NCHRP Project 70-01
Private-Sector Provision of Congestion Data

Final Work Plan

University of Virginia Center for Transportation Studies
August 4, 2005

This document serves as the final work plan that will guide the University of Virginia Center for Transportation Studies as it completes NCHRP Project 70-01.

METHODOLOGY

Task 1: Review Past Research on Private Sector Provision of Congestion Data

Previous field deployments and research studies of private-sector congestion data will be reviewed and summarized. This will involve a study of project reports and contacts with transportation agency personnel involved in the deployments. Some of the specific field deployments to be reviewed include:

- The CAPITAL project in the Washington, D.C. area
- The U.S. Wireless Corporation deployments in the Washington and San Francisco areas
- International deployments in Israel and the United Kingdom

Some of the key traits of the deployments in the United States are summarized in table 1. Again, it should be emphasized that members of the research team were involved as the independent evaluators of the CAPITAL and U.S. Wireless Corporation systems in Washington, D.C., and the team has an intimate knowledge of the abilities and limitations of these systems. Furthermore, the research team has already conducted extensive reviews of deployed systems, so the team already possesses a comprehensive understanding of many past field operational tests.

Table 1. Summary of major deployments of WLT-based Monitoring Systems in the United States

Vendor/System	Location	Year	Major Results
CAPITAL	Washington, D.C.	1994 – 1997	• 100 m position accuracy • Speed estimates could only be calculated for 20% of vehicles sampled
U.S. Wireless Corporation Radiocamera	Washington, D.C.	1999	• No data during 5% of time intervals • Mean speed estimation error around 7 mph, with some errors over 20 mph • Over 20% of estimates were had statistically significant differences from reality
	Oakland, CA	2000	• 60 m position accuracy • 60% of vehicles could not be matched to roadways • Median call length of 30 seconds, so speeds could not be estimated over long distances

Each completed deployment will be examined in the following areas:

- Project scope and duration
- Technological and sampling approach used to generate data
- Details of the contractual agreement between the vendor and the transportation agency
- Ability to accurately and reliably generate traffic condition data
- General impressions of the transportation agency on the successes and limitations of the deployment

In addition to field deployments, past simulation-based research studies of wireless phone tracking will be reviewed to determine if they offer additional insight into how these systems could be applied. This will include reviewing research conducted by the French department of transportation, the University of California-Berkeley, the University of Maryland, and the Helsinki Institute for Information Studies that examined the issue of WLT-based monitoring from a simulation perspective.

Finally, the team will also review other private-sector services that provide congestion data using technology other than WLT. For example, the team will investigate the services offered by ITIS Holdings in the United Kingdom. The ITIS Floating Vehicle Data system (FVD®) combines position information from a fleet of cooperating vehicles (via the global positioning system – GPS) to estimate traffic conditions. Essentially, this system, and others like it, relies on cooperating "probes" – while WLT-based systems hold the potential to sample any wireless device-equipped vehicle as a probe. Despite this difference, the research team feels that it is essential to look beyond only WLT-based systems in setting the foundation for this research.

Task 2: Develop State-of-the-Practice Report

The results of previous completed deployments and research will be synthesized into a document suitable for publication on the internet. This document will include:

- A summary of the characteristics and results of each field deployment
- A summary of the major findings of previous simulation-based studies
- Trends in abilities and limitations observed in previous deployments
- Guidance for important issues that should be addressed by DOTs considering deploying private-sector traffic monitoring systems.

Task 3: Evaluate Ongoing Field Deployments

The research team will focus on evaluating the following on-going deployments:

- **The Virginia Airsage Deployment**
- **The Baltimore NET Deployment:**

The project scope, duration, technological approach, and conditions of the agreement between the agency and the vendor will be reviewed. The performance measures used to assess each system will also be reviewed. If available, preliminary assessment results for the systems will also be summarized.

Task 4: Develop System Performance Requirements and Assessment Methodology

In previous deployments of private sector monitoring systems, transportation agencies often did not have a well-documented description of performance requirements that must be met, or the method that they would use to assess whether a system met performance requirements. As a result, there is a need to further explore both of these issues so that agencies can more intelligently select and evaluate private sector monitoring systems.

First, performance benchmarks for private sector congestion monitoring systems will be examined. A survey of state transportation agencies will be conducted to determine:

- What are the minimum and desirable levels of accuracy required for speed or travel time estimation?

- What are the minimum and desirable levels of system availability for monitoring systems?

It is expected that different transportation applications will require different levels of availability and accuracy. As a result, each agency will be asked to respond to these two questions for different applications such as traveler information, incident management, and performance measure development. This information will be used to define some typical performance benchmarks that agencies could use when assessing whether a particular private sector monitoring system meets their needs.

