U.S. Department
of Transportation

Research and
Special Programs
Administration

Advanced Traveler Information Service (ATIS): Private Sector Perceptions and Public Sector Activities

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January 2000

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Executive Summary

This paper presents the results of a study by the United States Department of Transportation Volpe Center to determine the nature and extent of the "data gap" between the needs of private sector Advanced Traveler Information Service (ATIS) providers, and the public sector data they receive. The study was motivated by the perception that such a data gap exists, and the need for a systematic description of this data gap before plans can be made to resolve it.

Defining the data gap problem involves looking at both sides of the issue: the demand for particular types of ATIS data and the availability of the data desired. This paper analyzes private sector data needs, and perceptions of availability and quality. For each issue raised, it examines the extent and characteristics of the problem on a national level, using information on the public sector.

To do this, the paper combines results from two different surveys. One of these is a survey of private sector Information Service Providers (ISPs) to understand their data needs and elicit their perspective of the data gap. The survey was conducted by the Volpe Center for the Federal Highway Administration (FHWA), specifically for the purpose of this paper.

The public sector data comes from a series of surveys of state and local public sector agencies that manage the highway and arterial system, respond to traffic incidents, and provide transit service. These surveys were conducted by the Oak Ridge National Laboratory for the FHWA to create a database of metropolitan ITS deployment in 1999. Data collection and transfer activities of the public agencies relevant to the ATIS data gap were taken from the database for this study.

The private sector survey reveals that some kinds of data, notably incidents, construction zones, traffic speeds, and road and weather conditions, are of high priority to most respondents. There are some similarities, but some divergences as well, between the priorities of the private sector, and the priorities for dissemination identified by the public sector. These differences may contribute to the data gap.

The following statements summarize the most important observations about the current nature and extent of the data gap:

- Public agencies in major metropolitan areas collect more traffic data than agencies in smaller areas.
- Geographic coverage of available data is often inadequate, and more likely to be inadequate the larger the metropolitan area.
- Inaccurate data is the second most common quality problem, after inadequate geographic coverage.
- Agencies in a single metro area provide data inconsistent with other agencies in the area.
- Timeliness and update frequency problems occur for incident data.
- Problems with inadequate spatial resolution are most important for traffic speeds.
- Some ISPs require greater temporal coverage than is available in most places.
- Public agencies are not necessarily willing to transfer data they collect.

The prospects for the future appear mixed. Freeway management agencies are likely to add miles of coverage to their current data collection. For ATIS products to extend to arterials, arterial data will need more substantial improvement than that necessary for freeways. One opportunity for gathering more complete traffic information is the increased use of electronic toll collection leading to potential toll tag use as probes. Analogous improvements in transit data availability will result from increased use of AVL. All of the above will improve the coverage, quality, and timeliness of public sector data collection, but the institutional issues with regard to data sharing and priorities remain to be addressed.

1.0 Introduction

Advanced Traveler Information Services (ATIS) provide real-time information to end-users of the surface transportation system. The information facilitates decisions about trip timing, mode choice, route choice, and other critical decisions, which cannot be made effectively without up-to-date, accurate information about traffic, road, and weather conditions that affect these choices. The end-users are private and commercial drivers on highways, and transit users. ATIS transmits information to users by media such as websites, cellular phones, and in-vehicle navigation systems.

Private sector companies increasingly provide ATIS in a number of metropolitan areas, representing a growing niche for high-tech service business. These companies are referred to as Information Service Providers (ISPs). ISPs generally obtain basic traffic, incident, and transit data from public agencies in their area of service, such as State DOTs, police departments, city traffic departments, and transit agencies. They may or may not supplement these public data sources with their own data collection operations. After obtaining the required data, they process and format it into information usable by consumers for decision-making, and transmit this information to the consumers.

In order to transmit ATIS information, however, it is necessary for the underlying data to exist and be available to the ISPs. A concern has emerged that the public sector data and information ISPs receive are often inadequate for their business. Not all necessary data are available and the quality of the data may be insufficient. The data may not exist, or they may exist only for some public jurisdictions within the market. Even if the data exist, they may not be made available to the private sector. Data that exist and are available may not be timely enough for ATIS purposes, or may be inaccurate. Collectively, these issues are called the ATIS "data gap" problem.

At the 1999 ITS America Annual Meeting, the ATIS Committee formed a task force to address this data gap, and the great variety across metropolitan areas in the quality, scope, and availability of key traffic and transit data. As with the development of ATIS data standards, the data gap is a problem that requires more systematic description of its characteristics and extent before plans can be made for its resolution. The task force was charged with producing a workshop that would address the nature and extent of this data gap, and discuss steps for a solution. This background paper for the workshop attempts to provide a systematic definition and framework for understanding the data gap issue, while serving as a starting point for extensive discussion of the subject at the workshop.

Defining the data gap problem involves considering both sides of the issue: the demand for particular types of ATIS data and the availability of the data desired. This paper analyzes private sector data needs, and uses the conclusions to focus a discussion of public sector data collection and availability, concluding with a comparison to better define the data gap.

To do this, the paper combines results from two different surveys. The survey of private sector ISPs itemizes and explores their data needs and elicits their perspective of the data gap. This survey was conducted by the Volpe Center for the Federal Highway Administration (FHWA), specifically for the purpose of this paper.

The public sector data comes from a series of surveys of state and local public sector agencies that manage the highway and arterial system, respond to traffic incidents, and provide transit service. These surveys were conducted by Oak Ridge National Laboratory for the FHWA to create a database of metropolitan ITS deployment in 1999. Data collection and transfer activities of the public agencies relevant to the ATIS data gap were taken from the database for this study.

Because of differences in the surveys and databases for the private sector and the public sector parts of this study, the results complement each other, but direct comparisons are not possible because of limited responses from each survey. The public sector database consists of individual agency responses, with multiple respondents for each metropolitan area. Enough agencies responded to describe national patterns in many ATIS-relevant activities of state and local government agencies.

Private companies survey responses sometimes generalized across all locations and sometimes answered for individual metropolitan areas. There were few respondents, almost entirely concerned with very large metropolitan areas. Respondents typically refer to their local or regional market as the metropolitan area they serve.

While data collection, archiving, transfer, and dissemination activities were covered on the public sector surveys, quality issues were not specifically addressed. The questions on the private sector survey can help point to quality issues. Because of the parallel construction of the surveys, it is possible in many cases to explore how widespread an issue raised by a private respondent may be.

2.0 Description of surveys and respondents

2.1 Public sector

The primary source for information on data collection and dissemination by public agencies is preliminary data from the 1999 metropolitan ITS deployment tracking database. Freeway and arterial data were taken from an earlier version of the database than transit.[1] This database contains the responses to a series of surveys that were sent to agencies in the 78 largest metropolitan areas in the United States. The metropolitan area boundaries are defined by their MPO planning boundaries. Agencies were asked about their technology use, operations, and responsibilities for transportation systems in the metro area. All freeway and toll road authorities in these areas received the freeway management survey. All transit agencies that are included in the National Transit Database in these areas received the Transit Management Survey. Local traffic management agencies in jurisdictions of at least 50,000 within the metropolitan areas received the arterial management survey. Numbers of respondents, response rate, and the number of metro areas represented are presented in Table 1. While most major metro areas are represented, some of the areas with no respondents for a particular system are areas with an ISP currently providing service.

Table 1. Response to the public sector survey

Survey	# of respondents	Response rate	# of metro areas represented
Arterial	336	69%	72
Freeway	93	76%	63
Transit	162	79%	62

The data from the deployment tracking database available for this analysis was not cleaned, verified or checked for quality or completeness before being transmitted for analysis. These activities, along with entering additional responses, continued in parallel with this analysis, but were not reflected in the versions of the database used. Consequently, the data are incomplete and at times contradictory. Not all

[1] Freeway and arterial data are drawn from the November 23, 1999 version, and transit data are taken from a December 16, 1999 version. Verification phone calls were made to a number of transit agencies during this time, increasing response rate and accuracy for this survey.

agencies in a metropolitan area responded, and the respondents didn't necessarily answer all questions, leading to lower response rates for many questions. Logical checks have been used to clean the data and exclude responses that are inconsistent. Most forward looking questions, such as for activities planned by 2005, are too inconsistent to be used.

Traffic and transit web sites were reviewed for the information that they present and the manner in which they present it. The results of the review of individual sites are compared to agencies' reported data collection in order to determine the extent to which gathered information is being made available to the public. A more complete review of web site features is presented in the accompanying report, "Features of Traffic and Transit Internet Sites".

There are some limitations for the analysis resulting from the data availability described earlier:

- For many issues, it is impossible to make general statements about individual metro areas unless a single agency's actions can affect data availability for the entire area.

- The incomplete information restricts examination of variation within a metro area.

The major strength of the public sector data is in allowing a national perspective on issues raised by the private sector. Because the public sector data represent many agencies in many cities, it is possible to evaluate how widespread a particular problem identified by a private sector respondent may be.

2.2 Private sector

The survey of private ISPs covers basic information about the company and its experiences obtaining data from the public sector. See Appendix A for the complete survey form. The respondents answered questions about their area of operations, nature of business, types of customers, information dissemination media, and data availability and quality. The questions about data availability and quality used many of the same categories of information as in the public sector survey to facilitate comparison.

