GeoInformationRouter - Localization in WLAN Environments Via Infrastructure

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Abstract
In this paper we present a completely infrastructure based localization technique for WLAN environments. Our modified Routers, called GeoInformationRouters, attach location information to the HTTP header. This information can be used to build web based LBS accessible using ordinary web browser on all different mobile and stationary devices starting from mobile phone, over netbooks or PCs without the need of special localization hardware on the device (such as GPS).

Introduction and Related Work
eMarketer[1] estimates there will be over 134 million users of Location Based Services (LBS) worldwide this year (2012: 486 m.). To use LBS the determination of users' positions is fundamental. Special hardware or additional software is required to obtain the position of a mobile or stationary device. A lot of research is done in the field of localization systems [2]: Skyhook[2], MagicMap [5], Redpin [1], Place Lab [3] or RADAR [4] are just a few examples. GeoTargeting [6] as an infrastructure based approach does not need client-sided software, but often this approach does not provide high precision and is error prone. In our approach we shift localization from single client devices completely to infrastructure. LBS are accessible without any effort and meets the following criteria: no use of additional hard-

[1] eMarketer: http://www.emarketer.com/Article.aspx?id=1006609
2 Skyhook: http://www.skyhookwireless.com

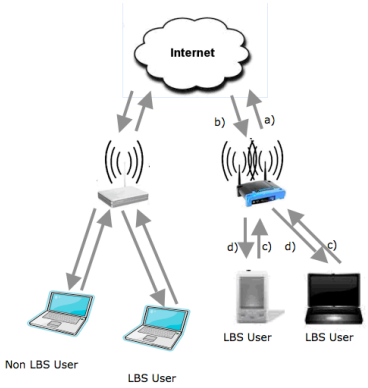

Figure 1: System overview with an example of an HTTP request with geo-information. a) HTTP request header <<postal code>> b) HTTP response local hotel information c) HTTP request header <<…>> d) HTT response local hotel information.

ware or software, use of existing infrastructure, use of different mobile devices, setup and maintenance fast and simple, user decide about privacy.

Concept and Implementation

The GeoInformationRouter themselves using the Skyhook localization system to position themselves in the environment. This location information of the routers will be attached to the meta information in the HTTP header. Accessing these meta information is very easy and they can be used in every dynamic web framework. This location information is only used if users accept using of geo information. The header itself will be extended with meta information about: postal code, street, latitude and longitude. If e.g. a cafe hosts a GeoInformationRouter, a tourist only accepts privacy terms and a hotel information system will automatically display hotels near his position. As a proof of concept we developed a router infrastructure to demonstrate the operating principles and to test the method on different client-platforms (software and hardware). An Asus WL-500 Premium (Multifunction Wireless Router) with OpenWRT5 was chosen as infrastructure platform. The decision if users want to transmit their location to a web service is saved on the router. Upon the first dial up to the GeoInformationRouter and a visit of a web site, users are diverted to a special homepage which runs on the GeoInformationRouters web server and have to decide if location should be transmitted or not. Each decision will be connected to the corresponding user clients MAC address. On a Linux operating system the "iptaples" regulate IP traffic. Routing decisions are based on rules, which allow modifying IP packets matching the rules conditions. This can for example be done before the routing process ("PREROUTING") or after "POSTROUTING". All HTTP traffic from clients using the GeoInformationRouter pass the "PREROUTING" chain and are forwarded to the "LBSDECISION" chain. In this chain the information of the MAC addresses are used to forward the request to "NONLBSUSERS" (location transmitted) or to "LBSUSERS" (location not transmitted). All HTTP requests of the "LBSUSERS" chain are routed to the standard "INPUT" chain, which will direct the information to a proxy server, which runs on the GeoInformationRouter. The proxy server (Privoxy6) than add the special location tags into the HTTP header (as can be seen in figure 1).

Conclusion

This approach introduces an easy, client-independent localization service with the possibility of privacy protection. Configuration and privacy protection is easily possible. With the adaptability of the systems it is easy to support upcoming standards like the W3C GeoLocation Standard[3].

Citations

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[3] W3C Geolocation Standard: http://dev.w3.org/geo/api/spec-source.html