THE EFFECTS OF A MARKET-BASED APPROACH TO UHF SPECTRUM MANAGEMENT AND THE IMPACT ON BROADCASTING

By Oliver & Ohlbaum Associates Ltd and DotEcon Ltd

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Digital switch over – the transition from analogue to digital TV and digital radio – presents an important opportunity for spectrum regulators to review the overall use of the UHF (ultra-high frequency) band of the electromagnetic spectrum at 470-862 MHz. Historically, this band has been allocated across Europe for analogue terrestrial television.

As digital technology will allow existing broadcasting services to be supplied using less spectrum, there is scope to use some of the UHF spectrum for alternative applications. This 'extra' spectrum is commonly known as the **'digital dividend'**. The 'digital dividend' is so called due to the benefits to society that can potentially be realised in the form of direct financial exploitation of this 'spare' spectrum or indirect benefits associated with the launch of new services using the spectrum.

This report investigates the potential impact of European countries taking a market-based approach to spectrum management of the UHF band and the impact on digital terrestrial television and radio broadcasting. Our overall finding is that considerable caution is required in determining which market mechanisms are used and how they might be applied to different parts of the band; the optimal approach will also vary across European countries. This finding is based on four key observations:

- There are sound economic reasons why a market for UHF spectrum is likely to fail and not allocate a socially optimal amount of spectrum to terrestrial TV
- This is because terrestrial TV generates significant public value for society that would not be visible in any hypothetical contest for spectrum with other uses, and cannot easily be replicated through provision of TV using other platforms
- The medium-term value that could be created by other uses of UHF spectrum – including rural broadband - appears modest
- The situation in individual European countries is highly varied which severely constrains the scope for a pan-European approach to spectrum management of the UHF band

Markets for UHF spectrum are likely to fail

Used in the right circumstances, market mechanisms can encourage a more efficient use of spectrum and facilitate expansion, entry and innovation in services. However, if the price signals produced by a market mechanism are incorrect, then markets are likely to fail to identify the most valuable services, depriving consumers and society as a whole of large welfare gains. In this report, we identify three particular reasons why markets are likely to fail if applied to the management of the UHF band:

- **High public value** – Some services generate large benefits for society at large that are not reflected in their business value and thus the respective provider's willingness to pay for spectrum.
- **Differences in the business models** – Differences in business models means that some types of provider may be less able to monetise their use of spectrum than others, despite generating large amounts of consumer value
- **Network effects** – Network effects exist where different users' usage decisions are taken independently but affect each other. These impacts may not be captured in a private organisation's willingness to pay for spectrum.

As we explain below, all these factors are present in terrestrial broadcasting. Taken together, they strongly suggest that a hypothetical market contest for UHF spectrum would result in

under-provision of spectrum for terrestrial television, which in turn provides a compelling case for intervention to set aside a proportion of UHF spectrum for digital TV.

Terrestrial broadcasting generates significant public value for society

European broadcasters employed over 2.2 million people[1] directly and indirectly, and invested around €19bn in original European commissioned TV programming[2] in 2006. This is founded on a stable but delicate equilibrium, or "Dual System", where a number of key publicly or commercially funded broadcasters in each market have the scale to invest in high-quality local programming. In 2006 **major public service and commercial channels accounted for 87% of all investment in original European programming** (excluding news programmes). Imposing significant extra cost risks upsetting this equilibrium and **sharply reducing investment in European content.**

However, broadcasting's broader contribution to society dwarfs its size in simple business terms, generating high levels of positive externalities – or 'public value' – for society as a whole. There are two other key factors that would also put terrestrial broadcasters at a disadvantage in a market contest for radio spectrum:

- Most terrestrial broadcasters rely on public funding or advertising business models in order to meet public service objectives, and provide universal free-to-air access. While these funding models deliver high public and consumer value, the broadcasters are less able than alternative service providers, such as mobile operators, to directly monetise the consumer relationship

- The wider benefits of the digital terrestrial platform as a whole are not reflected in the ability of individual channels to pay for use of UHF spectrum

The value that other uses of UHF spectrum would create is modest

Some studies sponsored by mobile operators and equipment makers have claimed that use of UHF spectrum for mobile broadband could generate benefits worth billions of Euros.[3] We call this the **'mobile myth'**. In fact, a closer investigation of the business case behind deploying mobile networks in UHF spectrum suggests there is little substance to these claims and the economic case for mobile in the UHF band in Europe is dubious:

- There is already a large amount of spectrum available to mobile network operators to offer voice and broadband services, including a further 190 MHz at 2600 MHz being made available across Europe.

- Predictions of large benefits from allocating more spectrum to mobile are based on aggressive forecasts for growth in demand for mobile broadband.

- UHF spectrum could be useful for rolling out mobile broadband to rural areas, where distance matters more than capacity, or for improving signal penetration through buildings. However, spectrum available at 450 MHz and 890-900 MHz may be sufficient for these purposes.

- In the mobile industry, the most important factors determining the viability of a spectrum band are the availability of cost-effective network equipment and a large

[1] Forge et al, 2007.
[2] Oliver & Ohlbaum, Prospects for the European TV content sector to 2012, October 2007.
[3] For example, a preliminary report by Spectrum Value Partners in October 2007, sponsored by a group of mobile operators and equipment makers, predicts benefits of €20bn from opening up the UHF band to mobile telephony and broadband.

choice of handsets. The economies of scale necessary to make this happen can only be achieved if there is harmonised availability of spectrum across Europe, but there is little prospect of this happening in the UHF band given pre-existing national decisions on the planning of digital TV.

- Cellular and broadband devices, if deployed in UHF spectrum, could cause significant interference to digital terrestrial TV reception.

The case for rural broadband is weak

The other widely proposed use of the UHF band is 'rural broadband', a stand-alone wireless service for communities that cannot access fixed services. Although the UHF band permits large service area coverage, the available bandwidth will not be sufficient to deliver "true" broadband (e.g. 2 Mbit/s or more) to many simultaneous users, whereas spectrum above 2000 MHz delivers much greater bandwidth and is already available to mobile operators.

Differences in national markets limit the scope for a pan-European approach

Policy makers hope to identify a common sub-band within the UHF band that could be made available for non-broadcasting services across Europe. However, there are two significant obstacles to undertaking such an approach in the UHF band:

- **Existing planning commitments** – Digital terrestrial television's use of UHF spectrum has been laid down by the ITU's GE06 plan that minimises the interference between signals across 108 countries. This plan uses all channels from 21-69 of the UHF spectrum in various parts of the European Union making it very difficult to harmonise any sub-bands across Europe without a major re-planning exercise

- **Requirements for DTT vary** – The requirements for DTT services vary hugely across Europe, reflecting differences in market structures and different social, regional and political priorities

These differences mean that it is almost certainly unrealistic to identify a homogenous digital dividend across Europe in the medium term. Further, if too much emphasis is placed on making spectrum available for hypothetical new uses, there is a real risk that policymakers could lose sight of the need to provide a critical mass of spectrum to support DTT, even though this is an existing service with proven value. Any initiative at the EU level should ideally take a long-term perspective, so as to ensure that each member state can allocate sufficient spectrum to DTT to provide adequate television channel capacity and flexibility to support technology upgrades to HD programming and beyond. In summary, we would make the following recommendations:

- Individual national markets need a critical mass of digital terrestrial broadcasting to ensure a fully functioning, vibrant, universal broadcasting market;

- Broadcast markets are radically different – national regulators should be able to decide exactly what this critical mass of DTT is in their respective market;

- Spectrum planning must allow the flexibility for the future technical evolution of DTT platforms and switch-over phases from old technologies to new, and;

- Regulators should take account of the differing business models of potential bidders, their overall value to society and their ability to monetise consumers – otherwise market mechanisms are likely to fail.

2. Introduction

Across Europe, plans are being made to migrate terrestrial television and radio broadcasting to digital transmission. As the date for full adoption of Digital Terrestrial Television (DTT) approaches, these include the switch off of the existing analogue broadcasts. At Analogue Switch Off (ASO), the broadcast spectrum used for these signals will be available for re-use. How this spectrum is used and managed is currently the subject of considerable debate at both a national and European level.

Broadcasting is a very large and important industry in Europe, generating direct revenues of €77 billion in the EMEA region in 2006[4]. The impact of any changes in the management of UHF spectrum in the region could be far-reaching, not only for the broadcasting sector, but also society more widely.

A valuable national resource: the historical allocation of UHF spectrum

The UHF band of broadcast spectrum (frequency range from 470 MHz to 862 MHz) is particularly well suited to broadcasting uses. Signal propagation is good, meaning that transmissions can be received many miles from the broadcast tower, and signals are reasonably effective at penetrating buildings, allowing reception inside the home.

As this portion of the spectrum is relatively limited, it has historically been allocated to a small number of channels operated by the main broadcasters, either the public service broadcasters (PSBs) or the leading commercial networks. This has generally been done by relevant broadcasting authority. Essentially this was done on a "first-come, first-served" basis and the incumbents dominated the airwaves. In most cases, this spectrum was gifted to the broadcasters. Usually this gift was in return for obligations to provide certain programming deemed to be of social value. In some cases it was subject to a licence fee, but not open to either competitive bidding or to transfer to uses other than broadcasting.

This control of UHF spectrum by incumbent broadcasters continued in every market until the development first of cable networks and then of direct broadcast satellite services. The huge increase in the number of television channels this has caused means there are now many more potential broadcast users of the UHF spectrum.

The characteristics that make this spectrum suitable for broadcasting also make it valuable to other, newer potential users of spectrum, particularly mobile applications. There may therefore be significant competition for the spectrum released at ASO.

New opportunities: analogue switch off and the digital dividend

Most European member states have already introduced DTT services in UHF spectrum, as shown in Figure 1 below. Currently (with the exception of Sweden and Finland which have switched off analogue terrestrial TV signals in 2007), they are running parallel services, transmitting in both analogue and digital. The widespread adoption of digital will allow the analogue services to be switched off, and thus the spectrum will be available for re-use.

[4] Oliver & Ohlbaum, Prospects for the European TV content sector to 2012, October 2007.

Figure 1 - DTT Platform Launch Dates, Number of Channels and Installed Base, 2006

	LAUNCH YEAR	NO. OF CHANNELS, 2006	NO. OF DIGITAL TERRESTRIAL HOMES, 2006 (MILLIONS)
UK	1998	40	7.70
GERMANY	2002	24	1.91
FRANCE	2005	29	3.20
ITALY	2004	33	4.12
BELGIUM	2004	4	0.06
SWEDEN	1999	50	0.75
CZECH REPUBLIC	2005	6	0.04
POLAND	N/A	N/A	-

SOURCE: EBU ANALOGUE SWITCH OFF STRATEGIES IN WESTERN/EASTERN EUROPE; COMPANY ACCOUNTS

This re-use is termed the "digital dividend" as it will provide general benefit to society:

- Either directly, through the financial returns to the national exchequer from licensing the released spectrum;
- Or indirectly, through the removal of duplicate services and the provision of new services (broadcasting or other) to society.

The European commission have also defined the digital dividend as the spectrum over and above the frequencies required to support existing broadcasting services in a fully digital environment, including current public service obligations[5]. An awareness of the value of this spectrum (generated in part by the various auctions for third-generation, or 3G, mobile licences) has led certain authorities to pursue a market-based approach to its allocation.

The future of spectrum usage: a purely market-based approach?

In the debate over what the released spectrum should be used for, a school of thought has emerged which advocates a market-based approach – that the way to attain efficient use of a scarce resource is to let potential users value their applications, and those which can generate the highest value from the spectrum will be awarded the right to use it. This argument extends to all users of this spectrum i.e. including those users already broadcasting DTT on spectrum awarded in previous years, not just new users seeking to use the former analogue spectrum.

This report considers the applicability of these arguments to the broadcast television industry and the effect such market-based mechanisms may have on the television sector[6]. However, many of the arguments outlined in this report relate equally to radio and its use of spectrum.

[5] EC Communication, Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover, 2007

[6] This report assesses the possible effects of a market-based approach to spectrum management of UHF and the impact on digital terrestrial broadcasting by analysing the pan-European market place and also eight individual member states in detail which provide a representative a cross-section of European television markets (Belgium; The Czech Republic; France; Germany, Italy, Poland, Sweden and the UK).

3. The role of the market in spectrum management

The introduction of market-based reform is revolutionising spectrum management, in many cases for the better. Giving the market a greater say in allocation and assignment should encourage more efficient use of spectrum and facilitate expansion, entry and innovation across services and technologies that use spectrum. Market mechanisms do not, however, replace the need for administrative decisions. There will remain an enduring government role in determining whether, when and how to deploy specific market mechanisms, such as auctions, trading and AIP, and the context in which they are used, in particular the scope for opening up specific spectrum frequencies to different services and technologies.

The current and future model for spectrum management in Europe is a 'mixed economy' approach. The use of some frequencies, for example those used by the emergency services or commercial services with high public value, may be subject to enduring controls to safeguard their provision. Meanwhile, decisions on the use of other frequency blocks may be left almost completely to the market.

Why use market mechanisms for spectrum allocation?

Throughout most of the twentieth century, the use of radio spectrum has been determined using central planning by government agencies. These agencies made administrative decisions on:

- Allocation – what type of service and technology is deployed in a particular spectrum band; and
- Assignment – which companies or institutions are granted licences to use the frequencies.

Spectrum engineers were tasked with identifying spectrum bands for specific uses, and these bands were broken up into licences that were directly awarded to a specified number of operators. Within Europe, national agencies coordinated their use of spectrum, so as to ensure that key consumer services (such as television, radio and mobile telephony) were provided in the same frequency bands, and that the risk of harmful interference at national borders was minimised. The UHF band, historically allocated to analogue television, is one of these pan-European planned spectrum bands.

Initially, the central planning approach worked fairly well, as demand for radio spectrum was limited. In the absence of significant scarcity, it made economic sense to focus on distributing spectrum users in ways that minimised interference costs, both between domestic operators and at national borders. Harmonisation of bands across Europe has also helped to bring down equipment costs, owing to scale economies in production.

However, by the 1990s, the planning system was coming under strain. The emergence of new services, such as mobile telephony and wireless broadband, and growing demand for existing services, such as terrestrial TV channels, was fuelling commercial demand for spectrum. Demand at many frequencies now outstrips supply. Historic licence conditions, which define detailed technology and service specifications, make less sense if there are many competing technologies and platforms that can provide the same services. The planning system was widely seen as impeding the launch of new innovative services and restricting scope for greater infrastructure-based competition in downstream markets.

Market mechanisms provide an alternative to central planning, both for allocation and assignment. The market puts resources in the hands of those who value them the most, which is typically (but not always) a good proxy for identifying operators that can deliver the greatest benefits to society. Moreover, in considering how to use spectrum, private

valuations take account of a wide variety of factors, such as take-up assumptions and the relative costs of deploying rival technologies. In the new landscape, mitigating interference is still important, but operators must trade off the cost of spectrum against the relative benefits associated with different deployment scenarios.

Of course, central planners can attempt to replicate the outcomes of markets, but they generally have a poor track record in this regard. Private players typically have better information than regulators for predicting the value of spectrum. Indeed, this information gap is arguably growing with the increasing range of services and technologies competing for spectrum. Regulators are also vulnerable to bureaucratic delays. By contrast, markets can move quickly; price signals can allow rapid redeployment of scarce resources to new or expanding uses and users.

For these reasons, both the European Commission and most national spectrum managers in Europe have looked increasingly favourably on market reforms. Some EU states now use auctions as their standard instrument for assigning radio spectrum. Meanwhile, the EC has called on member states to introduce spectrum trading and remove restrictions on the services and technologies that can use specific bands.[7] Some European states, such as the UK, have already enabled trading and change of use for the majority of commercial spectrum bands.

Market-based mechanisms for spectrum management

Allowing the market a role in determining how and who uses spectrum requires the introduction of market mechanisms. There are four main types of tools available to regulators:

- Change of use (also known as service neutrality) – allowing different types of services and technologies to compete for the same spectrum.
- Auctions – a price-based tool for determining primary assignment of spectrum (and allocation if spectrum use is allowed to be changed).
- Trading – a price-based tool for allowing change of ownership and reconfiguration of spectrum in the secondary market.
- Administrative incentive pricing (AIP) – an administrative tool for promoting efficient use of spectrum by charging a proxy for the opportunity cost.

It is helpful to draw a distinction between 'change of use' on the one hand, and auctions, trading and AIP on the other. Change of use is not really a market mechanism, but rather a policy decision about what type of users can use a specific spectrum band. It sets the context in which the other three market mechanisms (or any alternative administrative tools, such as beauty contests) operate.

Auctions, trading and AIP are all mechanisms for facilitating the assignment of spectrum to users with the highest value and/or encouraging inefficient users to give up spectrum. As we explain below, auctions and trading are proper market mechanisms that rely on price signals. AIP is an administrative tool that attempts to proxy the outcome of an efficient market. None of these tools are exclusive; depending on context, they can be used individually or together for any particular spectrum band.

[7] EC Communication, 2006, Review of the EU Regulatory Framework for electronic communications networks and services, COM (2006) 334 Final.

Change of use

Change of use (or service neutrality, as it is otherwise known) means granting spectrum usage rights holders the flexibility to change service and/or technology. This is by far the most radical element of the market reform agenda. In principle, a shift to a policy of service and technology neutrality opens up the possibility of any type of service or technology being deployed in any spectrum band where change of use is permitted. In practice, the way that spectrum is used will remain constrained to some extent, owing to the physical propagation characteristics of particular spectrum bands and the way that usage rights are defined so as to protect existing users from interference.

