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SYMPOSIUM ON MOTORIST-AID SYSTEMS

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INTRODUCTION

By late 1967, it had become increasingly apparent that while much work on motorist aids was in progress, the highway research community had limited knowledge both of the scope of pertinent research and the results obtained from operational motorist-aid systems.

In an effort to overcome this lack, the Special Committee on Electronic Research in the Highway Field sponsored a symposium on Motorist-Aid Systems at the 47th Annual Meeting of the Highway Research Board. A short presentation was made by each of eleven panel members and a lively and interesting question-and-answer session followed.

The presentations and the proceedings of the question-and-answer session are contained herein, as well as a bibliography on highway communications.

PRESENTATIONS

The Chairman of Special Committee No. 3, Mr. Richard C. Hopkins, opened the symposium by welcoming the eleven panel members and some thirty guests. He pointed out the especial appropriateness and timeliness of the symposium in that many states now desire to rapidly institute emergency communication links between highways and service dispatch centers. He felt their efforts were somewhat hampered by a general lack of knowledge in this area, which was in part due to the lack of information dissemination on motorist-aid systems. The hope was expressed that this symposium would help to overcome this lack.

Each panel member was then requested to identify himself and give a short presentation on his current work on motorist-aid systems. The presentations are next presented in the order in which they were given.

Eugene Cunningham--Bureau of Public Roads

Mr. Cunningham is a Highway Engineer with the Bureau of Public Roads, Office of Engineering and Operations.

This office has been charged with the duty of examining all plans and programs submitted by the various state highway departments when Federal-aid construction funds have been requested for the installation of a motorist-aid system.

This office works in conjunction with the Office of Research and Development which administers the research program of the system operation.

Raleigh H. Emery--Bureau of Public Roads

Mr. Emery is with the Bureau of Public Roads, Office of Research and Development, Traffic Systems Division, and his primary concern is research studies involving motorist-aid systems; however, he also works closely with the other offices of the Bureau and the agencies in setting up experiments in accordance with IM 60-1-66.

Mr. Emery is presently engaged in a study to determine how various characteristics of a system affect the following:

1. Efficiency = $\frac{\text{No. of motorists using system}}{\text{No. of motorists needing system}}$

and

2. Time (measured for the steps required to provide the required service).

These can be used to compare systems or specify performance, and eventually design data will be available to accomplish the desired results.

A. Taragin--Bureau of Public Roads

Mr. Taragin is Chief, Planning Division of the Office of Traffic Operations, Bureau of Public Roads. In this capacity he has the responsibility for identifying needed research in the fields of traffic engineering and operations and recommending research and development programs which will yield high payoffs in short time periods, and for developing and directing innovative programs to improve the safety and efficiency of traffic flow.

In the area of motorist-aid systems, his office works closely with the offices of Engineering and Operations and Research and Development in implementing the results of research in this area among others so that the motoring public may get the greatest benefit of expenditures of Federal and public funds.

Alex Kuprijanow--Airborne Instruments Laboratory

The problem of communicating with the disabled motorist is a serious one which will continue to exist in the foreseeable future. Improvements in highways and increased vehicle reliability will be counter-balanced by more travel, more interaction between cars, and more complex machinery with the driver remaining the same--relatively helpless.

Many persons and agencies have, at various times, been concerned with disabled vehicles, usually as related to their particular facility. The first study conducted at AIL probably was the first one of the overall problem. The results have been published in NCHRP Report No. 6.

This study was divided into three major parts. First, a quantitative determination of the rate of vehicle disablement as a function of highway type and traffic level, together with a distribution of the types of disablements. The distribution of services needed can be determined from this latter item.

Based on data obtained from numerous and diverse sources, a mathematical model relating the rate of occurrence of stops on a facility to the ADT and ADL traffic parameters was constructed. One can use this model to predict the stops per mile per day for given values of ADT and ADL. The validity of this model as a predictive tool has been repeatedly confirmed by data obtained after the model was derived.

In the process of utilizing data collected by diverse means from various sources, it was necessary to correct it so as to reflect the actual number of stops which occurred rather than the recorded ones. These latter stops included those reported by police patrols, distress calls received, etc.

The second part of the study was the definition of objectives. These were quite dependent on the person or agency who promulgated them. Some typical examples are as follows:

a) to increase safety of disabled motorist;

b) to increase safety of other motorists;

c) to maintain or increase capacity;

d) to provide motorist service; and

e) to aid in law enforcement.

An equally important objective is the necessity for defining the level of service desired--for example, a probability of P that one will have a service response in less than X minutes.

Finally, once the problem is defined and the objectives are established, it is possible to draw upon the wealth of experience, techniques, disciplines and equipments available to achieve workable solutions. A number of such solutions were analyzed briefly for several different road environments. One approach--that of using a solid-state light-emitting diode operating in the infra-red region--was investigated in detail. The feasibility of the techniques was shown and has been reported (NCHRP Report No. 40).

It was apparent from the first part of the study that no one existing solution was adequate neither for the totality of highway environments nor for the fullfillment of all the possible objectives. Further, the implementation cost per assist probably would vary considerably depending upon motorist utilization. It should be noted that if an active rather than a passive system is used, one must have user acceptance--otherwise the system will have little value.

