



# Homeland Security

Science and Technology

# TechNote

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts unbiased operational tests on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

Information provided by the SAVER Program will be shared nationally with the responder community providing life- and cost-saving assets to federal, state, and local responders.

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, please see the SAVER Web site or contact the SAVER Program Support Office.

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## Wireless Call Location Services

### Background

Emergency responders rely heavily on Enhanced 9-1-1 (E9-1-1) location services when responding to 9-1-1 calls. The E9-1-1 system routes callers to the closest Public Safety Answering Point (PSAP). Automated caller location information is provided to the PSAP operator, allowing the caller and operator to concentrate on the nature of the call. The PSAP operator uses this information to direct emergency responders to the scene as quickly as possible.

According to the National Emergency Number Association (NENA), it is estimated that 30 to 50 percent of 9-1-1 calls now originate from wireless phones. Unlike traditional landline phones where a caller is at a residence or business, there is no permanent address associated with a wireless phone number—wireless phones enable the caller to be anywhere. The complexity of determining a wireless caller's location has presented new challenges to emergency responders.

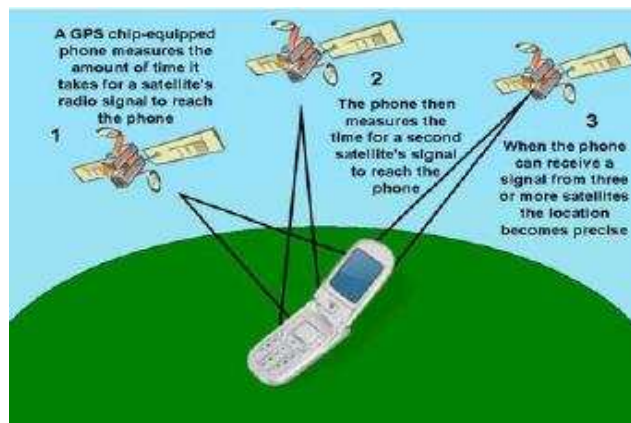
In an effort to address this issue, the Federal Communications Commission (FCC) and Congress established requirements for wireless service providers to determine the wireless caller's location, route the call to nearest PSAP, and provide the caller's number and location to the PSAP operator. The requirements were divided into two phases to allow providers and PSAPs to gradually implement the necessary technology. Phase I requires wireless service providers to provide PSAP operators with a caller's phone number and the location of the cellular tower to which a caller is connected. The actual location of the caller could range from several feet to several miles from the tower. Phase II requires wireless service providers to provide a 9-1-1 caller's location with a much higher accuracy—within 50 to 150 meters (164 to 492 feet) of the caller.

### Technology Overview

The Phase II location information supplied by service providers is determined using one of two location methods: handset-based or network-based.

**Handset-based location** uses GPS-enabled wireless phones and signals from the GPS network of satellites to determine a caller's exact location. When a caller initiates a 9-1-1 call from a GPS-equipped phone, the phone will use the embedded GPS technology to determine its location. When the phone can receive a signal from three or more GPS satellites, the location becomes precise and can be identified. Once this occurs, the caller's coordinates are provided by the phone to the service provider, who provides this information along with the caller's telephone number to the PSAP operator during a 9-1-1 call. This transfer of information is nearly instantaneous and does not require any action on the part of the caller or the PSAP operator.

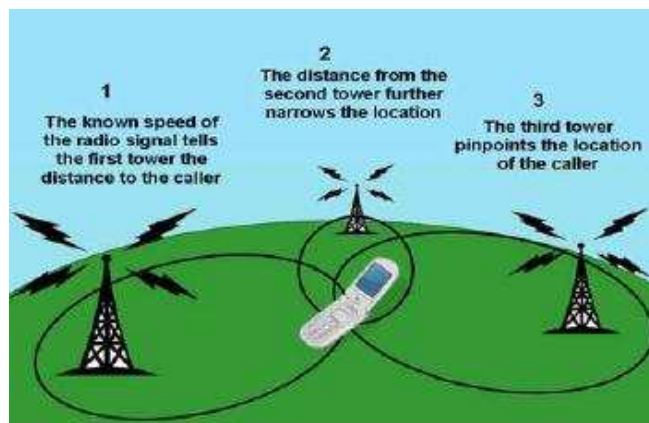
Handset-based location meets the Phase II requirements; however, handset-based location is dependent on two factors—a GPS-capable phone and a PSAP with the capability to process the incoming location information. In addition, a GPS-capable phone cannot



### Handset-Based Location Process

provide location data if it is unable to receive signals from the GPS satellites (e.g., indoors, tunnels).

**Network-based location** uses trilateration to provide automated location information and the required phone number to the PSAP operator. Trilateration is a location determination method that uses the known locations of three or more reference points (cellular towers) and the measured distance between the caller and each reference point. Network-based location requires the service provider to install the location equipment at the tower and PSAPs to have updated location systems. Network-based location does not require the caller to have a GPS-capable phone.



### Network -Based Location Process

When a caller initiates a 9-1-1 call, the phone transmits a radio signal to at least three towers. The location equipment in each tower tracks the time it takes the signal to reach the tower, then uses this information to determine the distance to the phone from each tower. The network can then pinpoint the caller's location. The coordinates are then provided by the location equipment to the service provider, who includes this information along with the caller's telephone number to the PSAP during an emergency 9-1-1 call. Like handset-based location, this transfer of information is nearly instantaneous and does not require any action by the caller or the PSAP operator. In order for this process to work anywhere in the U.S., service providers must implement location equipment in all towers, and PSAPs must have updated location systems installed to receive the wireless location information.

Network-based location service can work indoors and other places that GPS-equipped phones are unable to work. However, network-based location is not as accurate as handset-based location. The caller may not always have three towers within range and interference from mountains, hills, and other obstructions can cause issues in providing exact location measurements.

### Current Location Capabilities

As of January 2007, NENA estimated that about 80 percent of the population has Phase II E9-1-1 wireless location service. Some areas may not meet Phase II location requirements because of the high implementation costs. While the FCC has set deadlines for wireless providers and PSAPs to implement the Phase II requirements, many communities and service providers have applied for waivers

In the interim, PSAP operators may not always receive the most accurate automated location information about each caller's location in an emergency. After Phase II is fully implemented, caller location accuracy may still be off by a few hundred feet. These limitations can make locating a caller difficult for emergency responders. In addition, if a call originates from a service provider that uses handset-based location, but the caller's device is not GPS-enabled or was unable to receive signals from the GPS satellites, the PSAP operator may not receive any location information, in which case the caller would need to provide their location to the operator.

## **Future of E9-1-1 Wireless Location**

Architectures and technical standards are currently being developed that will improve automatic location capabilities and enhance the communication capabilities between the caller, PSAP operator, and emergency responder. Wireless network enhancements and new wireless devices will greatly improve 9-1-1 caller location accuracy. As wireless service providers and PSAPs implement and improve their automated location systems and services, the ability for callers to have the most accurate automated location information provided to PSAP operators will continue to increase.

## **Resources**

### **E9-1-1 Institute**

[www.e911institute.org](http://www.e911institute.org)

### **Federal Communications Commission**

[www.fcc.gov](http://www.fcc.gov)

### **National Emergency Number Association**

[www.nena.org](http://www.nena.org)