

# What is 9-1-1?

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## Management Briefing No. 3

ONE OF A SERIES OF NOTES ON  
TECHNOLOGY FROM ADCOMM

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Today, the number 9-1-1 symbolizes more than just a telephone number. 9-1-1 in today's society is not only the emergency help number, it is also a complex system of voice and data networks, a set of organizations dedicated to providing assistance, an industry, and a funding buzzword. To many of its users, 9-1-1 is the face of public safety in America.

## Emergency Numbers

Since its inception in the United States in 1968, the digits 9-1-1 have been adopted by nearly every community in the country as a special telephone number to be dialed when law enforcement, fire, or emergency medical help is needed. Other countries have adopted similar number schemes: the United Kingdom uses 9-9-9 as well as the European standard 1-1-2, much of Asia has adopted 1-1-0, and 0-0-0 is the equivalent in Australia.

The idea behind dedicated emergency numbers extends to 1937 London, where dialing 9-9-9 would set off an audible and visual alarm at the phone system's central exchange, alerting the operator that an emergency was being reported. These basic concepts – a short dedicated number triggering a specialized response – continue today despite the changes in technology.

Other three-digit numbers have been set aside for specialized services as well. The North American Numbering Plan (NANP) lists eight services including 2-1-1 for social services, 3-1-1 for municipal information and non-emergency police matters, and the 7-1-1 relay service for callers with hearing or speech disabilities. Outside North America, it is common to have a different three-digit number for medical, police, and fire with the caller thereby selecting the service they need.

## Telephone Networks

One technical advantage of assigning a specific number to emergency services is that the telephone company's equipment will recognize and route calls to the number differently. When a caller dials 9-1-1, the switching equipment at the telephone company's "central office" makes a different set of connections and uses a different network to route the call to the 9-1-1 center, called a public safety answering point (PSAP) in telephone parlance (see Figure 1).

This 9-1-1 network is made of different kinds of connections, cabling, and computer or mechanical switches, collectively called "facilities." In the earliest days of 9-1-1, these facilities were basic: if a caller dialed 9-1-1 they were connected to the local PSAP. As technology progressed, more features and capabilities were added. The ability to maintain a connection (also referred to as "holding a line open") was added, then the ability to show the PSAP what telephone number the caller was calling from. Tying the dialing number information to the customer records database gave the PSAP the location of the caller (when using a wired telephone). These latter two functions are called automatic number information (ANI) and automatic location information (ALI) respectively, and are the basis of what is called "Enhanced 9-1-1."

In the first years of 9-1-1, and even through the beginning of Enhanced 9-1-1 service, making a telephone call meant that a person would use a device connected to the telephone network by wires. The location might be a home, office, or phone booth; but the device one spoke into and heard the responses from was connected by copper cabling to the telephone network. And that telephone network was owned by one company known as The Bell System or, colloquially, "Ma Bell."

