Digital Dividend Review: 550-630 MHz and 790-854 MHz

British Entertainment Industry Radio Group (BEIRG)

Response to consultation on detailed award design

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Contact Details:

Alun Rees
Ranelagh International Ltd on behalf of the BEIRG Steering Committee
One Ranelagh Road
Westminster
London SW1V 3EX

Tel: 020 7828 1603

Introduction

The Programme Making and Special Events (PMSE) sector is a disparate, diverse and diffuse community of content producers, manufacturers, rental organisations and freelance engineers. The PMSE sector is responsible for both content production and content delivery for live and recorded entertainment. It plays a crucial role in the ongoing success of the £15 billion pa British Entertainment Industry. The PMSE sector is critical to the production of content for live entertainment of all genres. This sector extensively utilises wireless equipment such as Wireless Microphones, Wireless In-Ear Monitor Systems, Wireless Talk Back Systems and Wireless Instrument Systems.

For over fifty years wireless products have been used in the entertainment industry. In the past thirty years there have been vast improvements in production values and safety levels as a result of advances in wireless technology. The PMSE sector currently relies on the spectrum interleaved between existing TV Broadcast channels to enable the use of Radio Microphones, In-Ear Devices and other short-range wireless devices. This equipment has become an essential component of the British Entertainment Industry.

On a daily basis this sector is responsible for the production of content that receives world-wide acclaim and continues to attract a global audience. A vast array of organisations are reliant on radio spectrum for the production of content for **Performing Arts, Broadcasting, News Gathering, Independent Film and TV Production, Corporate Events, Concerts, Night Venues and Sports Events**. In addition, other sectors that utilise UHF spectrum include the Health Service, Education, Local Government, Political Programming and Conferencing.

Wireless equipment and the spectrum it operates on are now crucial to the British Entertainment Industry. **All parts of this important industry have a major impact on the daily lives of the entire UK population.**

Ofcom currently plan to auction UHF spectrum that is critical for use of wireless microphones, in-ear devices and talkback; this is referred to the 'cleared' spectrum. Despite the eviction of the incumbent PMSE users from the 'cleared' spectrum, Ofcom claim that that there will be 'broadly' sufficient spectrum to cater for a similar level of PMSE demand post-DSO. We strongly disagree with this assessment.

Ofcom's 'white space' maps clearly show that the decision to auction the 'cleared' spectrum will result in a dramatic reduction and increased fragmentation of useable spectrum available for PMSE post-Digital Switchover (DSO). If Ofcom proceed as planned and do not award additional[1] spectrum to the band manager with PMSE obligations, then many large-scale productions such as live music events and musicals will be rendered impossible in certain prime locations across the UK. Furthermore, many touring productions may become financially unviable.

If Ofcom are wrong about the implications of the DDR/DSO for PMSE but auction the cleared spectrum nonetheless, the consequences of this irreversible decision will be disastrous for the British Entertainment Industry. Therefore, we strongly urge Ofcom to hold back the cleared spectrum until it is proven in practice as well as theory[2] that the digital interleaved and channel 69 will be sufficient to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012. If the digital interleaved and channel 69 prove to be insufficient, then more spectrum must be awarded to the band manager with PMSE obligations[3].

[1] In addition to channel 69 and part of the digital interleaved

[2] E.g. finalised white space maps based on modelling and practical testing, as carried out and formulated in conjunction with PMSE stakeholders

[3] This is assuming the PMSE sector is not 'migrated' from channel 69

Unless Ofcom can prove[4] that the package to be awarded to the band manager will provide sufficient useable spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012, PMSE users of the cleared spectrum should not be evicted.

Indeed, we demonstrate in this document that, under current plans, the digital interleaved and channel 69 will not provide sufficient spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO. Therefore, more UHF spectrum must be awarded to the band manager with PMSE obligations for use of wireless microphones and in-ear monitor systems post-DSO.

[4] i.e. it has been proven in theory and in practice and all parties, including PMSE stakeholders (and BEIRG in particular), are satisfied that the package to be awarded to the band manager will provide sufficient useable spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO

Executive Summary

If Ofcom award UHF spectrum as proposed, there will be far too little spectrum available for PMSE in the run-up to and post Digital Switchover (DSO) and it will be far too fragmented. Evicting PMSE users as soon as DSO takes place in each region[5] will not give the PMSE sector sufficient time to adjust and re-equip. Although additional time for adjustment may help with the equipment development issue, it **will not** help with the spectrum availability issue. If Ofcom proceeds with its current plan, it will be disastrous for the PMSE industry and the cultural life of the UK.

- **If Ofcom's current proposals are adopted, large scale musicals and live music productions will not be possible in certain prime locations across the UK, potentially resulting in the closure of a number of major theatres and long term cultural and employment loss in those regions, and within the industry in general. Ofcom will also create a geographic cultural divide whereby certain major venues such as the Edinburgh Festival and Playhouse Theatres will not be able to host musicals and live music events whereas others will be able to continue to do so.**

Ofcom-generated and approved data, freely available from the JFMG website, shows that, post-Digital Switchover (DSO), there will be insufficient spectrum available in order to operate necessary quantities of PMSE equipment for large-scale musical productions to be staged at certain prime venues across the UK[6]. Analysis of the data clearly demonstrates that musicals such as *Mary Poppins ,Chitty Chitty Bang Bang, The Lion King, Spamalot, Miss Saigon, Phantom of the Opera, Les Miserables and Oliver* will be impossible to stage to current production standards at major theatres in Edinburgh, Nottingham, Bradford, Southend and Woking.

The country's largest touring theatres rely for over 50% of their annual output on musical productions. In the event that through the loss of spectrum it becomes impossible to stage these shows at certain theatres, the theatres would have to close[7].

Action: more UHF spectrum must be awarded to the band manager with PMSE obligations for use of wireless microphones and in-ear monitor systems post-DSO.

- **Many touring productions may be rendered financially unviable**

    a. **As a consequence of insufficient spectrum availability at certain venues**

If the size of the touring theatre circuit were reduced by the closure of certain theatres resulting from lack of spectrum availability, the loss of major venues from a national tour would make many tours financially unviable to produce and, as a consequence, could cause the closure of more theatres than just those directly affected[8].

Action: more UHF spectrum must be awarded to the band manager with PMSE obligations for use of wireless microphones and in-ear monitor systems post-DSO.

    b. **As a consequence of the greatly increased fragmentation of spectrum availability post DSO and therefore, the increased level of equipment that will be required in the venues where staging productions is still possible**

Currently, certain combinations of adjacent UHF bands are available for PMSE use on a near-nationwide basis. This allows travelling productions to use the same equipment at all tour venues. However, in the wake of DSO, spectrum availability for PMSE will become so sparse and so

[5] Or after six months if the notification period applies

[6] Working on the basis that a large-scale production requires over 50 MHz of interference free spectrum to operate its wireless microphones, in-ear monitor systems and wireless communications

[7] Many of these large theatres are unsuitable for the staging of Drama and it is highly unlikely in any event that the supply of Drama would or could increase to fill the gap left by the absence of musicals.

[8] (affected) by the spectrum availability issue

fragmented that multiple sets of equipment will be required[9]. BEIRG's latest models suggest that equipment costs for touring theatre will increase by a minimum of 100% post-DSO.

Action: In addition to channel 69, more spectrum must be awarded to the band manager with PMSE obligations that will be available on a nationwide basis post-DSO. This must have sufficient bandwidth to be useable for professional PMSE productions. To this end, BEIRG would like to refer Ofcom to the PMSE Pro User Group's 2007 submission in which it recommended that channels 67 and 68 be reserved for PMSE use. Furthermore, to prevent disruption to touring theatre earlier than necessary, users of wireless microphone and in-ear monitor systems must retain access to all of the cleared spectrum until after DSO is completed nationwide or after the 2012 Olympics, whichever is the latter.

- **Millions of pounds worth of wireless microphone and in-ear monitor systems will be either rendered redundant or require expensive modification**

Since the frequencies used for DTT will change from those used for analogue terrestrial television, the pattern of interleaved spectrum will also change. As a consequence, PMSE users of equipment operating in interleaved spectrum are likely to find it necessary to retune, modify or replace that equipment in order to use new frequencies after DSO. The PMSE Pro User Group estimated that equipment that will become redundant as a result of the DDR is worth well in excess of £30 million. Ofcom initially disputed this but has since valued the affected equipment at around £35 million.

In place of current proposals, the PMSE sector must be granted sufficient time that would allow them to amortize the value of current equipment that will inevitably become redundant under current plans.

- **Expensive new equipment that operates in the 'digital interleaved' will have to be developed, manufactured and purchased by users and rental companies**

Following the transition to DTT broadcasting and the change in the pattern of interleaved spectrum availability, the PMSE sector will have no option but to re-equip. There is at present an inadequate stock of PMSE equipment for use solely in the 'digital interleaved' spectrum. It is, therefore, essential that the industry begins to build up stocks of 'digital interleaved compatible' equipment. This will take a considerable period of time – see PMSE Pro User Group response to the DDR.

Action: Users of wireless microphone and in-ear monitor systems must retain access to the cleared spectrum until DSO is completed nationwide and the Olympics have taken place in 2012 irrespective of when auctions for the 'cleared' spectrum take place and licenses are awarded. For instance, Ofcom could make clear in the licence conditions for channels 31-40 and 61-68 that rights of usage do not start until September 2012

However, without guarantees of security of tenure in the digital interleaved areas of spectrum, there will be no commercial imperative for suitable equipment to be developed. The PMSE sector requires certainty of spectrum access over a reasonable period of time in order for expensive new PMSE equipment development to make economic sense. Furthermore, the PMSE sector, after having been forced to re-equip by the reorganisation of spectrum associated with DSO and DDR in 2012, may have to do so again in 2018.

Action: PMSE protected access to the 'digital interleaved' spectrum must continue to 2026 rather than 2018.

[9] Indeed, equipment costs for every large-scale professional PMSE user will increase due to the change in pattern of spectrum availability

TOO SOON, TOO LITTLE

An early eviction to a spectrum reservation that is too small; how Ofcom's plans still threaten the future of the Programme Making and Special Events (PMSE) sector

In this document, BEIRG demonstrates the disastrous impact that Ofcom's current plans for the release of UHF spectrum[10] will have on the PMSE sector.

Following extensive consultation Ofcom, quite rightly, came to the conclusion that intervention was required to save the PMSE sector from market failure. As a disparate and diverse community, the PMSE sector would not be able to take part effectively in an auction to secure spectrum required for use of wireless microphones, in-ear monitor systems and other short-range wireless devices. Having made the decision to intervene, Ofcom must ensure that the aim of intervention is fulfilled.

