Title: Spectrum management (Communications Review) **IA No:** DCMS070 **Lead department or agency:** DCMS **Other departments or agencies:** OFCOM	**Impact Assessment (IA)** **Date:** 08/02/2013 **Stage:** Development/Options **Source of intervention:** Domestic **Type of measure:** Primary legislation **Contact for enquiries**: **jane.**humphreys@culture.gsi.gov.uk and james.youngs@culture.gsi.gov.uk

Summary: Intervention and Options

RPC Opinion: RPC Opinion Status

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB on 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
£6,241m	£494m	£-23.08m	Yes	OUT

What is the problem under consideration? Why is government intervention necessary?

The Government believes that the market for radio spectrum would function with greater efficiency if the regulatory framework were more flexible. The measure proposes to modify existing spectrum management tools to provide new facilities, not foreseen when current legislation was drafted, and to strengthen the functioning of existing provisions. These market-based management tools allow for greater degree of spectrum efficiency. If changes are not made there is a possibility of regulatory failure that could stifle a well-functioning market to the detriment of technological innovation and growth.

What are the policy objectives and the intended effects?

To improve the flexibility of the regulatory framework for radio spectrum and ensure efficient spectrum use. This is to be done by releasing spectrum to those that value it the most; preventing spectrum hoarding; incentivising secondary market trading; and improving the ability to address the increasing demand for spectrum arising from technological change. It is intended to enable the regulatory framework to support wireless infrastructure changes in its contribution to economic growth. At the same time, it will maximise the benefits from social reserved allocations.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Option 1: No change to the legislation which sets out Ofcom's duties on spectrum management.
Option 2: Amend Ofcom's statutory duties to facilitate Dynamic Spectrum Access database licensing, incentive auctions and monetary penalties for breach of WTA licences. This is the Government's preferred option.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 03/2018

Does implementation go beyond minimum EU requirements?			N/A			
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** Yes	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes	
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** n/a	**Non-traded:** n/a		

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECT SIGNATORY: ..... Date: _____

Summary: Analysis & Evidence

Policy Option 1

Description: Amend Spectrum Management

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2014	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	**High:** Optional	**Best Estimate:** £6241m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	0		£0.1m	**£0.934m**

Description and scale of key monetised costs by 'main affected groups'

Incurred costs by Ofcom from running incentive auctions.

Other key non-monetised costs by 'main affected groups'

Licence holders, if they violate the WTA and incur a monetary penalty.
Costs incurred to develop and implement a dynamic spectrum database.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	0		£771m	**£6,241m**

Description and scale of key monetised benefits by 'main affected groups'

Benefits are dependent on how measures are exercised. The main firms that could benefit those that can provide services on the 'sweet spot' (UHF) spectrum band. Some of these include the mobile communication industry, TV broadcasters, Wi-Fi operators, radio broadcasting, white space device industry(WSD), Programme Makers and Special Events (PMSE), microwave links, satellite links and private mobile radio industry.

Other key non-monetised benefits by 'main affected groups'

The public sector, which includes emergency services, defence, and radars at airports

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Market-based tools are applied successfully.
CBA relating to digital switchover provides a sufficient valuation of released spectrum.
Implementation of dynamic spectrum access databases adhere to modelling assumptions.
Sufficient amount of spectrum is volunteered in order to conduct an incentive auction.
Licence holders do not violate the WTA and therefore no penalties are necessary.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £0m	**Benefits:** £23.08m	**Net:** £-23.08m	Yes	OUT

Background:

The UK applies market mechanisms to the management of the radio spectrum. The UK led the way in Europe introducing market mechanisms for managing spectrum efficiently through the Wireless Telegraphy Act 1998. These tools, including auctions, administered incentive pricing, and spectrum trading, were incorporated in the Electronic Communications Networks and Services Directives in 2002 and are now embedded across Europe. However, since the legislation was put in place it has become clear that some of the management tools are not operating as intended, while in other areas new tools have become available.

The purpose of the proposed measures is to:

- Encourage spectrum release (incentive auctions)
- Encourage new services that will support growth and are not currently enabled by existing framework for spectrum management (WSD, Dynamic Spectrum Access)
- Encourage efficient use of existing spectrum by expanding the penalties available (adding monetary penalty for WTA breach)

These aims will be achieved through three changes:

- Dynamic spectrum access will facilitate the use of "white space" amongst spectrum allocated to TV broadcasting which is currently under-used. With the use of dynamic spectrum databases new, low-powered applications can be allowed which do not interfere with existing use. This is expected to provide significant new business opportunities.

