaluates GoLink based on rides per service hour and subsidy per ride. In FY2026 Q1, GoLink averaged 4.85 rides per hour and a subsidy of \$14.91 per ride.¹²⁶

Some agencies have switched from fixed-route service to microtransit like Wilson, North Carolina (located east of Raleigh).¹²⁷ With about 49,000 residents, the city has high poverty rates and a low urban population density that made its previous bus system difficult to sustain.¹²⁸ The network served only about 40% of the city, operated roughly once per hour, and did not reach several major job centers, which local officials identified as a barrier to employment.¹²⁹ In September 2020, Wilson replaced its bus system with an on-demand microtransit service called RIDE, operated in partnership with Via Transportation.¹³⁰ Riders

¹²⁰ "GoLink," DART, Dallas Area Rapid Transit. www.dart.org/guide/transit-and-use/golink (12 May 2026).

¹²¹ Ibid.

¹²² Ibid.

¹²³ "2024 Annual Database Operating Expenses," Federal Transit Administration, [Transit.dot.gov](https://www.transit.dot.gov), n.d. <https://www.transit.dot.gov/ntd/data-product/2024-annual-database-operating-expenses> (17 July 2026).

¹²⁴ "Proposed FY 2025 Annual Budget & 20-Year Financial Plan," Dallas Area Rapid Transit, DART.org, 24 Sept. 2024. dartorgcmsblob.dart.org/prod/docs/default-source/about-dart/%28item-14-15%29-proposed-fy-2025-budget-and-20-yr-financial-plan_board-presentation.pdf (12 May 2026).

¹²⁵ Ibid.

¹²⁶ Ibid.

¹²⁷ "RIDE | On-Demand Microtransit in Wilson," American Association of State Highway and Transportation Officials, September 2021 https://aiaa.transportation.org/Documents/Wilson_Microtransit_Summary.pdf (22 Apr. 2026).

¹²⁸ Ibid.

¹²⁹ Ibid.; "Take a RIDE with Me: Highlighting the Adoption of Citywide Microtransit in Wilson, NC," Shared-Use Mobility Center, 17 April 2023. <https://learn.sharedusemobilitycenter.org/casestudy/take-a-ride-with-me-highlighting-the-adoption-of-citywide-microtransit-in-wilson-nc/> (22 Apr. 2026).

¹³⁰ Ryan Brumfield, "Transforming Public Transit with a Rural On-Demand Microtransit Project," Federal Transit Administration, U.S. Department of Transportation, 2023. www.rosap.nhtl.bts.gov/view/dot/72564 (22 Apr. 2026).

can request trips through an app or by phone, and vehicles are routed dynamically within defined service zones.¹³¹

The service uses small vehicles, including passenger vans and accessible vehicles equipped with ramps for riders using wheelchairs.¹³² Phone booking and alternative payment options allow access for residents without smartphones or bank accounts.¹³³ Because vehicles are dispatched only when trips are requested, service is better matched to actual demand.

The new on-demand service has higher operating costs, but it offers more than twice as many trips and serves the entire city. According to the 2024 National Transit Database (NTD), the city of Wilson, North Carolina, spent \$2,547,765 to operate the RIDE service.¹³⁴ The system provided 228,052 trips during the year, an operating cost of about \$51 per resident and \$11.17 per trip, based on the city's 2025 population estimate of 49,572.¹³⁵ Capital spending was minimal at \$5,808. Via supplies the vehicles, equipment, software, phone support, and drivers, reducing the city's need to purchase vehicles and other equipment for the service.¹³⁶

As demand increases, microtransit becomes less efficient. Riders expect shorter wait times and more-direct trips, which reduces the ability to share rides. Once enough riders begin traveling along the same route at the same time, fixed-route buses usually become more efficient because larger vehicles can carry more passengers at lower cost per rider.

2.3.2 DEMAND-RESPONSE TRANSIT (DRT)

Demand-response transit operates without fixed routes or schedules and typically requires riders to request trips in advance.¹³⁷ Vehicles are dispatched to pick up passengers at or

¹³¹ American Association of State Highway and Transportation Officials, "RIDE | On-Demand Microtransit in Wilson."

¹³² North Carolina Department of Transportation, "Transforming Public Transit with a Rural On-Demand Microtransit Project," Federal Transit Administration, U.S. Department of Transportation, April 2023. www.transit.dot.gov/sites/fta.dot.gov/files/2023-04/FTA-Report-No-0243.pdf (22 Apr. 2026).

¹³³ American Association of State Highway and Transportation Officials, "RIDE | On-Demand Microtransit in Wilson."

¹³⁴ "2024 Annual Agency Profile: City of Wilson, NC (NTD ID 44931)," Federal Transit Administration, National Transit Database, 2024. www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2024/44931.pdf (12 May 2026).

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ "Demand-Response Transit," Texas Transportation Institute, Texas A&M Transportation Institute, www.policy.tti.tamu.edu/strategy/demand-response-transit/ (22 Apr. 2026).

near their origin, often providing curb-to-curb or door-to-door service.¹³⁸ These services are commonly referred to as dial-a-ride and are typically provided using vans or small buses.¹³⁹

The form that DRT takes differs substantially between urban and rural areas. In urban areas, DRT service is primarily ADA complementary paratransit, which federal law requires transit agencies operating fixed-route bus or rail service to provide for riders whose disabilities prevent them from using those services.¹⁴⁰ These trips use accessible vehicles equipped with wheelchair lifts, ramps, and securement systems and provide individualized origin-to-destination service.¹⁴¹ Because agencies must provide every eligible trip, vehicles carry relatively few passengers, and specialized equipment increases vehicle costs, urban ADA paratransit is generally the most expensive form of DRT.

In rural areas, DRT serves a different purpose. Rather than complementing a fixed-route network, it often functions as the primary public transportation available to the general public because fixed-route service is limited or unavailable. These systems still face high costs because vehicles travel long distances to serve relatively few riders.¹⁴² Unless they complement fixed-route service, they generally do not operate under the same ADA complementary paratransit requirements as urban systems.¹⁴³ Although the reasons differ, both forms of DRT are expensive.

In 2024, the FTA reported about \$5.47 billion in operating expenses for DRT, serving about 91 million trips nation-wide, or roughly \$60 per trip.¹⁴⁴ Capital spending added another \$517 million, or about \$5 to \$6 per trip.¹⁴⁵ Therefore, operating expenses accounted for approximately 91% of the nearly \$6.0 billion spent on DRT, showing that day-to-day service is the main cost.

¹³⁸ Ibid.

¹³⁹ Ibid.

¹⁴⁰ “ADA Accessible Transportation,” ADA National Network, ADA.org, www.adata.org/factsheet/ADA-accessible-transportation (22 Apr. 2026); “What Is Paratransit Service and How Can I Get It?” Disability Rights Texas, www.disabilityrightstx.org/en/handout/what-is-paratransit-service-and-how-can-i-get-it/ (22 Apr. 2026).

¹⁴¹ Ibid.

¹⁴² Jeremy Mattson and Dilip Mistry, “Rural Transit Fact Book 2024,” Department Publication No. 325, Upper Great Plains Transportation Institute, North Dakota State University, June 2024. https://rosap.ntl.bts.gov/view/dot/76942/dot_76942_DS1.pdf (29 July 2026).

¹⁴³ “The ADA and Accessible Ground Transportation,” ADA National Network, ADA Knowledge Translation Center, n.d. <https://adata.org/factsheet/ground-transportation/> (29 July 2026).

¹⁴⁴ Federal Transit Administration, “National Transit Summaries and Trends,” 135,153.

¹⁴⁵ Ibid.

The 2024 NTD operating-expense database shows approximately \$4.2 billion in ADA-related expenses reported by 363 transit agencies, representing about 59% of the database's \$7.11 billion in gross DRT operating expenses.¹⁴⁶ The largest expenditures were reported by MTA (about \$272 million), Access Services of Los Angeles County (about \$250 million), Pace Suburban Bus (about \$219.9 million), and the Maryland Transit Administration and WMATA (about \$189 million).¹⁴⁷ Pace provided 3,215,055 ADA paratransit trips at an operating cost of \$68.40 per trip.

Agency data show similar cost patterns. In 2024, Valley Transit District in Connecticut reported a DRT operating cost of \$49.41 per trip on total operating expenses of \$2,126,127 and no capital spending.¹⁴⁸ In the same year, Paratransit, Inc., in Sacramento reported an operating cost of \$56.78 per trip on total operating expenses of \$2,941,810 and capital spending of \$338,742, primarily for vehicles.¹⁴⁹

Rural DRT remains expensive even though it generally costs less than urban ADA paratransit. The 2024 Rural Transit Fact Book, using 2022 data, reports that a typical rural DRT provider delivered about 14,761 rides per year, or about 40 trips per day. Whitfield County, Georgia illustrates this pattern. In 2024, its system provided 31,012 rides, averaging about 85 trips per day, with an operating cost of \$35.83 per trip and total operating expenses of \$1,111,184.¹⁵⁰

Rural DRT remains expensive even though it generally costs less than urban ADA paratransit.

¹⁴⁶ Federal Transit Administration, "2024 Annual Database Operating Expenses."

¹⁴⁷ Ibid.

¹⁴⁸ "2024 Annual Agency Profile: Valley Transit District (NTD ID 10042)," Federal Transit Administration, National Transit Database, 2024.
www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2024/10042.pdf (12 May 2026).