After a review by FHWA, the survey was posted for download on the ITS America website. A total of twenty responses were received. Three returned surveys were not consistent and complete, leaving seventeen respondents representing nine companies and eleven metro areas. The exception is the question on priority of data elements, for which eighteen consistent responses were received. Virtually all respondents operate in very large metropolitan areas, including some cities with the greatest amount of transit use in the country.

The respondents all operate in multiple market niches.[2] For the most part, companies with multiple locations responding reported the same types of activities in each location, although their experiences with data availability and quality varied. All of the respondents perform data processing and retail information to end-users. None of the respondents provide information packaging or retail services alone.

Consistent with their reports of information retail activity, all nine responding companies report private travelers and commercial highway users as current or planned customers. Other companies involved in ATIS are next on the list of most common customers, followed by the public sector.

[2] The market niches were defined as data collection, data processing, prediction using historic data, dynamic route guidance, information packaging, and information retail.

All respondents provide information to customers through customer-initiated request, such as when a customer logs on to a website or calls an information hotline. Fifteen of the 20 also disseminate information through customer subscription or registered profile, giving subscribers traffic updates on their pager, cell phone, or e-mail. As with activities and types of customers, the companies are mostly consistent across locations.

There is more variation in dissemination media across markets than in company activity or customer types. Websites are the most common dissemination medium, used by 19 of the 20 respondents. Companies also use a mix of other media appropriate to reach private travelers and commercial highway users. Consistent with their reports of providing information to other companies, all but two respondents also use FTP sites.

This description of respondents illustrates the opportunities for examining the needs and concerns of companies involved in particular activities. Groups considered in the analysis include companies that provide dynamic route guidance, companies that provide a service incorporating transit information, and companies that try to provide a single service across multiple locations.

3.0 Private and public sector data priorities

Private sector and public sector priorities for information provision to the public are not perfectly aligned. Mismatches between the private sector and the public sector may be cause for concern if they affect current availability or future decisions by the public sector.

Public agency ratings were based on the importance of distributing to the public, while the private company ratings were based on the importance of the data element to the business. The private sector is most interested in freeway data in the near term. The private sector ranking of particular types of information is as follows:

1. Traffic speeds
2. Incidents
3. Road conditions
4. Current and scheduled work zones
5. Weather conditions

Freeway agencies rank in a somewhat different order:

1. Current and scheduled work zones
2. Incidents
3. Road conditions
4. Emergency/evacuation routes and procedures
5. Weather conditions

Arterial agencies are relatively similar to freeway agencies in their top rankings:

1. Current and scheduled work zones
2. Incidents
3. Route designations
4. Emergency/evacuation routes and procedures
5. Road conditions

Beyond general agreement on the highest priority items, different priorities across types of private firms appear to arise from different market niches.[3] Data collection/processing respondents rank scheduled work zones, traffic volumes, ramp and signal queues higher than packaging/distribution respondents. Some information that is ranked lower by packaging and distribution companies, such as traffic volumes, is a high priority for public agencies and collection and processing companies. Companies that provide dynamic route guidance appear to value some static information, such as traffic speed limits and transit routes and schedules, more highly than other companies.

Private sector rankings are also affected by variation in metropolitan areas. For instance, the only respondents who rated transit vehicle location a high priority operate in the New York City area. Of the five respondents who rated signal queues on arterials high priority, two are from New York and two from Washington DC. These cities have the highest arterial congestion levels of the 70 cities studied in the *Urban Roadway Congestion Annual Report 1998*.[4] Most transit agency respondents in the New York area rated transit vehicle location a high priority. The few arterial agencies in the New York and Washington areas that responded did not rate information on signal queues a high priority to provide to the public.

The public sector ranks many types of static information most important to provide to the traveling public, followed by data that might be collected in real time and data they would use for planning purposes. At the bottom of the list for traffic agencies is information that relates to ramp metering.[5] The public sector rankings, particularly with respect to traffic, may reflect current availability and ease of distribution as much as a consideration of what would be best in an ideal world.

Arterial agencies are less interested in providing information to the public than either freeway agencies or the private sector. Traffic speed dissemination in particular is much lower priority for arterial agencies than private respondents. Since the questions listed traffic speeds, without specifying real-time, it is possible that if a distinction had been made between traffic speeds on highways and arterials, the private sector and arterial agency responses would be consistent since state DOTs were a much more common source of data than arterial agencies. Another possible explanation is that the private sector assumed real-time and the public sector assumed intermittent planning data they were collecting.

Transit agencies put information that may directly affect customer service ahead of information that could be characterized as planning or management information. Vehicle time and location was ranked most highly by transit agencies, especially those in areas with high reliance on transit. However, most private sector ISPs now consider it relatively low priority and are less interested in providing the information than the transit agencies themselves. For companies that now use transit information, vehicle time and location appears more important, but transit routes and schedules are still low priority.

4.0 Data availability and quality

This section discusses availability and quality of the high priority data elements identified by the private sector. In addition to current priorities, it includes information on elements that may be important in

[3] Respondents to the ISP survey chose to complete either the section designed for firms that do data collection and processing in addition to other functions or to complete the section for firms that are only involved in packaging and distribution of information.

[4] Texas Transportation Institute, 1998. *Urban Roadway Congestion Annual Report 1998*, Table 4.

[5] The information for ramp metering priorities presented only applies to agencies that operate ramp meters.

particular metro areas or future applications, such as arterial traffic conditions and transit vehicle time and location.

Data availability encompasses both transfer from a public agency and collection by the private sector. Consequently, when discussing the data gap, it is necessary to consider both private sector collection and public sector collection, transfer and distribution. Problems with data quality were examined from the private sector side in a question asking about the quality of each information element. Some of these quality problems can be examined on the public side, if they were covered by questions about the public sector technology use or operations.

This section is divided into two parts, one for all traffic data and the other for transit data. Within each of these parts, current data collection by both the public and private sector is discussed first, followed by quality of the data, current transfer and dissemination activities of the public sector, and a summary of deficiencies and potential for the future.

4.1 Traffic data

Traffic data includes both freeway and arterial data. Although there are many different types of information in the category, the focus is on the information that has the highest priority with the private sector.

Variation in data collection

In general, data collection of high priority information is characterized by

- Private sector collection of data
- Less collection of information on incidents than would be expected based on priorities
- Inconsistent collection across metropolitan areas, resulting from multiple agencies in the area making decisions independently
- Moderate amounts of real-time data collection, with more in more congested metro areas

Private company collection contributes very significantly to the availability of high priority data. The public sector also appears to be doing a good job of providing work zone and route designation information. Weather conditions are almost universally available because weather data are largely obtained from the National Weather Service and private sources, such as WSI.

High priority data elements are collected more often than low ones. Private sector respondents report that data are usually unavailable because they are not collected by anyone even though the technology exists. For the five highest rated data elements, only road conditions and traffic volumes are cited by ISPs, once each for this problem.

Freeway management agencies collect and archive information according to the *public* sector's priority rankings. However, despite the high priority of incidents to both the public and private sectors, collection of information on incidents is not universal. Arterial agencies collect less information than freeway agencies, with the exception of traffic speeds. A much higher percentage of agencies collect and archive traffic speeds than believe it is important to provide the information to the public. Table 2 summarizes the percentage of responding freeway and arterial management agencies that collect and archive the high priority types of information.

Table 2. 1999 data collection and archiving by freeway and arterial management agencies

	Freeway management agencies		Arterial management agencies	
Type of information	**Collect**	**Archive**	**Collect**	**Archive**
Traffic speeds	66%	44%	73%	57%
Incidents	71%	44%	45%	37%
Road conditions	69%	35%	39%	27%
Current work zones	84%	44%	64%	47%
Scheduled work zones	83%	47%	63%	45%
Weather conditions	69%	40%	28%	17%

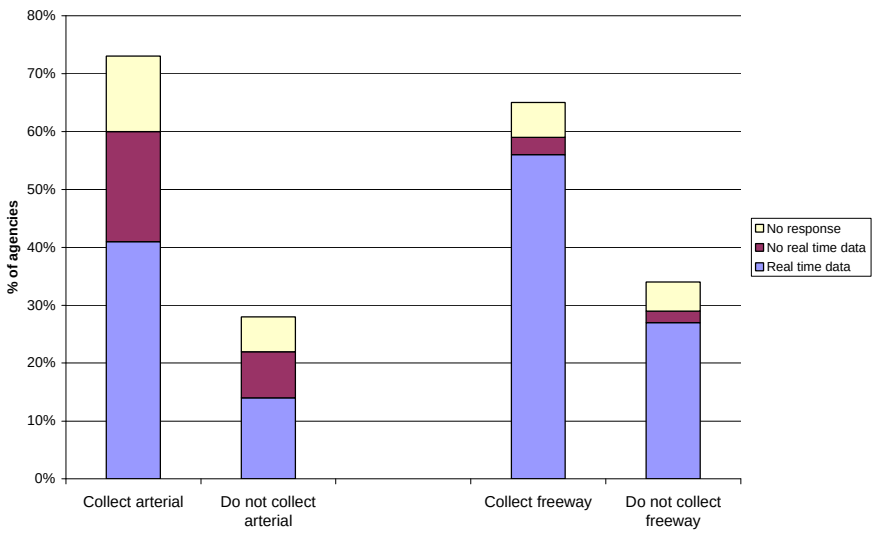
Despite the high percentages of agencies indicating data collection, inconsistency across metro areas reduces the availability and utility of the data. In many metro areas, there are multiple arterial and sometimes freeway agencies. Most of these areas have deficiencies in data collection from at least one agency. In no metropolitan area with more than two arterial management agencies responses did all arterial agencies report real-time data collection and collection of traffic speeds. Most large, congested metropolitan areas with a potential ATIS market have multiple public agencies. Consequently, the only places where it is possible to get real-time information from the public sector across the entire area is where there is not likely to be an ATIS market. The problem is worse in metropolitan areas with a very large number of public agencies, and for companies that try to provide a single service spanning an entire interstate travel corridor or multiple metropolitan areas.