Ofcom stated in their most recent DDR statement[11] that 'we will hold a beauty contest to award a package of interleaved spectrum to meet PMSE users' needs'. As it stands, the package of interleaved spectrum and channel 69 will not enable the band manager to meet PMSE users' needs in terms of both quantity and quality of spectrum provision. Indeed, far less UHF spectrum will be awarded to the new band manager than is currently managed by JFMG, and JFMG already has to borrow spectrum regularly to meet demand[12].

Ofcom's 'white space' maps, illustrating PMSE access to interleaved spectrum post-DSO, were published in a regulatory statement on 16th January 2008. The data used to produce the 'white space' maps has been used to generate an on-line database containing detailed information on the channels in interleaved spectrum that will be available for indoor and outdoor wireless-microphone use at any given location in the UK post-DSO. The on-line database is available on the JFMG website[13]. BEIRG's arguments and conclusions outlined in this document are based entirely on this on-line database and therefore on Ofcom-generated and approved data.

BEIRG has been told by Ofcom officials on several occasions that the white space maps and JFMG on-line database is pessimistic due to the conservative methodology used in their production. BEIRG hopes that this is the case, but without updated 'white space' maps showing certain increased availability of interleaved spectrum, this 'reassurance' is of little comfort to the PMSE sector. Furthermore, the 'white space' maps produced by Ofcom using data generated by Sagentia are based on theory only[14].

Unless Ofcom can prove[15] that the package to be awarded to the band manager will provide sufficient useable spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012, PMSE users of the cleared spectrum should not be evicted.

Indeed, we demonstrate in this document that, under current plans, the digital interleaved and channel 69 will NOT provide sufficient spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO. Therefore, more UHF spectrum must be awarded to the band manager with PMSE obligations for use of wireless microphones and in-ear monitor systems post-DSO.

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[10] UHF spectrum currently used for wireless microphones, in-ear monitor systems and other short-range wireless devices

[11] Published 13th December 2007

[12] http://www.jfmg.co.uk/pages/Docs/JFMGNews/JFMGNewsJuly08.pdf

[13] http://www.jfmg.co.uk/jfmgcamera/wireless/public/microphonedso.aspx

[14] Due to the timing of the second and third phase auctions of the geographical interleaved spectrum., it appears that the amount of interleaved spectrum auctioned and subsequently, what is left for PMSE, may not be fully realised until early 2010.

[15] i.e. it has been proven in theory and in practice and PMSE stakeholders are convinced

1. Under Ofcom's current plans, large scale live music events and musicals will not be possible in certain prime venues across the UK post-DSO due to insufficient spectrum availability. Ofcom will deny the citizens and consumers the opportunity to experience large-scale live music events and musical productions in those locations, thus creating a geographic 'cultural divide'.

1.1. CSMG, Ofcom's consultants, recently stated the following:

'*Digital switchover will be complete in the UK in 2012. As a result, 14 channels in UHF Bands IV and V will be nationally cleared of terrestrial television -- and Channel 36 of aeronautical radar -- and made available for new uses. Wireless microphone, IEM and talkback users of these bands will be affected by both a reduced availability of spectrum interleaved with digital terrestrial television and changes to the pattern of its availability*'.

This is correct but does not represent the scale of the problem. Following Digital Switchover (DSO), the significant decrease in spectrum availability for the PMSE sector in certain geographical locations will render large-scale musicals and live music productions impossible to stage in certain prime locations across the UK,

1.2. In a report commissioned by Ofcom, Sagentia used figures from 2005[16] to assess PMSE UHF spectrum demand relative to availability post-DSO. Sagentia also noted that 'PMSE demand could increase in some locations between 2005 and DSO in 2012'. This is an understatement; it is a fact that demand for wireless microphones and in-ear monitors in professional productions is increasing and will continue to increase up until 2012 and thereafter.

1.3. The PMSE sector currently works on the basis that 8 wireless microphones can be used interference-free in a standard 8 MHz TV band[17] in complex multi-channel set-ups. This is therefore the practical operating maximum in the context of large-scale productions. Using these figures, BEIRG has taken a sample of upcoming tour venues to assess the extent to which Ofcom's plans threaten the future of large-scale PMSE productions outside London to illustrate the severity of the problem.

1.4. The critical distinction here is between equipment availability and spectrum availability. Equipment issues will be addressed later in this document. Even if a sufficient volume of sufficiently spectrally agile equipment existed, there will be insufficient spectrum availability to cater for large-scale musicals and live events in certain prime locations across the UK post-DSO.

1.5. Most major musicals and theatre productions staged in the West-End in the past five years required between 40 and 60 MHz in the UHF spectrum for use of essential wireless microphone and in-ear monitor systems. West-End musicals frequently tour the UK, and when they do their spectrum requirements for use of wireless microphones, In-ear monitor systems or talkback are either replicated or increase. This is in part because audience expectations increase as time goes on.

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[16] Ofcom: '5.2 *Sagentia identified locations where peak demand for channels for wireless microphones before DSO exceeds the number of channels that can be expected to be available for PMSE after DSO. Figures for 2005 were used as the last year for which full demand data were available.* 5.4 *Where we identified significant reductions in channel availability, we used licensing information from JFMG to calculate the peak use of spectrum for wireless microphones during 2005. We compared this in each location with channel availability to assess whether there are likely to be constraints after DSO.*'

[17] JFMG data incorporates buffers of 600 KHz between 8 MHz TV channels pre-DSO, thus reducing available bandwidth within a full 8 MHz to 7.4 MHz. Their post-DSO data reduces these buffers to 200 KHz. At an absolute maximum, 12 wireless microphones can fit into channel 69. However, if channel 68 is auctioned, then interference from new neighbouring users is likely to increase. Therefore, it will be more difficult to fit the same number of wireless microphones into channel 69 after DSO/DDR than before.

1.6. To illustrate the magnitude of the problem, BEIRG has taken a sample of three **real-life** upcoming touring musical productions (planned from 2008 to 2011) and examined the venues at which they are due to be staged. These productions cannot be named due to commercial sensitivity. These three productions are due to be staged at 6, 14 and 19 venues respectively across the UK, several of which are due to host more than one of the musicals in question. The venues examined by BEIRG are the usual hosts for shows of this kind in the cities/towns in question

1.7. Of those venues examined from the three sample touring productions, the following will not be able to host large scale musical productions such as The Lion King, Spamalot, Miss Saigon, The Phantom of the Opera, Les Miserables, Mary Poppins, Chitty Chitty Bang Bang, My Fair Lady, Oliver and Beauty and the Beast post-DSO[18]:

Edinburgh: Festival Theatre[19]
Edinburgh: Playhouse Theatre[20]
Woking: New Victoria Theatre[21]
Stoke: Regent Theatre[22]
Nottingham: Royal Albert Hall[23], Theatre Royal
Southend: Cliffe Pavilion[24]
Bradford: Alhambra Theatre[25]

1.8. Ofcom may claim that, based on 2005 PMSE spectrum demand (data gathered from the JFMG licensing database), there will be 'broadly' sufficient spectrum availability post-DSO to cater for the PMSE requirements in the vast majority of locations. However, this argument reflects Ofcom's poor understanding of (1) the importance of the PMSE sector to citizens and consumers of the UK, (2) how the PMSE sector functions, (3) the inadequacies of the licensing/enforcement regime, (4) the uncertainty involved in the suggestion that DTT protection might be manipulated to 'enlarge' the white spaces, (5) the major limitations of new technologies when compared to analogue systems and (6) the fact that there are no short or medium-term alternatives for PMSE other than the use of UHF spectrum.

1.8.1. If Ofcom reduce spectrum availability for PMSE post-DSO as planned, they will deny the citizens and consumers living in the affected locations the opportunity to see or take part in large-scale musicals or live music events, thus resulting in cultural deprivation in certain areas of the UK[26]. Ofcom may argue that, in 2005, spectrum demand in these locations did not reach levels required to stage large scale PMSE events. However, this should not provide the justification for Ofcom reducing spectrum availability post-DSO to the extent that large-scale musicals and live music events will never be able to take place in these prime locations.

1.8.2. The licensing data from 2005 (i.e. a single production year) gives a woefully inadequate representation of past and future PMSE demand. Large-scale musicals and live music events which require 50+ wireless microphone channels are not staged at a particular venue every year. For instance, even if 50+ wireless microphone channels were not required for musical productions in Edinburgh, Woking, Stoke, Nottingham, Southend and Bradford in 2005, they will be required in coming years (as

[18] Channel 69 has been incorporated into this analysis – it was assumed that it could be used for 8 wireless microphones. 50 MHz of UHF spectrum has been taken as the standard bandwidth requirement for large-scale professional PMSE theatre and musical productions.
[19] 33.4 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[20] 33.4 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[21] 21.8 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[22] 47.0 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[23] 48.6 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[24] 38.16 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[25] 37.0 MHz bandwidth available for PMSE in UHF post-DSO, including channel 69
[26] The 'cultural divide'

demonstrated by the real-life planned touring musical productions described above). Furthermore, whereas spectrum demand in certain locations may not have reached levels required to stage large-scale musicals and live music events in 2005, it may have done so prior to 2005 or in 2006/2007.

1.8.3. BEIRG has estimated that over 90% of wireless microphone usage is unlicensed, a statistic that has never been refuted. In their analysis of PMSE demand in 2005 (and consequent prediction of whether there will be sufficient spectrum availability for PMSE post-DSO), Ofcom only took licensed usage into account (using JFMG data). The fact that Ofcom have drastically underestimated the PMSE sector's spectrum requirements further undermines their claim that there will be 'broadly' sufficient spectrum availability for PMSE post-DSO. Ofcom may argue that the only measure of PMSE spectrum demand is the licensing statistics and if the licensing statistics do not adequately represent PMSE use then this is the fault of those PMSE users who operate illegally. However, a significant proportion of the blame for unlicensed usage (and hence the drastic underestimation of PMSE spectrum requirements) lies with Ofcom, which has undertaken neither invigilation nor enforcement of the licensing regime[27], as evidenced by the lack of a single prosecution of a PMSE user for operating without a licence. Moreover, there is no evidence that Ofcom is going to do anything about this problem in future. While the onus for purchasing a licence lies with the user, if there is no incentive to do so then the proliferation of unlicensed use is unsurprising. In addition, there is little awareness in the PMSE sector, especially among community users, that a licence is required to operate a wireless microphone, IEM or talkback system. It is important to note that the current band manager JFMG can accept no blame for unlicensed usage – it has no enforcement powers and, since all licensing revenue is transferred directly to Ofcom, it has no financial incentive to raise awareness of the issue.

1.8.4. Ofcom have stated that they might be able to 'enlarge' the white space available to PMSE post-DSO by altering the protection options to DTT multiplexes in locations where there are coverage overlaps. However, even if Ofcom protect only the coverage of the 'best' DTT transmission site (referred to as the Digital Preferred Service Area ('DPSA') in NGW's original study for 71 transmission sites), this would not necessarily increase the amount interleaved spectrum available for wireless microphones and IEMs post-DSO. While the 'non-preferred' DTT transmission sites are no longer protected in the DPSA protection option (in the overlap region), RF will still be present and, depending on the power of the signal, will potentially interfere with low-power PMSE applications.

