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ABSTRACT

The market for traffic information has grown considerably in the past 10 years. Traffic information is different from other goods because the cost to users is negligible and the product is indirectly priced. As a result of these unique characteristics, the classic economic model can not be applied to determine the price or the amount of information which would be produced and consumed under competitive equilibrium. Examination of the history of traffic information as a marketable good and the structure of the market indicate that traffic information providers are experiencing significant economies-of-scale while the industry is migrating toward a monopolistic state. The market for commercial broadcast information has proven to be quite profitable for private industries. At the same time, a market for repackaged traffic information has developed; various commercial products and services can be derived from the data retrieved from traffic information systems. However, the companies selling customized information have not experienced the same level of success as traffic information providers. To explain this disparity, a comparison is made between the market for customized and commercial information. In addition, policies which maximize the benefits produced from traffic information are proposed. It was concluded that the industry is self-sustaining without public finance and that competition within local markets should be maintained.

Keywords: Traffic information, information broadcasting

INTRODUCTION

Traffic information systems are perceived by many as a method which can help to alleviate congestion. Recent advances in communications and transportation technology have made it possible to bring traffic and transit information readily to the users and managers of a system. Information such as the locations of traffic incidents, road conditions, and optimal routes are provided by Advanced Traveler Information Systems (ATIS) with the objective of influencing the traveler's decisions concerning mode choice, route choice, and departure time. Different types of information currently in development or in service include commercial broadcasts, route guidance systems, telephony, and paging systems.

Objective

There have been many ATIS efforts in recent years, such as the TravInfo System in the San Francisco Bay Area and the SmarTraveler in Boston. Work has been done to evaluate the feasibility of some technologies, but this has not contributed (nor was it the intention) to the justification of investments being made in traffic management. In order to validate the public sector's potential role as an information provider, it is first necessary to understand the behavior of private traffic information providers and the structure of the industry.

Very little has been written about traffic information providers and even less literature has been published about the structure of the industry. This study is an attempt to understand the structure and the behavior of the participants in the traffic

information industry and how the industry operates. The particular objectives of this study are to: (a) provide an overview of the commercial traffic information services in the United States; (b) explain why firms providing traffic information are what they are; and (c) determine what kinds of enterprise activities and arrangements would best meet traveler needs, including the role of public agencies that are concerned with system management.

Review of Literature

The behavior of travelers influences the performance of a transportation network and impacts the operations of ATIS. Thus it is important to know how ATIS will affect travelers' decisions. Extensive research has been conducted on the understanding of travelers' behavior and how their route choice might change if they were given some relevant pre-trip information. Previous research has focused on the demand for an ATIS system. Results (Beaton *et al*, 195) indicate that there is a strong interest for an ATIS service and for information estimating the expected delay for an incident, but not for information regarding alternate routes.

Research has also been performed to determine the factors which affect commuters' behavior and decision-making. Abdel-Aty *et al*. (1995) found that the commuter's perception of the accuracy of the report significantly influenced the decision to change routes. Khattak *et al*. (1996) used stated preference models to study how travelers might respond to future ATIS technologies and unexpected congestion. Respondents were willing to use an ATIS device which gave accurate delay information,

usually either by changing their departure time or taking an alternate route. The potential benefits of traffic information (e.g., travel-time savings) and the effectiveness of ATIS to reduce the delay caused by incidents has also been studied (Hall, 1993).

Other works have evaluated the quality of traffic information provided by specific information systems. Daniels *et al*. (1976) analyzed the behavior and attitudes of drivers toward driving information in the Chicago area. They concluded that traffic reports would reach more travelers if the commercial traffic reports given were more accurate and timely. Also, more drivers could be reached if more radio stations provided traffic reports. However, literature investigating the structure of the traffic information industry and how the providers (both public and private) interact with the consumers, i.e., radio stations and travelers, is limited and restricted. Commercial information suppliers have conducted internal research in areas such as determining the "best" method of collecting information, but these results remain proprietary.

Many of the ideas presented in this study of the industry evolved from phone interviews with and site visits to information providers and radio stations, published newspaper articles and books, and a survey of companies involved in the industry. Because the industry is operated by private firms, much of the desired information was unavailable. The data available at the industry level are limited in scope and detail, and news publications provided most of the information about how the industry operated, how it has changed in recent years, and who the major participants were in the industry.

The interviews conducted provided a more complete portrait of the industry's structure and the manner in which firms operate.

HISTORY OF THE INDUSTRY

The general public is usually unaware of the role traffic information providers play in supplying information to broadcast stations, since they remain anonymous when their product is disseminated. Despite these relations, information providers such as Metro Networks and Shadow Broadcast Services have the ability to influence a traveler's mode choice and/or route choice.

