

Public Safety Communications and Response – Yesterday, Today and Tomorrow

By Guy Roe

Senior Consultant, E9-1-1, MapInfo Corporation

In the beginning, if you needed emergency aid, you went, on foot or by horse, to the appropriate responder (Sheriff, Police, Fire Brigade) and you asked for help. Communication was in the form of direct, face-to-face interaction. Then came limited printed communication, the “Wanted Poster” of the old west is an example. Electricity brought us high speed communication in the form of the Telegraph and later, the telephone. For the first time, an individual could have communication capability right in their own home. There was also the telephone operator with a plug-based switch panel. When a call was initiated, the connection was made manually and the operator knew where the call originated and where the call was going. If it was a call for help, the operator could pass the information to the appropriate responding agency. The telephone also came to be used to dispatch assistance, with the station calling the cop on the beat using the police call box on the corner. Soon after came the radio and calls could be dispatched almost instantly. This was the “state of the art” for many years, even into the 1970’s, but there was much to improve.

As long distance had become a reality, the operator would manually time the call so that the appropriate billing could occur. As telephones and long distance became ubiquitous, manual timing became impractical, so, in the 1950’s, the telephone company, (yes, Virginia, there was only one then), developed Centralized Automated Message Accounting (CAMA) to automatically identify the calling number and time the call, allowing for the necessary billing. When the first 9-1-1 systems were developed in the 1970’s, it was decided that 9-1-1 systems could use CAMA to provide Automatic Number Identification (ANI) to identify the calling party. As Enhanced 9-1-1 (E9-1-1) developed, the ANI-provided number was used to initiate a query (dip) to an Automatic Location Information (ALI) database (DB), using a separate circuit, thus providing the 9-1-1 Center with the location of the caller as well. This worked, and actually continues to work pretty well for wireline calls.

When wireless (cellular) phones became prevalent, a new set of problems emerged for 9-1-1. The caller was no longer tied to a specific location. The wireless phone, by definition, was mobile. Early cellular phones were large, bulky and, most often, mounted in automobiles. As a result, mobile calls were often routed to the State Police or Highway Patrol. As handheld devices proliferated, the calls could, and did come from everywhere. 9-1-1 needed to know where the call was coming from. Traditional CAMA trunk lines were unable to handle the amount of data needed to locate a mobile caller using Callpath Associated Signaling (CAS, where the call and associated data travel the same telephone-based path), so Non-Callpath Associated Signaling (NCAS) was developed. NCAS sends the voice element of the call over telephone trunks while the signaling information about the call travels a different data transmission path. This was a forced work-around for a modification of a system that was never designed for 9-1-1 in the first place.

Today, we have a plethora of new modes of communication, many made possible by the Internet which communicates using a system of data packets delivered via Internet Protocol (IP). The most prevalent of these new communications modes, growing much faster than the wireless phone, is Voice over IP (VoIP) or Internet Telephony. But IP can provide transport for many new methods of communication and it is important that those involved in Emergency Services understand the implications and importance of IP.

In 2002, the Federal Communications Commission (FCC) undertook what has become known as the Hatfield Report, primarily to study technical and operational issues impacting Wireless 9-1-1. One of the principal findings of the Hatfield Report was “one over-arching issue that immediately emerged ... that the existing wireline E9-1-1 infrastructure, while generally reliable, is seriously antiquated. Indeed, it turns out that the existing wireline E9-1-1 infrastructure is built upon not only an outdated technology, but also one that was originally designed for an entirely different purpose. It is an analog technology in an overwhelmingly digital world.”

Long before the release of the Hatfield Report, the National Emergency Number Association (NENA) began developing a Future Path Plan (FPP) for 9-1-1. The stated purpose of the FPP is as follows. “In meeting the NENA mission, NENA's technical process must make sure two things happen—that we deal effectively with the new challenges in bringing 9-1-1 services to all callers, and that we retain appropriate previous capabilities and reliability. Integrating a growing variety of non-traditional ways to access 9-1-1, (such as telematics and text messaging devices), by adding components and functions to the overall 9-1-1 system must also consider if the proposed method is clearly more effective, more dependable, and/or more economical than other alternatives. A technical plan for future 9-1-1 systems needs to provide a long-term direction for development to support new call sources and needs.”

All NENA Future Models anticipate additional call and/or data originators and recipients and envision use of IP networks, likely in the form of private networks, possibly with portals to Virtual Private Networks (VPNs). In addition, all models recognize that any new, integrated solution has to be implemented according to a “top down” plan.

MapInfo Corporation, working with a consortium of “best of breed” partners, has developed an E9-1-1 solution, now called Mercuri3. This IP-based solution is the first, and thus far, the only technology solution to undergo formal NENA technical review for compliance with the FPP. This review found the E9-1-1 solution to be “Conditionally Compliant” with the FPP. In receiving this rating, the IP-based solution was reviewed on 5 criteria and determined to be fully “Compliant” in the four technical areas and “Conditionally Compliant” in the area of documentation and operating procedures, an area that will be brought into full compliance upon deployment of a pilot system.

