

Aegis Systems Ltd is one of Europe's foremost independent providers of specialist advice to users and regulators of the radio spectrum. Our global client base includes national governments, operators, manufacturers, investors and regulatory bodies. Our services range from detailed engineering studies through to market analysis and client representation at international regulatory fora. Our philosophy is one of openness and trust — working flexibly, professionally and with integrity. With a multi-disciplinary team of specialists from the broadcasting, space and telecommunications sectors, we are ideally placed to help your organisation meet the challenges of converging markets and technologies in the twenty-first century. This capability profile provides a brief insight into our work in the areas of client representation and standards development.

Standards Development

Aegis provides support to manufacturers, operators and regulators involved in the development of technical standards or regulations. This support can take the form of representation in standards or regulatory fora, drafting submissions to international bodies such as the International Telecommunications Union (ITU) or ECC (European Communications Committee), or direct participation in standards bodies such as the European Telecommunications Standards Institute (ETSI).

We have participated in ITU Study Groups for more than a decade, undertaking critical evaluation of submissions, and attending the World Radio Conferences where the ultimate decisions regarding international frequency allocations are made.

Within ETSI, we were responsible for developing the first Very Small Aperture Terminal (VSAT) equipment standard, which has been adopted throughout Europe. We can assist in the development of Interface Notifications necessary to meet the requirements of the European Union R&TTE Directive.

Our engineers have participated in many ECC project teams and task groups, representing a variety of clients in the public and private sector.

Client Representation

The regulatory framework is continuously adapting to meet the needs of new types of radio system. Operators and regulators need to be aware of potential regulatory changes that might affect their operations. Such changes are often determined in technical committees of international bodies such as the ITU or ETSI.

Aegis can provide support and representation in many of these committees, presenting the case for particular regulatory requirements to be implemented or changed or where appropriate defending the status quo.

Aegis can help protect your organisation's interests by:

- analysing regulatory developments and proposing an appropriate strategic response
- preparing input documents to meetings, backed up with technical / regulatory analyses
- examining opposing points of view and preparing counter arguments
- attending meetings, presenting the case to be made and countering any opposing positions.

Aegis can also assist regulatory bodies in preparing consultation documents related to radio spectrum issues and in analysing the subsequent responses.

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New Technologies

Over the last few years there has been an increasing demand for radio spectrum to support new services and technologies. In response, regulatory bodies have made spectrum available, such as 2.4 GHz, on a licence-exempt basis for technologies and services that can co-exist on a self-coordination basis. Wireless Local Area Network (WLAN) devices operating at 2.4 GHz are now widely used in the home and office to provide wire-free connectivity for IT and telecom equipment. Further spectrum has been made available to support new wireless services on both a licensed and licence-exempt basis. For example, the 5 GHz band is now available in many countries for both WLANs and public fixed wireless access services.

More recent developments include Ultra-Wide Band (UWB) devices, which are intended to support very high data rates over short distances, and the WiMax standard, which promises to extend WLAN functionality to wide area wireless networks.

As one of Europe's leading consultancies focussing on the management and use of radio spectrum, Aegis continually monitors developments within this diverse and fast moving sector. Our knowledge base embraces technical standards, market development, research activity and international regulatory matters. We can undertake bespoke studies for regulators, operators and vendors into new market or technology developments and address any specific areas of concern. These might include interference assessment, technical feasibility studies, benchmarking against other countries, or availability of products.

Convergence

Digital technology allows audio, video, text and other content to be multiplexed as a single data stream for delivery over a single transmission platform, such as a mobile phone or broadcast network. Similarly, digital devices can combine the functionality of telephones, televisions and computers in a single handheld or desktop terminal. These developments blur the traditional distinction between broadcasting, telecommunications and information technology, a phenomenon often referred to as convergence.

New wireless technologies are emerging to support convergent services. For example, DVB-H, the handheld variant of the digital video broadcasting standard, promises cost-effective delivery of TV and other audio-visual content to mobile phones, by combining broadcast technology with the existing mobile platforms. WLAN technology can be integrated into mobile phones, enabling users to roam seamlessly between fixed and mobile networks with a single, multi-mode terminal. In the home, wireless networks can distribute all manner of data, such as TV, audio, photographs and the Internet, to a wide variety of devices.

We can advise on these and other wireless opportunities across the entire range of radio frequencies and applications. Our broad base of knowledge enables us to identify the key areas of detailed research and development, effectively define and analyse the data, and present it in a way that allows clients to easily understand and compare the information. For regulators, we can provide strategic advice on how to identify suitable spectrum and use it effectively to support new technologies.

