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The Internet location services model

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Abstract

The Internet location services as embodied in the HTTP Enabled Location Delivery (HELD) protocol and associated presence and location encoding specifications is in contrast to the established location services model and protocols as seen in today's cellular and wireline PSTN networks. This paper makes the comparison between these two domains and elaborates on the structure and procedures of the Internet location services architecture. It describes the mechanics of the location service and describes its application to Internet services including the general approach to supporting location capabilities in the context of presence services.

Keywords: Internet location; IP location; HELD; LIS; Presence

1. Introduction

Under significant impetus from the need to have location determination in support of emergency calls, CMRS (commercial mobile radio service – conventional cellular or mobile network) network standards for location services developed rapidly through the last decade of the 20th Century [1] and into the next. Systems based on these standards are widely deployed in the world today. In all cases, however, these standards reflected the same characteristics of devices described above. That is, they are aimed at particular device types and access technologies and they have a built-in assumption that the devices to be located are associated with a home service provider. In the case of SUPL, for example, the location service does not exist except in the context of a home location service provider – which is generally considered to be the same as a home voice service network provider.

The rise of VoIP, and the inevitability of it replacing PSTN-based voice services, has already become subject to the same imperative to support location services as CMRS did. That is, a location service is fundamental to the support of emergency calls. Internet users, as already mentioned, can be fully mobile when using 3G and 4G networks. Even without that consideration, Internet users can move from one point of wired access to another taking their devices with them. This latter characteristic (often called "nomadicity" because the users are effectively nomadic as far as points of access are concerned) means that the issue of location determination arises even for fixed points of Internet access – such as wired DSL broadband connections. In the past, a CMRS provider took care of "roaming" issues and took on the onus of working with roaming partners to provide a consistent location service. But Internet access is found and used independently of the VoIP service provider so no such "home provider" dependency can be assumed.

A need exists to support a generic "location service"; a way for Internet connected devices to obtain location information that is consistent and independent of the underlying access technology and the application provider.

2. Defining a general approach

Devices used for PSTN access (cellular or wireline) have historically been built for specific access networks. Devices used for Internet access do not typically start with a presumption of a particular access technology. In many cases, the access network being used is just via one or other arbi-

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trary network interface controller (NIC) on the device. Indeed, it's not unusual for a single device to be equipped with WiFi, wired Ethernet, and 3G NICs with the facility to add other network adapters as time goes by. If an application on an Internet connected device wants to request location from the network, it is preferable if it can do this in the same way regardless of the NIC being used. It is also preferable if it is not dependent on each individual NIC driver to interpret the location request.

Typical control plane location services defined for CMRS networks, [2] for example, build the protocols and procedures for the location service directly into the signalling plane defined by the specific cellular network technologies. Indeed, in recent years, there has been a burgeoning activity dedicated to defining per-technology location-acquisition methods – e.g. LLDP-MED for Ethernet [3]. In the light of convergence – where global communications occur almost exclusively on IP and the Internet is established as the universal public network, a common approach to supporting a location service is desirable.

A few years ago, the issue of proliferation amongst location technologies became a concern for CMRS operators – particularly those large global cellular operators with many network properties using different technologies. Providing a consistent and cost-effective location service for their subscriber population meant implementing specific technologies in each of those properties. From this concern, the Secure User Plane Location (SUPL) architecture was defined and eventually moved under the auspices of the Open Mobile Alliance (OMA) [4]. This architecture used IP as the baseline transport protocol for the location service. In so doing, it permitted that service to be defined in a way that was largely independent of the access technology.

However, the heritage of SUPL derives directly from the cellular services model. Cellular subscribers contract to a particular "home mobile service provider". The extent to which subscribers can connect to other networks is dependent on a roaming agreement existing between the home service provider and the visited network. SUPL is based on this same premise. The mobile device assumes the existence of a home SUPL service. Authentication and authorization and the initiation of location sessions is tied to this home location service provider. This works fine in a cellular context where the use of third party network is dependent, in any case, on pre-existing agreement between the operator of the visited network and the operator of the home network. When it comes to the general Internet model users determine their own, largely independent, means of attaching to the Internet. They then utilize services on the Internet independently and without the expectation of a relationship between those services and the operator of the access network. Similarly, when considering this model of Internet usage, it is preferable if the access network provider does not have to have a relationship with some third party provider before the network users can request location information.

Taking the above points into consideration, the following desirable characteristics can be identified for a general Internet location service:

- Consistent across all access technologies regardless of device type or NIC currently in use.
- Ability to determine location at a particular point of Internet access without an assumed relationship with some third party service provider.
- Ability to be invoked at any time regardless of the nature of the access network – fixed or mobile.

Another important characteristic arises from the last point. CMRS location services generally provide the location as a geodetic (latitude and longitude) point. This makes sense because the users are mobile and their mobility is independent of any particular reference point or system. For example, they can easily be somewhere that cannot be expressed as a civic street address – even if the network had the ability to reverse geo-code the determined location. On the other hand, fixed points of Internet access can very commonly be associated with a street address (for example, residential DSL terminations). This form of location is very valuable for services such as emergency dispatch. As such this form should be supported. So, we can add another desirable characteristic for the Internet location service:

- Ability to provide location in geodetic and/or civic street address form as appropriate to the nature of the Internet access network.

The rest of this paper describes how these characteristics are supported using the HTTP Enabled Location Delivery protocol (HELD) [8].

3. The Internet location service model

In accordance with the characteristics described above, the Internet location service architecture assumes that the service can be found and utilized at each point of access without dependency on any remote or dissociated service provider. To this end, a network entity called a Location Information Server (LIS) is defined. As shown in Fig. 1, a device visiting a particular access network discovers and uses the LIS that is associated with that access network. So, the process is

1. Discover LIS.
2. Request location from LIS.

The location information may be used directly by some software application running directly on the device. Fig. 1 also shows step 3, often referred to as "location conveyance". This is where the location information is delivered to some Internet- or intranet-based service. The service may be VoIP, street mapping, a location-based information service such as Yellow Pages, or any of an array of