

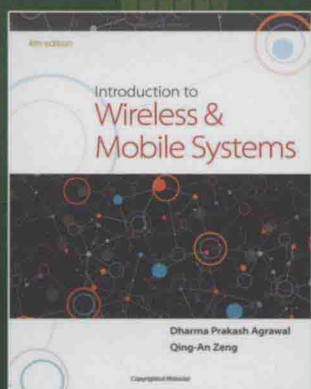
国外电子与通信教材系列

英文版

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无线移动通信系统 (第四版)

Introduction to Wireless and Mobile Systems
Fourth Edition



[美] Dharma Prakash Agrawal 著
Qing-An Zeng (曾庆安)

谭明新 改编

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内 容 简 介

本书系统、全面地介绍了无线移动通信的基本理论,分析了无线移动通信所涉及的各个主题,包括无线移动信号的传输、蜂窝的基本概念、多路无线接入、多址技术、调制技术、信道分配技术、通信系统的设计、网络协议、现有的蜂窝系统、IEEE 802系列技术、Ad Hoc网络与传感器网络、无线网络的安全性与隐私问题、卫星通信系统等。为了加强对书中概念的理解,各章还给出了开拓思维的实验。

本书可以作为高等院校通信工程、电信工程等电子信息类专业的移动通信、无线通信的双语课程教材,也可以作为相关工程技术人员的参考用书。

Dharma Prakash Agrawal, Qing-An Zeng
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击鼓传信是最早、最方便的通信方式，非洲人用圆木特制的大鼓所发出的声音可以传3~4公里远，再通过“鼓声接力”和专门的“击鼓语言”，可以在很短的时间内把消息准确地传送到50公里以外的另一个部落。这时利用了无线通信的如下基本原理：①信号的频率越低，衰减越小；②无线信号的中继与无失真传输；③通信信令；④无线传输存在明显的时延。电子通信出现以来，一直占据主导地位的有线通信如今部分被无线移动通信取代的根本原因是：在寻常百姓完全能够支付通信费用的条件下，无线移动通信基本实现了在“任何时候”可以与“任何地方”的“任何人”进行可靠的通信。换言之，与有线通信相比，移动通信更简便、快捷。

移动通信的本质特征是：双方进行通信时，至少有一方（或者双方）可以处于移动中。这时，通信过程中的两个核心问题即带宽问题和噪声问题尤其突出，体现在：①在有限范围内，采用的频率资源为一次性资源；②无线多径传输导致接收端的载噪比迅速下降。1G至4G的历次演变都大大提高了这两项指标。如今即将面临的5G如何持续提高这两项指标，拭目以待。

国内移动通信方面的教材所涉及的技术仅限于1G至3G系统与技术的完整介绍，引进版教材也至少是8~9年前出版的。可近些年来，无线移动通信的概念与范围进行了延伸，多项无线技术进入了或者正在进入商业应用，而国内却没有相关背景与知识的图书。电子工业出版社引进的*Introduction to Wireless and Mobile Systems, Fourth Edition*正好弥补了这一缺憾。该书在介绍常规无线移动通信（包括无线信道的传输特性、信道分配、多址技术、现有的无线系统）的基础上，还具有如下特点：

- 与日益增长的应用相适应，增添了IEEE 802.11技术与接入点、自组织网络、传感器网络、安全性与隐私等的完整介绍，且各自独立成章。本书以较大的篇幅介绍了这些新技术的基本原理与应用实例。
- 目前在国内，无线通信课程的实验器材基本上都是实验箱，完成简单的连接关系后接通电源即可观测到无线通信过程的基本指标，学生总像是局外人。与传统实验不同的是，本书每章给出的实验灵活多样，学生需要通过自己设计、编程、搭建模块等方式，才能观测到无线通信过程的各种现象与结果，这里的关键是，学生本人是实验的设计者、组织者和执行者。
- 本书每章增加了开放性项目，让学生自己开发解决问题的途径，其中有些问题是领域内悬而未决的问题。因此，只有几行字的开放性项目有可能激发学生的研究兴趣。

- 书中还介绍了通信问题（如原子钟）的基本知识、一些较新的观点与应用（如无线对讲机正在融入无线通信网）等。

考虑到国内读者的阅读习惯，为了让学生抓住重点，并有针对性地提高，本英文改编版删除了原著的部分章节，删除的内容如下：①第2章“概率、统计与话务理论”；②第4章“信道编码与差错控制”；③第14章“传感器网络”的部分内容；④第17章“卫星系统”的部分内容；⑤第18章“无线技术的最新进展”；⑥附录之爱尔兰B表、附录之索引。

