Cellular-to-WiFi Handoff, Micro-LBS, and the Symbiotic Power of Location

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Abstract

This document describes how wireless carrier location systems can be used as a mechanism to manage handoff between cellular networks and WiFi networks, thereby solving the ubiquitous location problem for location-based services (LBS). It also introduces the concept of micro-LBS and potential new applications therein.

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Introduction

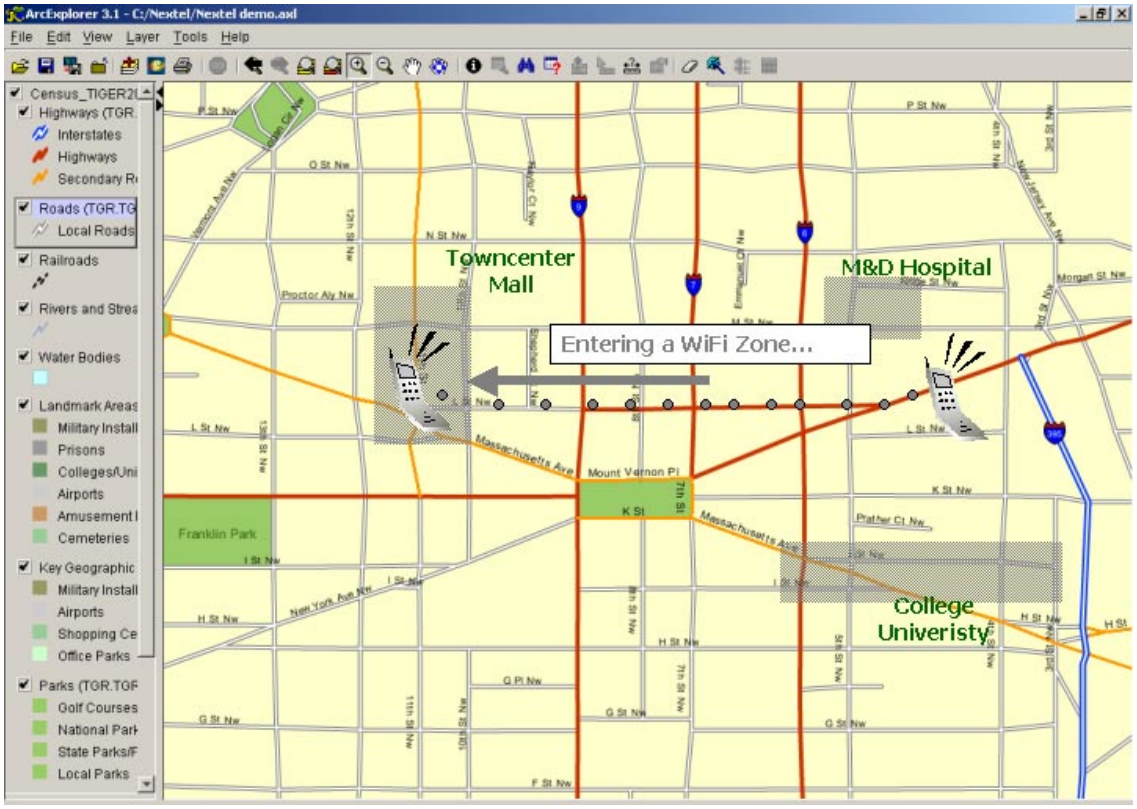
Over the last several years, WiFi networks have been cropping up everywhere. Corporate campuses, college campuses, shopping malls, train stations, airports, museums, hospitals, manufacturing plants, warehouses, and even Starbucks coffee shops have all installed WiFi networks on their premises. The trend suggests the world is becoming more unwired, hungrier for wireless broadband access, and that computing is becoming more miniaturized and pervasive. It also suggests that perhaps many are tired of waiting for 3G wireless data services and that WiFi may potentially threaten 3G plans and rollouts unless wireless carriers can find a way to offer an overlay of both technologies to device-toting users.