Traffic reports have been around for approximately forty years. Today they are a regular part of morning and afternoon radio programming. The start of traffic reporting, however, is not well documented; the nation's first traffic report may have been delivered by chance in the San Francisco Bay Area in 1957 (Castillo, 1986). A private pilot who flew every morning to give live weather reports for KSFO-AM noticed, as he was flying, a stalled car on the upper deck of the Bay Bridge. During one of his broadcasts, he mentioned the stalled car on the air and commented that as a result, traffic was backed up to the toll plaza. As a result of listener responses, the pilot was asked to fly over the Bay Bridge daily to give reports on the traffic conditions.

News spread about KSFO's traffic report. The following year, reporters at KMPC, KSFO's sister station in Los Angeles, began flying two aircraft. Other radio station managers across the country saw a demand among listeners for traffic reports and started to broadcast traffic information. Historically, traffic reporters were private pilots who learned how to talk on the radio. Many broadcasters learned to fly and gave up their jobs to start traffic reporting companies. At one time, there were "hundreds" of

information providers, as radio stations employed their own reporter and bore the cost of their own aircraft. It should be noted that traffic reports were not as common as they are today; not every radio station provided them. Ultimately, due to the high costs of operating an aircraft, most of the companies could not afford to fly planes and went out of business.

The Growth of Traffic Reporting Services

As congestion on the roadways has worsened, the demand for up-to-the minute traffic reports has grown. Studies conducted by numerous stations have shown that traffic reporting is important to listeners. Radio stations provide the information to their listeners as a type of community service since many stations' primary focus is the music and not news or traffic reports. The provision of traffic reports is also seen as a means to attract more listeners, or at least not lose listeners, who are interested in road conditions. In one case, the broadcasting of traffic reports brought a radio station's ratings during the morning commute period to the top (Hunt, 1985). Most stations do not have the money to operate their own aircraft nor to hire their own traffic reporter. Thus, they have come to rely on traffic reporting services to provide them with traffic reports.

The two largest private traffic reporting services in the U.S. today are Metro Networks, based in Houston, and Shadow Broadcast Services, based in Philadelphia. These traffic information providers offer their services on a barter system; traffic reporting services supply the radio station with traffic reports in return for inventory, i.e., air time, which is subsequently sold to advertisers. Therefore, the companies' main

source of revenue is generated from the packaging and selling of the commercial inventory provided by their radio and television affiliates. As a result, radio stations do not always pay a fee for the service. A third provider, Smart Route Systems, telephonically delivers traffic and transit information to travelers and also markets their information to broadcast stations and cellular phone services. Here, the broadcast stations usually pay a fee rather than transfer inventory to the providers. Despite the common perception that every station has its own helicopter and reporter, typically only one or two private information providers exist in a metropolitan area.

National Information Providers

The need for better traffic reporting inspired the beginning of Metro Traffic, which started in 1978. Mobile units were placed on the roads to observe traffic conditions and report via two-way radio to a central studio with aerial spotting for back-up purposes. The information was then assembled into professional reports by a broadcaster. Since their beginning, Metro's basic operations have remained unchanged as they have expanded into more than 60 U.S. markets.

Current reports show that Metro is the largest provider of traffic report services in the U.S., serving approximately 1,275 radio affiliates and 110 television affiliates. Although Figure 1 is only a rough approximation of the company's gain in new markets, it can be seen that Metro has grown dramatically during the last decade, more than tripling the number of markets from 20 in 1987 to 66 in 1997. They expect to expand into the

remaining 18 of the 75 largest Metropolitan Statistical Area (MSA) markets within the next two years.

Shadow Broadcast Services, the second largest traffic information provider, is a subsidiary of Westwood One and also affiliated with Westinghouse and Infinity Broadcasting. Shadow Traffic presently operates in fewer cities than Metro Traffic and has undergone several re-organizations since it was launched in 1976. Shadow Broadcast Services was started by truckers and drivers exchanging traffic tips to each other via CB under the handle "Shadow. Currently, they have operations in fifteen other cities, providing traffic, news, sports, and weather programming to more than 400 radio and television stations nationwide.

Although Shadow started operating before Metro, they have not experienced the same growth. However, with the backing of the well-financed Westwood and Infinity, they established an aggressive strategic growth plan to reach 27 cities in 1997 and have also been able to invest in new equipment (e.g., 20 video cameras in New York) to help disclaim some of the operations' reputation as a "less-than-accurate source of information" (Thompson, 1996).