At the heart of the IP-based E9-1-1 solution is the idea that a new infrastructure paradigm is needed for 9-1-1. Every study indicates that the current telephone technology based delivery network for 9-1-1 is dangerously outmoded and incapable of handling 9-1-1 in the future. The system proposes a dedicated, secure Public Safety IP network infrastructure that will provide adequate bandwidth for all Public Safety needs while remaining both secure and survivable.

In the MapInfo Mercuri3 solution, State or Regional Centers provide a secure entry point, a “doorway”, to the 9-1-1 system for all current and future types of emergency communication. The Centers are able to quickly and accurately deliver all types of 9-1-1 calls, with their associated data, to the correct Public Safety Answering Point (PSAP) using the Public Safety IP network infrastructure. These Centers are capable of receiving Wireline, Wireless, Voice over IP (VoIP) and future types of calls, and routing those calls based on Master Street Address Guide (MSAG) Valid Civil Address, Geographic Coordinates, Cell and Sector or Real Time GeoCode. Delivery to the PSAPs is via a single type of NENA standard feed, making it much easier for PSAPs to respond to new requirements while reducing operating costs. Because all 9-1-1 calls for service are routed through a central system, it becomes possible to keep statistics on call volumes for equitable distribution of 9-1-1 surcharges based on actual call volumes. This tends to eliminate inequities in surcharge distribution. Call statistics can also be used for deployment analysis.

A major benefit in IP-based delivery is that Public Safety 9-1-1 communication delivery is no longer limited to 10 or 20 digit streams. A single digital line, (DS1, 2 would typically be required for redundancy), can handle all of the needs, (including voice communication via VoIP), of a 4 – 8 seat PSAP. An IP Callpath Associated Signaling (IP-CAS) solution would deliver both the voice bearer traffic and the associated signaling together over the IP packet network.

Unlike specialized telephone circuits, IP technology is multi-directional, not restricted to passing data only between the Local Exchange Carrier (LEC), Central Office (CO) and the PSAP. An IP network is capable of receiving information from State or Regional Centers and then sharing information back to the Centers, between PSAPs, or with Emergency Management Centers and other Public Safety stakeholders.

An IP infrastructure is capable of transporting many types of data. The same network that supports delivery of 9-1-1 calls for service can also be used for a myriad of other Public Safety functions. For example, in New York State, IP infrastructure can support NYS eJustice initiatives, (such as the IP replacement for the NYS Police Information Network (NYSPIN), NCIC 2000 deployment and the Cardscan/Livescan fingerprint system), the statewide wireless radio system (SWN) and NYeNET access to non law enforcement data.

This 3rd Generation system is also prepared to handle emergency notification, (via voice and Web), national network integration and emerging IP services such as OnStar and Telematics. Because this is an integrated system, inter-jurisdictional voice and data transfers are easily facilitated and the IP based system can replace multiple types of communication system feeds with a single standardized type of IP feed.

An additional feature of the Mercuri3 E9-1-1 solution is the integrated Emergency Management and Control component. Combining the Critical Area Response Manager (CARM) for strategic emergency planning with the Spatial Event Server (SES) allows PSAP level data, previously unavailable outside of the individual PSAPs, to be shared between jurisdictions as

well as on a state or national Homeland Security level. These features and capabilities exceed anything previously proposed for strategic Emergency Management.

There would, of course, have to be at least 2 connections to each PSAP for redundancy and survivability. Because of the nature of IP networking, PSAP connections can be “looped” through multiple PSAPs such that if a connection is interrupted, the network will automatically and instantaneously redirect traffic around the other side of the “loop”. Because of the shared nature of IP connections, the cost of operation for each application is reduced. Ultimately, costs for CAMA connections and hardware can be eliminated resulting in additional cost savings. In addition, hardware cost, which can be distributed over multiple functions, is significantly lower for IP switches and routers than for telephone switches and selective routers.

The successful prototype of the IP-based solution and its NENA Certification, clearly show that the NENA Future Path Plan is not only possible, it is possible today. State and Regional authorities should be aware that IP based systems are possible today and should consider requiring IP based solutions and FPP compliance when new systems are needed. To use an automotive analogy, what we have today is a 1950’s era Volkswagen with a lot of add-ons. What we need is the hydrogen fuel cell-powered “Car of Tomorrow”. While we may not have the hydrogen fuel cell fully deployed today, it does exist and it does work. Systems going forward should be based on the best suspension we have available today (IP), rather than the Volkswagen suspension of yesterday (CAMA and other telco-based technology).

#####