RITA Intelligent Transportation Systems Joint Program Office

Deployment of ITS: A Summary of the 2010 National Survey Results

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ITS Joint Program Office
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16. Abstract

This report presents summary results of the 2010 ITS Deployment Tracking survey, the most recent survey conducted by the ITS Deployment Tracking Project. The U.S. Department of Transportation and its member agencies, including the Research and Innovative Technology Administration, have pursued a research and development agenda, the Intelligent Transportation System (ITS) Program, designed to integrate the latest in information technologies to improve the safety, mobility, and reliability of surface transportation modes. Within metropolitan areas, implementation of these advanced technologies has been accomplished by a variety of state and local transportation and emergency management agencies as well as the private sector. In order to measure the rate of ITS deployment within the nation's largest metropolitan areas, the ITS Deployment Tracking Project has conducted a nationwide survey of state and local transportation and emergency management agencies nearly every year since 1997.

The results presented in this report are intended to be a summary of the entire database from the 2010 survey. Access to the complete survey results and previous national surveys are available on-line at http://www.itsdeployment.its.dot.gov. The website also provides access to survey results in the form of downloadable reports, including a survey summary for each survey type and fact sheets. Nearly 1,600 surveys were distributed to state and local transportation agencies in 2010. A total of seven (7) survey types were distributed including: Freeway Management, Arterial Management, Transit Management, Transportation Management Center (TMC), Electronic Toll Collection (ETC), Public Safety – Law Enforcement, and Public Safety – Fire/Rescue.

Among other things, the data collection results indicate that ITS has moved from being experimental to mainstream and interest in continuing investments in ITS continues to be very strong. When asked about future deployment plans, one-third to three-fourths of the different agency types report they will expand current deployments and about half are planning to invest in new technologies over the next three years.

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The conclusions expressed in this document reflect solely the opinions of the authors and do not represent the opinions of the U.S. Department of Transportation or RITA.

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Executive Summary

Continuing advancement in communications, electronics, and computing offer the opportunity to revolutionize the management and operation of the surface transportation system. The U.S. Department of Transportation and its member agencies, including the Research and Innovative Technology Administration, have pursued a research and development agenda, the Intelligent Transportation System (ITS) Program, designed to integrate the latest in information technologies to improve the safety, mobility, and reliability of surface transportation modes. Within metropolitan areas, implementation of these advanced technologies has been accomplished by a variety of state and local transportation and emergency management agencies as well as the private sector. In order to measure the rate of ITS deployment within the nation's largest metropolitan areas, the ITS Deployment Tracking Project has conducted a nationwide survey of state and local transportation and emergency management agencies nearly every year since 1997. This report presents summary results of the 2010 ITS Deployment Tracking survey, the most recent survey conducted by the ITS Deployment Tracking Project.

The results presented in this report are intended to be a summary of the database from the 2010 survey. Access to the complete database of survey results is available on-line at http://www.itsdeployment.its.dot.gov/. The website provides access to individual responses to each question as well as the responses for each agency surveyed. A variety of downloadable reports are provided including a survey summary for each survey type and fact sheets for each metropolitan area. Finally, the complete database can be downloaded in spreadsheet format. As summarized in Table ES1 nearly 1,600 surveys were distributed to state and local transportation agencies in 2010. A total of seven survey types were distributed including: Freeway Management, Arterial Management, Transit Management, Transportation Management Center (TMC), Electronic Toll Collection (ETC), Public Safety – Law Enforcement, and Public Safety – Fire/Rescue. An appropriate agency in each metropolitan area completed the survey. For example, a representative from the agency responsible for managing the freeway system was asked to complete the Freeway Management survey.

Table ES1. 2010 ITS Metropolitan Deployment Tracking Survey Response Rate by Agency Type

Survey	Agency Type	Sent	Returned	% Returned
Freeway Management	Freeway	146	122	84%
Arterial Management	Arterial	356	290	81%
Transit Management	Transit	158	143	91%
Transportation Management Center (TMC)	TMC	258	229	89%
Electronic Toll Collection (ETC)	Toll road Operator	70	65	93%
Public Safety – Law Enforcement	Law Enforcement	266	226	85%
Public Safety – Fire/Rescue	Fire/Rescue	335	280	84%
Totals		1589	1355	85%

The overall response rate for all surveys was 85%. The response rates for each individual survey type ranged from a low of 81% for the Arterial Management survey to a high of 93% for ETC.

Each survey contained several broad categories of questions including:

- Questions designed to measure opinions regarding factors involved with the decision to purchase ITS and the benefits of particular technologies;
- Questions designed to measure the extent of current deployment of particular technologies; and
- Questions designed to measure the presence of transportation management practices and programs including integration of transportations services within corridors.

The report is broken into two major chapters, summarized below. The first chapter covers results from survey questions aimed at gathering inputs from agencies concerning opinions concerning several major topics, including general plans for future deployments, factors motivating the decision to purchase ITS technologies, and the benefits of specific ITS technologies. The second chapter of the report summarizes the deployment data gathered from each individual survey type, covering topics including deployment trends for coverage and adoption of key technologies, traveler information, corridor operations, and data archiving.

Agency Opinions Concerning ITS

Decision Factors

Four different types of agencies, freeway, arterial, transit, and toll operators were asked to rank the importance of the following nine factors in making a decision to purchase ITS technology:

- Funding/grant availability,
- Integration with currently deployed technologies,
- Integration with other agencies,
- Mobility benefits,
- Price of equipment,
- Public/constituents involvement,
- Safety benefits,
- Technology already in use by another agency, and
- Environmental benefits.

Safety was rated either first or second in importance by all agency types. Freeway and toll road agencies valued integration with existing technologies, and mobility benefits, slightly higher than arterial and transit agencies. Arterial and transit agencies rated the availability of funding or grants, and the price of equipment higher than freeway or toll road agencies. Environmental benefits and integration with other agencies were generally rated lower in importance by all agencies. This could change in the future as the national program increases emphasis on the environment through implementation of the Applications for the Environment: Real-Time Information Synthesis Program and the development of Integrated Corridor Management concepts.

Perceived Benefits

Another important area of inquiry in the 2010 survey asked agencies to rate the benefit of major ITS technologies. Both freeway and arterial agencies ranked cameras, traveler information, and sensors highest. Interestingly, ramp metering and adaptive signal controls received high benefit ratings, even though they are lightly deployed. Transit agencies ranked the benefits of communications technologies very high, followed by security cameras. Also highly ranked by transit agencies were computer aided dispatch (CAD) and automatic vehicle location (AVL) systems. The pattern of agency responses shows that all agency types see the most important benefits of ITS technology to be in supporting operations through collection and dissemination of data, managing traffic, and dispatching vehicles.

Planned Future Deployments

Agencies were also asked to specify the types of technologies they intend to purchase in the next three years. TMCs are focused on closed circuit television (CCTV) and dynamic message signs (DMS). Next in order, cited by about half as many agencies, are sensors and communications with field devices. Next, mentioned by about one fourth as many agencies, are TMC upgrades, environmental sensor stations (ESS), and adaptive signal control. Planned transit investments are oriented toward improving customer service, and included fare collection enhancements, such as smart cards, implementation of AVL and CAD, and providing real-time information.

Deployment Status and Trends

As in years past, the 2010 national survey gathered a wide variety of deployment data for the different agency types surveyed.

Freeway Management

Freeway management deployments show a substantial expansion of data collection by real-time traffic data collection technologies (up from an average of 41% in 2007 to 56% by 2010) and CCTV (increasing from 36% to 46% over the same period). Also expanding significantly are data dissemination technologies (the total number of DMS increased by one third from 2007 to 2010). Freeway agencies are moving to advanced technologies for data gathering and dissemination as well; the percentage of agencies using radar traffic sensors doubled from 2007 to 2010 and the percentage of agencies targeting traveler information to mobile devices as well as using Twitter or other social media expanded substantially. A new area of focus for the 2010 survey was corridor operations, and agency reports on the current status and planned expansion indicate that the corridor concept has had a major impact on operations. Coordination between freeway management agencies and arterial and transit agencies for incident management, weather response strategies, and cross jurisdictional traffic signal coordination are well established. Substantial future expansion is planned for sharing performance information, ramp control, and transit operations.

Arterial Management

The trends for arterial management deployment indicators, perhaps reflecting the concern expressed on funding issues in making deployment decisions, are generally flat. The coverage of emergency preemption and transit priority, signals under centralized or closed loop control, miles covered by

service patrols, CCTV, and highway advisory radio (HAR) all showed little growth. On the other hand, the number of signalized intersections covered by electronic surveillance increased substantially to nearly half of the intersections. While the growth in coverage of these well-established technologies was generally slow for 2010, the percentage of agencies adopting technologies that are relatively new for arterial agencies showed substantial expansion from 2007 to 2010. The percentage of agencies deploying video imaging detector systems (VIDS) and DMS more than doubled, while adoption of red light running cameras increased five times. Arterial management agencies have followed the practice of freeway agencies in adopting the use of Twitter and other social media as well as mobile devices to distribute traveler information. Arterial agencies are strongly committed to corridor operations, with a significant number of agencies reporting coordination on planned special events, traffic signal operations, and incident management. Areas targeted for future expansion include transit operations, sharing of performance information, and traffic responsive signal timing.

Incident Management

Incident management deployment trends vary widely between freeway and arterial agencies. The coverage of CCTV and service patrols on freeways expanded to cover just under half of the freeway mileage. Both of these technologies showed a decline on arterials. Incident detection algorithms are less widely deployed for both agency types, likely reflecting the alternatives for incident detection from the expansion of CCTV and cell phone reporting.

Transit management

The trends for deployment of key transit technologies are positive. The use of CAD to control demand responsive buses has expanded to 87% of the fleet, up from 62% in 2007. AVL is now in 66% of fixed route buses, more than doubling over the last ten years. The use of real-time monitoring of vehicle systems and the display of real-time traveler information at bus stops continued to expand, although to a lesser degree. The number of transit agencies adopting technologies showed a large increase as well. The percentage of agencies with AVL on fixed route busses more than doubled from 2007 to 2010. The percentage of agencies employing magnetic stripe readers increased eight times for the same period, as did the percentage of agencies adopting the use of smart card readers. Transit agencies have made a strong commitment to providing real-time information, with more than 80% of agencies using websites to make this information available.

Public Safety

Public safety agencies continue the expansion of the use of on-board vehicle navigation, now involving nearly half the vehicles. CAD coverage is stable at 80% of the fleet. Traffic signal preemption has been adopted by 19% of law enforcement agencies and 66% of the fire/rescue agencies.

Summary Observations

In general, the results from the 2010 survey show a continuation of a trend in which ITS deployment is supporting an evolution in traffic management. Specific observations include:

- As ITS has moved from being experimental to mainstream, interest in additional investments in ITS continues to be very strong. When asked about future deployment plans, one-third to three-fourths of the different agency types report they will expand

current deployments and about half are planning to invest in new technologies over the next three years.

- The expansion of real-time data collection through traffic sensors and cameras has changed the focus of information gathering from support for planning to support for operations, allowing management agencies to provide real-time traffic advisories, and to support real-time performance measurement and a more active role in managing traffic.
- The advances in communications and development of interagency communications standards have advanced the state of the practice for integration from virtually no real-time interagency integration to close operational coordination, shown in the most recent survey results by strong support for integrated operations along corridors.
- Technical advances have moved traffic management capabilities from relatively passive monitoring to data-driven incident management and proactive control of traffic through mechanisms like managed lanes, ramp metering, and adaptive traffic signals.
- Shown for the first time in the 2010 survey, traveler information based on infrastructure systems such as radio and DMS are migrating to personalized messaging through mobile devices and social media.
- The deployment of technologies to track and dispatch transit vehicles has made it possible to greatly improve customer service by providing travelers with real-time information on schedule adherence, supporting demand responsive operations, and improving route planning.
- Toll collection has rapidly moved from a completely manual operation to one largely automated through deployment of electronic toll collection systems. These deployments have improved safety, mobility, and accuracy of toll collection, while reducing costs. Further, when coupled with toll tag readers, electronic toll collection systems support traffic management by providing real-time data on traffic conditions.

Chapter 1 Agency Opinions About ITS

New for the 2010 Intelligent Transportation Systems (ITS) deployment tracking survey was inclusion of a number of questions to gather information on agency opinions concerning ITS, in addition to the typical focus on issues of counts and coverage of specific systems. These new questions were included to provide types of information that previously could only be inferred from the pattern of deployments and trends. Four areas were covered: (1) general plans to invest in ITS in the next three years; (2) factors influencing decisions to invest in ITS; (3) perceptions of the benefits of specific ITS technologies; and (4) deployment of specific technologies planned for the near future.

Plans to Invest in ITS

One measure of the health of the national ITS program is the extent that agencies are planning to make new investments in ITS in the near future. Questions concerning plans to make investments in ITS technologies were included in four of the seven survey types, targeting agencies managing freeways, arterials, transit, electronic toll collection, and transportation management centers. Agencies were asked to report on their general future investment plans (covering the period from 2010 – 2013) in two areas: expansion of the coverage of existing ITS technologies, and deployment of new types of technologies.

Figure 1-1 shows the percentage of the four agency types with plans to expand current coverage of ITS technologies, or to invest in new technologies. Overall, there is a very strong commitment to continued growth in deployment of ITS technologies, with results ranging from about one third to more than three fourths of the surveyed types of agencies planning to expand current deployments or deploy new technologies.

There are clear distinctions among the agency types. Nearly 80% of freeway management agencies and Transportation Management Centers (TMC) plan to expand coverage, and more than half will invest in new technologies in the next three years. Arterial agencies show a similar pattern, but with lower percentages. Transit agencies, on the other hand, show a stronger commitment to investing in new technologies than in expanding existing deployments, and toll collection agencies split the difference, with an equal percentage of agencies planning to expand or invest in new technologies.

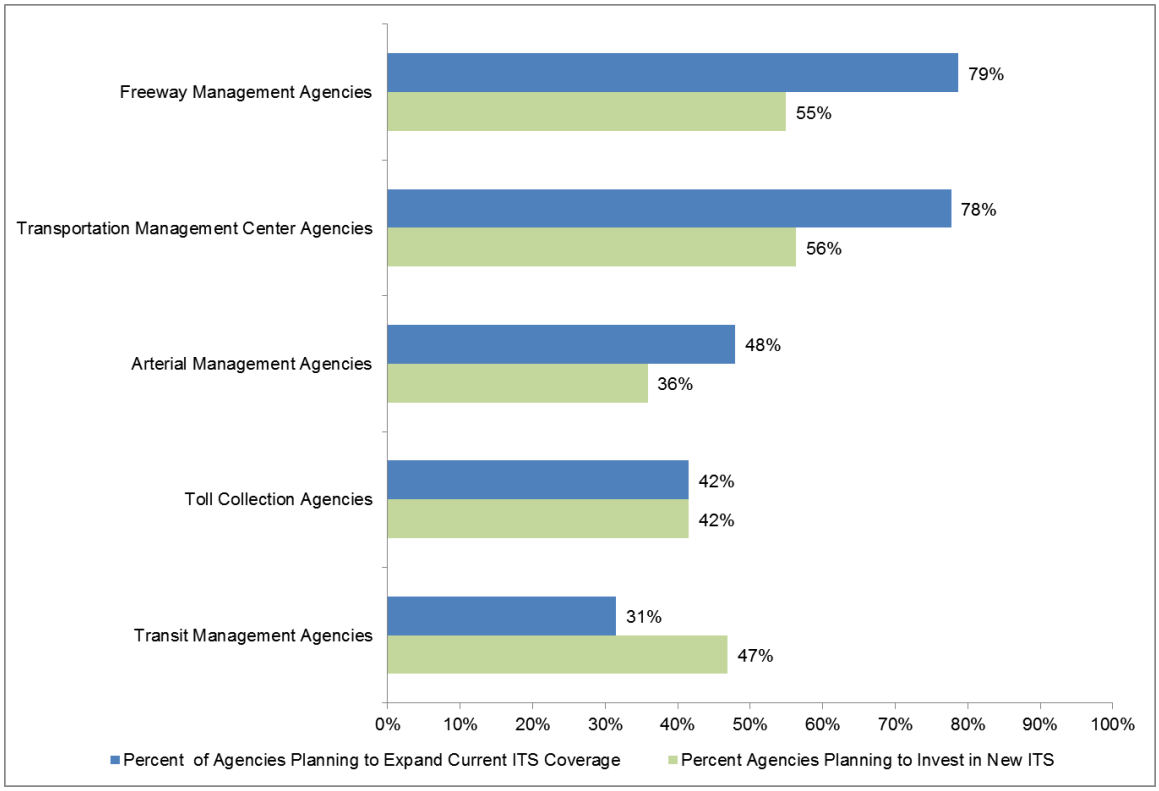

Figure 1-1. Percent of Agencies Planning to Invest in New ITS Technology or Expand Coverage 2010 - 2013.

What Factors Influence Decisions to Invest in ITS?

The issue of what factors impact decisions by state and local transportation agencies to invest in ITS technology has been an important research topic since the start of the national program. The 2010 national ITS deployment tracking survey provided the opportunity to gather information from more than a thousand agencies concerning this issue. Respondents were asked about their opinion of the importance of various factors making decisions to invest in ITS technologies. These questions were included in four of the seven surveys: freeway management, arterial management, toll collection, and transit management. Respondents were asked to rank the factors on a scale of 1 to 5, from Not at all Important (1) to Very Important (5). Nine factors were assessed by the four agency types targeted:

- Environmental benefits,
- Funding/grant availability,
- Integration with currently deployed technologies,
- Integration with other agencies,
- Mobility benefits,
- Price of equipment,
- Public/constituents involvement,
- Safety benefits, and
- Technology already used by another agency.

Each agency type had a unique pattern of responses, but the most important factor in deciding to deploy ITS overall was safety benefits. Other important factors were availability of funding and price of equipment as well as mobility benefits. Environmental benefits, public involvement, and the fact that other agencies had adopted ITS technologies were generally ranked lower in importance. The following four figures show the specific results from the different agency types.

Figure 1-2 shows the assessment by freeway management agencies concerning decisions to deploy ITS technology on freeways. The figure shows the factors in order of the average of the (1 to 5) rankings score of all the respondents (included in parentheses). The bars for each factor show the percentage of responses in each ranking category separated by different colors.

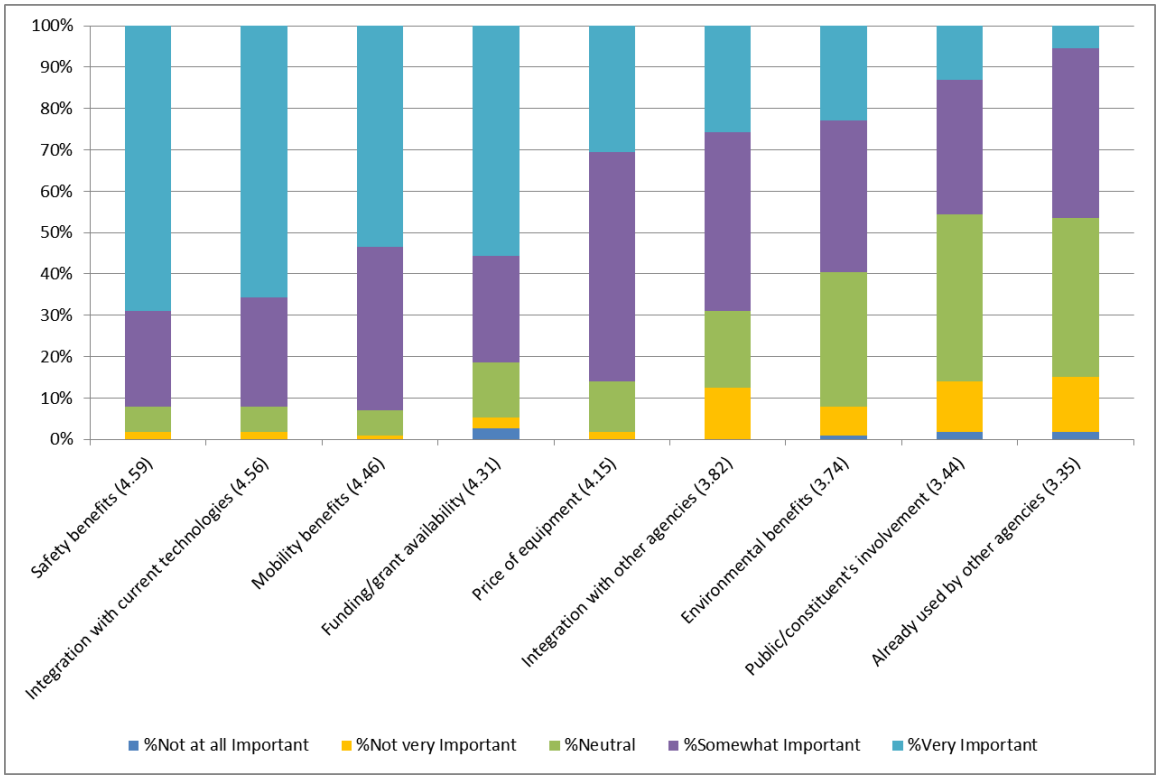

Figure 1-2. Importance Rating Assigned to Purchase Decision Factors by Freeway Management Agencies.

