4G :– A New Level of Connectivity in Mobile Communication

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Abstract—With the rapid development of communication networks, it is expected that fourth generation mobile systems will be launched within decades. Fourth generation (4G) mobile systems focus on seamlessly integrating the existing wireless technologies including GSM, wireless LAN, and Bluetooth. This contrasts with third generation (3G), which merely focuses on developing new standards and hardware. 4G systems will support comprehensive and personalized services providing stable system performance and quality service. This paper gives the details about the need for mobile communication and its development in various generations. In addition, the details about the working of 4G mobile communication were given. Finally, it narrates how 4G mobile communication will bring a new level of connectivity and convenece in communication.

Index Terms— 4G,Communication,Connectivity, GSM ,Internet, IP,Mobile Communication,Mobility, Network ,Security.

1 INTRODUCTION

COMMUNICATION is one of the important areas of electronics and always been a focus for exchange of information among parties at locations physically apart. There may be different mode of communication. The communication may be wired or wireless between two links. Initially the mobile communication was limited to between one pair of users on single channel pair. Mobile communication has undergone many generations. The first generation of the RF cellular used analog technology. The modulation was FM and the air interface was FDMA. Second generation was an offshoot of Personal Land Mobile Telephone System (PLMTS). It used Gaussian Shift Keying modulation (GMSK). All these systems had practically no technology in common and frequency bands, air interface protocol, data rates, number of channels and modulation techniques all were difficult. Dynamic Quality of Service (QoS) parameter was always on the top priority list. Higher transmission bandwidth and higher efficiency usage had to be targeted. On this background development of 3G mobile communication systems took place. In this Time Division Duplex (TDD) mode technology using 5MHz channels was used. This had no backward compatibility with any of the predecessors. But 3G appeared to be somewhat unstable technology due to lack of standardization, licensing procedures and terminal and service compatibility. Biggest single inhibitor of any new technology in mobile communication is the mobile terminal availability in the required quantity, with highest QoS and better battery life. The future of mobile communication is FAMOUS-FUTUERE Advanced Mobile Universal Systems, Wide-band TDMA, Wideband CDMA are some of the technologies. The data rates targeted are 20MBPS. That will be the 4G in the mobile communication. 4G must be hastened, as some of the video applications cannot be contained within 3G.

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2 DEVELOPMENT OF THE MOBILE COMMUNICATION

The communication industry is undergoing cost saving programs reflected by slowdown in the upgrade or overhaul of the infrastructure, while looking for new ways to provide third generation (3G) like services and features with the existing infrastructures. This has delayed the large-scale development of 3G networks, and given rise to talk of 4G technologies. Second generation (2G) mobile systems were very successful in the previous decade. Their success prompted the development of third generation (3G) mobile systems. While 2G systems such as GSM, andIS-95 etc. were designed to carry speech and low bit-rate data. 3G systems were designed to provide higher data-rate services. During the evolution from 2G to3G, a range of wireless systems, including GPRS, IMT-2000, Bluetooth, WLAN, and Hiper LAN have been developed. All these systems were designed independently, targeting different service types, data rates, and users. As these systems all have their own merits and shortcomings, there is no single system that is good to replace all the other technologies. Instead of putting into developing new radio interface and technologies for 4G systems, it is believed in establishing 4G systems is a more feasible option.

3 ARCHITECTURAL CHANGES IN 4G TECHNOLOGY

In 4G architecture, focus is on the aspect that multiple networks are able to function in such a way that interfaces are

transparent to users and services. Multiplicities of access and service options are going to be other key parts of the paradigm shift. In the present scenario and with the growing popularity of Internet, a shift is needed to switch over from circuit switched mode to packet switched mode of transmission. However 3G networks and few others, packet switching is employed for delay insensitive data transmission services. Assigning packets to virtual channels and then multiple physical channels would be possible when access options are expanded permitting better statistical multiplexing. One would be looking for universal access and ultra connectivity, which could be enabled by:

(a) Wireless networks and with wire line networks.