删除正文中②③的原因是读者已经系统地学习过这两门课程；保留了④⑤传感器网络、卫星系统的最基本的内容，从事这类工作的读者可以参考更专业、更全面的文献。

本书的中文版为英文原版的完整翻译，没有删除任何内容。感兴趣的读者可参考中文版。

本书的教辅包括习题解答和PPT，采用本书作为教材的教师可通过邮箱te_service@phei.com.cn申请获得。


于武汉



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Introduction

1.1 History of Cellular Systems

Long-distance communication began with the introduction of telegraphs and simple coded pulses, which were used to transmit short messages. Since then, numerous advances have rendered reliable transfer of information both easier and quicker. There is a long history of how the field has evolved and how telephony has introduced a convenient way of conversing by transmitting audio signals. Hardware connections and electronic switches have made transfer of digital data feasible. The use of the Internet has added another dimension to the wireline communication field, and both voice and data are being processed extensively. In parallel to wireline communication, radio transmission has progressed substantially. Feasibility of wireless transmission has brought drastic changes in the way people live and communicate. New innovations in radio communication have brought about the use of this technology in new application areas [1.1]. A chronological evolution of radio communication is given in Table 1.1, with specific events that occurred in different years clearly marked [1.2]. Table 1.2 lists how, for different applications, radio frequency (RF) bands have been allocated [1.3].

Wireless systems have been around for quite some time, and their obvious use in garage-door openers and cordless telephones had gone unnoticed until recently. The introduction of affordably priced wireless telephones has made them attractive for the general population. Their main usefulness is their capability to maintain the same contact number even if the user moves from one location to another, and this is illustrated in Figure 1.1. Wireless systems have evolved over time, and the chronological development of first-generation (1G) and second-generation (2G) cellular systems (known as mobile systems outside North America) is given in Tables 1.3 and 1.4, respectively.

The first-generation wireless systems were primarily developed for voice communication using frequency division multiplexing. To have efficient use of communication channels, time division multiplexing was used in the second-generation systems so that data could be also processed. The third-generation systems evolved due to the need for transmitting integrated voice, data, and multimedia traffic. The channel capacity is still limited, and attempts are being made to compress the amount of information without compromising the quality of received signals.

TABLE 1.1 History and Start (continued on next page)

Based on Mobile Communications Engineering: Theory and Applications by Lee, McGraw-Hill, 1997.

Year	Event and Characteristics
1860	Maxwell's equation relating electric and magnetic fields
1880	Hertz—Initial demonstration of practical radio communication
1897	Marconi—Radio transmission to a tugboat over an 18-mile path
1921	Detroit Police Department—Police car radio dispatch (2 MHz frequency band)
1933	FCC (Federal Communications Commission)—Authorized four channels in the 30 to 40 MHz range
1938	FCC—Ruled for regular service
1946	Bell Telephone Laboratories—152 MHz (simplex)
1956	FCC—450 MHz (simplex)
1959	Bell Telephone Laboratories—Suggested 32 MHz band for high-capacity mobile radio communication
1964	FCC—152 MHz (full duplex)
1964	Bell Telephone Laboratories—Active research at 800 MHz
1969	FCC—450 MHz (full duplex)
1974	FCC—40 MHz bandwidth allocation in the 800 to 900 MHz range
1981	FCC—Release of cellular land mobile phone service in the 40 MHz bandwidth in the 800 to 900 MHz range for commercial operation
1981	AT&T and RCC (Radio Common Carrier) reach an agreement to split 40 MHz spectrum into two 20 MHz bands. Band A belongs to nonwireline operators (RCC), and band B belongs to wireline operators (telephone companies). Each market has two operators
1982	AT&T is divested, and seven RBOCs (Regional Bell Operating Companies) are formed to manage the cellular operations
1982	MFJ (Modified Final Judgment) is issued by the U.S. Department of Justice. All the operators were prohibited to (1) operate long-distance business, (2) provide information services, and (3) do manufacturing business
1983	Ameritech system in operation in Chicago
1984	Most RBOC markets in operation
1986	FCC allocates 5 MHz in extended band
1987	FCC makes lottery on the small metropolitan service area and all rural service area licenses
1988	TDMA (Time Division Multiple Access) voted as a digital cellular standard in North America
1992	GSM (Global System for Mobile Communications) operable in Germany D2 system
1993	CDMA (Code Division Multiple Access) voted as another digital cellular standard in North America
1994	American TDMA operable in Seattle, Washington