# MIEMS, Part 2: The Maryland Emergency Medical Services Communications System

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*This paper is based on an address by the author at the 178th Annual Meeting of the Medical and Chirurgical Faculty of Maryland at Hunt Valley, May, 1976. Mr. Garrett was Project Director of the Maryland EMS Communications System from 1973 through June, 1977. For reprint and other data, write him at 9345 Reader Lane, Columbia, MD 21045.*

## Introduction

**Under construction for a period spanning four years, the Maryland Emergency Medical Services Communication System (EMSCS) is complete. It is the first complete statewide EMS communication system in the nation. This paper will trace its history, discuss its functions and describe its configuration.**

## Historical Background

The Maryland EMSCS began its development in the early 1970s in the metropolitan Baltimore region (EMS Region III). There, EMS planners and providers from Baltimore City and the five surrounding counties (Anne Arundel, Baltimore, Carroll, Harford and Howard) had been successful in obtaining a federal grant[1-2] to build a regional EMS Communications system. A non-profit corporation, Emergency Medical Services Development, Inc. (EMSDI), was formed to carry it out, a design was established, bids were let and the regional system was constructed. The Atlantic Research Corporation and Pioneer Medical Systems, Inc. were the major contractors. The unique system was first placed into operation in May, 1975; modifications and improvements have been continuing to this day.

In his Executive Order of Feb. 26, 1973, that established the Maryland Division of Emergency Medical Services (DEMS) The Maryland legislature in 1977 amalgamated the Division of Emergency Medical Services and the Maryland Institute for Emergency Medicine in a new Maryland Institute for Emergency Medical Services (MIEMS) under the University of Maryland. This amalgamation took effect on July 1, 1977 under the Directorship of R Adams Cowley, MD, Governor Marvin Mandel also directed that the DEMS shall ". . . promptly develop a program for establishing and operating the statewide emergency medical communications system." Dr. Cowley immediately placed into motion the planning efforts[3-4] and the budget procedures to execute that order. In June, 1974, the Division contracted with Spectra Associates, Inc., consulting communications engineers, to design and prepare detailed specifications for an integrated EMSCS that would bring to the other four EMS regions of the state a system compatible with and fully equivalent to the Region III system. (Figure 1.) Bids for the hardware for this 19-county EMSCS component were released in May, 1975 and a contract was awarded to the General Electric Company for the $2 million project on July 21, 1975.

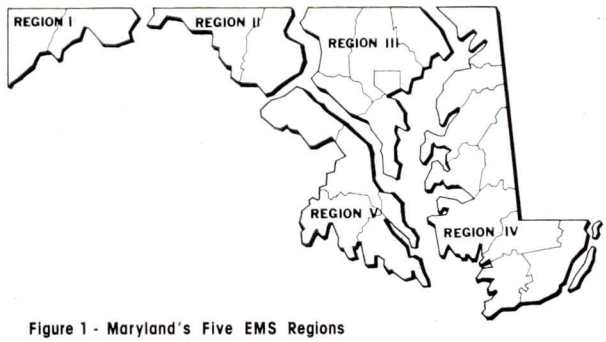


Figure 1 - Maryland's Five EMS Regions

In a mutual agreement between the DEMS, EMSDI and the Federal Department of Health, Education and Welfare (HEW) which had funded EMSDI during Region III EMSCS system establishment, the State assumed ownership of the Region III EMS hardware on July 1, 1975, and took over operation of the Metropolitan Baltimore system. EMSDI employees were transferred to State employment, and, as of that date, the DEMS (now MIEMS) has had full responsibility for development, operation and maintenance of the EMSCS in all five Maryland EMS regions. Thirteen full-time MIEMS employees are assigned to man the system's two communications centers (described below) and four others to manage and maintain the system. When complete, the system will represent a $3½ million capital investment, the source of which is shown in Table 1. Operating costs (other than personnel) of the system, borne completely by the State, approximate $250,000 annually, the bulk of which are for leased telephone lines and hardware maintenance.

