Wireless Emergency Services

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WIRELESS EMERGENCY SERVICES: INTRODUCTION

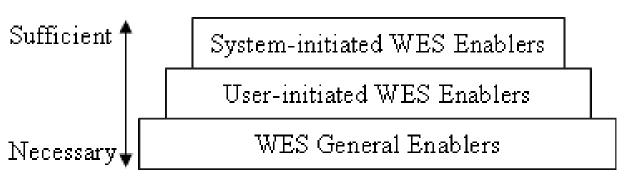
Generally speaking, wireless emergency services can refer to any services that provide immediate help to mobile phone users under emergency conditions. The first widely used WES (wireless emergency services) application is the Wireless Emergency Call Service, which extends the traditional Emergency Call Service (ECS) from fixed-line telephone networks to wireless telephone networks. In the middle of the 1990s, the U.S. Federal Communications Commission (FCC; 1996) issued the order FCC 94-102, requiring wireless carriers to provide the Enhanced 911 Service, the first WECS that delivers emergency calls made from mobile phones as well as caller location information to public-safety answer points (PSAPs). Other countries and regions have planned or implemented similar WECS. For example, the Coordination Group on Access to Location Information by Emergency Services (2002) planned the implementation of E112 service in the European Union.

Though WECS has the capability of pinpointing mobile users, it still responds to user requests like basic ECS, and this type of WES can be denoted as user-initiated WES. However, an emergency is "an unforeseen combination of circumstances or the resulting state that calls for immediate action" (Merriam-Webster Online Dictionary). Thus, emergency events are unforeseeable, but may lead to much worse consequences if no actions are taken immediately. In many cases, people are unaware of or unable to report emergency events, and user-initiated WES cannot help. This calls for another type of WES in which information systems detect the occurrence of emergency events and quickly determine who are (likely to be) involved and what kind of help is necessary. This type of WES can be called system-initiated WES in contrast to user-initiated WES. User-initiated WES and system-initiated WES, together, can provide people with comprehensive protection and minimize loss from mishaps. Demands from a variety of areas, ranging from medical health care, disaster management, to homeland security (e.g., Skinner & Mersham, 2002; Yen, 2004), are pushing WES development forward. This article discusses the latest technologies that make various WES applications possible, and how these applications evolve.

KEY TECHNOLOGICAL ENABLERS

WES applications are based on a variety of technologies: Some serve as infrastructures for both user-initiated and system-initiated WES (i.e., necessary conditions), while others enable each type of WES in specific (i.e., sufficient conditions). Thus, there are three levels of technological enablers: WES general enablers, User-initiated WES enablers, and system-initiated WES enablers (Figure 1). WES general enablers are those infrastructural technologies that support wireless telecommunication and multimedia information processing for both types of WES applications. User-initiated WES enablers include various position-determination technologies that allow wireless carriers to pinpoint mobile users. This positioning capability not only features user-initiated WES, but also makes system-initiated WES possible. System-initiated WES enablers are mainly context-aware technologies that allow WES applications to detect the occurrence of emergency events in user contexts.

Figure 1. The hierarchy of WES enablers



WES General Enablers

In addition to basic voice communications, WES involves the delivery of all kinds of multimedia information over wireless networks, such as textual and graphic messages, user positions, and sensor data. Thus, WES general enablers include new-generation wireless telecommunication technologies that support both voice and data communications, and the latest multimedia and network frameworks that support the integration, processing, and distribution of multimedia information.

New-generation (2.5G and above) wireless telecommunication technologies provide fast and reliable wireless data communications that are essential for WES applications. Most commonly used standards now under the Third-Generation Partnership Project (3GPP, see http://www.3gpp.org), including general packet radio service (GPRS), enhanced data rates for GSM evolution (EDGE)" with (EDGE; GSM - global system for mobile communications), and the universal mobile telecommunication system (UMTS), are packet based. Packet-based wireless networks give users "always-on" capability for data communications, which means users can send and receive information through wireless networks anytime while they are charged based on actual usage rather than connection time. This capability is particularly important for WES applications because users need to keep their WES-enabled mobile phones on standby most of the time for possible emergency events. New-generation wireless telecommunication technologies also provide the necessary bandwidth for WES data communications (e.g., GPRS networks typically transfer data at about 50 Kbps, EDGE networks at 384 Kbps, and UMTS up to 2 Mbps). Reliable and high-speed wireless networks allow the timely transmission of user information (e.g., positions and body conditions) from users to WES systems, and emergency-related messages (e.g., textual notification and evacuation map) from WES systems to users.

The latest multimedia and network frameworks that support WES include the MPEG-21 multimedia framework and the wireless intelligent networking framework. The MPEG-21 framework is a new set of multimedia standards regarding how to adapt digital items related to user delivery contexts (such as user and environmental characteristics) for universal multimedia access (MPEG Requirements Group, 2002; MPEG - Moving Picture Experts Group). Since information involved in WES is mostly multimedia in nature and emergency service delivery is closely related to user contexts, this new multimedia framework is particularly relevant to WES application development. The wireless intelligent networking framework, including the wireless intelligent network (WIN) concept developed by the Telecommunications Industry Association (TIA) and the customized applications for mobile network enhanced logic (CAMEL) concept developed by 3GPP, is about how to deliver intelligent network capabilities to mobile phone users (Christensen, Florack, & Duncan, 2001). Important capabilities for WES include roaming across WES providers (usually wireless carriers), hands-free operation based on voice recognition, and data-service capabilities such as short-message services (SMSs), enhanced messaging services (EMSs), and multimedia messaging services (MMSs; Le Bodic, 2003). These new multimedia and network frameworks support and enhance a variety of important WES functionalities for user convenience and service effectiveness.

User-Initiated WES Enablers

User-initiated WES is featured by its capability to pinpoint mobile users when they make emergency calls. Thus, position-determination technologies are mainly what enable user-initiated WES. There are generally two types of positioning technologies for mobile phones: network based and satellite based (Roth, 2004). Network-based systems use triangulation methods, such as the angle-of-arrival method and time-of-arrival method, to determine user positions as relative to fixed transceivers. Satellite-based systems, usually based on the Global Positioning System (GPS), obtain location information from satellite signal receivers embedded in mobile phones. Satellite-based positioning is usually more precise than network-based positioning.

Position-determination technologies are essential to user-initiated WES because mobile users may be unable to clearly describe where they are when they make emergency calls. It is up to wireless carriers to pinpoint callers so that necessary personnel and equipment can be dispatched immediately. This capability is also necessary for system-initiated