(b) Emergence of a true IP over the air technology.

(c) Highly efficient use of wireless spectrum and resources.

(d) Flexible and adaptive systems and networks.

4 SOME KEY FEATURES OF 4G TECHNOLOGY

Some key features (mainly from the users point of view) of 4G networks are:

1. High usability: anytime, anywhere, and with any technology.

2. Support for multimedia services at low transmission cost.

3. Personalization.

4. Integrated services.

First, 4G networks are all IP based heterogeneous networks that allow users to use any system at any time and anywhere. Users carrying an integrated terminal can use a wide range of applications provided by multiple wireless networks.

Second, 4G systems provide not only telecommunications services, but also data and multimedia services. To support multimedia services high data-rate services with good system reliability will be provided. At the same time, a low per-bit transmission cost will be maintained.

Third, personalized service will be provided by the new generation network.

Finally, 4G systems also provide facilities for integrated services. Users can use multiple services from any service provider at the same time.

To migrate current systems to 4G with the features mentioned above, we have to face number challenges. Some of them were discussed below.

4.1 MULTIMODE USER TERMINALS

In order to use large variety of services and wireless networks in 4G systems, multimode user terminals are essential as they can adopt different wireless networks by reconfiguring themselves. This eliminates the need to use multiple terminals (or multiple hardware components in a terminal). The most promising way of implementing multimode user terminals is to adopt the software radio approach. Figure.1 shows the design of an ideal software radio receiver.

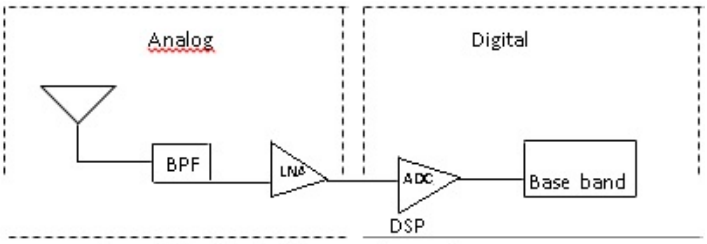

Figure.1: An ideal software radio receiver

The analog part of the receiver consists of an antenna, a band pass filter (BPF), and a low noise amplifier (LNA). The received analog signal is digitized by the analog to digital converter (ADC) immediately after the analog processing. The processing in the next stage (usually still analog processing in the conventional terminals) is then performed by a reprogrammable base band digital signal processor (DSP). The Digital Signal Processor will process the digitized signal in accordance with the wireless environment.

4.2 TERMINAL MOBILITY

In order to provide wireless services at any time and anywhere, terminal mobility is a must in 4G infrastructures, terminal mobility allows mobile client to roam across boundaries of wireless networks. There are two main issues in terminal mobility: location management and handoff management. With the location management, the system tracks and locates a mobile terminal for possible connection. Location management involves handling all the information about the roaming terminals, such as original and current located cells, authentication information, and Quality of Service (QoS) capabilities. On the other hand, handoff management maintains ongoing communications when the terminal roams. MobileIPv6 (MIPv6) is a standardized IP-based mobility protocol for Ipv6 wireless systems. In this design, each terminal has an IPv6 home address whenever the terminal moves outside the local network, the home address becomes invalid, and the terminal obtain a new Ipv6 address (called a care-of address) in the

visited network. A binding between the terminal's home address and care-of address is updated to its home agent inorder to support continuous communication.