Another criterion, and certainly an obvious one, is that of economic feasibility. Many technically feasible approaches must be discarded because of the high dollar cost involved.

In conclusion, any satisfactory motorist-aid system must satisfy the following criteria:

1) it must accomplish the desired objectives;

2) it must be technically feasible;

3) the approach must be evolutionary and offer potential for expansion and improvement;

4) it must be acceptable to the driving public; and

5) it must be economically feasible.

Daniel E. Molnar--Battelle Memorial Institute

Mr. Molnar is presently working on the first phase of a three-phase project sponsored by the Ohio Department of Highways. The total program is concerned with the disabled motorist problem on controlled-access rural highways.

The first phase of the program is concerned with the definition of the disabled motorist problem in Ohio, the study of known systems for use in solving the problem, and the recommendation of cost-effective solutions to the problem. Major sources of data for this phase are from surveys on selected

highways in Ohio, site visits to states having motorist-aid systems, and consultation with system manufacturers. A Phase I final report will be completed in February 1968.

Phase II of the program would deal with the installation of one or more test systems, and Phase III with the evaluation of the test installations.

Ronald W. Tweedie--Department of Transportation, State of New York

The Department of Transportation has been monitoring the Northway Emergency Telephone System since it was installed in January 1966 and is now engaged in a comprehensive research program to evaluate the use and operation of the system in relation to its physical characteristics, the characteristics of the Northway, and those of the system users. Specifically, the research is concerned with:

1) the need which the motorist has for emergency communication;

2) the value of the system in reporting accidents;

3) the economic benefits of the system; and

4) the relationship of the system use to each of several travel parameters.

Data pertaining to each call are recorded by the State Police, and almost 10,000 calls have been received to date. Computer programs produce a listing of the information from each call as well as monthly and cumulative summaries. The last of the 712 call boxes was installed during the latter part of 1967.

Donald E. Orne--Michigan Department of State Highways

Mr. Orne is an Engineer of Traffic Research for the Michigan Department of State Highways and participated today so as to discuss the Michigan Motorist-Aid Telephone Project on 30 miles of I-94. The project has 62 telephone sites, each connected to one of two State Police Posts. The sites are $13\frac{1}{2}$ feet from the edge of the pavement and spaced, on the average, at either one-half or three-quarter mile intervals. The entire system, within highway right-of-way and within police posts, is state-owned. Communications between these terminal points is by way of leased telephone line. The system is operational and data collection is just beginning.

Page Carter--American Telephone and Telegraph Co.

Mr. Carter is a Communications Supervisor with the Long Lines Department of the American Telephone and Telegraph Company, and is responsible for liaison between the Bell System and the Bureau of Public Roads on highway communications matters. The Bell System has motorist-aid telephone systems in service in several states including California, Maryland, New Jersey and New York.

Howard C. Lawrence--Radio Corporation of America

RCA has been active in various types of highway communications for many years. The RCA Emergency Radio Call Box system is of particular interest at this symposium. Each call box contains a one-watt, 72 mHz, frequency-shift keyed transmitter and a digital encoder which constructs a 25-bit, 5-word message, each word having a parity bit. Four words are used to identify box location in four decimal digits. The last word identifies the service requested. One to five push buttons are normally provided. All solid-state components are used and power is obtained from a small two ampere-hour storage battery trickle charged by a solar cell. A complete message is transmitted in one second.

On high traffic density highways, it is recommended that call boxes be installed at half-mile intervals on both sides of the road, opposite each other to discourage crossing of the highway. On low-density rural roads, boxes can be up to one mile apart, on one side of the road.

At the base station, usually in a police patrol headquarters, the call box message is decoded, automatically checked for parity, and if correct, displayed visually and printed on a paper tape, together with the time of receipt.

It is believed that a combination of coded call boxes and road patrols can give better service, at lower cost, than patrols alone.

Edward F. Weller--General Motors Corporation

Mr. Weller is the head of the Electronic and Instrumentation Department at the General Motors Research Laboratories.

This department has been very interested in highway communications for over ten years. An early development was Hy-Com, a system wherein audio messages were communicated to the driver via a VLF communication link. This was followed by DAIR, Driver Aid, Information and Routing. DAIR included audio signs, visual signminder (a method of displaying roadside signs within the car) code and voice emergency communication, and route guidance. More recently, GM has been engaged in an experimental route guidance system (ERGS), under contract to the Bureau of Public Roads. Hy-Com and DAIR have been doc-

umented by technical publications. The ERGS program will be documented by a final report to the BPR.

R. Henry Lesser--Ford Motor Co.

Mr. Lesser is the Manager of Electronic Systems Research in the Product Development Group of the Ford Motor Company. In this position he has the responsibility for product research of all electronic equipment relating to the vehicle including communication equipment.

QUESTION-AND-ANSWER SESSION

A total of 31 questions were raised after the introductory statements were made. These have been categorized into the following four groups--system benefits, system configuration, system performance and miscellaneous and are set forth as follows.