As Figure 1-2 shows, the average of the rankings ranged from 4.59 to 3.35, indicating that all factors were ranked above neutral in making a purchase decision. The most important reason for freeway agency personnel to decide to deploy ITS was the impact on safety, with a score of (4.59). Next in importance, and reflecting a high level of appreciation on the part of freeway management agencies for the technical issues involved with creating and maintaining an integrated system, was the need to integrate new systems with existing deployments (4.56). Also scoring very high were the mobility benefits of ITS (4.46). The next two factors, ranked somewhat lower than the first three involved economic issues: the availability of grants (4.31) and the price of equipment (4.15). All of these factors were significantly more important than the last four. Integration with other agencies was ranked lower (3.82), as were the environmental benefits (3.74). Public/constituents involvement (3.44) and the fact that the systems were already used by other agencies (3.35) were last in importance. The importance

of interagency integration may grow as more agencies adopt a corridor concept involving different agency types. It is also noteworthy that the four top ranked factors, safety benefits, integration with current technologies, mobility benefits, and funding/grant availability were ranked as very important by more than half of the respondents. The high ranking of mobility benefits shows the importance of ITS technologies to improving operations.

Figure 1-3 shows the ranking of factors impacting deployment decisions for arterial agencies. While the pattern of responses differs from the results for freeway agencies above, the identification of the key factors is similar. Arterial agencies assigned funding/grant availability (4.57) the highest average importance rating, followed by safety benefits (4.47), price of equipment (4.32), integration with current technologies (4.28), and mobility benefits (4.28). Ranking lower in importance were environmental benefits (3.73), integration with other agencies (3.66), already used by other agencies (3.55), and public/constituent's involvement (3.38). These results show that arterial agencies perceive ITS technology to have an important role in supporting safety and mobility, but are constrained by the economic issues in making decisions to deploy, apparently to a greater degree than freeway management agencies. As with freeway agencies, it may turn out that as the concept of integrated corridors becomes more widespread, that the importance of interagency integration will increase.

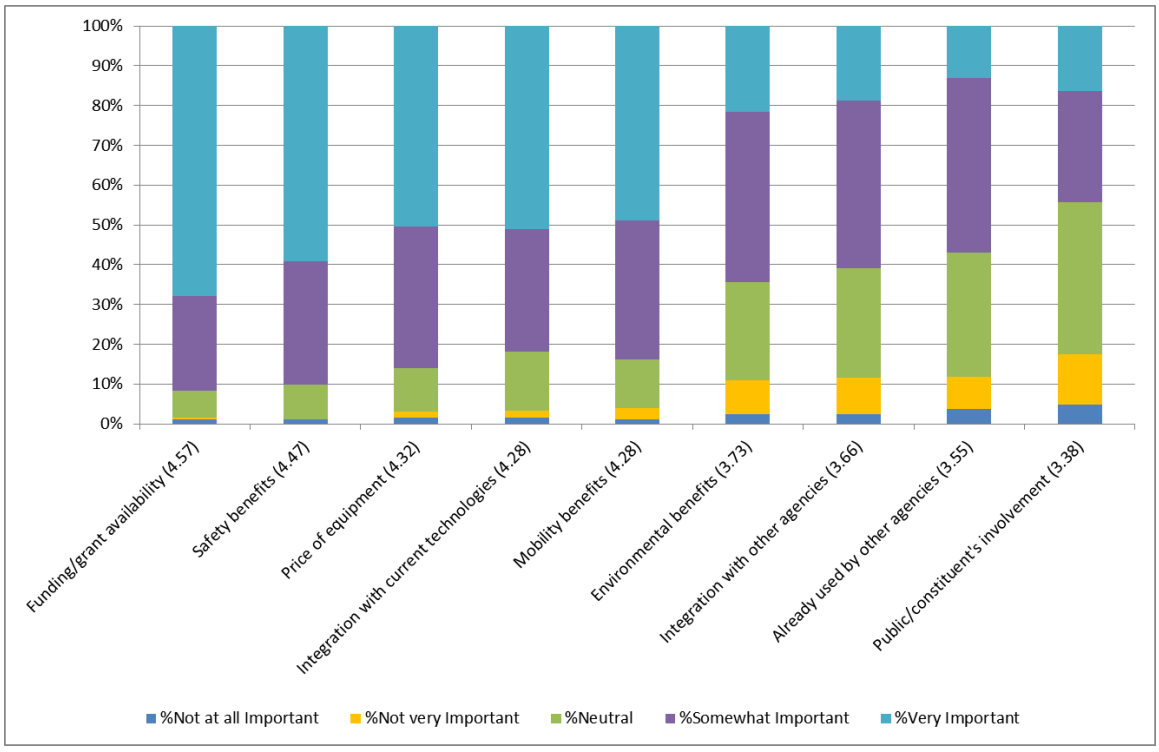

Figure 1-3. Importance Ratings Assigned to Purchase Decision Factors by Arterial Management Agencies.

Toll collection agencies have a different pattern of assessments of the deployment factors, shown in Figure 1-4. One difference is the magnitude of the average ratings—toll agencies have been enthusiastic in adopting electronic toll collection (ETC) technologies, and it shows with the first five factors having a very high average ranking. By far the strongest reason for deployment is improved safety (4.88), which likely reflects both the reduction of exposure of personnel in collecting tolls as well as the impact of improving the flow of vehicles at toll stations. Toll agencies also strongly value integration of toll tag systems (4.63), mobility benefits (4.50), price of equipment (4.50), integration with other agencies (4.48) and environmental benefits (4.31). Lower ranked factors include public/constituents involvement (3.85), already used by other agencies (3.65) and funding/grant availability (3.29).

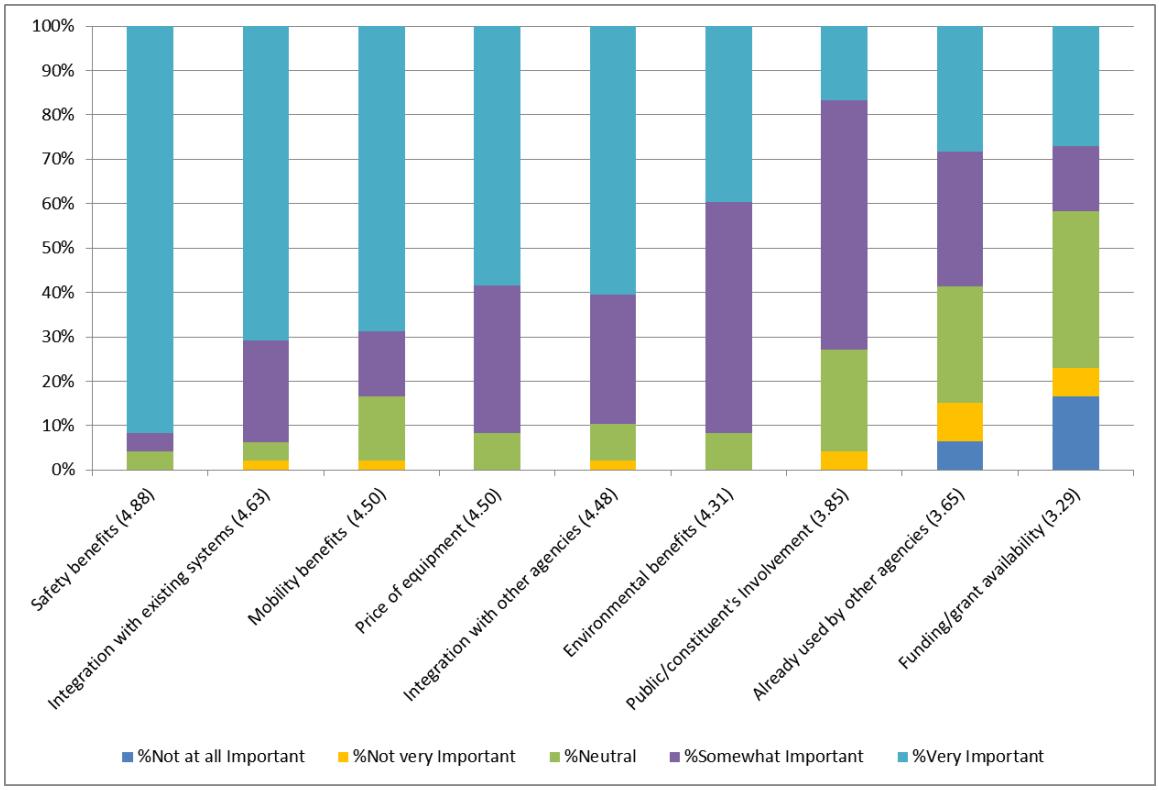

Figure 1-4. Importance Ratings Assigned to Purchase Decision Factors by Toll Collection Agencies.

Finally, the responses by transit agencies, shown in Figure 1-5, follow the pattern of the responses by arterial agencies, with funding/grant availability (4.74) and price of equipment (4.49), sandwiching safety benefits (4.61), as the top three factors. Integration with current technologies (4.38) is the only remaining factor ranked above 4. These are followed by environmental benefits (3.90), mobility benefits (3.89) public/constituents involvement (3.73), Transit Communications Interface Profile (TCIP) compliant (3.72), and already used by other agencies (3.68).

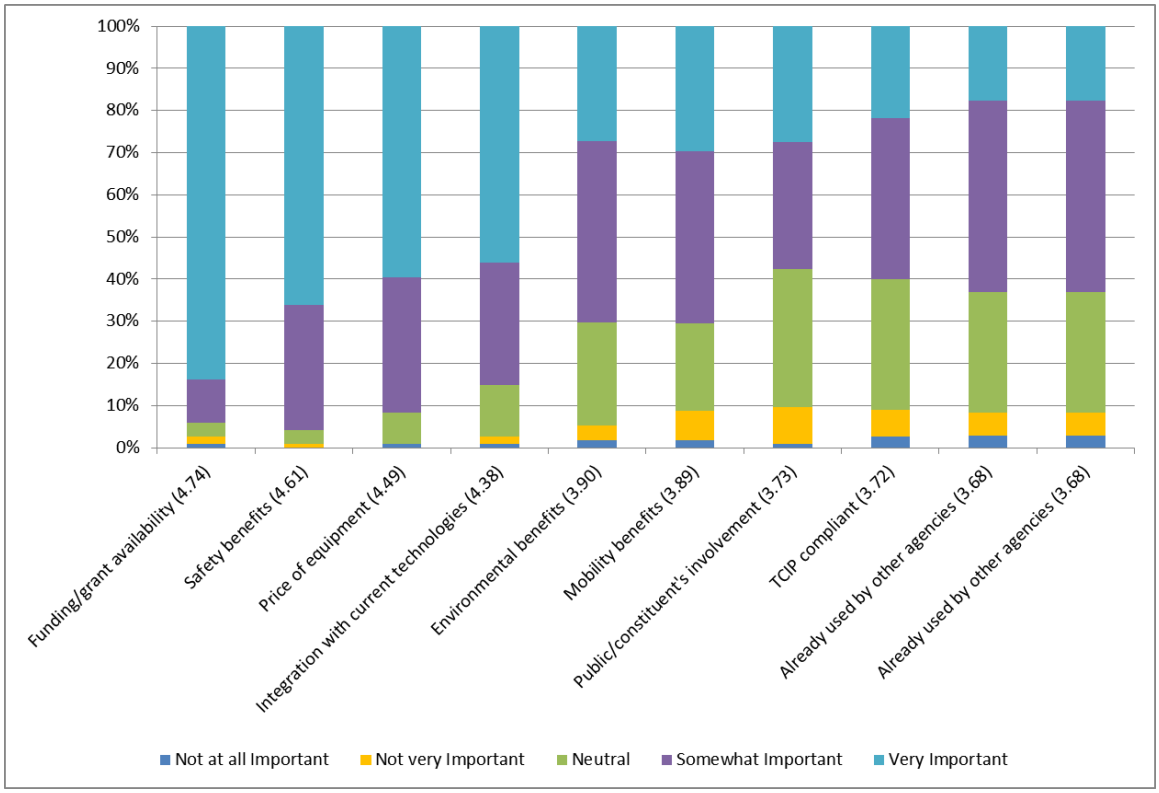

Figure 1-5. Importance Ratings Assigned to Purchase Decision Factors by Transit Management Agencies.

Overall, the results from these four agency types emphasize the importance that transportation management agencies place on safety and mobility and suggest that agencies recognize the role ITS technologies can play in solving these problems. In addition, however, agencies, particularly those involved with arterial and transit management, are also reporting that having funding available for ITS technologies plays a critical role in deciding to implement ITS projects. Growing infrastructure, safety, and mobility needs, combined with funding limitations, means that arterial and transit management agencies are required to carefully select ITS projects for implementation. It appears that when funding is available, agencies consider ITS technologies as important tools to manage safety and congestion problems.

Perceptions Regarding Benefits of ITS Technologies

The ITS Joint Program Office has an extensive effort aimed at gathering empirical data on the benefits of particular ITS technologies, typically expressed in terms of improvement of specific performance measures. One area that has not received as much attention is gathering assessments of the perceived benefits of ITS technologies from agencies having experience with the systems. The 2010 survey provided an opportunity to address this issue, and surveyed agencies were asked to rank the benefits of specific technologies with which they had experience, using a purely subjective ranking scale. These assessments could provide a number of useful insights to the ITS Joint Program Office. For example, situations in which technologies are ranked high for benefits but have a relatively low level of deployment may point to opportunities for research into factors such as operational

constraints, cost, or other factors impacting the utility of some ITS technologies. The benefits rankings can also provide priorities for program management actions including outreach and model deployments where perceived benefits appear to differ from the measured benefits.

Respondents at freeway management, arterial management, and transit management agencies were asked to assess the benefits of specific ITS technologies. In each case, only those agencies actually deploying a technology were asked to provide a ranking, and the ranking was to be made based on individual operational experience with the technology. As with the questions previously discussed concerning factors involved with making deployment decisions, respondents were asked to rate the technologies on a scale of 1 (No Benefit) to 5 (Significant Benefit). The next three figures show results for the surveyed agency types.

Figure 1-6 shows the results for freeway management agencies. As with the figures in the previous discussion, the average scores are shown in parentheses and the percentage of responses in each category are shown by different colors in the bars for each technology. The results show that the four systems with the highest benefit to freeway agencies reflect the use of ITS systems to support an active role in managing traffic. Cameras (4.85), traveler information systems (4.66), ramp control (4.42), and sensor loops (4.35) provide the highest scores for perceived benefit. Toll tags (4.26), useful in both traffic monitoring and implementing traffic control through pricing strategies, and another control strategy, lane management (4.09) also averaged above a ranking of 4 out of a possible 5. Systems ranked lower for benefits include archived data (3.93), automatic enforcement (3.92), and vehicle probes (3.64). It was somewhat surprising that two of the highly ranked strategies, ramp control and lane management, are relatively lightly deployed based on the percentage of agencies that have adopted the strategies. Diagnosing the issues impacting adoption of these technologies may be useful in improving operations through wider usage.

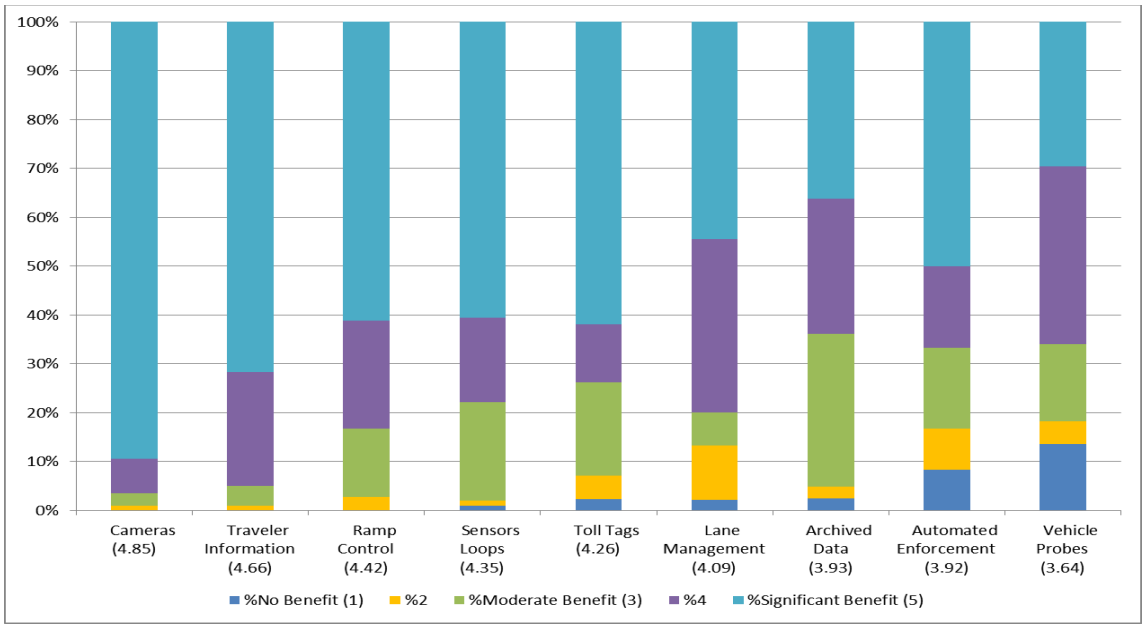

Figure 1-6. Benefit Ratings Assigned to ITS Technologies by Freeway Management Agencies.

Figure 1-7 shows the subjective assessments of benefits of technologies supporting arterial agencies. Two technologies dominate the ratings by a wide margin, sensor loops (4.49) and cameras (4.45). Both are involved with gathering information to support active management of traffic on arterials and are widely deployed. Traveler information (3.86), archived data (3.81) and adaptive signal control (3.68) were ranked lower, followed by lane management (3.49), vehicle probes (3.31), and automated enforcement (3.19). These results indicate an overall difference in the assessment of benefits of ITS by arterial agencies compared to freeway agencies, with freeway agencies appearing in general to value ITS significantly higher. Arterial agencies ranked only two out of the eight technologies higher than 4 out of a possible 5 on average. Freeway agencies, on the other hand, ranked 6 out of 9 technologies above 4 on average.

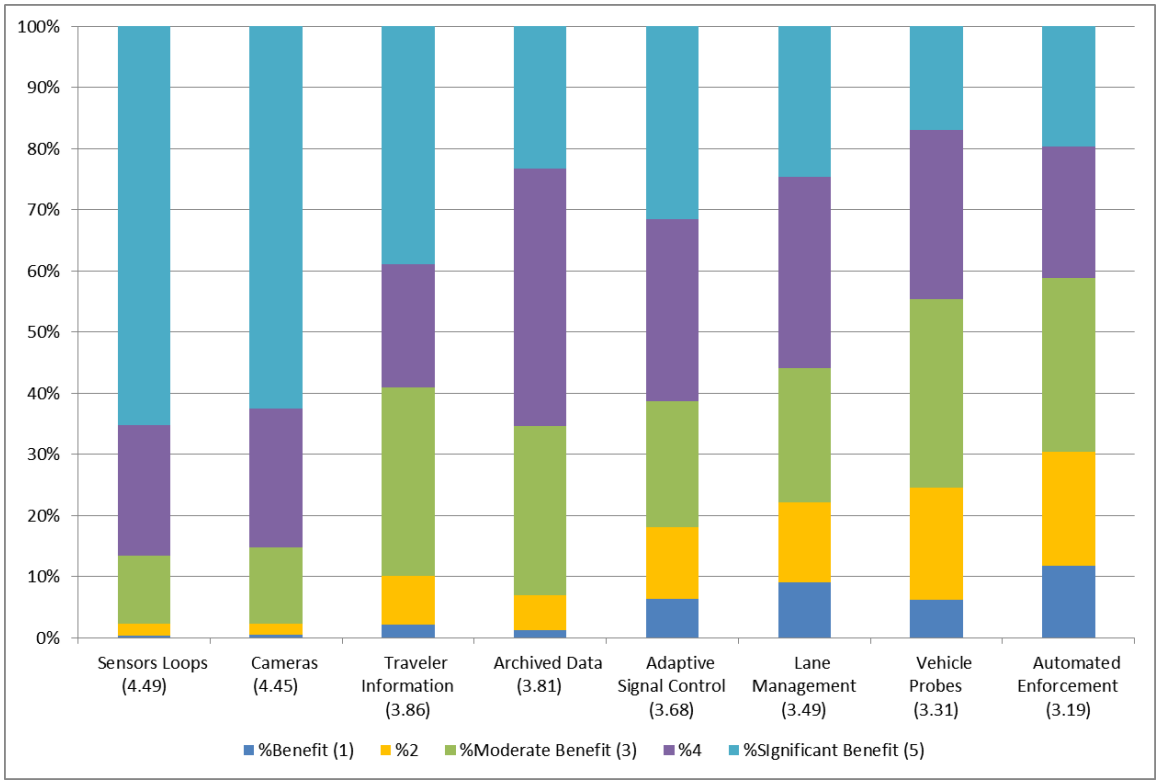

Figure 1-7. Benefit Ratings Assigned to ITS Technologies by Arterial Management Agencies.

