IMPLEMENTATION OF A RURAL ATIS: INITIAL FINDINGS FROM THE YATI SYSTEM

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ABSTRACT

Research on intelligent vehicle highway systems (IVHS) has focused almost exclusively on resolving problems common to urban areas while almost completely ignoring those which exist in rural locations. Only recently have efforts been made to improve travel conditions in rural environments. Yosemite National Park is one place where improvements are necessary. The entire Yosemite region has long suffered from traffic congestion, overcrowding, and pollution. An experimental advanced traveler-information system (ATIS), known as the Yosemite Area Traveler Information (YATI) System, is being implemented in hopes of improving conditions in the region.

The YATI System has been designed with the goals of reducing traffic congestion, improving air quality, enhancing mobility, and preserving and promoting tourism in and around Yosemite National Park. Yosemite region travelers will be provided with real-time information regarding current weather and travel conditions, as well as the status of lodging, public transit, and recreational and camping facilities. The information will be provided via changeable-message signs (CMS), highway advisory radio (HAR) and a multimedia database accessible through information kiosks, computer bulletin boards, and touch-tone telephone.

The results of data collected in the Yosemite region during the 1994 Memorial Day weekend are presented in this paper. While the initial impact of the YATI system appears to be limited, the potential benefits to travelers in the Yosemite region of a fully deployed system appears to be extensive. The data collected suggest that the YATI system could significantly improve travel conditions in the Yosemite region.

INTRODUCTION

As part of a recent emphasis on improving safety, traffic congestion, and traveler awareness in rural settings,[1] the YATI project will test several advanced transportation-management technologies in a rural environment where recreational and tourist traffic are the major sources of peak period congestion. The technologies to be tested include: CMS, HAR, and a multimedia database accessible through information kiosks, computer bulletin boards, and touch-tone telephone. The project is being funded by the Federal Highway Administration and the California Department of Transportation (Caltrans). Researchers from the University of California at Davis are responsible for evaluating the system and the evaluation plan is provided in a project research report.[2]

Results of data collected in the Yosemite region during the 1994 Memorial Day weekend are presented in this paper. During that time, the YATI system was partially operational with CMS and HAR functioning. Mailback surveys were distributed to visitors as they exited the park in order to evaluate traveler response to the various messages. In addition, traffic counts were manually conducted at park entrances to estimate vehicle delay.

The paper discusses traveler response to the information provided by advanced technologies. Perceptions of the location, message content, and usefulness of CMS and HAR are examined. The extent to which the traveler is affected (e.g. changes in travel behavior or trip quality) by the information is explored. Lastly, recommendations are made for ways in which the information can best benefit the traveler.

DATA COLLECTION METHODS

Park Visitor Surveys

Survey packets were distributed to visitors as they exited the park (the entire Yosemite region is shown in Figure 1). Each packet contained a mailback survey, a cover letter explaining the importance of the survey, and a self-addressed stamped envelope in which to return the survey. Project team members were situated at each of the park exits throughout the weekend and handed out surveys between 3:00 and 5:00 p.m. each day.

Surveys were distributed at the exits in proportion to the expected number of vehicles using the exit. Highways 120 West and 41 carry the greatest number of vehicles, the majority of which originate from Northern and Southern California, respectively. In all, 48% (202) of the 420 surveys distributed were returned. The rate of return was similar for each exit.

Park Entrance Delay Counts

Ranger stations are situated at each entrance to collect park fees, distribute information, and answer visitors' questions. During peak visitation periods, entrances often become oversaturated with vehicles trying to enter. Project team members conducted delay counts between 9:00 and 11:00 a.m. at selected entrances during each day of the weekend.

FINDINGS

The locations of HAR and CMS are shown in Figure 1. During Memorial Day weekend, these technologies provided static information. Typical message content included: "expect delays ahead," "expect delays in Yosemite Valley," or "no available camping in Yosemite Valley." The content of messages varied slightly for each of the park entrance routes.

