Untethering the microphone:

An economic study of the benefits of spectrum use for unlicensed wireless audiovisual devices in Australia

An updated analysis

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1 Executive summary

Windsor Place Consulting was commissioned by the Australian Music Association ('AMA') to prepare an economic analysis of the benefits of use of wireless audiovisual devices in Australia. The purpose of this study is to estimate these benefits quantitatively where possible and to examine other non-quantifiable categories of benefit. This March 2010 paper is update of a previous analysis undertaken in April 2008. It updates the analysis using new information.

The context of this investigation is the transition from analogue to digital television broadcasting in Australia. Starting in 2010 and to be completed by the end of 2013, this transition will result in the so called 'digital dividend' – the freeing up for new uses of electromagnetic spectrum in the UHF/VHF band including the 700 to 800MHz frequency band. The Australian Government has decided that it will seek to restack spectrum to maximise the digital dividend in line with major developed economies Since this is the spectrum band that is currently used extensively by wireless audiovisual devices (which include wireless microphones), the reallocation of this spectrum to possible new uses represents a risk to the future use of the existing stock of such devices and this category of spectrum use in the future. It is therefore important to determine the economy- and society-wide benefits of this type of use in order to better inform spectrum allocation decisions by Government and the Australian Communications and Media Authority ('ACMA').

This paper develops estimates of the benefits of using spectrum for wireless audiovisual devices and discusses issues relating to the future use of spectrum for these devices. We also consider a range of non-quantified benefits that result from the use of such spectrum by wireless audiovisual devices.

Table 1 provides a summary of the annual, 5-year present value and 10-year present value of user benefits arising from the use of wireless audiovisual devices.

Table 1: Benefit estimates by user category: disaggregated consumer surplus method

Method	Annualised net benefit	5 year PV ($ million)	10 year PV ($ million)
Aggregate Consumer Surplus Ratio	140	559	939
Disaggregated cost saving and quality benefits	190	759	1,275
Disaggregated Consumer Surplus Ratio	200	799	1,342

This represents the value in use of wireless audio equipment, a value put at risk by the change in spectrum. The cost to the sector, if there was no compensation is dependent on the options available – and for some equipment this would be replacement, and for other equipment it would be modification. It is indicatively estimated that the cost would be somewhere between $80 million and $220 million given a combination of these approaches.

2 Background

Windsor Place Consulting ('WPC') was commissioned in early 2008 by the Australian Music Association (see www.australianmusic.asn.au) to prepare an economic analysis of the benefits of use of wireless audiovisual devices in Australia. The Australian Music Association is the trade body for the music products industry, representing wholesalers, manufacturers, retailers and associated services for musical instruments, pro audio, print music, lighting and computer music products. This March 2010 report represents an update of this previous analysis and is based on updated and new information.

Australia is currently in a transition from analogue to digital television broadcasting with the analogue television signal switch off (ASO) scheduled to be completed by the end of 2013. The main benefit of ASO, besides quality improvement in TV picture quality, will be the freeing up of significant amounts of spectrum in the Ultra High Frequency and Very High Frequency bands ('UHF/VHF') including in the valuable 700 MHz frequency bands. The Australian Government has decided that it will seek to restack spectrum to maximise the digital dividend in line with major developed economies, and has agreed on a set of principles and a target digital dividend of 126 MHz.[1]This spectrum will become available because digital TV broadcast uses much less spectrum than analogue for comparable levels of programming (6 standard definition digital TV channels can be broadcast in the same frequency as 1 analogue TV channel).

It is likely that the Australian Government will promote the national interest by auctioning part, if not most, of this spectrum freed up by ASO. The global trend in spectrum management practice is to auction spectrum with few conditions regarding the use to which it can be put (subject to any interference issues) in the belief that the market will make the best (i.e. socially optimal) decision about spectrum use. This is in contrast to the traditional practices in which spectrum was allocated on a 'first come, first served basis' or by a 'beauty contest' process – the latter relying on assessment of the spectrum authorities of the best qualified applicant, or by sale with significant conditions and prescriptions about the use to which the spectrum was to be put.

These developments constitute a threat to a large, dispersed and diverse group of wireless audio device users in Australia. Wireless microphones, for example, are used in live music performance, conferences, live sporting events and in many other situations.

Wireless audio products currently operate in the same piece of the radio spectrum as analogue TV broadcasting. Wireless audio products share this piece of spectrum using a "class licence," operating in the gaps or "white space" between the comparatively widely spaced TV broadcasts. Even this space has been flagged for possible auction once analogue TV broadcasting ceases.

This paper develops estimates of the benefits of using spectrum for wireless audiovisual devices and discusses issues relating to the future use of spectrum for these devices. We also consider a range of non-quantified benefits that result from the use of such spectrum by wireless audiovisual devices.

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[1] see Australian Government, *Digital Dividend Green Paper*, January 2010.

3 Use of spectrum for wireless audio-visual devices

3.1 Description of users

The users of spectrum for wireless audiovisual applications in Australia are diverse and dispersed. This characteristic of the users complicates the analysis of the economic benefits of this type of spectrum use and also has implications for the economic efficacy of market-based spectrum allocation processes.

Probably the most thorough study of the economic of wireless audio-visual use of spectrum has been undertaken by the United Kingdom's communications regulator, Ofcom[2].

Ofcom has conducted a public consultation on this type of spectrum use and published the results of this consultation in mid-2007. This consultation was undertaken in the context of digital switchover ('DSO') which is scheduled to be completed in the UK by 2012. Ofcom published its direction of use of spectrum for 'programme-making and special events' ('PMSE') in 2008[3]. PMSE is Ofcom's term for the type of spectrum use discussed in this report and it is intended to be a broad term that captures the diversity of this type of use. It is a broader category than the one that is the focus of this paper but it shares many similar characteristics and presents a similar profile in terms of economic analysis and policy issues.

***Background social use*:** This is typically small-scale use for social or community purposes. It is referred to as 'background' because it is geographically widespread and relatively uniform in volume (compared to other types of use below). Users include many schools, churches and other religious institutions, local fêtes and fairs, amateur-theatre productions, and many community and local events;

***Background commercial use*:** This is similar in character to the background social use except that the users are commercial in character, and include typically small regional theatres, meeting venues and racecourses.

***Larger scale use within fixed sites*:** with multiple channels required. These users typically have multiple pieces of equipment. They may make quite extensive use of spectrum for PMSE, but the use is fixed in one location. This use is more geographically concentrated than the background use, with a focus in major urban areas, though some use is found in almost all parts of the country. Typical users in this category include larger theatres, television studios, and major exhibition sites.

***Special events*:** This category includes large, one-off, short-term events. These can have spectrum needs that vary widely, from modest to very large indeed (such as the Live8 and Bushfire relief

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2 see *Programme-making and special events: future spectrum access*, Ofcom, 20 June 2007

3 see *Access to interleaved spectrum for programme-making and special events after digital switchover*, Ofcom, 16 January 2008.

events). Examples of these events include many music concerts, sporting events, and public commemorations of various kinds. Special events of this kind can take place in densely populated urban centres, or in rural areas; and

***Tours*:** This category involves use of spectrum by a touring company operating over multiple sites. The spectrum requirements can be similar to those of special events, but the category is distinguished by the need to move from one geographical location to another. Examples of this category include tours by bands and theatrical productions.

***In Australia*:** In Australia there is a similar pattern of users. Key types of users include:

- Educational institutions including Schools (e.g. radio microphone at school assembly, school musicals etc), Universities and TAFEs;
- The convention and meetings industry;
- Concert promoters, festival organisers and other entertainment providers;
- Churches;
- TV, radio and other broadcasters;
- Performing arts organisations – both professional and amateur;
- Music theatre groups – both professional and amateur;
- Independent musicians;
- The fitness/aerobics industry (eg instructor wireless microphones);
- Auctioneers;
- Major events (e.g. Grand Prix);
- Political parties (e.g. state and federal conferences); and
- Home users as digital editing and voiceovers etc become easier with new lower cost home audiovisual technologies.