**Table 1—EMSCS Capital Investment**

| Source | Region III | Regions I, II, IV, V | Total |
|---|---|---|---|
| State Appropriations | — 0 — | $1,825,000 | $1,825,000 |
| HEW (Federal Demonstration Grant) | $ 724,000 | — 0 — | 724,000 |
| HEW (1203 and 1204 Grants) | 287,000 | 377,000 | 664,000 |
| Appalachia Regional Commission | — 0 — | 250,000 | 250,000 |
| Totals | $1,011,000 | $2,452,000 | $3,463,000 |

## Maryland EMS System Overview

The communications component of emergency medical services plays a vital, integrating role in an EMS system. The National Academy of Sciences—National Research Council first identified the important functions of an emergency medical services communications system and these guidelines[5] have been further defined by HEW's Division of Emergency Health Services[6] as well as by the Highway Safety Program of the Department of Transportation.[7] The EMSCS being developed for Maryland[8] embodies the concepts and functions outlined by these national bodies.

Since the communications network is not an end in itself, but is to serve the EMS system, it is helpful before describing the functions and configuration of the communications component to review the Maryland EMS system.

The Maryland EMS system[3] is based on the concepts of echelons of care and specialized care. Echelons of care implies differentiated capability; local facilities that can properly handle the majority of medical emergencies, regional facilities that can handle all but the most critical of cases, two "University Trauma Centers" in the City of Baltimore and tertiary "Specialty Referral Centers" that are staffed and equipped to handle the most difficult and challenging of critical illnesses and injuries. Specialization of care occurs at the secondary level (e.g., intensive care units and coronary care units), but is most obvious at the tertiary level where each Specialty Referral Center has a particular specialty designation and role. Thus, presently in Maryland, we have the following tertiary Specialty Referral Centers:

- Maryland Institute for Emergency Medicine (Adult Trauma).
- Johns Hopkins Hospital Pediatric Trauma Center.
- Neonatal Centers at University of Maryland, Johns Hopkins and Baltimore City Hospitals .
- Baltimore City Hospital Burn Center.
- Washington Hospital Center (District of Columbia) Burn Center.
- Curtis Hand Center, Union Memorial Hospital (Extremity full and partial amputations).

Other Specialty Referral Centers (e.g. Psychiatric, paranatal Spinal Cord), as well as regional EMS Referral Centers are in the process of establishment.

Transportation to local and regional facilities in Maryland is almost without exception by ambulance. Transportation to Specialty Referral Centers is most often by Maryland State Police Medevac helicopters, less often by US Park Police or US Army helicopters,[9] and when weather or proximity dictates, by land ambulance.

Maryland is fortunate in having almost all of its 24 local jurisdictions (23 counties and Baltimore City) equipped with "central alarms," or central fire and ambulance dispatching. In fact, at the end of 1977, only Worcester County did not have central ambulance dispatch (Ocean City has its own dispatch center). These county-wide central alarms are staffed around-the-clock by trained, paid county dispatchers (In one case, by Maryland State Police dispatchers.) Citizens anywhere in a county requiring aid can use one telephone number to call the central alarm which can dispatch all fire and ambulance companies in the county, whether paid, volunteer or private. Several central alarms also handle dispatch of local law enforecement (sheriff) and Maryland State Police units in their region. Three counties (Montgomery, Prince George's and Charles) already use the recommended universal emergency telephone number, 9-1-1, and several others are in the process of establishing it.

Thus the Maryland EMS Communications System must serve:

- Over 5,000 physicians and 12,000 nurses providing medical care in the state.
- 45 hospitals providing emergency service, some of which also serve as regional EMS referral centers.
- Two University Trauma Centers.
- Eight Specialty Referral Centers at present, with several more to be established in the near future.
- Two hundred and forty ambulance companies operating 350 first-run ambulances.
- Twenty-four Central Alarm dispatch centers.
- Fourteen Maryland State Police, two US Park Police and several US Army medevac helicopters together used several times daily in EMS transports.
- One statewide and 24 local civil defense agencies (primarily for disaster operations).

