Lessons Learned on the Operation of the LoST Protocol for Mobile IP-Based Emergency Calls

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ABSTRACT

The technology used in citizen-to-authority emergency calls is based on traditional telephony, that is, circuit-switched systems. However, new standards and protocols are being developed by the Internet Engineering Task Force (IETF) to allow emergency communications over packet switched networks, such as the Internet. This architecture is known as Next Generation-9-1-1 (NG-911). In this paper, the authors present lessons learned from experiments on the IETF standard called Location to Service Translation protocol (LoST). LoST maps the user’s location to the address of the emergency call center that serves that location. After implementing the standards in a test-bed with real-world systems, spatial databases, and communication networks, the authors observed performance issues that users may experience. Based on their observations, the authors propose practical ideas to improve the performance of the NG-911 system and LoST protocol operation for mobile users.

Keywords: Location-Based Services, Location to Service Translation (LoST), NG-911, Session Initiation Protocol (SIP), Test-Bed, Voice over IP (VoIP)

1. INTRODUCTION

Every minute, tens of thousands of emergency calls are placed in the United States. Thousands more are probably being made in other countries. Within each country or region, there is usually a common number to reach emergency services (e.g., 9-1-1, 1-1-2, etc). In order to better explain the context of this paper, next we provide a brief history of emergency calls, followed by a description of this paper’s motivation.

A. A Brief History of Emergency Call Systems

It was in 1937, in Great Britain, that the idea of a single emergency number was developed.

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By dialing 9-9-9, British citizens could contact the police, fire department, or medical services. Only later, in 1958 US legislators began to consider the use of a single emergency number. The number chosen in the US was 9-1-1. It is known that one of the reasons for this choice is that the numbers were located on opposite sides of the key-pad, which reduced the chances of accidental calls.

In 1968, the first 9-1-1 call was made in Alabama. Later that year, the American Telephone and Telegraph Company (AT&T) announced the 9-1-1 service. This first 9-1-1 service is also known as “traditional 9-1-1”. It directed all emergency calls to a nearby Public Safety Answering Point (PSAP) which was directly connected, via dedicated trunks, to the telephone company’s central office (CO). A typical PSAP consists of a group of call takers who are responsible for answering emergency calls as well as dispatching the appropriate emergency service (such as ambulance, or police, or fire fighters).

Because the plain old telephone system (POTS) network only established and terminated calls, call takers had few resources to determine the caller’s location. As a result, traditional 9-1-1 soon gave way to landline Enhanced 9-1-1 (E-911), which greatly increased the ability to locate the caller. E-911 employs an address database called Automatic Location Identification (ALI), which uses the telephone number of the caller to determine his/her identity and location. E-911 was implemented in 1978 and is still being used today (Figure 1).

Landline E-911, however, only temporarily met the new technological need. Cell phones soon made it necessary to again upgrade the system. The Federal Communications Commission (FCC) mandated that all United States wireless carriers provide the location information of the caller (Reed, Krizman, Woerner, & Rappaport, 1998). Implementation of this mandate would enable wireless carriers to “pinpoint” the location of any 9-1-1 caller.

The FCC mandate was divided in two phases: Phase I required the wireless carrier to send the PSAP the location of the antenna or cell site; Phase II required the wireless carrier to send an estimate of the geographic coordinates of the mobile user, typically using some type of network triangulation scheme (Feng & Law, 2002; Sayed, Tarighat, & Khajehnour, 2005). Not all wireless providers have implemented Phase II service as of 2009, based on the National Emergency Number Association (NENA)’s recent 9-1-1 Deployment Reports (NENA, 2010).

In the late 1990s, with the onset of voice over Internet Protocol (VoIP) (Goode, 2002) and other Internet services, researchers and developers have realized that a complete overhaul of the current E-911 system is necessary – proposing a Next Generation 9-1-1 (NG-911) (Hixson, Cobb, & Halley, 2007; NENA, 2007a, 2007b; Schulzrinne & Arabshian, 2002) system that...
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