In addition to providing traffic reports, both Metro Networks and Shadow Traffic have exploited economies-of-scope by expanding into other markets: local and regional news; weather and sports broadcasts; television traffic; and video news services. They have also become involved with traffic management systems (e.g., TravInfo) for local, state, and federal government agencies. Their expansion efforts during the last few years

have focused on acquiring other traffic reporting operations in smaller areas rather than starting up new operations. In some cases, this meant eliminating the competition. By acquiring operations in current markets, information providers are able to experience some economies-of-scale. In addition, their advertisers are then able to purchase spots at the national level and have their sponsorships heard in more cities.

The third provider, SmartRoute Systems, was founded in April 1988 as Enroute Systems. The company focuses on packaging and reselling information to drivers, using the telephone as their media to drivers. In 1991, Enroute Systems re-organized as a Field Operational Test (FOT) with funding from the U.S. Department of Transportation and became SmartRoute Systems, Inc. (DeBlasio, 1994). SmartRoute began its Boston operations in May 1991 and launched its second site in Cincinnati in June 1995. They are presently expanding into five new cities and plan to expand into the forty largest U.S. cities. Unlike Metro and Shadow, SmartRoute sells their information services directly to broadcast stations, commercial vehicle operators, delivery services, and cellular phone companies, receiving a monetary value for the information. More importantly, SmartRoute continues to receive public funding from the Massachusetts Highway Department for designing and operating *SmarTraveler*, a telephony ATIS project in the Boston metropolitan area which provides real-time, route-specific traffic and transit information. The unique public/private relationship SmartRoute created with government agencies might be used as a model for future incident management projects.

Local Information Providers

The success of traffic reporting services has spawned a number of local competitors. Because of the smaller, more independent nature of local providers, a complete list of all existing traffic information providers would be too difficult to assemble. Table 1 shows a partial list of the providers in operation as of 1997 (?) as well as those which have been bought out, by either Metro Networks or Shadow Traffic.

In some cities, traffic information providers were started by former Metro employees who felt that there was room for competition, as managers of radio stations have expressed dissatisfaction with Metro's services (Welch, 1988; Levine, 1995). Since Metro is the dominant provider in most markets, they may not be overly concerned about catering to the individual affiliate's needs, possibly leading to a decrease in Metro's quality. Also, some stations prefer having local people report the traffic and dislike dealing with the bureaucracy and policies of large corporations (Welch, 1988).

Local providers try to differentiate themselves from the competition, usually either by doing custom feeds or by using additional aircraft to cover traffic conditions. For example, Traffic Watch, Metro's rival in Baltimore, reported to specific radio or television stations at an assigned time, while Metro's network reports were aired by all the stations during the same time period (Synder, 1988). It should be noted that Metro currently customizes their reports to the individual radio and television stations.

In some markets, however, radio stations that choose to collect their own traffic information are the only competition for national providers. Some radio stations feel it is

more efficient to lease their own aircraft and/or mobile units and hire their own traffic reporters than to contract with a traffic information service. Thus, these radio stations are able to directly sell the air time around the traffic report to advertisers as well as serve as a check point for providers if the market was not competitive.

Different Services Offered

In most markets, a company will often try to capture market share by producing a product which is different from its competitor. However, for traffic information, the differences between the services offered are sometimes subtle. This may be due to the similar sources of information used by the different providers. For example, the most common methods of collecting information include the use of multi-channeled police and emergency scanners, the highway patrol's computer assisted dispatch (CAD), aircraft, and cellular callers. Since all providers receive the same information from the public data sources, the contents of traffic reports given by competing companies often do not differ by much. The largest differences appear in the style in which each provider chooses to report rather than the content of each report. In addition, despite the vast amount of information available, each report is restricted to 30-90 seconds in length. As a result, all providers will choose to report on incidents which affect the greatest number of listeners, although reports for smaller stations occasionally will be catered toward listeners in a particular region.

Technological advances in recent years have contributed to the growth of service differentiation in the traffic reporting industry. Travelers today are also able to view

traffic conditions on the Internet. Websites which are set up for most major cities show the speeds along certain segments of the roadways as well as report on incidents or accidents on the network. The information on these sites are usually provided by one of the national information providers. Websites offer the opportunity to report on many more incidents than a radio report since its length is not constrained.

