Intelligent Transportation Systems Deployment Tracking Survey: 2020 Key Findings

Final Report

www.itskrs.its.dot.gov/deployment
Final Report – November 2021
FHWA-JPO-21-890



U.S. Department of Transportation

Produced by Intelligent Transportation Systems Joint Program Office
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology

Notice

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-JPO-21-890		

4. Title and Subtitle	5. Report Date
Intelligent Transportation Systems Deployment Tracking Survey: 2020 Key Findings	November 2021
	6. Performing Organization Code V321

7. Author(s)	8. Performing Organization Report No.
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9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
U.S. Department of Transportation Volpe National Transportation Systems Center 55 Broadway Cambridge, MA 02142	**11. Contract or Grant No.** IAA 693JJ319N300031

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation Intelligent Transportation Systems Joint Program Office (ITS JPO) 1200 New Jersey Avenue, SE Washington DC 20590	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report summarizes the key findings of the 2020 Intelligent Transportation Systems (ITS) Deployment Tracking Survey (DTS). Since 1997, the ITS Joint Program Office (JPO) has used the DTS on an ongoing basis to collect information about ITS deployment in metropolitan areas across the United States by surveying state and local transportation agencies. These surveys measure ITS deployment nationwide and are used to inform the ITS JPO on strategic planning decisions such as response to ITS deployment gaps and ITS deployment planning and execution.

The 2020 DTS was administered online from December 3, 2020 to March 31, 2021. The survey population included freeway management, arterial management, and transit management agencies within 108 large and medium sized metropolitan areas nationwide, focusing on agencies that serve populations of 50,000 or greater. The survey achieved 578 completes with a response rate of 68 percent (101 freeway, 341 arterial, and 136 transit completes).

17. Keywords	18. Distribution Statement
Intelligent Transportation Systems, work zone technologies, safety systems, adaptive signal control, traveler information technologies, real-time data collection, cybersecurity	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	54	

Acknowledgements

The Volpe Center would like to thank all the freeway, arterial and transit agency staff who took the time to complete this survey; your responses are greatly appreciated. The Volpe Center also would like to thank Marcia Pincus, Intelligent Transportation Systems (ITS) Deployment Evaluation Program Manager, for her insights and support throughout this survey project. Additionally, the Volpe Center is grateful for the valuable feedback and review provided by Noblis. Finally, the Volpe Center would like to thank ITS JPO staff and ITS stakeholders who provided input on the survey instrument.

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Acronyms

Acronym	Meaning
APC	Automatic Passenger Counters
ASCT	Adaptive Signal Control Technology
AV	Automated Vehicle
AVL	Automatic Vehicle Location
CADS	Computer Aided Dispatch and Scheduling
CCTV	Closed-Circuit Television
CV	Connected Vehicle
DMS	Dynamic Message Signs
DTS	Deployment Tracking Survey
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GTFS-RT	General Transit Feed Specification Real-Time
HAR	Highway Advisory Radio
ICM	Integrated Corridor Management
IT	Information Technology
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
MDT	Mobile Data Terminals
RRFB	Rectangular Rapid Flashing Beacons
SIRI	Service Interface for Real-Time Information
TSP	Transit Signal Priority
USDOT	United States Department of Transportation

Executive Summary

Introduction

This report summarizes the key findings of the 2020 ITS Deployment Tracking Survey (DTS) administered by the John A. Volpe National Transportation Center (Volpe) in support of the United States Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO). Since 1997, the ITS JPO has used the DTS on an ongoing basis to collect information about ITS deployment in metropolitan areas across the United States by surveying state and local transportation agencies. These surveys track ITS deployment (type and to what extent deployed) nationwide. The resulting data are used to inform the ITS JPO and other stakeholders on strategic planning and investment decisions related to ITS deployment (including gaps), market development, and technology transfer activities.

Methodology

The 2020 DTS was administered to freeway management, arterial management, and transit management agencies (also referred to as freeway agencies, arterial agencies, and transit agencies, respectively, in this Report) within 108 large and medium sized metropolitan areas nationwide, focusing on agencies that serve populations of 50,000 or greater. The 2020 surveys are modified versions of those conducted in 2016, shortened to reflect a core set of ITS technologies. The Transit Management Survey (also referred to as the Transit Survey) was reformatted, utilizing skip logic so that agencies received the battery of ITS questions only for the service type(s) (e.g., bus, light rail, ferry, etc.) that they operate. The DTS was administered from December 3, 2020 to March 31, 2021 using an online survey instrument. The survey achieved 578 completes with an overall response rate of 68 percent. Each survey type exceeded its completion goal with 101 freeway, 341 arterial, and 136 transit surveys completed.

Key Findings for Freeway and Arterial Management Agencies

This section describes key findings from the Freeway and Arterial Management Surveys (also referred to as the Freeway Survey and the Arterial Survey in this Report).

ITS safety systems and work zone technology show increasing adoption.

The 2020 DTS shows continued growth in ITS safety system adoption among both freeway and arterial agencies and increased work zone technology adoption by freeway agencies, as USDOT and state agencies continue to emphasize safety as a top goal.

- Use of ITS safety systems is practically universal among freeway agencies, as 85 percent have adopted at least one technology, an increase of nine percentage points since 2016. Adoption of *queue warning systems* and *over-height warning systems* has increased significantly since 2016, with close to 50 percent of agencies now deploying these systems.

- In 2020, 82 precent of freeway agencies report use of work zone technologies, up 20 percentage points since 2013, with roughly half the growth since 2016. Key technologies include *portable closed-circuit television (CCTV)* and *queue detection and alert systems*, both of which have seen significant growth in recent years.
- Among arterial agencies, there was significant growth in the use of pedestrian safety technologies. Since 2016, use of *pedestrian warning systems* has increased 13 percentage points from 34 percent to 47 percent.

Several ITS technologies show steady growth among arterial agencies.

ITS technologies deployed at intersections such as *adaptive signal control technology (ASCT*), *CCTV,* and *transit signal priority (TSP)* have shown steady growth since 2013.

- Adoption of *ASCT* has grown at a slower overall pace, increasing 11 percentage points since 2013, with growth split relatively evenly across the two survey cycles. While this growth represents a 60 percent increase in agencies using ASCT since 2013, the technology is still used by less than one-third of arterial agencies overall. Agencies tend to deploy these technologies at a small portion of their intersections, with most agencies that deploy ASCT (59 percent) reporting use at less than 10 percent of their reported signalized intersections.
- Use of *CCTV* at intersections grew by seven percentage points between 2013 and 2016 (from 45 percent to 52 percent) and by another eight percentage points between 2016 and 2020, with 60 percent of agencies now using this technology.
- *TSP,* which is currently adopted by 28 percent of arterial agencies, shows a similar growth pattern to ASCT. Usage grew fairly evenly across the two survey cycles, with a total increase of 10 percentage points among arterial agencies since 2013.[1]

While most arterial agencies use *real-time data collection at intersections* (95 percent) a smaller proportion collect data on arterial roadways (45 percent). Use of *real-time data collection*, which includes both *roadside infrastructure* and *vehicle probe readers*, shows steady growth, increasing by three percentage points from 2013 to 2016 and then by six percentage points from 2016 to 2020.

- *Roadside infrastructure* use is up ten percentage points since 2013, reaching 40 percent in 2020. Growth has been evenly distributed across the survey cycles (2013 to 2016 and 2016 to 2020).
- *Vehicle probe readers* have seen similar growth in usage, up 12 percentage points since 2013 to 25 percent in 2020, although most of the growth occurred between 2013 to 2016. *Bluetooth* remains the most commonly used vehicle probe reader technology for arterial agencies with 20 percent usage.[2]

Adoption of some technologies is widespread, reflecting their maturity in the market.

The percent of freeway agencies using *real-time data collection* methods is high (85 percent), with adoption remaining relatively flat in recent years.

- Adoption of *roadside infrastructure* detection technologies is high, at 74 percent, remaining steady over the last two survey cycles. *Radar/microwave detection* is a mature roadside infrastructure technology with 71 percent of freeway agencies reporting use.

[1] Transit agency findings on the deployment of TSP are described later in the Report (Figure 21).

[2] The data from the vehicle probe reader questions are difficult to interpret because some agencies (it is unclear how many) included purchased (i.e., externally collected) probe data in their responses.

Among arterial agencies, large majorities have adopted *inductive loops* (89 percent) and *video imaging* (82 percent) to detect traffic at signalized intersections, indicating these are mature technologies.

External data are widely used by freeway and arterial agencies.

The survey results suggest that *external data* are emerging as another source of real-time traffic collection data. Almost all freeway agencies (93 percent) and a majority of arterial agencies (59 percent) report using external data from any source.

Mobile application (app) usage is up.

Arterial and freeway agencies are increasingly deploying *custom-built* or *third-party applications* (collectively, *mobile apps*), which may reflect travelers' increasing preference for use of their mobile phones to receive real-time information en route.

- Among freeway agencies, use of *mobile apps* grew by 28 percentage points since 2016 (to 73 percent). Among arterial agencies, who report less use of traveler information methods, growth was also significant (10 percentage points), with 22 percent of arterial agencies currently reporting *mobile app* use.
- While *social media* and *websites* are still the two most commonly used methods of disseminating traveler information among freeway agencies (81 percent and 80 percent, respectively), as well as among arterial agencies (38 percent and 35 percent, respectively), these methods saw declines in usage across both freeway and arterial agencies in 2020.
- Two of the more traditional and least used methods, *511* and *highway advisory radio (HAR)*, also experienced notable usage declines in 2020. Future surveys may want to explore the extent to which mobile apps are replacing versus complementing other traveler information methods.

Key Findings: Transit Management Agencies

This section describes key findings from the Transit Survey.

Many transit specific ITS technologies see increasing adoption.

Overall, adoption of *automatic vehicle location (AVL)*, *computer aided dispatch and scheduling (CADS)*, *mobile data terminals (MDT)*, and *automatic passenger counters (APC)* has increased significantly since 2010, with agency adoption rates above 70 percent.[3] While experiencing moderate growth since 2016 (six percentage points), adoption of *transit signal priority (TSP)* remains relatively low at 32 percent of surveyed transit agencies.

- Technologies experiencing notable growth between 2016 and 2020 include *CADS* (from 65 percent of transit agencies to 85 percent) and *APC* (from 60 percent to 71 percent). Adoption of *AVL* grew more modestly (from 84 percent of transit agencies to 92 percent), as did *MDT* (from 74 percent to 79 percent) and *TSP* (from 26 percent to 32 percent).

[3] This finding references the percent of transit agencies adopting ITS technologies, with transit modes combined. The increase in adoption varies somewhat by specific mode (e.g., bus vs. demand responsive).

- With *fixed route bus* being the most common service type offered by surveyed transit agencies (91 percent), deployment of ITS technologies on buses tends to mirror that reported by transit agencies overall. Since 2016, there has been significant growth in the adoption of *CADS* (from 57 percent to 73 percent) on fixed route buses and somewhat more modest growth in *APC* (from 69 percent to 77 percent) and *MDT* (from 65 percent to 70 percent). Adoption of *AVL* and *TSP* was relatively flat on fixed route buses in the most recent survey cycle.
- Nearly eight-in-ten agencies operating *ADA paratransit vehicles* have adopted *AVL*, *CADS* and *MDT*. The adoption of *CADS* on ADA paratransit vehicles grew by a significant 11 percentage points, from 67 percent in 2016 to 78 percent in 2020, whereas *AVL* growth appears to have slowed, increasing by a more modest five percentage points (from 73 percent to 78 percent). Since the last survey, *MDT* adoption also has remained relatively flat (76 percent in 2016 and 78 percent in 2020).
- On their *demand responsive vehicles*, 80 percent of transit agencies have adopted *MDT*, and 73 percent report adopting *AVL* and *CADS*, whereas 11 percent have adopted *APC*. Increases were seen in *AVL*, *CADS*, and *MDT* adoption on demand responsive vehicles since 2016; however, these findings should be interpreted with caution due to the relatively small number of agencies that report demand responsive service (i.e., small sample sizes).

Use of traveler information systems is increasing among transit agencies.

Like freeway and arterial agencies, use of *mobile apps* has increased significantly among transit agencies, but use of *social media* and *email/text alerts* also experienced strong growth.

- The 2020 Transit Survey shows that *mobile apps* are now the most used traveler information system among transit agencies, with 75 percent reporting use of *custom-built* or *third-party applications* (collectively, *mobile apps*). Adoption of *mobile apps* is up nearly 50 percentage points since 2013 (when apps were first measured), with growth evenly split across the last two survey cycles.
- *Websites* fall just below apps at 72 percent, remaining relatively stable since 2016. Use of *social media* (67 percent) and *email/text alerts* (63 percent) are up significantly since 2016, whereas the more mature technologies, such as *511* (18 percent) and *kiosks* (15 percent) are the least used and show minimal growth from 2016.

Although still rare, there has been growth in partnerships with ride-hailing companies.

Overall, nearly one-third of transit agencies are engaging in partnerships with *private transportation services*, similar to what was reported in 2016; however, the average number of partnerships per agency increased from 1.3 to 2.1.

- Partnerships with *ride-hailing companies* increased significantly, from 4 percent in 2016 to 15 percent in 2020. Partnerships with *microtransit services* also grew by six percentage points (from 3 percent in 2016 to 9 percent in 2020).

A large majority of transit agencies report plans to upgrade their fare payment systems within the next 5 years to accept additional or different types of payment.

Nearly three-quarters (72 percent) of transit agencies are planning to upgrade their fare payment systems in the *next five years*, with one-quarter planning to do so in the *next year*.

A majority of transit agencies report use of real-time standards.

Just over one-half of transit agencies (54 percent) indicate use of real-time standards, including *General Transit Feed Specification Real-Time (GTFS-RT)* and/or *Service Interface for Real-Time Information (SIRI)*. Among agencies providing real-time information via mobile apps, this climbs to 70 percent.

Key Findings: Freeway, Arterial and Transit Management Agencies

This section describes key findings from the Freeway, Arterial, and Transit Surveys.

Freeway agencies show more interest in Integrated Corridor Management compared to arterial and transit agencies.

While 21 percent of freeway agencies report *deploying Integrated Corridor Management (ICM)*, an additional 46 percent indicate they *plan to deploy* an ICM system. Fewer arterial and transit agencies either have *deployed ICM* (12 percent and 8 percent, respectively) or *plan to deploy* (20 percent and 18 percent, respectively).

ITS cybersecurity planning shows room for growth.

Just over one-half (55 percent) of freeway agencies have developed an *ITS-specific cybersecurity policy*, compared to 40 percent of transit agencies and 24 percent of arterial agencies. *Plans to deploy* are similar across the agency types (15 to 17 percent of agencies indicate such plans). Notably, 18 percent of freeway and transit agencies, as well as 10 percent of arterial agencies report having experienced a cybersecurity event (affecting their *Information Technology (IT) systems* and/or *transportation operations*) in the last three years.

Large majorities of all agency types plan to invest in ITS in the next three years.

Nearly all freeway agencies (97 percent), and roughly two-thirds of arterial (65 percent) and transit agencies (68 percent) plan to *expand or upgrade* their current ITS in the next three years. A large majority of freeway agencies also plan to *invest in new ITS* (78 percent), whereas arterial and transit agencies are somewhat less likely to *invest in new ITS* (47 percent and 54 percent, respectively).

Conclusions

The 2020 DTS provides high-level insights that agencies can use to determine where assistance or outreach may be needed to support adoption of ITS technologies. It also raises some questions that may merit further research and investigation.

The 2020 DTS shows that a number of ITS technologies experienced increasing levels of adoption since 2016. Among freeway agencies for example, there was notable growth in the adoption of *work zone* and *safety system technologies*, and among arterial agencies, the use of *pedestrian warning systems* increased significantly.

Among freeway agencies, more than eight-in-ten report the use of *real-time data collection* technologies, and nearly three-quarters have adopted *roadside infrastructure* detection technologies. In particular, *radar/microwave* is widely adopted (71 percent). Likewise, among arterial agencies, the adoption of detection technologies at signalized intersections, including *inductive loops* and *video imaging,* is very high and appears to reflect the maturity of these technologies.

For real-time traveler information methods, the use of *mobile apps* has increased dramatically since 2016, whereas other dissemination methods, such as *511, HAR, email/text alerts,* and even *social media*, have experienced decreased use among freeway and arterial agencies. The long-term trend lines show how use of traveler information dissemination methods have evolved, though it is unclear to what extent technologies that provide information en route are replacing versus complementing other more traditional sources of traveler information. Future surveys may want to address this question.

For other technologies, such as arterial agency adoption of *ASCT* and *TSP*, growth generally has been steady, but overall, fewer than one-third of arterial agencies report adoption of these technologies. It would be helpful to better understand agencies' perceived need for these technologies, and the challenges or barriers they face in deploying them, in order to understand the opportunity for growth.

On the transit side, there has been a significant increase in the adoption of *CADS* and *APC* since 2016, and more moderate growth of *AVL* and *TSP*. With the exception of TSP, these are mature transit technologies and are adopted by a large majority of agencies.

Like freeway and arterial agencies, transit agencies are increasingly using *mobile apps* to disseminate real-time traveler information. The use of s*ocial media*, and *email/text alerts* also has experienced growth among transit agencies. In addition, a large majority of transit agencies (72 percent) report plans to upgrade their fare payment systems *within the next five years* to accept new payment methods.

Two other topics that might deserve a more detailed examination include both ICM and the use of external data, particularly probe data. First, given that there appear to be relatively high levels of interest among freeway agencies in *deploying ICM*, it would be useful to understand what strategies and technologies agencies are deploying (or planning to deploy) as part of their ICM, the extent to which agencies are coordinating with other modes, and the challenges faced in deploying ICM. Second, the surveys also found that a large number of agencies are using *external data sources*, including third-party commercial data, such as probe data. It may be worth further investigating the ways in which agencies are using this data to complement or fill in the gaps of their own real-time data collection. This information could also be useful to other agencies who are considering the use of third-party commercial data.