The possibility of allowing change of use was not addressed in the original EC Framework Directive. However, it has been adopted by some European regulators (e.g. Ofcom) and the case for more flexible usage of frequency bands for electronic communications is now being actively pushed by the European Commission, for example through the WAPECS initiative in the RSPG. Although the concept of 'service neutrality' has stirred great controversy amongst the European spectrum community, it seems that most regulators now intend to take a more flexible approach to defining usage rights on a band-by-band basis.

Change of use can be applied both to newly awarded usage rights at the primary assignment stage and to existing licences, although the latter is more complicated as it requires a change to existing licence terms. Permitting different uses and users significantly affects the impact of other market-based tools. For example, with auctions, it necessitates defining usage rights and setting up bidding rules that can enable different services and technologies to compete against each other on a reasonably level playing field. With trading, it opens up the possibility of an entirely new service entering a spectrum band, which could radically change the interference environment. With AIP, change of use increases the range of alternative uses available, which may affect the opportunity cost of the existing user and thus the appropriate price level.

A number of studies have suggested that there are potentially very large efficiency gains associated with permitting change of use. For example, a 2002 study by Analysys, DotEcon and Hogan & Hartson found that benefits from allowing change of use and trading across the EU could amount to €8-9bn per annum (increase in consumer surplus) in comparison to the then status quo.[8] The majority of these benefits are associated with increased consumer surplus from earlier introduction of innovative new services. However, it is important to recognise that these studies make two critical assumptions:

- That regulators can effectively redesign usage rights such that new and existing uses are not exposed to unreasonable uncertainty regarding their interference environment.
- That regulators will follow a band-by-band approach to permitting change of use, tailoring the extent of service neutrality so as to protect key services that generate high social value not reflected in their willingness or ability to pay for spectrum.

Introduction of change of use without these safeguards could be very harmful, potentially undermining many potential benefits from reform generally. Moreover, the negative effects would be disproportionately focused on specific public and commercial services that either are particularly vulnerable to interference or offer high social value.

[8] Analysys, DotEcon & Hogan & Hartson, May 2004, Study on conditions and options in introducing secondary trading of radio spectrum in the European Community, Part D.

Auctions

A spectrum auction is the process of buying and selling frequencies by offering them up for bid, taking bids, and then selling the item to the winning bidder. They are usually used by spectrum managers for the primary assignment of spectrum licences (or frequency blocks that can be combined to create a licence) in bands that have not hitherto been awarded or have been reclaimed from previous users. In recent years, auctions have replaced administrative mechanisms such as direct awards or beauty contests as the dominant approach in Europe for awarding spectrum bands whenever there is significant likelihood of excess demand.

Auctions provide a method for determining the market value of a commodity that has an undetermined or variable price. Both situations are potentially relevant to spectrum. Most primary spectrum awards (e.g. the 3G awards) are for a limited number of licences of ten years or longer. In these cases, there may be very limited information from other awards about the value of the spectrum, so it would be very difficult to set a market-clearing price. There are also other types of spectrum licences (e.g. programme making and special events) that have high turnover but where demand may vary over time; in this case, it is easier to predict typical market clearing prices, but auctions could play a role in varying prices so as to iron out peaks and troughs in demand.

Auctions are popular with regulators because they use the price mechanism to identify those users that value the spectrum most highly, and therefore should (usually) provide the highest value service. They avoid the administrative hassle and potential legal minefield of attempting to pick winners. Outcomes are transparent and the process is usually reasonably quick and simple for bidders to follow. They also generate revenues for the public purse that directly reflect the opportunity cost of the use of a scarce, public-owned resource.

There are a wide variety of auction formats that are used for spectrum awards[9], such as:

- *Single round, sealed bids*, in which spectrum lots are awarded to the highest bidders in a one shot process.
- *Simultaneous multiple round auctions (SMRAs),* in which many spectrum lots are sold simultaneously with prices rising over multiple rounds, until there is no longer any excess demand.
- *Combinatorial auctions*, in which bidders may submit package bids for multiple lots instead of bidding separately for individual lots on a frequency or regional basis.

The optimal choice of auction format will depend on the number and type of spectrum lots being awarded, the nature of demand and the policy priorities of the spectrum manager. Often, there may be a number of approaches that should produce similar outcomes. What really matters is that the design is robust to strategic behaviour, offers a reasonably level playing field between different types of bidders (e.g. incumbents versus entry) and encourages all bidders with viable business cases to participate.[10]

If well-designed, auctions are very effective tools for identifying the market value of spectrum. However, there are risks:

- Even if the auction design is good, mistakes in defining the underlying spectrum usage rights may systematically disadvantage one group of bidders over another. For example, in the case that different services are competing for the same

[9] For a description of some of the many formats, see: DotEcon Ltd and Analysys Consulting Ltd, 2006, Introduction of new instruments in spectrum management in Denmark, Section 5.2.
[10] Klemperer, P, 2002, What really matters in auction design, *Journal of Economic Perspective*, Vol 16(1), pp169-189.

spectrum, some types of bidders may be exposed to greater uncertainty over their prospective interference environment, which in turn could lower their valuation of the spectrum and jeopardise an efficient outcome by excluding a higher valued service from obtaining access to spectrum.

- Auctions identify the current market price. If, however, they are scheduled at a time of broader market volatility (e.g. as was the case with many European 3G auctions), then the outcome may appear distorted in retrospect.
- The willingness to pay of bidders may not be reflective of the social value that their use will create. Auctions identify winning bidders purely on the basis of willingness to pay; if some value cannot be monetised and value varies significantly across bidders, then a market outcome may be not be efficient. As we discuss in section four, these risks are increased significantly if 'change of use' is permitted and there are multiple services competing for the same spectrum.

In summary, auctions are a useful tool for primary awards and will typically deliver more efficient outcomes than administrative alternatives. However, both auctions and the underlying usage rights must be carefully designed. Particular attention should be given to the types of uses and users that may be expected to bid for spectrum. The greater the variety of such uses, the greater the difficulty of creating a level playing field across which all bidders can compete. In some case, regulators may face tough decisions about excluding some types of bidders and/or services, so as to avoid creating undue uncertainty for bidders over the interference environment or to protect the social value associated with some uses.

Trading

Trading means allowing change of ownership via transactions in the secondary market. The most common types of trade in spectrum are direct sales or leasing. Such trading of natural resources is commonplace across most sectors of the EU economy, subject to varying degrees of regulatory oversight. A common analogy made with spectrum is the market for land, where private ownership is widespread. Private landowners are free to buy or sell land. However, the way land is used is subject to planning restrictions, which may be reviewed on a case-by-case basis.

Direct transfers of spectrum licences have historically been prohibited in EU countries. However, de facto trading of whole licences via the sale of parent companies has been common for many years. Indeed, in many of the 3G auctions in Europe, operators deliberately bid for licences using holding company subsidiaries, so as to preserve future flexibility. In addition, some spectrum managers have permitted informal trading; for example where two organisations approach the spectrum manager together (one returning a licence, the other receiving it), the regulator is generally unaware of whether a financial transaction or payment in kind is taking place.

Since the introduction of the EC Framework Directive in 2002, member states have had the discretion to introduce formal procedures for trading. Most EU countries have subsequently introduced measures that allow full transfers of existing licences, subject to regulatory approval. Some also allow reconfiguration of licences, i.e. aggregating or breaking up existing licences by frequency, geography or time of access. Typically, trades are subject to prior approval by the spectrum manager, in particular so that it can assess whether there would be any competition concerns in relation to the proposed transfer. However, in some spectrum bands, it is possible to identify classes of trade that can be automatically approved.

In general, allowing trading should be beneficial for both users and society. It provides an incentive for sellers to pass on spectrum to those who value it more highly. As a result,

spectrum becomes an asset that owners can use to raise funds against. Importantly, there is no obligation on any party to sell spectrum, so trades only happen if licensees want to sell. Trading also avoids the need for regulators to reclaim and reassign spectrum that is not being used efficiently.

Most objections about trading really reflect associated concerns about change of use. Trading without change of use is limited to transfers between companies offering similar services and using similar technologies; this is unlikely to have any impact on the interference environment nor significantly affect the level of provision of a service (providing there are competition safeguards). However, trading with change of use may have a more radical impact. New technologies could change the interference environment for other band users not directly involved in the trade. They could also result in reduced provision of an existing service, which might be undesirable if there are externalities, such as network effects or high public value (see discussion in sections four and five).

In conclusion, trading without change of use will typically be applicable to most spectrum. The only exceptions are likely to be where there are specific uses or users that deliver specific public service obligations that cannot easily be provided by other means or by the new users. Trading with change of use is more controversial and requires a band-by-band approach. As with auctions, there will be bands where change of use may not be appropriate, or at least needs to be significantly restricted. Further, in all cases, usage rights must be defined in a way that does not create undue interference concerns for existing users.

Administrative incentive pricing

AIP has been proposed in some European countries (e.g. the UK) for licensees that were 'gifted' their spectrum in return fulfilling public service obligations and general public interests. The rationale is that by setting AIP to reflect the 'opportunity cost' of the spectrum (i.e. its value to the next best user), the incumbent will have an incentive to return or trade underused spectrum.

From a regulatory perspective, this approach offers some advantages. Imposing charges:

- Creates a strong disincentive for inefficient hoarding of spectrum;
- Extracts scarcity rents from users and provides revenue stream for government;
- Avoids the need for administrative decision on reclaiming licences, as users have strong incentives to return or sell underused spectrum; and
- Extracts 'windfall gains' from existing users that did not have to pay the market price for their spectrum.

However, there are some general problems with AIP. Firstly, it is not a true market tool. The price must be set administratively. Given that spectrum markets may be thin or non-existent, there may be no readily available benchmarks for determining the market value of spectrum. Various methodologies have been proposed, for example either modelling the value of spectrum to alternative uses or modelling the costs associated with moving the existing use to an alternative spectrum band or platform.[11] However, these are complex to undertake and subject to large margins or error.

[11] The latter approach, known as the 'least cost alternative' approach is used by Ofcom for determining AIP levels. For more information, see: Indepen, Aegis system and Warwick Business School, 2004, An economic study to review spectrum pricing.

Secondly, the effectiveness of AIP in practice is often reduced because regulators necessarily have a bias towards setting charges at a low level. This is because if they set prices too high, they would choke off efficient demand.

Finally, it is questionable whether the 'stick' of AIP is really necessary if the 'carrot' of trading is already available. In general, the lure of revenues from trading should provide just as strong an incentive as AIP for bidders to sell underused spectrum, provided there is no great asymmetry in the treatment of direct out-of-pocket expenses and opportunity costs. Further, AIP is not relevant in the case that auctions have been used (at least for the initial duration of the licence), as bidders have already paid the full opportunity cost of the spectrum.

In summary, the efficiency rationale for AIP appears rather limited. AIP is not needed if there are auctions and, provided that there is trading, is not necessary for efficiency even if there is no auction.

4. Understanding when markets work and when they fail

Markets rely on price signals as a proxy for the value that different uses and users can generate for society. However, price signals are not necessarily an accurate reflection of relative value-added for society, for example because a service generates significant benefits for the wider public (e.g. enhancements to education or culture) not reflected in the willingness to pay of commercial players. As a result, there are circumstances under which a spectrum market will fail to deliver efficient outcomes, potentially depriving society of large amounts of economic value.

To demonstrate why this is the case, this report presents a 'framework' that places private willingness to pay for spectrum in the context of the various sources of economic value that spectrum use may generate. This framework can be used to identify circumstances where the market might fail to deliver efficient outcomes and where particular market mechanisms may be ineffective. We then consider the application of this framework to the UHF band and to terrestrial broadcasting in particular. It is apparent from this that the risk of market failure is particularly high for terrestrial broadcasting relative to other users owing to the special role of broadcasting in generating sources of economic value that are unlikely to be adequately reflected in the willingness or ability of broadcasters to pay for radio spectrum.

A framework for understanding when markets for spectrum work and when they may fail

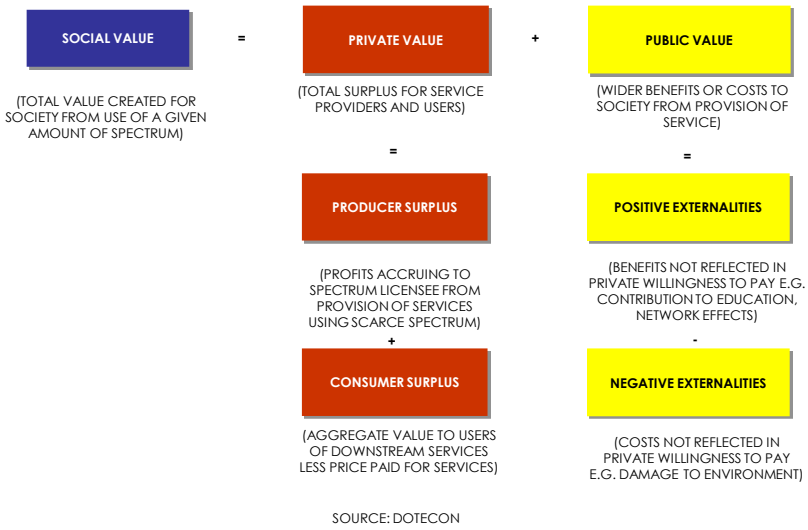
The core objective in spectrum management is to promote efficient use of spectrum. Spectrum is used efficiently when the total amount of value for society created by its use is maximised. We call this 'social value'. Note that what matters here is not the absolute amount of value associated with a particular use of spectrum but the additional benefits to society from a particular service using the spectrum in question rather than some other frequencies, or rather than being provided through other means (e.g. cable instead of wireless transmission). An efficient allocation and assignment is achieved where the marginal social value associated with putting spectrum to different uses or giving it to different users, is equalised across uses and users.

Figure 2 illustrates the core components of social value. There are two main sources of value: 'private value'; and 'public value'.

Private value is created in two ways. Firstly, individual consumers enjoy value-added when they use a service at a price below their value. In economics, the sum of this private value-added across all consumers is known as 'consumer surplus'. Secondly, companies or institutions that provide the service may enjoy revenues that exceed their costs of production; this is known as producer surplus. The sum of consumer surplus and producer surplus is the total private value-added.

Not all benefits (or costs) from a service accrue directly to private consumers and producers. Many types of services also generate external effects that add or reduce value for other members of society. We call this 'public value'. Public value can be positive, for example general educational benefits arising from consumption of a service, or negative, for example damage to the environment.

Figure 2 - The Relationship between Social and Private Value



Markets work by distributing spectrum to those users who are prepared to pay the most. When we allow markets to determine the allocation and assignment of spectrum, we are making an implicit assumption that the willingness to pay of private companies or institutions will be a reasonable proxy for the relative amount of social value that these different uses can generate. However, this is not necessarily the case, as can be seen from the framework outlined in Figure 2. A private company will determine its willingness to pay for spectrum based on its expected future stream of profits, i.e. the expected uplift in its producer surplus relative to: using spectrum in a different frequency band; relying on a technology that does not use spectrum; or not offering services at all. A purely market-driven actor will not give any consideration to the level of consumer surplus or public value.

This means that markets can only be relied upon to produce an efficient distribution of spectrum when the incentives of a purely market-driven actor are aligned with those of a social planner. This requires that:

- Producer surplus is broadly proportional to social value for all competing uses and users, and;
- The market mechanism through which allocation and assignment takes place resembles a competitive market.

If these conditions hold, the maximisation of profits by market participants leads to the maximisation of social welfare. Of course, in practice, we should not expect markets to be fully efficient – what matters is whether we can reliably expect markets to be more efficient than planning in identifying who should be using spectrum and for what purposes. This requires a band-by-band analysis of the reasons why markets might fail and the impact of specific market instruments. For most bands and commercial uses of spectrum, we would expect the market to do considerably better than planning. However, as we explain below, for the UHF band and for terrestrial broadcasting in particular, there are good reasons to be concerned about the market's ability to deliver an efficient use of spectrum.

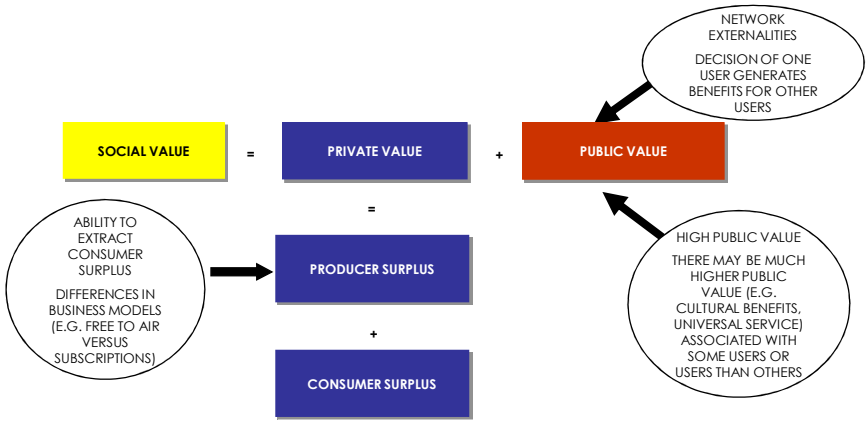
The main reasons why markets may fail

There are many reasons why markets may fail to deliver efficient outcomes. We focus here on three issues of particular relevance to any hypothetical market contest for spectrum that involved broadcasters:

- High public value;
- Differences in business models;
- Network effects.