¹⁴⁹ "2024 Annual Agency Profile: Paratransit, Inc. (NTD ID 90223)," Federal Transit Administration, National Transit Database, 2024.
www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2024/90223.pdf (12 May 2026).

¹⁵⁰ "2024 Annual Agency Profile - Whitfield County (NTD ID 41138)," Federal Transit Administration, National Transit Database, 2024.
www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2024/41138.pdf (12 May 2026).

Vehicle costs vary widely depending on vehicle type and specifications. In March 2024, the Transit Authority of River City (TARC) in Louisville, Kentucky, estimated the cost of a wheelchair-accessible cutaway paratransit vehicle at approximately \$137,672 under a state procurement contract.¹⁵¹ In a separate October 2024 procurement for Section 5310 subrecipients, TARC listed wheelchair-accessible minivans at \$74,650 and full-size wheelchair-accessible vans at \$88,235.¹⁵² These examples show that operating costs remain the primary driver of total DRT costs.

These cost patterns reflect the role DRT is intended to serve. DRT works best where demand is too low or unpredictable to support fixed-route service, so vehicles carry relatively few passengers and have limited opportunities to combine trips. As demand becomes higher and more concentrated along regular routes and schedules, fixed-route transit can move more passengers per vehicle at a lower cost per trip. Across all corridor types, the same principle applies: transit technology should match travel demand, service objectives, and local operating conditions.

2.4

CONCLUDING PRINCIPLE FOR TECHNOLOGY SELECTION

Decisions on the choice of transit mode to build should be based on how many riders a corridor can consistently support and whether those riders are traveling along the same route at the same time. The key tradeoff is between capacity and flexibility. High-capacity systems need steady demand along a corridor to justify their cost and permanence. Lower-cost, flexible services can reach more areas but carry fewer riders per trip and usually cost more per rider.

Agencies should match investment to demand. If they build more capacity than demand can support, it increases costs without improving service. If they invest too little in high-demand corridors, it can limit access and reliability. The best technology is the one that meets current demand and accommodates expected growth without locking in unnecessary costs or limiting future options.

¹⁵¹ “Resolution 2024-12: Purchase of Paratransit Vehicles,” Transit Authority of River City, 27 March 2024. www.ridetarc.org/wp-content/uploads/2024/03/Resolution-2024-12-Purchase-of-Paratransit-Vehicles-1.pdf (22 Apr. 2026).

¹⁵² “Resolution 2024-39: Vehicles for Section 5310 Subrecipients,” Transit Authority of River City, 23 October 2024. www.ridetarc.org/wp-content/uploads/2024/10/Resolution-2024-39-Vehicles-for-Section-5310-Subrecipients.pdf (22 Apr. 2026).

TABLE 2: COMPARISON OF TRANSIT SERVICE TYPES

Service Type	Best Use	Capital Cost	Operating Expense per Passenger-Mile	Adaptability (Ease of Changing Service)
BRT	Busy bus corridors that need faster, more reliable service.	Low to moderate	\$1.94	Moderate
LRT	Busy urban corridors where rail is useful but heavy rail is not needed.	High	\$1.88	Low
HRT	Very busy urban corridors with all-day demand.	Very high	\$1.07	Very low
DRT	ADA paratransit, rural service, and trips where fixed routes do not work.	Low to moderate	\$6.80	Very high
Commuter Rail	Long suburb-to-city trips during rush hour.	High	\$1.03	Very low
Bus (local, limited, and other fixed-route service)	Basic transit coverage across a service area.	Low	\$2.32	High
Express/Commuter Bus	Suburb-to-city trips where rail is not justified.	Low	\$0.99	High
Microtransit	Low-density areas or short local trips that fixed routes do not serve well.	Low to very low	Not separately reported in the NTD	Very high

Source: Federal Transit Administration, National Transit Database: 2024 National Transit Summaries and Trends.

PART 3

CHOOSE THE RIGHT OPERATOR: IN-HOUSE VS CONTRACTING

Transit performance depends not only on the technology used, but also on who operates the service and how it is managed. After selecting a mode, agencies must decide whether to operate the service directly or contract with an outside provider. This decision affects cost, flexibility, accountability, and day-to-day performance. The key question is not whether contracting reduces costs, but whether a service can be clearly defined, measured, and managed through a contract.

Deciding between in-house operation and contracting requires agencies to consider how closely the service is connected to the rest of the network, whether the agency or a contractor has the necessary operating capacity, the full cost of each model, service quality and oversight, and the availability of qualified bidders. Agencies should evaluate these factors for the specific service, because neither operating model is consistently better in every situation.

3.1

IN-HOUSE OPERATION

In-house operation refers to transit service provided directly by a public agency using its own employees to operate vehicles, rather than service provided by a contractor under a formal agreement.¹⁵³ Agencies often use this model for services that form the core transit network, including local bus, BRT, LRT, and HRT. The GAO found that fixed-route bus, HRT, and LRT services are most often operated by the transit agency itself because agencies want to maintain direct control over coordination, monitoring, and responses to service issues, which can become more difficult under contracted operations.¹⁵⁴

Direct operation (DO) may be preferable when an agency places a high priority on retaining unified authority across closely connected operational functions during daily service and disruptions.¹⁵⁵ Rail operations control centers centralize decisions involving train movements, power, communications, infrastructure maintenance, and incident response, while fixed-route bus dispatchers coordinate available operators and vehicles with maintenance, field supervision, and service-restoration decisions.

Keeping an established HRT, LRT, or fixed-route bus service in-house may also be appropriate when an agency already has the workforce, technical expertise, facilities, and management systems needed to meet its service standards.¹⁵⁶ If the service meets measurable performance targets and a contractor cannot demonstrate a credible improvement, transferring it may add transition and coordination requirements without improving service.¹⁵⁷

¹⁵³ “Public Transit: Transit Agencies’ Use of Contracting to Provide Service,” U.S. Government Accountability Office, September 2013. www.gao.gov/assets/gao-13-782.pdf (22 Apr. 2026).

“National Transit Database 2025 Policy Manual,” Federal Transit Administration, U.S. Department of Transportation, 2025. www.transit.dot.gov/sites/fta.dot.gov/files/2025-09/2025-NTD-Full-Policy-Manual.pdf (22 Apr. 2026).

¹⁵⁴ U.S. Government Accountability Office, “Transit Agencies’ Use of Contracting.”

¹⁵⁵ Ibid.

¹⁵⁶ Karen Trapenberg Frick, Brian Taylor, and Martin Wachs, “Contracting for Public Transit Services: Evaluating the Tradeoffs,” California Policy Research Center, Oct. 2006. <https://escholarship.org/content/qt3v9449jg/qt3v9449jg.pdf> (8 June 2026).

¹⁵⁷ Ibid.

3.2

CONTRACTING

Contracting means a transit agency hires an outside provider to operate some or all services under a formal agreement, while the agency continues to select, oversee, and monitor that service.¹⁵⁸ Some contracts include not only labor, but also software, dispatch tools, and booking platforms.¹⁵⁹ This is especially common for demand-response and paratransit services. For example, the Regional Transportation Commission of Washoe County (RTC Washoe County) in Reno, Nevada, hired MTM Transit as its contractor, which provided app-based booking, real-time tracking, and integrated dispatch and routing systems.¹⁶⁰ Such arrangements can give agencies access to specialized capabilities, support new or expanded services, and reduce the need for adding new internal capacity, such as software systems, vehicles, or staffing.¹⁶¹

Even when a service or technology is contracted out, public agencies remain responsible.

Even when a service or technology is contracted out, public agencies remain responsible. They still determine who the service is for, where it operates, how it connects to the network, what fares apply, and what outcomes define success. They can also cancel contracts that do not meet their needs and pivot to other private companies that can better serve their customers, or bring the service in house.

Contracting may be preferable when an agency can clearly define the service, assign operational responsibilities, and monitor contractor performance.¹⁶² Paratransit, DRT, and microtransit have operating parameters that can be specified in a contract, including

¹⁵⁸ Ibid.

¹⁵⁹ Ibid.

¹⁶⁰ “Mobility Innovation Case Studies,” American Public Transportation Association, July 2021. www.apta.com/wp-content/uploads/APTA-Mobility-Innovation-Case-Studies-Final-Report-07.28.21.pdf (22 Apr. 2026).

¹⁶¹ U.S. Government Accountability Office, “Transit Agencies’ Use of Contracting.”

¹⁶² “FY26 Comprehensive Review Contractor’s Manual,” Federal Transit Administration, 20 Jan. 2026. www.transit.dot.gov/sites/fta.dot.gov/files/2025-12/Fiscal-Year-2026-Contractor-Manual.pdf (8 June 2026).

service areas, operating hours, eligibility rules where applicable, and trip-booking requirements. Commuter bus routes and lower-ridership fixed-route bus services can also be contracted as discrete routes or groups of routes. Agencies must still coordinate the contracted service with the rest of the network and remain responsible for service standards, oversight, and applicable federal requirements.

Contracting may also be appropriate when an agency lacks the workforce, vehicles, facilities, or specialized expertise needed to start or expand a service, and a qualified provider can supply those capabilities. If the service requirements and expected outcomes can be defined before procurement and monitored throughout the contract, contracting can give an agency flexibility to introduce or adjust service without developing the same operating capacity in-house.

3.3

COST ANALYSIS

Comparing the costs of in-house operation and contracting requires examining the cost of providing the same amount and quality of service under each model, not simply comparing an agency's operating budget with a contractor's bid. Differences in labor agreements, service design, and local market conditions make comparisons across agencies difficult. System-wide expenses for planning, finance, information technology, marketing, and executive administration should be counted as contracting savings only if they would decline or disappear. The comparison should also include solicitation, proposal-evaluation, transition and rebidding costs, and any capital expenses the agency would continue to pay after contracting.

