Intelligent Transportation Systems Deployment Tracking Survey: 2023 Transit Management Findings

Final Report

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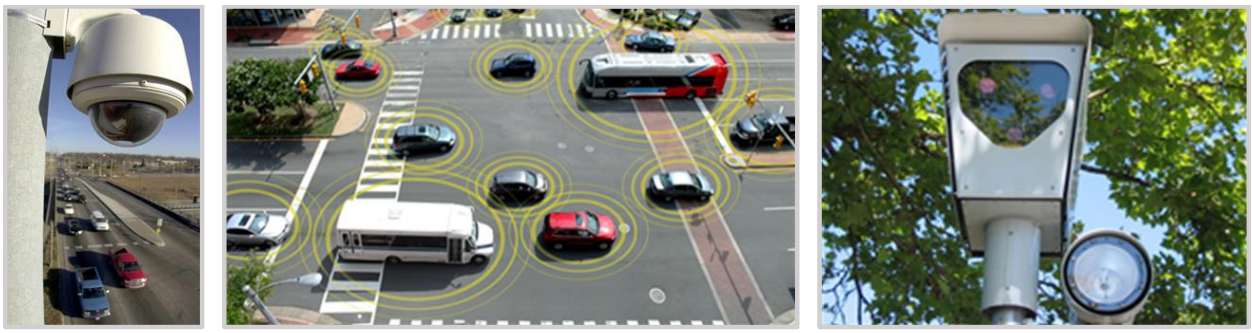

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16. Abstract

This report summarizes the Transit Management Survey findings of the 2023 Intelligent Transportation Systems (ITS) Deployment Tracking Survey. From 1999 to 2020, the ITS Joint Program Office (JPO) used the ITS Deployment Tracking Survey on an ongoing basis to collect information about ITS deployment in a subset of metropolitan areas across the United States by surveying state and local transportation agencies. With this most recent 2023 ITS Deployment Tracking Survey, a new survey methodology was implemented, which greatly expanded the geographic coverage of the ITS Deployment Tracking Survey to include smaller urban and rural areas in addition to large metropolitan areas.

The 2023 Transit Management Survey was administered online from October 3, 2023 to January 19, 2024 to a sample of transit management agencies. The survey achieved a response rate of 63 percent with 464 completed surveys. Where comparable data are available, trends are shown for a subset of 2023 transit management agencies in large metropolitan areas that have been previously surveyed as part of the historical ITS Deployment Tracking Survey (i.e., part of the sample from 1999 – 2020).

The ITS JPO and other stakeholders may use the resulting data to inform strategic planning and investment decisions, identify opportunities to accelerate the deployment of ITS, establish baseline deployment for newer ITS technology deployments, document shifts in ITS deployment patterns and ITS market evolution, and identify opportunities for knowledge transfer and technical assistance.

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Acronyms

Acronym	Meaning
ADA	Americans with Disabilities Act
APC	automatic passenger counter
AV	automated vehicle
AVA	automatic voice announcement
AVL	automatic vehicle location
BIL	Bipartisan Infrastructure Law
BRT	bus rapid transit
CADS	computer aided dispatch and scheduling
CBTC	communications based train control
CV	connected vehicle
DOT	Department of Transportation
EFP	electronic fare payment
FTA	Federal Transit Administration
GAO	Government Accountability Office
GTFS	General Transit Feed Specification
ICM	integrated corridor management
ITS	Intelligent Transportation Systems
ITS JPO	Intelligent Transportation Systems Joint Program Office
MDC	mobile data computer
MDT	mobile data terminal
MMS	maintenance management systems
NTD	National Transit Database
SME	subject matter expert
TCH	transit control head
TNC	Transportation Network Company
TMCC	Travel Management Coordination Center
TSP	transit signal priority
VOMS	vehicles operating in maximum service
USDOT	United States Department of Transportation

Executive Summary

Introduction

This report summarizes the **Transit Management Survey** findings of the 2023 Intelligent Transportation Systems (ITS) Deployment Tracking Survey. The United States Department of Transportation's (USDOT) Intelligent Transportation Systems Joint Program Office (ITS JPO) conducts these surveys to track ITS deployment. The mission of the ITS JPO is to lead collaborative and innovative research, development, and implementation of ITS to improve the safety and mobility of people and goods. The ITS JPO's ITS Deployment Evaluation Program administers the ITS Deployment Tracking Survey with assistance from the USDOT's John A. Volpe National Transportation Systems Center (Volpe).

The ITS JPO has been administering the ITS Deployment Tracking Survey to a subset of large metropolitan areas in the United States since 1999. **With this most recent 2023 ITS Deployment Tracking Survey, a new survey methodology was implemented, which greatly expanded the geographic coverage of the ITS Deployment Tracking Survey to include smaller urban[1] and rural areas in addition to large metropolitan areas.** This change in methodology reflects a need to (1) obtain a better understanding of ITS deployment nationwide and (2) obtain ITS deployment information from communities of all sizes, not just from large metropolitan areas.

The ITS JPO and other stakeholders may use the resulting data to inform strategic planning and investment decisions, identify opportunities to accelerate the deployment of ITS, establish baseline deployment for newer ITS technology deployments, document shifts in ITS deployment patterns and ITS market evolution, and identify opportunities for knowledge transfer and technical assistance.

Methodology: Transit Management Survey

The 2023 Transit Management Survey was administered to a stratified random sample[2] of transit management agencies (also referred to as transit agencies in this report) from large urban, small urban, and rural areas nationwide. The sampling frame was developed using the National Transit Database (NTD).[3] The population for sampling was restricted to public entities (i.e., private-for-profit corporations as reported in the NTD's organization type were removed), and transit agencies with a fleet size of 10 or

[1] This term is used to refer to small metropolitan and micropolitan areas.

[2] Stratified random sampling is a type of probability sampling method that involves dividing a population into subgroups or strata based on certain characteristics and then selecting a random sample from each stratum (see: https://researchmethod.net/stratified-sampling/).

[3] The NTD is a legislative requirement (see Title 49 U.S.C. 5335(a)). This statute requires that recipients or beneficiaries of grants from the Federal Transit Administration (FTA) under the Urbanized Area Formula Program (§5307) or Other than Urbanized Area (Rural) Formula Program (§5311) submit data to the NTD.

more vehicles operating in maximum service (VOMS) among rural transit agencies.[4] Transit agencies in large and small urban areas did not have a minimum number of vehicles for eligibility. With the changes in survey methodology, more than three times as many transit management agencies received the Transit Management Survey in 2023 compared to the 2020 survey.

A soft launch of the Transit Management Survey occurred on October 3, 2023, with the full launch following on October 5, 2023. Survey invitations were sent to transit management agencies by email. The final number of eligible agencies included 733 transit management agencies.

During survey administration, multiple reminder efforts were undertaken to encourage survey response, including several rounds of reminders by email and telephone. The survey closed on January 19, 2024, resulting in 464 completed Transit Management Surveys and a **response rate of 63 percent**.

Of the 464 total completed surveys, 60 transit management agencies had been part of the previous ITS Deployment Tracking Survey sample (i.e., in the subset of large metropolitan areas). In this report, these 60 transit agencies are referred to as the "historically surveyed transit agencies." Trend analysis compares these agencies' responses in 2023 to responses from previous 2020 and 2016 ITS Deployment Tracking Surveys. Trend charts are shown for questions that are the same (or very similar) across the survey years. Where trend data are available, the results are presented in Chapter 4.

Key Transit Management Survey Findings

This section summarizes the key findings from the Transit Management Survey.

The most common modes operated among responding transit management agencies are fixed route bus (64 percent) and demand responsive (64 percent). American with Disabilities Act (ADA) complementary paratransit is operated by 46 percent of responding transit agencies, and about one fifth operate flexible route bus service (21 percent), a new response option in 2023. The other surveyed modes are each operated by less than five percent of responding transit management agencies.

Use of ITS technologies on vehicle fleets is widespread across surveyed transit modes.

- Across all transit modes, the most widely deployed ITS technologies on vehicles include:
  - *Automated vehicle location (AVL)* (81 percent)
  - *Computer-aided dispatch and scheduling (CADS)* (70 percent)
  - *Mobile data terminals (MDT), mobile data computers (MDC), or transit control heads (TCH)* (62 percent)

[4] The Government Accountability Office (GAO) used this criterion in its 2015 survey of small urban and rural transit providers (see: https://www.gao.gov/assets/gao-16-638.pdf). GAO based this threshold decision on discussions with industry associations and a survey pretest. The ITS JPO adopted this same eligibility criterion in its 2019 Small Urban and Rural Transit Survey and the 2023 Transit Management Survey.

- Less than one half of transit management agencies deploy other surveyed ITS technologies on vehicles, including:
    - *Automatic passenger counters (APC)* (37 percent)
    - *Maintenance management systems (MMS)* (27 percent)
    - *Transit signal priority (TSP)* (13 percent)[5]
    - *Communications-based train control (CBTC) railway signaling system* (2 percent)[6]

Over half of the 363 transit management agencies operating fixed route services[7] deploy at least one of the surveyed in-vehicle traveler information technologies.

- Overall, 55 percent of transit management agencies operating fixed route service deploy in-vehicle traveler information technologies. These in-vehicle technologies include:
    - *Automatic voice announcement systems* (*AVA)* (52 percent)
    - *Dynamic electric signage* (43 percent).

The majority of transit management agencies use websites and social media to share real-time traveler information; other sources are used by about one third or fewer transit agencies.

- Overall, 78 percent of transit management agencies use at least one method to *disseminate real-time traveler information to the public*, including service changes, transit schedule adherence, or arrival and departure times.

- A majority of transit management agencies use *websites* (60 percent) or *social media* (53 percent) to share real-time traveler information with the public. Methods used by a lower percentage of transit agencies include:
    - *Email or text/SMS alerts* (36 percent)
    - *Third party mobile apps* (34 percent)
    - *Agency branded mobile apps* (26 percent)

[5] This *TSP* percentage (13 percent) is based on all transit agencies for the purposes of comparing ITS across all modes. However, *TSP* was asked of a subset of transit agencies operating fixed route bus, flexible route bus, or light rail/streetcar service. Of these 345 transit agencies, 17 percent reported use of *TSP*.

[6] This *CBTC* percentage (2 percent) is based on all transit agencies for the purposes of comparing ITS across all modes. However, CBTC was asked of a subset of transit agencies operating heavy or rapid rail, commuter rail, or light rail/streetcar service. Of these 26 transit agencies, 15 agencies reported use of *CBTC*.

[7] Fixed route services surveyed include fixed route bus, flexible route bus, heavy or rapid rail, commuter rail, light rail or streetcar, and ferry.

A majority of transit management agencies provide an open data feed or plan to do so, mostly for fixed route services. Among those transit agencies with an open data feed, large majorities provide static information and real-time information to the public.[8]

- Forty-two (42) percent of surveyed transit management agencies *provide an open data feed*, while 20 percent are *working on providing* an open data feed.
- Of the transit management agencies providing the open data feed, nearly all provide information about their *fixed route service* (93 percent), and a large majority provide *static information* (89 percent) and *real-time information* (81 percent).

Cash and physical tickets/tokens/vouchers are the two most commonly used fare media among surveyed transit management agencies, and less than half of transit agencies report use of electronic fare payment (EFP).

- A large majority of transit management agencies accept *cash* (83 percent), and nearly two thirds use *physical tickets/tokens/vouchers (i.e., no embedded technology)* (61 percent) to access the transit system. Other fare media used by less than half of surveyed transit agencies include:
  - *Mobile apps* (29 percent)
  - *Agency branded or regional "smart cards"* (18 percent)
  - *Agency branded or regional magnetic stripe cards* (17 percent)
  - *Contactless credit/debit cards* (7 percent)
  - *Mobile wallet* (6 percent)

- About one fourth of surveyed transit management agencies indicated *free/no fare media required* (26 percent), which could apply to one or all modes/services offered by a transit agency.
  - These transit agencies are almost evenly split among those that reported only *free/no other fare media* (12 percent of transit agencies), and those that reported both *free/no fare media* and at least one other fare type (14 percent of transit agencies).

- Among all surveyed transit management agencies, 42 percent use *EFP*, with more than half planning to upgrade their fare media payment systems in the next five years (52 percent).

Just under one fifth of surveyed transit management agencies are partnering with mobility service providers, with microtransit partnerships being the most prevalent.

- Nearly one fifth of surveyed transit management agencies are partnering with *mobility service providers* (18 percent), and among those who are partnering, the common partnership types include:
  - *Microtransit* (47 percent)
  - *Ride-hailing/ridesourcing/ transportation network companies (*29 percent)
  - *Taxis* (27 percent)
  - *Bike-sharing* (24 percent)

[8] Static information remains the same over a period of time (e.g., transit schedule, service day, route, transit stop locations, etc.), while real time information provides live or near live vehicle and/or schedule information (e.g., service changes, schedule adherence, arrival and departure times, vehicle location, crowding, service disruptions, etc.).

A majority of transit management agencies have deployed at least one wireless telecommunication technology to enable their ITS, whereas a lower percentage of transit agencies deploy wired technologies.

- About two thirds of surveyed transit management agencies deploy at least one wireless telecommunications technology to enable ITS (64 percent), with the most common wireless telecommunications including:
  - *Cellular (LTE-4G)* (47 percent)
  - *Wi-Fi* (37 percent)
  - *5G New Radio and small cell infrastructure* (24 percent)

- A lower percentage of transit management agencies deploys wired telecommunication technologies to enable ITS (43 percent). Nearly one third deploy *fiber-optic cable* (31 percent), and less than 11 percent deploy the other surveyed wired technologies.

- However, 24 percent of transit management agencies reported that they *don't know* what telecommunications technology their agency has deployed.

Emerging technologies, such as connected vehicles (CV) and automated vehicles (AV), are being tested or deployed by relatively few of the surveyed transit management agencies, and only a limited number of transit agencies report they are planning to deploy these emerging technologies.

- Overall, 5 percent of surveyed transit management agencies are *developing, testing, or deploying CV* technologies, and 10 percent are *planning for CV*.

- Similarly, 7 percent of transit management agencies reported *leading* (2 percent) or *supporting AV testing or deployment* (5 percent).

The most common ITS standards or specifications for transit management agencies are the General Transit Feed Specification (GTFS) and GTFS Real-Time.

- Overall, 42 percent of surveyed transit management agencies implement at least one ITS standard or specification. The most common include:
  - *General Transit Feed Specification (GTFS)* (33 percent)
  - *GTFS Real-Time* (26 percent).
- However, one fifth of transit management agencies reported *don't know* (20 percent), and more than one third reported that *no ITS standards and specifications are implemented* (35 percent).

While more than one third of transit management agencies reported they plan to expand/upgrade their existing ITS or invest in new ITS, a similar percentage reported they don't know their agencies' plans.

- More than one third of transit management agencies plan to *expand or upgrade their existing ITS* in the next three years (39 percent), yet a similar percentage reported *don't know* (35 percent).

- Similarly, 34 percent of transit management agencies reported plans to *invest in new or emerging ITS* in the next three years, while 38 percent reported *don't know*.

Transit management agencies in large urban areas are significantly more likely to deploy both mainstream and emerging ITS compared to transit agencies in small urban and rural areas.

- Transit management agencies in large urban areas are significantly more likely than transit agencies in small urban areas and transit agencies in rural areas to do the following:
    - Deploy *MDT* (70 percent large urban compared to 60 percent small urban and 55 percent rural)
    - Deploy *MMS* (36 percent large urban compared to 20 percent small urban and 22 percent rural)
    - Deploy *TSP* (25 percent large urban compared to 8 percent small urban and 1 percent rural)
    - Engage in *AV activity* (15 percent large urban compared to 3 percent small urban and 2 percent rural)

In some cases, transit management agencies in both large urban areas and small urban areas deploy ITS at significantly higher rates than transit agencies in rural areas.

- Compared to transit management agencies in rural areas, transit agencies in large urban areas and small urban areas are more likely to *use EFP* (56 percent large urban and 46 percent small urban compared to 24 percent rural).

- Transit management agencies in large urban areas and small urban areas are both significantly more likely than transit agencies in rural areas to disseminate real-time information to the public using the following methods:
    - *Websites* (68 percent large urban and 65 percent small urban compared to 48 percent rural)
    - *Social media* (56 percent large urban and 62 percent small urban compared to 44 percent rural)
    - *Third party mobile apps* (47 percent large urban and 37 percent small urban compared to 16 percent rural)
    - *Agency branded mobile apps* (34 percent large urban and 31 percent small urban compared to 12 percent rural).

For some ITS, deployment is significantly different across all three area types.

- Transit management agencies in large urban areas deploy *APC* (60 percent) at significantly higher rates than transit agencies in small urban areas (38 percent) and rural areas (10 percent). Transit agencies in small urban areas also deploy APC at significantly higher rates than those in rural areas.

- Transit management agencies in large urban areas (59 percent) are significantly more likely than transit agencies in small urban areas (46 percent) to *provide an open data feed,* and both are significantly more likely to do so than transit agencies in rural areas (21 percent).

Among historically surveyed transit management agencies (i.e. agencies in previous ITS Deployment Tracking Surveys), ITS deployment continues to grow for a range of ITS technologies.

Among historically surveyed transit management agencies, it is possible to assess trends in ITS deployment because these agencies were surveyed in previous ITS Deployment Tracking Surveys. The trend data show that for these historically surveyed transit agencies in a subset of large metropolitan areas, there is statistically significant growth since 2020 in the deployment/use of the following ITS:

- **Transit Vehicle ITS:** *MMS* (from 34 percent in 2020 to 58 percent in 2023 across all modes), *TSP* (from 26 percent in 2016 to 45 percent in 2023 across all modes)

- **In-Vehicle Traveler Information:** *Dynamic electronic signage* (from 42 percent in 2020 to 78 percent in 2023)

- **Traveler information dissemination to public**: *websites* (from 72 percent in 2020 to 87 percent in 2023)

- **Open data feed***: provide an open data feed* (from 57 percent in 2020 to 76 percent in 2023)

- **Telecommunication technologies:** *5G New Radio and small cell infrastructure* (from 10 percent in 2020 to 38 percent in 2023)

- **Independent Travel for People with Disabilities:** *Trip reservation systems with ways to reserve trips that account for an individual's mobility needs* (44 percent in 2020 to 63 percent in 2023), i*ndoor navigation support (e.g., wayfinding beacons, digital mapping)* (from 5 percent in 2020 to 20 percent in 2023)

Conclusions

With the 2023 ITS Deployment Tracking Survey, the ITS JPO significantly expanded the geographic coverage of the Transit Management Survey to include smaller urban and rural areas in addition to the previously surveyed subset of large metropolitan areas, enabling the reporting of ITS deployment nationwide.

The survey found that a large majority of surveyed transit management agencies have deployed AVL and CADS on their vehicle fleets, and nearly two thirds have deployed MDT. With respect to other key ITS, 42 percent of surveyed transit agencies deploy EFP, and a majority are planning to upgrade their fare media systems. More than one third of transit agencies reported that they plan to expand or upgrade their current ITS, and a similar proportion indicated plans to invest in new ITS.

A large majority of surveyed transit management agencies provide real-time traveler information to the public and just over half deploy in-vehicle traveler information (i.e., automated voice announcements and/or dynamic electronic signage). Additionally, more than half of surveyed transit agencies currently provide or are working to provide an open data feed.

In general, transit management agencies in large urban areas (and in many cases those in smaller urban areas) tend to deploy ITS at higher rates than transit agencies in rural areas.

Among historically surveyed transit management agencies (i.e., transit agencies from a subset of large metropolitan areas), the trend data show increased deployment for several ITS technologies. With the next ITS Deployment Tracking Survey, it will be possible to assess ITS trends for the entire sample.

Chapter 1. Introduction

Purpose of the Report

This report summarizes the **Transit Management Survey** findings of the 2023 Intelligent Transportation Systems (ITS) Deployment Tracking Survey. The United States Department of Transportation (USDOT) Intelligent Transportation Systems Joint Program Office (ITS JPO) administers these surveys to track ITS deployment. The mission of the ITS JPO is to lead collaborative and innovative research, development, and implementation of ITS to improve the safety and mobility of people and goods. The ITS JPO's ITS Deployment Evaluation Program administers the ITS Deployment Tracking Survey with assistance from USDOT's John A. Volpe National Transportation Systems Center (Volpe).

The ITS JPO has been administering the ITS Deployment Tracking Survey to a subset of large metropolitan areas in the United States since 1999. **With the most recent 2023 ITS Deployment Tracking Survey, a new survey methodology was implemented, which greatly expanded the geographic coverage of the ITS Deployment Tracking Survey to include smaller urban[9] and rural areas in addition to large metropolitan areas.** The change in methodology reflects a need to (1) obtain a better understanding of ITS deployment nationwide and (2) obtain ITS deployment information from communities of all sizes, not just from large metropolitan areas.

The ITS JPO and other stakeholders may use the resulting data to inform strategic planning and investment decisions, identify opportunities to accelerate the deployment of ITS, establish baseline deployment for newer ITS technology deployments, document shifts in ITS deployment patterns and ITS market evolution, and identify opportunities for knowledge transfer and technical assistance.

Background

Since 1999, the ITS JPO has used the ITS Deployment Tracking Survey to collect information about the extent of ITS deployment in a subset of large metropolitan areas across the United States. The surveys were, and continue to be, administered to State and local transportation agencies, including freeway, arterial, and transit management agencies. The ITS JPO initially developed the ITS Deployment Tracking Survey to track and manage progress made toward a ten-year ITS deployment goal announced by the U.S. Secretary of Transportation in 1996.[10] The Secretary's goal focused on tracking ITS deployment rates in large metropolitan areas. At the time, ITS was a relatively new set of technologies that tended to be deployed in large metropolitan areas to address congestion, safety, and other transportation issues experienced most acutely by the nation's largest cities. The surveys were conducted every 1-2 years during the initial ten-year goal measurement period.

[9] This term is used to refer to small metropolitan and micropolitan areas.

[10] U.S. Transportation Secretary Peña's goal stated that the 75 largest metropolitan areas should be outfitted with an integrated ITS infrastructure in the next ten years.

Following the ten-year goal period, which ended around 2007, the surveys were conducted less frequently, on a roughly 3-year cycle, and continued to monitor the deployment of ITS in a subset of large metropolitan areas across the country.

However, in the years following the goal period, it became clear that the ITS Deployment Tracking Survey no longer provided the most complete picture of the extent and nature of ITS deployment in the U.S. During this time, ITS technologies became more mainstream and, as such, were increasingly deployed outside of large metropolitan areas. The ITS JPO's Benefits, Costs, and Lessons Learned databases[11] showed an increasing number of examples of ITS deployments in smaller urban (i.e., small metropolitan and micropolitan) and rural areas.

The ITS JPO's 2019 **Small Urban and Rural Transit Provider Survey** further demonstrated the high rates of deployment of some ITS technologies among smaller urban and rural transit providers.[12] Based on these trends, the ITS JPO determined that an update to the survey methodology was necessary to address these important gaps in survey coverage and better reflect a fuller range of communities and situations where ITS technologies are deployed.

The ITS JPO's ITS Deployment Evaluation Program began initial investigations into the development of a new survey approach and methodology following the 2016 ITS Deployment Tracking Survey. At that time, the ITS Deployment Evaluation Program began exploring potential sampling approaches with input from stakeholders, subject matter experts (SMEs), and survey statisticians. In 2022, a **Pilot Survey** of State Departments of Transportation (DOT) and smaller urban and rural local arterial management agencies was conducted to test the new sampling approach. The **Pilot Survey** showed that smaller urban and rural local arterial management agencies were willing and able to participate in the ITS Deployment Tracking Survey.

The ITS JPO decided to execute its new survey methodology starting with the 2023 ITS Deployment Tracking Survey, thereby expanding its geographic coverage to include smaller urban and rural areas in addition to large metropolitan areas. The methodology for each survey type (Freeway Management, Arterial Management, Transit Management) is highlighted below:

- **Transit Management Survey**
  - Surveys a random sample of transit management agencies (also referred to as transit agencies in this report) across large urban, small urban and rural areas from the National Transit Database (NTD).[13,14]

[11] For more information about the ITS Benefits, Costs, and Lessons Learned Databases, see: https://www.itskrs.its.dot.gov/

[12] See: https://www.itskrs.its.dot.gov/deployment/othersurveys_surta_2019.

[13] The NTD is a legislative requirement (see Title 49 U.S.C. 5335(a)). This statute requires that recipients or beneficiaries of grants from the Federal Transit Administration (FTA) under the Urbanized Area Formula Program (§5307) or Other than Urbanized Area (Rural) Formula Program (§5311) submit data to the NTD. See: https://www.transit.dot.gov/ntd.

[14] Detailed information about the Transit Management Survey methodology can be found in Chapter 2. For detailed information about the survey methodology for the Freeway Management Survey and Arterial Management Survey, please see each of the respective reports. (see: https://www.itskrs.its.dot.gov/deployment/2023DTS).

- **Freeway Management Survey**
  - Surveys all State DOT districts and toll authorities that manage freeways.

- **Arterial Management Survey (two distinct populations)**
  - **Arterial State DOT Survey**: surveys all State DOT districts that manage arterial roads.

  - **Arterial Local Survey**: surveys a random sample of places and counties of varying population sizes (i.e., across metropolitan, micropolitan and rural areas) that manage arterial roads.

In addition to providing more comprehensive data about the extent of ITS deployment nationwide, the new ITS Deployment Tracking Survey methodology positions the ITS JPO to also baseline and, over time, track the growing pipeline of ITS projects that are currently being (and will be) deployed as a result of the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL).[15] Grant programs established under the BIL provide numerous funding opportunities for a wide variety of projects in communities of all sizes and location types. Several of the BIL grant programs offer opportunities to fund deployment of ITS to help communities solve transportation challenges.

[15] See: https://www.transportation.gov/bipartisan-infrastructure-law.

Chapter 2. Methodology

This chapter describes the process for implementing the new ITS Deployment Tracking Survey methodology for the Transit Management Survey.

Sample Development

For the Transit Management Survey, a stratified random sampling[16] was conducted. The survey team used the NTD to identify qualified transit agencies across the country and to create a sampling frame.

The sampling frame of transit management agencies was first restricted to public entities only. This was done by removing private-for-profit corporations as reported in the NTD's Organization Type field.[17] All other categories appear to be comprised of public transit agencies and are therefore included in the sampling frame. A fleet size of more than 10 vehicles operating in maximum service (VOMS) was set for transit agencies in rural and tribal areas.[18]

Prior to developing the transit sampling frame, the survey team determined that the largest transit management agencies (VOMS of 900 or greater) should be drawn with certainty (i.e., automatically included), referred to as "certainties" in this report. This decision to select certainties ensured that the largest transit agencies are included in the sample, as they are the most likely to be deploying a range of ITS, and it allows the survey to preserve some continuity with the historical ITS Deployment Tracking Survey data. The certainties, which included 30 transit agencies, were removed from the sampling frame prior to sample selection, because they were already selected to be in the sample with a probability of one.

The sampling frame was then stratified by large urban, small urban, and rural area types. In its Reporting Module field, the NTD reports transit agencies that are located in urban areas or rural areas or are tribal transit agencies.[19] Tribal transit agencies and transit agencies in rural areas were combined into the rural area type for the purposes of this survey.

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[16] Stratified random sampling is a type of probability sampling method that involves dividing a population into subgroups or strata based on certain characteristics and then selecting a random sample from each stratum. (See: https://researchmethod.net/stratified-sampling/)

[17] The "Private-for-Profit Corporations" organization type in the NTD identifies privately-owned intercity bus providers. This category was excluded from the survey population due to the ITS Deployment Tracking Survey's focus on public transit management agencies.

[18] The Government Accountability Office (GAO) used this criterion in its 2015 survey of small urban and rural transit providers (see: https://www.gao.gov/assets/gao-16-638.pdf). GAO based this threshold decision on discussions with industry associations and a survey pretest. The ITS JPO adopted this same eligibility criterion in its 2019 Small Urban and Rural Transit Survey and the 2023 Transit Management Survey.

[19] Urban transit providers were identified as recipients of FTA's Urbanized Area Formula Grants, while rural transit providers and Tribes were identified as sub-recipients of the FTA's Non-urbanized Area Formula Grants (see: https://www.transit.dot.gov/ntd).

Urban transit agencies were split into transit agencies in large urban areas and small urban areas using the NTD's Urbanized Area Population field. For the purposes of this survey, transit agencies in large urban areas were determined to be those located in urban areas with populations greater than 200,000, while transit agencies in small urban areas were those located in urban areas with populations of 200,000 or less. This process created three strata within the sampling frame as shown in Table 1.

Table 1. Stratification of Transit Agencies

Strata	Number of Non-Certainty Transit Agencies	Percent of Total
Large Urban Transit Providers	544	39.5%
Small Urban Transit Providers	329	23.9%
Rural Transit Providers	503	36.6%
Total	**1,376**	**100%**

Using a target of 325 non-certainty survey completes, stratified sampling with proportional allocation was used to estimate the initial number of non-certainty completes required for each stratum to reach the target response rate for representation. This target was set so that there would be sufficient sample in key subgroups to obtain estimates that represent the population with a 95 percent confidence interval and an expected margin of error (MOE) of +/-0.10.

The survey team determined that a greater number of small urban subgroup completes was desired than what was proportionally allocated. The adjustments produced an updated sampling frame referred to as the adjusted, expected non-certainty completes. Differential response rates for each stratum, based on the 2020 ITS Deployment Tracking Survey and the 2019 Small Urban and Rural Transit Survey, were applied to the distribution of adjusted, expected non-certainty completes, producing the (rounded) total non-certainty areas to be sampled (n=710).

Contact Development

Following the enumeration of all transit management agencies, the survey team identified a survey contact for each transit agency. This process involved online research to find an appropriate point of contact, such as an executive director or operations manager, as well as the collection of other relevant information (e.g., whether the transit agency appeared to manage ITS).

Using the contact information available (either a specific contact or general transit agency phone number or email), the survey team reached out to every transit agency via email to describe the survey's purpose and eligibility criteria (i.e., transit agency must manage transit vehicles to be within the survey population) and to confirm the contact's suitability to respond to the survey. Those who did not respond to the initial email received up to four phone calls coupled with follow-up emails to identify a suitable point of contact.

Table 2 shows the results of the contact confirmation process for the 740 originally identified transit management agencies (30 certainties and 710 sampled). The survey team sent a survey to all eligible

transit agencies with contact information, including confirmed and unconfirmed contacts. Transit agencies with unknown contact information could not be sent a survey. Transit agencies which indicated “do not contact” to the survey team during contact confirmation also were not sent a survey.[20] Transit agencies that were deemed ineligible because they do not manage transit vehicles were removed from the sample.

The survey was sent to 721 transit management agencies (see the first two rows of Table 2). The 13 transit agencies that either had unknown contact information or indicated do not contact did not receive a survey invitation.

Table 2. Summary of Transit Agency Contact Confirmation

Sample Disposition (original sample= 740)	Count
Points of Contact Confirmed	656
Unconfirmed, but Contact Information on File	65
Unknown Contact Information	8
Do Not Contact	5
Ineligible	6

Source: USDOT

Data Collection and Processing

Survey Questionnaire

Key topics covered by the 2023 Transit Management Survey include transit modes operated, ITS adoption on transit modes, traveler information systems, agency partnerships, fare media, telecommunications, connected vehicles, automated vehicles, integrated corridor management, ITS for service planning, transportation demand management, independent travel for people with disabilities, ITS standards, ITS cybersecurity, and future deployment planning.

The 2023 Transit Management Survey is a modified version of the 2020 survey. One key change between 2020 and 2023 is that the questions about ITS coverage (i.e., number of transit vehicles covered by X technology) were simplified. Rather than asking about the number of fleet vehicles or transit facilities equipped with each ITS technology, transit agencies were asked to report on the percentage of fleet vehicles and transit facilities equipped with a technology using defined ranges.[21]

[20] For the purposes of calculating response rates, however, transit agencies with unknown contact information and agencies indicating do not contact were still deemed eligible and included in the eligible sample, as the survey team did not have enough information to classify them as ineligible.

[21] In the 2023 Deployment Tracking Survey, information on fleet coverage by transit ITS was gathered by mode using a single response question with six coverage ranges (0%, 1 to 24%, 25% to 49%, 50% to 74%, 75% to 99%, and 100%).

Another key change from the 2020 survey to the 2023 survey was the addition of several new questions on connected vehicles and automated vehicles, as these emerging technologies had not been asked in an ITS JPO survey effort since 2019.[22]

Other substantive changes to the questionnaire were largely driven by the input of SMEs. The full questionnaire, with new questions identified, is shown in Appendix C. In addition, minor modifications were made to some questions to improve clarity. New response options were also added to some questions, based on either common respondent input to open-ended responses ("Other") in the 2020 survey or SME input. Another noteworthy change is the increased use of definitions (via "hover boxes") for ITS technologies and other terms to assist respondents in filling out the survey.

Respondent Dashboard

An online personalized dashboard (Figure 1) was developed to administer the ITS Deployment Tracking Survey to each respondent. The online dashboard provided details on the survey effort, including information about the survey sponsor, frequently asked questions, and the survey contractor's privacy policy. The online dashboard also allowed respondents to download a PDF version of the survey questionnaire and included unique links to access their survey. If respondents exited the survey prior to completion, responses to any completed questions were saved and were accessible by respondents if they returned to the survey.

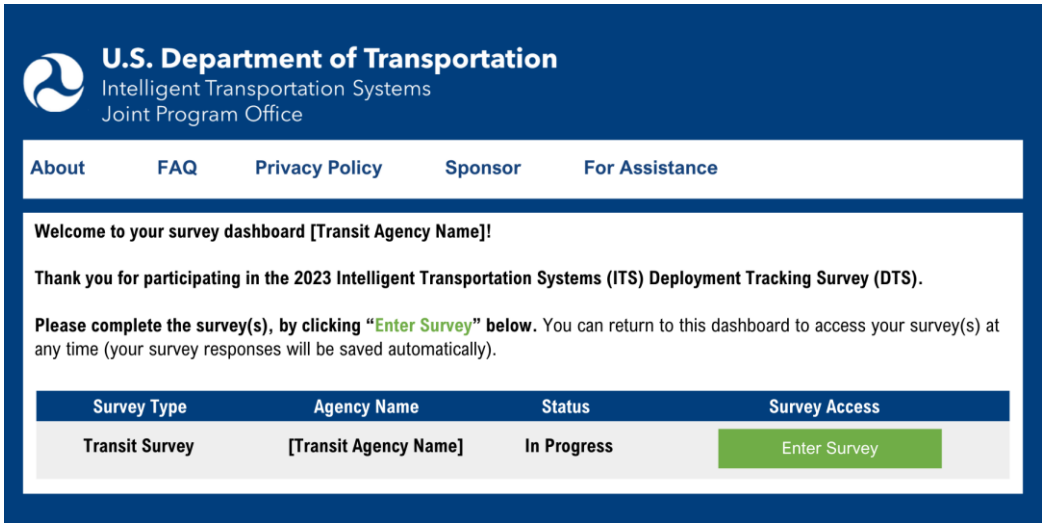


Figure 1. Example of Personalized Survey Dashboard

Survey Administration

To test the functionality of the survey process, including the online survey instruments and dashboard, the survey invitation was sent to a small subset of freeway, arterial, and transit management agencies (i.e., soft launch) on October 3, 2023, prior to the full launch of the ITS Deployment Tracking Survey. The full launch occurred on October 5, 2023. In total, the Transit Management Survey was sent to 721 transit

[22] See: https://www.itskrs.its.dot.gov/deployment/othersurveys_surta_2019.

agencies; however one of these transit agencies was deemed ineligible during survey administration because it did not manage transit vehicles. As a result, the final total eligible sample for the Transit Management Survey was 733.[23]

Multiple reminder efforts were undertaken to encourage survey response. Two rounds of reminder emails were sent in October 2023. Following these reminders, those who had not yet completed their assigned survey were contacted by phone up to three more times in November and December of 2023. Telephone reminders included a voicemail left for contacts who could not be reached by phone. Telephone reminders were also followed by an email to contacts. Additional telephone calls with email reminders were sent in mid-December targeting under-represented geographic areas. In early January 2024, emails were also sent to respondents whose surveys were "in progress," encouraging respondents to complete their survey.

The survey was closed on January 19, 2024. Of the 733 eligible transit management agencies, 464 transit management agencies completed the survey for a **response rate of 63 percent**.

Data Cleaning and Weighting

The survey data went through an extensive review and cleaning process and open-ended responses were reviewed and coded into existing response categories as appropriate. The survey team consulted with USDOT SMEs to ensure that write-in responses were accurately recoded if appropriate.

Following data cleaning, the data were weighted. The purpose of design weights is to account for the sample design used when selecting a sample. Design weights are calculated as the inverse of the probability of selection for each sampled unit. In most cases, a sample weighted using the design weights will match the characteristics of the population from which the sample was selected. The transit management agencies were selected for the sample using a stratified, proportional selection within strata sample design. Strata were formed by area type – large urban, small urban, and rural. Transit agencies with VOMS of 900 or greater were selected with certainty for the survey. These transit agencies were assigned weights of 1 and removed from further calculations.

For the remaining transit management agencies, the survey team calculated their selection probabilities by dividing the number sampled within each stratum by the total number of transit agencies within each stratum from the sample frame. Both the numerators and denominators were adjusted to remove the transit agencies selected with certainty.

After calculating the design weights, the survey team then examined nonresponse patterns. This involved statistical testing for differences between respondents and eligible nonrespondents on a set of characteristics known for both groups. In general, nonresponse was greatest among transit management agencies in large metropolitan areas. Transit agencies identified as ineligible were excluded from these analyses. Weights were adjusted to account for nonresponse within the sampling strata. This involved calculating adjustment factors in each of the strata cells, defined as the sum of the weights for the full

[23] Out of the 740 originally sampled transit management agencies, a total of seven 7 agencies were deemed ineligible either during contact confirmation or survey administration, leaving 733 eligible transit agencies. Transit agencies that indicated do not contact or for whom there was no contact information (n=13) were deemed eligible.

eligible sample divided by the sum of the weights for the respondents. In a final step, the weights were scaled to sum to the number of responding transit agencies for the survey.

Chapter 3. Transit Management Survey Findings

This chapter summarizes the results of the 2023 Transit Management Survey, which was distributed to transit management agencies (also referred to as transit agencies in this report).

Overview of Respondents

The responding transit management agencies comprise of public transit agencies that report to the NTD and that operate transit vehicles (with the additional qualification that transit agencies in rural areas operate more than 10 vehicles in the fleet). Transit management agencies can be categorized into the following area types:

- **Large urban areas** include transit management agencies located in urbanized areas with populations greater than 200,000.
- **Small urban areas** include transit management agencies located in urbanized areas with populations of 200,000 or less.
- **Rural areas** include transit management agencies located in rural areas or tribal transit agencies.

The weighted percentages, as well as the weighted number (WN) and unweighted number (UWN) of transit management agency respondents by area type are shown in Table 3.

Table 3. Respondents by Area Type

Statistical Area	Percent	WN	UWN
Large urban areas	41%	190	138
Small urban areas	23%	109	156
Rural areas	36%	166	170

Source: USDOT

Reporting Notes

The chapter is organized by ITS technologies and topics. In each section, findings are presented for all 2023 transit management agency respondents (i.e., a total of 464 respondents), where applicable. All findings are weighted based on the sampling rate for each individual stratum and nonresponse bias. In some cases, percentages presented are based on a subset of respondents who received the question due to skip logic[24] in the survey. The 2023 survey question number and the number of respondents for each question are referenced at the bottom of each figure. In cases of a reduced base, both weighted (WN) and unweighted (UWN) numbers of respondents are shown (i.e., WN=#, UWN=#), while the percentages shown within the figures are all based on weighted data.

In some cases, respondents chose not to respond to a question. These non-responses are referred to as "missing" responses and are identified either in the figure, at the bottom of the figure, or in the Appendix.

Subgroup findings are also presented where applicable. These analyses highlight significant differences by area type, comparing the responses of transit management agencies serving larger urban areas, small urban areas, and rural areas.

In comparing differences across subgroups, significance testing was performed at a significance level of 0.05, with a 95 percent confidence interval.

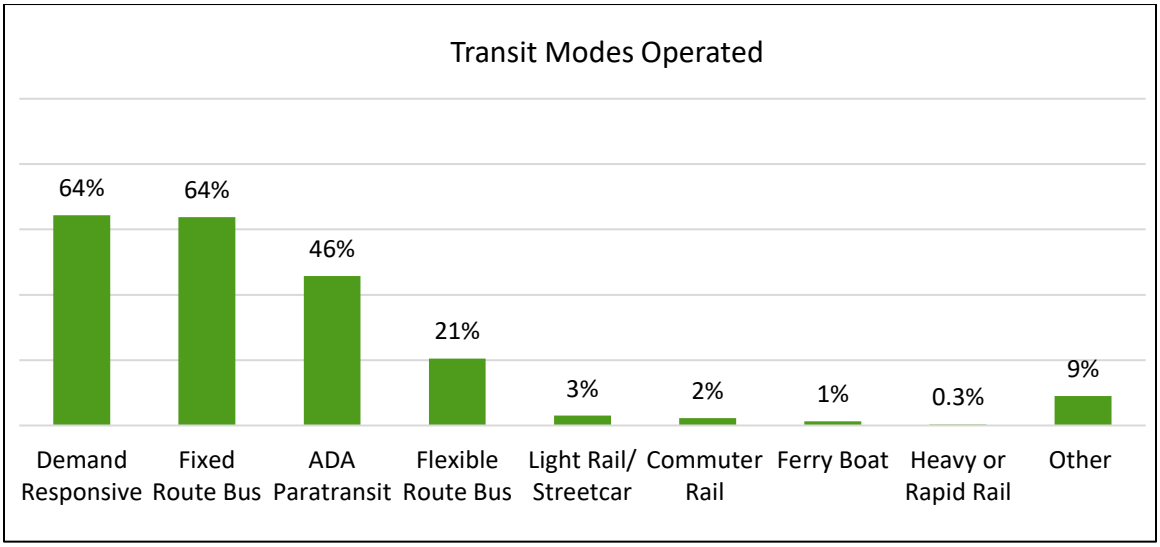
[24] Skip logic is survey programming that automatically skips respondents past one or more questions based on their response to a previous question. For example, if an agency does not operate fixed route bus service, they would skip out of the series of questions that ask about transit ITS deployment on fixed route buses.

Transit Modes

The 464 transit management agencies responding to the 2023 Transit Management Survey provide a representative look at the transit modes operated and transit ITS deployed across the country.