Travelers are also able to use faxing or paging services to receive traffic information. In such cases, a report is faxed to the customer within minutes of his request. Other than a fax machine, special equipment is not required for this service. There are two approaches to the paging of information. Some companies have attempted to market their own paging device which is connected to the traffic information service. To receive traffic information, individuals would purchase a gadget and pay a monthly service fee. This approach has not been very successful because it requires the traveler, who can obtain free information from the radio, to make an investment. The other approach has proven to be more successful since it utilizes the alphanumeric pager already available on the market. The pager is programmed to receive and display traffic information, including accident reports, scheduled road/ramp closures, and roadway conditions, for a monthly fee which some customers have been willing to pay.

As a result of the different types of services offered, different levels of service have been introduced into the market. For example, the information broadcast over the radio is limited in scope while the information available on the Internet is more comprehensive. The paging services allow the customer to choose the routes and areas to

be covered in his reports or the type of information received, e.g. reports which only provide information about areas where traffic is moving below a certain speed or reports which only provide information regarding incidents affecting normal traffic flow on freeways, ramps, or major surface streets. In the future, a more elaborate tiered market for traffic information may develop as a result of additional technological advances and further exploration of the market.

STRUCTURE OF THE INDUSTRY

Flow of Information

The economic network of the industry varies from market to market, but the most common scenario is shown in Figure 2 and is as follows:

- The information providers absorb the costs of the equipment and labor necessary to gather the information. This information can be collected in a number of ways.
- The information providers then market their information to broadcast stations. The broadcast stations give the traffic information provider a fixed amount of airtime. The information providers then agree to fill the majority of this allotment with traffic information and sell the remaining segment to an advertising sponsor.

In some cases there is also a transfer of money between the information providers and the broadcast stations. The direction of this transfer appears to depend on the presence of competition among information providers while the magnitude varies with the demand. For example, in a competitive market the provider may pay a broadcast station

to for the right to supply their traffic reports; conversely, without competition the provider could raise the price of the reports to be delivered.

Traffic Information Providers

Methods of Collecting Information

In most cities, providers use methods which are operated by the public sector and introduce their own data collection methods when necessary. The choice among the available data collection methods seems to be driven by the questions outlined in Figure 3.

- *Does the information presently collected provide adequate reports?* According to the results of our survey, this appears to depend upon the presence of competing information providers, the competition's level of accuracy, and the ability of broadcast stations to differentiate among products. The course(s) of action taken is motivated by the providers' desire to maintain customers.

- *If the information collected is insufficient, which source should be used to supplement the information?* The three most common methods include the use of aircraft, cellular phones, and closed-circuit television. The first two do not require capital investment and offer more flexibility, which is invaluable due to the varying location of incidents. The third medium allows constant monitoring of the locations of particular importance, e.g. major thoroughfares or locations common for incidents. Each method has its own marginal benefits, limitations, and costs and can be described as follows:

Aircraft. Helicopters and planes are often visible ways by which providers can show that they are monitoring traffic. Despite the high operating costs ($60/hr for aircraft and $400/hr for helicopter) and the difficulty of operation in bad weather, many providers use aircraft to remain competitive. Also, air surveillance allows for almost immediate incident verification.

Cellular Phones. Different information providers have negotiated contracts with cellular phone companies to encourage their use for traffic information purposes. For example, the two primary radio stations for traffic information in the Bay Area are KCBS-AM and KGO-AM. Each company has an exclusive contract with one cellular provider. Drivers who subscribe to a particular cellular phone service can call one of the two radio stations free-of-charge to report an incident. For part of the day, the radio station receives the call themselves, while at other times the calls are forwarded to an information provider. These promotional agreements are beneficial for both parties in that they allow the information collectors to gather information at minimal cost while the cellular providers receive free mention of their services on the radio. Another example is Smart Route Systems which has negotiated contracts with cellular providers such that callers may call to receive free traffic updates. In return, cellular providers are allowed to preface each traffic report with a promotional message.

CCTV. CCTV cameras provide a means for verifying incidents from a central control point. However, they require an initial investment to be made and maintenance thereafter.

CCTVs are often adjustable in direction or magnification but offer less flexibility since they are permanently installed. The cameras are also susceptible to vandalism and theft.

Traffic Information Consumers

Traffic information providers generally supply their traffic information to radio and television stations on a barter basis. Due to the high costs of aircraft rental and maintaining a traffic reporting staff, most radio stations choose to forfeit commercial slots to traffic information providers in exchange for traffic reports. Radio stations provide traffic reports to attract listeners and rely on traffic reports almost as much as popular on-air personalities. In effect, the larger the listener base they have, the higher the advertising rate they can charge. Similarly, if the information provider is able to contract radio stations with major market shares, they too can raise the sponsorship rate.