Finally, given the relatively large number of agencies that have not developed an *ITS-specific cybersecurity policy*, there is room for growth in this area.

Chapter 1. Introduction

Purpose of the Report

This report summarizes the key findings of the 2020 ITS Deployment Tracking Survey (DTS), administered by the United States Department of Transportation (USDOT) John A. Volpe National Transportation Center (Volpe) in support of the USDOT Intelligent Transportation Systems Joint Program Office (ITS JPO). These surveys track ITS deployment (type and to what extent deployed) nationwide. The resulting data are used to inform the ITS JPO and other stakeholders on strategic planning and investment decisions related to ITS deployment (including gaps), market development, and technology transfer activities. 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 DTS data serve a critical role in supporting this mission.

Background

Since 1997, the ITS JPO has used the DTS to collect information about ITS deployment in metropolitan areas across the United States. The surveys track the deployment of ITS technology by state and local transportation agencies. The DTS has been administered to freeway, arterial, and transit management agencies 12 times prior to the 2020 survey effort, and roughly once every three years since 2007.[4] The ITS DTS survey program was initially developed to support ITS deployment program assessment by the ITS JPO, and to track and manage progress toward the ten year ITS deployment goal set by the Secretary of Transportation in 1995. The survey was conducted every 1-2 years during the goal measurement period. Following the goal period, the survey was conducted less regularly on a roughly 3-year cycle to monitor the deployment of ITS across the country. Prior to 2020, the most recent ITS DTS was conducted in 2016. In the fall of 2019, the ITS JPO administered a DTS-related special topic survey to obtain a baseline on the deployment of connected vehicle (CV) and automated vehicle (AV) technologies. This CV/AV survey was administered to the DTS population (108 large and medium sized metropolitan areas). The ITS Small Urban and Rural Transit Provider Survey was also conducted in 2019, in response to a General Accountability Office recommendation that the ITS JPO track the deployment of ITS among small urban and rural transit providers.

Data collection for the 2020 DTS was conducted between December 3, 2020 and March 31, 2021, roughly 9 to 11 months after COVID-19 pandemic restrictions were introduced. The pandemic did not appear to significantly impact survey response rates; however, it is unclear what impact, if any, the pandemic has had or will have on ITS adoption or plans for adoption. Future surveys may add clarity and additional insight on this issue.

[4] Source: 2017 ITS JPO Deployment Tracking Survey Assessment Report.

Chapter 2. Methodology

This chapter describes the methodology for the Deployment Tracking Survey (DTS), including sample development, the survey instrument, and data collection. The final section addresses data reporting.

Sample Development

The 2020 DTS was administered to freeway management, arterial management, and transit management agencies (also referred to as freeway agencies, arterial agencies, and transit agencies, respectively, in this Report) within 108 large and medium sized metropolitan areas nationwide, focusing on agencies that serve populations of 50,000 or greater. The 2020 survey utilized the agency contact lists from the most recent DTS conducted in 2016. Prior to data collection, each agency was contacted by email or phone to notify them of the upcoming survey and to verify that the listed contact was the appropriate respondent for the 2020 DTS. Replacement contacts were obtained when necessary. In total, 91 percent of contacts in the sample were verified. Survey invitations were sent to all contacts, including the nine percent who were not verified.

Survey Instruments

The 2020 survey instruments were modified versions of those conducted in 2016, shortened to reflect a core set of ITS technologies. The Transit Management Survey (also referred to as the Transit Survey in this Report) was reformatted, utilizing skip logic so that agencies received the battery of ITS questions only for the service types (e.g., bus, light rail, ferry, etc.) that they operate. With input from Federal Transit Administration (FTA) staff, the survey team made a number of changes to the transit survey expanding batteries on traveler information systems and fare payment and adding additional response categories for questions on agency partnerships and independent travel for people with disabilities.

Changes to the Freeway Management Survey (also referred to as the Freeway Survey) and the Arterial Management Survey (also referred to as the Arterial Survey) included adding a question on external data usage, updating question wording to improve clarity, adding response options to reflect newer ITS technologies or services, and removing out-of-date options. Questions on cybersecurity were added to each survey, along with questions on whether agency staff or contractors are used for ITS installation, maintenance, and inspection. The survey team shared the survey with ITS JPO staff for their review and comment, as well as with subject matter experts at the Volpe Center and Noblis. Stakeholder input was particularly helpful in designing the new cybersecurity questions.

Table 1 highlights key topics covered by each survey type.

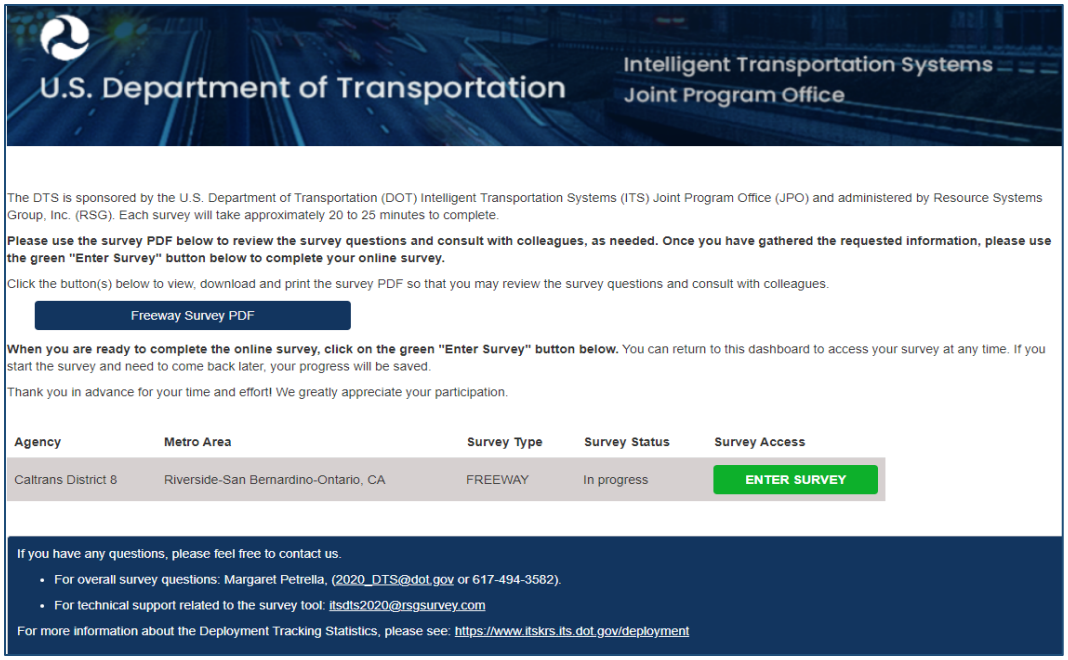
Table 1. Survey Topics by Agency Type

Category	Freeway Survey	Arterial Survey	Transit Survey
Real-time Data Collection	X	X	-
Sources of External Data	X	X	-
Traffic Management (e.g., managed lanes, ramp metering)	X	-	-
Traffic Signal Management Technologies	-	X	-
Transit Management Technologies	-	-	X
Safety and Work Zone Technologies	X	X	-
Integrated Corridor Management	X	X	X
Performance Measurement	X	X	X
Telecommunications	X	X	X
Agency Coordination and Data Sharing	X	X	-
ITS Cybersecurity	X	X	X
Maintenance of ITS Devices	X	X	X
Inspection and Maintenance Staffing	X	X	X
Future Plans for ITS Deployment	X	X	X

Source: USDOT

Data Collection

The DTS was administered using an online survey instrument. Each respondent was provided access to a personalized dashboard that provided details on the survey effort, allowed them to download fillable PDFs of the survey instrument(s), and included unique links to access their survey(s). Several respondents were assigned two or more surveys, representing multiple metropolitan areas and/or more than one type of survey (freeway, arterial, or transit) for a single metropolitan area. If respondents left the survey prior to completion, responses to any completed questions were saved and were accessible by respondents if they returned to the survey (see Figure 1 for an example of a Freeway Survey dashboard).



Source: USDOT

Figure 1. DTS Respondent Dashboard

To ensure that the online survey instrument and email distribution were working correctly, the survey invitation was sent to a small subset of freeway and arterial contacts (i.e., soft launch) on December 3, 2020, prior to the full launch of the Freeway and Arterial Surveys. The full launch of the Freeway and Arterial Surveys occurred on December 8, 2020. The Transit Survey was launched one week later, on December 15, 2020. In total, 854 invitations were sent out: 139 freeway, 503 arterial, and 212 transit (Table 2).

Three rounds of reminder emails were sent out in December 2020 and January 2021. Additional efforts to contact those who had not completed their assigned survey(s) were conducted by phone in February and March of 2021. Agencies were called and encouraged to complete the survey. Messages were left for respondents who could not be reached by phone, and email reminders were also sent. The survey was closed March 31, 2021, resulting in 578 completes and an overall response rate of 68 percent. The final response included 101 freeway, 341 arterial, and 136 transit completes (Table 2).

Table 2. Results by Survey Type

Agency Type	Invitations	Number of Completes	Percent Complete
Freeway	139	101	73%
Arterial	503	341	68%
Transit	212	136	64%
Total	**854**	**578**	**68%**

Source: USDOT

The survey data went through an extensive review and cleaning process and open-ended responses were reviewed and coded into existing or new categories (where applicable).

Reporting

Where available, trend data are shown for the key findings. In some cases, however, the question wording changed substantially over time, so it is not possible to show the trend for some years. For the Arterial Survey, the 2010 data are not presented. The survey was administered to a subset of agencies during that survey cycle, so the data are not comparable to other years.

For most survey questions, trend is reported either over the last three (2013, 2016, 2020) or four surveys (2010, 2013, 2016 and 2020), and for a smaller subset of questions longer term trend is available (i.e., 2002-2020). Sample sizes for all survey years are provided in Appendix A and are not provided in the trend charts due to space constraints. Table 3 highlights how different magnitudes of change in the trend data are interpreted, providing a unform way of describing the trend data.

Table 3. Interpretation of Trend Data

Change (positive or negative)	Growth (or Decline) Category
Zero percentage points	No growth or decline
One to four percentage points	Minimal growth/decline (not meaningful)
Five to eight percentage points	Moderate growth/decline
Nine percentage points or more	Significant growth/decline

For all charts not displaying trend data, data are from the 2020 surveys. Question numbers from the 2020 surveys are referenced at the bottom of each figure.

Chapter 3. Key Survey Findings

This chapter presents the 2020 DTS findings for key deployment tracking questions. Findings are based on total sample unless otherwise noted.

Key Findings for Freeway and Arterial Management Agencies

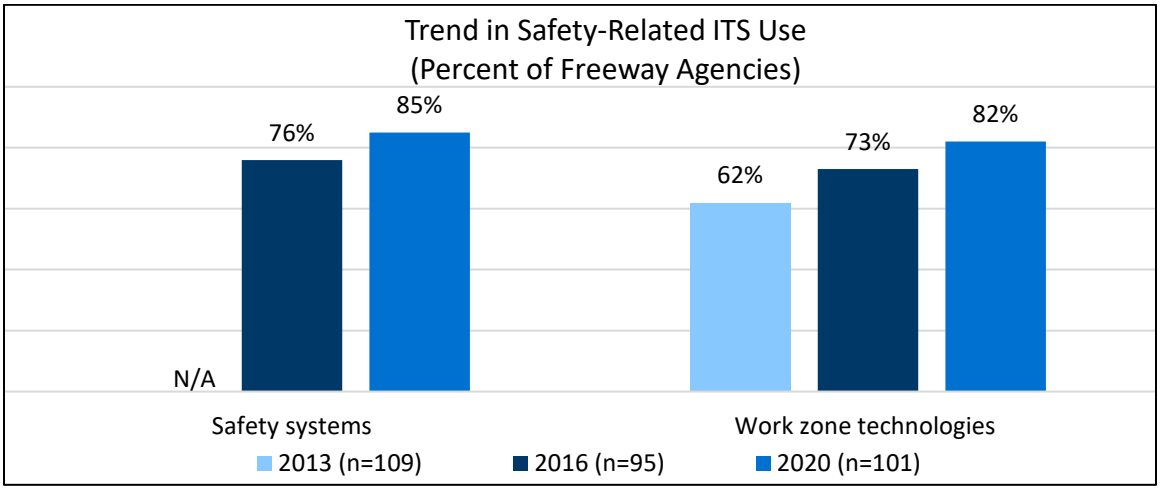
The following section of the report highlights findings for freeway and arterial agencies.

Key Finding: Safety-Related ITS Show Growth

There has been growth in adoption of safety systems and work zone technologies as USDOT and state agencies continue to emphasize safety as a top goal.

Freeway Safety Systems and Work Zone Technologies

In recent years, significantly more surveyed freeway agencies have adopted safety-related ITS. Figure 2 shows that since 2016, the number of agencies deploying safety systems increased from 76 percent to 85 percent. There has been a 20 percentage point increase in adoption of work zone technologies since 2013 (from 62 percent to 82 percent), with significant growth between each survey period.[5]



2020 Q12, Q17 *Source: USDOT*

Figure 2. Trend in Safety-Related ITS Use – Freeway Agencies

[5] The safety systems indicator was created by counting the agencies that reported use of one or more safety system technologies. The work zone indicator represents responses to a screener (i.e., yes/no) question on whether or not the agency deploys work zone technologies. The 2013 safety systems use is not shown, because the data are not comparable (the list of technologies changed significantly since 2013).

The commitment of USDOT and state agencies to improving safety may be one of several factors contributing to growth in the use of these safety-related ITS technologies, although the data cannot confirm this link.

Figure 3 shows the trend in the surveyed freeway agencies' deployment of safety system technologies from 2016 to 2020. Freeway agencies use a range of ITS safety systems, on average 2.7 per agency. Two safety systems saw significant increases from 2016: *queue warning systems* increased by nine percentage points from 38 percent to 47 percent, and *over-height warning systems* increased by eight percentage points from 37 percent to 45 percent. These technologies are also reported as the most commonly used safety systems.

Technologies such as *dynamic curve warning* (30 percent), and *dynamic speed limit* (24 percent) have remained relatively stable since 2016, while *reference location sign* usage (29 percent) saw a moderate decline. Safety systems such as *auto/manual ramp gates* (16 percent), *downhill truck speed warning* (9 percent), and *wireless truck inspection* (7 percent) are used by a small fraction of agencies with minimal variation since 2016. *Lane use control* (20 percent) and *wrong way detection* (39 percent) were new answer options in 2020, so no trend is shown. *Other* safety technologies were mentioned by 10 percent of agencies. The most common response for the *other* responses included technology specifically for tunnels (e.g., tunnel fire system, tunnel traffic management, and lane use control for tunnels). It should be noted that some technologies, such as *downhill truck speed warning*, are applicable in areas with specific physical characteristics, and so the ceiling for adoption is likely to be lower.

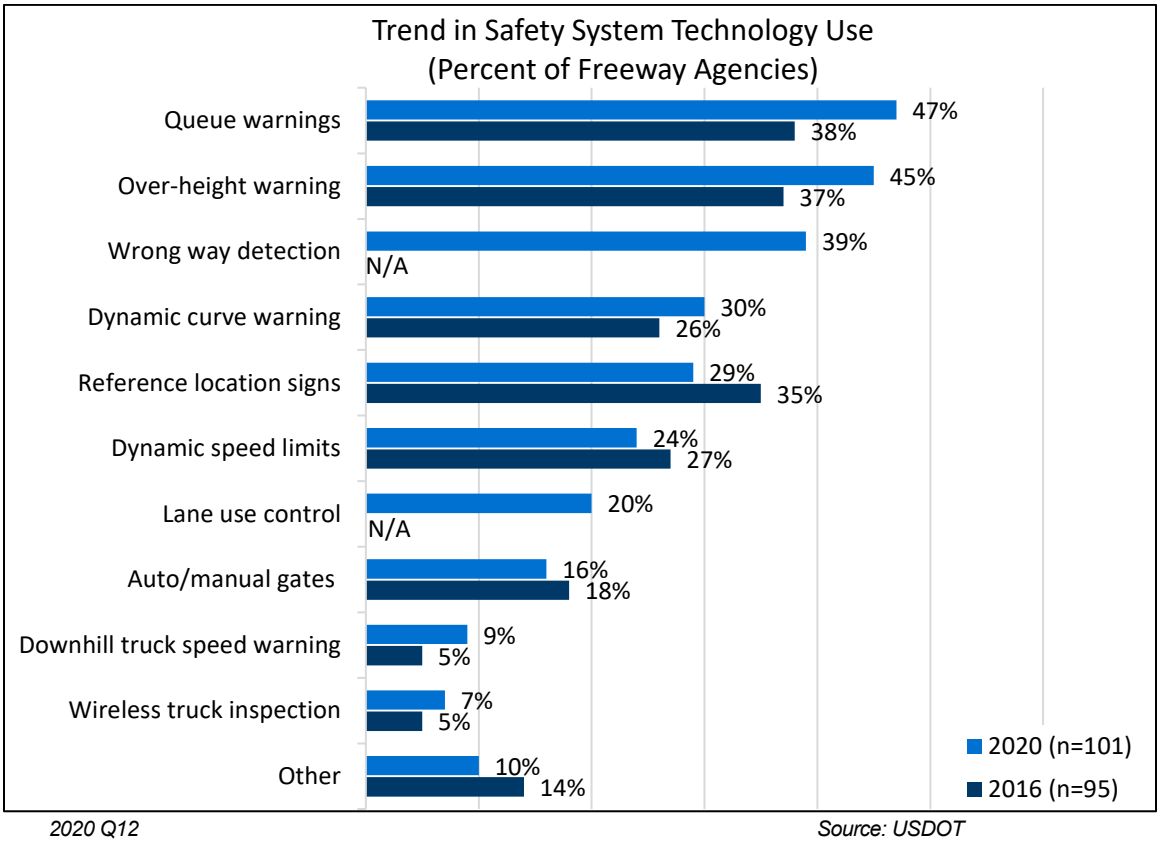


Figure 3. Trend in Safety System Technology Use – Freeway Agencies

On average, surveyed freeway agencies have deployed 2.8 work zone technologies. Figure 4 shows that the biggest change from 2013 to 2020 was seen in use of *queue detection* (up 26 percentage points to 47 percent), which experienced significant growth across both survey cycles (2013 to 2016 and 2016 to 2020). There also has been a notable increase in the use of moveable technologies; *portable CCTV* use is up a significant 20 percentage points since 2013 (to 65 percent) and *portable traffic monitoring device* use has increased moderately, up eight percentage points since 2016 (to 36 percent).