Figure 2 shows that nearly two thirds of responding transit management agencies operate *demand responsive* service (64 percent), and the same percentage operate *fixed route bus* service (64 percent). Close to half of responding transit agencies operate *ADA complementary paratransit* service (46 percent) and about one fifth operate *flexible route bus* service (21 percent), which was a new response category in 2023.[25]

Light rail/streetcar, commuter rail, heavy or rapid rail, or ferry boat were each reported by less than 5 percent of respondents. Nine (9) percent of respondents entered a response in the *other service* category. Notable write-in categories include: microtransit (n=11), commuter service (n=7), vanpool (n=4), shuttle (n=3), rideshare (n=3), and medical transportation (n=3).



2023 Q1; (n=464, 0% missing) *Source: USDOT*

Figure 2. Transit Modes Operated

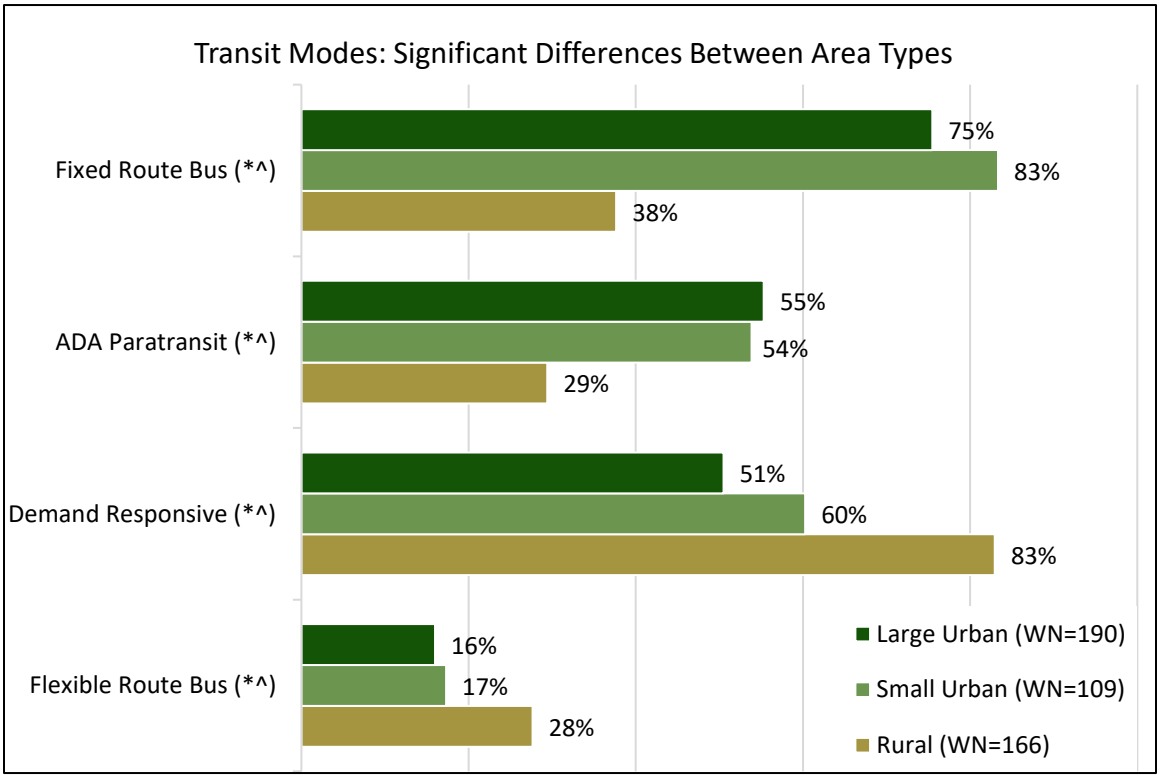
Additional analysis found that, in total, 74 percent of responding transit management agencies provide bus service (fixed and/or flexible): 53 percent provide only *fixed route bus service*, 11 percent provide both *fixed route* and *flexible route* service, and 10 percent provide only *flexible route* service.

[25] The number of agencies reporting ADA complementary paratransit does not match the number reporting fixed route bus service; however, an agency may have a fully accessible system and not require additional ADA complementary paratransit service. An agency's service area also may be covered by ADA complementary paratransit through partnerships, regional ADA complementary paratransit service, or other arrangements.

Figure 3 shows the significant differences in the operation of transit modes by area type. A large majority of transit management agencies in large urban areas (75 percent) and small urban areas (83 percent) operate *fixed route buses*, which is significantly higher compared to transit agencies in rural areas (38 percent).

About half of transit agencies in large urban areas (55 percent) and small urban areas (54 percent) operate *ADA complementary paratransit,* which is significantly higher than transit agencies in rural areas (29 percent).

In contrast, transit management agencies in rural areas (83 percent) are significantly more likely than transit agencies in large urban areas (51 percent) and small urban areas (60 percent) to operate *demand responsive* service. Transit agencies in rural areas (28 percent) are also more likely to operate *flexible route buses* than transit agencies in large urban areas (16 percent) and small urban areas (17 percent).[26]



2023 Q1; (Large Urban UWN = 138, Small Urban UWN =156, Rural UWN =170) *Source: USDOT*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies.

Figure 3. Transit Modes: Significant Differences Between Area Types

[26] Other modes not included in the subgroup analysis due to small sample sizes are light rail/streetcar, commuter rail, heavy or rapid rail (including subway), and ferry boats. These modes are primarily operated by transit agencies in large urban areas.

Transit ITS Adoption Across Modes

This section presents results for transit ITS adoption across modes. The results show the percentage of agencies that have equipped at least a portion of their revenue vehicles with each transit ITS technology.[27]

Figure 4 shows across all transit modes, 81 percent of surveyed transit management agencies deploy *automatic vehicle location (AVL)*, 70 percent deploy c*omputer-aided dispatch and scheduling (CADS),* and 62 percent deploy *mobile data terminals (MDT).*[28] Lower adoption levels are seen for *automatic passenger counters (APC)* (37 percent) and *maintenance management systems (MMS)* (27 percent).

Mode-specific technologies, including *transit signal priority (TSP)* (13 percent) and *communications-based train control (CBTC)* (2 percent)[29] have the lowest levels of adoption.

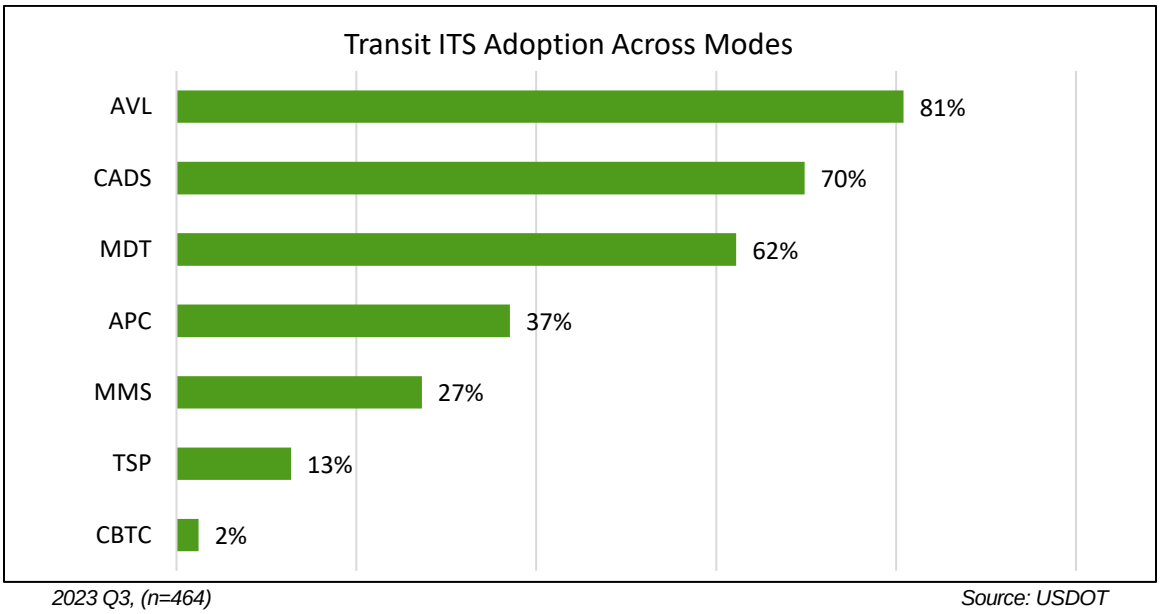


Figure 4. Transit ITS Adoption Across Modes

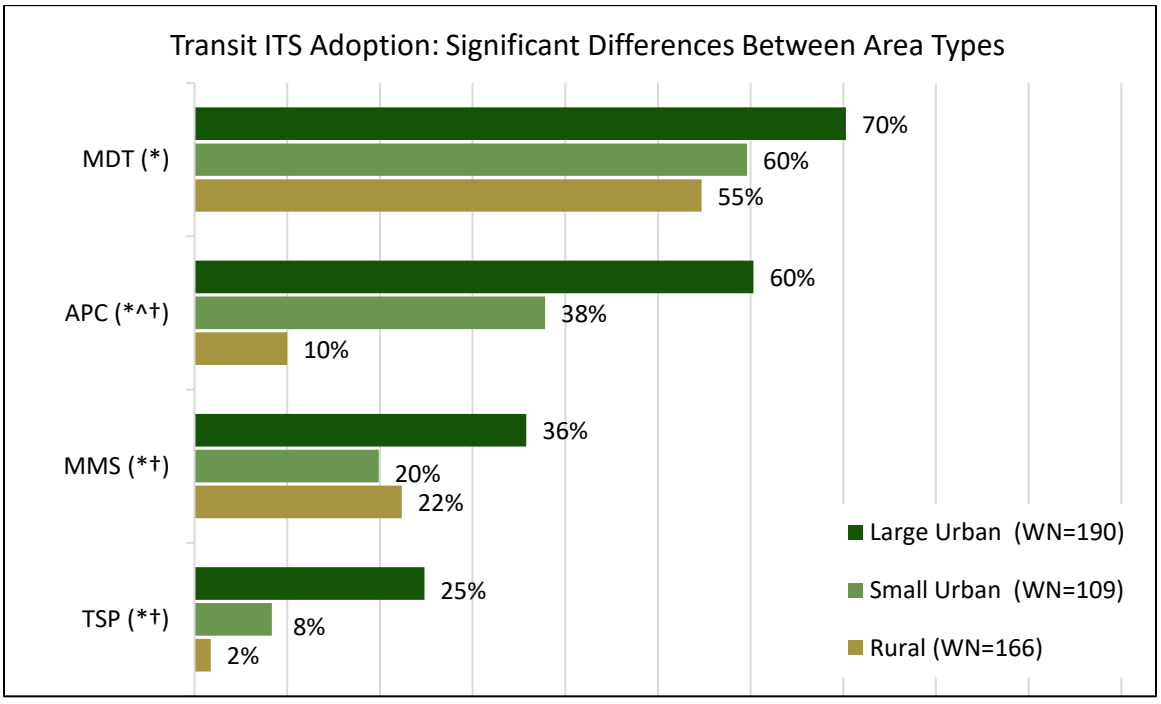
[27] Transit ITS adoption is derived from coverage questions that asked transit management agencies to report by mode the percentage of revenue vehicles equipped with each transit ITS technology. The results presented in this section show the percentage of transit agencies that have equipped at least a portion of their revenue vehicles (in any mode) with each surveyed ITS technology.

[28] Throughout the report, the term, mobile data terminals (MDT), is used to refer to the technology category encompassing mobile data terminals (MDT), mobile data computers (MDC), and transit control heads (TCH).

[29] A subset of transit management agencies operating fixed route bus, flexible route bus, or light rail/streetcar service were asked about TSP. Of these 345 transit agencies, 17 percent deploy TSP. A subset of transit agencies operating light rail/streetcar, heavy rail, or commuter rail service were asked about CBTC. Of these 26 transit agencies, 11 transit agencies deploy CBTC.

Figure 5 shows transit ITS adoption levels differ significantly by area type.

- Almost three fourths of transit agencies in large urban areas (70 percent) have deployed *MDT*, which is significantly higher than deployment by transit agencies in rural areas (55 percent).
- A majority of transit agencies in large urban areas (60 percent) have deployed *APC*, which is significantly higher than deployment by transit agencies in both small urban areas (38 percent) and rural areas (10 percent). Transit agencies in small urban areas are also significantly more likely to deploy *APC* than rural areas.
- Over one third of transit agencies in large urban areas (36 percent) deploy *MMS*, which is significantly higher than deployment by transit agencies in small urban areas (20 percent) and rural areas (22 percent).
- One fourth of transit agencies in large urban areas (25 percent) deploy *TSP*, which is significantly higher than transit agencies in both small urban areas (8 percent) and rural areas (2 percent).



2023 Q3; (Large Urban UWN = 138, Small Urban UWN =156, Rural UWN =170) *Source: USDOT*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

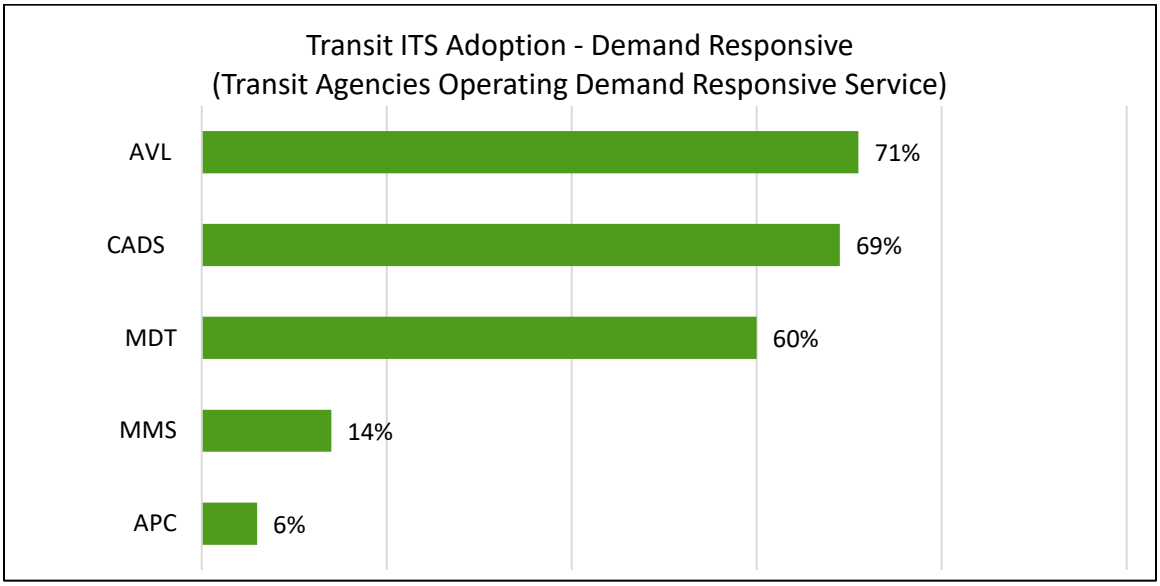
Figure 5. Transit ITS Adoption: Significant Differences Between Area Types

Transit ITS Adoption by Transit Mode

This section reports mode-specific transit ITS technology adoption rates and fleet coverage levels. Findings are presented for the three most common modes: demand responsive, fixed route bus, and ADA complementary paratransit. Transit ITS adoption on other surveyed transit modes is not reported due to small sample sizes.

Demand Responsive Service

Figure 6 shows that of the 305 transit management agencies that reported operating demand responsive service, 71 percent deploy *AVL*, 69 percent deploy *CADS*, and 60 percent deploy *MDT* on at least a portion of their fleet. Fewer transit agencies deploy *MMS* (14 percent) and *APC* (6 percent) on their demand responsive fleets.



2023 Q3; (WN=299, UWN =305) *Source: USDOT*

Figure 6. Transit ITS Adoption - Demand Responsive (Transit Agencies Operating Demand Responsive Service)

Table 4 shows surveyed transit management agencies operating demand responsive service in large urban areas (11 percent) are significantly more likely than transit agencies in rural areas (3 percent) to deploy *APC* on demand responsive vehicles, whereas *MMS* is significantly more likely to be deployed by transit agencies in rural areas (19 percent) compared to transit agencies in large urban areas (7 percent).

Table 4. Transit ITS Adoption on Demand Responsive Service (Transit Agencies Operating Demand Responsive Service): Significant Differences Between Area Types

Technology	Large Urban (WN=96; UWN=70)	Small Urban (WN=65; UWN=94)	Rural (WN=137; UWN=141)
APC*	11%	4%	3%
MMS*	7%	14%	19%

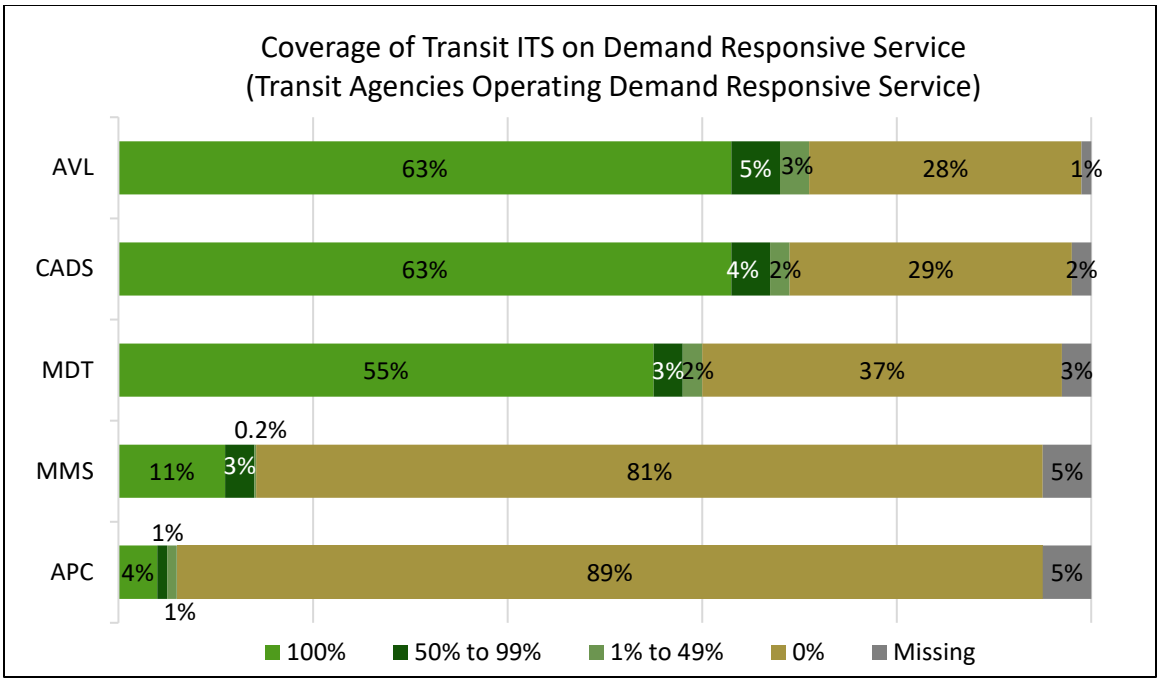
** statistically significant difference between large urban and rural transit agencies* *Source: USDOT*

Demand Responsive Fleet Coverage

In addition to technology adoption levels, the 2023 Transit Management Survey provides information on fleet coverage. Coverage is defined as the percentage of fleet vehicles equipped with an ITS technology. Surveyed transit management agencies were asked to report the percentage of vehicles equipped with each applicable ITS technology using six coverage response categories. These coverage response categories were combined into four categories for reporting: 100 percent of vehicles, 50 to 99 percent of vehicles, 1 to 49 percent of vehicles, and 0 percent of vehicles.

Figure 7 shows the transit ITS coverage for the 305 transit management agencies operating demand responsive service.

- About three fourths of transit agencies operating demand responsive service deploy AVL on their fleet (71 percent). While 63 percent deploy AVL on *100% of vehicles*, 5 percent deploy AVL on *50% to 99%* of their vehicles, and 3 percent deploy AVL on *1% to 49%* of their vehicles.
- Similarly, 69 percent of transit agencies operating demand responsive service deploy CADS. While 63 percent deploy CADS on *100%* of their demand responsive vehicles, 4 percent deploy CADS on *50 to 99%* of their vehicles, and 2 percent deploy CADS on *1% to 49%* of their vehicles
- A majority of transit agencies operating demand responsive service deploy MDT (60 percent). While 55 percent deploy MDT on *100%* of their vehicles, 3 percent deploy on *at 50% to 99%* of their vehicles, and 2 percent deploy on *1% to 49%* of their vehicles.
- A small share of transit agencies deploy MMS on their demand responsive fleets (14 percent). Eleven (11) percent deploy on *100%* of vehicles, and 3 percent deploy MMS on a smaller portion of their fleet.
- Only 6 percent of transit agencies operating demand responsive service deploy APC. Four (4) percent deploy on *100%* of vehicles, and 2 percent deploy APC on a smaller portion of their fleet.

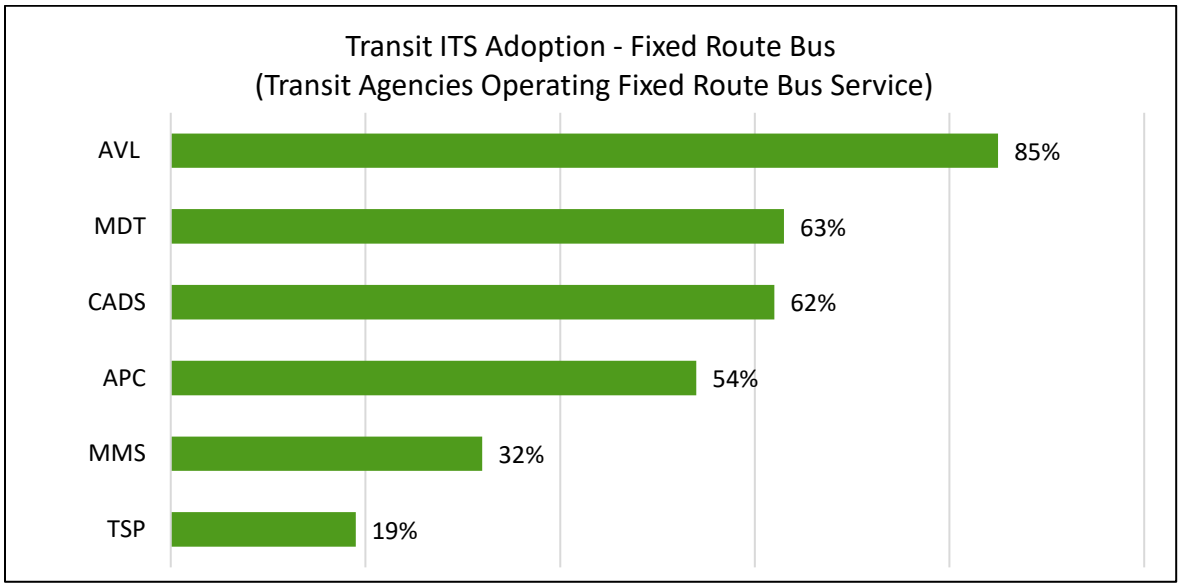


2023 Q3; (WN = 299, UWN = 305) *Source: USDOT*

Figure 7. Coverage of Transit ITS on Demand Responsive Service (Transit Agencies Operating Demand Responsive Service)

Fixed Route Bus

Figure 8 shows a large majority of the 299 transit management agencies operating fixed route bus service have adopted *AVL* (85 percent), and nearly two thirds use *MDT* (63 percent) and *CADS* (62 percent). About half of transit agencies deploy *APC* (54 percent), and fewer transit agencies use *MMS* (32 percent) or *TSP* (19 percent).



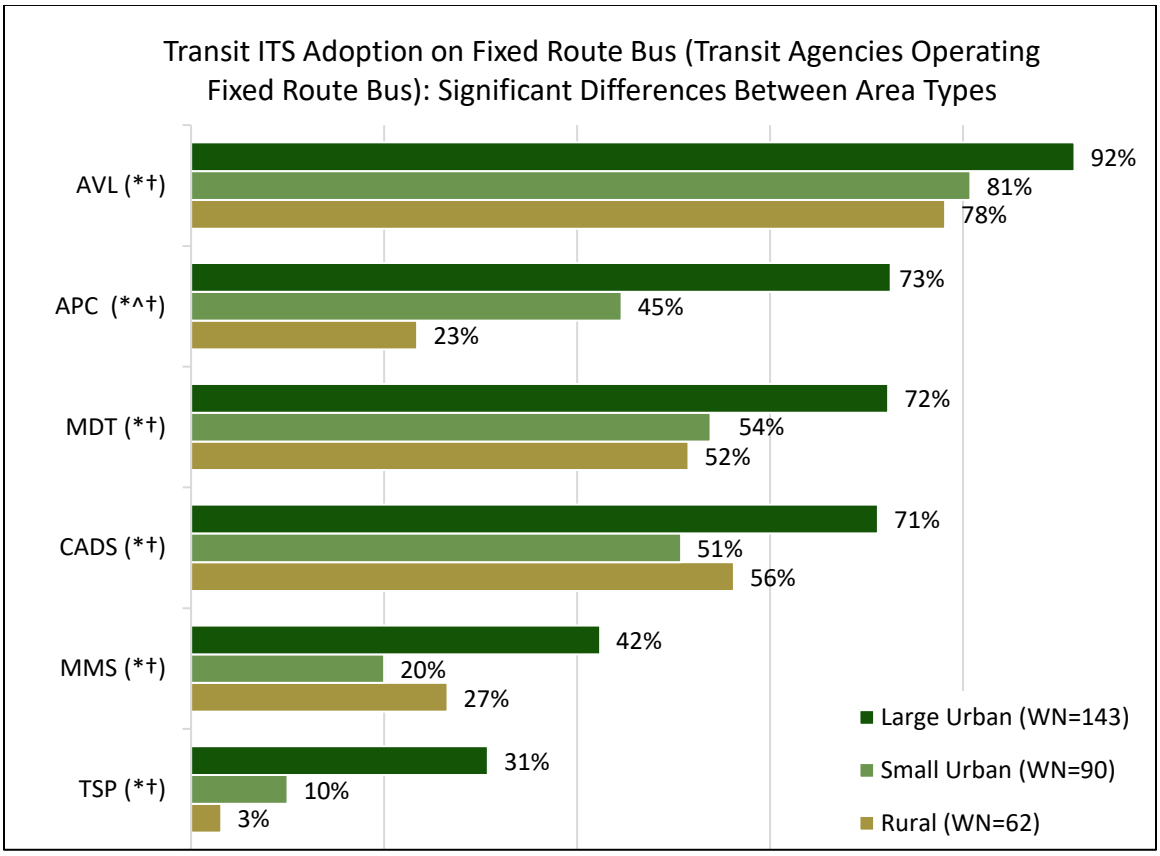
2023 Q3, (WN=296, UWN=299) *Source: USDOT*

Figure 8. Transit ITS Adoption - Fixed Route Bus (Transit Agencies Operating Fixed Route Bus)

Figure 9 shows significant differences in transit ITS deployment by area type for surveyed transit management agencies operating fixed route bus service.

- The deployment of *AVL* on fixed route buses is high for transit agencies in all area types. However, significantly more transit agencies in large urban areas (92 percent) deploy *AVL* compared to transit agencies in small urban areas (81 percent) and transit agencies in rural areas (78 percent).
- Transit agencies in large urban areas are significantly more likely to deploy *APC* (73 percent) than transit agencies in small urban areas (45 percent). Transit agencies in both large urban and small urban areas are significantly more likely to deploy *APC* than transit agencies in rural areas (23 percent).
- Almost three fourths of transit agencies in large urban areas deploy *MDT* (72 percent), which is significantly higher than both transit agencies in small urban areas (54 percent) and transit agencies in rural areas (52 percent).
- Similarly, almost three fourths of transit agencies in large urban areas (71 percent) deploy *CADS*, which is significantly higher than transit agencies in small urban areas (51 percent) and transit agencies in rural areas (56 percent).

- *MMS* is deployed by 42 percent of transit agencies in large urban areas, which is significantly higher than both transit agencies in small urban areas (20 percent) and transit agencies in rural areas (27 percent).
- Nearly one third of transit agencies in large urban areas deploy *TSP* (31 percent), which is significantly higher than both transit agencies in small urban areas (10 percent) and transit agencies in rural areas (3 percent).



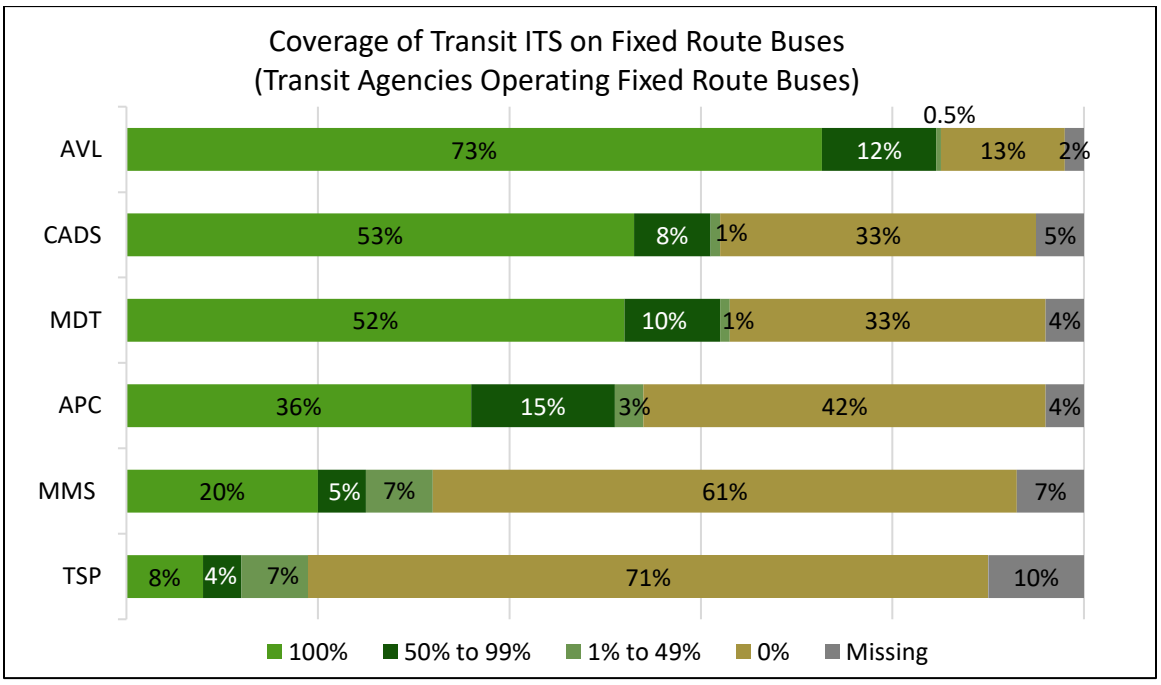
2023 Q3 (Large Urban UWN=105, Small Urban UWN=130, Rural UWN=64) *Source: USDOT;*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Figure 9. Transit ITS Adoption - Fixed Route Bus (Transit Agencies Operating Fixed Route Bus): Significant Differences Between Area Types

Fixed Route Bus Fleet Coverage

Figure 10 shows the transit ITS coverage for the 299 transit management agencies operating fixed route bus service.

- A large majority of transit agencies operating fixed route buses deploy AVL (85 percent), where 73 percent of transit agencies operating fixed route bus service deploy on *100%* of vehicles, 12 percent deploy on *50% to 99%*, and less than 1 percent deploy on *1% to 49%* of vehicles.
- A smaller majority of transit agencies deploy *CADS* on their fixed route buses (62 percent), where 53 percent deploy *100%* of vehicles, 8 percent deploy on *50% to 99%*, and 1 percent deploy on *1% to 49%* of their vehicles.
- Almost two thirds of transit agencies deploy *MDT* on their fixed route buses (63 percent), where 52 percent deploy on *100%* of vehicles, 10 percent deploy on *50% to 99%*, and 1 percent deploy on *1% to 49%* of vehicles.
- *APC* is deployed by more than half of the transit agencies operating fixed route bus service (54 percent), where 36 percent deploy on *100%* of vehicles, 15 percent deploy on *50% to 99%*, and 3 percent deploy on 1*% to 49%* of vehicles.
- Nearly one third of transit agencies deploy *MMS* on their fixed route buses (32 percent), where 20 percent deploy on *100%* of vehicles, 5 percent deploy on *50% to 99%*, and 7 percent deploy on 1*% to 49%* of vehicles.
- *TSP* is deployed by 19 percent of transit agencies operating fixed route buses. Eight (8) percent deploy on *100%* of vehicles, 4 percent deploy on *50% to 99%*, and 7 percent deploy on 1*% to 49%* of vehicles.



2023 Q3; (WN=296, UWN=299) *Source: USDOT*

Figure 10. Coverage of Transit ITS on Fixed Route Buses (Transit Agencies Operating Fixed Route Buses)

ADA Complementary Paratransit Service

Figure 11 shows transit ITS adoption levels for the 213 transit management agencies that operate ADA complementary paratransit service. This mode shows high adoption for *AVL* (77 percent) and *CADS* (70 percent). *MDT* is also deployed by a majority of transit agencies operating this service (64 percent). *MMS* (17 percent) and *APC* (9 percent) are less commonly deployed on ADA complementary paratransit vehicles.

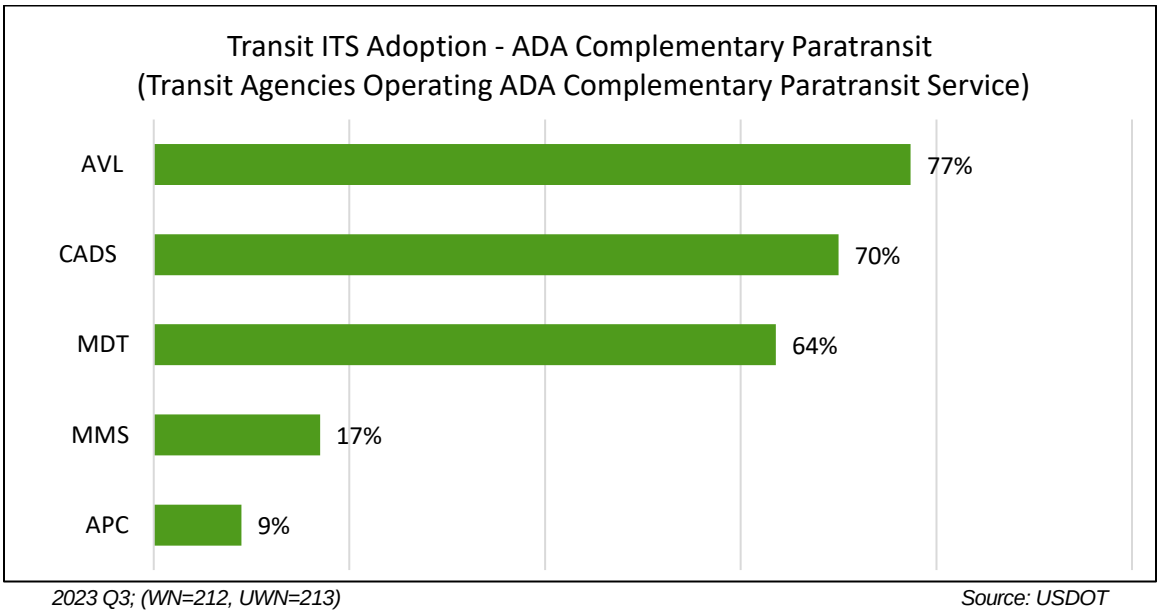


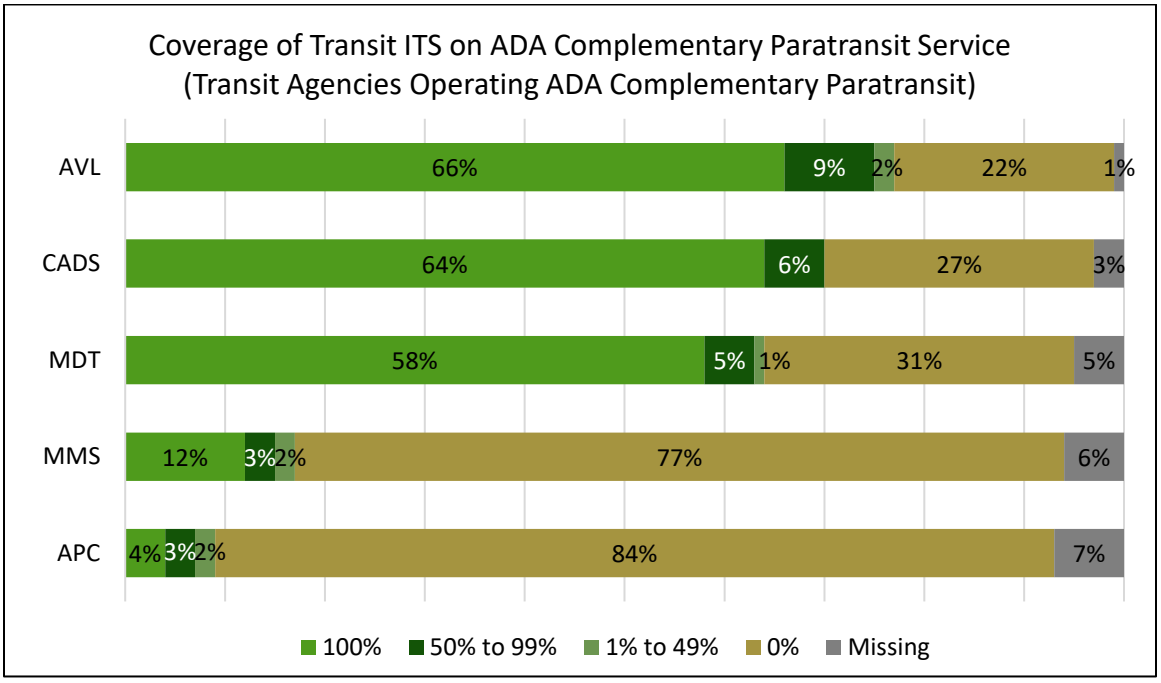
Figure 11. Transit ITS Adoption - ADA Complementary Paratransit (Transit Agencies Operating ADA Complementary Paratransit Service)

Among transit management agencies operating ADA complementary paratransit service, transit agencies in rural areas (26 percent) are significantly more likely than transit agencies in small urban areas (11 percent) to deploy *MMS*. There are no statistically significant differences in deployment by area type for other transit ITS technologies deployed on ADA complementary paratransit.

ADA Complementary Paratransit Fleet Coverage

Figure 12 show transit ITS coverage for the 213 transit management agencies operating ADA complementary paratransit service.

- A large majority of transit management agencies operating ADA complementary paratransit deploy *AVL* (77 percent). Two thirds deploy on *100*% of vehicles (66 percent), 9 percent deploy on *50% to 99%*, and 2 percent deploy on *1% to 49%* of their vehicles.
- Over two thirds of transit agencies deploy *CADS* (70 percent) on their ADA complementary paratransit vehicles. About two third deploy on *100%* of vehicles (64 percent), and 6 percent deploy on *50% to 99%* their vehicles.
- Nearly two thirds of transit agencies operating ADA complementary paratransit deploy *MDT* (64 percent). A majority deploy on *100%* of vehicles (58 percent), 5 percent deploy on *50 to 99%*, and 1 percent deploy on *1% to 49%* of their vehicles.
- Fewer transit agencies operating ADA complementary paratransit service deploy *MMS* (17 percent), with 12 percent deploying on *100%* of vehicles, 3 percent deploy on *50% to 99%*, and 2 percent deploy on *1% to 49%* of their vehicles.
- Just 9 percent of transit agencies operating ADA complementary paratransit deploy *APC* on their vehicles. Four (4) percent deploy on *100%* of vehicles, 3 percent deploy on *50% to 99%*, and 2 percent deploy on *1% to 49%* of their vehicles.



2023 Q3; (WN=212, UNW=213) *Source: USDOT*

Figure 12. Coverage of Transit ITS on ADA Complementary Paratransit Service (Transit Agencies Operating ADA Complementary Paratransit)

Traveler Information Systems

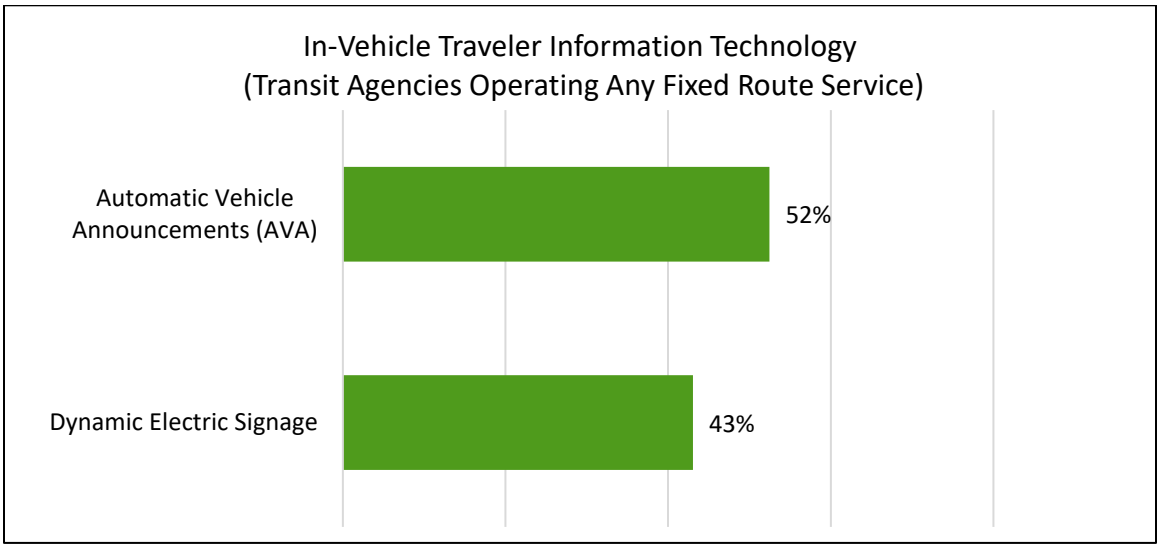
This section presents findings for real-time traveler information systems, including:

- In-vehicle traveler information
- Traveler information at transit facilities
- Real-time traveler information dissemination methods to the public
- Open data feed
- Trip planners

In-Vehicle Traveler Information

Figure 13 shows the use of in-vehicle traveler information technology among the 363 responding transit management agencies that operate any fixed route service (i.e., fixed or flexible route bus, heavy or rapid rail, commuter rail, light rail or streetcar, ferry).[30]

Overall, 55 percent of transit management agencies operating a fixed route service use at least one of the surveyed in-vehicle traveler information technologies. About half of these transit agencies deploy *automatic voice announcement systems* (*AVA)* (52 percent) in their vehicles, and 43 percent deploy *dynamic electric signage* in their vehicles.