In 2024, agencies reported approximately \$65.7 billion in direct operation (DO) and purchased transportation (PT) operating expenses. Of this, \$52.9 billion, or 80.5%, was DO, and \$12.8 billion, or 19.5%, was PT.¹⁶³ The use of PT varied substantially by mode. PT made up about 61% of demand-response expenses, 51% of vanpool expenses, 37% of commuter-bus expenses, 28% of commuter-rail expenses, 15% of motor-bus expenses, 9% of LRT expenses, and 1% of HRT expenses.¹⁶⁴ These figures show that agencies rely much more heavily on PT for demand-response service than for motor bus and rail. However, this does not mean that contracting is cheaper than DO.

¹⁶³ Federal Transit Administration, "2024 Annual Database Operating Expenses."

¹⁶⁴ Ibid.

The strongest national evidence comparing in-house and contracted service comes from fixed-route bus operations. A study examined more than 400 transit agencies, using NTD data from 1992 through 2000.¹⁶⁵ It estimated average reductions in operating cost per vehicle-hour of \$4.09 for agencies that partially contracted service and \$2.89 for agencies that fully contracted service.¹⁶⁶ Based on the sample's average operating cost of \$53.06 per vehicle-hour, those estimates were equivalent to approximately 7.8% and 5.5%, respectively.¹⁶⁷ They varied based on agency size, service patterns, agency type, and wage differences between public and private operators. The study also accounted for the potential relationship between an agency's existing costs and its decision to contract. Without that adjustment, a comparison could incorrectly attribute preexisting cost differences to contracting.

A second national study analyzed NTD data from 1993 through 2004 and reached different conclusions. It found no cost difference between fully contracted and fully in-house motor-bus service.¹⁶⁸ For demand-response service, contracting was associated with approximately 20% lower total costs.¹⁶⁹ However, this association did not establish that contracting caused the difference. The author cautioned that factors other than contracting may have contributed to the lower demand-response costs. The study also found that contracting did not reduce administrative expenses or slow cost growth and that using multiple motor-bus contractors increased costs. Because the overall results were mixed, the author questioned whether competitive contracting generally lowers transit costs.

Transit Cooperative Research Program (TCRP) Synthesis 171 identified a limitation in the cost-savings studies it reviewed. Many relied on reports from managers at agencies that had already contracted service. Managers at agencies that kept service in-house reported that contracting did not or would not reduce costs.¹⁷⁰

¹⁶⁵ Hiroyuki Iseki, "Effects of Contracting on Cost Efficiency in U.S. Fixed-Route Bus Transit Service," *Transportation Research Part A: Policy and Practice* 44, no. 7 (August 2010). 457–472. www.sciencedirect.com/science/article/abs/pii/S096585641000042X (8 June 2026).

¹⁶⁶ Ibid.

¹⁶⁷ Ibid.

¹⁶⁸ Roland Zullo, "Transit Contracting Reexamined: Determinants of Cost Efficiency and Resource Allocation," *Journal of Public Administration Research and Theory* 18, no. 3 (July 2008). 495–515. www.academic.oup.com/jpart/article-abstract/18/3/495/918348 (8 June 2026).

¹⁶⁹ Ibid.

¹⁷⁰ Michael J. Walk et al., *Third-Party Contracts for Fixed-Route Bus Operations and Maintenance: Performance Metrics*, (Washington, D.C.: The National Academies Press, 2023). 9–17. www.nationalacademies.org/read/27074/chapter/4 (8 June 2026).

Cost comparisons must also include administrative expenses that remain after operations are transferred. GAO found that 84% of agencies surveyed that contracted service retained a specific unit to oversee the contractor, indicating that most continued to incur staff costs for contract administration and performance monitoring.¹⁷¹ The available evidence therefore does not show that either operating model consistently costs less.

3.4

SERVICE QUALITY

The operating model affects how an agency controls service quality. Under DO, agency employees operate the transit vehicles, and the agency directly manages the operating workforce.¹⁷² Under PT, a contractor uses its own employees to operate service under a written contract, while the agency establishes performance requirements and monitors the contractor.¹⁷³ In both cases, the agency remains responsible for ensuring that service is provided and meets its standards.

The available evidence does not establish a consistent service-quality advantage for either operating model. A customer satisfaction survey conducted by the Denver Regional Transportation District (RTD) found no measurable difference in customer satisfaction between in-house and contracted services.¹⁷⁴ In TRB Special Report 258, 237 transit-system general managers responded to a national survey.¹⁷⁵ Among managers of systems that contracted service, respondents were generally satisfied with the reported cost savings but less satisfied with service quality.¹⁷⁶

Because service quality varies across agencies and contracts, agencies must evaluate each operator using measurable performance standards. For example, in fiscal year 2024, Los Angeles Metro reported that Transdev met only three of eight contract performance indicators on average each month, with continuing problems involving complaints,

¹⁷¹ U.S. Government Accountability Office, “Transit Agencies’ Use of Contracting.”

¹⁷² “National Transit Database (NTD) Glossary,” Federal Transit Administration. www.transit.dot.gov/ntd/national-transit-database-ntd-glossary (8 June 2026).

¹⁷³ “National Transit Database (NTD) Glossary”; Walk, *Third-Party Contracts for Fixed-Route Bus Operations and Maintenance*.

¹⁷⁴ U.S. Government Accountability Office, “Transit Agencies’ Use of Contracting.”25.

¹⁷⁵ Transportation Research Board, *Contracting for Bus and Demand-Responsive Transit Services: A Survey of U.S. Practice and Experience*, (Washington, D.C.: National Academy Press, 2001). 11. <https://onlinepubs.trb.org/onlinepubs/sr/sr258.pdf> (8 June 2026).

¹⁷⁶ Ibid.

mechanical reliability, and traffic collisions.¹⁷⁷ Therefore, Metro transferred two of the contractor's routes to directly operated divisions and four routes to two other contractors.¹⁷⁸ This case shows how performance measures can identify service-quality problems and inform whether routes should be brought in-house or reassigned to another qualified provider.

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The available evidence does not establish a consistent service-quality advantage for either operating model.

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For directly operated service, agency managers have a direct line of authority to address performance problems.¹⁷⁹ For contracted service, agencies may rely partly on contractor-provided data and must retain staff to verify the data and enforce performance requirements. In TCRP Synthesis 171's fixed-route bus survey, 30 of 34 respondents had procedures to verify contractor data, but only 19 of those 30 checked every measure.¹⁸⁰ Although 31 of 34 had dedicated oversight staff, 12 of the 30 answering the staff-time question reported having enough time for oversight only some of the time.¹⁸¹ Without reliable data and sufficient staff time, agencies may fail to identify or correct contractor performance problems.

TCRP Synthesis 171 found limited empirical evidence that financial incentives and penalties improve service quality and wide variation in how agencies defined performance measures, set standards, and assigned monetary values.¹⁸² Because these provisions do not by themselves ensure better service, agencies should tie them to outcomes the contractor can control and verify that meeting one target does not worsen another.

¹⁷⁷ "Contracted Transportation Services," Los Angeles County Metropolitan Transportation Authority, 21 Mar. 2024. <https://metro.legistar.com/LegislationDetail.aspx?FullText=1&G=A5FAA737-A54D-4A6C-B1E8-FF70F765FA94&GUID=AD25F59D-0E2E-494C-977E-F0B97A338E70&ID=6582560> (8 June 2026).

¹⁷⁸ Ibid.

¹⁷⁹ U.S. Government Accountability Office, "Transit Agencies' Use of Contracting." 21.

¹⁸⁰ Walk, *Third-Party Contracts for Fixed-Route Bus Operations and Maintenance*. 33.

¹⁸¹ Ibid.

¹⁸² Ibid.

3.5

CONTRACTOR AVAILABILITY

The number and qualifications of firms willing to bid determine whether contracting leads to real competition. According to the GAO report, the national transit contracting industry comprises a few large national providers, regional firms, and numerous smaller companies, concentrated primarily in fixed-route bus, demand-response, and paratransit services.¹⁸³

Because capacity varies by service and location, agencies should determine whether multiple firms have the workforce, management experience, technical skills, and financial resources required for the proposed contract.

Recent national data on bidder participation by transit mode are limited. The NTD identifies awarded contractors and whether contracts were competitively procured, but it does not report the number of bids or qualified proposers. In TRB's nationwide survey conducted in 2000, approximately 54% of 144 demand-responsive contracts received fewer than three bids, compared with 33% of 87 fixed-route bus contracts.¹⁸⁴ The share was approximately 68% among contracts reported by small systems, 40% among medium-sized systems, and 19% among large systems.¹⁸⁵ Although these findings are historical and do not cover rail or other modes, they show that bidder participation varied by service and system size.

FTA procurement guidance requires agencies to provide full and open competition.¹⁸⁶ For competitive proposals, agencies must solicit proposals from multiple qualified entities and avoid requirements that unduly restrict competition.¹⁸⁷ When competition is inadequate, including when only one source is available, FTA directs the agency to perform a cost analysis.¹⁸⁸ Any resulting noncompetitive award must also be justified in the procurement record.

¹⁸³ U.S. Government Accountability Office, "Transit Agencies' Use of Contracting."4.

¹⁸⁴ Transportation Research Board, Contracting for Bus and Demand-Responsive Transit Services. 88.

