

Organised by Helios and PolicyTracker

Understanding Modern Spectrum Management

A Five Day Training Course

29 September - 3 October 2008
Held at Merton College, Oxford, UK



- A thorough grounding in the radio spectrum and its application
- In depth analysis of the latest economic and policy arguments
- Lively, engaging and interactive course modules delivered by specialist trainers
- Modules from world experts: Professor Martin Cave, Professor Gérard Pogorel and Professor William Webb
- Social events including a reception and a formal dinner
- Comprehensive pack of learning materials
- Historic setting in one of Britain's oldest universities
- Excellent value: price includes accommodation and full board

Understanding Modern Spectrum Management

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The aim of the course

Spectrum management requires knowledge of an unusually wide range of subjects: engineering; economics; law; policy and regulation. It is also a field where accepted practices are changing rapidly. Technological developments mean increasing demand for spectrum for an ever-widening range of applications. This has resulted in a growing pressure to replace traditional technical approaches with a more market-orientated approach.

This course provides the technical foundations for modern spectrum management while bringing attendees up to speed with the latest thinking in economics, law and policy-making.

Who should attend?

The course is aimed at people who either work for regulators or work for a commercial organisation which needs to understand the principles of spectrum management. The programme is particularly relevant for the following fields: mobile; broadcasting; wireless broadband; electronics manufacturers; and public sector spectrum users such as aviation, maritime, emergency services and military.

The content is well suited to three groups of people:

- staff wanting a solid grounding in all aspects of spectrum management
- those with an expertise in one aspect of spectrum management

who are seeking to broaden their knowledge base

- those wanting to familiarise themselves with the latest thinking in the field.

The benefits of the course

- Not just an opportunity to learn: a chance to **debate the latest thinking with world-renowned experts** who helped develop the central principles of modern spectrum management
- **Comprehensive reading pack** included
- A chance to **interact with colleagues from other countries** and sectors
- Social events
- **Ideal learning environment:** the beautiful and historic grounds of Merton College, Oxford
- **Accommodation and full board included** in price
- Certificate on completion of the course

Course format

The course is delivered through a flexible combination of lectures, exercises, practical demonstrations, debate and questions and answer sessions with expert speakers. Class size is limited to 25 people.

Modern spectrum management in an historic setting



The quad, dining hall, accommodation and gardens at Merton College

About Merton College

Merton College is an historic and serene setting for the course. It was founded in 1264 and boasts the world's oldest continuously functioning university library. The College Chapel dates from c.1290, with renovations from some of Britain's most famous architects, including Christopher Wren and Sir Gilbert Scott. The college is set in picturesque and well-maintained grounds

Course attendees will stay in modern accommodation on the college site with full ensuite facilities and internet access. They will dine in the magnificent Hall, built in 1277. World-famous museums, monuments, shops and restaurants are a short walk away in Oxford City Centre.



Course Team

Professor Martin Cave



Martin Cave is the Director of the Centre for Management under Regulation at Warwick University Business School. For the UK government he has carried out the Independent Review of Spectrum Management (2002) which led to the introduction of spectrum trading as well as completing an audit of public sector spectrum holdings in 2005. Professor Cave has advised a wide range of governments and regulators as well as the World Bank and was a member of the UK Competition Commission from 1996 to 2002. He has written 139 books and articles, including *The Essentials of Modern Spectrum Management* (2007) with William Webb and Chris Doyle

Professor Gérard Pogorel



Gérard Pogorel is Professor of Economics and Management, at Ecole Nationale Supérieure des Télécommunications, (ENST) in Paris, France. He has published numerous articles, books, and reports including: *Towards More Flexible Spectrum Regulation* WIK-BNetzA report (Bonn, 2005, co-author), *Radio Spectrum Policy and Management - A Turning Point*, He is a regular speaker at conferences and workshops across Europe and was Scientific Advisor for the EU-IST project "Spectrum Policies and Radio Technologies for Viable Wireless Services (SPORT VIEWS)".

Professor William Webb



William Webb is Head of Research and Development and Senior Technologist for the UK regulator, Ofcom. He also leads some of the major reviews conducted by Ofcom including the Spectrum Framework Review and Ultra-Wideband Consultation. He has worked for Motorola and a range of communications consultancies in the fields of hardware design, computer simulation, propagation modelling, spectrum management and strategy development. William Webb has published eight books (including *The Essentials of Modern Spectrum Management*), sixty papers, and four patents. He is a Visiting Professor at Surrey University and a Fellow of the Royal Academy of Engineering.

