Leveraging Mobile High-Speed Data Access

Seamless Roaming between WiFi and 3G Networks

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This white paper addresses:

- Complementary technologies for achieving business goals
- Where seamless roaming pays off
- How seamless roaming is defined and achieved
- The user experience
- The technology
- An overview of Mobile IP operation
- Some advantages of Mobile IP

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Why integrate WiFi/WLAN and 3G technologies?

By understanding the basic character of today's mobile high-speed data technologies, enterprises can take full advantage of the opportunities they present, chiefly to increase productivity and cut costs. This paper discusses the added value that results from integrating WiFi and Third-Generation (3G) mobile networks to create comprehensive solutions—with seamless roaming. This integrated approach offers expanded coverage, with faster, more convenient access to company data from a broader range of remote locations. It also presents companies with an important opportunity to upgrade business processes, making them more cost-effective and competitive.

Contents

The first part of this paper focuses on business issues, while later sections address technical concerns. Here are the topics covered:

Complementary technologies for achieving business goals

With its use of unlicensed spectrum, relatively simple deployment and very low equipment cost, WiFi technology is sometimes regarded as a direct competitor to 3G technologies. However, one key difference makes these technologies complementary, rather than competitive: WiFi networks have a more limited range than 3G networks.

Initially, WiFi networks were designed to extend enterprise networks without the burdensome cabling of fixed LANs, which is why they're also known as wireless LANs or WLANs. Now, however, WiFi is used for more than mobile high-speed data on company premises. A new breed of operator, known as wireless Internet service providers (WISPs), is using WLAN standard IEEE 802.11b to extend broadband access to public "hot spots," such as airports, hotels, conference centers and cafés.

But despite this expansion in usage, WiFi's limited range makes it impractical as a technical and economic alternative to 3G technologies for ubiquitous wide area coverage. As a result, businesses can gain greatest advantage from mobile data solutions that seamlessly integrate these two types of mobile technology—just as they gain more power and convenience by integrating wireline LANs and WANs.

The greatest benefit comes from expanded coverage. By integrating WiFi networks with 3G resources, telecommunications operators can extend mobile high-speed access, in more locations, faster. Many mobile professionals already have IEEE 802.11b-enabled laptops and personal digital assistants (PDAs) that they could use in WiFi hot spots (public locations where a high concentration of high-speed data users are likely to gather). Integrated 3G mobile solutions leverage these existing locations—and extend them by giving end users the ability to roam seamlessly across the wider area, supported by 3G networks.

Where seamless roaming pays off

In some business activities, the integration of WiFi and 3G technologies can be particularly valuable, such as:

- **General access to intranet resources** – While on company premises, employees can use the corporate WLAN for everyday mobile data connectivity. At home or on the road, they can use wide-area 3G coverage to quickly access the same resources. As a result, employees can save time and increase their productivity.

- **Vertical applications** (such as field sales and service, healthcare, real estate and finance) – Many of these applications require easy, portable access to data both on the corporate premises (best achieved by the company's wireless LAN) and off premises (where 3G technology works best). Integrated WiFi and 3G solutions support continuous access to these applications.

- **Productivity improvements for these applications** – Continuous access to Mission Critical data presents a valuable opportunity for businesses to gain a competitive edge by upgrading current business processes to take full advantage of expanded data access. For example, fast access to product information and part numbers can speed the sales and order processes, while a quick look at installation and repair diagrams can enhance service on the customer premises.

- **Fleet applications** – These applications have data needs similar to vertical applications. But in this case, delivery vehicles would probably make use of the corporate WLAN while still in the company parking lot. Then, as they leave the premises, they would switch to the 3G network. Field service technicians could access parts databases and arrange deliveries of needed products or parts while at a customer's location using either a customer's WLAN or a 3G network.

How seamless roaming is defined and achieved

Seamless roaming can also be referred to as "service continuity." For data connections, this phrase means that a network's end users can move easily between WiFi/WLAN technology and 3G technology without really noticing the effects on their data connection. What's required to achieve service continuity depends on the type of applications an end user is running. Most data applications are not "real time" in nature. For these applications, service continuity can be defined as "maintaining the session as the user moves."