¹⁸⁵ Ibid. 89.

¹⁸⁶ "Third Party Contracting Guidance (Circular 4220.1G)," Federal Transit Administration, 16 Jan. 2025. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2025-01/Third-Party-Contracting-Guidance-%28Circular-4220.1G%29.pdf> (8 June 2026).

¹⁸⁷ Ibid.

¹⁸⁸ Ibid.

3.6

CASE STUDIES

#1 CITY OF ARLINGTON, TEXAS (VIA)

Arlington illustrates how a city can contract a technology-enabled on-demand rideshare service. Arlington On-Demand provides service throughout the city and connections to the CentrePort TRE Station and the Eastchase Parkway area in Fort Worth.¹⁸⁹ The service has no fixed routes or schedules. Riders book and pay through an application or by telephone, and dynamic routing groups passengers traveling in the same direction.

To operate the service, the city issued a request for proposals in 2022 seeking an experienced demand-response rideshare provider. The solicitation was distributed to 496 registered vendors, but only three submitted proposals.¹⁹⁰ River North Transit, a subsidiary of Via, received the contract.¹⁹¹

Arlington's NTD data show its broader reliance on outside providers for demand-response service. Because the NTD combines Arlington's demand-response expenses, the figures cover all such service rather than Arlington On-Demand alone. In 2024, the city reported approximately \$11.8 million in demand-response operating expenses.¹⁹² Approximately \$1.25 million was directly operated and \$10.54 million was contracted.¹⁹³ The contracted amount included \$3.15 million in general PT and \$7.39 million in transportation network company (TNC) service, in which a ride-hailing company uses an app to dispatch drivers in vehicles not reserved exclusively for public transit. Contracted service represented approximately 89% of the total.

¹⁸⁹ "FY 2026 Adopted Operating Budget and Business Plan," City of Arlington, Texas, 16 Sept. 2025. <https://www.arlingtontx.gov/files/assets/city/v/7/finance/documents/budget-amp-business-plan/adopted-budget-documents/fy-2026-adopted-operating-budget-and-business-plan.pdf> (8 June 2026).

¹⁹⁰ "Execute a Contract for On-Demand Rideshare Services, Project 22-0031," City of Arlington, Texas, 29 Nov. 2022. <https://www.arlingtontx.gov/files/assets/city/v/1/finance/documents/financial-transparency/contracts-and-procurement/bid-documents/goods-and-services/2022/22-0031-staff-report.pdf> (8 June 2026).

¹⁹¹ Ibid.

¹⁹² Federal Transit Administration, "2024 Annual Database Operating Expenses."

¹⁹³ Ibid.

#2 FOOTHILL TRANSIT, LOS ANGELES COUNTY

Foothill Transit illustrates the use of contractors for a traditional fixed-route bus network.¹⁹⁴ The agency serves the San Gabriel and Pomona Valleys in Los Angeles County. It directly employs its management and administrative staff and owns its buses and operating facilities while contracting bus operations and maintenance.¹⁹⁵ Foothill Transit divides these contracted operations between two providers: Transdev operates service from the Arcadia/Irwindale facility, while Keolis operates service from the Pomona facility.

In the 2024 NTD, Foothill Transit reported approximately \$135.1 million in operating expenses for contracted motor-bus service, representing all of its NTD-reported motor-bus operating expenses.¹⁹⁶ Despite this extensive use of contracting, its most recent procurement for the Arcadia/Irwindale operation received only two proposals, one from Keolis and one from Transdev. Both firms satisfied the prequalification requirements and advanced to the evaluation stage. Transdev received the award.

3.7

CONCLUSION

An agency should change how a service is operated only when the alternative can meet defined service standards at a lower total cost or provide capabilities the current operator lacks without making the service harder to coordinate with the rest of the network. Before making that change, the agency should confirm that the proposed operator has the required staff, facilities, technical capacity, and access to reliable performance data. The agency should assign responsibility for correcting poor service and specify what will happen if performance does not improve. These requirements allow agencies to retain, replace, or contract an operator based on documented cost and performance rather than assumptions about either model.

¹⁹⁴ “FY 2022 Annual Comprehensive Financial Report,” Foothill Transit, 2022.
https://www.foothilltransit.org/sites/default/files/2023-11/foothill_transit_acfr_fy2022_-_final.pdf (8 June 2026).

¹⁹⁵ Ibid.

¹⁹⁶ “2024 Annual Agency Profile: Foothill Transit (NTD ID 90146),” Federal Transit Administration, 2024.
https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2024/90146.pdf (8 June 2026).

PART 4

IMPROVED SERVICE OPERATIONS

Mode and operator choices do not determine whether scheduled service is delivered each day. Reliability also depends on route design, running and recovery time, operator and vehicle availability, dispatch decisions, boarding time, and maintenance. These functions should be managed with route-level measures that identify where service is failing and whether the cause is the plan, staffing, fleet condition, or conditions on the street.

This part addresses service design, scheduling, real-time management, fare collection, predictive maintenance, and AI. Each tool is tied to a defined operating problem, a calculation, and a review point so agencies can correct or end changes that do not improve service.

4.1

DESIGN SERVICE

Service design determines where transit operates, where a vehicle stops, and how often it runs.¹⁹⁷ Agencies must balance operating costs and fleet requirements with rider goals such as shorter travel times, fewer transfers, and equitable access to service.¹⁹⁸ With a fixed budget, serving more areas may mean less-frequent service. Concentrating service on fewer routes may shorten waits but require some riders to walk farther or transfer.

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To manage these tradeoffs, agencies need measurable service standards. The Federal Transit Administration requires transit agencies operating established routes and schedules—including bus, BRT, LRT, and HRT—to set numerical standards for crowding, frequency, on-time performance, and access to service.¹⁹⁹ FTA explains that agencies may measure access by the percentage of residents living within a specified distance of a route, stop, or station. Standards may vary by mode and time of day. FTA provides separate examples of a zero-to-five-minute-late window, no early departures, and, as an example target, 95% of scheduled trips operating on time.²⁰⁰ However, the FTA does not require agencies to use these metrics.

Each standard should identify what is being measured, how it is calculated, the target, and when the agency will take corrective action. On-time performance should be calculated by dividing the number of recorded arrivals within the adopted window by all valid recorded

¹⁹⁷ Mahmoud Owais, “Transit Network Design Problem: A Half Century of Methodological Research,” *Innovative Infrastructure Solutions* 11, no. 3 (2026). 2-4. <https://link.springer.com/article/10.1007/s41062-025-02356-5> (8 June 2026); “Stops, Spacing, Location and Design,” Federal Transit Administration. <https://www.transit.dot.gov/research-innovation/stops-spacing-location-and-design> (8 June 2026).

¹⁹⁸ Owais, “Transit Network Design Problem.” 2-4.

¹⁹⁹ “Title VI Requirements and Guidelines for Federal Transit Administration Recipients (FTA Circular 4702.1B),” Federal Transit Administration, 1 Oct. 2012. IV-4–IV-6. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Title_VI_FINAL_1.pdf 8 June 2026.

²⁰⁰ Ibid.

arrivals.²⁰¹ For the missed-trip rate, WMATA divides scheduled trips not operated by total scheduled trips.²⁰² Vehicle crowding can be calculated by dividing passengers by seats, as specified by FTA. An agency that instead uses total capacity, including standing room, should identify that measure and not combine the results with calculations based only on seats.²⁰³

These measures should be reviewed regularly by route, time of day, and, where relevant, direction so agencies can identify where and when problems occur.²⁰⁴ Results outside the adopted standard should be investigated to determine whether schedules, frequency, or vehicle assignments need to change.²⁰⁵ Repeated overcrowding or capacity-related pass-ups, when riders cannot board because a vehicle is full, should lead to service changes such as adding trips or assigning a larger vehicle.

Los Angeles Metro’s 2025 policy shows how an agency can apply different service standards to different modes. It considers a bus on time when it is no more than one minute early or five minutes late.²⁰⁶ The policy sets on-time targets of 90% for LRT and 95% for HRT and identifies 85% as the desired bus target and 78.5% as the interim goal.²⁰⁷ It also sets a goal of no more than 2% canceled service.²⁰⁸ It is important to note that these are Metro standards, not federal requirements.

Stop-spacing standards should reflect service type and local conditions. Closely spaced stops shorten walks but increase travel time as buses slow, board and discharge passengers, and reenter traffic; wider spacing reduces travel time but lengthens walks. When reviewing stops closer than the standard, agencies should consider ridership, transfers, major destinations, safe crossings, terrain, and access for passengers with disabilities.

²⁰¹ Ibid.

²⁰² “Metro Strategic Transformation Plan / Service Excellence Report: Performance Measure Definitions,” Washington Metropolitan Area Transit Authority, June 2026. <https://www.wmata.com/content/dam/wmata-com/about/records/SER%20Definitions.pdf> (8 June 2026).

²⁰³ “Title VI Requirements and Guidelines for Federal Transit Administration Recipients.”

²⁰⁴ “Metro 2025 Transit Service Policy,” Los Angeles County Metropolitan Transportation Authority, Board Report No. 2025-0304, 17 July 2025. <https://datamade-metro-pdf-merger.s3.amazonaws.com/2025-0304.pdf>. 64. (8 June 2026). Presentation.

²⁰⁵ Ibid.; “Metro Rapid Demonstration Program Evaluation Report: Appendix B—Service Quality,” Federal Transit Administration. <https://www.transit.dot.gov/research-innovation/metro-rapid-demonstration-program-evaluation-report-appendix-b-service-quality> (8 June 2026).