1.8.5. Of course, if technologies existed that used the UHF spectrum more efficiently than the 'analogue' wireless microphones and IEMs currently favoured by the PMSE industry, this could help alleviate the PMSE sector's spectrum scarcity problem post-DSO. In light of this, Ofcom recently commissioned CSMG, a telecoms and media consultancy, to analyse how wireless microphones, in-ear monitors (IEM) and talkback systems might make efficient use of spectrum, and potentially operate in alternative spectrum to the UHF band, in the future[28]. BEIRG is disappointed and surprised that Ofcom has not published the results of CSMG's analysis. We understand that the following conclusion appears in the draft report - that wireless microphone technology is unlikely to either (a) become more spectrally efficient or (b) be able to operate in alternative spectrum to the UHF band, at least into the medium term. BEIRG agrees with this assessment for the following reasons:

[27] Though it is Ofcom's responsibility to do so

[28] It seems perverse that Ofcom decided to commission an inquiry into whether technological developments might allow the PMSE sector to operate at current and anticipated levels post-DSO in the context of significantly reduced spectrum availability after the decision to reduce spectrum availability (i.e. auction the cleared spectrum and evict incumbent PMSE users) had been made. BEIRG believes that Ofcom should endeavour to fully understand the implications of their decisions prior to making them.

1.8.5.1. In terms of bandwidth requirement, analogue microphones already use the UHF spectrum as efficiently as possible whilst ensuring that high audio-quality, low-latency and reliability, as required by PMSE users, are maintained. Conversely, digital wireless microphone technology is in its infancy and those which do exist are yet to demonstrate that they can use spectrum as efficiently as their analogue counterparts and that comparable efficiency to analogue devices does not come at the expense of audio quality and latency[29].

1.8.5.2. Development of spectrally efficient equipment in terms of bandwidth requirement is constrained by the 200 KHz standard bandwidth of a professional radio microphone, a specification which exists to ensure professional audio quality.[30]

1.8.5.3. Any transition to a new technology (such as digital) is likely to take a considerable period of time. Analogue wireless microphones and IEMs are currently favoured by the vast majority of PMSE users (professional and community users alike); this will remain the case for the foreseeable future.

1.8.5.4. Whilst systems with a larger tuning range than existing equipment could help alleviate the problems of interleaved spectrum scarcity and fragmentation post-DSO, developing the corresponding equipment with required filtration characteristics is extremely expensive.

1.8.6. Ofcom may also suggest that, in order to alleviate the problem of reduced UHF spectrum availability for PMSE post-DSO, wireless microphones and IEMs should be manufactured to operate in spectrum outside the 470-862 MHz band currently used. However, there are very few viable frequencies available for wireless microphones, IEM and talkback use. Wireless microphones and IEM use 470 – 862 MHz almost exclusively due to historical security of tenure, quality and quantity of spectrum. Talkback uses 425.3125-469.8750 MHz almost exclusively for the same reasons. Spectrum below 470 MHz has very limited capacity for PMSE. Of those bands that are currently available for PMSE above 862 MHz, those above 1800 MHz are not desirable for use of wireless microphone and IEM systems and Ofcom has already started the auction processes for the 1517 MHz – 1525 MHz and 1785 MHz – 1800 MHz bands respectively[31]. Furthermore, without guarantees of security of tenure in areas of spectrum where there is sufficient quality and quantity, the corresponding equipment will not be developed[32]. In relation to the cleared spectrum, Ofcom have stated that 'if licensees are to have a reasonable prospect of earning a commercial return on their investments they will therefore need a reasonable degree of certainty that they will be able to continue offering service through to around 2027'[33]. The same issue of commercial viability applies to the PMSE sector, irrespective of whether spectrum is rented or owned.

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[29] It is important to note that Sennheiser and Shure, leading equipment manufacturers for theatres and concerts, do not currently produce digital equipment. Whilst doing R&D in digital, they do not consider digital to offer sufficient performance and commercial advantages, relative to analogue, for high-end users.

[30] Please see ETSI TR 102 546 V1.1.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Technical characteristics for Professional Wireless Microphone Systems (PWMS); System Reference Document

[31] As far as BEIRG is aware, no wireless microphones or IEMs are currently manufactured to operate in either the 1517-1525 or 1785-1800 MHz bands

[32] In relation to security of access that the PMSE sector requires in the digital interleaved, the PMSE Pro User Group stated that 'whilst manufacturers have invested, and continue to invest, heavily in developing new technologies the earliest conceivable date to complete this transition would almost certainly adhere to the following timetable. It is the PMSE Pro User Group's considered opinion that there would be a further development lead in time for new equipment of at least 3 years from now, followed by a further 7 years for market penetration, and then in addition a further period for the equipment's life span. This would constitute a minimum period of 10 years for professional usage, and for all that total 20 year period (3+7+10 years), there would have to be the certainty of defined spectrum availability.' (See PMSE Pro User Group's response to Programme Making and Special Events: Future Spectrum Access

[33] http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf Section 6.56

Ofcom may suggest that, in order to secure sufficient spectrum availability for use of wireless microphones and IEMs post-DSO, PMSE stakeholders should acquire additional spectrum through the DDR auction process. This would be unviable for the following reasons:

1. As Ofcom have themselves stated, *'(the PMSE) sector is an extremely diverse community, and we do not think it would be able to take part effectively in an auction, creating a serious risk of market failure.'*[34] This is why Ofcom decided to '*hold a beauty contest to award a package of interleaved spectrum to meet PMSE users' needs.*'[35] This situation has not changed; as we stated in our response to the DDR statement, '*the PMSE sector is a disparate, diverse and diffuse community of content producers, manufacturers and rental organisations. Many of its members are extremely small and there is no way they could compete at auction. They possess neither the financial resources nor is there a mechanism to coordinate bidding for the collective needs of this community…therefore it cannot take part in an auction system*.'[36] If the DDR spectrum is as valuable as the US spectrum auctions might indicate, then the PMSE sector has no chance of raising the revenue required to secure it for the reasons that we have outlined and Ofcom have accepted.

2. The band manager will not be in place in time to acquire additional interleaved or cleared spectrum in the DDR auction. Even if it was, it would have no obligations to licence this to the PMSE sector in order to meet reasonable demand from PMSE users because, presumably, these obligations will only apply to the package of spectrum awarded through the beauty contest..

If Ofcom are wrong about the implications of the DDR/DSO for PMSE but auction the cleared spectrum nonetheless, the consequences of this irreversible decision will be disastrous for the British Entertainment Industry. Therefore, we strongly urge Ofcom to hold back the cleared spectrum until it is proven in practice as well as theory[37] that the digital interleaved and channel 69 will be sufficient to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012. If the digital interleaved and channel 69 prove to be insufficient, then more spectrum must be awarded to the band manager with PMSE obligations.

BEIRG has demonstrated that, under Ofcom's current plans, large scale live music events and musicals will not be possible in certain prime venues across the UK post-DSO due to insufficient spectrum availability. Ofcom will deny the citizens and consumers the opportunity to experience large-scale live music events and musical productions in those locations, thus creating a geographic 'cultural divide'.

BEIRG has also demonstrated that the spectrum scarcity problem post-DSO is unlikely to be solved[38] by (1) altering the protection options of the DTT multiplexes, (2) the arrival of new 'spectrally efficient' technologies, (3) using 'alternative' spectrum available for PMSE or (4) acquiring new spectrum through the auction process.

The only way that Ofcom can secure the future of the PMSE industry is by awarding more spectrum, of sufficient quantity and quality with enduring security of access, to the band manager with PMSE obligations.

2. Under Ofcom's current plans, many touring productions may be rendered financially unviable or be restricted to certain venues post-DSO

2.1. Touring theatre and musical productions need to use the same wireless microphone and in-ear monitor systems as they travel around the country. This is for both practical and

[34] http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf
[35] http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf
[36] http://www.ofcom.org.uk/consult/condocs/ddr/responses/nr/PMSEProUserGroup.pdf
[37] E.g. finalised white space maps based on modelling and practical testing, as carried out and formulated in conjunction with PMSE stakeholders
[38] At least into the medium term

financial reasons. The alternative to using the same equipment would be to 'swap out' equipment every time the production moved to a different location and the pattern of spectrum availability changed. This would involve increased transport costs, extra personnel and time. But more importantly, it would entail considerable additional expense in rental costs since the rental company would require a larger and more mobile inventory, costs which would have to be passed on to consumers.

2.2. Sagentia and Ofcom have presented the information on interleaved availability post-DSO by referring to each location in isolation. However, the PMSE industry relies on a UK pool of equipment that through careful planning and logistics operates on a countrywide basis.

2.3. All PMSE equipment has a finite 'window' through which it accesses spectrum. The width of this window, i.e. how much spectrum can be accessed, is defined as the equipment's 'tuning range'. On individual systems, the tuning range is fixed; the window cannot be moved up and down the frequency scale. It follows that, as they move around the UK, touring theatre and musical productions can only use the same equipment if there is sufficient available spectrum within the bands accessible by the production's equipment at each venue on the tour. Those responsible for planning equipment requirements and deployment have the difficult job of finding a viable 'pathway through the patchwork' of available and non-available spectrum.

2.4. An average-size musical production needs to access at least 32 MHz of interference-free UHF spectrum per venue[39], which may not be contiguous. High-spec professional wireless microphone systems used to satisfy the requirements of these productions commonly have components with a tuning range or 'window' of 24 MHz. As things currently stand, a normal production will typically tour with a system that uses three different components that each have the ability to access a different 24 MHz of UHF spectrum. Currently (i.e. pre-DSO), this arrangement results in the full 32 MHz production requirement being fulfilled 99% of the time. Ofcom's 'white space' maps show that, post-DSO, three components with a 24 MHz window are much less likely to be able to cater for a 32 MHz production due to the reduction and fragmentation of available bands.

2.5. However, the question is less about whether components that access three different 24 MHz windows of spectrum can fulfil the 32 MHz requirement at each venue, but which three 24 MHz windows of spectrum can be used to fulfil the 32 MHz requirement at every venue hosting the production. This is the difference between using the same three components (that access a different 24 MHz) at each and every venue (i.e. the same equipment) and, in the most extreme scenario, three different components (that access a different 24 MHz) at each and every venue. The difference in cost between these two scenarios is considerable; for instance, if totally different components have to be used at each and every venue on a 6-venue tour, it will cost the production approximately 6-times more than it would to use the same components at every venue. This is because the rental company will require a much larger inventory of equipment and the transfer of equipment will require additional time and staff for transport, setup and rehearsal.

2.6. At a conservative estimate, it costs an average-sized touring production around £1000 per week to rent its radio microphones and in-ear monitor systems equipment. Ofcom's 'white space' maps and the corresponding data available on the JFMG website suggest that, post-DSO, this cost will increase by at least a factor of 2.

