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PSAPs Face the Challenges of Emerging Technology

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Verifying location information is the key to ensuring a speedy response to all emergency calls, especially in the case of wireless and voice over Internet protocol (VoIP) phone calls and other technologies on the horizon. Public safety telecommunicators and PSAPs need to be aware of the challenges that emerging technologies pose. However, before looking at how 9-1-1 could work in the future, it's important to understand the origins of 9-1-1 and how it works today.

BRIEF HISTORY OF 9-1-1

In 1968, AT&T made the digits "9-1-1" available for use as a national emergency number. In 1999, Congress designated 9-1-1 as the universal emergency telephone number within the United States for reporting an emergency and requesting assistance. Since then, 9-1-1 systems have continued to grow and evolve

Now, the public expects and demands high-quality 9-1-1 service. People expect the 9-1-1 system to work essentially the same way whether they are calling from their home, their business or their car. As public safety communications personnel know, that's not necessarily the case.

HOW 9-1-1 SYSTEMS WORK

When a person dials 9-1-1 from a landline, the call is sent to a computer that confirms the number of the caller and matches it to the proper PSAP that covers that telephone number and address. The call is then selectively routed to the correct PSAP for the telecommunicator to begin call processing. Calls are routed according to the master street address guide (MSAG), which is essentially a table that

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identifies all street names, a range of theoretically possible house numbers for each street and the unique set of law enforcement, fire and emergency medical providers responsible for that address.

Basic 9-1-1 systems, installed from the late 1960s through the 1970s, use dedicated lines for sending the caller to the correct answering point. Basic 9-1-1 has fallen out of favor in most areas of the country, and industry experts consider the technology obsolete. However, these systems are still being used in some areas (for more information on each phase, visit www.fcc.gov/911).

Enhanced 9-1-1 (E9-1-1) systems provide automatic number identification (ANI) and automatic location information (ALI), so the caller's telephone number and physical address are displayed on a monitor. The ANI/ALI benefits of E9-1-1 can greatly assist in providing timely responses to callers requiring emergency assistance. However, ANI/ALI information may be incorrect, and telecommunicators should never assume the incident location is the same as the address on the screen. Always confirm the ANI/ALI information and verify the incident location prior to terminating the call.

Some E9-1-1 systems access other databases to display special information related to the address, such as law enforcement jurisdictions, fire service districts or EMS response stations. Systems may also display information about residents with special needs, location access information or directions to a location. This supplemental information may be provided by the 9-1-1 system hardware/software or by a third-party subscription service.

WIRELESS

When cell phones were introduced in the 1980s, they were expensive and not in general use. After the FCC approved handheld cell phones in the 1990s, more and more people purchased cell phones and subscribed to the service. Because calls from cell phones can be placed from almost unlimited locations, call volumes increased and the accuracy of ALI declined. This spurred 9-1-1 professionals around the country and APCO International to ask the FCC to mandate that wireless carriers implement technology that would provide accurate call-back and location information.

Just as 9-1-1 from landlines has/had phases, the stages of technology affecting 9-1-1 calls from wireless phones are referred to in stages. The first, most basic, phase is commonly referred to as *Wireless Phase 0*. This stage is very similar to basic 9-1-1, in that when 9-1-1 is dialed from a cell phone, the call is routed to a PSAP. However, it may not be the correct PSAP for the area and may be 100 or more miles away. It all depends on how the call is routed. No call-back information is provided if there's no voice contact or if the calltaker is unable to obtain the number from the caller. If the call is routed to an administrative line and the PSAP has caller ID, the call-back number may be displayed there.

The absence of accurate location information delays emergency responses. Thus, Wireless Phase I was introduced to provide the phone number (call-back number) of the wireless device and the cell site (and sector of the cell site if that site is sectored) from which the 9-1-1 call originated. This information is delivered to the PSAP in the ALI display. When a wireless subscriber initiates a 9-1-1 call, the closest tower typically picks up the signal.

To implement Phase I, the wireless carrier must program its mobile switch to immediately send 9-1-1 calls to the appropriate 9-1-1 selective router. This way, if there is no voice contact or the calltaker cannot verify the phone number with the caller, then the number will still appear on the ANI display. This step does not provide much help with location information, but in some cases, wireless companies will be able to provide information about the subscriber. Check your agency's policies and procedures for obtaining information about wireless subscribers from cell phone companies.

Although Phase II does not provide exact location information, it does allow for identification of the closest possible address through the use of GPS and satellite technology. Phase II must be implemented by both the wireless carriers and the PSAP in order to transmit this information.

There are two basic types of location technology in use by wireless carriers: network- and handset-based. Network-based technology gathers location information via radio signal triangulation. The FCC has established that the accuracy of network-based location technology must be within 100 meters (328.08 feet) for 67% of calls and within 300 meters (984.25 feet) for 95% of calls. Handset-based technology provides location information via GPS satellites. The FCC has established that the accuracy of handset-based location technology must be within 50 meters (164.04 feet) for 67% of calls and within 150 meters (492.13 feet) for 95% of calls.