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Benchmarking

In an increasingly competitive market, regulators, operators and vendors need to maintain best practice in all their activities to ensure customer satisfaction and maximise competitiveness. Benchmarking involves the independent, objective assessment or comparison of organisational structure, processes (including authorisation, enforcement and monitoring procedures) or parameters such as network coverage and tariffs.

As a completely independent company with extensive experience in radiocommunications regulation and technology, Aegis can undertake informed, in-depth research to assess your organisation's capabilities relative to key competitors or international counterparts.

The benchmarking process will identify areas where changes can potentially be made to maximise efficiencies, to gain market advantage, to benefit from new technology or licensing opportunities, or to implement new requirements—such as European Union Directives—more effectively.

Further support can be provided in developing project plans and the implementation of agreed proposals with clients.

Market Intelligence

As one of Europe's leading consultancies focussing on the management and use of the radio spectrum, Aegis continually monitors developments within this diverse and fast moving sector. Our knowledge base embraces technical standards, market development, research activity and international regulatory matters. We can advise on the latest developments across the entire range of radio spectrum applications, including broadcasting, telecommunications and radionavigation, whether Earth-bound or in space.

This broad base of knowledge is essential for providing specific market intelligence to clients. It enables us to identify the key areas of detailed research, effectively define and analyse the data, and present it in a way that allows clients to understand and compare the information easily.

The output of these studies can often be strategic advice. Aegis has a long and successful track record of providing strategic and relevant advice to a variety of clients, including regulatory agencies, equipment vendors and network operators.

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Frequency Management

Aegis has been actively involved in frequency management at both a national and international level for over a decade, supporting both regulators and industry. We have also participated in a number of working groups in the International Telecommunications Union (ITU) and the Conference of European Post and Telecommunications Administrations (CEPT).

Our professional staff combine in-depth knowledge of radio theory and practice with hands-on operational and regulatory experience. We provide expertise across the full range of radio applications, whether fixed or mobile, terrestrial or space, local or global. We also have a long track record of developing co-existence criteria to enable different services to share the same radio spectrum.

Our wide experience in spectrum engineering enables us to offer our clients fast, accurate and pragmatic solutions to practical and theoretical problems in spectrum engineering. Areas where Aegis can provide support include:

- Frequency co-ordination
- Interference analysis
- Development of frequency management policy

Licensing & Regulatory Support

Market liberalisation and technological development have created unprecedented opportunities in an increasingly competitive global telecommunications market. Radio technology provides a cost-effective solution but requires access to appropriate radio spectrum — a finite natural resource that is in increasingly short supply. The inherent value of radio spectrum is acknowledged by the growing trend towards market-based pricing mechanisms, such as auctions, in many countries. In the most attractive markets the price of radio spectrum can be a significant proportion of the total network investment.

Aegis plays a significant role in supporting national and regional regulators in their efforts to promote competition and introduce new services and technology. Our expertise in this area, gained largely in one of the most competitive telecommunication environments in the world, makes us the ideal partner for regulators and administrations seeking to develop their own domestic markets.

Areas where Aegis can provide support include:

- Frequency allocations and authorisations
- Spectrum pricing
- Spectrum trading
- Scenario planning

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Support for Regulators

A growing number of national regulators are awarding spectrum through auctions. Aegis can provide technical assistance throughout the process. The first step is generally to determine whether an auction is appropriate based on an assessment of potential market demand. Factors that can influence market demand for radio spectrum include:

- the limitations placed on services and technologies that can be deployed in the spectrum
- the competition from other wired or wireless platforms
- the suitability of the spectrum, for example in terms of available bandwidth, geographic coverage and potential for interference.

Aegis can advise on these issues based on best practice around the world, taking account of technical standards, market developments, research activities and international regulatory developments.

Where the auction route is chosen, Aegis can provide further support in defining spectrum packages, service or technical limitations to avoid interference, and determining suitable reserve prices.

Support for Bidders

Aegis can support potential bidders for radio spectrum by assessing the suitability of the available spectrum to meet the bidder's business aspirations. This might involve considering the implications of any service or technology limitations that are imposed based on our extensive knowledge of the development of technical standards and proprietary equipment as well as international regulatory matters.

We can also assess the ability of the spectrum packages to provide sufficient bandwidth to meet network roll-out requirements and whether it will be necessary to obtain more than one spectrum allocation in any geographic area.

Potential for interference from other in-band or adjacent band services can be modelled to understand the potential impact on network roll-out costs or quality of service, avoiding costly remedial measures after service launch.

We can advise on the latest developments across the entire range of radio spectrum applications, including broadcasting, mobile, fixed wireless access, and convergent wireless services. Aegis has considerable experience of undertaking interference and coverage analysis in all of these areas as well as specific expertise on co-existence between different radio services.