For transit agencies, as shown in Figure 1-8, communications (4.82) is the most highly rated technology followed by security cameras (4.67). These high rankings may be associated with the fact that the two systems support both operations and security. Then next two rated technologies, computer aided dispatch (4.58) and automatic vehicle location (4.57), are also highly ranked and improve service by supporting sophisticated demand responsive operations. Also highly ranked are data management – GIS (4.21) electronic fare payment (4.19), traveler information (4.15), automatic passenger counters, and maintenance tracking (4.06). Lower ranked for benefits by transit agencies were transit signal priority (3.22) and weather information systems (2.80). It is notable that nine of the eleven technologies have a rating above 4 out of a possible 5, showing that transit agencies generally value ITS technology highly.

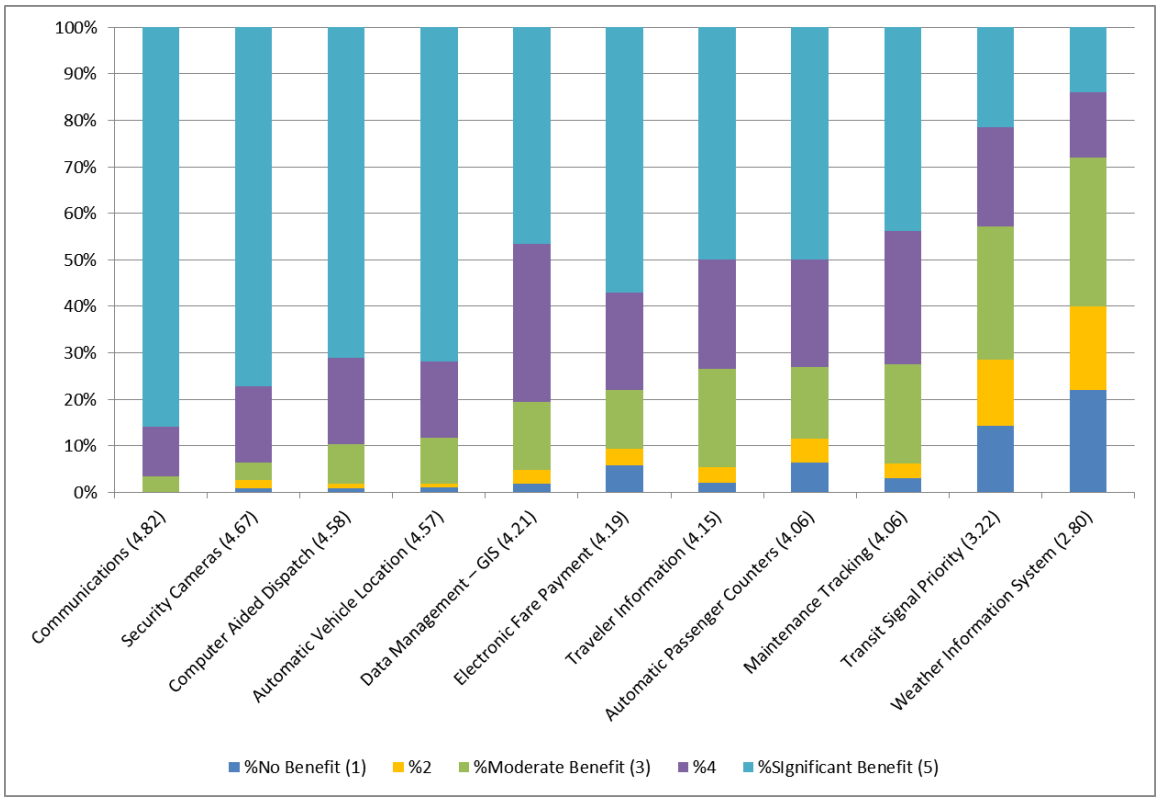

Figure 1-8. Benefit Ratings Assigned to ITS Technologies by Transit Management Agencies.

Generally, the results for the three types of agencies show a strong positive impression of the benefits of ITS technologies, with the majority of the technologies ranked above 4 out of a possible 5. Technologies supporting operations are particularly highly rated by all three agency types.

Future ITS Deployment Plans for Specific Technologies

Respondents who indicated that their agency was planning to invest in ITS technologies were asked to comment on the particular technologies to be purchased. This section summarizes comments from freeway, arterial, and transit agencies. Not all agencies that could have provided comments chose to do so, and as a result, the number of agencies included is less than the number indicating plans to make future investments. On the other hand, the results provide a clear picture of the relative importance of the different technologies to the different agency types.

Figure 1-9 shows the planned deployments for freeway management agencies. By far, the two technologies most highly ranked for benefits in the preceding section, closed circuit television (CCTV) and dynamic message signs (DMS), were listed most often by freeway agencies as planned future deployments. Next in importance are two related technologies, radar sensors and travel time systems. Toll tag readers and variable speed limits were also mentioned.

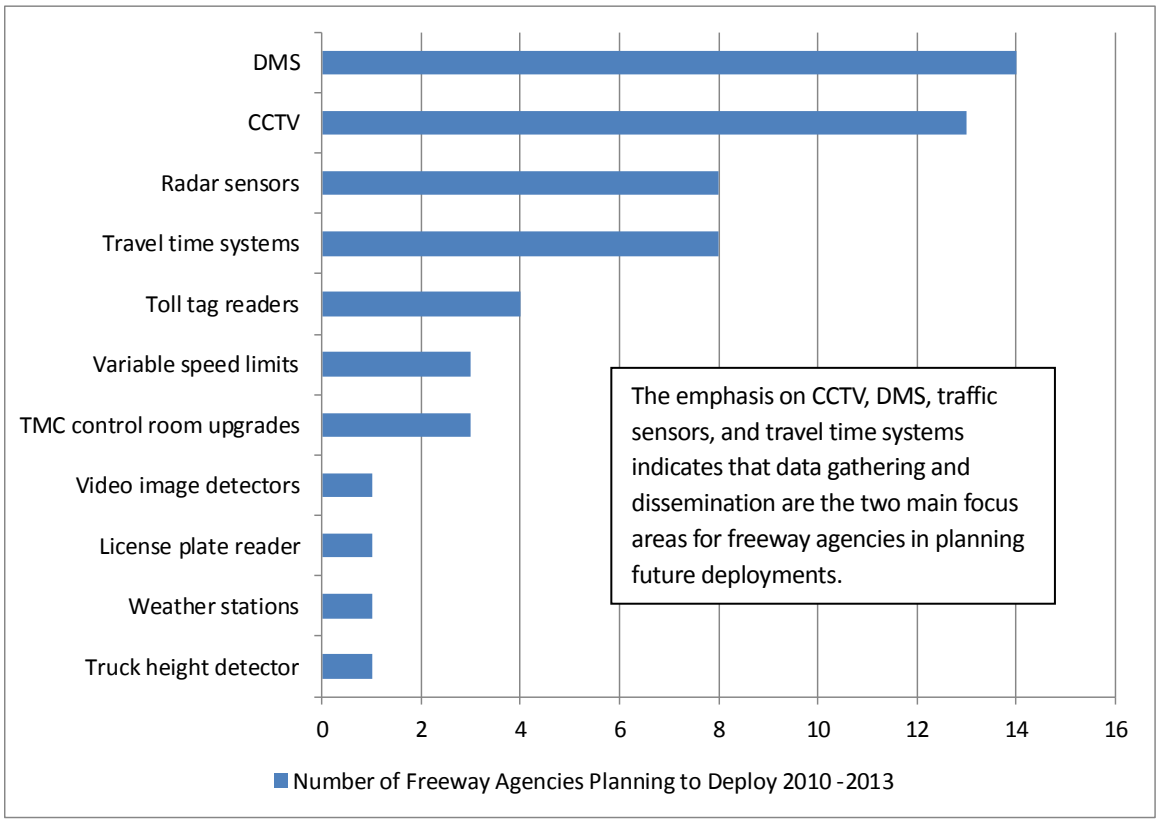

Figure 1-9. Planned Future Deployments for Freeway Management Agencies 2010 – 2013.

Figure 1-10 shows the deployment plans for arterial agencies. As with freeway agencies, the primary focus of future deployments is to improve data collection and dissemination. The two most commonly mentioned technologies are closely related, CCTV and improved communications with field devices, with deployment of DMS next most commonly mentioned. A second area of emphasis for arterial agencies in planning ITS deployments is to improve operations, through deployment of close loop signal control in addition to upgrades to existing signal controllers. Deployment of transit priority, video imaging detector systems, and traffic adaptive signaling are also advanced technologies that will improve operational capability.

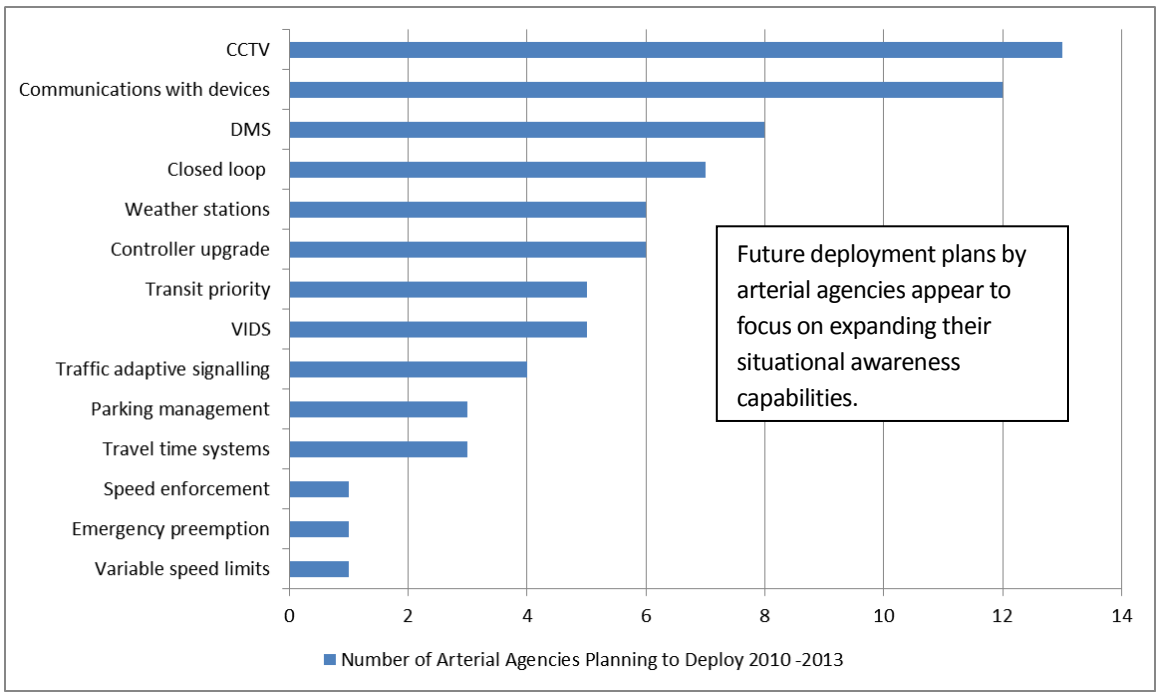

Figure 1-10. Planned Future Deployments for Arterial Management Agencies 2010 – 2013.

Figure 1-11 shows the plans for future deployments by transit agencies over the next three years. The four most often mentioned technologies are all directly related to improving service to transit passengers. Most often mentioned are improvements to fare payment, through smart cards or other electronic enhancements. Next is automatic vehicle locations (AVL) and real time traveler information which together improve customer mode decision making. AVL in association with computer aided dispatch (CAD) support improved dynamic scheduling capability, and deployment of CAD/AVL systems is also mentioned frequently. After these top four technologies, automatic passenger counters and security cameras follow closely, with less emphasis shown for radio upgrades, traffic signal priority, and mobile data transmitters.

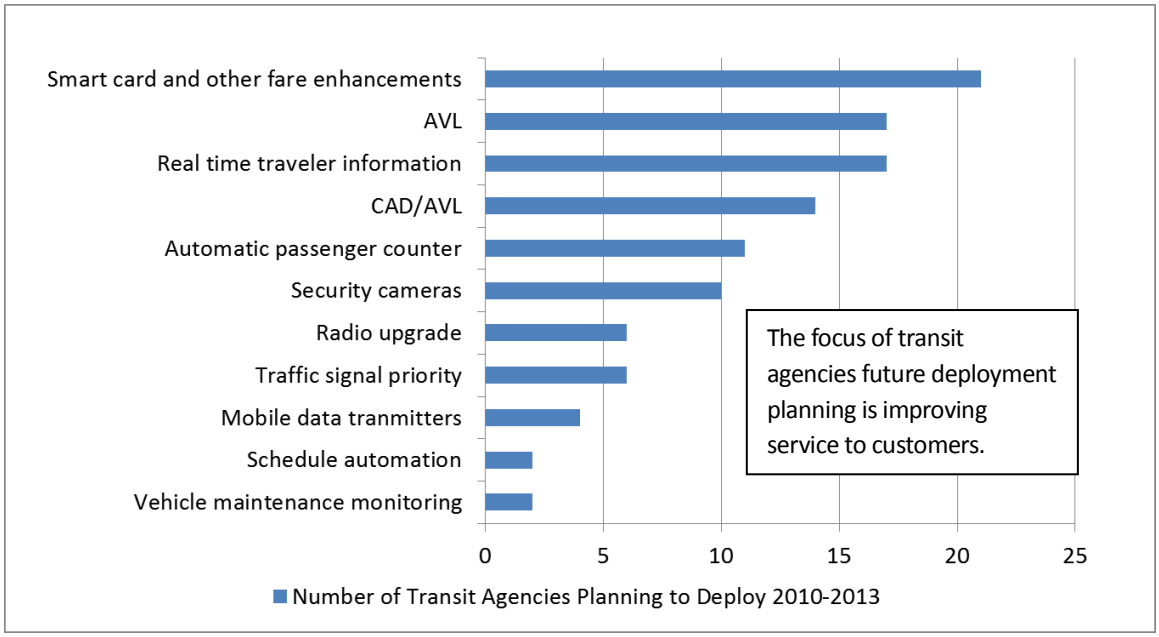

Figure 1-11. Planned Future Deployments for Transit Management Agencies 2010 - 2013.

Chapter 2 National ITS Deployment Data and Trends

The 2010 ITS deployment tracking survey continued to gather a consistent set of data elements designed to track the level of deployment in major cities. As summarized below, deployment continued to increase in these areas in 2010 for a range of agencies. Beginning in the mid-1990's, state and local transportation agencies, toll road operators, as well as public safety agencies have embraced technology to support management of the surface transportation system. Real-time surveillance of transportation system operating conditions provide agencies with the capability to quickly and accurately identify and treat incidents impeding travel flow as well as operate traffic control devices in response to changing travel conditions. In addition, agencies are providing timely and accurate information to assist travelers in making travel plans including route and mode choice. Through automating financial transaction agencies reduce costs while increasing convenience to the traveler. Finally, technology innovations assist public safety agencies in responding to incidents through assisting in dispatching and vehicle routing. The following sub-sections summarize results from the seven deployment tracking surveys.

Freeway Management

Deployment and Adoption of Key Technologies

Figure 2-1 shows that the key ITS technologies supporting real-time data collection and traveler information dissemination experienced rapid growth in coverage from the last survey, and this growth is consistent with long term trends. The number of DMS deployed in the Nation's largest 78 metropolitan areas increased approximately 60% from 2000 to 2010, greatly expanding agency capability to communicate directly with freeway travelers. In addition, there has been a threefold increase in the capability of freeway management agencies to visually monitor travel conditions as the CCTV coverage of freeway miles increased from approximately 15% in 2000 to 45% in 2010. Finally, there has been a continuous and rapid increase in the percent of freeway miles under electronic surveillance from 18% in 2000 to 55% in 2010. Real-time traffic data collection technologies, CCTV, and DMS form the basis for real-time management of traffic on freeways and the deployment trends make it likely that deployment of these core systems will continue to expand over the next several years, providing an evolving capability to monitor traffic and communicate with motorists.

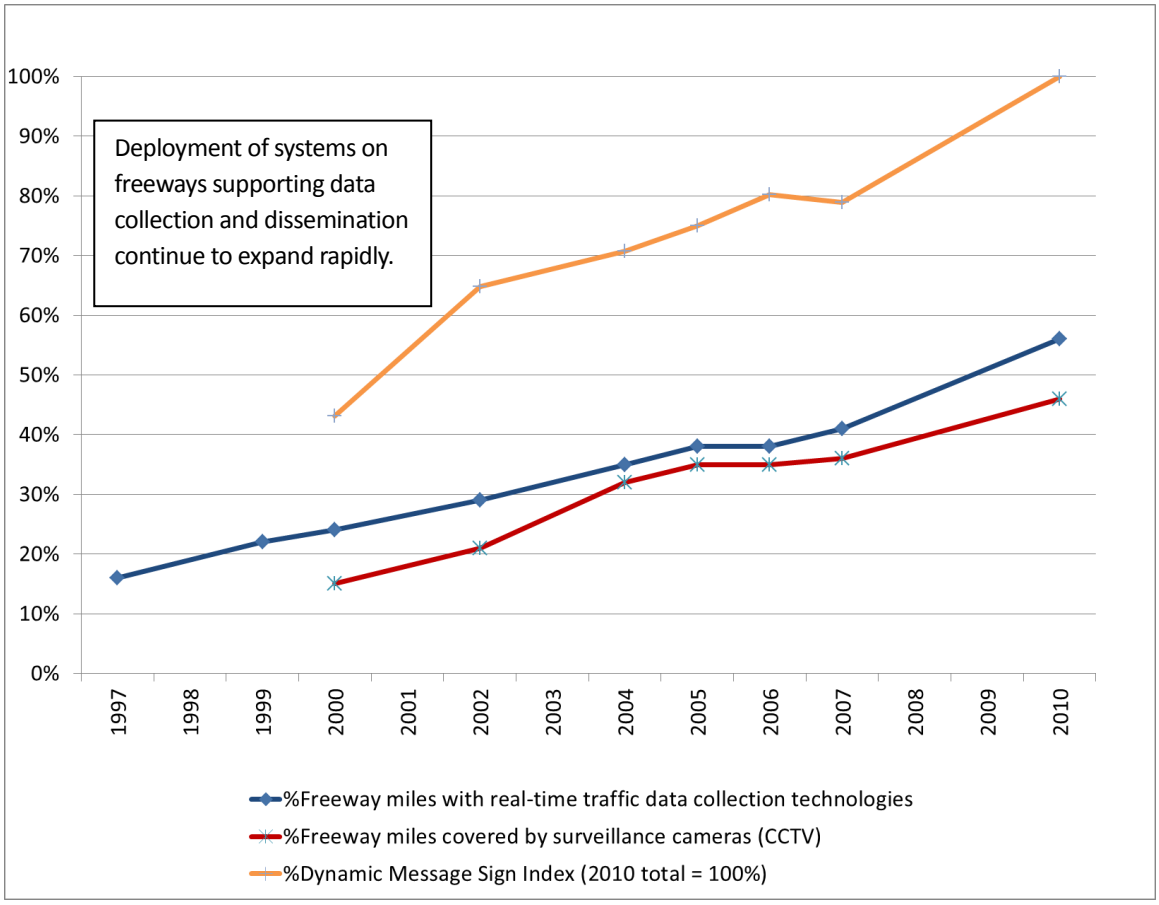

Figure 2-1. Freeway Management Deployment Indicators.

Figure 2-2 shows the rate of adoption of key ITS technologies by freeway management agencies in 2000 compared to the adoption rates reported in 2010. Adoption of CCTV and DMS expanded substantially over this period and by 2010 both technologies are approaching universal adoption. Highway advisory radio (HAR) is now adopted by almost two-thirds of surveyed freeway agencies. The data on adoption of different sensor technologies show a movement to radar detectors in place of other alternatives. The results indicate that the adoption of radar stations has doubled, increasing from 27% of agencies to 54% of agencies, while adoption of loop stations have remained at 39% and video image detectors (VIDS) has declined from 15% to 12% of agencies. These trends suggest that freeway agencies may be replacing loop and VIDS with radar stations. One possible explanation is the relative reliability of the different sensors. The 2010 survey included questions about sensor reliability and the results show that approximately 93% of radar stations were operational while only 55% of loop stations were operation and 34% of VIDS were operational. It is curious that adoption of ramp metering actually declined somewhat even though the agencies that have adopted ramp metering rank it highly for benefits. There was also only a slight growth in adoption of high occupancy vehicle (HOV) lanes.

