A HIGHWAY COMMUNICATION SYSTEM FOR THE MOTORIST: THE CASE FOR TWO-WAY RADIO

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The author briefly reviews the communications systems currently in operation and those proposed by highway departments for users of American highways who find themselves stranded or in need of information. The paper reports on the volunteer two-way mobile voice radio system that has been developing in the U.S. in the 27 MHz Citizens Radio Service. The author proposes that a highway communication radio service be set up by federal agencies. The principal intent of this service is for aid to the motorist and for contact with him by highway, law enforcement, and other public service agencies. It is suggested that this service be implemented on an interim basis in the 26 to 30 MHz band using voice communication and readily available, inexpensive transceivers for communication on the emergency channel 9 of the CRS and on a minimum of five adjacent channels. No change in FCC citizens Class D license should be required. In conclusion, recommendations are made for the development of the hardware and implementation of the radio system.

• WITH the increase in highway travel, good roads, higher speeds, recreational areas, and limited-access highways, a motorist needing information, direction, or assistance is well aware of the necessity for communicating with other vehicles or an off-the-road terminal equipped to furnish necessary assistance.

Realizing this need, highway departments have been using and are continuing to install a minimal system of fixed terminals adjacent to the road for contact with a dispatcher who can furnish various types of assistance. These roadside terminals employ either the telephone or the single-direction radio call boxes (1). These are usually located on a ½- to 1-mile spacing. Another type employs the aid of another driver who receives instructions from a roadside sign to flash his headlights at a specific point in the road to bring aid to the driver in trouble. This signal is picked up by a photocell device that triggers an alarm at the central dispatcher's location. The dispatcher sends a patrol car to the area.

A system undergoing consideration at this time by several eastern states is one that employs the call-box system that can be activated from the vehicle. The driver uses in the vehicle a low-power transmitter that operates in the 450 MHz highway band. A coded transmission from the vehicle is received by the call box. The box transmits a coded signal to the central control operator to send aid to that area.

The foregoing systems in present use require the driver to leave the vehicle and go to the nearest communication terminal. Implementation of these terminals on all major highways would represent a staggering outlay for the state and federal agencies and would present a mammoth maintenance problem.

MOTORIST USE OF TWO-WAY RADIO

A motorist system employing 27 MHz citizens band radio has been developing during the past 10 years. Drivers have found that they could, at very moderate cost, obtain

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FCC licenses and equip their vehicles with transceivers. This equipment provides the driver with a means to contact a volunteer (2) or other monitor (4) to send aid, notify police, or give direction. The driver accomplishes this, in any location on any road and if necessary while in motion, without leaving the vehicle. In addition, the driver could, in many cases, keep in contact with home or office having similar equipment.

Since July 24, 1970, channel 9 of the Citizens Radio Service (CRS) has been set aside for aid to the motorist. Present limitations of this arrangement are interference from foreign skip and illegal operation, non-uniformity of channels monitored, and unreliability of volunteer personnel. In spite of these problems, a very worthwhile service is being provided on channel 9 of the CRS.

Why Two-Way Voice Radio Is Attractive to the Motorist

Results of tests using two-way radio as described have established the acceptance of voice communication with an off-the-road monitor. This assumption of public acceptance can be supported by the experience with the Detroit driver-aid network (3, 4, 5), the Ohio REACT Emergency Network (7, 8), and the national REACT operation (2). The ability for the driver (especially female drivers) to have voice communication with an operator who can send assistance or provide information gives the driver and her occupants a sense of security not felt with other means of communication. In support of voice communications as the transfer of information, one must remember that nearly all police patrol car-to-base communication is conducted by voice.

Driver-Aid Radio Systems in Use

General Motors Research Laboratories sponsored the programs listed below as research projects and as a public service to learn the answers to important questions concerning the average driver's use of a voice radio system:

1. An urban monitoring service for driver aid and traffic control (3, 4, 5);
2. A statewide volunteer monitoring service (7, 8); and
3. A nationwide volunteer monitoring service (1, 2).

At this point it should be understood that the only way a driver-aid two-way radio service could be tested was to use transceivers operating in the CRS. Not only is this advantageous for licensing, but also the transceivers are easily installed, simple to operate, inexpensive, and highly reliable solid-state devices for base and mobile service.