The FCC established that wireless carriers are not obligated to provide E9-1-1 service until a PSAP requests it. And PSAPs must meet some requirements before making such a request: They must have a cost-recovery mechanism in place. They must have the ability to receive and utilize Phase II latitude and longitude information. The PSAP's 9-1-1 service provider must implement ALI server software changes and the required data interface to the wireless carrier. These requirements are referred to as *PSAP readiness*.

One major operational difference between wireless E9-1-1 calls and landline calls is the need to occasionally *rebid* the call information. A rebid is necessary for wireless calls when the caller's latitude and longitude data are unavailable at the time the call is delivered to the PSAP. Typically, Phase II wireless calls are routed the same way as a Phase I call. The caller's latitude and longitude are not available at call setup. The wireless carrier's location technology currently takes 15–30 seconds to estimate the caller's location.

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WIRELESS LOCAL NUMBER PORTABILITY

Another emerging aspect of wireless technology is wireless local number portability (WLNP). WLNP lets wireless subscribers change service providers within a designated area while retaining the same phone number. This may create challenges for the telecommunicator because it's theoretically possible that two cell phones with the same number will exist briefly in the same service area. Only one of them will be capable of accepting incoming calls, which could result in the telecommunicator calling back an individual and reaching an old wireless service phone instead. This might lead the telecommunicator to believe the caller is not answering the phone. *Another possibility:* The call could be completed to the person now in possession of the old phone, who most likely is not the actual caller.

VoIP

VoIP is a revolutionary technology that will reach 7 million people this year. It has the potential to completely rework the world's phone systems and will more than likely one day replace the traditional phone system. Both individuals and businesses are switching to VoIP because it offers a way to streamline costs and communication efforts. By using free VoIP software, users can turn a standard Internet connection into a way to place free phone calls and entirely bypass the phone company and its charges.

VoIP converts the voice signal from the sender into data packets that travel over the Internet and then converts the data packets back to a voice signal at the receiving end. This is done digitally and bypasses the traditional circuit-switched protocols of the public switched telephone network. Chances are good that you are making VoIP calls when you place a long-distance call. Phone companies use VoIP to streamline their networks. By routing thousands of phone calls through a circuit switch and into an IP gateway, they can seriously reduce the bandwidth they're using for the long haul.

VoIP phones can look like landline phones and are similar in that they can be assigned and used at fixed addresses that can be MSAG-validated. There are also some very important differences. The main difference is phone number portability. Phone number portability with VoIP phones works similarly to cell phone number portability in that you

may take your phone number with you no matter where you live in the United States. Because of this portability and other technological issues, obtaining location information is as important with VoIP phones as it is with cellular phones. A PSAP could receive a VoIP call from another state. There are other issues when receiving 9-1-1 calls from VoIP phones. The call may come into the correct PSAP, but it may come in through administrative lines (seven-digit, non-emergency). Although these calls may provide caller ID if the receiving phone is so equipped, they do not provide any ALI.

There are complex issues affecting the deployment of VoIP E9-1-1. VoIP service providers, PSAPs, 9-1-1 system service providers and vendors have actively reviewed various methods to meet the FCC's order and provide E9-1-1 to all VoIP customers. APCO holds the position that the FCC must have the authority to prevent VoIP providers from offering new service to customers in areas where the provider cannot meet current FCC requirements.

The ability of the VoIP user to seamlessly access 9-1-1 is dependent on the type of service the VoIP service provider offers its subscribers. Some local telephone companies offer VoIP services that are just like their landline services. In this case, the telephone company sells static (non-moveable) telephone service with a locally assigned telephone number. VoIP 9-1-1 calls are processed using the existing wire line 9-1-1 network and routed to the appropriate PSAP along with the ANI/ALI data.

Internet service providers (ISPs) typically are not traditional telephone companies and lack direct access to the ALI database and the 9-1-1 network, making the routing of VoIP 9-1-1 calls to the appropriate PSAP problematic. Some ISPs market and offer what they describe as "limited 9-1-1 service," in which calls are delivered to a PSAP's administrative telephone line rather than through the dedicated 9-1-1 network. This creates several problems. The 9-1-1 call may never reach the PSAP. If it does, the administrative line could be busy or remain unanswered if calltakers are busy with calls that came in via the 9-1-1 line. In these cases, ANI/ALI data will not be delivered to the PSAP, and the telecommunicator will have no call-back information.

Just as other advances in call-receiving technology are referred to in phases, VoIP is

as well. The first phase is *i1*. During this stage, the VoIP 9-1-1 call goes to a service center where it's manually referred to the correct PSAP. With *i2*, the location and call-back number are received by the PSAP. The standards are under development for *i3*, which serves as the foundation for NG9-1-1.