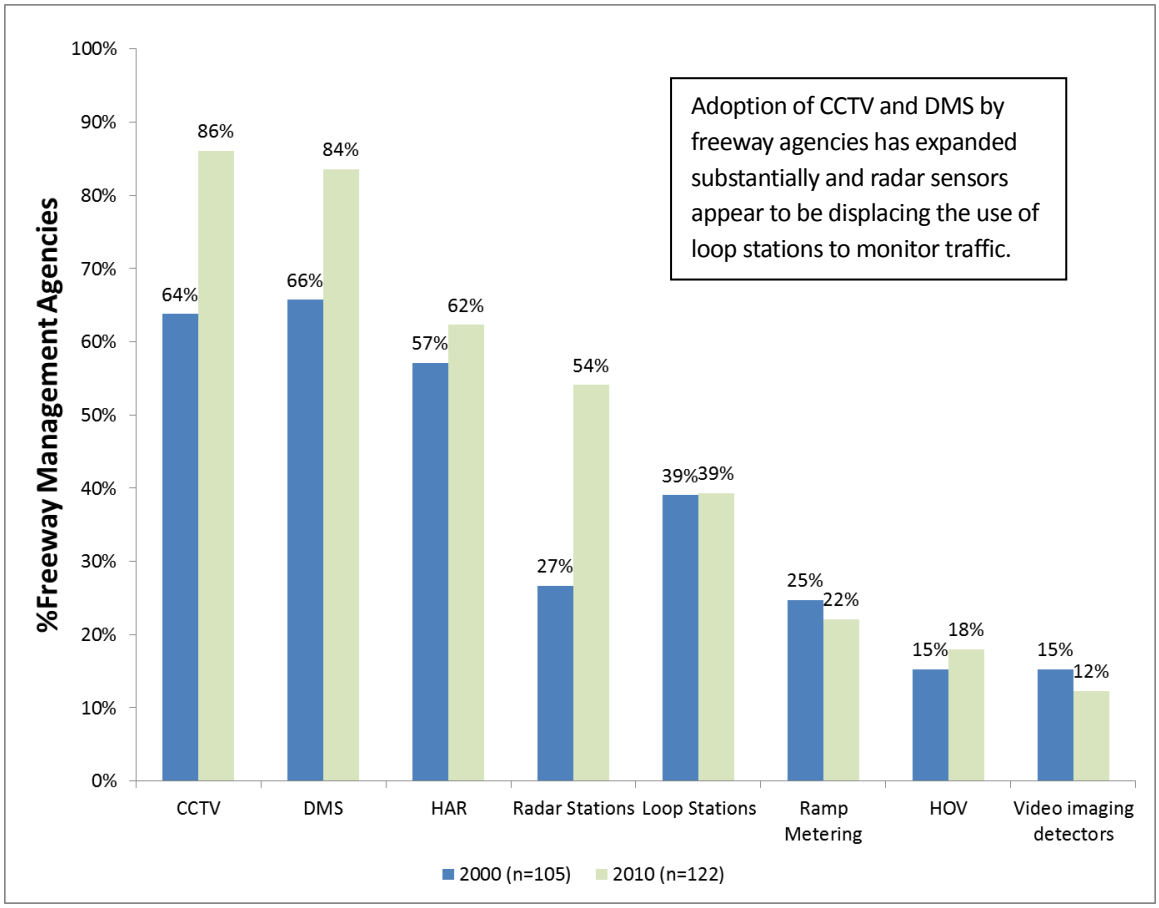

Figure 2-2. Technologies Adopted by Freeway Management Agencies, 2000 - 2010.

Traveler Information

As summarized in Figure 2-3, the use of the internet has become a major travel information medium, supporting both pre-trip planning and en route decision making. The use of web pages to provide pre-trip information is the most widely adopted traveler information technology, followed closely by the more traditional DMS used to provide en route information. Two wireless media, 511 and HAR, are next in rate of adoption and are used by more than 60% of agencies. Email has become an important method to distribute information, both pre-trip (alerts to desktop, subscription services) and en route (alerts to mobile devices). Interestingly, slightly over 40% of responding agencies report the use of posting on Twitter or other social network sites, media not available ten years ago. The results suggest that social networking sites are growing as methods to distribute traveler information as travelers become more proficient in their use. The low cost and wide reach of these sources are attractive to agencies.

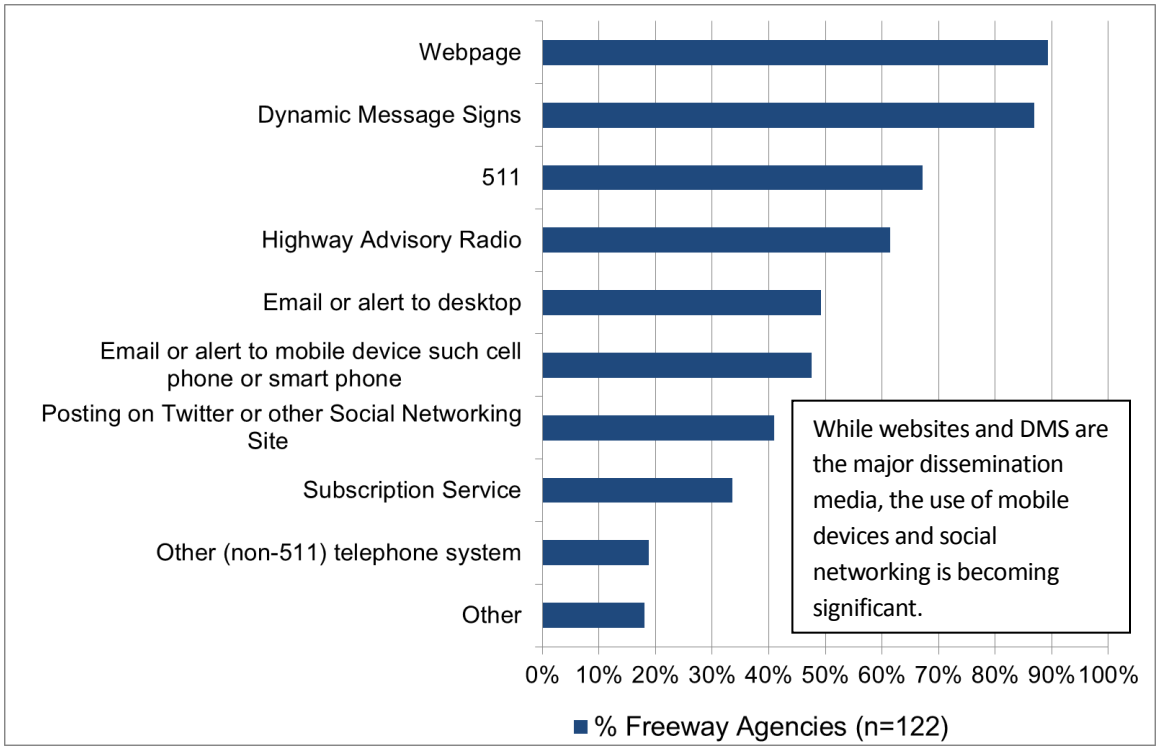

Figure 2-3. Methods to Distribute Traveler Information Adopted by Freeway Management Agencies.

Freeway agencies use ITS to disseminate a wide variety of traveler information. As summarized in Figure 2-4, freeway management agencies are taking advantage of the availability of a variety of real-time information obtained from sensors, including incident information, weather advisories, and travel time to better inform travelers. Incident location is distributed to travelers by more than 80% of freeway management agencies, followed closely by construction information. Travel time, either by segments or routes, is distributed by about one third of freeway agencies. As surveillance technology continues to expand in coverage, it is likely that travel time reporting over a particular route will expand. Other real-time information, obtained from weather sensors, covering visibility restrictions, precipitation, high winds, and temperature are also distributed by a high proportion of freeway agencies.

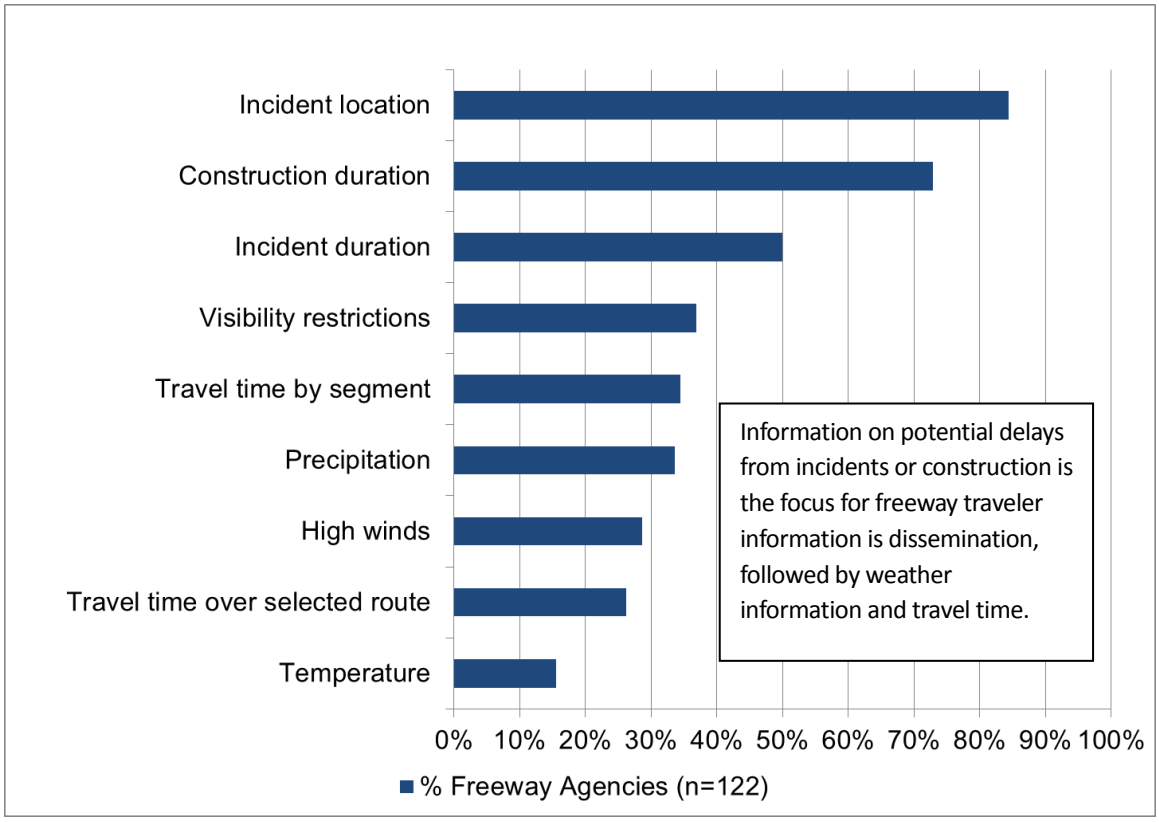

Figure 2-4. Information Distributed by Freeway Management Agencies.

Corridor Management

Freeway agencies were asked to report on the corridor management strategies they currently use or plan to adopt in the near future. Corridor management involves coordinating traffic management and transit delivery strategies over the entire spectrum of freeway, arterial, and transit services to maximize person throughput. As presented in Figure 2-5, the number of freeway management agencies reporting that they currently employ one or more corridor management strategies, or plan to employ such strategies in the future, shows that the concept of integrated operations along a corridor is well established. Traffic incident management, inclement weather traffic control strategies, and cross jurisdictional traffic signal coordination are the most frequently employed corridor management strategies cited by freeway management agencies. The areas of corridor coordination targeted for the greatest future growth include real-time transfer of performance information, traffic responsive signal timing, and transit operations. Overall, these results indicate that adoption of corridor management strategies by freeway agencies will undergo rapid expansion in the near future.

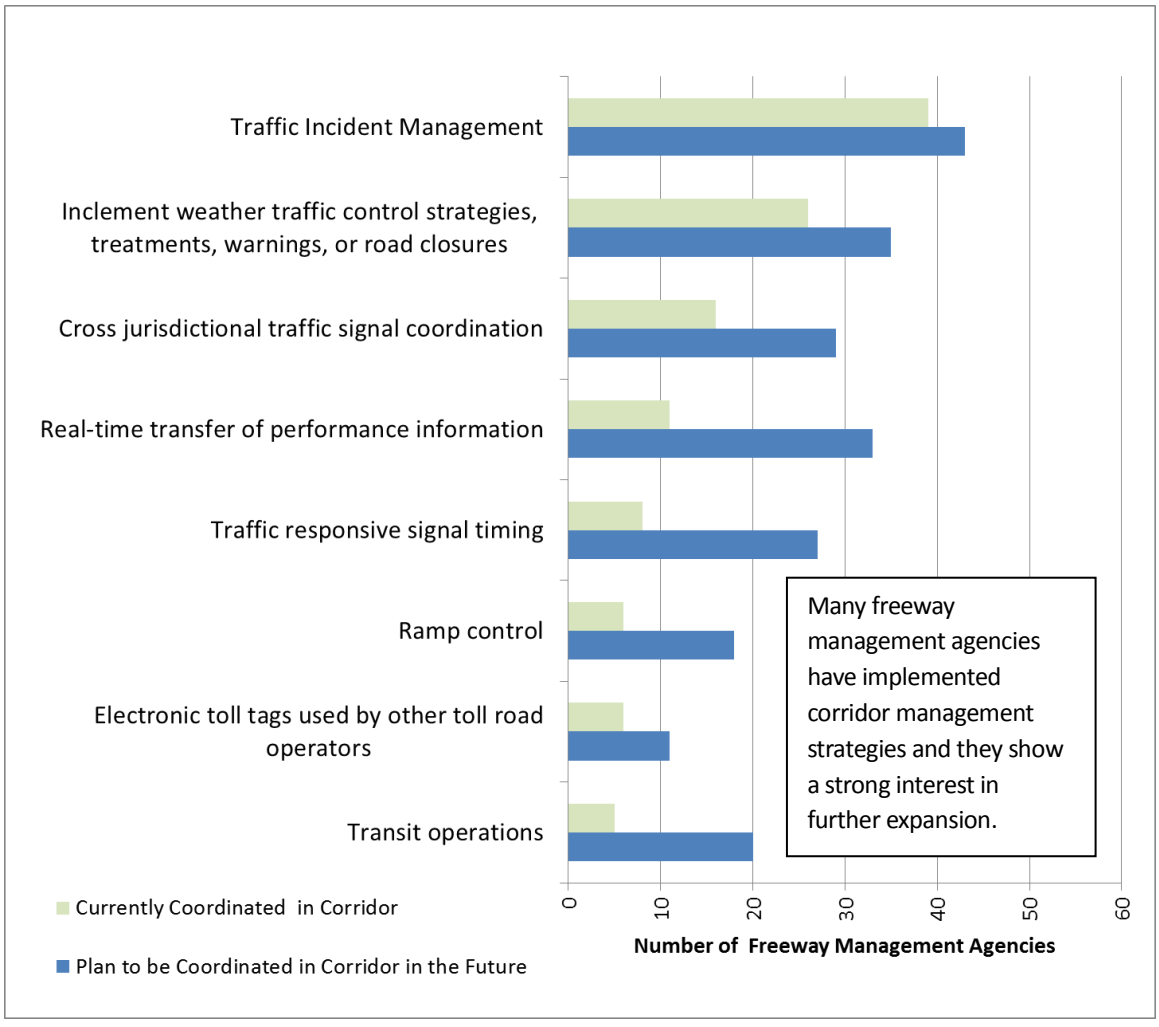

Figure 2-5. Current and Future Corridor Management Strategies Identified by Freeway Management Agencies.

Data Archiving

Data archiving augments the impact of ITS sensor systems on planning and operations. Freeway management agencies collect and archive a wide range of real-time data on traffic performance and weather conditions employing ITS surveillance technologies and environmental sensor stations (ESS). As summarized in Figure 2-6, traffic volumes and speeds are the most commonly archived data followed by lane occupancy, vehicle classification, and travel time. The data are often used to characterize traffic flow conditions to travelers in real-time and are also used to plan and evaluate highway performance. Information from weather sensors, including road conditions and visibility restrictions are also widely archived.

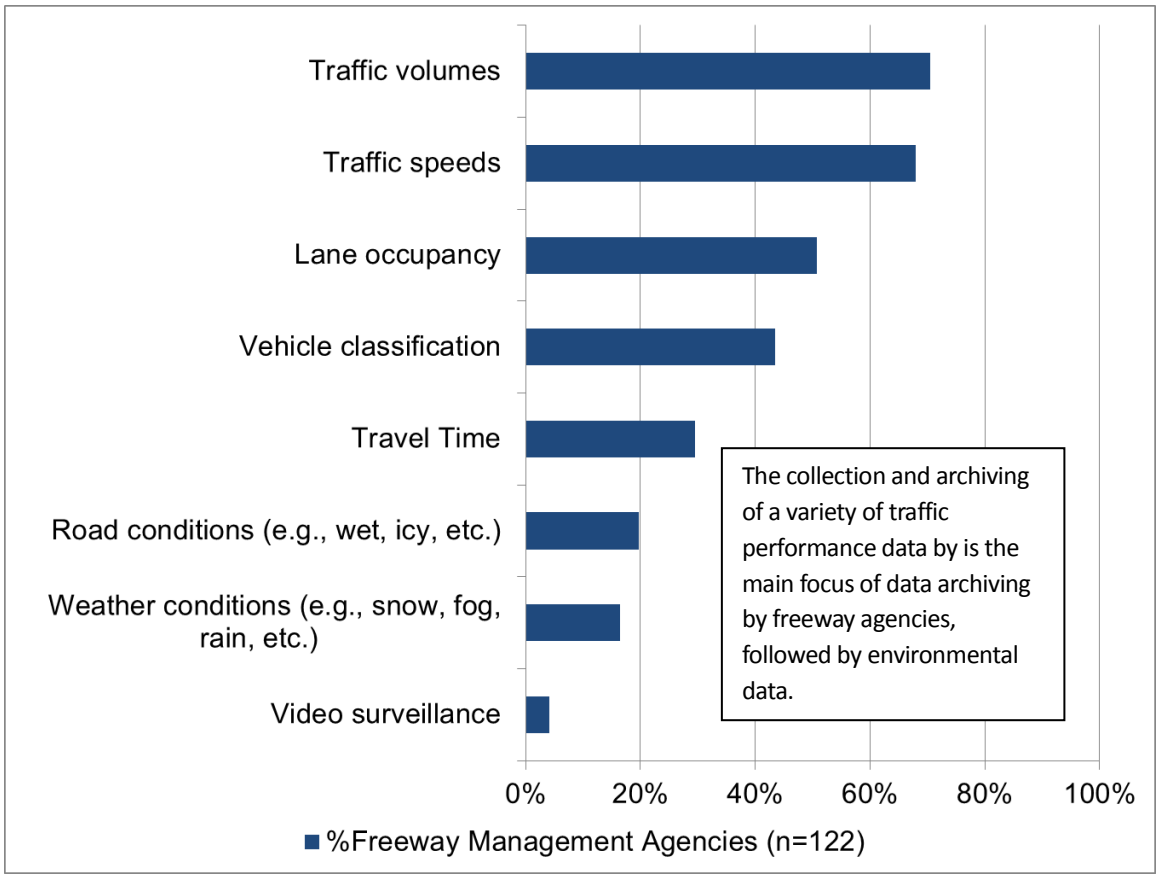

Figure 2-6. Information Archived by Freeway Management Agencies.

The data being archived by freeway agencies can support a variety of functions. As outlined in Figure 2-7, the most frequently cited use of archived data is for applications that support planning, such as traffic and safety analysis, operation planning and analysis, and capital planning. Other uses of archived data include construction impact assessment, and support for operations including travel time prediction, traffic control, and development of incident prediction algorithms.