These possible reasons why markets are likely to fail are shown in Figure 3 below. Any or all of these factors could result in price signals across competing users being unreflective of social value. Of course, whether or not this leads to serious market failure will depend on what uses and users are competing for particular spectrum. If all prospective users plan to deliver similar technologies and services, then the relationship between price signals and social value may not be very important, as funding models may be similar and all services will likely produce similar public value and network effects. The greater the variety of prospective services, the greater the risk that price signals may produce a socially inefficient outcome.

Figure 3 - Reasons Why Markets Are Likely to Fail in Broadcasting



SOURCE: DOTECON

1. High public value

Communication and media services in general provide wide benefits to society not necessarily reflected in private valuations. This is particularly true of broadcasting. As we discuss in section five of this report, a number of studies have demonstrated that television produces a wide range of public benefits, such as promoting education levels and cultural awareness, and supporting a cohesive society. This high public value associated with broadcasting is also reflected in public policy initiatives that set aside radio spectrum for broadcasters and specify universal coverage and content obligations. Other uses of spectrum, such as mobile telephony, also generate some public value, but this appears modest relative to broadcasting.

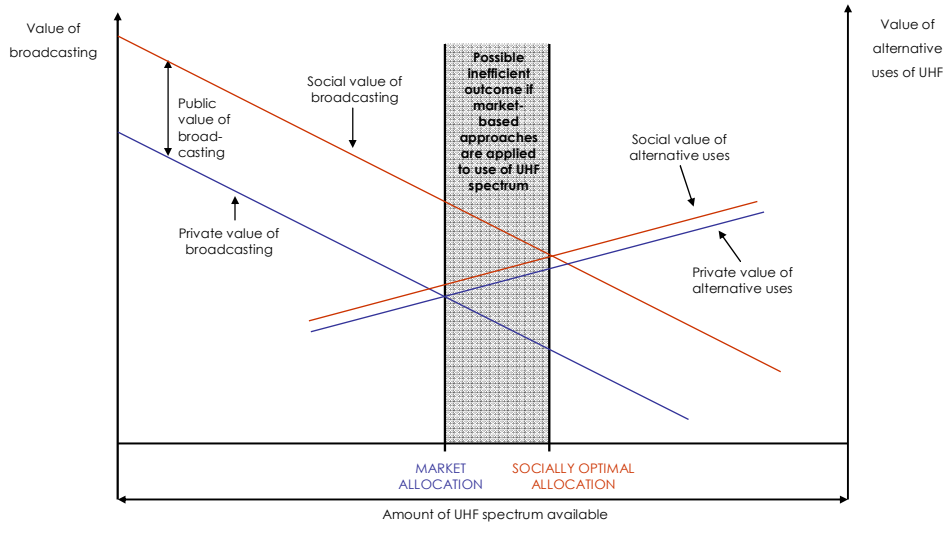
Public value of broadcasting is primarily associated with content and availability of channels. Creation of public value depends on attracting an audience; and some forms of public value depend on the diversity of the audience. Nevertheless, there is no reason to expect close correlation between private value and public value of channels.

Variation in public value - both within broadcasting and between broadcasting and other services - suggests that there may be a material risk of market failure if allocation and assignment is left entirely to the market. Specifically, if uses and users that generate high public value are forced to compete head-on with those that generate only modest public value, then the result will be that too little spectrum is allocated to users generating high public value.

Consider the example in Figure 4 below. Suppose that a spectrum band is to be divided between broadcasting and alternative uses. The marginal private value created by granting additional spectrum to broadcasting compared to the marginal private value created by granting additional spectrum to alternative uses is shown by the two sloping blue lines. The orange sloping lines plot the marginal social value (i.e. private plus public value) created by granting additional spectrum to broadcasting and to alternative uses. Note that the diagram illustrates a case where the public value associated with broadcasting is significantly greater that the public value associated with alternative uses.

The efficient outcome, which maximises value for society is determined by the intersection of the two orange lines (as represented by the right-hand vertical black line). Spectrum to the left of the intersection should be allocated to broadcasting and spectrum to the right should be allocated to alternative uses. However, if the decision is left to the market, the distribution of spectrum will be determined only by private values, which is the intersection of the two blue lines. In this case, a smaller amount of spectrum is allocated to broadcasting and a larger amount is allocated to alternative uses. As a result, the total value realised for society is less than the level that could have been realised if public value had also been taken into account.

Figure 4 - Why Markets Might Fail in the Allocation of Spectrum in Broadcasting



SOURCE: DOTECON

In relation to the supply of UHF spectrum for terrestrial television, the risk of market failure will depend on the scale of public value associated with broadcasting services in EU countries, and the extent to which realisation of this public value is specifically associated with the UHF band. We explore these points further in sections five, six and seven, where we argue that public value is indeed very large and that a significant proportion of this may be specifically associated with terrestrial television.

2. Funding models

Many spectrum users operate business models based on subscriptions and direct sales to end-users. Therefore (absent market power concerns), their revenues and profits, and thus their expected producer surplus, should be closely correlated to the value of their services to end-users. However, this is not necessarily true for broadcasters where a free-to-air funding model is common:

- Commercial free-to-air broadcasters rely primarily on advertising revenues.
- Publicly owned broadcasters are variously financed by licence fees, advertising revenues, and government grants and typically operate on a not-for-profit basis.

For many commercial broadcasters, willingness to pay for spectrum depends on expected advertising revenues (and the associated producer surplus), which in turn depends on the value placed on their services by advertisers, rather than from viewers. Even though demand from advertisers is linked to the *number* of viewers, it is not necessarily strongly related to the *value* that viewers place upon the broadcaster's service. Therefore, there is no reason to expect the willingness to pay for spectrum of commercial broadcasters to be closely correlated with consumer surplus of viewers.

Publicly funded broadcasters' ability to pay for spectrum is also constrained – in many countries public funding of broadcasting is under pressure. Note that there are good economic and public policy reasons in support of the free-to-air funding model, which can be expected to generate relatively high consumer surplus (and thus social value), as there is no exclusion of consumers. Further, terrestrial broadcasters may also have limited scope to switch to alternative subscription funding, owing to universal coverage obligations and entrenched consumer expectations of free television.

These differences in funding models between terrestrial broadcasters and other services may lead to market failure. Specifically, if free-to-air broadcasters are competing for spectrum with other uses, they may be at a disadvantage because their willingness to pay does not adequately reflect the consumer benefits that their use can generate. Furthermore, any additional costs placed on them (such as the need to pay market prices for spectrum) may actually reduce their value – as their funding is essentially fixed, any new cost will have to be met by reducing funds available for programming. The impact of this would be that the market would allocate insufficient spectrum to free-to-air broadcasters. We explore the extent of impact of differences in funding models further in section five.

3. Network effects and externalities

Network effects (or externalities) describe the positive linkages between private users that may not be captured in private willingness to pay. Channels on a digital terrestrial platform compete for audience share with each other. However, DTT as a whole also competes with other platforms (e.g. cable, satellite) for viewers. The attractiveness of platforms depends on the portfolio of channels being available – viewers want both choice of channels and content. Each channel contributes to the attractiveness of the platform and thus generates benefits for other channels, which are not reflected in the broadcaster's willingness to pay (i.e. they are network externalities).

The existence of strong network effects in DTT imply that insufficient spectrum may be allocated to DTT based purely on willingness of individual, independent broadcasters to pay for spectrum. Network effects may also exist for other potential uses of UHF spectrum and may be asymmetric across potential uses. However, they appear particularly strong for DTT, as this is typically an open platform shared by a number of different broadcasters (whereas competing uses are typically closed platforms with a single operator that can internalise

network effects across a range of services). Even where subscription-based services share a DTT platform, the attractiveness of these may depend on the nature and availability of free-to-air services sharing the same platform. Again, we explore these relationships between channels further in the following sections.

Implications for the use of market mechanisms in the UHF band

These initial observations, backed up by the evidence presented in subsequent sections of this report, suggest that there would be a significant likelihood of market failure if the allocation and assignment of UHF spectrum were left entirely to the market. More specifically, terrestrial broadcasting would likely be significantly under-supplied (perhaps not even supplied at all in some countries) relative to the social value that it generates.

For incumbent broadcasters, change of use of the UHF band does offer some potential advantages. The value of their spectrum holdings may increase. They may also take the opportunity to use spectrum for provision of new types of media services, such as mobile TV. However, change of use presents two potential threats outlined below.

- First, any increase in the market value of spectrum, owing to demand from non-DTT services, may hinder the scope for improving the DTT platform over time, keeping it up-to-date and competitive with other television platforms such as satellite and cable. In particular, competition for scarce UHF spectrum may reduce the flexibility for broadcasters requiring extra capacity needed to launch high-definition services. Launching high-definition channels will require a "simulcasting" period where the existing standard-definition channels and new high-definition channels will need to be broadcast in parallel for some time, requiring extra capacity.
- Second, if trading results in broadcast spectrum being switched to alternative use, the overall attractiveness of the DTT platform may be reduced owing to network effects. In the worst case, the viability of the DTT platform could be threatened. As discussed in later sections, this could lead to the loss of significant public value associated with terrestrial television.

The risk of market failure is primarily associated with the introduction of 'change of use' in the UHF band. Depending on local circumstances, the risk of market failure could be foreclosed by 'ring-fencing' all or some of the available spectrum for terrestrial broadcasting. In practice, this is already the approach that most European regulators are taking; the question therefore is whether they have ring-fenced enough spectrum. Furthermore, depending on how 'service-neutral' usage rights are defined, the actual scope for change of use may anyway be limited. Specifically, in the UHF band, the scope for change of use will necessarily be constrained by requirements to protect incumbent DTT use from interference. The existence of public service obligations on some broadcasters may also limit the scope for change of use (as may be no alternative way of fulfilling obligations).

The impact of other types of market mechanisms largely depends on whether they are introduced with or without change of use. For example, in the UHF band, auctions and trading might be used to:

- Assign DTT capacity to broadcasters and allow broadcasters to buy and sell multiplex capacity (no change of use).
- Assign digital dividend spectrum to competing uses, e.g. DTT multiplexes versus mobile TV versus wireless broadband, and allow these different types of users to buy and sell spectrum with each other.

The differences between these two approaches are significant. In the first case, DTT broadcasting capacity is ring fenced and auctions and trades only determine the assignment of licences to broadcasters. There may still be market failure concerns related to the provision of particular types of channels and content, but the risk that broadcasting services may be replaced by non-broadcasting services with lower public value is foreclosed. In the second case, the auction or trades determines allocation between broadcasting and other uses (as well as assignment). As bids will be based on private valuations, the outcome may not be efficient if:

- There is significant public value associated with particular uses (e.g. broadcasting) not reflected in willingness to pay.
- Differences in funding models mean that willingness to pay for spectrum of free-to-air broadcasting understates the relative level of consumer surplus they produce.
- There are network effects between broadcasters, such that a change in service resulting from a trade impacts on demand for another broadcasters' services.

Decisions about the use and level of AIP are also significantly affected by whether there is change of use. If spectrum is ring-fenced for broadcasting, then it is government not broadcasters that are denying alternative use, so opportunity costs should only be set with regard to marginal broadcasters.

With or without change of use, there are a number of specific difficulties with attempting to apply AIP to broadcasting. Firstly, an efficient AIP level should take account of externalities (public value, network effects), which are very difficult to quantify. Secondly, spectrum licences often have associated public service obligations, which mean that broadcasters may not have any alternative to using spectrum. In this case, AIP is simply an unavoidable tax as it has no impact on incentives to hold the spectrum. Finally, AIP will reduce funds available for programming, unless offset by alternative funding arrangements.

In conclusion, the biggest issue for the UHF band is 'change of use'. Opening up some of the spectrum to new uses may generate significant benefits. However, on a country-by-country basis, if sufficient spectrum is not ring-fenced for broadcasting, new uses could displace socially valuable services, resulting in inefficient spectrum use and lost economic value. Auctions and trading work best when competing uses are expected to provide similar services, or where there are no clear public policy grounds for favouring a particular type of use. Given the specific market failure concerns associated with terrestrial broadcasting in the UHF band, governments should think very carefully about when and how to use auctions and trading for different parts of the UHF band, and whether they should be applied with or without change of use. Meanwhile, AIP does not appear to offer any great benefits that cannot be achieved by other market tools.

Having highlighted the risks associated with exposing terrestrial broadcasting in the UHF spectrum band to a broad-based market approach, we now turn to a more detailed analysis of the role of terrestrial broadcasting and alternative uses. Specifically, we consider why broadcasting may be different from other uses and requires a different approach to spectrum allocation; why certain alternative uses of UHF spectrum may be less efficient than broadcasting; and how national member state broadcast markets differ. These three key subjects are analysed in sections five, six and seven below.

5. Is broadcasting different? The difficulties of applying market-based approaches to spectrum allocation in broadcast markets

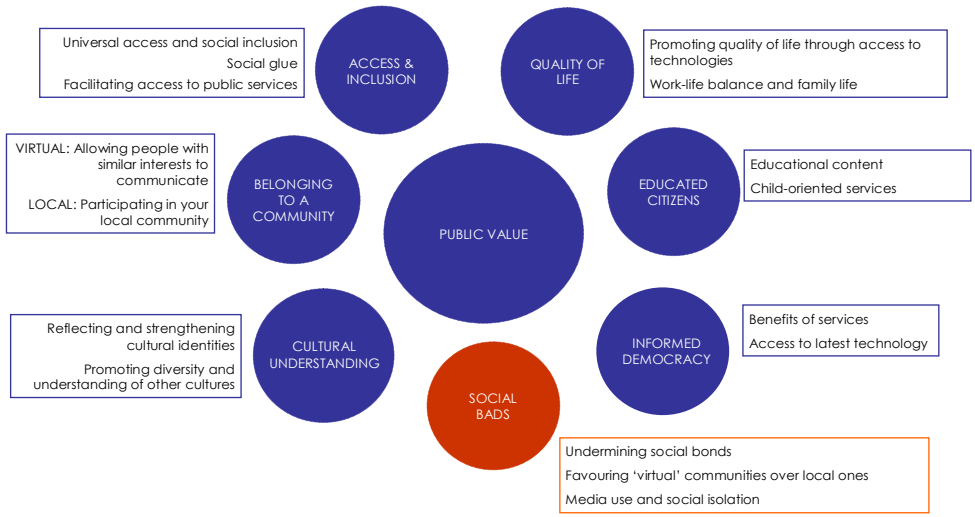
As discussed in the previous chapter, there are a number of reasons why market-based mechanisms are likely to fail to deliver an efficient allocation of spectrum to different uses. In this section, we consider whether broadcasting is different to other potential competing uses of UHF spectrum. Specifically, we assess whether the high levels of public value associated with broadcasting justify intervention in the market to ensure that public policy objectives are met and that an efficient allocation of spectrum to terrestrial television occurs.

1. Broadcasting generates high public value

Broadcasting is one of the few truly universal services, enjoyed by every segment of society. As well as generating huge private value for viewers, television also generates positive externalities – which we call 'public value' – for society as a whole. The ways in which television contributes public value are many and various. A report in 2006 for the UK regulator, Ofcom identified six categories of public value, as illustrated in Figure 5.[12]

A brief description of each of these categories is provided below. It is apparent from this analysis that while the public value of broadcasting in general is high, it is disproportionately so in relation to terrestrial broadcasting. Further, the roll-out of DTT promises to increase the breadth and depth of the television experience provided to viewers

Figure 5 - Sources of Public Value from Broadcasting



SOURCE: DOTECON; AEGIS; ANALYSYS; MASON (2006 ANNEX C)

Educated citizens (educational content, child oriented services)

There are numerous positive externalities associated with education. Some of these are economic in terms of the contribution to the labour market of a more skilled, numerate and literate public while others are based on the knock-on democratic effect of having more educated citizens, able to make better informed choices. The educational benefit of television has been surveyed in detail by Christina Holtz-Bacha and Pippa Norris[13]. This

[12] This list is derived from work undertaken by DotEcon and Dr Damian Tambini for Ofcom, as part of Ofcom's Digital Dividend Review.
[13] Holtz-Bacha, C and Norris, P, 2000, To Entertain, Inform and Educate: Still the Role of Public television in the 1990s?, Political Communications, 18(2).

research, based on Eurobarometer survey data, demonstrates a strong association between news viewing and political knowledge, and also found that this was stronger when public TV news was chosen. It is widely accepted that there is a "virtuous circle" whereby stronger knowledge is reinforced by viewing television news and other educational content.

Informed democracy (benefits of services, access to latest technology)

Informed democracy requires citizens to be provided with information about those issues that are matters of political and industrial controversy at any particular time. It is also concerned with empowering citizens to obtain information that relates to issues that concern them, and in which they have an interest. Many of the arguments described above for education also hold true for the role of UHF delivered broadcast services in relation to democratic communication.

Despite overall audiences for new programming slowly declining, television news retains its position as the pre-eminent source of political information for European citizens. Notably, the role of new services, such as the internet, as sources of news is limited, by comparison with the traditional sources of news such as television[14]. In addition, despite the slight decline in overall television viewing and also viewing of news programming, TV still remains the main source of new information and has retained this leading role for the past decade, despite the rise of new platforms and services.

Cultural understanding (reflecting and strengthening cultural identities; promoting diversity and understanding of other cultures)

Cultural, national, regional and ethnic identity is emerging as one of the centrally important social questions of the current period. Cultural understanding as a subject is very broad, and includes at least three separate forms of value: strengthening of national identity through mainstream broadcasting; strengthening and recognising immigrant groups; and the separate objective of ensuring interconnections and communication between groups.