The team will develop a model methodology for assessing private sector monitoring systems. This task will involve learning how these systems have been evaluated in the past, and what lessons have been learned from the deployments. The model methodology will include guidance on:

- Appropriate measures of effectiveness for evaluating the system
- Methods to collect data on the desired MOEs
- Number and characteristics of sites where data should be collected
- Guidelines for setting thresholds to determine whether system performance is acceptable for specific applications

Task 5: Simulation of WLT-based Monitoring Systems

One of the shortcomings of the previous field deployments is that they only assessed a limited set of monitoring system traits, traffic levels, and geometric characteristics. Consequently, the results of the field deployments are often specific to an individual combination of roadway and technology properties, and they may not necessarily be able to be generalized across a broad range of conditions. As a result, it is often difficult to determine whether system design or roadway characteristics are the root of any observed deficiencies in the system, or to compare different systems to one another directly.

A custom simulation tool previously developed by the research team (see Figure 1) will be used to model the observed characteristics of these past deployments, and to assess how well the simulated actual systems would perform under a wider variety of roadway network characteristics. This will allow the researchers to separate the influence of roadway and system design parameters on system performance, and also to create more direct comparisons between the performance of different systems. Given that the researchers have already developed the simulation tool, it offers an ideal opportunity to further investigate how WLT-based monitoring systems perform. The past deployments will be examined to determine characteristics of each field test, such as:

- Observed error of location estimates
- Observed duration of calls tracked by the system
- Time between location estimates
- Method of matching location estimates to roads
- Traffic flow characteristics

- Roadway networks simulated

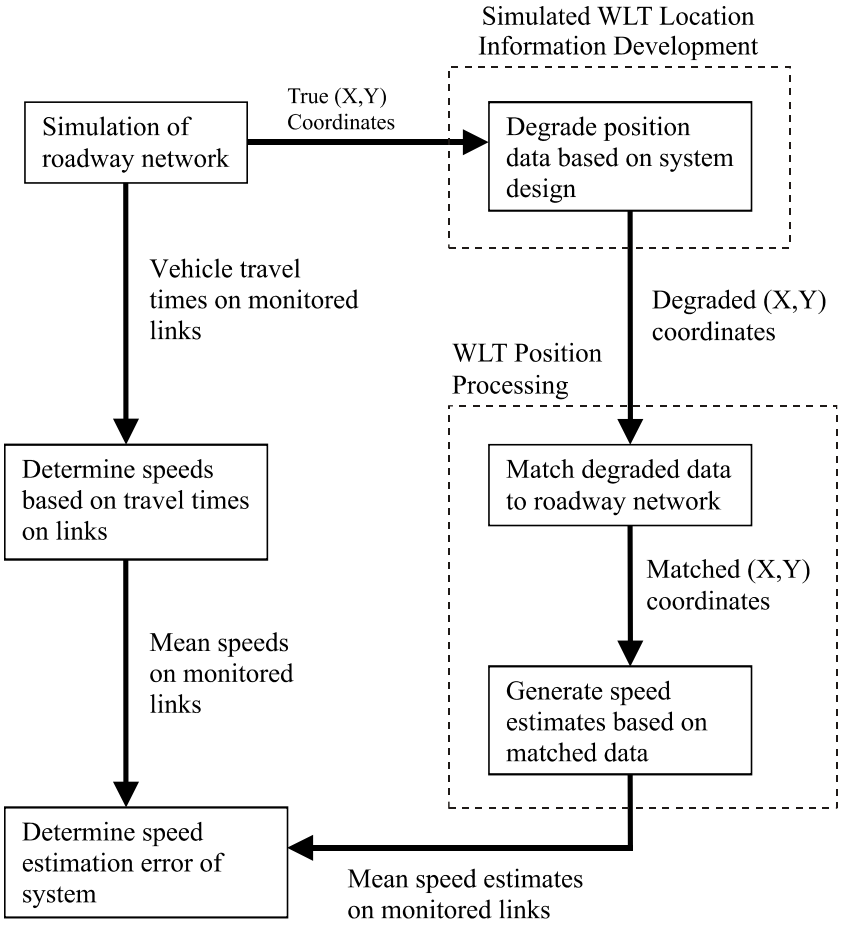

Figure 1. WLT Simulation System Diagram

These factors will then be simulated using the test bed to learn how well the system parameters would perform in other situations, as well as to provide consistent measures of performance across different monitoring systems that have been deployed. For example, it is difficult to compare the performance of the US Wireless deployments in Oakland and in Washington D.C., since the networks examined were *very different*, monitoring system performance changed, and different performance measures were used. If simulation can be used to evaluate monitoring system characteristics consistently on the same network, then it is possible to gain a better understanding of how system design and roadway network characteristics interact to impact overall performance. The simulations will provide insight into important factors that system designers and DOTs should examine before deploying these systems. Thus, the simulations will serve to augment the existing field test results and provide more insight into the potential areas of application for these systems.