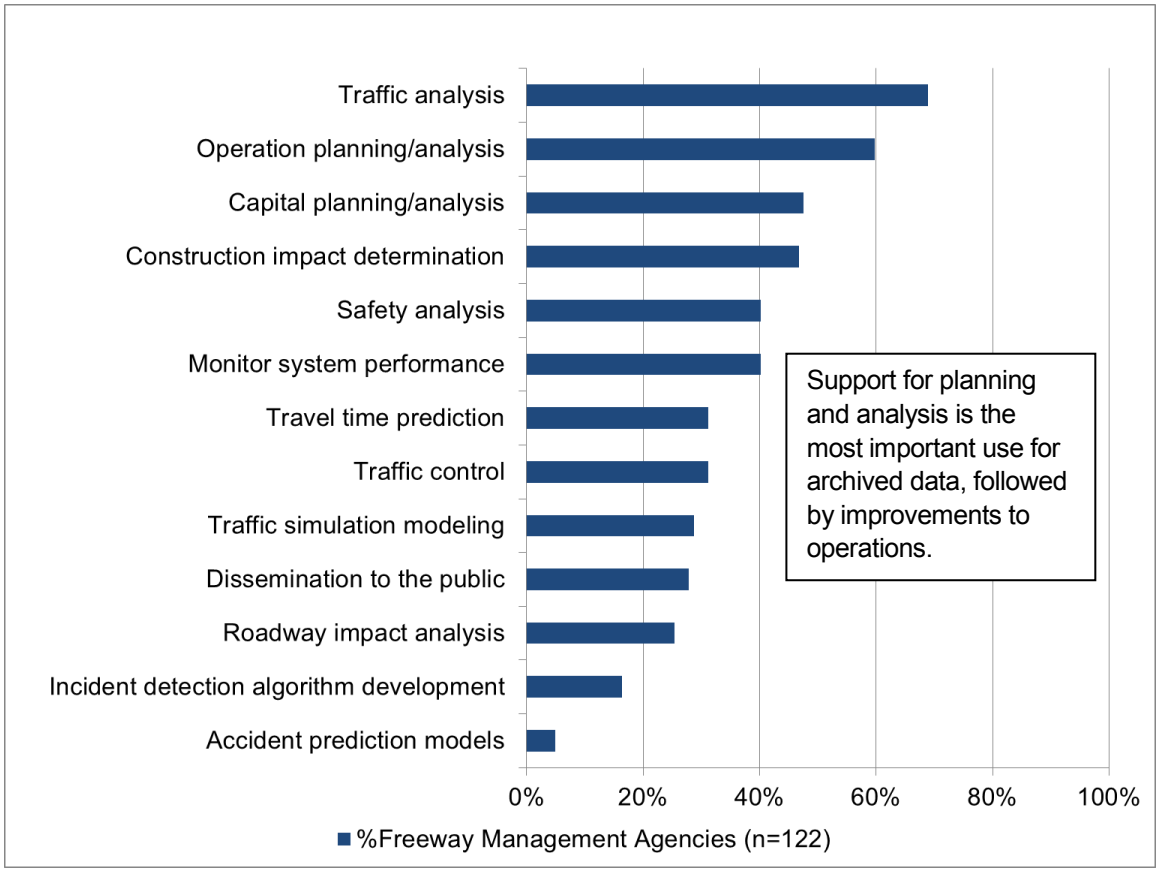

Figure 2-7. Use of Archived Data by Freeway Management Agencies.

Arterial Management

Deployment and Adoption of Key Technologies

Arterial management deployment trends are summarized in Figure 2-8. Since 2000, the percentage of signalized intersections covered by electronic surveillance has continued to expand from a low of approximately 20% in 2000 to a high of 48% in 2010. On the other hand, while a significant proportion of signalized intersections were under centralized or closed loop control in 2010 (50%), this was essentially equal to the proportion in 2000. The trend for a number of other arterial management technologies has remained relatively flat over the past decade, with the exception of percentage of arterial miles equipped with traffic signal preemption for emergency vehicles which has increased from approximately 12% in 1997 to 22% in 2010. Deployment trends remained relatively constant for arterial HAR, arterial service patrols, arterial CCTV, and arterial transit priority.

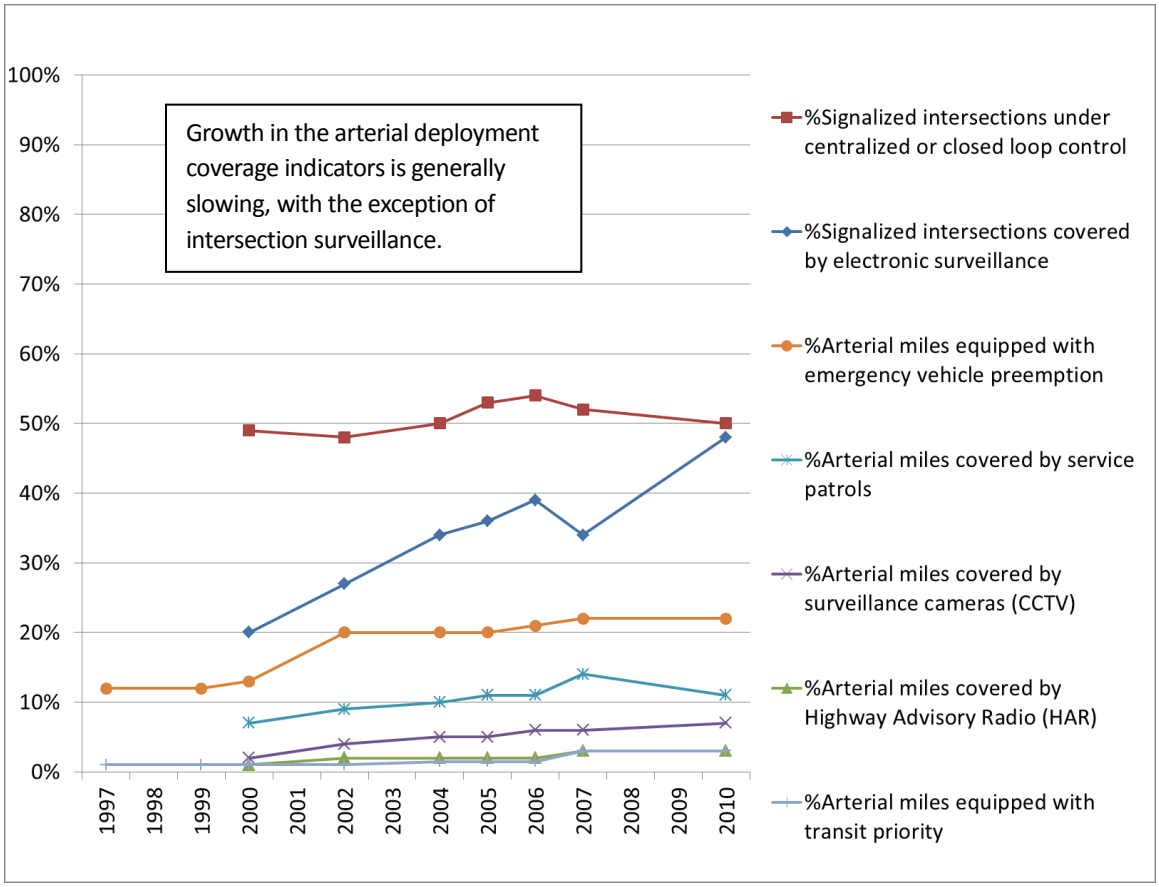

Figure 2-8. Arterial Management Deployment Indicators.

While it is difficult to say why deployment has remained relatively flat during this period, one possible reason may relate to funding limitations. Earlier it was noted that the availability of funding was rated as an important factor influencing the decision to deploy ITS technologies. It is likely, therefore, that funding limitations among local agencies has restricted the ability of arterial management agencies to

expand ITS deployment. In addition, funding requirements for maintenance may be discouraging ITS deployment as agencies that can afford to deploy ITS may not have resources to maintain ITS investments and are therefore reluctant to expand capability.

Figure 2-9 compares the level of adoption by arterial management agencies for several field devices in 2000 with the level of adoption for the same devices in 2010. The figure includes trends for technologies to support several traffic management functions including surveillance, enforcement, traveler information, and parking management.

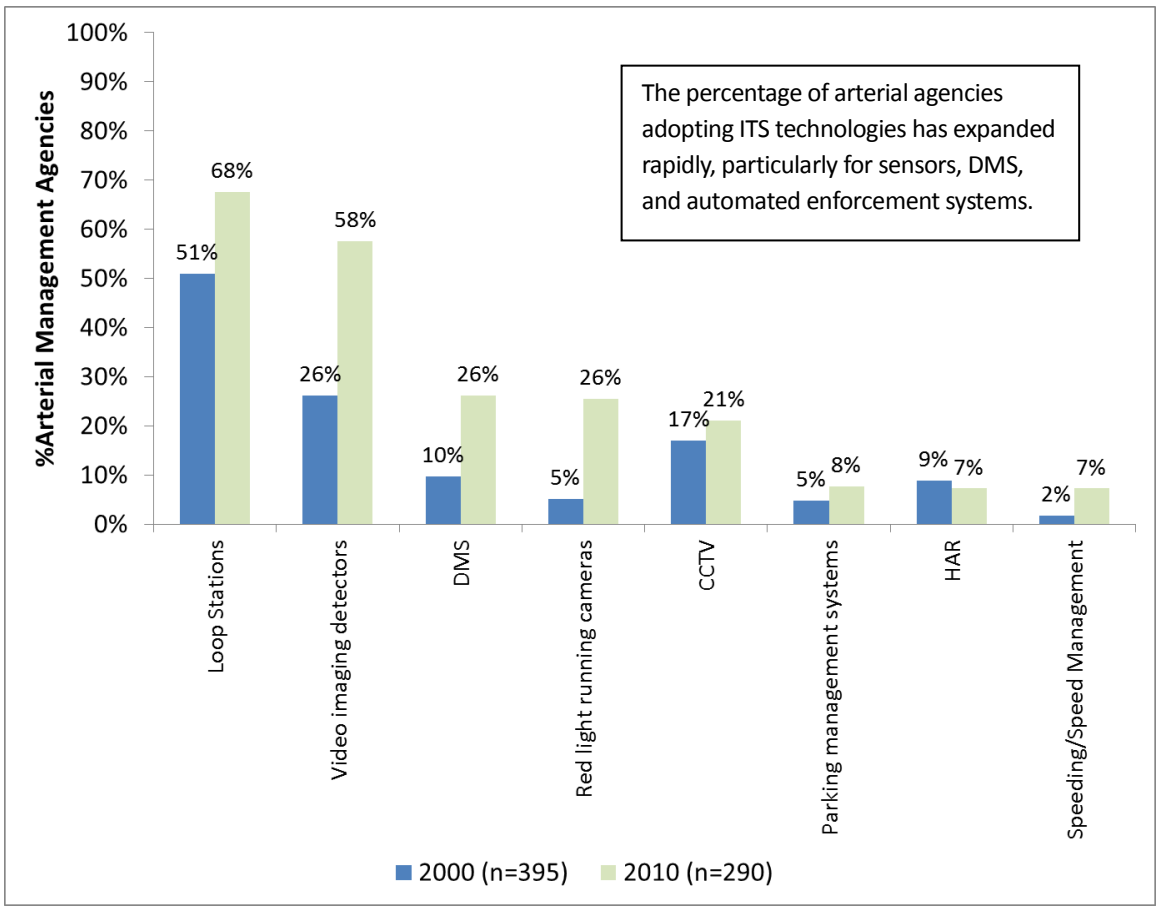

Figure 2-9. Technologies Adopted by Arterial Management Agencies, 2000 - 2010.

As summarized in Figure 2-9, the percentage of agencies adopting in-pavement loop stations to monitor travel conditions increased from 51% to 68% of arterial management agencies surveyed from 2000 to 2010. VIDS adoption has increased from 26% of agencies surveyed in 2000 to 58% of agencies surveyed in 2010. The trends for these sensors vary significantly from that observed for freeway management agencies, which reported no growth for loop stations and a slight reduction for VIDS over the same period. The adoption of DMS by arterial agencies increased much more rapidly than for freeway agencies, nearly tripling from 10% of responding agencies in 2000 to 26% of responding agencies in 2010. The adoption of CCTV increased from 17% of agencies surveyed in 2000 to 21% of agencies surveyed in 2010. Over this period, HAR adoption declined from 9% of agencies in 2000 to 7% of agencies in 2010. The adoption of parking management systems increased from 5% in 2000 to 8% in 2010. Automated enforcement technologies have been adopted

by an increasing number of agencies. In 2000, approximately 5% of agencies reported adopting red light running cameras while in 2010, over one quarter (26%) reported adopting red light running cameras. The adoption of speed management devices also increased during this period from 2% of agencies in 2000 to 7% of agencies in 2010.

Traffic responsive signal timing provides a capability to implement strategies to optimize traffic signal operations. However, the results of the 2010 survey indicate that traffic responsive signal timing has been implemented in only a limited number of signalized intersections. In the 2010 survey, questions were included to provide input from arterial management agencies concerning why traffic responsive signals are not more widely deployed. Figure 2-10 summarizes the reasons why agencies have not implemented these systems. The most common reasons cited were cost to deploy followed by uncertainty about benefits and cost to operate and maintain. While costs may be fixed, additional outreach or research to better establish the benefits of traffic adaptive signaling might change the cost/benefit analysis in favor of deployment.

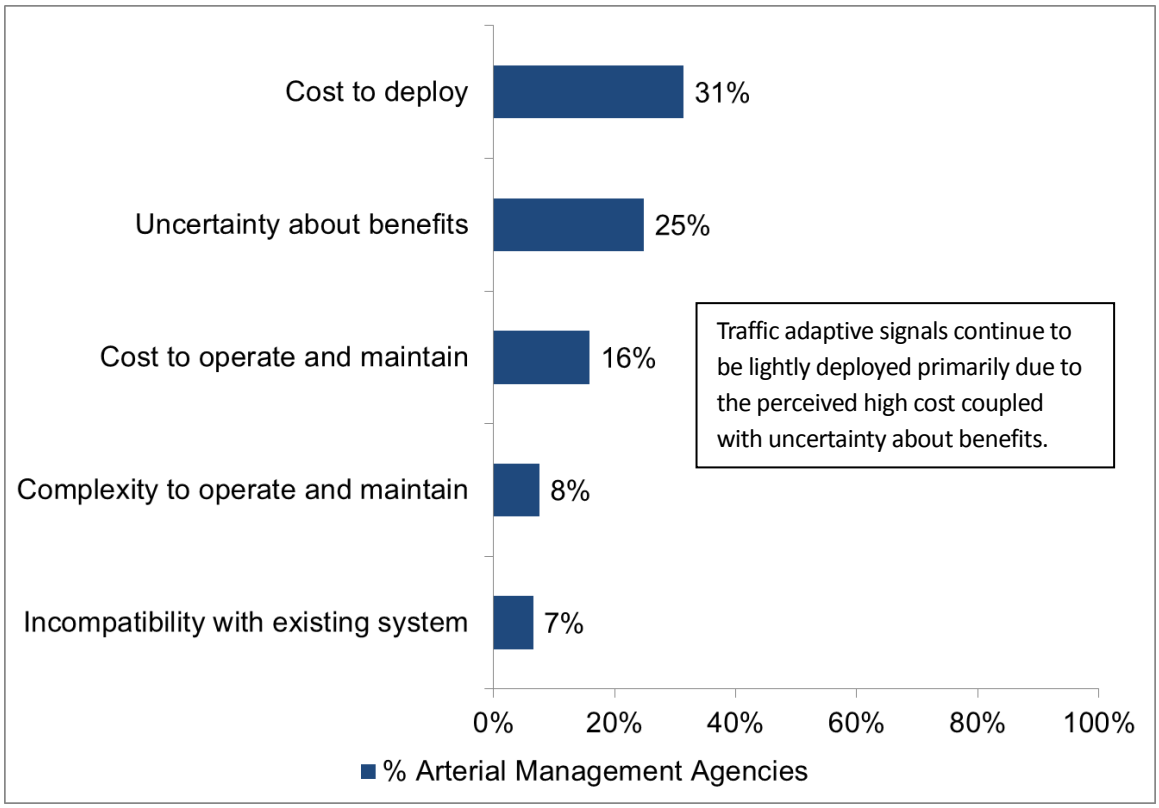

Figure 2-10. Reasons for not Using Traffic Responsive Signal Systems.

Traveler Information

Arterial Management agencies reported the use of a range of methods to distribute traveler information. As summarized in Figure 2-11, the most frequently used method, by a large margin, is webpage, reported by 40% of arterial agencies. This method is followed by DMS, 511 and email or alert to desktop computer. Interestingly, nearly 10% of responding agencies report the use of posting on Twitter or other social network sites. The overall pattern of the percentages of agencies adopting particular technologies is similar to that for freeway agencies, although at a lower rate of adoption.

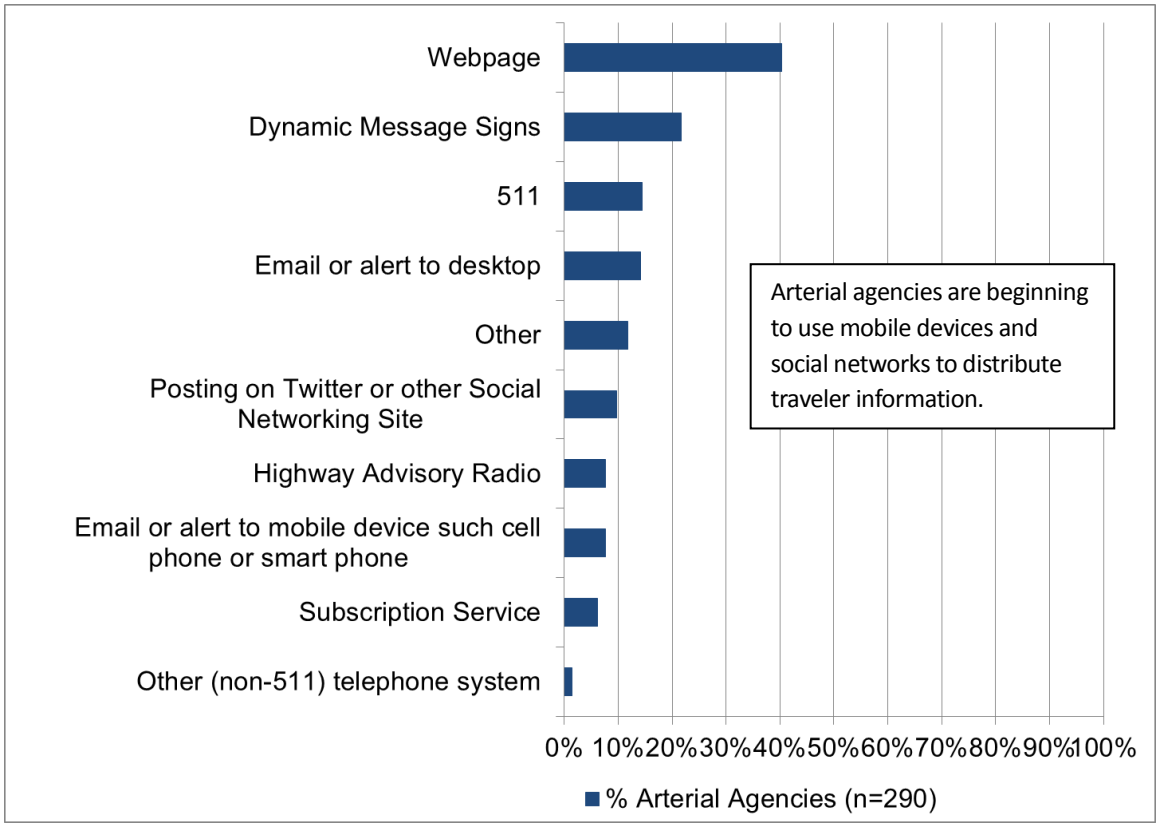

Figure 2-11. Methods Used to Distribute Traveler Information by Arterial Management Agencies.

As presented in Figure 2-12, arterial management agencies distribute a variety of information to travelers. Information related to traffic slowdowns is by far the most widely distributed, including construction location and duration as well as the number of lanes closed and incident location and duration. Agencies also reported distributing environmental information and a limited number of agencies report distributing travel time over a selected route or route segment.

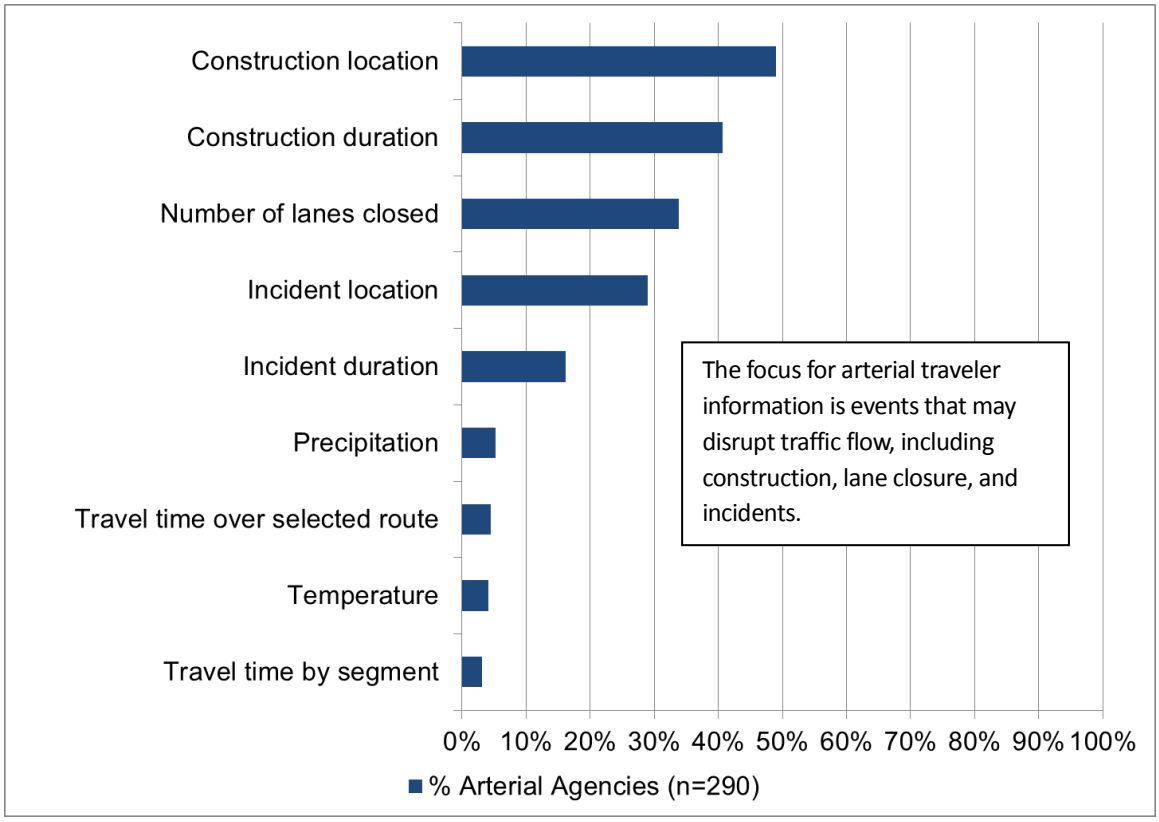

Figure 2-12. Information Distributed by Arterial Management Agencies.