2023 Q4; (WN=363, UWN=363) *Source: USDOT*

Figure 13. In-Vehicle Traveler Information Technology (Transit Agencies Operating Any Fixed Route Service)

[30] In-vehicle traveler information technology usage is derived from technology coverage questions. The results for AVA and dynamic electric signage reflect the percentage of transit agencies equipping at least a portion of their revenue vehicles (in any fixed route mode) with these technologies. See Appendix B. 2023 Transit Management Survey Additional Findings for detailed in-vehicle traveler information technology coverage results by mode.

Transit Facilities

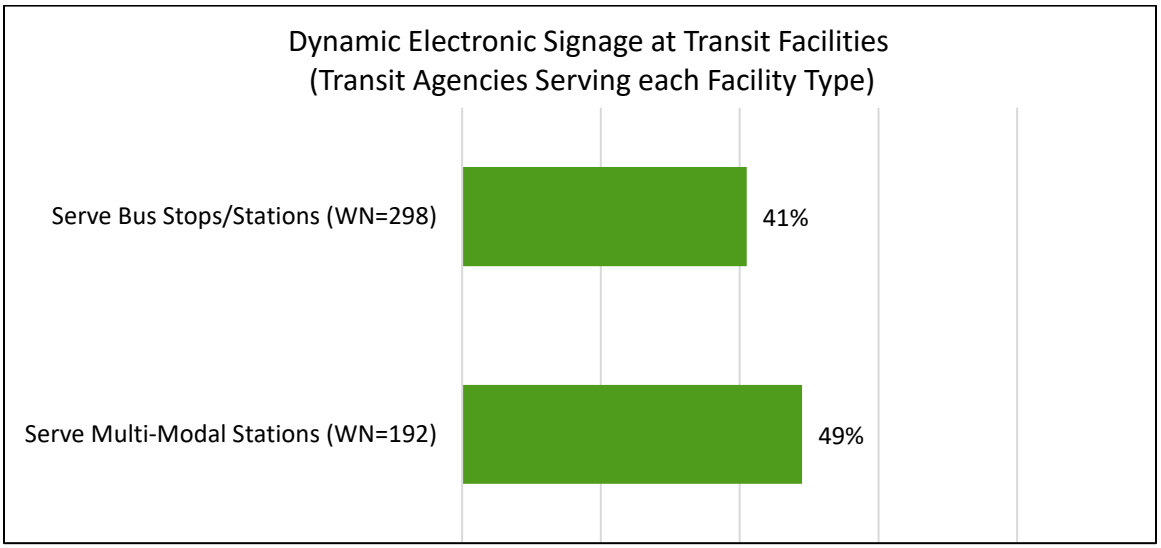
Of the 343 transit management agencies operating fixed or flexible route buses, 87 percent reported serving *bus stops/stations (including BRT stops/stations).* This varies significantly by area type as nearly all transit agencies in large urban areas (95 percent) and a large majority of transit agencies in small urban areas (89 percent) serve *bus stops/stations* compared to about three fourths (73 percent) of transit agencies in rural areas.

Of the 363 transit management agencies operating any fixed route service, 53 percent reported serving *multi-modal or transfer stations.* This also varies significantly by area type as over half of transit agencies in large urban areas (61 percent) and small urban areas (58 percent) operating fixed route service serve *multi-modal or transfer stations* compared to 35 percent of transit agencies in rural areas.

Traveler Information at Transit Facilities

Figure 14 shows that among the 298 transit management agencies serving bus stops/stations, 41 percent are providing real-time traveler information to the public at these facilities using *dynamic electronic signage*.

Of the 192 transit agencies serving multi-modal stations, 49 percent provide real-time traveler information at these facilities using *dynamic electric signage*.[31]



2023 Q6, Q8; bus stops/stations (UWN=297), multi-modal stations (UWN=193) *Source: USDOT*

Figure 14. Dynamic Electronic Signage at Transit Facilities (Transit Agencies Serving each Facility Type)

[31] Provision of real-time traveler information using dynamic electronic signage at transit facilities was derived from facility coverage questions. The results reflect the percentage of agencies serving the facility type that provide real-time traveler information to at least a portion of their stops or stations using dynamic electric signage.

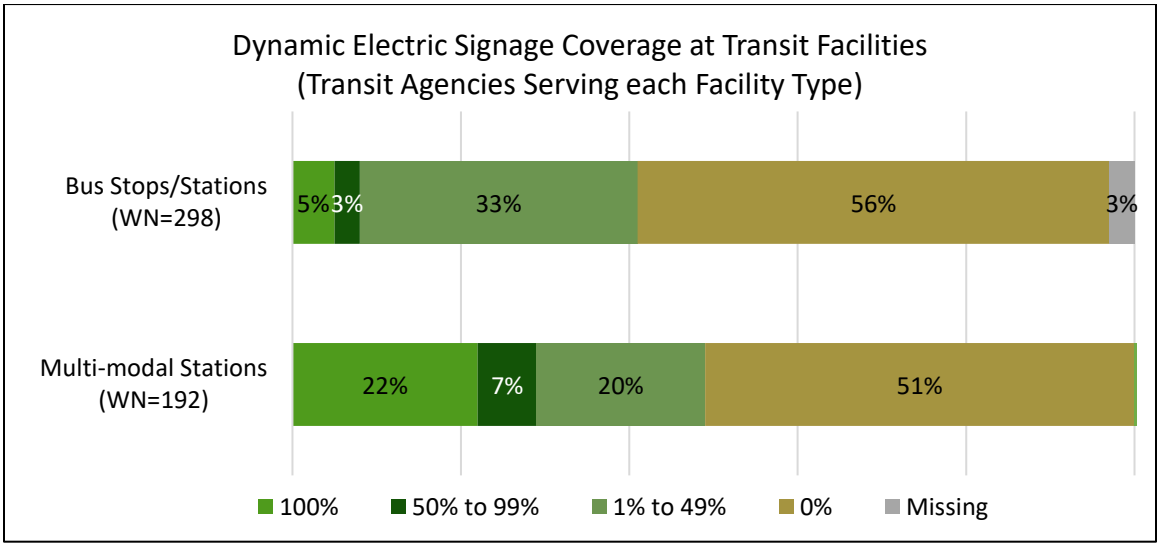
Transit management agencies serving bus stops/stations in large urban areas are significantly more likely to deploy *dynamic electric signage* (53 percent) than transit agencies serving bus stops/stations in small urban areas (32 percent) and in rural areas (25 percent).

Transit management agencies serving multi-modal stations in large urban areas are significantly more likely to deploy *dynamic electric signage* (64 percent) than transit agencies serving multi-modal stations in small urban areas (40 percent), which are both significantly more likely than transit agencies in rural areas (20 percent) to deploy *dynamic electric signage*.

Dynamic Electric Signage Coverage at Transit Facilities

Figure 15 shows the coverage of dynamic electric signage at facilities. Of the 297 transit management agencies serving bus stops/stations, 5 percent deploy dynamic electric signage at *100% of bus stops/stations*, 3 percent deploy at *50% to 99%*, and 33 percent deploy at *1% to 49%* of bus stops/stations. A majority of transit agencies serving bus stops/stations *do not deploy* any dynamic electric signage (56 percent).

About one fourth of the 193 transit management agencies serving multi-modal stations deploy dynamic electronic signage at *100% of multi-model stations* (22 percent), 7 percent deploy at *50% to 99%*, and 20 percent deploy at *1% to 49%* of multi-modal stations. About half of transit agencies serving multi-modal stations *do not deploy* dynamic electric signage (51 percent).



2023 Q6, Q8; bus stops/stations (UWN=297), multi-modal stations (UWN=193) *Source: USDOT*

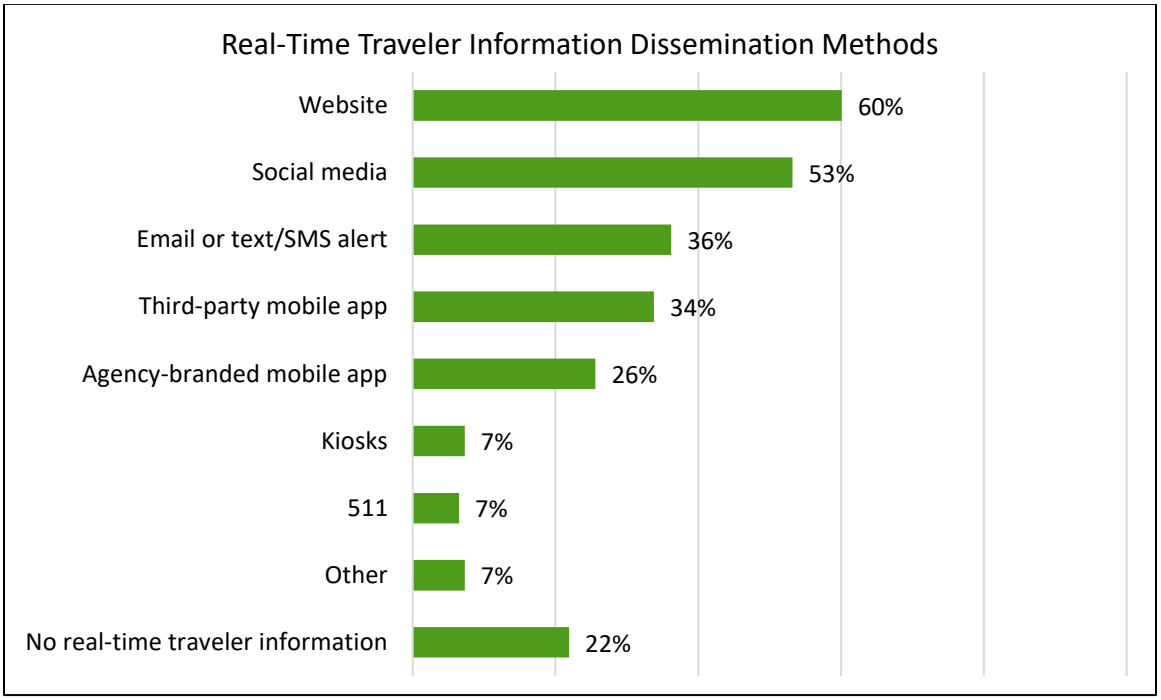
Figure 15. Dynamic Electric Signage Coverage at Transit Facilities (Transit Agencies Serving each Facility Type)

Real-Time Traveler Information Dissemination

Over three fourths of surveyed transit management agencies use at least one method to disseminate real-time traveler information to the public (78 percent), including service changes, transit schedule adherence, or arrival time and departure times. These transit agencies use an average of 3.0 different methods.

Figure 16 shows *websites* (60 percent) and *social media* (53 percent) are used by over half of transit management agencies to disseminate real-time traveler information. About one third of transit agencies use *email or text/SMS alert* (36 percent) and *third-party mobile applications* (34 percent), and about one fourth use *agency-branded mobile applications* (26 percent).

Less than 10 percent of transit agencies provide real-time traveler information through either *kiosks* or *511*. Twenty-two (22) percent of transit agencies reported *no real-time traveler information is disseminated*.



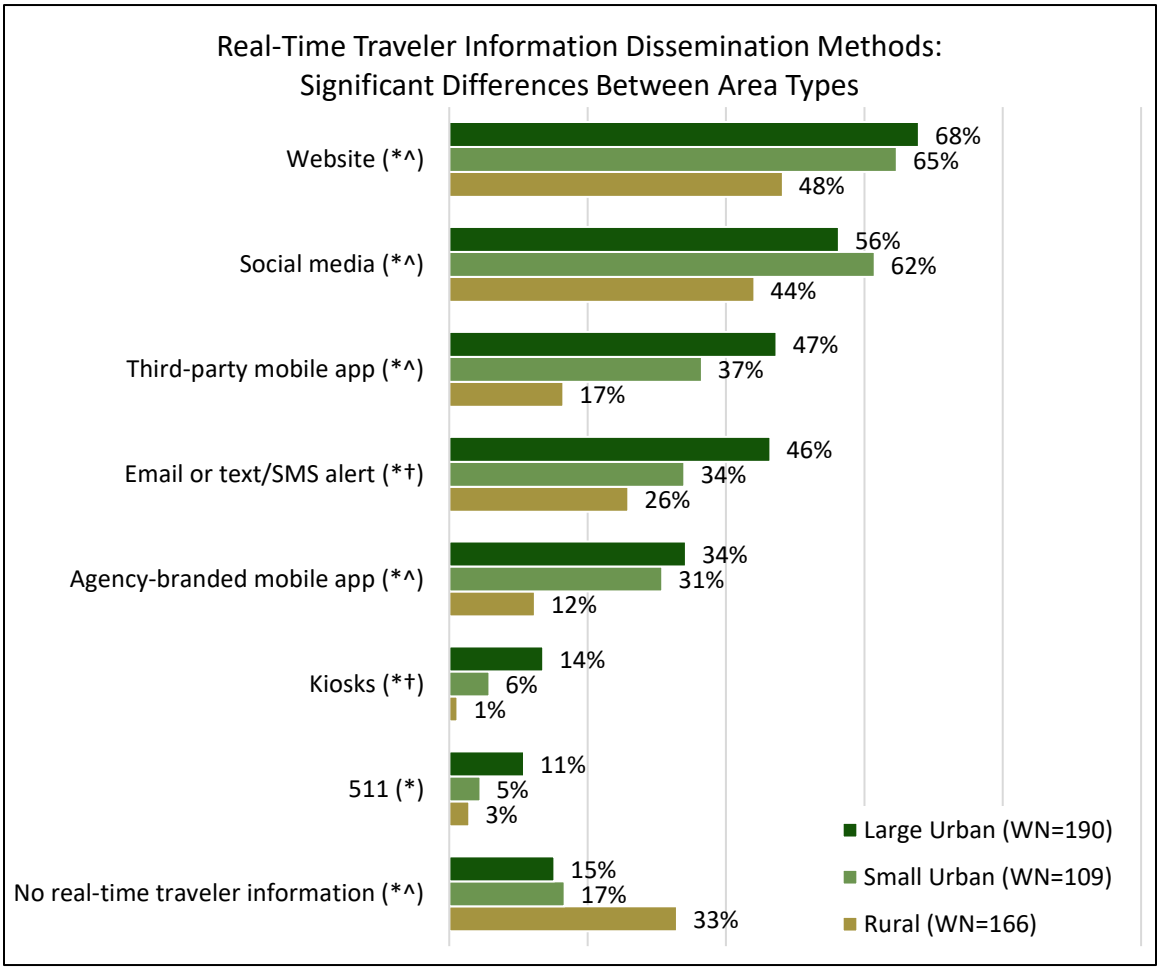
2023 Q12; (n=464; 1% missing) *Source: USDOT*

Figure 16. Real-Time Traveler Information Dissemination Methods

Figure 17 shows that use of real-time traveler information dissemination methods varies significantly by area type. Transit management agencies in large and small urban areas are significantly more likely than transit agencies in rural areas to use *websites, social media, third-party mobile apps, agency-branded mobile apps,* and *kiosks.* Large urban transit agencies are also more likely to use kiosks than small urban transit agencies.

Use of *email or text/SMS alerts* is significantly higher among transit agencies in large urban areas compared to transit agencies in small urban and rural areas. Use of *511* is only significantly higher among large urban transit agencies compared to rural transit agencies.

One third of transit agencies in rural areas (33 percent) reported *no real-time traveler information*, which is significantly higher than transit agencies in large urban areas (15 percent) and transit agencies in small urban areas (17 percent).

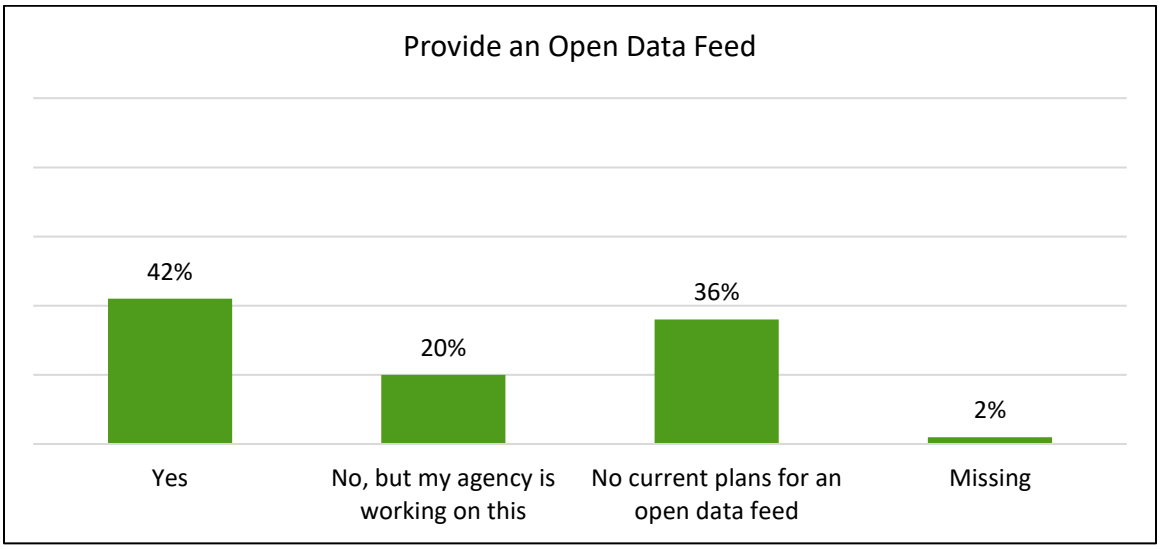


2023 Q12; (Large Urban UWN=138, Small Urban UWN=156, Rural UWN=170) *Source: USDOT*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Figure 17. Real-Time Traveler Information Dissemination Methods: Significant Differences Between Area Types

Open Data Feed

Figure 18 shows that 42 percent of surveyed transit management agencies *provide an open data feed* (*e.g., to app developers, information service providers, other agencies, or the public)*, and one fifth of transit agencies are *working on providing an open data feed* (20 percent). About one third have *no current plans for an open data feed* (36 percent).



2023 Q9; (n=464) *Source: USDOT*

Figure 18. Provide an Open Data Feed

Table 5 shows transit management agencies in large urban areas (59 percent) are significantly more likely than transit agencies in small urban areas (46 percent) to *provide an open data feed,* and both are significantly more likely than transit agencies in rural areas (21 percent) to *provide an open data feed*.

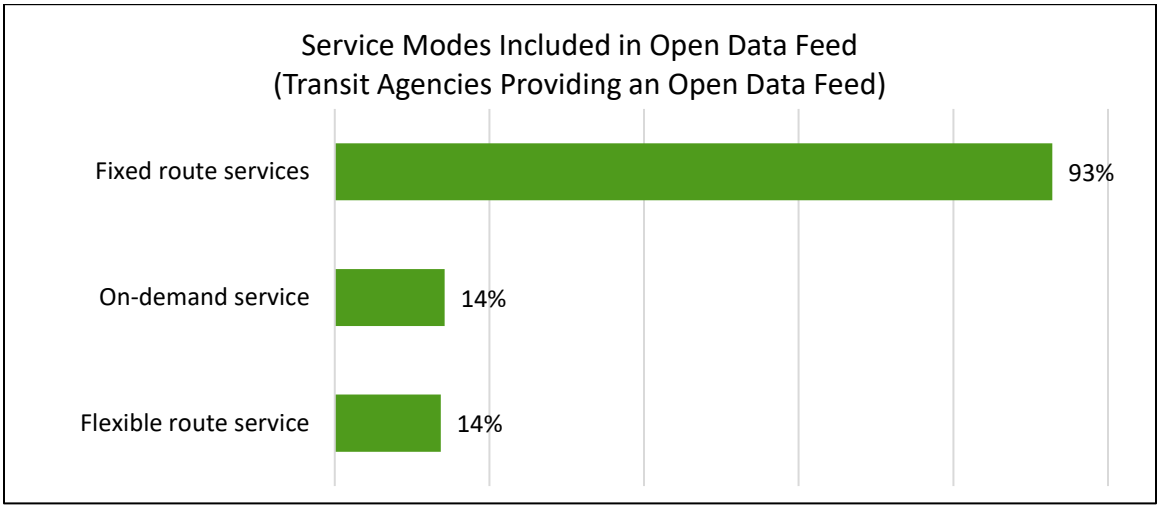
Furthermore, transit agencies in rural areas (57 percent) are significantly more likely to have *no current plans for an open data feed* compared to both transit agencies in small urban areas (28 percent) and transit agencies in large urban areas (24 percent).

Table 5. Open Data Feed: Significant Differences Between Area Types

Open Data Feed	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
Yes *^†	59%	46%	21%
No current plans for an open data feed *^	24%	28%	57%

** statistically significant difference between large urban and rural transit agencies* *Source: USDOT*
^ statistically significant difference between small urban and rural transit agencies
† statistically significant difference between large urban and small urban transit agencies

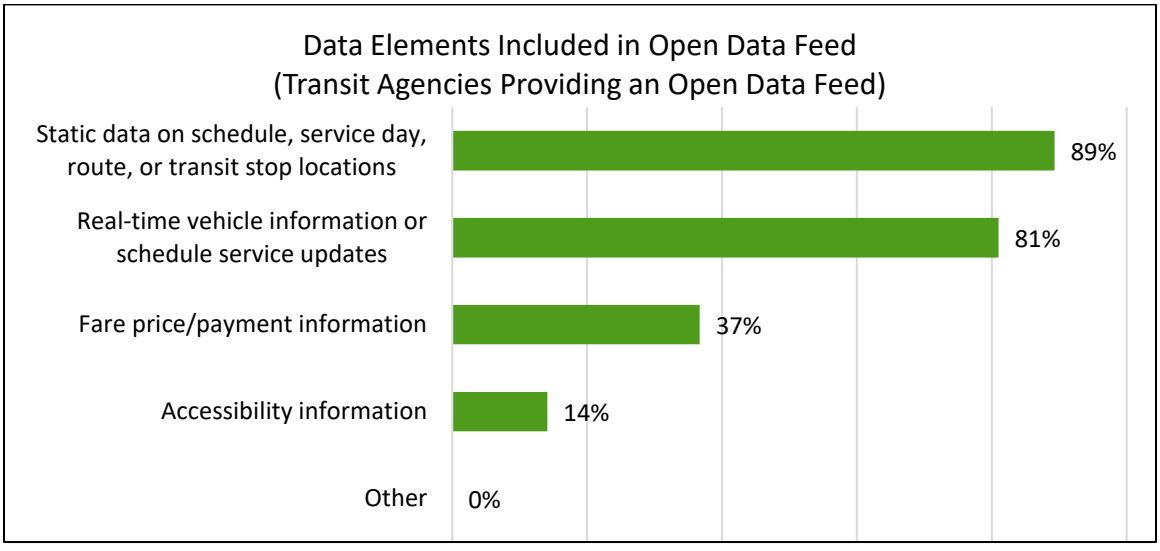
Figure 19 shows nearly all the 191 transit management agencies that provide an open data feed include *fixed route services* (93 percent) in their open data feed. A smaller percentage of these transit agencies include *on-demand service* (14 percent) or *flexible route services* (14 percent).



2023 Q10; (WN=196, UWN=191; 0% missing) *Source: USDOT*

Figure 19. Service Modes Included in Open Data Feed (Transit Agencies Providing an Open Data Feed)

Figure 20 shows a large majority of the 191 transit management agencies that provide an open data feed provide *static data on schedule, service day, route, or transit stop locations* (89 percent), and a similarly high percentage provide *real-time vehicle information or schedule service updates* (81 percent). Fewer transit agencies provide *fare price/payment information* (37 percent), and 14 percent provide *accessibility information (e.g., elevator/escalator outages, accessible entrances, availability of accessible vehicles)*.

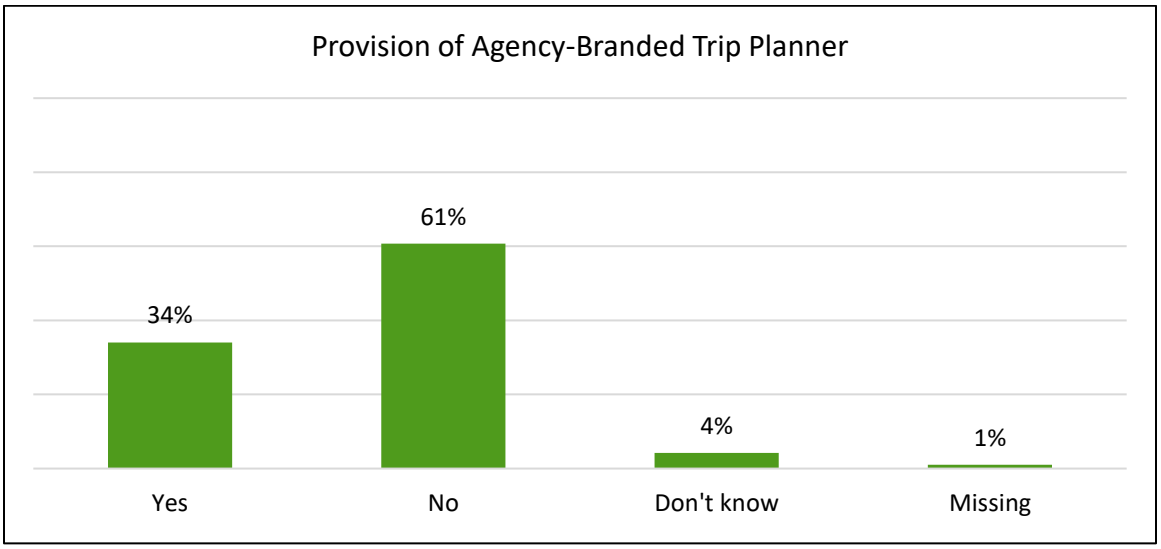


2023 Q11; (WN=196, UWN=191; 1% missing) *Source: USDOT*

Figure 20. Data Elements Included in Open Data Feed (Transit Agencies Providing an Open Data Feed)

Trip Planner

Figure 21 shows that over one third of transit management agencies *provide an agency-branded trip planner (web-based and/or mobile application)* (34 percent), while the majority of transit agencies reported *do not provide an agency-branded trip planner* (61 percent). Four (4) percent responded *don't know*, a new response option in the 2023 survey.



2023 Q13; (n=464) *Source: USDOT*

Figure 21. Provision of Transit Agency-Branded Trip Planner

Transit management agencies in large urban areas (51 percent) are significantly more likely to *provide an agency-branded trip planner* than transit agencies in small urban areas (36 percent), and both are significantly more likely than transit agencies in rural areas (15 percent) to *provide an agency-branded trip planner*.

Features of a Trip Planner

Figure 22 shows that among the 156 transit management agencies providing agency-branded trip planners, transit agencies most commonly incorporate *real-time transit information (e.g., real-time transit schedule, arrival/departure, delay, passenger crowding, etc.)* (77 percent), a new response category in the 2023 survey.

Approximately one third of transit agencies incorporate *modes other than transit (e.g., walking, biking, or driving routes to stops/stations)* (36 percent), and 29 percent incorporate *electronic payment of fares for their agency's services*.

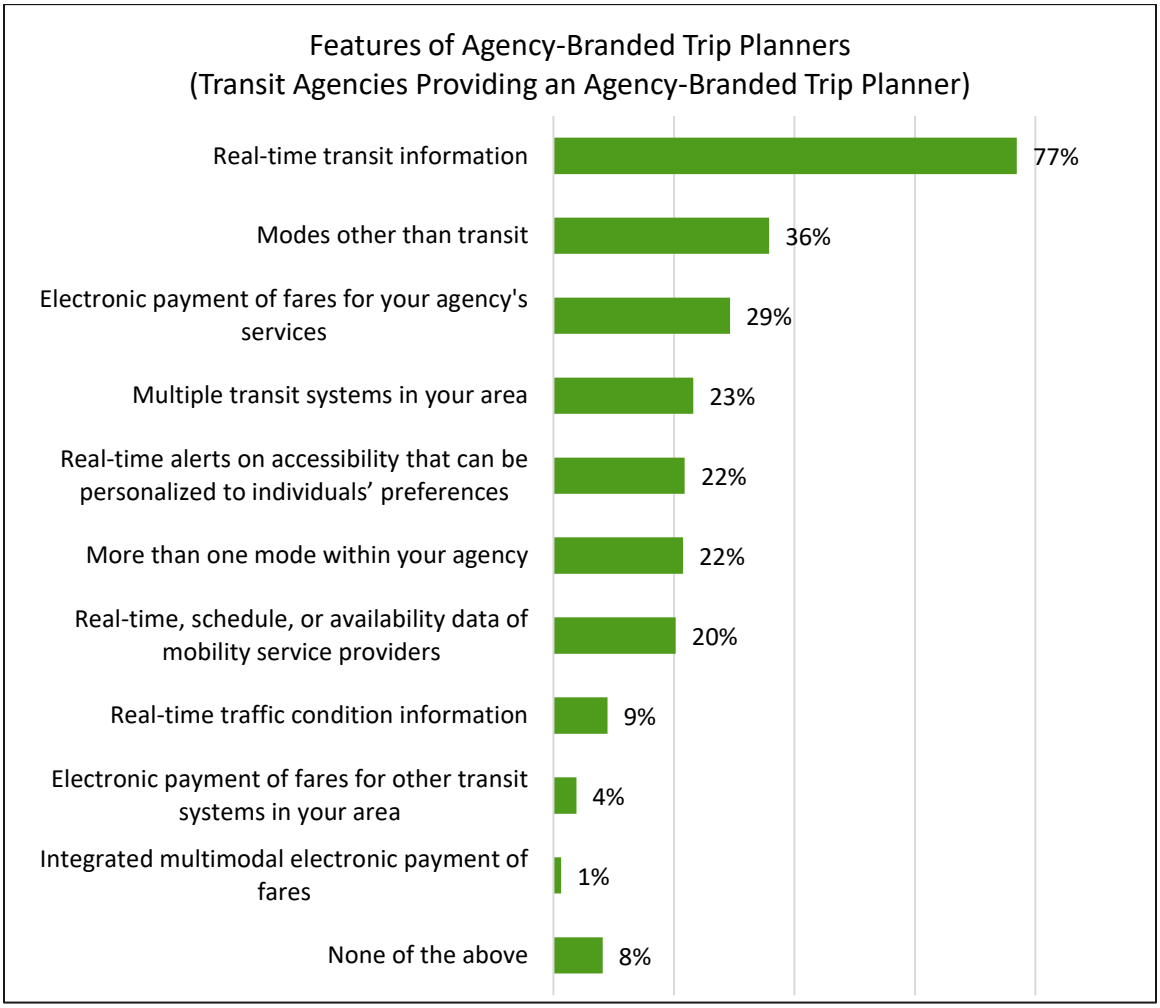
Fewer than one fourth of transit management agencies with agency-branded trip planners incorporate:

- *Multiple transit systems in the area* (23 percent)
- *More than one mode within the agency (i.e., rail to bus connections)* (22 percent)

- *Real-time, schedule, or availability data of mobility service providers (e.g., bike-sharing, scooter-sharing, taxis, ride-hailing)* (20 percent)

- *Real-time alerts/announcements on accessibility that can be personalized to individuals' preferences (e.g., temporary route barriers, elevator/escalator outage information at stations, etc.)* (22 percent), a new response option in 2023.

Fewer than 10 percent of transit management agencies *incorporate real-time traffic condition information*, *electronic payment of fares for other transit systems in the area*, and *multimodal electronic payment of fares (e.g., mobility service providers, tolls, parking, etc.)*, a new response option in 2023.



2023 Q14; (WN=161, UWN=156; 1% missing) *Source: USDOT*

Figure 22. Features of Agency-Branded Trip Planners (Transit Agencies Providing an Agency-Branded Trip Planner)

Fare Media

This section presents findings for fare media, including:

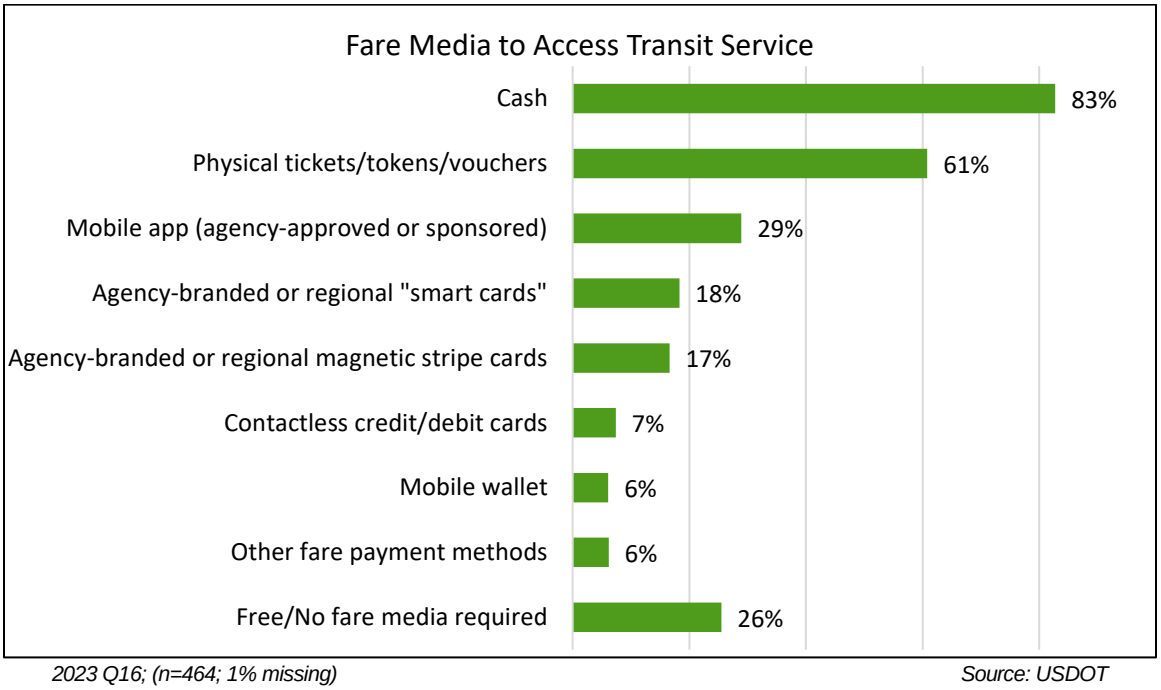
- Fare media to access agency's transit services
- Methods to purchase fare media
- Electronic fare payment (EFP) systems

Fare Media to Access Transit Service

Figure 23 shows that a large majority of transit management agencies accept *cash* (83 percent), and more than half accept *physical tickets/tokens/vouchers* (61 percent), a new response category in 2023, to access the transit service (e.g., at turnstile, in-vehicle, etc.). Eight (8) percent of all transit agencies report *cash* as their only fare media.

Nearly one third of transit agencies accept payments via *mobile apps* (29 percent), and less than one fifth accept *agency-branded or regional "smart cards"* (18 percent) and *agency-branded or regional magnetic strip cards* (17 percent). Less than 10 percent of transit agencies accept *contactless credit/debit cards*, *mobile wallet*, or *other fare payment methods.*

About one fourth of transit management agencies reported *free/no fare media required* (26 percent), which was a new response category in 2023 and could apply to one or all modes/services offered by the transit agency. Twelve (12) percent of all transit agencies reported only *free/no fare media*, while 14 percent reported both *free/no fare media* and another fare media (i.e., some routes, services, or ridership types may be free/no fare, whereas others require a fare).

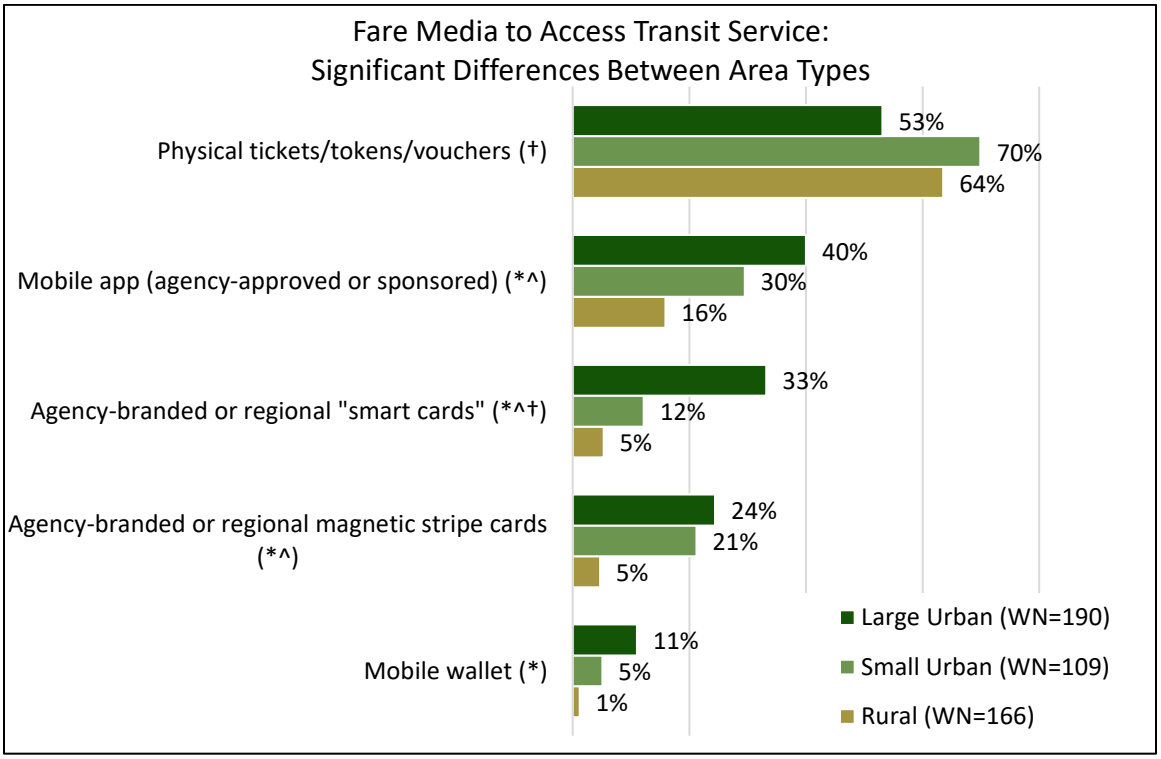


2023 Q16; (n=464; 1% missing) *Source: USDOT*

Figure 23. Fare Media to Access Transit Service

Figure 24 shows there are significant differences in the types of fare media accepted among transit management agencies in different area types.

- Significantly more transit agencies in small urban areas (70 percent) accept *physical tickets/tokens/vouchers* than transit agencies in large urban areas (53 percent).
- Transit agencies in large urban areas (40 percent) and small urban areas (30 percent) are both significantly more likely than transit agencies in rural areas (16 percent) to use *mobile apps*.
- Use of *agency-branded or regional "smart cards"* is significantly more likely among transit agencies in large urban areas (33 percent) than transit agencies in small urban areas (12 percent). Use by agencies in both area types is also significantly higher than by transit agencies in rural areas (5 percent).
- Transit agencies in large urban areas (24 percent) and transit agencies in small urban areas (21 percent) are both significantly more likely than transit agencies in rural areas (5 percent) to use *agency branded or regional magnetic stripe cards*.
- Transit agencies in large urban areas (11 percent) are significantly more likely than transit agencies in rural areas (1 percent) to accept payments via *mobile wallet*.

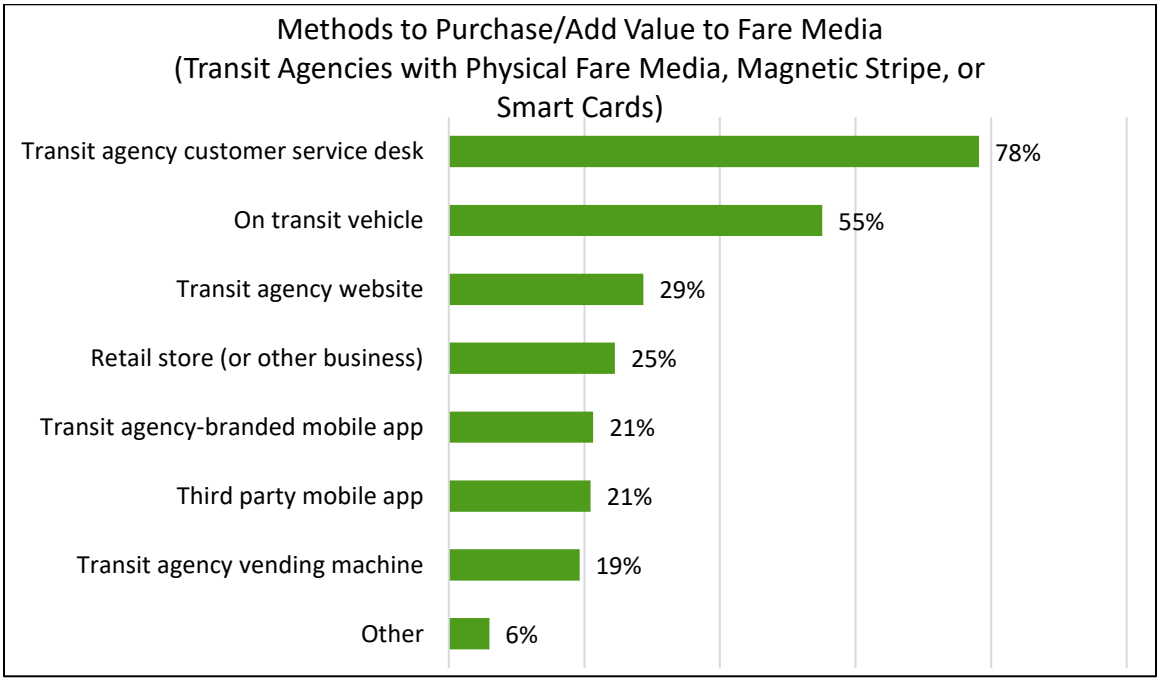


2023 Q16; (Large Urban UWN=138, Small Urban UWN=156, Rural UWN=170) *Source: USDOT*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Figure 24. Fare Media to Access Transit Service: Significant Differences Between Area Types

A total of 335 surveyed transit management agencies reported use of physical tickets/tokens/vouchers (i.e., no embedded technology), agency-branded or regional magnetic stripe cards, or agency-branded or regional smart cards.