2.7. To illustrate the severity of the considerable increase in equipment costs in the wake of DSO, BEIRG has selected two real-life average-sized theatrical productions that are due to be touring the UK in 2008 and 2009. For each production, BEIRG has calculated UHF spectrum availability for PMSE before and after DSO at each venue (using the tool on the

[39] It is possible to fit 6 wireless microphones comfortably into a standard 8 MHz TV band and 8 at the very most. Channel 69 can accommodate 8 wireless microphones comfortably and 12 is the maximum. The average touring theatre production requires between 32 and 40 wireless microphones and in-ear monitors. This is why at least 32 MHz of interference-free UHF spectrum is required at each venue.

JFMG website). Using this data, BEIRG has produced a spectrum availability spreadsheet for each production which clearly shows the extent to which the same three sets of equipment with a 'window' of 24 MHz can be used at each venue. The results do not make encouraging reading.

2.8. Assumptions:

2.8.1. There will be sufficient volumes of wireless microphones and in-ear monitor systems that operate anywhere in the 'digital interleaved' spectrum due to be awarded to the band manager with PMSE obligations

2.8.2. Each component of the systems used by all of the productions in question has a 'window' of 24 MHz[40]

2.8.3. Each production requires a minimum of 32 MHz of interference-free spectrum[41] (i.e. total bandwidth) at each venue before and after DSO (i.e. not necessarily contiguous)

2.8.4. A full 8 MHz channel accommodates as many wireless microphones after DSO as before[42]and comprises 8 MHz of available spectrum both before and after DSO

Touring theatre production example A:

Production A is due to take place at the following 6 UK venues in 2008:

1. Empire Theatre, Liverpool
2. Playhouse Theatre, Edinburgh
3. New Victoria Theatre, Woking
4. Grand Theatre and Opera, Leeds
5. King's Theatre, Glasgow

[40] The equivalent of 3 standard 8 MHz TV bands – this is a standard high-spec tuning range used by professional PMSE users – equipment with a larger tuning range is hugely expensive whereas a smaller tuning range is insufficiently flexible

[41] Working on the further assumption that the ratio of wireless mics to available bandwidth (MHz) in UHF spectrum is approx 1:1 (maximum efficiency)

[42] For the purposes of this model, a free 8 MHz TV band is designated with an available bandwidth of 8 MHz both before and after DSO. This is to (1) make the explanation clearer and (2) because BEIRG disagrees with Sagentia's assessment of the guard band required to protect digital as opposed to analogue TV broadcasts; due to the pattern of an analogue signal, PMSE applications can overlap with analogue broadcasts, unlike digital broadcasts.
Sagentia has stated that '*Digital TV has negative protection ratios throughout most of the adjacent channel compared with the significant protection required for analogue TV reception. This in itself means that more of the adjacent channel to a Digital TV broadcast is usable for PMSE than the channel adjacent to an analogue TV broadcast*.'
The upshot of this is that, as represented on the JFMG website, a full 8 MHz band pre-DSO (i.e. interleaved with analogue broadcasts) 7.4 MHz because of the perceived requisite guard band. As the adjacent channels digital broadcasts are perceived to be more useable for PMSE than analogue, the buffer has been reduced to 200 KHz and so an available 8 MHz band is increased to 7.8 MHz post-DSO. However, these details do not affect the clear demonstration that currently, touring productions can use 3 sets of equipment with a 24 MHz window whereas much more equipment will be required post-DSO.
It is also unclear how the following analysis from Sagentia aligns with the 200 KHz buffer or 'guard band' designated to protect DTT on the JFMG website:
'*The DTT channel bandwidth is 8MHz. However real DTT receivers have intermediate frequency (IF) bandwidths that are greater than the 8MHz TV channel. This means that signals from beyond the 8MHz bandwidth are able to enter a DTT receiver and interfere with wanted signals in adjacent channels. Operation of PMSE equipment within this wider bandwidth i.e. at the edge of the adjacent channel, is likely to give rise to interference within a DTT receiver. The question is how big the guard band needs to be in order to protect receivers in the adjacent channel. We conducted a brief survey of IF filters made for DTT receivers. This suggests that they have significant attenuation beyond 5MHz from their centre frequency. Protecting a guard band of 1MHz each side of the used TV channel should give adequate protection from PMSE use. We believe that a 1MHz guard band should be adopted until it is demonstrated that a narrower guard band is safe*.'

6. Regent Theatre, Stoke

Pre-DSO situation:

'Window' of equipment (TV bands)	Minimum bandwidth available at every venue
67 – 69	16 MHz
61 - 63	8 MHz
34 - 36	16 MHz
41 - 43	16 MHz
54 - 56	16 MHz

The table shows that a system with three components, each which accesses a different 24 MHz window of spectrum, will be able to fulfil the 32 MHz requirement of touring production 'A' pre-DSO (16 X 3 = 48 MHz); indeed, several combinations of equipment with different 24 MHz tuning ranges are possible. Pre-DSO, the same set of equipment (with the same three components) can be used at every venue.

Post-DSO situation

Production A will not be possible at the New Victoria Theatre in Woking post-DSO.
Production A will require a minimum of 5 different components each with a 24 MHz spectrum window to take place in Edinburgh[43]
Production A will be able to use the same components in Leeds[44] as it did in Edinburgh
Production A will be able to use the same components in Glasgow[45] as it did in Edinburgh and Leeds
In addition to the components used in Edinburgh[46], Glasgow and Leeds, production A will require a minimum of two more components[47], each with a different 24 MHz spectrum window, so it can take place in Liverpool[48] and Stoke[49]

[43] (1) **TV 29-31** encompasses 5.8 MHz (543.100-548.900 MHz); (2) **TV 37-39** encompasses a full 8 MHz band (TV38); (3) **TV 48-50** encompasses 5.8 MHz (687.100-692.900 MHz); (4) **TV 55-57** encompasses 5.8 MHz (751.100-756.900 MHz) and (5) **TV 67-69** encompasses a full 8 MHz band (TV69)
(5.8 + 8 + 5.8 + 5.8 + 8 = 33.4 MHz)

[44] Edinburgh equipment encompasses the following available frequencies (MHz) in Leeds: 535.100-540.900; 696.100-701.900; 702.100-708.900; 751.100-757.900; 758.100-764.900 and TV69
(5.8 + 5.8 + 6.8 + 6.8 + 6.8 + 8 = 40 MHz)

[45] Edinburgh equipment encompasses the following available frequencies (MHz) in Glasgow: 535.100-541.900; 542.100-548.900; TV38; 695.100-700.900; 751.100-756.900 and TV69
(6.8 + 6.8 + 8 + 5.8 + 5.8 + 8 = 41.2 MHz)

[46] Edinburgh equipment encompasses the following available frequencies (MHz) in Liverpool: 543.100-548.900; 703.100-708.900; 759.100-764.900; TV69
(5.8 + 5.8 + 5.8 + 8 = 25.4 MHz)
Edinburgh equipment encompasses the following available frequencies (MHz) in Stoke: 535.100-540.900; 759.100-764.900; TV69
(5.8 + 5.8 + 8 = 19.6 MHz)

[47] (6) **TV 51-53** encompasses 727.100-732.900 MHz in Liverpool and 711.100-717.900 MHz, TV52 and 726.100-732.900 MHz in Stoke
(7) **TV 42-44** encompasses 647.100-653.900 MHz and 654.100-660.900 MHz in Liverpool

[48] 25.4 + 5.8 + 6.8 + 6.8 = 44.8 MHz

[49] 19.6 + 6.8 + 8 + 6.8 = 41.2 MHz

Summary of production A

Prior to DSO, production A can use a set of equipment with the same 3 components, each of which accesses a different 24 MHz of UHF spectrum, at all 6 tour venues (rental cost approx £1000 p/w)
Post-DSO, production A will require a minimum of 7 components, each of which accesses a different 24 MHz of UHF spectrum, in order for the production to take place at 5 of the 6 tour venues (rental cost approx £2300 p/w)
Post-DSO, production A will not be possible at one of the tour venues

This model serves to demonstrate that, as a result of DSO and DDR, PMSE equipment rental costs for touring theatre will increase: in this case by 130%

Touring theatre production example B

Production B is due to take place at the following UK venues in 2009 (this is just a sample section but will take place at a number of other venues with similar problems):

1. Theatre Royal, Nottingham
2. Empire Theatre, Liverpool
3. Hippodrome Theatre, Birmingham
4. Derngate Theatre, Northampton
5. Cliffe Pavilion, Southend
6. Orchard Theatre, Dartford

Pre-DSO situation

'Window' of equipment (TV bands)	Minimum bandwidth available at every venue
67 - 69	16 MHz
58 - 60	10.2 MHz
36 - 38	8 MHz
29 – 31	9.2 MHz

The table shows that a system with three components, each of which accesses a different 24 MHz window of UHF spectrum, will be able to fulfil the 32 MHz requirement of touring production 'B' pre-DSO (16 + 10.2 + 9.2 = 35.4 MHz). Pre-DSO, the same system (with the same three components) can be used at every venue.

Post-DSO situation

Production B will require a minimum of 5 different components each with a 24 MHz spectrum window in order for the production to take place in Southend[50]
Production B can use the same components in Liverpool[51] as in Southend
Production B can use the same components in Northampton[52] as in Southend and Liverpool

[50] (1) **TV 21-23** encompasses 5.8 MHz (471.100 – 476.900 MHz); (2) **TV 26-28** encompasses 5.8 MHz (519.100-524.900); (3) **TV 37-39** encompasses a full 8 MHz band; (4) **TV 42-44** encompasses 5.8 MHz (639.100-644.900) and (5) **TV 69** encompasses a full 8 MHz band

[51] Southend equipment encompasses the following available frequencies (MHz) in Liverpool: 471.100-476.900; 519.100-524.900; 647.100-653.900; 654.100-660.900; TV69
(5.8 + 5.8 + 6.8 + 6.8 + 8 = 33.2 MHz)

[52] Southend equipment encompasses the following available frequencies (MHz) in Northampton: 479.100-485.900;

Production B can use the same components in Dartford[53] as in Southend, Liverpool and Northampton
In addition to the 5 components used in Southend[54], Liverpool, Northampton and Dartford, production B will require a minimum of one component[55] with a different 24 MHz spectrum window in order for the production to take place in Nottingham[56] and Birmingham[57]

Summary of production B

Prior to DSO, production B can use one system with the same three components (each with a different 24 MHz spectrum window) at its first 6 tour venues (rental cost approx £1000 p/w)
Post-DSO, production B requires a minimum of 6 components (each with a different 24 MHz spectrum window) in order for the production to take place at the same 6 tour venues (rental cost approx £2000 p/w)

This model serves to demonstrate that, as a result of DSO and proposed actions resulting from the DDR, PMSE equipment rental costs for touring theatre will increase: in this case by 100%

Section 2: Conclusion

Under Ofcom's current plans, many touring productions may be rendered financially unviable or be restricted to certain venues post-DSO.