- An active secondary market in spectrum has yet to fully develop. With the ability to conduct incentive auctions Ofcom will be able to offer incentives to spectrum holders and encourage them to release unused spectrum. Ofcom will then re-package and auction any spectrum released. In this way, market participants will be encouraged to employ spectrum that is allocated but unused.

- If a holder of spectrum is in breach of the Wireless Telegraphy Act (WTA), even in a minor way, Ofcom can currently only prosecute licensees or revoke their licences. Such measures are often disproportionate to the offence. It is planned to introduce a system of penalties which provide appropriate incentives for compliance.

Spectrum

A radio wave is a form of electromagnetic radiation with a wavelength that is longer than visible light. Radio waves can be grouped according to the length of the wave. A key characteristic is the higher the frequency the shorter the wavelength. The collection of frequencies is called spectrum.

These waves can be used to send a signal from one location to another. By sending many in quick succession information data, such as sound, images, text etc…, can be transferred wirelessly. However there are some constraints. The lower the frequency the longer the distance the data can travel, however the slower the data transfer rate. Conversely, the higher the frequency the shorter the distance the data can travel however the faster the data transfer rate.

Both distance and transfer rate are necessary for commercial applications. The 'sweet spot' (300 MHz to 3 GHz) has emerged as the most suitable bandwidth for many commercial applications. This is because the signal travels a few kilometres to a few tens of kilometres, works well indoors, and requires an antenna size that can be incorporated into commercial devices. Therefore spectrum in the 'sweet spot' is in high demand but is in scarce supply.

Commons good

Spectrum is a commons because it is rivalrous and non-excludable. Rivalrous refers to the fact that if many people are using it then others cannot, this is due to interference. Non-excludable refers to the fact

that anyone can transmit and use up valuable radio waves if they have the equipment. Examples of industries with commons good problem are fishery and timber industries. Therefore, a relatively rigid management system is often applied to the allocation of spectrum which is in high demand, in order to prevent signal interference. This prevents the failure of the commons which would render the use of spectrum useless for all.

Use of Market Mechanisms

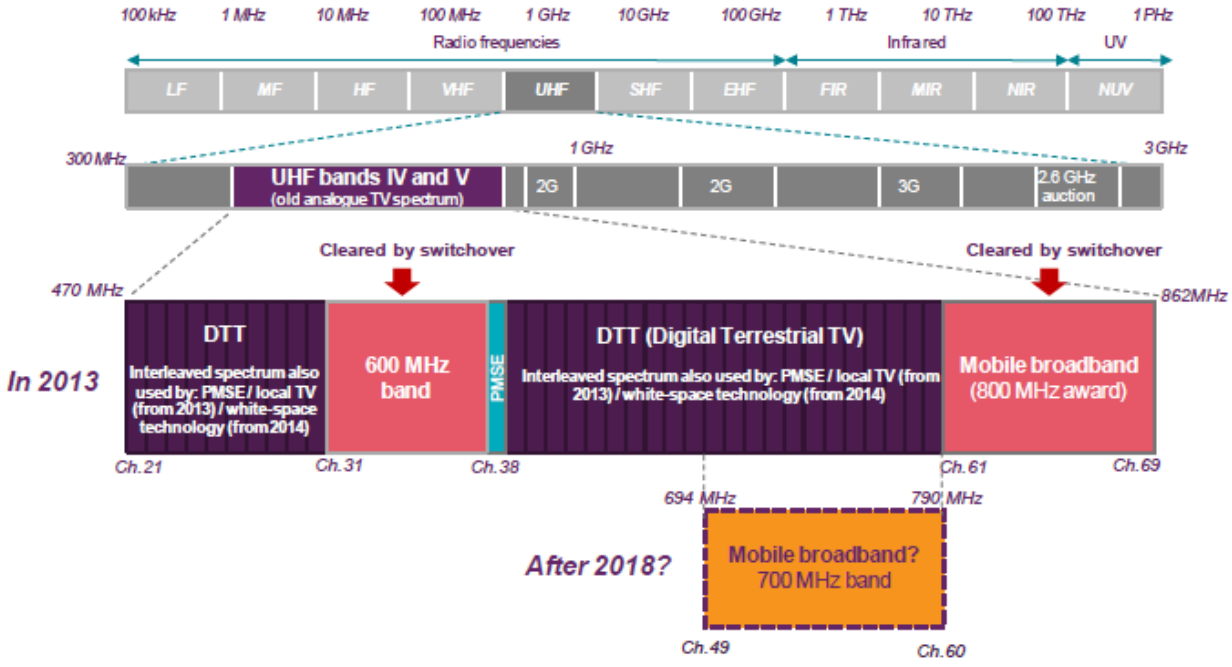
Compared to a rigid spectrum management system, market mechanisms grant business greater freedoms relating to spectrum allocation and usage. Businesses generally hold the most market information and are better suited to evaluate market demand and supply. In the context of spectrum licences with a set duration, market mechanisms allow these licences to be reallocated and reassigned in for example the secondary spectrum market. Spectrum trading allows for the release of spectrum to those that value it the most, resulting in more efficient allocation of spectrum.