Figure 25 shows that of these 335 transit agencies, over three fourths offer travelers the ability to purchase or add value to fare media at a *transit agency customer service desk* (78 percent), and over half offer purchase *on transit vehicles* (55 percent). Less than one third of these transit management agencies offer purchase through the *transit agency website* (29 percent), and one fourth offer purchase at *a retail store (or other business)* (25 percent). About one fifth of these transit agencies offer purchase through *transit agency-branded mobile app* (21 percent), *third party mobile app* (21 percent), and *transit agency vending machine* (19 percent).



2023 Q17; (WN=330, UWN=335; 3% missing) *Source: USDOT*

Figure 25. Methods to Purchase/Add Value to Fare Media (Transit agencies with Physical Fare Media, Magnetic Stripe, or Smart Cards)

Figure 26 shows there are significant differences in the methods available to purchase or add value to fare media among transit management agencies in different area types.

- Significantly more transit agencies in rural areas offer purchase of fare media *on transit vehicles* (66 percent) compared to both transit agencies in large urban areas (49 percent) and transit agencies in small urban areas (52 percent).

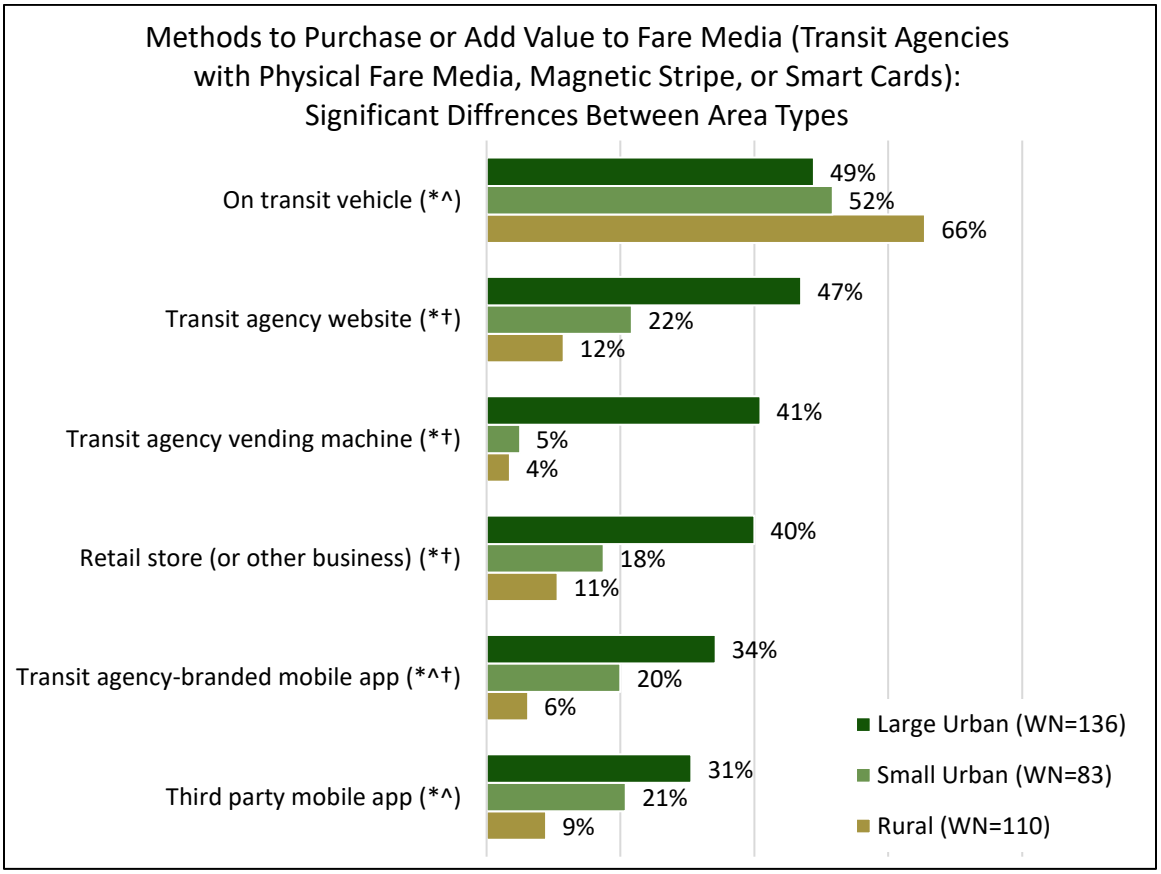
- Transit agencies in large urban areas (47 percent) are significantly more likely to offer purchase through the *transit agency website* than both transit agencies in small urban areas (22 percent) and transit agencies in rural areas (12 percent).

- Forty-one (41) percent of transit agencies in large urban areas offer purchase through a transit *agency vending machine*, which is significantly higher than both transit agencies in small urban areas (5 percent) and transit agencies in rural areas (4 percent).

- Forty percent (40) of transit agencies in large urban areas offer purchase at a *retail store (or other business)*, which is significantly higher than both transit agencies in small urban areas (18 percent) and transit agencies in rural areas (11 percent).

- Transit agencies in large urban areas (34 percent) are significantly more likely to offer purchase through the *transit agency-branded mobile app* than both transit agencies in small urban areas (20 percent) and transit agencies in rural areas (6 percent). A significantly higher percentage of transit agencies in small urban areas also report this compared to transit agencies in rural areas.

- Transit agencies in large urban areas (31 percent) and transit agencies in small urban areas (21 percent) are significantly more likely to offer purchase of fare media through a *third-party mobile app* than transit agencies in rural areas (9 percent).



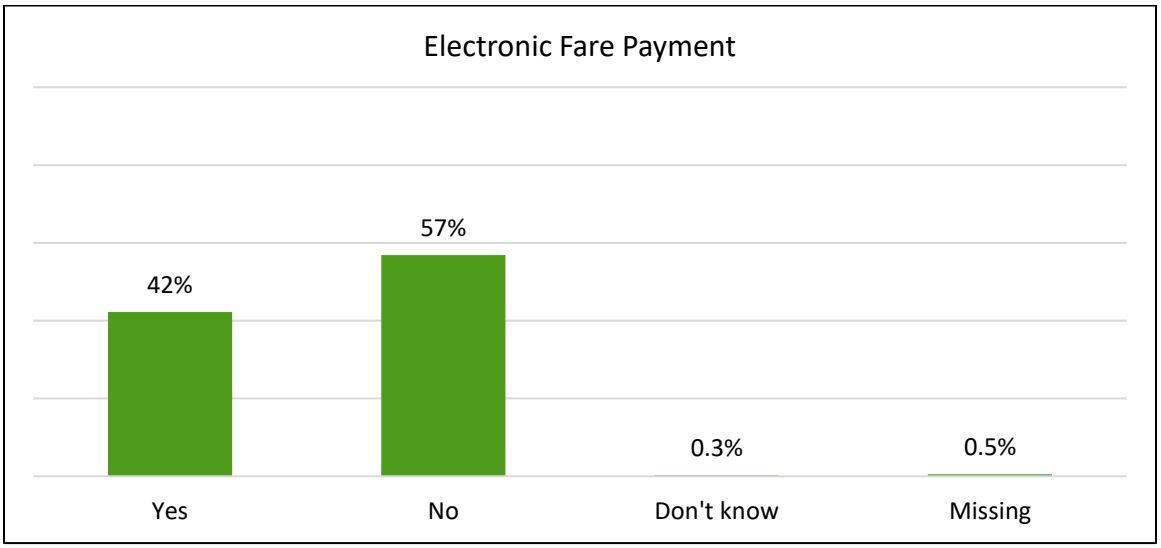
2023 Q17; (Large Urban UWN=102, Small Urban UWN=120, Rural UWN=113) *Source: USDOT*
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Figure 26. Methods to Purchase or Add Value to Fare Media (Transit Agencies with Physical Fare Media, Magnetic Stripe, or Smart Cards): Significant Differences Between Area Types

Electronic Fare Payment

Transit management agencies offer EFP as an automated means of collecting and processing fares for public transportation services. This may include various payment media, such as smart phones, magnetic stripe cards, and more.

Figure 27 shows that 42 percent of transit management agencies reported *use of EFP,* while 57 percent reported *no use of EFP*.



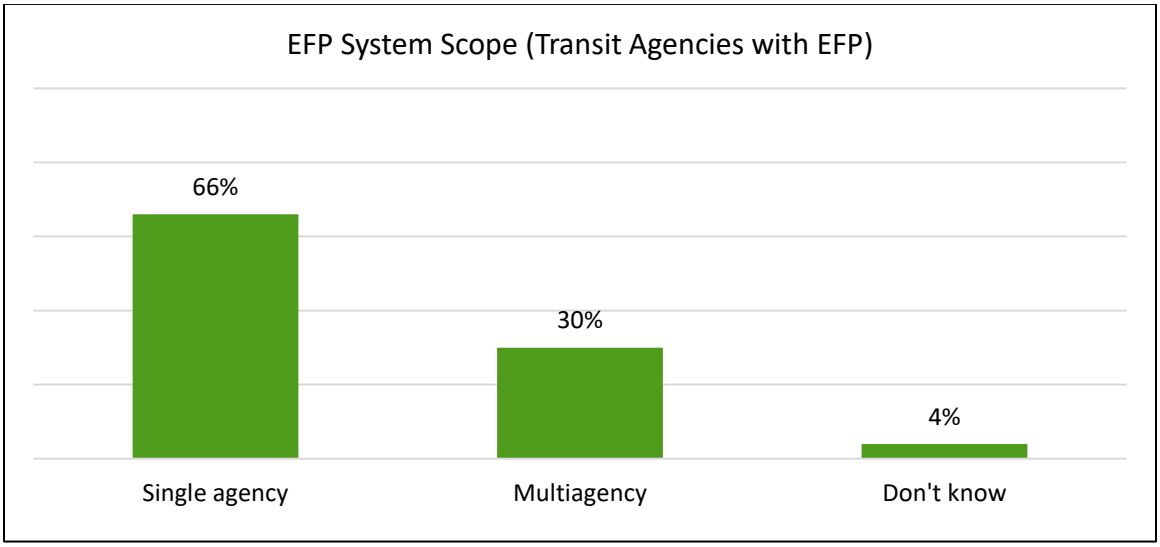
2023 Q15; (n=464) *Source: USDOT*

Figure 27. Electronic Fare Payment

A majority of transit management agencies in large urban areas (56 percent) and nearly one half of transit agencies in small urban areas (46 percent) offer *EFP*, which are both significantly more likely to offer *EFP* than transit agencies in rural areas (24 percent).

Characteristics of EFP

Figure 28 shows that of the 195 transit management agencies with EFP, two thirds reported the system scope of their EFP system is *single agency* (66 percent), whereas about one third of transit agencies reported the scope is *multiagency* (30 percent).



2023 Q18a; (WN=196, UWN=195; 0% missing) *Source: USDOT*

Figure 28. EFP System Scope (Transit Agencies with EFP)

Table 6 shows that the system scope of a transit management agency's EFP system varies significantly by area types. Over three fourths of transit agencies in small urban areas (78 percent) and transit agencies in rural areas (78 percent) have a *single agency* scope, which is significantly higher than the 56 percent of transit agencies in large urban areas.

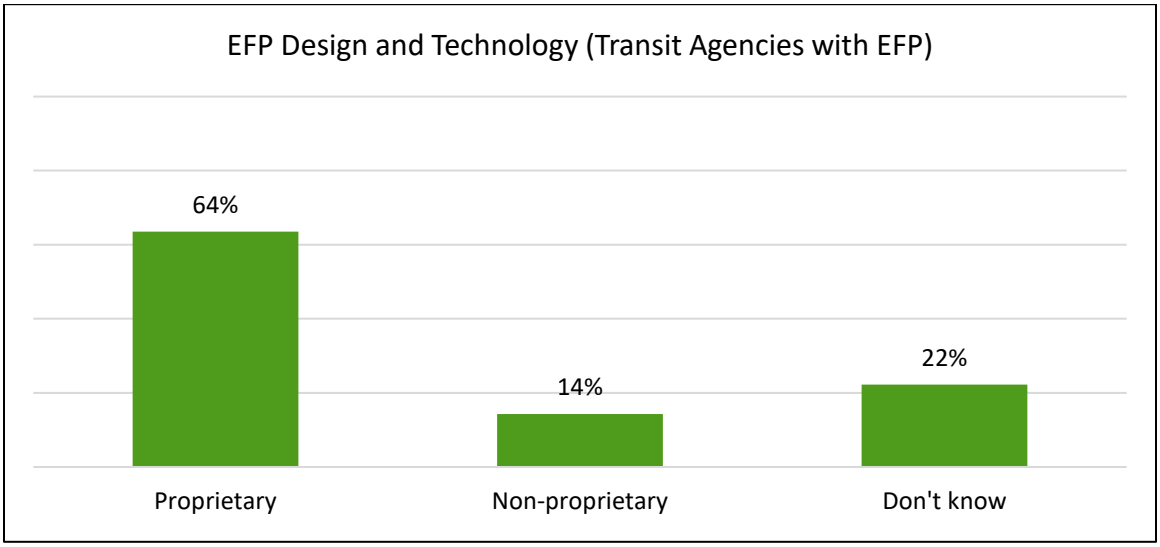
In contrast, 45 percent of transit agencies in large urban areas have a *multiagency* scope, which is significantly higher compared to both transit agencies in small urban areas (17 percent) and transit agencies in rural areas (10 percent).

Table 6. EFP System Scope (Transit Agencies with EFP): Significant Differences Between Area Types

EFP System Scope	Large Urban (WN=107; UWN=83)	Small Urban (WN=49; UWN=71)	Rural (WN=40; UWN=41)
Single agency (*†)	56%	78%	78%
Multiagency (*†)	45%	17%	10%

** statistically significant difference between large urban and rural transit agencies;* *Source: USDOT*
† statistically significant difference between large urban and small urban transit agencies

Figure 29 shows nearly two thirds of the 195 transit management agencies offering EFP use *proprietary* design and technology (64 percent), whereas 14 percent of transit agencies use *non-proprietary* design and technology, and 22 percent of transit agencies report *don't know.*



2023 Q18b; (WN=196, UWN=195; 0% missing) *Source: USDOT*

Figure 29. EFP Design and Technology (Transit Agencies with EFP)

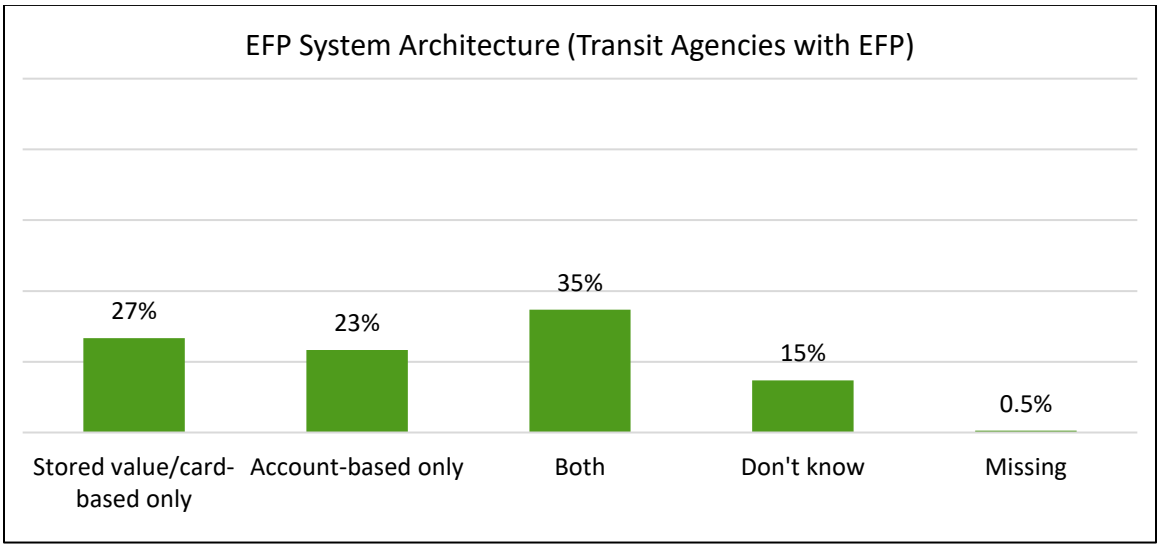
Table 7 shows that nearly three fourths of transit management agencies in large urban areas (73 percent) use an EFP system with a *proprietary* design and technology, which is significantly higher than transit agencies in rural areas (46 percent). Transit agencies in rural areas (39 percent) are significantly more likely to report *don't know* compared to transit agencies in large urban areas (16 percent).

Table 7. EFP Design and Technology (Transit Agencies with EFP): Significant Differences Between Area Types

EFP System Design and Technology	Large Urban (WN=107; UWN=83)	Small Urban (WN=49; UWN=71)	Rural (WN=40; UWN=41)
Proprietary *	73%	58%	46%
Don't Know *	16%	21%	39%

** statistically significant difference between large urban and rural transit agencies* *Source: USDOT*

Figure 30 shows that of the 195 transit management agencies with EFP systems, over one third use *both stored value/card-based and account-based* (35 percent) system architecture, whereas about one fourth use *stored value/card-based only* (27 percent), and a similar percentage use *account-based only* (23 percent) system architecture. *Don't know* was reported by 15 percent of transit agencies.

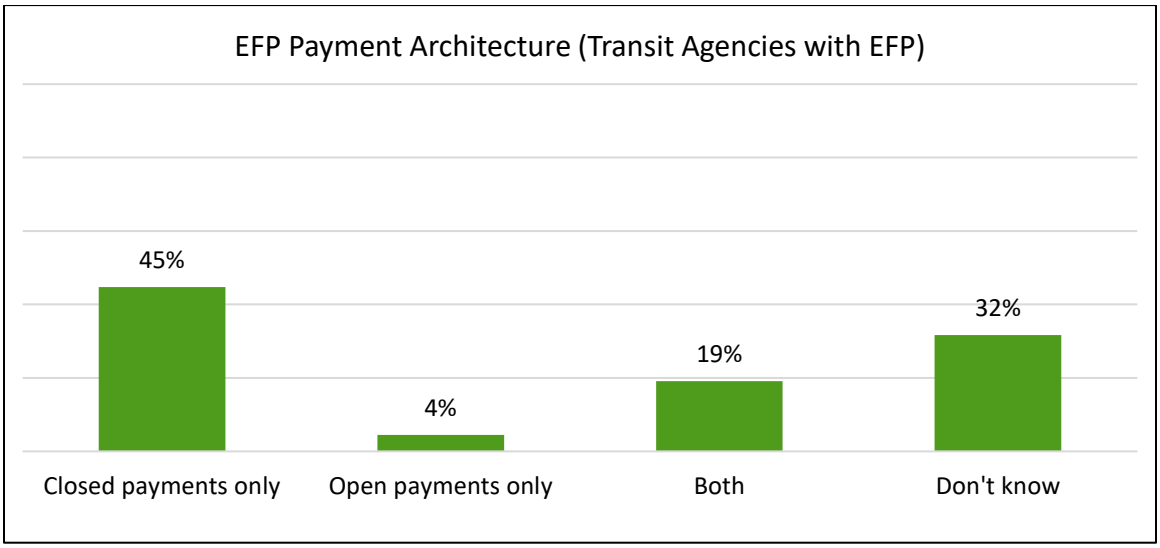


2023 Q18c; (WN=196, UWN=195) *Source: USDOT*

Figure 30. EFP System Architecture (Transit Agencies with EFP)

Figure 31 shows that of the 195 transit management agencies with an EFP system, 45 percent use *closed payments only* payment architecture (i.e., accepts only agency-branded fare media), while 4 percent of transit agencies use an *open payments only* payment architecture (i.e., accepts payment methods that may be used to purchase things other than fares from a specific transit agency like credit cards).

A payment architecture of *both closed and open payments* is used by 19 percent of transit agencies. Notably, nearly one third of transit agencies reported *don't know* (32 percent).



2023 Q18d; (WN=196, UWN=195; 0% missing) *Source: USDOT*

Figure 31. EFP Payment Architecture (Transit Agencies with EFP)

Table 8 shows a majority of transit management agencies with an EFP system in large urban areas (57 percent) use a *closed payments only* payment architecture, which is significantly higher than both transit agencies in small urban areas (34 percent) and transit agencies in rural areas (27 percent).

Transit agencies in large urban areas (20 percent) are also significantly less likely to report *don't know* than both transit agencies in small urban areas (46 percent) and transit agencies in rural areas (44 percent).

Table 8. EFP Payment Architecture (Transit Agencies with EFP): Significant Differences by Area Type

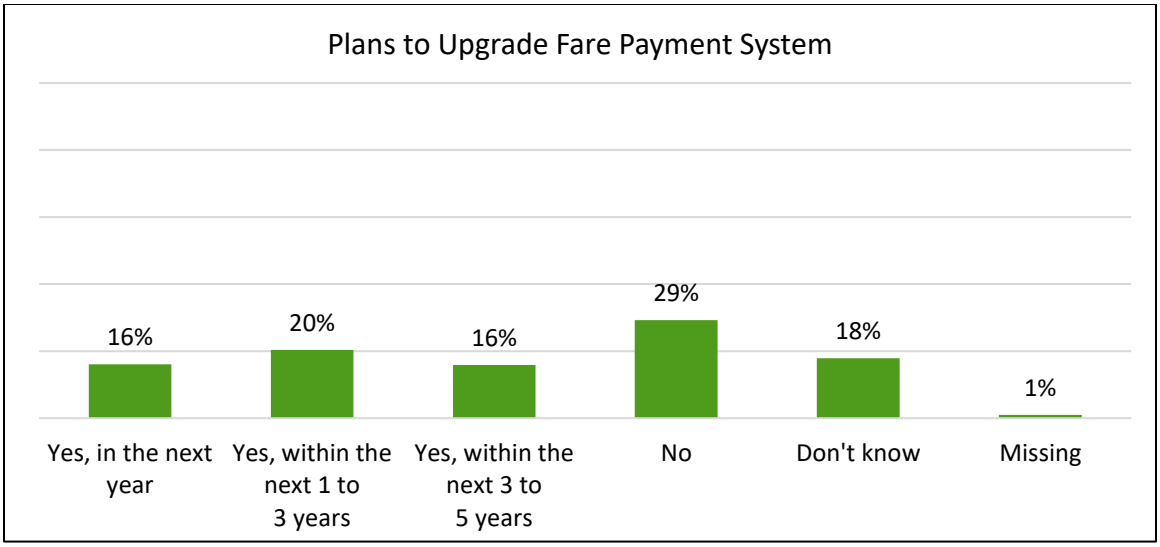
EFP Payment Architecture	Large Urban (WN=107; UWN=83)	Small Urban (WN=49; UWN=71)	Rural (WN=40; UWN=41)
Closed Payments Only *†	57%	34%	27%
Don't Know *†	20%	46%	44%

** statistically significant difference between large urban and rural transit agencies;*
† statistically significant difference between large urban and small urban transit agencies
Source: USDOT

Plans to Upgrade Fare Payment System

Figure 32 shows that more than half of all surveyed transit management agencies plan to upgrade their fare payment system to accept additional or different types of fare media within the next 5 years (52 percent).

Sixteen (16) percent of transit management agencies plan to upgrade their fare payment systems *in the next year*, 20 percent of transit agencies in the *next 1 to 3 years*, and 16 percent of transit agencies in the *next 3 to 5 years*. However, 29 percent of transit agencies have *no plans* to upgrade their fare payment system, and 18 percent responded *don't know*.



2023 Q19; (n=464) *Source: USDOT*

Figure 32. Plans to Upgrade Fare Payment System

Transit management agencies in large urban areas (18 percent) and transit agencies in small urban areas (24 percent) are significantly more likely than transit agencies in rural areas (8 percent) to have plans to upgrade their fare payment systems in the *next year*.

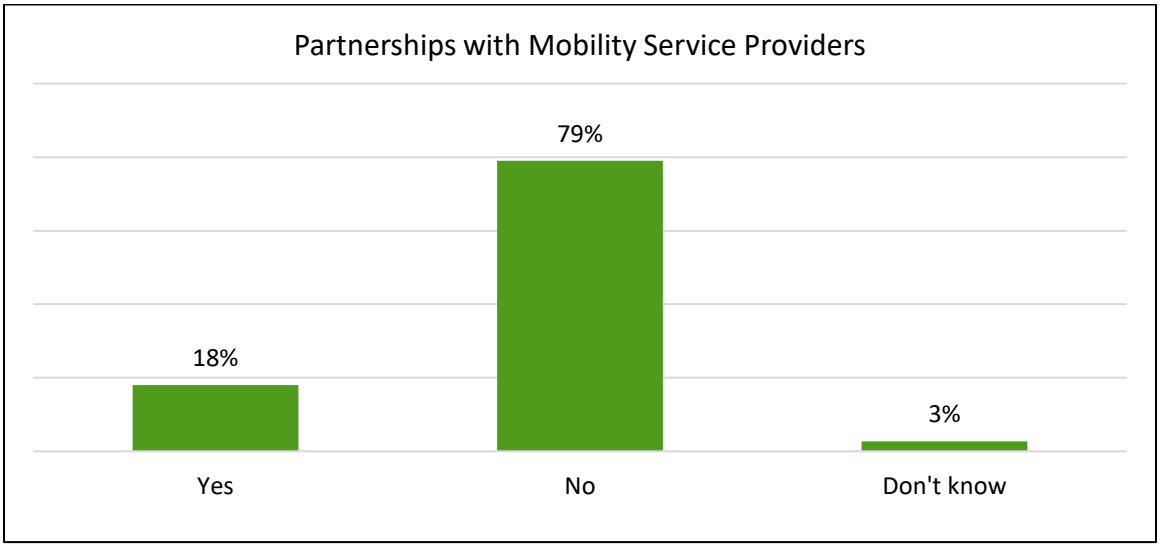
Partnerships and Coordination

This section presents findings for different types of partnerships and coordination, including:

- Partnerships with mobility service providers
- Travel Management Coordination

Partnerships with Mobility Service Providers

Figure 33 shows that 18 percent of surveyed transit management agencies *partner with any mobility service provider (e.g., ride-hailing, bike-sharing, microtransit, taxi),* whereas the majority of transit agencies *do not partner with a mobility service provider* (79 percent). The 2023 survey introduced a *don't know* response option which was reported by 3 percent of respondents.



2023 Q20; (n=464, 0.5% missing) *Source: USDOT*

Figure 33. Partnerships with Mobility Service Providers

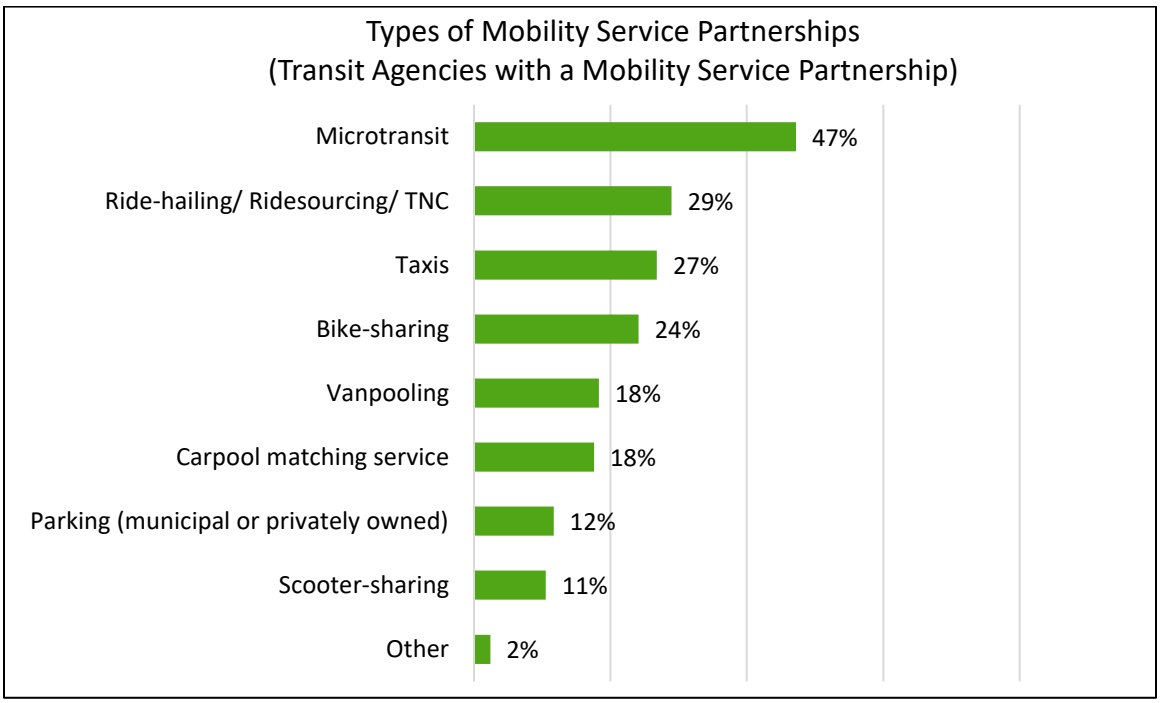
Transit management agencies in large urban areas (26 percent) are significantly more likely than transit agencies in small urban areas (12 percent) and transit agencies in rural areas (12 percent) to *partner with mobility service providers*.

Types of Mobility Service Partnerships

Figure 34 shows the types of mobility service provider partnerships reported by the 82 responding transit management agencies with a mobility service partnership. On average, these transit agencies partner with 1.9 providers.

Almost half of these 82 transit management agencies partner with a *microtransit* service (47 percent). About one fourth partner with *ride-hailing ridesourcing/Transportation Network Company (TNC)* (29 percent), *taxis* (27 percent), and *bike-sharing* (24 percent).

Less than one fifth of transit agencies partner with *vanpooling* (18 percent), *carpool matching service* (18 percent), *parking (municipal or privately owned)* (12 percent), and *scooter-sharing* (11 percent).

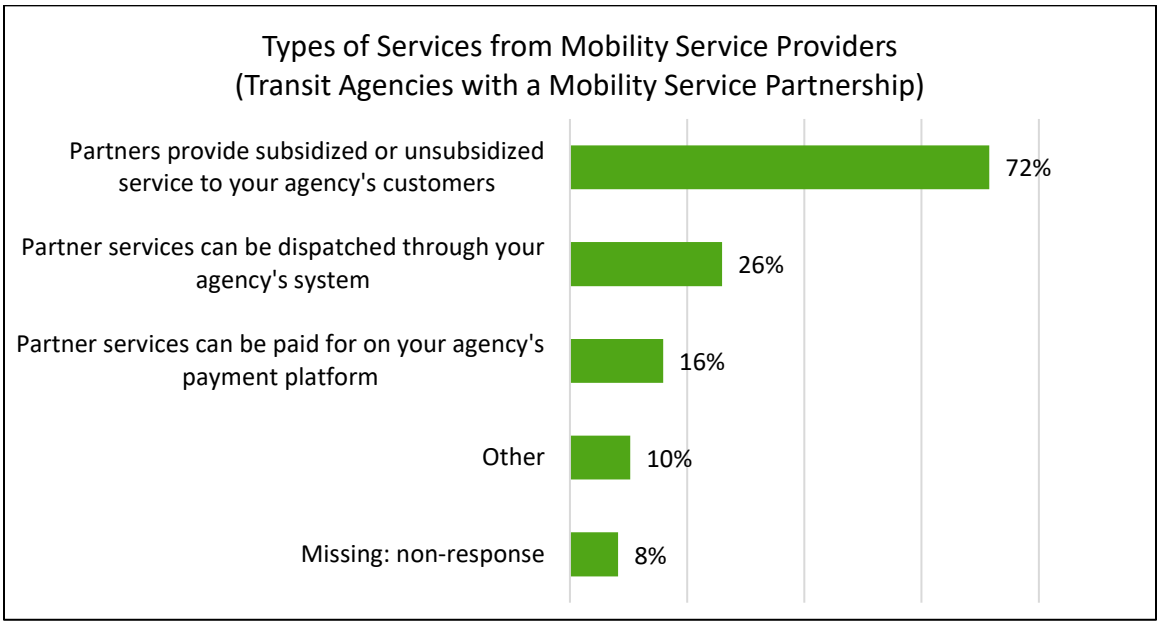


2023 Q21; (WN=82, UWN=82; 4% missing) *Source: USDOT*

Figure 34. Types of Mobility Service Partnerships (Transit Agencies with a Mobility Service Partnership)

Figure 35 shows that, of the 82 responding transit management agencies with mobility service partnerships, these transit agencies most often reported that *partners provide subsidized or unsubsidized service to agency's customers* (72 percent).

About one fourth reported that partner services can be dispatched through the agency's system (26 percent), and 16 percent reported that partner services can be paid for on the agency's payment platform. *Other* types of services were reported by 10 percent of transit agencies with mobility service partnerships.



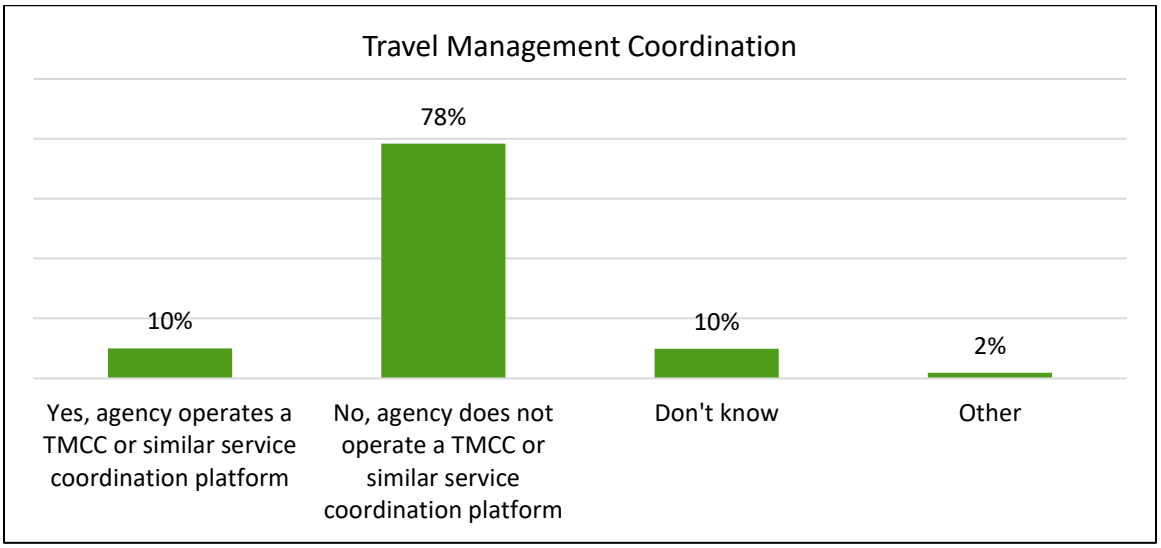
2023 Q22; (WN=82, UWN=82; 8% missing) *Source: USDOT*

Figure 35. Types of Services from Mobility Service Providers (Transit Agencies with a Mobility Service Partnership)

Travel Management Coordination

Figure 36 shows the reported use of a service coordination platform (e.g., Travel Management Coordination Cetner (TMCC)) to coordinate transportation for clients of human service agencies (e.g., health, employment, etc.).

Only 10 percent of surveyed transit management agencies *operate a TMCC or similar service coordination platform*, while the majority of transit agencies *do not operate a TMCC or similar coordination platform* (78 percent). Another 10 percent of transit agencies reported *don't know.*



2023 Q23; (n=464; 0.4% missing) *Source: USDOT*

Figure 36. Travel Management Coordination

Telecommunication Technologies to Enable ITS

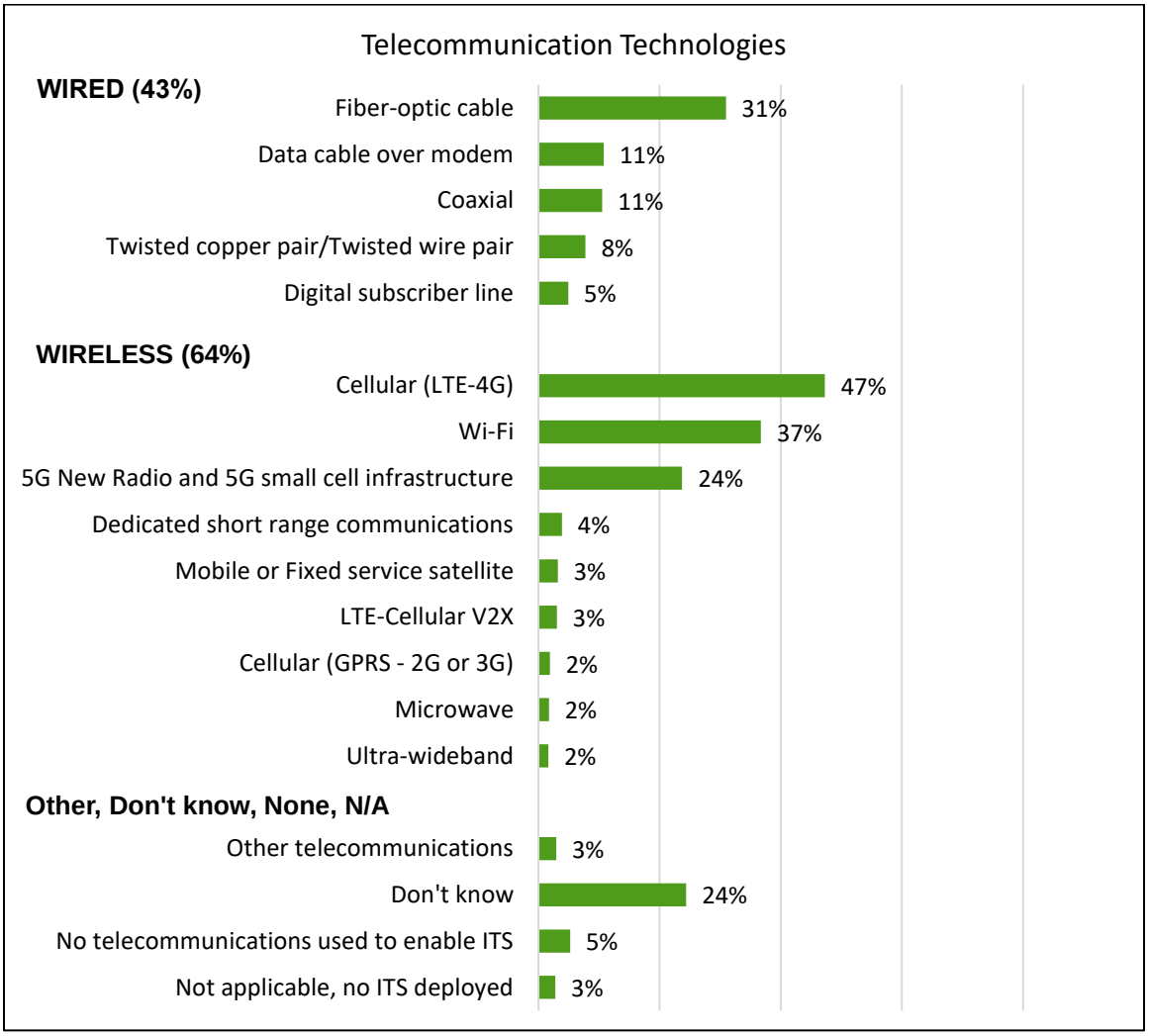
Telecommunications technologies enable communications between ITS devices, roadside devices, and/or a central processing location, typically for data collection and dissemination.

Among all surveyed transit management agencies, 66 percent use at least one telecommunication technology (either wired or wireless) to enable ITS. Almost one fourth of transit management agencies (24 percent) responded *don't know*, 5 percent reported *no telecommunications used to enable ITS on arterials,* and 3 percent reported *no ITS infrastructure or devices are deployed*.

Figure 37 shows that 43 percent of transit management agencies use at least one wired telecommunication technology, whereas almost two thirds use at least one wireless telecommunication technology (64 percent). On average, transit management agencies using any telecommunication technologies use 2.9 different wired and/or wireless technologies.

Fiber-optic cable (31 percent) is the most used type of wired telecommunication technology by transit management agencies to enable ITS. Fewer transit agencies use the other types of wired telecommunications, including *data cable over modem* (11 percent), *coaxial* (11 percent), *twisted copper pair/twisted wire pair* (8 percent), and *digital subscriber line (DSL)* (5 percent).

Of the wireless technologies used to enable ITS, about half of transit management agencies use *cellular (LTE-4G)* (47 percent), over one third use *Wi-Fi* (37 percent), and almost one fourth use *5G New Radio and 5G small cell infrastructure* (24 percent). *Dedicated short range communications*, *mobile or fixed service satellite*, *LTE-Cellular V2X*, *cellular (GPRS – 2G or 3G)*, *microwave*, or *ultra-wideband* are each deployed by fewer than 5 percent of transit management agencies.



2023 Q36; (n=464; 1% missing) *Source: USDOT*

Figure 37. Telecommunication Technologies

Table 9 shows transit management agencies in large urban areas (39 percent) deploy *fiber-optic cable* at significantly higher rates than both transit agencies in small urban areas (25 percent) and transit agencies in rural areas (26 percent).

Similarly, transit agencies in large urban areas (13 percent) deploy *twisted copper pair/twisted wire pair* at significantly higher rates than both transit agencies in small urban areas (3 percent) and transit agencies in rural areas (5 percent).