Task 6: Investigate Institutional Implications of Various Approaches

A critical component to the successful implementation of private-sector congestion monitoring systems is developing a better understanding of the legal, privacy, and business issues related to using these systems. First, business models for using private sector systems will be examined and evaluated using information from previous studies. Potential areas for examination include:

- Should a transportation agency purchase an entire system, or only purchase the "service" of data provision?
- Are there likely to be any restrictions placed on the use of the data provided to the agency? For example, members of the research team have encountered situations where the agency was permitted to use purchased data for operational purposes, but not as inputs into planning models.
- How are agreements between the system vendor and wireless carriers executed?
- What formal contracting language has been used to create an agreement between an agency and a private sector vendor?

A law student from the University of Virginia will also be hired to analyze the legal and privacy implications of these systems. The law students will assess whether there are legal or privacy barriers to implementing these systems. If barriers exist, potential courses of action to overcome these barriers will be developed. Depending on the findings of this task, these courses of actions might include:

- Requirements for how data is communicated between wireless carriers, private sector traffic monitoring firms, state transportation agencies, and the public
- Model enabling legislation to permit the use of these systems (if required)
- Model practices for dealing with privacy concerns.

In addition, the students will conduct a thorough analysis of the protections afforded to consumer-proprietary network information (CPNI), protected by federal law

Task 7: Determine Expected Performance Characteristics of Systems and Implementation Issues

In this task, the operational and institutional results of previous studies will be examined to isolate the lessons learned. The results of previous deployments, ongoing demonstrations, and previous simulation-based studies will be examined to determine the

expected capabilities of private-sector generated congestion information. Likewise, the results of previous and ongoing deployments will be examined to determine any institutional, legal, or implementation issues that should be addressed in future deployments. It is expected that this review should provide answers in the following areas:

1. What technologies have been used in the past, and what have been their relative areas of application and limitations?

2. What data were produced by the private-sector systems?

3. What level of accuracy and system coverage can DOTs reasonably expect from private-sector congestion monitoring systems?

4. What performance measures did DOTs use to evaluate the effectiveness of the system? How did they collect data to measure performance, and what thresholds were set for minimum acceptable operation?

5. How have previous deployments dealt with privacy and legal issues, and what steps (if any) are required to ensure that these systems can be subjected to widespread deployments?

6. What has been the approximate cost to deploy the system, and what level of potential cost savings could be achieved by using private sector systems?

7. What was the nature of the relationship between the DOT, the private-sector vendor of congestion data, and any outside involved parties (such as wireless service providers)? Was the structure of these relationships adequate from the DOT's perspective? If not, how should they be improved?

The answers to these questions will be combined with the results of Tasks 4, 5, and 6 to develop a guidance document that the transportation community can use to guide the process of entering into travel time provision service agreements, and managing the agreements once they have been executed. The guidance document will include the following components:

- *A process that DOTs can use to determine whether a particular vendor's system is likely to meet agency needs.* This process would be used to establish whether a potential system meets certain minimum requirements for performance, similar to pre-qualification in construction. A list of questions that potential vendors should be asked, as well as a list of minimum functional requirements based on the results of previous work will be developed. A combination of checklists and more detailed requirements will be included to accomplish this. The goal of this process would be to effectively screen out systems that are unlikely to perform adequately.

- *A detailed discussion of the legal and economic framework of private sector systems.* Potential legal and privacy barriers will be reviewed. Advantages and disadvantages of different private sector business models will also be reviewed. An economic analysis based on available data will be presented to show what level of cost savings can be expected from a private sector system.

- *A model procedure for assessing system effectiveness for acceptance purposes.* This procedure will define potential measures of effectiveness, data collection processes, and possible acceptance thresholds.

- *Guidance for private-sector providers of traveler information*. In addition to the relevant guidance provided from a public-sector perspective, this section will include the following:
    - Description and assessment of business models used in prior deployments
    - Description of project time-lines from prior deployments
    - Identification of obstacles encountered by the private sector in prior deployments
    - Description of working relationships with wireless providers in prior deployments
    - Data use and distribution restrictions from prior deployments

Task 8: Develop Final Report

A final report documenting the results of the results of the research will be developed. The focus of the final report will be on the model policies and procedures developed in task 7. The intended audience of the final report will be state and local transportation agencies considering the use of private sector systems, as well as private-sector providers of traveler information.

SCHEDULE

Task	2005 - 2006											
	7	8	9	10	11	12	1	2	3	4	5	6
Task 1: Review Past Research on Private Sector Provision of Congestion Data												
Task 2: Develop State-of-the-Practice Report												
Task 3: Evaluate Ongoing Field Deployments												
Task 4: Develop System Performance Requirements and Assessment Methodology												
Task 5: Simulation of WLT-based Monitoring Systems												
Task 6: Investigate Institutional Implications of Various Approaches												
Task 7: Determine Expected Performance Characteristics and Implementation Issues												
Task 8: Develop Final Report												