



OFCOM: DIGITAL DIVIDEND REVIEW BECTU'S COMMENTS

1. The Broadcasting, Entertainment, Cinematograph, and Theatre, Union represents over 27,000 members working in the UK, who are engaged across a sector that embraces film, TV, and radio, production and distribution, as well as live theatre and arena events. Many of them come into daily contact with wireless devices grouped into the licensed Programme-Making and Special Event category (PMSE), and a significant proportion of specialist practitioners in the field of radio microphones are members. We also represent members involved in the coding, multiplexing, and transmission, of Digital Terrestrial Television (DTT) on the Freeview platform.
2. BECTU members working in the TV transmission sector, specifically Arqiva and National Grid Wireless, also have a vested interest in the future of the UHF spectrum, since the masts they operate are likely to play a key role in providing any new services that may be licensed.
3. Our response to Ofcom's Digital Dividend Review focuses on three issues related to use of UHF spectrum in the UK after the Digital Switch-Over (DSO) of terrestrial TV broadcasting takes place between 2008 and 2012.

These are:

- the adequate provision of spectrum for PMSE activities after the changes;
- the future of High Definition (HD) television transmissions on the free-to-air Freeview system;
- and the degree to which we believe that the regulator, and government, should devise interventionist proposals for allocation of freed-up spectrum to specific users.

PMSE - RADIO MICROPHONES AND OTHER DEVICES.

4. At the outset, it is worth emphasising that BECTU associates itself fully with the well-argued submission to Ofcom from the PMSE Pro User Group, and confirms that this document represents a solid consensus on radio microphones across the entire entertainment and broadcasting industry, uniting suppliers, employers, freelance practitioners, and trade unions.
5. Wireless devices have become ubiquitous in the entertainment, broadcasting, and film-making, industries. Cable-free devices are commonplace, and will be found from the stages of West End theatres, through film and TV productions, whether on location or studio-based, all the way to TV news reports of train crashes in Cumbria. The ability of performers, contributors, presenters, and

on-screen journalists, to move freely while still being audible through radio microphones, and able to listen to talkback and foldback through wireless in-ear monitoring, has been taken for granted for many years.

6. Creative workers in the sector who are responsible for the look and feel of UK broadcasting, film, and entertainment, have taken advantage of this technology to turn their industry into a world leader. Stage musicals, for example, have been transformed into dynamic spectacles of sound and movement, which, arguably, have put the UK performance industry ahead of Broadway, and other world entertainment centres. Leading producers and impresarios have already warned that limits on use of radio devices would deter them from scripting, developing, casting, and producing stage shows in the UK.
7. In film production, our craft members in sound design, mixing, and dubbing, have maintained the UK's position as an envied centre of excellence by becoming leaders in the art of Dolby 5.1 surround-sound, the new standard for cinema and High Definition TV productions, which depends on close-mic-ing of every speaking artiste, invariably with radio devices, to allow the creation of a three-dimensional sound field in post production. The sector is heavily dependent on inward investment from the major US production companies, and the insuperable difficulties of shooting for Dolby 5.1 release without radio microphones could, for many of them, be a deciding factor in moving their activities to Eastern Europe, which is already diverting production investment from the UK due to wage differentials.
8. TV productions, live and recorded, have become intense users of radio devices, with the grandeur, spectacle, and simple practicality, of many programmes depending entirely on radio microphones, and radio talkback or monitoring. The production techniques for most current household favourites in the genres of entertainment, sport, events, factual programming, and drama, will need to be fully-revamped if sound technicians are unable to use dozens, or even hundreds, of radio PMSE devices simultaneously. In terms of look and feel, some productions would be impossible to mount, including many programmes whose formats have been sold abroad to other broadcasters, posing the risk that concept development would move out of the UK, undermining the nation's position as a major exporter in this field.
9. Sound operators, hire companies, theatres, and broadcasters, currently hold large inventories of radio equipment, much of which will need to be replaced if the DDR proposals are implemented unamended. It is not uncommon for individual freelance sound operators to own radio devices worth up to £10,000, a major capital cost for a lone trader.
10. The extent to which these industries make use of licensed spectrum, both in UHF Channel 69, and the interleave "white space" in the rest of the band is often underestimated. At the extremes, major events like the BBC's "Comic Relief", or concerts like "Live8" can take up over 100 spot frequencies, for radio mics, monitoring, and talkback, and the forthcoming London 2012 Olympics is expected to use even more. This intense use of radio equipment and frequencies is compounded at major programme production sites such as