A. SYSTEM BENEFITS

1. QUESTION: In the use of communication links for disabled motorists, has the use been all technical or has there been some social use? (Richard E. Wendt, Jr., Consultant)

ANSWER: By technical, I assume you mean use strictly by the disabled motorist. The extra benefits of the system have been reflected in numerous reports of wrong-way drivers and roadway hazards. The State Police frequently use the system for official purposes; however, there have been surprisingly few calls for information. (R. W. Tweedie)

ANSWER: The primary usage of emergency telephone systems has been for motorist service and emergencies. There have been limited attempts at social use. In one case a housewife remembered she had a roast in the oven and requested the police to call home and ask the family to shut off the oven at a specific time.

On the Northway system the State Police use the emergency phones for certain conversations between a patrol and headquarters when they do not wish the conversation overheard on the radio. (Page Carter)

ANSWER: The Detroit Lodge Freeway CB Experiment was designed to determine if communications employing an in-car radio frequency link could be of value. Recognizing the fact that a clear channel for emergency communications would be desirable, but also recognizing the fact that CB was available, the system was instituted using Channel 9. The system has been in operation for about one and a half years. One hundred City of Detroit and GM employee vehicles are equipped with five watt transceivers which can communicate to a base located in the TV surveillance center at Herman Kiefer Hospital. During this time a variety of emergency calls have been received varying from auto fires, collisions, flat tires, ice on pavement, etc., to calls such as children rolling down the embankment, dogs caught in railings, etc. Channel 9 is used by all CB'ers but since the initiation of this program they have voluntarily restricted their calls during the morning and evening rush hours so that our program could be effective. Calls during the morning and evening rush hours so that our program could be effective. Calls to and from the base station have been limited to reporting emergencies and not for social use. (E. F. Weller)

ANSWER: The principle use as experienced in the City of Detroit/General Motors CB Radio Demonstration Project is that calls are primarily pertinent to vehicle problems. There is some usage which related to requests from CB-equipped motorist about traffic-flow conditions on certain portions of the roadway system. Naturally, nonautomotive incidents are reported too, as Mr. Weller pointed out...grass fires on expressway embankments, etc. The popularity (and success) of the system has been most gratifying. Evidence to this effect is to be found in the fact that, even prior to any press releases or publicity on the project (early demonstration period), the CB community became aware of the existence of KUY-3173 and surmised its reasons for existence. Initially, it was intended that the City of Detroit and GM employees, whose cars (about 100) were particularly equipped, would do the reporting. However a significant percentage of calls began coming into the KUY-3173 base station from "non-project-related" individuals.

A number of "dramatic" calls were also received. For example, one instance, which received press coverage later, was the occasion of a vehicle fire. The incident was reported to KUY-3173 base. About 2 minutes later the fire engines were on the scene. Too, the Log records several reports of children being struck by cars. Another type of call, of which two come to mind, has to do with suicides on the Expressway. In one

A. SYSTEM BENEFITS (continued)

case, the situation was reported to KUY-3173 base and help dispatched. The suicide did not ensue. On another occasion a person leaped from an expressway bridge. The incident was witnessed by a CB'er who reported it. Appropriate authorities were notified almost immediately.

Other less dramatic calls relate to youngsters throwing objects from bridges onto the expressway, obstacles and debris in the roadway, and untoward surface conditions.

Under normal circumstances a transmission sequence lasts 30 seconds or less. Perhaps a modal transmission time would be about 20 seconds. (H. J. Bauer, General Motors Research Labs.)

ANSWER: The communication links have not been used for any social use. There have been inquiries, however, from participants in the program and other citizens regarding the conditions of traffic on the freeway system. If available, this information has been furnished. (A. F. Malo, City of Detroit, Department of Streets and Traffic)

2. QUESTION: I think police might be prepared to take care of some needs. What seems to me is being missed here is that we are dealing with motorist services. There are a number of studies being carried on and our problem is what questions can you pose so that we would be able to obtain answers to help them to identify the system without concern about the price technicality? (A. Taragin)

ANSWER: I agree with Mr. Taragin that hardware price is a minor aspect of the problem of stranded motorists on the highway. It covers more than a hardware system for emergency calls and motorist-aid, its designation, provides a better description. A motorist-aid system, as we see it, consists of two elements - the call system, or hardware; and the response system, or software.

There is no question in my mind that industry can provide almost any hardware system we are willing to specify and pay for. They are already producing several systems at different cost levels. We need to focus more of our attention on the key element of a motorist-aid system--aid to the motorist. This raises a number of questions - Who, on a round the clock schedule, receives the motorist's call for help? How soon and by whom is help dispatched? Who pays for the service? Then there is a matter of software performance or level of service to consider. How long after an emergency call does help arrive: Ten minutes? Twenty minutes? Two hours? One factor is obviously the response load at the moment. If, in a given highway section where only two ambulances are readily available, three accidents occur at various points, can we tolerate - or are we willing to pay for a fast (say 10- to 20-minute) level of service? What is the legal responsibility in the event of a loss of life because of a slow response?

In our current research studies on the operation of installed motorist-aid systems, we seem to be emphasizing the physical characteristics of hardware, such as mode of operation, station spacing and construction costs. I should like to urge that greater effort be devoted to software or the response system and its operating characteristics. We all recognize that the number of critical--I repeat critical--incidents is a small fraction of the total - possibly not more than 2 - 3%, if that much. The "severity factor" of an incident type rather than its occurrence frequency, however, may be the determinant for level of service to be provided. For example: Case No. 1--A salesman, on a pleasant summer morning, gets a flat tire. He arrives late for his appointment and as a consequence loses a big order. Case No. 2--The same situation, except the driver is a young woman with an infant in the front seat and a pre-school child in the rear. It was sunny. It is now dusk. Case No. 3--Let us further modify the conditions. It is November, 7 PM (darkness set in about 6 PM). It is raining, or snowing, or a light freezing rain is falling. Case No. 4--In either 2 or 3 above, the woman did not bring the car to a safe stop on the shoulder. The tire blew, she lost control, the car rammed into a tree, pole, or another fixed object. It is a serious accident.