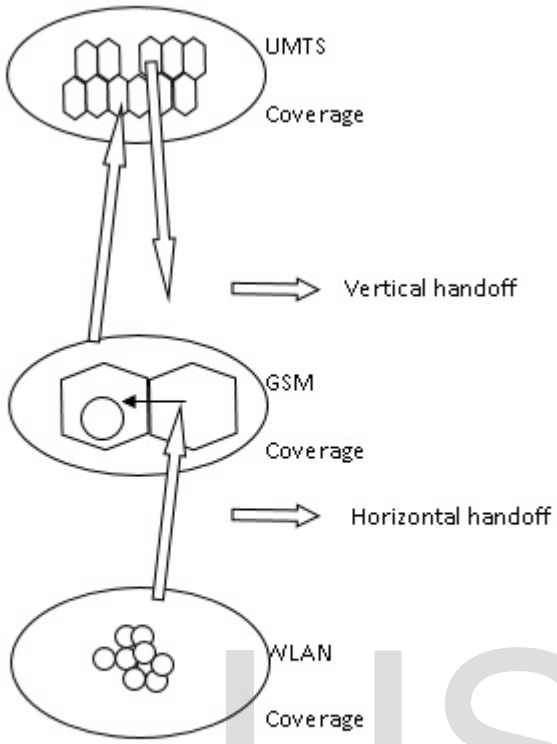

Figure.2: Vertical and Horizontal handoff of a mobile terminal

Figure.2 shows an example of horizontal and vertical handoff. Horizontal handoff is performed when the terminal moves from one cell to another cell within the same wireless system. Vertical handoff, however, handles the terminal movement in two different wireless systems (e.g, from WLAN to GSM).

4.3 PERSONAL MOBILITY

In addition to terminal mobility, personal mobility is a concern mobility management. Personal mobility concentrates on the movement of users instead of user's terminals, and involves the provision of personal communications and personalized operating environments.

A personal operating environment, on the other hand, is a service that enables adaptable service presentations inorder to fit the capabilities of the terminal in use regardless of network types. Currently, There are several frame works on personal mobility found in the literature. Mobile-agent-based infrastructure is one widely studied solution. In this infrastructure, each user is usually assigned a unique identifier and served by some personal mobile agents (or specialized computer programs running on same servers. These agents acts as intermediaries between the user and the Internet. A user also belongs to a home network that has servers with the updated user profile (including the current location of the user's agents, user's performances, and currently used device descriptions). When the user moves from his/her home network to a visiting network, his/her agents will migrate to the new network. For example, when somebody makes a call request to the user, the caller's agent first locates user's agent by making a location request to user's home network. By looking up user's profile, his/her home network sends back the location of user's agent to the caller's agent. Once the caller's agent identifies user's location, the caller's agent can directly communicate with user's agent. Different agents may be used for different services.

4.4 SECURITY AND PRIVACY

Security requirements of 2G and 3G networks have been widely studied in the literature. Different standards implement their security for their unique security requirements. For

For example, GSM provides highly secured voice communication among users. However, the existing security schemes for wireless systems are inadequate for 4G networks. The key concern in security designs for 4G networks is flexibility. As the existing security schemes are mainly designed for specific services, such as voice service, they may not be applicable to 4G environments that will consist of many heterogeneous systems. Moreover, the key sizes and encryption and decryption algorithms of existing schemes are also fixed. They become inflexible when applied to different technologies and devices (with varied capabilities, processing powers, and security needs). As an example, Tiny SESAME is a lightweight reconfigurable security mechanism that provides security services for multimode or IP-based applications in 4G networks.

5 CONCLUSIONS

The future of mobile communication is FAMOUS-Future Advanced Mobile Universal Systems. The data rates targeted are 20 MBPS. That will be the FOURTH GENERATION 4G in the mobile communication technology. 4G must be hastened, as some of the video applications cannot be contained within 3G.This paper highlights that current systems must be implemented with a view of facilitate to seamless integration into 4G infrastructure. Inorder to cope with the heterogeneity of network services and standards, intelligence close to end system is required to map the user application requests onto network services that are currently available. This requirement for horizontal communication between different access technologies has been regarded as a key element for 4G systems. Finally, this paper describes how 4G mobile communication can be used in any situation where an intelligent solution is required for interconnection of different clients to networked applications aver heterogeneous wireless networks.

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