Television may create positive or negative externalities in terms of their impact on cultural understanding. On the one hand, TV programmes may expose society to new perspectives and open up new possibilities for individuals and groups to communicate across cultural, ethnic and regional boundaries; on the other hand, some programming could also narrow users' outlook and confirm prejudices. Equally, TV programming also plays an important role in maintaining of national or local identities; offering a social glue that may bind otherwise disparate communities. Overall, with appropriate public policy guidance and/or internal governance, television services are possibly the most important instrument for delivering public service through the promotion of cultural understanding. By contrast, alternative uses of UHF spectrum, such as mobile telephony, are likely to make little impact in this area.

Belonging to a community (either 'virtual' in the form of connecting with other people with similar interests, or 'local' in the sense of participating with local community)

Television continues to be seen as a medium that can connect you to your community by providing news and information about issues and events. It provides a forum for discussion of local issues and can foster a sense of pride and commitment to community issues. This is an important source of public value.

Terrestrial broadcasting offers uniquely high public value relating to community building due the strength of free regional broadcasting services and also opening up communities associated with specialist interest groups (in addition to social, demographic, geographical ethnic communities). Furthermore, digital terrestrial broadcasting has the potential to

[14] Ofcom, The Communications Market 2005, page 266.

significantly enhance the public value generated by community building due to an increased focus on provision of local broadcasting services, particularly in markets such as Spain and Italy where local broadcasters are able to offer a greater number and variety of services due to the increased capacity of the platform.

Access and inclusion (social inclusion and universal access, 'social glue' provided by common references and access to public services)

There are two aspects to access and universality. On the one hand, extending access to previously excluded groups can release broader social value; on the other, achieving universality releases significant further value and network externalities[15]. The European Commission Universal Service Directive describes universal service as "the provision of a defined minimum set of services to all end-users at an affordable price". Indeed, Brookes argues[16] that there are significant network externalities involved in the value generated when large numbers of viewers access the same broadcasts: "Social capital results from broadcasting through externalities. These are a source of market failure in economics. A particular type of externalities creates social capital – network externalities. My enjoyment of a programme increases the more my friends or colleagues have also watched it and can talk about it – there are positive external effects from people watching the same programme".

Quality of life (promoting quality of life through access to technologies; work-life balance; and family life)

According to the EC Communication of 2005: "As the use of ICT grows, so does its impact on society". This i2010 statement recognises this in three ways: "making sure that ICT benefit all citizens; making public services better, more cost effective and more accessible; and improving quality of life"[17]. It is clear that digital terrestrial broadcasting improves the quality of life of European citizens not only through sources of public value outlined above but by including public service broadcasting values, being cost effective and universally accessible.

Social bads associated with broadcasting are minimised by terrestrial television services

Broadcasting and associated interactive services may also generate social bads in addition to the high levels of public value outlined above. While broadcasting contributes to broader social value in many ways, viewers sometimes also perceive them as responsible for undermining social bonds and creating social isolation.

However, it should be noted that while it is important to recognise that such social bads may result from broadcasting service provision; these are true for all forms of broadcasting on all platforms. The higher audience share for and greater influence of public service and commercial broadcasters on the terrestrial platform, compared to alternative platforms, minimises the impact of such social bads generated by terrestrial broadcasting.

2. Broadcasting business models are different

Market mechanisms can only be reliably expected to function efficiently if the business models of rival bidders are sufficiently similar to enable them to use the same valuation framework for spectrum. The main broadcast networks, including public service

[15] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive).
[16] Brookes, M, 2004, 'Watching Alone: Social capital and public service broadcasting', page 6.
[17] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, i2010 - A European Information Society for growth and employment, {SEC (2005) 717}.

broadcasters, that operate on terrestrial broadcasting platforms across Europe, typically use either a free-to-air, advertising-based funding model and/or rely on public funding. This non-exclusionary approach can generate a very large consumer surplus, as programming is available to huge audiences, who will likely place a large range of values on accessing particular channels and shows.

As we discussed in the previous section, for a market to function effectively, it is important that there is a consistent correlation between expected consumer and producer surplus across all potential spectrum users. Unfortunately, in this case, the difference in funding models means that we cannot assume that such a correlation will exist. For advertising-funded television, producer surplus is linked to the consumer surplus generated by advertisers not viewers, which suggests a significant risk that spectrum valuations will not adequately reflect the true benefits to viewers. For public funded television, there may be a more direct relationship between willingness to pay for spectrum and expected consumer surplus, but this still depends on availability of funds from government, as such entities typically operate on a not-for-profit basis.

In summary, we cannot be sure that the value that consumers place on terrestrial broadcasting services will be adequately reflected in the business models of the main broadcasters and thus their willingness to pay for spectrum relative to other types of users. Therefore, these broadcasters may be unable to compete on a level playing field with alternative potential users of spectrum that can more easily monetise the value that consumers place on their services. Further, this disadvantage faced by free-to-air broadcasters is likely to endure for the foreseeable future, given the strong public policy preference in Europe for provision of a critical mass of services free-to-air on the terrestrial platform.

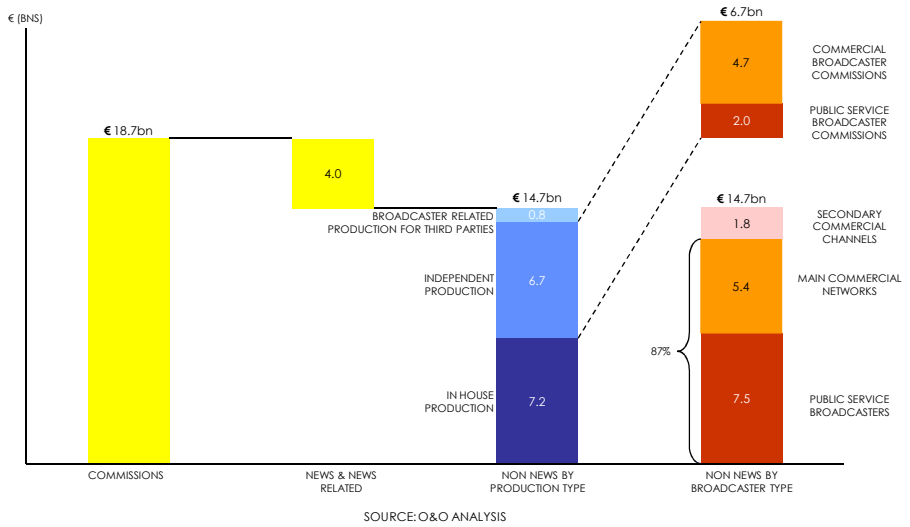
Investment in high-quality original European programming threatened

Europe has a vibrant, varied and sizeable television content industry. This has, to a large degree, been nurtured and sustained by the television industry ecology in Europe, and is particularly dependent on the large free-to-air broadcasters. As Figure 6 shows below, in 2006, public service broadcasters (PSBs) and major commercial networks accounted for 87% of all new European programme commissions (excluding new programmes).

Any disruption in either the economic model or the availability of universal distribution for these channels would have a significant effect on the content sector. The current industry structure is in a stable but delicate equilibrium with a number of broadcasters in each market having the scale to invest in substantial original content commissioning. Opening the sector to full market mechanisms would upset this equilibrium. The funding models of the major broadcasters described above have little scope for increasing revenue to meet new costs likely to be associated with market-based mechanism for allocating spectrum. The increased costs of spectrum would therefore lead to significantly less funding available for investment into new content.

The European television content industry being diminished would also have significant impact on exports, where in addition to the direct financial loss, the intangible benefits of representing European culture through programming exports would also suffer.

Figure 6 - European Television Content Value Chain, 2006

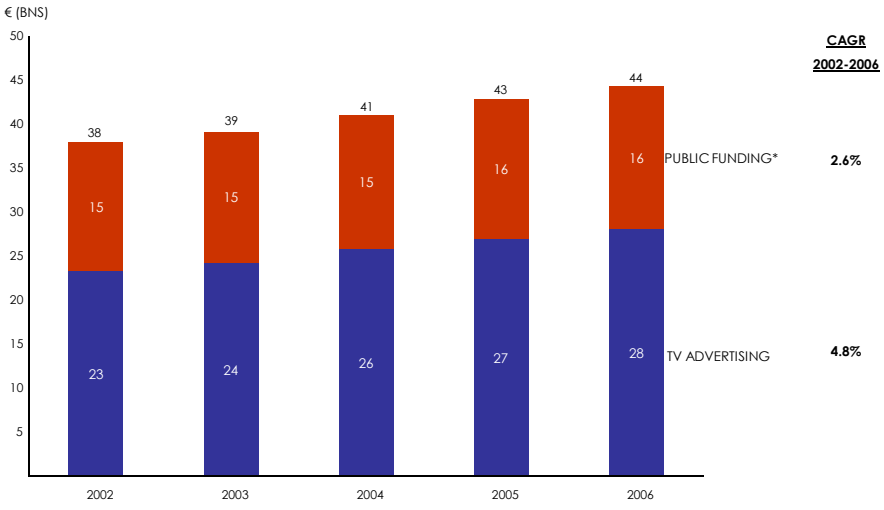


SOURCE: O&O ANALYSIS

Broadcaster business models under pressure

Because broadcasting business models are necessarily different, broadcasters would be unable to compete in the open market against such alternative service providers for spectrum. The problem is further compounded by the fact that in Europe the broadcasting business models are under increasing pressure. Figure 7 below shows that between 2002 and 2006 public funding and licence fee revenues grew at a compound annual growth rate of only 2.6%, the result of a prevailing desire of individual member state governments to tightly control such funding and to look to extract increased operating efficiencies from public service broadcasters spend.

Figure 7 - European TV Revenues from Public Funding and Advertising, 2002-2006



COUNTRIES INCLUDED: AUSTRIA, BELGIUM, DENMARK, FINLAND, FRANCE, GERMANY, GREECE, IRELAND, ITALY, NETHERLANDS, NORWAY, PORTUGAL, SPAIN, SWEDEN, SWITZERLAND, UK, CZECH REPUBLIC, HUNGARY, POLAND, ROMANIA

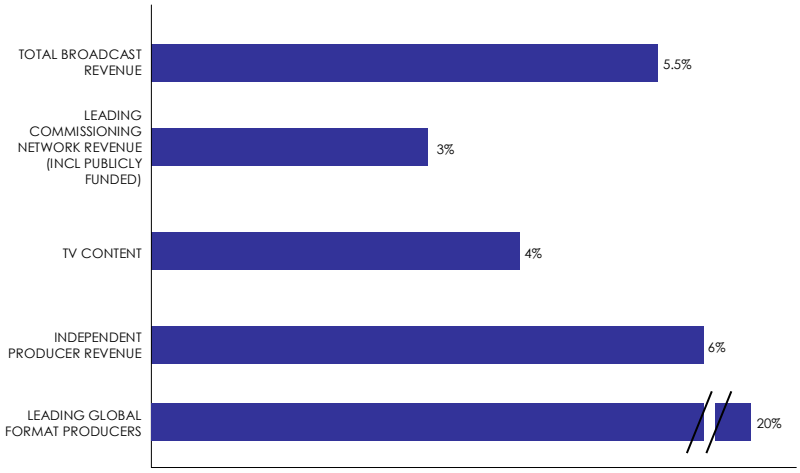
SOURCE: PWC *INCLUDES LICENSE FEES AND GOVERNMENT GRANTS

At the same time, advertising business models are increasingly under pressure. TV advertising grew at a compound annual growth rate of 4.8% across Europe between 2002 and 2006, as shown in Figure 7 above. However, the revenue growth rate for major commissioning broadcasters in Europe, including public service broadcasters, was only 3% between 2001

and 2006, as shown in Figure 8 below. Going forward, it is likely that this growth will slow further as TV advertising markets continue to struggle. Advertising business models have come under pressure due to channel fragmentation resulting from increasing multichannel penetration eroding individual channel audience share over time. In addition channels funded by advertising have seen revenue growth limited by the impact of Internet-based advertising taking advertising spend that might otherwise have been spent with broadcasters.

At the same time, the cost of production is rising faster than the revenues so squeezing margins and the ability of broadcasters to absorb additional cost associated with any market-based approaches to UHF spectrum allocation through competition for such spectrum with non-broadcast players. Spend on TV programming is growing at a compound annual growth rate of 4%, as shown in Figure 8 below, a cost that is growing faster than the overall revenue growth for major commissioning broadcasters. Cost inflation for certain genres is particularly high such as that driven by rapidly growing competition for premium content rights including high-quality US imports and sports rights as well as the relatively new and still underexploited genre of formats.

Figure 8 - European TV Content Sector Estimated Annual Revenue Growth, 2001-2006



SOURCE: O&O ANALYSIS

The resulting squeeze on traditional broadcaster business models, from a revenue and also a cost perspective, means that they are unable to absorb additional costs that might result from the application of market-based approaches. This is a result of historical positioning due to the need to retain a free-to-air status, as applies to a critical mass of terrestrial television services, and also the resulting desirable impact on society from the generation of high levels of public value.

Were broadcasters are exposed to additional costs and competition the likely result would be a decline in ability to spend on quality programming content. This would mean that there would very likely be a decline in high quality but expensive genres such as drama and original fiction and an increase in less risky cost efficient formats, while premium US imports and high-value sports rights would increasingly migrate to premium pay-TV services that are better positioned to compete for such programming genres due to their ability to extract a high level of private value from the market. The result would be a distinct drop in the levels of public value generated from terrestrial broadcasting activities.

3. Network effects and the possible distortion of broadcasting markets

As outlined in section three of this report, each channel on the terrestrial platform contributes to the overall attractiveness of the platform, which competes more widely with other platforms (e.g. cable and satellite). Thus, channels on the same platform are not only competitors but also complements; the existence of one channel may thus generate benefits for other channels which are not reflected in the broadcaster's willingness to pay for spectrum (a network externality). Consequently, the relative attractiveness of the terrestrial broadcasting platform, when compared to alternative broadcast platforms, could be threatened by any market fluctuations and distortions that might occur should market-based approaches to UHF spectrum management and the concept of service neutrality be applied to it.

Markets can be distorted by periodic fluctuations such as economic bubbles, such as the dot com boom and bust, which may distort relative ability of players to pay for spectrum. This could also lead to major price fluctuations making business planning processes uncertain for broadcasters in an increasingly unstable environment. In theory, short and medium-term deviation from the efficient allocation, owing to market volatility, can be corrected over time through spectrum trading. However, in practice, the market for spectrum is unlikely to be sufficiently liquid to guarantee such an outcome.

Further, a loss of critical mass of television provision and/or concentration of spectrum in the hands of a few spectrum users could damage or even prevent a plural and diverse broadcasting market from operating. The financial strength of global media conglomerates and large telcos, which both generate high private value or new growing players such as dominant web search engines and also consumer software vendors, could allow them to bid for and then control spectrum. This could be on the basis on unproven business models or in order to simply prevent alternative users acquiring valuable spectrum.

Broadcasting is particularly vulnerable to disruption of service continuity

The consequence of any possible distortion of broadcasting markets outlined above could have long-term and permanent consequences for broadcasting and also the ability to derive consistently high public value from terrestrial services using UHF spectrum. Broadcasting relies on consistent brand management and the long-term development of brand and audience loyalty which is built up alongside cultural equity associated with many established media brands. This is true both at the channel and platform level.

Equally channel business models are built on long-term investment in content and audience development over significant periods of time. The introduction of market-based tools for the management of UHF spectrum, and therefore the introduction of higher risk associated with new investment combined with a lack of certainty of being able to plan beyond a specific spectrum licence window, could seriously disrupt the ability to invest for the long-term. This might undermine a channel's position in a national market. Given the added uncertainty that market-based tools might introduce to terrestrial broadcasting markets there would also be greater barriers to entry for new channels and TV services looking to enter the market.

If market-based approaches to the spectrum management of UHF were to be introduced then the potential negative impact on public value generation could lead to the creation of a two-tier broadcasting system with a low value free-to-air terrestrial platform serving marginalised demographic groups, principally older and more downmarket audiences unable and or unwilling to take a premium pay-TV service.

6. Why UHF spectrum is most suited to broadcasting and the limitations of alternative uses

At present, around half of the spectrum commonly referred to as ultra high frequency (UHF) is used for television broadcasting. Around Europe, 392 MHz of spectrum at the lower end of the UHF band is used for television services, from 470 to 862 MHz, but this part of the spectrum is seen as one of the most highly valued parts of the entire spectrum. The reason for the high value commonly associated with the lower part of the UHF band is due to its excellent propagation characteristics. This makes the UHF band highly flexible for a range of services as well as being highly efficient in terms of cost of roll-out.

This chapter assesses the reasons why UHF spectrum is particularly valuable to broadcasters and other potential users and analyses the feasibility of being able to make use of the lower part of the UHF band for alternative services. There are significant legacy technical reasons why the lower part of the UHF band might only be of limited value to mobile service providers, the most likely alternative user of UHF spectrum.

UHF spectrum is particularly suited to broadcasting

The lower part of the UHF band was used for the introduction of television purposes primarily because this part of the spectrum offers particularly good signal propagation characteristics with the optimal combination of range and capacity compared to other parts of the spectrum. This feature of the UHF section of the spectrum allows users to minimise the investment required to build and maintain broadcast transmitters or base stations.

Digital terrestrial broadcasting and the use of specific spectrum channels

It can be argued that the broadcasting industry's use of UHF spectrum could be more efficiently used and harmonised within certain sub-sections of the band. This frees up region-wide spectrum bands for alternative uses. However, there are significant technical, logistical and economic reasons why digital terrestrial broadcasting plans cannot be changed.