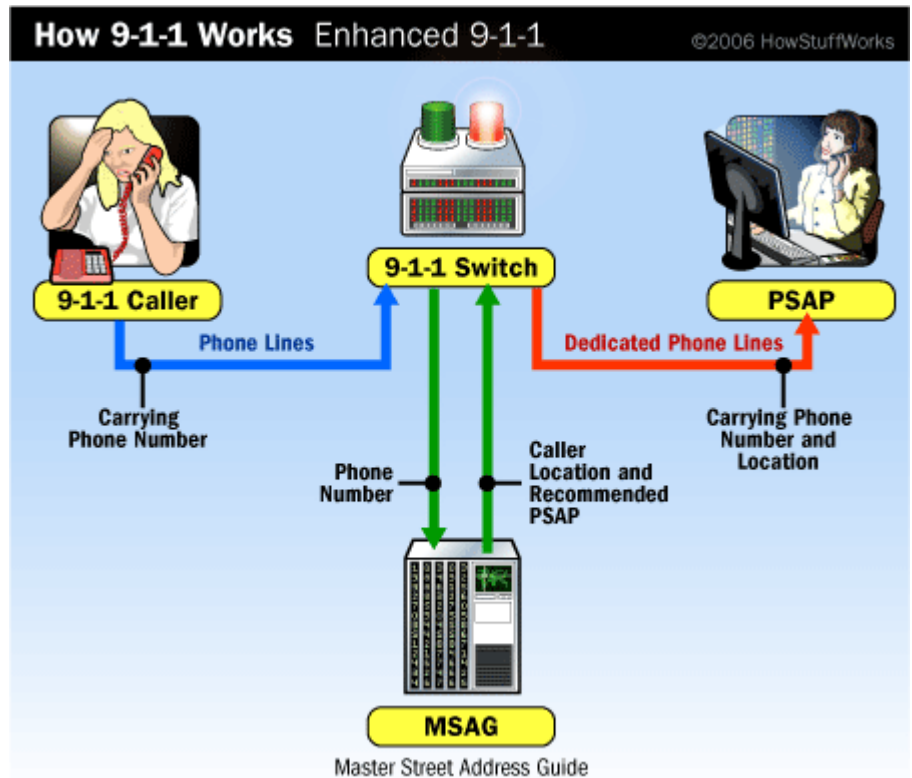
## The Bell Breakup

Up until 1984, there was essentially one telephone company in the United States: AT&T. Also known as The Bell System (referring to the man credited with inventing the telephone, Alexander Graham Bell), AT&T owned the networks, central office equipment, and even telephones in peoples' homes. While there were many effects on service, rates, and capability because of this monopoly, the process of making changes to the system was simplified by having only one authority to consider.

Following a 1974 anti-trust lawsuit, AT&T agreed in 1982 to divest itself of local exchange carriers in exchange for the opportunity to compete in the computer business. The resulting seven companies were known as Regional Bell Operating Companies (RBOCs) or "Baby Bells," being the metaphorical spawn of "Ma Bell." The divestiture was official January 1, 1984.

One desired result of the divestiture (from the U.S. Justice Department's perspective) was the opening of the telephone service market to other companies, thus bringing competition to the industry. As other telephone companies sprang up around the country, the handling of 9-1-1 calls become slightly more complicated. PSAPs were still operated by local governments, but instead of a single telephone company citizens could obtain their service from different companies. Making sure the customers of these other companies would be routed to the proper PSAP when they dialed 9-1-1 became more complex because now there were multiple companies that had to be coordinated.

The technical issues involved in routing 9-1-1 calls were not particularly more complex, however. In many cases the newly formed companies rented facilities from AT&T, which was obliged by the settlement to make them available. Thus the same copper line that was installed by AT&T in 1980 would still be used in 1985, it might just be leased to another telephone company.



**FIGURE 1**

Enhanced 9-1-1 calls provide the calling party's address to the 9-1-1 call receiver by referencing the caller's number with a database of address information, called the "master street address guide" (MSAG). The MSAG will eventually be replaced by dynamic map information in fully realized Next Generation 9-1-1 systems (NG911).

As the billing and coordination issues became more complex, PSAP managers had to become smarter about how these aspects of the telephone system worked. The telephone network, though, remained relatively stable. All of that would change with the rise of cellular telephones.

## Mobile Phones

Mobile telephones are radios. Instead of using copper wires to connect to the telephone network directly, radios inside the device connect to intermediate devices wirelessly. The intermediate devices are then connected to the telephone network, usually via wires. The number, type, and function of intermediate devices vary from carrier to carrier but in all cases are considerably more complex than wired networks.



As cellular telephones began to penetrate the market, the need for callers to contact 9-1-1 from these devices grew. There were two complications, however: these telephones were mobile by definition – so relying on customer billing information to display location was not going to work and, secondly, cellular telephones were not part of the existing telephone network – and they were handled by entirely different companies.

The first problem – location of the caller – was solved in two phases. Phase 1 displays the address of the cellular tower the cell phone is accessing to make the call. Because of the nature of radio frequency propagation, this is sometimes not the tower closest to the caller; however, it does provide some basis for routing the call to the proper PSAP. Phase 2 uses either a “handset” solution involving GPS and orbiting satellites or a “network” solution using triangulation and multiple towers to determine the caller’s location.

The issue of multiple companies accessing the 9-1-1 system continues today, adding complexity to the PSAP manager’s job. Like the increase in local exchange carriers following divestiture, the increase of wireless carriers means more coordination on the part of the 9-1-1 manager. The coordination is necessary not only to ensure proper routing of 9-1-1 calls but also to ensure tax revenues collected by the company are distributed to the proper 9-1-1 center.

## Other Devices, Other Networks

The early 2000s saw the rise of the Internet as a daily fixture in people’s lives. The set of computer protocols the Internet uses to connect computers and networks around the world together is called “Internet Protocol,” or “IP.” IP has proven to be so popular that most computer networks in the world today – both public and private – use it as the foundation for communication.

A technology known as “Voice over IP” or VoIP is used to convert audio, like a human voice, into computer data packets that are then sent through the Internet or other IP-based network to a device on the far end, where the data packets are converted back to audio. Because this technology can be used across virtually any IP-based network, it is rapidly becoming ubiquitous. Services like Google Voice, Skype, and others use VoIP technology to enable VoIP across both wired and wireless connections.