Economic value of spectrum

Access to spectrum is key to innovation and competition in the fast-growing information and communications technology sector as well as to a wide range of other commercial and non-commercial applications, including defence, safety-of-life and emergency services and science.

Wireless technology is increasing in importance to meet rising demand for communication and entertainment while on the move. The report for DCMS and BIS by Analysys Mason published 5th November 2012 estimates that spectrum contributed £52bn to GDP in 2011, an increase in real terms of 25% since 2006. Of this, 60% was attributable to mobile communications, and 20% to broadcasting.

Figure 1



(Source: Ofcom)

The diagram sets out the allocation of spectrum relative to frequency. The frequency range for the UHF band is 300MHz – 3GHz (3000MHz) and referred to as the 'sweet spot' mentioned earlier. The UHF bands IV and V are of particularly high commercial value compared to the rest of spectrum and, therefore, of particular focus for this impact assessment. The range has an ideal combination of data transfer rate and the distance data can travel, thereby characterised by high and market demand and relative scarcity.

Digital TV switchover replaced analogue terrestrial television signals with wholly digital signals. The more efficient use of spectrum by the digital signal has allowed a significant amount of spectrum to be cleared. In figure 1 shows the clearance of channels 31 to 38 (the "600MHz" band) and channels 61 to 69 (the "800MHz" band). The spectrum currently retained for terrestrial television also accommodates secondary

use by PMSE and local TV, and in the near future is expected to accommodate dynamic spectrum access services (also called TV White Space services). Future plans, as indicated in Figure 1, are likely to see television cleared from the 700MHz band with mobile broadband services subsequently introduced.

In order to maximise the potential economic benefits it is necessary to ensure that a market-based toolkit is available to ensure efficient spectrum allocations. Digital TV switchover and subsequent replanning also forms the basis for the illustrative examples applied in the cost benefit analysis.

Legal Framework

Ofcom's spectrum duties are set out in section 3 of the Wireless Telegraphy Act 2006 which states that:

> (1) In carrying out their radio spectrum functions, Ofcom must have regard, in particular, to—
>
> > (a) the extent to which the electromagnetic spectrum is available for use, or further use, for wireless telegraphy;
> >
> > (b) the demand for use of the spectrum for wireless telegraphy; and (c) the demand that is likely to arise in future for the use of the spectrum for wireless telegraphy.
>
> (2) In carrying out those functions, they must also have regard, in particular, to the desirability of promoting—
>
> (a) the efficient management and use of the part of the electromagnetic spectrum available for wireless telegraphy;
>
> (b) the economic and other benefits that may arise from the use of wireless telegraphy;
>
> (c) the development of innovative services; and (d) competition in the provision of electronic communications services.

Problem under consideration:

Market mechanisms for managing spectrum efficiency were introduced through the Wireless Telegraphy Act 1998. These tools, including auctions, administered incentive pricing and spectrum trading, were incorporated in the Electronic Communications Networks and Services Directives in 2002. However, since the legislation was put in place it has become clear that some of the management tools are not operating as intended, while in other areas new tools have become available.