Table 9. Telecommunication Technologies: Significant Differences Between Area Types

Telecommunication Technologies	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
Fiber-optic cable (*†)	39%	25%	26%
Twisted copper pair/Twisted wire pair (*†)	13%	3%	5%

** statistically significant difference between large urban and rural transit agencies;*
† statistically significant difference between large urban and small urban transit agencies

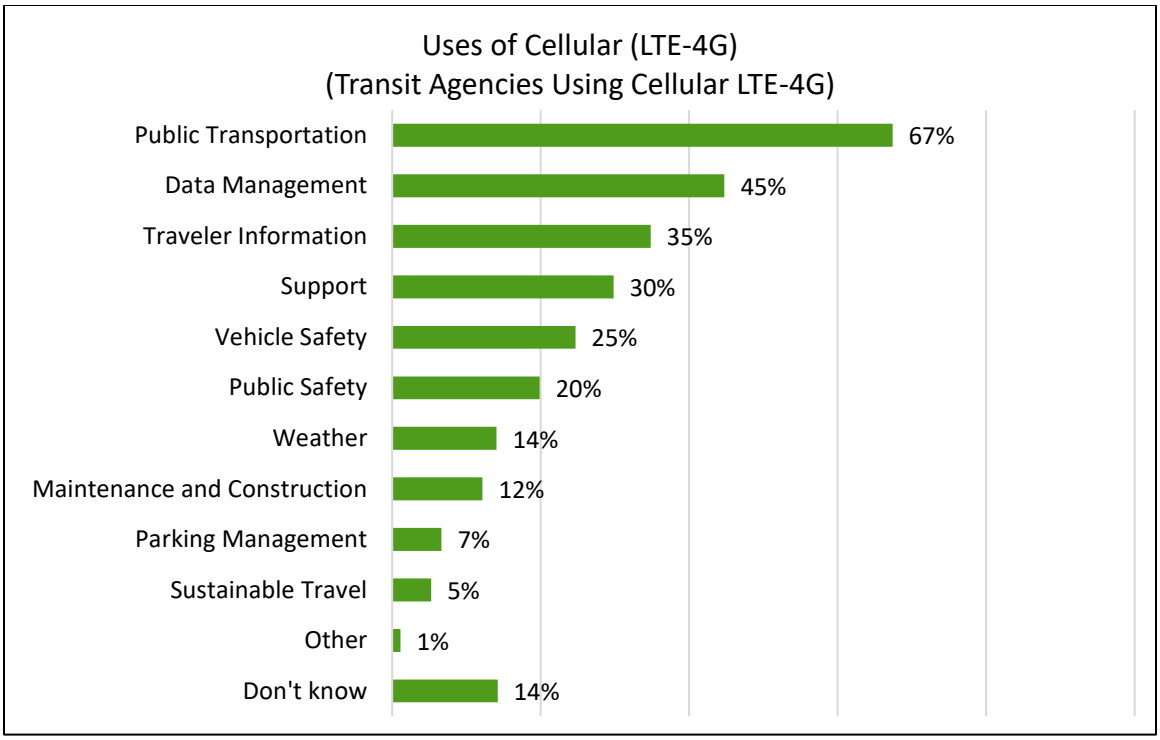
Source: USDOT

For the first time in 2023, responding transit management agencies were asked how their agency uses telecommunication technologies to enable ITS.[32]

Figure 38 shows about two thirds of the 220 transit management agencies using cellular (LTE-4G) use it for *public transportation* (67 percent), and nearly half for *data management* (45 percent). About one third of transit agencies using cellular (LTE-4G) use it for *traveler information* (35 percent) and *support* (30 percent), about one fourth for *vehicle safety* (25 percent), and one fifth for *public safety* (20 percent).

Other uses of cellular (LTE-4G) include *weather, maintenance and construction, parking management,* and *sustainable travel*, which were each reported by fewer than 15 percent of transit management agencies that use cellular (LTE-4G).

[32] This follow-up question applied to a subset of telecommunications technologies. Excluded technologies were coaxial, fiber-optic cable, mobile or fixed service satellite, ultra-wideband, or microwave.



2023 Q37; (WN=219, UWN=220; 6% missing) *Source: USDOT*

Figure 38. Uses of Cellular (LTE-4G) (Transit Agencies Using Cellular LTE-4G)

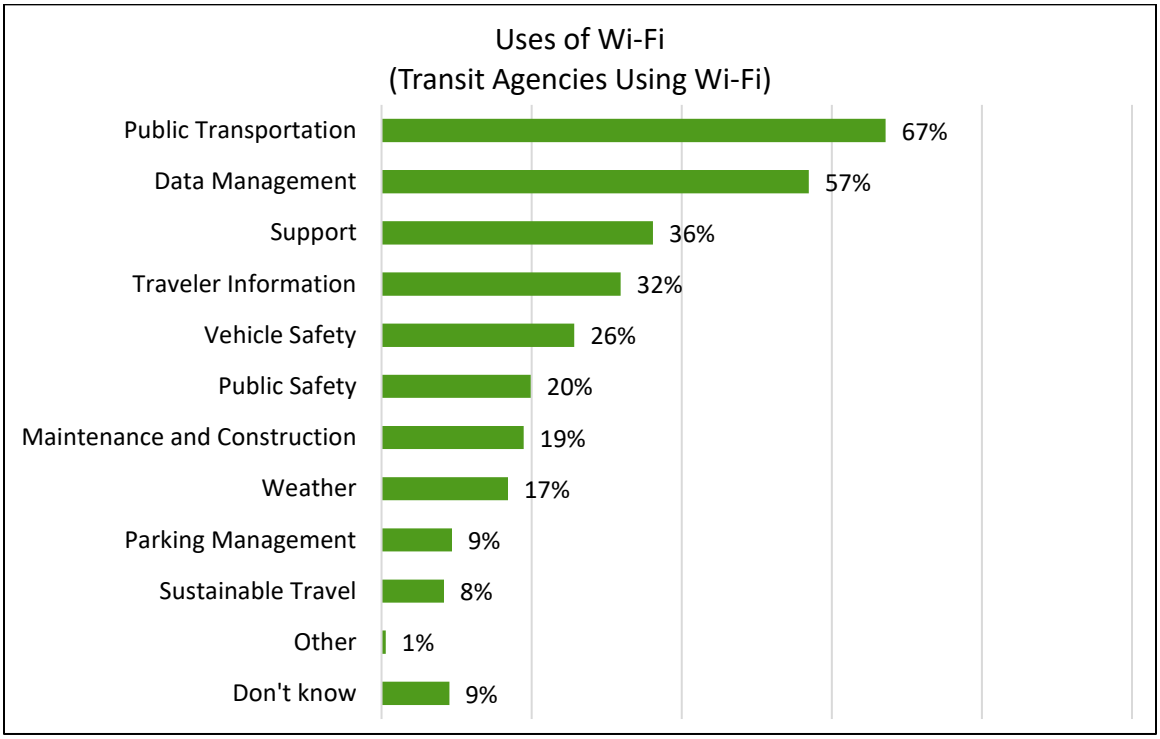
Table 10 shows significantly more transit management agencies in large urban areas use cellular (LTE-4G) for *public transportation*, *data management, traveler information,* and *support* compared to transit agencies in rural areas. Additionally, significantly more transit agencies in large urban areas use cellular (LTE-4G) for *traveler information* and *vehicle safety* compared to transit agencies in small urban areas.

Table 10. Uses of Cellular (LTE-4G) (Transit Agencies Using Cellular LTE-4G): Significant Differences Between Area Types

Uses of Cellular (LTE-4G)	Large Urban (WN=100; UWN=79)	Small Urban (WN=46; UWN=66)	Rural (WN=73; UWN=75)
Public Transportation (*)	74%	68%	57%
Data Management (*)	53%	41%	36%
Traveler Information (*†)	52%	26%	17%
Support (*)	37%	29%	20%
Vehicle Safety (*†)	35%	14%	17%

** statistically significant difference between large urban and rural transit agencies;* *Source: USDOT*
† statistically significant difference between large urban and small urban transit agencies

Figure 39 shows that about two thirds of the 171 transit management agencies that use Wi-Fi use this technology for *public transportation* (67 percent), over half reported use for *data management* (57 percent), and about one third reported use for *support* (36 percent) and *traveler information* (32 percent). Other surveyed uses of Wi-Fi include *vehicle safety, maintenance and construction, weather, parking management,* and *sustainable travel*, each of which were reported by fewer than 30 percent of transit agencies that use Wi-Fi.



2023 Q37; (WN=170, UWN=171; 11% missing) *Source: USDOT*

Figure 39. Uses of Wi-Fi (Transit Agencies Using Wi-Fi)

Transit agencies in large urban areas (44 percent) are significantly more likely than transit agencies in small urban areas (16 percent) and transit agencies in rural areas (25 percent) to report using *Wi-Fi* for *traveler information.*

Among transit management agencies using *5G New Radio and Small cell infrastructure* a majority reported use for *public transportation* (61 percent), and 43 percent reported use for *data management*.

Connected Vehicles

The questionnaire included a number of questions on the deployment of connected vehicle (CV) technologies. Due to the complex skip logic in this section of the survey, a summary of the questions is presented here.

All 464 transit management agencies were asked first about whether they are currently developing, testing, or deploying CV technologies (or partnering to develop, test, or deploy). Response options included *yes*; *no, but my agency is planning for CV*; *no plans for CV*; and *don't know*.

The subset of transit management agencies that reported they are not currently developing, testing, or deploying CV but are planning for CV deployment in the future were asked two follow-up questions:

- Whether their plans for CV are documented *(yes, no, don't know)*
- When they plan to begin developing, testing, or deploying CV (*within the next 3 years, in 3 to 6 years*, or *in 7 or more years*)

The subset of transit management agencies that reported they are currently developing, testing, or deploying CV technologies (or partnering to develop, test, or deploy) were asked two follow-up questions:

- Whether they are deploying (or partnering to deploy) roadside units (RSUs) *(yes, no, don't know)*
- Whether they are developing, testing or deploying (or partnering to develop, test, or deploy) CV applications *(yes, no, don't know)*

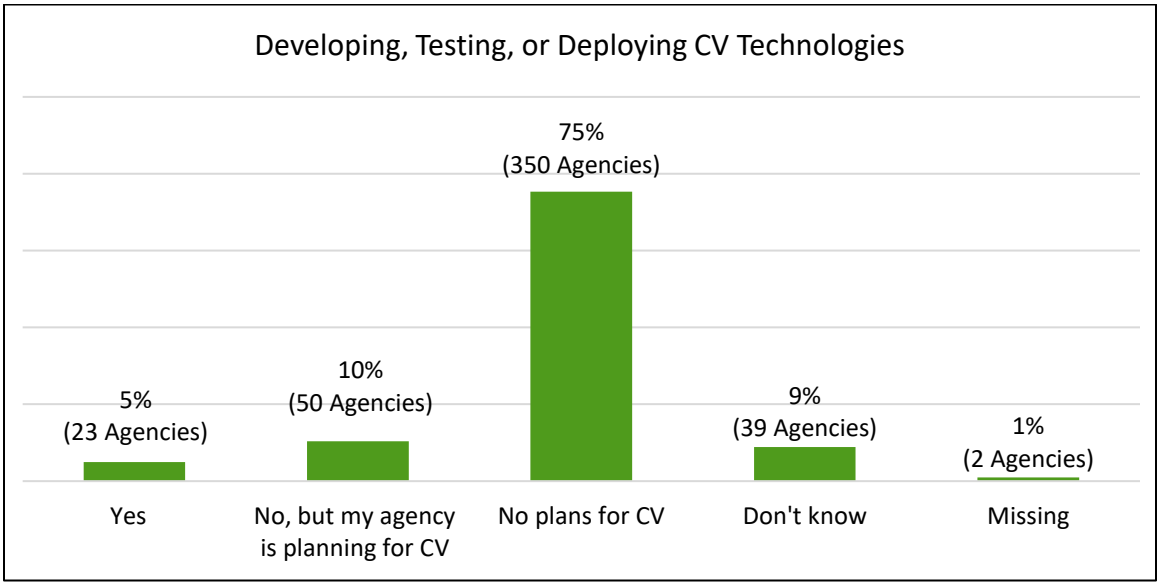
If a transit management agency indicated it was developing, testing, or deploying (or partnering to develop, test, or deploy) CV applications, it was asked a single follow-up question:

- Which specific CV applications is the agency developing, testing or deploying (or partnering to develop, test, or deploy)

The findings for all these questions are presented in this section. In the charts, the percentages (weighted) are shown for each response, as well as the unweighted number of transit management agencies.

Developing, Testing, Or Deploying CV Technologies

Figure 40 shows that of all 464 responding transit management agencies, 5 percent are *currently developing, testing, or deploying connected vehicle (CV) technologies (or partnering with other agencies to develop, test, or deploy)*, and an additional 10 percent are not currently developing, testing, or deploying but are *planning for CV*. Three fourths of transit agencies have *no plans for CV* (75 percent), and 9 percent reported *don't know*.



2023 Q24; (n=464) *Source: USDOT*

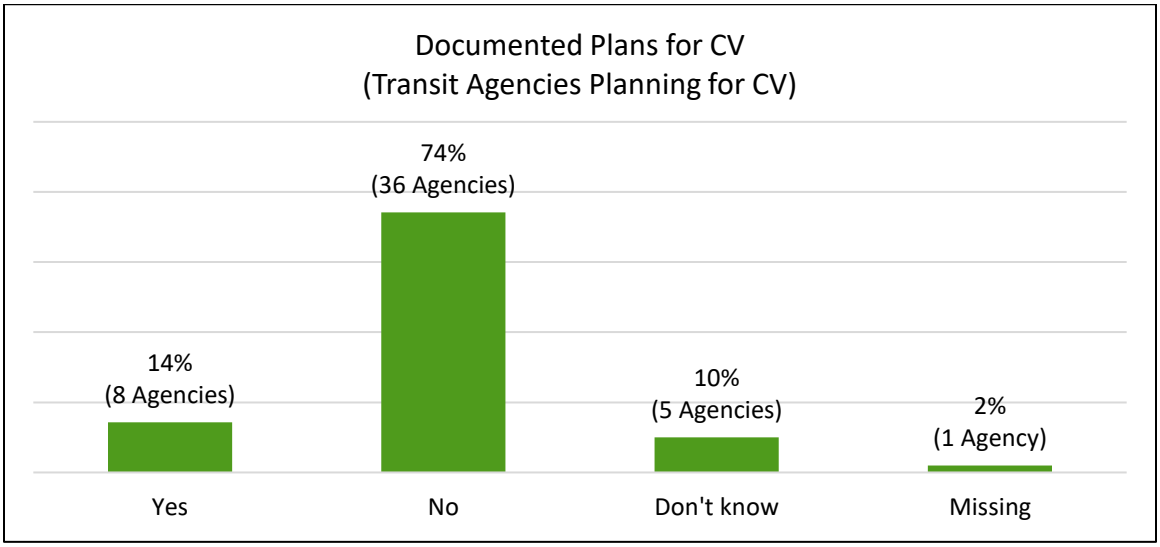
Figure 40. Developing, Testing, or Deploying CV Technologies

Transit management agencies in rural areas are significantly more likely to have *no plans for CV* compared to transit agencies in large urban areas (82 percent compared to 68 percent).

Planning For CV (But Not Currently Developing, Testing, or Deploying)

The 50 responding transit management agencies that are not currently developing, testing, or deploying CV but are planning for CV (referred to as "transit agencies planning for CV" in this section, and as shown previously in Figure 40) were asked if those plans are documented.

Of these transit agencies planning for CV, 14 percent *have documented plans to develop, test, or deploy CV,* as shown in Figure 41. Almost three fourths have *no documented plans for CV* (74 percent), and 10 percent reported *don't know*.



2023 Q25; (WN=48, UWN=50) *Source: USDOT*

Figure 41. Documented Plans for CV (Transit Agencies Planning for CV)

Additionally, among these 50 transit management agencies planning for CV, 45 percent expect to begin developing, testing, or deploying CV *within the next 3 years,* 23 percent *in 3 to 6 years*, and 11 percent *in 7 or more years*. Twenty (20) percent of transit agencies reported *don't know*.

Deployment of RSUs and CV Applications Among Transit Agencies Developing, Testing, or Deploying CV (or Partnering to Develop, Test, or Deploy)

Due to the small number of respondents who reported currently developing, testing, or deploying CV (or partnering to develop, test, or deploy), the following results are presented using the unweighted number of transit management agencies.

The 23 transit management agencies that reported they are currently developing, testing, or deploying CV (or partnering to do so) were asked separate questions about their deployment of RSUs and deployment of CV applications.

Of the 23 respondents currently developing, testing or deploying CV (or partnering to do so) (as shown previously in Figure 40), 5 are *deploying or partnering to deploy RSUs* to support CV and/or AV testing/deployment and 9 are *developing, testing, or deploying (or partnering to develop, test, or deploy) CV applications*,[33] including:

- *Transit signal priority* (6 agencies)
- *Intelligent traffic signal system* (4 agencies)
- *Pedestrian in signalized crosswalk warning* (2 agencies)
- *Blind spot/Lane change warning* (2 agencies)
- *Forward collision warning* (2 agencies)
- *Integrated dynamic transit operations* (2 agencies)
- *Intersection movement assist* (1 agency)
- *Red light violation warning* (1 agency)
- *Agency data applications* (1 agency)

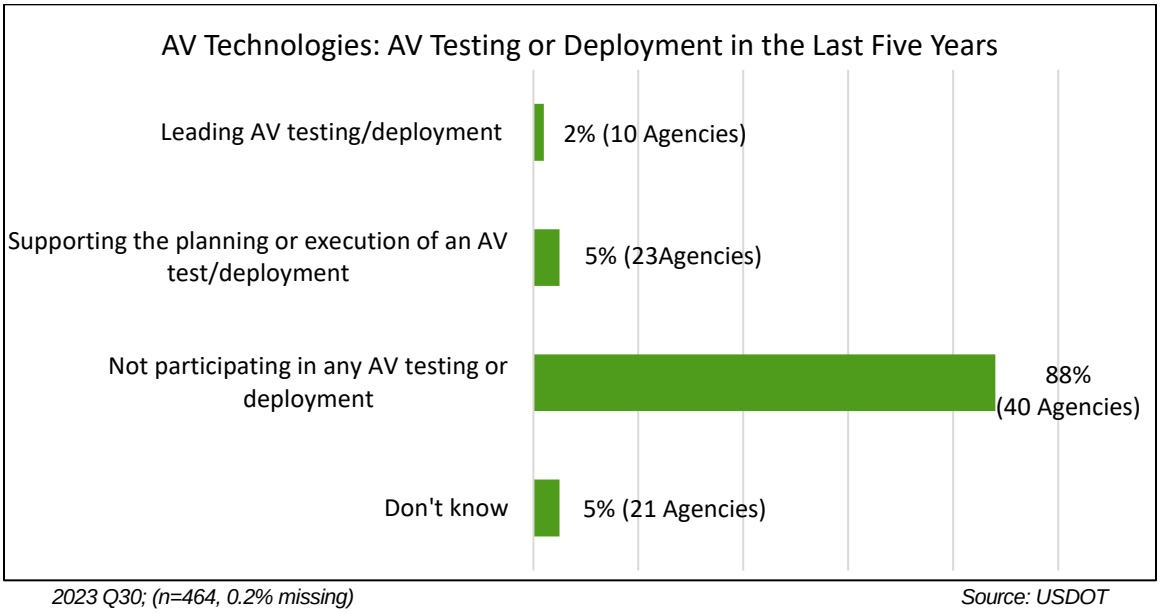
No transit management agency deploying (or partnering to deploy) CV applications reported deploying *curve speed warning; reduced speed/work zone warning; emergency electronic brake lights; vehicle turning right in front of bus warning; queue warning; dynamic eco routing; eco-approach and departure at signalized intersections; road weather warning;* and *other CV applications*.

[33] Respondents were asked, "Is your agency developing, testing, or deploying (or partnering with other agencies to develop, test, or deploy) any connected vehicle applications, including in-vehicles (i.e., using an onboard unit (OBU), Human Machine Interface (HMI), or similar) or among pedestrians or cyclists (i.e., using a handheld device)? *This may include applications that your agency is testing either on its own fleet or in partnership with automakers/original equipment manufacturers."*

Automated Vehicles

Figure 42 shows that of all 464 responding transit management agencies, 2 percent reported *leading or has led automated vehicle (AV) testing/deployment* in the last five years, and another 5 percent reported *supporting or has supported the planning or execution of an AV test/deployment* in the last five years. No agency reported both leading and supporting an AV test/deployment.

A large majority of transit agencies are *not participating in any AV testing or deployment* (88 percent), and 5 percent of respondents reported *don't know*.



2023 Q30; (n=464, 0.2% missing) *Source: USDOT*

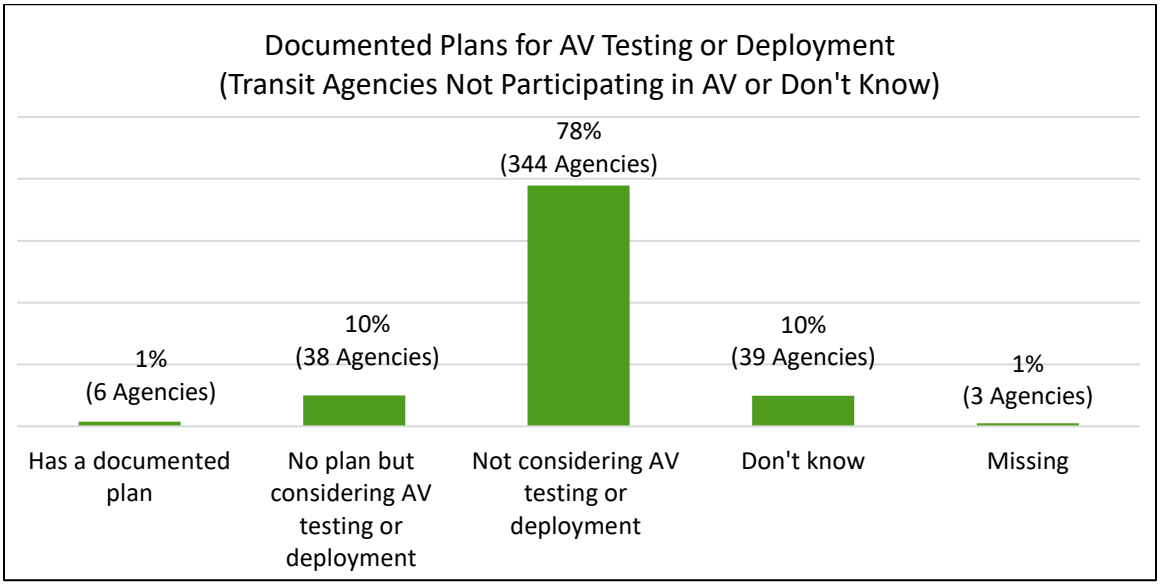
Figure 42. AV Technologies: AV Testing or Deployment in the Last Five Years

Fifteen (15) percent of transit management agencies in large urban areas reported *leading* or *supporting AV testing/deployment,* which is significantly higher than both transit agencies in small urban areas (3 percent) and transit agencies in rural areas (2 percent).

Local Agencies Not Participating in AV Testing/Deployment

The 430 transit management agencies that reported *not participating in AV testing/deployment* or reported *don't know* (as previously shown in Figure 42) were asked if their agency had any documented plans to participate in AV testing or deployment in the future.

Figure 43 shows that of these 430 transit agencies, 1 percent *have a documented plan,* and 10 percent reported *no plans but are considering AV testing or deployment*. More than three fourths of these transit agencies are *not considering AV testing or deployment* (78 percent), and 10 percent reported *don't know.*



2023 Q31; (WN=429, UWN=430) *Source: USDOT*

Figure 43. Documented Plans for AV Testing or Deployment (Transit Agencies Not Participating in AV or Don't Know)

Due to the small number of respondents who received the remainder of the AV follow-up questions, the following results are presented using the unweighted number of transit management agencies.

The 44 transit agencies that either have a documented plan for AV or have no plan but are considering AV testing or deployment were asked about their timeline for testing or deploying AV. Of these 44 transit management agencies, 11 expect to begin deploying *within the next three years*, 13 *in 3 to 6 years*, and six (6) *in 7 or more years*. Fourteen (14) transit agencies reported *don't know*.

The 33 transit management agencies who reported leading or supporting AV testing or deployment (as previously shown in Figure 42) partnered with a range of entities:

- *Universities* (9 agencies)
- *State agencies* (8 agencies)
- *Automakers or original equipment manufacturers* (7 agencies)
- *Advanced driver assistance systems developers* (6 agencies),
- *Automated driving systems developers* (6 agencies)
- *Private sector consultants* (6 agencies)
- *Metropolitan planning organizations* (5 agencies)
- *Other transit agencies* (4 agencies)
- *Transportation Network Companies* (3 agencies)
- *Other local agencies* (3 agencies)
- *Other* (4 agencies)

Transit management agencies leading or supporting AV testing or deployment in the last five years were asked about the types of tests or deployments they executed.

The 33 transit management agencies who reported leading or supporting AV reported the following types of tests or deployments:

- *Automated passenger fixed route* (19 agencies)
- *Automated passenger on-demand* (6 agencies)
- *Automated bus rapid transit (BRT)* (3 agencies)
- *Automated maintenance/bus yard operations* (1 agency)
- *Other tests or deployments* (6 agencies)

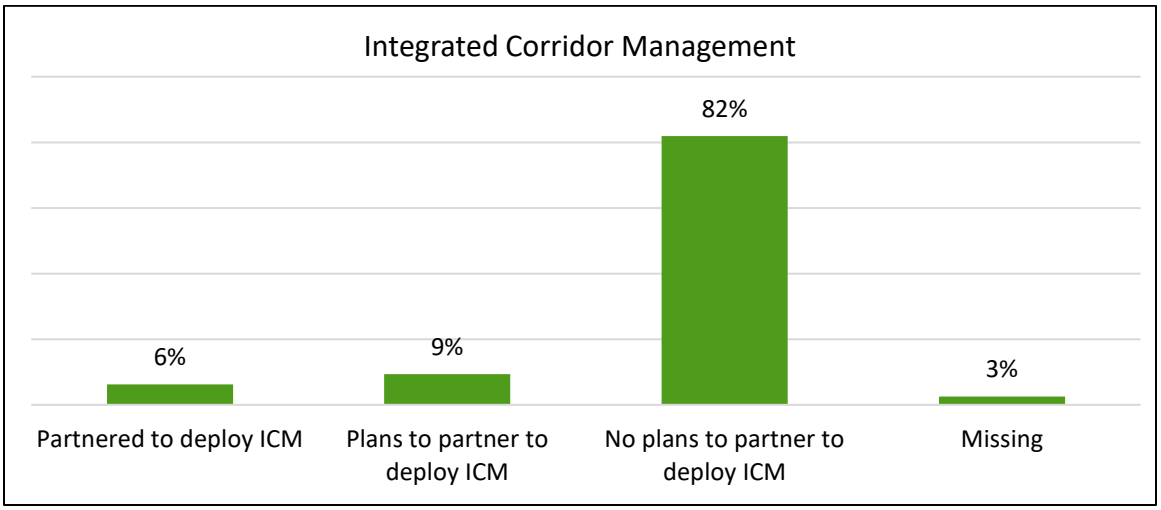
Across the AV tests and deployments, the 33 transit management agencies reported testing or deploying on the following vehicle types:

- *Novel-design low speed shuttle* (15 agencies)
- *Cutaway bus or minibus* (8 agencies)
- *Full-sized transit bus* (6 agencies)
- *Light-duty passenger vehicles* (6 agencies)
- *Articulated bus* (2 agencies)
- *Other* (1 agency)

Integrated Corridor Management

Integrated Corridor Management (ICM) is an approach to managing a transportation corridor as a multimodal system, integrating operations such as traffic incident management, work zone management, traffic signal timing, and real-time traveler information dissemination to maximize the capacity of all facilities and modes across the corridor. A corridor includes freeway, arterial, and public transit facilities with cross-facility connections.

Figure 44 shows that 6 percent of all surveyed transit management agencies have *partnered to deploy ICM,* and 9 percent *plan to partner to deploy ICM*. However, the majority of transit agencies reported *no plans to partner to deploy ICM* (82 percent).



2023 Q46; (n=464) *Source: USDOT*

Figure 44. Integrated Corridor Management

Table 11 shows transit management agencies in large urban areas are significantly more likely to have *partnered to deploy ICM* or *have plans to partner to deploy ICM* compared to both transit agencies in small urban areas and transit agencies in rural areas. Transit agencies in small urban areas (86 percent) and transit agencies in rural areas (91 percent) are significantly more likely to have *no plans to partner to deploy ICM* compared to agencies in large urban areas (72 percent).

Table 11. Integrated Corridor Management: Significant Differences Between Area Types

ICM	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
Partnered to deploy ICM (*†)	11%	4%	2%
Plans to partner to deploy ICM (*†)	15%	6%	5%
No plans to partner to deploy ICM (*†)	72%	86%	91%

** statistically significant difference between large urban and rural transit agencies;*
† statistically significant difference between large urban and small urban transit agencies

Source: USDOT

ITS Data for Service Planning

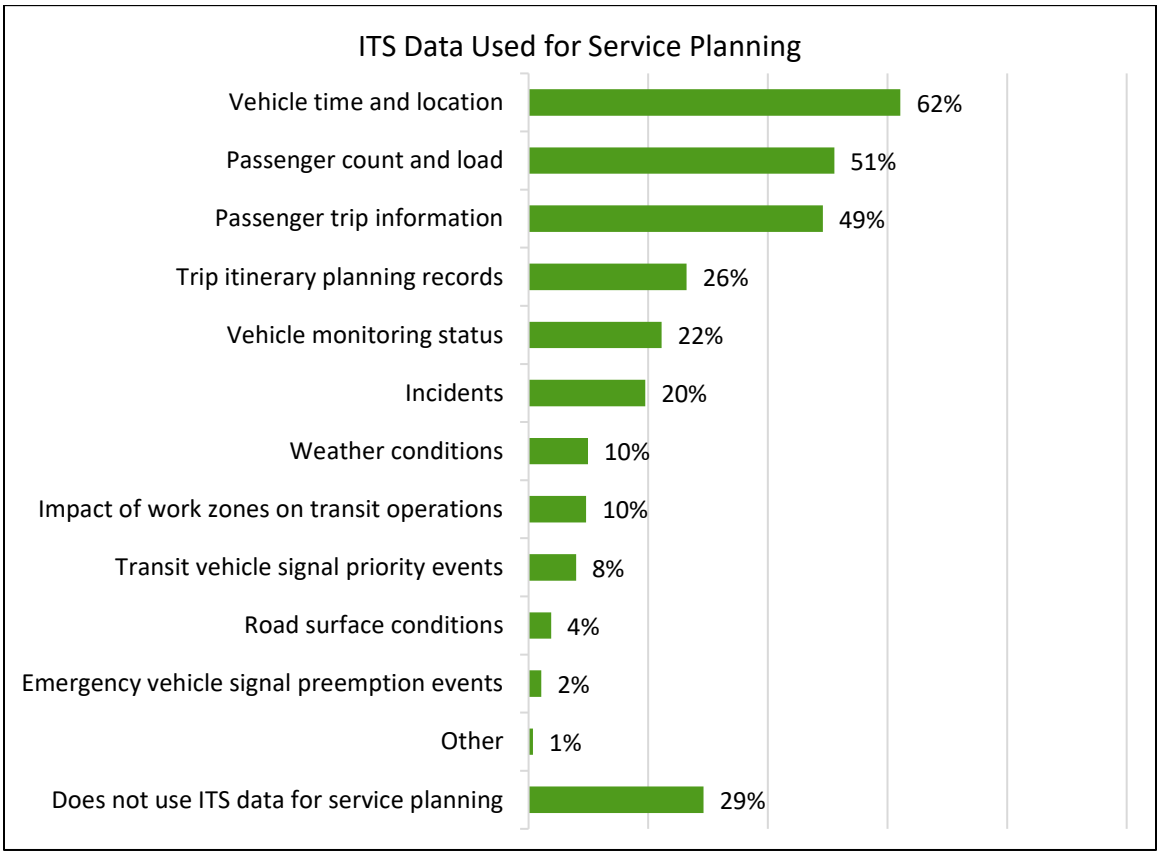
About two thirds of transit management agencies use one or more types of ITS data for service planning (68 percent). Figure 45 shows a majority of transit agencies use *vehicle time and location (e.g., on-time performance)* (62 percent), while about half use *passenger count and load* (51 percent) and *passenger trip information (e.g., fare transactions, trip origin/destination location)* (49 percent).

About one fourth of transit agencies each report use of *trip itinerary planning records (e.g., from apps or trip planners)* (26 percent) and *vehicle monitoring status (i.e., vehicle diagnostics and health)* (22 percent), and 20 percent report use of *incidents* for service planning.

Types of ITS data used by less than 10 percent of responding transit agencies include:

- *Weather conditions*
- *Impact of work zones on transit operations*
- *Transit vehicle signal priority events*
- Road surface conditions
- *Emergency vehicle signal preemption events*

Nearly one third reported their agency *does not use ITS data for service planning* (29 percent).



2023 Q47; (n=464, 2% missing) *Source: USDOT*

Figure 45. ITS Data Used for Service Planning

Table 12 shows the significant differences between the types of ITS data used for service planning by area type. Transit management agencies in large urban areas (69 percent) are significantly more likely than transit agencies in rural areas (55 percent) to use *vehicle time and location*. Transit agencies in large urban areas are more likely to use data on impacts of work zones (15 percent) compared to transit agencies in rural areas (4 percent), and data on *transit vehicle signal priority events* (13 percent) compared to transit agencies in rural areas (3 percent).

Transit agencies in large urban areas (63 percent) are significantly more likely than both transit agencies in small urban areas (49 percent) and transit agencies in rural areas (39 percent) to use *passenger count and load* data.

Vehicle monitoring status data are significantly less likely to be used by transit agencies in small urban areas (13 percent) compared to both transit agencies in large urban areas (27 percent) and transit agencies in rural areas (23 percent).

Table 12. ITS Data Used for Service Planning: Significant Differences Between Area Types

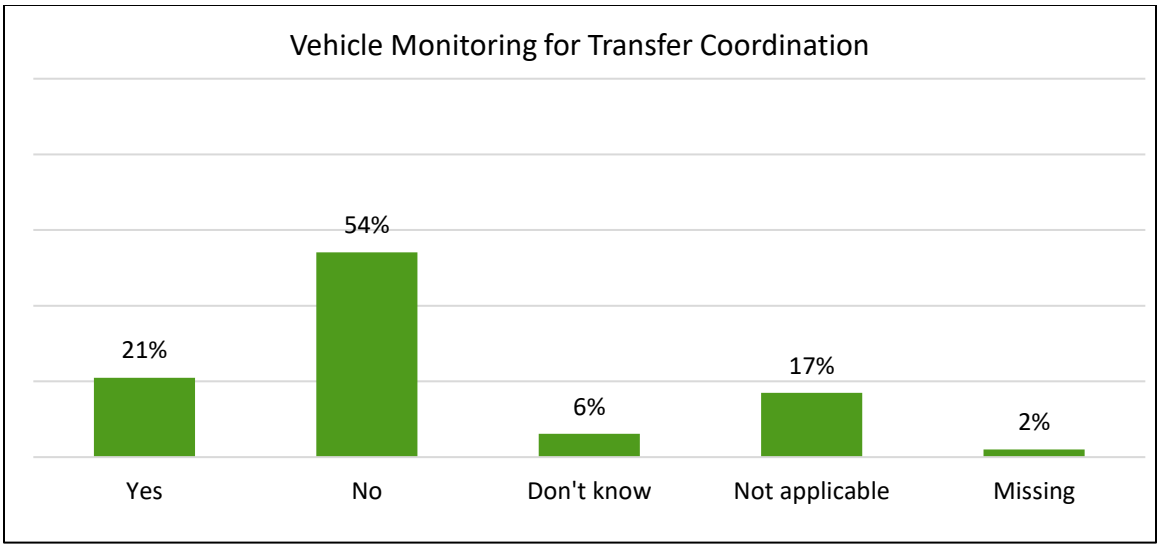
ITS Data Used for Service Planning	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
Vehicle time and location (*)	69%	61%	55%
Passenger count and load (*†)	63%	49%	39%
Vehicle monitoring status (^†)	27%	13%	23%
Impact of work zones on transit operations (*)	15%	9%	4%
Transit vehicle signal priority events (*)	13%	7%	3%

** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Source: USDOT

Transportation Demand Management

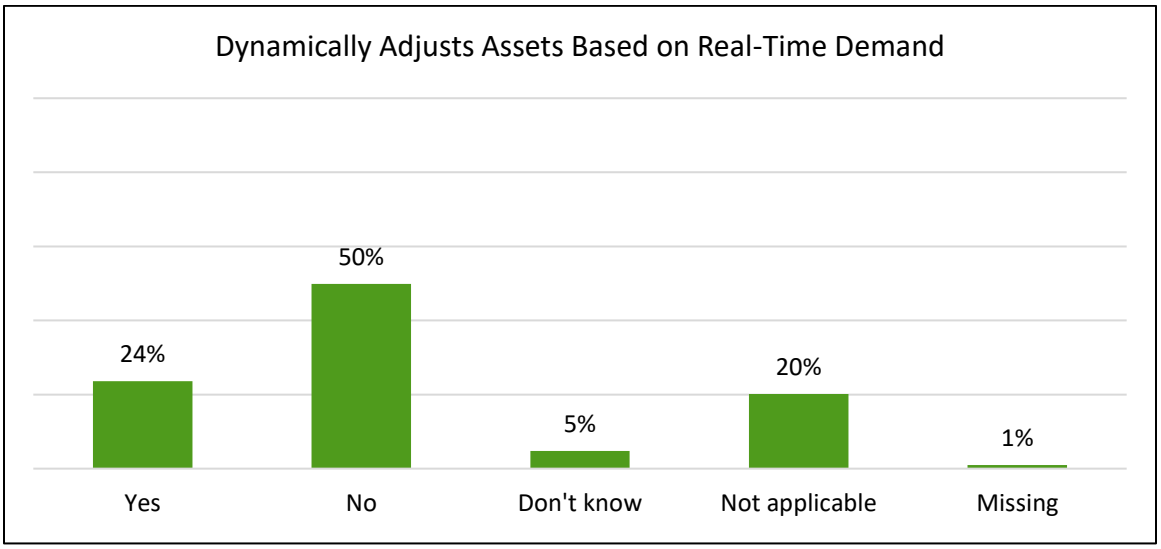
Figure 46 shows that 21 percent of all responding transit management agencies use *vehicle monitoring and communication technologies* to hold vehicles to facilitate the coordination of passenger transfers between vehicles or transit systems (i.e., connection protection). A majority of transit agencies *do not* deploy this technology (54 percent), and 17 percent responded *not applicable*. *Don't know*, a new response option in 2023, was reported by 6 percent of transit agencies.



2023 Q48; (n=464) *Source: USDOT*

Figure 46. Vehicle Monitoring for Transfer Coordination

Figure 47 shows about one fourth of transit management agencies *dynamically adjust the assignment of assets* based on real-time demand to cover the most overcrowded sections of the network (24 percent). Half of transit agencies *do not* use this strategy (50 percent), and one fifth reported *not applicable* (20 percent). *Don't know,* a new response option in 2023, was reported by 5 percent of transit agencies.



2023 Q49, (n=464) *Source: USDOT*

Figure 47. Dynamically Adjusts Assets Based on Real-Time Demand

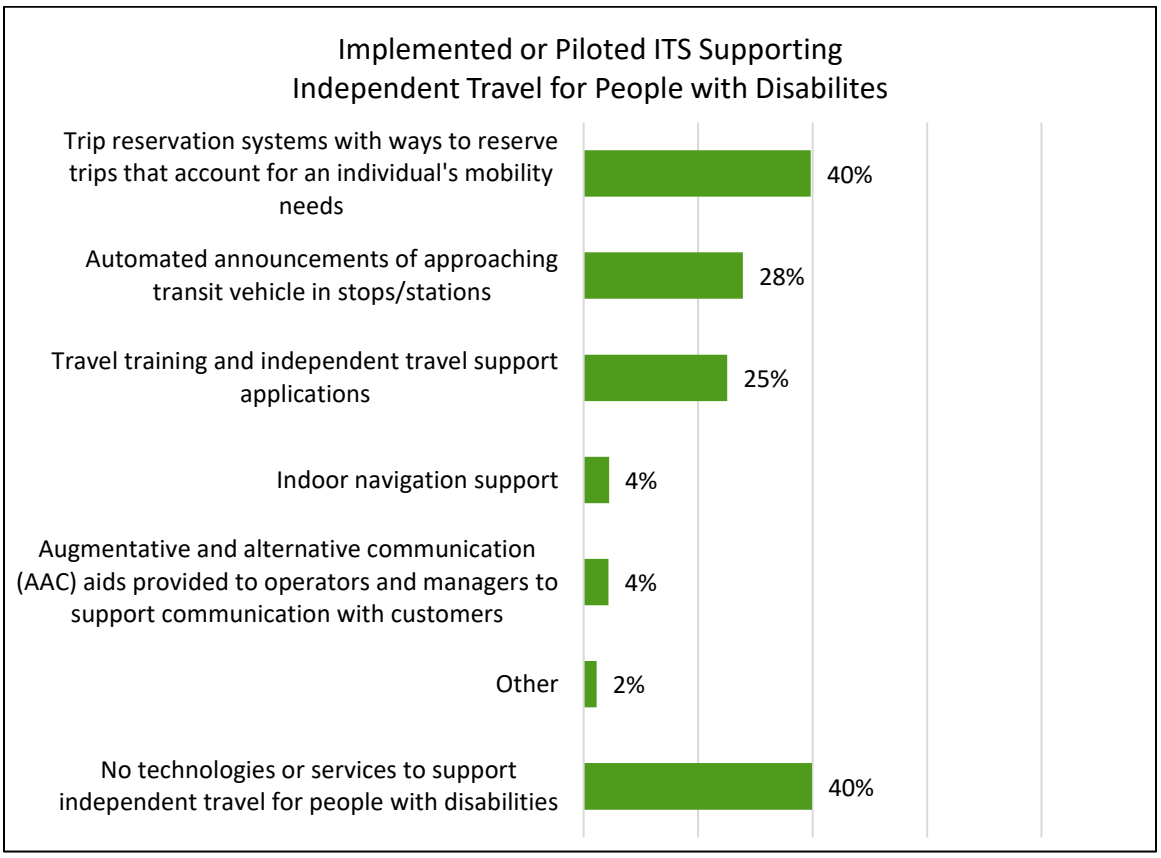
Transit management agencies in rural areas (32 percent) are significantly more likely to *dynamically adjust assignment of assets based on real-time demand* than both transit agencies in large urban areas (19 percent) and transit agencies in small urban areas (19 percent).

ITS for Independent Travel for People with Disabilities

Figure 48 shows the surveyed technologies or services that transit management agencies have implemented or piloted to support independent travel for people with disabilities. These technology solutions may not reflect all services offered to riders with disabilities.

Forty (40) percent of all surveyed transit management agencies use *trip reservation systems with ways to reserve trips that account for an individual's mobility needs in addition to a phone call with customer service representative*, and about one fourth of transit agencies deploy *automated announcements of approaching transit vehicle in stops/stations* (28 percent) and *travel training and independent travel support applications* (25 percent).

Indoor navigation support, as well as *augmentative and alternative communication aids provided to operators and managers to support communications with customers* are each deployed by fewer than 5 percent of transit management agencies. Forty (40) percent of transit agencies reported *no technologies or services to support independent travel for people with disabilities are currently implemented or piloted*.



