

Organised by Helios and PolicyTracker

Understanding Modern Spectrum Management

A Five Day
Training Course
17 - 21 September 2012
Pembroke College, Oxford, UK



- Detailed discussion of current policy issues: re-farming; digital dividend; whitespace; and the capacity crunch
- 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 delivered by specialist trainers
- Featuring world experts: Professors William Webb and Gérard Pogorel
- Historic setting in England's oldest university
- Excellent value: price includes accommodation, full board and social events

New practical
workshops added
on spectrum
orienteeing and
auctions

Understanding Modern **Spectrum Management**

A Five Day Training Course / 17 - 21 September 2012

"The course was excellent all through; nice to meet people from all over the world with the same issues."

Claes-Erik Rundstrom, Head of Radio Distribution, Swedish Radio

"Nice broad overview of current spectrum issues. Interesting discussions."

Gerhard Berz, Focal Point Navigation Infrastructure, EUROCONTROL

"The level at which information was presented was great - one of the best overviews I have seen."

Catherine Gladman, Manager, Policy & Research, Spectrum Planning ACMA

The aim of the course

Spectrum management requires knowledge of an unusually wide range of disciplines: engineering, economics, law, policy and regulation. It is also a field where accepted practices are changing rapidly. In recognition of this the course is continually being updated to cover the latest policy developments including re-farming, the digital dividend, whitespace and the capacity crunch. 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 to spectrum management with a more market-orientated approach. This course delivers the essential technical foundations needed to support modern spectrum management while bringing attendees up to speed with the latest thinking in economics, law and policymaking.

Who should attend?

The course is aimed at those who either work for regulators or 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, satellite, electronics manufacturers, and public sector spectrum users such as aviation, maritime, emergency services and defence.

The content is well suited to three groups of people:

- Staff wanting a solid grounding in 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

The course is not just an opportunity to learn; it is a unique chance to debate the latest thinking with world-renowned experts who helped develop the central principles of modern spectrum management. Further benefits include:

- Sharing experiences with colleagues from other countries
- Comprehensive reading pack included
- Social events reflecting the unique historic nature of Oxford
- Ideal learning environment: the beautiful and ancient grounds of Pembroke College
- Accommodation and full board included in the price
- Certificate on completion of the course

Course format

The course is delivered through a flexible combination of lectures, exercises, practical demonstrations, debate and 'question and answer' sessions with expert speakers.

Modern spectrum management in a historic setting

About Pembroke College

Pembroke College was founded in 1624 and is a serene setting for the course in the heart of historic Oxford. The college is based around three quadrangles and includes the beautiful Damon Wells Chapel. The famous English poet, Sir John Betjeman, said it was his favourite Oxford college and



alumni include JRR Tolkien, Samuel Johnson, and James Smithson, posthumous founder of the Smithsonian Institution in the US. Course attendees will dine in Pembroke's magnificent hall and stay in modern accommodation on the site with full en-suite facilities and internet access. World-famous museums, monuments, shops and restaurants are a short walk away in Oxford City Centre.



The course presenters

Amit Nagpal



Amit Nagpal is a Partner at Aetha Consulting, a consultancy providing strategic and regulatory advice to the telecoms industry. Amit has over 20 years of experience in spectrum management having started his career as a

graduate engineer with the UK Radiocommunications Agency (now Ofcom) and most recently through providing spectrum policy and valuation advice to regulators, telecoms operators and industry bodies.

William Webb



William Webb is CTO of Neul, a company developing a wireless machine-to-machine standard. Previously he worked for seven years as Head of Research and Development and Senior Technologist for the UK regulator, Ofcom where he led

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 has published eleven books (including *The Essentials of Modern Spectrum Management*), seventy papers, and four patents. He is a Visiting Professor at Surrey University and a Fellow of the Royal Academy of Engineering Pricing

Richard Womersley



Helios' Richard Womersley has over 20 years consulting, operational and business experience in radio spectrum management, public telecoms and digital broadcasting. He is an experienced and popular trainer.

In addition, he 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.

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 worked for 10 years as a university lecturer.