Since economic scarcity characterises spectrum within the 'sweet spot' bandwidth, the Government believes that the market for radio spectrum would function with greater efficiency if the regulatory framework were more flexible. The measure proposes to modify existing spectrum management tools to provide new facilities, not foreseen when current legislation was drafted, and to strengthen the functioning of existing provisions. These market-based management tools allow for greater degree of spectrum efficiency. If changes are not made there is a possibility of regulatory failure that could stifle a well-functioning market to the detriment of technological innovation and growth.

Rationale for intervention:

Electromagnetic spectrum is a finite and valuable resource of considerable economic and social importance. Some spectrum users value spectrum more than other users. Spectrum management is essential for preventing signal interference and to avoid the failure of the commons. However, there are instances in which a well-functioning market would be better suited to reallocate and reassign spectrum licences. Mechanisms, such as, auctions, administered incentive pricing and spectrum trading enable greater efficiency in use and allows users to adapt to market change and develop new technologies.

However, Ofcom's management of spectrum is governed by a regulatory framework. If this framework is not kept up-to-date there is a risk of potential regulatory failure underpinning the market for radio spectrum. This, in turn, may lead to a mismatch between the incentive mechanisms and market demand. Additional flexibility to support existing market mechanisms will help ensure efficient use.

The economic rationale for intervention is therefore to:

- Improve the efficiency of spectrum use;
- Incentivise the release of spectrum by allowing for greater market based assignment;
- Incentivise the secondary market for spectrum; and
- Improve spectrum management.

The improved market mechanisms proposed will increase competition by reducing barriers to entry, making more spectrum available to the market, removing hidden subsidies and incentivising the market to determine optimal spectrum usage.

Policy objective:

To improve the flexibility of the regulatory framework for radio spectrum in order to ensure:

- Efficient spectrum assignment by releasing spectrum to those that value it the most;
- Prevent spectrum hoarding;
- Incentivise secondary market trading;
- Improve ability to address the increasing demand for spectrum arising from technological change.
- Overall to enable regulatory framework to support wireless infrastructure changes and its contribution to economic growth.
- Maintain the ability to protect social reserved allocations (spectrum used by defence, emergency services etc…)

Description of options considered (including do nothing):

Option 1: do nothing

For the purposes of this impact assessment the 'do nothing' sets the baseline for the cost and benefit analysis. Without any change to the current regulatory framework economic circumstances remain the same. Therefore to do nothing has a net present value (NPV) of zero.

Option 2: Introduce incentive mechanisms

1. Dynamic Spectrum Access and Database Licensing

There are gaps of spectrum which exist amongst the frequency bands that have been reserved for TV broadcasting. These could be put to use by employing Dynamic Spectrum Access Databases to allocate them. The databases store information on what spectrum is available at a given time and geographical location. These frequencies can then be allocated to spectrum users without the risk of interference. This allows users, such as small firms, to access spectrum for a specific duration and geographical location.

The role of these databases was not foreseen when writing the 2003 Communications Act. Ofcom requires the powers to license the operators of these databases. They would also require the ability to set fees for these licensees to recover their costs (or even above that level to facilitate a level of optimal use).

Dynamic spectrum access has an array of potential usages, such as:

- *Rural broadband* - Providing fixed wireless broadband communications to rural communities.
- *Hot-Spot coverage* - Involves the use of TV white spaces to provide fixed or mobile indoor/ outdoor communications in hotspots.
- *In-home broadband* - This involves the use of TV whitespaces to provide in-home wireless

communications, similar to Wi-Fi technology.

- *In-home multimedia distribution* - Similar to the in-home broadband application, would use TV whitespace to send content from one device to another
- *Machine to machine communications* - This typically refers to a low data-rate connections between sensors and devices used for purposes of control, telemetry, or remote monitoring. E.g. control and monitoring factory equipment, remote reading of utility meters and remote sensing of the environment.

2. Enabling the use of incentive auctions - by allowing auction proceeds to be transferred to original licence holder

   Since 1998, auctions have become established as the best means of assigning spectrum to users who will use the spectrum most efficiently, and are generally to be used where there is clear spectrum for which there are more potential licensees than the spectrum can support. However in all cases the auction receipts are passed in their entirety to the Exchequer.