Travel time systems (42 percent) are commonly used for work zone safety and have remained relatively stable since 2013. Reported use of *route guidance* has varied over the past two survey cycles and is currently at 25 percent. Less common technologies in 2020 include *variable speed limit* (16 percent), *dynamic lane merge* (10 percent), *temporary ramp metering* (8 percent) and *intrusion alarm* (7 percent). *Other* work zone technologies were mentioned by 23 percent of agencies. [6]

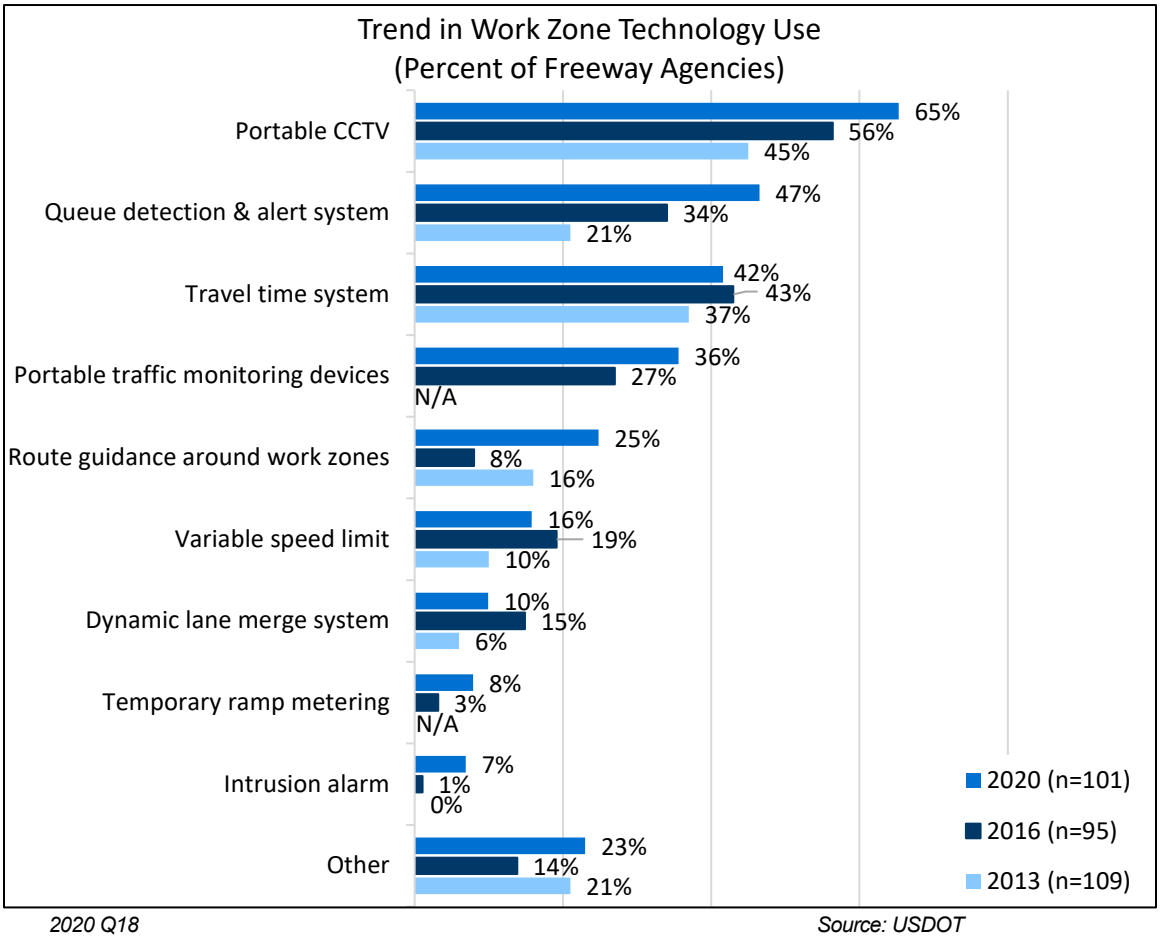
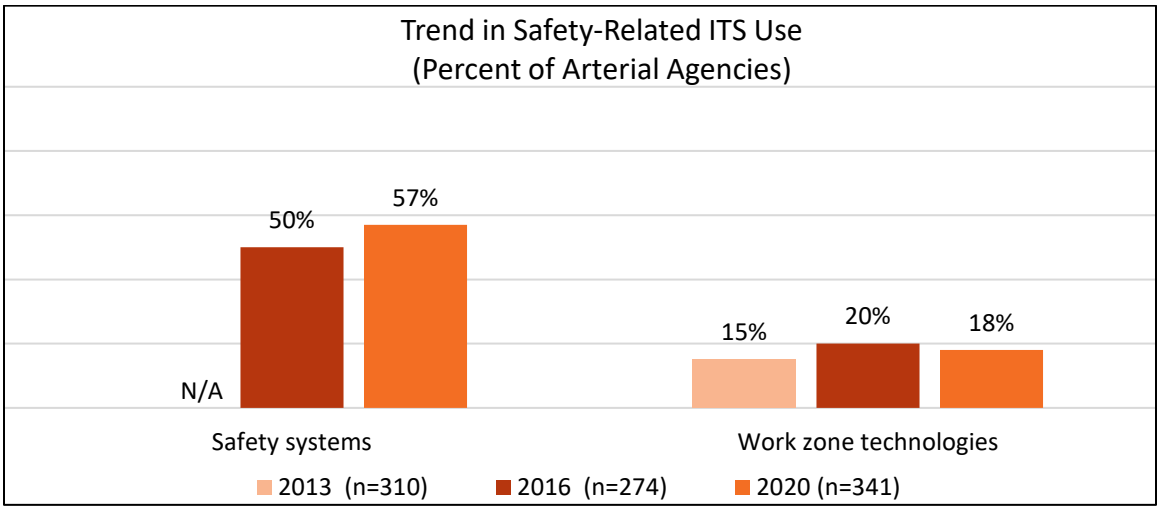


Figure 4. Trend in Work Zone Technology Use – Freeway Agencies

[6] Portable traffic monitoring devices and temporary ramp metering first appeared on the 2016 survey.

Arterial Safety Systems and Work Zone Technologies

Surveyed arterial agencies have seen moderate growth in ITS safety systems adoption, up seven percentage points since 2016 to 57 percent (Figure 5).[7] About one-fifth (18 percent) of arterial agencies have adopted work zone technologies, with minimal change in the trend since 2013. Due to low usage, this Report does not address the arterial agency findings for individual work zone technologies.



2020 Q17a, Q22 *Source: USDOT*

Figure 5. Trend in Safety-Related ITS Use – Arterial Agencies

Figure 6 shows that the increased use of safety systems by surveyed arterial agencies is largely driven by the adoption of pedestrian safety technologies. Since 2016, use of *pedestrian warning systems* increased significantly, up 13 percentage points from 34 percent to 47 percent (and an additional 2 percent specified *rectangular rapid flashing beacons (RRFB*) in response to the *other* category). Follow-up questions indicate that 70 percent of agencies deploying these technologies are doing so at intersections, covering 10 percent of them, on average.

Use of other safety systems, however, remain relatively low and deployment appears flat. Future surveys should continue to monitor both the use and coverage of pedestrian safety technologies to better understand the use and impact of these systems.

The 57 percent of arterial agencies who deploy safety systems report use of 1.7 technologies, on average. Adoption rates remain low for technologies not focused on pedestrians. Safety technologies that are growing for freeway agencies such as *queue warning* and *over-height warning* do not show the same pattern for arterial agencies. *Queue warning* (5 percent) and *over-height warning* (9 percent) show minimal change from 2016.

[7] The safety systems indicator was created by counting the agencies that reported use of one or more safety system technologies. The work zone indicator represents responses to a screener (i.e., yes/no) question on whether or not the agency deploys work zone technologies. The 2013 safety systems use is not shown, because the data are not comparable (the list of technologies changed significantly since 2013).

Other technologies that show low, stable usage include *dynamic curve warning* (9 percent), *dynamic speed limit* (8 percent), and *bicyclist warning* (6 percent). *Wrong way detection* (4 percent) was a new answer option in 2020, so no trend in shown. *Speed feedback* (3 percent) was a response category generated from responses to the *other* category.[8] *Other* responses were reported by 5 percent of agencies and included *RRFB* (2 percent).[9]

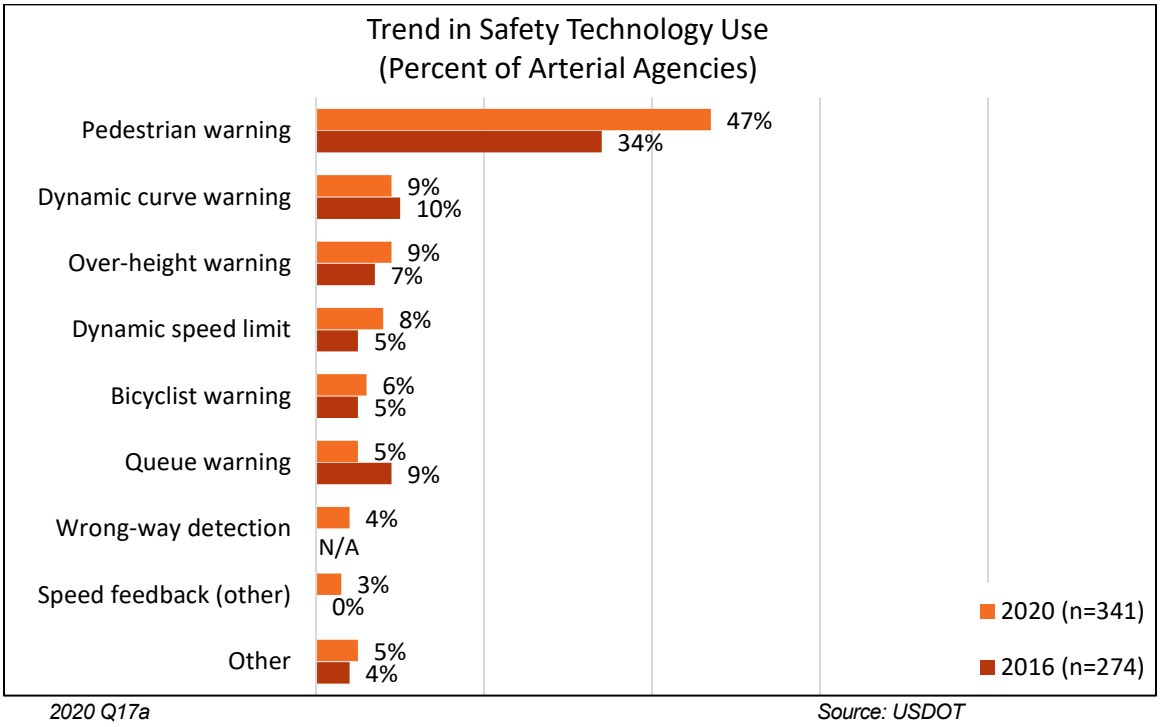


Figure 6. Trend in Safety System Technology Use – Arterial Agencies

[8] The "other" response category allows respondents to write in responses, specifying what they mean by "other." If at least 3 percent of respondents write in the same response, these are typically recoded into a new response category for reporting purposes.

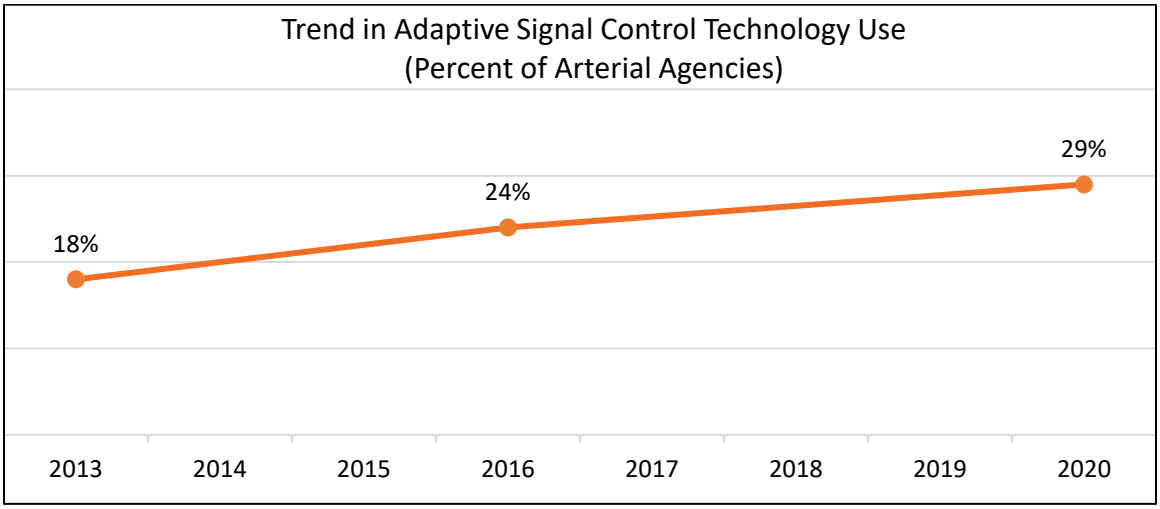
[9] The 2020 survey included an additional response option for intrusion alarms, which is not included in the chart because zero percent of agencies reported this technology.

Key Finding: ITS Technologies Showing Steady Growth on Arterials

Among arterial agencies, several ITS technologies show steady growth, including adaptive signal control, closed-circuit television, radar/microwave detection, transit signal priority, and real-time data collection technologies.

Adaptive Signal Control Technology

Agency use of a*daptive signal control technology (ASCT)* as an operational strategy to improve coordinated signal timing has seen increased adoption in recent years due, in part, to advances from the private sector that enable agencies to deploy ASCT at a small number of intersections rather than across larger systems. Since 2013, there has been an 11 percentage point increase in adoption of *ASCT* among arterial agencies, about half of which occurred since the 2016 survey (Figure 7).[10]

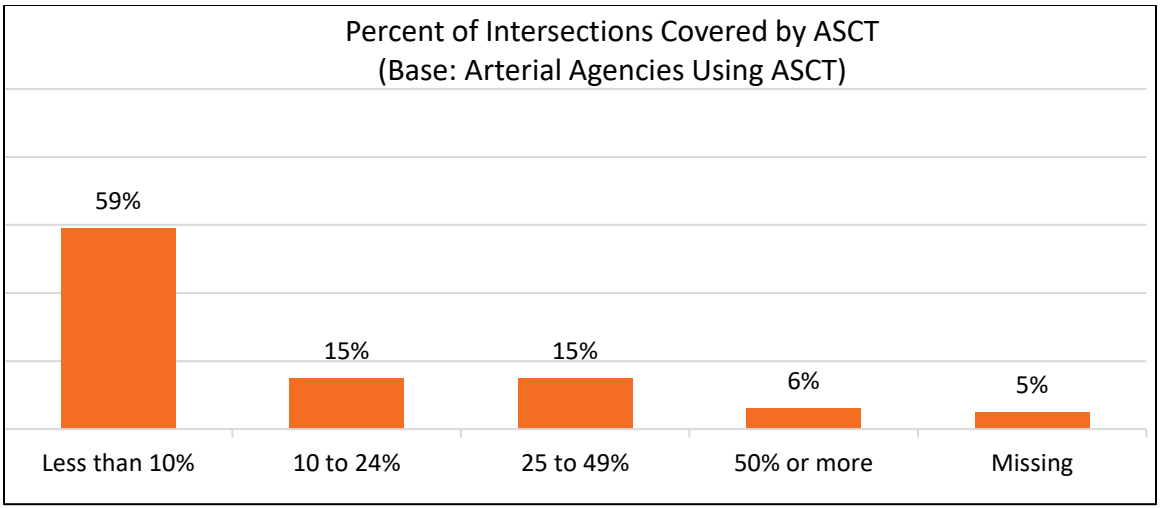


2020 Q9 *Source: USDOT*

Figure 7. Trend in Adaptive Signal Control Technology Use – Arterial Agencies

A measure of ASCT coverage shows that agencies are deploying this technology at select intersections (Figure 8). A majority of surveyed arterial agencies deploying *ASCT* (59 percent) do so at less than 10 percent of signalized intersections. Another 30 percent of agencies cover between 10 and 49 percent of signalized intersections, and 6 percent of agencies cover at least 50 percent of intersections. Future surveys may want to explore the extent to which agencies perceive a need for adopting and/or expanding ASCT in order to better understand the opportunity for growth for this technology.

[10] See Appendix A for sample sizes for each survey year. As noted in the Methodology section, the trend line charts do not show sample sizes due to space constraints.