Perceptions of CMS Operation

Few (15.9%) of the 202 respondents recalled seeing a message displayed on a CMS on the way into the park. Figure 2 illustrates the number of respondents entering the park by entrance route and the percentage who recalled seeing a message displayed on a CMS. It is apparent that large disparities in information acquisition exist: 31.4% of Highway 140 respondents recalled seeing a message being displayed versus only 7.3% of Highway 120 East respondents.

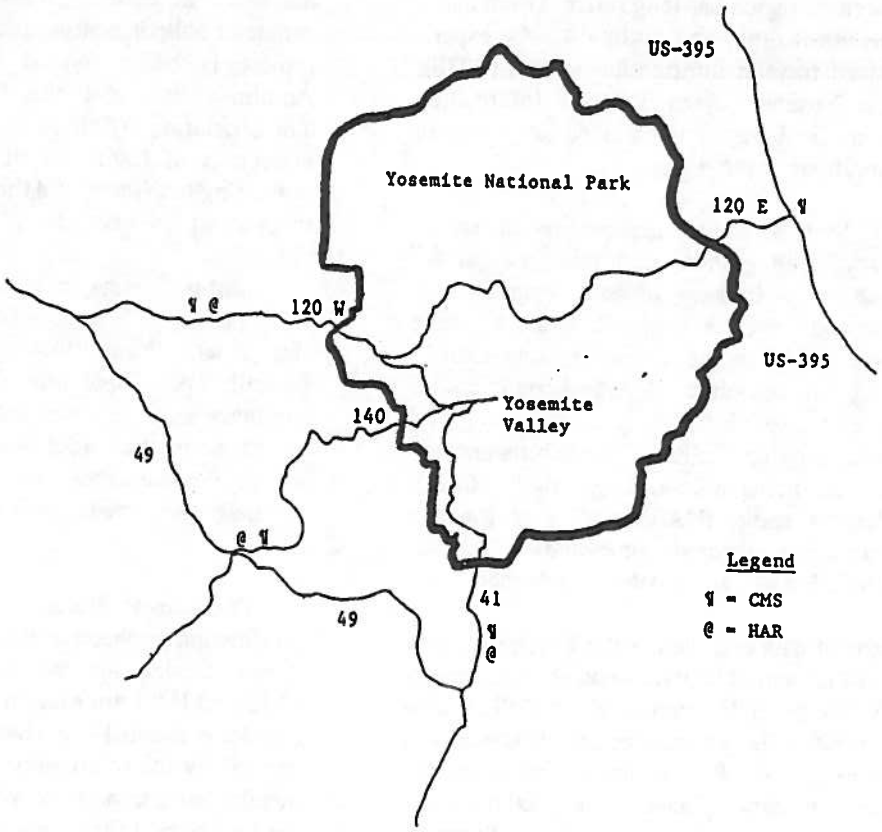

Figure 1. Yosemite region

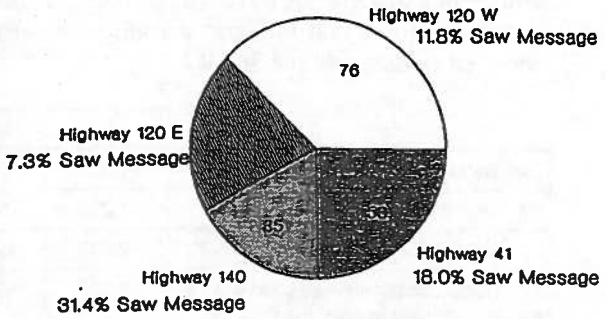

Figure 2. Number of respondents entering park and percent recalling CMS messages by highway

Of the 32 respondents who saw a message displayed, 21 (65.6%) thought that the information was useful. This percentage was almost identical for each entrance. The vast majority of these respondents (87.5%) believed that it would not have been more helpful to locate the sign in another location. Given that this perception was similar across the four entrances, it can be concluded that the location of the CMS was not associated with whether a respondent recalls a message being displayed.