Other consumers of traffic information include traffic reporting services which repackage the information and government agencies which use it for freeway management. Traffic information is available for some cities via the Internet (e.g., Los Angeles, Chicago, and Seattle) or telephone (e.g., Boston and San Francisco). The majority of these appear to be financed by public agencies. For example, Chicago's site is sponsored by the Illinois and Indiana DOTs and the Los Angeles map and TravInfo phone system are sponsored by the California Department of Transportation. It should be emphatically noted that commercial broadcasts are the only self-sufficient group in the industry.

Trends

In recent years, the market for traffic information has migrated toward a monopolistic state. This trend is a result of the economies of scope and scale inherent in the market, as well as some characteristics of larger agencies. Economies-of-scale result when larger agencies buy out local information providers. The buyer which already has operations in the area does not absorb many additional costs and inherits a profitable list of new customers. The additional costs are small since the provider experiences decreasing average costs, having already collect the information. This is due to the decreasing impact of fixed costs (i.e., gathering and broadcast equipment) and linear variable costs (i.e., personnel). Economies-of-scale result from larger companies having the resources and capital to provide more information and more accurate reports than their smaller competitors. Thus, larger providers are more efficient and attractive as an information source. Large agencies such as Metro and Shadow have two characteristics which give them additional advantages over smaller local providers: (a) they have a larger financial base for initial investment; and (b) the promise to broadcast stations of increased advertisement from national sponsors which the national providers can offer through its nationwide connections.

PROSPECTS FOR THE INDUSTRY

Value-Added-Resellers

In addition to the commercial reports, various products and services can be derived from the data retrieved from traffic information systems. Value-Added-Resellers (VARs) are companies which repackage and resell the information to travelers. Some of the commercial products and services which VARs have considered developing as well as products and services available on the market today include: pagers, cellular phones, automated route guidance, and kiosks. Companies are able to present the information in a more convenient and innovative form to their customers. In general, VARs take one of three approaches with their product: (a) customized, route-specific information; (b) routing and alternate route information; and (c) in-vehicle navigation and route guidance.

Since most VARs are currently developing and marketing dynamic and multi-modal ATIS products, they intend to use the information from FOTs or commercial providers to expand and/or enhance their current products/services by being able to update their information more frequently. These products/services include: traffic and transit conditions, road construction, incidents, ride-matching, commuting alternatives, and routing. In addition, many VARs intend to introduce a new ATIS product/service in the near future.

Many of the planned products and services require some type of communication equipment. For example, one company which manufactures car audio equipment and other mobile electronic products hopes to introduce an in-vehicle navigation system

which is CD-ROM-based and designed to pick up and decode real-time traffic information data from wireless broadcasts. The system alerts drivers by displaying the area affected by traffic congestion, construction, or incidents on a screen. Another feature the system offers is finding the best route between given origin and destination points. However, users must purchase the equipment which includes an antenna, the video monitor, and Gyro sensor before being able to receive in-vehicle information. The company plans to sell the system for approximately $2000 to its customers.

Another company has developed an on-line transportation demand management/rideshare system. The system will directly disseminate the information to its end-users. Users of the on-line system connect via both networks and modem dial-ups to access information about commute alternatives as well as coordinate ridesharing efforts. A similar system will also be offered by a private, non-profit organization to individuals, catering to their needs and can be accessed by telephone, fax, and mail. Costs for these services were not available. Also, travelers can receive updated traffic or transit information via voice-mail, e-mail, paging services, and faxing services. Customized, route-specific traffic information can be processed and then distributed to individuals via fax, e-mail, or page within minutes of obtaining the information.

The Market for VARs

Although VARs provide traffic and transit information to travelers just as information providers such as Metro Traffic and Shadow Broadcast do, VARs differ in that their revenue is often derived directly from the users of the information. Travelers

who subscribe to these services pay a fee, usually monthly, for the information they receive. The direct payment creates a more classic model of the demand in the market. For example, companies can create more specialized products to develop the tiered market which is common for other goods, and they are able to charge different prices for each specialized product. The largest market for specialized products appears to exist with commercial vehicles (e.g., distributors, taxicabs, rental agencies). These users are willing to pay for tools such as route guidance, because they are often traveling in unfamiliar areas and have a higher value of time.

Many attempts have been made to sell customized traffic information directly to the users. However, experience seems to show that individuals' willingness-to-pay is not very high and that the market for value-added information would be small. Beaton and Sadana's study (Beaton *et al*, 1995) showed that seven percent of the respondents indicated they would subscribe to "basic ATIS services" with no monthly fee. This percentage drops to only 3.7 percent if a $5 fee is imposed for the same services. It appears that the public is not inclined to pay large subscription fees for traffic information and few people are interested in obtaining traffic information from sources other than commercial radio broadcasts.