3.2 Description of wireless audiovisual devices

Wireless audiovisual devices include wireless microphones, wireless guitar transmitters and wireless video cameras across a range of product quality covering profession, 'prosumer' and home user groups.

In Australia, wireless audiovisual devices use spectrum in the 520-820MHz frequency range. They tend to be low transmission power devices and therefore operate in a short range – typically around 100 metres with some significant variations for particular types of specialist devices.

Wireless audiovisual devices have several unique characteristics which make them critical for multiple uses such as live-to-air TV broadcasts and musical productions, through to church and school halls. These characteristics are:

- Real time (100% duty cycle with no lag or delay);
- High quality audio (broadcast quality); and
- Radiated power (up to 50mW with a typical range of 100 metres).

At the present time and probably for period of perhaps five (5) years there will be no close substitute for such analogue wireless products. Nor will any other technical solution be more efficient in terms of spectrum utilisation.

Although analogue products do not use spectrum as efficiently as digital technology the critical requirement for very low latency excludes the use of wireless digital products at this time. This very low latency is particularly required in live music and other performance applications where a time delay would make performance impossible. It is likely that digital audiovisual devices will eventually achieve the latency of analogue devices but, as mentioned, this is some time away, depending on the real time ability of wireless digital devices to digitally process speech.

4 Economic analysis of spectrum use for wireless audiovisual devices

4.1 Management of spectrum resources

Spectrum is a 'sovereign resource' that is managed by governments within the international frameworks set by the International Telecommunications Union ('ITU') with the objective of maximising national economic welfare or, to use the appropriate term from economic theory, 'social welfare'.

Over the past 15 years, spectrum management policy has undergone a shift towards a more market-based approach. This approach is characterised by (i) less prescription from government and industry regulators about the uses to which particular parts of the spectrum will be put and (ii) the allocation of spectrum being on the basis of some form of price based allocation systems (including auctions). The underlying belief of this approach is that markets are better than governments at making decisions about the optimal use of spectrum - especially in periods where technology and demand patterns are changing rapidly. This is the approach being followed by most developed country markets including the United States, United Kingdom, New Zealand and, in Australia, ACMA follows this approach. For defined parts of the spectrum, successful spectrum auction bidders who become spectrum licensees 'are able to deploy any device from any site within their spectrum space, provided that device operation is compatible with the core licence conditions and the technical framework established for the band by ACMA'[4].

The use of auctions is based on the belief that they will ensure that the bidder that places the highest valuation on the spectrum resource will be the best licensee from the economic social welfare perspective. The highest bidder will theoretically be the one with the business plan that will generate the greatest return from providing the services that consumers are willing to pay for and so end user benefits will be maximised.

There are a number of theoretical questions regarding this conclusion namely (i) there is significant uncertainty and risk about new services which utilise spectrum, and (ii) there may be significant market power issues . As such spectrum auction processes may not necessarily identify the best bidder from the social welfare perspective. Nonetheless, these problems also apply to government selection of licensees by other means and it is generally agreed that, for a range of spectrum bands and spectrum uses, that the market produces superior social welfare outcomes.

However, not all spectrum allocations are undertaken via market-based processes. Various allocations are made and need to be made by government for community groups, public safety, research, military and various other uses. Allocations of spectrum are also made available on a class licence basis. The alternatives, apparatus licences and spectrum licences, assign exclusive spectrum usage rights to particular licensees. In contrast, in the case of class licences, the types of devices that can be used within a particular spectrum band are defined along with their permitted

[4] ACMA website, www.acma.gov.au/WEB/STANDARD/pc=PC_300172, accessed 09/03/08

characteristics and use limitations. This distinctive characteristic of class licences has a range of implications for spectrum allocation policy.

The class licence under which wireless audiovisual devices are used is *Radiocommunications (Low Interference Potential Devices) Class Licence 2000*.

4.2 The economics of class licence allocation

The need for class licence arises because many economic benefits are created by the use of low power, short range devices however it is not efficient to individually licence these devices because the costs of creating and administering the large number of licences required would be prohibitive.

The nature of class licence and the characteristics of class licence users mean that market-based spectrum allocation may not produce socially optimal results. The main barriers to socially optimal outcomes are *transactions costs* and the *free rider* problem.

Because there are so many users of short range devices, the costs to organise the whole group of current users and for them to make a single entity bid for spectrum in an auction exceeds the benefits of spectrum use. Even if major users of this spectrum could band together to bid, their bidding entity is be likely to be unstable because any particular member of such a group would have an incentive to defect in order to avoid paying and hence 'free ride' on the spectrum. Class licences are a way of bypassing these transactions costs and still achieving the small per user but widely distributed benefits of spectrum use.

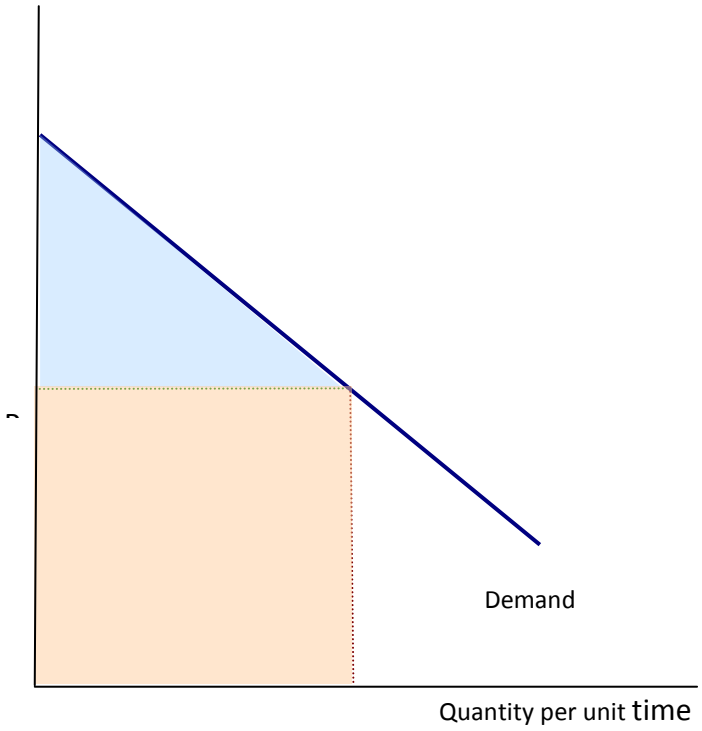
4.3 Economic benefits of spectrum use

4.3.1 The demand curve and consumer surplus

Economic theory provides a precise description of why the consumption of any product or service generates a benefit for consumers. This description is based on the concept of a market demand curve. Figure 1 shows a simple linear demand curve with price on the vertical axis and the quantity demanded per unit time on the horizontal axis. The demand curve can be thought of as a ranking of consumers from those that place the highest (subjective) valuation on the product to those that place a low value on it. The consumer that would be prepared to pay the highest price are represented by the top left of the curve. The highest price any consumer would be willing to pay is represented by the point at which the demand curve intersects the vertical axis (called the *choke point*).

If we assume that the market price is 'P' (for reasons that we will explain later) then we can see that, according to the demand curve, some consumers would be willing to buy the product for more than they actually have to pay (in fact, this is true of all consumers represented by the demand curve *above* the horizontal line at P).

Figure 1: The demand curve and consumer surplus



This exposition elaborates the simple notion that consumers will buy a product only if they believe that the benefits of consuming it are greater than or equal to the costs (in this case, the price). Therefore, we can assume that, on average, some amount of *net* value over and above the price paid is created in the act of consumption. This net benefit over and above price is called 'consumer surplus'. In diagrammatic terms consumer surplus is illustrated by the blue shaded triangle in Figure 1, usually described as the area above the price line and below the demand curve. What consumers pay in total is the rectangular orange area (equal to price times quantity). Total benefit is the sum of the two areas but the net benefit is just the consumer surplus triangle.