Richard Womersley



Richard Womersley has an honours degree in Electrical and Electronic Engineering accompanied by over 15 years consulting, operational and business experience in the fields of radio spectrum management, public telecoms and digital broadcasting. He is an experienced trainer and has conducted consultancy projects for regulators, operators, governments and end-users on issues covering national and international policy; regulation and its implications; pricing, auctions and licensing; service and technology roll-out; and interference. His work has spanned Europe (including the European Commission, EBU, Ofcom and the UK Government), the Middle East, the Caribbean, the Americas, Africa, South Asia, East Asia and Australasia.

Martin Sims



Martin Sims is a journalist and academic who specialises in communications policy issues. He set up *PolicyTracker*, the spectrum policy newsletter and has published articles on many facets of the subject. His work has been published in academic journals and books and he is a former editor of *Intermedia*, the policy journal of the International Institute of Communications. As a journalist he was a news editor in independent radio then worked for BBC network news. He has an honours degree and a masters degree in communication studies and lectures at the University of East London.

The course organisers

The course is being run by Helios and PT Publishing. PT Publishing produces *PolicyTracker*, the online and printed journal of spectrum management (www.policytracker.com) as well as business reports and conferences.

Helios (www.askhelios.com) is a technical and business consultancy and training provider working in radiocommunications, satellite and terrestrial navigation and air traffic management. It has a successful track record in providing public, bespoke and in-house training as well as delivering complex, multidisciplinary consulting assignments.

Pricing

The course costs £2995 (+ VAT) per attendee. This includes:

- ensuite accommodation at Merton College
- all meals from Monday breakfast to Friday lunch
- study materials
- social events

An early bird discount of £250 is available until July 31 2008. To book please complete the form on the back page or visit www.policytracker.com The price does not include transport to or from the venue. Limited facilities for disabled attendees are available, please enquire when booking.

Programme

Part one: The technical foundations of spectrum management

The first day of the course delivers a solid grounding in the fundamentals of the radio spectrum, providing delegates with the knowledge necessary to delve deeper into the principles of spectrum management. The material is presented in a manner that is accessible both to those with and without any prior engineering knowledge and is supported by practical, 'hands-on' examples that give extra colour and depth to this important topic.

The second day of the course builds upon the fundamentals gained on the first day to strengthen delegates' knowledge of the application and exploitation of the radio spectrum. It covers many of the key areas which are necessary for a holistic understanding of spectrum management. The topics are presented in an involving and engaging style, and real-life examples are used to enhance the learning experience.

Monday 29 September

09.00 – 09.30

Registration

09.30 – 10.00

Introductory Session

- Overview of the Course
- 'Who/Where/Why'
- Housekeeping

10.00 – 10.30

The Radio Spectrum

This short session will provide a historical perspective on the radio spectrum, investigating its discovery, development and exploitation. We will characterise the spectrum to underpin some of the key principles that drive the value of different bands. A review of how the spectrum is classified and an exploration of its uses and users will complete the session to give delegates a broad perspective on the nature of the radio spectrum.

Topics covered include:

- The History of the Radio Spectrum – Maxwell, Hertz, Marconi and friends
- Where did it come from?
- What is it?
- What are its characteristics?
- How is it classified?
- Who uses it?

10.30 - 11.00 break

11.00 – 12.30

Propagation

The path of a radio signal from one place to another is rarely straightforward. A number of complex factors interact with and disrupt the signal. Understanding these factors leads to a greater appreciation of many of the difficulties associated with the use of the spectrum. This session will explore the propagation of radio signals and other factors which can influence the ability of a signal to be successfully received to give delegates a full appreciation of the complex radio environment.

Topics covered include:

- Free space path loss
- Reflection, refraction, scattering, diffraction and absorption
- Ground, sky and space waves

- Effects of the ionosphere and troposphere
- Noise (natural and man-made)

12.30 - 13.30 Lunch

13.30 – 15.00

Antennas

Left to their own devices, radio signals spread out uniformly in all 3 dimensions. Focussing a signal in a given direction both improves the chances of reception and reduces the chances of interference and is the first element in using the spectrum efficiently. This session introduces various types of antenna and helps delegates grasp the principles behind their function and application. It also helps demystify many of the claims made about these devices.