As a result of low or no perceived user cost for commercial broadcasts, companies that require their customers to purchase special equipment to receive the same information have not been able to sustain themselves. For example, in 1992 a San Francisco company developed a pager which would alert the individual of traffic jams and

congested segments of the road. In order to receive the information, users needed to purchase the special pager for $199 as well as pay $15 in monthly service fees. The market did not respond well to the paging service and the company ceased operations a year later. This indicates that although a market exists for VAR services, it may not be large enough to become profitable.

It is difficult to assess the true value of traffic information and evaluate the prospects for value-added products/services. Substantial amounts of funding have been invested, both by the public and the private sector, into developing and conducting market research for ATIS products and services. However, the individual VARs' research results are considered proprietary and unavailable. Companies which have attempted to sell customized traffic information directly to travelers have not been able to turn profits. SmartRoute, although still in operation, receives a significant portion of their funding from government sources and private companies. The demand for traffic information services has not materialized, forcing some companies to go out of business or become dependent upon federal funding.

CONCLUSIONS

Traffic information alone will not sell. One way to increase the value of traffic information is to package it with an electronic device such as a cellular phone or pager. The market for traffic information appears to be technology driven in that the use of personalized information may increase significantly as technology advances. It is difficult, however, to determine the size of the potential market. Studies (Perez, 1993) have shown that individual drivers can appreciate in-vehicle information devices, but do not value the information enough to pay more than the cost of the device itself. Also, in order for the market to generate customers, the system needs to be able to provide real-time traffic information. Current traffic data collection methods need to be refined and expanded as they do not permit this.

The uniqueness of the traffic information industry and the recent direction it has taken raise a very important issue. Since the industry is largely unregulated, and direct pricing is rarely employed between suppliers and users of broadcast information, many operations are (partially) publicly subsidized as FOTs or as new avenues of dissemination. The need for public financing is questionable since (a) the costs could be mitigated by investments by competing private suppliers; and (b) the benefits gained from products/services other than commercial broadcasts may be negligible. Therefore, it is necessary to question what role the public agencies are best suited to play.

The market for traffic information appears to be expanding rapidly in all dimensions including: use of technology to reduce costs, increased demand among

information media and drivers, and increased cooperation between public and private agencies. The growth in the demand for commercial broadcasts is evidenced by the stations' self-advertising. The potential for growth in personalized information exists, and numerous attempts are being made to capture this. One should also note the competition between the providers of commercial broadcasts and VARs; as reports become more frequent on commercial broadcasts, the marginal benefit which VARs can offer with real-time information diminishes. The final shape of the market will be driven by individuals' willingness to participate, and growth will stabilize only when the demand for information can grow no further or the technologies have reached their limitations.

Future Research

The traffic information industry has been shown to exhibit significant economies-of-scale and of-scope, and in many metropolitan areas competition among providers is non-existent. One area to be addressed is the loss in efficiency which occurs with multiple providers. At the same time, the increased benefits which would result from the higher level of accuracy and equilibrium pricing expected under competition should also be considered. Results may help determine the market size necessary to support multiple providers and whether public subsidization of traffic information operations would be appropriate.

A second area to explore is the public investment necessary to enhance the infrastructure for incident detection or information dissemination. Public operations may be able to cooperate with privately-financed information providers for access to their

information (perhaps in exchange for the providers' access to police reports). The investment of private industries can be expected to increase with the presence of competition among providers. This could minimize the need for public investment.

A third area of research might involve a comparison, in terms of time saved and stress reduction, etc., between an individual who uses broadcast information and an individual who has immediate, in-vehicle information. Such research could provide an indication of the market potential for VARs, particularly as broadcast reports become more frequent and the marginal benefits offered by VARs becomes smaller.