THE FUTURE

NG9-1-1 is an IP-based replacement for E9-1-1 features and functions, supporting all sources of emergency access to the appropriate public safety agency. It will operate on managed, multipurpose IP networks and expand multimedia data capabilities for PSAPs and other emergency communications entities. This technology integration is still a few years away, but public safety agencies and the FCC are heading toward total interoperability.

This means that in the not so distant future, 9-1-1 centers will be equipped to handle not only landline, cellular and VoIP calls, but also to receive 9-1-1 text messages, photos and videos from a scene. This seems a far cry for some areas that don't yet have basic 9-1-1, but these areas will also reap the benefits of emerging technologies.

The ALI trend is toward self-location by the originating device. The plan is that IP-based or compatible devices will send their location as part of the emergency call or non-voice message. Technical solution development for IP support of combined voice and data flow in the 9-1-1 system is well underway.

NG9-1-1 offers the possibility that 9-1-1 calls from any networked communication device will arrive with location data and that there will be call access, transfer and backup between and among PSAPs and other authorized emergency organizations without geographic restrictions. To better facilitate this process, interoperability and standards need to be coordinated with emergency services network providers within North America and the international community.

Some of the challenges for NG9-1-1 include non-local phone numbers; nomadic services; VoIP mobility; WiFi/WiMAX; text messaging; data-rich-environment needs (including video); existing 9-1-1 infrastructure transition; management of networks; data exchange standards; rights management approach (who gets what data); the ability to process incoming calls from various communication devices, including

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SMS, text messaging and video relay; deciding how much data is provided with the call, as opposed to accessed after the call is received; ability to transfer calls and data anywhere; dynamic call rerouting among PSAPs; virtual PSAPs; transitioning from current technology to new without losing quality of service; current E9-1-1 service levels and systems that must remain operational for an undetermined length of time; cost and funding sources; and overall transition management.

COMM CENTER CHALLENGES

Calls placed from wireless devices offer many challenges for telecommunicators,

primarily because wireless devices are portable and, therefore, not associated with a permanent location. Although wireless E9-1-1 Phase I and Phase II technology provide location assistance, it's important to remember that the Phase I data received at the PSAP is the location of the cell site, and the Phase II location is an estimated location and, therefore, imprecise.

Another challenge specific to wireless calls is the large volume of duplicate and inadvertent calls that may be received by the PSAP. Telecommunicators must not assume every wireless caller is reporting the same incident or that every silent wireless call is accidental. Each call has to be processed on its own

merit. This reduces the time available for other emergency calls.

The bottom line in processing wireless calls is location, location, location. The wireless caller should be queried for any and all location information that can help pinpoint their exact location. This includes street addresses, cross streets, intersections, landmarks, exact locations in buildings and so forth. Also, a call-back number should be determined early so the calltaker has recourse if the signal is lost. || **PSC** ||

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- 1. What year was the number 9-1-1 made available for use as a national emergency number?**
 - 1965
 - 1968
 - 1970
 - 1999
- 2. Which phase of 9-1-1 automatically provides ANI/ALI information from landline phones?**
 - Enhanced 9-1-1
 - Phase I
 - Basic 9-1-1
 - Phase II
- 3. Through what routing table are 9-1-1 calls from landlines routed?**
 - GPS
 - MSAG
 - ESN
 - PSAP
- 4. In wireless 9-1-1, which phase introduced the availability of call-back information?**
 - Phase 0
 - Phase I
 - Phase II
 - NG9-1-1
- 5. Why would a 9-1-1 calltaker need to *rebid* the call information?**
 - Pricing structures are of major concern to PSAPs.
 - The wireless device could send a false signal.
 - The caller's latitude and longitude information are not available at call setup.
 - The wireless device does not have GPS.
- 6. VoIP stands for:**
 - Vehicles on International parkways
 - Vonage operations International protocol
 - Voice operations Involving protocol
 - Voice over Internet protocol
- 7. Wireless local number portability means:**
 - The customer can plug in their landline phone anywhere and keep the same phone number.
 - The customer can get a new cell phone from a different provider and keep the same number.
 - The customer can call from their cell phone from anywhere in the United States.
 - Landlines and wireless devices can have the same phone number.
- 8. With what government entity is APCO—and other public safety organizations—involved to help regulate the technological advances regarding 9-1-1?**
 - DHS
 - DOT
 - FBI
 - FCC
- 9. NG9-1-1 refers to:**
 - Integrating wireless calls into the technology mesh
 - Integrating VoIP calls into the technology mesh
 - Integrating landline calls into the technology mesh
 - Integrating all possibilities into the technology mesh
- 10. The most important part of processing a 9-1-1 call is knowing:**
 - The type of device the caller used
 - The location of the emergency
 - The routing device is
 - The location of the caller

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