²⁰⁶ “Metro 2025 Transit Service Policy.” 22.

²⁰⁷ Ibid.

²⁰⁸ Ibid.

The Alameda-Contra Costa Transit District (AC Transit) recommends stop spacing based on service type. The recommended spacing is 800 to 1,300 feet for local, overnight, supplementary, and microtransit services and 1,300 to 1,900 feet for rapid-only and BRT services.²⁰⁹ When rapid and local services operate on the same street, rapid stops may be 1,700 to 2,600 feet apart.²¹⁰ Freeway-express stops may also be 1,300 to 2,600 feet apart but may use local-service spacing where no underlying local service exists.²¹¹ AC Transit permits exceptions based on location, infrastructure, safety, accessibility, feasibility, reliability, and rider comfort.



Service changes should be evaluated after implementation against goals set before the change and revised if they reduce access, ridership, or reliability without sufficient travel-time or operating benefits.



Service changes should be evaluated after implementation against goals set before the change and revised if they reduce access, ridership, or reliability without sufficient travel-time or operating benefits. Agencies should compare travel time, ridership, passenger loads, missed trips, complaints, access, connections, and operating cost. LA Metro evaluates schedule adjustments shortly after implementation, conducts a detailed schedule review after three months, and evaluates route changes against their goals after about six months.²¹²

²⁰⁹ “Bus Stop Guidelines for Placement, Relocation, and Removal (Board Policy No. 501),” Alameda–Contra Costa Transit District, 26 Feb. 2025. <https://www.actransit.org/sites/default/files/2025-04/BP%20501%20-%20Bus%20Stop%20Guidelines%20for%20Placement%20Relocation.pdf> (8 June 2026).

²¹⁰ Ibid.

²¹¹ Ibid.

²¹² “Metro 2025 Transit Service Policy.” 40.

4.2 BUILD SCHEDULES FROM OBSERVED CONDITIONS

Scheduling turns the service plan into the specific times, vehicles, operators, and garage movements needed to deliver service each day. Running time sets how long each trip is expected to take, while recovery time gives a vehicle time to absorb delay before its next departure.²¹³ Vehicle assignments determine which trips each vehicle will operate, and operator assignments determine which trips each driver will cover.²¹⁴ Pull-out and pull-in times show when vehicles leave and return to the garage.²¹⁵ Short running times create late trips, too little recovery time carries delay into the next trip, and weak vehicle or operator assignments can leave scheduled trips uncovered.

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After agencies review observed running times, they need to decide how much time to build into the schedule. If scheduled time is based on unusually fast trips, buses will fall behind under normal conditions.

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After agencies review observed running times, they need to decide how much time to build into the schedule. If scheduled time is based on unusually fast trips, buses will fall behind under normal conditions. Feasibility criteria help agencies set running and recovery time based on how long trips take most of the time.²¹⁶ TCRP Report 113 defines an 85% feasibility criterion as the running time that 85% of observed trips could meet.²¹⁷ It defines half-cycle time as the time needed to complete a trip and recover before the next departure. Using a higher percentile for this combined time reduces the risk that a late arrival will delay the next trip. The Tri-County Metropolitan Transportation District of Oregon (TriMet), the public transit agency serving the Portland, Oregon metropolitan area, used a 95% criterion, meaning that a bus had only a 5% chance of arriving too late to begin

²¹³ Randall Pine, James Niemeyer, and Russell Chisholm, *Transit Scheduling: Basic and Advanced Manuals* (TCRP Report 30, Part A), Transportation Research Board, National Research Council, 1998. https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_30-a.pdf (17 July 2026).

²¹⁴ Ibid.

²¹⁵ Ibid.

²¹⁶ Samuel Zimmerman, John L. Wolf, and David Levinson, *Using Archived AVL-APC Data to Improve Transit Performance and Management* (TCRP Report 113), Transportation Research Board of the National Academies, 2006. https://www.trb.org/publications/tcrp/tcrp_rpt_113.pdf (17 July 2026).

²¹⁷ Ibid.

its next trip on time.²¹⁸ These percentiles are scheduling tools, not federal rules. Agencies should choose and update them with local data as traffic, route design, or boarding conditions change.

Schedule reliability should be measured based on service frequency. On less-frequent routes, riders rely on the timetable, so agencies should report early, on-time, and late departures using the adopted on-time window. On routes operating every 10 minutes or less, agencies should also measure whether vehicles stay evenly spaced. One way to do this is to identify intervals between vehicles that are more than one-half of the scheduled interval shorter or longer than planned. Poor results should trigger a review of running time, recovery time, and vehicle and operator assignments.

A schedule is workable only if the agency has enough vehicles and operators to deliver it. Before each service change, agencies should compare the vehicles and operators needed during the busiest period with those available and confirm that spare vehicles, maintenance capacity, and operator-change locations are sufficient. For agencies operating at least 50 fixed-route revenue vehicles, FTA guidance states that spare buses generally should not exceed 20% of the number of vehicles operated in maximum fixed-route service.²¹⁹ FTA does not set one spare ratio for rail because fleet requirements vary by system. Reporting scheduled and completed trips with operator and vehicle availability helps managers determine whether missed service results from the timetable, staffing shortages, or unavailable vehicles.²²⁰

4.3

MANAGE SERVICE IN REAL TIME

Dispatchers need a clear view of operations. They must know where vehicles are, which operators and vehicles are available, what incidents are happening, how many passengers are on board when that information is available, and what service is scheduled. Computer-aided dispatch (CAD) helps staff manage service in real time, automatic vehicle location (AVL) shows where vehicles are, and automatic passenger counters (APCs) record boardings

²¹⁸ Ibid.

²¹⁹ Federal Transit Administration, *Award Management Requirements*, Circular C 5010.1F, U.S. Department of Transportation, Nov. 1, 2024. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-09/C5010.1F-Circular-11-01-2024.pdf> (17 July 2026).

²²⁰ Ibid.

and exits.²²¹ These tools help staff spot late trips, unavailable operators or vehicles, crowding, and gaps between vehicles.²²²



Computer-aided dispatch (CAD) helps staff manage service in real time, automatic vehicle location (AVL) shows where vehicles are, and automatic passenger counters (APCs) record boardings and exits.



Once a problem is identified, the response depends on service frequency. On routes with longer intervals between vehicles, dispatchers should protect scheduled departures and connections. On frequent routes, they may hold a vehicle, insert a spare, reassign an operator, or short-turn a trip by reversing it before the end of the route to fill a service gap. Agencies should specify who may authorize each action, when riders and connecting services must be notified, and how the decision will be recorded.

A *Journal of Public Transportation* study of TriMet, the transit agency serving the Portland, Oregon metropolitan area, shows how real-time management can work.²²³ Using TriMet's automated Bus Dispatching System, field supervisors held vehicles, short-turned trips, or reassigned trips to maintain headways on six routes. Headway variation declined, though not significantly, while passenger loads became more evenly distributed. Overall, the improvements in service regularity contributed to a 16% reduction in passenger-load variance.

Each dispatch action should be recorded with its cause. Repeated holds, short turns, or gaps caused by unavailable operators or vehicles should be referred for a scheduling, staffing, or maintenance review. Dispatch can restore service during a disruption, but it cannot resolve a recurring problem with the operating plan.

²²¹ "Transit Operations Decision Support System (TODSS) Core Requirements Prototype Development Case Study and Lessons Learned," Federal Transit Administration, Apr. 2010.
https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/Task_7_Final_TODSS_Report_V3.pdf 17 July 2026.

²²² Ibid.

²²³ James G. Strathman, Thomas J. Kimpel, Kenneth J. Dueker, Richard L. Gerhart, Kenneth Turner, David Griffin, and Steve Callas, "Bus Transit Operations Control: Review and an Experiment Involving Tri-Met's Automated Bus Dispatching System," *Journal of Public Transportation* 4, no. 1 (2001).
<https://digitalcommons.usf.edu/cgi/viewcontent.cgi?article=1742&context=jpt> (17 July 2026).

4.4

REDUCE BOARDING DELAYS

The time a vehicle remains at a stop while passengers board and exit is called dwell time.²²⁴ Fare payment is a major part of bus dwell time, particularly at busy stops. FTA reports that contactless payment, which allows riders to tap a card, phone, or other payment device, can reduce payment time.²²⁵ All-door boarding, payment before boarding, low-floor vehicles, level boarding, and adequate door and aisle space can also shorten dwell time. Reducing these delays helps vehicles maintain reliable service along the route.

Fare-payment changes can improve boarding speed, but they should not eliminate practical payment options for riders who use cash or do not have smartphones or bank accounts.²²⁶ The Metropolitan Atlanta Rapid Transit Authority (MARTA) launched its Better Breeze fare system in March 2026.²²⁷ Riders can tap a bank card or mobile wallet at rail faregates and bus validators or use a reloadable Breeze card.²²⁸ MARTA also accepts cash on local buses and at ticket machines and Ride Stores, preserving a cash option.²²⁹

Fare-payment changes can improve boarding speed, but they should not eliminate practical payment options for riders who use cash or do not have smartphones or bank accounts.

Agencies should compare boarding time, total dwell time, and service reliability before and after changing boarding or fare-payment practices. They should also retain practical ways to pay with cash and obtain or reload fare cards so that faster boarding does not limit access.

²²⁴ “Fare Collection,” Federal Transit Administration. <https://www.transit.dot.gov/research-innovation/fare-collection> (17 July 2026).