Topics covered include:

- The 'isotropic' radiator
- Polarisation
- Dipoles and co-linears
- Yagis
- Dishes
- Antenna gain and efficiency

15.00 - 15.30 break

15.30 – 17.00

Modulation

Getting a radio signal from one point to another is the first step in communicating; the next is to encode some content onto that signal. This session explores the different modulation schemes used for transferring content. It highlights the pros and cons of different modulation types and introduces the principles and benefits of many of the modern schemes being used in the latest radio technologies.

Topics covered include:

- Amplitude Modulation
- Frequency (and Phase) Modulation
- Hybrid (AM/FM) Modulation
- Analogue versus Digital Modulation Schemes
- Error correction and coding
- Spread Spectrum and OFDM

Programme

Tuesday 30 September

09.00 – 10.30

Coverage and Service Planning

Many factors affect an operator's ability to successfully deliver a reliable service across a given coverage area. This session explores the issue of service planning looking at the tools and procedures used both to predict and to measure radio coverage, to enable delegates to further understand the value and utility of the spectrum.

Topics covered include:

- Prediction versus Measurement
- Factors influencing coverage (transmitter power, frequency)
- Interference and its impact
- Differences in planning methods

10.30 - 11.00 break

11.00 – 12.30

Radio Technologies

There are a bewildering variety of radio devices and technologies in use around the world. In this session we quantify and qualify the most widely used technologies as well as get to grips with what makes each one different from (or indeed the same as) each other.

Topics covered include:

- Fixed Links
- Private Mobile Radio
- Low Power Devices
- Digital Broadcasting (radio and television)
- 2G, 3G and 4G cellular
- Mobile Broadband
- Satellite, VSAT and MSS

12.30 - 13.30 Lunch

13.30 – 15.00

Spectrum Efficiency

There is world-wide pressure to improve the effectiveness and efficiency with which the radio spectrum is used, but a great deal of argument as to exactly what represents 'efficient use'. This session examines the various ways that efficiency can be measured, both technically and economically, and looks at the factors which can influence the efficiency of any given service or technology. Examples of the efficiencies of various applications will also be presented and discussed to allow delegates to fully understand why and where pressure is exerted.

Topics covered include:

- Assessing technical efficiency
- Economic efficiency
- Factors influencing efficiency
- Example efficiencies of different technologies

15.00 - 15.30 break

15.30 – 17.00

Technological Developments

Radio technology is rapidly developing and new concepts are being practically realised faster than ever. In this session we will look at some of the latest technological developments; discover the weaknesses of current systems they are aiming to address and consider the contribution they can make to improving spectrum efficiency.

Topics covered include:

- Ultra Wide-Band (UWB)
- Software Defined Radio
- Cognitive Radio and 'White Space'
- Adaptive Antennas
- MIMO

Feedback on previous Helios courses

"Breadth and depth well balanced. Practical examples."

"The depth of the course was excellent covering lots of details and how they inter-relate"

"Everything was relevant, and practical information was very useful."

"The course was very interesting. Excellent. Thanks!"

"The presenters were enthusiastic and knowledgeable. The content was involving."

"A great course, well delivered."

"This is what I've been looking for - at last I understand the technology!"

Programme

Part two: Economic, policy and legal issues

This section will introduce the latest economic theories about spectrum management by looking at their origins in a critique of administrative approaches to frequency allocation. We will then examine the key policy issues raised by a more market-based approach and consider how these are being tackled both nationally and by international institutions like the EU and ITU. Professor Gérard Pogorel of ENST in Paris will give his own perspective on the variety of policy choices facing spectrum managers. On the Thursday Professor Martin Cave will give an assessment of the current issues in the field and the day will conclude with a case study of the UK approach to spectrum liberalisation presented by Professor William Webb, Ofcom's Head of Research and Development. All their presentations will be followed by question and answer sessions. The last day of the course is devoted to the more complex areas of spectrum management where a multiplicity of policy goals need to be addressed, as well as considering the way spectrum liberalisation is likely to influence the business and policy environment.