2023 Q50; (n=464; 4% missing) *Source: USDOT*

Figure 48. Implemented or Piloted ITS Supporting Independent Travel for People with Disabilities

Table 13 shows the implementation or piloting of technology or services to support independent travel for people with disabilities varies significantly by area type. Transit management agencies in large urban areas (37 percent) and transit agencies in small urban areas (37 percent) are significantly more likely to implement or pilot *automated announcements of approaching transit vehicle in stops/stations* compared to transit agencies in rural areas (11 percent).

Similarly, transit agencies in large urban areas (31 percent) and transit agencies in small urban areas (28 percent) are significantly more likely than transit agencies in rural areas (16 percent) to deploy *travel training and independent travel support applications.*

Transit agencies in rural areas (48 percent) are more likely than transit agencies in large urban areas (33 percent) to report *no technologies or services to support independent travel for people with disabilities*.

Table 13. Implemented or Piloted ITS Supporting Independent Travel for People with Disabilities: Significant Differences Between Area Types

ITS Supporting Independent Travel for People with Disabilities	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
Automated announcements of approaching transit vehicle in stops/stations (*^)	37%	37%	11%
Travel training and independent travel support applications (*^)	31%	28%	16%
No technologies or services to support independent travel for people with disabilities are currently implemented or piloted (*)	33%	40%	48%

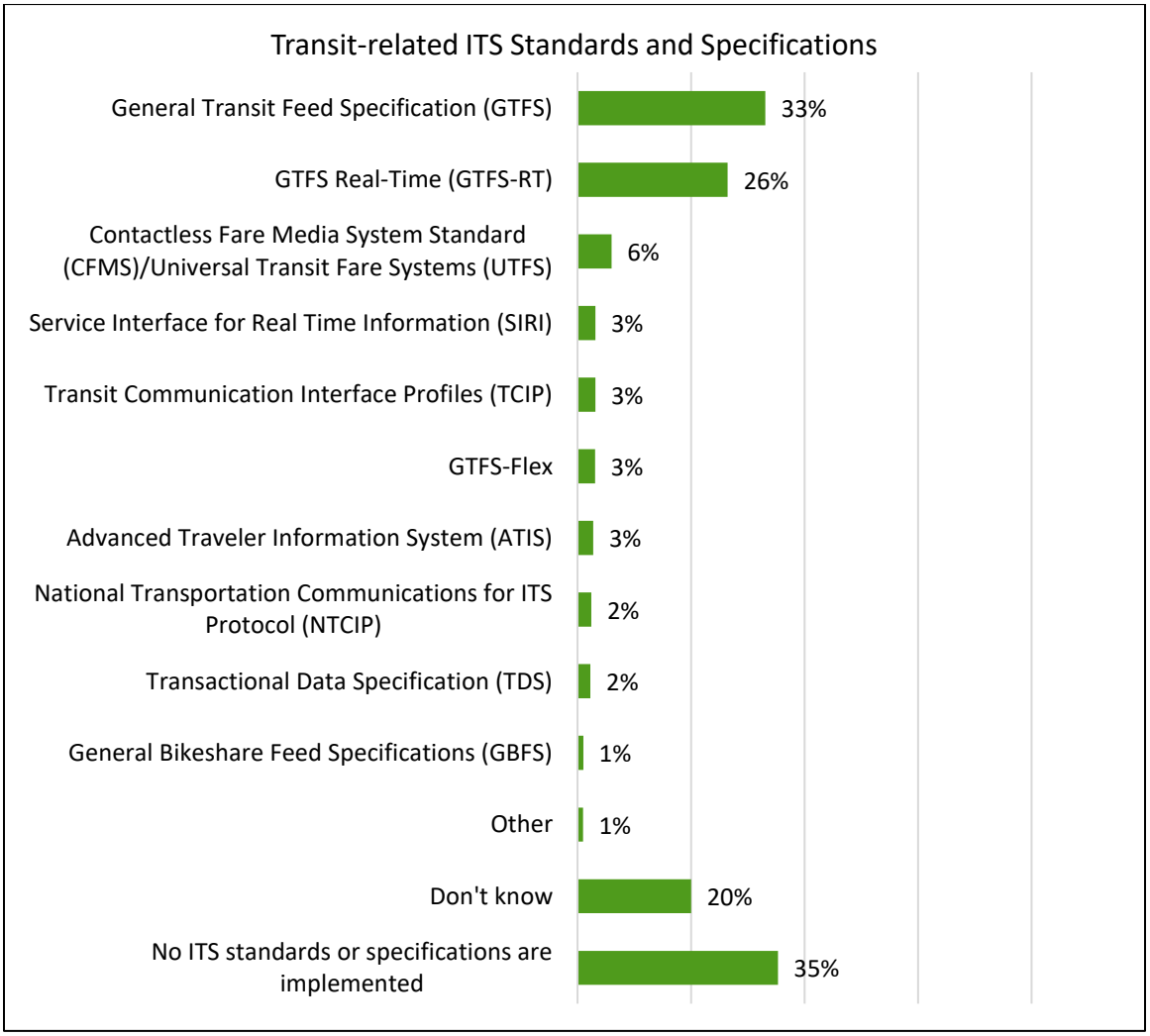
** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies

Source: USDOT

ITS Standards

Forty-two (42) percent of surveyed transit management agencies reported using at least one transit-related ITS standard or specification.

Figure 49 shows one third of all surveyed transit management agencies implement *General Transit Feed Specification (GTFS)* (33 percent), and about one fourth implement *GTFS Real-Time* (26 percent). Fewer than 6 percent of transit agencies reported any of the remaining standards and specifications. One fifth of transit agencies reported *don't know* (20 percent), and 35 percent reported *no ITS standards or specifications implemented*.



2023 Q51; (n=464; 3% missing) *Source: USDOT*

Figure 49. Transit-related ITS Standards and Specifications

Table 14 shows transit management agencies in large urban areas (48 percent) are significantly more likely to use *GTFS* than both transit agencies in small urban areas (34 percent) and transit agencies in rural areas (15 percent). Transit agencies in small urban areas are also significantly more likely to implement *GTFS* than those in rural areas (34 percent compared to 15 percent).

Transit agencies in large urban areas (38 percent) and transit agencies in small urban areas (28 percent) are significantly more likely to implement *GTFS Real-Time* compared to transit agencies in rural areas (13 percent). Overall, transit agencies in rural areas (47 percent) and transit agencies in small urban areas (36 percent) are significantly more likely to report *no ITS standards or specifications* than transit agencies in large urban areas (25 percent).

Table 14. Transit-related ITS Standards and Specifications: Significant Differences Between Area Types

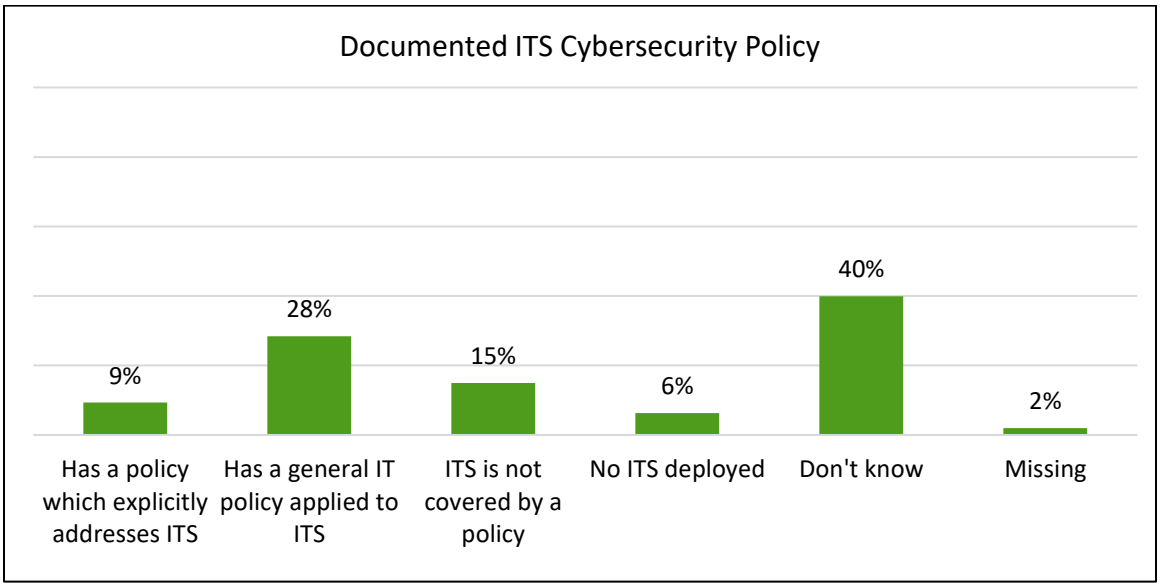
ITS Standards and Specifications	Large Urban (WN=190; UWN=138)	Small Urban (WN=109; UWN=156)	Rural (WN=166; UWN=170)
GTFS (*^†)	48%	34%	15%
GTFS Real-Time (*^)	38%	28%	13%
No ITS standards or specifications are implemented (*†)	25%	36%	47%

** statistically significant difference between large urban and rural transit agencies;*
^ statistically significant difference between small urban and rural transit agencies;
† statistically significant difference between large urban and small urban transit agencies

Source: USDOT

ITS Cybersecurity

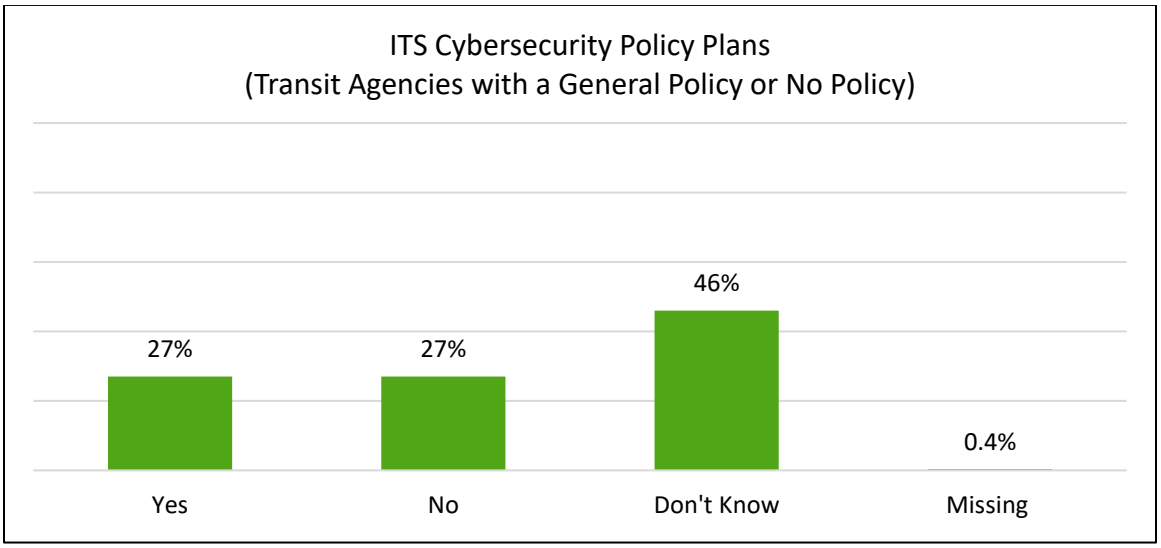
Figure 50 shows, among all surveyed transit management agencies, 9 percent *have* a *cybersecurity policy which explicitly addresses ITS,* and 28 percent *have a general information technology (IT) cybersecurity policy applied to ITS*. Fifteen (15) percent of transit agencies reported that *ITS is not covered by a cybersecurity policy* and 6 percent reported their *agency has not deployed ITS*. Forty (40) percent of transit agencies reported *don't know*.



2023 Q40; (n=464) *Source: USDOT*

Figure 50. Documented ITS Cybersecurity Policy

Figure 51 shows that, for the 198 transit management agencies with a general IT cybersecurity policy which applies to ITS or for which ITS is not covered by a cybersecurity policy, 27 percent *have plans to develop a cybersecurity policy to explicitly address ITS*, and the same percentage *have no plans to develop a policy* (27 percent). Nearly half of respondents reported *don't know* (46 percent).



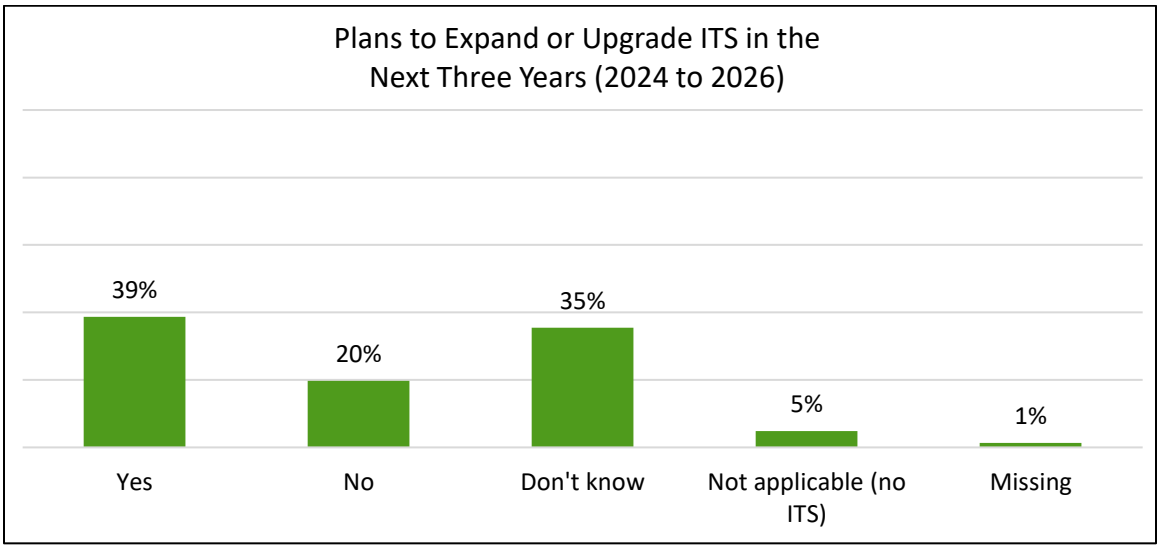
2020 Q41; (WN=198, UWN=203) *Source: USDOT*

Figure 51. ITS Cybersecurity Policy Plans (Transit Agencies with a General Policy or No Policy)

Future ITS Deployment

All transit management agency respondents were asked about their ITS deployment plans in the next three years (2024 through 2026).

Figure 52 shows that 39 percent of transit management agencies *plan to expand or upgrade their current ITS*. One fifth of respondents have *no plans to expand or upgrade* (20 percent), and 35 percent reported *don't know.* Five (5) percent of transit agencies reported that plans to expand or upgrade ITS were *not applicable, no ITS deployed*.

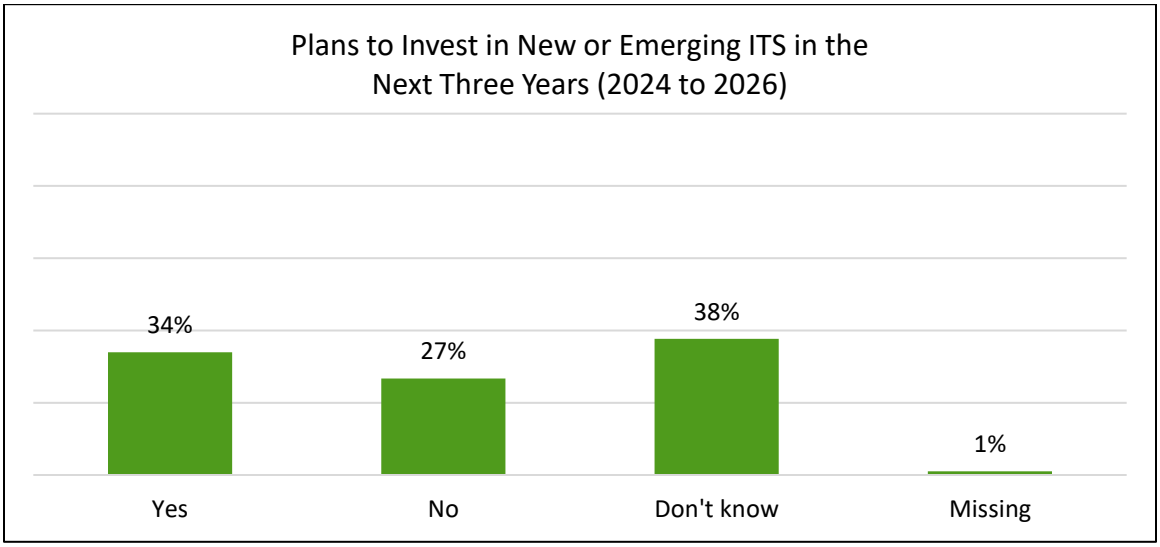


2023 Q52; (n=464) *Source: USDOT*

Figure 52. Plans to Expand or Upgrade ITS in the Next Three Years (2024 to 2026)

Transit management agencies in large urban areas (45 percent) and transit agencies in small urban areas (43 percent) reported *plans to expand or upgrade their ITS* at significantly higher rates than transit agencies in rural areas (29 percent).

Figure 53 shows that about one third of transit management agencies *have plans to invest in new or emerging ITS* (34 percent), while over one fourth of transit agencies reported *no plans to invest in new or emerging ITS* (27 percent). Thirty-eight (38) percent of respondents *don't know*.



2023 Q53; (n=464) *Source: USDOT*

Figure 53. Plans to Invest in New or Emerging ITS in the Next Three Years

Significantly more transit management agencies in large urban areas *have plans to invest in new or emerging ITS* compared to transit agencies in rural areas (39 percent compared to 27 percent).

Chapter 4. Transit Management Survey Trend Analysis

This chapter provides trend analysis (where applicable and available) for the 2023 Transit Management Survey and previous Transit Management Surveys (1999 – 2020). The trend analysis provides valuable information to the ITS JPO and its stakeholders on how ITS technologies are evolving, including which technologies have low levels of deployment, which are gaining traction, and which may have reached maturity and are mainstream.

Trend analyses are available for a subset of 2023 transit management agencies in large metropolitan areas that have been previously surveyed as part of the historical ITS Deployment Tracking Survey (i.e., part of the sample from 1999 – 2020). This subgroup within the 2023 ITS Deployment Tracking Survey, referred to as "historically surveyed transit management agencies," includes 60 transit respondents. To remain comparable to the historical data, the results of this chapter are presented using unweighted data.

The sample size for the 2023 historically surveyed transit management agencies is relatively smaller than the sample sizes for the 2020 and 2016 ITS Deployment Tracking Survey because the previous surveys focused only on large metropolitan areas. The 2023 historically surveyed transit management agencies are a subset of the full 2023 sample.[34]

Since the 2023 ITS Deployment Tracking Survey is the first year in which the survey population was expanded to include transit management agencies in small urban and rural areas, trend data are not available for the "total" response this year. The trend for the total (i.e., expanded) transit management agency population will be reported with the next ITS Deployment Tracking Survey.

Reporting Notes

This chapter is organized by ITS technologies and topics for which trend is available. The 2023 ITS Deployment Tracking Survey question number is referenced at the bottom of each figure. The number of respondents is referenced in each figure with the respective survey year.

Trend may be shown for an indicator (i.e., the percentage of transit agencies each survey year that deployed at least one technology of a given type of ITS, such as at least one ITS safety systems technology), or trend may be shown for a list of response options for a given type of ITS.

In the historical ITS Deployment Tracking Survey (1999-2020), data only included the responses of transit management agencies in large metropolitan areas, which have a higher incidence of ITS deployment than transit agencies in small urban and rural areas. As a result, the percentages shown in the trend tend

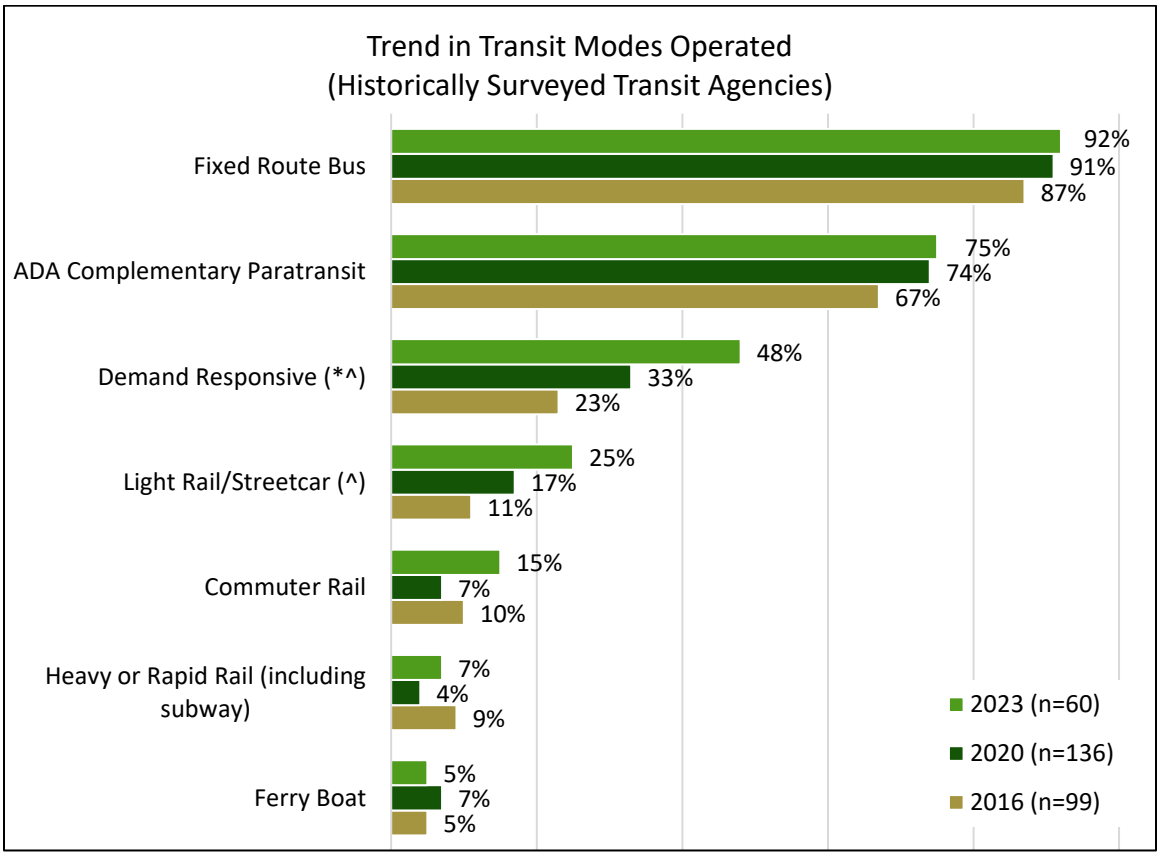
[34] Trends shown for previous ITS Deployment Tracking Surveys (e.g., 2020 and 2016 ITS Deployment Tracking Surveys) include the data for the responding agencies of each respective survey. While the overall sample of agencies invited to participate in the historical ITS Deployment Tracking Survey (1999-2020) remained stable across surveys, the agencies responding to the survey varied, to some degree, with each survey effort. Some agencies consistently responded to the ITS Deployment Tracking Survey, whereas others did not. The trend for a given year represents the data of responding agencies for that year.

to be higher than the percentages reported for all respondents in Chapter 3, which also include the responses of transit agencies in small urban and rural areas.

When reporting trends, significance testing was performed at a significance level of 0.05, with a 95 percent confidence interval.

Transit Modes Trend Analysis

Figure 54 shows that the modes operated by historically surveyed transit agencies have generally remained stable since 2016. However, two modes, *demand response* and *light rail/streetcar,* have seen significant growth. Almost half of historically surveyed transit agencies reported operating *demand responsive* service in 2023 (48 percent). This is a significant increase from both 33 percent of transit agencies in 2020 and 23 percent of transit agencies in 2016. The operation of *light rail/streetcar service* increased a significant 14 percentage points, from 11 percent in 2016 to 25 percent in 2023, but it is not statistically significant from the 17 percent of transit agencies in 2020.



2023 Q1 *Source: USDOT*

**statistically significant difference between 2020 & 2023;*
^statistically significant difference between 2016 & 2023

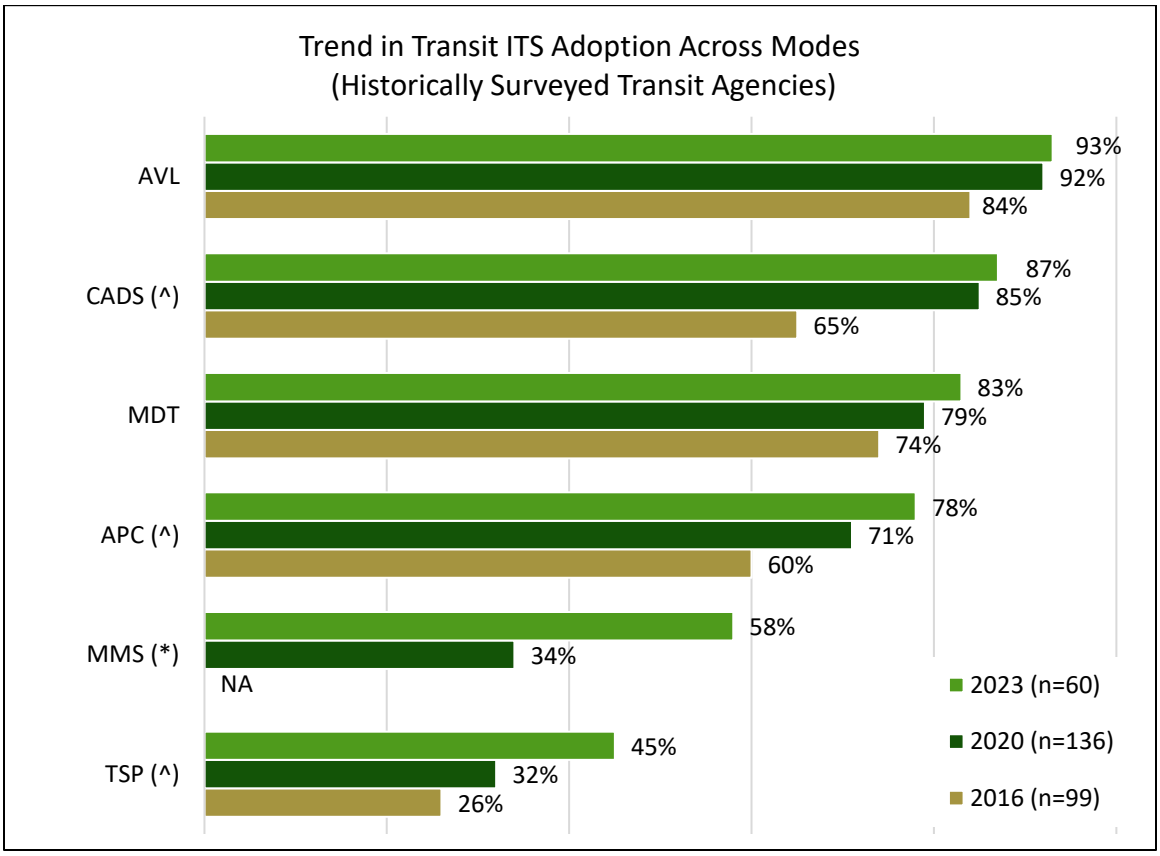
Figure 54. Trend in Transit Modes Operated (Historically Surveyed Transit Agencies)

Transit ITS Adoption Across Modes Trend Analysis

Figure 55 shows the trend of transit agencies that have equipped at least a portion of their revenue vehicles with transit ITS technologies. Technologies with significant increases in adoption since 2016 but with stable deployment between 2020 and 2023 include:

- *CADS* (65 percent in 2016 to 87 percent in 2023)
- *APC* (60 percent in 2016 to 78 percent in 2023)
- *TSP* (26 percent in 2016 to 45 percent in 2023)

MMS, a new response category in the 2020 survey, saw adoption increase significantly between 2020 and 2023, from 34 percent to 58 percent.



2023 Q3
Source: USDOT
**statistically significant difference between 2020 & 2023;*
^statistically significant difference between 2016 & 2023

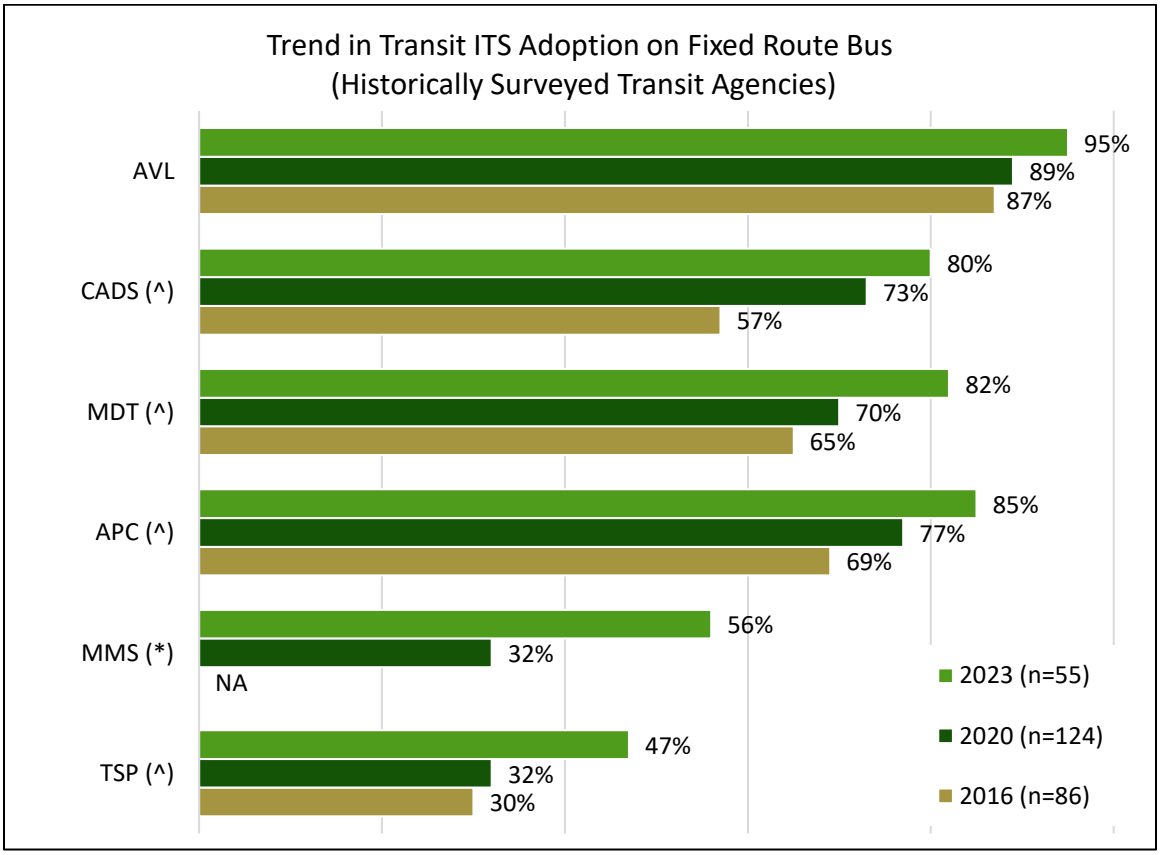
Figure 55. Trend in Transit ITS Adoption Across Modes (Historically Surveyed Transit Agencies)

Transit ITS Adoption on Fixed Route Bus Trend Analysis

Most transit ITS deployed on fixed route buses saw significant increases in adoption since 2016, while deployment was stable between 2020 and 2023 (as shown in Figure 56), including:

- *CADS* (57 percent in 2016 to 80 percent in 2023)
- *MDT* (65 percent in 2016 to 82 percent in 2023)
- *APC* (69 percent in 2016 to 85 percent in 2023)
- *TSP* on fixed route buses (30 percent in 2016 to 47 percent in 2023)

The only exceptions are *AVL,* which was reported to be almost universally deployed in each of the three survey years, and MMS, which was a new response category in the 2020 survey. *MMS* adoption increased significantly from 2020 to 2023, moving from 32 percent to 56 percent.



2023 Q3
Source: USDOT
**statistically significant difference between 2020 & 2023;*
^statistically significant difference between 2016 & 2023

Figure 56. Trend in Transit ITS Adoption on Fixed Route Bus (Historically Surveyed Transit Agencies)

Traveler Information Systems Trend Analysis

This section presents trend analysis for real-time traveler information systems, including:

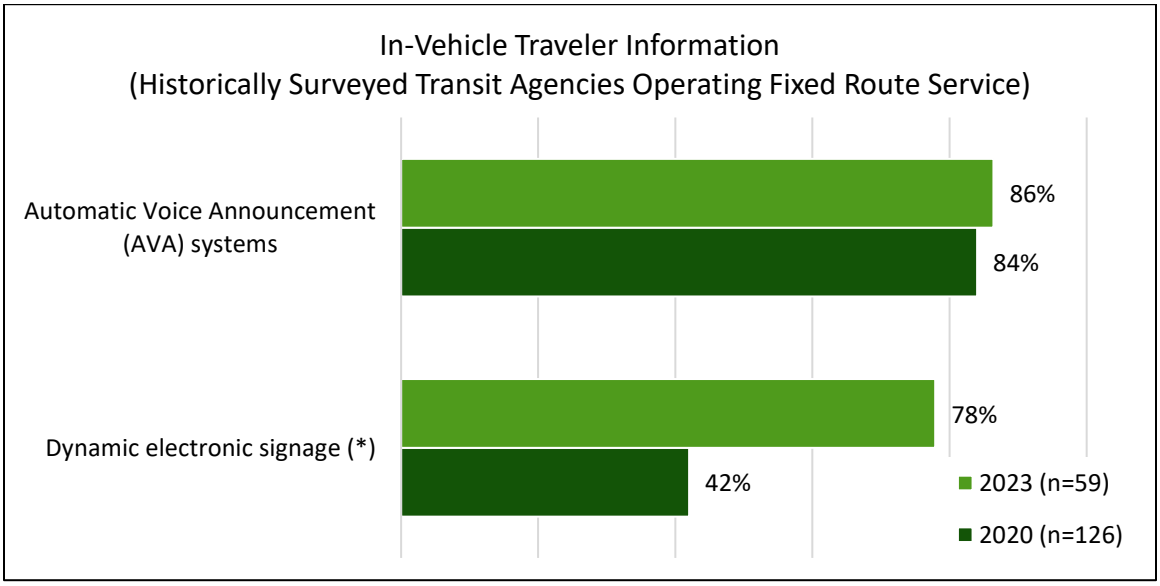
- In-vehicle traveler information
- Traveler information at bus stops/stations
- Traveler information dissemination methods to the public
- Open data feed
- Trip planners

In-Vehicle Traveler Information

Figure 57 shows the trend for in-vehicle traveler information technology among the 59 historically surveyed transit management agencies operating at least one fixed mode (i.e. fixed route bus, heavy or rapid rail, light rail/streetcar, commuter rail, ferry).

A large majority of historically surveyed transit agencies operating fixed route service deploy in-vehicle *AVA systems,* and percentages remained stable from 2020 to 2023. About three fourths of historically surveyed transit agencies operating fixed route service deploy *dynamic electronic signage* in 2023 (78 percent), which is a statistically significant increase from 42 percent of transit agencies deploying *dynamic electronic signage* in 2020.

This question was updated in 2023, and the name of the technology changed from *dynamically updating passenger displays* to *dynamic electric signage.* The significant increase in usage may be (at least in part) an artifact of the change in the response option.



2023 Q4 *Source: USDOT*
**statistically significant difference between 2020 & 2023*

Figure 57. In-Vehicle Traveler Information (Historically Surveyed Transit Agencies Operating Fixed Route Service)

Traveler Information at Bus Stops/Stations

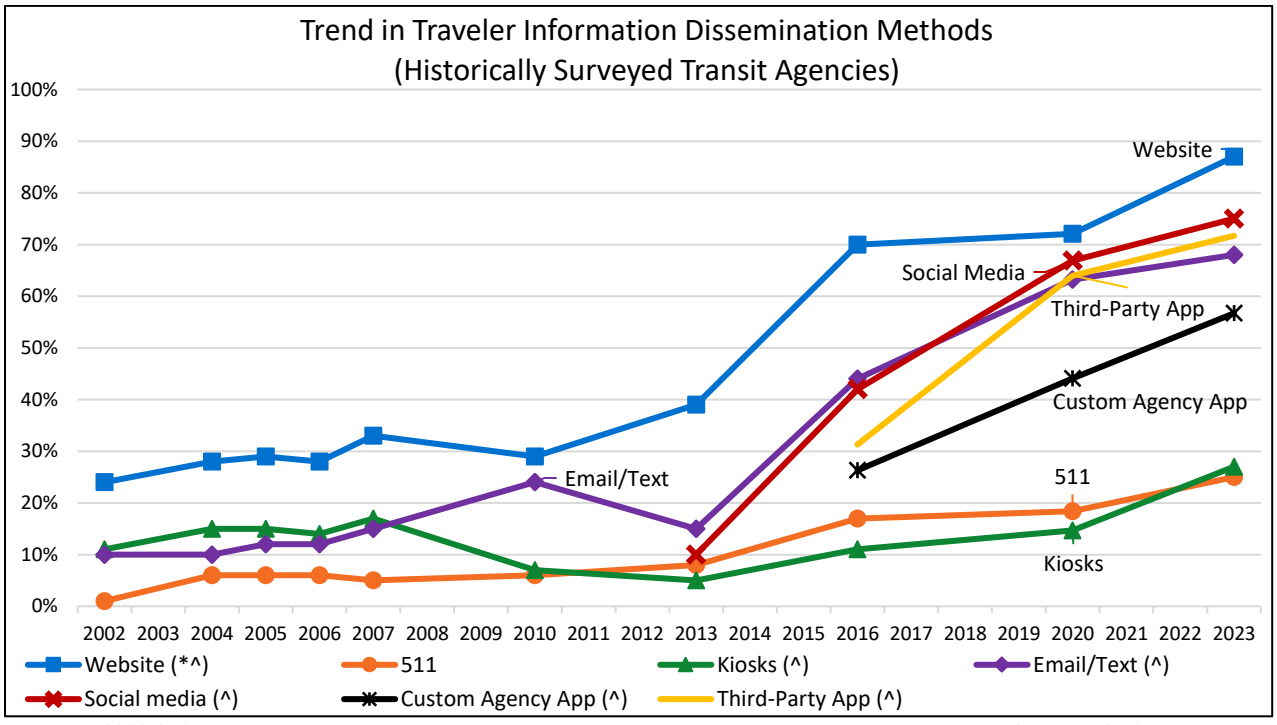
The adoption of *dynamic electronic signage* to provide real-time traveler information to the public at bus stops/stations among those historically surveyed transit management agencies with bus stops/stations has significantly increased from 49 percent in 2020 to 65 percent in 2023.

Real-Time Traveler Information Dissemination

In 2023, nearly all historically surveyed transit management agencies reported using at least one method to disseminate real-time traveler information to the public (98 percent).

Figure 58 shows a large majority of historically surveyed transit agencies use *websites* (87 percent in 2023), which is a significant increase from 72 percent in 2020. Usage of most of the other traveler information dissemination methods increased significantly since 2016 with stable deployment between 2020 and 2023, including:

- *Social media* (42 percent in 2016 to 75 percent in 2023)
- *Third-party apps* (31 percent in 2016 to 72 percent in 2023)
- *Email/text* (44 percent in 2016 to 68 percent in 2023)
- *Custom agency apps* (26 percent in 2016 to 57 percent in 2023)
- *Kiosks* (11 percent in 2016 to 27 percent in 2023)



2023 Q12

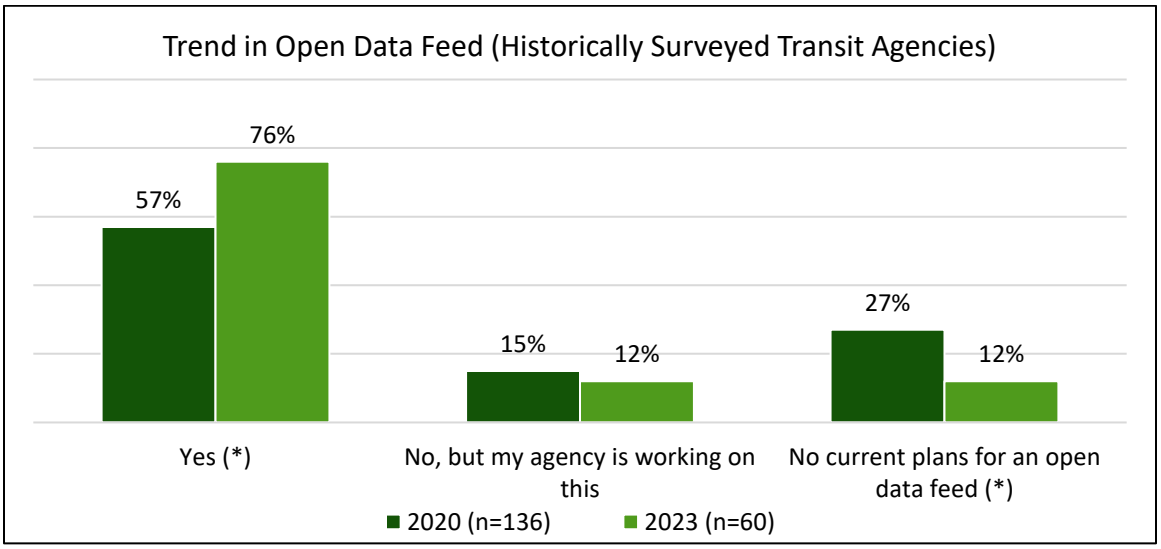
Source: USDOT

**statistically significant difference between 2020 & 2023;*
^statistically significant difference between 2016 & 2023

Figure 58. Trend in Traveler Information Dissemination Methods (Historically Surveyed Transit Agencies)

Open Data Feed

Figure 59 shows about three fourths of historically surveyed transit management agencies *provide an open data feed* (76 percent), which is a statistically significant increase from 57 percent of transit agencies who reported an open data feed in 2020. The percentage of transit agencies with *no current plans for an open data feed* also decreased significantly from 27 percent in 2020 to 12 percent in 2023.