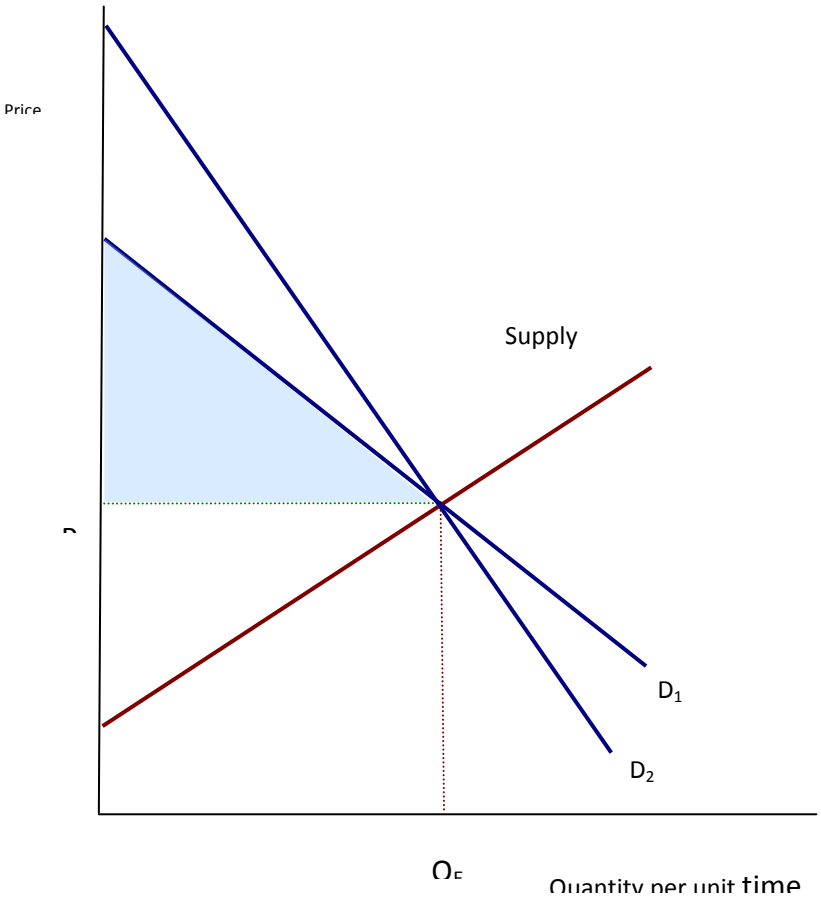
4.3.2 Elasticity of demand

Another important concept is 'elasticity of demand' usually represented by the symbol '$\mathcal{E}_D$'. Elasticity of demand is a measure of the sensitivity of changes in the quantity demanded in response to a change in price and is defined as:

$\mathcal{E}_D$ = percentage change in quantity demanded / percentage change in price

Because demand *increases* in response to a price *decrease*, the value of $\mathcal{E}_D$ is typically negative. Elasticity depends on two things: 1) the slope of the demand curve and 2) the point on the demand curve at which elasticity is being measured. Figure 2 illustrates why it is critical to know the slope of the demand curve for calculating consumer surplus. The flatter the demand curve and the higher (negative) the value of elasticity, the lower the value of consumer surplus. Goods and services that consumers regard as 'necessities' are likely to have a lower elasticity of demand than goods regarded as 'luxuries'.

Figure 2: Effect of the slope of the demand curve on consumer surplus



Elasticity will tend to be higher if a particular good has close substitutes – other products that consumers regard as acceptable alternatives. It is usually the case that the elasticity of demand for any good is usually more elastic in the long run than in the short run.

A relevant example of such variations in elasticity would the elasticity of demand for wireless devices by businesses and by consumers. Because a company that, for example, stages major popular music concerts derives a large value from the use of wireless equipment, it would be willing to pay a much higher price for that equipment than a home consumer. As such these two types of consumer effectively constitute two different markets. This is reflected, to some degree, in the fact that professional equipment will tend to be significantly more expensive than consumer equipment. Nonetheless, some consumers will be willing to pay very high prices for good quality equipment. Such consumers are represented by the top left-hand extreme of the demand curve.

We will use the concepts of consumer surplus and elasticity of demand below in the discussion of the valuation of the benefits of wireless use. The point to note at this stage is that in a market where voluntary exchange takes place, benefits are created because some or most consumers obtain some benefit over and above what they are required to pay in the marketplace.

4.3.3 Flow on benefits to other markets

It is clear that wireless audiovisual devices are *inputs* to a range of commercial activities such as conferences, sporting events and music performances. If wireless audiovisual equipment provides cost advantages for such activities then it will be possible to stage such events at lower cost than otherwise would be the case. In practice it might seem that wireless equipment would constitute a relatively minor input in these activities, particularly considering its cost relative to venue, talent etc. However, it is important to note that the availability of wireless equipment has now been so thoroughly incorporated into the staging of many such events that, were it to become unavailable, it is probably likely that Australia would be left off the touring calendar of some performers. Consider also, for example, the important role played by the driver-point-of-view camera in motor sport and the frequent use of wireless headset microphones by music performers.

The fact that the cost of this equipment is relatively low in these commercial use contexts suggest that the surpluses associated with their purchase and use are very high at least in these types of high-value commercial activities.

4.3.4 Cultural benefits and broader economic benefits

The consumer surplus approach to measuring benefit will only capture benefits that are realised in well-functioning markets. But there are sources of benefit that are not generated within markets. Thus benefit estimates based on consumer surplus estimates will tend to understate the actual society-wide benefit because of factors such as:

- Impacts on productivity and therefore economic activity – where the product is used commercially, costs savings result in increased competitiveness, with the potential for higher levels of economic activity resulting from this increased competitiveness. The impacts in terms of employment and the general level of economic activity are not considered in the evaluation above;

- Impacts on social value – large proportions of the use of this equipment are in areas of not for profit activity (eg churches). Given the financial resources of such sectors, it is arguable that the quality outcomes associated with wireless is well above the price that the user group can afford to pay, and therefore community value is above the surplus estimated based on the underlying price; and

- In the context of both of the above, there is a probable outcome that some activities will not occur at all without access to this spectrum for this use. So for example, without availability of wireless, Australia would not be on the visiting schedule of major musical acts, theatre productions or conferences, where wireless is part and parcel of the presentation.

4.4 Other developments in wireless audiovisual device markets

The transition from analogue to digital television is not the only issue facing current and future users of wireless audiovisual devices. There are a number of developments in the market for wireless devices that will tend to add to the pressure for spectrum allocation to this class in the future.

There is currently rapid growth in the demand for wireless audiovisual devices: Ofcom estimates that growth in the UK is around 10 to 20% per year and WPC's discussions with the AMA suggests that growth in Australia is at a similar level.

Technological advances are creating more applications for wireless audiovisual devices and the availability of low-end devices imported from South East Asia is becoming more widespread.

These developments, in the long term, will inevitably increase in the pressure on the spectrum allocated to these devices and it is likely that longer term solutions will be need to encourage efficient spectrum use. This pressure will exacerbated by competition for spectrum by other uses such as mobile telephony and wireless broadband.

Thus there is a need to find a solution in the short term to avoid the significant disruption that would result from the loss of the use of this spectrum in the transition to digital TV broadcasting but this is also a need for a long term solution that balances the benefits created in the use of wireless audiovisual devices with the benefits created in other uses.

In the UK use of spectrum for this various short-range applications is managed by Joint Frequency Management Group ('JFMG') Limited. JMFG is a UK-based private limited company, which is contracted by Ofcom to exclusively co-ordinate spectrum frequency assignments, and to collect usage fees. Historically, these fees have been based on the recovery of administrative costs but it is a familiar principle of spectrum management policy that charging for spectrum use encourages efficiency in its use.

The more general conclusion from this discussion is that the use of spectrum continues to grow rapidly and that this means that the potential benefit from use, in all applications, will grow over time.