WEDNESDAY 1 OCTOBER

09:00 – 10:30

The origins of modern spectrum management

This session will examine how policy-makers and economists have questioned the traditional "command and control approach" and argued for an increasing role for market mechanisms in the allocation of spectrum.

Topics will include:

- Why has spectrum emerged from obscurity to a central policy issue?
- An overview of the development of spectrum policy
- The key principles of spectrum liberalisation

10.30 - 11.00 break

11.00-12.30

Legal and policy issues in their institutional context

A more market-based approach to spectrum raises legal and policy issues which need both national and international resolution.

Topics will include:

- The role of key institutions: CEPT, European Commission, ITU and national administrations
- Spectrum hoarding and competition policy
- Interference
- Spectrum licensing and flexibility of use
- Should some services be treated differently?
- What role for spectrum commons?
- Certainty for product development

12.30 - 13.30 Lunch

13.30 - 15.00

Professor Gérard Pogorel: Spectrum policies and markets - sorting the approaches

This session will propose a balanced set of criteria to decide which spectrum management regime to use, thus allowing the completion of rigorous impact assessments of alternative policies. The taxonomy illustrates the possible rationales for a diversity of regimes broader than the usually exposed standard trilogy of Command and Control, Market and Commons.

The spectrum management options are as follows:

- Should frequencies be allocated according to a harmonised plan?
- Should the technologies allowed be standardised?
- Should spectrum usage rights be exclusive, eased, or collective?
- Should usage rights be assigned through market mechanisms (auctions and trading), administrative procedures, or hybrid procedures?

15.00 - 13.30 break

15.30 - 17.00

Professor Gérard Pogorel: a future framework for spectrum licensing

In a liberalised environment licences have to give a legally watertight right both to operate any technology or service in a given band and to ensure that neighbouring services are protected from interference. This raises technical and legal issues of how the rights of use should be specified. This session will examine different national approaches to authorisation, as well the WAPECS generic licensing initiative being developed by the European regulators organisation, CEPT.

Topics will include:

- Implementation: UK, US, France, Germany and Australia
- Dealing with the legal issues
- How successful have the various approaches been?
- Competition issues
- The importance of licensing in a liberalised environment
- WAPECS and clusters

THURSDAY 2 OCTOBER

09.00 - 10.30

Professor Martin Cave: what has liberalisation achieved so far?

Professor Cave is one of the leading international authorities on spectrum liberalisation, having produced the first report on the subject for the UK government and subsequently advised the World Bank as well as the Canadian government and the German regulator. In this session he will assess the economic effects of the moves made so far towards spectrum liberalisation and address the issues raised by some of its critics.

Topics to include:

- A detailed economic analysis of the benefits of liberalisation
- The development of the secondary market
- Addressing interference issues
- Rethinking harmonisation
- Competition issues

10.30 - 11.00 break

Programme

11.00 - 12.30

Professor Martin Cave: priorities for the future

With many countries having implemented measures like spectrum auctions and technology neutral licensing Professor Cave will examine the economic arguments for taking further steps towards liberalisation.

Topics to include:

- The liberalisation agenda
- Public sector spectrum
- Can the market model be applied to all frequency bands and all uses of the spectrum?
- Spectrum liberalisation in developing countries
- Do economists need to do further work on spectrum management?

12.30 - 13.30 Lunch

13.30 - 15.00

Professor William Webb: lessons from the UK approach to spectrum licensing

In Europe the UK has led the way in taking a market-based approach to spectrum management. It introduced spectrum trading in December 2004; has already set out how it will take a market-based approach to releasing the former analogue TV frequencies; and is just starting an ambitious programme of spectrum release. In this session Professor Webb, Ofcom's Head of Research and Development will assess the regulators progress.

Topics to include:

- Ofcom's perspective on spectrum liberalisation
- Spectrum trading
- Spectrum Usage Rights - regulatory issues
- Liberalisation and broadcasting
- What are the limits of the market-based approach?

15.00 - 13.30 break

15.30 pm - 17.00pm

Professor William Webb: liberalisation - the engineering perspective

Technological advances have played a large part in driving liberalisation: both creating increased demand for spectrum and finding new ways of controlling interference. In this session Professor Webb assesses what the development of current technologies as well as the emergence of new ones will mean for policy-makers in the sector.