Although this result can be attained in a number of ways, Lucent Technologies prefers to use Mobile IP, an IETF protocol defined in RFC 3344. This protocol enables mobility at the network layer—and allows a mobile node, such as an organizer, laptop or PDA, to change its location without the need to restart applications or terminate and re-establish an ongoing connection.

To gain the benefits of the Mobile IP protocol, end users must install an appropriate mobile "client" onto the data devices they will use. Then they simply log into this software using their chosen passwords. After activating the session, these end users will be able to use data transfer applications such as Web browsing, FTP and streaming media sessions. They will also be able to move from one area of coverage to another, or to a different system, with no noticeable change in service other than a slight momentary pause. For example, a user could walk outside the company headquarters leaving the coverage of the Corporate WLAN, continue the session on the mobile network as they drive across an area with 3G coverage, then resume on WLAN as a stop off at a cafe offering WiFi access—all without interrupting the data session.

While some users and applications can work adequately without a seamless handover, others require "always on" connections. For example, package delivery might connect with corporate resources via a wireless LAN as they work in the enterprise parking lot, but they need to continue their data sessions via 3G networks when they're away from corporate premises. Government services, like police, fire and ambulance, clearly need fast information at all times. Using local network resources while they're within the range of the wireless LAN—and switching seamlessly to public 3G resources as needed—optimizes bandwidth and minimizes costs for wireless data usage overall.

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The user experience

Even when applications do not require seamless connectivity, the integration of WiFi/WLAN and 3G offers valuable benefits for the user experience. Mobile professionals who use these solutions are never required to know the type of coverage that is delivered in each location— and whether it's going to change. The Mobile IP client hides the complexity, making the user experience simple and seamless.

The Technology

Figure 1 shows Wireless LAN/3G mobile integration using Mobile IP with additional network elements in the mobile service provider's network.

WISP Data Center + Central Office

Billing System

Internet Other IP Network

HA

AAA Server

3G Network

PDSN/GGSM/FA

WLAN "Hot Spot"

FA

Ethernet

3G Radios

802.11 Access Points

3G Radios
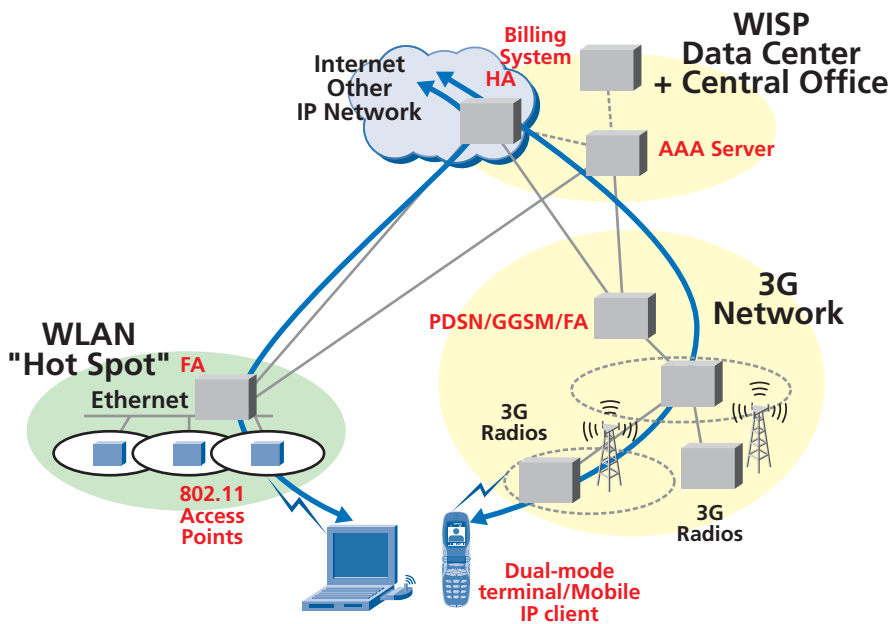
Dual-mode terminal/Mobile IP client

Figure 1 - 3G - Wireless LAN - Integration using Mobile IP

3G architectures remain unchanged by the introduction of WiFi/WLAN access. When using Mobile IP, the integrated WLAN solution includes two additional elements in mobile operator's network: a Mobile IP Home Agent and a Foreign Agent.