If there were a higher frequency part of the spectrum where transceivers of similar cost could legitimately operate, it would be highly desirable. Freedom from skip, medical, and industrial interference would be most welcome. The 450 MHz highway frequencies were not available at the time of these tests, and, had they been, the cost of transceivers for an equivalent range would have been and still appears to be prohibitive for the average driver.

Listed below are the results of the urban Detroit CB Radio Driver Aid Network program, including answers from a poll of over 100 participating drivers.

1. Could the average driver, with a little practice, use the two-way voice radio to make contact and report details of irregular situations, to request the proper aid, and to give the location in accident cases? The drivers polled answered in the affirmative. There was no problem after listening to others on the air and after a little operating practice.

2. Would drivers with two-way radios feel more secure knowing that they could make contact for assistance without leaving the vehicle? All drivers answered with a definite yes, and many indicated that they would buy a radio when the test was over for their security and convenience.

3. Would this facility reduce the time for an ambulance or wrecker or both to reach the scene of an accident? The report on the Detroit CB driver-aid program (5) indicates a saving of time for service agencies to reach an accident or tie-up. This could not be evaluated completely because the Detroit police had to confirm the aid request by sending a patrol car to the scene before ordering the service.

4. Would there be jamming of the frequency by a number of drivers trying to report the same situation? It was surprising to find that seldom was there any interference created by more than one driver trying to report the same situation. Often a driver hearing the report would add information when the first report was finished.

5. Would the lack of secrecy present a real problem for a voice radio system? The fears we had concerning secrecy as previously reported (4) have not materialized. No problem involving secrecy has shown up during the Detroit or Ohio programs to date. A check with REACT national headquarters files also shows no recorded complaints from the public. There have, however, been cases where two or more wreckers showed up at an accident or for service. This can be avoided by requesting identification of the company contacted for the service.

6. What would system maintenance be like for the mobiles, the fixed remote repeaters, and the connecting phone lines? When GM Research Laboratories were sponsoring the Detroit system (1966 through 1968), mobile radio maintenance was confined to antenna breakage or theft. System problems were wire line interruptions (approximately 10 per year) between the 10 remote repeaters and the master control. The remaining problems were confined to repeater antennae being blown down or tampered with by building maintenance personnel.

The statewide (8) and nationwide (2) REACT programs are sponsored by GM Research Laboratories as a public service. We are anxious to learn how volunteer monitors can cooperate with law enforcement, i.e., whether the police agencies could benefit from a volunteer surveillance group reporting to headquarters.

The report to the APCO Conference by Chiaramonte of the Ohio State Highway Patrol covering his experience with volunteer highway radio monitors speaks highly of the cooperation of REACT volunteers with his department and of the benefits to Ohio residents of having well-trained groups of volunteer radio operators.

We also wanted to know if volunteer operators can consistently monitor an emergency frequency during the major part of every day. Because these operators are volunteers, we have found inconsistencies in the frequency monitored and problems with their not being on duty. However, in a state police-operated program such as the one in Ohio, these problems are minimal.

FCC ACTION IN SUPPORT OF A MOTORIST-AID FREQUENCY

Realizing the convenience and need for a motorist radio service and for uninterrupted contact during emergency calls, the FCC reassigned channel 9 of the CRS for aid to the motorist and emergency use only after July 24, 1970. Therefore, the use of two-way voice radio for solving many highway communications problems has become recognized and important to several million vehicle owners who use the radio services described.

CONSIDERATION FOR A TOTAL RADIO SYSTEM

The highway communication systems described are concerned mainly with drivers stranded or in other trouble. A total system should offer much more for the driver and should satisfy the requirements of law enforcement, road patrols, and other public services.

There has always been one question in the minds of those considering driver-aid systems that use vehicle-mounted terminals: Would the driver purchase the equipment and keep it in operating condition? It has been the author's experience with these systems that, if the radio is only for use when the driver is in trouble, many drivers, due to their driving pattern, would not consider it worth the expense. However, if a total communication system that provides the driver with other needed services and the ability to use the equipment for personal communication is made available, the driver would have an incentive to own and maintain the equipment. There are also a large number of public-spirited drivers who would use a radio to help other drivers in trouble (4).