Corridor Management

Arterial management agencies are heavily involved with integrated corridor operations and reported that they currently employ a number of corridor management strategies or plan to employ corridor management strategies in the future. As presented in Figure 2-13, cross jurisdictional traffic signal coordination, planned special events, and traffic incident management coordination were reported as the most frequently employed corridor management strategies. Arterial agencies are planning to expand participation in corridors significantly, with a particular focus on transit operations, traffic responsive signal timing, and real-time transfer of performance information. These results point to a growing ability of arterial agencies to monitor traffic conditions along a corridor in real time, particularly the focus on expanding traffic responsive signal timing and performance tracking, as well as an increasing emphasis on interagency integration.

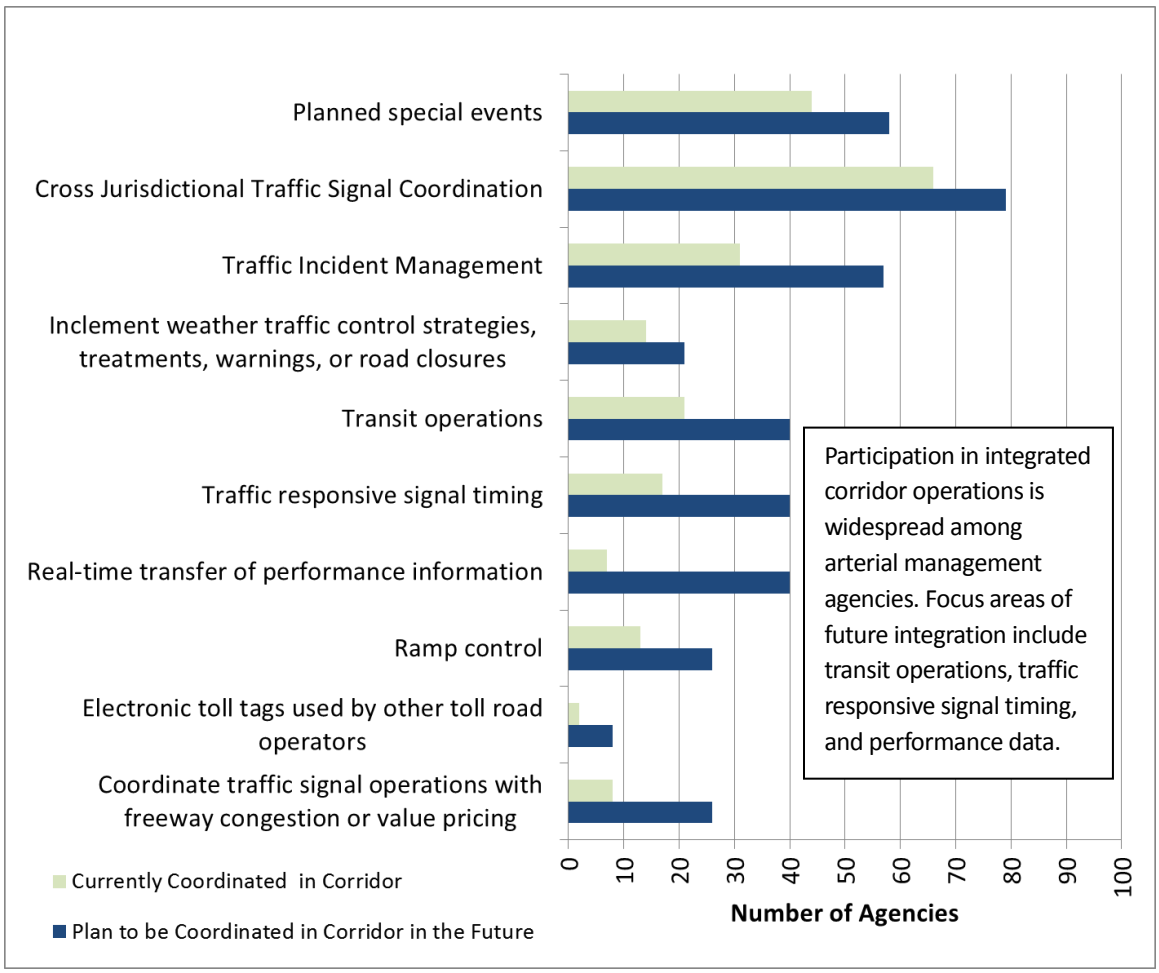

Figure 2-13. Current and Future Corridor Management Strategies Identified by Arterial Management Agencies.

Data Archiving

Arterial agencies collect and archive a wide range of real-time data. The variety of performance data being collected and archived indicates a major commitment to the use of sensors to monitor performance on arterials. As summarized in Figure 2-14, traffic volume data are the most commonly archived data followed by traffic speed and traffic signal phasing and timing. Other performance data collected includes lane occupancy, vehicle classification, turning movements, and travel time. The prominence of vehicle classification is likely a reflection of the extent of deployment of VIDS.

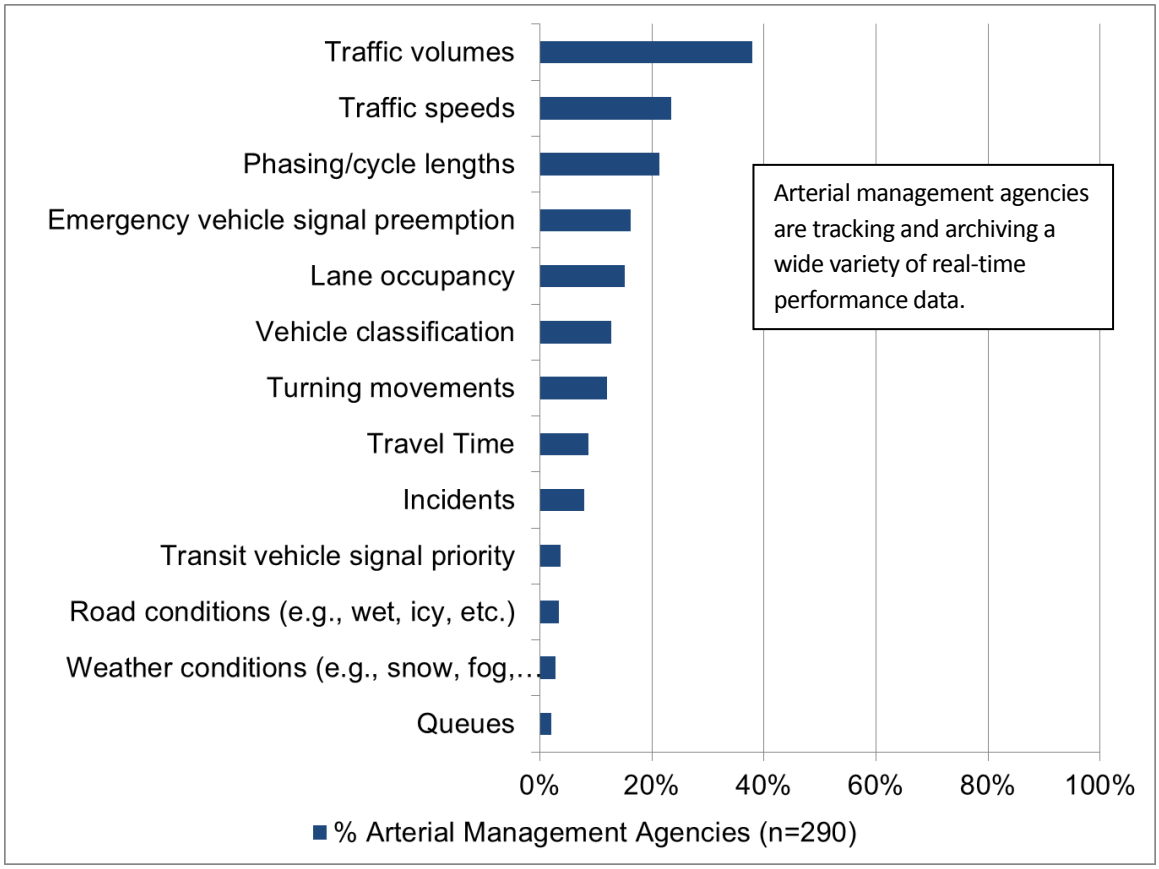

Figure 2-14. Information Archived by Arterial Management Agencies.

As outlined in Figure 2-15, the most frequently cited use of archived data is to support a variety of planning functions, including traffic, operations, and capital planning, as well as modeling, performance monitoring, and safety analysis. Another important use of archived data by arterial agencies is in support of traffic management, cited by more than a quarter of the surveyed agencies.

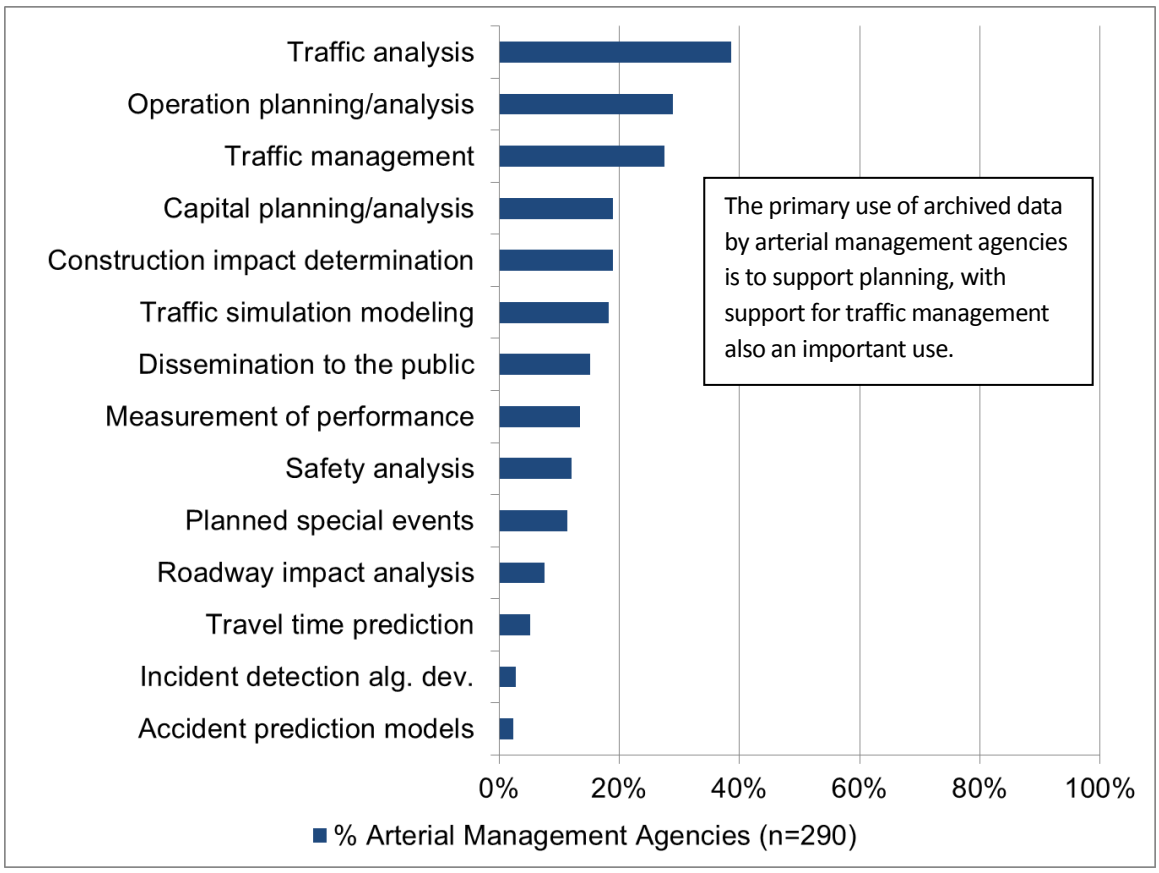

Figure 2-15. Use of Archived Data by Arterial Management Agencies.

Incident Management

Data on incident management deployments, gathered from the freeway management survey and the arterial management survey, are summarized in this section. Incident management is designed to quickly identify and respond to a variety of non-recurring events, including crashes that can impede the flow of traffic on the freeway and arterial street system. Agencies rely upon CCTV and incident detection algorithms to identify incident occurrence. In addition, agency use dedicated service patrols or highway helper services to both identify and respond to incidents. Very often, motorists who observe incidents provide reports directly to police, emergency response, and traffic management officials using cell phones calls.

The coverage of incident management services have grown greatly during the last decade. As summarized in Figure 2-16, freeway service patrols now cover nearly 50% of the freeway miles in these areas, up from a total of 30% in 1997. In addition, CCTV coverage grew from approximately 15% of the freeway centerline miles in 2000 to nearly 50% in 2010. The deployment of incident detection algorithms on freeways has been more limited, increasing only slightly from 2000 to 2010. In general, there has been only a slight increase in incident management indicators for arterials since 2000. In 2010, approximately 8% of arterial miles were covered by surveillance cameras, up from approximately 2% in 2000. In addition, there has been an increase in the percent of arterial miles covered by service patrols from 8% in 2000 to 12% in 2010.

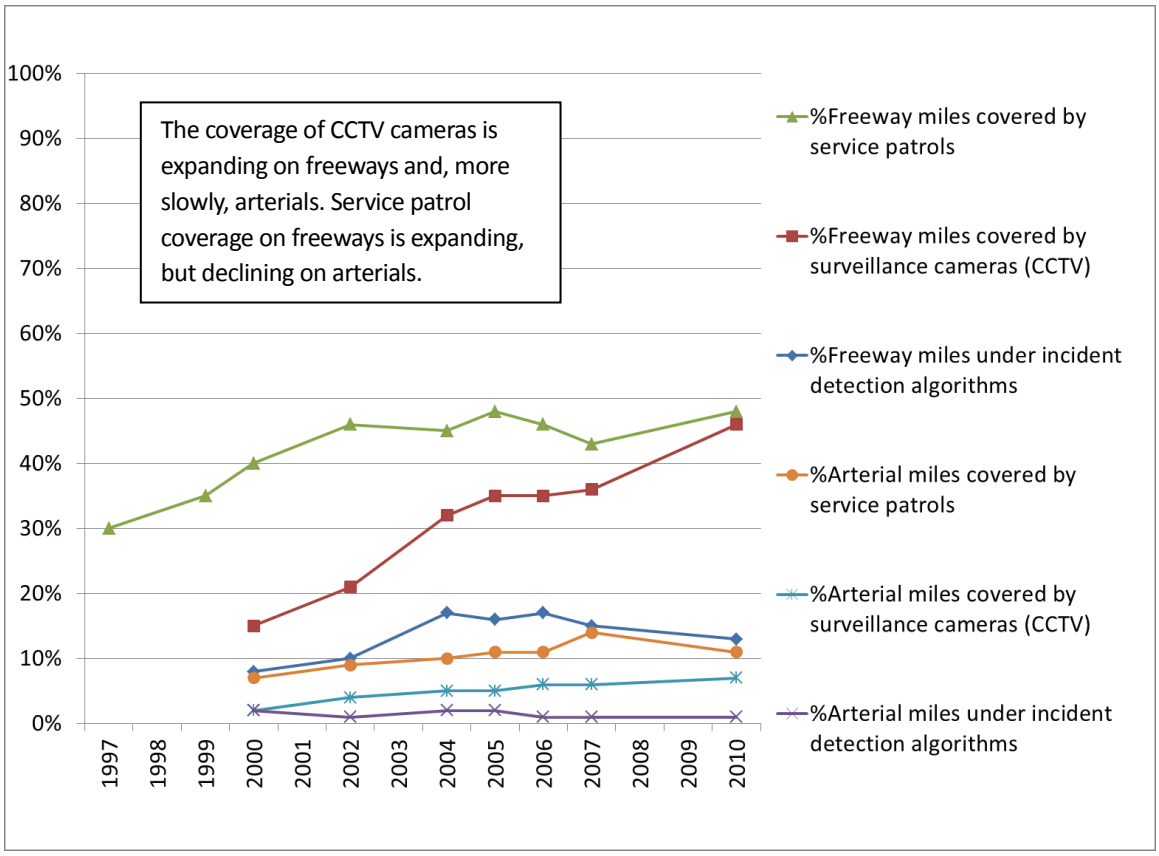

Figure 2-16. Incident Management Deployment Indicators.

The limited deployment on arterials, in contrast to freeways, may be related to the fact that freeways are limited access facilities, and often carry a high volume of traffic, where incidents can result in high levels of delay because travelers have limited alternative routes available. On the other hand, travelers on arterials often have more alternative routes available to divert away from incident locations which may result in a lower aggregate level of delay. Therefore, because the impact of incidents on arterials is smaller than the impact on freeways, agencies may have decided to limit investment in arterial incident management and apply traffic management funding for other purposes.

Transit Management

Transit management consists of a broad range of strategies and technologies designed to improve the operations of transit vehicles and services. Among the technologies are included: AVL, electronic fare payment, traffic signal priority, and traveler information. Operating buses and paratransit vehicles are a primary focus of many transit management agencies, however agencies also operate light rail, heavy rail, commuter rail and ferry services.

Deployment and Adoption of Key Technologies

Transit management deployment trends are summarized in Figure 2-17. Since 2000, there has been significant increase in the deployment of several transit management technologies. The percentage of fixed route buses equipped with AVL increased rapidly from approximately 31% in 2000 to 66% in 2010. In addition, the percentage of demand responsive vehicles equipped with CAD increased from 28% in 2000 to 88% in 2010. Finally, during the period 2000 to 2010, the proportion of fixed route buses equipped with electronic real-time monitoring system components increased from 15% to 35%. In addition, and perhaps and indicator of a new increasing trend, the percentage of bus stops with displays of dynamic traveler information increased from less than 1% in 2007 to 3% in 2010.

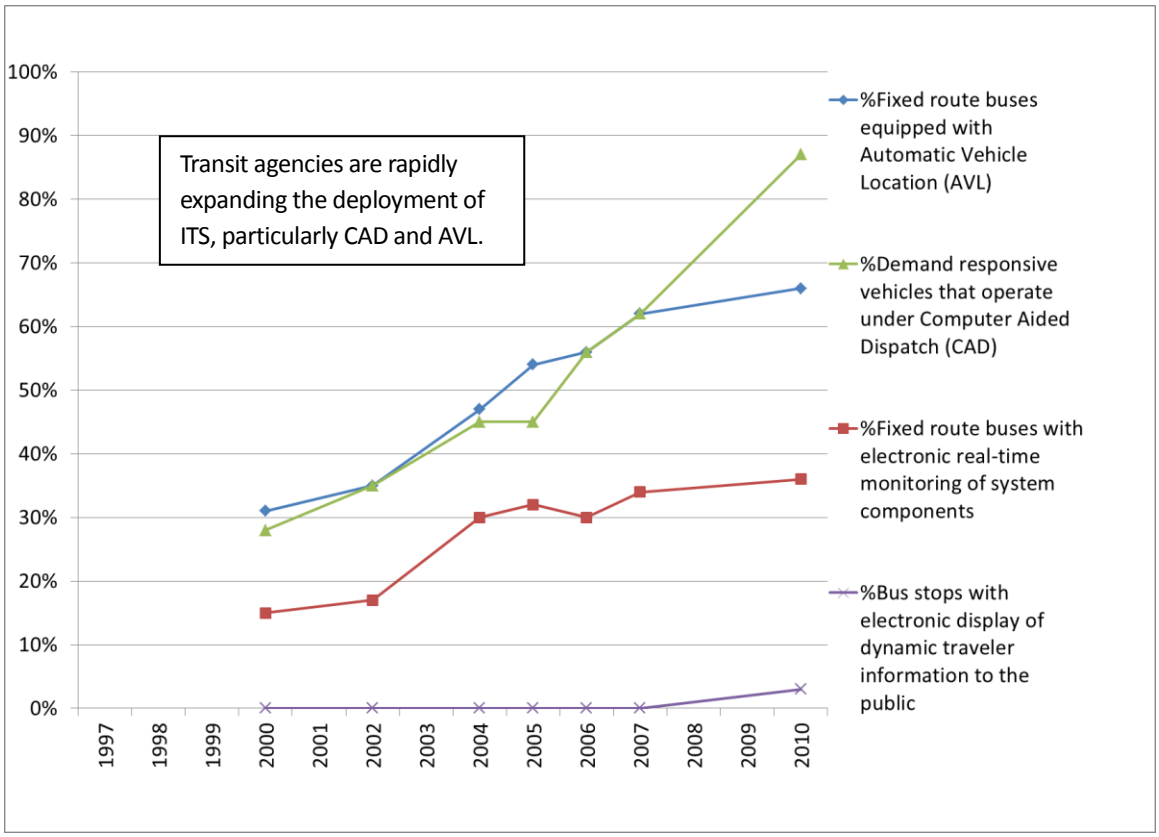

Figure 2-17. Transit Management Deployment Indicators.