## EMSCS Functions

The communications capabilities in our EMS system are those required to enable the following functions:

1) Notification of an emergency to appropriate agencies.
2) Dispatch of aid (when required).
3) Coordination among response agencies (e.g., ambulance, fire, law enforcement, civil defense).
4) Decisions regarding patient disposition.
5) Decisions and directions regarding patient care.
6) Coordination among medical providers (e.g., hospitals, specialty care centers).

The existence of the central alarm system in Maryland provides an excellent notification and dispatch function which is already in place. Improvements generally relate to upgrading the training of the dispatch personnel and to changing the county-wide seven-digit emergency numbers to 9-1-1 where that capability does not yet exist. The MIEMS and the regional councils are jointly working toward 9-1-1 implementation statewide within two or three years.

In implementing the Governor's Executive Order, the MIEMS' challenge was to *add* to the existing notification and ambulance dispatch capability a communications system for *medical* purposes; that is, to meet functions four-six previously-mentioned. Before the EMSCS was established, only a few ambulances in Maryland could communicate with local hospitals, and there was no means by which coordination among local providers and secondary and tertiary care facilities (i.e.

Specialty Referral Centers) elsewhere in the state could be quickly accomplished. The new Maryland EMSCS can be thought of as meeting two general requirements. First, a **local requirement** to enable communications among physicians, hospital personnel, ambulance attendents and dispatchers in a local (e.g., county/city) area for medical decisions and direction of patient transport and care; and second, a **statewide requirement** to enable the rapid acquisition of the EMS system's resources (e.g., consultation, Specialty Referral Center admission, Medevac helicopter transport) when local providers determine that their patient has a need for them.

The local requirement is generally fulfilled in the Maryland EMSCS by means of a two-way radio system. The statewide linkage of local providers with the state's full EMS resource capability is provided by means of a network of leased and public service telephone lines called EMSTEL.

## Syscom

The EMSTEL telephone network has a nerve center known as the Systems Communications Center, or SYSCOM, located at the Maryland Institute for Emergency Medicine in Baltimore, and staffed 24 hours daily with trained MIEMS EMS communications operators. These operators have the ability to summon aid and to coordinate the use of any of the state's EMS system resources. For example, they coordinate all Maryland State Police Medevac helicopter flights and make the arrangements for admission of all helicopter-transported patients to Specialty Referral Centers. They also can quickly arrange consultation between a physician anywhere in the state, and a specialist at one of Maryland's Specialty Referral Centers .

EMSTEL, the primary communication tool used by SYSCOM, connects SYSCOM with the metropolitan Baltimore Emergency Medical Resource Center (EMRC) in EMS Region III and with central alarms in each county in EMS Regions I, II, IV and V. Switchgear at SYSCOM, the Baltimore EMRC (also staffed 24 hours per day by trained MIEMS communication operators) and at each central alarm enables any of Maryland's hospitals, Specialty Referral Centers, ambulances, helicopters or public or private telephones to be directly connected together on an "as-needed" basis. A back-up to the EMSTEL network is a toll-free (from anywhere in Maryland) inbound WATS service to SYSCOM. Two WATS lines, (800-492-0610 and 800-492-0611), enable an EMS provider anywhere in the state direct access of SYSCOM from any available telephone.

In addition to the EMSTEL telephone lines, a SYSCOM radio base station provides direct communication to ambulance and Medevac helicopters. A switching arrangement at SYSCOM and the Baltimore EMRC enables any of the EMSTEL and radio channels to be interconnected. Figure 2 illustrates the statewide EMSTEL communications network.