That the above examples require difference degrees of prompt and adequate service is self evident. Or to put it another way, their severity-index has a wide range. Motorist-aid is thus not merely the simple problem of placing a call for help.

We design highways to a "30th hour" capacity. Which of the above cases or their severity-index or severity-moment becomes our basis for design? I propose that in our research studies on the performance of motorist-aid systems, we highlight sociologic

A. SYSTEM BENEFITS (continued)

aspects, define and isolate that small percentage of critical cases, and find out what goes on. Then focus our efforts on evolving severity-index and possibly a severity-moment (severity-index times occurrence frequency) as a measure or determinant for a level of service. Having established a measure, we engineers, scientists, etc., should be able to provide highway administrators with plans for several levels of service using alternate schemes, and their corresponding estimates of total operating costs--not cost estimates for hardware installation, but annual operating costs of the total system software as well as hardware. What level of service to provide at what cost, corresponding estimates of total operating costs--not cost estimates for hardware installation, but annual operating costs of the total system software as well as hardware. What level of service to provide at what cost, rather than which hardware system is the cheapest to install, is, in my viewpoint, the key question for an administrator's decision. (Stanley Woolman, Department of Transportation)

3. QUESTION: In your study of motorist needs, what considerations have been made of police-patrol requirements? (James Koan, FHWA, Bureau of Public Roads)

ANSWER: In all our comparisons we have attempted to make logical judgments as to the role of highway patrolmen. For some of the systems the patrol is not affected, i.e., they perform services just as they do today. For certain systems (push button) the patrol will have to answer calls, at least until the driving public can become educated in a more efficient use of such systems. (D. Molnar)

4. QUESTION: From my personal experience with motorist-aid systems, I am wondering whether there are not in Bell Labs a group of ivory-tower scientists who have analyzed the total system? There are problems as we now know. What has been done with their efforts on the highway? (S. Wollman)

ANSWER: I am not aware of any work which has been or is being done at Bell Telephone Laboratories specifically on motorist-aid systems or total highway communications. However, the Bell System Companies are working closely with highway departments in several states in providing communications services for research and development projects in these fields. (Page Carter)

ANSWER: Many analyses of various motorist-aid communication systems have been made. The system to be supplied is usually a trade-off between the features desired and the cost of supplying them. With a spacing of one half mile between call boxes, a coded-box system costs about one-half as much as a wired telephone voice system, and can give the information normally required. (H. C. Lawrence)

B. SYSTEM CONFIGURATIONS

a) Method of Communication

1. QUESTION: Could we hear something of the trend in the communications link--wire line, radio, or citizen's band? (R. Doble, Philco-Ford Corp.)

ANSWER: It is a little early to see a trend. All of the types of systems you mentioned are being used. Data and user comment on these systems will aid others in specifying future systems. Wire-line systems are most economical when call boxes are closely spaced, such as the 400-foot spacing of telephones on bridges at the northern end of the New Jersey Turnpike. Radio is most economical for spacing over about 1/8 mile. I personally feel that the economies of a radio system in rural locations will result in a trend in this direction.

Citizens Band requires a rather expensive vehicle installation. No official channels for aid-requests have been established, and base stations are manned by volunteers. Authorization of special frequencies and implementation of non-volunteer base stations is required to make a C B aid system truly operational. (H. C. Lawrence)

ANSWER: While the emergency telephone has proven its value as an aid to the motorist, we expect that advancements in areas of total highway communications will enable even more effective use of the cable. It can serve as the transmission medium for traffic counting, audio signing, etc., without consuming valuable radio-frequency spectrum. (Hilton Dana, New York Telephone Co.)

ANSWER: There is no established trend, and research programs are in progress which may provide additional methods. For example, we are working toward a system which will use the

B. SYSTEM CONFIGURATIONS (continued)

"cooperative motorist" to report the presence of motorists who need help.

I might point out that a problem as complex as this one is almost never solved by a predominate system. It appears that different solutions will be required depending on road structure, frequency availability, terrain, weather, traffic characteristics and other factors. (Raleigh Emery)

ANSWER: It is obvious that clear channels are very desirable for emergency highway communications. To this end the Automobile Manufacturers Association, in Docket 13847, had petitioned the Federal Communication Commission for clear channels in the 450-470 mHz band. (E. F. Weller)

2. QUESTION: Would you comment further in regard to economics of radio in your more rural western states? What types of systems would you recommend for the very rural area? (Don Ryan, Bureau of Public Roads, Sacramento, California)