5 Modelling the benefits of spectrum use for wireless audiovisual devices

5.1 Discussion of methodology

Professional and consumer users of wireless audiovisual devices obviously purchase such devices because such devices create benefits or value for such users. The value created in the use of short range wireless devices comes in at least two (2) distinct ways:

- Cost savings: the equipment enables users to do similar things at a lower cost than with wired products, for example, not having to use microphone cables may reduce the labour time required to set up a venue for a performance; and
- Quality improvements: for example, the use of wireless devices may enable a sports reporter to get closer to the action an aerobics instructor will be able to communicate more efficiently to a larger class and so on.

These sources of value will vary type and extent from one type of application to the next and from one type of user to the next.

There are two basic approaches to assessing the quantification of this value in use:

- Estimates based on an aggregate perspective: this method entails estimating the benefit per device to the user and then applying this to the number of units in the market; and
- A disaggregated approach: this entails identifying the combination of costs savings and value creation due to quality improvement according the type of user or user group. This is the approach taken by Quotient Associated Ltd in 2006, for Ofcom.

There are limitations to both of these approaches. The first and critical limitation is the quality of data on the number of users and devices. Data quality issues include:

- A number of short range wireless devices are not captured in any Australia data. This is because they are brought into Australia by individuals from overseas or are purchased on-line and therefore are not recorded either in the Australian Wireless Audio Group ('AWAG') sales data, or in ABS import data (note the quantum of ABS recorded imports is over double that of AWAG sales). While much of this will be in the lower end equipment for personal consumer use, and therefore may not affect the value calculations significantly, there is likely to be some in the medium-end personal use particularly in music and semi-amateur theatre.
- There is limited information on who uses the equipment and what it is used for. Unlike the UK, where Ofcom has commissioned detailed studies, in Australia, users do not have to be licensed, and therefore use is not tracked.

It should be noted that this study is not a benefit cost valuation of a given policy change. The issue that will eventually be before ACMA is what to do with respect to the UHF/VHF spectrum utilised by short range wireless audiovisual devices. The brief for this study is to investigate the current

benefit derived from the use of spectrum for these devices. This partly informs the questions that ACMA will need to consider in the future.

In any valuation or benefit analysis, what is included as value or benefit can vary quite considerably. For example, respondents to the Ofcom research project suggested that short-range wireless equipment was worth in value some £15 billion annually to the UK economy. This value was relative to an estimated spend on equipment of some £60 million. However Ofcom noted that within the submissions there was no rationale provided that justified this value. It is possible that the £15 billion was estimated as the value added (or contribution to GDP) of the industries that make extensive use of wireless technologies.

In the Australian market it is also possible to identify the contribution to the overall economy of the industries that use wireless audiovisual devices. We can identify under Australian and New Zealand Industry Classification Codes (ANZIC), industries that are likely to make relatively extensive use of wireless equipment (film, radio and television production, the performing arts, and sport and recreation) and using Input Output tables (ABS 2005/06) indicates that in 2005/06 these sectors[5] had gross value added (wages and salaries and returns to capital) of $14 billion. The hospitality sector is also likely to be a significant user (particularly with respect to the entertainment component of the services they provide).

Table 2 shows the contribution of these industries to the Australian economy.

Table 2: Contribution of wireless device using industries to the economy

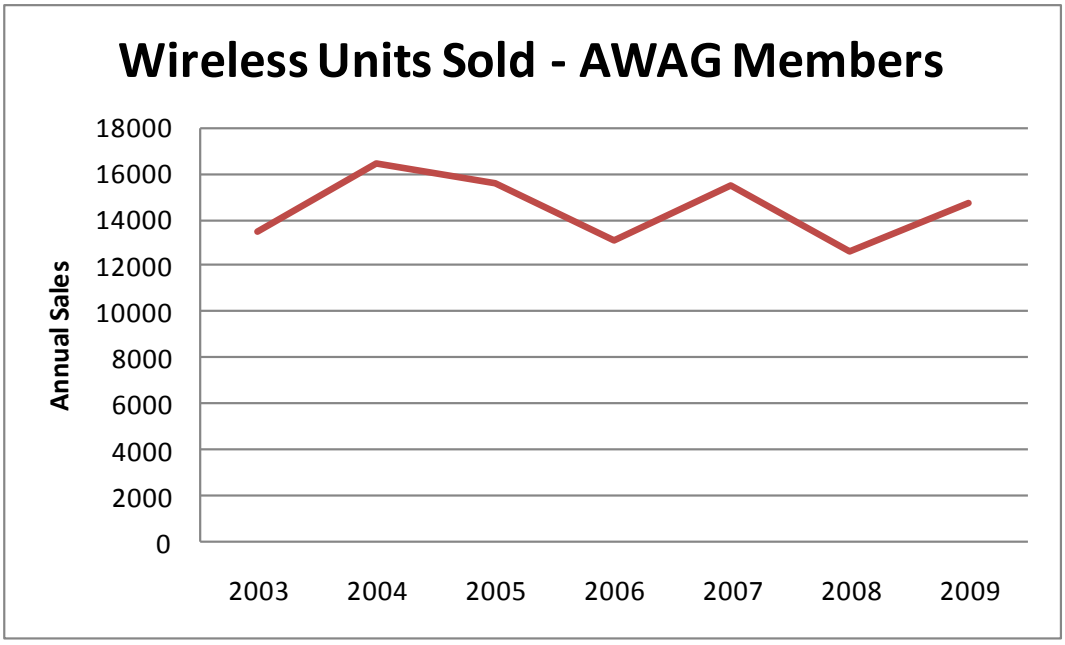
	Gross value added 2005/06 ($ million)	Proportion of Total Value Added (GDP), 2001/02	Employ--ment 2005/06 ($ million)	Proportion of Total Employment, 2005/06
Motion picture, radio and television services	4,388	0.45%	50,104	0.50%
Libraries, museums and the arts	3,054	0.32%	77,496	0.77%
Sport, gambling and recreational services	6,649	0.69%	146,900	1.46%
Total "Heavy" Users	14,091	1.46%	274,500	2.73%
Accommodation, cafes and restaurants	20,092	2.08%	479,875	4.78%
Total "Regular" Users	34,183	3.53%	754,375	7.51%

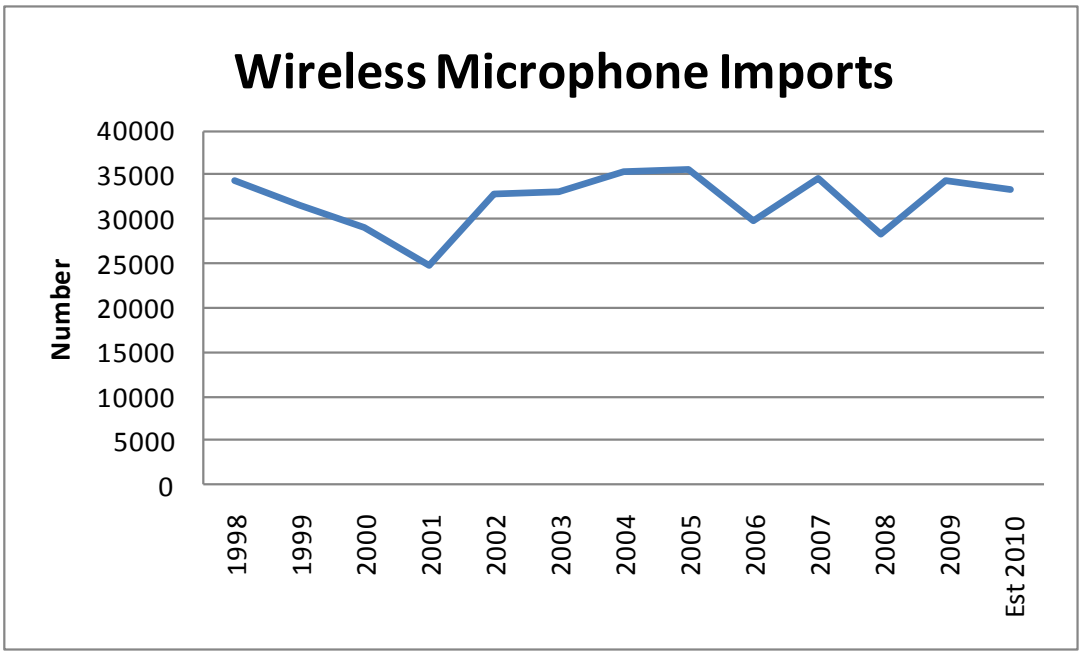
Source: ABS Input Output Tables, 2005/06

[5] The input output tables are defined at 109 industry sectors, and some parts of the sector (eg video distribution) will not use wireless equipment significantly, but other parts will be heavily dependent.