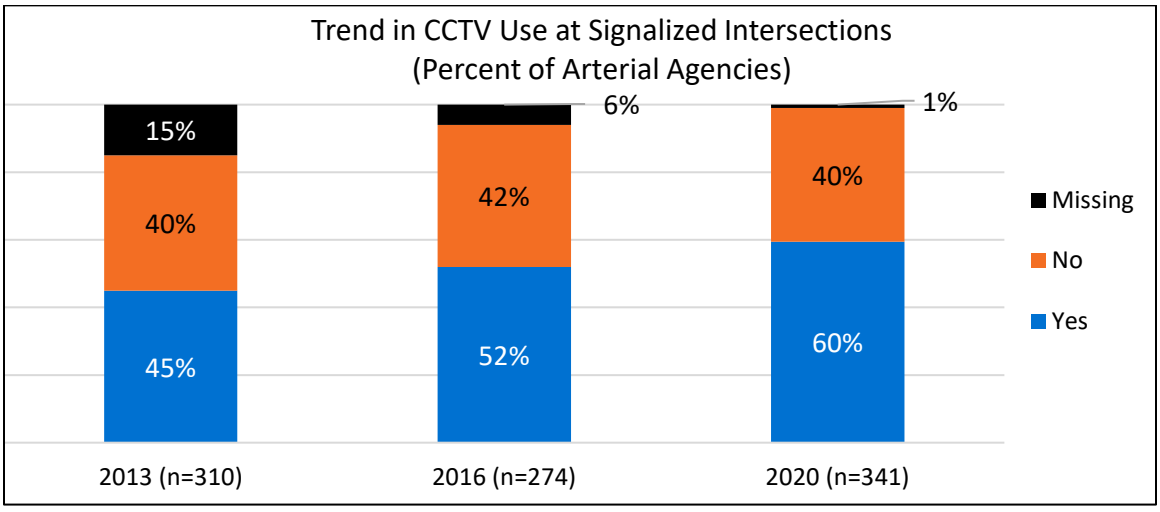


2020 Q9a; (n=100) *Source: USDOT*

Figure 8. Percent of Intersections Covered by ASCT – Arterial Agencies

Closed-Circuit Television (CCTV)

CCTV use at intersections for traffic control shows steady growth since 2013 (Figure 9). Although the CCTV question changed in the 2020 survey, asking about general CCTV use (for traffic control) at intersections rather than requiring an estimate of the number of intersections covered by CCTV, the results still point to growth. *CCTV* use increased seven percentage points from 2013 to 2016 (to 52 percent) and eight percentage points from 2016 to 2020 (to 60 percent).

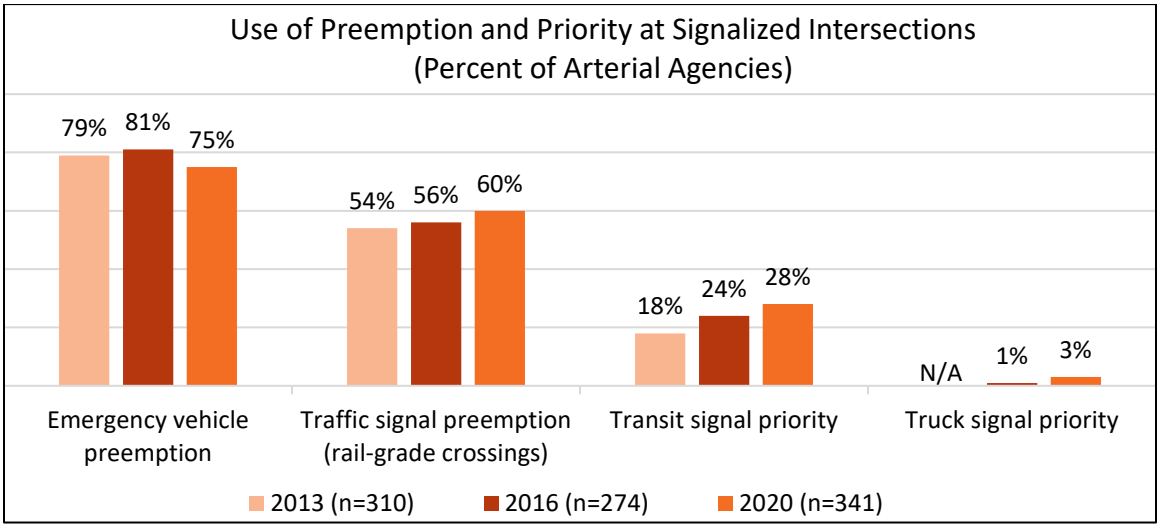


2020 Q8 *Source: USDOT*

Figure 9. Trend in CCTV Use at Signalized Intersections – Arterial Agencies

Preemption and Priority at Signalized Intersection

As Figure 10 illustrates, *traffic signal preemption at rail crossings* (60 percent) shows moderate growth since 2013 (up six percentage points),[11] while adoption of *transit signal priority* has grown by a more significant 10 percentage points (to 28 percent) since 2013. Neither of these technologies, however, has seen notable growth in the last survey cycle (2016 to 2020). The adoption of *emergency vehicle preemption* has leveled off, with 75 percent indicating usage in 2020. Three percent of surveyed arterial agencies have adopted *truck signal priority* in 2020.



2020 Q11 *Source: USDOT*

Figure 10. Use of Preemption and Priority at Signalized Intersections – Arterial Agencies

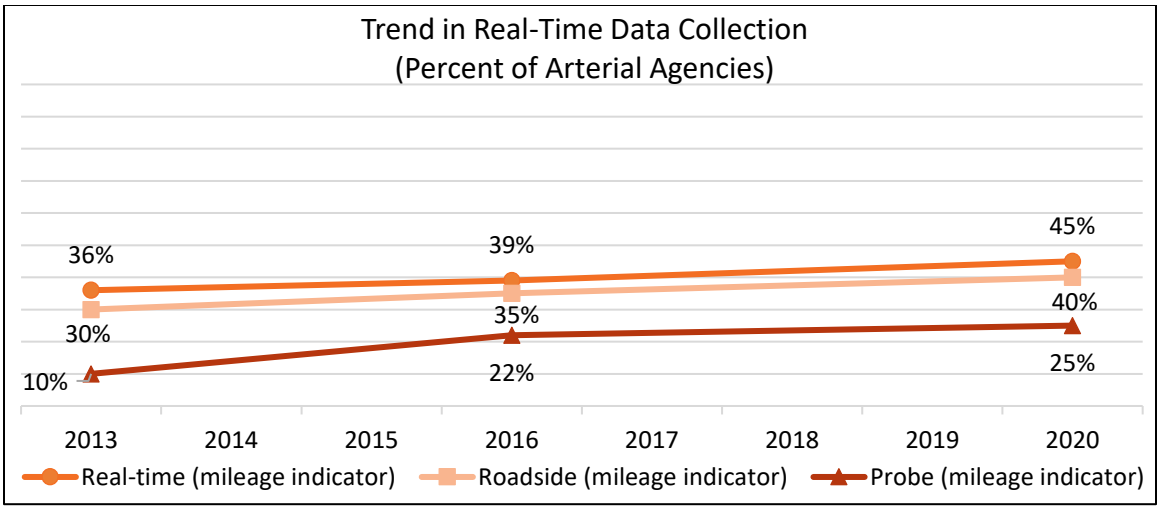
Real-Time Data Collection Technologies

While most surveyed arterial agencies use *real-time data collection at intersections* (95 percent) a smaller proportion collect data on arterial roadways (45 percent) as measured by a mileage indicator.[12] Figure 11 shows use of *real-time data collection*, which includes both roadside infrastructure and vehicle probe readers, is up nine percentage points since 2013, and shows moderate growth since 2016 (up six percentage points). Use of *roadside infrastructure* has grown by a similar amount since 2013, increasing evenly across the survey cycles from 30 percent in 2013 to 40 percent in 2020. The percent of agencies indicating *vehicle probe reader* use increased significantly from 2013 to 2016 (up 12 percentage points), but shows signs of leveling off, with an increase of three percentage points since 2016 (25 percent).

Due to changes in the question wording in vehicle probe reader technology question from 2016 to 2020, and feedback from a few respondents indicating they have been including purchased external probe data (e.g., from services such as INRIX or HERE) as part of their mileage covered by vehicle probes, it is difficult to interpret the vehicle probe reader usage trend shown in Figure 11. Future DTS surveys may want to take a closer look at the role external data are playing in real-time data collection.

[11] Previous surveys specified highway-rail grade crossings; the 2020 response option is general rail grade crossings.

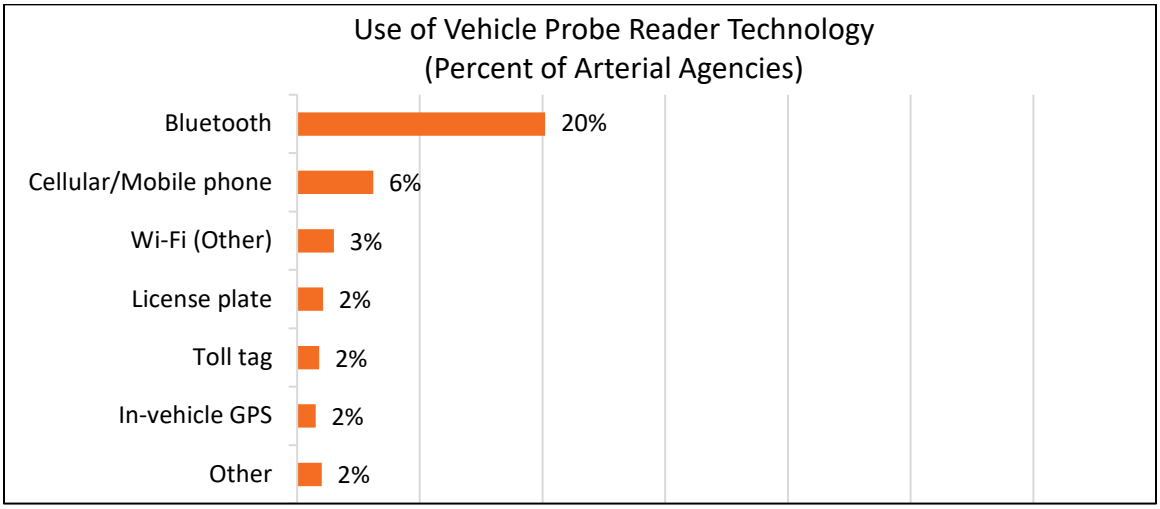
[12] Mileage indicators are based on open-numeric questions, asking for the total number of miles covered by each technology category (total real-time data collection, roadside infrastructure detection, or vehicle probe readers). Agencies indicating more than zero miles are included in the mileage indicator.



2020 Q3, Q4, Q5a *Source: USDOT*

Figure 11. Trend in Real-Time Data Collection – Arterial Agencies

Overall, 27 percent of arterial agencies report deploying one or more vehicle probe reader technologies as measured by a technology indicator.[13] Figure 12 shows that in 2020, surveyed arterial agencies report that *Bluetooth readers* (20 percent) are the most deployed vehicle probe technology. *Cellular/mobile phone readers*, the second most used technology at 6 percent, and *Wi-Fi readers* (at 3 percent) were recoded as a separate category from the o*ther* write-in responses. Technologies with lowest usage include *license plate readers* (2 percent), *toll tag readers* (2 percent), *in-vehicle GPS readers* (2 percent), and *other* data (2 percent).



2020 Q5b (n=341) *Source: USDOT*

Figure 12. Use of Vehicle Probe Technology – Arterial Agencies

[13] This technology indicator is a count of the number of arterial agencies reporting use of one or more vehicle probe technologies. The difference in the findings between this technology indicator (27 percent) and the mileage indicator (25 percent) could be due to different question formats.

Key Finding: Adoption of Some Technologies Has Become Widespread, Reflecting the Maturity of Those Technologies in the Market

Among arterial agencies, adoption of detection technologies is nearly universal, with inductive loops and video imaging being the most widely used.

Among freeway agencies, real-time data collection and roadside infrastructure detection is high and may be plateauing. In particular, use of radar/microwave detection is widespread, reflecting the maturity of the technology.

Detection Technologies at Intersections – Arterial

Use of *detection technologies at signalized intersections* is well established among surveyed arterial agencies (95 percent in 2020 and 94 percent in 2016). As illustrated in Figure 13, use of *inductive loops* (89 percent) is nearly universal and *video imaging* is also widely adopted, at 82 percent – pointing to the maturity of these technologies in 2020. Sixty percent report using *radar/microwave* detection, while *magnetometers* was measured as a specific category for the first time in the 2020 survey, showing close to 20 percent adopting this technology. Another technology described as *infrared cameras/thermal imaging* was written into the *other* response by 3 percent of agencies.

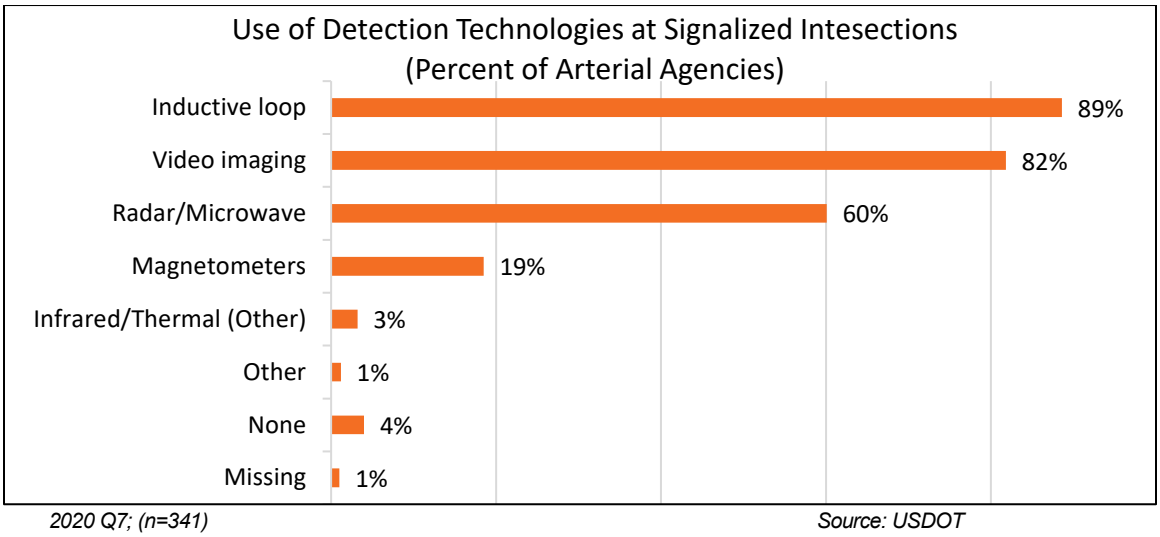
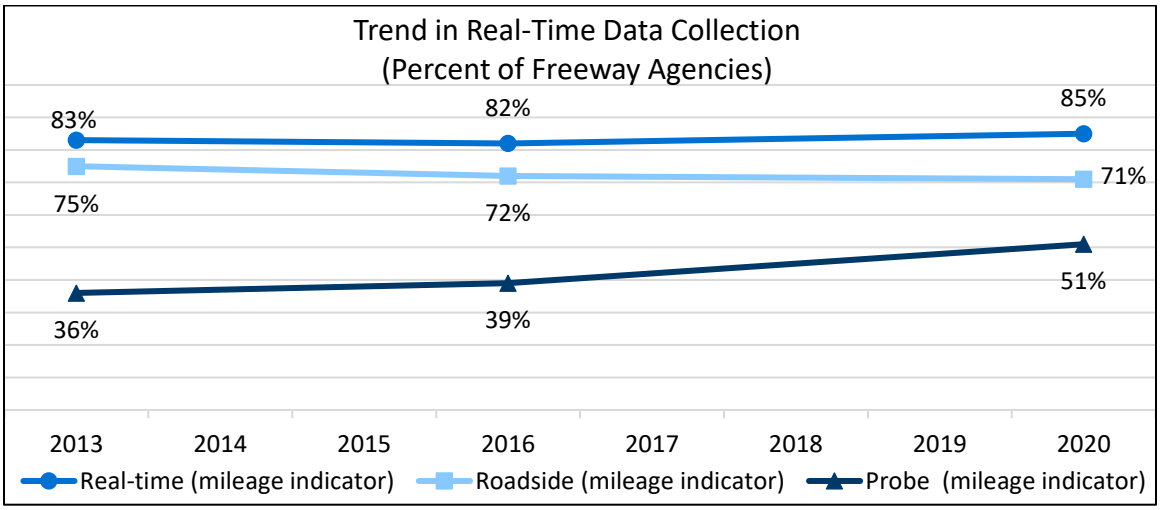


Figure 13. Use of Detection Technologies at Signalized Intersections – Arterial Agencies

Real-Time Data Collection Technologies – Freeway

The trend data displayed in Figure 14 show that use of real-time data collection technologies remains high and steady among surveyed freeway agencies, with 85 percent indicating centerline miles covered by *real-time data collection technologies* in 2020. Real-time data collection technologies include roadside infrastructure such as *inductive loops, radar detectors, video imaging detection*, or *magnetometers*, as well as vehicle probe readers such as *toll tag, license plate, Bluetooth, GPS*, etc. Likewise, a large majority of surveyed freeway agencies (71 percent) report centerline miles with *roadside infrastructure,* with the trend remaining relatively flat across the last two survey cycles. Results indicate that the percentage of agencies reporting freeway centerline miles covered by *vehicle probe readers* has increased significantly from 2013 (up 15 percentage points to 51 percent), but as with arterial agencies, these results are difficult to interpret due to changes in question wording and possible respondent confusion as to whether to include purchased external data when reporting the number of centerline miles covered by probes.