BEIRG has used two sample touring productions to illustrate the negative cost implications of the Digital Switchover and the Digital Dividend on medium-scale touring productions if Ofcom proceeds as planned.

Medium-scale touring theatre and musical productions generally take place at many more than six venues around the UK, but a sample of only six was used in each of the models outlined above. This is because spectrum available for PMSE post-DSO will be so scarce, so dispersed and so varied from venue to venue that it is very difficult to ascertain the minimum amount of equipment that is required to cater for the entire tour. However, it is certain that additional equipment will be required to cater for the production to take place at further venues.

There will not be sufficient spectrum available for PMSE post-DSO in certain geographical locations for productions to maintain current production values. Furthermore, the spectrum that will be available for PMSE is highly fragmented dispersed and the pattern of fragmentation varies significantly between locations, which will have a negative impact on both touring and static productions.

The consequences of DSO/DDR for the touring theatre industry are potentially disastrous. As we have demonstrated, equipment costs will increase by a minimum of a factor of 2[58].

486.100-492.900; 510.100-516.900; 527.100-533.900; TV38; 655.100-660.900; TV69
(6.8 + 6.8 + 6.8 + 6.8 + 8 + 5.8 + 8 = 49 MHz)

[53] Southend equipment encompasses the following available frequencies (MHz) in Dartford: TV38; TV42-44; TV69
(8 + 8 + 8 + 8 + 8 = 40 MHz)

[54] Southend equipment encompasses the following available frequencies (MHz) in Nottingham: 487.100-492.900; 511.100-516.900; 655.100-660.900; TV69
(5.8 + 5.8 + 5.8 + 8 = 25.4 MHz)
Southend equipment encompasses the following available frequencies in Birmingham (MHz): 479.100-484.900; 527.100-532.900; 655.100-660.900; TV69
(5.8 + 5.8 + 5.8 + 8 = 25.4 MHz)

[55] (6) **TV 58-60** encompasses 775.100-781.900 MHz and 782.100-788.900 MHz in Nottingham and 775.100-781.900 MHz and 782.100-788.900 MHz in Birmingham

[56] 25.4 + 6.8 + 6.8 = 39 MHz

[57] 25.4 + 6.8 + 6.8 = 39 MHz

[58] BEIRG does not accept any argument that these figures exaggerate the problem because not all touring productions use equipment that is restricted to a 'window' of 24 MHz. This is because, generally speaking, the cost of the equipment is proportionate to the amount of spectrum it can access due to higher development and manufacturing costs. If more

3. As a consequence of DSO/DDR, millions of pounds worth of wireless microphone and in-ear monitor systems will be rendered redundant or require significant expensive modification

3.1. Ofcom has rightly stated[59] that '*PMSE equipment operating in channels 21-30 or 41-62 is likely to be affected by DSO. This is because the frequencies used for DTT will change from those used for analogue terrestrial television, and so the pattern of interleaved spectrum will also change. As a consequence, PMSE users of equipment operating in interleaved spectrum are likely to find it necessary to retune, modify or replace that equipment in order to use new frequencies after DSO*.'

3.2. Sagentia have stated that '*PMSE users may need to migrate to a different frequency for one of three reasons: (1) DSO; (2) Their channel is no longer available for PMSE use as a result of the DDR. This applies to channels 31-40, 61 – 68; (3) The number of channels (and therefore radio microphone frequencies) available for PMSE use at any given location is lower than the demand for PMSE channels. These locations are referred to as "pinch points"*.'

3.3. In its submission to Ofcom's consultation on the Digital Dividend Review, the PMSE Pro-User Group stated that the value of equipment that would become redundant as a result of the DDR was well in excess of £30 million and that Ofcom estimates of equipment currently held by the PMSE industry were 'wildly inaccurate'. Ofcom has since admitted that the 'total value of relevant PMSE equipment' is 'around £35 million'[60].

3.4. BEIRG's view is that compensation must be paid to owners of PMSE equipment that will be rendered redundant or require expensive modification as a result of DSO/DDR.

3.5. When considering this course of action, it is important to remember some of Ofcom's DDR objectives:

3.5.1. 'Encourage more efficient use of spectrum'
3.5.2. Help the PMSE industry adapt to 'full market mechanisms'
3.5.3. 'Minimise disruption to the PMSE industry'
3.5.4. 'Avoid the risk of market failure'.

3.6. If appropriate compensation were paid to owners of PMSE equipment that will be rendered redundant or require expensive modification as a result of the DDR then this would help fulfil all of these objectives.

3.7. Compensation would help minimise disruption to the PMSE sector and help avoid market failure because it would ease the financial burden on those who will have to invest in an entire inventory of new equipment following the DDR, especially those who have not yet amortized the cost of their existing equipment. As BEIRG has said before, Ofcom also needs to acknowledge that equipment for which full depreciation has taken place continues to hold value within the industry because of the longevity of the life of the equipment and its rental value within the PMSE sector. This means that equipment filters down through the industry. As things stand, DSO/DDR will abruptly end the life cycle of this equipment by making it entirely redundant. Compensation would allow these companies to invest in equipment that operates in the digital interleaved.

3.8. In relation to the requirement for compensation to owners of PMSE equipment that operates in the spectrum which will be released for new uses as part of the DDR, we

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spectrally agile equipment is required in large quantities (i.e. that with larger tuning range), then the rental organisations will have to buy it, and then pass on the large costs to the users. Furthermore, many touring PMSE productions use equipment that has a tuning range of less than 24 MHz, thus making it even more difficult to use the same equipment across different venues post-DSO.

[59] 2.5, DDR statement 13th December 2007

[60] A3.151: annex to December DDR Regulatory Statement

would like to highlight the example of channel 38 as a possible precedent. According to Ofcom, the Department for Innovation, Universities and Skills (DIUS) and HM Treasury have agreed terms under which radio astronomy use of channel 38 will cease during 2012. The results of this agreement could mean that UK Science will 'realise a considerable financial benefit'[61] as a result of placing channel 38 in the DDR cleared auction. The PMSE sector should be similarly compensated.

4. Expensive new equipment that operates in the 'digital interleaved' will have to be developed, manufactured and purchased by users and rental companies

4.1. As outlined above, the consequence of the reduction and change in pattern of spectrum availability for PMSE post-DSO is that the vast majority of PMSE equipment currently in the marketplace (with a value in excess of £30 million) will be rendered redundant or require significant modification.

The PMSE sector will have to re-equip. However, this is currently very difficult as it is still uncertain as to how DSO and the DDR will affect the pattern of availability. Due to the timing of the second and third phase auctions of the geographical interleaved spectrum, it appears that the amount of interleaved spectrum auctioned and subsequently, what is left for PMSE, may not be fully realised until early 2010.

5. A larger volume of equipment or (more expensive) spectrally agile equipment will be required post-DSO to achieve current results, the consequence of which will be further increases in cost

5.1. The huge reduction and the change in pattern of PMSE spectrum availability post-DSO will mean that every large-scale professional PMSE user will have to spend much more on wireless microphones and in-ear monitor systems to achieve current results, whether it be for increased equipment or higher levels of (expensive) spectrally agile equipment.

5.2. In this regard, Sagentia correctly recognises that 'the number of available frequencies at many locations is reduced'. Sagentia suggests that as a result, 'a number of existing users' will have to 'migrate to one or more different frequencies'. This is somewhat of an understatement, as this document demonstrates.

5.3. The examples of Cliffes Pavilion in Southend and the Edinburgh Playhouse described above in section 2 illustrate the problem effectively. In both cases, three sets of equipment with a tuning range of 24 MHz could easily cater for a medium-scale production pre-DSO. However, post-DSO, five sets of equipment with a tuning range of 24 MHz will be required to cater for the same event at these venues. This is due to the reduction of available bands and the considerable fragmentation of those which are available. The spreadsheets attached to this document further illustrate this point.

[61] 4.26

Conclusion

The PMSE sector needs more, not less, spectrum availability post-DSO and more time to adapt to the changes

Ofcom currently plans to sell off much of the spectrum currently used for wireless microphones and in-ear monitor systems. The remaining digital interleaved spectrum due to be allocated to the band manager with PMSE obligations will be too scarce and too fragmented: **Ofcom is on course to fail the PMSE sector[62].**

Potential solutions

1. More spectrum must be set aside for PMSE use post-DSO[63], ideally available on a nationwide basis between 470 and 862 MHz

1.1. This will mean that large-scale PMSE productions will be able to continue to take place across the UK

1.2. This would potentially reduce the amount of equipment required to achieve current results post-DSO if the spectrum was located between 470 and 862 MHz

1.3. In addition to channel 69, more spectrum must be made available for professional PMSE use on a nationwide basis post-DSO. This would be the most effective way of solving the problems posed to the touring theatre industry by DSO/DDR. As we have demonstrated, for the same equipment to be useable across each tour venue then there must be spectrum available across the same frequency range[64].

1.4. It is important to note that while BEIRG is outlining lack of spectrum availability post-DSO as a major threat to the PMSE sector, it is Ofcom's responsibility to find the solution. BEIRG will be happy to assist with this solution where possible.

1.5. Not only should additional spectrum be available UK-wide for the PMSE sector post-DSO, it should consist of three or more contiguous 8 MHz bands. To this end, BEIRG would like to refer Ofcom to the PMSE Pro User Group's 2007 submission in which it recommended that channels 67 and 68 be reserved for PMSE use. Our position therefore remains unchanged; the PMSE sector still needs guaranteed access to 3 contiguous bands post-DSO, and it is incumbent upon Ofcom, as the regulator with responsibilities to citizens and consumers, to find a solution. Channels 37, 38 and 39 may be another option in this regard[65].

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[62] Estimated annual turnover of Musical and other productions using radio equipment in TMA theatres; £250 million..
Employment of performers, musicians and technicians by these productions gives about 66,000 days of employment p.a.
Theatre based employment of administration, marketing, box office, technicians and support staff: provides about 75,000 days employment p.a.
Producers head office staff and freelance technicians and others in prepping and running shows: provides about 312,000 days employment p.a.
Dependant external trades (scene shops/sound & lighting shops/printers/catering etc): provides between 1000 - 5000 jobs, equating to a minimum of 312,000 days of annual employment.
In the larger theatres in Major cities circa 50% of productions are musicals - without this component these theatres do not have a viable operating year.
Altogether a minimum of about 765,000 days employment per year

[63] i.e. awarded to the commercial band manager with PMSE obligations

[64] See section 2 above

[65] BEIRG recognises that channel 38 will be limited to very low-power applications in much of Great Britain due to the protection required for radio astronomy in neighbouring countries. However, depending on the use of adjacent frequencies, channel 38 in isolation may be of limited use to the PMSE community. Any PMSE user of channel 38 would be threatened by interference from high-power new users of channels 37 and 39. Therefore, until the use of channels adjacent to 38 is determined, its usability to the PMSE sector is unclear. It is important to note that, even under

2. Users of wireless microphone and in-ear monitor systems must retain access to the cleared spectrum until DSO is completed nationwide and the Olympics have taken place in 2012[66]

2.1. This will provide the much-needed time for manufacturers to develop and produce the new equipment capable of operating in the digital interleaved.