Another problem is that collection of data does not imply *real-time* collection of data such as would be needed for ATIS. For instance, agencies periodically collect traffic speed data for planning purposes, rather than operation of the system. The high degree of archiving of traffic speed data for arterials suggests that much of the information is used for planning purposes. Only 55% of the arterial management agencies reporting types of information collected had real time electronic collection of vehicle volume, speed, or density. About a quarter of those agencies reported that they do not collect traffic speeds.[6]

Figure 1 shows arterial and freeway management agencies reporting collection or noncollection of traffic speed data by whether or not they collect real-time electronic traffic data. Freeway data collection is currently much better suited to providing data for ATIS. Comparing the arterial management responses to responses to the analogous freeway management questions shows the difference. A much higher percentage of freeway management than arterial management agencies report deploying real-time traffic data collection technologies. About a third of the freeway management agencies reporting real time data collection do not collect traffic speeds.

[6] In order to produce this break-out, it was necessary to use the responses from a relatively small subset of agencies that received the survey. Although the response rate for the question was about 27%, representing agencies in 55 out of 78 metro areas, it appears to be an unbiased sample in terms of level of government and metro area congestion.

Figure 1. Collection of Traffic Speed Data



Mitigating the problem of the lack of real-time data, public sector collection reflects differences in traffic across metro areas. On average, places with real time data collection have greater traffic on their freeways than places without real time data collection. Table 3 compares the average daily traffic per freeway lane in areas that collect real time traffic speeds with places that don't. Although it appears that there is a large difference between places without real time data that collect traffic speeds and those that don't, the appearance is probably due to the very small sample size within those cells.

Table 3. Average metropolitan area average daily traffic per freeway lane

	Real time data	**No real time data**	**No response**	**Average**
Collect traffic speeds	13,853	9,553	13,393	13,598
Do not collect traffic speeds	14,017	12,826	12,737	13,778
Average	13,907	10,644	13,112	13,659

An implication of this pattern in collection is that it is likely that the private sector is understating the problem of public data availability on a national level. While private ATIS companies are unlikely to be interested in places with little congestion, if they are providing a service for an entire corridor some of the less congested places may take on greater importance.

Variation in data quality

ISPs expressed different degrees of satisfaction with the data they received, depending on the service they provide. In a couple of cases where it was possible to compare perceptions within a metropolitan area, the respondent who is satisfied with the data provides a service with less detailed information on local roads and gets its data entirely from the State DOTs, while the respondent who is not satisfied also gets data from local cities. A similar situation occurred where one ISP reported problems with the format of traffic speed data while another respondent did not have a problem with the same data from the same public agency.

Even considering differences in perceptions, it appears that some agencies routinely provide more accurate information than others do. For instance, one agency accounts for two of the four citations for inaccurate current work zones data and both citations for inaccurate scheduled work zone data. Similarly, three of the four citations for inaccurate incident data refer to the same public agency.

ISPs' most frequently cited reason for insufficient data quality is inadequate geographic coverage. The problem results mainly from incomplete data collection in metropolitan areas with multiple jurisdictions, particularly with respect to traffic speeds. The most common complaints, in order of frequency of citation are as follows:

1. Inadequate geographic coverage
2. Inaccurate information
3. Insufficient update frequency
4. Not timely enough
5. Inadequate spatial resolution

There were also a number of issues mentioned three times or fewer, including unavailability of data 24 hours a day, inconsistency of data between adjacent jurisdictions in the area of service, difficult data format, and unspecified magnitudes of problems. Geographic coverage and spatial resolution are the only problems given for which it is possible to directly develop a national picture based on the public sector responses. To some extent the issues of update frequency and temporal coverage can be explored indirectly. Since data accuracy was not considered on the public sector survey, there is no way to examine whether there are patterns in characteristics of agencies or metropolitan areas with agencies that tend to have less accurate data.

Incident and traffic speed data are the high priority items with the lowest quality. More respondents receive incident and traffic speed data of insufficient quality than sufficient. Both of these types of data, and traffic volume frequently have inadequate geographic coverage. The geographic coverage problem has two sources: noncollection by some agencies within the service area, and lack of coverage of some roads under the jurisdiction of agencies that are collecting data. In addition to having problems with geographic coverage, incident data often are not accurate, timely, or updated frequently enough. Of the five ISPs who mentioned these problems, four were disatisfied with both the update frequency and timeliness of the data. In three of these cases, the public agency also gave inaccurate incident data.

Traffic data quality

Consistent with the private sector complaint about insufficient geographic coverage, on average, freeway agencies reporting real-time traffic data collection cover about a third of the miles for which they are responsible, so about two thirds of each agency's system is unsurveilled. Arterial management respondents reported very low numbers of intersections under surveillance so it is likely that coverage on arterials is rather spotty. Table 4 summarizes the percentages of freeway agencies using particular real-time traffic data collection technologies and the average coverage of the responsible agency's system.[7] Because many metropolitan areas have multiple agencies with responsibility for portions of the highway network, the percent coverage for an agency is usually more than the percent coverage in a metropolitan area. Because of the low response rate, it is not possible to determine percent coverage for an entire metropolitan area in most cases.

Table 4. Freeway real-time traffic data collection technology use

Technology	% of agencies using	% of responsible agency's miles covered
Loop detectors	56	37

[7] Of the 60 agencies reporting detection and verification of incidents, 49 agencies representing 41 metropolitan areas identified the technology and miles of coverage. Of the 52 agencies reporting real-time traffic data collection, 36 agencies representing 31 metropolitan areas identified the technology and miles of coverage.

Microwave radar	28	18
Video imaging detectors	11	2
Probe readers	8	11
Other	17	18

Loop detectors are the most widespread of real-time traffic data collection technologies on both arterials and freeways, both in terms of numbers of agencies using and coverage. They are used by agencies everywhere on the spectrum of population size and traffic density. Video imaging detectors appear to be used only in the largest metro areas covering very small parts of the agency's system. Despite private sector interest in data derived from probe readers, there are only three metropolitan areas with agencies currently reporting the use of probe readers: Houston, New York and San Antonio.

Technologies are used in combination or singly, with different agencies within a single metro area choosing different combinations, and consequently generating data that may be inconsistent in format with other agencies' data. For instance, in the New York area, one agency uses loop detectors and video imaging detectors, another uses microwave radar and probe readers, and a third uses only probe readers. Of the eight ISP respondents who collect their own speed data, three use loop and/or radar detectors to get quantitative speed information; the rest estimate speeds from aircraft observations, video images, and call-ins from drivers.

ISPs mentioned some problems with spatial resolution of data. There is wide variation across freeway agencies in the number of detectors per covered mile. Although the number of detectors varies with type of technology, some agencies use many more per mile than others. When additional technologies are used, they appear to substitute for loop detectors because the average number of loop detectors per mile of freeway drops from 16 to 8.4. There is no way to calculate the number of detectors per mile on arterials because the public sector respondents reported the number of signalized intersections under surveillance.

Incident data quality

Incident detection geographic coverage by the public sector appears to be greater than real-time traffic data collection. Because of the existence of police patrols and cellular phone reporting, very high fractions of a metropolitan area can be covered with the use of minimal additional equipment. This heavy reliance on human observers reporting may contribute to some of the problems with accuracy mentioned previously. While the majority of responding areas with incident detection use CCTV and computer algorithms, the coverage from these technologies is substantially more limited than from police patrols and cell phones. ISPs who collect incident data do so from aircraft observations, video images, and call-ins from drivers.

Table 5. Highway incident detection technology use

Technology	**% of agencies using**	**% of miles covered in each area**
CCTV	71	31
Computer algorithms linked to traffic surveillance equipment	71	31
Police patrols	37	72
Free cellular phone call to a dedicated number other than 911	31	80
Private sector sources	10	22
Other	10	48

There is no direct information available on frequency of updates, however communication among agencies responding to an incident could indicate how likely all agencies are to have current information. Of the 71 responding freeway management agencies, 42 had a central focal point for facilitating the flow of information among agencies responding to an incident. These agencies tended to be in higher traffic areas than agencies without a central focal point. About two thirds of the places with focal points used a freeway or traffic management center. Using a police, fire or joint dispatch center was somewhat less common. It is likely that agencies using a central focal point for facilitating the flow of information would have better information themselves, and thus more likely to be able to provide better or more frequent updates.

One company in southern California would like to get traffic speed, incident and work zone information 24 hours a day. No other company mentioned this requirement, although time of day limitations may be of interest. To the extent that collection and availability of data to ISPs is dependent on human intervention rather than occurring automatically, the hours of operation of freeway and incident management centers may provide an indication of when data would be available to ISPs. Table 6 summarizes hours of operation for freeway and arterial management agencies with real time traffic data collection. For each type of agency there is a column indicating the percent of respondents who report staffing either 24 hours a day or during peak hours. The second column presents the percentage of agencies within each staffing category that exchange electronic data with other agencies.