2020 Q2, Q3a, Q4a *Source: USDOT*

Figure 14. Trend in Real-Time Data Collection – Freeway Agencies

When asked what type of roadside infrastructure technologies their agency deployed in 2020, 74 percent of surveyed freeway agencies indicate use of at least one technology.[14] Figure 15 shows that adoption of technologies such as *radar/microwave detection* (71 percent) is widespread, reflecting the maturity of that technology in the market. Forty-two percent are deploying *inductive loops*, followed by 13 percent deploying *video imaging detection*, 9 percent deploying *magnetometers*, and 4 percent indicating *other* roadside infrastructure technologies.

[14] This technology indicator is a count of the number of freeway agencies reporting use of one or more roadside infrastructure technologies. The difference in the findings between this technology indicator (74 percent) and the mileage indicator (71 percent) could be due to different question formats.

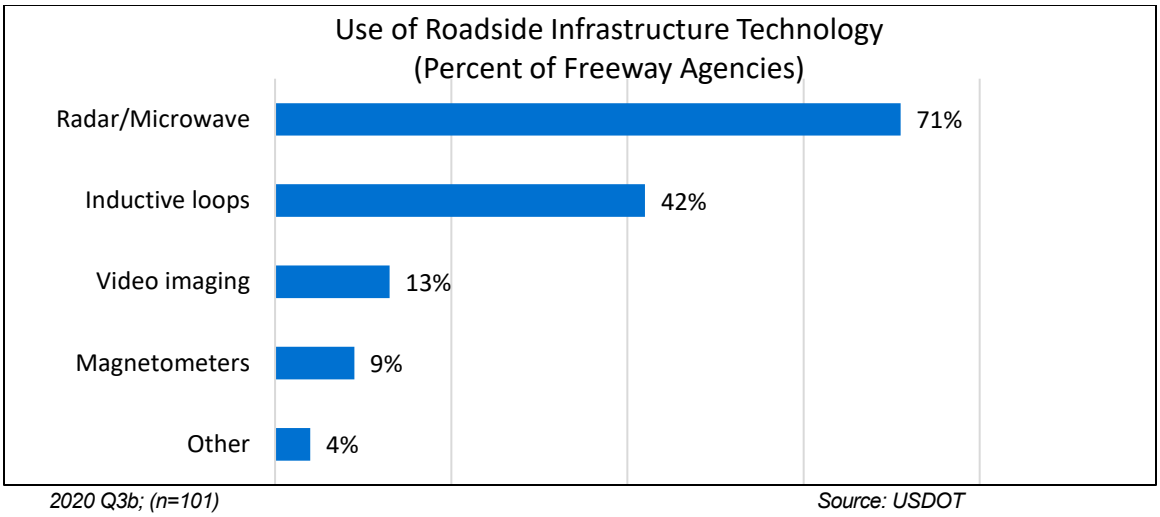


Figure 15. Use of Roadside Infrastructure Technology – Freeway Agencies

Overall, 53 percent of freeway agencies report deploying one or more vehicle probe reader technologies.[15] Figure 16 shows the most commonly reported vehicle probe reader is *Bluetooth* at 27 percent. This is followed by *toll tag readers* (16 percent), *in-vehicle GPS* (10 percent), *cellular/mobile phone readers* (5 percent), and *license plate readers* (4 percent). Six percent of freeway agencies responded with *other* which includes 3 percent writing in that they purchase data. Over the past three survey cycles, *Bluetooth* have remained the most common type of vehicle probe technology. However, trend data are not shown, because it is unclear what the data are measuring; there is evidence that freeway agencies may have interpreted this question differently and differed on whether or not the agency itself deployed vehicle probe reader technologies or if the agency purchased these data from a third party.

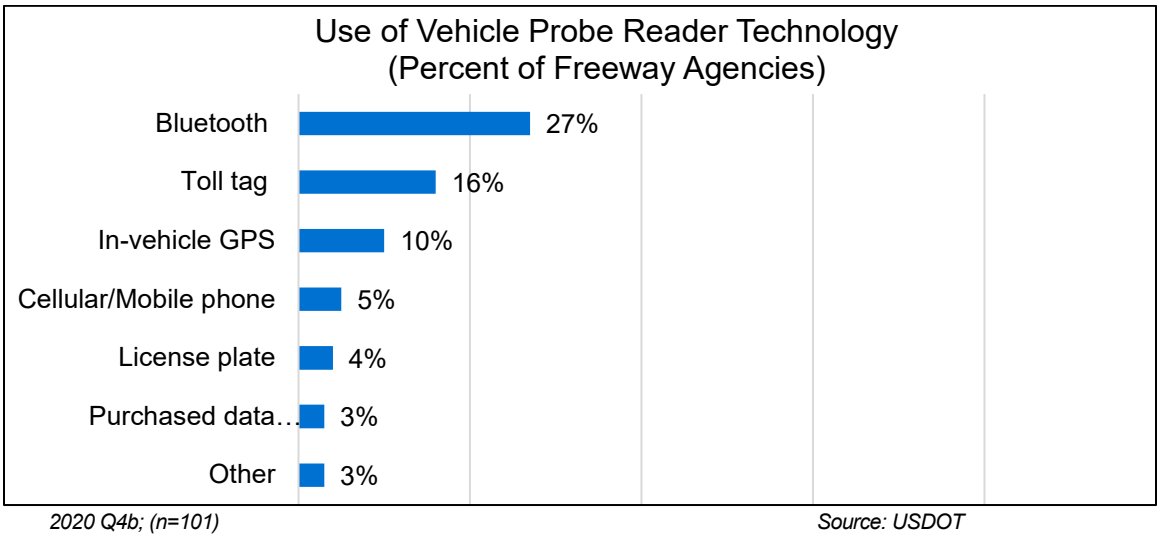


Figure 16. Use of Vehicle Probe Technology – Freeway Agencies

[15] This technology indicator is a count of the number of freeway agencies reporting use of one or more vehicle probe technologies. The difference in the findings between this technology indicator (53 percent) and the mileage indicator (51 percent) could be due to different question formats.

Key Finding: External Data Widely Used by Freeway and Arterial Agencies

The survey results suggest that external data are emerging as another source of real-time traffic collection data.

External Data

A more comprehensive question was added to the 2020 DTS to capture the use of data collected outside of freeway and arterial agencies (external data). Almost all surveyed freeway agencies (93 percent) and a majority of surveyed arterial agencies (59 percent) are using at least one source of external data for traffic information. Incident management is another area where external data are used by freeway agencies; in a separate question, 40 percent indicate use of any external (including crowdsourced) data for this purpose. Future surveys may want to explore the ways in which agencies are using this data to complement or fill the gaps of their own real-time data collection and how freeway and arterial agencies are using data to manage traffic and safety operations.

Freeway agencies use a mix of external data sources for traffic information (Figure 17). Most surveyed agencies (82 percent) report purchasing data from a *third-party commercial provider*, while 68 percent use information from *publicly available mapping and traffic information applications*. Sourcing traffic data from the public is also common, with 52 percent of freeway agencies indicating use of *notifications from the public*. Use of information from *police or highway computer-aided dispatch (CAD)* was not an original response category, but 7 percent of freeway agencies wrote this option in the *other* choice. Another 3 percent of freeway agencies selected the *other* choice, and 7 percent indicated they are not using any external data sources.[16]

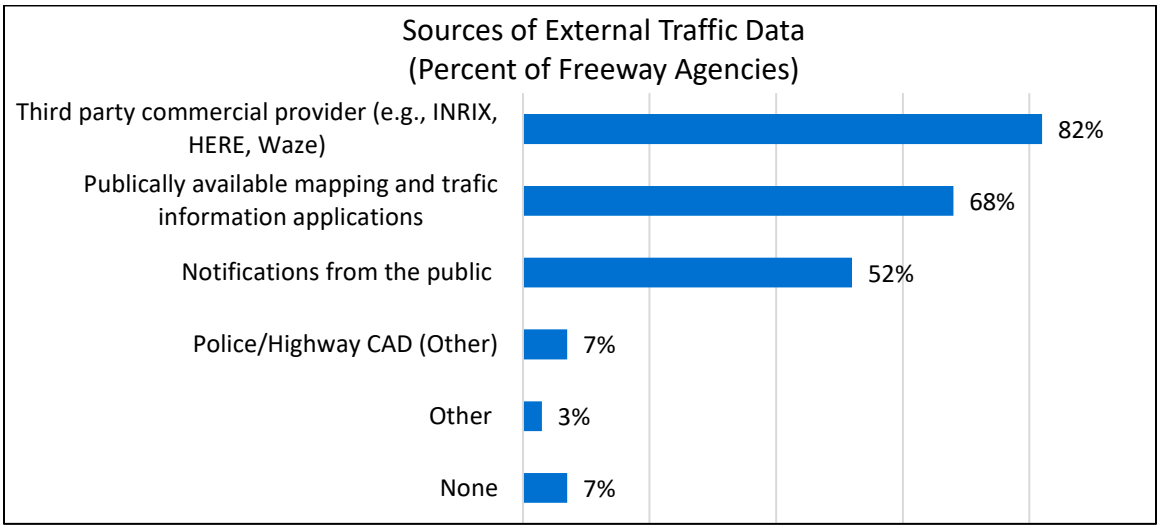


Figure 17. Sources of External Traffic Data – Freeway Agencies

[16] This question had a *don't know* response option which was not selected by any respondents.

Figure 14 shows that among surveyed arterial agencies, *publicly available mapping and traffic information apps* are the most used at 40 percent but are followed closely by data from *third-party commercial providers* (34 percent) and *notifications from the public* (34 percent). Use of information from *other transportation agencies (e.g., State DOT, MPOs, etc.)* was not a response category, but 5 percent of arterial agencies wrote this option in under the *other* choice. Thirty percent indicate that they *did not know* if their agency was using external data sources for traffic information, and 11 percent report no sources were used.

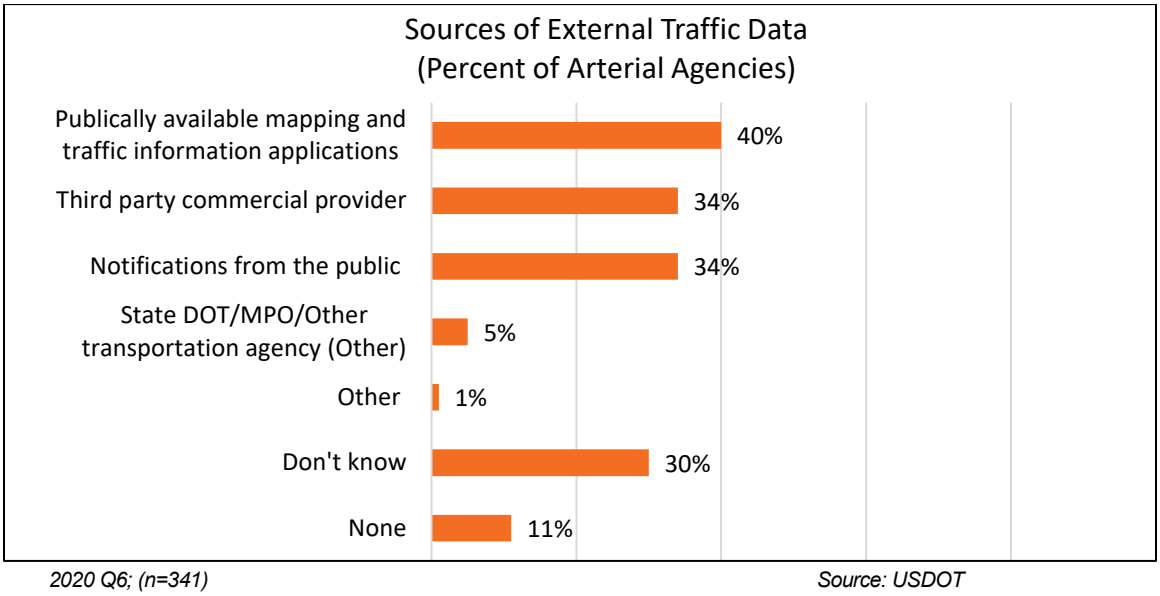


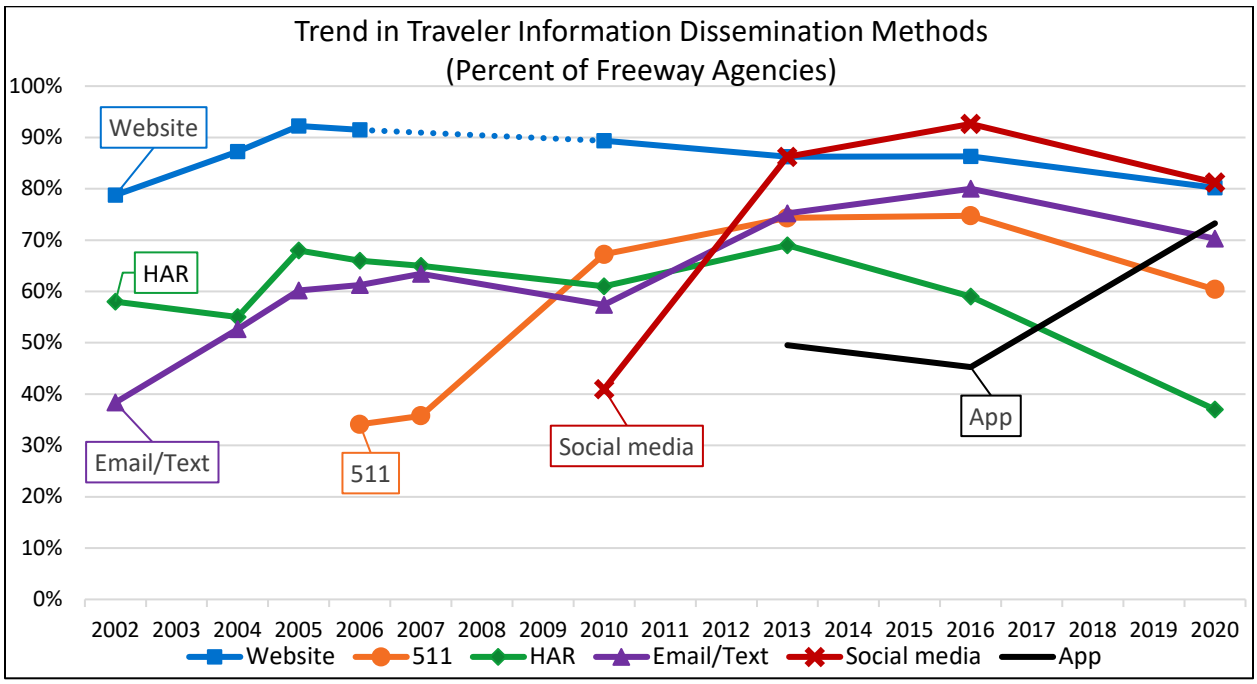
Figure 18. Sources of External Traffic Data – Arterial Agencies

Key Finding: Freeway and Arterial Agencies Increasingly Use Mobile Apps to Disseminate Traveler Information

While social media and websites are still the most commonly used methods of disseminating traveler information, agencies are increasingly deploying custom-built or third-party mobile applications (mobile apps).

Traveler Information – Freeway

Mobile apps (*custom-built* and/or *third-party apps*) are the only type of traveler information method showing growth in 2020; all others show a decline (Figure 19).[17] Future surveys should monitor the trend to determine if 2020 was an anomaly or represents a shift in traveler information system usage. Despite usage declines from 2016 to 2020, *social media* (down 12 percentage points to 81 percent) and *websites* (down six percentage points to 80 percent) are still used by most freeway agencies to disseminate information. These methods are followed by *mobile apps* (up 28 percentage points to 73 percent) and *email/text alerts* (down 10 percentage points to 70 percent). *511 systems* (60 percent) and *highway advisory radio (HAR)* (37 percent) are now the least used technologies, showing steeper declines since 2016 than the other method (down 15 percentage points, and 22 percentage points, respectively).



2020 Q20 *Source: USDOT*

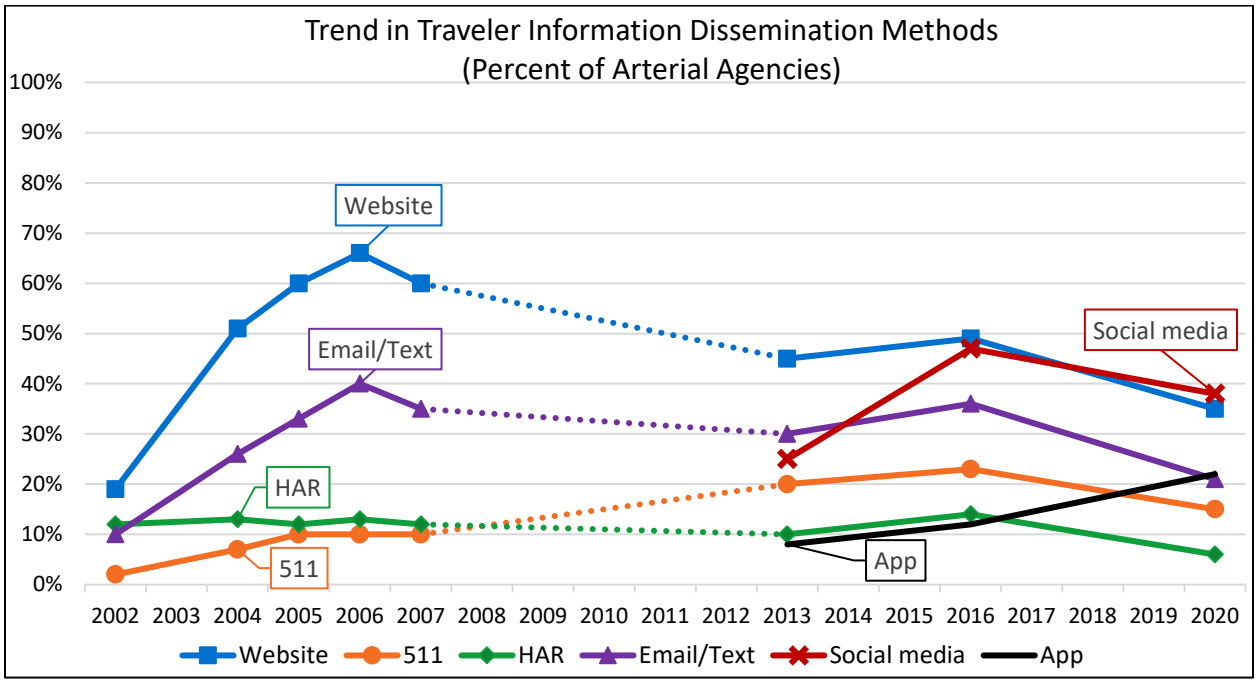
NOTE: In 2007 "websites" was not a response option, so data for that survey year were imputed, as represented by the dashed lines for websites between 2006 and 2010.