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Spectrum Valuation

A number of countries are adopting a more market-oriented approach to spectrum licensing, including the ability to trade frequencies and in some cases to vary the manner in which spectrum is used, sometimes referred to as liberalisation. This creates opportunities for new players, technologies and services to gain access to the market by purchasing spectrum from existing users, perhaps along with other assets such as transmission sites or infrastructure.

Aegis continually monitors developments in the management and use of the radio spectrum and can provide an independent assessment of the potential value of radio spectrum based on our knowledge of:

- radio propagation issues
- availability of alternative spectrum or platforms
- potential technology and service developments and the likely demand for the spectrum in the future
- potential competition from alternative technologies and services
- minimum spectrum requirements to support a service or technology.

We can also provide an evaluation of any other assets offered with the radio spectrum.

Interference issues

Interference potential is a key factor in determining whether spectrum is suitable for a particular application, particularly where service quality is a consideration. Both interference to and from other services needs to be considered, as either could have a significant impact on service quality and the cost of network roll-out. Examples of potential constraints include:

- The potential for interference from other services that might restrict the use of the spectrum. This restriction might affect usable bandwidth, geographic area or achievable quality of service.
- Restrictions that might be imposed on deployment because of the potential to cause interference to other services. This might affect usable bandwidth, geographic area and impose limitations on usable output power.

Aegis has extensive experience of interference modelling in many different deployment environments, including urban, suburban and rural settings. We have particular expertise in analysing co-existence between different services and developing cost-effective interference mitigation techniques to facilitate spectrum sharing. We are therefore ideally placed to help potential and existing users of radio spectrum to make the most effective use of this unique and valuable resource.

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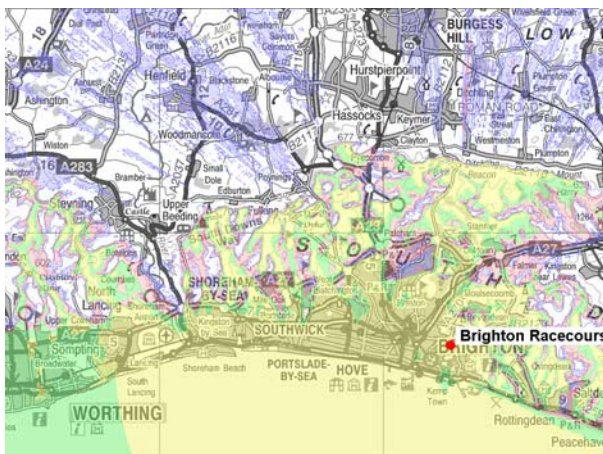
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Propagation Modelling

Aegis has over a decade of experience modelling radio propagation from VHF through to the millimetre wave bands. It was once sufficient when modelling spectrum-sharing scenarios to make the worst-case assumption of free-space propagation: with the increasing congestion of the spectrum, this is no longer appropriate, and models that take account of terrain, climatic and clutter effects are required.

Study Group 3 of the ITU-R continues to develop suitable models and algorithms based on the latest academic research, and we have implemented the majority of these in the Aegis Spectrum Engineering Toolkit. For cases not covered by existing ITU-R Recommendations, we have developed models tailored to specific situations. The models are also informed by experimental work carried out by our staff.



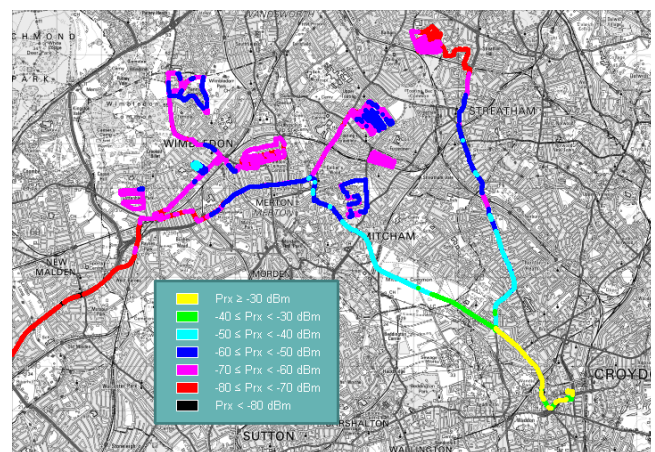
Coverage prediction

Interference Analysis

As use of spectrum has grown, radio systems have also become larger and more complex. Co-existence between radio systems requires thorough analysis of multiple interferers in an increasingly dynamic interference environment. In many cases, complexity is further compounded by the statistical nature of radio-wave propagation on the wanted and interfering paths.