5.2 Aggregate approach to estimating benefit

Data provided by AWAG indicates that there are average annual sales of devices of approximately 15,000 units per year by AWAG members (see figure below). ABS data (also provided by AWAG) indicates that there are some 32,000 units imported per year. As there is minimal local production of this type of equipment it can be presumed that the 32,000 units are inclusive of 15,000 sales of AWAG members and not additional (AWAG members therefore represent around 40% of total units). If it is assumed that average life of each unit is five years, and using the 2009 import volumes this would suggest that in the long term there are of the order of 133,000 units in use within the community (and more if they have a longer average life).





The average wholesale price of wireless audiovisual devices is reported by AWAG as approximately $650. If it is assumed there is a retail margin (including GST) of 150%[6], then the average retail price would be of the order of $1,625.

Therefore, the average user spend per year on this equipment is approximately $50 million, and the replacement value of wireless audiovisual equipment currently in use within Australia at the present time is around $220 million (assuming a 5 year life and allowing for straight line depreciation).

It should be noted, however, that the price of a device includes, in most cases, the cost of the underlying equipment. So, for example, in paying for a wireless microphone, the customer pays for the microphone and for its wireless feature. The ratio of wireless functionality to the underlying functionality will vary from very high in some equipment (for example, a wireless guitar signal transmitter that replaces a simple guitar cable) to somewhat lower in others (a high-value microphone). It is assumed that the average ratio of inherent value in wireless to value of equipment is 80%, and therefore the annual value paid by users for wireless is of the order of $40 million annually. There are some additional costs, such as electricity, but they would generally be minor.

The average spend on such equipment can be taken to represent a *minimum* annual value of the use of wireless spectrum to users – it is what the users are prepared to pay to acquire the devices. Most users will enjoy a benefit in use of greater than the price. As described above, this referred to as *consumer surplus* in economic theory.

Because the price paid is a minimum value for benefit many users would be prepared to pay a higher price than they are actually required to pay in the market. This concept of consumer surplus is central to the economic evaluation of benefits created in markets. In the case of wireless audiovisual devices there is no data or analysis of which we are aware that estimates the extent of consumer surplus in relation to the price of these products.

From a technical perspective, knowing the ratio of consumer surplus per consumer to the prices requires knowing the shape of the demand curve for wireless audiovisual devices. Knowing the shape of the demand curve makes it possible to calculate the elasticity of demand. In the absence of such detailed information one approach is to use a estimate the consumer surplus ratio ('CSR') - which is the ratio of the total value of consumer surplus in a particular market to the value of revenue in that market within a specific time period.

The CSR is determined by the elasticity of demand for a product and the shape of the demand curve. As described above, the elasticity of demand is defined as the percentage change in the quantity of a good demanded divided by the percentage change in price that caused it.

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6 The assumed margin is much higher than that used in the previous study – based on additional information provided by AWAG, which indicated that the previous study applied too low a margin. Further it is possible that the ABS estimate of wholesale value may be an underestimate.

If a product has a low elasticity of demand then a relatively large change in price will cause a relatively small change in the quantity demanded. This applies to goods that are considered 'essentials' such as petrol. Note that in the long run demand is always more elastic than in the short run – in the short run it is difficult to drive less but in the long run one can buy a smaller car or move closer to work.

As demonstrated in the discussion above, a product with a low elasticity of demand will therefore have a high CSR and vice versa. Based on our experience is estimating demand curves and CSRs we believe a reasonable range for the CSR for wireless devices would between 1.5 to 3.0[7]. Applying these ratios gives the following results for total benefits to users from use of wireless devices. The *gross* annual benefit represents the revenues paid in the market for the wireless component of the equipment purchased in a given year (which represents a minimum of the value created) *plus* the value of consumer surplus (the extra amount some users of equipment would be prepared to pay). The consumer surplus or *net* benefit to consumers, is gross benefit less the total revenue actually paid for the equipment (specifically, its wireless component only) and as such represents an estimate of the economic benefit to end users of the use of the equipment. The estimates of benefit are given in Table 3.

Table 3: Benefit estimates, aggregate consumer surplus approach

Assumed consumer surplus ratio	Gross annual benefit ($ million)	Net annual benefit ($ million)	5 year present value[8] of net annual benefit ($ million)	10 year present value of net annual benefit ($ million)
1.5	100	60	240	403
2.5	140	100	399	671
3	160	120	479	805

Thus, these estimates suggest that use of wireless equipment creates a gross annual benefit of the order of $100 to $160 million annually and a net economic benefit of $60 to $120 million.

7 Recent work undertaken by the authors on, for example, estimated consumer surplus value in terms of demand for broadband identifies CSR's of the order of 2-3. *Economic evaluation of broadband adoption on Yorke Peninsula*, prepared for Information Economy Directorate, Department of Further Education Employment Science and Technology, the Government of South Australia. We suggest that the market for wireless equipment would be slightly more competitive (ie more substitutes) than broadband – although in the more professional sectors and for some users it could be considered as essential and therefore elasticity would be very low and CSRs therefore would be high. We can beef this up a bit with some more references

8 Discount rate of 8% real has been applied.

Over a 5 year period the gross benefit would have a present value of up to $640 million and the net value would be up to $480 million. Over a 10 year period the gross benefit would have a present value of up to $1,070 million, and a present value of net benefit would be up to $805 million. These calculations of present value are done using an 8% real discount rate as recommended in various government Treasury and Finance policy manuals.

It could be considered that these estimates are an understatement of the value, as they do not fully incorporate the following items of secondary impacts such as:

- Impacts on productivity and therefore economic activity – where the product is used commercially, costs savings result in increased competitiveness, with the potential for higher levels of economic activity resulting from this increased competitiveness. The impacts in terms of employment and the general level of economic activity are not considered in the evaluation above;

- Impacts on social value – large proportions of the use of this equipment are in areas of not for profit activity (eg churches etc). An argument is that, given the financial resources of such sectors, there is a considerable impact of the quality outcomes associated with wireless that is well above the price that the user group can afford to pay, and therefore where it is used the community value is above the surplus estimated based on the underlying price; and

- In the context of both of the above, there is a probable outcome that some activities will not occur at all without access to this spectrum for this use. So for example, without availability of wireless microphones, Australia would not be on the visiting schedule of major musical acts, theatre productions or conferences, where wireless is part and parcel of the presentation.

5.3 The disaggregated approach to benefit estimation

As mentioned above, the work done by Ofcom over the past two years probably constitutes the most detailed study of wireless audiovisual device use and associated benefits. Our calculations of benefit using the aggregate approach suggest that total benefits of the use of wireless audiovisual devices are in the order of some $140 million or above annually. It would, of course, be useful to compare a disaggregated estimate with the estimate from the aggregated approach in order to determine if the two methods provide order-of-magnitude similar results.

Ofcom commissioned detailed reports[9] in 2006 and also received many responses to its public consultations. Below we derive some of the benefit estimates using this research as a base and apply these to the Australian market to derive a disaggregated benefit estimate for Australia.

