

# Emerging Wireless Technologies

## 4G Applications and Services

*Foreword: The Public Safety Wireless Network (PSWN) Program is conducting an ongoing assessment of advancements in the wireless communications industry. The scope of this assessment is to identify emerging wireless services and technologies for potential public safety use in the near future and beyond. This document is the second in a series of studies on emerging wireless technologies. This particular study primarily concentrates on applications (services and challenges) that are planned for deployment in fourth generation wireless networks.*



In the previous installment in this series, general applications for fourth generation (4G) networks were introduced. This document further develops and provides more details of services envisioned in 4G networks.

It is generally accepted that 4G networks will provide more than just wireless voice telecommunications. In fact, the main thrust of 4G technologies is to provide high-speed, high-bandwidth, packetized data communications. It is generally expected that in 4G even voice traffic will be delivered to the handset in packets (as opposed to delivery via dedicated circuit switching).

Circuit switching refers to the technique in which a dedicated channel is used to transmit and receive voice or data. Packetized data communications refers to the digital signaling technique in which

information (voice or data) is converted into binary code and partitioned into short segments. These segments are then re-assembled in the correct order and converted back into usable information at the destination.

Packet switching is more desirable to carriers and providers than circuit switching for a host of reasons. One reason is capacity. It is inefficient to serve only a single subscriber per channel because the full bandwidth of the channels is not being used at all times during a voice call. When a typical user makes a call, there are lulls where neither party is talking. In circuit switching, that lull is still being transmitted over the channel. The first generation of wireless (cellular) technology used this technique.

Current wireless systems share channels in a packet environment to deliver voice communications. In packet switching, only actual voice content is packetized and sent to the system. Advances in technology and in multiple access techniques have made this possible. Unfortunately, today's wireless access techniques do not support high-speed or high-bandwidth transmissions. This limitation is the impetus for the evolution of wireless communications.

In today's wireless marketplace, users demand value-added services. With all the hype heralding third-generation (3G) services, users have come to expect that the next generation of wireless technology will be not only a voice communications medium but will have Internet-like functionality. Service providers and application developers are on the path to realizing these user expectations, but there is still a long road ahead.

In reality, the dream of Internet-style functionality via wireless communications may not be fully realized in the 3G deployment. The multiple access techniques

planned for 3G will not support the bandwidth and data transmission speeds required for the advanced applications users expect. 3G technologies will certainly have greater functionality than today's wireless systems; however, not until 4G deployment will these so called "killer" applications be supported.

### **User and Industry Expectations and Justifications**

Today's wireless users expect great things from tomorrow's wireless networks. As stated earlier, these expectations have been fueled by hype about what the next generations of wireless networks will offer. Application developers and service providers are paying close attention to user expectations to determine what services to develop and offer.

Wireless users can be categorized into generalized segments. The wireless industry must understand these segments and what drives each segment's requirements and expectations for the next generation of wireless technology.

Users can be segmented in many ways. According to a recent presentation by Lucent Technologies at the Supercomm 2001 conference in June, Lucent is considering segmenting users into the following categories: Gender, Age, Internet Usage, Income Brackets, and Mobile Professional.

The Gender segment refers to new female users, versus traditional male users. These users are typically medium-income individuals. The types of applications being developed for this segment are social and entertainment applications such as instant messaging and chatting.

The Age segment is composed of the youth market—generally individuals 18 years old or younger. Typically these users do not pay for their own service—their parents or guardians do. The types of applications being developed for this

segment are social and entertainment applications such as music services.

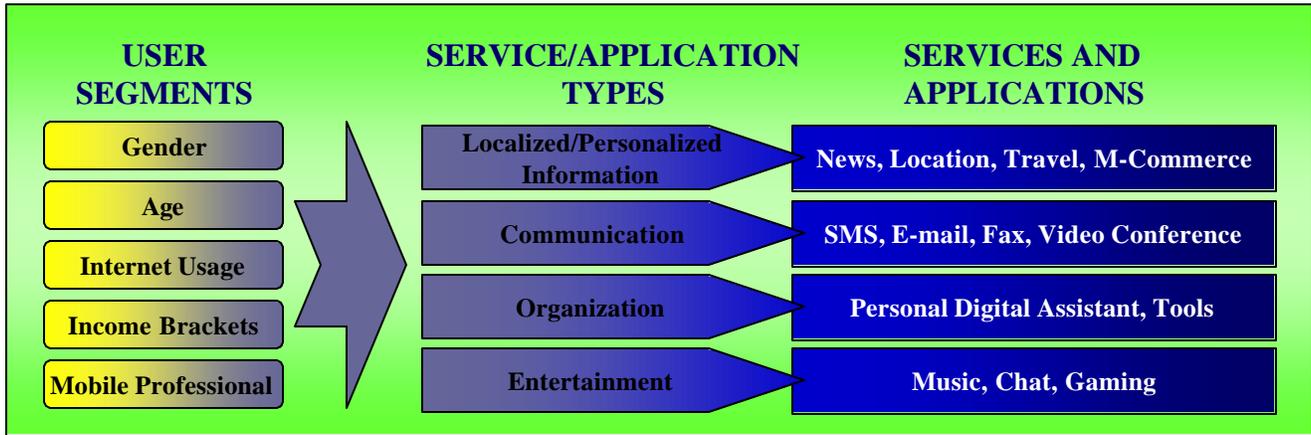
The Internet Usage segment is composed of individuals that typically spend longer than average (i.e., more than about 32 minutes per session<sup>1</sup>) browsing the Internet. Typical users in this segment are technology focused. The types of applications being developed for this segment are information applications such as personalized news services and streaming news feeds (i.e., delivered with audio, video, text, or any combination of the three). These users are especially difficult for providers to satisfy because they are accustomed to the Internet model of billing (i.e., essentially unlimited usage for a small, fixed fee).