Aegis offers a comprehensive interference analysis service for all types of radiocommunication systems. The Aegis Spectrum Engineering Toolkit enables us to model interference arising between radio applications operating at any frequency from 9 kHz to beyond 100 GHz, whether space-based or terrestrial, fixed or mobile.

We are also equipped to make a wide variety of laboratory and field measurements.



Field measurements

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Propagation Measurements and Experimental Studies

Aegis has built up a comprehensive range of modelling and prediction software, and the use of these tools forms the backbone of many of our technical studies.

A requirement still exists, however, for practical measurements—both to provide the empirical evidence on which to base software models and also to address situations where generic models cannot provide sufficient information to resolve a specific problem.

As a consequence, Aegis has the capability to carry out a range of ad hoc investigations and measurements.

Large-scale measurement campaigns have recently examined the statistics of building penetration loss at a number of frequencies, and the wideband characteristics of indoor and wide-area wireless channels.

More specific studies have concerned the mutual interference between Bluetooth and Wi-Fi systems at 2.4 GHz, and the performance of the Radio Data System (RDS) used by FM radio stations.

The majority of such work has been made public, either through publication or by incorporation into ITU-R texts.



Wideband channel sounder



**Balloon
Platform**



Multi-band test transmission site

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Study on Spectrum Management in the field of Broadcasting

A study for the European Commission prepared by Aegis Systems Ltd, Indepen Consulting Ltd and IDATE.

http://europa.eu.int/information_society/topics/ecom/useful_information/library/studies_ext_consult/index_en.htm

Costs and benefits of relaxing international frequency harmonisation and radio standards

A report to Ofcom prepared by Aegis Systems Ltd and Indepen Consulting Ltd.

http://www.ofcom.org.uk/research/industry_market_research/m_i_index/spectrum_research/framework/harmonisation/?a=87101

Evaluating spectrum percentage occupancy in licence-exempt allocations

A study for Ofcom prepared by Aegis Systems Ltd and Transfinite Systems.

http://www.ofcom.org.uk/research/industry_market_research/technology_research/ses/ses2003-04/ay4529/perc_occup_lic.pdf

An economic study to review spectrum pricing

A study for Ofcom prepared by Aegis Systems Ltd, Indepen Consulting Ltd and Warwick Business School.

http://www.ofcom.org.uk/research/industry_market_research/m_i_index/spectrum_research/independent_review/?a=87101

Implications of international regulation and technical considerations on market mechanisms in spectrum management

A report to the UK Government Independent Radio Spectrum Management Review, prepared by Aegis Systems Ltd and Indepen Consulting Ltd.

<http://www.aegis-systems.co.uk/download/spreview.pdf>

Study on administrative and frequency fees related to the licensing of networks involving the use of frequencies

A study for the European Commission, prepared by Aegis Systems Ltd and Connogue Ltd.

<http://www.aegis-systems.co.uk/download/eufees.pdf>

Demand for use of the 2.4 GHz ISM Band

Report on future demand for Bluetooth and other wireless networking technologies and the implications for spectrum management. Produced for the Spectrum Management Advisory Group (UK Ministerial Advisory Body).

<http://www.aegis-systems.co.uk/download/ism2.pdf>

VHF Broadcast Re-planning

Report on re-planning options for VHF sound broadcasting, to accommodate expansion in local radio services. Produced for the UK Radiocommunications Agency, Radio Authority and British Broadcasting Corporation.

<http://www.ofcom.org.uk/static/archive/ra/topics/broadcasting/document/vhfreplan/index.htm>

Fixed Service – Fixed Satellite Sharing in the 37.5–42.5 GHz band

Report on sharing criteria for co-existence between these two services. Produced for the UK Radiocommunications Agency.

<http://www.aegis-systems.co.uk/download/vbs2.pdf>

Co-ordination between Broadband Fixed Wireless Access Systems

Report on co-existence criteria for BFWA networks operating in adjacent geographic areas or frequency bands. Produced for the UK Radiocommunications Agency.

<http://www.aegis-systems.co.uk/download/mws.pdf>

3G Mobile Overview

Public workshop presentation on 3G mobile, prepared for Director of Telecommunications Regulation, Ireland.

<http://www.aegis-systems.co.uk/download/3g.pdf>

Sharing Between UWB Automotive Radars and Fixed Service Links at 24 GHz

Report on sharing between UWB automotive radars and fixed links in the 24 GHz band prepared for the UK Radiocommunications Agency.

<http://www.aegis-systems.co.uk/download/uwb-r.pdf>

Building Penetration Loss for Slant-paths at L-, S- and C-Band

Presented at the IEE International Conference on Antennas and Propagation, March 2003.

<http://www.aegis-systems.co.uk/download/ieeicap1.pdf>