Additional analyses found that CMS message recall may be associated with driving distraction and familiarity with surroundings. For instance, 20% of respondents who felt that traffic conditions were very good, good, or okay on the way into the park recalled seeing a message, while only 6% of respondents who felt that traffic conditions were bad or very bad recalled seeing a message. Familiarity with surroundings appears to play a role in CMS message recall. While 19% of respondents who had previously visited Yosemite recalled seeing a message, only 11% of first-time visitors recalled seeing one.

Respondents who saw a message displayed on the CMS were asked how the message changed or improved their trip. The vast majority (81.3%) indicated that the message did not affect their travel plans. In response to the information, one party changed its route to the park, another changed its departure time to the park, while one party changed its parking location in the park.

Although CMS messages did not seem to alter travel behavior, they did seem to improve respondents' perceptions of their trip to Yosemite. Advisories such as "expect traffic congestion in Yosemite Valley" and "expect delays ahead" were most often cited by respondents as improving the quality of their trip.

All respondents were asked what type of information they would most prefer the CMS to display. Of 192 responses, road closures and current traffic conditions were overwhelming preferred (69.3% and 64.5% support, respectively), followed by parking availability and campsite availability (41.1% and 33.9% support, respectively). This is certainly encouraging as the YATI system can provide travelers with this type of information.

Perceptions of HAR Operation

Slightly less than one-fifth (39) of the 202 respondents tuned their radio to listen to HAR broadcasts. Figure 3 illustrates that the highest percentage (34.3%) of respondents who listened to the broadcasts used Highway 140 to enter the park. Conversely, not one out of 41 respondents entering the park via Highway 120 East listened to the broadcasts. This supports the credibility of survey responses, as it was later determined that HAR was not operating on Highway 120 East during the weekend.

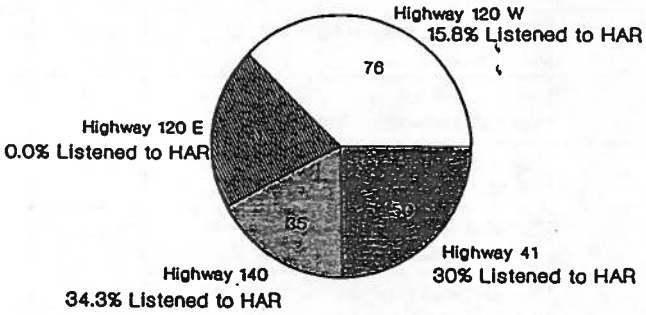

Figure 3. Number of respondents entering park and percent who listened to HAR by highway

Continual monitoring of CMS and HAR operation is important. During Memorial Day weekend, Caltrans officials managed CMS and HAR operations. They report that a dead battery prevented the broadcast of HAR messages along Highway 120 West during a portion of the weekend. The precise downtime is not known. It is possible that this downtime is responsible for the comparatively low percentage of Highway 120 West travelers who listened to HAR broadcasts.

Of the 39 respondents who listened to HAR broadcasts, 18 (46.2%) thought that the information was useful. Many respondents reported that the broadcasts were disrupted by static. The majority of respondents (74.4%) who listened to HAR broadcasts indicated that it did not alter any portion of their trip. Four respondents, however, reported that the HAR broadcasts resulted in a change in their departure time to the park and two indicated that it resulted in a change in their route to the park.

Residency was found to be an important factor in whether a respondent listens to HAR broadcasts. Over 27% of U.S. residents listened to broadcasts as compared with only 6% of non-U.S. residents. Such variables as perceived traffic conditions, gender, group size, number of tourist attractions visited, and first time/repeat visitor were not found to be important.

Table 1 presents the types of information which were broadcast. Trip quality was most often improved by broadcasts that warned visitors to expect traffic congestion in Yosemite Valley and delays ahead.