The Income Bracket user segment is composed of middle-aged, value-conscious individuals. The types of applications being developed for this segment are information services such as up-to-the-minute, personalized stock tickers. These users are also generally safety oriented; therefore, regular, reliable voice and data communications are paramount.

The Mobile Professional segment refers to users who rely on wireless devices to conduct day-to-day business. This segment includes professionals who travel on a regular basis. These users are generally very important to service providers because they often spend more to obtain the services they require. The types of applications being developed for this segment are messaging applications such as mobile faxing, e-mailing, and instant messaging. To augment solid applications, providers are also developing subscriber equipment to allow for roaming on disparate, worldwide wireless networks using a single communications device (worldwide interoperability). Like the Income Brackets segment, the Mobile Professional bracket

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<sup>1</sup> Based on statistics gathered by Nielson//NetRatings as of August 5, 2001



demands regular, reliable voice and data communications.

Public safety interests fit well in the Mobile Professional segment. In addition to the overall functionality required by the Mobile Professional segment, public safety users require guaranteed secure communications. More details regarding the impacts of next generation applications on the public safety community are presented later in this document.

### General Services and Applications

For purposes of this document, services are defined as functions offered to subscribers by providers. Applications are defined as programs, software, or features that take advantage of (apply) the services offered by the networks. Generally, four categories of services or applications are being developed for use in the next generations of wireless communications. They are Localized/Personalized Information, Communications, Organizational, and Entertainment.

Although localized/personalized information services and applications are geared to most users across all the user segments previously mentioned, these services are more critical to the Internet Usage, Income Brackets, and Mobile Professional segments. Localized/personalized information services and applications will provide users with general news, financial news, location guides, mobile commerce, and travel services. These services will allow the user to

establish a single profile that will be associated with the user whether in his/her home coverage area or roaming on other systems.

In some European countries (e.g., Scandinavia), there are applications that track public transportation. This information allows users to time their arrival to mass transportation stops with the arrival of the bus or train. This type of localized/personalized information service is currently deployed on a limited basis in countries with enhanced 2.5G wireless networks<sup>2</sup>. This service can be either push-based or pull-based, depending on whether the subscriber wants the mass transit information automatically sent to the wireless device or if the subscriber wants the mass transit information on an as-needed basis. Push and pull services are discussed in detail later in this document.

Communications services and applications involve messaging and other means of staying connected. These services and applications are important to all the user segments, especially the Mobile Professional segment. Communications services include short messaging service (SMS), e-mail, video conferencing, fax, and bulletin boards. Although some of these services are available in today's wireless systems, in future generations these services will be greatly enhanced. (Speed and

<sup>2</sup> More details regarding 2.5G can be found in the previous installment in this article series, "Emerging Wireless Technologies , A look into the future of wireless communications - beyond 3G"

reliability are the most notable enhancements planned for these services.)

Organizational services include personal digital assistant (PDA) capabilities, currency exchange based on user location, and other personal management applications (e.g., calendars, call management, and address books). Organizational services and applications are relevant to all the user segments but are geared primarily to the Income Brackets and Mobile Professional user segments.

Entertainment services are viewed by service providers as having the greatest potential for immediate return on investment. Entertainment services may include streaming audio, streaming video, chat, photo trading, and gaming. In the Asian wireless market, where preliminary iterations of 3G are being deployed, entertainment services are generating substantial revenue. The user segment targeted for entertainment services is the Age segment.

Another service generating much excitement in the industry is mobile commerce (M-Commerce). M-commerce is the ability for subscribers to purchase items (e.g., gas, food from vending machines, etc.) using a wireless device. For example, to purchase an item from a vending machine, users would dial a phone number or access code associated with the item (most likely marked on the vending machine) and the item would be dispensed. In this scheme, the vending machine would be connected to the public switched telephone network (PSTN) via a modem or other gateway-type device. The wireless service provider would pass the information to the vending company and the vending company would, in turn, pass the information to the vending machine to instruct it to dispense the item. The user's wireless service account would be billed for any items purchased, much like a credit card. This type of M-commerce is currently being tested and implemented (on a very limited basis) in select countries in Europe and Asia already having advanced,

2.5G wireless networks. M-commerce can be considered an Information and/or an Organization type of service.