²²⁵ Ibid.

²²⁶ Ibid.

²²⁷ “MARTA’s Better Breeze Fare Payment System Goes Live March 28, 2026,” Metropolitan Atlanta Rapid Transit Authority, 18 Mar. 2026. <https://itsmarta.com/marta-breeze-goes-live-mar28th.aspx> (17 July 2026).

²²⁸ Ibid.

²²⁹ Ibid.

4.5

USE PREDICTIVE MAINTENANCE AND AI FOR DEFINED PROBLEMS

Preventive maintenance inspects vehicles and replaces components at required time or mileage intervals. Predictive maintenance adds a data-based layer by using sensor readings, diagnostic codes, and historical data to identify components that may fail.²³⁰ It should supplement required inspections and safety procedures, not replace them. Agencies should begin with components responsible for the most road calls and maintenance-related missed service.

Agencies should measure performance before and after using predictive maintenance so they can prove whether the tool is actually helping. They should track breakdowns, road calls, missed trips, vehicle availability, and costs, and they should separate the results by vehicle type and age so problems are not hidden in system-wide averages.

New York City Transit (NYCT) tested a contractor's predictive-maintenance system on 326 buses.²³¹ The system analyzed sensor data and developed repair plans that led to 50 buses being sent to maintenance facilities.²³² The American Public Transportation Association (APTA) reports that the test increased maintenance productivity by 75% and reduced material costs by 24%.²³³ These results apply to the test fleet and may not transfer to fleets with different vehicles, sensor coverage, or data quality.

Predictive maintenance is one use of data-driven software in transit. Artificial intelligence (AI) refers here to software that uses data to identify patterns, make predictions, or recommend actions.²³⁴ Transit applications include forecasting passenger demand and arrival times, recommending vehicle and operator assignments, identifying unusual operating data, and preparing service information for riders. In APTA's 2026 survey of 32 transit agencies, 15 agencies, or 47%, reported using or planning to use AI for operations,

²³⁰ "Artificial Intelligence (AI) and Machine Learning (ML) in Public Transit: A Primer," American Public Transportation Association, May 2026. 16. <https://www.apta.com/wp-content/uploads/2026/05/APTA-AI-Primer-May-2026.pdf> (17 July 2026).

²³¹ "Artificial Intelligence (AI) and Machine Learning (ML) in Public Transit: A Primer," American Public Transportation Association, May 2026. 17. <https://www.apta.com/wp-content/uploads/2026/05/APTA-AI-Primer-May-2026.pdf> (17 July 2026).

²³² *Ibid.*, 17.

²³³ *Ibid.*, 17.

²³⁴ *Ibid.*, 2.

but only three already had an operational tool in use.²³⁵ FTA also found that an AI-based dispatch system helped Prairie Hills Transit in South Dakota transfer trip information to drivers about 78% faster and increase on-time pickups and drop-offs by roughly 10%.²³⁶ These examples demonstrate possible uses, not results every agency should expect.

FTA also found that an AI-based dispatch system helped Prairie Hills Transit in South Dakota transfer trip information to drivers about 78% faster and increase on-time pickups and drop-offs by roughly 10%.

Before testing predictive maintenance or another AI tool, agencies should define the problem, baseline performance, target, cost, acceptable error rate, and review date. They should begin with a limited pilot, compare results with the existing method, and expand only if service or cost improves. Procurement requirements should address data ownership, system connections, cybersecurity, privacy, accessibility, bias, error reporting, data retention, and the return or transfer of agency data. Agency staff should retain authority over service changes, safety or enforcement decisions, and customer information that could affect access to service.

4.6

CONCLUSION

Operational improvement is an ongoing management responsibility, not a one-time project or technology purchase. Agencies should distinguish isolated disruptions from recurring problems, identify the cause, assign responsibility for correcting it, and confirm that the response improved the service riders receive. A new practice or tool should continue only when it produces measurable benefits without reducing access, safety, or accountability. This approach keeps decisions focused on results and prevents temporary operating problems from becoming accepted conditions.

²³⁵ Ibid., 5, 12.

²³⁶ “Providing a Dynamic, Data-Driven Micro-Transit Service with Smart Dispatch Using Artificial Intelligence,” Federal Transit Administration, Report No. 0269, Sept. 2024. 16. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-09/FTA-Report-No-0269.pdf> (17 July 2026).; “Transit Bus Automation Facts,” U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, 2025. <https://www.itskrs.its.dot.gov/2025-b01922> (17 July 2026).

PART 5

ROADWAY AND SYSTEM OPERATIONS

Transit performance depends not only on service design but also on how efficiently buses move through the roadway network. Even well-planned routes can lose time at intersections, traffic signals, and other recurring delay points. Improving reliability does not always require corridor-wide changes; agencies can often target the locations and operating conditions that slow service.

This section examines two approaches: queue jumps, which give buses a short, dedicated approach at intersections, and intelligent transportation systems (ITS), which use vehicle location, passenger-counting, dispatch, real-time information, and traffic-signal technology to improve operations.

5.1

QUEUE JUMPS

Queue jumps address delay at a very specific point in the network: the intersection. The Federal Transit Administration defines a queue jump lane as a short stretch of bus lane used with signal priority so buses can bypass waiting traffic and get an early green signal.²³⁷

²³⁷ “Signal Priority,” Federal Transit Administration, U.S. Department of Transportation, www.transit.dot.gov/research-innovation/signal-priority (22 Apr. 2026).

Queue jumps work best in places where delays occur in specific spots rather than along the entire route. Even a short delay at a busy location can slow down every trip, so fixing that spot improves performance throughout the day.



Queue jumps address delay at a very specific point in the network: the intersection.



This also sets their boundaries. If delays occur along long stretches of a route or are caused by factors like boarding time or scheduling, queue jumps do not help much.

Street design also limits their use. There must be enough space to create a dedicated approach lane, which may require removing curb parking, restricting existing lanes, or widening the roadway, and the design must allow buses to merge back into traffic safely.²³⁸ Competing curb uses, such as parking, loading activity, and right-turn movements, can interfere with bus operations and reduce the effectiveness of queue jump treatments.²³⁹

Even with these limits, queue-jumping is widely used on routes where full bus lanes cannot be built. In Albany, New York, the Capital District Transportation Authority (CDTA) has added 13 queue jump lanes to its bus rapid transit network, including the BusPlus corridors.²⁴⁰ These lanes use transit signal priority (TSP), so buses can get ahead of traffic at intersections with regular delays. CDTA keeps adding more queue jumps as part of its corridor upgrades, focusing on fixing specific delay spots rather than changing entire routes.²⁴¹

Implementation costs vary widely depending on design and location. In Nashville, Tennessee, planning estimates for the city's bus rapid transit program indicate that constructing queue jump lanes can cost on the order of \$1 million or more per intersection

²³⁸ American Public Transportation Association, Designing Bus Rapid Transit Running Ways.

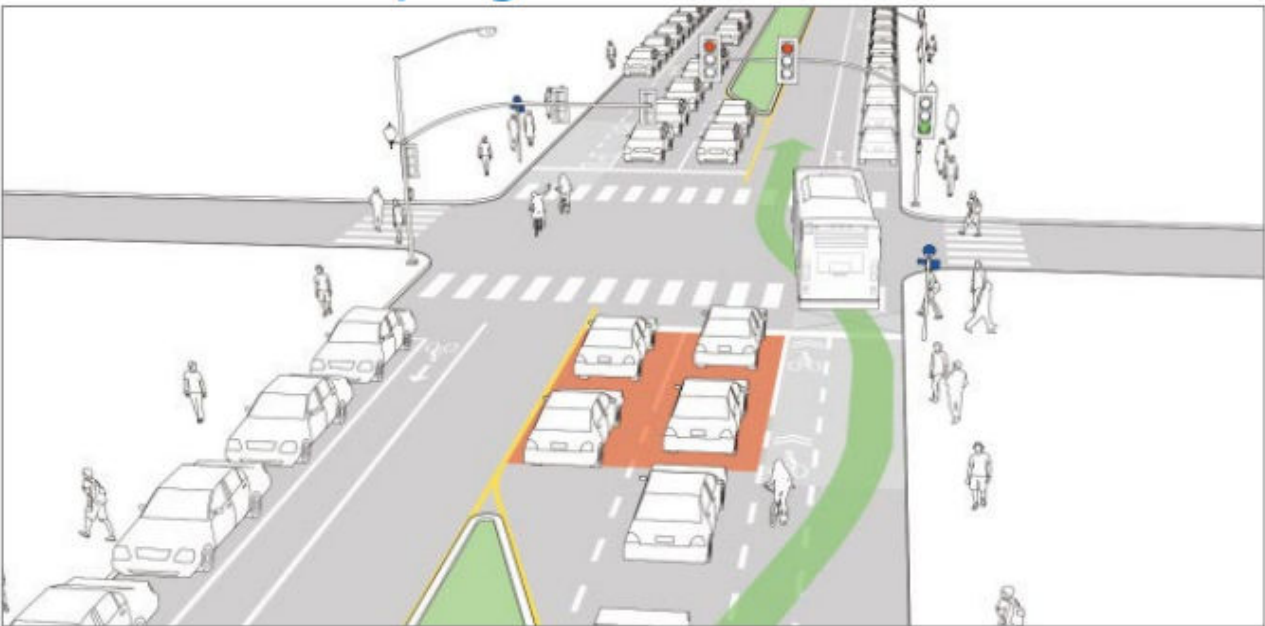
²³⁹ Ibid.