As noted above, following its public consultations, Ofcom categorised wireless users into the following groups:

- Background social use;

[9] for example see, *Supply and demand of spectrum for Programme Making and Special Events in the UK*, Report to Ofcom, December 2006, by Quotient Associates.

- Background commercial use;
- Larger scale use within fixed sites;
- Special events; and
- Tours.

This classification emphasises professional and consumer use patterns and also geographic patterns of use. However, in sponsored research by Ofcom – undertaken by Quotient – which was a study in which economic benefits for various groups were estimated - the following alternative group of categories were used:

- News Gathering;
- Outside broadcasts;
- Studio based programme making;
- Local Entertainment and Events; and
- Community uses.

This classification is more *function*-based and is therefore more suited to a disaggregated benefit estimation approach.

As noted above, in each of these applications, the benefit can be considered in terms of cost savings and/or quality improvements. The cost savings benefits are obviously important to commercial operators who use wireless audiovisual devices.

Costs for commercial operators are made up of equipment costs (generally a small proportion of total costs), cost of spectrum use (remembering that in the UK spectrum use is based on a licence and fees), and other costs, primarily labour. It is noted that equipment costs for wireless alternatives are often less than for wireless itself, and therefore much of the cost saving through wireless use is in labour and set up.

Quality improvements through wireless use are primarily due to speed of transfer of audiovisual information, technical quality of audiovisual information (amount of information per frame or per second) and mobility for user of the equipment. It is this latter factor that is particularly critical it would seem as mobility of the user results in many benefits such as being to get 'closer to the action' in news reporting, freedom of mobility for performers and creative freedom for producers to create otherwise impossible viewing angles and shot compositions.

Ofcom's analysis or conclusions in relation to benefits for each category are summarised in Table 4 below:

Table 4: Cost savings and quality benefits by user category

	Most Likely Alternative to wireless	Cost Implications	Quality Issues
News Gathering	Would use PMR for talk back, wired microphones to replace wireless, and wired cameras with a satellite link for programme links	Estimated increase in cost of £70 per day per assignment – which represents a 5 fold increase in costs	These alternatives are suggested as achieving similar quality, so the issue is primarily cost related. There may be increased time in getting product to air as set up effort increase on location
Outside broadcasts	As for news gathering	Estimated increase in cost of £75 per day per assignment – which also represents a 5 fold increase in costs	These alternatives are suggested as achieving similar quality, so the issue is primarily cost related
Studio based programme making	Would use DECT phone system for talk back and wired microphones and multiple wired cameras	Estimated increase in cost of £14 per day per assignment – which represents a 2 fold increase in costs	The mobility effect would be significant in terms of impact on creativity, and "naturalness"
Local Entertainment and Events	Would use DECT phone system for talk back and wired microphones and, where used, wired cameras	Estimated **de**crease in cost of £6 per day per assignment – which represents a 40% decrease in costs	Again significant mobility impediment reducing quality and range of shots, stage presence etc
Community uses	Would use PMR for talk back, wired microphones to replace wireless, and where used alternative spectrum for program links	Estimated increase in cost of £5 per day per assignment – which represents a 80% increase in costs	Mobility impediments likely to be significant

In short, for news gathering and outside broadcasts, Ofcom's conclusion is that there are alternatives to wireless audiovisual devices but that these cost significantly more. For more localised activity in studios , theatres or churches, the cost issue is less pertinent.

Ofcom discusses the following issues relating to wireless use and the valuation of benefits:

- Financial incentives – Ofcom notes that a significant proportion of wireless users are not for profit organisations who make decisions based not strictly on commercial grounds. Thus users of the services provided by non-profit organisation may receive benefits which are very difficult or impossible to measure;

- Essentiality – the use of wireless technology is now an integral part of some products and services and therefore these could be provided at all using wired products – for example, the driver's point-of-view-camera in motor racing; and

- chargeability – in normal service provision situations, an improved product could command a higher price. However, where a service has significant public good dimensions to (particularly, non-excludability) it may not be possible to charge for higher quality service.

In all categories of use quality benefits, particularly in the form of increased mobility, are significant. Ofcom's research did not provide valuations on either cost or quality issues in terms of the aggregate value to the UK community. While it identified individual use benefits in terms of cost savings Ofcom did not translate this to an in aggregate figure. It did not put valuations on quality outcomes even for individual use. It would seem likely that Ofcom has not provided this aggregate value because there are two significant difficulties in doing so:

- Lack of information about the number of applications or assignments involved. As noted above Ofcom discusses the cost saving per application. But it does not provide an overall number of the applications per annum. It is presumed that the data for this is not available, even in this licensed situation; and

- Difficulties in defining and also assignment a monetary value to the quality aspects.

5.4 The scope of activity linked to wireless use

Like the UK and other developed country markets, in Australia, the scope of activity in which wireless devices are used is hugely varied and there is, unfortunately, limited detailed information on users, patterns of use and the relative importance of wireless devices in their various commercial uses.

To give some idea of the economic and cultural activity that is likely to be supported by the use of such equipment the following summary of information collected mainly by the ABS is provided. These sectors are the most likely to have relatively intensive use of wireless devices and to be, in some degree, dependent on wireless audiovisual equipment.

5.4.1 Film and Video Production Services

At the end of June 2003 there were 2,174 film and video production services businesses with employment of 16,427 persons. These businesses generated $1,596.6m in income and incurred $1,504.8m in expenses during 2002-03.

5.4.2 Television Services

There were 9,094 employees working for 27 commercial free-to-air and six subscription television broadcasters at the end of June 2003. These businesses generated $5,158.8m in income and incurred $4,991.3m in expenses during 2002-03.

5.4.3 Pub, Tavern and Bar Businesses

At the end of June 2005, there were 3,454 pub, tavern and bar businesses operating in Australia. The total number of premises (4,252) were split almost evenly between capital cities and suburbs (2,108) and non-metropolitan areas (2,144). During 2004-05, income generated by pub, tavern and bar businesses was $11,114.3m, which represented an average of $3.2m per business. Total expenses incurred for the same period were $10,369.5m. In 2004-05, pub, tavern and bar businesses provided 194,769 paid live performances.

5.4.4 Hospitality Clubs

At the end of June 2005, there were 2,116 hospitality clubs operating in Australia. Of the 2,310 premises, 995 (43.1%) were located in capital cities and suburbs and 1,315 (56.9%) were located in non-metropolitan areas. The 2,116 organisations comprised 1,816 clubs with gambling facilities and 300 clubs without gambling facilities. During 2004-05, income generated by hospitality clubs was $7,374.7m which represented an average of $3.5m per organisation. Total expenses incurred for the same period were $6,763.9m. In 2004-05, hospitality clubs provided 114,082 paid live performances.

5.4.5 Business Events Venues Industry

At the end of June 2001, there were 121 businesses within the scope of the business events venues industry as described above. Of the 121 businesses, 13 were convention/exhibition businesses and 108 were businesses with other business events venues, such as accommodation, casinos and showground businesses. The 121 businesses in the industry contained 1,495 lettable rooms with event floor space of 657,011 square metres at the end of June 2001. 51,557 meetings and conferences and 4,227 exhibitions were conducted in the venues of these businesses. The total income of the industry was $655m, with the 13 convention/exhibition businesses contributing $169m and the other business events venues generating the remaining $486m. There were 10,347 persons working in the business events venues industry, of whom 7,865 or 76% were casuals, who worked a total of over 4.8 million hours during 2000-01.

5.4.6 Music and Theatre Production

At the end of June 2003 there were 865 music and theatre production organisations operating in Australia, comprising 657 for profits and 208 not for profits. These organisations had employment of 7,842 persons. During the month of June 2003, these organisations had 2,548 volunteers assist with music and theatre productions. During 2002-03 these organisations generated $622.1m in income and incurred $575.6m in expenses. During 2002-03 there were 53,241 paid performances and 14.2 million paid attendances at various music and theatre productions.