   Licensees who have invested in spectrum, and in infrastructure for the services which make use of that spectrum, have little incentive to surrender all or part of the spectrum on which they may no longer place any significant value. The policy objective is to provide incentives on UK spectrum licensees to release spectrum into the market. They can, of course, already sell directly to another party, but rarely do. In any case, there may be instances in which Ofcom is better placed to identify suitable releases, for example by being better placed to aggregate spectrum releases from more than one licensee to enable an effective auction amongst multiple trading partners.

   An incentive auction is a market-based means of repurposing spectrum by encouraging licensees to voluntarily offer Ofcom unused/low valued spectrum to be auctioned off. The offered spectrum is repackaged and then auctioned off by Ofcom. As an incentive, a share of the proceeds then goes back to the original licensee. In order to enable the use of incentive auctions it is necessary for Ofcom to be permitted to transfer some auction proceeds to the original licensee holder, rather than paying all sale proceeds into the Consolidated Fund. Negotiations with HMT to acquire this permission is on-going, nevertheless for the purposes of this IA it is assumed that the direct transfer could occur.

3. Penalties for WTA breaches

   Currently, in the event of spectrum usage breaches Ofcom only have the power to prosecute licensees or revoke their licences. Neither remedy is proportionate for addressing various breaches of licences.

   Revocation of a licence can be appropriate and has been used. However, it is not always an appropriate response taking into account the potential disbenefits for citizens and consumers. Where a licensee provides major, high-value service to society – whether on commercial terms or in supporting the delivery of public services – it is not a plausible incentive for compliance, because Ofcom would not act against the interests of citizens and consumers. A topical example is that Ofcom would be extremely unlikely to revoke a 4G mobile licence for breach of the condition dealing with performance on delivery of assistance to TV viewers.

   Ofcom requires the power to discourage rule breaking and make the penalty proportionate to the offence. We are proposing the use of monetary penalties which are levied on a scale that can effectively cause operators to avoid licence breaches.

Monetised and non-monetised costs and benefits of each option (including administrative burden):

Cost/Benefit Table of Policy Options

PV Cost / PV Benefit / NPV £m (2011 prices)	Option 1 Best Estimate	Option 2 Best Estimate
PV Costs		
Dynamic Spectrum Access		
Quota trading setup	0	-
Administrative burden	0	-
Incentive auctions		
Standard costs	0	£0.93m
Penalties for Wireless Telegraphy Act licence breaches		
Administrative burden	0	-
Net Cost	**0**	**£0.93m**
PV Benefits		
Dynamic spectrum access		
Consumer surplus	0	£5723.62m
Spurring Innovation	0	+
Profits and efficient allocation	0	£286.18m
Incentive auctions		
Efficient allocation of spectrum	0	£231.88m
Technology adaption and diffusion	0	+
Penalties for Wireless Telegraphy Act licence breaches		
Reduction in licence breaches	0	+
Allocative efficiency	0	+
Net Benefit	**0**	**£6,241m**

Option 1:

This is the baseline with a NPV equal to zero.

Option 2:

Determining the Value of Spectrum

The key rationale for the measure proposed is the allocation and assignment of spectrum that will provide an overall welfare benefit. For efficient assignment and allocation to be achieved, the spectrum must be reassigned and reallocated to those that value it the most.

In 2005, DTI and DCMS conducted a cost benefit analysis for the digital TV switchover considering the ending of analogue TV signals and replacement by digital television. The study focuses on a similar portion of spectrum and consumer surplus that is under consideration in this IA. It is therefore a more direct evaluation than other surveys. Estimates used came from various industry stakeholders regarding the costs of conversion of the broadcasting network and the benefits to broadcasters from not having to maintain analogue networks. Estimates of the benefits from future use of spectrum and of costs to consumers who would not convert voluntarily before switchover were derived from survey work commissioned by the Department of Trade and Industry (DTI) including revealed and stated preference studies. Ofcom also contributed to estimates.

The greater efficiency of digital signals meant 14 frequency channels, each of 8MHz, could be cleared of TV use. According to the cost benefit analysis pertaining to this measure the net present value (NPV) from the re-use of released spectrum value was £1,181m (2004 figure). This figure incorporates the release of channels 31 to 35, and channels 37, 39 and 40 (600 MHz band) and channels 63 to 68 (800

MHz band). [Note: subsequently a decision was taken to free channels 36 and 69 from their previous uses and to clear channels 61 and 62 instead of channels 39 and 40)

- Accounting for inflation from £1,181m in 2004 becomes £1,392m in 2011
- NPV of £1,392m / 14 channels = NPV of £99.43m per channel
- Each channel used 8 MHz, as such £99.43 / 8 MHz per channel = £12.42m per MHz
- The CBA assumes the released spectrum will be used for additional DTT channels.