Figure 19. Trend in Traveler Information Dissemination Methods – Freeway Agencies

[17] It is not clear whether the usage reductions are due to the evolution of information technologies or to changes in question wording. The 2020 question specifically asks about real-time traveler information, whereas previous surveys referred to traveler information (and did not reference "real-time").

Traveler Information – Arterial

As we saw with freeway agencies, *mobile apps* are the only method showing increased usage by surveyed arterial agencies in 2020 (Figure 20). *Social media* is the most used method, despite declining 11 percentage points to 38 percent since 2016. *Website* usage declined even further (14 percentage points), making it the second most used method at 35 percent. *Mobile apps* increased 10 percentage points during the same time period, with 22 percent of arterial agencies using *custom-built* and/or *third-party apps*. The most significant drop in usage was seen in *email/text alerts*, declining 15 percentage points from 36 percent to 21 percent since 2016. As with freeway agencies, *511 systems* (15 percent) and *HAR* (6 percent) are the least used methods in 2020, each down eight percentage points since 2016.



2020 Q25 *Source: USDOT*

NOTE: Dashed lines indicate data are not available or are not comparable

Figure 20. Trend in Traveler Information Dissemination Methods – Arterial Agencies

Key Findings: Transit Management Agencies

The following section describes key findings from the Transit Survey. In most cases the findings reference **adoption** (i.e., whether or not an agency has deployed a technology), and the percent of transit agencies is presented. However, for findings on **coverage**, which is the extent to which a technology is deployed on transit agencies' fleet vehicles, the statistics reference the percent of equipped vehicles.

Key Finding: Transit Agencies are Increasingly Adopting Surveyed ITS Technologies

Since 2016, computer aided dispatch and scheduling, and automatic passenger counters experienced the most significant growth, and along with automatic vehicle location, these technologies are widely deployed, reflecting their maturity in the market. While use of transit signal priority increased slightly, overall adoption rates remain relatively low.

ITS Transit Technologies

Overall, adoption of *automatic vehicle location* (*AVL*), *computer aided dispatch and scheduling (CADS)*, *mobile data terminals* (*MDT*), and *automatic passenger counters* (*APC*) increased significantly since 2010, with agency adoption rates above 70 percent (Figure 21). While experiencing moderate growth recently (six percentage points since 2016), adoption of *transit signal priority* (*TSP*) remains relatively low at 32 percent. *AVL* adoption grew by eight percentage points since 2016, showing nearly universal adoption by transit agencies (92 percent). Since 2010, growth in *AVL* adoption has been steady, with each survey cycle showing an increase of seven to eight percentage points.[18]

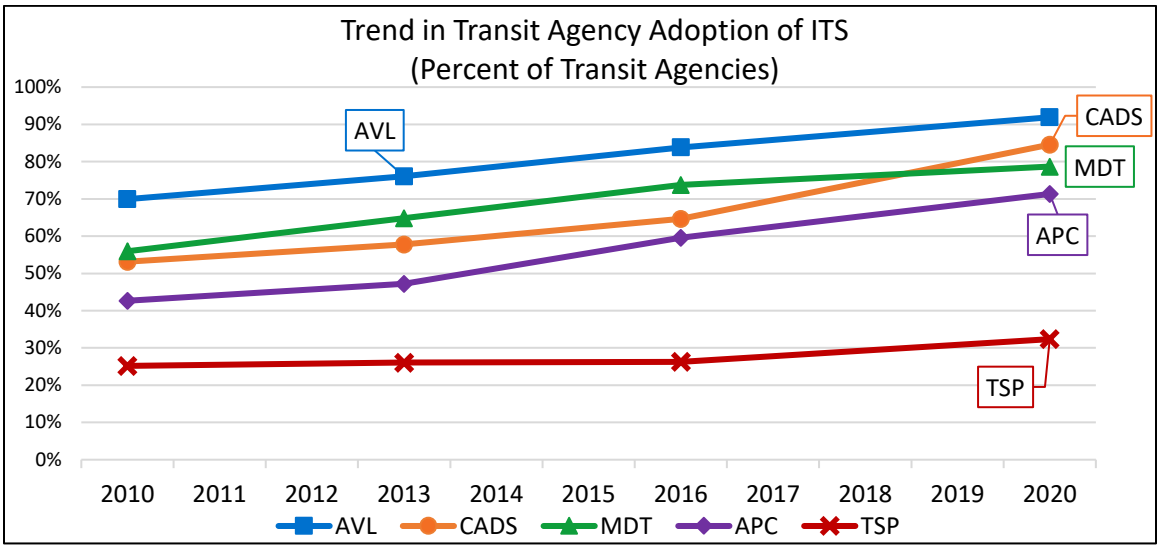


Figure 21. Trend in Transit Agency Adoption of ITS

[18] Trend is not shown for *maintenance management systems (MMS)*, which is reported by 34 percent of agencies, as this was a new response category in the 2020 survey.

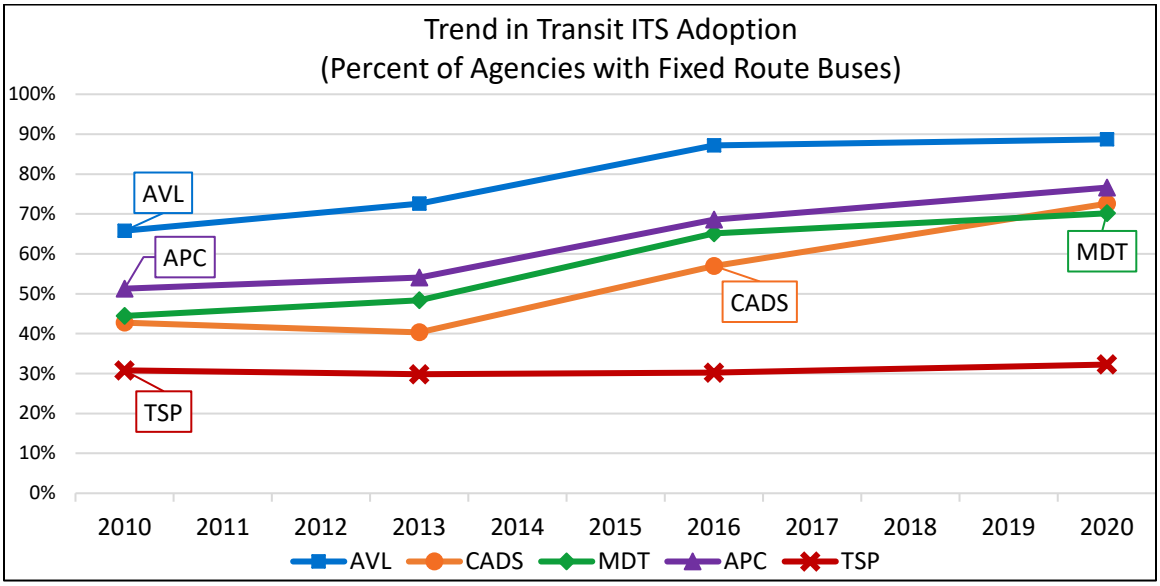
The recent significant growth of *CADS* is notable, with 85 percent of transit agencies reporting use of *CADS* in 2020, up from 65 percent in 2016 (a 20 percentage point increase). This compares to a 12 percentage point increase from 2010 to 2016, when *CADS* displayed moderate but steady growth. While adoption of *APC* was relatively flat from 2010 to 2013, the technology has seen significant growth (of 24 percentage points) since that time (from 47 percent in 2013 to 71 percent in 2020). Adoption of *MDT* has grown from 56 percent in 2010 to 79 percent in 2020; however, nearly all of this growth occurred between 2010 and 2016. Nearly one-third (32 percent) of surveyed transit agencies have adopted *TSP*, representing a modest increase of six percentage points since 2016, whereas usage had previously been flat (at 25 percent) during the period from 2010 to 2016. It would be helpful to better understand agencies' perceived need for TSP, and the challenges or barriers they face in deploying this technology, in order to understand the opportunity for growth.

The following section presents findings on the adoption of transit ITS technologies on fixed route buses, ADA paratransit vehicles, and demand responsive vehicles; the sample sizes for all other modes (i.e., light rail, commuter rail, streetcar, heavy or rapid-rail, and ferry) are too small to report (see Appendix A for sample sizes).

Fixed Route Buses

On fixed route buses, *AVL* has been adopted by a large majority of transit agencies (89 percent), and adoption has been flat since 2016. Adoption of *CADS* increased by 16 percentage points, from 57 percent in 2016 to 73 percent in 2020. *APC* grew more modestly over the same time period (from 69 percent to 77 percent), as did *MDT* (from 65 percent to 70 percent). *TSP* adoption (32 percent in 2020) has remained relatively flat since 2010 (Figure 22).

With the exception of TSP, all other technologies experienced significant growth in adoption on buses from 2013 to 2016. *CADS* continued to grow at similarly high levels during the period 2016 to 2020, whereas there was more modest growth for *APC* and *MDT*, and *AVL* remained relatively flat.



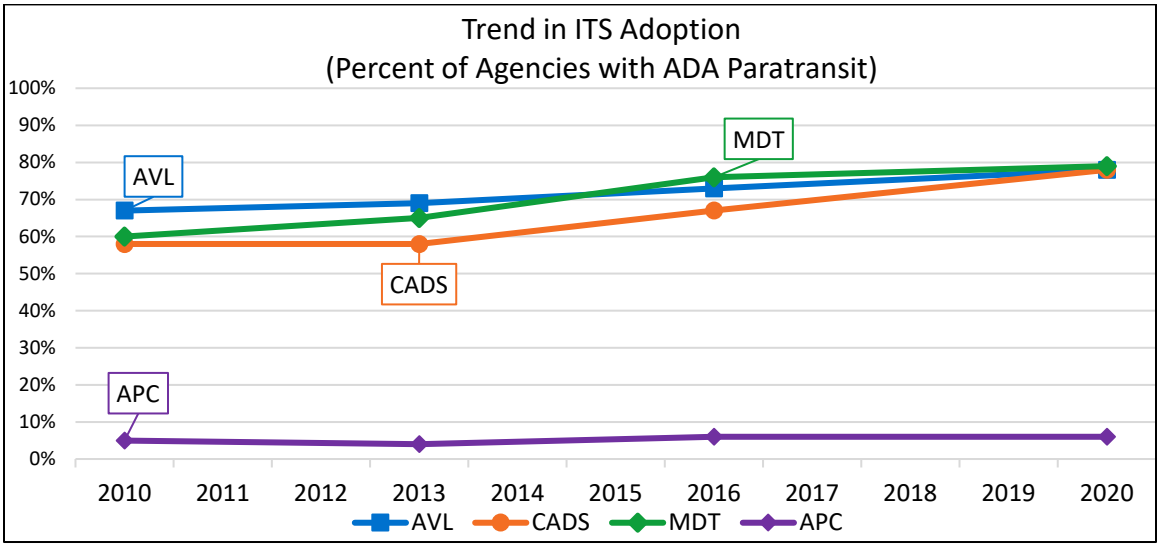
2020 Q2; (n=124) *Source: USDOT*

Figure 22. Trend in Transit ITS Adoption by Transit Agencies with Fixed Route Buses

In addition to adoption, the survey data enables an assessment of technology coverage, that is, the extent to which each technology is deployed on agencies' fleets.[19] On fixed route buses, among agencies that have *AVL*, *CADS* and *MDT*, coverage is universal; that is these technologies are on nearly 100 percent of bus fleet vehicles. Coverage of *APC* is nearly as high; agencies that have deployed APC have equipped, on average, 92 percent of their fixed route buses. *TSP* coverage is lower, at 47 percent, suggesting that agencies are deploying TSP in a more limited fashion.

ADA Paratransit Vehicles

As shown in Figure 23, nearly eight-in ten surveyed transit agencies operating ADA paratransit vehicles have adopted *AVL*, *CADS* and *MDT*. Not surprisingly, adoption of *APC* remains consistently low, at 6 percent, as ADA paratransit trips are generally scheduled in advance, so counters are not needed. There has been significant growth in the adoption of all three technologies – AVL, CADS and MDT – on ADA paratransit vehicles since 2010, with *CADS* and *MDT* showing the greatest growth overall (20 percentage points and 19 percentage points, respectively). In the most recent survey cycle, *CADS* has shown significant growth, increasing 11 percentage points (from 67 percent to 78 percent). *AVL* growth, however, appears to have slowed, increasing by five percentage points (from 73 percent to 78 percent), and *MDT* adoption has also remained relatively flat (76 percent in 2016 and 78 percent in 2020). APC deployment has been comparably low (6 percent), and trend has been flat.



2020 Q2; (n=100) *Source: USDOT*

Figure 23. Trend in ITS Adoption by Transit Agencies with ADA Paratransit Vehicles

[19] The survey asked agencies to identify the total number of vehicles, by mode, equipped with each technology, in addition to the total number of vehicles (by mode) in their fleets. Coverage was measured by mode for each transit agency (e.g., an agency's number of buses with AVL was divided by the total number of buses in their fleet), and the average was calculated across all agencies.

Agencies adopting *AVL, CADS, MDT*, and/or *maintenance management systems (MMS)* on their ADA paratransit vehicles have done so for their entire fleet of ADA paratransit vehicles (100 percent). *APC*, for the small number of agencies that have adopted them, are also used on nearly all vehicles (95 percent).

Demand Responsive Vehicles

The 2020 DTS shows increases since 2010 in use of AVL, CADS, and MDT among agencies operating demand responsive service, while trend in APC use remained flat.[20] However, these findings are not shown due to small sample size and should be interpreted with caution (see Appendix A for sample sizes).

Key Finding: More Transit Agencies are Using Traveler Information Systems

Like freeway and arterial agencies, use of mobile apps has increased dramatically among transit agencies; in addition, there has been significant growth in the use of social media and email/text alerts. Transit agencies are also increasingly providing dynamic traveler information across station types and in vehicles.

Mobile apps (*agency-branded* and/or *third-party apps*) are now the most used traveler information system among transit agencies, with 75 percent reporting use (Figure 24). Adoption of *mobile apps* has grown substantially since 2013, when the apps were first measured, up 50 percentage points (from 25 percent), and showing significant growth across both survey cycles. *Websites* fall just below mobile apps at 72 percent, and while *website* usage grew between 2013 and 2016, it has remained relatively stable since 2016. Like mobile apps, *social media* (at 67 percent) has shown strong growth since 2013, up 56 percentage points from 2013. Similarly, use of *email/text alerts* has grown 48 percentage points since 2013, from 15 percent to 63 percent in 2020. Although both *511* (18 percent) and *kiosks* (15 percent) show overall growth of 10 percentage points since 2013, adoption slowed from 2016 to 2020. On average, transit agencies are using 4.6 of the surveyed traveler information systems.

[20] On their demand responsive vehicles in 2020 (not shown), 80 percent of surveyed transit agencies operating this service report having adopted *MDT*, and 73 percent report adopting *AVL* and *CADS*, whereas 11 percent have adopted *APC*. In 2010, 50 percent of agencies reported AVL, 44 percent of agencies reported MDT and CADS, and 12 percent of agencies reported APC.