2023 Q9 *Source: USDOT*
**statistically significant difference between 2020 & 2023*

Figure 59. Trend in Open Data Feed (Historically Surveyed Transit Agencies)

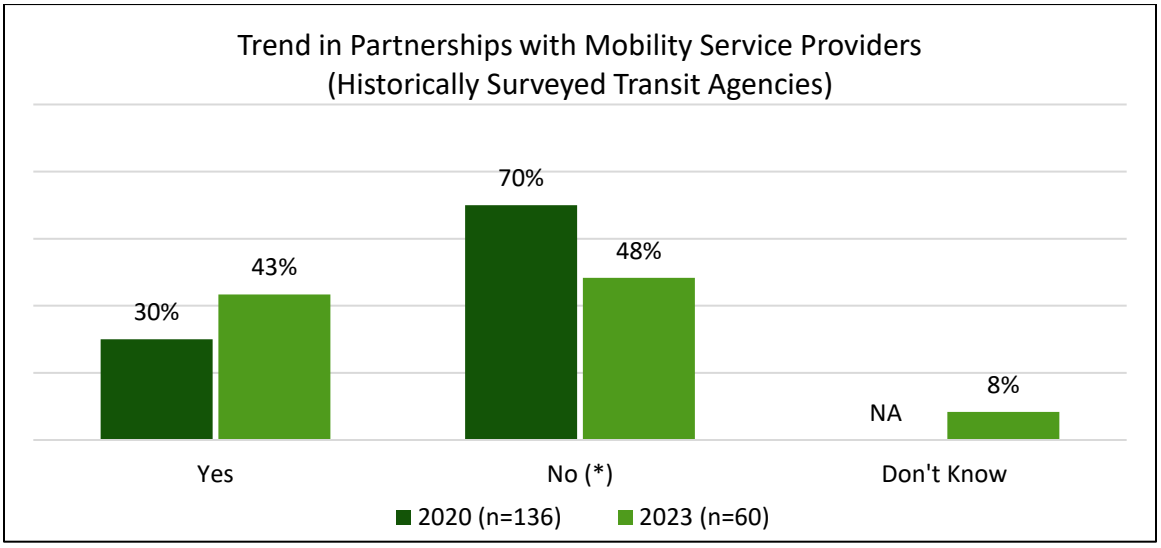
Trip Planner Trend Analysis

In 2023, more than two thirds of historically surveyed transit management agencies *provide an agency-branded trip planner* (67 percent), which is not a statistically significant difference compared to 2020 (74 percent).

Regarding the trip features that transit agencies incorporate in their trip planner (e.g., incorporating modes other than transit, such as walking, biking, or driving routes to stops/stations), there are no statistically significant differences from 2020.

Mobility Service Partnerships Trend Analysis

The trend in partnerships with mobility service providers (e.g., ride-hailing, bike-sharing, microtransit, taxi) is unclear (Figure 60). While the 13-percentage-point increase in historically surveyed transit management agencies reporting a *partnership with mobility service providers* is not significant, the decrease in transit agencies reporting *no partnerships with mobility service providers* is significant, declining from a large majority (70 percent) to less than half (48 percent). The addition of the new response category in 2023, *don't know*, drew 8 percent of respondents in 2023 and may have affected the trend.



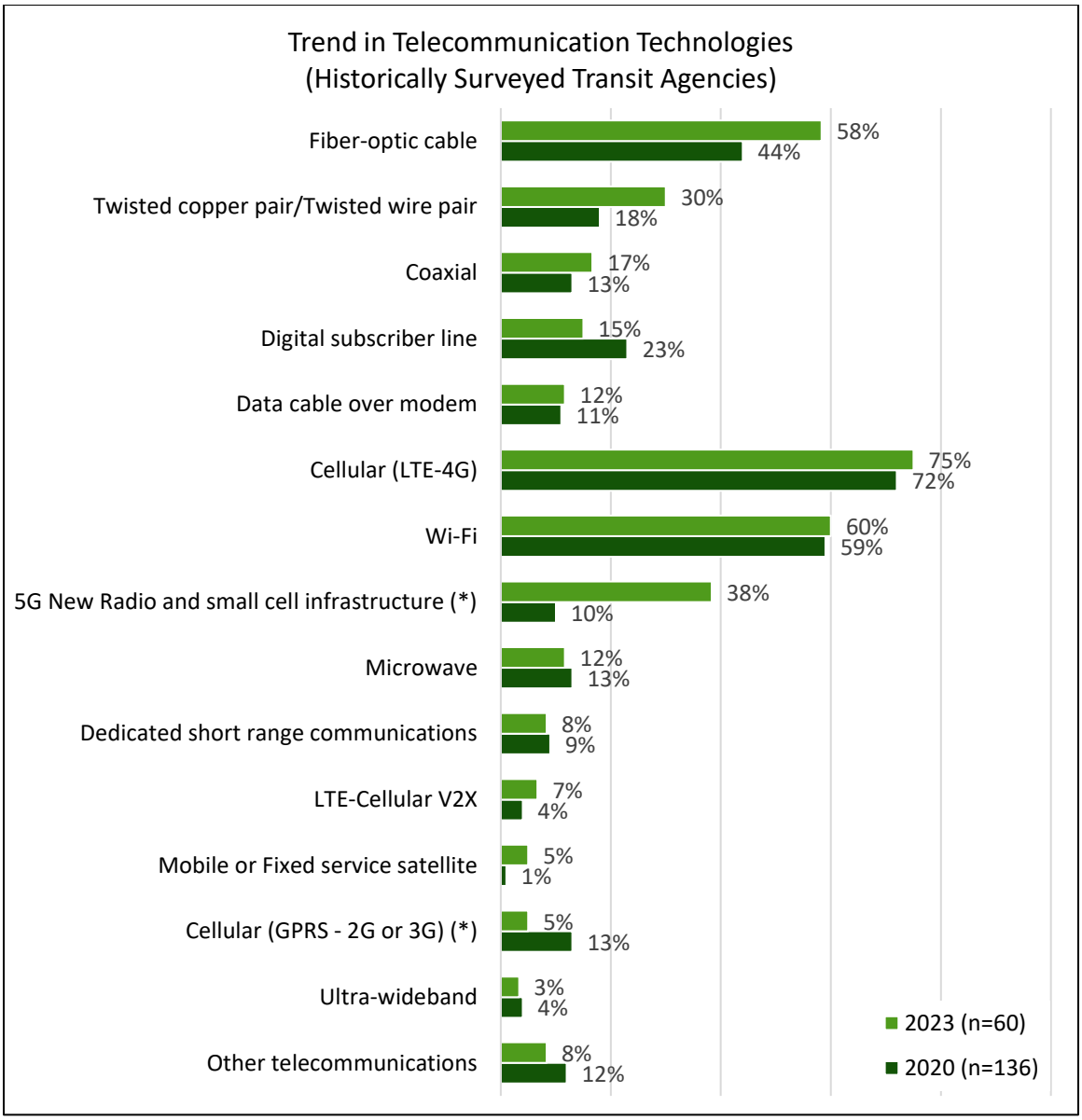
2023 Q20 *Source: USDOT*
**statistically significant difference from 2020*

Figure 60. Trend in Partnerships with Mobility Service Providers (Historically Surveyed Transit Agencies)

Telecommunication Technologies Trend Analysis

Among historically surveyed transit management agencies, 83 percent use at least one telecommunications technology with 67 percent using at least one wired telecommunications technology and 82 percent using at least one wireless telecommunications technology in 2023.

Figure 61 shows that, among the surveyed telecommunication technologies, there are two significant changes from 2020 to 2023. The percent of historically surveyed transit agencies using *5G New Radio and small cell infrastructure* increased from 10 percent in 2020 to 38 percent in 2023, while the use of *cellular (GPRS – 2G or 3G)* decreased from 13 percent in 2020 to 5 percent in 2023.



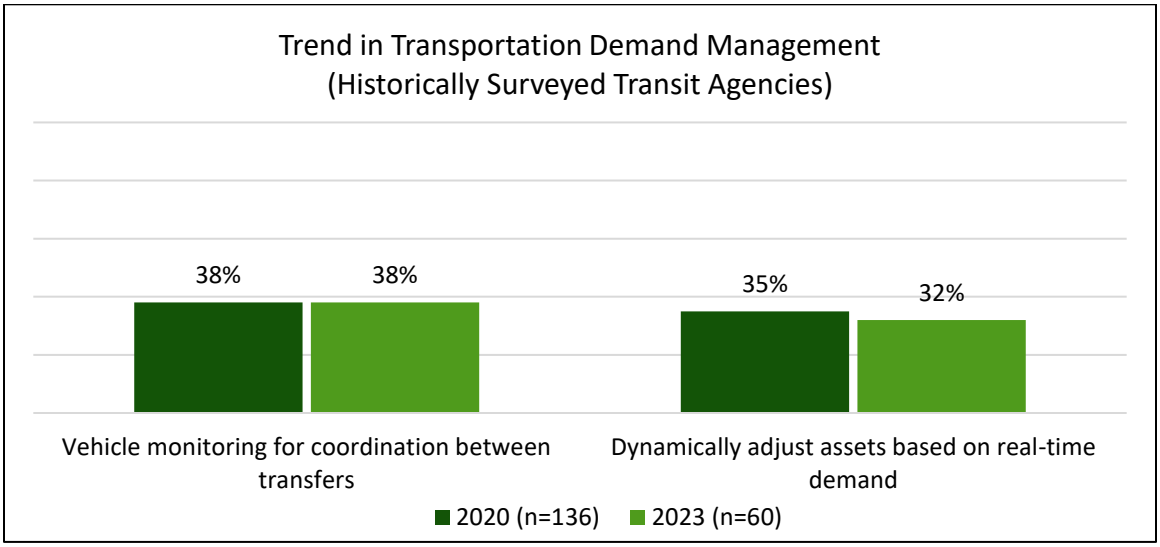
2023 Q36 *Source: USDOT*

**statistically significant difference between 2020 & 2023*

Figure 61. Trend in Telecommunication Technologies (Historically Surveyed Transit Agencies)

Transportation Demand Management Trend Analysis

As shown in Figure 62, there are no statistically significant differences among historically surveyed transit management agencies' use of transportation demand management strategies between 2020 and 2023.



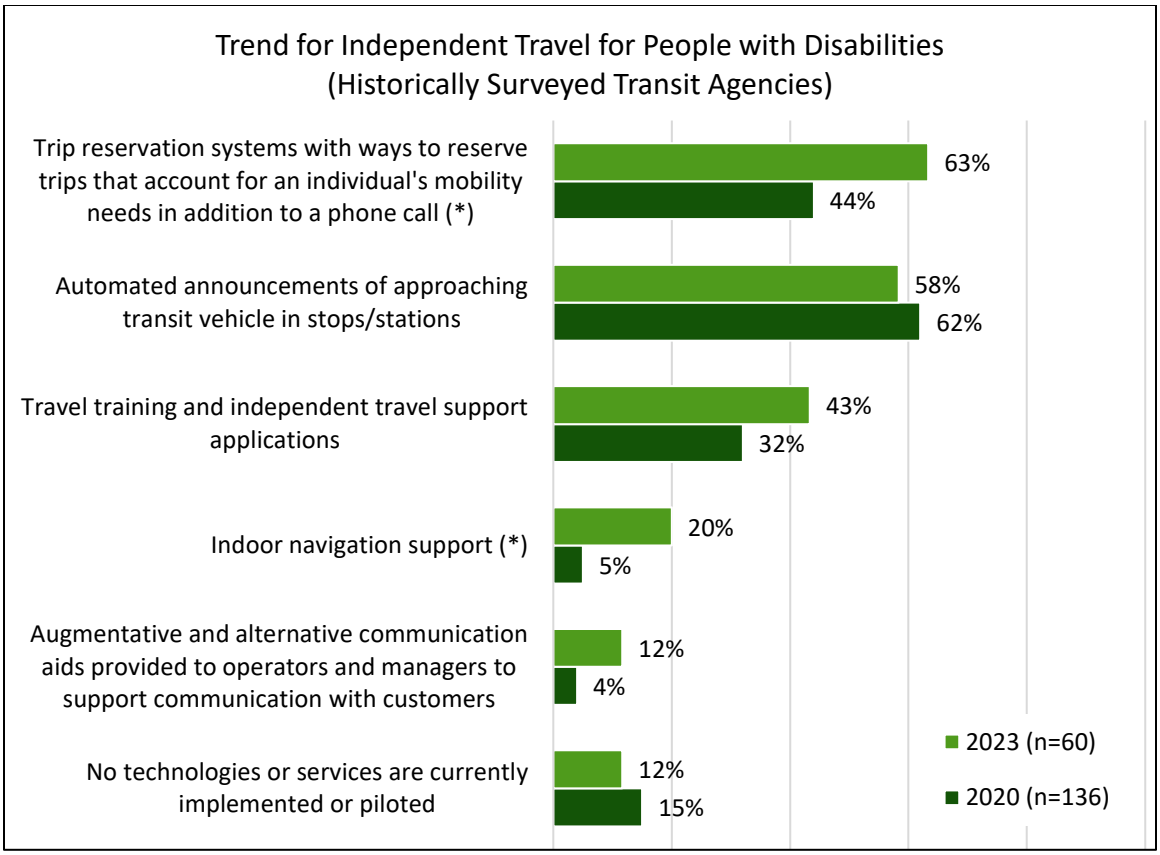
2023 Q48, Q49 *Source: USDOT*

Figure 62. Trend in Transportation Demand Management (Historically Surveyed Transit Agencies)

ITS for Independent Travel for People with Disabilities Trend Analysis

Figure 63 shows trend in implemented or piloted technologies or services to support independent travel for people with disabilities among historically surveyed transit management agencies.

Historically surveyed transit agencies reported significantly increased use of both *trip reservation systems with ways to reserve trips that account for an individual's mobility needs in addition to a phone call with customer service representative and TTY/TDD line* (44 percent in 2020 to 63 percent in 2023) and *indoor navigation support (e.g., wayfinding beacons, digital mapping)* (5 percent in 2020 to 20 percent in 2023).



2023 Q50 *Source: USDOT*
**statistically significant difference between 2020 & 2023*

Figure 63. Trend for Independent Travel for People with Disabilities (Historically Surveyed Transit Agencies)

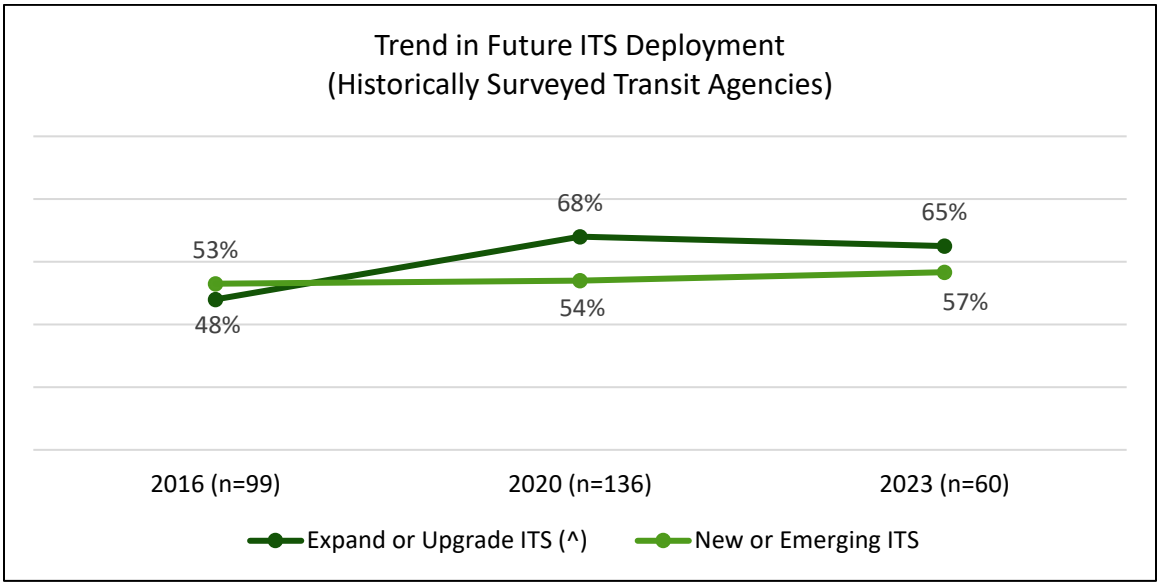
ITS Standards Trend Analysis

Among historically surveyed transit management agencies, there were no statistically significant changes in the use of individually surveyed ITS standards or specifications. However, the overall trend in ITS standards is unclear due to the statistically significant 12 percentage point increase in *don't know* from 10 percent in 2020 to 22 percent in 2023. In addition, other new response options were added in 2023 that may have affected the trend.

Future Deployment Planning Trend Analysis

Figure 64 shows the trend in historically surveyed transit management agencies that plan to *invest in new or emerging ITS* is stable from 54 percent in 2020 to 57 percent in 2023.

About two thirds of historically surveyed transit management agencies plan to *expand or upgrade ITS* (65 percent) in 2023. This is a statistically significant increase from 48 percent in 2016.



2023 Q52, Q53 *Source: USDOT*
^statistically significant difference between 2016 & 2023

Figure 64. Trend in Future ITS Deployment (Historically Surveyed Transit Agencies)

Chapter 5. Conclusions

With the 2023 ITS Deployment Tracking Survey, the ITS JPO significantly expanded the geographic coverage of the Transit Management Survey to include smaller urban and rural areas in addition to the previously surveyed subset of large metropolitan areas.

The 2023 survey found that a large majority of transit management agencies have adopted AVL and CADS, as well as MDT. Moreover, a large majority of transit agencies that deploy these technologies on their fixed route buses, demand responsive, or ADA complementary paratransit are equipping their entire fleet. Other transit vehicle ITS, such as APC, MMS, TSP, and CBTC, are deployed more selectively.

The Transit Management Survey finds that for nearly all surveyed ITS technologies, deployment tends to be higher among transit agencies in large urban (and sometimes transit agencies in small urban areas) compared to transit agencies in rural areas. Two notable exceptions are AVL and CADS, which are mature technologies that are widely deployed.

More than three fourths of surveyed transit management agencies are providing real-time travel information to the public. A majority are using websites and social media to share real-time information, and about one third are using email and text/SMS alerts or third-party mobile apps. In addition, dynamic electric signage is commonly used in fixed route vehicles and at transit facilities. A majority of transit agencies provide an open data feed or plan to do so, pertaining almost universally to fixed route services.

With respect to other key ITS, 42 percent of surveyed transit management agencies deploy EFP, and a majority are planning to upgrade their fare media systems. More than one third of transit management agencies reported that they plan to expand or upgrade their current ITS, and a similar proportion indicated plans to invest in new ITS.

Among the historically surveyed transit agencies (i.e., from a subset of large metropolitan areas), it is possible to assess trends in ITS deployment (where questions are comparable over time), because these transit agencies were surveyed as part of the ITS Deployment Tracking Survey in previous years. The trend data for these historically surveyed transit management agencies show increased deployment levels for several ITS technologies since 2020, including:

- **Transit ITS Across Modes:** *MMS* (from 34 percent in 2020 to 58 percent in 2023)

- **Traveler information Systems:**
  - *dynamic electronic signage* in fixed route services (from 42 percent in 2020 to 78 percent in 2023)
  - *dynamic electronic signage* at bus stops/stations (from 49 percent in 2020 to 65 percent in 2023)
  - *open data feeds* (from 57 percent in 2020 to 76 percent in 2023)
  - *websites* (from 72 percent in 2020 to 87 percent in 2023)

- **Telecommunication technologies:** *5G New Radio and small cell infrastructure* (from 10 percent in 2020 to 38 percent in 2023)

- **ITS for Independent Travel for People with Disabilities:** *trip reservation systems with ways to reserve trips that account for an individual's mobility needs* (from 44 percent in 2020 to 63 percent in 2023); *indoor navigation support* (from 5 percent in 2020 to 20 percent in 2023)

Given the 2023 survey is the first ITS Deployment Tracking Survey in which smaller urban and rural areas were surveyed, there are no trend data for these new populations. The 2023 survey establishes a baseline for transit management agencies' deployment of ITS nationwide. Following the next ITS Deployment Tracking Survey (anticipated in 2026), it will be possible to assess trends for the nationwide sample.

Appendix A. Changes in the Transit Management Survey Methodology

As summarized in this report, the geographic coverage of the 2023 ITS Deployment Tracking Survey was greatly expanded. The historical ITS Deployment Tracking Survey (1999 – 2020) included a subset of large metropolitan areas, including 114 large metropolitan areas in the 2020 ITS Deployment Tracking Survey.[35] In 2023, survey coverage was expanded to include small metropolitan, micropolitan, and rural areas, in addition to previously surveyed large metropolitan areas. The changes to the survey methodology are described in Table 15.

Table 15. Summary of Methodology Changes to the Transit Survey and the Resulting Benefits

Historical Deployment Tracking Survey (1999– 2020)	New Methodology (2023+)	Benefits
A panel of transit management agencies in a subset of large metropolitan areas (n=212)	A stratified random sample of transit management agencies from the NTD in large urban, small urban, and rural/tribal areas (n=733)	Enables the nationwide measurement of ITS deployment by transit management agencies.

[35] Originally the survey was administered to agencies in 78 large metropolitan areas, and in 2002, the survey was expanded to include 108 large metropolitan areas. Following the 2010 Census, updates were made to metropolitan area definitions, resulting in the addition of six new metropolitan areas to the 2013 ITS Deployment Tracking Survey, for a total of 114 surveyed metropolitan areas. These 114 large metropolitan areas continued to be surveyed in 2016 and 2020.

Appendix B. 2023 Transit Management Survey Additional Findings

This Appendix includes findings for transit modes and questions that are not included in the body of the report or where the findings presented in the report are aggregated across modes. Where sample size permits, the results are shown as percentages based on the weighted data. The results are shown as unweighted counts when the sample size is less than 45. Transit modes with less than 10 responses are not included in the appendix (i.e., heavy/rapid rail and ferry boat).

Q02. Does your agency provide American with Disabilities Act (ADA) Complementary Paratransit service through a partnership or agreement with another agency or organization?

Table 16. ADA Complementary Paratransit Service Partnership

Response	Percent of Transit Management Agencies
Yes	32%
No	65%
Don't Know	3%
Missing	0%

2023 Q2; (n=464) *Source: USDOT*

Q03. For your agency's Fixed Route Bus Only service, what percentage of revenue vehicles are equipped with Automatic Vehicle Location (AVL), Computer-Aided Dispatch and Scheduling (CADS), Mobile Data Terminals (MDT), Mobile Data Computers (MDC), or Transit Control Heads, Automatic Passenger Counters (APC), Maintenance Management Systems (MMS), Transit Signal Priority (TSP)?

Table 17. Transit ITS Adoption: Fixed Route Bus Only

Percent of Transit Management Agencies Base: Transit Agencies with Fixed Route Bus Only	AVL	CADS	MDC	APC	MMS	TSP
0%	14%	36%	36%	41%	62%	72%
1% to 24%	1%	0%	0.3%	1%	5%	6%
25% to 49%	0%	1%	0%	2%	3%	1%
50% to 74%	2%	2%	2%	6%	1%	1%
75% to 99%	7%	3%	5%	7%	2%	2%
100%	75%	53%	52%	39%	19%	8%
Missing	2%	6%	5%	4%	7%	10%

2023 Q3; (WN=246, UWN=246) *Source: USDOT*

Q03. For your agency's Flexible Route Bus Only service, what percentage of revenue vehicles are equipped with Automatic Vehicle Location (AVL), Computer-Aided Dispatch and Scheduling (CADS), Mobile Data Terminals (MDT), Mobile Data Computers (MDC), or Transit Control Heads, Automatic Passenger Counters (APC), Maintenance Management Systems (MMS), Transit Signal Priority (TSP)?

Table 18. Transit ITS Adoption: Flexible Route Bus Only

Percent of Transit Management Agencies Base: Transit Agencies with Flexible Route Bus Only	AVL	CADS	MDC	APC	MMS	TSP
0%	25%	38%	51%	92%	90%	86%
1% to 24%	2%	2%	0%	0%	0%	2%
25% to 49%	2%	2%	0%	0%	0%	0%
50% to 74%	4%	2%	6%	2%	0%	0%
75% to 99%	3%	0%	3%	0%	0%	0%
100%	62%	52%	36%	0%	4%	0%
Missing	2%	4%	4%	6%	6%	12%

2023 Q3; (WN=45, UWN=44) *Source: USDOT*

Q03. For your agency's Light Rail/Streetcar service, what percentage of revenue vehicles are equipped with Automatic Vehicle Location (AVL), Computer-Aided Dispatch and Scheduling (CADS), Mobile Data Terminals (MDT), Automatic Passenger Counters (APC), Maintenance Management Systems (MMS), Transit Signal Priority (TSP), or Communications-Based Train Control (CBTC) railway signaling system?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 19. Transit ITS Adoption: Light Rail/Streetcar Service

Count of Transit Management Agencies Base: Transit Agencies with Light Rail/Streetcar Service	AVL	CADS	MDC	APC	MMS	TSP	CBTC
0%	2	7	8	1	10	8	11
1% to 24%	1	0	1	2	3	4	1
25% to 49%	1	0	0	1	0	0	1
50% to 74%	0	0	0	2	0	1	0
75% to 99%	3	3	4	4	2	0	1
100%	11	8	5	7	1	2	3
Missing	0	0	0	1	2	3	1

2023 Q3; (UWN=18) *Source: USDOT*

Q03. For your agency's Commuter Rail service, what percentage of revenue vehicles are equipped with Automatic Vehicle Location (AVL), Computer-Aided Dispatch and Scheduling (CADS), Mobile Data Terminals (MDT), Automatic Passenger Counters (APC), Maintenance Management Systems (MMS), or Communications-Based Train Control (CBTC) railway signaling system?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 20. Transit ITS Adoption: Commuter Rail Service

Count of Transit Management Agencies Base: Transit Agencies with Commuter Rail	AVL	CADS	MDC	APC	MMS	CBTC
0%	2	4	5	6	6	2
1% to 24%	0	0	0	1	1	0
25% to 49%	1	0	2	2	1	1
50% to 74%	1	0	0	0	1	0
75% to 99%	1	1	1	0	1	0
100%	8	8	5	4	3	8
Missing	0	0	0	0	0	2

2023 Q3; (UWN=13) *Source: USDOT*

Q03. For your agency's Other service, what percentage of revenue vehicles are equipped with Automatic Vehicle Location (AVL), Computer-Aided Dispatch and Scheduling (CADS), Mobile Data Terminals (MDT), Mobile Data Computers (MDC), Automatic Passenger Counters (APC), or Maintenance Management Systems (MMS)?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 21. Transit ITS Adoption: Other Services

Count of Transit Management Agencies Base: Transit Agencies with Other types of service	AVL	CADS	MDC	APC	MMS
0%	13	16	16	28	27
1% to 24%	1	1	1	0	1
25% to 49%	0	0	0	0	1
50% to 74%	0	0	0	1	0
75% to 99%	1	1	0	1	0
100%	20	18	19	4	6
Missing	3	2	2	4	3

2023 Q3; (UWN=38) *Source: USDOT*

Q04. For your agency's Fixed Route Bus Only service, what percentage of revenue vehicles are equipped with Automatic Voice Announcement (AVA) systems or Dynamic electronic signage?

Table 22. In-Vehicle Traveler Information: Fixed Route Bus Only

Percent of Transit Management Agencies Base: Transit Agencies with Fixed Route Bus Only	Automatic Voice Announcement	Dynamic Electronic Signage
0%	38%	50%
1% to 24%	1%	3%
25% to 49%	2%	2%
50% to 74%	3%	2%
75% to 99%	4%	4%
100%	51%	36%
Missing	1%	3%

2023 Q4; (WN=246, UWN=246) *Source: USDOT*

Q04. For your agency's Flexible Route Bus Only service, what percentage of revenue vehicles are equipped with Automatic Voice Announcement (AVA) systems or Dynamic electronic signage?

Table 23. In-Vehicle Traveler Information: Flexible Route Bus Only

Percent of Transit Management Agencies Base: Transit Agencies with Flexible Route Bus Only	Automatic Voice Announcement	Dynamic Electronic Signage
0%	98%	94%
1% to 24%	0%	0%
25% to 49%	0%	0%
50% to 74%	2%	7%
75% to 99%	0%	0%
100%	0%	0%
Missing	0%	0%

2023 Q3; (WN=45, UWN=44) *Source: USDOT*

Q04. For your agency's Light Rail/Streetcar service, what percentage of revenue vehicles are equipped with Automatic Voice Announcement (AVA) systems or Dynamic electronic signage?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 24. Transit ITS Adoption: Light Rail/Streetcar Service

Count of Transit Management Agencies Base: Transit Agencies with Light Rail/Streetcar Service	Automatic Voice Announcement	Dynamic Electronic Signage
0%	1	3
1% to 24%	1	1
25% to 49%	0	0
50% to 74%	2	1
75% to 99%	1	2
100%	13	11
Missing	0	0

2023 Q4; (UWN=18) *Source: USDOT*

Q04. For your agency's Commuter Rail service, what percentage of revenue vehicles are equipped with Automatic Voice Announcement (AVA) systems or Dynamic electronic signage?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 25. Transit ITS Adoption: Commuter Rail Service

Count of Transit Management Agencies Base: Transit Agencies with Commuter Rail	Automatic Voice Announcement	Dynamic Electronic Signage
0%	3	3
1% to 24%	0	1
25% to 49%	0	0
50% to 74%	1	1
75% to 99%	2	2
100%	7	6
Missing	0	0

2023 Q4; (UWN=13) *Source: USDOT*

Q04. For your agency's Other service, what percentage of revenue vehicles are equipped with Automatic Voice Announcement (AVA) systems or Dynamic electronic signage?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 26. Transit ITS Adoption: Other Services

Count of Transit Management Agencies Base: Transit Agencies with Other types of service	Automatic Voice Announcement	Dynamic Electronic Signage
0%	29	31
1% to 24%	0	0
25% to 49%	1	2
50% to 74%	2	0
75% to 99%	0	0
100%	4	4
Missing	2	1

2023 Q4; (UWN=38) *Source: USDOT*

Q05. What types of stops/stations are served by your agency's fixed route transit service(s)?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 27. Transit Facilities: Transit Agencies with Rail

Stations	Count of Transit Management Agencies Base: Transit Agencies with Rail
Rail Stops/Stations	23
Multimodal Stations	22
Other	0

2023 Q5; (UWN=26) *Source: USDOT*

Q07. What percentage of your agency's rail stops/stations provide real-time traveler information to the public using dynamic electronic signage?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 28. Dynamic Electronic Signage at Rail Stops/Stations

Range	Count of Transit Management Agencies Base: Transit Agencies that Use Rail Stops/Stations
0% of rail stops/stations	5
1% to 24% of rail stops/stations	2
25% to 49% of rail stops/stations	0
50% to 74% of rail stops/stations	0
75% to 99% of rail stops/stations	3
100 % of rail stops/stations	13
Missing	0

2023 Q7; (UWN=23) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) Data cable over modem?

Table 29. Telecommunications Technologies: Use of Data cable over modem

Uses	Percent of Transit Management Agencies Base: Transit Agencies Using Data cable over modem
Data Management	59%
Maintenance and Construction	31%
Parking Management	21%
Public Safety	20%
Public Transportation	55%
Support	39%
Sustainable Travel	12%
Traveler Information	31%
Vehicle Safety	25%
Weather	14%
Other	2%
Don't know	8%
Missing	15%

2023 Q32; (WN=50; UWN=49) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) 5G New Radio and Small cell infrastructure?

Table 30. Telecommunications Technologies: use of 5G New Radio and Small Cell Infrastructure

Uses	Percent of Transit Management Agencies Base: Transit Agencies Using 5G New Radio and Small Cell Infrastructure
Data Management	43%
Maintenance and Construction	14%
Parking Management	6%
Public Safety	17%
Public Transportation	61%
Support	25%
Sustainable Travel	6%
Traveler Information	22%
Vehicle Safety	23%
Weather	14%
Other	0%
Don't know	12%
Missing	15%

2023 Q37; (WN=110, UWN=114) *Source: USDOT*

The remaining uses of telecommunication technologies are reported as unweighted counts, due to small sample sizes.

Q37. How is your agency using the telecommunication technology(ies) Twisted copper pair/Twisted wire pair?

Table 31. Telecommunications Technologies: Use of Twisted copper pair/Twisted wire pair

Uses	Count of Transit Management Agencies Base: Transit Agencies Using Twisted copper pair/Twisted wire pair
Data Management	24
Maintenance and Construction	8
Parking Management	5
Public Safety	12
Public Transportation	25
Support	18
Sustainable Travel	4
Traveler Information	17
Vehicle Safety	6
Weather	7
Other	0
Don't know	4
Missing	4

2023 Q37; (UWN=37) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) Digital subscriber line (DSL)?

Table 32. Telecommunications Technologies: Use of Digital subscriber line

Uses	Count of Transit Management Agencies Base: Transit Agencies Using Digital subscriber line
Data Management	12
Maintenance and Construction	7
Parking Management	4
Public Safety	6
Public Transportation	13
Support	10
Sustainable Travel	3
Traveler Information	6
Vehicle Safety	6
Weather	7
Other	2
Don't know	1
Missing	7

2023 Q32; (UWN=23) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) Cellular (GPRS - 2G or 3G)?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 33. Telecommunications Technologies: Use of Cellular (GPRS - 2G or 3G)

Uses	Count of Transit Management Agencies Base: Transit Agencies Using Cellular (GPRS - 2G or 3G)
Data Management	4
Maintenance and Construction	2
Parking Management	1
Public Safety	3
Public Transportation	4
Support	4
Sustainable Travel	0
Traveler Information	4
Vehicle Safety	3
Weather	3
Other	0
Don't know	2
Missing	1

2023 Q32; (UWN=10) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) LTE-Cellular V2X (LTE-CV2X)?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 34. Telecommunications Technologies: Use of LTE-Cellular V2X (LTE-CV2X)

Uses	Count of Transit Management Agencies Base: Transit Agencies Using LTE-Cellular V2X
Data Management	7
Maintenance and Construction	3
Parking Management	1
Public Safety	4
Public Transportation	10
Support	5
Sustainable Travel	2
Traveler Information	6
Vehicle Safety	5
Weather	4
Other	1
Don't know	3
Missing	2

2023 Q32; (UWN=15) *Source: USDOT*

Q37. How is your agency using the telecommunication technology(ies) Dedicated short range communications (DSRC)?

Due to the small sample size, this table shows counts of agencies rather than percentages.

Table 35. Telecommunications Technologies: Use of Dedicated short range communications

Uses	Count of Transit Management Agencies Base: Transit Agencies Using Dedicated short range communications
Data Management	2
Maintenance and Construction	2
Parking Management	0
Public Safety	5
Public Transportation	10
Support	3
Sustainable Travel	1
Traveler Information	2
Vehicle Safety	3
Weather	1
Other	0
Don't know	4
Missing	2

2023 Q32; (UWN=18) *Source: USDOT*

Q39: What is your agency's primary approach for conducting maintenance activities on Intelligent Transportation Systems (ITS) assets?

Table 36. Primary Approach for Conducting Maintenance

Response	Percent of Transit Management Agencies
My agency primarily schedules maintenance based on the regularly monitored condition of ITS assets	13%
My agency primarily schedules maintenance of ITS assets based on regular intervals	21%
My agency primarily conducts maintenance in response to reported ITS asset failures or events, such as a vehicle collision or component failure	21%
My agency does not have ITS assets	7%
Other	2%
Don't know	36%
Missing	1%

2023 Q39; (n=464) *Source: USDOT*

Appendix C. 2023 Transit Management Survey Questionnaire

Prior to administering the Transit Management Survey, the ITS JPO consulted with subject matter experts (SMEs) on the survey content to determine if any questions should be revised, or if questions should be eliminated or added. This appendix contains the 2023 Transit Management Survey Questionnaire. New questions in the 2023 ITS Deployment Tracking Survey are marked with a (+). Notably, questions 24 through 35 were adapted from the 2019 Connected Vehicle and Automated Vehicle Survey.[36]

[36] See: https://www.itskrs.its.dot.gov/deployment/othersurveys_surta_2019.

Welcome to the Transit Management Survey!

Before you get started, please review the following definition:

Intelligent Transportation Systems (ITS) encompass the electronic, communication, and information processing technologies that enable transportation agencies to collect and transmit data in real time (or near real time) for use in transportation operations. ITS are deployed to support safety, mobility, environmental, and other goals. A few examples of ITS technologies for transit include automatic vehicle location (AVL), automatic passenger counters (APCs), electronic fare payment, and transit signal priority.

Navigating the Survey:
Use the “Next” and “Previous” buttons below to navigate the survey. Answers from each survey page are automatically saved when you go to the NEXT survey page.

To return to the dashboard, click on the "Return to Dashboard" button on the bottom of the page.

For many questions, there will be terms that are underlined. In this reference pdf, additional information for these terms is provided in a box below the question.

Note: The instructions in red font show the survey skip logic, which is automated in the online survey.

Transit Agency Characteristics

1. [ASK ALL – AT LEAST ONE TRANSIT MODE IS REQUIRED. IF THE MODE OPERATED BY YOUR AGENCY DOES NOT APPEAR ON THE LIST, PLEASE SELECT "OTHER" AND SPECIFY THE MODE.] **Which of the following transit modes does your agency operate in its revenue service?** *Please select all that apply.*

- ❑ Fixed Route Bus
- ❑ Flexible Route Bus
- ❑ Heavy or Rapid Rail (including subway)
- ❑ Light Rail/Streetcar
- ❑ Commuter Rail
- ❑ American With Disabilities Act (ADA) Complementary Paratransit
- ❑ Demand Responsive
- ❑ Ferry Boat
- ❑ Other (please specify): _____

DEFINITIONS SHOWN IN HOVER BOXES:

Flexible Route Buses have a fixed route with the ability to move off route within a specified range.

2. (+) [ASK ALL] **Does your agency provide American with Disabilities Act (ADA) Complementary Paratransit service through a partnership or agreement with another agency or organization (e.g., human service organization, regional service, etc.)?** *Please select one.*

- ○ Yes
- ○ No
- ○ Don't know

Transit Vehicle Characteristics

[ASK Q3 AND Q4 SEQUENTIALLY FOR EACH QUALIFYING MODE SELECTED IN Q1 – IF BOTH FIXED ROUTE BUS AND FLEXIBLE ROUTE BUS ARE SELECTED, ASK ONLY ONCE WITH MODE = BUS (FIXED ROUTE/FLEXIBLE ROUTE).]

If you reported multiple modes in Q1, you may see the next two questions on ITS technologies (Q3) and traveler information technologies (Q4) repeated for those modes.

3. **For your agency's** [INSERT MODE FROM Q1] **service, what percentage of revenue vehicles are equipped with each of the following technologies?** *Please select one response in each row.*

Percent of Vehicles

	0%	1% to 24%	25% to 49%	50% to 74%	75% to 99%	100%
Automatic Vehicle Location (AVL)	○	○	○	○	○	○
Computer-Aided Dispatch and Scheduling (CADS)	○	○	○	○	○	○
Mobile Data Terminals (MDT), Mobile Data Computers (MDC), or Transit Control Heads (TCH)	○	○	○	○	○	○
Automatic Passenger Counters (APC) – Do not include registering fareboxes or mobile ticket readers	○	○	○	○	○	○
Maintenance Management Systems (MMS) (i.e., remote monitoring of vehicle components)	○	○	○	○	○	○
Transit Signal Priority (TSP) [ONLY IF BUS, LIGHT RAIL/STREETCAR IN Q1]	○	○	○	○	○	○
Communications-Based Train Control (CBTC) railway signaling system [ONLY IF HEAVY OR RAPID RAIL, COMMUTER RAIL, LIGHT RAIL/STREETCAR]	○	○	○	○	○	○

DEFINITIONS SHOWN IN HOVER BOXES:

Automatic Vehicle Location (AVL) is a computer-based vehicle tracking system which uses real-time location technology and a wireless data communications system to transmit location data from vehicles to a transit operations center.

Computer-Aided Dispatch and Scheduling (**CADS)** is software that incorporates routes, schedules, trip orders, and vehicle assignments to let dispatchers manage operations.

Mobile Data Terminals (MDT), **Mobile Data Computers (MDC)**, and **Transit Control Heads (TCH)** are in-vehicle computerized devices that communicate with a central dispatch office. They provide two-way text-based communications and can upload collected data during a scheduled run.

Automatic Passenger Counters (APC) are electronic machines near vehicle doors that count passengers entering and exiting at each transit stop. Common types of APC are electronic infrared beams, light beams, mechanical treadle mats, and camera-based detection.

Maintenance Management Systems (MMS) can monitor vehicle components (e.g., fuel and fluid levels) and can alert operators of mechanical failures. Advanced systems capture conditions such as temperature and voltage to help predict when parts might fail.

Transit Signal Priority (TSP) refers to the use of sensors or signal timing to detect approaching transit vehicles and grant them priority at signalized intersections. TSP systems can extend green lights, provide an early green light, or use bypass (or queue jump) lanes for transit vehicles.

Communications-Based Train Control (CBTC) is a railway signaling system that makes use of the telecommunications between the train and track equipment for traffic management and infrastructure control. CBTC allows for a moving block system rather than a fixed block system.

[Q4 ASKED ONLY FOR FIXED ROUTE BUS, FLEXIBLE ROUTE BUS, HEAVY OR RAPID RAIL, COMMUTER RAIL, LIGHT RAIL/STREETCAR, FERRY, AND OTHER. – IF BOTH FIXED ROUTE BUS AND FLEXIBLE ROUTE BUS ARE SELECTED ASK ONLY ONCE WITH MODE = BUS (FIXED ROUTE/FLEXIBLE ROUTE).]

4. **For your agency's** [INSERT MODE FROM Q1] **service, what percentage of revenue vehicles are equipped with each of the following real-time traveler information technologies?** *Please select one response in each row.*

	Percent of Vehicles					
	0%	**1% to 24%**	**25% to 49%**	**50% to 74%**	**75% to 99%**	**100%**
Automatic Voice Announcement (AVA) systems (e.g., automatically triggered stop name announcements and transfer information)	o	o	o	o	o	o
Dynamic electronic signage (e.g., visual displays of upcoming stops, estimated arrival times for upcoming stops, transfer information, service alerts)	o	o	o	o	o	o

DEFINITIONS SHOWN IN HOVER BOXES:

Automatic Voice Announcement (AVA) systems provide audio or recorded announcements that are schedule- or location-based, such as upcoming stops or major intersections. AVA may also include exterior display and announcement of route numbers & destinations.

Dynamic electronic signage includes dynamic message signs and other visual displays inside the vehicle that provide real-time information - such as estimated arrival times for upcoming stops - and may include transfer information or service alerts.