Advantages of a Radio System to Road Agencies

The total capability and advantages of the driver-aid radio system have not been realized to date as will be pointed out in the paragraphs to follow. If this capability is

made available to public service agencies, they would realize the following gains over present and proposed highway communications systems:

1. The fixed monitoring equipment for communicating with vehicles can be installed at points remote from the highway, avoiding damage and vandalism;
2. One fixed transceiver installation can cover many miles of a specific highway and surrounding roads;
3. One master control operator can monitor at least 10 remote transceivers as has been demonstrated by the Detroit driver-aid network (4);
4. A standby channel as part of a mobile transceiver in each vehicle would provide the facility for road patrol and other public service agencies to contact the vehicle operator; and
5. The vehicle owner would own his own terminal.

Required Services for a Motorist Radio System

It has been adequately demonstrated by all working systems that the main service of any highway communication system is the ability for the driver to summon aid and obtain information and direction. It has also been demonstrated and evaluated (9, 10, 11) that a desirable if not necessary service as part of a total system is the transmission of traffic bulletins, weather reports, and emergency reports pertinent to the immediate and surrounding area by highway departments for driver safety.

This single-direction transmission is known as "audio signing." A third feature of a total system that has been tested and also suggested by highway operators is the ability for patrol cars, fire departments, and ambulances to make contact with all drivers (6). These requests have included devices to warn drivers of an approaching fire truck, ambulance, or patrol car. Due to the increasing use of air conditioning and improved soundproofing of passenger vehicles, the average horn is not effective under these and noisy traffic conditions. Sirens have an omnidirectional effect. Two examples of how the local audio sign, vehicle-to-vehicle system could work follow.

1. The in-car audio sign receiver is turned on with the ignition key. The driver has no control over the volume or received frequency in this mode. It is always on standby with the speaker muted to receive an encoded signal from mobile or fixed roadside transmitters.
2. The operator of a fire truck, ambulance, or patrol car en route transmits his direction and location such as "Proceeding north on Woodward Avenue." All vehicles within a reasonable distance and approaching cross streets would be warned of his approach. The voice could be augmented by a tone.

Summary of Service Requirements for a Highway Communication Radio System

The following is a summary of the communication services that appear to be required by both the motorist and public service agencies:

1. Two-way voice communications between the driver and a public service agency (this should be possible from an agency base or mobile station);
2. A vehicle receiver on standby to accept encoded local (immediate area) audio signing, i.e., transmission of emergency warnings from roadside transmitters and for verbal contact from public agency service vehicles to the motorist; and
3. Regional audio signing, i.e., broadcasts of traffic, weather, and emergency bulletins for motorist safety and convenience on selectable channels.

A PROPOSAL FOR A HIGHWAY COMMUNICATION RADIO SERVICE

Up to this point the report has reviewed the systems that are used in varying degrees by the driving public. They are as follows:

1. Roadside telephones and call boxes,
2. The cooperative driver or FLASH system,

Table 1. Proposed highway communications systems.

Intended Use	Type of Operation	Channel Number[a]	Equipment Required by Driver	Equipment Required by Public Service Vehicles	Fixed Public Service Station
Emergency car-to-car and car-to-base	Two-way simplex	A-9, B	Highway communication CRS transceiver	Highway communication transceiver with encoder and decoder	Highway communication transceiver, tri-channel monitor
Nonemergency car-to-car and car-to-base	Two-way simplex	C	Highway communication CRS transceiver	Highway communication transceiver with encoder and decoder	Highway communication transceiver, tri-channel monitor
Local audio sign and alerting[b]	One-way to traffic	D[c]	Highway communication CRS transceiver with encoder and decoder	Same	Low-power fixed roadside transmitters
Weather and emergency audio signing	One-way from public service base	E	Selectable channel in transceiver	Transmission not allowed	25-W base transmitter only
Traffic central audio signing	One-way from public service base	F	Selectable channel in transciever	Transmission not allowed	25-W base transmitter only

[a]Channels do not provide for personal communication; only public service agencies would be licensed to transmit voice on channels D, E, and F; emergency and audio signing channels should be allowed antennae heights as in business radio service.
[b]Provides for standby, fixed tuned channel in all vehicles to be turned on by ignition key; speaker is muted until turned on by encoded signal.
[c]Push button to activate the transmitter to radiate an encoded carrier; tone modulated for alerting drivers to nearby emergency situation; voice contact to be made on an emergency channel.