This causes considerable concern for 9-1-1 centers, however. Along with legal wrangling over whether or not companies providing VoIP to businesses and residences are selling a voice service (which would require 9-1-1 service be provided) or a data service (which would not), the issue of

location becomes more complicated. IP devices today can be mobile (several telephones, along with other portable electronics, include VoIP capability), fixed (like a desktop computer), or nomadic (such as a laptop computer). Voice calls can be made on all of these devices, and unlike the traditional telephone there is no fixed street address to which assistance can be sent.

### Next Generation 9-1-1

The latest change in the 9-1-1 landscape is the advent of so-called “Next Generation” services (NG911). Broadly, these services encompass the addition of data to the traditional voice capability of 9-1-1. NG911 services include text messaging, video and picture transmission, instant messaging, and other kinds of data receipt.

NG911 requires a change in the underlying network infrastructure; instead of the proprietary network protocols used for decades on telephone system facilities, NG911 services require IP networks. The migration of state and local networks from older protocols to IP has already begun in Washington State and continues in other areas of the country.



More detail on Next Generation 9-1-1 can be found in ADCOMM’s Management Briefing No. 4 “9-1-1 Technology.”

### 9-1-1 Organizations

PSAPs are call centers charged with answering 9-1-1 calls. Though “9-1-1” is often perceived to be a single, unified service nationwide, this is not true. PSAPs are typically either a division of a law enforcement or fire department, a separate division of a City or County, or a standalone “joint powers agency” formed by customer municipalities. Often the local funding possibilities affect the organizational model chosen.

Regardless of model, in the United States all PSAPs are public entities; the few experiments in private call centers answering 9-1-1 have not proven successful.

Regardless of the model chosen, 9-1-1 is a service operated by people. Employees are typically trained to interview distressed callers and determine location and type of incident, enter information into computer systems, operate telephone equipment, provide medical instruction, and many other skills. Many jurisdictions have combined 9-1-1 answering responsibilities with radio dispatch functions. In some centers the same staff members perform both functions while in others the staff is specialized in one function or the other.

Like other service businesses, personnel costs are typically 70 to 80 percent of the organization’s total budget. Equipment maintenance is another major component; the administrative overhead is usually relatively low. Capital improvements generally fall into the categories of telephone systems, radio systems, and computer-aided dispatch systems.

Recruiting, hiring, training, and retaining employees is the number one concern for most PSAP managers. Retention rates in some centers can be as low as 70 percent; a 30 percent turnover rate of employees is not uncommon. Most turnover occurs in the first year of employment, one reason that many PSAPs have extended the probationary period for new employees to 12 months.



## Face of Public Safety

9-1-1 is the face of public safety for most citizens; the voice at the end of the telephone represents police, fire, and emergency services to the caller in their time of need. Sometimes called the “first of the first responders,” 9-1-1 employees must remain cognizant of the impression their professionalism makes not only for their own agency but for the field responder as well. The call receiver can set the tone for the entire citizen contact, having a profound effect on responder safety and the ultimate success of the incident. A poorly handled call – one in which the call receiver becomes excited or is rude – places the citizen calling into a potentially negative frame of mind and will often greet the field responder with that attitude. This increases the possibility of violence at the scene, an outcome no one wants. On the other hand a 9-1-1 call handled professionally, with empathy and accuracy, bolsters confidence in the citizen and is more likely to result in a positive interaction with the responder.

The increased role of technology combined with the increased understanding of the personal interaction skills required to perform the job has engendered changes in both the traditional role and the work force performing the job. Today’s successful 9-1-1 communicators must be comfortable with new technology, adapt quickly to changing circumstances, be able to visualize potential outcomes and plan for them, and interact professionally with members of the general public, many of whom are having one of the worst days of their lives.

## Summary

In summary, 9-1-1 is the public’s vital connection between their need for assistance and the resources available to provide the needed help. The job of answering emergency phone calls and dispatching units on the radio has changed from becoming just two elements in a larger job description (that often included being the jail matron, secretary, filing clerk, and report writer) to a specialized profession requiring high competencies in technology, human behavior, resource management, and performing well under intense stress.

Technology will continue to drive changes in the 9-1-1 systems across the country; traditionally emergency services have reacted to the public’s demand for new ways to access services. The Next Generation 9-1-1 movement is another example of that dynamic. Increased managerial complexity will also continue to dominate the 9-1-1 field as it becomes more difficult to find the unique blend of technological competence, personal skills, and sense of public duty in candidates. The rising cost of training and retention combined with the increasing call for public agency accountability and reduced revenue to support even public safety initiatives add to the pressure today’s 9-1-1 leaders face. The role of experts who understand the technology, the operations, and how they work together will also continue to rise in importance as the 9-1-1 system progresses.