ITS Field Operational Test Summary

Advanced Driver and Vehicle Advisory Navigation Concept (*ADVANCE*)

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Introduction

The *ADVANCE* ITS Field Operational Test demonstrated the use of an in-vehicle advanced traveler information system in the northwest suburbs of Chicago, Illinois. It was expected to be the first large-scale dynamic route guidance system deployment in the U.S., resulting in the distribution of 3,000 in-vehicle devices. In late 1994, based primarily on the projected market limitations of what was likely to be an expensive system, the project partners scaled back the project scope, and agreed upon a targeted deployment of 75 in-vehicle systems.

Operational testing took place between June 1995 and December 1995.

Project Description

The *ADVANCE* system was designed to provide drivers, familiar with the area in which they were driving, with the fastest route to their destination through an in-vehicle traveler information and route guidance system. The system provided route guidance information using a static database of travel times and dynamic information on traffic conditions. The dynamic traffic information combined data from traditional roadside vehicle detection devices with data from *ADVANCE* system-equipped cars acting as traffic probes. The traffic information was reported to a Traffic Information Center (TIC) where a computer system determined the route with the shortest travel time to a set of predetermined destinations. The TIC then communicated the route information using radio frequency transmission to a Mobile Navigation Assistant (MNA) in an *ADVANCE*-equipped vehicle. Using this information, a driver could select a route to follow. The driver received Dynamic Route Guidance (DRG) to the selected destination via the selected route.

The tests compared driving times of vehicles using DRG to times of vehicles following static routes.

The objectives of the *ADVANCE* test were to:

- Assess the feasibility of providing DRG
- Assess the impact of DRG on travel time for drivers familiar with the arterial network
- Evaluate the use of probe vehicle data to characterize the traffic conditions on the network
- Evaluate the performance of the software algorithms for analyzing traffic input data and determining the shortest time routes
- Assess the user acceptance of and the performance of the in-vehicle Mobile Navigation Assistant (MNA).

ADVANCE consisted of five primary subtests.

- Traffic Related Functions (TRF)—component and system level software performance assessment

- TIC Architecture and User Interface—assessment of the function and ease of use of the Traffic Information Center (TIC)
- Incident Detection Study—assessment of the ability of the system to provide incident detection capability
- Familiar Drivers—assessment of user perceptions regarding usefulness/value of the system
- Yoked Driver Study—assessment of travel time savings.

Results

The *ADVANCE* tests demonstrated that it is feasible to use a Dynamic Route Guidance (DRG) system to improve travel times under certain conditions. The evaluation of the integrated system of computerized traffic information analysis software, in-vehicle advisory systems, and a dedicated radio frequency communication system showed that it is possible to collect, analyze, and communicate potentially useful information to drivers. This integrated system was able to provide drivers with information that allowed them modify their routes to use shorter time alternatives.

ADVANCE showed that the potential impact on travel times of the use of such an integrated system was measurable, although subject to some limitations. DRG provided the potential for motorists to reduce travel times by 4 percent, and potentially more under conditions of non-recurrent congestion. Some tests established that route diversions and travel time savings are sometimes associated with the use of real-time data for route planning. In an arterial network like that of the *ADVANCE* tests, in which DRG is subject to key functionality limitations, large time savings may not be a typical outcome. Where substantial savings occurred during the tests, the cause appeared to be the availability of less congested (but longer) alternate routes close to the highly congested routes. Such alternate routes, in the absence of DRG, are likely to appear illogical to drivers on the congested route. Drivers, therefore, are unlikely to find or follow these routes without a route planner using real-time information for the entire network.

A key component of the *ADVANCE* tests was the use of probe vehicles. In the Yoked Driver Study, the fleet of probe vehicles traveled between the origin-destination pairs over a variety of reasonable alternate routes shortly before the group of three test vehicles began their trip. Using the MNA, the probe vehicles reported their travel times on each link to the TRF at the TIC. The probe-reported results were compared to manually recorded observations of travel times over the same links. The reported travel times from the probe vehicles were highly accurate. A total of 99.4 percent of the reported values were found to be reliable and were included in the statistical sample. The comparison of reported times to manually recorded times showed that 87.6 percent of the probe values were within 5 seconds and 94.0 percent were within 10 seconds. A high percentage of the comparisons were within 2 seconds. The tests also showed that statistically accurate results are obtained using only a few probe vehicles. The tests demonstrated that three probe vehicles traversing a link within a 5-minute interval produced an accurate sample. Increasing the number of traversals beyond three produced only a minor increase in the accuracy of the measurement. The tests concluded that very high levels of probe deployment are probably not necessary for an effective probe-based ATIS.

Probe vehicles encountered some problems. The system operating concept required that each probe transmit its position at the end of each link. The testing found that this concept did not

work well under heavily congested conditions, where traffic resulted in the probe being detained along the link, effectively preventing the determination of a link travel time.

The overall conclusion was that MNA data as deployed in *ADVANCE* provided a reliable indicator of traffic conditions and could thus be a valuable resource for traffic monitoring and analysis in future ATIS deployments. The results also argue strongly that probe vehicles can cost-effectively provide reliable data for developing real-time travel time estimates and projections.

One evaluation of the tests assessed the quality of the travel time prediction algorithm of the TRF. This algorithm used both probe and detector data to generate link travel time estimates for several 5-minute time intervals. These intervals began with the current interval and continued for 5-, 10-, and 15-minute intervals into the future. The predicted values were compared to recorded values experienced by the drivers of the test vehicles. The evaluation found that the algorithm accurately predicted travel times during off-peak periods, when the sampling rate was moderate, but tended to underestimate travel times during peak periods. This suggests that the prediction algorithm may have been calibrated too conservatively (e.g., somewhat too willing to ignore clusters of high probe travel time reports).

The familiar drivers who participated in the tests expressed some reservations about the usefulness of the MNA as a guidance tool for route selection. The drivers reported that the routes provided by *ADVANCE* were not particularly good and tended to be inferior to their own routes. This conclusion is consistent with the selection of drivers who were very knowledgeable of the arterial network in the test area. Drivers generally expressed a preference for having a greater degree of control over their choice of routes. They would prefer that the MNA "learn" their preferences as part of its functionality. The drivers did show a high level of interest in having access to real-time traffic information, especially concerning non-recurring congestion, such as that resulting from incidents. Most drivers envisioned the MNA as an "intelligent assistant" to their driving. Such an assistant would acquire the real-time data, evaluate the route chosen by the driver, and when appropriate, recommend more time-efficient alternatives.

Legacy

The *ADVANCE* TIC provided traffic management officials with valuable experience that they used to establish a much larger, more inclusive Corridor Transportation Information Center (C-TIC). This C-TIC provides real-time traffic information to a broad spectrum of interests in the Gary-Chicago-Milwaukee (GCM) corridor. The experience gained in the *ADVANCE* tests considerably reduced "shakedown" delays and setbacks that might have otherwise occurred in estaqblishing the C-TIC.

Test Partners

- Federal Highway Administration (FHWA)
- Illinois Department of Transportation (DOT)
- Motorola
- Illinois Universities Transportation Research Consortium (University of Illinois at Chicago, Northwestern University)

References:

The *ADVANCE* Project: Formal Evaluation of the Targeted Deployment, Argonne National Laboratory, January 1997.