## The "Local" EMSCS Systems

Although equivalent in terms of their capabilities, the configurations of the Region III EMSCS and the

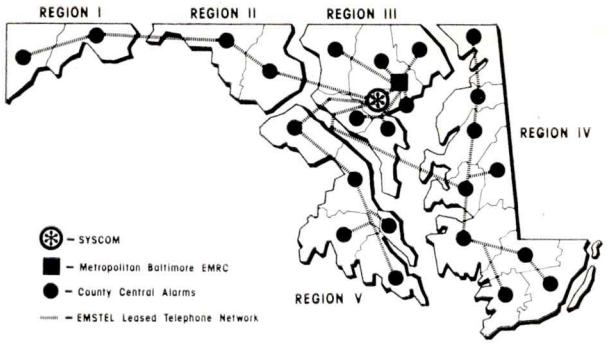


**Figure 2 - The EMSTEL Telephone Network**

system in the other four regions are very different because of their different genesis. Both portions of the system will be fully compatible with each other, and both use the new, special, ultra-high frequency (UHF) radio channels limited solely for EMS use by the Federal Communications Commission.

The Region III system[10] uses high-powered portable radios (Figure 3) carried in ambulances that can com-

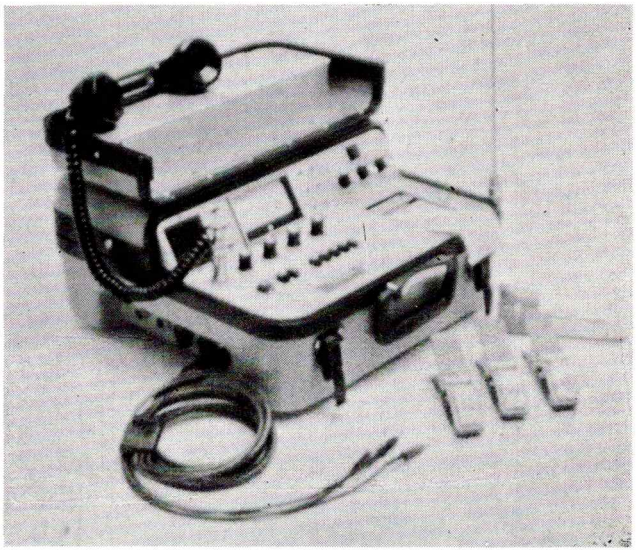

**FIGURE 3: HIGH-POWERED EMS PORTABLE RADIOS USED IN METRO BALTIMORE REGION.**

municate directly with base stations, whether in or out of an ambulance. When fed a cardiac monitor/defibrillator, the portable can transmit electrocardiogram (ECG) telemetry data as well. All 11 of the Region III base stations, located to provide good radio coverage, are controlled directly by the Metropolitan Baltimore EMRC over leased telephone lines or over MIEMS-owned microwave control circuits. Ambulances and helicopters in Region III communicate with the EMRC by radio through this system. A sophisticated control console (Figure 4) in the EMRC allows the MIEMS communication operator there to connect the radio system to any of the region's special EMSCS hospital terminals (Figure 5).

One of these terminals is located in each of the region's 23 hospital emergency departments. Four others are located at "Cardiac Consultation Centers:

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Reprinted from *Maryland State Medical Journal*, June 1978. 


**FIGURE 4: METRO BALTIMORE EMERGENCY MEDICAL RESOURCE CENTER.**

**FIGURE 5: METRO BALTIMORE HOSPITAL EMS COMMUNICATIONS TERMINAL**

University of Maryland Hospital, Johns Hopkins Hospital, US Public Health Service Hospital and Sinai Hospital. At these centers, ECG telemetry from the field is interpreted and medical (i.e., physician) direction and control is provided for advanced life-support operations by ambulance paramedics.

Other EMRC terminals are in the Specialty Referral Centers in the Baltimore area. Using this system, an ambulance crew can be placed into direct voice contact with any hospital emergency department. When medical control is being exercised by a Cardiac Consultation Center, the hopsital emergency department which will be receiving the patient (even if different from the center) can monitor all telemetry and conversation between the center and the ambulance crew.