- **Mobile IP Home Agent (HA):** A router located on a mobile node's home network (in this case the network operator). It maintains the current location for each departed mobile node (either WLAN/WiFi hotspot or 3G network) and tunnels the received packets for the mobile node to its current location.

- **Mobile IP Foreign Agent (FA):** This router is located on a mobile node's visited network (either WLAN/WiFi hotspot or 3G network). It supports the registration of the mobile node, upon attachment, and enables the mobility process by co-operating with the Home Agent. The Foreign Agent extracts packets intended for the mobile node by de-capsulation of the packets tunneled from the Home Agent; packets sent by the mobile node are transmitted via the Foreign Agent.

Two types of Foreign Agents are supported by Lucent's solution:

• A Foreign Agent in each WLAN hot spot with support for 802 protocols.

• Foreign Agent functionality in the core of the 3G mobile network.

The use of Foreign Agent is optional. The Mobile IP protocols include a mode of operation known as "co-located IP address" where the Mobile IP client software performs the equivalent role of Foreign Agent. This mode of operation is adopted when it is not possible to have Foreign Agent functionality, such as an existing PDSN/GGSN or a roaming WLAN network that doesn't support it.

An overview of Mobile IP operation

Here's a high-level description of Mobile IP operation in this context. The mobile node (laptop computer, PDA or other end-user device) uses the Agent Solicitation message to request the address and other information of the Foreign Agent providing Mobile IP services. The Foreign Agent replies by transmitting an Agent Advertisement.

The mobile node obtains its care-of address on the visited network through the Agent Advertisement—and registers this address with its Home Agent in its home network via the Foreign Agent. Care-of address is associated with a foreign network visited by the mobile node, and it changes as the node moves from one foreign network to another. The Foreign Agent then informs the Home Agent of the current node location by means of the care-of-address. It also serves as the default router for the mobile node when it is connected to this foreign network. The mobile node changes its location and points-of-connection to the network without interruption to the higher layer applications, while maintaining its permanent IP address.

The Home Agent is responsible for intercepting all IP packets sent to the mobile node at its home network address. When an IP packet sent to the relevant mobile station arrives from the Internet, the Home Agent encapsulates it in an IP packet and directs it to the care-of address of the Foreign Agent. The Foreign Agent receives the tunneled packet, removes the encapsulation, matches the packet's destination address to that of the registered mobile node and forwards it to its final destination through the appropriate interface.

Any packets to be transmitted by the mobile node are normally directed to the destination through the use of standard IP routing procedures, and they do not have to involve the Home Agent. However, the Mobile IP protocol also includes the possibility of tunneling these packets all the way to the Home Agent, also known as reverse tunneling. This method of operation can be valuable when the network is not able to route those packets; for example, because they use some sort of source IP address processing or because the home network uses a private addressing scheme that is not routable through the public network.

Some advantages of Mobile IP

Mobile IP is not the only solution to provide service continuity between 3G networks and WiFi/WLANs. Other mechanisms include tighter integration of the WLAN subsystem, where the WLAN traffic joins the 3G traffic at some point in the 3G system, thereby converting the WLAN system into an element of the 3G system. Proprietary, vendor-specific solutions also are available.

However, the Mobile IP solution offers the following advantages for enterprises:

• It's an IP based, data-centric solution, based on IETF standards with no changes to established WLAN and 3G networks, which enables different vendor equipment inter-working with minimum effort.

• It minimizes coupling and interdependence between WLANs and 3G networks.

• This solution can extend to other types of data access networks including wireline networks.

Your next step

You can begin to reap the benefits of integrating mobile 3G capabilities with WiFi networks today. Speak with your local mobile service provider about using 3G high-speed mobile data capabilities to leverage your applications.

To learn more about Lucent's High Speed Mobile Data Solutions for Enterprises, please contact us at 888-552-2544, or visit our web site at www.lucent.com.

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