5.4.7 Performing Arts Festivals

During 2002-03, there were 176 performing arts festivals operating for greater than two consecutive days. During the conduct of these festivals, 1,272 people were employed and there were 15,728 volunteers. Performing arts festivals generated $88.5m in income and incurred $82.8m in expenses during 2002-03. During 2002-03 there were 23,138 paid performances and 1.5 million paid attendances at these performing arts festivals across Australia.

5.4.8 Amusement and Theme Parks

At the end of June 2001, there were 30 amusement and theme parks operating in Australia, and these had 4,150 persons working in them. During 2000-01, there were 8.9 million visits to these amusement and theme parks. Total income for businesses operating these parks was $287 million.

5.4.9 Churches and Places of Worship

A major use of wireless equipment is in churches and places of worship. The National Christian Life survey indicates that there 1.6 million weekly attendances over 10,500 Christian denomination congregations – or an average of around 150 attendees per congregation[10]. Given the large number of participants this is likely to be a significant source of benefit.

5.4.10 Fitness Industry

The ABS summarises the fitness industry from its survey on Sports and Physical Recreation Services for 2004/05 as follows. There are a total of 824 organisations operating as health and fitness centres. Of these organizations, total income was $679.4 million, and operating surplus before tax was 4.6%. These organizations employed 16,781 people of which 67.3% were female and 67.5% were casual employees. Over two million people participate in aerobics/fitness activities offered by these facilities and aerobics/fitness is the second most popular form of exercise after walking (4 million people participating annually).

In addition, Fitness Australia information indicates that there are around 1,500 'traditional' fitness centres in Australia and very high growth in the weight-loss circuit business (given the obesity epidemic!), PT/Studio and other fitness/wellbeing related businesses at the small-business end of the market. They suggest that the total health and fitness market is around 2,600 businesses. As ABS statistics indicate that fitness facilities employ an average of 20 people per organization, it would be safe to estimate that the total industry employs between 40-50,000 people, turns over $1.2 billion annually and provides services to around 3 million people.

5.4.11 Conclusion regarding use in industry

Although the list of industries above indicates that the use of wireless audiovisual devices is extensive, it does not include all uses of such devices. There are a number of other niche uses, for example, education facilities which use significant numbers of wireless microphones in lecture theatres and auditoriums and the retail sector which uses them for marketing.

The list above suggests that activities which involve use of wireless audiovisual equipment involve close to 500,000 paid performances of various kinds per year, generate incomes of the order of $32 billion a year, and involve employment (mixed of full-time and part time) of some 130,000 people. Thus a significant proportion of the economy has some dependence on wireless audiovisual devices.

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[10] Source: www.ncls.org.au/.

5.5 Modelling the benefits of spectrum use for wireless audiovisual devices: the disaggregated approach

In addition to the aggregate modelling above, there are therefore two ways in which WPC can estimate benefits in more detail. It should be noted that there is very limited information on which to base this modelling approach and therefore the results should be considered indicative.

5.5.1 Disaggregated estimation of benefit based on cost benefits and quality improvement

As discussed above, Ofcom's research has identified quantitative cost savings associated with various wireless equipment use categories. In addition, Ofcom has identified a range of quality benefits associated with wireless device use. While Ofcom's research did not allocate values relating to the quality benefits of wireless, it appeared that mobility was the main benefit in relation to studio and entertainment use. In order to obtain quantitative estimates of benefit we have adopted the costs savings estimates from Ofcom's analysis (measured in pounds which we convert to AUD values). In addition, in the table below, we assign a quantitative estimate of the value of quality benefits on a 'per assignment' basis.

There is no data of which we are aware to substantiate the estimates we have used to undertake the indicative modelling. However, we believe that, given that quality benefits have been clearly acknowledged to be significant, that valuing them at zero because data is not available is extreme and does not give the best indication of benefit. We consider that these estimates are conservative particularly considering the 'essentiality' characteristic of wireless audiovisual devices in some applications.

The term 'per assignment' is based on Ofcom's research, but the term is not clearly defined. We have assumed that an assignment is a specific activity that makes use of wireless equipment and relates to the acquisition of a licence to use the equipment from the relevant spectrum administrator, JFMG Ltd. For example, we have assumed an assignment in a television production is one day's shooting, and may involve the use of a considerable number of devices. Similarly, an assignment in newsgathering is one visit to a newsworthy site and the collection of the story, and in doing so using between one and a significant number of wireless audiovisual devices (eg microphones, video feed etc).

Table 5: Cost savings and quality benefits estimates by user category

Use category	Cost Savings £ per assignment	Quality Value £ per assignment
News Gathering	70	5
Outside broadcasts	75	5
Studio based programme making	14	20
Local Entertainment and Events	-6	20
Community uses	5	20

WPC have converted these values to Australian dollars at an exchange rate of £0.45 equals AUD1.00. We have assumed the following:

- The estimated 133,000 units are distributed[11] as follows:
    - 3% to newsgathering;
    - 6% to outside broadcasts;
    - 4% to studio activity;
    - 41% to local entertainment and events;
    - 5% to the fitness industry and
    - the balance (41%) to community uses.
- Each "assignment" involves on average 5 pieces of equipment for news gathering and for community uses (would vary from 1-5) and 10 for the other categories; and
- That the average piece of equipment is used on the number of days specified in the table below.

Applying these assumptions, the value of cost savings and quality impacts are indicated as below. The results indicate that the existence of wireless audiovisual equipment used in this way, against the next best alternative produces around $114 million annually, $54 million through cost savings and $60 million through quality impacts. General community use has the most aggregate value

[11] Based on advice from the Australian Music Association and its members.

(and distributed over more users), the regular fully commercial uses have significant value, whereas local entertainment has lower value (but over more uses and users).

Table 6: Benefit estimates by user category: disaggregated cost savings and quality method

	Number of appliances	Pieces of equipment per assignment	Days use per year	Cost savings ($m)	Quality benefit ($m)	Total benefit ($m)
News Gathering	3,990	5	300	37.2	2.7	39.9
Outside broadcasts	7,980	10	200	26.6	1.8	28.4
Studio based programme making	5,320	10	300	5.0	7.1	12.1
Local Entertainment and Events	54,530	10	100	-7.3	24.2	17.0
Community uses	54,530	5	50	6.1	24.2	30.3
Fitness Industry	6,650	2	300	0.0	66.5	66.5
TOTAL	133,000			68	126.5	194.1

5.5.2 Disaggregated estimation of benefit based on consumer surplus ratios

An alternative way to estimate benefits from the use of wireless audiovisual devices is to use the consumer surplus method used for the aggregate method in Section 5.2 but instead apply ratios to the disaggregated data. In theory, the value of consumer surplus should be driven by factors such as cost savings and quality improvements and therefore with perfect data we would expect these estimates to be roughly equal. Of course, our data is limited in quality but we nonetheless would expect order of magnitude agreement between the estimates.

For this approach we use Ofcom's original category of users because, in using this approach, we do not need to use the functional categories because we do not need to use the cost savings estimates associated with these categories and, in addition, using this alternative categorisation provides us with a better 'triangulation' on the result of the previous method.

We estimate the benefits below on the basis of the following assumptions:

- Background social use (explained below) is assumed to be 80% of community use in the table above. Background commercial use is news gathering and outside broadcasts, large scale use within fixed sites is assumed to be studios, and 60% of entertainment and events, Special events are assumed to be 30% of entertainment and events and 20% of community use, and tours 10% of entertainment and events;

- It is assumed that background social use and special events and tours use lower valued equipment on average (ie more equipment at the lower end) – assumed to 50 percent of the average price, and the other uses make use of more expensive equipment (1.5 times the average price);

- It is assumed that demand for wireless equipment is relatively inelastic due to the essentiality of its use in commercial applications. The less elastic is demand, the greater the ratio of the consumer surplus value to the value of the equipment. The ratio is assumed to be 2 for social use (more elastic) and 5 for other uses (highly inelastic); and

- As in the aggregate analysis it is assumed that 80% of the value in equipment is for the wireless characteristics, and 20% for the underlying function (eg microphone).