2.2. This will provide users and rental companies with time to assess their needs and re-tune, modify or replace their affected equipment.

2.3. This will provide more time for users and rental companies to re-coup their investments in existing equipment that will become redundant or require extensive modification.

2.4. This will save touring productions from having to swap equipment as they move around the UK and they pass into areas which are due to release the cleared spectrum before 2012

2.5. It is extremely doubtful that phased termination of PMSE access and phased availability of channels 31-40 and 61-68 will be appropriate for the new operators of these bands. The new licensees will, in all probability, be intending to run their new services nationwide (telecommunications companies for example). As nationwide use of these bands will not be possible until London has switched over to digital broadcasting in 2012, it would have no value to evict PMSE users from channels 31-40 and 61-68 until this date[67].

2.6. This will help to ensure that there will be sufficient spectrum availability and sufficient equipment availability to cater for the immense demands of the London 2012 Olympics[68].

Unless Ofcom can prove[69] that the package to be awarded to the band manager will provide sufficient useable spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012, PMSE users of the cleared spectrum should not be evicted.

Indeed, we have demonstrated that, under current plans, the digital interleaved and channel 69 will NOT provide sufficient spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO. As discussed in section 1 of this document, the spectrum availability problem for PMSE post-DSO is unlikely to be solved[70] by (1) altering the protection options of the DTT multiplexes, (2) the arrival of new 'spectrally efficient' technologies, (3) using 'alternative' spectrum available for PMSE or (4) acquiring new spectrum through the auction process. Therefore, in order to secure the future of the PMSE sector, more UHF spectrum, of sufficient quantity and quality with enduring security of access, must be awarded to the band manager with PMSE obligations for use of wireless microphones and IEMs post-DSO.

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ideal conditions, channel 38 is unlikely to be able to accommodate any more than 8 wireless microphones, and possibly less. Additionally, channel 38 is not sufficiently close to the digital interleaved spectrum reserved for PMSE to help significantly with the fragmentation problem.

[66] ….irrespective of when auctions for the 'cleared' spectrum take place and licenses are awarded. For instance, Ofcom could make clear in the licence conditions for channels 31-40 and 61-68 that rights of usage do not start until September 2012

[67] One of Ofcom's explicit objectives is to 'minimise disruption to the PMSE industry'. Eviction of the PMSE sector from the spectrum in which it currently operates will cause massive disruption; this should not be exacerbated needlessly.

[68] On the supply side, both equipment and spectrum availability are set to radically fall (due to the phased termination of PMSE access to cleared spectrum ending in London before the Games and LOCOG's technology freeze). On the demand side, both equipment and spectrum requirement are set to radically rise (due to the Games themselves, Cultural Olympiad and increase in normal demand).

[69] i.e. it has been proven in theory and in practice and PMSE stakeholders are convinced

[70] At least into the medium term

Specific comments on the consultation document

4.26 – Compensation for incumbent users being evicted from the cleared and interleaved spectrum reservations

In relation to the requirement for compensation to owners of PMSE equipment that operates in the spectrum which will be released for new uses as part of the DDR, we would like to highlight the example of channel 38 as a possible precedent. According to Ofcom, the Department for Innovation, Universities and Skills (DIUS) and HM Treasury have agreed terms under which radio astronomy use of channel 38 will cease during 2012. The results of this agreement could mean that UK Science will 'realise a considerable financial benefit'[71] as a result of placing channel 38 in the DDR cleared auction. The PMSE sector should be similarly compensated.

4.34 – Channel 69 and nationwide spectrum availability for PMSE use

As demonstrated above, in addition to channel 69, more spectrum must be made available for professional PMSE use on a nationwide basis post-DSO. Not only should the additional spectrum be available UK-wide for the PMSE sector post-DSO, it should consist of three or more contiguous 8 MHz bands. To this end, BEIRG would like to refer Ofcom to the PMSE Pro User Group's 2007 submission in which it recommended that channels 67 and 68 be reserved for PMSE use. Channels 37, 38 and 39 may be another option in this regard.

BEIRG recognises that channel 38 will be limited to very low-power applications in much of Great Britain due to the protection required for radio astronomy in neighbouring countries. However, depending on the use of adjacent frequencies, channel 38 in isolation may be of limited use to the PMSE community. Any PMSE user of channel 38 would potentially be threatened by interference from high-power new users of channels 37 and 39. Therefore, until the use of channels adjacent to 38 is determined, its usability to the PMSE sector is unclear. It is important to note that, even under ideal conditions, channel 38 is unlikely to be able to accommodate any more than 8 wireless microphones, and possibly less. Additionally, channel 38 is not sufficiently close to the digital interleaved spectrum reserved for PMSE to help significantly with the fragmentation problem.

In the DDR statement of 13th December 2007, Ofcom stated that *'in relation to channel 69, this is heavily used by PMSE users because its availability across the UK allows traveling productions to use the same equipment and the same frequency plan at all venues. We also recognise the importance that PMSE users attach to the higher quality product that can be provided through licensing. We have decided that use of channel 69 should continue on a licensed basis. We will include channel 69 with the rights to be awarded to the band manager'*[72].

However, in the consultation document on the release of the cleared spectrum, Ofcom state that '*We do note however, that channel 69 in isolation is of limited value to PMSE users because touring companies, who generally use channel 69, also require access to channels 67 and 68. Looking ahead, we propose to enter into discussions with the PMSE stakeholders to identify whether there is alternative spectrum, comparable in quality and quantity that could be used in place of channel 69 that may offer a superior long-term solution for PMSE needs*'[73].

It seems perverse that Ofcom originally planned to include channel 69 in the package awarded to the band manager in order to allow traveling productions to use the same equipment and same frequency plan at all venues but now admits that channel 69 in isolation is of limited value in this regard. It is especially perverse because the PMSE User Group has repeatedly urged Ofcom to reserve channels 67 and 68 as well as channel 69 for PMSE use. We are concerned that developments at CEPT and the 'opportunity cost' of awarding channel 69 to the band manager is primarily dictating Ofcom's eagerness for PMSE to 'migrate' from it, rather than concern for the future of the PMSE industry.

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[71] See http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf Section 4.26
[72] See http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf Section 7.82
[73] See http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf Section 4.34

More generally, we are concerned that Ofcom severely underestimates the value of channel 69 to PMSE users. While touring companies generally require access to channels 67 and 68 as well as 69, hundreds of thousands of community users depend on channel 69 for use of wireless microphones and IEMs. It is our view that channel 69 should be retained in the package to be awarded to the band manager; if it was not included, then the problems for the PMSE sector in terms of spectrum availability post-DSO[74] and equipment redundancy would be further exacerbated. In this regard, Ofcom must understand that, at least into the medium term, there is no viable alternative for the PMSE sector to the UHF spectrum. This point is explained in greater detail in section 1 (above).

Question 2 - the interleaved spectrum in channels 61 and 62

We believe that interleaved channels 61 and 62 should not be included in the DDR cleared award because this will further reduce the availability of interleaved spectrum that would otherwise be available for PMSE applications. As we have demonstrated, post-DSO there will be insufficient spectrum availability to cater for large-scale events in certain geographical locations. Ofcom are proposing to include channels 61 and 62 in the award because they have a perceived higher opportunity cost than other interleaved channels due to the non-mandatory harmonisation framework being developed by CEPT. However, despite channel 69 being part of the same non-mandatory framework, Ofcom have, thus far, decided to award channel 69 to the band manager with PMSE obligations. We do not see why they cannot do the same with channels 61 and 62, which currently appear be of little value nationwide due to existing DTT multiplex commitments.

Question 3 – licence-exempt use of channels 61 and 62 by cognitive devices

We strongly agree with Ofcom's proposal not to allow licence-exempt use of channels 61 and 62 by cognitive devices. However, this protection afforded to new licensees of the cleared spectrum must be extended to all those who use spectrum on a licensed basis, including the PMSE sector.

Ofcom stated in section 4.42 of the consultation document that '*(a)s yet, it is unknown whether cognitive technologies would be able to detect and avoid other potential uses of the cleared spectrum. Moreover, as explained in the DDR Statement there may only be a small incremental benefit in allowing cognitive access to the cleared spectrum over and above our proposal to allow cognitive use of the interleaved spectrum. This leads us to believe that the associated costs and risks to licensees of the cleared spectrum might be too high given the size of the possible benefits. If, in the future, cognitive radio is developed that can be used in the cleared spectrum, these could be used by licensees.'*[75]

Prototype cognitive devices submitted to the FCC[76] have so far failed to demonstrate that they can adequately detect digital TV signals, let alone low power devices like radio microphones (i.e. incumbent and future users of the interleaved spectrum and channel 69)[77]. Indeed, prototype 'White Space' devices recently failed field tests carried out by the FCC at an NFL game between the Washington Redskins and the Buffalo Bills. The prototype devices were unable to consistently identify operating wireless microphones or distinguish occupied from unoccupied TV channels.

Like the potential new licensees of the cleared spectrum, the risks to the licensees of the interleaved spectrum and channel 69 (i.e. the PMSE sector) will be too high given the possible benefits. Irrespective of whether spectrum is rented or owned, the licensees must be afforded the same degree of protection.

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[74] As outlined above

[75] See http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf Section 4.42

[76] Federal Communications Commission

[77] The transient nature of spectrum use by the PMSE sector makes it difficult to see how cognitive devices will be able to avoid interfering with radio microphones and in-ear monitor systems. However frequently cognitive devices scan, they cannot predict when a PMSE device will start to use a certain licensed frequency, which is dictated by human agency. Furthermore, as anyone who has been to a musical or live music event will know, no level of interference with PMSE applications is acceptable; unless there is no delay whatsoever between scans of the cognitive device, then we cannot see how interference with PMSE applications can be avoided.

We would view cognitive use of the interleaved spectrum in channels 61 and 62 as setting a worrying precedent for allowing cognitive use of the entire digital interleaved without sufficient evidence that they do not cause any harmful interference to incumbent users such as DTT and PMSE.

BEIRG believes that it is essential for Ofcom to undertake its own testing of cognitive equipment and take into account test results in the EU as well as the United States[78]. Ofcom must be cautious of accepting test results from the FCC, which do not necessarily apply to the type of DVB in the UK. It is absolutely crucial that the testing process be rigorous and undertaken with a methodology agreed with incumbent licensees, which would be PMSE stakeholders in the case of the interleaved spectrum and channel 69.

