COMMENTARY

The Future of Emergency Medical Services Communications Systems:
Time for a Change

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Modern emergency medical services (EMS) are approximately 35 years old. The transformation of ambulances from "horizontal taxicabs" capable of little more than patient transportation to a system capable of sophisticated, life-saving, prehospital and hospital intervention has been dramatic. Emergency medical services communications systems have, by and large, not experienced similar transformation. Current and developing advances in communications technology could address this.

Immediate opportunities for EMS communications systems to integrate such advances exist, and more are evolving in the federal and national arenas. Incorporating broadband as a means of improving communications among EMS providers, between EMS, fire, and police, and between EMS and hospitals is one example. In affecting these advances, EMS has the potential to become the greatest user of public safety bandwidth and a very large user of federal communications funding.

There is no assurance that EMS will have access to such capabilities or funds. Additionally, EMS is not prepared to lobby for new resources and capabilities. First, we need to determine what information prehospital and hospital emergency care providers need, in what form, and at what stage in the course of an EMS patient care episode. It is the EMS community itself, including state and local government agencies responsible for EMS, that must organize to take advantage of these opportunities and capabilities.

Where We Are

The commentary by Carl Van Cott highlights the evolution of the existing EMS radio systems including the very high frequency (VHF) radio channels and ultra high frequency (UHF, in the 460MHz range; often called the "10 med channels") channels for ambulance to hospital (for reporting patient condition and seeking medical direction) and other communications. With the exception of electrocardiogram (EKG) biotelemetry sent over the UHF EMS channels, these communications were solely for voice use. Even today, the EMS communications system probably consists of 98% voice and 2% biotelemetry and other data transmissions.

Some local EMS systems have been solicited to participate in new or existing regionwide or statewide 700MHz and 800 MHz radio systems that are usually operated by law enforcement and/or government transportation agencies. These systems offer more voice channels for specializing communications but have significantly less transmission range, which makes them less practical in rural areas. Governmental owners of such systems solicit new users like EMS when the cost of maintaining an existing system becomes challenging. For rural EMS operations, this can be an expensive proposition. Erecting new antennae, for example, would be necessary. In addition, when urban EMS systems become integrated into 700/800 MHz systems, the

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specialty centers involved must often maintain VHF/UHF capabilities for communicating with ambulances coming in from outside of that area.

Broadband capacity at 2.4 MHz is a technology being provided by some municipalities for public internet access in urban environments. Municipalities are also encouraging public safety agencies to employ this technology. Broadband will become increasingly important to EMS as data communications are utilized more. Careful consideration, however, should be given when considering its use for mission-critical communications and for any communications involving confidential patient information. The unlicensed and public access characteristics of this system render its reliability and security suspect. Another broadband service at 4.9 MHz is reserved for licensing by public safety organizations. Use of this service is believed to alleviate reliability and security issues to a greater extent. Both 2.4 MHz and 4.9 MHz services are extremely short range and, thus, of use in primarily urban environments.

Where We Could Be

During an EMS emergency call today, events, decision making, and resulting actions largely occur on a sequential basis as new information is presented. In a rural car crash, for instance, the crash occurs, the crash is detected, EMS is called, EMS responds, EMS arrives and evaluates, additional resources are called (eg, extrication services, helicopter), additional resources respond, medical direction is sought and provided, treatment is administered, and the patient is transported. Each segment in the EMS response presents potential delays. Each also presents opportunities to accelerate appropriate medical intervention through improved communications that enable some events, decision making, and actions to occur more simultaneously. Delays during EMS calls can cost tens of minutes, if not hours, during the patient's "golden hour," the time from the crash event to when the patient arrives under a surgeon's scalpel.

In the future, through advanced automatic crash notification (AACN) systems in cars, standard equipment on many car models now produced, the crash event and location will be available to local EMS and other responders almost immediately. Current and future AACN features can also transmit change in velocity at crash, direction of impact, air bag deployment, seatbelt status, number of occupants, and rollover status. Future systems may include an "urgency algorithm" which notifies responders of the likelihood that an occupant was severely injured in the crash. Not only does this virtually eliminate the delay in detecting and locating crashes, but it allows prehospital and hospital providers to be immediately notified of all or severe crashes in their response/catchment areas. With appropriate protocols in place, simultaneous dispatch of ground and air ambulances and extrication services could then occur in severe crashes. Similarly, hospitals and trauma centers could notify their staffs to be ready and notify prehospital responders of their availability to take patients. One can imagine similar capabilities in "help, I've fallen and can't get up" devices for populations at risk.

When EMS responders arrive at the scene in the future, they will be able to do more simultaneously. The initial provider at a car crash will make a quick, triaging assessment of each patient, placing and leaving a small electrocardiogram (EKG) and vital signs monitor on each, inserting each patient's emergency health record "smart card" into his personal digital assistant (PDA) or communications device, describing brief findings about each into a lip microphone which is translated to a text file, and shooting brief video of each through a shoulder or head camera. Each of these data streams goes into patient-specific data bases in the responder's PDA and is transmitted to a mobile data unit in the ambulance.