As noted above, a direct line between SYSCOM and the EMRC enables any mobile unit or facility in Region III to be connected (via EMSTEL) with any mobile unit or facility in the other regions of the state. Direct data lines between the EMRC and the six central alarms in Region III provide an automatic regional status display at the EMRC. These and the leased lines to hospitals are used to carry signals to the EMRC display (a large, wall-sized map, Figure 4) that shows the service status of all of the region's 125 ambulances as well as the patient reception capability (i.e. full or not full) of each of the region's emergency departments and coronary care units on a real-time basis.

The EMSCS "local" subsystem in EMS Regions I, II, IV and V is configured around county cells.[11] Each county central alarm serves the county in the same capacity as the Baltimore EMRC serves Region III. The basic difference is in the ambulance radio configuration. The ambulances in Region I, II, IV and V are equipped with a permanently-installed mobile radio and a separate, lightweight, low-powered "patientside portable" (Figure 6). The portable can transmit from

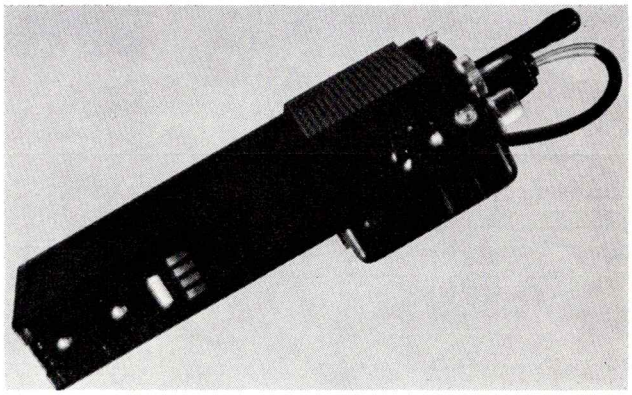

**FIGURE 6: LIGHT-WEIGHT EMS PATIENT-SIDE PORTABLE RADIO.**

patientside to the nearest ambulance. The mobile radio in the ambulance has the ability to "repeat" the portable's message (simultaneously) to a base station and, when the message is traveling in the opposite direction, from the base station to the portable. Monitor/defibrillators can be connected either to the portable or the in-ambulance mobile radio (which has a control panel in the patient compartment as well as the cab) for ECG telementary transmission.

All base stations in a county are connected to the special EMSCS operating console (Figure 7) at the

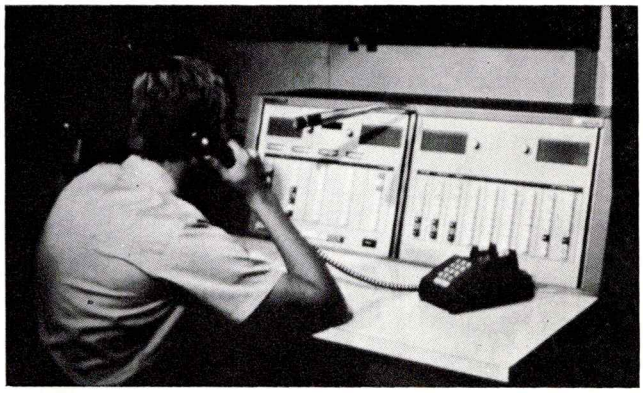

**FIGURE 7: CENTRAL ALARM EMS OPERATING CONSOLE.**

central alarm. Also connected to this console are EMS remote control consoles (Figure 8) located in each hospital emergency department in the county and a radio/telephone patch that enables the mobile unit