It is imperative that cognitive radio devices do not interfere with all incumbent users and licensees of interleaved spectrum. The PMSE sector must be fully and actively involved in the testing process, which should be conducted at a dignified pace. It is essential that PMSE sector representatives, as well as Ofcom, are completely satisfied that cognitive devices will not interfere with their applications before any cognitive access to the interleaved is permitted.

Separate from the more technical concerns, we believe that the principle that these devices should be allowed to operate, on a license exempt basis, in the same area of spectrum that PMSE users will be paying for via AIP requires further detailed consultation and discussion.

Question 5 – the timetable

We strongly believe that Ofcom should not proceed with the current timetable of spectrum release. No cleared spectrum should be released until Ofcom proves that there will be sufficient spectrum availability for the PMSE sector post-DSO to meet current and anticipated future requirements for use of wireless microphones, IEMs and talkback. As we have demonstrated above, Ofcom has not, so far, proved this. Indeed, in view of the timing of the second and third phase auctions of the geographical interleaved spectrum, it appears that the amount of interleaved spectrum auctioned and subsequently, what is left for PMSE, may not be fully realised until early 2010.

According to section 4.6 of the consultation document, Ofcom's position on the timing of spectrum awards is to '*release spectrum that is available as soon as possible…..(as it) allows the market to decide the best use of the spectrum and ensures that benefits from new services or increased competition flow to citizens and consumers as quickly as possible*.' We urge Ofcom to consider the costs of such an approach to the existing and potential social benefits provided by incumbent users. As explained in section 1 (above), under Ofcom's current plans, large scale live music events and musicals will not be possible in certain prime venues across the UK post-DSO due to insufficient spectrum availability for PMSE. Ofcom will deny citizens and consumers the opportunity to experience large-scale live music events and musical productions in those locations, thus creating a geographic 'cultural divide'.

In section 4.65 of the consultation document, Ofcom state that '*we judge that the market is better placed than the regulator to decide the use of spectrum, and that an auction to this timescale would offer a fair opportunity for participation by the wide range of potential bidders*.' As outlined in section 1 of this document, the PMSE sector is incapable of participating in an auction process. Acquiring additional spectrum through the auction mechanism is not a viable option by which the PMSE sector might solve the spectrum scarcity issue post-DSO.

Ofcom's 'white space' maps clearly show that the decision to auction the 'cleared' spectrum will result in a dramatic reduction and increased fragmentation of useable spectrum available for

[78] The prototype cognitive radio devices being are currently being designed to detect U.S. 8VSB DTV signals, not the OFDM-A type used in the UK and elsewhere in Europe. Also, these cognitive devices submitted to the FCC so far do not even pretend to the able to detect wireless microphones let alone offer protection. This does not entail a genuine cognitive radio function and therefore are only in effect manual scanners.

PMSE post-Digital Switchover (DSO). If Ofcom proceed as planned and do not award additional[79] spectrum to the band manager with PMSE obligations, then many large-scale productions such as live music events and musicals will be rendered impossible in certain prime locations across the UK. Furthermore, many touring productions may become financially unviable.

Ofcom have stated that they might be able to 'enlarge' the white space available to PMSE post-DSO by altering the protection options to DTT multiplexes in locations where there are coverage overlaps. However, even if Ofcom protect only the coverage of the 'best' DTT transmission site (referred to as the Digital Preferred Service Area ('DPSA') in NGW's original study for 71 transmission sites), this would not necessarily increase the useable amount interleaved spectrum available for wireless microphones and IEMs post-DSO. While the 'non-preferred' DTT transmission sites are no longer protected in the DPSA protection option (in the overlap region), they still transmit RF and, depending on the power of the signal, have the potential to interfere with low-power PMSE applications.

If Ofcom are wrong about the implications of the DDR/DSO for PMSE but auction the cleared spectrum nonetheless, the consequences of this irreversible decision will be disastrous for the British Entertainment Industry. Therefore, Ofcom must hold back the cleared spectrum for PMSE use until it is proven in practice as well as theory[80] that the digital interleaved and channel 69 will be sufficient to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012. If the digital interleaved and channel 69 prove to be insufficient (we have demonstrated that they are), then more spectrum must be awarded to the band manager with PMSE obligations[81].

Unless Ofcom can prove[82] that the package to be awarded to the band manager will provide sufficient useable spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO, including the Olympics in 2012, PMSE users of the cleared spectrum should not be evicted.

Indeed, we have demonstrated in this document that, under current plans, the digital interleaved and channel 69 will NOT provide sufficient spectrum availability to cater for current and anticipated levels of PMSE demand post-DSO. Therefore, more UHF spectrum must be awarded to the band manager with PMSE obligations for use of wireless microphones and in-ear monitor systems post-DSO.

If Ofcom decides that there will be sufficient spectrum availability for the PMSE sector post-DSO and proceeds with release of the cleared spectrum regardless of BEIRG's concerns, we offer the following observations with regard to the current timetable:

Currently, the PMSE sector heavily depends on use of UHF channels 31-40 and 61-68 for the production of content across the UK. Under current plans, these channels will be unavailable for PMSE use after digital switchover (DSO) is complete. The digital switchover is taking place in a phased transition that commenced in Whitehaven last year and will be completed in London in 2012. Under current plans, PMSE access to these channels will be terminated on a piecemeal basis as each region switches to digital broadcasting. Ofcom has attempted to provide some security by allowing PMSE temporary access to channels 63-68 up until the point when new users 'need' access to the spectrum, with six months' eviction notice.

While we acknowledge and appreciate that Ofcom have heeded our concerns to a certain extent by proposing to extend temporary access from 6 to 12 months and include channels 31-40 as well as 63-68,a twelve-month transition period is still not long enough:

- it will not provide sufficient time for manufacturers to develop and produce the new

[79] In addition to channel 69 and part of the digital interleaved
[80] E.g. finalised white space maps based on modelling and practical testing, as carried out and formulated in conjunction with PMSE stakeholders
[81] This is assuming the PMSE sector is not 'migrated' from channel 69
[82] i.e. it has been proven in theory and in practice and PMSE stakeholders are convinced

equipment capable of operating in the digital interleaved;
- it will not provide users and rental companies sufficient time to assess their needs and re-tune, modify or replace their affected equipment and
- it is not enough time for users and rental companies to re-coup their investments in equipment, which typically has a life-cycle of 10 + years

As far as PMSE users and rental companies are concerned, a phased termination of PMSE access to the cleared spectrum will cause serious disruption, which would be in direct conflict with Ofcom's stated objectives with regard to the PMSE sector. For instance, it will result in touring theatre and live music shows having to use multiple sets of equipment as productions travel around the country due to the shortage of available channels and disparity in channel availability from region to region.

It is also doubtful that phased termination of PMSE access and phased availability of the cleared spectrum will be appropriate for the new operators of these bands. The new licensees will, in all probability, be intending to run their new services nationwide (telecommunications companies for example). As nationwide use of these bands will not be possible until London has switched over to digital broadcasting in 2012, it would have no value to evict PMSE users from the cleared spectrum until this date. Indeed, Ofcom recognise that 'it may be unlikely that they (potential providers of new services) will offer commercial services in the first 12 months after award' since 'this period may instead be used for further developing business plans and/or building infrastructure.'[83]

If PMSE users are evicted from currently available spectrum on a piecemeal basis, which is then not used for new consumer services until switchover is completed nationally (Ofcom does not favour any roll-out obligations), then there will be a significant period of time during which spectrum lies fallow when it could otherwise by used by the PMSE sector. This would undermine Ofcom's obligations to (1) further the interests of citizens and consumers and (2) promote the efficient use of spectrum as well as their stated objective of minimising disruption to the PMSE industry.

Ofcom's current timetable for release of the cleared spectrum also threatens the production and broadcasting of the 2012 Olympics and the UK-wide Cultural Olympiad in terms of both spectrum and equipment availability. Unless the 'cleared' spectrum currently used by the PMSE sector is retained UK-wide until after the Olympics, there will be insufficient spectrum and insufficient equipment availability to meet the immense demand for wireless applications at the London Games and the wider Cultural Olympiad. Indeed, the UK Government risks not fulfilling its commitments to the IOC with regard to providing spectrum. It is important to note that spectrum availability does not guarantee that it can be exploited by the appropriate equipment. If Ofcom does not ensure that equipment exists or can be viably manufactured to operate in the spectrum it provides, then merely providing the spectrum will not facilitate production and broadcasting of the Olympics.

There will be unprecedented demand for wireless microphones, IEMs and talkback at the London Olympics and across the UK in the run-up to the Games. The proliferation of wireless technology, the ever-expanding audience and locus of the time zone means that the London 2012 Olympics is likely to be the most globally-consumed live event ever. The suitability of GMT for live broadcast across the globe will heighten the demand for live feeds (relative to previous Olympics). The Cultural Olympiad will encompass numerous local and regional events focused at live sites across the UK. Normal PMSE demand will continue to increase even before production and broadcasting of the Olympics are taken into account. Under the current timetable for auction and release of the spectrum 'freed up' by the Digital Dividend, the PMSE sector will not have enough access to spectrum or equipment to meet these demands.

We would anticipate that the spectrum interleaved with the existing analogue television platforms alone would be insufficient to cater for the PMSE requirements of the Olympic Games. Therefore, as the digital interleaved is accepted to be smaller than the 'analogue' interleaved, we are concerned that it alone will be insufficient to cater for the PMSE requirements of the Olympics.

[83] 4.80

We believe that Ofcom has not sufficiently emphasised the fact that the 2012 Olympics and associated events, whilst concentrated in London, will be taking place across the UK and that spectrum will be required to cater for all of these events countrywide. The requirements for each venue must be assessed individually. For example, BEIRG is concerned that termination of PMSE access to the cleared spectrum as DSO takes place in the West Country region (2009) may compromise the ability to cover the sailing events in Portland[84]. It is risky to terminate PMSE access to the cleared spectrum on a regional basis when it will be required for the Cultural Olympiad, for which the precise requirements are, as yet, unknown.

In situations where spectrum is scarce and the risk of harmful interference is high, content producers usually carry spare sets of wireless equipment so they can migrate into other channels (ideally adjacent) when problems occur. The knock-on effects of this unplanned migration cause problems for users operating in these channels. The practicalities of content production in saturated spectrum mean that more bands must be allocated to wireless microphones and in-ear monitors than theory might suggest.

Therefore, in order to fulfill PMSE spectrum requirements for production and broadcasting of the Olympics and the UK-wide cultural Olympiad, we recommend that the PMSE sector retains access to the cleared spectrum on a nationwide basis until September 2012 at the very earliest.

