Chapter 1
Evolution of Wireless and Mobile Communications

M. A. Matin
Institut Teknologi Brunei, Brunei Darussalam

ABSTRACT
There has been a tremendous growth of mobile communications markets all over the world, as they provide ubiquitous communication access to citizens. Wireless technologies are the core of mobile communications. They fundamentally revolutionize data networking, telecommunication, and make integrated networks to increase capacity and coverage. This has made the network portable because of affordable digital modulation, adaptive modulation, information compression, wireless access, multiplexing, and so on. It supports exciting applications such as sensor networks, smart homes, telemedicine, video conferencing and distance learning, cognitive radio networks, automation, and so on. This chapter provides an overview of the evolution of wireless and mobile communications from 2G to 4G.

1. INTRODUCTION
The world is undergoing a major wireless revolution both in terms of wireless and mobile technology that provides ubiquitous communication access to citizens (Matin, 2012). The rapid worldwide growth of cellular communication is based on the second-generation (2G) Global System for Mobile Communications (GSM) standard which uses generalized minimum shift keying modulation, block coding, and time-division multiple access (TDMA) to achieve circuit switched bit rates 16 kb/s, and packet data rates 100 kb/s (GSM, 1998). The 2G mobile communications support new or extended services, as well as consumer needs and technology advances in access, and network areas. The other 2G U.S. digital cellular standard known as code-division multiple access (CDMA) developed by Qualcomm, Inc. and standardized

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by the Telecommunications Industry Association (TIA) as an Interim Standard (IS-95), uses spread spectrum modulation, convolutional coding, and CDMA to achieve roughly similar bit rates as GSM (CDMA Cellular Standard). The IS-95 can support up to 64 users that are orthogonally coded and simultaneously transmitted on each 1.25 MHz channel. New data-centric standards have been developed to superimpose on existing 2G technologies to provide high data rate transmission that are required to support modern Internet applications. These new standards represent 2.5G and allow existing 2G equipment to be modified and enhanced with new base station software upgrades to support higher data rate transmissions for Web browsing, email traffic, mobile commerce and location based mobile services. Both GSM and CDMA migrated to the “3G” standards called wideband CDMA known as the Universal Mobile Telecommunication System (UMTS) in Europe and CDMA-2000 in the United States. The most important changing step of GSM towards UMTS is GPRS. GPRS introduces Packet Switching into the GSM core network and allows direct access to packet data networks. This enables packet data transmission well ahead of 64 kbit/s limit of integrated service digital network (ISDN) through the GSM core network. GPRS prepares and optimizes the core network for high data rate packet switching transmission, as UMTS does with UTRAN over the RAN. Thus, GPRS is a precondition for the UMTS introduction. These 3G standards use wideband spread spectrum, adaptive modulation, convolutional coding, and CDMA to achieve this peak service bit rates of up to 2 Mb/s (ITU, 2009). Cellular networks are growing fast from their telecom roots to become more Internet protocol (IP)-based network as in Fourth generation (4G). 4G has started around 2005 which enables a wide range of services including computing and multimedia applications ranging from navigation to mobile video streaming. The emergence of such technologies and the increasing growth of subscriber demand have triggered the researcher and industries to move on to the 4G network and it is expected that 4G will further converge into the future mobile Internet protocols over the next decade.

2. WIRELESS TECHNOLOGIES

Wireless technologies have been a crucial part of communication in the last few decades which enables multimedia communications between people and devices which is far apart from each other. It brings fundamental revolutionizes to data networking, telecommunication, and makes integrated networks. Wireless technologies have made the network portable because of digital modulation, adaptive modulation, information compression, wireless access and multiplexing. It supports exciting applications such as sensor networks, smart homes, telemedicine, and automation. The early wireless technology is primarily used in the military, emergency services, and law enforcement organizations. As the society moves forward to the information centrality, the need to have information accessible at anytime and anywhere takes on a new dimension. With the rapid growth of mobile telephony and networks, the vision of a mobile information society (introduced by Nokia) is slowly becoming a reality. It is common to see people are communicating with each other via their mobile phones and devices. With today’s networks and coverage, it is possible for a user to have connectivity almost everywhere. The growth in commercial wireless networks occurred primarily in the late 1980s and 1990s.

Figure 1 shows a summary roadmap for wireless technology (Raychaudhuri & Mandayam, 2012), identifying some revolution during the period 2000–2010. The diagram is structured into four levels: radio hardware platforms, wireless physical layer technologies, network protocols and software, and mobile systems/applications. In the hardware platform level, it is observed that there has been a proliferation of new radio