Table 6. Hours of operation for freeway and arterial agencies with real-time data collection

Hours of operation	Freeways (71 agencies)		Arterials (103 agencies)	
	% respondents reporting staffing	% with type of staffing exchange electronic data with other agencies	% respondents reporting staffing	% with type of staffing exchange electronic data with other agencies
Staffed 24 hours/day	38%	59%	7%	0%
Staffed peak hours	17%	33%	23%	21%
No response	45%	25%	70%	10%

More freeway management centers are staffed 24 hours a day than just during peak periods. The reverse is true for arterial management agencies. For both types of staffing, a higher percentage of freeway management agencies than arterial management agencies exchange electronic data with other agencies. Even so, only 22% of freeway management agencies are staffed 24 hours a day and exchange electronic data with other agencies. For ISPs who need around the clock information, it appears that the number of cities where it is likely to be available is limited.

Transfer and dissemination

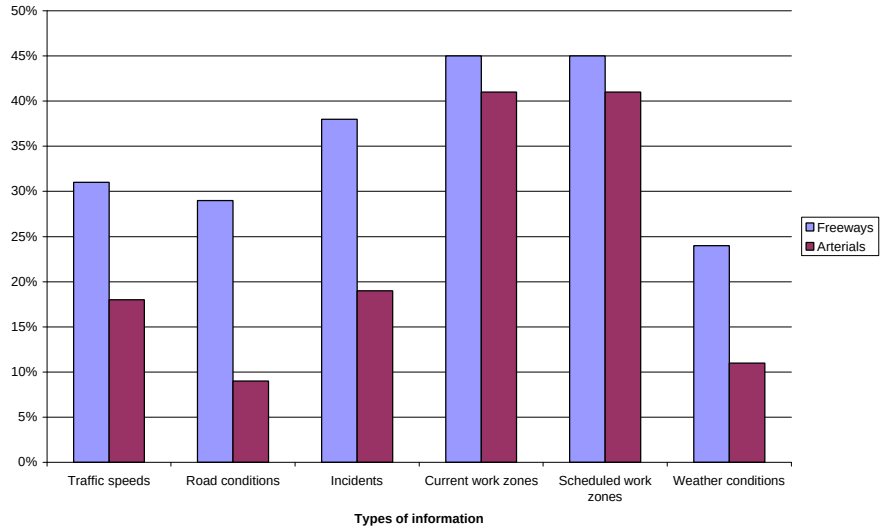
Along with lack of collection, one of the most common reasons for unavailability of data is that they are collected by some agency but not made available. As defined on the private sector survey, lack of availability could result from no collection, no sharing, or too high a price. For the very large metropolitan areas represented by the private sector respondents, the problem of public agencies collecting but not sharing data outweighs the problem of public agencies not collecting any data at all.

Responses from both the private and public sector surveys indicate that there is a pattern of some public agencies not sharing data with private ISPs. From the perspective of the ISPs surveyed it appears that it is common for a public agency to not share data as a matter of policy. There are other constraints, as well. There is an exceptional case resulting from equipment constraints, such as being physically out of ports to provide feeds of its data and having many sensors that do not have functioning connections to

the processing instrumentation. Another ISP states that a public agency in their area of service charges too much for access to their incident database.

Whatever the reason, transfer of information to other agencies or dissemination of the information directly to the public occurs less often than collection. Freeway management agencies tend to transfer all types of information except work zones much more than arterial management agencies. A much smaller percentage of the agencies transfer the information than state that it is a priority for the public to have access to the information. Since the question about transferring information does not specify that the information is being transferred for the purpose of dissemination, the percentages presented in Figure 2 are probably overstated with respect to current transfers to private sector ISPs.

Figure 2. 1999 Transfer of Information



In fact, ATIS providers are not among the most common data requestors. The top five groups requesting data from freeway or arterial agencies are listed below in order of frequency of mention by public sector agencies. While the media was mentioned as a top recipient for freeways, and not insignificant for arterials, ATIS providers did not make this list. For freeways, ATIS providers are shortly behind universities, but for arterial information they express substantially less interest. In large measure, the rankings reflect the data available. As noted earlier, real-time information is much more prevalent for freeways than arterials, making it more useful to the media and to potential ATIS providers.

Table 7. Common data requestors

	Freeway	Arterial
1	Media (i.e. TV stations, radio stations)	Consultants
2	State DOT personnel	State DOT personnel
3	Consultants	MPOs
4	MPOs	Media (i.e. TV stations, radio stations)
5	Universities	Universities

In cases where the agency collects real-time information on traffic, about half again as many agencies receive requests from the media or ATIS providers than transfer information on traffic speeds. Those agencies who receive requests from ATIS providers and transfer the information tend to be from areas with somewhat greater amounts of traffic, as measured by the average daily traffic per freeway lane, than those agencies that do not transfer the information. The reverse is true for agencies that receive

requests from the media. Incident information is transferred by close to half of the agencies that report collecting it, detecting and verifying incidents and receiving requests from ATIS providers or the media. The same pattern holds for incidents as for traffic speeds of greater transfer of information in higher traffic areas.

Despite the somewhat low level of interest expressed by ATIS providers and the reported relatively low levels of transferring information to another organization, information is being disseminated to the public other than through traditional media. There are a number of methods that are used to provide travel time, speeds and conditions to the public. The most common types are web sites and telephone systems. It seems likely that a number of the methods listed are not used directly by public agencies, but indirectly through the private sector. Table 8 summarizes the range of technologies used by agencies that disseminate information to the public or provide information to other agencies to do so.

Table 8. Percent of freeway and arterial agencies disseminating information by media type

	Freeway		**Arterial**	
Media type	**Incident**	**Traffic**	**Incident**	**Traffic**
Cell phone/data	14%	7%	6%	3%
Cell phone/voice	10%	20%	15%	6%
Dedicated cable TV	10%	15%	22%	26%
E-mail or other direct PC communication	22%	24%	20%	23%
Facsimile	28%	31%	22%	26%
In-vehicle navigation systems	2%	2%	4%	1%
Interactive TV	3%	-	4%	1%
Internet Web sites	50%	62%	46%	43%
Kiosks	14%	11%	24%	13%
Pagers or personal data assistants	31%	31%	30%	11%
Telephone system	41%	49%	44%	33%
Total number of agencies disseminating	**58**	**55**	**54**	**70**

If agencies collect information on incidents and have a web site that provides traffic information, they usually post incident information. The opposite is true for agencies that collect traffic speeds and have camera views. Only about a third of the web sites associated with agencies with either of these types of information portray it. More sites have intermodal information or links to it than agencies report collecting or transferring that type of information. Half of the 16 agencies answering the question on the deployment tracking survey about collecting intermodal information posted or linked to that type of information on the web. Only two agencies reported collecting it.

Table 9. Provision of information on web pages by agencies or associated ISPs

Type of information	**Post or provide to ISP to post**		**Frequency of updates**
	# of sites	**% of sites**	
Incidents	27	87	Majority < 5 minutes or unspecified
Traffic speeds	8	31	Majority unspecified
Camera views (CCTV)	8	35	All either < 5 minutes or unspecified

Current status and future potential

It appears that the criticisms of data availability and quality made by the private sector are reflected in the public sector results. Data are not consistently collected at the required resolution or made available across the required geographic area. Freeway data tends to be better than arterial. Larger, higher traffic metropolitan areas tend to have better data collection and coordination than lower traffic areas, but they suffer from having more agencies with different degrees and methods of collection, and different policies on sharing data.

There is potential for increased public sector data collection or dissemination, based on current deployments. The primary opportunity that was mentioned by ISP respondents is using data from traffic probes. The extent of the possibility of using toll tags as probes can be examined using the deployment tracking survey data, supplemented with information from IBTTA.[8] Electronic toll collection has been expanding rapidly, and there are now many cities that have enough toll tags in circulation to provide good quality data. The following metropolitan areas currently have enough toll tags to use as probes, assuming that approximately 2% of drivers must be using tags in order for probe readers to provide sufficient information. Most of these areas predict increasing use of tags by 2005.

- Baltimore, MD
- Boston, Lawrence, Salem, MA
- Chicago, Gary, Lake County, IL-IN
- Dallas, Fort Worth, TX
- Denver, Boulder, CO
- Hampton Roads, VA
- Miami, Fort Lauderdale, FL
- New Orleans, LA
- Orlando, FL
- Philadelphia, Wilmington, Trenton, PA-DE-NJ
- Richmond, Petersburg, VA
- Washington, DC-MD-VA
- Wichita, KS

In addition to these metropolitan areas, there are a number of other areas with electronic toll collection that did not provide estimates of the number of tags in use or do not currently have enough to use as probes. These areas include the following cities.

- Albany, Schenectady, Troy, NY
- Atlanta, GA
- Buffalo, Niagara Falls, NY
- Detroit, Ann Arbor, MI
- Houston, TX
- Los Angeles, CA
- New York, Northern New Jersey, Southwestern Connecticut, NY-NJ-CT
- Oklahoma City, OK
- San Francisco, Oakland, San Jose, CA
- Syracuse, NY

[8] International Bridge, Tunnel and Turnpike Association, "Electronic Toll & Traffic Management (ETTM) Systems Survey" 1998.