²⁴⁰ "Queue Jump Lanes," Capital District Transportation Authority, 10 Oct. 2023. https://projects.cdta.org/blog/queue-jump-lanes_1#:~:text=CDTA%20has%20installed%2013%20queue,to%20begin%20in%20November%202023. (22 Apr. 2026).

²⁴¹ Ibid.

when projects require roadway reconstruction and right-of-way acquisition.²⁴² By contrast, in Denver, Colorado, adding only the specialized signal heads needed for queue jump operation has been estimated to cost less than \$1,000 per intersection when a dedicated lane already exists.²⁴³ These examples show that queue jump costs depend heavily on whether the project involves full roadway changes or only signal upgrades.

FIGURE 4: BUS QUEUE JUMP SIGNALS



Bus queue jump signals improve transit performance by giving buses a head start at congested intersections. Graphic source: NACTO.

Source: Arlington County, Virginia, “Bus Queue Jump Signals.”

²⁴² “Chapter 7: BRT for Gallatin Road,” Nashville Metropolitan Transit Authority, 2009. 7-7. www.filetransfer.nashville.gov/portals/0/SiteContent/MTA/docs/StrategicTransitMasterPlan/09Ch7BRT.pdf (22 Apr. 2026).

²⁴³ “Traffic Signal Prioritization,” National Association of City Transportation Officials, 2021. www.static1.squarespace.com/static/5e5b095245a44a402cf55654/t/6148c739d2bea875d5209294/1632159545476/Traffic+Signal+Prioritization.pdf (22 Apr. 2026).

5.2 INTELLIGENT TRANSPORTATION SYSTEMS

While queue jumps provide physical space for buses, intelligent transportation systems (ITS) use communications, detection, computing, and traffic-control technology to locate vehicles, exchange operating data, and manage traffic signals.²⁴⁴

Automatic vehicle location (AVL) uses onboard positioning equipment, usually Global Positioning System (GPS) technology, to report a vehicle's location.²⁴⁵ Automatic passenger counting (APC) systems use door sensors or similar equipment to record how many passengers board and exit.²⁴⁶ APC data help agencies identify where passenger loads are highest. AVL data feed computer-aided dispatch (CAD) systems, which combine vehicle locations with schedules, vehicle assignments, disruption reports, and communications so dispatchers can monitor service and issue instructions.²⁴⁷ The same AVL data also support real-time information systems that provide riders with arrival and service updates through signs and mobile applications.

For these systems to work together, agencies should use consistent route, trip, stop, vehicle, and time identifiers. They should also monitor missing vehicle locations, trips that cannot be matched to the schedule, and unreasonable passenger counts. Incorrect data can affect dispatch decisions, schedules, passenger information, and performance reports.

Transit signal priority (TSP) uses vehicle-detection systems to send priority requests to traffic-signal controllers.²⁴⁸ These requests may be transmitted through vehicle-to-infrastructure (V2I) communication, which allows vehicles and traffic signals to exchange

²⁴⁴ Mohamed Elassy, Mohammed Al-Hattab, Maen Takruri, and Sufian Badawi, "Intelligent Transportation Systems for Sustainable Smart Cities," *Transportation Engineering* 16 (2024). [https://www.sciencedirect.com/science/article/pii/S2666691X24000277#:~:text=Intelligent%20Transportation%20Systems%20\(ITSs\)%20have,algorithms%20%5B1%2C2%5D](https://www.sciencedirect.com/science/article/pii/S2666691X24000277#:~:text=Intelligent%20Transportation%20Systems%20(ITSs)%20have,algorithms%20%5B1%2C2%5D). (22 Apr. 2026).

²⁴⁵ "National Transit Database (NTD) Glossary," Federal Transit Administration. <https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary> (8 June 2026) ; "Transit Asset Management Systems Handbook," Federal Transit Administration, Oct. 2020. 46. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2020-10/TAM-Systems-Handbook.pdf> (8 June 2026).

²⁴⁶ "National Transit Database (NTD) Glossary."

²⁴⁷ "Transit Asset Management Systems Handbook." 46. ; "ITS for Bus Rapid Transit," U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, Dec. 2023. <https://www.itskrs.its.dot.gov/briefings/executive-briefing/its-bus-rapid-transit> (8 June 2026).

²⁴⁸ "Traffic Signal Timing Manual: Chapter 9, Advanced Signal Timing Topics," Federal Highway Administration, June 2008. <https://ops.fhwa.dot.gov/publications/fhwahop08024/chapter9.htm> (17 July 2026).

information.²⁴⁹ When a request is granted, the signal may extend a green light or shorten a red light so the bus can pass through the intersection sooner.²⁵⁰ A queue jump combines a short bus lane with signal priority, allowing buses to move ahead of waiting traffic near an intersection.²⁵¹

Agencies should define when and where signal priority will be granted. Conditional systems may limit requests to buses that are late or heavily loaded or operating on designated routes. TSP should be installed at intersections where signal delay regularly affects service. These limits can reduce effects on cross traffic while directing priority to buses and locations most likely to benefit.

Transit signal priority (TSP) uses vehicle-detection systems to send priority requests to traffic-signal controllers.

TSP costs depend on the equipment already in place and the technology deployed. A 2010 TCRP synthesis reported conventional TSP detection equipment costs ranging from \$2,500 to \$40,000 per intersection and \$50 to \$2,500 per transit vehicle.²⁵² More recent connected-vehicle deployments are priced by component. USDOT's 2024 assessment reported signal-controller upgrades of \$2,200 to \$13,000 per signal, roadside units of \$900 to \$5,250 each, and ongoing operations and maintenance costs of approximately \$2,000 to \$3,000 per intersection each year.²⁵³

²⁴⁹ "Vehicle-to-Everything (V2X) Technology—Transit Signal Priority (TSP)," U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, Dec. 2024. <https://www.itskrs.its.dot.gov/briefings/executive-briefing/vehicle-everything-v2x-technology-transit-signal-priority-tsp> (17 July 2026).

²⁵⁰ "Traffic Signal Timing Manual." Chapter 9; "Active Traffic Management Feasibility and Screening Guide: Chapter 5, Analyze and Prioritize Individual Roadway Links and Active Traffic Management Strategies," Federal Highway Administration, 2015. <https://ops.fhwa.dot.gov/publications/fhwahop14019/ch5.htm> (17 July 2026).

²⁵¹ "Signal Priority," Federal Transit Administration, 6 Dec. 2015. <https://www.transit.dot.gov/research-innovation/signal-priority> (17 July 2026).

²⁵² "Transit Signal Priority (TSP)," U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, 2013. <https://www.itskrs.its.dot.gov/2013-sc00286> (17 July 2026).

²⁵³ "Vehicle-to-Everything (V2X) Technology—Transit Signal Priority (TSP)," U.S. Department of Transportation.

A USDOT analysis shows how these costs and benefits can compare over time. In a hypothetical 25-mile urban TSP project covering 105 intersections and 60 buses, USDOT estimated capital costs of approximately \$1.96 million and annual operating and maintenance costs of \$254,200.²⁵⁴ Over 10 years, the project was estimated to produce approximately \$12.95 million in benefits, or \$3.60 in benefits for every \$1 spent.²⁵⁵ Most of those benefits came from shorter transit travel times. Because this was a hypothetical project, agencies should use local data before assuming similar results on another corridor.



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TSP is only one part of ITS. Other components, such as CAD, AVL, voice communications, and real-time information displays, can require larger system-wide investments because they cover vehicles, dispatch systems, communications equipment, and passenger information infrastructure. In 2020, the Hillsborough Area Regional Transit Authority in Florida estimated \$9.8 million to replace its CAD and AVL system for approximately 200 buses.²⁵⁶ In 2015, the Alameda-Contra Costa Transit District spent about \$21 million on a CAD, AVL, and voice-communication system.²⁵⁷ King County Metro reported costs ranging from \$3,590 to \$17,810 for each digital real-time information display, depending on its size and power source.²⁵⁸ These figures cover different equipment, project scopes, and years, so

²⁵⁴ “Use Case: Transit Signal Priority Benefit-Cost Analysis,” U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, 11 July 2022. https://www.itskrs.its.dot.gov/sites/default/files/doc/Transit_Signal_Priority_BCA_Use_Case_20220711_Final_508.pdf (17 July 2026).

²⁵⁵ Ibid.

²⁵⁶ “Adopted Operating and Capital Budget Executive Summary: Fiscal Year 2020,” Hillsborough Area Regional Transit Authority, 2 Jan. 2020. <https://www.itskrs.its.dot.gov/2020-sc00451> (17 July 2026).

²⁵⁷ “Deployment of a New CAD/AVL and Voice Communication System to Cost the Alameda-Contra Costa Transit \$21 Million,” U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, ITS Deployment Evaluation, 14 Feb. 2017. <https://www.itskrs.its.dot.gov/2016-sc00368> (17 July 2026).

²⁵⁸ “King County Metro Estimated the Installation Unit Costs of Digital Real-Time Information Signs to Range from \$3,590 to \$17,810, Depending on Their Size and Whether They Use Ground or Solar Power,” U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office, ITS Deployment Evaluation, 18 Sept. 2023. <https://www.itskrs.its.dot.gov/2023-sc00541> (17 July 2026).

they illustrate the range of ITS expenses but are not directly comparable or current cost estimates.