3. The urban Detroit CB Radio Driver Aid Network, and
4. REACT—volunteer CB radio channel 9 monitors.

It is obvious that none of these satisfies the requirements for a total motorist service as described in the summary of service requirements. Therefore, the author proposes that the U. S. Department of Transportation and the Federal Communications Commission establish a highway communication radio service and that frequencies be provided to implement the interim services for the motorist given in Table 1. The items given in the table satisfy the needs of today and the foreseeable future for a total voice communication system between the motorist and public service agencies.

The number of radio channels listed in the table represents the minimum for implementation of the system. Note that channel 9 of the CRS is included. This inclusion guarantees the participation of some 2,000,000 transceiver-equipped motorists and approximately 100,000 monitors nationwide with a majority already cooperating with public service agencies.

The intended use for the car-to-car and car-to-base systems is for contacting public service agency headquarters, their authorized monitor, or their patrol car. Of course, if no service is available to motorists in an area, other motorists may respond to emergency requests. However, no personal communication is intended for any CRS two-way frequencies. The proposed highway communication radio service is intended to be implemented between 26 and 30 MHz for compatibility with CRS equipment, thereby providing frequencies for personal communication.

The other systems given in the table are for outbound transmission only by public service agencies and for an emergency alerting service.

An important part of the Detroit network test revealed that, in times of heavy snow and rain, the ability to broadcast bulletins regarding traffic tie-ups and snowbound or flooded roads as soon as they occur reduced to a large degree the driver emergency calls. Channels D and E are intended for these purposes.

The new service to provide local audio signing will require the addition of encoders and decoders. It is also intended that the design of the decoder will permit any local encoded audio sign messages to override any other reception by the vehicle transceiver. A basic standby receiver that provides an access for communication with vehicle operators is part of this new service. The device is intended to be turned on at all times on a fixed frequency with volume set at a level high enough to override vehicle noise. Reception of an encoded signal would activate the speaker so the message could be heard.

Channel D provides for radiation of an encoded tone signal to be picked up by other vehicles in the immediate area.

The reception of the tone or possibly a beep tone is intended to inform the listener that someone is in trouble. When the tone stops, voice contact is made on the emergency channel. By this means the communication loop between vehicles is closed. The standby receiver with decoder provides a silent means to detect transmission of emergency warnings and information. The other items listed in the table are self-explanatory.

IMPLEMENTATION OF THE HIGHWAY COMMUNICATION RADIO SERVICE

As explained earlier, the basic emergency two-way CRS channel 9 is currently in operation and could become part of the proposed service. Five additional frequencies could be assigned adjacent to the 27 MHz CRS to accommodate the highway communication radio service. FCC reassignment of CRS channels 24, 25, 26, 27, and 28 (the little-used channels interspersed with the CRS Class D frequencies for remote control of models) would provide excellent compatibility with channel 9. Most of this remote-control service has moved to 72 MHz and in most cases would not cause trouble even if some areas shared the channel with the highway communication radio service.

The system therefore could start immediately to use A, B, D, and E services, and the additional service, encoders, and decoders for item C could be added as the system becomes implemented.

Note that the proposed system would also require only a Class D CRS license. Voice transmission from the motorist is allowed on only two-way systems using a 5-W transmitter. Special licenses would be required for the public service agencies to operate the one-way transmitters. Having a lower power requirement, the local audio sign system could also be covered under a Class D license. The addition of emergency and audio signing channels would provide increased coverage for highway base, repeater, and audio sign stations.

RECOMMENDATIONS

Past services of many kinds developed for the public have had the basic systems and specifications for the hardware and public service facilities worked out by a committee of knowledgeable engineers from industry, an excellent example being the National Television Systems Committee who worked out the national television system.

The author suggests that committees chaired by HRB and staffed by engineers from industry and members of AASHO, the National Highway Traffic Safety Administration, the International Municipal Signal Association, AT&T, and the FCC work out the technical and implementation details of the plan proposed here and a satisfactory licensing plan for the millions of motorists who will use the system.

CONCLUSION

The author has presented a workable solution for implementing a highway communication radio service. The service should satisfy the communication needs of the motorist and those of public service agencies for contact with him.

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