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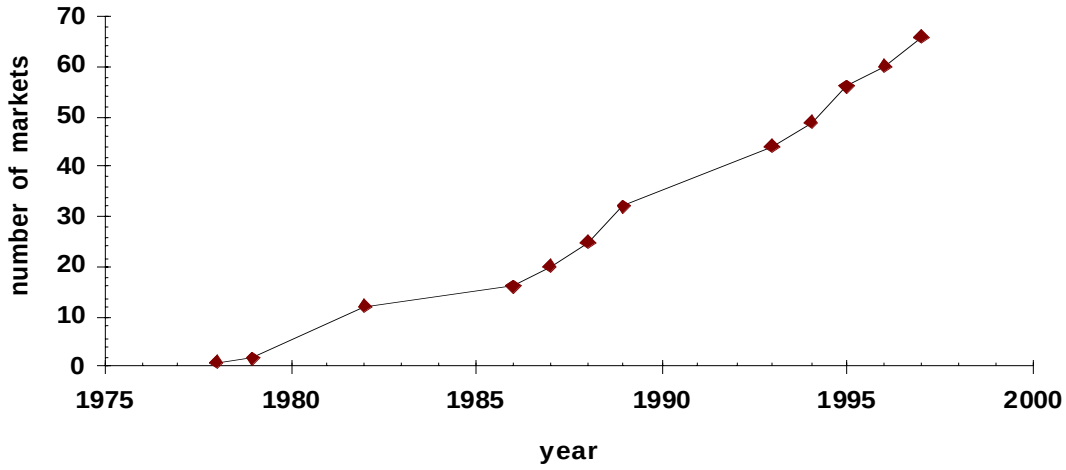

Source: Assembled from various news articles.