Type of Information	Highway 120 West	Highway 140	Highway 42
Number of Respondents Who Listened to HAR Broadcasts	12	12	15
Type of Information			
Advised to expect congestion in Valley	2	2	2
Provided with a better route to reach Valley	0	0	2
Provided with other destinations besides Valley	0	0	3
Advised to expect delays ahead	2	4	2
Provided with available campsite locations	1	0	1
Provided with available parking locations	0	0	3

Table 1. Trip improvement resulting from HAR broadcasts by highway

All respondents were asked to rate the difficulty they had getting around in the park. The majority (54.4%) indicated that they had "no difficulty" getting around the park. Almost 42% reported having "some difficulty" while 4% indicated having "a lot of difficulty." Based on these results, a binary logit model was constructed to determine which variables influence whether a respondent has difficulty getting around in the park. Details of the modeling formulation and assumptions are given in a project research report.[3]

The model results are given in Table 2. Positive coefficients indicate a higher probability that respondents with that perception or characteristic will experience difficulty getting around (given that all other perceptions and characteristics are identical). For instance, the fact that the coefficients are negative for variables X_1 and X_2 suggests that respondents who arrived at the park on Friday (5/27), or Monday (5/30), had reduced probabilities of experiencing travel difficulties. This is not surprising given that the largest traffic volumes were observed on Saturday and Sunday.

	ß	t-stat
Experienced difficulty constant	1.558	2.108
X_1: Arrived at the Park on Friday 5.27	-1.228	-2.870
X_2: Arrived at the Park on Monday 5/30	-2.649	-2.486
X_3: Traffic conditions were good or very good on the road to enter the Park	-1.296	-3.061
X_4: Advised by Highway Radio broadcasts to expect delays ahead	2.975	2.249
X_5: Used Highway 140 to enter and exit the Park	3.169	2.706
X_6: Visited Wawone or Mariposa Grove	-1.089	-2.486
X_7: Aware of transit services to the Park provided by neighboring communities	-0.873	-1.561
X_8: Disagreed or strongly disagreed that there is plenty of parking for private vehicles in Yosemite Valley	1.244	2.937
X_9: Disagreed or strongly disagreed that information is readily available about tourist activities outside the Park	1.246	2 .900
X_{10}: Did not take the Yosemite Valley shuttle because it didn't go "where I want to go"	-1.487	-2.161
X_{11}: Rated overall trip to Yosemite as excellent	-1.467	-3.658
X_{12}: California resident	0.955	2.152
X_{13}: Employed	-0.928	-1.857
Summary Statistics		
Observe Frequency of Choices		
1: Difficulty Getting Around in Park	89	
2: No Difficulty Getting Around in Park	109	
Cases Correctly Predicted: 77.95%		
Log Likelihood at zero = -135.16		
Log likelihood at convergence = -88.08		

Table 2. Logit model results of respondents' difficulty getting around in the park

According to Table 2, respondents who were advised by HAR broadcasts to expect delays ahead (X_4) had higher probabilities of having difficulty getting around in the park. This may indicate that messages which warn of possible delays ahead are accurate or that perceptions of travel difficulty are altered by these warning messages.

Most of the findings from Table 2 are as expected. For instance, respondents who rated their trip as excellent (X_{11}) had a reduced likelihood of having experienced travel difficulties. Similarly, respondents who rated traffic conditions as good or very good on the way into the park (X_3) also had reduced probabilities of

having experienced travel difficulties. Respondents who disagreed or strongly disagreed with the statements that there is plenty of parking in Yosemite Valley (X_8) and that information is readily available about tourist activities outside the park (X_9) had increased probabilities of having experienced travel difficulties. This is not surprising since respondents who felt that there is a lack of adequate parking in Yosemite Valley probably had difficulty finding a space and as a result, difficulty in their travels. Similarly, respondents who believed that there was not adequate information about tourist activities outside the park may have wanted this information in order to enjoy less crowded, more accessible activities.