ANSWER: Radio systems become increasingly practical economically as the area becomes more rural and existing wire lines more remote. A radio push-button system is more economical than a radio-voice system. A push-button system with call boxes spaced one half mile apart on both sides of the road, and base stations in police headquarters about 40 miles apart would cost $4000 to $5000 per mile installed. Where traffic is light and crossing the highway to reach a call box is not considered unduly hazardous, the cost would be about $2500 per mile. Spacing the call boxes one mile apart brings the cost even lower. When this cost is compared with the approximately $45,000 it costs to keep one patrol car on the road 24 hours a day for 365 days, the economics of a radio-call box system become apparent. (H. C. Lawrence)

3. QUESTION: When you are dealing with a system such as telephone and a company that has the necessary equipment, the Bureau is willing to participate in the installation charges only. Has the Bureau done anything about this future in funding? (R. Tweedie)

ANSWER: There are several requirements which are to be met by the State when Federal-aid funds are requested for the installation of an emergency call system. The competitive bidding provisions of Sections 112 of Title 23, USC and the provisions PPM 21-6.3 pertaining to the purchase of equipment are two of these requirements.

However, if it can be shown to be in the public interest that a savings in public funds can be obtained with a leasing agreement, Federal participation in the cost would be permissive on a short-term basis, say two years, provided the maintenance costs for the system are excluded. (P. E. Cunningham)

ANSWER: Another alternative is available for a telephone system. The Bureau will participate in the construction of a state-owned system. The installation recently completed in Michigan was contracted on a basis of open bidding with BPR participation on the complete installation. (R. H. Emery)

4. QUESTION: What is the typical duration of the voice messages? (S. E. Gordon, Communications and Systems, Inc.)

ANSWER: The State Police have indicated that most communications are completed in less than one minute. (R. W. Tweedie)

5. QUESTION: What is the present reaction to push-button requests versus voice requests? (R. Doble)

ANSWER: In general, the State Highway Patrols are inclined toward voice communications. This preference causes some agencies to consider only voice communications, and this has meant telephones in nearly all instances. The requests for systems to be installed with Federal participation are, however, about evenly split between call boxes and telephones. In some instances a voice overlay has been requested for the call boxes, and I believe the suppliers of call boxes are working toward this. (R. H. Emery)

ANSWER: The reaction varies. Police, in general, initially prefer voice requests because they have used voice communications to patrol cars. A push-button system costs about half as much to install as a wired telephone system, based on actual costs for existing systems and competitive bids for others. The conventional push-button system provides a printed record of the request and the time it is received, reducing the tasks of the operator. It takes less operator time to handle a printed and displayed request than to handle a voice request. The push-button system avoids problems of language

B. SYSTEM CONFIGURATIONS (continued)

and user excitement which may prevent him from clearly defining his problem or giving his proper location. The Atlantic City Expressway Authority, which has a 100-box push-botton system on a 44-mile rural toll road, feels that their system gives them the information they need at a cost they can afford. (H. C. Lawrence)

ANSWER: A direct comparison of the public acceptance of push-button call boxes versus voice grade telephones is available from data accumulated in Los Angeles. Radio call boxes (i.e., push-button) have been in operation at quarter mile intervals along 10 miles of the Hollywood and small portions of the Santa Ana and Harbor Freeways since November 1962. Emergency telephones, likewise spaced a quarter of a mile apart were installed in July of 1962 along the Harbor Freeway. Each system covers approximately 10 miles of Freeway.

For a six month period (July-December 1965), 4193 telephone calls were recorded for the 80 telephones, or 23 calls per day. Thus for the 10-mile section covered by the telephones, 2.3 calls per mile per day were made.

For the same time period, in the 10-mile section covered by the call boxes 13 calls per day were made, or about 1.3 calls per mile per day.

A review of the records at the Los Angeles Police Department dispatch center where both types of calls are received indicated the current (summer 1967) rate of about 500 calls per month on the telephones and 150 calls per month on the call boxes or 1.7 and 0.5 calls per mile per day respectively for the two systems.

Thus it appears that the greater acceptance of telephones versus push-button call boxes is attributable to their operational differences: whereas in the former the motorist can express his needs verbally and receives a positive response/reassurance/advice, after he pushes the button he must assume that "something" will happen, aid is forthcoming, and even that his message was received.

It is also believed that a time saving may result since the motorist can request the particular service needed (assuming single button call boxes as those in LA on the telephone as opposed to the call boxes; however, no data as to the time savings was found.

In terms of equipment utilization, it was deduced that approximately 40% of the disabled motorists who might be justified in using the emergency communication equipment do in fact use the telephones (hence a correspondingly lower percentage take advantage of the push-button call boxes). Of those who do not use the equipment, or about 60%, 20% (approximately) help themselves, and the remaining 40% do not use the equipment out of ignorance, fear of incurring charges, or because they are aided by police or other motorists before they have a chance to call. (A. Kuprijanow)

ANSWER: We can only state the voice-communication side, but the New York State Police are emphatically in favor of direct voice communication. Public response has also been good; no complaints have been received. (R. Tweedie)

6. QUESTION: Is there any bilingual problem? (R. C. Hopkins)

ANSWER: There have been a few instances where our French-speaking neighbors have been unable to relate the exact cause of their disability. In these cases, a State Trooper is immediately dispatched to ascertain the trouble. (R. Tweedie)

7. QUESTION: Is there any work going on for automatic tape recording of the voice--a tape recording from the time the call is started until it is completed to obtain a legal record of just what the caller said? (S. Wollman)