Once additional responders are assigned to patients, their devices are used to enter their identifications, monitor patient vital signs, and add new voice/text and video data into the respective patient-specific data files. The EMS scene coordinator, as well as yet to arrive EMS, extrication, and helicopter crews and the local and trauma center hospital staffs can access databases for updates on any or all of the patients' conditions. Field providers utilize PDAs or mobile data units like laptop or tablet computers. Hospital staff may use the same or desktop units. All are combination voice and data communications units. Looking at a screen with a patient's real-time vital signs, video image, and provider's notes, medical direction physicians can begin to anticipate more information they may want and orders they will give crews at the scene or en route to the hospital. As patients become assigned to specific EMS crews for transport to specific hospitals, access to their databases becomes limited to their prehospital and hospital providers. Best routing to a scene and then from scene to hospital by ground ambulance can be determined through local transportation agency real-time traffic monitoring databases.

The Technology Required

This vision for where we could be comes at a price and with risks. In April 2007 the Blackberry network crashed. Technology such as mobile data units, PDAs, and computers with integrated voice communications exist today, but these can be costly. Personal digital assistant-based emergency health record entry and reliable speech-recognition technology has been developed in military systems such as the Battlefield Medical Information System Tactical,[1] which is available for commercial licensure. Video and vital signs monitoring for one or multiple patients through miniaturized devices has been demonstrated by a research and development group coordinated through Johns Hopkins.[2] A number of EMS systems have piloted video use in ambulances

If hospital and prehospital emergency care and other public safety players involved in any EMS call maintain databases detailing the status and availability of their resources, it becomes theoretically possible to network them in a system that is accessible by the field PDAs and other devices described. Then we add to the network those databases created by public safety, advanced automatic crash notification, traffic and other control/dispatch centers that describe evolving car crashes, EMS call, traffic flow, and other system events. Finally added is the ad hoc patient databases created at the scenes of EMS calls, and these 3 components become a "network of networks" in which voice and data communications can exist. To complete the system picture, the screen of any of the data/voice communications devices could present a simple, map-like picture of the provider's response or catchment area. The screen would depict icons for all the relevant events occurring in real time (eg, car crashes, ambulance calls) and resources (eg, local hospital emergency department, EMS, fire rescue). By selecting an icon, an authorized user could then drill down on an event or resource to find out more about it. At the lowest level of a car crash event icon, one might find the patient video, vital signs, and provider notes data described earlier.

Federal and National Activities and Opportunities for State and Local Action

If EMS is going to participate in the type of data communications network described above, it must acquire communications frequencies with greater bandwidth than it has now. The VHF/UHF and 700/800MHz capabilities it now utilizes have bandwidth sufficient for voice communications and simple EKG biotelemetry. Sending text data (like provider's notes), real-time vital signs data, basic streaming video, higher definition video, and medical quality video require increasingly wider frequency bands to provide the speed of data transmission needed to send these files for real-time use. Transmitting a huge video file on one of today's EMS VHF frequencies would be slower than sending it by dial-up internet access. For vital signs transmission, at least wide-band capability would be needed, and for high to medical quality video, broadband is required. With multiple EMS crews sending data to various hospitals in any one area at the same time, the bandwidth required could well outstrip that available.

Congress and the Federal Communications Commission (FCC) have ordered analog television stations off a frequency band in the 700 MHz range (channels 60-69; 746 MHz-806 MHz). They have allocated some of this for public safety use and the FCC is now considering proposals for how it will be divided up when it is released in 2009. The remainder was to be auctioned in 2009 for commercial use with a billion dollars of the proceeds to go to public safety in states and locales for improving radio interoperability. Congress is likely to approve the expenditure of that $1 billion to be spent this year. The National Public Safety Telecommunications Council, FCC, and US Department of Homeland Security (SafeCom Interoperability Program) websites can be monitored for progress.[3,4,5] Despite the early availability of these funds, there are proposals before the FCC to give the remaining analog TV channel range to public safety for a national broadband network under the supervision of a public safety controlled consortium rather than auctioning them off for commercial use.

The SafeCom Program is constantly developing tools for state and local interoperability and system development efforts. Included in these are guidelines for the development of statewide interoperability executive committees. Such committees exist in most states by one name or another and should be targeted by EMS interests to seek inclusion for public safety broadband planning efforts and access to bandwidth.

The FCC has ordered that the VHF and UHF frequencies that include the traditional EMS frequencies be made even narrower by 2013. This means that where there once existed one narrow-band channel for use, there will be as many as four. Local EMS agencies that have been attracted to the current 700/800MHz system offerings in their states because of the availability of many open channels for EMS use may find that sticking with their VHF/UHF systems provides not only greater range and less expense but more voice channels in few years. **NCMJ**

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