A New, Useful LBS Application—Cellular-to-WiFi Service Handoff

There are two obvious problems with marrying conventional cellular networks to WiFi networks. First, not all mobile devices support both cellular bearers (GSM, CDMA, iDEN, etc) and IEEE 802.11b, though I'm sure most handset manufacturers have plans to solve this over time, as some already have. Second, and perhaps more important and critical, cellular-to-WiFi service handoff has not been solved. When a user on a cellular network enters into a WiFi coverage area, there is no mechanism in place to hand off the call from the cellular network to the WiFi network. Can location be used to unravel the problem? Can location capabilities in cellular networks be used as a mechanism to manage WiFi service handoff? The answers to these questions can be found through geography and by thinking geographically.

WiFi networks are typically confined to small geographic areas like a campus, and these areas, or footprints, can be mapped and represented by GIS databases as geographic zone features similar to a demographic area, postcode, ZIP Code, or other semantically defined geographic zone. Conventional cellular networks that already support location capabilities through A-GPS, TDOA, etc. are capable of tracking device locations. Combine this cellular location capability with a WiFi coverage zone map, and you now have the ability to intelligently trigger a cellular-to-WiFi services handoff based on location when a user enters into a WiFi zone (Figure 1).

Figure 1
GIS Representation of a Cellular-to-WiFi Services Handoff Based on Location



This handoff trigger is based on the same premise of location-based *presence* for the purposes of zone-based alerting in cellular networks, but the zone happens to be a WiFi area in this case. Cellular-to-WiFi handoff is a location-based application in itself, and it directly benefits wireless carriers that build out WiFi hot spots (e.g., T-Mobile USA). However, you need not stop there. There are more possibilities for WiFi in location-based services.

Dig Deeper Into WiFi—Micro-LBS Is in There, Too

In addition to the cellular-to-WiFi handoff issue, seamless outdoor/indoor positioning and ubiquitous location are two other challenges facing the LBS industry. For example, A-GPS positioning methods work well in urban outdoor environments, but they are quirky, unreliable, and their accuracy degrades when the device is indoors and has limited line-of-sight to satellites. In response to this problem, some vendors have invested in research and development to address location-enabled WiFi networks for indoor positioning (see www.ekahau.com). These vendors have successfully built software-only, server-centric solutions capable of positioning WiFi-enabled devices to one meter or less in indoor and outdoor environments or wherever there is adequate WiFi coverage. While these WiFi

solutions' technical details are intriguing and are based on geographic information system (GIS) data modeling of signal strengths, I will focus on the more broad implications of the technology and how it may solve the problem of ubiquitous location between the cellular and WiFi worlds, and also how the technology could potentially introduce a new breed of "microgeography" LBS applications.

Imagine the proverbial mass-market oriented LBS transaction scenario, where a mobile user is trying to find an ATM nearby. The user would likely invoke a location-based concierge application whereby the cellular network would determine his/her location and he/she would subsequently receive details about the point-of-interest destination within a given proximity. The details of the returned information might include directions to the site and other relevant information. Upon receiving the information, the user decides to travel to the destination, which for the purposes of this example is within a shopping mall. The ATM is inside the mall, which is quite large. In a cellular-to-WiFi handoff-enabled world, the user would receive additional directions once inside the mall based on WiFi location capabilities and would quickly find the ATM. This is an exhausted service example that in the real world has little value to the average user, but it is used here to explain the basic idea behind the technology.

There is also potential for stand-alone WiFi microlocation-based applications independent of cellular networks. Location-enabled WiFi networks covering corporate campuses, college campuses, shopping malls, train stations, airports, museums, hospitals, manufacturing plants, and warehouses provide micro-GIS application possibilities for business, education, retail, transportation, health care, and the supply chain management industries, respectively. These industries have demand for these types of location technologies and spatial solutions. For example, hospitals are looking for ways to track doctors, patients, and medical resources. Shipping companies are looking for ways to track packages and supply chains within their warehouses. Manufacturing plants are interested in monitoring and tracking assembly lines and production flows. Students are interested in campus-based friend finder applications. The list goes on and on, and the imagination can run wild with possibilities.

Conclusion—The Symbiotic Power of Location

Location in cellular networks can be used to solve WiFi handoff challenges. Location can be used in WiFi networks to introduce a whole new set of micro-GIS location-based applications. Finally, location itself creates a symbiotic relationship between both networks, bringing them together to create location ubiquity. The industry colloquialism "power of location," and ESRI's own saying, "geography creates communities," both hold true in this case. Geography is truly a wonderful thing!