ANSWER: There are a number of standard tape-recorder systems available which are activated by a signal from a communication transmitter or receiver. Any of these could be applied to an emergency call system. With the coded call box a printed paper tape shows the time call was received, the type of aid requested, and the location of the call box used. The police headquarters log, and usually the tape recording of the voice communications to and from the patrol car, show when aid was sent and the result of sending that aid. (H. C. Lawrence)

ANSWER: This feature can be provided by using a standard Bell System recorder connector; however, the customer must supply the recording device. (Hilton Dana)

B. SYSTEM CONFIGURATIONS (continued)

8. QUESTION: Would you like me to discuss the two-wire system? (R. E. Borup, New Jersey Department of Transportation)

ANSWER: We plan to bury a two-conductor cable or wire at a depth of 4-6 inches along the row of delineator posts on a section of Interstate 287. A loop of wire will be extended up each delineator post terminating in a normally-open switch.

The system will consist of four closed-loop legs; one each to the north and to the south of a central point in both the north bound and south bound roads. The central point will be a station at which a 12-volt direct current will be applied to the system.

Measuring instruments will measure and record the resistance from the central station to any point along the wire where a switch is closed by the disabled motorist.

The system may be modified at a later date to include voice-to-voice communication, but for the present, a simple resistance measuring circuit is all that is planned. (R. E. Borup)

b) Identification of Communication Facilities

1. QUESTION: Has anyone considered putting colored lights on call boxes? (S. E. Gordon)

ANSWER: The New York Telephone Company developed and proposed a low-level lighting system to be used on the Northway Emergency telephones. This lighting would consist of a neon lamp at each station which would operate from facility line current and therefore not require an external power supply. The light, although of low voltage, would be an effective aid to motorists in locating the phones except under extremely low visibility conditions.

The New York State Department of Transportation has decided not to add lighting at the present time. (P. Carter)

2. QUESTION: Do you think maybe it would be time to identify emergency call systems in some way, possibly light by day time? (W. J. Lindsay, Bureau of Public Roads)

ANSWER: I am not aware of any standards that have been adopted to date for identifying emergency call systems. However, most operating voice communication or telephone installations on highways and bridges have the picture of a telephone hand piece on a sign with the word "Emergency" at each location. The push-button type installation has a small square sign with the message "Call Box" and some of both type installations have a low burning light at each location.

I would agree that it may be the right time to standardize the signing and lighting of emergency call systems. (P. E. Cunningham)

ANSWER: The Austin, Texas traffic authorities placed emergency telephones at intersections and identified them with red lights. This caused confusion as a traffic control device and led to the inadvertent stopping of many motorists. The red lights were replaced with blue ones and the disruption of traffic ceased. (Clyde Lee, University of Texas)

ANSWER: The Michigan project is using a white legend on blue background symbol signing to identify the phone sites. The signing is attached to the light and phone support. A constant burning 67-watt blue lamp also is used as an additional means of nighttime site indentification. In selecting blue, a number of other colors were evaluated and rejected. Traffic signal colors were deemed inappropriate due to possible misinterpretation and adverse traffic operational effects. Fluorescent orange would be in conflict with current proposals to use fluorescent orange on construction area warning signs. However, a material having fluorescent properties does have distinct daytime visibility advantages. Blue possibly may be identified by the public as a symbol of assistance and authority since blue is the predominant color of the police function (uniforms, patrol vehicles, etc.). Also, blue is in conformity with current national standards for motorist services signing. (D. E. Orne)

3. QUESTION: On a dark night with no moon, is blue visible? If so, at what distance? Has the Telephone Co. done any work in this respect? (S. Woolman)

B. SYSTEM CONFIGURATIONS (continued)

ANSWER: New York Telephone Co. has not done anything specific with colors of lights. However, in planning the initial installation of the Northway System, studies were made to determine the most satisfactory color of boxes and signs and the specific placement of signs. Federal yellow had a greater reflective capability from automobile headlamps than red. We tried adding glass chips to yellow paint to increase reflection, but this was unsatisfactory since the chips tended to collect dirt and actually decreased the reflection. We also discovered that by lowering the signs from ten feet above the ground to four inches above the box, reflection from headlights was greatly increased. (H. Dana)

ANSWER: Based on limited subjective nighttime field evaluation, we find the blue light to have a high degree of visibility. When viewed, on a dark rainy night, one light was always visible and usually the next two were visible to the driver. In contrast to numerous sources of white light within the drivers field of vision in the rural freeway environment there was no difficulty in determining by the color coding the phone site locations. (D. E. Orne)

ANSWER: The spectral response of the normal human eye is well known, and it is relatively easy to predict the distance over which a particular color light will be visible. This is also, of course, a function of the intensity of the light source. (R. H. Lesser)

4. QUESTION: The State of Washington has used the blue light and found it very effective. What about vandalism on these projects? (W. O. Kingman, Highway Safety Bureau)

ANSWER: To date, only two of our 62 phone sites have been subject to vandalism and those incidents were generated by the individuals' anger due to malfunctioning telephones. The system at that time was not yet operational. Three phone installations, to date, have been struck by vehicles with little resulting damage to the vehicle. Since the phones are connected directly to a State Police Post, we anticipate very little vandalism. If vandalism does become a problem, information may be posted to inform the user that the phone is a direct connection to the State Police. This might be a deterrent to vandalism and may also overcome a currently developing problem of users assuming the motorist-aid phone is connected to the public telephone system. (D. E. Orne)

