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978-1-107-09422-2 - Spectrum Management: Using the Airwaves for Maximum Social and Economic Benefit

Martin Cave and William Webb

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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.

Martin Cave is a regulatory economist who has worked extensively on telecommunications and spectrum issues. He is a visiting professor at Imperial College Business School and an Inquiry Chair at the UK Competition and Markets Authority. Previously he was a professor at Warwick Business School, BP Centennial Professor at the London School of Economics, and a member of the Spectrum Advisory Board of the UK regulator Ofcom.

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Using the Airwaves for Maximum Social and Economic Benefit

MARTIN CAVE
*Imperial College Business School and the Competition
and Markets Authority*

WILLIAM WEBB
Weightless SIG



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Contents

<i>Preface</i>	<i>page</i> ix
<i>Acknowledgments</i>	x
<i>Plan of the book</i>	xi
<i>List of abbreviations</i>	xii
Part I: Fundamentals	1
1 Spectrum management around the world	3
1.1 The uses of radio spectrum	3
1.2 Why spectrum needs managing	9
1.3 National spectrum regulation	11
1.4 International spectrum regulation	14
1.5 Differences across countries and regions	17
1.6 Global, regional, or national spectrum management?	18
1.7 Successes and challenges	21
2 The technical challenge	24
2.1 Introduction	24
2.2 Transmitting a radio signal	24
2.3 How signals propagate	28
2.4 Mechanisms of interference	33
2.5 Tolerance of interference	38
2.6 The need for regulation	40
3 The economic challenge: a basic primer on spectrum economics	42
3.1 Characteristics of spectrum as an economic resource	42
3.2 What is an efficient allocation of spectrum across uses?	44
3.3 A more realistic formulation of the problem	45
3.4 The broad range of modes of access to spectrum	46
3.5 Alternative ways of allocating and assigning spectrum	47
3.6 Conclusion	58
Part II: Economic management of spectrum	61
4 Using auctions to assign spectrum	63
4.1 Introduction	63

vi	Contents	
	4.2 Some types and effects of auctions	63
	4.3 Designing mechanisms to award spectrum licenses	65
	4.4 The spectrum auction process	68
	4.5 Auction theory	70
	4.6 Auction objectives	72
	4.7 Auction formats	74
	4.8 Combinatorial clock auctions	85
	4.9 Incentive auctions	88
	4.10 Conclusion	91
5	Other aspects of spectrum auction design	94
	5.1 Introduction	94
	5.2 Auction logistics	94
	5.3 Lot design	97
	5.4 Ensuring a competitive auction	98
	5.5 Auctions and downstream competition	103
	5.6 Can demand for unlicensed spectrum be accommodated in a spectrum auction?	109
	5.7 Conclusion	111
6	Spectrum trading	113
	6.1 Introduction	113
	6.2 Spectrum secondary markets	114
	6.3 Forms of spectrum trading	115
	6.4 Competition concerns and other objections to spectrum trading	117
	6.5 Spectrum trading in practice	120
	6.6 Concluding remarks	125
7	Spectrum pricing and valuation	128
	7.1 Introduction	128
	7.2 The separate components of spectrum prices	129
	7.3 Finding opportunity-cost prices: an initial approach	132
	7.4 Interrelations among opportunity-cost estimates	135
	7.5 Opportunity-cost spectrum pricing in practice	137
	7.6 Other pricing applications in practice	140
	7.7 Administrative prices and trading	143
	7.8 Conclusion	144
	Part III: Sharing and other emerging approaches to spectrum management	147
8	Spectrum sharing and the commons	149
	8.1 Basic approach to commons	149
	8.2 The tragedy of the commons	152
	8.3 Restriction on usage in various bands	154
	8.4 The Ofcom Licence-Exemption Framework Review	157

	Contents	vii
8.5	Summary	160
9	Dynamic spectrum access	162
9.1	Introduction	162
9.2	Approaches to dynamic access	163
9.3	Licensed shared access	167
9.4	Unlicensed shared access	168
9.5	Advantages and disadvantages of shared access	172
9.6	Example 1: TV white space	174
9.7	Example 2: US 3.5 GHz band	184
9.8	Example 3: government sharing	185
9.9	In conclusion: the need to increase flexibility	187
10	Controlling interference: licensing and receivers	192
10.1	Introduction	192
10.2	Spectrum usage rights	192
10.3	Receiver standards	197
	Part IV: Case studies and conclusions	205
11	The struggle for the UHF band	207
11.1	The issues at stake	207
11.2	Broadcasting, the digital switch-over, and current trends	208
11.3	Broadcasting technical options	212
11.4	Mobile data, national broadband plans, and spectrum management	215
11.5	Smartphones and the data crunch	217
11.6	Resolving noneconomic valuation issues	219
11.7	Finding an efficient allocation for the 700 MHz band	221
11.8	The struggle for the UHF band: the options	226
11.9	Possible outcomes	228
11.10	Implications for spectrum management	229
12	Public-sector spectrum use	231
12.1	Introduction	231
12.2	Differences between commercial and public-sector use	232
12.3	A program of reform of public spectrum use	234
12.4	An example of public-sector spectrum reform: the UK	239
12.5	Conclusion	240
13	Spectrum and the wider economy	241
13.1	Introduction	241
13.2	Spectrum, spectrum-using services, and their impact on welfare	241
13.3	Effects of spectrum-using services on GDP and employment	243
13.4	Effects of spectrum-using services on productivity	244
13.5	Conclusion	248

Cambridge University Press
978-1-107-09422-2 - Spectrum Management: Using the Airwaves for Maximum Social and Economic Benefit
Martin Cave and William Webb
Frontmatter
[More information](#)

viii	Contents	
	13.6 Annex	249
14	Where next?	252
	14.1 Trends	252
	14.2 Our agenda to improve spectrum use	254
	14.3 In conclusion	256
	<i>About the authors</i>	258
	<i>Index</i>	260

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978-1-107-09422-2 - Spectrum Management: Using the Airwaves for Maximum Social and Economic Benefit

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Frontmatter

[More information](#)

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.

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Frontmatter

[More information](#)

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