### **Push, Pull, and Location-Based Services**

Push and pull services are services that rely on the network's ability to locate subscribers. In 4G, it is envisioned that networks will be able to pinpoint the exact location of subscribers, both indoors and out. This ability will make it possible for value-added functionality to be offered by service providers.

Both push and pull services are further enhanced by user profiles. User profiles, established and updated by subscribers, assure that information to each user is truly customized. User profiles contain the subscriber's preferences (e.g., likes/dislikes, schedules, and formats) and permissions (i.e., who is allowed to know who and where they are). The user's profile would reside in a database maintained by the service provider.

The user profile will be used by the serving network to push services to subscribers. For example, if a user likes a particular type of food, the network will see the preference in the user's profile and will push information regarding restaurants that serve that type of food in the general locale of the user. Similarly, the user will be able request this same information from the network (pull) if he or she chooses not to have this information pushed to the wireless device.

The challenge with location-based services is not in the applications but in the implementation. For location services to be of any real value, the network must be able to determine the location of subscribers to a high degree of accuracy—perhaps to within a few feet. Current wireless networks do not have this capability. In today's networks, location can be determined by looking at the serving cells that are communicating with the user's handset. At best, this technique can be accurate to within a few city blocks,

not nearly the accuracy needed for 4G applications.

Current plans for 4G involve using Internet Protocol version 6 (IPv6) to route data packets to the handset. IPv6 has built-in location tracking that will enhance the network's ability to pinpoint a subscriber's location.

Some have proposed applying global positioning system (GPS) capabilities in handsets to help locate subscribers. GPS, however, would be helpful only to a minor extent. GPS relies on the ability its receiver to "see" multiple satellites orbiting the Earth. If the receiver has no access to the sky (i.e., it is indoors), no location information can be provided.

Aside from location, the network must be able to determine various other statistics. The network must be "aware" of the users' availability and capability. Privacy groups have already expressed concerns regarding network awareness. It is critical that service providers and users manage permissions closely in 4G networks.

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### **What About Public Safety?**

Can the public safety community benefit from these new and innovative applications planned for the wireless consumer? The answer is a definite "Yes". Many of the new applications and services can be directly applied to the public safety community. In fact, many seem to be made specifically to serve public safety.

Location-based services will be to very helpful and will likely have great

impact on the public safety community. Public safety users will be able to provide faster incident response because of the accuracy provided by the pinpoint identification of the physical location of users in the 4G environment. As described in the first installment in this series, Telegeoprocessing (a combination of Geographical Information Systems [GIS] and GPS working in concert over a high-capacity wireless mobile system) will make several public safety applications a reality. Among these applications are virtual navigation and telemedicine.

Another benefit to public safety that can be realized in the enhanced 4G environment is the ability to locate people in need of assistance. For example, if a user makes an emergency call from a wireless device and is unable to give an address or location to the emergency operator, the emergency operator can pinpoint the user's position via the wireless network's built-in functionality. This type of service will offer users peace of mind and will help the public safety community do its job more effectively.

A push-based service that would aid public safety is the ability for the network to send users information, such as the location of the nearest police precinct, whenever the subscriber's wireless device registers on a new system. Another service that may be of interest to public safety is the ability for the network to push information regarding incidents (either emergency or non-emergency, depending on the user's profile) in the area where the user is currently registered and located. This type of service may be very useful in situations where normal first responders cannot reach the incident as quickly as the user (e.g., in metropolitan areas where traffic gridlock impedes the first responders' ability to arrive on scene expeditiously, or a situation where an armed law enforcement officer, outside of his or her normal jurisdiction, could respond to a call for help more quickly than a "local" officer could respond).

Similarly, users may some day be able to request that these local emergency numbers be automatically programmed to speed dial buttons on their wireless device. This capability will likely require software-defined handsets that can be reprogrammed by the network. These software-defined devices will not only provide this functionality, but will also assure compatibility and interoperability on disparate network transmission technologies. With devices such as these, one device will be capable of seamlessly “roaming” and automatically operating on multiple networks.

## Conclusions

Applications and services for 4G are still being defined. The possibilities are limited only by the imaginations of the developers and the needs of the users. It is certain that the first 4G applications deployed will be geared to the mass consumer market. That does not mean that other entities will not immediately benefit from these applications. With a little ingenuity, even the most commercially oriented service can be adapted for specialized use.

*Postscript: The purpose of this article is to further educate the reader regarding advancements in the applications and services that will be a part of the next generations of wireless services. In upcoming articles, other developments in 4G (e.g., protocols, billing, and standards) and other emerging wireless technologies will be presented in greater depth.*

### References:

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