Besides this potential on the public side, some private sector companies are exploring other means of gathering data. For instance, Traffic Station recently announced that it would partner with U.S. Wireless in order to allow it to access U.S. Wireless' real-time traffic data. U.S. Wireless monitors the flow of cellular traffic on roads and highways to determine traffic speed and congestion. Monitoring cellular traffic may provide more widespread and consistent coverage than will be available from the public sector in many metropolitan areas.

4.2 Transit data

Vehicle location is the only type of transit data in which the private sector expressed noticeable interest. While ISPs in New York consider vehicle location information high priority, but do not use it, companies operating in cities with less use of transit are using the information. Consequently, the discussion of transit data availability, quality and dissemination focuses primarily on vehicle location. Information on other transit agency collection and dissemination is presented only to provide context.

Variation in data collection

Close to half of the responding transit agencies collect vehicle time and location information. In general, much more data is collected than the respondents believe is a high priority to provide to the public. Data collection seems to be more oriented toward planning than provision to the public. Archiving appears to follow the same pattern.

Looking at the metro areas with the greatest percentage of person trips by transit in 1990,[9] it appears that the respondents' vehicle location data availability is similar to all other metro areas. Slightly higher percentages collect and archive the data than in other places, but it is not a very great difference. These areas also tend to have multiple transit agencies serving the region. It is worth noting that the agencies collecting the data are not necessarily the largest central transit agency. In two of these transit intensive metropolitan areas examined, the major agency did not collect data although some of the other agencies that responded did.

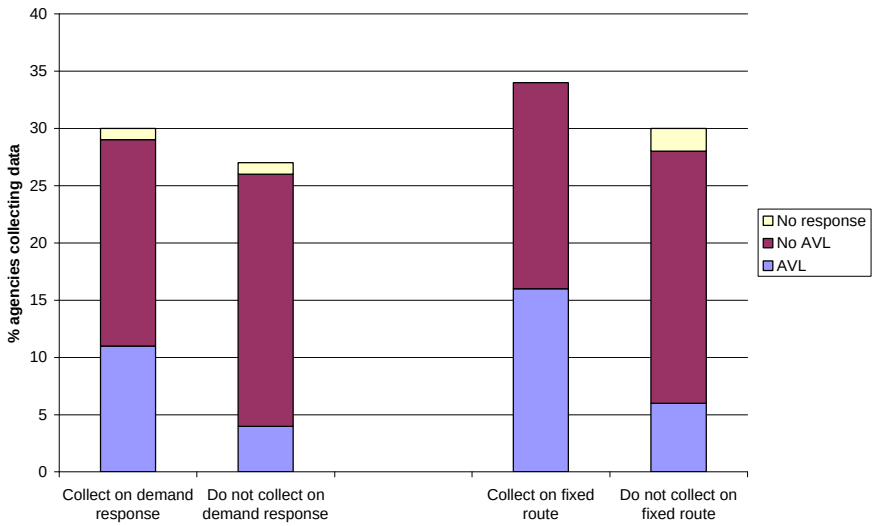
As pointed out for traffic information, collection of data does not imply collection of *real-time* data. For transit, AVL is the means of collecting real-time data on vehicle time and location. Figure 3 illustrates the use of AVL on fixed route buses and demand response services for agencies with and without collection of vehicle time and location data. On average, whether or not the agencies report collecting vehicle time and location, agencies with AVL tend to have more vehicles than agencies without AVL. With that context, there are two points worth noting on this chart:

- Not all agencies that report collecting vehicle time and location have the means to do it automatically in real time because they do not have AVL.
- Some agencies report having AVL but do not claim to collect vehicle time and location information.

This disconnect implies that there is an opportunity to increase the information available to the public without the need for a substantial investment in technology. The agencies with AVL that do not collect vehicle time and location information tend to be either in smaller metropolitan areas or outlying areas of the larger metro areas.

[9] New York City, Philadelphia, Chicago, Washington, San Francisco, and Boston all had 2% or greater of the person-trips taken in the area by transit according to the 1990 National Personal Transportation Survey. No Philadelphia transit agency responded to the question on collecting, archiving or transferring data, so Philadelphia is not included in these statements.

Figure 3. AVL and collection of vehicle time and location data



Variation in data quality

No ISPs noted data quality problems with transit vehicle location information, simply lack of availability. It is likely, however, that an ISP considering providing information that crossed service areas of multiple agencies would have the same problems of geographic coverage noted by users of traffic data. Some agencies have real-time vehicle location data available, most do not. It is not consistent across metropolitan areas unless there is only one transit agency.

Transfer and dissemination

The pattern of transferring and disseminating data for transit agencies is different from agencies responsible for freeway or arterial traffic management. While the traffic agencies often transfer information that is likely to be of interest to the public, transit agencies appear to transfer information to other agencies that would be of interest to the agencies. Only 8% of agencies report transferring vehicle time and location data. As will be discussed later, it appears that transit agencies tend to take responsibility for disseminating the information to the public themselves, rather than providing it to other groups to do so.

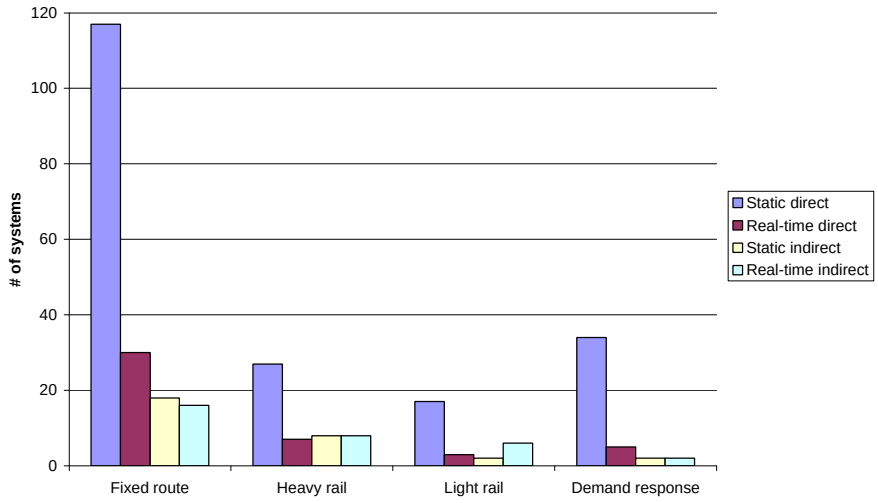
Unlike traffic management agencies, data requests come mostly from governmental agencies. The media was fifth on the list of types of groups requesting information. The top groups sorted by frequency of citation are as follows:

1. State DOT personnel
2. Federal DOT personnel
3. MPOs
4. Consultants
5. Media (i.e. TV stations, radio stations)
6. Universities
7. Advanced Traveler Information Systems (ATIS) providers

It is very common for transit agencies to provide information directly to the public. As can be seen in Figure 4, many more agencies provide static information, such as route schedules and fares, directly to the public than indirectly provide it by giving information to another organization that then distributes it. Some real-time information, such as schedule adherence or arrival and departure times, is also being

provided but not on as great a scale. Web sites and telephone systems are used most, but other common technologies are kiosks and audible enunciators. Very few web sites provide real-time information. Of the nine agencies reporting collecting vehicle time and location and AVL on buses, only one posted real-time information on its web site.

Figure 4. Provision of Transit Information Through Traveler Information Systems



Current status and future potential

Transit agencies are doing a good job of providing static information, such as route schedules and fares to the public. While some real-time information is collected on vehicle time and location, much less is being transferred to ISPs or disseminated directly to the public. In part, the lack of transfer results from lack of interest on the part of ISPs. There may be a mismatch between metropolitan areas where there is a potential market for real-time transit data and metropolitan areas where data are being collected.

In addition to the potential to more fully use the potential of existing AVL systems, noted earlier, there are many more systems currently being implemented or planned. There are 20 AVL systems in the implementation phase, with a signed contract. There are 38 systems in the planning phase, where a grant has been awarded, local money has been allocated, or an RFP has been issued. The agencies represented cover the range of types of agencies in both larger and smaller metro areas. As AVL becomes more common, perhaps the availability of real-time data will also improve.

5.0 Conclusions

The survey results provide insight into the nature and extent of the ATIS data gap. The identification of issues was based on responses of ISPs to a private sector survey. The discussion of the extent of the problems was derived from public sector deployment tracking survey responses. There are two caveats:

- The 20 respondents from 9 companies mostly operate in major cities with well-developed traffic control and management infrastructure and institutions relative to smaller metropolitan areas.
- The public sector survey responses were preliminary and have not been verified.

Before summarizing particular private sector concerns and their extent, it is useful to reiterate current priorities and activities. Private organizations appear to be most interested in information on freeway

conditions, followed by arterial then transit. Some basic data such as traffic speeds and incidents emerge from the survey as being universally important. Because of the high priority ISPs place on traffic data, many of them collect it to supplement the information available from the public sector. To a large extent, transit agencies disseminate their own information to the public rather than provide it to a third party for distribution.

5.1 Current nature and extent of the data gap

Based on the survey data, the following statements summarize the most important observations about the current nature and extent of the data gap:

Public agencies in major metropolitan areas collect more traffic data than agencies in smaller areas. One private sector respondent with operations in several metropolitan areas believes that non-collection of data, arising from non-existence of collection infrastructure, is a serious problem. In addition to the major metropolitan areas in which most of the other ISPs surveyed operate, this respondent serves several relatively smaller metropolitan areas. This respondent states, "Of the 65-75 U.S. cities where traffic is important, I estimate 15 to 20 have significant traffic management instrumentation and facilities that can be utilized for ATIS." Results from the public sector survey confirm the general statement.