Ofcom's current timetable may result in there being insufficient quantities of equipment available for the production and broadcasting of the Olympic Games;

1. The PMSE sector needs to have access to both the cleared spectrum and digital interleaved if it is to have sufficient spectrum to cover the Olympics
2. The PMSE sector needs to have sufficient quantities of equipment available that operates in both the cleared spectrum and digital interleaved if the spectrum provided is to be exploited

However, due to the phased release of the cleared spectrum across the UK and transition to digital broadcasting, there will not be sufficient quantities of useable PMSE equipment that operates in the cleared spectrum to cater for the production demands of the 2012 Olympics (even if Ofcom defer the start date of the rights to use the cleared spectrum in London until after the Olympics).

Under current plans, PMSE equipment that operates in the DDR cleared spectrum will be rendered redundant (and hence disposed of and replaced) or require expensive modification as the cleared spectrum is released region by region across the UK[85], culminating in London in 2012. However, the pool of PMSE equipment held for use in London[86] will alone be too small to cater for the requirements of the Olympics. Therefore, a large quantity of additional equipment, which is currently held for use in regions outside London, will be required. However, the additional equipment[87] currently held for use outside London is unlikely be available because it will have been rendered redundant (and disposed of and replaced)[88] or modified[89].

The size of the potential pool of equipment available for production of the Olympics will be reduced the earlier that PMSE users are prevented from operating in the cleared spectrum. Conversely, the longer Ofcom permit PMSE users to retain access to the cleared spectrum across the UK, the larger the potential pool of equipment will be. Therefore, Ofcom must allow the PMSE sector to

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[84] With regard to the nationwide celebration, Ofcom have stated that '*Many activities will be focused on some 60 live sites…in London and across the UK. These will operate throughout the four years of the Cultural Olympiad, increasing in number over that period in the run-up to 2012. They will have specific spectrum requirements for wireless microphones, point-to-point and satellite links and other wireless communications*'[84].

[85] In accordance with the DSO timetable subject to 6 months notice for PMSE users who will be evicted from the cleared spectrum in locations where DSO first takes place

[86] That operates in the cleared spectrum

[87] That operates in the cleared spectrum

[88] As dictated by the DSO timetable

[89] Modified to operate in the digital interleaved (not the cleared spectrum)

retain certainty of access to the entire cleared spectrum UK-wide until September 2012 at the earliest to ensure sufficient equipment availability for the production and broadcasting of the London Olympics.

The equipment availability problem will be exacerbated by the following;

1. LOCOG's technology freeze in 2010
2. The fact that it is still unknown which frequencies in the digital interleaved will be available for the PMSE sector at the time of the Games. Indeed, due to the timing of the second and third phase auctions of the geographical interleaved spectrum, it appears that the amount of interleaved spectrum auctioned and subsequently, what is left for PMSE, may not be fully realised until early 2010.

The required equipment cannot be made unless manufacturers know what spectrum will be available. If LOCOG's technology freeze functions as anticipated (i.e. no equipment can be used for production and broadcasting of the Olympics unless its performance is proven by the beginning of 2010) then little or no equipment that operates in the digital interleaved will be useable for the Olympics because it will not have been manufactured until after available frequencies in the digital interleaved have been established in 2010.

It might be argued that since Ofcom made the decision to allow temporary PMSE use of channels 63-68, with a notice period of six months, the PMSE sector would have access to the cleared spectrum outside London until after the 2012 Games. However, under Ofcom's current plans this would not be the case; they have only agreed to allow temporary PMSE use of channels 63-68 in the regions where DSO will take place before the end of 2009.

Ofcom have suggested they could acquire spectrum temporarily to solve the spectrum availability issue. However, even if Ofcom did so, the security of tenure for the PMSE sector in that newly-acquired spectrum would be of such a short duration that it would not be commercially viable to develop and manufacture the corresponding equipment (as it would become redundant as soon as the Games were over). Indeed, in relation to the cleared spectrum, Ofcom have stated that 'if licensees are to have a reasonable prospect of earning a commercial return on their investments they will therefore need a reasonable degree of certainty that they will be able to continue offering service through to around 2027'[90]. The same issue of commercial viability applies to the PMSE sector.

Taking DSO as a fact and the PMSE transition from accessing 'analogue' interleaved to 'digital' interleaved, the PMSE sector must retain access to the cleared spectrum across the UK to retain the biggest pool of equipment available for the 2012 Olympics.

Ofcom is monitoring developments on a European level. Point 4.72 of the consultation document indicates that CEPT[91]'s work on the 790-862 band is expected to produce guidance that is non-mandatory, in accordance with its mandate. BEIRG notes that it is possible that CEPT's guidance will become mandatory. This provides little assurance to the PMSE sector that they have security of tenure within channel 69. It therefore seems premature to auction the UHF spectrum between 790 and 854 MHz until there is a firm agreement on this issue.

Question 6 – temporary PMSE access to the cleared spectrum

Most of BEIRG's response to this question is encompassed within our response to question 5: 'the timetable'.

For the reasons outlined above, we believe that nationwide PMSE temporary access to channels 61-68 must be extended from 6 months until at least after the Olympic Games in 2012. The period of temporary access must also apply to channels 31-40.

[90] 6.56
[91] European Conference for Post and Telecommunications

1. This will provide time for manufacturers to develop and produce the new equipment capable of making most efficient use of the digital interleaved (but only if the PMSE sector has security of tenure and there is certainty as to precisely which frequencies will be available in the digital interleaved[92])
2. This will provide users and rental companies time to assess their needs and plan the modification and replacement of their equipment
3. This will provide more time for users and rental companies to re-coup their investments in existing equipment that will become redundant or require extensive modification.
4. This will delay the time when touring productions will be forced to swap equipment as they move around the UK[93]
5. This will prevent the cleared spectrum from being left fallow, which would occur if new licensees of the cleared spectrum delayed rolling out their services until the spectrum is available on a nationwide basis[94]
6. This will help to ensure that there is sufficient spectrum and sufficient equipment to cater for the PMSE requirements of the London 2012 Olympics

There also appears to be some ambiguity with regard to Ofcom's approach to channel 36; while Ofcom are seeking views on whether to extend temporary PMSE access for six months and include channels 31-40, section 4.57 of the consultation document states '*that Channel 36 will be available for new use immediately after the award of the DDR spectrum in Summer 2009*'. It is BEIRG's view that any extension of temporary access to the cleared spectrum should apply to channels 31-40 inclusive; channel 36 is used extensively on a geographical basis for professional PMSE productions.

BEIRG notes that, in section 4.8 of the consultation document, Ofcom state that the '*pattern of interleaved spectrum use **may** be more complicated for some PMSE users after DSO, with a potential need to purchase equipment beyond just like-for-like replacements to access new frequencies*'. This is wrong. As we have demonstrated in this document, the pattern of available interleaved spectrum **will** be vastly more complicated for all professional PMSE users post-DSO. As stated above, the vast majority of PMSE equipment currently in the marketplace (with a value in excess of £30 million) will be rendered redundant or require significant modification

Question 7 - deferring the start date for rights to use the cleared spectrum in London until after the Olympics

For the reasons outlined above, we believe that Ofcom should defer the start date for rights to use the cleared spectrum across the UK (i.e. not just in London) until after the Olympics

Protection of existing DTT

As sections 5.64 and 5.65 state, the UK Planning Model (UKPM) predicts that the six multiplexes currently cover around 73% of UK households from 80 transmission sites. Following the commercial multiplex operators' indication that they will adopt the maximum power possible at these sites at switchover, JPP 'optimised the UK switchover plan to implement this'. It is now '**currently** expected' that the six multiplexes will collectively cover just over 90% of UK households following switchover.

[92] PMSE devices are not developed in case spectrum becomes available, but rather when sufficient spectrum, in terms of both quantity and quality, is definitely available for a significant period of time. Without guarantees of security of tenure in desirable areas of spectrum, the corresponding equipment will not be developed. The PMSE sector requires certainty in order for expensive new developments to make economic sense and duration of guaranteed access for the PMSE sector should match that of the new licensees of the cleared spectrum.

[93] If the cleared spectrum is released on a piecemeal basis, touring companies will be forced to swap equipment as they pass into areas which are due to release the cleared spectrum before 2012. However, even if the cleared spectrum is released on a nationwide basis when DSO is complete across the UK, touring companies will be forced to swap equipment when they start to access the more fragmented digital interleaved spectrum

[94] Thus ensuring that services are guaranteed to citizens and consumers and the spectrum is used efficiently, in accordance with Ofcom's statutory duties

These sections of the consultation document illustrate a major problem with the DDR/DSO process: there is much uncertainty involved; decisions are based on theory rather than practice. As a consequence, it is impossible for Ofcom and PMSE users to know for certain which frequencies will be available for PMSE post-DSO. It would be reasonable to conclude that as a consequence of the commercial multiplex operators' decision to adopt maximum power at these sites at switchover, the useable interleaved spectrum available for PMSE post-DSO will be further reduced.

Question 12 – protecting existing users of adjacent spectrum who could be affected by harmful interference by new licensees

We agree that PMSE users in channel 69 could be affected by harmful interference from new users in adjacent spectrum (i.e. channel 68). However, Ofcom should also note that PMSE users operating in interleaved channels adjacent to new licensees could also be susceptible to harmful interference (indeed, wireless microphones and IEMs are more susceptible to interference since they operate at a lower power).

We agree that the best way to finalise the protection clause approach and to address the practical implementation issues is through direct engagement with interested stakeholders. Of course, Ofcom should engage with users and manufacturers of wireless microphones and IEMs, of whom BEIRG is the primary representative association. It is essential that substantial testing of how PMSE applications interact with the DTT multiplex broadcasts is undertaken, in conjunction with PMSE stakeholders, in the first major region to switch over. Only when practical tests in live performance conditions are carried out will it become clear whether the digital interleaved will be sufficient to fulfill current and anticipated PMSE spectrum demand post-DSO. Whilst comprehensive testing is carried out by Ofcom and PMSE stakeholders and the implications of DSO remain unclear, the PMSE sector must retain access to the cleared spectrum on a nationwide basis. Indeed, as further work is required to determine protection of DTT broadcasts, further work is required to determine the impact of the entire DSO/DDR process on the PMSE industry.

Question 26 - Ofcom's preference for UK-wide licences

We believe that Ofcom's preference for auctioning UK-wide spectrum rights is inconsistent with releasing the spectrum for use on a regional basis.

Ofcom have stated that '*in analysis of potential uses of the cleared spectrum undertaken for the first DDR Consultation in December 2006, stakeholders expressed a clear preference in accessing spectrum with UK-wide coverage and very limited interest in spectrum with a smaller coverage. In our latest stakeholder research, stakeholders again expressed their preference for being able to offer UK-wide services*.' If Ofcom's research is correct and potential new licensees want UK-wide and not regional coverage, then there is no logic in evicting PMSE users from the cleared spectrum until DSO is complete across the UK.

Ofcom's research underpins our concerns that spectrum may be left fallow if the PMSE sector is evicted and not replaced with new services for citizens and consumers until 2012.