Figure 2-18 compares the level of adoption for several field devices in 2000 with the level of adoption for the same devices in 2010. As summarized in Figure 2-18, transit management agencies have greatly increased the rate of adoption of AVL and electronic fare payment technologies. The proportion of agencies adopting AVL on fixed route bus increased from 21% to 54% and the number deploying magnetic strip readers increased from 5% to 40%. The adoption of smart card readers also increased during this period from 3% to 24% of agencies responding. Interestingly, the proportion of agencies adopting traffic signal priority decreased from 28% to 25%.

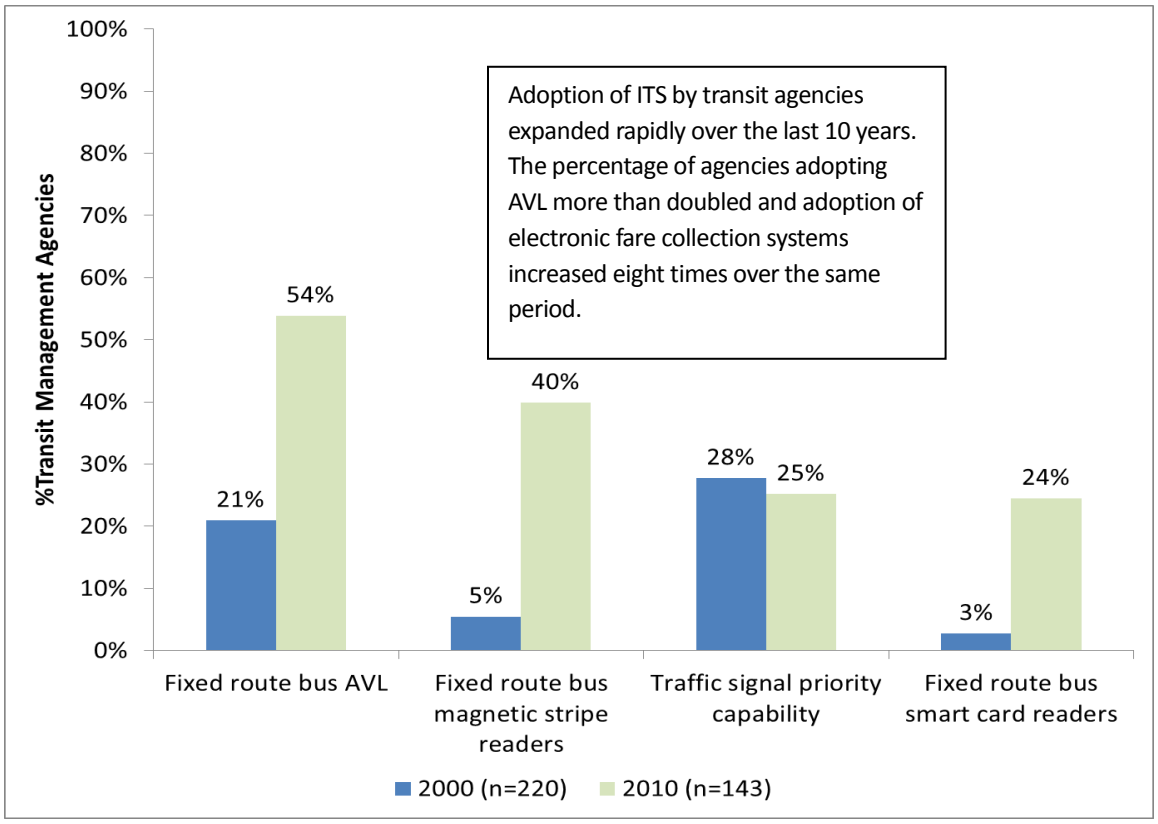

Figure 2-18. Technologies Adopted by Transit Management Agencies, 2000 - 2010.

Traveler Information

Transit management agencies reported the use of a range of methods to distribute traveler information, including both real time information and static information. In every case, real-time data is the focus. As summarized in Figure 2-19, the most frequently used method is webpage followed by other (non-511) telephone systems, email or alert to desktop computer and 511. Interestingly, approximately 20% of responding agencies report the use of email or alerts to mobile devices such as cell phone or smart phone.

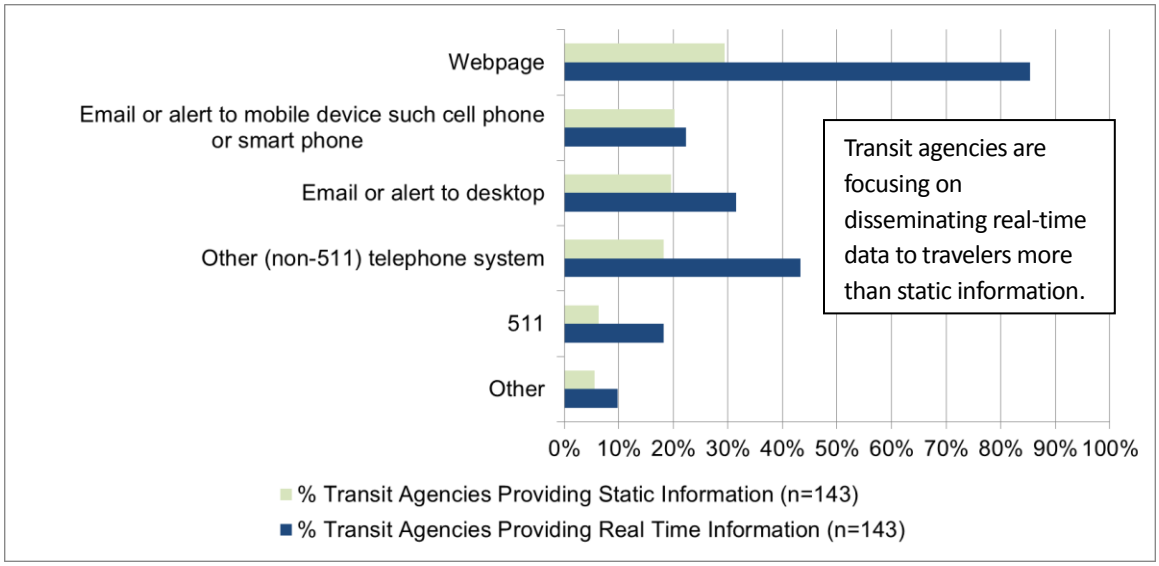

Figure 2-19. Methods Used to Distribute Traveler Information by Transit Management Agencies.

Corridor Management

Transit Management agencies reported that they currently employ a number of corridor management strategies or plan to employ a number of corridor management strategies in the future. As presented in Figure 2-20, transit operations, traffic incident management and planned special events are among the leading current strategies. In addition, substantial growth is planned for corridor management strategies in general.

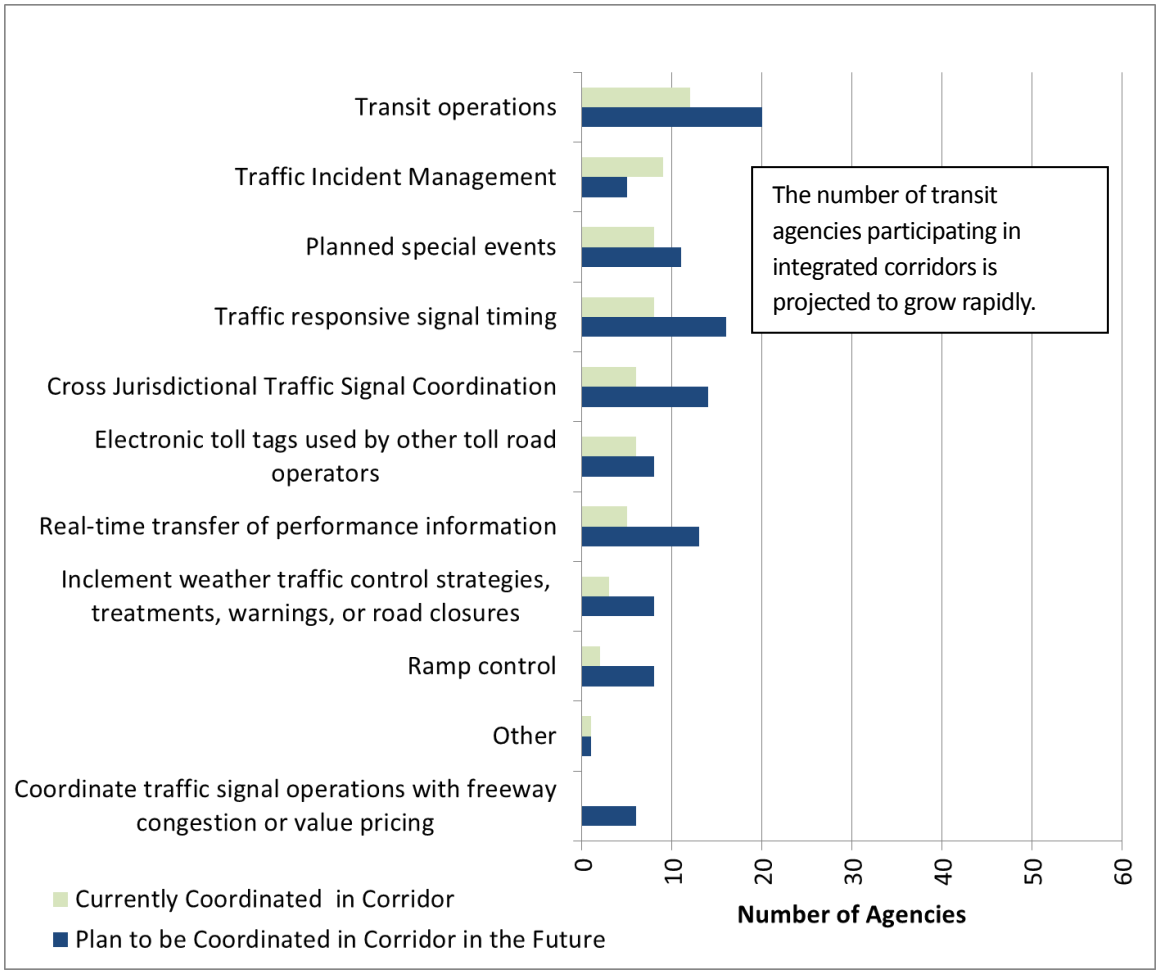

Figure 2-20. Current and Future Corridor Management Strategies Identified by Transit Management Agencies.

Archived Data

As summarized in Figure 2-21, vehicle time and location as well as passenger count are the most commonly archived data followed by passenger information. As outlined in Figure 2-22, the most frequently cited use of archived data includes operation planning and performance management.

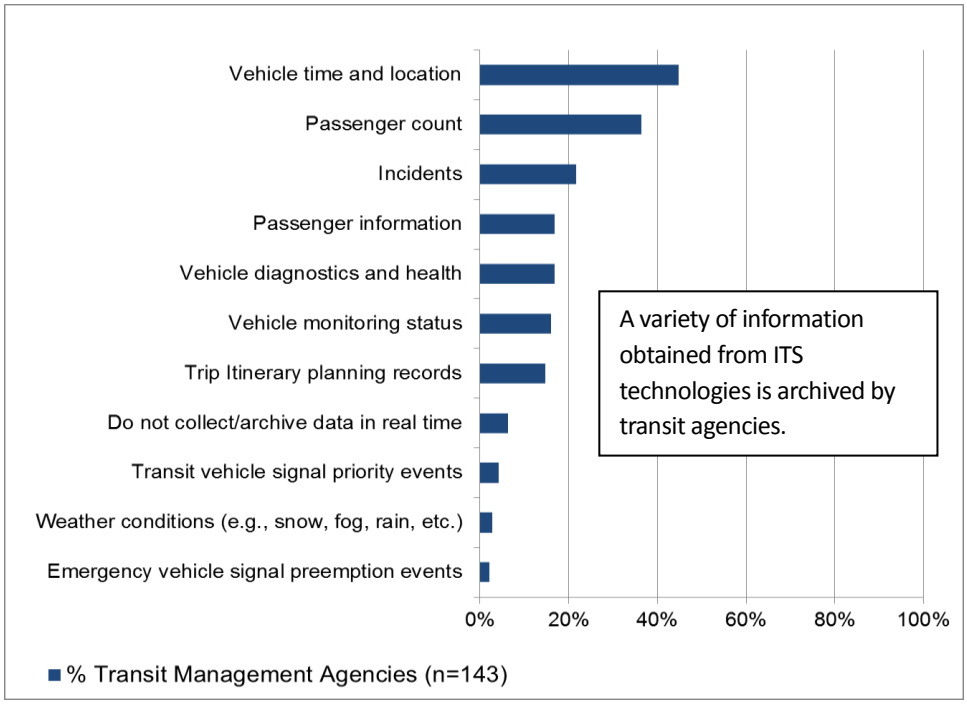

Figure 2-21. Information Archived in Real-Time by Transit Management Agencies.

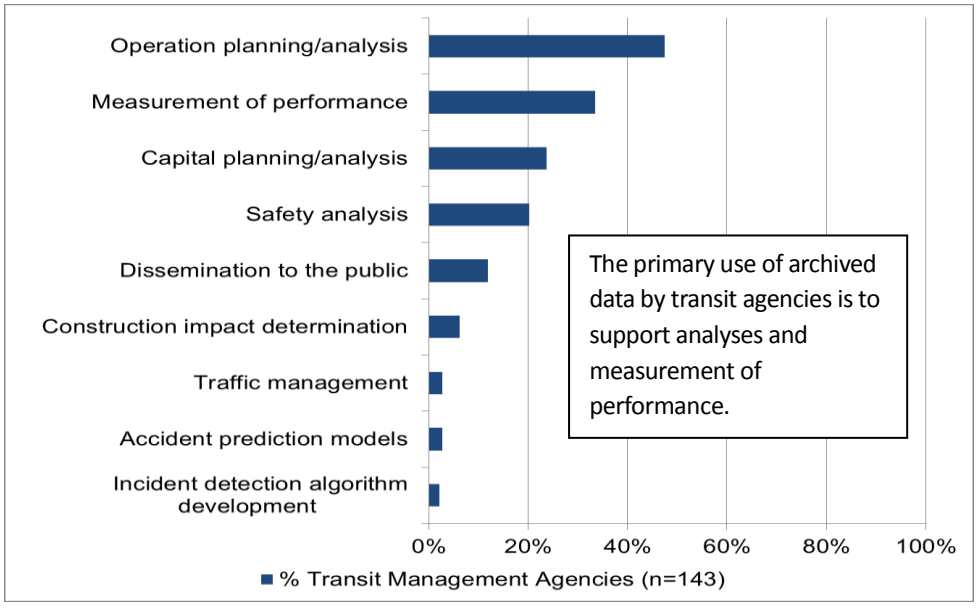

Figure 2-22. Use of Archived Data by Transit Management Agencies.

Transportation Management Centers (TMCs)

The TMCs provide the focal point for freeway and arterial traffic management. In addition, many TMCs also support public safety and transit management functions. Figure 2-23 summarizes the distribution of functions performed by TMCs. The majority of TMCs offer Arterial Management only (30%) and Freeway Management and Arterial Management (24%).

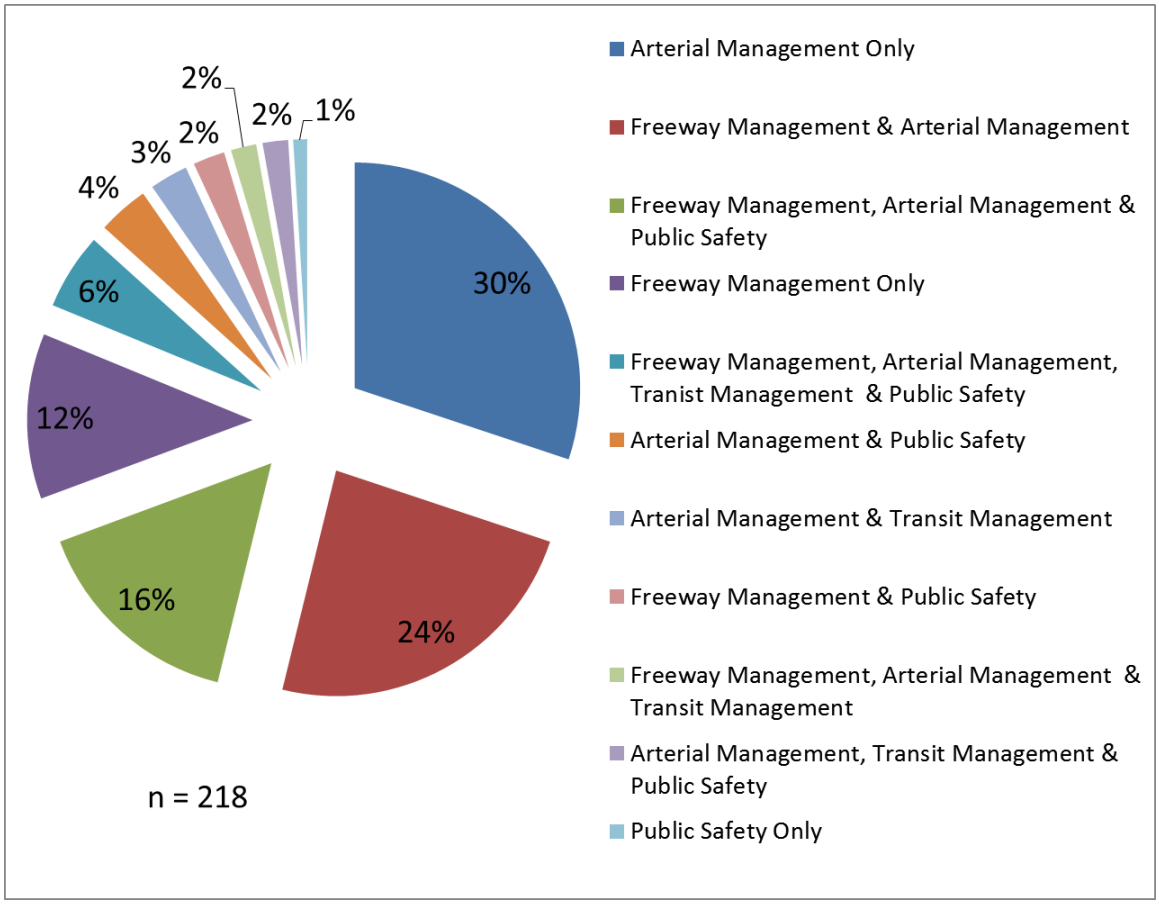

Figure 2-23. Functions Supported by Transportation Management Centers.

Figure 2-24 summarizes the functions performed on freeways by TMCs. Incident management, traveler information, special event traffic management, and roadway surveillance are functions carried out by more than half of the TMCs responding to the survey. Incident response dispatch and management of work zones are also important functions of freeway TMCs. Emergency response functions in the form of evacuation management and emergency services traffic control are next in frequency and were reported by more than a third of the TMCs. In all, the surveyed TMCs perform one or more of 16 different functions on freeways.