Professor Gérard Pogorel



Gérard Pogorel is Professor of Economics and Management at Ecole Nationale Supérieure des Télécommunications, (ENST) in Paris, France. He is the joint author of a new

book, *The Radio Spectrum*, and has published widely on the subject including the WIK-BNetzA report: *Towards More Flexible Spectrum Regulation* (Bonn, 2005, co-author). 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)".

Ann LaFrance



Ann LaFrance is Coordinating Partner for the Squire Sanders communications law team in EMEA and leader of the firm's European data protection and privacy practice. Ms. LaFrance has over two decades of experience working on

regulatory, policy, competition and commercial matters involving the TMT sector in Europe, the United States, the Middle East and key emerging markets around the globe. She began her career as a telecommunications lawyer with Squire Sanders in Washington, DC, and from 1996-2004, she served as Chief International Counsel for MCI Communications Corp. (since acquired by Verizon) in Washington, Brussels and London/Reading. Now based in London, Ms. LaFrance's practice covers a wide range of telecommunications and media issues involving national and international law, policy and regulation, including spectrum policy and licensing matters.

"Good build up from the basics to enhancing capabilities to deal with spectrum management now and for the future. Great facilities – and topics were all very good."

Kwame Baah-Acheamfuor, Senior Manager, Regulatory Administration, National Communications Authority, Ghana

"Highlights for me: accessibility of content; tour of Oxford; variety of delegates."

Jo North, Communications Manager, JFMG

"I think it a very good course. The right level/balance between general overview and the details."

Rene Vroom, Head of Innovation, Agentschap Telecom NL Radio Communications Agency – Netherlands



The course includes numerous social events and networking opportunities

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 radio-communications, 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.

Over 200 satisfied delegates!

DAY 1: Monday 17 Sept

DAY 1 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 modern 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.

MONDAY 17 SEPTEMBER

Trainer: *Richard Womersley*

08.45 – 09.00 **Registration**

09.00 – 09.30 **Introductory Session**

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

09.30 – 10.30 **The Radio Spectrum**

This session provides a historical perspective on the radio spectrum, investigating its discovery, development and exploitation. We will examine the characteristics of different bands and demonstrate some of the technical principles that drive their economic value. 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 medium.

Topics will 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 explores the propagation of radio signals and other factors that can influence the ability of a signal to be successfully received.

Topics will 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 **Modulation**

Getting a radio signal from one point to another is the first step in communicating; the next is to encode content onto that signal. This session explores a variety of different modulation schemes. 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 to help delegates understand developments in spectrum usability and efficiency.

Topics will include:

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

15.00 – 15.30 **Break**

15.30 – 16.30 **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. It enables delegates to understand the trade-offs between delivering coverage and ensuring spectrum efficiency.

Topics will include:

- *Prediction versus measurement*
- *Factors influencing coverage (transmitter power, frequency)*
- *Interference, electromagnetic compatibility (EMC) and its impact*
- *The liberalised approach encouraged by WAPECS*

16.30 – 17.00 **Spectrum Orienteering**

Following on from the day's exploration of the theory of the radio spectrum, this session presents a practical exercise giving hands-on experience of the real-life radio environment. Played in teams, the objective of spectrum orienteering is to navigate your way around the spectrum in the fastest possible time. A course will be laid out and you will have to find your way around it using only your knowledge of the radio spectrum. Not only will this help you to get to grips with the realities of radio propagation and interference, but it will also help you get to know your fellow course delegates better too.

DAY 2: Tuesday 18 Sept / DAY 3: Wednesday 19 Sept

The second day of the course builds upon the technical 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.

TUESDAY 18 SEPTEMBER

Trainer: Richard Womersley

09.00 – 10.30

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 will include:

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

10.30 – 11.00

Break

11.00 – 12.30

The Digital Dividend

The Digital Dividend is considered by many as one of the most disruptive new pieces of spectrum to become available in the past 15 years due, in particular, to the excellent propagation characteristics it possesses. This module explains where the digital dividend comes from and why it is more than just the dividend accruing from developments in digital video compression. It considers the size and shape of the released spectrum as well as some of the issues associated with its effective utilisation.

Topics will include:

- The problems of analogue television planning
- The benefits of digital terrestrial television
- The 'double whammy' digital dividend
- How much spectrum could be released?
- What are the unique characteristics of digital dividend spectrum?