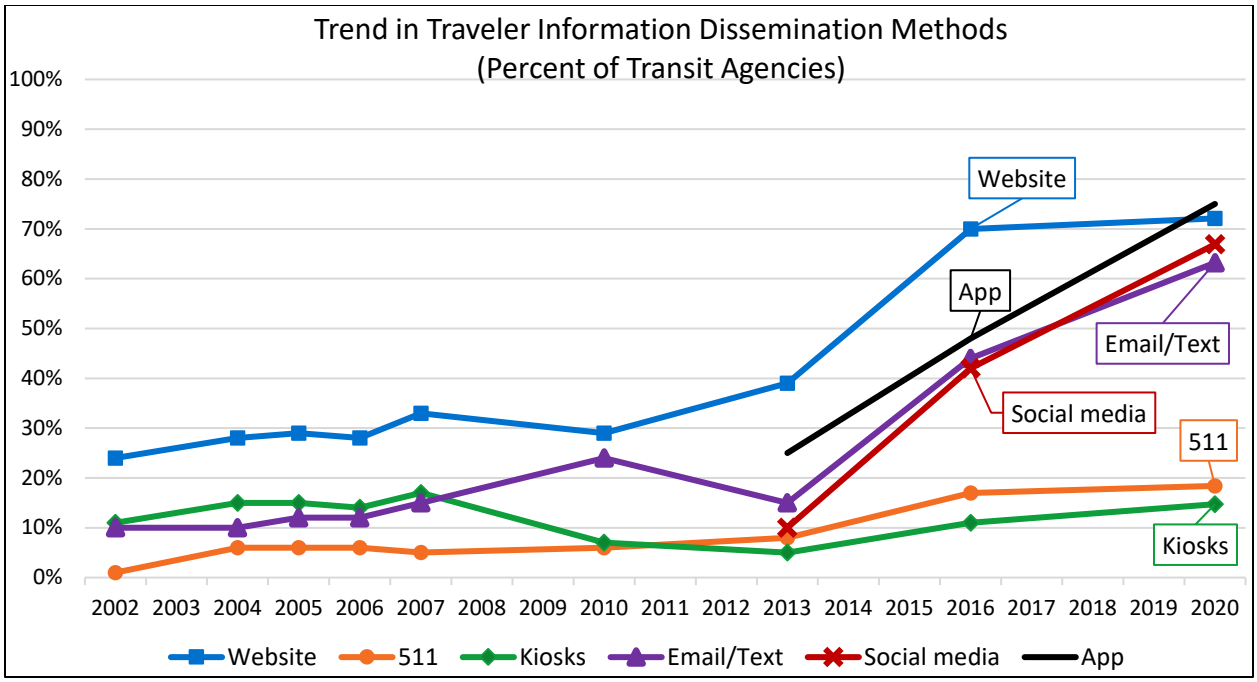


Figure 24. Trend in Traveler Information Dissemination Methods – Transit Agencies

Agencies were also asked to report on their use of *dynamic message signs* (DMS) at stations, in vehicles, and at bus stops (Figure 25). There has been steady growth in the use of DMS across the three venues. During the most recent survey cycle, there was significant growth (17 percentage points) in the use of *DMS in stations*, from 38 percent of agencies in 2016 to 55 percent in 2020. Likewise, the recent growth in adoption of *DMS in vehicles* is notable, from 12 percent of agencies in 2016 to 25 percent in 2020. While there is significant growth in the use of *DMS at bus stops* since 2010, adoption since 2013 has been minimal.

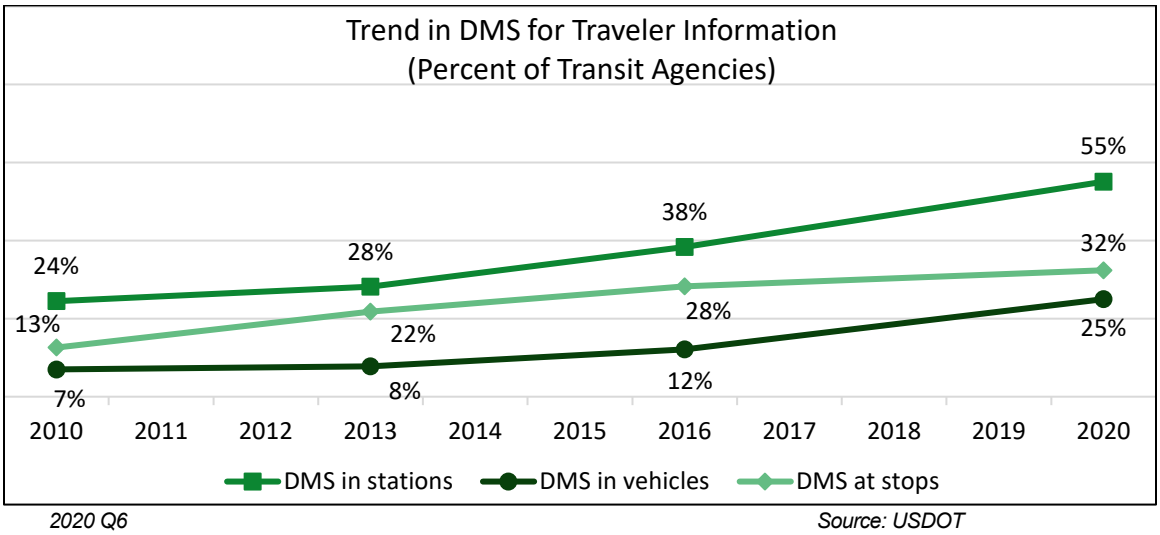


Figure 25. Trend in DMS for Traveler Information – Transit Agencies

Key Finding: Transit Agencies are Partnering with Select Service Providers

Although still rare among surveyed transit agencies, there has been significant growth in partnerships with ride-hailing companies, and to a lesser extent, with microtransit services.

Figure 26 shows the trend in transit agency partnerships with private transportation providers from 2016 to 2020. While the overall level of partnering has remained stable since 2016 (30 percent in 2020 versus 32 percent in 2016), the average number of partnerships per agency increased from 1.3 to 2.1. *Ride-hailing* and *taxi* are the two most commonly used partnerships in 2020, with a significant increase in partnerships with *ride-hailing companies*, from 4 percent in 2016 to 15 percent in 2020. Partnerships with *microtransit services* also grew, by six percentage points (from 3 percent in 2016 to 9 percent in 2020). In 2020, 6 percent or fewer agencies engage in partnerships with *bike-share* (6 percent), *carpool matching* (5 percent), *parking* (4 percent), *scooter-share* (4 percent) and *other* providers (6 percent). Both *carpool matching* and *scooter-share* were new response options in 2020, so trend is not shown

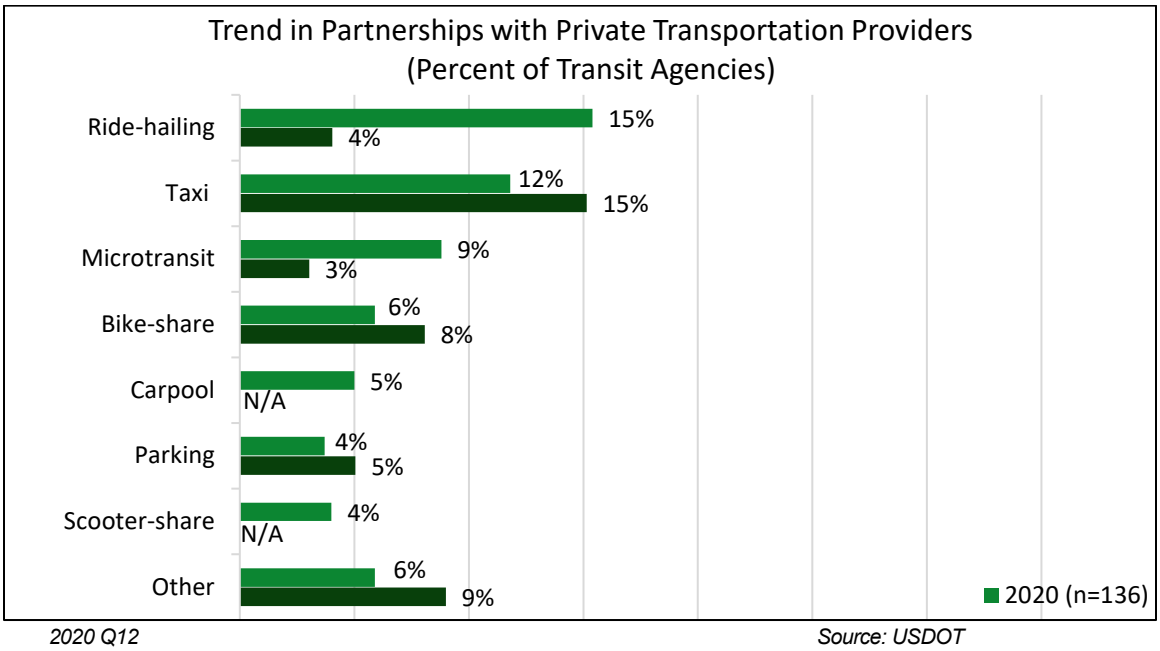
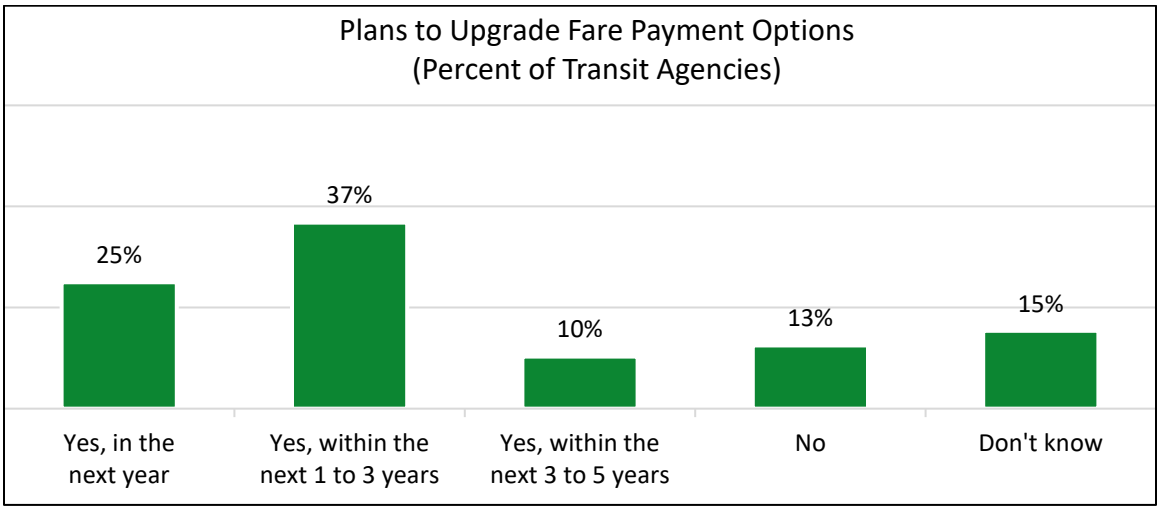


Figure 26. Trend in Partnerships with Private Transportation Providers – Transit Agencies

Key Finding: Transit Agencies are Upgrading their Fare Payment Systems

A large majority of transit agencies report plans to upgrade their fare payment systems within the next 5 years to accept additional or different types of payment.

One quarter of transit agencies (25 percent) report plans to upgrade their fare payment systems in the *next year* to accept additional or different types of fare media, and an additional 37 percent indicate plans to do so in the *next one to three years* (Figure 27). A smaller number (10 percent) have plans to upgrade their systems in the *next four to five years.* Thirteen percent of surveyed transit agencies report they have *no plans* to upgrade their fare payment systems, and 15 percent report they *do not know*.



2020 Q10; (n=136) *Source: USDOT*

Figure 27. Plans to Upgrade Fare Payment Options – Transit Agencies

Key Finding: A Majority of Transit Agencies Report Use of Real-time Standards

Just over half of transit agencies report use of real-time standards, including General Transit Feed Specification Real-Time and/or Service Interface for Real-Time Information.

Figure 28 displays the findings on the use of ITS standards.[21] Overall, 80 percent of transit agencies report use at least one ITS standard, 10 percent indicate they *do not know,* and 10 percent said *no ITS standards* were used. Fifty-nine percent of surveyed transit agencies report using *General Transit Feed Specification* (*GTFS) (de facto standard)*, and just over one half (53 percent) use *General Transit Feed Specification Real-Time (GTFS-RT)*. While 8 percent report use of the other real-time standard – *Service Interface for Real-Time Information* (*SIRI)* – many of these agencies are also using GTFS-RT, resulting in 54 percent of transit agencies that use any real-time standards. Among agencies that provide real-time traveler information via agency or third-party mobile app, the use of real-time standards increases to 70 percent.

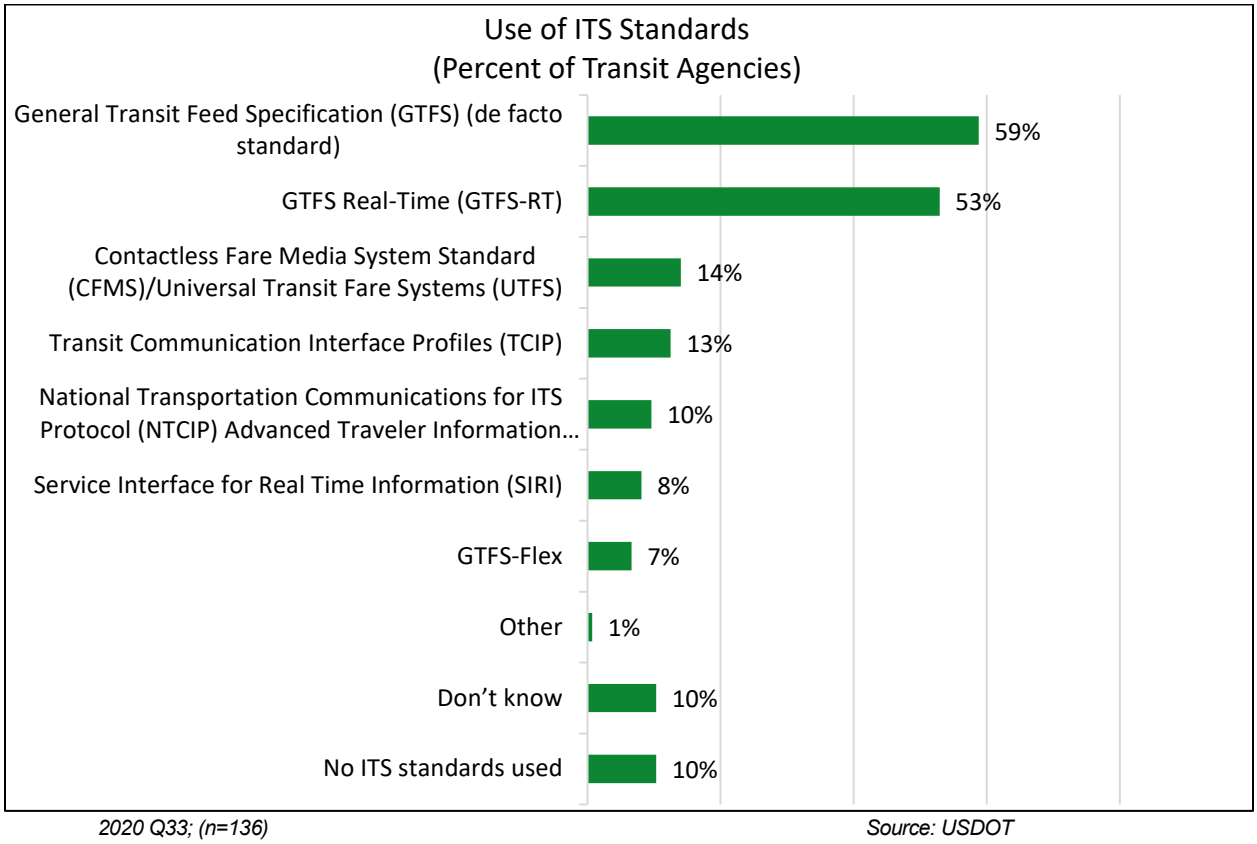


Figure 28. Use of ITS Standards – Transit Agencies

[21] The 2020 survey included a response option for *Network Timetable Exchange (NeTEx)* (not shown), which was reported by zero percent of agencies.

Key Findings: Freeway, Arterial, and Transit Management Agencies

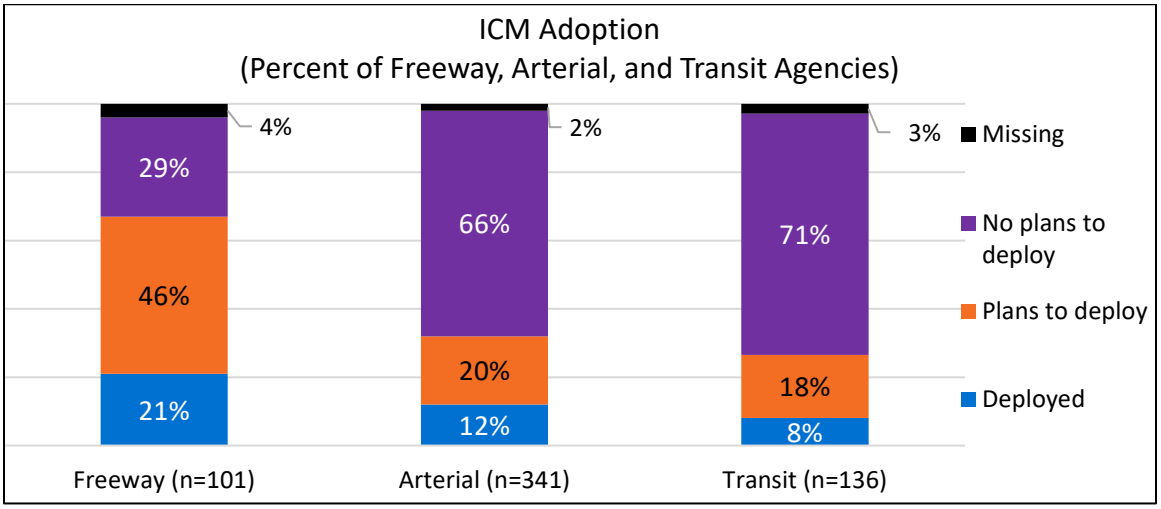
Key Finding: Freeway Agencies Show More Interest in Integrated Corridor Management (ICM) Compared to Arterial and Transit Agencies

While freeway agencies show a high level of interest in ICM, a majority of arterial and transit agencies indicate they are not planning to deploy.

Integrated Corridor Management (ICM) is an approach to manage 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 to maximize the capacity of all facilities and modes across the corridor. A corridor was defined as including freeway, arterial, and public transit facilities with cross-facility connections.

Approximately one-fifth (21 percent) of surveyed freeway agencies report that their agency has *deployed ICM* and an additional 46 percent *plan to deploy,* suggesting a high level of interest in ICM (Figure 29). Among surveyed arterial agencies, 12 percent have *deployed ICM* and an additional 20 percent *plan to deploy* ICM. Among surveyed transit agencies, about one-quarter either have *deployed ICM* (8 percent) or *plan to deploy (*18 percent). Large majorities of arterial and transit agencies (66 percent and 71 percent, respectively) indicate they have *no plans to deploy* ICM.