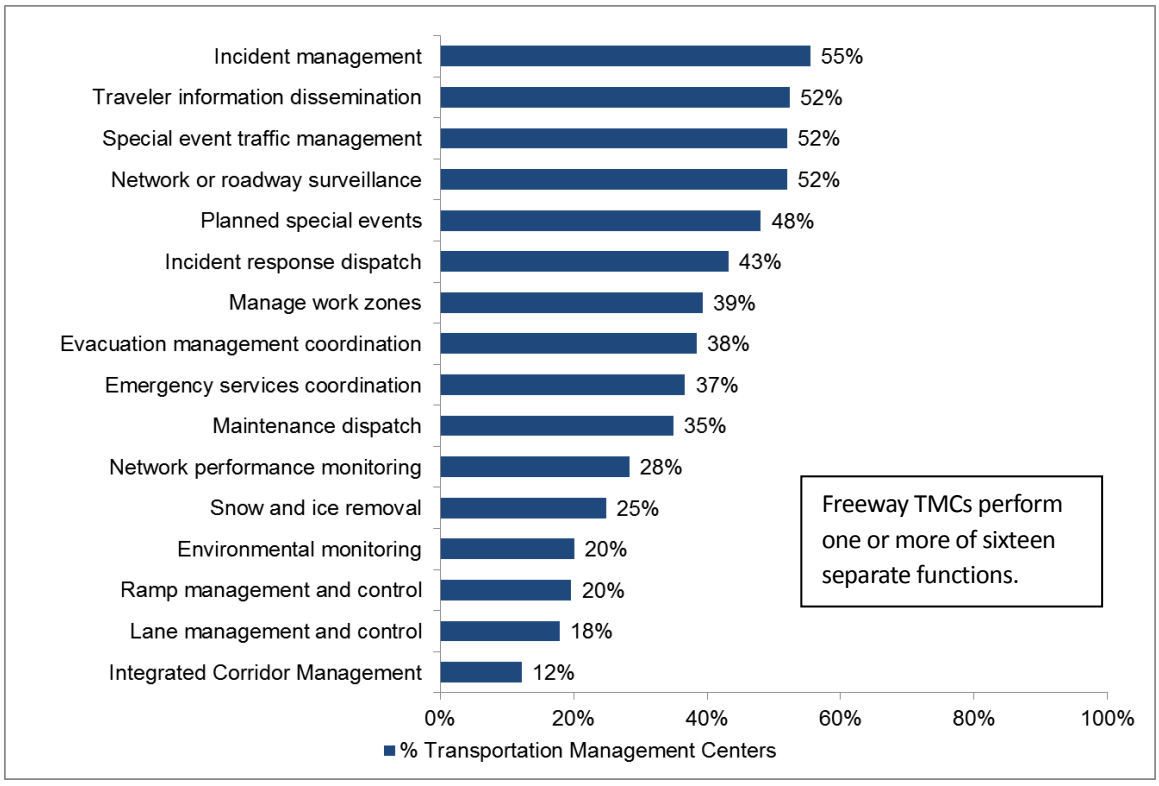

Figure 2-24. Functions Performed by Transportation Management Centers on Freeways.

Figure 2-25 summarizes the functions performed on arterials by TMCs. Traffic signal coordination or control, special event traffic management, and roadway surveillance were reported by more than 60% of the arterial TMCs. Traveler information dissemination and incident management are reported by half of the TMCs. In general, the pattern of functions is similar to that for freeway TMCs shown in Figure 2-24 above.

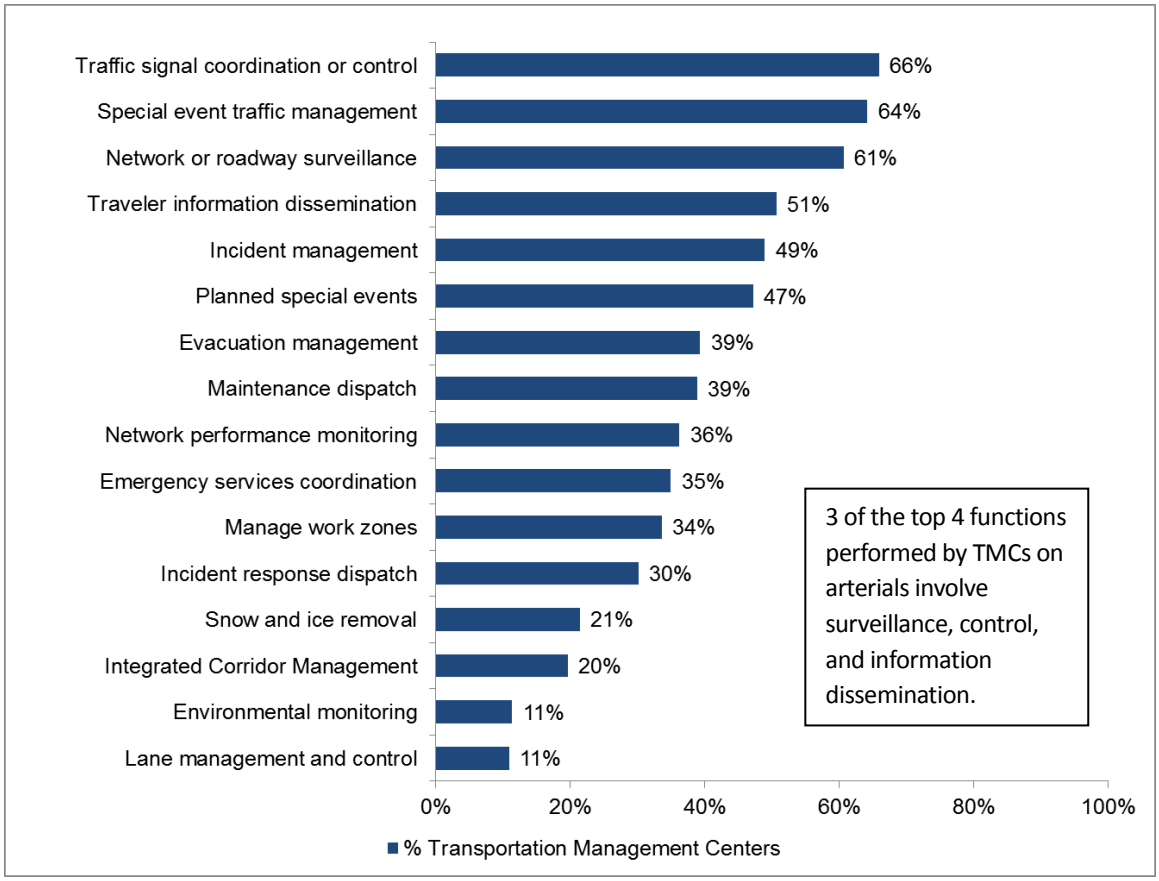

Figure 2-25. Functions Performed by Transportation Management Centers on Arterials.

Electronic Toll Collection (ETC)

ETC provides toll road operators with the capability to automatically collect toll revenue through the application of in-vehicle, roadside, and communication technologies to process toll payment transactions. The results of the 2010 survey confirm that toll road operators have widely adopted ETC technologies. As summarized in Figure 2-26, approximately 98% of toll collection lanes offer ETC and a significant amount of toll collection plazas offer ETC capabilities (83%).

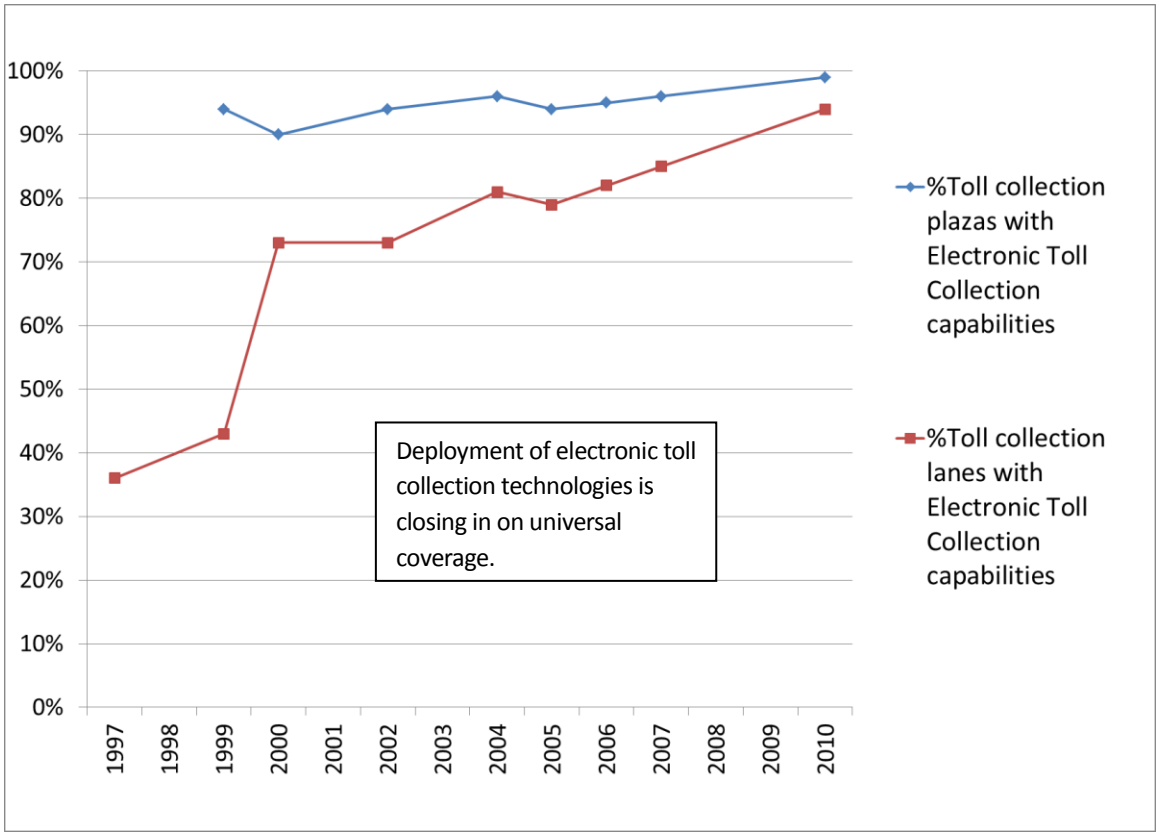

Figure 2-26. Electronic Toll Collection Deployment Indicators.

Figure 2-27 summarizes the percentage of agencies employing ETC capabilities and integrated toll tags. Integrated toll tags permit users to pay toll expenses across a number of toll road operators. Sharing toll collection technologies among agencies offers travelers a significant level of added convenience. Motorists are provided the ability to use one single toll tag to pay tolls on facilities operated by several toll agencies.

The percentage of agencies offering integrated toll remained relatively constant from 2000 (66%) to 2010 (68%). Figure 2-27 also shows that nearly all toll road operators surveyed offer ETC capabilities (98%).

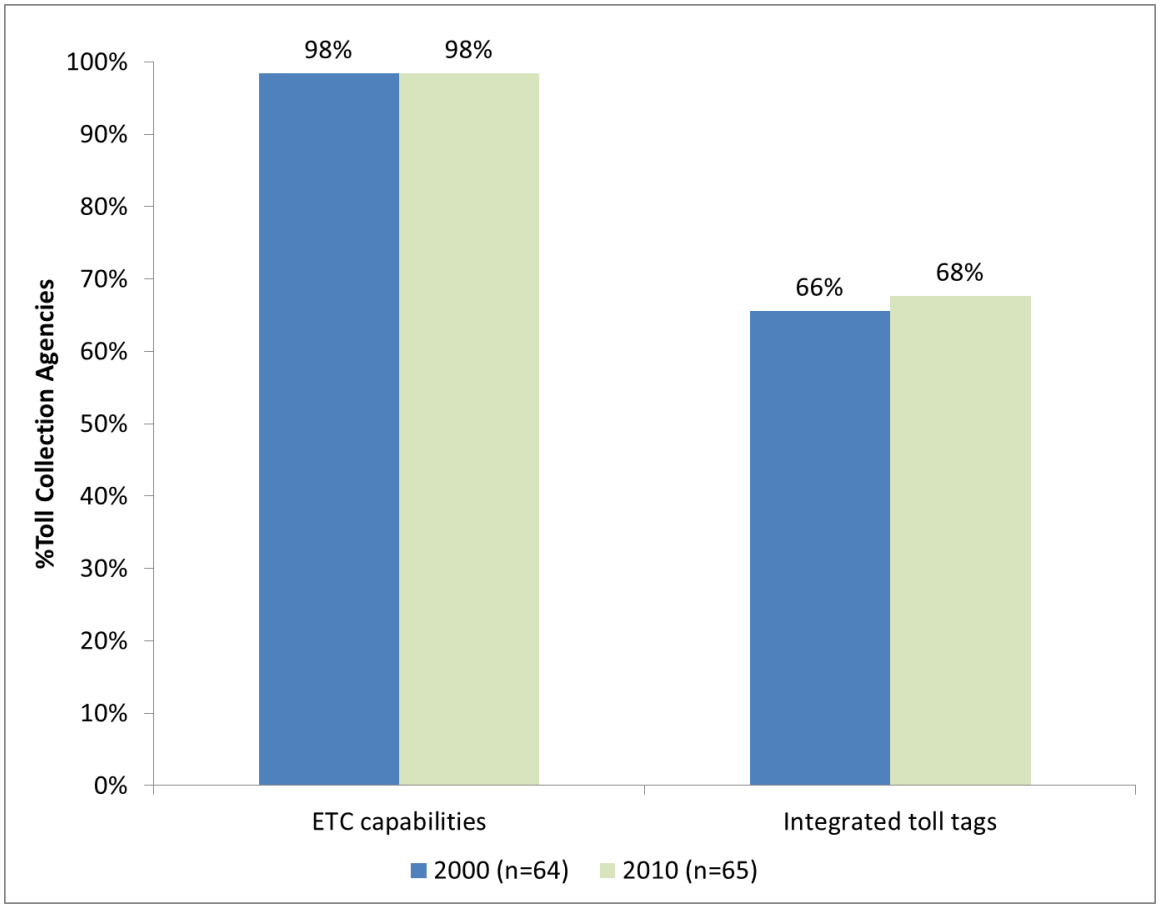

Figure 2-27. Technologies Adopted by Toll Collection Agencies, 2000 - 2010.

Emergency Management

Emergency response agencies including police and fire-rescue departments have adopted on-board navigation capabilities as well as CAD to support vehicle dispatching and incident response. Emergency vehicle fleet management uses AVL equipment to provide CAD of vehicles. The use of real-time information on vehicle location and status is used to make optimal assignment of vehicles to incidents. The installation of route guidance equipment in emergency service vehicles provides improved directional information for drivers and improves responsiveness of emergency vehicles.

As summarized in Figure 2-28, nearly 80% of vehicles were under CAD in 2010 in the Nation's 78 Largest Metropolitan Areas, up from 68% in 2000. In addition, the percentage of vehicles equipped with on-board navigation capabilities increased from 3% in 2000 to 43% in 2010. ITS technologies are clearly being widely embraced by emergency management agencies.

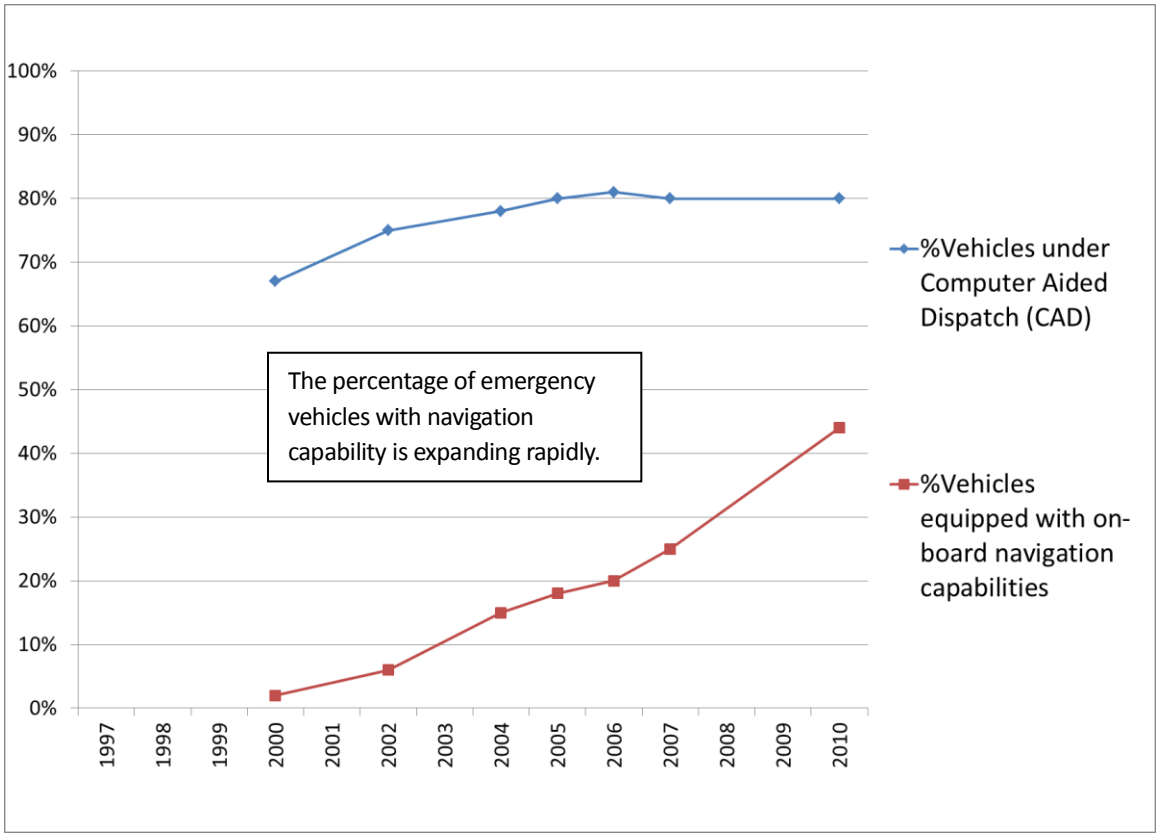

Figure 2-28. Emergency Management Deployment Indicators.

Figure 2-29 compares the proportion of fire rescue and law enforcement agencies deploying select technologies in 2010. Signal preemption is more widely deployed among fire rescue agencies (66%) than law enforcement agencies (19%). AVL is deployed at a higher rate among law enforcement agencies (51%) than fire rescue agencies (42%), as is CAD where law enforcement deployment (91%) is slightly higher than fire rescue (86%). On-board navigation deployed among fire rescue agencies (61%) is slightly higher than law enforcement agencies (55%).

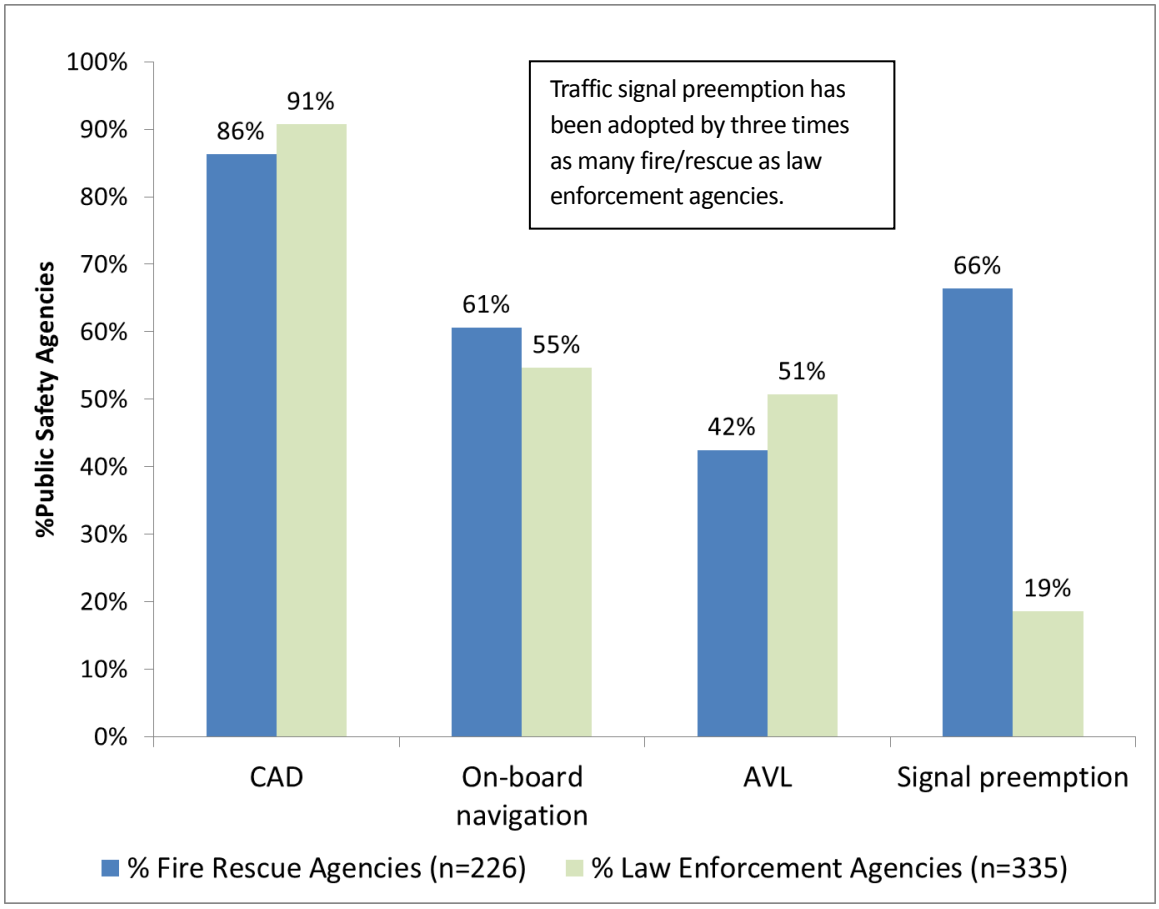

Figure 2-29. Technologies Adopted by Public Safety Agencies.

List of Acronyms

AVL	Automated Vehicle Location
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
DMS	Dynamic Message Signs
ESS	Environmental Sensor Stations
ETC	Electronic Toll Collection
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle
ITS	Intelligent Transportation Systems
RITA	Research and Innovative Technology Administration
TCIP	Transit Communications Interface Profile
TMC	Transportation Management Center
VIDS	Video Imaging Detector Systems

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