Geographic coverage of available data is often inadequate, and more likely to be inadequate the larger the metropolitan area. This is a very common problem identified by the private sector survey, since most of the metropolitan areas covered span several political jurisdictions. The larger the metropolitan area, the more likely it is to be a problem. Within the MPO-defined metropolitan areas identified for the public sector survey there are very few metropolitan areas that appear to have equal amounts of coverage across all agencies with responsibility for either freeways or arterials, let alone both.

Another reason for poor geographic coverage, mentioned by one private sector respondent, is that public agencies may install data collection instrumentation on some but not all of the roads they operate. No freeway agency reported having data collection technologies installed on the entire mileage of their system. Even excluding mileage that the agencies have decided would not be appropriate for the addition of technologies, there is only one agency with complete coverage. The average is about a third of their entire system, slightly more if only the mileage they plan for deployment of technologies is included. Since the mileage that they consider when planning for deployment is about 86% of total miles, it is likely that there will never be complete coverage, but it is also likely that the mileage covered will increase over time.

Inaccurate data is the second most common quality problem, after inadequate geographic coverage. Incident and work zone information most often had quality problems. It also seems that some agencies routinely provide more accurate information than others do. There is no information from the public sector survey to examine the extent of the problem.

Agencies in a single metro area provide data inconsistent with other agencies in the area. A consequence of multiple jurisdictions in the area of service is that sometimes the data provided by different regions are not consistent in their format or their content. The inconsistency can lead to serious problems in creating a seamless ATIS service for the entire area served by the ISP. One ISP observes: "The metro area is very diverse and the level of ATIS info that is available varies greatly from one jurisdiction to another, making it a real challenge to provide a cohesive solution." There may even be inconsistencies between different districts of the same agency, as one respondent found for work zone

data from different districts of a state highway agency. Unfortunately, the larger the metropolitan area and hence potential market, the more agencies have responsibility for portions of the system, and the more likely that data will be inconsistent in format or content.

Timeliness and update frequency problems occur for incident data. Update frequency is a significant issue for incidents because ISPs like to have periodic reports on the progress in clearing incidents, and not just a bulletin when the incident occurs and again when it is cleared. It is likely that in general areas with more traffic have better communication and information about incidents because they are more likely to use a central focal point for facilitating communication about the incident.

Problems with inadequate spatial resolution are most important for traffic speeds. For some data elements, such as traffic speeds and volumes, lane occupancy, and vehicle classification, the spatial separation between detection points makes a difference to the quality of the data. Thus, if sensors for traffic speeds along a freeway are spaced 10 miles apart, with several on and off ramps in between, the traffic speed data will be of limited use as compared to speed data collected on the same freeway at, say, one-mile intervals. This problem was cited a few times, most often for traffic speeds data.

It is difficult to make strong statements about spatial resolution nationwide because there is substantial variation across agencies in the spatial resolution of traffic data. While the average number of loops deployed per mile is 12.6, the standard deviation is 13.8. Most other types of technologies are similarly variable in their deployment. There does not seem to be a strong correlation between traffic conditions and how closely the technologies are deployed. Consequently, it is also not possible to make generalizations about what types of places have very good spatial resolution and what types might be lacking. The best that can be done is to say that it is a problem in some metropolitan areas or with some agencies and not others.

Some ISPs require greater temporal coverage than is available in most places. Reporting data only for weekday daytimes is not sufficient in some cases, since people increasingly work non-traditional shifts and recreational or weekend traffic can also be significant in many cities. Two private sector respondents identified lack of temporal coverage as a problem. One respondent was referring to data from a public agency. The other was referring to data from another private ISP, which concentrates on the traditional working hours on weekdays for its data collection in some metropolitan areas.

There were no specific questions on the public sector survey related to the time period during which information was transferred. By combining information on hours of staffing, operations conducted and whether or not the agency has real-time traffic data collection it is possible to deduce what agencies might have the potential to report on a 24 hour basis given current operations and who is currently exchanging electronic data. Close to 40% of agencies with real-time traffic data collection are staffed 24 hours a day. A little over a fifth of the agencies reporting real-time data collection are currently staffed 24 hours a day and exchanging electronic data as part of their operations. So, a relatively small fraction of agencies are currently providing information around the clock.

Public agencies are not necessarily willing to transfer data they collect. Unwillingness of the public sector to share data is a fairly common problem experienced by several private sector respondents. Fewer than half of the public sector agencies that have real-time information on traffic or incidents transfer traffic speed or incident information to another organization. One ISP speculates that they cannot obtain the data because of a lack of "trust between public and private sector, willingness to let go of the information with the understanding that it will help the general public even if the private sector makes a buck in the process," and misplaced public sector concerns about "data ownership: if the private

sector supplements publicly collected information with their own data, the public sector sometimes has difficulty accepting the fact that this new value-added information is now the property of the private sector."

Another respondent, who lists several data elements (such as traffic volumes and speeds, lane occupancy, vehicle classification, road and weather conditions) as being collected by the Highway Department but not made available, points out that the institutional barrier to a public agency sharing data is sometimes not so much an explicit policy not to share the data, but rather, the lack of any explicit policy about data sharing. In such circumstances, data that are available are provided by the public agency on an ad-hoc basis. The source for such data can dry up with even a simple change in personnel in the public agency.

5.2 Future prospects

The prospects for the future appear mixed. While it is likely that freeway management agencies will add miles of coverage to their current data collection, real-time data collection is much more prevalent on freeways than arterials. For ATIS products to extend to arterials, arterial data will need more substantial improvement than that necessary for freeways. One opportunity for gathering more complete traffic information is the increased use of electronic toll collection leading to potential toll tag use as probes. Another is private sector data collection through innovative technologies such as monitoring the flow of cellular phone traffic on roads and highways. Analogous improvements in transit data availability will result from increased use of AVL.

Institutional changes, such as developing appropriate policies for sharing information with ISPs, or improving communication among responding agencies to incidents, could significantly alter the information available. Aligning public and private sector perspectives on what is valuable to provide to the public could also improve efforts on both sides to provide that information.

Appendix: Private sector respondents and survey form

The following companies responded to the private sector survey:

- ALK Associates
- Etak
- Fastline
- Metrocommute
- Metro Networks
  - Chicago
  - Dallas
  - Los Angeles
  - Miami
  - New York
  - San Francisco
  - Seattle
  - Washington, DC
- SmartRoute Systems
  - Boston
  - Cincinnati
  - Detroit
  - Minneapolis/St. Paul
  - Washington, DC
- Traffic Station
- TranSmart Technologies
- Travel Advisory News Network

Jane Lappin
ITS Program Manager
EG&G Services
John A. Volpe National Transportation Systems Center
Cambridge, Massachusetts

October 28, 1999

Colleagues:

At the 1999 ITS America Annual Meeting, the ATIS Committee formed a task force to address the ATIS data gap problem. The task force was charged with producing a workshop that would address the great variances in the quality, scope, and availability of key traffic and transit data. If ATIS services are to achieve market acceptance, data must be timely, accurate, and consistent from region to region. MMDI evaluation findings make it clear that ATIS customers will not pay for services that cannot provide sufficient network coverage and information quality. As with the development of ATIS data standards, this is a problem that requires more systematic definition before plans can be made for its resolution.

Attached with this letter is a survey of private sector ATIS service providers. Your response to this survey will be used to frame and characterize the ATIS data gap problem. Findings will be presented for discussion at the ITS America ATIS Data Gap Workshop (February 9-10 in Scottsdale, AZ), where they will be compared with results from a national survey of state and local traffic and transit agencies that collect data. Findings will also be published in the proceedings from the workshop.

We need your help. The attached survey was written for commercial ATIS service providers to identify and characterize the areas in which traffic and transit data are lacking in coverage, quality, reliability, and availability. If you are an ATIS service provider involved in any aspect of travel data collection, processing, or dissemination, please complete the attached survey. This would include ATIS companies that

- Gather traffic information directly using privately owned collection instruments,
- Obtain their information primarily from public agencies and process it for resale by other ISPs,
- Use traffic information to develop real-time route guidance for in-vehicle navigation units, and
- Plan to sell travel information directly to private travelers.

The survey should take no more than 15 minutes to complete. Once complete, please fax it to me, Jane Lappin, at 617.494.2787. If you have any questions, phone me at 617.494.3692, or email to **lappin@volpe.dot.gov**.

Thank you for your assistance in this matter.

Jane Lappin

Survey of ATIS Information Service Providers
October 1999

Introduction

This survey of ATIS service providers is divided into three major sections. In the first section, we need your name and contact information (for any follow-up questions we may need clarified), and basic information describing the nature of your business. The two sub-sections that follow correspond to the business activities that comprise a commercial ATIS service. You need complete only one subsection.

If you operate in more than one geographic region, please fill out one survey for each region in which you operate. This level of detail is needed in order to compare private sector data needs with the corresponding public sector survey of the travel data they report as being available.

There are places in the survey that solicit comment*; feel free to comment whenever you want to clarify or expand upon a response. You may attach additional sheets for your comments as needed.* When complete, please fax your survey to Jane Lappin at 617.494.2787.