Traditionally, multi-frequency networks have been used for broadcasting around Europe, where different UHF channels are used to provide similar services from different transmitter sites. The use of multi-frequency networks has allowed broadcasters to maximise the reach and coverage area of broadcast signals from a minimal number of transmitter sites, dependant on the given geography within any particular region.

Multi-frequency networks have allowed broadcasters to minimise the interference between signals from different transmitter sites by using different channels within the UHF spectrum to broadcast services in adjacent regions. Upon the launch of digital terrestrial TV services it was therefore crucial to broadcast new digital signals in channels not used by analogue signals but receivable by roof-top aerials already used in each particular region. Television aerials are designed to work most efficiently over a narrow range of frequencies, generally between 20 and 30 channel ranges. For example, a narrow-band aerial may allow the reception of signals carried in UHF channels 21-37 while a wide-band aerial may be able to receive most channels carried in the section of the UHF spectrum used for broadcasting. In general, a house is fitted with the aerial most appropriate to the local transmission signals.

Wideband aerials are not widely used around Europe and so any decision to move TV channel frequencies in any particular region will involve significant hidden cost to individuals needing to replace equipment – the typical cost of an aerial replacement is €100-200.

The value created by terrestrial broadcasting cannot be captured by other platforms

There is extremely high public value associated with digital terrestrial broadcasting use of UHF spectrum, as outlined in previous chapters. This value cannot be fully captured by use of alternative platforms, due to the increased cost to viewers of obtaining and/or lack of availability of cable, satellite or IPTV services. Without a strong digital terrestrial platform offering in European markets, significant public value will be lost.

The need to retain the competitiveness of DTT broadcasting platforms

A key element of public value generated by digital terrestrial broadcasting is that created by being a free-to-air service requiring only the purchase of reception equipment and the paying of any appropriate licence fee. Indeed a multichannel offering enabled by digital terrestrial broadcasting increases the public value associated with the platform in relation to cable and satellite pay-TV platforms by offering a much greater range and choice of broadcasting services.

In order to avoid any future loss of public value generated by digital terrestrial broadcasting, it will be essential to maintain the value of free-to-air proposition and its appeal and competitive strength when compared to alternative TV platforms available within and across national markets. Central to maintaining the strength of the digital terrestrial platform offerings in Europe will be to enable the perpetual roll-out of the latest technologies and new innovative services that will be adopted and launched by competing broadcast platforms to gain competitive advantage and offer better value for money to consumers.

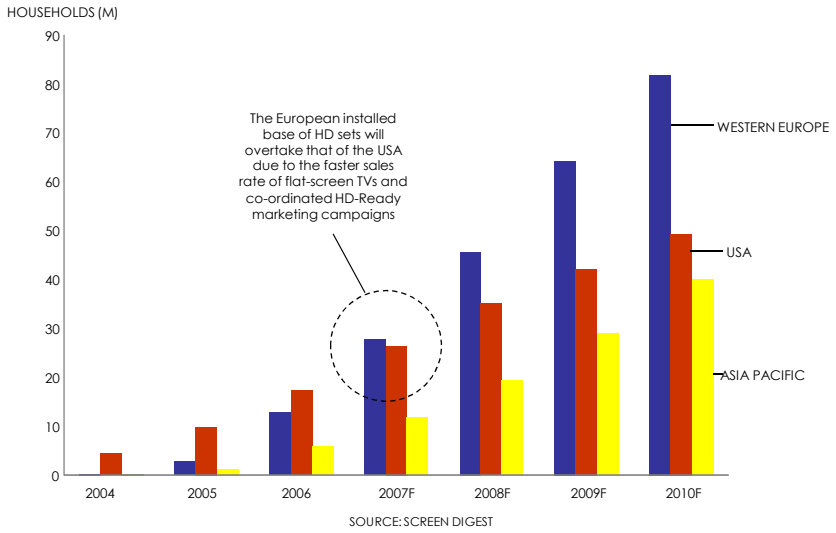
High-definition required on DTT platforms to retain European competitiveness

Currently, the key technology that requires concerted and coordinated action to introduce on DTT is high-definition (HD) broadcasting. HD service provision will require the dedication of significant amounts of bandwidth, contentious in the already constrained parameters of UHF broadcasting spectrum. Typically between 8 and 12 Mbits/s will be required to broadcast a HD channel, using the latest MPEG-4[18] compression standards, compared to around 3 Mbits/s for a standard-definition (SD) channel today broadcast using MPEG-2 technology. In order to provide HD TV services on DTT platforms it will be essential to provide enough capacity for a critical mass of HD channels in each regional market. Typically this will amount to four or five channels in each country, requiring one or two dedicated DTT multiplexes.

Consumer demand for and the value they associate with HD television is strong and growing rapidly. In Europe, HD services on pay-TV platforms have grown well in the early stages of market development showing clear consumer demand. BSkyB in the UK had acquired 292,000 HD subscribers by the end of June 2007, its fastest uptake of a new TV service. Meanwhile, the HD-only platform "N" in Poland has reached the milestone of 200,000 subscribers within its first year of operation. The demand for HD services is proven. Figure 9 below shows the projected uptake of HD ready displays in Europe to 2010. This follows the trajectory already demonstrated in the US, where Nielsen announced in October 2007 that 13.7% of all US households are equipped with a suitable display and decoder to receive HD services. DirecTV, with 16 million digital satellite subscribers in the United States has also announced that it will ramp up its HD offering to more than one hundred channels by the end of 2007.

[18] MPEG is an encoding and compression standard for digital multimedia content defined by the Motion Pictures Expert Group (MPEG). MPEG-2 extends the basic MPEG system to provide compression support for television quality transmission of digital video and is currently used by most digital TV platforms around the world. MPEG-4 is a new advanced version of the system further reducing bandwidth requirements for broadcasting channels, effectively enabling "bandwidth hungry" high-definition channels to be broadcast cost effectively.

Figure 9 - HD TV Ready Households in Europe, Asia and the USA, 2004-2010



Given the high demand for HD broadcasting, an appropriate amount of UHF spectrum will be needed in order to maintain the strength of the DTT platforms around Europe and to retain consumer demand for the platform. Without HD, the DTT platform would be marginalised – more affluent consumers will be able to pay for access to pay-TV services as the supply of HD television becomes standard on these broadcasting platforms. The result could be a two-tier system, with advertising revenues and key channels following the high-value consumers, leaving the universal provision offered by DTT as a low-end collection of less attractive services.

It would be very difficult for many leading European broadcasters to justify significant investment in HD programming without a universal service offering. Publicly funded channels in particular would be unable to devote funding to services which only a proportion of its consumers could access.

This would lead to a lower quality of service provision and thus an erosion of social value. More importantly, it would reduce the ability of Europe to compete in the international market and to enter into co-production agreements with non-European broadcasters. The global markets for television programming are increasingly reliant on HD production, but even in international markets, television content is underpinned by domestic investment. A Europe which underinvested in HD content would be unable to provide content to the two largest television markets in the world, and thus lose key export revenues.

Appropriate UHF spectrum required for DTT future technology transition

HD will not be the only new technology that will need to be enabled in order to keep DTT platforms strong and compelling compared to cable, satellite and IPTV pay-TV services. New broadcasting standards such as DVB-T2[19] and MPEG-4 are currently two of the most important technological advances that will lead to significant medium-term efficiency gains in the use of UHF spectrum for broadcasting. It is hoped that DVB-T2 will provide around 30% spectral efficiency gains while MPEG-4 allows the bandwidth required to broadcast a

[19] DVB-T2 is a new standard for the modulation and coding of television broadcasting signals on digital terrestrial platforms, developed by Europe's Digital Video Broadcasting consortium. DVB-T2 builds on the existing DVB-T standard, currently used by almost all digital terrestrial platforms, and provides an approximate 30% improvement in capacity.

standard definition channel to be halved. Together, they will liberate significant capacity, available for further DTT channel provision or other uses.

In order to introduce new technologies, broadcasters may need to simulcast key channels and/or programming on new channels for an interim period to avoid disrupting core DTT services until the majority of consumers have upgraded their systems. As with the transition from analogue to digital, this means that new channels may have to be introduced using additional bandwidth. To force new technology adoption by limiting the mainstream existing service would only serve to weaken the appeal of the DTT platform in the medium term, resulting in a considerable loss of public value.

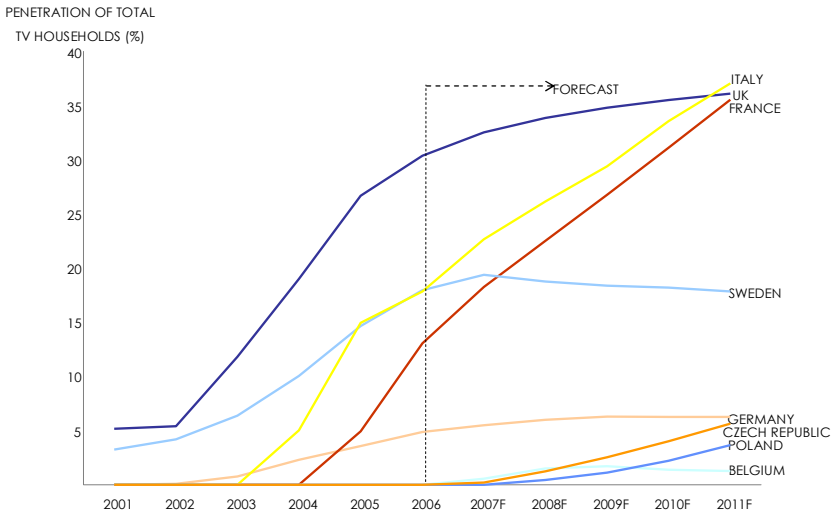
Other new services that will likely launch on DTT, which may require the medium-term use of additional spectrum, include video-on-demand based services pushed directly onto the hard-disk drives of consumers personal video recorder set-top boxes and second generation interactive services based on java and flash graphics capabilities. It is thus important for national licensing authorities to retain some flexibility in frequency allocation to allow for short-term investment of capacity to produce long term gains.

Substitutability of terrestrial broadcasting and social value

If terrestrial broadcasting services are put at risk by the introduction of market-based approaches to the management of UHF spectrum it is likely that this would directly threaten the high public value associated with free-to-air broadcasting. It is often argued that the terrestrial television services that rely on the UHF band can simply be substituted with users taking advantage of alternative televisions services. However, every single alternative substitution technology would mean that consumers would have to directly pay an often considerable monthly fee to continue to receive the televisions services that are currently enjoyed on a free-to-air basis. All cable, satellite and broadband internet services require costly monthly subscriptions and consumer premise equipment, even if indirect.

Digital terrestrial television services deliver unusually high public value and so need to be maintained as strong, principally free-to-air platforms as a result. Despite slowing growth, and also the continued growth of cable, satellite and IPTV, terrestrial still remains a key reception method across Europe and will remain so. Around forty percent of the European population of the eight countries analysed in detail for this study currently rely on terrestrial TV services. In addition, digital terrestrial platforms are forecast to grow strongly, as shown in Figure 10 below, with the increased provision of channels offering a considerable uplift in social value associated with the platform.

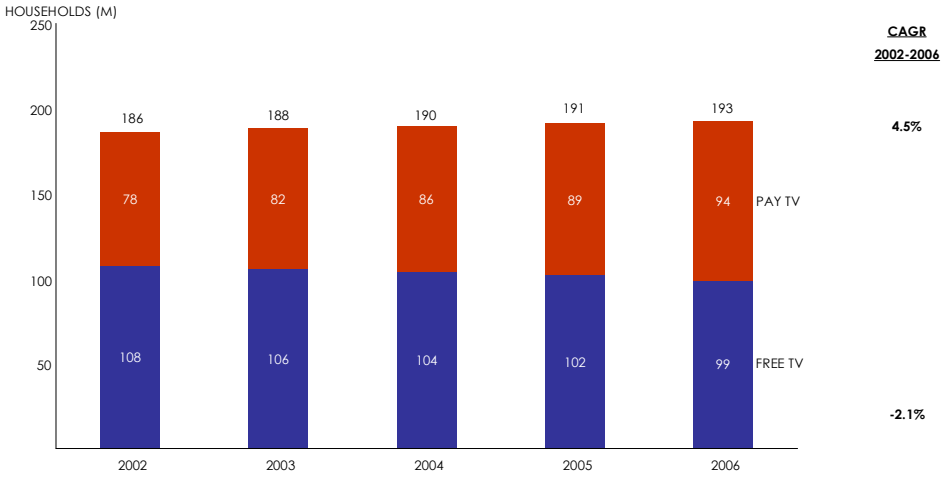
Figure 10 - DTT Penetration of Total TV Households, Primary TV Sets in the Home, 2001-2011



SOURCE: O&O ANALYSIS; COMPANIES ACCOUNT, TV INTERNATIONAL SOURCEBOOK 2007

The digital terrestrial services around Europe are almost all underpinned by the free-to-air model. Free-to-air services are a particularly strong and successful form of digital broadcasting given the failure and collapse of terrestrial pay-TV services QuieroTV in Spain in 2001 and ITV Digital in the UK in 2002. Sweden is the only market in Europe where pay-TV subscribing households on terrestrial outnumber the free-to-air installed base. A large proportion of the European population does not want to pay for television, as shown by the high proportion of free TV homes in Europe in Figure 11, and they should not be forced to do so.

Figure 11 - Free and Pay-TV homes in Europe, 2002-2006



COUNTRIES INCLUDED: AUSTRIA, BELGIUM, DENMARK, FINLAND, FRANCE, GERMANY, GREECE, IRELAND, ITALY, NETHERLANDS, NORWAY, PORTUGAL, SPAIN, SWEDEN, SWITZERLAND, UK, CZECH REPUBLIC, HUNGARY, POLAND, ROMANIA

SOURCE: PWC

The public value associated with terrestrial broadcasting cannot be captured by other platforms. Terrestrial is essential in order for broadcasters and governments to apply principles of universality, particularly in a market where free-to-air satellite services are not widely adopted or in demand. Despite the prevalence of cable and satellite services in

Europe, they are almost always owned and operated by companies looking to extract a high consumer surplus. Very few utility cable operators remain in the hands of municipal authorities and those that are, are in the process of privatisation. As they roll out digital services the cable operators are looking to raise the average revenue per user to justify the digital infrastructure investment.

The direct costs of service provision of satellite television services as an alternative are also very high. While a digital terrestrial set-top box, now priced at as little as €30 in many markets, is the only investment required of a consumer to receive a digital terrestrial free-to-air service, purchasing and installing satellite reception equipment is comparatively expensive at around €200 for the set-top box, dish and installation. It is also important to note that coverage of satellite is far from universal owing to:

- the problem of reception in multi-dwelling units where a dish cannot be orientated in the correct position to receive signals; and

- the mismatch between satellite footprints (with unavoidable spill across national and regional boundaries) and content rights (which are typically licensed on a national basis) – which means that it is not cost-effective to provide either satellite footprints to some European regions and/or certain types of programming to some national satellite providers.

Therefore, digital terrestrial services will remain central to providing a low-cost free-to-air based broadcasting service with universal reach. Cable operators do not have the reach in many markets and satellite operators are unable to provide the localised services that terrestrial and cable can provide. In order for regionalised services and increasing local services to be provided by satellite a conditional access system and also customisable electronic programme guide needs to be supplied to satellite users. Viewing cards can then be used to make sure that households receive the correct video services listed in the correct position in the electronic programme guide. However, such services are costly and require considerable operational investment which would inevitably have to be passed on to the consumer, adding to the cost of replicating terrestrial free-to-air services on satellite.

Any introduction of market-based approaches to UHF spectrum management that leads to consumers needing to substitute to alternative reception methods is likely to significantly reduce the public value associated with broadcasting. Such moves would force consumers to pay for services that more than half of European households currently choose to receive free-to-air.

Legacy reasons why there are limitations to alternative uses of UHF spectrum

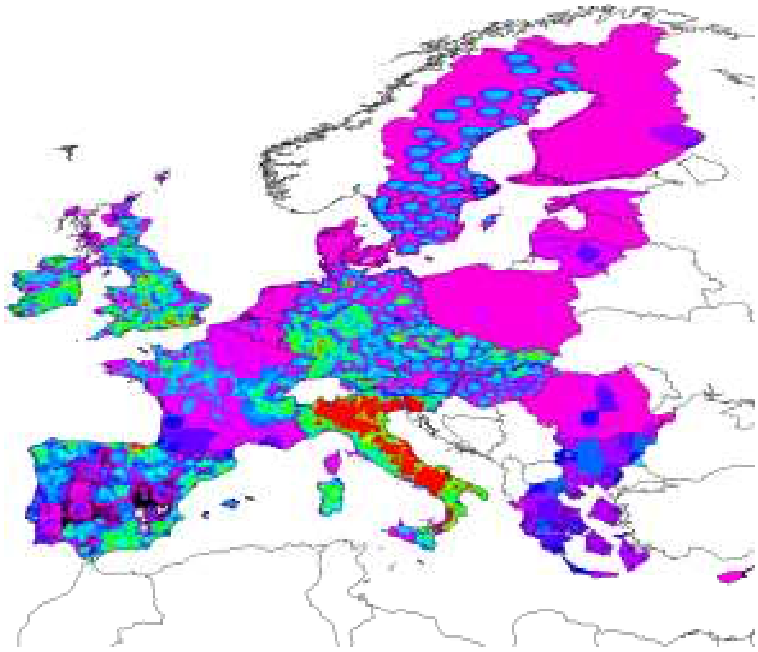
Any alternative use of UHF spectrum that might be secured, should principals of service neutrality and or market-based approaches be applied to a portion of or all of the UHF band in Europe, will have to take into account the structured current use of the band for digital terrestrial broadcasting. This will be particularly important should any mobile operators look to make use of UHF spectrum and there are serious doubts as to whether these operators can make any use at all of the spectrum because of the absolute inability to harmonise the sub-bands within the wider UHF portion of the spectrum. This section outlines the very real problems associated with harmonising sub-bands, and the questionable ability of mobile operators or indeed any other alternative users of the spectrum to make meaningful use of the spectrum in the medium-term.