Using these assumptions the total value of the equipment is calculated, including its cost and the surplus value. This is annualised by calculating the annuity value of the total value, assuming a five (5) year life and 8% real discount rate.

The resulting net annualised benefit of $82 million is around half that calculated by the previous method. Therefore the gross annualised benefit is about 70% of that estimated in the method above, that is, $114 million per year compared with $82 million using the CSR method. This is a good result given that they are the same order of magnitude.

Larger scale use in fixed sites emerges as the biggest beneficiary and background commercial use and background social use also significant.

Table 7: Benefit estimates by user category: disaggregated consumer surplus method

	Number of appliances	Price Range of Equipment	Average value per piece of equipment	Surplus ratio	Gross annualised benefit ($m)	Net annualised benefit ($m)
Background social use	43,624	300-3,000	500	2	$13.1	8.7
Background commercial use	18,620	2,500-15,000	6,089	5	136.3	113.6
Larger scale use within fixed sites	38,038	200-15,000	1,624	5	74.3	61.9
Special events	27,265	200-3,000	708	5	23.2	19.3
Tours	5,453	300-2,000	750	5	4.9	4.1
	133,000		1,657		251.8	207.7

AWAG has provided a detailed description of the type of equipment and involved re the various user categories.

User Category	**Product description and price**
News gathering	• Entry point product for prosumers (videographers, schools etc) is available from around $1,500 and above • Professionals (i.e. TV production houses and freelance AV operators) will use product (often Sony or Sennheiser) in the $2500 to $5000 per unit range. • These users typically have 5/6 systems on hand according using a combination of camera mounted, lapel and hand held devices • The 'staff crews' of the TV networks will tend to use higher specified equipment similar to the equipment they used in studio for reasons of interoperability. These products tend to be in the $8,000 - $15,000 per unit price range
Outside broadcasts	• Product used in this segment is most likely to come from an AWAG member. Shure, Sony, AKG, Audio Technica and Sennheiser brand products are among the most common • Professional standard single units typically sell for between $3,000 and $5,000 with higher specified product extends to as much as $15,000 per unit • Larger production companies may have a suite of up to 500 devices ranging in value from $3,000 to $15,000

User Category	Product description and price
Studio based programme making	• Studio broadcast devices- like those we "seen" as lapel and hand held systems on TV • Professional standard product is available from around $2700 per unit • Typically the major broadcasters will use product priced between $8,000 and up to $15,000 per unit
Local Entertainment and Events	• Product used in this segment is mostly likely to come from an AWAG members including Shure, AKG, Audio Technica and Sennheiser brands. • Single units range in price for this type of user from $1,000 to $2,000 per unit. The market leading Shure product sells for around $1,500 per unit • The primary users of this equipment include the entertainment industry, meetings and conventions industry, tourism industry, higher education and the more professional performers, entertainers and bands • Higher end users in both the education and worship sectors also use significant amounts of these types of devices • There is substantial cross over between the equipment used in sector and that used in the Outside Broadcast sector • While most users in this sector will use devices of up to $2,000 per unit in value there are a number of higher levels users (such as the musical theatre production companies) who will use devices in the $10,000 - $15,000 per unit price range. In a large scale production such as Wicked or Billy Elliot the production company may deploy as many as 40 to 50 of these high end devices • Guitar and other instrument transmitters are also widely used by this sector. These products are priced from as low as $199 per unit, though the branded products typically sell for between $500 and $1000 per unit
Community uses	• There is a vast range of product available to consumers. The cheapest systems are available from about $300. A known brand, such as Shure, AKG, Audio Technica typically retail for between $500 and $1,000, the most popular products selling for between $600 and $700 per unit • Typical users of these types of systems include churches, schools, local musicians and bands, entertainment, venues, auctioneers, real estate agents and so on • Guitar and other instrument transmitters are also popular amongst some of these users priced from about $199 to as much as $1,000 per unit
Fitness industry	• Special products have been developed for this purpose. The receivers are similar to those used by other segments noted above • The microphones however are specially designed for more robust use though, though they will have a life of just three years or so as vibration and sweat take their toll • Complete systems range in price from around $850 RRP to $1700 range while replacement microphones typically from $250 to $500

This detailed information is used to provide an alternative consumer surplus estimate – based on this different categorisation of users. The data on use is linked, based on the prices and numbers in each class to that in Table 7. But we have assumed some differences in the surplus value (lower in local entertainment and fitness).

Table 8: Benefit estimates by user category: disaggregated consumer surplus method with use categories from Table 5

	Number of appliances	Price Range of Equipment	Average value per piece of equipment	Surplus ratio	Gross Annualised Value ($m)	Net Annualised Value ($m)
News Gathering	3,990	2,500-15,000	9,000	5	43.2	36.0
Outside broadcasts	7,980	3,000-15,000	9,000	5	86.3	72.0
Studio based programme making	5,320	2,700-15,000	7,000	5	44.8	37.3
Local Entertainment and Events	54,530	200-2,000	750	4	41.0	32.8
Community Uses	54,530	300-3,000	500	2	16.4	10.9
FItness	6,650	250-1,700	850	4	5.7	4.5
	133,000		1,645		237	193.5

6 Estimating the costs of policy change

The estimates above provide an indication of the value contribution that wireless AV equipment provides – that is, the benefit that users of wireless AV equipment derive from its availability. The prospect of future spectrum rationalisation raises the issue of the need to develop a policy to deal with the implications of the transition to a new spectrum band for AV devices. For existing equipment there are two cases:

1. Some of the equipment, particularly older and cheaper devices cannot be modified to operate in new spectrum and will have to be disposed ofand replaced. The need to replace devices can bring with it a number of issues, including:
   - In some cases the "owner" will not have the cash flow to replace and therefore will be limited to less effective option (lower quality or non-wireless)
   - In other cases, the new equipment will come at a significant cost, but given technology advances will be better than the equipment that is replaced in quality terms
2. Some equipment may have modifiable frequency settings and be adapted to function in new spectrum (where it is financially justified and where it is technically possible).

The question of how "much will the shift in spectrum cost the industry?" is therefore somewhat complicated.

The upper bound for the cost (in terms of equipment only) of transitioning to new spectrum is replacement cost for all existing devices.

This is estimated to be around $220 million in replacement value terms. However, the equipment will vary in age from very new to quite old – up to 10 years. Therefore the existing stock of equipment would have considerably lower written down value – and using an average depreciable life of 5 years, that value is of the order of $160 million.

However, as noted some of the equipment will be able to be modified and make use of new spectrum. There is no current information on the proportion of such equipment to the current total stock, but it is likely to be in the newer and higher price equipment that can be modified and for which such modification is worthwhile.

So the other extreme of the cost of the shift in spectrum would be to assume that all equipment could be modified (for illustrative purposes), at an average cost of $300 per device. Under these assumptions the cost of the shift would be $40 million. There are also the costs of time (not having access to the device), and inconvenience while the equipment is being modified (and in the case of replacement the search costs) which could indicatively be at least this amount again.

The reality therefore is that the cost is likely to be somewhere between these two values of $80 million and $220 million but probably closer to the upper bound.

It should also be noted that if the new spectrum allocated to wireless AV devices is significantly distant from the spectrum that its currently used it may be the case that it is not possible to switch any existing equipment to the new allocated frequencies. In this case the upper bound is much more likely to be the replacement cost of the stock of equipment.

Finally, it should be pointed out that the range expressed below if an estimate of the range of values to users that is at risk should spectrum allocation be changed.

This estimate alone does not account for the potential full costs of the spectrum reallocation. It should be recognised that existing users will need to be induced to 'bring in' existing equipment even though it will still work, at least initially, until interference from other uses renders it non-functional (it should also be kept in mind that interference is a two-way street). In addition, there will be the costs of an education and communications program to consider as well as program administration costs.

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