International Journal of Information Technology and Knowledge Management
July-December 2009, Volume 2, No. 2, pp. 411-414

NEXT GENERATION WIRELESS NETWORKS

Punam Bajaj[*], Geetanjali Babbar[*], Anu Chawla[**] & Monika Malhotra[***]

Next generation mobile networks, commonly referred to as 4G, and are envisaged as a multitude of heterogeneous systems interacting through a horizontal IP-centric architecture. Researchers and industry leaders are trying to contribute their ideas to the deployment of the yet-undefined 4G wireless world that is estimated to be operational around 2010. Although 4G is currently undefined there are many current opinions that outline the vision of the new wireless technologies. 4G must be dynamic and adaptable with built-in intelligence. Key challenges will be personalization, seamless access, quality of service, intelligent billing. Future wireless networks will need to support diverse IP multimedia applications to allow sharing of resources among multiple users. There must be a low complexity of implementation and an efficient means of negotiation between the end users and the wireless infrastructure. In this paper we have discussed challenges, Service & applications in next generation mobile network.

INTRODUCTION

The approaching 4G (fourth generation) mobile communication systems are projected to solve still-remaining problems of 3G (third generation) systems and to provide a wide variety of new services, from high-quality voice to high-definition video to high-data-rate wireless channels. The term 4G is used broadly to include several types of broadband wireless access communication systems, not only cellular telephone systems. One of the terms used to describe 4G is MAGIC—Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service. As a promise for the future, 4G systems, that is, cellular broadband wireless access systems have been attracting much interest in the mobile communication arena. The 4G systems not only will support the next generation of mobile service, but also will support the fixed wireless networks.

The future 4G infrastructures will consist of a set of various networks using IP (Internet protocol) as a common protocol so that users are in control because they will be able to choose every application and environment. Based on the developing trends of mobile communication, 4G will have broader bandwidth, higher data rate, and smoother and quicker handoff and will focus on ensuring seamless service across a multitude of wireless systems and networks. The key concept is integrating the 4G capabilities with all of the existing mobile technologies through advanced technologies. Application adaptability and being highly dynamic are the main features of 4G services of interest to users. These features mean services can be delivered and be available to the personal preference of different users and support the users' traffic, air interfaces, radio, environment, and quality of service. Connection with the network applications can be transferred into various forms and levels correctly and efficiently. The dominant methods of access to this pool of information will be the mobile telephone, PDA, and laptop to seamlessly access the voice communication, high-speed information services, and entertainment broadcast services. Figure 1 illustrates elements and techniques to support the adaptability of the 4G domain. The fourth generation will encompass all systems from various networks, public to private; operator-driven broadband networks to personal areas; and ad hoc networks. The 4G systems will interoperate with 2G and 3G systems, as well as with digital (broadband) broadcasting systems. In addition, 4G systems will be fully IP-based wireless Internet.

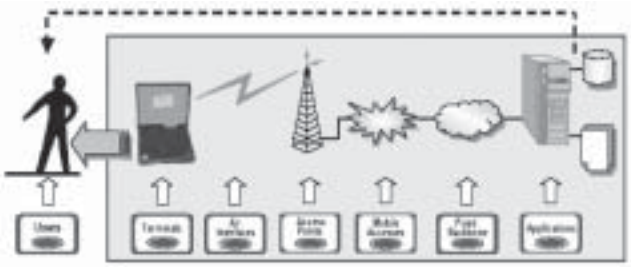

Figure 1

This all-encompassing integrated perspective shows the broad range of systems that the fourth generation intends to integrate, from satellite broadband to high altitude platform to cellular 3G and 3G systems to WLL (wireless local loop) and FWA (fixed wireless access) to WLAN (wireless local area network) and PAN (personal area network), all with IP as the integrating mechanism. With

[*] Chandigarh Engineering College, Landran
E-mail: bajaj_punam@yahoo.com
E-mail: ergeetanjalibabbar@yahoo.co.in

[**] Govt. College of Girls, Chandigarh.
E-mail: annu_khurana@yahoo.com

[***] IT Group of Institute, Banur. *E-mail: chadha.monika@gmail.com*

4G, a range of new services and models will be available. These services and models need to be further examined for their interface with the design of 4G systems. Figures 2 and 3 demonstrate the key elements and the seamless connectivity of the networks