The results from Table 2 suggest that HAR and CMS messages can have a profound effect on travel difficulty. Given that static messages influenced travel difficulty, real-time messages are expected to provide an even more substantial effect.

Additional analyses revealed the following interesting finding: only 11 (5.4%) of the 202 respondents recalled seeing a CMS message *and* listened to an HAR broadcast.

The fact that respondents more often felt that the information received from the CMS was useful (65.6% thought it was useful) versus the information received from the HAR broadcasts (46.2% thought it was useful) is not surprising. Perhaps respondents had higher expectations of the HAR broadcasts and were disappointed by the "staticy reception," the lack of real-time information, or the omission of other important information. Historically, however, CMS is more credible than HAR.[4]

Vehicle Delay at Park Entrances

Project team members conducted delay counts at selected entrances during the weekend. On Saturday, the Highway 140 and Highway 120 West entrances were monitored from 9:00 to 11:00 a. m. The Highway 120 West entrance was also monitored on Sunday. At each entrance, the number of vehicles entering the queue at the entrance booth and the number departing from the entrance booth (into the park) were recorded each minute. In addition, the duration of time the queue was present was also recorded. Figures 4 through 6 illustrate the cumulative number of arrivals (into the queue) and departures (into the park) for each entrance.

A comparison of Figures 4 and 5 indicates that considerable vehicle delay occurred on Saturday at the Highway 120 West entrance while delay was minimal at the Highway 140 entrance. By 11:00 a.m., the queue at the Highway 120 West entrance extended approximately one mile back from the entrance booth and contained more than 200 vehicles. In contrast, the queue at the Highway 140 entrance booth at 11:00 a.m. was negligible.

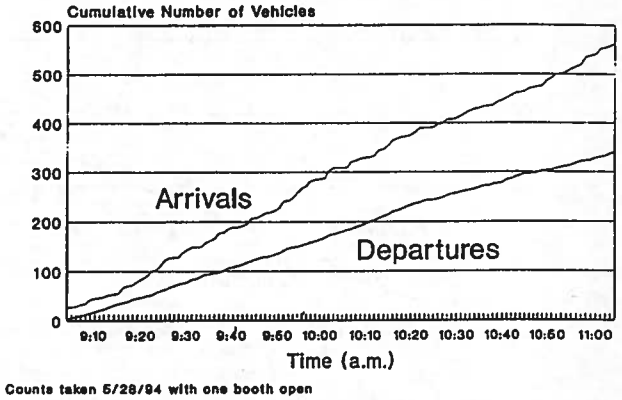

Figure 4: Highway 120 West arrivals versus departures (5/28/94)

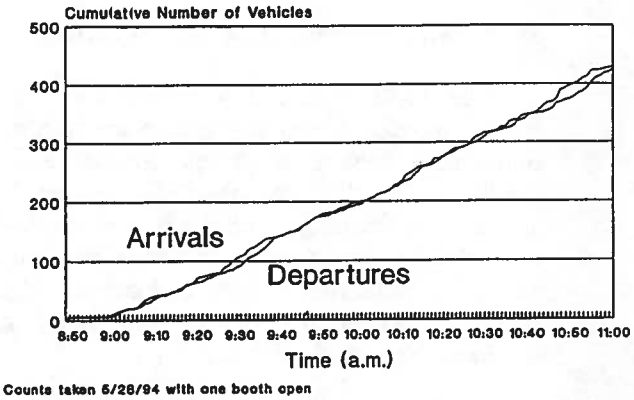

Figure 5: Highway 140 West arrivals versus departures (5/28/94)

Previous research indicates that about 65% of those who use Highway 120 West to enter the park and 45% of those who use Highway 140 to enter the park originate from Northern California.[3] Most travelers have the opportunity to select either route to access the park. A fully deployed system which operates in real-time could have been of great benefit to visitors on Saturday. Travelers could have been advised to take Highway 140 instead of Highway 120 West to access the park.