1. Dynamic Spectrum Access

Economic Considerations

By allowing the use of Dynamic Spectrum Access, spectrum will be assigned more efficiently than at present. From the same quantity of this limited resource, there would be a larger contribution to output in the economy.

As this relates to new technology and the development of a new market it is inherently difficult to estimate the amount of MHz that can be utilised by dynamic spectrum databases. In order to make an estimate, it is assumed that initially, primary users would be white space devices (WSD). A WSD uses gaps in radio spectrum, called 'white spaces', which exists amongst frequency bands reserved for TV broadcasting. A current estimate of spectrum of bandwidth available for WSDs is between 104MHz and 160MHz. However this is dependent on the usage allocations for the 700MHz and the 600MHz bands. There are also indications that WSDs have the potential to operate at both lower and higher frequencies thereby expanding the number of frequencies in which the dynamic database can be applied. It is therefore anticipated that approximately (100 + 160) / 2 = 130MHz will be released for use by these databases within the UHF spectrum.

Under consideration is new and untested technology. Due to many unknowns, a simple model is applied as a demonstration. The scope of analysis is 10 years and it is assumed that the database and its services achieve full operability within this time. The full estimated 130 MHz are unlikely to be used immediately and instead it is anticipated that usage will grow over time. As such, it is assumed an uptake of 13 MHz per year on average (130MHz / 10 years). The development of the spectrum database is likely to be successful however significant uncertainties reside with services that utilise the database. At this time, it is not possible to state whether the database and its services will or will not be economically successful. The risk factor is therefore set at 50% for the first year. As time goes by it is likely that the market adjusts, faults are resolved and businesses gain confidence in the new technology. With fully operability assumed in 10 years, the risk factor is reduced by 5% per year (50% uncertainty first year / 10 years). Modelling in such a manner displays benefits growing over time.

- Annual benefits = (Frequencies being used) x (12.42m) x (Risk factor)

Costs

- *Quota trading setup* - The cost for Ofcom to set up a system where potential users can access and pay for unused spectrum.
- *Administrative burden* - The cost of administrating the licences and allowing the databases to operate.

Benefits

- *Consumer surplus* - The benefits to consumers has been calculated as £12.42m per MHz in 2011 prices. There is anticipated to be approximately 130MHz released for use by these databases within the UHF spectrum. The Annual benefits = (Frequencies being used) x (12.42m) x (Risk factor) model discussed above is applied.

- *Spurring innovation* – It is anticipated that many SMEs will make use of this database and could act as a driver of innovation. Saying what uses will be created for this spectrum is hard to predict and this will not be quantified in the analysis.
- *Profits and efficient allocation* - There will be larger profits for firms who are able to cut their costs and spectrum that was being unused will be creating output. It is assumed firms capture an equivalent of 5% of the modelled consumer surplus.

Assumptions

- Consumer surplus calculation: There is linear growth of spectrum being used increasing by 13 MHz a year over a 10 year period. Risk will start at 50% and fall by 5% a year.
- Available spectrum utilised by WSDs corresponds to the available spectrum for dynamic spectrum databases.
- The £12.42m cost benefit analysis value assumes the released spectrum will be used for additional DTT channels or activity of similar economic value.

2. Enabling the use of incentive auctions - by allowing auction proceeds to be transferred to original licence holder

Economic Considerations

Licensees that have obtained spectrum have little incentive to sell unused/low valued spectrum, even though potential users highly value the same spectrum. Incentive auctions provide licensee holders a means to combine spectrum with other licensee holders and offer the market useful blocks of spectrum. This leads to an overall increase in the release of spectrum being obtained by those that value it the most.

Ofcom has alternative mechanisms to reallocate and reassign spectrum through grant mechanisms and revocation of licences. However the voluntary process of incentive auctions is a more market based approach and may accelerate the release of spectrum. Since it is a voluntary process, it is expected that spectrum would not be offered to be sold unless there is a perceived economic gain. In the context of spectrum found in the 'sweet spot' spectrum may voluntarily be offered for an incentive auction because it is unused/low valued or it is clear that other users value it more and are willing to pay for it.