Difficulties of harmonising UHF bands

Plans for the use of UHF spectrum in Europe, and indeed across a wider geographical area, and to coordinate digital terrestrial broadcasting service's use of specific UHF channels has been laid out for the long-term by the outcome of the International Telecommunications Union's (ITU) RRC-06 Geneva conference – the GE06 Agreement. Figure 12 below shows the usage of UHF spectrum for digital terrestrial broadcasting services in Europe resulting from the GE06 Agreement. The complexity and different objectives of national planning of the spectrum usage across the EU-27 territory is clear.

One hundred and eight countries participated in the conference and reached a binding agreement to plan use of the spectrum to be used after digital switch over to minimise the considerable impact of cross-border interference of terrestrial signals and also to achieve this aim while taking into account current national allocations of spectrum for digital terrestrial broadcasting, which vary significantly by country as shown below.

Figure 12 - DTT UHF Multiplexes to be used in Europe After Digital Switchover[20]



SOURCE: EBU

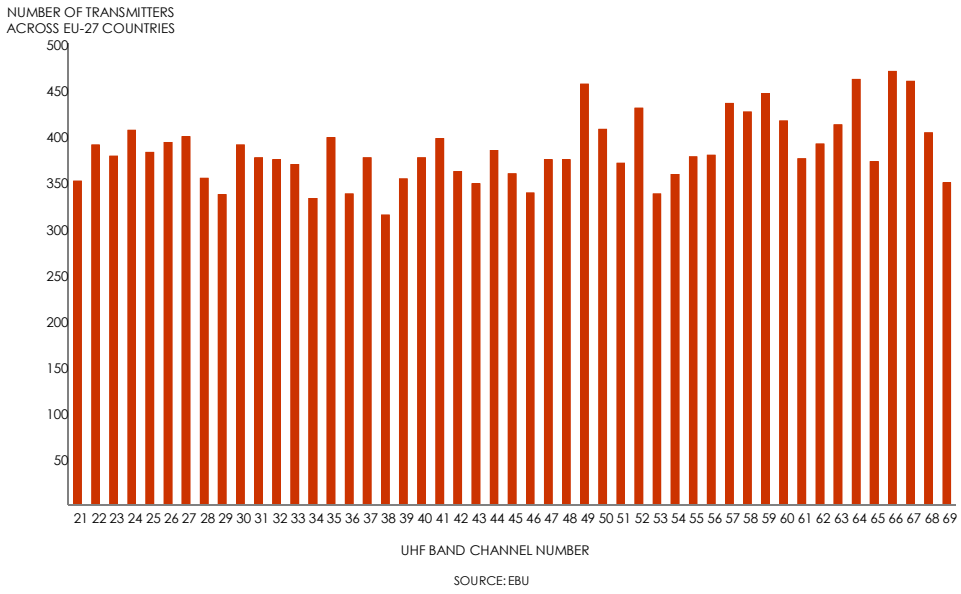
Figure 12 above shows the diversity of different planning mechanisms in different countries and the clearly contrasting UHF spectrum planning objectives (e.g. Poland compared to Germany) in terms of area and population coverage and use of spectrum to achieve national aims. A high density of planning in Italy is clearly visible showing planning of a high number of DTT multiplexes and significant overlaps in service areas, as well as the problems of planning along borders. For example, in France, the number of multiplexes is lower near the border with Belgium than in other parts of the country. This map shows that the concept of harmonisation of sub-bands of UHF spectrum across the 27 European Union countries is a difficult and complex task, given the diversity of already planned and co-ordinated national spectrum usage.

[20] Map colour scheme: Red for the maximum number of multiplexes in a given area, progressing through orange, yellow, green, blue, violet and black as the number of multiplexes reduces.

This highly complicated collaborative spectrum planning task was last carried out in the 1960s in Stockholm to plan the original use of analogue TV spectrum in Europe and it is unlikely that such a complete process could be either organised or re-negotiated in the near term. As a result of GE06 plan, a substantial investment in technology and digital broadcast infrastructure has already been made in rolling out services making it unlikely that spectrum allocations for DTT can be changed at this late stage in the service deployment around Europe.

Even if the planning process could feasibly be revisited it would be impossible to make significant changes given that countries such as Finland, Sweden and the Netherlands have already switched off analogue terrestrial broadcasting while others such as the UK and the Czech Republic are already well under way with switch-over processes. Currently all channels of the UHF spectrum under consideration are used for digital terrestrial TV services in several regions around Europe so there is no single sub-band that can be harmonised across Europe and used for alternative services, such as mobile services, in a co-ordinated manor across Europe. Figure 13 below shows the number of broadcast transmitter regions in Europe making use of each UHF channel. This chart shows that of all the UHF channels 21-69 across the EU-27 region even the least used channel (38) is used for DTT services in 314 transmitter regions while the most used is channel 66, used by 470 transmitter regions.

Figure 13 - Number of Transmitters in EU-27 Countries Using Each UHF Channel for DTT[21]



Therefore, even small localised changes to the use of specific channels in specific regions would lead to a potentially highly complicated knock-on effect of transmitter interference problems requiring complicated bilateral international negotiations to resolve, if indeed they could be resolved at all. The GE06 Agreement models allocated spectrum use as efficiently as possible across the region to minimise this interference. Any attempt at re-planning would need to be co-ordinated within the framework of the GE06 Agreement in the form of bi-lateral agreements between countries.

[21] Usage of UHF channels by transmitter after digital switch over as stipulated by the Geneva-06 plan defined at the ITU RRC-06 conference.

The digital dividend differs by country

Given the impossibility of creating harmonised sub-bands within UHF spectrum in Europe, there is no spectrum band that can be allocated across the region. Indeed, even on a member state by member state basis there are considerable differences in the UHF channels being released for alternative uses as part of the digital dividend in each market. For example, in the UK, two sub-bands are being released as digital dividend spectrum. Channels 31-40 (excluding channel 38 which is reserved for radio astronomy) and channels 63-69.

In theory therefore, the upper part of the UHF spectrum, close to bandwidth currently already used by mobile operators in the 900 MHz range, could be released for harmonisation across Europe. However, in Spain all digital terrestrial broadcasting services are concentrated in this upper part of the spectrum, including four national single frequency multiplexes in channels 66-69 on a single frequency network, exactly the same bandwidth being released in the UK. As outlined earlier in this document, the digital dividend differs in terms of amount of spectrum and also position of that spectrum within the UHF band considerably.

A further considerable barrier to allocating digital dividend spectrum in a co-ordinated manner across Europe is the fact that a considerable number of binding decisions have already been taken in various member states as to how the digital dividend spectrum will be used at the national level. It will therefore be impossible to back-track on these spectral decisions in order to co-ordinate at a pan-regional level, given the heavy investment and legal provision already made by public and private players in rolling out such services. For example, spectrum has been allocated for mobile and HD services in the form of additional multiplexes in Belgium and France and Germany while mobile DVB-H broadcast services are already up and running in Italy with more than 500,000 users to date on spectrum leased from national broadcasters RAI and Mediaset.

The mobile myth

Cellular mobile telephony and related services is typically cited up as the most valuable alternative use of UHF spectrum in Europe and the most likely bidder should concepts of service neutrality and market-based approaches be applied to its management at a European level. There is no doubt that the bands currently used for broadcasting, which are generally toward the lower end of the spectrum than most mobile spectrum allocations, could be extremely useful to mobile operators looking to offer new and advanced services. This is particularly true given the excellent propagation qualities of the UHF band compared to higher frequencies currently used for most mobile service, thus allowing mobile operators to build fewer base-stations and to penetrate buildings more effectively with their signals. However, there are some significant barriers to mobile operators being able to effectively make use of UHF spectrum across Europe and it would be politically unacceptable for operators to acquire spectrum and to then not make full and efficient use of it, given the demand for the spectrum for broadcasting services.

First is lack of a harmonised band for mobile services. In order for handset and other mobile equipment vendors to obtain the necessary region-wide economies of scale, the bandwidth used must ideally be at the same frequency or very close in the frequency plan. Otherwise, different handsets will have to be designed for individual markets, something the handsets manufacturers would almost certainly not do due to the poor profitability of such an approach.

Second, interference with the existing mobile telephony band at 900 MHz could be a considerable problem for mobile operators looking to exploit spectrum in the upper part of

the UHF band. It is debatable whether mobile operators could therefore effectively and efficiently make use of this spectrum.

Third, business models for mobile TV and other potential uses of the UHF spectrum are unproven. The economics of the mobile industries potential use of additional UHF spectrum is unproven and successful business models for mobile TV have yet to demonstrate despite a plethora of commercial services having rolled out around the world. Despite the above factor making the launch of mobile services in harmonised bands an impossibility, mobile TV services could be potentially be made available on spectrum allocated at the national level, as is the case in markets such as France, Germany and Belgium at present. One or two mobile TV market entrants would not require much spectrum, so could probably be accommodated without disrupting broadcasting services. Planning for such mobile services is already under way at the member state level.

Other alternative uses of UHF spectrum are unproven

Even if the ability of mobile operators to make efficient use of UHF spectrum is called into question there are several other candidate technologies and services that might make alternative use of digital-dividend spectrum. Such services could be launched if operators look to take advantage of any further spectrum that might be obtained if market-based approaches and concepts of service neutrality are applied to UHF spectrum, at the expense of broadcasting services. Such services include:

- PMSE: programme making and special events services require highly-localised spectrum for equipment connection such as short range radio communications devices and microphone equipment.
- Rural broadband: the concept that wireless broadband services could be provided using UHF spectrum in order to provide high-bandwidth broadband services to communities that are poorly served by fixed-line telecoms operators in terms of choice of services and speed of access.
- WiMAX: the Worldwide Interoperability for Microwave Access standard is a telecommunications technology aimed at providing wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access. WiMAX is likely to be used for a wide range of voice and broadband connectivity services aimed at a large proportion of homes, above and beyond being a leading candidate technology for provision of rural broadband services.

Given the local and regional nature of PMSE services and rural broadband there is little requirement for use of a harmonised band at the national level, let alone on a pan-European basis. As a result, both of these services are particularly well suited to the interleaved spectrum, the unused capacity between UHF channels currently not used for broadcasting in particular regions and not allocated as part of any digital dividend spectrum allocations. In many countries, PMSE services already use the interleaved spectrum successfully so there is little reasons to deviate from this successful policy. This is especially true given that the limited economic viability of PMSE services means that any exposure to market forces for spectrum allocation may make such services unviable for users such as TV production companies and theatres.

UHF is not the most suitable band for rural broadband

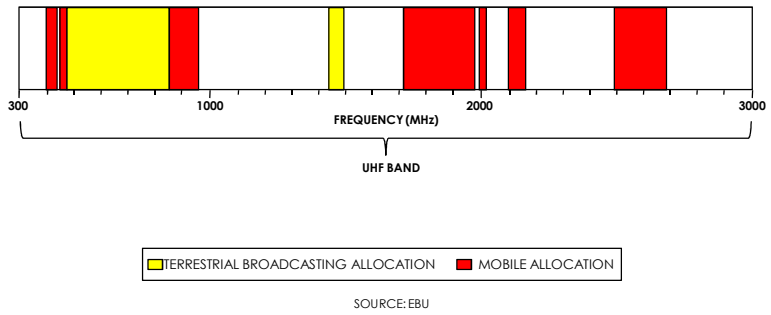
Many policy makers have suggested that digital dividend spectrum could be used to provide rural broadband services. Many rural homes are unable to receive high-speed connections due to their location well away from local telephone exchanges. However,

despite the social importance of the provision of broadband access for rural homes and also the attractiveness of this idea to policy makers, use of the digital dividend spectrum is unlikely to provide an optimum solution to the problem.

Although UHF permits large service areas, the available bandwidth will not be sufficient to deliver "true" broadband (e.g. 2 Mbit/s or more) to many simultaneous users, whereas spectrum above 2000 MHz delivers much greater bandwidth.

Fixed telecoms and mobile operators already have other bands available to them that are likely to prove sufficient in terms of quantity of bandwidth and also have the added benefit of avoiding any potentially problematic interference issues within the UHF band. There is already a large amount of UHF spectrum allocated to mobile services, as shown Figure 14 below. This spectrum potentially allows them to offer voice and broadband services within existing bands allocated to them at 450 MHz, 900 MHz, 1800 MHz and 2100 MHz, with a further 190 MHz harmonised at 2600 MHz made available across Europe.

Figure 14 - Spectrum allocation in Europe for terrestrial broadcasting and mobile services



Predictions of large benefits from allocating more spectrum to mobile are based on aggressive forecasts for growth in demand for mobile broadband. However, the UHF band is not particularly suitable for providing capacity to meet peak demand in urban areas, where operators require dense networks of cell sites. In these areas, it is more efficient to user higher frequency bands, such as those above 2000 MHz, where signals travel shorter distances and can be more intensively reused. In rural areas distance matters more than capacity, or for improving signal penetration through buildings. However, spectrum already available at 450 MHz and 890-900 MHz may well be sufficient for these purposes.

Aside from the actual suitability of certain bands for rural broadband, it is uncertain that such services would generate social value greater than other uses of the UHF band, given that only a small minority of households in Europe that would benefit. It is likely that large subsidies would be required to encourage the roll-out of rural broadband services because the usage density of such services makes them unattractive as a business proposition; they would already have been offered using other available bands and methods if it was economically attractive to do so.

Interleaved spectrum is available for broadband services

Given the marginal and also regional demand for rural broadband, any unused interleaved spectrum is highly suitable for the provision of such services. With significant amounts of bandwidth available, due to the need to avoid DTT signal interference between adjacent

regions, this part of the UHF band is likely to be more than sufficient for rural broadband service provision. Use of interleaved spectrum would also avoid the risk of a significant reduction in the overall social value generated from the UHF band if such rural broadband services were favoured over DTT broadcasting services generating high public value.

WIMAX technology is widely seen as the most promising technology for the delivery of rural broadband services. However, there is a high degree of uncertainty as to whether there is widespread demand for such wireless broadband services based on WiMAX. It is widely accepted the initial roll-out of WiMAX services would in all likelihood actually be in urban areas to compete directly with fixed line operators and to benefit from the same economies of scale enjoyed by fixed line operators in urban regions. As such the demand for, economic viability and social desirability of WiMAX and other broadband uses of UHF spectrum are highly questionable.

7. One size does not fit all: national broadcast markets are different

Compared to many other major industries and markets, broadcasting differs due to the fact that individual national markets exhibit such considerable structural differences. Within Europe there is no set pan-regional social or business dynamic that determines factors such as the relationship between free-to-air broadcasting services and pay-TV, consumer usage of terrestrial versus satellite and cable: broadcasting and media markets (and to a large extent the companies operating in every sector of them) remain predominantly national.

The difficulties of a pan-European approach to UHF spectrum management

Given that the structure of broadcasting and media markets around Europe differs so radically, the amount of public value generated by the broadcasting industry and also the ways in which it is generated differ to such a degree that a uniform pan-European approach to spectrum management is not appropriate, or indeed possible.

In this section we provide a comparative assessment of the structure of European broadcasting markets and discuss the impact of each core market characteristic on the ability to manage UHF spectrum using market-based approaches. This section outlines the relative importance of terrestrial broadcasting using UHF bands among countries, taking into account the size of the digital terrestrial market for TV reception on second and third TV sets in the home. This section then assesses the impact of varying business models and funding structure among nations on the ability to successfully apply market based approaches to UHF spectrum and considers the impact of differences in the market at the individual national broadcaster level and the wider content production segment.

The TV reception platform mix differs by country

The core platform technologies used by viewer around Europe to watch television vary considerably among European member states leading to distinct differences in the public, as well as private value, that can be generated from broadcasting activities on each platform. The relative state of the digital TV market development in each nation also has a strong knock-on effect on the desirability of and ability to apply market-based approaches to UHF spectrum management in each market.

- **Terrestrial** – In the eight sample countries assessed for this study, 38% of all households rely on terrestrial reception on their primary TV set in the home. However, the reliance on terrestrial broadcasting in each market differs considerably. At the end of 2006 more than 70% of Italian households relied on terrestrial as the means of reception on the primary TV set in the home. In contrast, only 3% of Belgian households relied on terrestrial broadcasting at the end of 2006. Figure 15 below shows the wide range of penetration rates of terrestrial TV reception on the primary TV set in the home.
- **Cable** – Certain European markets have traditionally placed a far greater emphasis on cable television reception and services than others. Cable networks pass more than 30 million homes in Germany and around 21 million homes chose cable as their primary viewing platform, often due to the provision of cable TV services as a basic utility with subscriber fees included as part of property rent historically. In contrast, while more than half of all UK households can receive cable, only 14% of households take cable services due to the premium pay-tv positioning of services and the strength of alternative platforms.
- **Satellite** – Satellite reception has equally as wide a diversity among European nations in terms of uptake, the type of service offered on the platform and the

relative public value associated with it. Satellite has become an important medium of choice for rolling out premium pay TV services in many markets but at the same time free-to-air satellite is wide spread and growing in most markets in Europe. In Germany around 10 million homes rely on free-to-air satellite for TV reception on their main TV set, while a further 3 million homes receive a premium pay-satellite service. In contrast, in Italy out of 6 million satellite homes at the end of 2006, the premium pay satellite operator Sky Italia had just over 4 million subscribers with 2 million homes relying on free-to-air satellite services in a market that has no cable services.

