Spectrum Management

With this definitive guide to radio spectrum management, you will learn from leading practitioners how spectrum can be managed effectively and made available both now and in the future.

All aspects of spectrum management are covered in depth, from the fundamentals of radio spectrum and technical and economic basics, to detail on methods such as auctions, trading, and pricing, and emerging approaches including shared and dynamic spectrum access and new ways of licensing. With the help of real-world case studies, you will learn how this knowledge comes together in practice, as the authors illustrate the role of spectrum in the wider economy and offer valuable insights into key future trends.

Authoritative and up-to-date, and bringing together the key technical, economic, and policy issues into one definitive resource, this is the essential guide for anyone working or studying in areas related to radio spectrum management.

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Professor William Webb was instrumental in designing Weightless, a new global standard for wireless M2M communications, is CEO of the Weightless SIG, and has 17 patents pending or granted for the technology. He was a co-founder and CTO of Neul, a Cambridge start-up established to commercialize Weightless technology, was president of the IET during 2015, was a member of Ofcom's Spectrum Advisory Board (OSAB), and is on the board of TPRC. In 2005 he became one of the youngest ever Fellows of the Royal Academy of Engineering. He is also a Fellow of the IEEE.

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Using the Airwaves for Maximum Social and Economic Benefit

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Preface

We published our previous book, *Essentials of Modern Spectrum Management*, in 2007. Much in the world has changed since then, with the explosion in demand for mobile data, the emergence of dynamic spectrum access and other sharing approaches, and the deployment of new auction techniques. Some of the developments that were promising in 2007, such as ultra-wideband, have not yet delivered, while others, such as television white spaces, are now being pioneered.

When we decided it was time for a new edition, we concluded that the changes required to the 2007 version were so extensive as to merit a completely new approach. Hence this book, which aims to cover the major issues relating to the technologies, economics and practices of using and managing spectrum, to consider different approaches, to look ahead, and to make recommendations for future spectrum management.

Acknowledgments

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Plan of the book

This book consists of four parts:

The first is a primer, designed to ensure that all readers have sufficient knowledge to tackle the material in the rest of the book. It covers spectrum management fundamentals, technical issues, and basic economics.

The second covers conventional economic methods of spectrum management, such as auctions, trading, and pricing, which have been evolving for a decade or more.

The third looks at spectrum management approaches which we believe will become more prominent in future, including shared and dynamic spectrum access and new ways of licensing based on interference caused.

The fourth looks at some case studies and issues. It uses the UHF TV band to illustrate a number of principles from earlier chapters, considers approaches that might be adopted in the public sector in international spectrum management, and examines the role of spectrum in the wider economy. Finally, it contains our projection of trends and the key agenda which we think needs to be tackled.

Abbreviations

3GPP	Third Generation Partnership Project
ACL	adjacent channel leakage
ACMA	Australian Communications and Media Authority
ACS	adjacent channel selectivity
AGC	automatic gain control
AGL	above ground level
AIP	administered incentive pricing
ANFR	Agence nationale des fréquences (France)
ATC	ancillary terrestrial component
AWS	advanced wireless services
BAS	broadcast auxiliary service
BFWA	broadband fixed wireless access
CCTV	closed circuit TV
CEO	chief executive officer
CEPT	Central European Post and Telecommunications
CMA	cellular market area
CW	continuous wave
DAB	digital audio broadcasting
DECT	digital European cordless telephone
DoD	Department of Defense (US)
DSA	dynamic spectrum access
DTT	digital terrestrial television
DVB	digital video broadcasting
EA	economic area
EBU	European Broadcasting Union
ECC	European Communications Committee
EIRP	equivalent isotropic radiated power
eMBMS	evolved multimedia broadcast multicast service
EMC	electromagnetic compatibility
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communications Commission
FDD	frequency division duplex
GAA	general authorized access

GDP	gross domestic product
GHz	gigahertz
GPS	global positioning system
GSM	global system for mobile communications
HTHP	high-tower high-power (transmitter site)
ICT	information and communications technology
IEEE	Institution of Electrical and Electronic Engineering
IET	Institution of Engineering and Technology
IoT	Internet of Things
IPTV	Internet protocol TV
ISD	inter-site distance
ISM	industrial, scientific, and medical
ITU	International Telecommunication Union
kHz	kilohertz
LEFR	Licence-Exemption Framework Review
LSA	licensed shared access
LTE	long-term evolution (of cellular technology)
LTLP	low-tower low-power (transmitter sites)
M2M	machine-to-machine
MCL	minimum coupling loss
MED	Ministry of Economic Development (New Zealand)
MFN	multifrequency network
MHz	megahertz
MIMO	multiple-input multiple-output (antennas)
MNO	mobile network operator
MPEG	Motion Picture Experts Group
NAB	National Association of Broadcasters
NATO	North Atlantic Treaty Organization
NRA	national regulatory authority
NTIA	National Telecommunications and Information Administration
OSAB	Ofcom Spectrum Advisory Board
PCAST	President's Council of Advisors on Science and Technology
PCS	personal communications services
PFD	power flux density
PFWA	public fixed wireless access
PMR	private mobile radio
PMSE	program making and special equipment
PPDR	public protection and disaster relief
PSB	public-service broadcasting
PVR	personal video recorder
RET	revenue equivalence theorem
RFID	radio frequency identification
RSC	Radio Spectrum Committee

RSPG	Radio Spectrum Policy Group (of the EC)
RSPP	Radio Spectrum Policy Programme
SAA	simultaneous ascending auction
SAS	spectrum access system
SDARS	satellite digital audio radio service
SFN	single-frequency network
SIG	special interest group
SIM	subscriber identity module
SLC	significant lessening of competition
SMR	specialized mobile radio
SMRA	simultaneous multiple-round auction
SNR	signal-to-noise ratio
SUR	spectrum usage right
TDD	time division duplex
TNR	Transfer Notification Register
TVWS	TV white space
UHDTV	ultra-high-definition TV
UHF	ultra high frequency
UN	United Nations
UWB	ultra-wideband
VHF	very high frequency
W	watt
WCS	wireless communications service
WRC	World Radio Conference