ITS FIELD OPERATIONAL TEST SUMMARY

**U.S. Department
of Transportation**

**Federal Highway
Administration**

**Research and Development
Turner-Fairbank Highway
Research Center
6300 Georgetown Pike
McLean, Virginia 22101-2286**

CAPITAL-IVHS Operational Test and Demonstration Program (CAPITAL)

Introduction

The CAPITAL project was to assess whether the triangulation of cellular phones aboard vehicles could provide a more cost efficient approach than the presently used induction loops and video cameras. The test was carried out in the Washington DC area and included I-66, I-495, I-270 and various state roads (see Figure l).. It covered a period of 27 months, ending in November 1995. Team leader was E-Systems.

Purpose

The specific objectives of the study were to:

- Determine the accuracy and completeness of traffic information derived from geolocation data.

- To determine if information from cellular phone traffic can be effectively integrated into a real-time wide area traffic-management system.

- Determine the costs associated with deploying a wide area traffic monitoring system.

Methodology

Commercially available direction finding equipment was installed on one in four Bell Atlantic Mobile cellular towers in the region. The equipment detected call initiation messages from cellular phones and then triangulated the signal from several towers

to obtain at least four position fixes. An algorithm discarded obviously erroneous fixes and calculated the vehicle speed.

To establish the accuracy of a single triangulation ('fix'), cellular phones were placed in known locations.

In order to determine the accuracy of the speed reading, five test vehicles with cellular phones drove through the area. Their electronic driving logs were then compared to the speeds calculated from four or five fixes, taken at intervals of about 5s.

The signals from cell phones aboard random cars were also triangulated. A series of speed readings were compared against police records of incidents.

Results

CAPITAL was designed with previous generation cell phone technology in mind. During the test however, new phones with substantially lower transmission power became prevalent. This would have necessitated closer spacing of the direction finding equipment.

With the minimum of two towers for triangulation, the accuracy as determined by the mean error was around 150m. Using an additional third tower improved the accuracy to 108m. Tests with a moving vehicle confirmed that the system could distinguish traffic on highways from that on arterial roads.

The errors in individual fixes multiplied when determining speed, sometimes resulting in readings in excess of 200mph. Even though the algorithm discarded some obviously erroneous readings and at least three speed readings were averaged, the errors were big enough to invalidate 80% of all speed data.

Likewise the automatic incident detection based on speed readings proved unsatisfactory. This was mainly due to the fact that normal congestion produced very similar readings to incidents. However, it was found that the speed readings could assist an operator to judge the traffic flow and detect incidents.

The integration of CAPITAL data into a real-time wide area traffic management system could not be evaluated since the traffic management function worked inconsistently.

Providing a service similar to CAPITAL in the 190 sq. miles area of the Washington D.C.-Baltimore corridor was calculated to require installation at 23 towers and requiring $1.6 million in capital costs. During the test, the monthly costs per site were $1,300.

An equivalent array of induction loops was estimated to cost between $1.1 and 5.6 million. No monthly operating costs were calculated.

Future Application

No follow-up tests are currently planned. It would be advisable to postpone any such tests until cellular phone technology configuration stabilizes.

References

"Final Evaluation Report for the CAPITAL Operational Test and Demonstration Program," *Transportation Studies Center of the University of Ma yland, Nov. 1996*
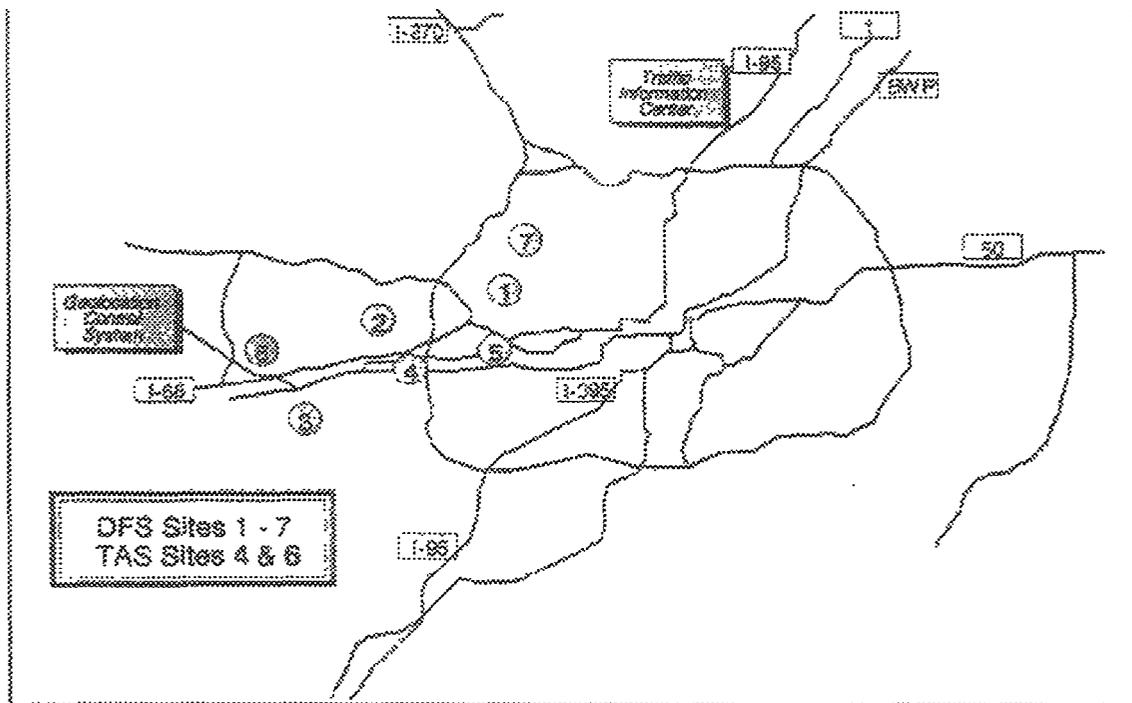
Figure 1. Test area with location of direction finding equipment