Because ITS systems require ongoing operation, agencies should plan for maintenance, communications, operating rules, and coordination with traffic agencies before deployment. They should also measure bus travel time, signal delay, schedule or headway reliability, and effects on cross traffic before and after implementation. ITS is most useful on frequent routes where traffic signals cause substantial delay and transit and traffic agencies can manage the system together.

5.3

CONCLUSION

Roadway improvements should begin with evidence showing where delay occurs and what causes it. The treatment should match the scale of the problem, and responsibility for operating and maintaining it should be established before construction or procurement. Agencies should compare conditions before and after implementation and correct the treatment before expanding it. Improvements should produce meaningful transit benefits without creating unacceptable effects for other street users. This makes roadway operations a continuing responsibility shared by transit and traffic agencies rather than a one-time investment.

PART 6

CONCLUSIONS, POLICY RECOMMENDATIONS, AND OVERALL GUIDANCE

Transit agencies operate in metropolitan areas that are constantly changing. Where people live and work, when they travel, and the destinations they need to reach do not remain fixed. A transit system that once fit those patterns may become less useful even if the agency continues operating the same routes and services. The challenge is therefore not simply to provide more transit, but to provide service that continues to fit the transportation needs of the communities it serves.

The analysis throughout this brief also shows why no single transit mode, operating model, or technology can improve every system. Heavy rail, light rail, buses, microtransit, contracted operations, new technology, and roadway treatments each address different needs. Their value depends on how well they fit within the larger transit network and whether they improve the trip passengers experience. Choices that are effective in one corridor or metropolitan area may offer little benefit elsewhere because demand, development patterns, and operating conditions differ. The following recommendations are based on this analysis.

#1 Transit agencies should match service and investment to passenger demand, travel patterns, congestion, available space, full costs, and the ability to adjust service as conditions change.

In most networks, local bus service provides the foundation, with higher-capacity service added as demand increases. Limited-stop service can first improve travel times on busy routes without major construction. Where greater speed and reliability are needed, BRT—whether Heavy, Lite, or Freeway—may be appropriate if the corridor does not justify rail. LRT may be appropriate when demand exceeds ordinary bus capacity and supports investment in fixed rail infrastructure. HRT should be limited to the highest-demand corridors where fully separated infrastructure is warranted.

#2 For suburb-to-central-city travel, the choice is generally between express bus and commuter rail.

Agencies should consider express bus first because it requires less initial investment and can be adjusted more easily. Commuter rail is appropriate when demand is high and concentrated, suitable tracks are available, and expected ridership supports the fixed investment.

#3 Flexible service is most appropriate where demand is too low or too dispersed for an efficient fixed route.

Microtransit can provide shared, on-demand trips within a defined service area. DRT can provide ADA paratransit, rural transportation, and other low-demand services that require advance booking or more individualized trips. Both services should offer accessible vehicles, telephone booking, and payment options for riders who cannot use an application or electronic payment. Performance should be measured by passengers per service hour, subsidy per rider, and cost per trip. If more riders begin traveling along the same path at similar times, the agency should determine whether fixed-route service could carry them more efficiently.

#4 After selecting the service, an agency must determine whether to operate it directly or use a contractor.

Core bus and rail services may be easier to operate in-house when they require close coordination among dispatch, maintenance, infrastructure, and incident response and the agency already has the necessary workforce, facilities, expertise, and management systems. Contracting may be appropriate when the service can be clearly defined and measured or when a qualified provider can supply vehicles, workers, software, or specialized expertise that the agency lacks. Paratransit, DRT, microtransit, commuter bus, and lower-ridership bus routes may be easier to separate from the main network and specify in a contract. However, no service should be transferred solely on the assumption that contracting will lower costs or improve quality.

Before changing an operator, the agency should compare the cost of providing the same routes, schedules, service hours, and performance standards under each model. The comparison should include retained administration, solicitation, proposal evaluation, transition, rebidding, oversight, and any capital expenses the agency would continue to pay. The agency should confirm that prospective contractors have the required workforce, experience, technical capacity, and financial resources and seek proposals from multiple qualified firms without unnecessarily restricting competition. If competition is inadequate, the agency should complete the required cost analysis and document its justification.

#5 Whether service is operated directly or under contract, the agency should establish measurable requirements for service delivery, complaints, mechanical reliability, safety, and access to performance data. Enough staff must be assigned to verify the information, enforce the requirements, and correct deficiencies. Incentives and penalties should apply only to results within the operator's control, and the agency should confirm that meeting one target does not harm another part of the service. Contracts should identify who is responsible for correcting poor performance and what will happen if it continues. The agency remains responsible for coordinating the service with the rest of the network, maintaining service continuity, setting fares and standards, and meeting federal requirements.

Performance standards should also guide route design and daily operations. Agencies should set clear measures, targets, and thresholds for taking action on service frequency, crowding, on-time performance, missed trips, passenger access, and stop spacing. Results should be reviewed by route, direction, and time of day. Before changing routes or stops, agencies should consider travel time, ridership, passenger loads, missed trips, complaints, access, network connections, reliability, operating costs, and fleet needs.

#6 Once routes and stops are set, agencies should build schedules from observed operating conditions, prevent delay, and ensure reliability. Vehicle-location and passenger-count data should cover several days for each route, direction, and time of day. Schedules should account for running and recovery time, labor rules, operator changes, non-revenue travel, staffing, maintenance capacity, and vehicle availability. Less frequent routes should be measured against their timetables, while routes operating every 10 minutes or less should also be measured by the spacing between vehicles. Written procedures for disruptions should state what actions are allowed, who can authorize them, who must be notified, and what must be documented. Recurring delays, gaps, holds, and short turns should trigger a review of schedules, staffing, or maintenance instead of repeated temporary responses.

Reliable schedules also depend on reducing delays at stops. Depending on the service, boarding improvements may include all-door boarding, payment before boarding, low-floor or level-boarding vehicles, and sufficient door and aisle space. Agencies should compare boarding time, total dwell time, and reliability before and after implementation. Cash-payment and fare-loading options should remain available for riders who do not have smartphones, bank accounts, or electronic payment methods.

Vehicle reliability is also necessary to prevent delays and missed service. Predictive maintenance should target parts that commonly cause breakdowns, road calls, or missed service, but it should not replace required inspections. Agencies should track breakdowns, road calls, vehicle availability, missed trips, and maintenance costs by vehicle type and age. AI should be tested only when the agency has identified a specific operational problem. Before testing it, the agency should record current performance, define the expected improvement and acceptable error rate, calculate the cost, and set a review date. The agency should expand the system only if it improves service or lowers costs. It should also address data ownership, compatibility with existing systems, cybersecurity, privacy, data retention, accessibility, bias, and error reporting. Decisions about service, safety, and enforcement should remain under agency control.

Improvements to street and signal operations should address documented sources of delay. Queue jumps are appropriate at intersection bottlenecks where there is enough space for an approach lane and a safe merge. Their design and cost estimates should account for parking, loading, turning vehicles, lane restrictions, construction, right-of-way, and signal work. They should not be used to address boarding delays, scheduling problems, or congestion that extends along an entire corridor.

Where traffic signals reduce reliability, TSP can support a queue jump or operate without a separate bus lane, particularly on frequent routes. Conditional priority can limit requests to late or heavily loaded buses, designated routes, or locations with recurring problems, reducing unnecessary effects on cross traffic. Agencies should determine when priority will be requested, who controls the signal settings, and how the system will respond when equipment or communications fail.

These priority decisions depend on accurate and compatible data from the agency's intelligent transportation systems (ITS). Agencies should use common route, trip, stop, vehicle, and time identifiers across AVL, APC, CAD, passenger-information, and traffic-signal

systems. Missing vehicle locations, unmatched trips, and unreasonable passenger counts should be corrected before the data are used for dispatch, scheduling, performance reports, rider information, or TSP.

The full local cost of these systems should include onboard equipment, communications, software, system integration, signal work, cybersecurity, training, maintenance, and technical support. Historical projects with different equipment, scopes, and implementation dates should not be treated as directly comparable cost estimates. Before deployment, agencies should assign responsibility for signal settings, communications failures, software updates, data validation, cybersecurity, maintenance, operating rules, and reporting. They should then compare travel time, signal delay, reliability, system availability, maintenance costs, and effects on cross traffic before and after implementation.

6.1

OVERALL DECISION-MAKING GUIDANCE

For every decision, agencies should define the problem, choose an option that fits local conditions, state the expected improvement, and measure the results. A route change, operating model, technology, or roadway improvement that does not work should be corrected before it is expanded. Agencies should require stronger evidence for larger and harder-to-reverse investments because fixed infrastructure, specialized equipment, and long-term contracts are costly and difficult to change.

Ultimately, transit is a transportation service rather than a collection of projects, vehicles, or technologies. Its success depends on whether people can reach their destinations within a reasonable amount of time and with enough reliability to make the service useful. Public resources devoted to transit should therefore be judged by whether the system provides dependable access at a cost taxpayers can sustain.

ABOUT THE AUTHOR

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Originally from Puerto Rico and now based in Georgia, Rivera earned her Bachelor of Arts degree in International Affairs with concentrations in economics, business, and policy from Kennesaw State University.

Before joining Reason, Rivera served as a Reservist Emergency Management Specialist with the Federal Emergency Management Agency (FEMA). She also held various research and policy roles with the National Association of State Procurement Officials (NASPO), legislative offices, and nonprofits, where she focused on policy analysis, governance, and economic issues. She is passionate about leveraging research and innovation to shape policies that are more equitable, efficient, and accessible for the communities they serve.