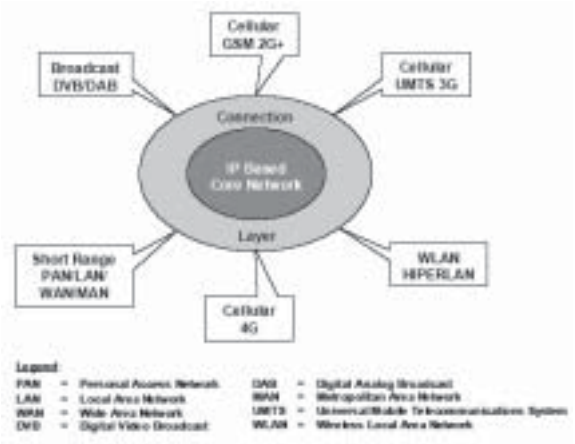

Figure 2

Figure 3

KEY CHALLENGES FOR 4G

A layered structure for 4G is proposed. The five layers are the distributed, cellular, hot spot, personal network and fixed layer. The supported mobility and covered cell size increase from the fixed layer to the distributed layer. Interworking will be required between different access systems in terms of intra-system and inter-system handover as well as seamless services of mobility, security and quality of service. The 3G to 4G transition is towards a predominance of automated and autonomously initiated machine-to-machine interactions. 4G must be dynamic and adaptable with built-in intelligence. Key challenges will be personalisation, seamless access, quality of service, intelligent billing.

1. Personalisation

In summary the following requirements characterize a "personalization architecture": support of personal context-user profiling, context awareness; seamless service provisioning-advanced signaling and session control, AAA (authentication, authorization, accounting); open third party access (e.g., web services); adaptability (on all levels)-content, communication (protocols), service logic; reconfigurable terminals-new strategies for pervasive/ ubiquitous computing; programmable open platforms.

2. Seamless Access

Seamless access in 4G will go much beyond the roaming as we know it today and will be a much more sophisticated affair. Seamless Access in 4G will mean connectivity to the end user across a wide range of access technologies and access networks with minimal input from the user. The following requirements characterize "seamless access": seamless network integration based on IP; terminal mobility, personal mobility, service mobility, session mobility; new 4G wireless technologies should be IP-centric; dynamic resource allocation at all network/system levels; adaptability/ programmability of network components; secure but simple service agreements; SIM-card like universal authentication.

3. Quality of Service

4G service quality will be the collective effect of the performance of all system elements in combination with the user expectations, which determines the degree of satisfaction of the 4G customer. The operator's perspective is characterized by the customer service requirements, the customer perception of QoS, the offered QoS, and the QoS actually delivered. QoS modeling and QoS signaling would be crucial factors for a future 4G system that integrates heterogeneous network types.

4. Intelligent Billing

User related requirements include: QoS dependent charging billing support to diverse access; support to real time billing information; support to interworking of prepaid systems; support to "per-call" service situations. Operator related requirements include: billing support to IP traffic; flexibility of costs calculations (time, volume, QoS dependent, access dependent); distribution of revenue by value chain operators; customer relationship management; reliability of billing operations; instant fraud detection and cut-off.

GENERAL SERVICES & APPLICATIONS

1. 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 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.

2. 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.

CONCLUSION

This paper is in first place an overview of the issues regarding the next generation wireless networks, the so-called 4G networks, focusing on features & challenges in 4G. Starting from user scenarios, we have extrapolated a new framework—the "user-centric" System—that illustrates the key features of 4G: user friendliness, user personalization, terminal heterogeneity, and network heterogeneity. As a consequence, our definition is as follows: 4G will be a convergence platform providing clear advantages in terms of coverage, bandwidth, and power consumption. Moreover, it will offer a variety of new heterogeneous services, from pop-up advertisements to location based and IP data-casting ones. All these characteristics will be supported by multimode/ reconfigurable devices and the implementation of interworking ones.

REFERENCES

[1] E. Bohlin *et al.*, "The Future of Mobile Communications in the EU: Assessing the Potential of 4G," *ESTO Pub.*, (2004).

[2] F. Bauer *et al.*, "Synthesis Report on Worldwide Research on *4G Systems*," Del. D7.1 1ST MATRICE, (2003), available at *http://istmatrice.org.*

[3] J. M. Pereira, "Fourth Generation: Now, It Is Personal," *Proc. IEEE PIMRC*, **2** (2000) 1009–16.

[4] B. Shneiderman, *Leonardo's Laptop—Human Needs and the New Computing Technologies*, MIT Press, (2002).

[5] L. Zhen *et al.*, "Consideration and Research Issues for the Future Generation of Mobile Communication," *Proc. IEEE CCECE*, **3** (2002) 1276–81.

[6] S. Y. Hui and K. H. Yeung, "Challenges in the Migration to 4G Mobile Systems," *IEEE Commun. Mag.*, **41**(12) (2003) 54–59.

[7] "Visions of the Wireless World Beyond the Third Generation", *Proc. IEEE Int. Conf. on Telecommunications (ICT 2001)*, **1** (Bucharest, Romania) (2001) 9-14.