Traveler Information

5. [EXCLUDE IF ADA AND/OR DEMAND RESPONSE ONLY] **What types of stops/stations are served by your agency's fixed route transit services?** *Please select all that apply.*

- ❑ Bus Stops/Stations (including BRT stops/stations) [ASKED FOR FIXED ROUTE AND FLEXIBLE ROUTE BUS]
- ❑ Rail Stops/Stations (including stations serving heavy or rapid rail (including subway), commuter rail, or light rail/streetcar) [ASKED ONLY FOR HEAVY OR RAPID RAIL, COMMUTER RAIL, LIGHT RAIL/STREETCAR]
- ❑ Multi-modal Stations or Transfer Stations [ASKED FOR ALL EXECPT ADA AND DEMAND RESPONSE]
- ❑ Other (please specify): _____

6. [IF BUS STOPS SELECTED IN Q5] **What percentage of your agency's bus stops/stations provide real-time traveler information (e.g., real time schedule and system information) to the public using dynamic electronic signage (e.g., visual displays of estimated arrival times, transfer information, service alerts)?** *Please select one response.*

- ○ 0% of bus stops/stations
- ○ 1% to 24% of bus stops/stations
- ○ 25% to 49% of bus stops/stations
- ○ 50% to 74% of bus stops/stations
- ○ 75% to 99% of bus stops/stations
- ○ 100 % of bus stops/stations

7. [IF RAIL STATIONS SELECTED IN Q5] **What percentage of your agency's rail stops/stations provide real-time traveler information to the public using dynamic electronic signage (e.g., visual displays of estimated arrival times, transfer information, service alerts)?** *Please select one response.*

- ○ 0% of rail stops/stations
- ○ 1% to 24% of rail stops/stations
- ○ 25% to 49% of rail stops/stations
- ○ 50% to 74% of rail stops/stations
- ○ 75% to 99% of rail stops/stations
- ○ 100 % of rail stops/stations

8. [IF MULTIMODAL STATIONS SELECTED IN Q5] **What percentage of your agency's multi-modal stations provide real-time traveler information to the public using dynamic electronic signage (e.g., visual displays of estimated arrival times, transfer information, service alerts)?** *Please select one response.*

- ○ 0% of multi-modal stations
- ○ 1% to 24% of multi-modal stations
- ○ 25% to 49% of multi-modal stations
- ○ 50% to 74% of multi-modal stations
- ○ 75% to 99% of multi-modal stations
- ○ 100 % of multi-modal stations

9. [ASK ALL] **Does your agency provide an open data feed (e.g., to app developers, information service providers, other agencies, or the public)?** *Please select one.*

- ○ Yes
- ○ No, but my agency is working on this – SKIP TO Q12
- ○ No current plans for an open data feed – SKIP TO Q12

10. (+) [IF Q9 = YES] **Which types of service modes are included in your open data feed?** *Please select all that apply.*

- ❑ Fixed route services (e.g., bus, light rail/streetcar, commuter/heavy rail, and/or ferry)
- ❑ Flexible route service (e.g., fixed route bus with ability to move off route within a specified range)
- ❑ On demand service (e.g., ADA paratransit, demand responsive)

11. (+) [If Q9 = YES] **Which of the following data element(s) are included in your agency's open data feed?** *Please select all that apply.*

- ❑ Static data on schedule, service day, route, or transit stop locations, (e.g., system map)
- ❑ Real time vehicle information or schedule service updates (e.g., vehicle location, crowding, service disruptions, etc.)
- ❑ Fare price/payment information
- ❑ Accessibility information (e.g., elevator/escalator outages, accessible entrances, availability of accessible vehicles)
- ❑ Other (please specify): _____

This next question covers general methods your agency uses to share real-time traveler information (not including methods at stops or stations).

12. [ASK ALL] **What methods does your agency use to disseminate real-time traveler information to the public, including service changes, transit schedule adherence, or arrival and departure times?** *Please select all that apply.*

- ❑ 511
- ❑ Social media
- ❑ Email or text/SMS alert
- ❑ Agency-branded mobile application (e.g., white-label commercial app, custom built)
- ❑ Third-party mobile app (e.g., Google Maps, Moovit, Transit)
- ❑ Website
- ❑ Kiosks
- ❑ Other (please specify): _____
- ❑ No real-time traveler information is disseminated

13. [ASK ALL] **Does your agency provide an agency-branded trip planner (web-based and/or mobile application)?** *Please select one.*

- o Yes
- o No
- o Don't know

14. [If Q13 = YES] **Which of the following applies to your agency's trip planner?** *Please select all that apply.*

- ❑ Incorporates real-time *transit* information (e.g., real-time transit schedule, arrival/departure, delay, passenger crowding, etc.)
- ❑ Incorporates more than one mode within your agency (e.g., rail to bus connections)
- ❑ Incorporates multiple transit systems in your area
- ❑ Incorporates real-time, schedule, or availability data of mobility service providers (e.g., bike-sharing, scooter-sharing, taxis, ride-hailing)
- ❑ Incorporates modes other than transit (e.g., walking, biking, or driving routes to stops/stations)
- ❑ Incorporates real-time *traffic* condition information
- ❑ Incorporates electronic payment of fares for your agency's services
- ❑ Incorporates electronic payment of fares for other transit systems in your area
- ❑ Incorporates integrated multimodal electronic payment of fares (e.g., mobility service providers, tolls, parking, etc.)
- ❑ Incorporates real-time alerts/announcements on accessibility that can be personalized to individuals' preferences (e.g., temporary route barriers, elevator/escalator outage information at stations, etc.)
- ❑ None of the above apply to my agency's trip planner

Electronic Fare Payment

15. [ASK ALL] **Does your agency use electronic fare payment (EFP)?** *Please select one.*

- ○ Yes
- ○ No
- ○ Don't know

DEFINITIONS SHOWN IN HOVER BOXES:

Electronic Fare Payment (EFP), also known as Automatic Fare Collection (AFC), provides an automated means of collecting and processing fares for public transportation services. EFP may include various payment media such as smart phones, magnetic stripe cards, smart cards, or credit cards to pay for transportation services.

16. [ASK ALL] **What types of fare media can travelers use to access your agency's transit service (e.g., at turnstile, in-vehicle)?** *Please select all that apply.*

Basic Fare Payment Methods:

- ❑ Cash (e.g., cash farebox)
- ❑ Physical tickets/tokens/vouchers (i.e., no embedded technology) [ASK Q17]

Electronic Fare Payment Methods:

- ❑ Agency branded or regional magnetic stripe cards (e.g., stored-value or time-based card) [ASK Q17]
- ❑ Agency branded or regional "smart cards" (e.g., RFID and/or chip cards) [ASK Q17]
- ❑ Contactless credit/debit cards
- ❑ Mobile wallet (e.g., Apple Pay, Google Pay)
- ❑ Mobile app (agency-approved or sponsored application)

Other

- ❑ Free/No fare media required
- ❑ Other fare payment methods (please specify): _____

17. (+) [ASK IF Q16 = PHYSICAL TICKETS/TOKENS/VOUCHERS/PASSES, AGENCY BRANDED OR REGIONAL MAGNETIC CARD, AGENCY BRANDED OR REGIONAL "SMART CARD"] **Where can travelers purchase (or add value to) their fare media?** *Please select all that apply.*

- ❑ On transit vehicle
- ❑ Transit agency vending machine
- ❑ Transit agency customer service desk
- ❑ Transit agency website (i.e., online)
- ❑ Transit agency branded mobile app
- ❑ Third party mobile app
- ❑ Retail store (or other business)
- ❑ Other (please specify): _____

The next questions ask about different characteristics of your agency's electronic fare payment (EFP) system.

18. [ASK IF Q15 = YES]

a. Which of the following best describes the system scope of your agency's EFP system?

Please select one.

- ○ Single agency
- ○ Multiagency
- ○ Don't know

b. Which of the following best describes the design and technology of your agency's EFP system? *Please select one.*

- ○ Proprietary
- ○ Non-proprietary
- ○ Don't know

DEFINITIONS SHOWN IN HOVER BOXES:

Proprietary design and technology are owned by a single vendor, (i.e., EFP system can only use equipment from the vendor).

Non-proprietary design and technology use standard data-exchange protocols to enable the use of equipment from multiple vendors.

c. Which of the following best describes the system architecture of your agency's EFP system? *Please select one.*

- ○ Stored value/card-based only
- ○ Account-based only
- ○ Both stored value/card-based and account based
- ○ Don't know

DEFINITIONS SHOWN IN HOVER BOXES:

Stored value/card-based systems hold a specific monetary value, and funds are subtracted as journeys are completed.

Account-based system architecture ties transit balances to a traveler's account through a back-office

system to determine fare and settle transactions. This does not require a passenger to buy a ticket in advance of traveling, and allows operators to apply "best fare" or "fare capping".

d. Which of the following best describes the payment architecture of your agency's EFP system? *Please select one.*

- ○ Closed payments only
- ○ Open payments only
- ○ Both closed and open payments
- ○ Don't know

DEFINITIONS SHOWN IN HOVER BOXES:

Closed payments use closed loop EFP technology to accept transit agency fare media only (e.g., agency branded or reginal magnetic stripe cards, agency branded or regional smart cards, or agency tickets/tokens).

Open payments use open loop technology which accept payment methods that may be used to purchase things other than fares from one transit agency (e.g., credit cards).

19. [ASK ALL] **Is your agency planning to upgrade its fare payment system to accept additional or different types of fare media in the next 5 years?** *Please select one.*

- ○ Yes, in the next year
- ○ Yes, within the next 1 to 3 years
- ○ Yes, within the next 3 to 5 years
- ○ No
- ○ Don't know

Agency Partnerships

20. [ASK ALL] **Does your agency partner with any mobility service providers (e.g., ride-hailing, bike-sharing, microtransit, taxis)?** *Please select one.*

- ○ Yes
- ○ No – SKIP TO Q23
- ○ Don't know – SKIP TO Q23

21. [IF Q20 = YES] **With which mobility service providers does your agency partner?** *Please select all that apply*.

- ❑ Ride-hailing/Ridesourcing/Transportation Network Company (TNC)
- ❑ Bike-sharing
- ❑ Scooter-sharing
- ❑ Microtransit
- ❑ Taxis
- ❑ Parking (municipal or privately-owned)
- ❑ Carpool matching service
- ❑ Vanpooling
- ❑ Other (please specify): _____

DEFINITIONS SHOWN IN HOVER BOXES:

Ride-hailing, also known as Transportation Network Companies (TNCs) or ridesourcing services, provides on-demand or pre-arranged transportation services where drivers of personal vehicles are compensated by riders, connected through an application.

Bike-sharing is a service in which travelers access bicycles on an as-needed basis for one-way or roundtrip travel.

Scooter-sharing is a service in which users have short-term access to electric scooters on an as-needed basis.

Microtransit provides privately or publicly operated technology-enabled transit service, typically using multi-passenger shuttles or vans to provide services with either dynamic or fixed routing.

Carpool matching service allows passengers to connect with drivers of personal vehicles who have similar points of origin and destinations.

22. [IF Q20 = YES] **In what ways do these mobility service providers partner with your agency?** *Please select all that apply.*

- ❑ Partners provide subsidized or unsubsidized service to your agency's customers
- ❑ Partner services can be dispatched through your agency's system
- ❑ Partner services can be paid for on your agency's payment platform
- ❑ Other (please specify): _____

23. [ASK ALL] **Does your agency use a service coordination platform (e.g., Travel Management Coordination Center (TMCC)) to coordinate transportation for the clients of human service agencies (e.g., health, employment, etc.)?** *Please select one.*

- o Yes, agency operates a TMCC or similar service coordination platform
- o No, agency does not operate a TMCC or similar service coordination platform
- o Don't know
- o Other (please specify): _____

Connected Vehicle Technologies

This section includes questions about connected vehicle technologies.

24. (+) [ASK ALL] **Is your agency currently developing, testing, or deploying connected vehicle (CV) technology (or partnering with other agency(ies) to develop, test, or deploy)?** *Please select one.*

- o Yes – SKIP TO Q27
- o No, but my agency is planning for CV
- o No plans for CV – SKIP TO Q30
- o Don't know – SKIP TO Q30

DEFINITION SHOWN IN HOVER BOX:

Connected vehicle (CV) technologies enable vehicles, roadway infrastructure, and mobile devices to wirelessly exchange data and "talk" to one another. Connected vehicles encompass vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications, collectively known as "V2X." When integrated into a vehicle, roadway infrastructure, or mobile devices, these technologies can deliver significant transportation safety, mobility, and environmental benefits.

25. (+) [IF Q24 = NO, BUT PLANNING FOR CV] **Does your agency have any documented plans (e.g., internal planning documents, State Transportation Improvement Plan (STIP), etc.) to develop, test, or deploy CV technology?** *Please select one.*

- o Yes
- o No
- o Don't know

26. (+) [IF Q24 = NO, BUT PLANNING FOR CV] **When do you expect to begin developing, testing, or deploying connected vehicle technology?** *Please select one.*

- o Within the next 3 years – SKIP TO Q30
- o In 3 to 6 years – SKIP TO Q30
- o In 7 or more years – SKIP TO Q30
- o Don't know – SKIP TO Q30

27. (+) [IF Q24 = YES] **Is your agency deploying (or is your agency partnering with other agencies to deploy) roadside units (RSUs) to support connected and/or automated vehicle testing/deployment?**

- o Yes, deploying or partnering to deploy RSUs
- o No
- o Don't know

28. (+) [IF Q24 = YES] **Is your agency developing, testing, or deploying (or partnering with other agencies to develop, test, or deploy) any connected vehicle applications, including in-vehicles (i.e., using an on-board unit (OBU), Human Machine Interface (HMI), or similar) or among pedestrians or cyclists (i.e., using a handheld device)?** *This may include applications that your agency is testing either on its own fleet or in partnership with other agencies or automakers/original equipment manufacturers. Please select one.*

- o Yes
- o No – SKIP TO Q30
- o Don't know – SKIP TO Q30

29. (+) [IF Q28 = YES] **Which connected vehicle (CV) applications is your agency developing, testing, or deploying (or partnering to develop, test, or deploy)?** *This may include applications that your agency is testing either on its own fleet or in partnership with other agencies or automakers/original equipment manufacturers. Please select all that apply.*

Safety Applications (Vehicle to Infrastructure (V2I)):

- ❑ Curve Speed Warning (CSW)
- ❑ Pedestrian in Signalized Crosswalk Warning
- ❑ Red Light Violation Warning (RLVW)
- ❑ Reduced Speed/Work Zone Warning (RSWZ)

Safety Applications (Vehicle to Vehicle (V2V)):

- ❑ Blind Spot/Lane Change Warning (BSW/LCW)
- ❑ Emergency Electronic Brake Lights (EEBL)
- ❑ Forward Collision Warning (FCW)
- ❑ Intersection Movement Assist (IMA)
- ❑ Vehicle Turning Right in Front of Bus Warning (VTRFBW)

Mobility Applications:

- ❑ Integrated Dynamic Transit Operations (IDTO) (e.g., Connection Protection (T-CONNECT), Dynamic Transit Operations (T-DISP), and Dynamic Ridesharing (D-RIDE))
- ❑ Intelligent Traffic Signal System (I-SIG)
- ❑ Queue Warning (Q-WARN)
- ❑ Transit Signal Priority

Environment Applications:

- ❑ Dynamic Eco Routing
- ❑ Eco-Approach and Departure at Signalized Intersections

Agency and Road Weather Applications:

- ❑ Agency Data Applications (e.g., probe data collection, CV-enabled data collection, etc.)
- ❑ Road Weather Warnings (e.g., Motorist Advisories and Warnings (MAW); Enhanced Maintenance Decision Support System (MDSS))

Other CV Applications being developed, tested, or deployed:

- ❑ Please specify any other CV applications: _____

DEFINITIONS SHOWN IN HOVER BOXES:

Curve Speed Warning (CSW) alerts a driver if current speed is too fast for an approaching curve.

Pedestrian in Signalized Crosswalk Warning notifies a driver when a pedestrian is using a crosswalk in the vehicle's projected path.

Red Light Violation Warning (RLVW) issues a warning when a driver is about to run a red light.

Reduced Speed/Work Zone Warning (RSWZ) alerts a driver to use caution when traveling through a work zone.

Blind Spot/Lane Change Warning (BSW/LCW) alerts a driver changing lanes if there is a vehicle in the driver's blind spot.

Emergency Electronic Brake Lights (EEBL) application notifies a driver if there is a sudden-braking vehicle ahead (or several vehicles ahead).

Forward Collision Warning (FCW) alerts a driver when a vehicle ahead is stopped or traveling slower and there is a risk of a rear-end collision.

Intersection Movement Assist (IMA) warning notifies a driver if it is not safe to enter an intersection - for example, if another vehicle is running a red light or making a sudden turn.

Vehicle Turning Right in Front of Bus Warning (VTRFBW) notifies a bus driver when a vehicle attempts to turn right in front of the bus as the bus pulls away from a bus stop.

Integrated Dynamic Transit Operations (IDTO) includes three applications that improve transit mobility, operations, and services: Transfer Connection Protection dynamically holds vehicles at bus stops to meet with connecting passengers; Dynamic Transit Operations adjusts transit routing to pick up passengers or avoid congestion; and Dynamic Rideshare facilitates first-mile and last-mile shared riders.

Intelligent Traffic Signal System (I-SIG) uses high-fidelity data collected from vehicles (through V2V and V2I wireless communications), pedestrian, and non-motorized travelers to control traffic signals and maximize flows in real time, and may also seek to optimize overall network performance (i.e., accommodating transit or freight signal priority, preemption, and pedestrian movements).

Queue Warning (Q-WARN) provides a vehicle operator with sufficient warning of an impending queue backup, allowing the operator to brake safely, change lanes, or modify the route such that secondary collisions can be minimized or even eliminated. It is distinct from collision warning, which pertains to events or conditions that require immediate or emergency actions.

Transit Signal Priority is an application that allows transit agencies to manage bus service by granting buses priority at intersections. Decisions are made using information communicated by the transit vehicle (e.g., passenger count data, service type, scheduled and actual arrival time, and heading information) to roadside equipment via an on-board device.

Dynamic Eco-Routing application determines the most eco-friendly route, in terms of minimum fuel consumption or emissions, for individual travelers. This application recommends routes that produce the fewest emissions or reduce fuel consumption based on historical, real-time, and predicted traffic and environmental data (e.g., prevailing weather conditions).

Eco-Approach and Departure at Signalized Intersections is an application that uses traffic signal phase and timing (SPaT) data to determine speed advice that can be presented to drivers, allowing

them to adapt their vehicle's speed to pass the next traffic signal on green or to decrease to a stop in the most eco-friendly manner.

Agency Data Applications include applications used to collect, transmit, analyze, or report local data related to traffic conditions, road conditions, travel patterns, or other metrics. Examples include: Probe-based Pavement Maintenance, Probe-based Traffic Monitoring, CV-enabled Origin-destination Studies, Work Zone Travel Information applications, etc.

Road Weather Warnings issue alerts and advisories to travelers about deteriorating road and weather conditions on specific roadway segments.

Automated Vehicle Technologies

This section asks about automated vehicle tests and deployments; your responses should also include any pilots or demonstrations related to automated vehicles.

30. (+) [ASK ALL] **Has your agency participated in any automated vehicle (AV) tests or deployments in the last five years?** *Please select all that apply.*

- ○ Yes, my agency is leading or has led AV testing/deployments (i.e., completed or in progress) - SKIP TO Q33
- ○ Yes, my agency is supporting or has supported the planning or execution of AV testing/deployments - SKIP TO Q33
- ○ No, my agency is not participating in any AV testing/deployment
- ○ Don't know -

DEFINITION SHOWN IN HOVER BOX:

Automated vehicles (AVs) are those in which at least some aspect of a safety-critical control function (e.g., steering, throttling, or braking) occurs without direct driver input. AVs may include light-duty vehicles, transit vehicles, commercial motor vehicles, and small delivery devices, among others. Automated vehicles are widely categorized by their levels of driving automation defined by the Society of Automotive Engineers (SAE). These levels begin with Level 0 (no driving automation) and conclude with Level 5 (full driving automation).

31. (+) [IF Q30 = NO OR DON'T KNOW] **Does your agency have any documented plans (e.g., internal planning documents, State Transportation Improvement Plan (STIP), etc.) to participate in automated vehicle (AV) testing or deployment in the future?** *Please select one.*

- ○ Yes, my agency has a documented plan
- ○ No, but my agency is considering AV testing or deployment
- ○ No, my agency is not considering AV testing or deployment – SKIP TO Q36
- ○ Don't know – SKIP TO Q36

32. (+) [IF Q31 = YES HAS DOCUMENTED PLAN OR CONSIDERING] **When does your agency expect to participate in automated vehicle testing or deployment?** *Please select one.*

- ○ Within the next 3 years – SKIP TO Q36
- ○ In 3 to 6 years – SKIP TO Q36
- ○ In 7 or more years – SKIP TO Q36
- ○ Don't know – SKIP TO Q36

33. a. (+) [IF Q30 = AGENCY SUPPORTING (AND ONLY OPTION 2 SELECTED)]: **Which entity(ies) are/were leading the automated vehicle testing or deployment?** *Please select all that apply.*

33. b. (+) [IF Q30 = AGENCY LEADING (OPTION 1 ONLY) OR BOTH OPTIONS 1 AND 2]: **For the automated vehicle testing or deployment that your agency is/was leading, what other entity(ies) are/were you partnering with?** *Please select all that apply.*

- ❑ Automakers or Original Equipment Manufacturers (OEMs), including Transit Vehicle Manufacturers
- ❑ Advanced Driver Assistance Systems (ADAS) Developers (or Driver Support Features Developers)
- ❑ Automated Driving Systems (ADS) Developers
- ❑ Transportation Network Companies (TNCs) (e.g., Uber or Lyft)
- ❑ State agencies
- ❑ Metropolitan Planning Organizations (MPOs)
- ❑ Universities
- ❑ Other transit agencies
- ❑ Other local agencies
- ❑ Private sector consultants (please specify): _____
- ❑ Other (please specify): _____
- ❑ Don't know

34. (+) [IF Q30 = AGENCY LEADING OR SUPPORTING] **Which of the following automated vehicle (AV) tests or deployments has your agency led or supported in the last five years?** *Please select all that apply.*

- ❑ Automated Bus Rapid Transit (BRT)
- ❑ Automated Passenger Fixed Route
- ❑ Automated Passenger On-Demand
- ❑ Automated Maintenance and Bus Yard Operations
- ❑ Other AV test/deployment (please specify): _____

DEFINITIONS SHOWN IN HOVER BOXES:

Automated Bus Rapid Transit (BRT) applies rail transit concepts to automated buses to deliver fast and efficient service. These concepts focus on eliminating causes of delay that typically slow regular bus services and may include dedicated lanes, busways, traffic signal priority, off-board fare collection, platforms, and enhanced stations.

Automated Passenger Fixed Route service provides rides along a single route with pre-defined stops and a set schedule. The route may be limited to closed environments, such as parking lots, busways, campuses, and retirement communities, or it may operate in mixed traffic on public roads in areas such as business parks or downtown districts.

Automated Passenger On-Demand provides on-demand service between any two addresses within a defined service area. The concept is similar to the automated passenger fixed route service; however, it is not restricted to predefined routes or schedules - users can request pick-ups and drop-offs on demand (e.g., using an application on a smartphone, tablet, or kiosk).

Automated Maintenance and Bus Yard Operations is the deployment of automated driving systems (ADS) on transit vehicles for use within the domain of the bus yard. Use cases may include precision movement for fueling/recharging, maintenance, disinfection/bus wash, or automated parking and recall.

35. (+) **For your** [INSERT TYPE FROM Q34] **test or deployment, which type of vehicle is being used?** *Please select all that apply.*

- ❑ Full-sized transit bus
- ❑ Articulated bus
- ❑ Motorcoach (over-the-road bus)
- ❑ Cutaway bus or minibus
- ❑ Novel-design low-speed shuttle
- ❑ Light-duty passenger vehicle (e.g., car, van, SUV)
- ❑ Other (please specify): _____
- ❑ Don't know

Telecommunications

36. [ASK ALL] **What type of telecommunications technologies does your agency use to enable Intelligent Transportation Systems (ITS)?** *Please select all that apply.*

Wired:

- ❑ Coaxial – OMIT FROM Q37
- ❑ Fiber-optic cable – OMIT FROM Q37
- ❑ Twisted copper pair/Twisted wire pair
- ❑ Digital subscriber line (DSL)
- ❑ Data cable over modem

Wireless:

- ❑ 5G New Radio and 5G small cell infrastructure
- ❑ Cellular (LTE-4G)
- ❑ Cellular (GPRS – 2G or 3G)
- ❑ LTE-Cellular V2X (LTE-CV2X)
- ❑ Dedicated short range communications (DSRC)
- ❑ Wi-Fi
- ❑ Mobile or Fixed service satellite (FSS) – OMIT FROM Q37
- ❑ Ultra-wideband (UWB)
- ❑ Microwave – OMIT FROM Q37
- ❑ Other telecommunications (wired and/or wireless) (please specify): _____ – OMIT FROM Q37
- ❑ Don't know – SKIP TO Q38
- ❑ No telecommunications used to enable ITS – SKIP TO Q38
- ❑ Not applicable, no ITS infrastructure or devices are deployed – SKIP TO Q38

DEFINITIONS SHOWN IN HOVER BOXES:

Coaxial cable is mainly used to provide communications between field controllers and a central controller. Coaxial cables have an inner conductor, insulating layer, conductive shielding, and protective outer jacket.

Fiber-optic cables transmit large amounts of information over long distances (e.g., camera images) through use of many super-thin strands of optical glass fiber.

Twisted copper pair/Twisted wire pair is composed of two insulated copper wires twisted around one another. This is mainly used to provide basic telephone services and ethernet over short distance.

Digital subscriber line (DSL) is a wireline transmission technology that uses existing infrastructure to provide integrated traffic video and field device communications. This includes all forms of DSL (e.g., ADSL, RADSL, HDSL, SDSL).

Data cable over modem service enables operators to provide broadband using standard cable lines (e.g., 56 kilobits/second).

5G New Radio and 5G small cell infrastructure (which communicates over very short distances) represents the newest generation of cellular data communication. The 5G New Radios can operate within and share existing 4G LTE infrastructure in non-standalone (NSA) mode (e.g., cell towers). The other critical component of 5G, small cell infrastructure, consists of small antennae placed in the public right-of-way to act as a high-speed intermediary between a field device and the larger cell tower.

Cellular (LTE-4G) is the fourth generation of cellular data communication. LTE (Long Term Evolution) is standard to 4G and is both forward and backward compatible. Cellular LTE 4G operates in the 600 MHz, 700 MHz, 850 MHz, 1.7 GHz, 1.9 GHz, 2.3 GHz, 2.5 GHz spectrum.

Cellular GPRS – 2G or 3G are the older generations of cellular data communications and are being phased out. These generations of cellular rely on radio signals in a digital format and operate in the 470-690 MHz, 690-805 MHz, 1.850-1.995 GHz spectrum.

LTE-Cellular V2X (LTE-CV2X) operates in the reduced 5.895-5.925 GHz spectrum, known as the Safety Band (dedicated for safety-of-life and public benefit transportation purposes). LTE-CV2X is intended to service connected vehicle technology.

Dedicated short range communications (DSRC) is a two-way radio communication operating in the reduced 5.895-5.925 GHz spectrum, currently known as the Safety Band (dedicated for safety-of-life and public benefit transportation purposes). The Federal Communications Commission (FCC) is planning to phase out DSRC in the future.

Wi-Fi provides wireless high-speed internet access or communications between devices (point-to-point or point-to-multipoint). It includes agency-installed Wi-Fi access points and client devices, or subscription-based Wi-Fi in the 2.4 GHz, 5.8 GHz, and (recently) 6 GHz spectrum.

Mobile or Fixed service satellite (FSS) provides radio communication between two or more fixed or mobile receivers. MSS or FSS allows uploading/downloading data across a wide range (137 MHz-51.4 GHz) of spectrum in the form of space-to-earth, earth-to-space, or broadcast communications.

Ultra-wideband (UWB) is a short-range communication technology ideal for transmitting data at high speeds between devices 10 to 30 meters apart, using any spectrum as unlicensed communications (similar to radar).

Microwave (also known as Ultra High Frequency (UHF) or Extremely High Frequency (EHF)) communicates as fixed point-to-point backhaul or as very short-range, line-of-sight radar/Lidar communications, typically between 300 MHz and 300 GHz spectrum.

37. (+) [FOR EACH TELECOM TECH CHECKED IN Q36 EXCEPT FOR COAXIAL, FIBER OPTIC CABLE, FSS, AND MICROWAVE] **Please indicate how your agency is using the telecommunication technology(ies) shown below to enable ITS.**

Each of the use cases listed is based on Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) service packages. Click this link for more information: https://www.arc-it.net/html/servicepackages/servicepackages-areaspsort.html. *Please select all that apply in each column*.

- ❑ Data Management
- ❑ Maintenance and Construction
- ❑ Parking Management
- ❑ Public Safety
- ❑ Public Transportation
- ❑ Support
- ❑ Sustainable Travel
- ❑ Traveler Information
- ❑ Vehicle Safety
- ❑ Weather
- ❑ Other (please specify): _____
- ❑ Don't know

DEFINITIONS SHOWN IN HOVER BOXES:

Data Management: Two relevant service packages are ITS data warehouse and performance monitoring.

Maintenance and Construction: Examples include maintenance and construction vehicle maintenance, winter maintenance, roadway maintenance and construction, work zone management, maintenance and construction signal priority, asset tracking, etc.

Parking Management: Examples include parking space management, smart park and ride system, parking electronic payment, regional parking management, etc.

Public Safety: Examples include the monitoring of transportation infrastructure or assets, emergency response and recovery, and disaster response and recovery, etc.

Public Transportation: Examples include dynamic transit operations, transit fare collection management, transit security, transit fleet management, transit signal priority, etc.

Support: Examples include connected vehicle system monitoring and management, map management, ITS communications, location and time, security and credentials management, field equipment maintenance, etc.

Sustainable Travel: Examples include emissions monitoring, eco-traffic signal timing, roadside lighting, electric charging stations management, etc.

Traveler Information: Examples include broadcast traveler information, dynamic route guidance, infrastructure-provided trip planning and route guidance, dynamic ridesharing, and shared use transportation, etc.

Vehicle Safety: Examples include autonomous vehicle safety systems, V2V basic safety, situational awareness, curve-speed warning, pedestrian and cyclist safety, stop sign gap assist, automated vehicle operations, etc.

Weather: Examples include weather data collection, weather information processing and distribution, spot weather impact warning, etc.

38. (+) [ASK ALL] **If your agency has any notes or additional information about its use of telecommunications, please provide below.**

Maintenance of Transit ITS Technology

39. (+) [ASK ALL] **What is your agency's primary approach for conducting maintenance activities on Intelligent Transportation Systems (ITS) assets?** *Please select one.*

- o My agency primarily schedules maintenance based on the regularly monitored condition of ITS assets.
- o My agency primarily schedules maintenance of ITS assets based on regular intervals.
- o My agency primarily conducts maintenance in response to reported ITS asset failures or events, such as a vehicle collision or component failure.
- o My agency does not have ITS assets
- o Other (please specify): _____
- o Don't know

Cybersecurity

40. [ASK ALL] **Does your agency have a documented cybersecurity policy that explicitly addresses Intelligent Transportation Systems (ITS) technologies/equipment?** *Please select one*

- o My agency has a cybersecurity policy which explicitly addresses ITS. – SKIP TO Q42
- o My agency's general cybersecurity policy (i.e., for information technology (IT)) is applied to ITS.
- o My agency's ITS is not covered by a cybersecurity policy.
- o My agency has not deployed ITS technologies/equipment – SKIP TO Q43b
- o Don't know – SKIP TO Q42

41. [IF Q40 = OPTIONS 2 OR 3] **Is your agency planning to develop a cybersecurity policy that explicitly addresses ITS?** *Please select one.*

- o Yes
- o No
- o Don't know

42. (+) [EXCLUDE IF Q40 = OPTION 4 (NO ITS)] **In the last five years, has your agency conducted incident response exercises that include ITS equipment/technologies to prepare for ITS cybersecurity events?** *Please select one.*

- ○ Yes, my agency's incident response exercises have included ITS equipment/technologies
- ○ No, my agency's incident response exercises have **not** included ITS equipment/technologies
- ○ My agency has not conducted incident response exercises in the last five years
- ○ Don't know

DEFINITION SHOWN IN HOVER BOX

Incident response exercises are agency-run tests of protocols that mitigate violations of security policies and recommended practices.

43.

a. [EXCLUDE IF Q40 = OPTION 4 (NO ITS)] **In the last three years, has your agency had any cybersecurity events or attacks (e.g., ransomware, data breach) that affected its information technology (IT) system and/or ITS technologies/equipment?** *Please select all that apply. If your agency has experienced multiple events or attacks, please respond based on all experiences.*

- ❑ Yes, affecting IT system – SKIP TO Q44
- ❑ Yes, affecting ITS technologies/equipment – SKIP TO Q44
- ❑ No – SKIP TO Q46
- ❑ Don't know – SKIP TO Q46

b. [ASK IF Q40 = OPTION 4 (NO ITS)] **In the last three years, has your agency had any cybersecurity events or attacks (e.g., ransomware, data breach) that affected its information technology (IT) system?** *If your agency has experienced multiple events or attacks, please respond based on all experiences.*

- ○ Yes – SKIP TO Q45
- ○ No – SKIP TO Q46
- ○ Don't know – SKIP TO Q46

DEFINITION SHOWN IN HOVER BOX:

Information technology (IT) systems include personal computers or commercial servers along with the network equipment to connect this equipment together.

44. (+) [IF Q43a = YES (OPTIONS 1 OR 2)] **What was (or were) the initial point(s) of entry for the cybersecurity event(s) or attack(s)?** *Please select all that apply. If your agency has experienced multiple events or attacks, please respond based on all experiences.*

- ❑ IT system
- ❑ ITS equipment/technologies
- ❑ Don't know

45. [IF Q43a = YES (OPTIONS 1 OR 2) OR Q43b = YES] **Did any of the cybersecurity event(s) or attack(s) affect transportation system operations?** *Please select one.*

- Yes
- No
- Don't know

Integrated Corridor Management

This question focuses on Integrated Corridor Management (ICM). ICM is an approach that manages a transportation corridor as a multimodal system (freeway, arterial, and public transit), integrating operations such as traffic incident management, work zone management, traffic signal timing, managed lanes, real-time traveler information, and active traffic management to maximize the capacity of all facilities and modes across the corridor.

For the purposes of this survey, a corridor is defined as: a largely linear geographic band and a bounded travel shed of (mostly) commute and daily trips. The corridor must include **freeway**, **arterial**, and **public transit facilities**, with cross-facility connections.

You can find more information about ICM at https://rosap.ntl.bts.gov/view/dot/38816.

46. [ASK ALL] **Has your agency partnered with freeway and/or arterial agencies to deploy Integrated Corridor Management (ICM) in one or more corridors (i.e., integrating operations across freeways, arterials, and public transit networks) to actively manage travel demand and capacity in the corridor as a whole?** *Please select one.*

- Yes, my agency has partnered to deploy ICM
- No, but my agency plans to partner to deploy ICM
- No, my agency has no plans to partner to deploy ICM

Service Planning

47. [ASK ALL] **Does your agency use any of the following Intelligent Transportation Systems (ITS) data for service planning?** *Please select all that apply.*

- ❑ Vehicle time and location (e.g., on-time performance)
- ❑ Vehicle monitoring status (i.e., vehicle diagnostics and health)
- ❑ Passenger count and load
- ❑ Trip itinerary planning records (e.g., from apps or trip planners)
- ❑ Passenger trip information (e.g., fare transactions, trip origin/destination location)
- ❑ Road surface conditions (e.g., wet, icy)
- ❑ Emergency vehicle signal preemption events
- ❑ Transit vehicle signal priority events
- ❑ Weather conditions (e.g., snow, fog, rain)
- ❑ Incidents
- ❑ Impact of work zones on transit operations
- ❑ Other (please specify): _____
- ❑ My agency does not use ITS data for service planning

Transportation Demand Management

48. [ASK ALL] **Does your agency employ vehicle monitoring and communication technologies to hold vehicles to facilitate the coordination of passenger transfers between vehicles or between transit systems (i.e., connection protection)?** *Please select one.*

- ○ Yes
- ○ No
- ○ Don't know
- ○ Not applicable

49. [ASK ALL] **Does your agency dynamically adjust the assignments of assets (e.g., buses) based on real-time demand to cover the most overcrowded sections of the network?** *Please select one.*

- ○ Yes
- ○ No
- ○ Don't know
- ○ Not applicable

Independent Travel for People with Disabilities

50. [ASK ALL] **Has your agency implemented or piloted any technologies or services to support independent travel for people with disabilities?** *Please select all that apply.*

- ❑ Automated announcements (i.e., audio) of approaching transit vehicle in stops/stations
- ❑ Trip reservation systems with ways to reserve trips that account for an individual's mobility needs in addition to a phone call with customer service representative and TTY/TDD [telecommunications device for the deaf] line
- ❑ Indoor navigation support (e.g., wayfinding beacons, digital mapping)
- ❑ Travel training and independent travel support applications (e.g., pre-trip planning applications, en-route navigation applications with dynamic step-by-step instructions, Virtualization applications)
- ❑ Augmentative and alternative communication (AAC) aids provided to operators and managers to support communication with customers
- ❑ Other (please specify): _____
- ❑ No technologies or services to support independent travel for people with disabilities are currently implemented or piloted

Intelligent Transportation Systems (ITS) Standards

51. [ASK ALL] **Does your agency implement transit-related Intelligent Transportation Systems (ITS) standards or specifications?** *Please select all that apply.*

- ❑ Transit Communication Interface Profiles (TCIP)
- ❑ National Transportation Communications for ITS Protocol (NTCIP)
- ❑ Advanced Traveler Information System (ATIS)
- ❑ Contactless Fare Media System Standard (CFMS) / Universal Transit Fare Systems (UTFS)
- ❑ General Transit Feed Specification (GTFS) (*de facto* standard)
- ❑ GTFS Real-Time (GTFS-RT)
- ❑ GTFS-Flex (proposed/prototype extension of GTFS to model demand-responsive transportation services)
- ❑ General Bikeshare Feed Specifications (GBFS)
- ❑ Service Interface for Real Time Information (SIRI)
- ❑ Transactional Data Specification (TDS)
- ❑ Other (please specify): _____
- ❑ Don't know
- ❑ No ITS standards or specifications are implemented

DEFINITION SHOWN IN HOVER BOX

Transit Communication Interface Profiles (TCIP) is an interface standard. Its primary purpose is to define standardized mechanisms for exchanging data among transit business systems, subsystems, components, and devices. https://www.arc-it.net/html/comm/profile68.html

National Transportation Communications for Intelligent Transportation System (ITS) Protocol (NTCIP) is a family of standards that provides both the rules for communicating (called protocols) and the vocabulary (called objects) necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system. https://www.ntcip.org/about/

Advanced Traveler Information Systems (ATIS) is the upper-layer standard required to implement traveler information communications. https://www.arc-it.net/html/comm/profile68.html

Contactless Fare Media System Standard (CFMS) provides for a consistent and uniform method for storing and retrieving information from smart cards used in transit applications. The standard consists of 5 parts which are designed to be implemented together as part of a foundation for end-to-end integration of fare collection information processing. https://www.apta.com/research-technical-resources/standards/technology/APTA-IT-UTFS-S-001-07/

General Transit Feed Specification (GTFS) (de facto standard) is a data specification that allows public transit agencies to publish their transit data in a format that can be consumed by a wide variety of software applications. Otherwise known as GTFS Schedule, the data primarily consist of static information like stops, routes, schedule, and fares. https://gtfs.org/

GTFS Realtime (GTFS RT) is a feed specification that allows public transportation agencies to provide real-time updates about their fleet to application developers. GTFS RT was designed around ease of implementation, good GTFS interoperability, and a focus on passenger information. https://gtfs.org/realtime/

GTFS-Flex is a proposed extension that adds modeling of demand response, continuous stops, route deviation, and other non-fixed-route services to GTFS. A GTFS-Flex-enabled trip planner can read these additional categories of transit data and generate matching itineraries, giving a user more trip options in search results. https://trid.trb.org/view/1858112

General Bikeshare Feed Specifications (GBFS) is a real-time data specification that allows micromobility providers to publicly present service information, including vehicle and dock location and availability. https://gbfs.mobilitydata.org/

Service Interface for Real Time Information (SIRI) covers transit communications between centers and their transit vehicles. SIRI provides traveler information on real-time transit vehicle location, predicted transit-vehicle arrival/departure, and predicted transit-trip travel time. https://ops.fhwa.dot.gov/publications/fhwahop13046/sec4.htm

Transactional Data Specification (TDS) is a set of rules that explain how, and in what format, computer systems exchange data needed to fulfill individual demand-responsive transportation trip requests and responses. https://www.trb.org/Main/Blurbs/180593.aspx

Future Deployment Planning

52. [ASK ALL] **Does your agency plan to expand or upgrade current Intelligent Transportation Systems (ITS) during the next three years (2024 through 2026)?** *Please select one.*

- o Yes
- o No
- o Don't know
- o Not applicable, my agency has not deployed ITS

53. [ASK ALL] **Does your agency plan to invest in new or emerging ITS during the next three years (2024 through 2026)?** *Please select one.*

- o Yes
- o No – SKIP TO Q55
- o Don't know – SKIP TO Q55

54. [IF Q53 = YES] **Please describe the new or emerging ITS technologies your agency plans to invest in.**

Additional Comments

55. Please use the space below to provide any additional comments regarding your agency's deployment, operations, or maintenance of ITS. Please be as specific as possible when commenting on particular ITS technologies.

56. Can we contact you if we have any follow-up questions about your agency's experience deploying ITS? *Please select one.*

- ○ Yes
- ○ No – SKIP TO Q57

How can we best reach you if we have follow-up questions about your agency's experience deploying ITS?

56a. The phone number we have on file is [RESPONDENT PHONE]**. If this is not your preferred phone number, please provide your preferred phone number below:**

56b. The email address we have on file is [RESPONDENT EMAIL]**. If this is not your preferred email, please provide your preferred email address below:**

57. Please confirm if you are ready to submit your responses. *Please select one.*

- o Yes, I have completed the survey and I would like to submit my final responses (Note: if you click this button, you will not be able to return to the survey).
- o No, I am still working on the survey and will complete it later.

Thank you for your time and effort in completing this survey!

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