

# Chapter 1

## Introduction to Mobile and Wireless Communications Networks

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### ABSTRACT

*Wireless communication networks offer transmission of signals, such as voice, data, and multimedia, without using wires, which is the crucial part of mobile communications. After successful deployment of wireless cellular networks in licensed bands and Wi-Fi networks in unlicensed bands, such as Industry, Scientific, and Medical (ISM) and Unlicensed National Information Infrastructure (UNII), over the last decade, several wireless networks, application, and services are emerging. Furthermore, wireless networks offer several advantages including mobility while getting service, scalability for further extension, reduced cost-of-ownership, and so on. However, there are some disadvantages and concerns, such as security, data rate, reliability, range, etc. The demand of ubiquitous communications is driving the development of wireless and mobile networks. Wireless communication is the fastest growing segment of the communication industry. This chapter provides the fundamentals of wireless and mobile networks and their advantages and disadvantages.*

### INTRODUCTION

Wireless communications is the fastest growing segment of the communication industry. Wireless technologies and applications have been widely deployed in various areas. Generally, wireless

networks are categorized into two different types based on the structure of the networks: Infrastructure-based wireless networks and infrastructure less wireless networks.

Wireless network where wireless devices communicate with each other through centralized infra-

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structure such as base station in cellular network and access point in Wi-Fi networks is known as infrastructure-based wireless network. In this type of network, generally, centralized infrastructure is fixed and wireless users are mobile. Mobile users connect to fixed equipment through wireless links and can move anywhere within a coverage area of a basestation or access point. Mobile users can also move from one basestation's coverage area to another by using handover features.

Wireless devices communicate with each other without using any centralized infrastructure forming a network called infrastructure-less network. This type of network is also known as wireless ad hoc network or peer-to-peer network and all users could move forming true mobile communications. The network topology of wireless ad hoc network is dynamic and changes constantly.

Both infrastructure and infrastructure-less wireless network can transmit voice, data or multimedia without using wires such as in cellular network, Wi-Fi with VoIP, etc. Wireless communication networks are popular because of several advantages such as mobility and convenience, cost efficiency, and ease of integration with other networks and network components, ease of expansion.

## **WIRELESS COMMUNICATION NETWORKS**

Wireless networks are further classified as wireless personal area network, wireless local area network, wireless metropolitan network and wireless wide area network.

### **Wireless Personal Area Network (WPAN)**

Wireless network for interconnecting wireless devices centered around an individual person's workspace using ISM bands is known as wireless

personal area network. Examples of WPAN are Bluetooth, Z-Wave, ZigBee, UWB and Body Area Network. WPAN devices follow IEEE 802.15 standard.

### **Bluetooth**

In Bluetooth networks, wireless users use a pairing or association process to establish encryption and authentication between two devices. The association process takes 1 to 4 seconds. Bluetooth was standardized as IEEE 802.15.1. Bluetooth provides theoretical data transfer speeds of up to 24 Mbit/s. Bluetooth devices form a master slave like structure while pairing and use 48-bit hardware address of a master, shared 128-bit random number, and a user-specified PIN of up to 128 bits. It is assumed that the Bluetooth network is secured; unfortunately it is possible to break the Bluetooth network [Shaked, Y., & Wool, A., 2005] by sniffing the packet or exploiting vendor specific flaws such as default setting of allowing any pairing. To protect Bluetooth devices, users need to change default setting and choose strong PINs.

### **ZigBee**

ZigBee network operates in the ISM bands and its data transmission rates vary from 20 to 900 kb/s. Two devices take about 30 milliseconds to get associated. IEEE 802.15.4 standard defines the characteristics of ZigBee devices. To provide network security, ZigBee runs in two different security modes: Residential mode and Commercial mode. In residential mode, all users use pre-deployed key for the entire PAN and for all applications. Residential mode security protects the PAN from external eavesdroppers; however it does not provide the security from the user within the same PAN. In Commercial mode, the coordinator node in a trust center is used to pre-share the two master keys that provide extra security on top of residential mode. This method

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