ANSWER: We have had little trouble. (R. W. Tweedie)

ANSWER: Vandalism has not been a major problem. While we had anticipated difficulties, it appears that the public has treated the system with respect. On one isolated occasion on the Northway, 23 handsets were removed, but the State Police apprehended the culprits on the spot. The design of the system and the voice capability enabled the police to be immediately aware of the prank. The parties involved made full restitution for damages and apologized publicly for their actions. We have had a few other occasional losses of single handsets, but it is not considered a major problem. (H. P. Dana)

c) Power Source

1. QUESTION: How would battery-solar cell type of system work in a northern climate? Do you use lead-acid batteries? Will they survive the below zero type of temperatures for several months? (A. Kuprijanow)

ANSWER: The solar cell charging system can be sized to the environment in which it must work. A bright sky, even without the sun, is sufficient to charge the batteries in current systems. Only about five watt-seconds are required for a transmission so that the amount of energy to be replaced after a transmission is small.

We use lead-acid batteries. Nickel-cadmium batteries have been tried but were found less satisfactory for the low-drain requirements of call boxes. Lead-acid batteries can survive below zero temperatures for long periods of time if properly charged. Some of our call boxes include a battery condition monitor. Each time a request for aid is transmitted, or if desired, once a day, the battery condition can be sent automatically to the base station. (H. C. Lawrence)

d) Location of Communication Facility

1. QUESTION: How do you maintain accessibility to the phone? (J. O'Neill, General Signal Railway Co.)

ANSWER: The phones are located 12 feet from the pavement edge. Our maintenance forces are able to clear the snow between the pavement and the telephones. (R. W. Tweedie)

B. SYSTEM CONFIGURATIONS (continued)

2. QUESTION: What will we do if they change the requirements to 30' away from the pavement? (A. F. Malo, Detroit Department of Streets and Traffic)

ANSWER: (No answer was given to this question.)

C. SYSTEM PERFORMANCE

1. QUESTION: Would you take a couple of minutes to brief us on what is being done on the Atlantic City Expressway? (R. C. Hopkins)

ANSWER: The Atlantic City Expressway has installed, and is operating, what might be considered a model system. All of the services are under close control of the Expressway Authority, and it makes for a tight system. For example, the services are performed by service facilities under contract. These service facilities are required to answer calls and maintain minimum standards including radio communications with the police dispatcher.

The prices charged for service are published on a tag which is presented to the motorist before the service is requested. This tag is in two parts and one of them is attached to the vehicle when the service is requested.

In order to complete the cycle, all services are billed on an Expressway form which must be signed by the motorist. A copy of this form is sent to the Expressway office to provide a check on the service and charges.

These things together with the Call Box system, 20-minute police patrol, police communication system, and radio contact with the service vehicles combine to provide the Atlantic City Expressway with what can be considered a model system. Their efforts have paid off with a very satisfactory operation. (R. H. Emery)

2. QUESTION: In the use of operating call box systems, what percentage of the vehicles that need aid manage to get a call box against those who have to walk a sizeable distance? (George Gray, R. C. A. Medical Electronics)

ANSWER: Whereas we do not have any figures on this, several qualitative observations can be made. Specifically, the spatial distribution of disablements on California's freeways observed appeared to be fairly random; on the other hand, long-term observation might well indicate patterns of stops which are not random. Police officers have stated that there are specific locations where certain stop types appear to occur at greater than average rates. Furthermore, relatively higher numbers of stops were observed on several freeway sections with wide shoulders/medians versus elevated portions with little or no such comparatively safe stopping places.

The spacing of both the call boxes and telephones on Los Angeles' freeways is one quarter of a mile on each side of the freeway. Thus any motorist who wants to use the call box should be able to stop within less than about 600 feet of the nearest one--barring a catastrophic vehicle failure at a low vehicle speed or while stopped (as in congestion). On the Northway, the telephones are spaced one half mile apart; however, since a coasting vehicle is less likely to be impeded by traffic than on the urban freeway, again barring a catastrophic failure the driver should be able to come to a stop less than a quarter of a mile from the nearest telephone.

A disabled motorist walking any distance to a call box is in some danger of being struck by another vehicle. This is a serious problem on the urban freeway; hence the closer spacing of call boxes there, and even closer on facilities such as bridges and their approaches, and tunnels where call boxes/telephones are frequently spaced 200 feet apart, frequently on both sides of each set of lanes carrying traffic in either direction. (A. Kuprijanow)

3. QUESTION: When you go out and respond to the motorist call, what percentage do you find at the call box and what percentage had to walk a considerable distance down the road to the call box? Will these data start coming in as you get into saturation surveys? (C. Gray)

ANSWER: These data are not presently available. (R. H. Emery)

ANSWER: We have no specific information of that nature; however, with one half mile spacing, I don't consider this a problem. (R. Tweedie)

C. SYSTEM PERFORMANCE (continued)

4. QUESTION: Is the frequency of breakdown urban or rural?

ANSWER: In our study four segments of controlled-access, rural highways were surveyed. Thus, all of our results pertain to rural incidence of breakdowns. (D. Molnar)