Monetising costs and benefits is highly dependent on the amount spectrum that is released, and resulting reallocation from the incentive auction. There are therefore a high number of possible combinations. Therefore an illustrative example with clear assumptions is used to evaluate the mechanics of an incentive auction.

Above the value of spectrum per MHz has been calculated and uprated to 2011 prices. Every MHz has an estimated value of £12.42m.

- **Illustrative example**

Incentive auctions can be applied to a wide range of scenarios, as such an illustrative example used to demonstrate the mechanics of its application. Under consideration is a scenario in which several companies have attained spectrum licences within the 'sweet spot' for a period of 5 years. After obtaining the licence 20% of companies require the spectrum for a period of only 4 years. There is, therefore, 1 year in which 20% of the originally allocated spectrum is not fulfilling its full economic potential.

Depending on the number of companies involved and the amount of spectrum attained this can accumulate to 20 MHz being voluntarily offered to Ofcom to be used in an incentive auction.

- 20 * £12.42m = £248.4m for one year spectrum is reallocated and reassigned that would otherwise be of low economic value.
- The costs of conducting an incentive auction are covered by the revenue generated by the auction. Due to the relative complexity of incentive auctions it is assumed that the cost of the auction of 20 MHz is estimated to be £1m with a high degree of variation. However these costs would become more predictable as the frequency of these types of auctions increase.

Costs

- *Standard costs* – A small increase in administrative costs is expected in order to process auctions proceeds being transferred to original licence holders and the exchequer. This will incur minimal accounting cost and would be incorporated as a cost for conducting an incentive auction. Conducting an incentive auction is likely to incur intermediary costs such as information gathering; co-ordination; and negotiation amongst licensee holders and licensee purchasers. This will be dependent on the complexity of an auction. According to Ofcom this could vary from a few hundred thousand pounds to a few million. Incentive auctions are likely to be more complex than auctions used currently but would unlikely to have a major impact upon the overall cost.

Benefits

- *Efficient allocation of spectrum* – The increased exchange of spectrum from incentive auctions will reduce spectrum hoarding and migrate spectrum to both uses and users that value it the most. If a portion of the spectrum released by incentive auction is unused/low value spectrum, the overall output will increase by the users that value spectrum the most. However, within the 'sweet spot' it is assumed that a licence holder will find a use and value it highly.

- *Technology adaption and diffusion* – The reallocation of spectrum to users with a high demand for spectrum lowers entry costs and supports the possibility of new services. The investment into these services encourages technological innovations.

Assumptions

- 20 MHz of high value bandwidth can be voluntarily attained from licence holders
- The cost benefit analysis assumes the released spectrum will be used for additional DTT channels or activity of similar economic value

3. Penalties for Wireless Telegraphy Act licence breaches

Economic Considerations

Revocation or prosecution is ineffective and can lead to large negative externalities and hence not in the public interest. An alternative is, therefore, required by Ofcom to allow them to act as an effective regulator in spectrum matters. Monetary penalties represent a tool for better spectrum management that is more flexible than prosecution or revocation because it is more proportionate to the breach.

It will be necessary to set monetary penalties at an optimal level where it is no longer profitable for firms to break licence conditions. This will disincentivise such breaches. It will also be possible to tailor such disincentives to the probability and extent of harm resulting from breaches of the Act.

Costs

- *Administrative burden* - This may include the cost of investigation and documenting licensees' behaviour.

Benefits

- *Disincentive to breach* - WTA requirements protect consumer benefits and assists with spectrum management. Monetary penalties will help ensure licence holders comply with requirements in a manner envisioned when a licences was issued.

Rationale to justify level of analysis (proportionality):

The required level of analysis for this IA should reflect how regulatory tools will ensure that Ofcom has the toolkit that is flexible enough to handle market changes and ensure effective spectrum management. There is not necessarily a plan to use these tools, and more detailed action would have to be proposed and agreed upon at during its implementation. Therefore the level of analysis can be minimised and focus shifted towards overarching impacts.