Section 1.
Contact Information

1. Your name_____

   Title/Designation: _____

   Company _____Parent corporation (if applicable) _____

   Street/P.O. Box: _____

   City: _____

   State: _____

   ZIP code: _____

   Telephone: (_____) _____-_____

   Fax: (_____) _____-_____

   Email: _____

About Your Company

2. In which geographic markets is your company currently active? Please list them by primary city, rural region, or recreational area. For the purposes of this question, a geographic market corresponds to a major metropolitan area, a rural region, or recreational area.

3. Which geographic region does this survey apply to?

4. In which of the following ATIS service activities is your company engaged? Check all that apply:
   - ❑ Collect real-time travel (traffic and transit) data directly from the network
   - ❑ Aggregate (from other sources), process, and format real-time travel data
   - ❑ Perform predictive analysis using historic travel data
   - ❑ Process real-time traffic data to create dynamic route guidance services
   - ❑ Package real-time travel information with other information services for distribution to an information service retailer
   - ❑ Provide real-time travel information directly to private travelers
   - ❑ Other (describe briefly) _____

5. Who are your current or planned direct customers? Check all that apply.
   - ❑ Companies that aggregate, process, format, or analyze travel data, including companies that create dynamic route guidance
   - ❑ Companies that package travel information with other information for retail distribution, e.g., other web sites, broadcast or cable television, and information packagers.
   - ❑ Companies that sell information to consumers, e.g., a mobile phone service provider
   - ❑ Companies that provide more than one of the services listed above.
   - ❑ A division of your own company which performs one or more of the services listed above
   - ❑ Private travelers (you provide services directly to the end-user).
   - ❑ Commercial highway users (trucking companies, etc.)
   - ❑ Public agencies (other than emergency services)
   - ❑ Emergency service providers (ambulance, fire, police, etc.)
   - ❑ Other (please describe briefly)_____

6. *This question applies only to those companies that provide information directly to the consumer, or private traveler.* Which of the following information dissemination modes do you use? Check all that apply.
   - ❑ Customer initiates request (by logging on to website, calling information line from their mobile phone, etc.)
   - ❑ Information is sent to customer based on customer's registered profile
   - ❑ Other (Please specify) _____

7. What media and platforms do you use for information dissemination to your customers? Check all that apply.

   - ❑ Web sites
   - ❑ Telnet
   - ❑ ftp
   - ❑ Highway Advisory Radio (HAR)
   - ❑ Dynamic Message Signs (DMS)
   - ❑ Mobile phone/voice
   - ❑ Mobile phone/data
   - ❑ Telephone
   - ❑ Fax
   - ❑ Regular broadcast radio or TV
   - ❑ In-vehicle navigation system (Note: This category would include products such as Neverlost, not services such as Onstar)
   - ❑ In-vehicle computer
   - ❑ Pager
   - ❑ Personal digital assistant or palm-top computer
   - ❑ Company intranet
   - ❑ Company in-house broadcasting
   - ❑ Other (please describe) _____

Instruction for respondents*:* The remainder of the survey is divided into sections classified by ATIS business activity. Please complete only one section.

Fill out Section 2 (page 5) if you

- *Collect real-time travel (traffic and transit) data*
- *Aggregate, process and format real-time travel data*
- *Perform predictive analysis using historic travel data*
- *Process real-time traffic data to create dynamic route guidance services*
- If you perform some of the business activities above, and also provide information services to either an information service retailer (such as OnStar or ATX) or provide services directly to the private traveler, please fill out section 2.

Fill out Section 3 (page 11) if you

- *Package real-time travel information with other information* for distribution to an information service retailer
- *Provide real-time travel information directly to consumers*

Section 2. For companies that:

- Collect real-time travel (traffic and transit) data
- Aggregate, process and format real-time travel data
- Perform predictive analysis using historic travel data
- Process real-time traffic data to create dynamic route guidance services
- Perform some of the business activities above, and also provide information services to an information service retailer or directly to the private traveler.

1. Your name, job title, and contact information (if different from page 1)

   Name: _____ Title: _____

   _____

   Telephone: ( ) - Fax: ( ) -

   Email: _____

2. For the following list of ATIS data elements:

   - In columns 2 through 4, rank each element in terms of its importance to your business by checking High, Medium (Med), or Low.
   - In column 5, check if the data element is available to you. A data element is defined as being *available* to you in this survey as long as:
     - It is collected, either by your company or by some other agency;
     - The collecting agency shares the information, either by providing it for free or selling it;
     - If the agency is selling it, the price they charge is not too high for your purposes.

Note: *If the data element is collected by another agency but is unreliable or of insufficient quality, it is still regarded as available, however you may want to qualify your response.*

Table 2. The importance and availability of ATIS data elements		2.	3.	4.	5.
Data element		**High**	**Med**	**Low**	**Is it available?**
a.	Traffic volumes				
b.	Traffic speeds				
c.	Traffic speed limits				
d.	Lane occupancy				
e.	Vehicle classification				
f.	Transit vehicle location				
g.	Transit routes and schedules				
h.	Ramp queues				
i.	Signal queues				
j.	Metering rate				
k.	Turning movements				
l.	Signal phasing/cycle lengths				
m.	Road conditions (ice, wet, debris, etc.)				
n.	Route designations (snow emergency, changing one-way designation, etc.)				
o.	Weather conditions				
p.	Incidents (location, nature, time, estimated clearance time)				
q.	Current work zones (location, duration, lane closures)				
r.	Scheduled work zones (as above)				
s.	Intermodal connections (airport parking, transit schedules etc.)				
t.	Other (describe)				
u.	Other (describe)				

This question applies only to those companies that supplement existing traffic and transit data sources with their own data collection. All other companies should skip this question and continue with the following questions.

3. For the following list of ATIS data elements:

   - In column 2, check *if you collect the data element directly from the transportation network* (e.g., CCTV, manually, or aircraft).
   - In column 3, describe the method or tool you use to collect the data. A list of possible tools is provided below.

Table 3. Collecting data from the transportation network		2.	3.
Data element		**Do you collect it?**	**Describe how you collect it**
a.	Traffic volumes		
b.	Traffic speeds		
c.	Traffic speed limits		
d.	Lane occupancy		
e.	Vehicle classification		
f.	Transit vehicle location		
g.	Transit routes and schedules		
h.	Ramp queues		
i.	Signal queues		
j.	Metering rate		
k.	Turning movements		
l.	Signal phasing/cycle lengths		
m.	Road conditions (ice, wet, debris, etc.)		
n.	Route designations (snow emergency, changing one-way designation,		
o.	Weather conditions		
p.	Incidents (location, nature, time, estimated clearance time)		
q.	Current work zones (location, duration, lane closures)		
r.	Scheduled work zones (as above)		
s.	Intermodal connections (airport parking, transit schedules etc.)		
t.	Other (describe)		
u.	Other (describe)		

The following list of data collection tools is provided for your convenience, as examples of data collection tools.

- Loop detectors
- Video imaging detectors
- Probe readers
- Acoustic detectors
- Microwave radar
- Free cellular phone call to a dedicated number other than 911
- Free cellular phone call to area radio station
- Police patrols
- Computer algorithms linked to traffic surveillance equipment
- CCTV
- Drivers paid to provide traffic reports for defined road segments, days, and times

4. For each data element that is *available to you from another agency and relevant to your business*, please answer the following:

   - In column 2, state which agency (or business) it comes from.
   - In column 3, check if it is of sufficient quality for your purposes. In this survey, data of sufficient quality is defined as data meeting current minimum requirements for converting into a quality, marketable product.
   - In column 4, if the data element is of insufficient quality, indicate why it is of insufficient quality. For your convenience, a list of data quality problems with letter codes is provided as an example.

Table 4. Origin and quality of travel data		**2.**	**3.**	**4.**
Data element		**Agency it comes from**	**Sufficient quality?**	**Why not? (use letter codes if possible)**
a.	Traffic volumes			
b.	Traffic speeds			
c.	Traffic speed limits			
d.	Lane occupancy			
e.	Vehicle classification			
f.	Transit vehicle location			
g.	Transit routes and schedules			
h.	Ramp queues			
i.	Signal queues			
j.	Metering rate			
k.	Turning movements			
l.	Signal phasing/cycle lengths			
m.	Road conditions (ice, wet, debris, etc.)			
n.	Route designations (snow emergency, changing one-way designation,			
o.	Weather conditions			
p.	Incidents (location, nature, time, estimated clearance time)			
q.	Current work zones (location, duration, lane closures)			
r.	Scheduled work zones (as above)			
s.	Intermodal connections (airport parking, transit schedules etc.)			
t.	Other (describe)			
u.	Other (describe)			

The following list of data quality problems with corresponding letter codes is provided for your convenience, as an example. For clarification of terminology, see next page.

a) Data not accurate.
b) Data not at required spatial resolution.
c) Data do not cover required geographic area.
d) Data not updated at required frequency.
e) Data not timely enough.
f) Other (please describe briefly in column 4).

Instructions for respondents: The following examples clarify the terminology provided as descriptions of why the data are insufficient.