12.30 – 13.30

Lunch

13.30 – 15.00

Latest Developments in Wireless Technology

This session will explore some of the latest developments in wireless technology. Delegates will learn some of the techniques which manufacturers are going to in order to make more effective use of the spectrum, as well as some of the more novel uses to which wireless connectivity is being put. In addition to understanding how these technologies work, we will also look at why they are needed and the changes in regulatory environment that might be needed to accommodate them.

Topics will include:

- Dealing with the capacity crunch – what techniques can be used
- Machine to machine (M2M) communications and their implication for networks
- Sensor networks
- Power line telecommunications (PLT) and its use of the radio spectrum
- Multiple and distributed antenna networks – how many will we need and what do they offer
- Can we use micro-metre and nano-metre wavelengths?
- What might a future wireless network look like

15.00

Classes end giving delegates time to explore Oxford

On the third day Professor William Webb, formerly Ofcom's head of research and development, will consider how far a market-based approach can go in tackling the problems facing the industry. He will argue that its limitations have been exposed by the exponential growth in demand for wireless data.

WEDNESDAY 19 SEPTEMBER

09.00 – 10.30

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

Trainer: Martin Sims

These organisations deserve special study because they have other cultural and public safety policy goals as well as the stimulation of competition and economic growth. This session considers the challenges of incorporating these broader goals into a more market-orientated approach to spectrum.

Topics will include:

- Technological developments and changing consumer behaviour
- Debates about the "digital dividend"
- Releasing and sharing public sector spectrum

10.30 – 11.00

Break

11.00 – 12.30
DAYS
continued

Cycles in spectrum management: From direct control to liberalisation and back again

Trainer: William Webb

In the years 2000-2004 increasing frustration with the long-standing command & control approach to spectrum management led regulators to examine alternatives. Ofcom and the FCC pioneered the use of market forces such as trading, auctions and technology-neutral licenses as an alternative approach to overcome what was seen as the slow and cumbersome existing approach. But some 10 years later all is not well with market forces. Trading has been much less than expected, technology neutrality has proven difficult to implement, and auctions are being threatened by legal proceedings. Further, the world is changing towards fewer networks but with wireless communications becoming part of the essential national infrastructure. This suggests there may be some merit in some central control and that perhaps some middle ground between command & control and market forces is the way ahead.

Professor Webb, formerly Ofcom's Head of Research and Development assesses what history has taught us about philosophies of spectrum management and where regulators might go in the future.

Topics will include:

- Why regulators and others became frustrated with command & control
- The Ofcom approach to implementing market forces
- A review of the Ofcom approach a decade on – what has worked and what hasn't
- How the communications marketplace has changed
- Implications for future spectrum management approaches

12.30 – 13.30

Lunch

13.30 – 15.00

Liberalisation - the engineering perspective

Trainer: William Webb

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 policymakers in the sector.

Topics will include:

- A technologist's 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

15.30 – 17.00

The origins of modern spectrum management

Trainer: Martin Sims

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 become a central policy issue?
- An overview of the development of spectrum policy
- The wider policy context
- The key principles of spectrum liberalisation

17.00

Classes end giving delegates time to explore Oxford

.....
 On the fourth day we will study how the use of auctions can contribute to spectrum efficiency, as well as taking part in a combinatorial spectrum auction to get a sense of the possibilities of this new auction type. There will also be sessions on spectrum scarcity and legal issues.

THURSDAY 20 SEPTEMBER

09.00 – 10.30

A practical introduction to spectrum auctions part 1

Trainer: Martin Sims

In the past decade auctions have become the default mechanism for assigning the more valuable spectrum bands. In this session and the next we will consider how spectrum auctions fit into the wider liberalisation framework and consider the pros and cons of the various auction formats. Delegates will also consider how to value spectrum licences.

Topics will include:

- The problems with beauty contests
- The variety of auction formats
- Valuing spectrum
- Bidding strategies
- Analysing recent auction results
- Take part in a mock auction!

10.30 – 11.00

Break

11.00 – 12.30

A practical introduction to spectrum auctions part 2

Trainer: Martin Sims

In this session we will run a mock auction using online software. This will be an opportunity to explore the characteristics of an increasingly popular format, the combinatorial clock auction. This has the advantage of ensuring that bidders win all their desired lots but the disadvantage of increasing complexity.