ANSWER: From experience gained so far on the Northway System, it appears that usage of the system is in direct proportion to the volume of traffic. Of course, traffic volumes are frequently related to location. For example, on the Loudonville section, which consists of 36 telephones and can be considered urban, 1169 calls were received from January 1, 1967 to November 30, 1967. In the same period, in the rural Glens Falls section of 196 boxes, 1268 calls were handled. (H. Dana)

5. QUESTION: Would you explain what you are now doing with regard to the use of the passing motorist to report vehicles who need help? (R. C. Hopkins)

ANSWER: In a study for the Bureau of Public Roads, AIL has established the feasibility of using passing motorists to report vehicles needing help. An operational system would work as follows: A motorist passing a disabled vehicle parked on the shoulder and displaying a distress signal would continue along his route to the next reporting station which would be marked by a standard symbol. Without stopping or slowing down, he would flash his headlights (from low to high beam) or sound his horn three times. A detector located at the roadside would relay a coded signal to a central monitoring station, where the observer would dispatch a vehicle to assist the motorist. The detectors can be located just before the exit ramps at interchanges. (Ivon Wisepart, Airborne Instruments Laboratory)

6. QUESTION: What is the degree of motorist cooperation? (A. Kuprijanow)

ANSWER: AIL has conducted field experiments at five locations. The locations were chosen to provide a cross-section of highway types and user characteristics. It was found that the response rates varied inversely with the vehicular rate of flow. The maximum response rates recorded at each of the experiment locations were as follows:

	% of Motorists Responding
Long Island Expressway, New York	24
Interstate 70, Kansas	100
Interstate 15, California	36
Richmond-Petersburg Turnpike, Virginia	25
Interstate 80, Nebraska	65

It should be noted that no educational campaign was conducted to alert the motorists prior to the experiments. (I. Wisepart)

7. QUESTION: Did you find that the response varied with the severity of the incident? (Darcy Sullivan, Illinois Department of Highways)

ANSWER: In order to determine how motorists would react to various types of disablements, a disabled vehicle was "staged" along the test section. During periods with no vehicles on the shoulder, "false alarms" were received from only a few percent of the motorists. During other "scenes," such as the following, the response rate increased with the apparent degree of help needed:

i) abandoned vehicle;

ii) man sitting in car with no obvious needs;

iii) man looking under hood;

iv) man changing flat tire.

The maximum responses were obtained when a SEND HELP sign was displayed by the "disabled" motorist. (I. Wisepart)

C. SYSTEM PERFORMANCE (continued)

8. QUESTION: Mr. Lesser, in your opening remarks you mentioned disappointment with the results. In what way were you disappointed? (Edith Bairdain, Consultant)

ANSWER: We were disappointed that the system had not received greater utilization, and that some of the participants in monitoring the channel did not do so conscientiously. Those people who had utilized the system did benefit in most cases, but we believe, to make such a system effective, it must receive much more publicity so that the public is aware of it and the monitoring must be done by people paid specifically to perform that function. The number of calls logged increased approximately ten times when we used paid monitors as opposed to the period when we were using volunteers and service-station attendants. (R. H. Lesser)

9. QUESTION: The service life of this apparatus is going to be important. What sort of lives are projected for this hardware? (R. E. Wendt)

ANSWER: For all of our comparisons of motorist-aid systems we used a ten-year period of life. We realize that telephone lines probably will last much longer, but we wanted to use a standard time period. Ten years allows for technological improvements. (D. E. Molnar)

ANSWER: On the Michigan project the initial study and initial maintenance contract is of two years duration. However, we are anticipating at least a ten-year useful life of the equipment. (D. E. Orne)

ANSWER: It is conventional practice to amortize the push-button call boxes on a ten-year basis. With the exception of batteries which have a life expectancy of two years under normal operation, there are no parts which would be expected to wear out. With proper maintenance, the system should last indefinitely. The system on the Capital Beltway has even shown its ability to take knock-downs by vehicles and still work. Eight boxes have been knocked down so far and all of them have functioned properly when they were picked up. (H. C. Lawrence)

ANSWER: This should be an area of major concern for those responsible for the choice of Motorist Aid Systems, especially since the use of such systems is in its infancy. With rapidly developing technology, the purchaser can soon find himself with an obsolete system and be confronted with increasing maintenance problems.

On a lease basis with a common carrier, obsolescense, service life, and maintenance are of minimum concern to the contracting agency, since the carrier assumes responsibility for these problems. Thus advantages can be taken of new technology, and the implementation of new concepts can be achieved with minimum expenditure. (H. Dana)

D. MISCELLANEOUS

1. QUESTION: Is a bibliography on motorist-aid systems likely to be prepared? (R. E. Borup)

ANSWER: A bibliography is not available, however, there is an article due to come out in "American Highways" which evaluates the state of the art and tabulates all the projects known to the Bureau. This paper by Mammano and Surti may be of some value to you. (R. H. Emery)

ANSWER: A bibliography will be attached to the symposium proceedings which will be published as an HRB Circular. (R. C. Hopkins)

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This Highway Research Board Circular was prepared by Messrs. R. E. Fenton and E. F. Weller of the Subcommittee on Highway Communications, with the assistance of Mr. R. C. Hopkins.