Reducing the need for analysis per measure:

- Dynamic Spectrum Access – trials would be conducted initially in order to determine economic benefit.
- Incentive auctions – not necessary to use unless outcome would be beneficial – can evaluate potential costs and benefits for each auction.
- Breach of WTA licences – To estimate the costs and benefits of this policy would be speculative. One cannot attempt to predict the frequency of failing to pay penalties or the scale of said penalties. Each penalty will be issued on a case by case basis and the costs and benefits are unquantifiable.

Risk and assumptions:

1. **Dynamic Spectrum Access**
    a. *Demand risks* - If there is less demand for this service than anticipated, the benefits of the policy will be correspondingly reduced.
    b. *Interference risks* - If the database or technology doesn't work as well as we hope then there will be interference between users of the database.

2. **Incentive auctions**
    a. *Demand risk* – an incentive auction is a voluntary process and dependent on an appropriate number of license holders offering an appropriate amount of spectrum. This risk is mitigated by 1) consultations on whether or not to run an auction and 2) Ofcom's ability to revoke licences and run an auction.
    b. *Auction design risk* – Since an incentive auction is more complex than the currently used auction format there is a risk of faulty incentives and unforeseen outcomes.
    c. *Legislative risk* – Complexity of incentive auctions leads to misunderstanding and possibly litigation.

3. **Penalties for WTA breaches**
    a. *Legislative cost risks*- If monetary penalties are applied upon firms with large budgets for litigation, Ofcom could spend a considerable amount of resources on dealing with litigation issues.
    b. *Business cost risk* – If a firm decides to breach licence rules then they will have to pay monetary penalties.

Direct costs and benefits to business calculations (OITO):

Utilising the illustrative examples of the measure proposed the equivalent annual net cost to business EANCB is £-23.08m.

Dynamic spectrum access and incentive auctions have significant economic potential. The measures add tools and flexibility for Ofcom to better employ market-based mechanisms to spectrum management. This has the potential of greater efficient allocation and potentially a significant number of new entrants.

Dynamic Spectrum Access in particular has significant potential for SMEs and possibly micro businesses as it enables the use of cost effective spectrum, for limited period of time and without extensive licensing procedures.

WTA breaches resulting monetary penalties ensure firms adhere to legal obligations and protect consumer benefits.

Some of the cost benefit analysis is dependent on illustrative examples. However estimates reflect a fast growing market with significant economic potential.

Wider impacts:

Economic and financial :

- *Increased trading of spectrum* - the increased availability of unused/low valued spectrum presents additional opportunities for additional output in the form spectrum services.
    - Overall availability of spectrum will increase the competition for spectrum
    - Increase the potential for spectrum based services to become available

- *Small business enterprises* - The uses of dynamic spectrum access present an array of opportunities for small business.
    - They will have lower costs in such that they do not have to request a licence for spectrum from Ofcom.
    - They will be able to reduce operating costs through machine to machine communications.
    - Online businesses will also be able to reach more customers, especially ones using the hotpots or rural broadband.

- *Better spectrum management* – The use of improved market based mechanisms will ensure that Ofcom has the flexible tools to manage spectrum in a market of technological innovation.

Social

- *Network externalities and globalisation* – While a significant portion of electronic communication between individuals relies on spectrum, the increased connectivity is relatively new. Therefore, taking into consideration the nature of the measures proposed, it would not be proportionate to analyse as part of this IA.

Environmental

- No significant impacts are expected based on the measures proposed and would not be proportionate.

Summary, preferred option and description of implementation plan:

The preferred option is to implement the measures proposed.

The intention is to introduce the proposed measures as part of the Communication Review 2014 White Paper. This would entail changes to the regulatory framework giving Ofcom greater flexibility in implementing market incentives. Additional consultations dealing with the shape and form of market mechanisms would be required prior to implementation. However the regulatory framework would already be in place to do this.

The monetisation of the cost benefit analysis is dependent on exercising the measures proposed. As such, analysis only provides an indication regarding the scale of cost and benefits.

- Dynamic Spectrum Access has significant economic benefits from using unused spectrum, though dependent on the development of new technologies.
- Incentive auctions help ensure efficient assignment and allocation of spectrum, though dependent on this type of auction becoming necessary.

- Penalties for WTA breaches provide a proportionate mechanism to help ensure compliance with WTA requirements. The cost benefit analysis however is dependent on WTA requirement being breached.