FIGURE 1 Metro Networks, 1978-1997

FIGURE 2 Flow of Information

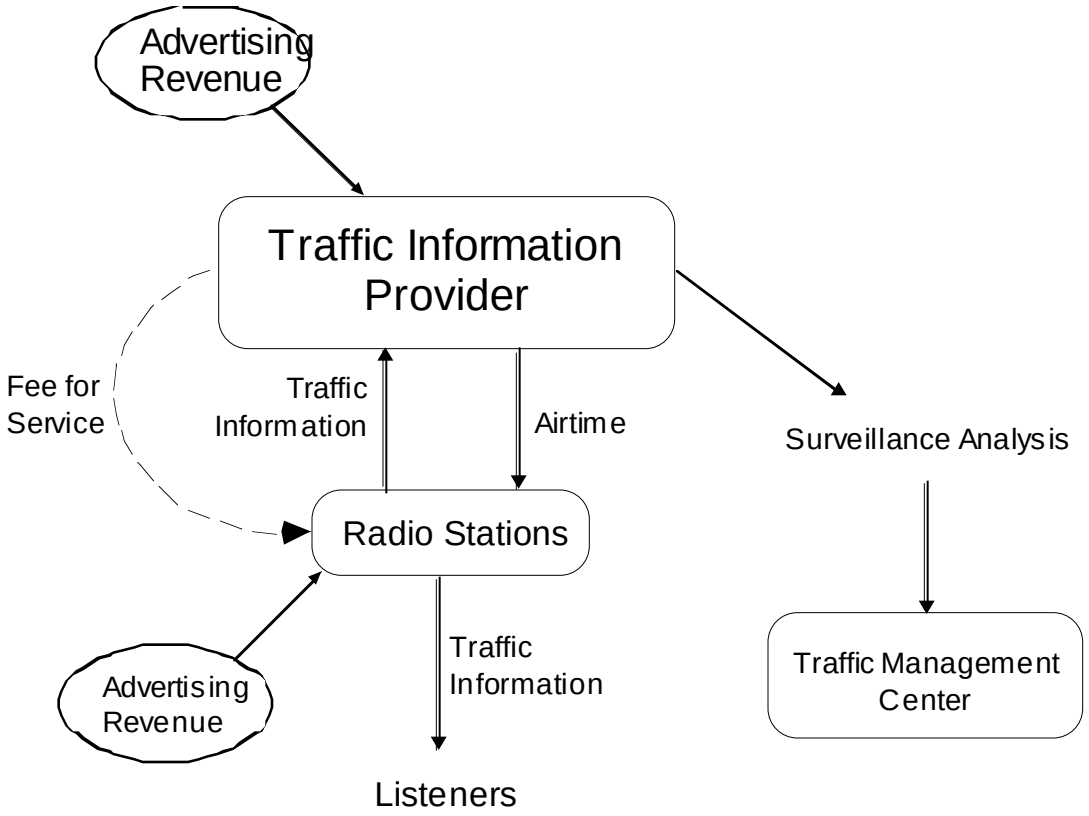

FIGURE 3 Choice of Data Collection Method Decision Tree

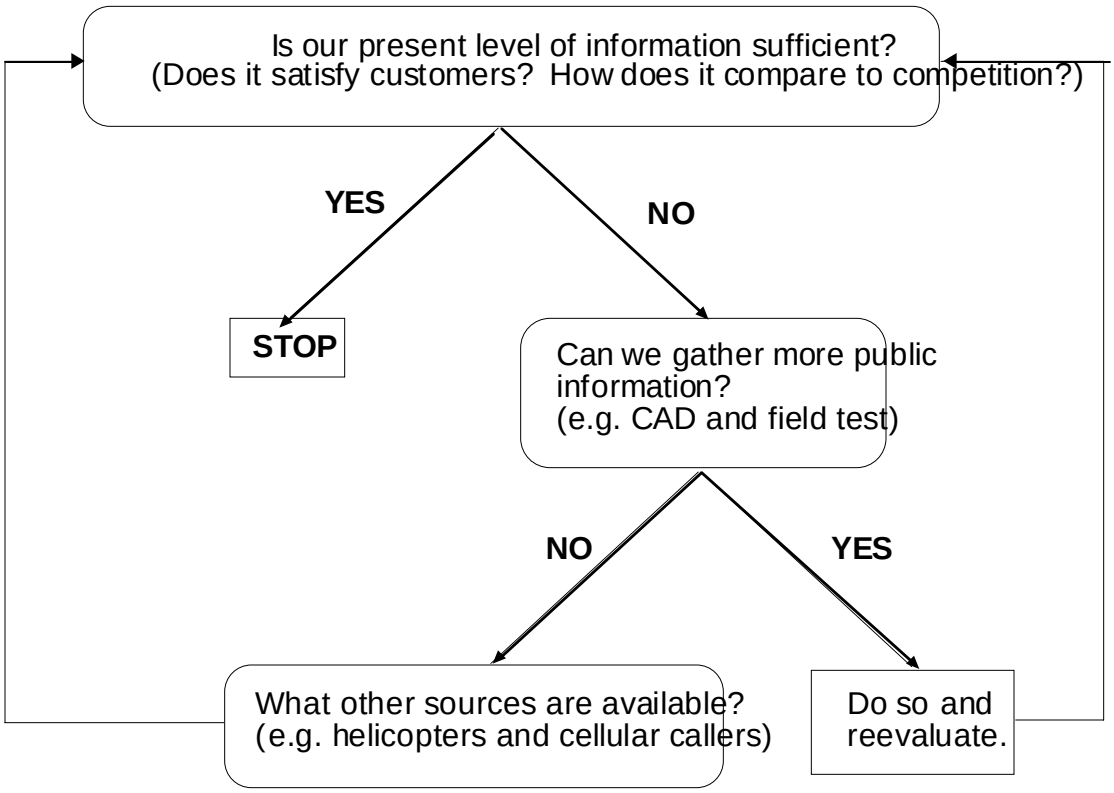

TABLE 1 List of Traffic Information Providers

Company Name	City	Year Started	Company Sold To	Year Sold
Aeromedia, Inc.	Salt Lake City	*	Metro Traffic	1/96
Air Traffic Communications	Santa Ana, CA	1989		
Air Watch Communications	San Diego, CA	1983		
Airborne Broadcast Consultants	Las Vegas, NV	*	Metro Traffic	3/95
Airborne Broadcast Systems, Inc.	Nashville and Memphis, TN Louisville, KY	*	Metro Traffic	3/95
Airborne Traffic Network, Inc.	Kansas City, MO Omaha, NE	1988	Metro Traffic	11/96
Baron Aviation, Inc.	Cleveland, OH	1985		
Charlotte Traffic Patrol, Inc.	Charlotte, NC	*	Metro Traffic	10/94
Computraffic	St. Louis, MI	*	Metro Traffic	1994
Florida Traffic Watch	Miami, FL	1995		
Hildebrand Communication, Inc.	St. Louis, MI	*	Metro Traffic	7/94
L.A. Network	Los Angeles, CA	1982		
Metro Networks	Baltimore	1978		
Road Watch	Connecticut	1993		
Shadow Broadcast Services	Philadelphia	1976		
Skyview Broadcasting Networks, Inc.	Phoenix and Tucson, AZ	*	Metro Traffic	7/94
SmarTraveler	Boston, MA	1991		
	Cincinnati, OH	1995		
Traffic Central	San Francisco, CA	1986		
Traffic Net Group	Rhode Island and Connecticut	*	Metro Traffic	1/96
Traffic Patrol Broadcasting	Charlotte, NC	1986		
Traffic Patrol Broadcasting	Dallas, TX and Miami, FL	1984		
Traffic Patrol Broadcasting	Raleigh-Durham	1987		
Traffic Scan, Inc.	Atlanta, GA	*	Metro Traffic	3/95
Traffic Watch	Cincinnati and Columbus, OH Orlando, FL	1986	Metro Traffic	7/94
Traffic Watch	Baltimore	1983	Metro Traffic	7/94
Wisconsin Information	Oklahoma City,	*	Metro Traffic	7/94

Systems, Inc.	Albuquerque, Omaha

* = year unavailable
Source: Assembled from various news articles.