Figure 15 - Terrestrial TV Penetration of Total TV Homes for Primary TV Sets by Country, 2006

	TERRESTRIAL PENETRATION TO TOTAL TV HOMES, 2006 (ANALOGUE AND DIGITAL %)
UK	51.9
GERMANY	8.7
FRANCE	56.3
ITALY	70.8
BELGIUM	2.9
SWEDEN	20.9
CZECH REPUBLIC	61.3
POLAND	29.4

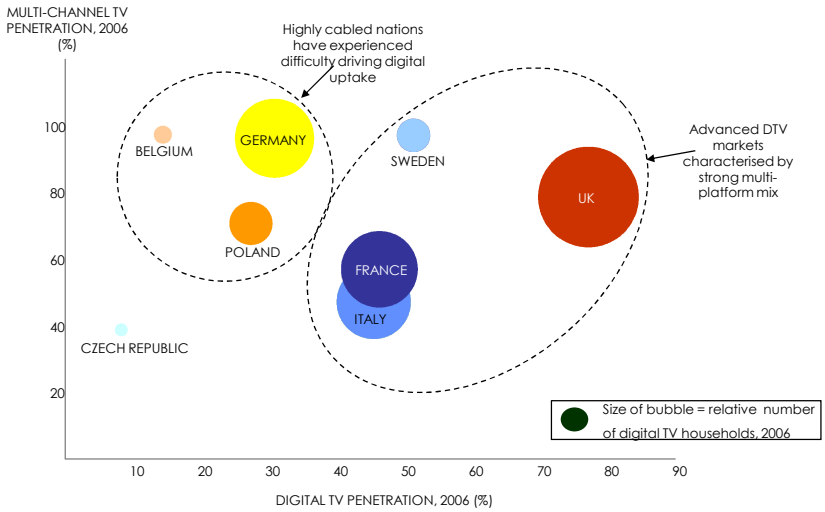
SOURCE: O&O ANALYSIS

Terrestrial plays an important role in digital TV market development

Terrestrial services are crucial in driving digital TV uptake in the majority of national markets in Europe. Digital terrestrial TV services are already the leading digital TV platform in the UK and Spain and are forecast to overtake satellite as the leading digital TV platform in France in 2009 and Italy in 2012. While almost all satellite reception around Europe is now digital, in comparison cable operators have struggled to drive penetration of digital services.

Figure 16 below shows the relative development of each sample country studied, comparing the rate of digital TV penetration to multichannel penetration and the absolute size of the digital TV market at the end of 2006. Operators and broadcasters in highly cabled markets have struggled to drive take-up of digital services owing to the difficulty of differentiating digital cable services from analogue services. Analogue cable subscribers receive around 30 channels for a basic utility fee of around €10 per month and there have been few incentives for subscribers to pay additional amounts to receive an expanded digital service. The market for premium pay-TV services, principally for premium movies and sports programming, remains niche in these cable dominated markets, particularly in Belgium and Germany.

Figure 16 - Digital TV and Multichannel TV Penetration by Country, 2006



SOURCE: O&O ANALYSIS; COMPANY ACCOUNTS; TV INTERNATIONAL SOURCEBOOK 2007

The complexity and particularly the national nature of the TV reception platform mix in Europe makes pan-regional policy making in relation to terrestrial TV and UHF spectrum very difficult indeed. Equally, the competitive importance and market dynamics between the platforms is finely balanced.

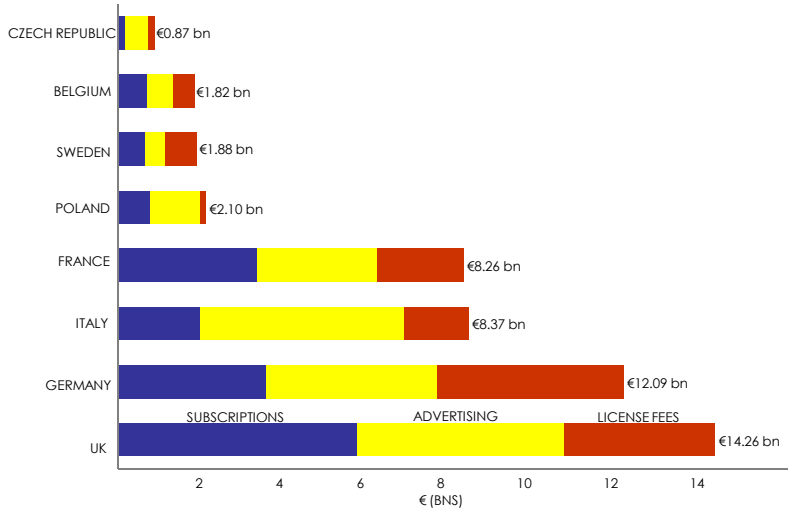
Any intervention at the European level that might lead to a weakening of the consumer offer or financial status of key players that support terrestrial TV services could enhance the possibility of dominant monopoly pay-tv operators emerging in many markets. Indeed the consolidation or collapse of competing premium pay-TV operators since 2000 has already led to a single major pay-TV player emerging in the UK, France, Italy and Spain. Given the strong and rapidly growing consumer demand for free digital terrestrial services in all major markets in Europe and the exceptionally high public value associated with the platform, there are significant risks to future digital TV market development and a compelling consumer choice of platforms from introducing pan-European market-based approaches to UHF spectrum management which would not suit the particular dynamics of individual markets.

The funding structures of national markets differ

National broadcasting markets in Europe are funded with a varying mix of business models, licence fees and government grants. There is a danger that if market-based mechanisms were applied to UHF spectrum management at a pan-European level that there would be significant risk to the sustainability of certain funding models in particular member states.

In order to assess the potential risk associated with market-based approaches to the spectrum management of UHF, it is important to assess the varying proportion of revenue generated from different sources within broadcasting markets. It is also important to understand the relative impact on the public value generated by broadcasting and its ability to continue to operate effectively under models of market-based allocation of spectrum on a pan-European basis. Figure 17 below shows television industry revenues by business model in 2006 for each of the eight countries examined in detail for this study.

Figure 17 - Television Revenues by Type of Business Model by Country, 2006



SOURCE: O&O ANALYSIS; COMPANY ACCOUNTS; TV INTERNATIONAL SOURCEBOOK 2007; OBS; PWC; ZENITH OPTIMEDIA

The imposition of market-based tools for the management of UHF spectrum and the associated increase in costs that various players would need to fund would potentially put specific players in specific markets at a considerable disadvantage compared to other players in the markets which would see no increase in costs.

Public service broadcasters funded by licence fees or government grants are poorly positioned to meet market rates for UHF spectrum as this funding would need to be achieved by the provision of additional funds from central government or a substantial and permanent increase in the licence fees collected. Given the prevailing climate of public service broadcasting funding cuts and policies aimed at increasing the efficiency of spending on public service broadcasting around Europe it is very difficult to see any kind of spectrum fee for public service broadcasters leading to anything but a reduction in budgets for programming and rights acquisitions and reducing the high public value associated with more expensive local original productions.

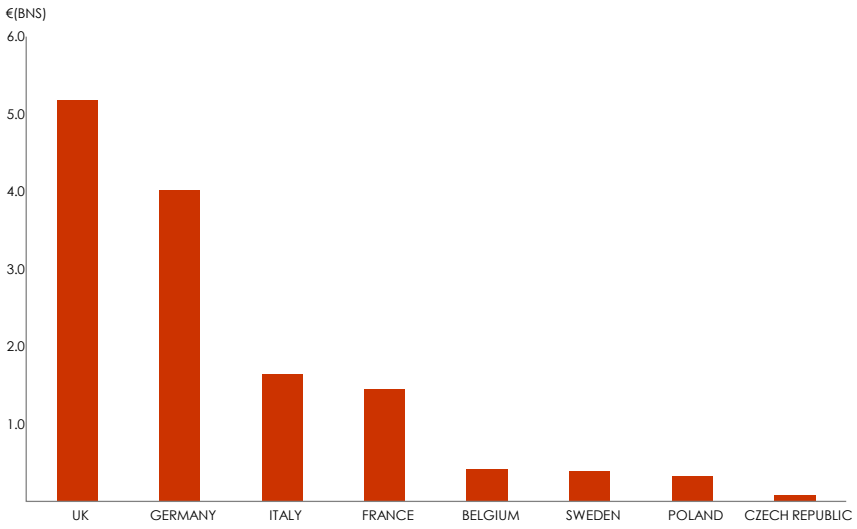
Similar to the pressure that would affect public service broadcasting business models, advertising funded broadcast business models would be adversely affected in markets where TV advertising represents a larger proportion of the overall market and control a greater proportion of spending on domestic originations as well as foreign programme and format acquisitions. The impact would be negative on the wider national programme production markets and subsequent reduction in prospects for job creation and economic expansion on local content production markets, harming the impact of pan-European regulatory initiatives to encourage and promote national and European original programme production.

The vast majority of private value attributable to terrestrial TV in Europe is derived from advertising and licence fee funding of broadcaster due to the relatively low penetration of pay-TV subscription based business models on the terrestrial platform. Given that the particular vulnerability to market-based approaches the terrestrial platform would be adversely affected in many markets compared to investment derived from viewing on cable and satellite platforms.

Programme production markets are at different stages of development

The wider implication of the differing structure of funding models around Europe is the resulting impact further down the broadcasting chain that would occur due to any pan-European implementation of market-based approaches to UHF spectrum management. Investment in local originated programming is radically different in member states leading to different relative impacts on broadcast markets should pan-European approaches to the management of UHF spectrum be implemented. Figure 18 below shows the comparative total broadcaster spending on originations by country in 2005.

Figure 18 - Total Broadcaster Spend on Originations Including News by Country, 2005



SOURCE: O&O ANALYSIS, COMPANY ACCOUNTS; TV INTERNATIONAL SOURCEBOOK 2007

European regulation relating to European production quotas is designed to stimulate and protect European television production but comparative levels in certain markets remain low. Overall spend on originations in France is considerably smaller than would be expected compared to overall market size due to a lower reliance on expensive fiction originations while the UK's spending on originations is also high due to a higher national productions targets being set in the UK than for other European member states. Consequently, the negative downstream impact on commissioning originations will be felt more strongly in markets where a high proportion of overall programming spend is already on expensive local fiction formats in particular.

A squeeze on such budgets would lead to an overall reduction in such spend and lead to wider use of a greater amount of cheaper formats and imports. Second, in less established production markets such as Poland, the Czech Republic and Sweden where the national markets do not sustain a broad production base, the potential impact of market-based tools for spectrum management would be even greater in comparison to the overall size of the production market.

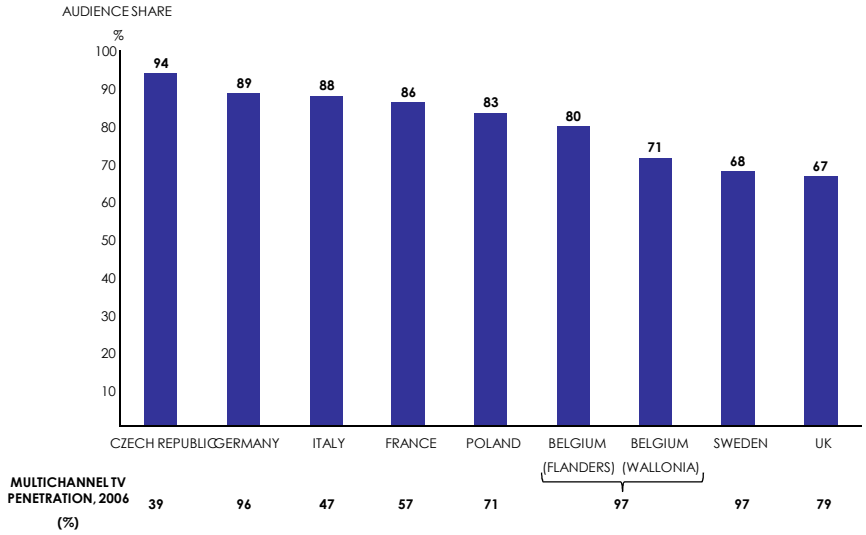
Traditional broadcaster network strength varies from market to market

Given the predominance of public service and advertising funded commercial broadcasters on terrestrial platforms around Europe mentioned, it is these networks that are the most vulnerable players in the TV market to the implementation of market-based approaches to

spectrum management and the associated potential additional costs of operating and risks to competitive positioning.

However, the relative strength of these broadcasters compared to the wider market varies considerably by member state, making the uniform imposition of market-based tools to spectrum management impractical and potentially damaging to certain markets compared to others. Figure 19 below shows the relative national audience share of the major traditional broadcast networks in Europe, which have a predominant position on terrestrial platforms.

Figure 19 - Audience Share of Main Traditional Broadcast Networks in Europe



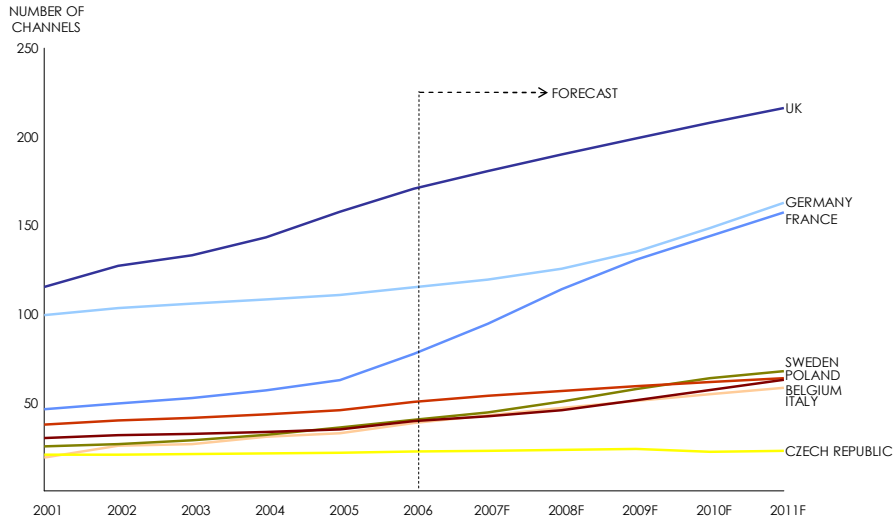
SOURCE: O&O ANALYSIS; COMPANY ACCOUNTS; TV INTERNATIONAL SOURCEBOOK 2007; OBS

There is not necessarily a relationship between the pace of digital TV market development and audience fragmentation leading to the erosion of traditional broadcaster audiences. Despite growing digital TV penetration in Germany the leading broadcasters have retain 89% of the available audience due to market fragmentation having occurred as analogue cable services rolled out in the 1980s and the growth of free-to-air satellite services in the 1990s.

At the other end of the scale, the UK's traditional network broadcasters are experiencing severe audience erosion as multichannel penetration increases rapidly. In Italy, despite the growth of multichannel DTT and satellite services in recent years the traditional networks, RAI and Mediaset, have retained a strong overall audience share owing to the failure of a strong alternative national broadcast group to emerge.

The disparity between member state broadcasting markets is accentuated by the relative speed of development of multichannel national markets. Figure 20 below shows the relative rate increase in the number of channels received in each household for the national markets included in this study.

Figure 20 - Weighted Average Channels Received per Household in Europe, 2001-2011



SOURCE: O&O ANALYSIS; COMPANY ACCOUNTS; TV INTERNATIONAL SOURCEBOOK 2007

The prevalence of several strong digital platforms in advanced digital TV markets such as the UK and France leads to a high average number of channels which can be received on average in each household. However, in contrast the continued reliance on analogue cable with around 30 channels in many markets, such as Poland, Germany, Sweden and Belgium indicates that as cable platforms digitise the business models of the major traditional broadcast networks will increasingly come under pressure from audience fragmentation but at considerably different rates and with varying degrees of severity over time and between countries.

The imposition of consistent market-based tools in a uniform manor across member states would therefore have a widely varying impact on the broadcaster's rate of development. Member states which are in the relatively early stages of digital TV market development, such as the Czech Republic and Belgium, could well experience higher negative impacts in relation to the extra costs and competition associated with market-based tools for the management of UHF spectrum than states where the market adjustment to audience fragmentation with multichannel market growth has already largely occurred.

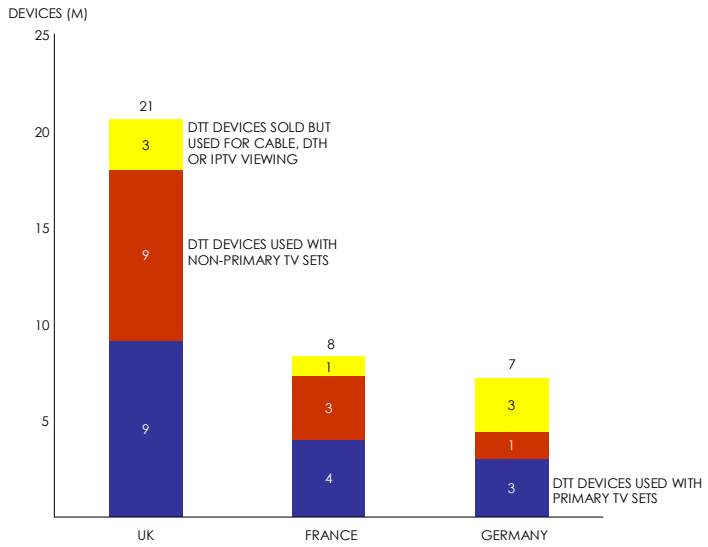
Secondary TV set viewing raises the public value associated with terrestrial TV services

The public value associated with digital terrestrial television increases significantly when considering the importance of second or third and other additional TV sets in the home. There are approximately 2.5 TV sets per household in Europe and so enabling digital viewing on non-primary TV sets in the home will become a crucial enabler of digital switch over.