Topics to include:

- A technologists view of future spectrum developments
- Cognitive radio, mesh networking and the TV "whitespace" debate
- Spectrum usage rights - technical issues
- The role of standards in spectrum policy
- The future role of Industry self-regulation

FRIDAY 3 OCTOBER

9.00 - 10.30

Broadcasting and public sector spectrum: special cases for spectrum managers?

Broadcasters and public sector organisations like the military, the emergency services, civil aviation and marine services deserve special study because they have other policy goals beyond the stimulation of competition and economic growth associated with other business-orientated spectrum users. Broadcasters are expected to deliver cultural and citizenship benefits, while with public sector services there are safety of life and national defence issues. This session will consider the challenges of incorporating these broader goals into a more market-orientated approach to spectrum.

Topics to include:

- Are traditional broadcasting policy models being undermined by technological developments and changing consumer behaviour?
- Analogue TV switch-off: debates about the "digital dividend"
- The inter-relation between spectrum management and other policy goals
- Releasing and sharing public sector spectrum

11.00 -12.30

The policy agenda for the next decade

From regulators to manufacturers, everyone in the wireless sector needs to have a picture of where the industry is likely to be heading over the next decade. The growing influence of spectrum liberalisation will certainly have an impact on these projections. Will an increasingly flexible approach put an end to spectrum scarcity? How will the growing variety of technological solutions and the regulatory enthusiasm for making spectrum available affect market prices? What impact will liberalisation have on existing business structures? This session will suggest some of the frameworks to address these questions.

Topics to include:

- What are the new disruptive technologies?
- The rise of wireless broadband: the impact on the mobile sector
- Commercial implications of liberalisation: competition, co-operation and concentration?
- Learning to share

12.30 - 13.30 Lunch

Course ends

UNDERSTANDING MODERN SPECTRUM MANAGEMENT

29 SEPTEMBER - 3 OCTOBER 2008

REGISTRATION FORM

Complete the form below and fax back to +44 (0)20 7099 1677 or post to PT Publishing Limited, Sunnyhill House, 3-7 Sunnyhill Rd, SW16 2UG, London, UK. You can also register and pay online at www.policytracker.com

For further advice call our
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| Course fees | | | | |
| Early bird registration (Up to July 31 2008) | £2745 + £480.38 VAT = £3225.38 | £2500 + £437.50 VAT = £2937.50 | | |
| Standard registration fee (August 1 onwards) | £2995 + £524.13 VAT = £3519.13 | £2745 + £480.38 VAT = £3225.38 | | |
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TOTAL

HOW TO PAY

- Pay and register online at www.policytracker.com
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- Please send an invoice for the amount shown in the 'Total' box above. If you would like the invoice sent to someone else within the organisation, please complete their details below.

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Terms and Conditions

Course Fees: Fees for the 5 day training course are £2995, excluding VAT. VAT is charged at standard UK rate but employees of foreign governments can be exempt. Please contact us for more details. All fees include 5 nights accommodation at the course venue, breakfast, lunch, refreshments, dinner and course documentation.

All course fees must be paid by the due date stated on the invoice. All bookings are provisional and will only be confirmed once payment has been received. Policy Tracker and Helios (the organisers) reserve the right to reallocate places if full payment has not been received.

Delegates are responsible for the payment of additional accommodation and all other expenses incurred within the venue. These costs should be settled by the delegate directly with the venue.

Cancellations: Cancellations received in writing up to 14 days before the start of the event will be refunded in full less an administrative charge of 10% (+ VAT where relevant). We are unable to refund cancellations received 14 days or fewer prior to the start of a course. However, in such cases and at the organisers' discretion, a place may be offered at a later course. Delegate substitutions may be made at any time, though confirmation of any changes must be received by email, fax or post prior to the start of a course.

Non-attendance: In the event of non-attendance, full course fees will remain payable and no refunds will be made.

Changes to Programme or Venue: The organisers reserve the right to make changes to or cancel a published course due in part or in full to unforeseen circumstances or insufficient numbers. In such circumstances, all reasonable efforts will be made to notify delegates of any necessary changes in good time and if necessary to reschedule or to relocate the course. Delegates will be entitled to a refund of the course fee if the course is cancelled or is changed to a date or location which is not acceptable to the delegate. The organisers will have no liability to delegates for damages of any nature arising from the cancellation of a course or from a change in its date, its location or its speakers.

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