

Chapter 28

Design Issues of 4G–Network Mobility Management

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ABSTRACT

Fourth Generation wireless networking (4G network) is expected to provide global roaming across different types of wireless and mobile networks. In this environment, roaming is seamless and users are always connected to the best network. Moreover, 4G networks will be packet switched systems entirely based on the IPv6 protocol. The essentiality of Quality of Service (QoS) and the heterogeneous nature of 4G pose high demands onto the mobility management technology. Due to this, one of the most challenging research areas for the 4G network is the design of intelligent mobility management techniques that take advantage of IP-based technologies to achieve global roaming among various access technologies. In order to address the issue of heterogeneity of the networks, IEEE 802.21 working group proposed Media Independent Handover (MIH). The scope of the IEEE 802.21 MIH standard is to develop a specification that provides link layer intelligence and other related network information to upper layers to optimize handovers between heterogeneous media. The IEEE 802.21 group defines the media independent handover function that will help mobile devices to roam across heterogeneous networks and stationary devices to switch over to any of the available heterogeneous networks around it.

INTRODUCTION

The explosive growth of the Internet and the increasing demand for all sorts of IP-based services like voice & data, multimedia has led the wireless industry to evolve its core network towards the IP technology. It is expected that in future, IP connectivity will penetrate the access network as well,

resulting in an all-IP network concept (Akan, & Edemen, September 2010). A 4G system is expected to provide a comprehensive and secure all-IP based solution where users are allowed to roam between different types of access networks. The International Telecommunications Union (ITU) has specified that the peak speed requirements for the 4G standard are to be 100Mbps for a mobile

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connection and 1Gbps for stationary connections (Akyildiz, Gutierrez-Estevez, & Reyes, 2010).

The future 4G infrastructures will consist of a set of various networks using IP as a common protocol. It will have broader bandwidth, higher data rate, and smoother and quicker handoff. The focus of 4G will be ensuring seamless service across a multitude of wireless systems and networks such as cellular networks, WiFi, WiMAX, satellite, Digital Video Broadcasting - Handheld (DVB-H) (Cerqueira, Zeadally, Leszczuk, Curado & Mauthe, 2011). After successful implementation, 4G - technology is likely to enable ubiquitous computing, that will simultaneously connects to numerous high data speed networks offers faultless handoffs all over the geographical regions.

4G will be a convergence platform providing clear advantages in terms of coverage, bandwidth and power consumption. 4G services will be end-to-end QoS (Belhouli, 2007), high security (Aiyash, Mapp, Lasebae, & Phan, May 2010), available at anytime, anywhere with seamless mobility, affordable cost, one billing, and fully personalized. It is about convergence, convergence of networks, of technologies, of applications and of services, to offer a personalized and pervasive network to the users. The 4G network will be an umbrella of multitude of technologies. The glue is likely to be seamless mobility over heterogeneous wireless networks.

4G network systems require higher reliability and high spectral efficiency. To achieve this Orthogonal Frequency Division Multiplexing (OFDM) is considered to be the best modulation technique for 4G- networks (John, October 2011). OFDM can provide large data rates with sufficient robustness to radio channel impairments. Orthogonal FDM's spread spectrum technique spreads the data over a lot of carriers that are spaced apart at precise frequencies. This spacing provides the "orthogonality", which prevents the receivers/demodulators from seeing frequencies other than their own specific one. The main benefit of OFDM is high spectral efficiency. 4G networks will also

use smart antenna technology, which is used to aim the radio signal in the direction of the receiver in the terminal from the base station. When teamed up with adaptive techniques, multiple antennas can cancel out more interference while enhancing the signal.

Although 4G wireless technology offers higher data rates and the ability to roam across multiple heterogeneous wireless networks, several issues require further research and development. Since 4G is still in the cloud of the sensible standards creation, ITU and IEEE form several task forces to work on the possible completion for the 4G mobile standards as well. 3GPP LTE (Bai et al., 2012) is an evolution standard from UMTS, and WiMAX is another candidate from IEEE. These technologies have different characteristics and try to meet 4G characteristics to become a leading technology in the future market. The advantage of 4G wireless systems has created many research opportunities. The expectations from 4G are high in terms of data rates, spectral efficiency, mobility and integration. Figure 1 gives the scenario of 4G network.

KEY COMPONENTS OF 4G NETWORK

The key components of 4G Network are access scheme, Mobile IPv6, Multi-Antenna Systems, Software Defined Radio (SDR). The brief overview of key components is given below.

Access Schemes

As the wireless standards evolved, the access techniques used also exhibited increase in efficiency, capacity and scalability. There are various numbers of multiple access techniques which are proposed for 4G system named as Direct Spread-Code Division Multiple Access (DS-CDMA), Multicarrier-CDMA (MC-CDMA), Orthogonal FDMA (OFDMA), Interleave Division Multiple

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