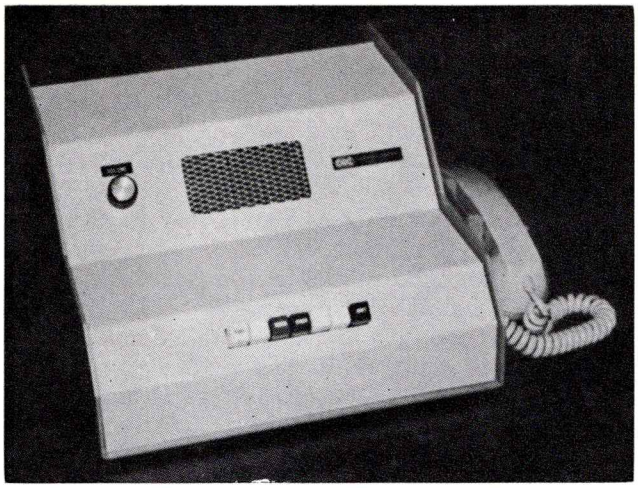

**FIGURE 8: HOSPITAL EMERGENCY DEPARTMENT EMS REMOTE CONTROL CONSOLE.**

(ambulance or helicopter), hospital and/or the EMSTEL telephone network to be tied directly together. Using the trained central alarm communication operators to control the communications switching function frees the ambulance crew and the hospital emergency department physician or nurse from complicated operating functions. The hospital remote control console is a simple, telephone-like instrument; the ambulance radio is quite like the radios in use for many years by ambulance crews.

The integration and compatibility of the entire system is guaranteed by several design features:

1. Of the two UHF EMS radio channels authorized by the Federal Communications Commission (FCC) for dispatch and coordination, one ("CALL-1") is implemented throughout the state, in all five regions and in all mobile units including the Medevac helicopters. CALL-1 is monitored continuously at SYSCOM, the Baltimore EMRC, and at each central alarm in Regions I, II, IV and V. Thus, any helicopter or ambulance in the state, whether in their normal operating area or on a long-distance transport, has instant access to the system and to aid.

2. From the eight UHF EMS channels assigned by the FCC for medical use, one or more are assigned to each county for primary use, and two for secondary use. The assignments are on a "patchwork quilt" basis, so that no two neighboring counties have identical primary channel assignments. In addition to these, every county (including Region III) has one additional medical channel ("MED-8") implemented, which provides another statewide channel similar to CALL-1.

3. In designing the Maryland EMSCS, all of the contiguous states were contacted and the communications plan out with EMS communications managers in those states. This was done to ensure compatibility when ambulances cross state lines, and to ensure that the system in one state does not unintentionally interfere with communications in another. For example, in Western Maryland, where neighboring Pennsylvania and West Virginia ambulances often come to Maryland, and where Maryland ambulances often go to hospitals in those two states, an additional Very-high frequency (VHF) mobile radio capability is contained in the Maryland EMSCS. This is because those two states have the older VHF rather than the newer and preferred UHF systtems in operation.

## Conclusion

The Maryland EMS Communications System is the result of five years of planning and construction. The design could not have been done without the full cooperation of all of the EMS providers (hospitals, physicians, central alarms, ambulance companies, law enforcement agencies, county and city government and civil defense officials) cooperating and participating. For example, the Maryland EMSCS fixed location where base stations, towers, operating consoles and hospital equipments are located, number over 100, yet only a few (less than 10) are on State-owned property. The rest are in private or local government facilities. Thus, from the very beginning, the system has been (and remains) a joint venture among the state's EMS providers and the Maryland Institute for Emergency Medical Service.

Gov. Mandel and, subsequently, the Maryland Legislature, provided the direction and the funds necessary to get the basic system built. Federal grants from the DHEW and the Appalachia Regional Commission (ARC) enabled improvements and expansion to complete the EMSCS.

**Table 2 — Federal Grants**

| Agency | Grant Number |
|---|---|
| DHEW | 03-H-000,398-01 |
| DHEW | 03-H-000,398-02 |
| DHEW | 03-H-001,033-01 |
| DHEW | 03-H-001,033-02 |
| ARC | MD-4295-75-I-202-0530 |
| ARC | MD-4535-76-I-214-1215 |

Table 2 lists those Federal grants that partially-supported the work described herein.

The benefactors of the EMSCS will be the citizens of Maryland, who will derive improved emergency medical care as a result. The State and all those who made contributions to it can be rightfully proud; the system should serve as a model for the 49 other states to follow.

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