Due to survey length, the survey did not include follow-up questions on the nature of agencies' ICM deployments. As a result, the data do not include information on what technology deployments and operational strategies comprise their ICM. There may be a range of technologies in ICM deployments, with some agencies deploying more sophisticated systems than others. Additional data are needed to understand the nature of these ICM deployments, and the extent to which agencies are coordinating with other partner agencies in the corridor.



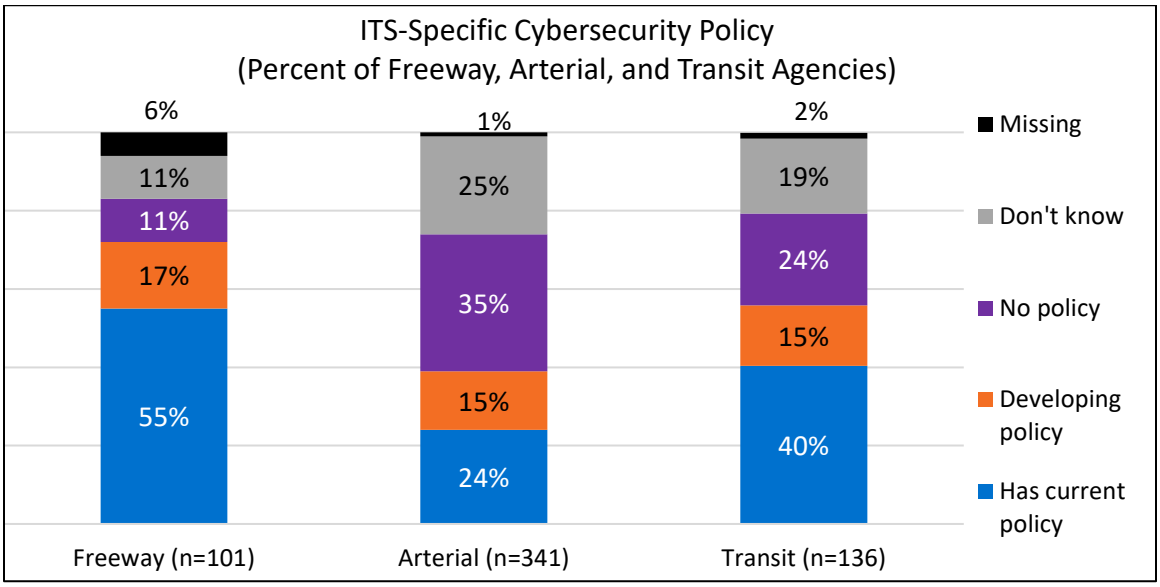
2020 Freeway Q23, Arterial Q28, Transit Q15 *Source: USDOT*

Figure 29. ICM Adoption – Freeway, Arterial, and Transit Agencies

Key Finding: ITS Cybersecurity Planning Shows Room for Growth

About one-half of freeway agencies have developed an ITS-specific cybersecurity policy, compared to forty percent of transit agencies and 24 percent of arterial agencies.

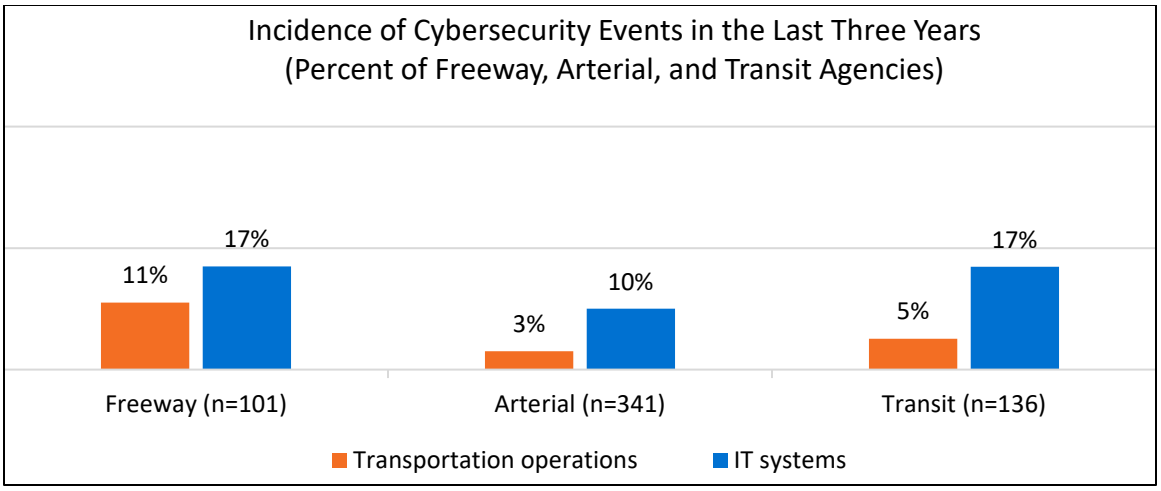
Figure 30 shows that 55 percent of surveyed freeway agencies have a *documented ITS-specific cybersecurity policy*, compared to 40 percent of transit agencies and 24 percent of arterial agencies. A similar proportion across agency types (15 to 17 percent) are *currently developing* a policy.



2020 Freeway Q29, Arterial Q33, Transit Q23 *Source: USDOT*

Figure 30. ITS-Specific Cybersecurity Policy – Freeway, Arterial and Transit Agencies

Figure 31 displays agencies' experience with two types of cybersecurity events and shows that agencies were more likely to experience an event that affected their IT systems than an event that affected transportation operations. Overall, 18 percent of surveyed freeway and transit agencies and 10 percent of arterial agencies report experiencing a cybersecurity event that affected their *IT systems* and/or *transportation operations* in the last three years. Most respondents who reported that a cybersecurity event affected their *transportation operations* also indicated an event that affected their *IT systems* (the data does not indicate whether it was the same or a different cybersecurity event).



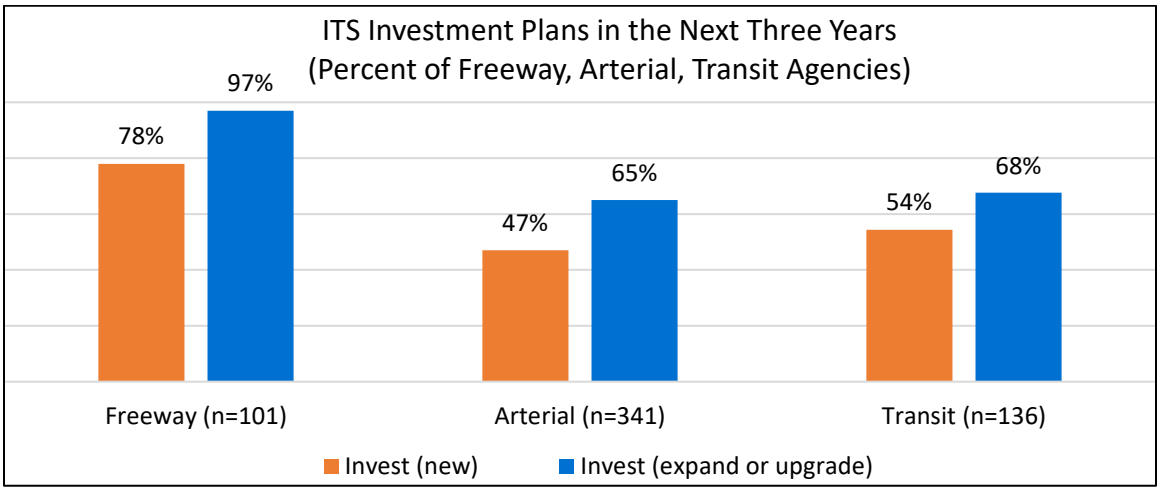
2020 Freeway Q30, Q31, Arterial Q34, Q35, Transit Q24a, Q24b *Source: USDOT*

Figure 31. Incidence of Cybersecurity Events in the Last Three Years – Freeway, Arterial and Transit Agencies

Key Finding: Large Majorities of all Agency Types Plan to Invest in ITS

Nearly all freeway agencies plan to expand or upgrade their ITS in the next three years and a large majority plan to invest in new ITS. Among arterial and transit agencies, nearly two-thirds plan to expand or upgrade their ITS, and nearly one-half say they will invest in new ITS.

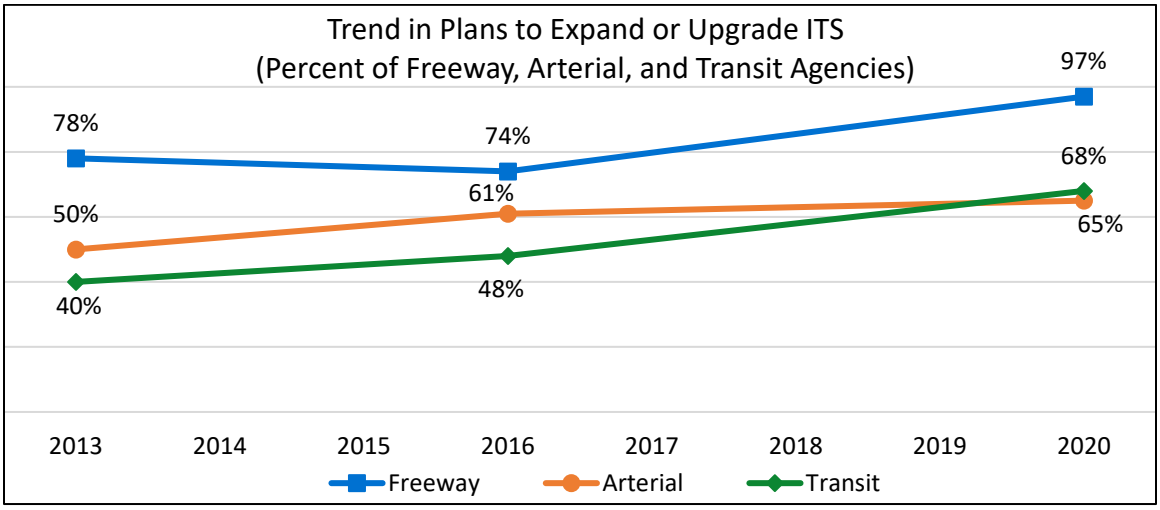
Figure 32 illustrates that nearly all surveyed freeway agencies (97 percent), and roughly two-thirds of surveyed arterial agencies (65 percent) and surveyed transit agencies (68 percent) plan to *expand or upgrade* their current ITS investments and/or deployments in the next three years. A large majority of freeway agencies also plan to *invest in new ITS* (78 percent), whereas arterial and transit agencies are somewhat less likely to *invest in new ITS* (47 percent and 54 percent, respectively).



2020 Freeway Q36, Q37, Arterial Q39, Q40, Transit Q34, Q35 *Source: USDOT*

Figure 32. ITS Investment Plans in the Next Three Years – Freeway, Arterial and Transit Agencies

Among all agency types, there has been growth since 2013 in the number of surveyed agencies that report plans to *expand or upgrade* their ITS, most notably among freeway and transit agencies (Figure 33). In the case of freeway agencies, the percent of agencies planning to *expand or upgrade their ITS* grew by 23 percentage points since 2016, from 74 percent to 97 percent. There was a similar growth in the percent of transit agencies planning to *expand or upgrade their ITS*, from 48 percent to 68 percent, whereas arterial agencies saw little change on this measure since 2016 (from 61 percent to 65 percent). Trend in agency plans to *invest in new ITS* (not shown) showed less growth than plans to *expand or upgrade ITS*.[22]



2020 Freeway Q36, Arterial Q39, Transit Q34 *Source: USDOT*

Figure 33. Trend in Plans to Expand or Upgrade ITS – Freeway, Arterial and Transit Agencies

[22] Among arterial agencies, 47 percent report plans to *invest in new ITS* in 2020, compared to 39 percent in 2013. Among freeway agencies, 78 percent report plans to *invest in new ITS* in 2020, compared to 69 percent in 2013. Among transit agencies, 54 percent report plans to *invest in new ITS* in 2020, compared to 46 percent in 2013.

Chapter 4. Conclusions

The 2020 DTS is the latest survey in an ongoing effort by the USDOT ITS JPO to monitor the progress of ITS adoption and deployment among freeway, arterial, and transit agencies in 108 large and medium sized metropolitan areas across the US. The survey has been conducted for more than twenty years, and while the questions have evolved and new questions have been added over time, trend data are available for a majority of the technologies. The pandemic did not appear to significantly impact survey response rates; however, it is unclear what impact, if any, the pandemic has had or will have on ITS adoption or plans for adoption. Future surveys may add clarity and additional insight on this issue. The surveys provide insights on where agencies are deploying proven ITS as well as where technical assistance or outreach may be needed to increase adoption of newer ITS technologies. Survey responses and data trends can also raise questions that may merit further research and investigation.

Growth of Safety-Oriented Technologies

The 2020 DTS shows that a number of ITS technologies experienced increasing levels of adoption since 2016. Among freeway agencies for example, there was notable growth in the adoption of *work zone* and *safety system technologies*, and among arterial agencies, the use of a *pedestrian warning systems* increased significantly. This growth may reflect, in part, USDOT and state agencies' commitment to emphasizing safety as a top goal.

In general, adoption of ITS *safety systems* (85 percent) and *work zone technologies* (82 percent) is high among freeway agencies (i.e., agencies that have adopted at least one technology within each category), but there is still room for growth as many agencies continue to expand their suite of safety systems. There are a range of different safety technologies that serve different purposes, so agencies could adopt different types of safety technologies based on their specific needs.

Mature ITS Technologies

Among freeway and arterial agencies some ITS technologies experience widespread adoption. For example, use of *detection technologies at signalized intersections* is well established among arterial agencies (95 percent in 2020 and 94 percent in 2016). Use of *inductive loops* (89 percent) is nearly universal and *video imaging* is also widely adopted (82 percent), pointing to the maturity of these technologies. Among freeway agencies, adoption of *real-time data collection* is high, at 85 percent and shows minimal change in the last two surveys. The use of *roadside infrastructure* technologies also is high, in part due to the widespread adoption of *radar/microwave,* which reflects the maturity of this technology in the market.

Opportunities for Growth for Arterial Management ITS

For other technologies, such as arterial agency adoption of *ASCT* and *TSP*, growth has generally been steady since 2013, however, fewer than one-third of agencies have adopted these technologies (29 percent and 28 percent, respectively). It would be helpful to better understand agencies' perceived need for ASCT and TSP, and the challenges or barriers they face in deploying these technologies, in order to understand the opportunity for growth.

Outside of signalized intersections, the use of *real-time data collection technologies* on arterial roads shows steady growth, and the 2020 survey finds that nearly one-half of arterial agencies are now using such technologies.

The Rise of Mobile Apps

Among all agency types, the use of *mobile apps* has increased dramatically since 2016. However, among freeway and arterial agencies, other technologies, such as *511, HAR, email/text alerts,* and even *social media*, have experienced decreased use. The long-term trend shows how the use of traveler information dissemination methods have evolved, though it is unclear to what extent methods that provide information en route are replacing versus complementing other more traditional sources of traveler information, such as 511 and HAR.

Interestingly, among transit agencies, the dramatic increase in the use of *mobile apps* has been accompanied by an increase in the use of *social media* and *email/text* (*websites* grew significantly from 2013 to 2016 then levelled off). Agencies are also increasingly using *DMS in stations* and *in vehicles*.

Growth in Transit ITS

There has been a significant increase in the adoption of *CADS* and *APC* since 2016, and more moderate growth of *AVL* and *TSP*. With the exception of TSP, these ITS transit technologies are adopted by a large majority of agencies, and coverage on fleets is also high; for some technologies and fleet types, coverage is universal. In addition, a large majority of transit agencies plan to upgrade their fare payment systems in the *next five years* to accept other fare payment options.

Interest in Integrated Corridor Management

Responses from freeway agencies demonstrate interest in ICM, whereas arterial and transit agencies were less likely to say they were *deploying* or *planning to deploy* ICM. It is important to note that ICM could comprise a range of technologies, depending on the needs of the agencies, and also may vary with respect to the extent of coordination across facilities and the level of automation of the ICM decision support system used to coordinate and activate response plans. Future surveys may want to gather more detailed data on what technologies agencies are deploying as part of their ICM, and the level of coordination and automation of their systems.

Use of External Data

The survey also found that a large number of agencies are using external data sources, including *third-party commercial data*, such as probe data. In future surveys, it may be worth further investigating the ways in which agencies are using this data to complement or fill in the gaps of their own real-time data collection.

Cybersecurity – an Area to Watch

On cybersecurity, just over one-half of freeway agencies have a *documented ITS-specific cybersecurity policy,* compared to 40 percent of transit agencies and about one-quarter of arterial agencies. Notably, nearly one-fifth of freeway (18 percent) and transit agencies (18 percent) and 10 percent of arterial agencies report experiencing a cybersecurity event that affected their *IT systems* and/or *transportation operations*. Future surveys may want to explore agencies' ITS cybersecurity planning in more detail, as cybersecurity continues to be a critical issue for federal, state, and local agencies.

Appendix A. Survey Year Sample Sizes

Table 4. Survey Sample Sizes

Survey Year	Freeway	Arterial	Transit	Transit - Fixed Route Bus	Transit- ADA Paratransit	Transit - Demand Responsive
2002	146	516	210	-	-	-
2004	133	508	213	-	-	-
2005	103	423	203	-	-	-
2006	129	470	211	-	-	-
2007	123	434	206	-	-	-
2010	122	290[23]	143	117	84	34
2013	109	310	142	124	97	37
2016	95	274	99	86	66	23
2020	101	341	136	124	100	45

[23] The 2010 Arterial Survey data are not presented because the survey was administered to a subset of agencies during that cycle; the data are not comparable to other years.

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