- An example of inadequate spatial resolution: If you get data on traffic speeds at 5-mile intervals along a roadway but you need the data at one-mile intervals.
- An example of inadequate geographic coverage: If the data cover only two out of the three adjacent counties which form your area of service, or if they cover only freeways but not arterials in your area of service, or if important road segments are not covered.
- *Note the distinction* between *frequency* (option d) and *timeliness* (option e). The distinction arises for two reasons. First, some data (such as incident data) may not be regularly updated, but are relevant when an incident does occur and again when the incident has been cleared. Secondly, even for a data element with a characteristic frequency, there may be a *lag time* that is independent of frequency.

5. For each data element that is *unavailable, but which you would like to have for your business,* please answer the following questions:
   - In column 2, check if it is collected by another agency but not made available to you.
   - In column 3, check if it is collected by another agency but access is too costly for your purposes.
   - In column 4, check if no one collects it in your geographic area of business even though the technology exists.
   - In column 5, check if no one collects it because existing technology isn't sufficient to capture the data.
   - In column 6, briefly describe any other reasons for its unavailability.

Table 5. Data that are unavailable	**2.**	**3.**	**4.**	**5.**	**6.**
Data element	**Collected but not available**	**Collected but too costly**	**Not collected even though technology exists**	**Not collected, technology insufficient**	**Other (describe)**
a. Traffic volumes					
b. Traffic speeds					
c. Traffic speed limits					
d. Lane occupancy					
e. Vehicle classification					
f. Transit vehicle location					
g. Transit routes and schedules					
h. Ramp queues					
i. Signal queues					
j. Metering rate					
k. Turning movements					
l. Signal phasing/cycle lengths					
m. Road conditions (ice, wet, debris, etc.)					
n. Route designations (snow emergency, changing one-way designation, etc.)					
o. Weather conditions					
p. Incidents (location, nature, time, estimated clearance time)					
q. Current work zones (location, duration, lane closures)					
r. Scheduled work zones (as above)					
s. Intermodal connections (airport parking, transit schedules					
t. Other (describe)					
u. Other (describe)					

Instruction for respondents: In questions 6 through 9 below, you are asked to suggest solutions to the data quality and availability problems you have identified in your answers above. *Do not* feel obligated to cover all data elements identified as missing. Focus only on those missing data elements which are of particular importance to you, and/or any other data elements you want to focus on. Please provide a brief written description in each case.

6. For the missing data elements which are not collected or not collected at sufficient quality ***because of technological limitations***, what technological solutions do you envision to solve the problem?

7. For the missing data elements which are not collected or unavailable to you ***because of cost constraints***, what incentives, public support, and/or other solutions do you envision to overcome these cost constraints?

8. For the missing data elements which are not collected or unavailable to you ***because of institutional constraints***, what institutional arrangements/agreements do you envision to overcome these constraints?

9. What solutions do you envision to overcome any other constraints?

10. Please describe any other data and information availability or quality issues, or any other problems with data and information, which have not been identified in this survey.

11. Please suggest solutions to the problems and constraints identified in 10 above.

Section 3.

For companies that package and disseminate traffic and transit information

Please note: These questions refer only to the travel information you provide, not to news, stocks, sports, etc.

1. Your name, job title, and contact information (if different from page 1)

   Name: _____ Title: _____

   _____

   Telephone: (_____) _____ - _____ Fax: (_____) _____ - _____

   Email: _____

2. For the following list of ATIS information elements:

   - In columns 2 through 4, rank each element in terms of its importance to your business by checking High, Medium (Med), or Low.
   - In column 5, check if the information element is available to you. An information element is defined as being *available* to you in this survey as long as:
     - It is provided by some agency or business;
     - The price charged by the provider is not too high for your purposes.

Note: *If the information element is collected but is of insufficient quality for your purposes, it is still regarded as available, however you may want to qualify your response.*

Table 2. The importance and availability of ATIS information elements		**2.**	**3.**	**4.**	**5.**
Information element		**High**	**Med**	**Low**	**Is it available?**
a.	Traffic volumes by roadway segment				
b.	Traffic speeds by roadway segment				
c.	Traffic speed limits by roadway segment				
d.	Lane occupancy (HOV lanes, express lanes, etc.)				
e.	Travel times between customer-specified origins and destinations				
f.	Travel times on customer-specified routes				
g.	Transit vehicle location				
h.	Transit wait time estimates				
i.	Transit travel time estimates				
j.	Transit routes and schedules				
k.	Ramp queues				
l.	Signal queues				
m.	Road conditions (ice, wet, debris etc.)				
n.	Route designations (snow emergency, changing one-way designation, etc.)				
o.	Weather conditions				
p.	Incidents (location, nature, time, estimated clearance time)				
q.	Current work zones (location, duration, lane closures)				
r.	Scheduled work zones (as above)				
s.	Intermodal connections (airport parking, transit schedules etc.)				
t.	Real-time video of traffic conditions				
u.	Other (describe)				
v.	Other (describe)				

3. For each information element that is *available to you and relevant to your business*, please answer the following:

   - In column 2, state which agency/business it comes from. If it comes from another division of your company, please say so.
   - In column 3, check if it is of sufficient quality for your purposes. In this survey, information of sufficient quality is defined as information meeting current minimum requirements for converting into a quality, marketable product.
   - In column 4, if the information element is of insufficient quality (i.e. if you have not checked column 3), indicate why it is of insufficient quality. For your convenience, a list of information quality problems with letter codes is provided as an example.

Table 3. Origin and quality of travel information		**2.**	**3.**	**4.**
Information element		**Agency it comes from**	**Sufficient quality?**	**Why not? (use letter codes if possible)**
a.	Traffic volumes by roadway segment			
b.	Traffic speeds by roadway segment			
c.	Traffic speed limits by roadway segment			
d.	Lane occupancy (HOV lanes, express lanes, etc.)			
e.	Travel times between customer-specified origins and destinations			
f.	Travel times on customer-specified routes			
g.	Transit vehicle location			
h.	Transit wait time estimates			
i.	Transit travel time estimates			
j.	Transit routes and schedules			
k.	Ramp queues			
l.	Signal queues			
m.	Road conditions (ice, wet, debris etc.)			
n.	Route designations (snow emergency, changing one-way designation,			
o.	Weather conditions			
p.	Incidents (location, nature, time, estimated clearance time)			
q.	Current work zones (location, duration, lane closures)			
r.	Scheduled work zones (as above)			
s.	Intermodal connections (airport parking, transit schedules etc.)			
t.	Real-time video of traffic conditions			
u.	Other (describe)			
v.	Other (describe)			

The following list of information quality problems with corresponding letter codes is provided for your convenience, as an example. For clarification of terminology, see next page.

a) Information not accurate.
b) Information not at required spatial resolution.
c) Information does not cover required geographic area.
d) Information not updated at required frequency.
e) Information not timely enough.
f) Other (please describe briefly in column 4).

Instructions for respondents: The following examples clarify the terminology provided as descriptions of why the information is insufficient.

- An example of inadequate spatial resolution: If you get information on traffic speeds at 5-mile intervals along a roadway but you need the data at one-mile intervals.
- An example of inadequate geographic coverage: If the information covers only two out of the three adjacent counties which form your area of service, or if it covers only freeways but not arterials in your area of service, or if important road segments are not covered.
- *Note the distinction* between *frequency* (option d) and *timeliness* (option e). The distinction arises for two reasons. First, some information (such as incident information) may not be regularly updated, but are relevant when an incident does occur and again when the incident has been cleared. Secondly, even for an information element with a characteristic frequency, there may be a *lag time* that is independent of frequency.

4. For each information element that is *unavailable, but which you would like to have for your business,* please answer the following questions:

   - In column 2, check if it is collected by another agency/business but not made available to you.
   - In column 3, check if it is collected by another agency/business but access is too costly for your purposes.
   - In column 4, check if no one collects it in your geographic area of business.
   - In column 5, briefly describe any other reasons for its unavailability.

Table 4. Information that is unavailable		**2.**	**3.**	**4.**	**5.**
Information element		**Collected but not made available**	**Collected but too costly for you**	**Not collected by anyone**	**Other (describe)**
a.	Traffic volumes by roadway segment				
b.	Traffic speeds by roadway segment				
c.	Traffic speed limits by roadway segment				
d.	Lane occupancy (HOV lanes, express lanes, etc.)				
e.	Travel times between customer-specified origins and destinations				
f.	Travel times on customer-specified routes				
g.	Transit vehicle location				
h.	Transit wait time estimates				
i.	Transit travel time estimates				
j.	Transit routes and schedules				
k.	Ramp queues				
l.	Signal queues				
m.	Road conditions (ice, wet, debris etc.)				
n.	Route designations (snow emergency, changing one-way designation, etc.)				
o.	Weather conditions				
p.	Incidents (location, nature, time, estimated clearance time)				
q.	Current work zones (location, duration, lane closures)				
r.	Scheduled work zones (as above)				
s.	Intermodal connections (airport parking, transit schedules etc.)				
t.	Real-time video of traffic conditions				
u.	Other (describe)				
v.	Other (describe)				

Instruction for respondents: In question 6 below, you are asked to identify any additional information quality and availability issues not identified above. In question 7 below, you are asked to suggest solutions to the information quality and availability problems you have identified in your answers above. *Do not* feel obligated to cover all information elements identified as missing. Focus only on those missing information elements which are of particular importance to you, and/or any other information elements you want to focus on. Please provide a brief written description in each case.

6. Please describe any data and information availability or quality issues, or any other problems with data and information, which have not been identified in this survey.

7. Please suggest solutions to the problems and constraints identified above.