In many markets digital terrestrial television will be disproportionately important for converting additional sets to digital compared to its use on primary TV sets in the home. This is because primary set viewing is more likely to be through a premium pay-TV platform requiring an expensive set-top box, whereas demand for such pay services on additional TV sets in the home is limited. Therefore, cheap free-to-air services are and will remain dominant on non-primary TV sets in the home. Given that terrestrial TV services are often the only free-to-air services available in the market with low equipment costs and ease of connection, terrestrial will remain the dominant platform across Europe for TV reception on additional TV sets.

Figure 21 below shows the status of digital terrestrial TV market development on both primary and additional TV sets in the home. While around 3 million German homes rely on digital terrestrial for the main TV set in the home, terrestrial is used on an additional 1.4 million second or third TV sets. In France, more than 8 million DTT devices have been sold with an estimated 3.3 million in use on non-primary TV sets.

Figure 21 - Cumulative Digital Terrestrial Reception Devices Sales and Usage



SOURCE: O&O ANALYSIS, OFCOM, GOLDMEDIA, TNT

As digital terrestrial markets develop and mature, driven by impending digital switch over, the growth and penetration of the DTT installed base on non-primary TV sets will continue to increase. In the UK, Europe's most mature digital TV market, more than 20 million digital terrestrial devices have now been sold but only 9.1 million of these devices are used on the primary TV set in the home with nearly the same number of DTT devices (8.9 million at the end of June 2007) are now used on non-primary TV sets. In contrast, in the UK, only 1.6 million cable and satellite devices are used on non-primary TV sets.

8. Conclusions

This report has investigated the potential impact of European countries taking a more market-based approach to spectrum management of the UHF band and the impact on digital terrestrial television and radio broadcasting. Our overall finding is that while there is some scope for limited use of market mechanisms in the UHF band, considerable caution is required in determining which market mechanisms are used and how they are applied to different parts of the band; the optimal approach will also vary across European countries. This finding is based on four key observations:

- Market mechanisms, if used in the right context, can facilitate more efficient use of spectrum; but they can also fail. Unfortunately, there are good reasons why a market for UHF spectrum may not allocate a socially efficient amount of spectrum to terrestrial TV.

- This is because terrestrial TV generates significant public value for society that would not be visible in any hypothetical contest for spectrum with other uses, and cannot easily be replicated through provision of TV using other platforms.

- The medium-term value that could be created by other uses of UHF spectrum relative to broadcasting appears modest – claims that mobile or wireless broadcasting could generate huge value gains are based on unrealistic assumptions about harmonised spectrum availability and equipment costs, and do not adequately consider the scope for replicating these services using other spectrum bands.

- The situation in individual European countries is highly varied, both with respect to the importance of terrestrial TV as a long-term source of social value, and the size and location of any digital dividend. This severely constrains the scope for a pan-European approach to spectrum management in the UHF band.

Market mechanisms might not be appropriate for UHF spectrum management

Market mechanisms provide an alternative to central planning, both for allocation and assignment. The use of market-based tools might put resources in the hands of those who value them the most, which is typically (but not always) a good proxy for identifying operators that can deliver the greatest benefits to society.

However, there are many reasons why markets are likely to fail to deliver efficient outcomes. In this report we have focused on three issues of particular relevance to any hypothetical market contest for spectrum that involved broadcasters:

- **High public value** – Some services generate large benefits for society at large that are not reflected in their business value and thus the respective provider's willingness to pay for spectrum. Markets may therefore under-provide spectrum to such services relative to services with largely private value.
- **Differences in the business models** – Differences in business models means that some types of provider may be less able to extract consumer surplus than others. This may result in high value services being outbid by rivals generating lower overall value but which are more profitable.
- **Network effects** – Network effects exist where different users' usage decisions are taken independently but affect each other. These impacts may not be captured in private willingness to pay. If this is the case, such services may be underprovided with spectrum relative to alternative uses.

Any or all of these factors could result in price signals across competing users being unreflective of total social value and so leading to an inefficient and possibly culturally and politically unsatisfactory outcome. If price signals do not reflect total social value, market failure would occur, independent of differing uses and users.

Given the high public value associated with broadcasting services on the terrestrial platform, and the inability of broadcasters to extract a consumer surplus, they would be unable to effectively compete for UHF spectrum on the open market when compared to other potential users of spectrum whose ability to pay is reflected by higher ability to extract private value, such as mobile operators.

In the case that market mechanisms fail to allocate UHF spectrum to digital terrestrial broadcasting, regulatory intervention may be appropriate to ensure that broadcasting services would receive sufficient spectrum to provide digital television services to the general public in line with public policy objectives. The type and degree of intervention would depend on the structure and state of development in each individual member state.

Market mechanisms must be tailored to specific national circumstances

The risk of market failure is primarily associated with the introduction of 'change of use' in the UHF band. Depending on local circumstances, the risk of market failure could be mitigated by 'ring-fencing' all or some of the available spectrum for terrestrial broadcasting. In practice, this is already the approach that most European regulators are taking; the question therefore is whether they have ring-fenced enough spectrum. Furthermore, depending on how 'liberalised' usage rights are defined, the actual scope for change of use may anyway be limited.

Specifically, in the UHF band, the scope for 'change of use' will necessarily be constrained by requirements to protect current DTT users from interference. The existence of public service obligations on some broadcasters may also limit the scope for change of use (as there may be no alternative way of fulfilling obligations).

Terrestrial broadcasting generates significant value for society

Broadcasting makes an important contribution to employment and economic growth. European broadcasters employed over 2.2 million people[22] directly and indirectly, and invested around €19bn in original European commissioned TV programming in 2006[23]. This is founded on a stable but delicate equilibrium, or "Dual System", where a number of key publically or commercially funded broadcasters in each market have the scale to invest in substantial content acquisitions and original commissions.

In addition, Terrestrial television broadcasting delivers particularly high levels of public value owing to its association with and contribution to cultural identity, and its ability to inform and educate society. Much of this high public value cannot be reflected in any ability to extract private value from the market owing to the provision of broadcasting services to the viewer free-to-air, ensuring access for all.

Further, the public funding and advertising business models applied to achieve these public policy choices means that the large consumer surplus generated by such broadcasting is not necessarily reflected in a broadcaster's valuation of that spectrum; this puts free-to-air broadcasters at a potential disadvantage relative to other spectrum users that make use of

[22] Forge et al, 2007.
[23] Oliver & Ohlbaum, Prospects for the European TV content sector to 2012, October 2007.

subscription models. A broadcaster's inability to extract private value, and consequently their lower ability to pay for spectrum, is in part due to a funding model driven by public policy objectives rather than purely private economic rationale.

With public funding and also advertising business models under increasing pressure broadcasters may become even less well placed to compete directly for spectrum at market rates. The application of market-based tools could therefore lead to a significant reduction on original programming spend resulting in a significant drop in the public value created by the broadcasting industry in each member state. Some market-based tools may be appropriate for certain parts of the spectrum or to allow competition between broadcasters but it would be inefficient and undesirable from an economic, social and political point of view to implement pan-European market-based approaches to spectrum management of UHF.

The substitutability of digital terrestrial broadcasting reduces social value

The benefits of broadcasting over UHF cannot necessarily be replicated on other platforms. Specifically, the universal coverage at low cost that broadcasting using UHF spectrum enables cannot be replicated by other platforms. In most markets alternative platforms are predominantly pay-TV platforms. Where strong free-to-air satellite platforms exist, they require equipment that is considerably more expensive and difficult to install, compared to the cheap purchase and simple installation of digital terrestrial set-top box or the use of an integrated television set.

The value that alternative uses of UHF spectrum would create is modest

The business case for mobile TV has yet to be proven successful for mass-market adoption and the economics supporting the possible use of spectrum for WiMAX, or other wireless broadband solutions, to better serve rural areas are uncertain. In fact, a closer investigation of the business case behind deploying mobile networks in UHF spectrum suggests there is little substance to claims that high social value can be created from alternative uses of UHF spectrum:

- There is already a large amount of spectrum available to mobile network operators to offer voice and broadband services, including existing bands at 450 MHz, 900 MHz, 1800 MHz and 2100 MHz, with a further 190 MHz at 2600 MHz being made available across Europe.

- Predictions of large benefits from allocating more spectrum to mobile are based on aggressive forecasts for growth in demand for mobile broadband. However, the UHF band is not particularly suitable for providing capacity to meet peak demand in urban areas, where operators require dense networks of cell sites. In these areas, it is more efficient to user higher frequency bands, such as those above 2000 MHz, where signals travel shorter distances and can be more intensively reused.

- UHF spectrum could be useful for rolling out mobile broadband to rural areas, where distance matters more than capacity, or for improving signal penetration through buildings. However, spectrum available at 450 MHz and 800 MHz may be sufficient for these purposes.

- In the mobile industry, the most important factors determining the viability of a spectrum band are the availability of cost-effective network equipment and a large choice of handsets. The economies of scale necessary to make this happen can only be achieved if there is harmonised availability of spectrum across Europe, but there is little prospect of this happening in the UHF band given pre-existing national decisions on the planning of digital TV.

- Cellular and broadband devices, if deployed in UHF spectrum, could cause significant interference to digital terrestrial TV reception, even with significant frequency separation. As these devices roam, measures to mitigate interference will be hard to implement reliably.

Alternative non-broadcasting uses of the UHF band could in fact lead to damaging interference problems. Interference occurs, in particular, when broadcasting and mobile services are delivered in the same bands. As a result, great care should be taken when considering applying principals of service neutrality to the UHF band which may lead to such damaging interference problems.

National broadcast markets differ considerably

Compared to many other major industries and markets, broadcasting differs due to the fact that individual national markets exhibit such considerable structural differences. Within Europe there is no set pan-regional social or business dynamic that determines factors such as the relationship between free-to-air TV services and pay-TV, consumer usage of terrestrial versus satellite and cable: broadcasting and media markets (and to a large extent the companies operating in every sector of them) remain predominantly national.

Even in markets where viewing of terrestrial TV is comparatively low on primary TV sets in the home, due to a high penetration of cable and satellite services, many homes watching cable, satellite and IPTV delivered signals on their primary TV depend on terrestrial TV for reception on additional TV sets in the home. In the UK alone, more than nine million digital terrestrial TV devices have been purchased to date for use on non-primary TV sets.

It is also questionable whether there is the same spectrum availability around Europe to apply any form of market-based approaches to on a pan-European basis. The 'digital dividend' means different things in different countries. The use of specific channels of the UHF band for digital terrestrial television services beyond digital switchover have already been planned and negotiated across the whole of the European Union and beyond to minimise the problem of interference across border regions and to ensure the optimum efficiency of spectrum usage across the entire region.

In addition, major decisions have already been taken by national governments and regulators relating to specific or potential uses of any resulting digital dividend spectrum, driven by national market structure and specific needs for specific services such as high-definition or mobile TV in individual markets.

Spectrum management must be planned on a national basis, taking into account specific circumstances of the broadcasting sector, where considerably different approaches have already been taken to both the amount of UHF spectrum to be used for broadcasting and also which parts of the spectrum are most appropriate.

Applicability of market-based mechanisms will vary by country and sub-band

This report has shown that the pan-European application of market-based approaches to UHF spectrum management in the medium term is technical and logistically extremely challenging and could be highly costly in terms of discriminating against socially valuable and proven broadcasting services. Applicability will vary for different parts of UHF spectrum and in different countries depending on how the spectrum is deemed best used.

Certain parts of the spectrum will need to be assigned to current broadcasters in order to maintain the high public value associated with broadcasting which cannot fully be captured

by alternative platforms. Equally, when deciding on whether market-based approaches might be relevant, regulators will need to differentiate between situations where capacity that might be required for DTT is not yet assigned and where there is additional digital dividend spectrum that might be made available for alternative uses.

What is certain is that due to the national structure of terrestrial television broadcasting and wider media markets in Europe and also the well advanced and carefully planned roll-out of digital terrestrial broadcast services, the amount of spectrum for any different uses will vary by country according to national circumstances and public policy choices.

In summary, we would make the following recommendations:

- Individual national markets need a critical mass of digital terrestrial broadcasting to ensure a fully functioning, vibrant, universal broadcasting market;
- Broadcast markets are radically different – national regulators should be able to decide exactly what this critical mass of DTT is in their respective market;
- Spectrum allocations must have the flexibility to allow the future technical evolution of DTT platforms and switch-over phases from old technologies to new, and;
- Regulators should take account of the differing business models of potential bidders, their overall value to society and their ability to monetise consumers – otherwise market mechanisms are likely to fail.

9. ABOUT THE AUTHORS

OLIVER & OHLBAUM ASSOCIATES LTD

O&O was established in 1995 to provide strategic advice at board level to the media, entertainment and sports industries. Since its foundation, O&O has advised over 150 different companies and 30 CEOs in the UK and European television, radio, publishing, online and sports markets. O&O has provided evidential support to regulators, competition authorities and government initiatives and inquiries at a UK and European level. O&O has also helped investors understand the likely future path of regulation and the changes in valuation that might result. O&O has provided advice to a number of Europe's leading private equity groups and has been involved in one way or another with most of the major developments and initiatives in the media, entertainment and sport sectors since 1995. Clients have included the European Commission, Ofcom, the EBU, the BBC, ITV, Channel 4, SBS Broadcasting, Pro7Sat1, NBCUniversal, KKR, Permira, UEFA, BT, O2, Infront Sports and Media etc.

Throughout all its activities O&O offers a unique combination of knowledge that covers:

- Constantly updated market and competitor analysis
- Strategy development at the most senior levels
- Understanding of the technical developments that shape the media industry
- Deep experience of working in the regulatory and policy environment
- Practical experience of deal making and negotiation
- Understanding of the most up to date relevant economic theory, financial modeling and forecasting techniques

DOTECON LTD

DotEcon is an economic consultancy focusing on network industries. They offer analytical and empirical support to public sector bodies and private sector companies, assisting with:

- Regulatory design and implementation;
- Competition policy and commercial litigation cases;
- Public policy design;
- Market design and auctions; and
- Business strategy.

DotEcon combines the ability to integrate rigorous theoretical economics with a thorough understanding of market realities to provide reliable, practicable and concise advice. They draw on a wide range of specialist skills, including econometric analysis, economic and financial modelling, and the development of bespoke software tools.

The company was founded in June 1999 by Dr Christian Koboldt and Dr Dan Maldoom, two former academic economists with extensive consulting experience. DotEcon has eleven full-time economists based at our office in London. Through extensive project work, DotEcon has acquired a reputation for producing rigorous and objective analysis to tight deadlines, and for finding innovative solutions to unusual problems. This reputation is reflected in the high volume of business won through returning customers and client recommendation

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	CT	Ceská Televize
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	TV2	TV2/Danemark
Estonia	ERR	Eesti Rahvusringhääling
Finland	MTV	MTV Oy
	YLE	Oy Yleisradio Ab
France	Canal +	Canal +
	E1	Europe 1
	FT	France Télévisions
	FT2	France 2
	FT3	France 3
	Lagardère Active	Lagardère Active
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	SRF	Radio France
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Germany	ARD	Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland
	ProSieben Sat.1	ProSieben Sat.1
	VPRT	Verband Privater Rundfunk und Telemedien
	ZDF	Zweites Deutsches Fernsehen
Greece	ERT	Elliniki Radiophonia-Tileorassi SA
Hungary	MR	Magyar Rádió
	MTV	Magyar Televízió
Iceland	RUV	Rikisutvarpid (Icelandic National Broadcasting)
Ireland	RTE	Radio Telefís Éireann
	TG4	Teilifís na Gaeilge
Italy	RAI	Radiotelevisione Italiana
Latvia	LR	Latvijas Radio
	LT	Latvijas Televizija
Lithuania	LRT	Lietuvos Radijas ir Televizija

Luxemburg	CLT	CLT Multi Media
	ERSL	Établissement de Radiodiffusion Socioculturelle du Grand-Duché de Luxembourg
	RTL Group	RTL Group
Malta	PBS	Public Broadcasting Services Ltd
Netherlands	NPO	Nederlandse Publieke Omroep
Norway	NRK	Norsk Rikskringkasting As
	TV2	TV2 Gruppen As
Poland	PR	Polskie Radio
	TVP	Telewizja Polska
Portugal	RTP	Rádio et Televisão de Portugal
Romania	ROR	Societatea Româna de Radiodifuziune
	TVR	Televiziunea Romana
Slovakia	SR	Slovensky Rozhlas
	STV	Slovenská Televizia
Slovenia	RTVSLO	Radiotelevizija Slovenija
Spain	COPE	Radio Popular SA COPE
	RTVE	Radiotelevisión Española
	SER	Sociedad Española de Radiodifusión
Sweden	SVT	Sveriges Television
	SR	Sveriges Radio
	TV4	TV-4 Nordisk Television
	UR	Sveriges Utbildningsradio
United Kingdom	BBC	British Broadcasting Corporation
	C4	Channel 4
	five	five
	ITV	ITV
	S4C	Sianel 4 Cymru
Pan European	AER	Assocation of European Radios
	EBU	European Broadcasting Union (including also its Members outside the EEA)