12.30 – 13.30

Lunch

13.30 – 15.00

Spectrum's role in supporting mobile data growth

Trainer: Amit Nagpal

While there is considerable emphasis amongst regulators on the need for more mobile spectrum to support future demand, this is a multi-faceted issue. In this session we will take a critical perspective on the range of possible solutions.

Topics will include:

- Next generation technologies, new network architectures and additional spectrum
- The need for a portfolio of spectrum
- Alternative bands for 4G
- Spectrum roadblocks

15.00 – 15.30

Break

15.30 – 17.00

Legal issues in spectrum management

Trainer: Ann LaFrance

Successful spectrum management needs to be underwritten by a solid understanding of legal principles. From licensing to running an auction there are legislative issues which can undermine the most promising policy initiatives. This module explains the potential pitfalls and suggests ways that problems can be prevented,

Topics will include:

- Legislative underpinnings
- Licensing procedures
- Key licence provisions
- Potential legal issues arising from claw back and refarming
- Competition law issues

The last day of the course is an opportunity to explore some of 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.

FRIDAY 21 SEPTEMBER

09.00 – 10.30

Spectrum management policies: examining options and alternatives

Trainer: Gérard Pogorel

This session examines spectrum policy against the background of a balanced set of public policy and business strategy criteria. It intends to help decide which spectrum management regime to use for the diversity of radio services, thus allowing the completion of rigorous impact assessments for alternative policies. It explores the rationales for a broader range of approaches rather than the usual options of command and control, market and collective use.

Topics will include:

- 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?

10.30 – 11.00

Break

11.30 – 13.00

Spectrum policy in practice: current issues

Trainer: Gérard Pogorel

This session will put into context some of the key debates in spectrum policy.

Topics will include:

- The extent and management of the digital dividend, current and future
- The perspectives of collective use in particular in white spaces
- Reflections on auctions: upfront payments vs renting frequencies
- The challenges for the international and European Wireless Broadband area in the era of smart-phones and tablets

13.00

Course ends

Understanding Modern **Spectrum Management**

Registration Form / 17 - 21 September 2012

The simplest way to register for this course is at our website: www.policytracker.com/training. However, you can also complete the form below and email to training@policytracker.com, fax to +44 (0)207099 1677 or post it to the address below

.....

Title (*Mr, Mrs, Miss, Ms, Dr*) Address

First name

Surname

Job title

Email Postcode Country

Company Tel

VAT registration number Fax

Course fees	Standard Price	* - £250	Quantity	Total
Early bird registration (Up to 24 August 2012)	£2,745* + £549.00 VAT = £3,294.00			
Standard registration fee (August 25 onwards)	£2,995* + £599.00 VAT = £3,594.00			
<i>Special offer for first PolicyTracker subscription</i>				
<i>Non-UK businesses (not liable for VAT)</i> First PolicyTracker annual online subscription for 5 users	£700 [normal price £955]			
<i>UK Businesses (liable for VAT)</i> First PolicyTracker annual online subscription for 5 users	£700 + £140.00 VAT = £840.00 [normal price £955 ex VAT]			
*Discount of £250 for PolicyTracker subscribers or existing Helios clients - please enquire when booking				TOTAL

HOW TO PAY (please tick relevant box)

- Pay and register online at www.policytracker.com
- I enclose a cheque /postal order payable to
PT Publishing Limited (*Unfortunately no post-dated
cheques can be accepted*)
- 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.

I would like to pay by bank transfer: our IBAN address is
GB 43 NW BK 602129 55531334 Swiftcode: NWBKGB2L
For further information contact PT Publishing on
+44 (0)20 7100 2875 or training@policytracker.com

.....

Title (*Mr, Mrs, Miss, Ms, Dr*) Address

First name

Surname

Job title

Company Postcode Country

Address Tel

..... Fax

Terms and Conditions

Course Fees: Standard fees for the 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.

Company details: PT Publishing Limited, 4 Houghton Square, SW9 9AN, London, UK Tel +44 (0)20 7100 2875 Fax +44 (0)20 7099 1677
The company is registered in England No. 5081138 at Chasefield Road, London SW17 8LN, UK. VAT no: 876 9710 66