Reasonable predictions of vehicle delay at entrances can be made several days or hours in advance of peak travel times (which is necessary to give route guidance advice). Whereas only one entrance booth was operating at the Highway 120 West entrance on Saturday, two

booths were operating at the entrance on Sunday. Only intermittent queues were observed on Sunday (see Figure 6) even though there were more vehicle arrivals than the previous day. Thus, the expected number of open entrance booths and expected vehicle arrivals (from the year before) can be used to predict vehicle delay.

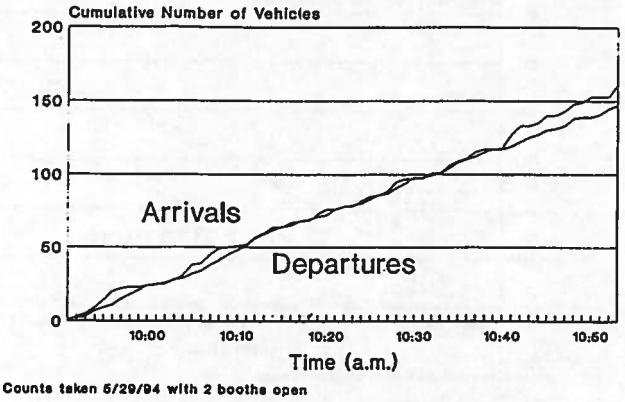

Figure 6: Highway 120 West arrivals versus departures (5/29/94)

SUMMARY AND RECOMMENDATIONS

The YATI system is a rural ATIS designed to provide travelers to the Yosemite region with real-time information regarding current weather and travel conditions as well as the status of recreation, lodging, and camping facilities. The extent to which the system meets the goals of reducing traffic congestion, improving air quality, enhancing mobility, and preserving/ promoting tourism in and around Yosemite is being evaluated by researchers at U.C. Davis.

The initial deployment of advanced technologies to the Yosemite region received a lukewarm response from park visitors. The system of CMS and HAR deployed throughout the region displayed only static information and suffered unknown periods of downtime.

The survey of 202 Memorial Day weekend visitors revealed that 16% recalled seeing a message displayed on a CMS on the way into the park. While the messages rarely changed respondents' travel behavior (only four respondents changed their travel plans), they often improved trip quality (by advising travelers to expect congestion in Yosemite Valley or delays ahead). Almost 20% of respondents tuned their radio to hear HAR broadcasts. Only 46% of those who heard the broadcasts felt that the information was useful. Conversely, 65% of respondents who recalled seeing a message on a CMS on the way into the park felt that the information was useful.

Delay counts taken at entrances revealed that a fully functioning YATI system could have been extremely helpful during the weekend. Predictions of vehicle delay at park entrances can be made to decide which messages to send along each approach corridor. Alternatively, YATI can be employed as a planning tool to better understand the traffic congestion and air quality implications of staffing decisions.

Data collected during Memorial Day weekend suggest that while the initial impact of the YATI system on travelers appears to be limited, the potential benefits are extensive.

FUTURE PLANS FOR THE YATI SYSTEM

During the summer of 1995, CMS and HAR will operate continually and on a real-time basis. They will be continuously monitored to minimize system downtime and ensure that appropriate messages are disseminated. By September 1995, information kiosks will be operational in selected cities along each of the four park access routes. Besides providing real-time information on weather and travel conditions, the kiosks will offer users information on available lodging, camping and parking, alternative destinations inside and outside the park, and alternate modes of travel to the park and inside the park.

During the winter of 1995, the YATI system will remain in operation. Users will be supplied with current weather and road conditions, including chain requirements and warnings of icy roads. By the summer of 1996, all components of the YATI system will be operational. This includes the touch-tone telephone database and computer bulletin board services. The gradual deployment of these technologies enables the project team to evaluate the effectiveness of each individual system component and identify any synergistic effects of the various components.

ACKNOWLEDGMENTS

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