BBC Television Centre, The London Studios, or Granada's Manchester complex, for instance, where several major shows may be recording, rehearsing or broadcasting live at the same time. If each of the eight major studios at TVC were working simultaneously, the requirement for individual radio channels could easily top 400 when mics, in-ear monitoring and talkback requirements are totalled. This figure would be in addition to anyone using Channel 69 – such as a News team covering the Children In Need broadcast.

11. A typical West End or touring stage musical can use up to 50 spot UHF frequencies, and in film production, where operators tend to use Channel 69 more than the interleave space, it is common for separate sound stages in major centres like Pinewood to arrange protocols between themselves which enable the 8 or maximum 10 frequencies that can be squeezed into one 8Mhz slot to be passed around during the course of the day to prevent interference.
12. Taking account of the day-to-day use of PMSE devices, BECTU believes that the DDR proposal for radio devices in the broadcast and entertainment sector is unworkable, namely the loss of access to 14 channels during DSO, and the prospective loss of the remaining 32 after 2012. Empirical evidence from our members, many of whom are specialist practitioners in use of radio microphones and other wireless devices, indicates that Channel 69, if allocated as the sole area of spectrum for their activities, will be woefully insufficient to meet the demands of modern programme-makers and directors.
13. Although Channel 69 currently allows 14 discrete spot frequencies for PMSE use, operators cannot make simultaneous use of more than 8-10 in a single location. The frequencies they choose to use in a given location, whether on Channel 69 or other 8Mhz interleave channels, need to be spaced across the available 8Mhz in order to avoid interference from adjacent channel activity (comprising the other radio devices on-site, and neighbouring analogue and DTT transmitters), intermodulation products caused by the operation of multiple low-power transmitters in close proximity, and second-image interference to super-heterodyne receivers.
14. Co-channel interference between devices operating on the same spot frequency, currently only a minor problem (except on Channel 69 which frequently suffers the presence of non-professional users), would also become a significant issue if larger production centres, and public or sporting events, were limited to a single 8Mhz band (as per the Pinewood problem in paragraph 8). This form of interference is obviated under present arrangements thanks to the wide availability of separate frequencies, even in instances where intense use of radio devices is made, and is also minimised by the management and policing of PMSE spectrum by JFMG.
15. Ideally, practitioners in the PMSE sector would prefer to retain as much as possible of the interleave spectrum that will exist after DSO, and would also prefer that present arrangements for Channel 69 should not be changed. At the very least BECTU would support the broad coalition within the industry,

which is calling for a contiguous portion of spectrum covering UHF channels 67, 68, and 69, to be dedicated to professional PSME usage.

16. BECTU also believes that low-power professional use of channels 36 and 38 should continue for as long as they remain dedicated to aviation radar and radio astronomy, subject to the current restrictions.
17. Even if these five channels were made available to the PMSE sector, BECTU's members working in the field predict that the resulting lack of spectrum will severely inhibit their activities, particularly in situations where multiple devices are deployed in single locations to meet the needs of the modern entertainment and broadcasting industries.
18. Our members have pointed out the shortcomings of two potential technical developments, which, in some quarters, have been mooted as solutions to a severe reduction in bandwidth for PMSE, namely digital radio mics and allocation of spectrum at higher frequencies than UHF.
19. Compared to analogue equipment currently in use, digital radio mics are in their infancy, and any claims that they will solve problems of interference at a stroke, and therefore allow more intense use of available spectrum, are largely untested. Very few models have been released into the UK market, and it is already clear the technology needs further development before it will provide an affordable solution to audio professionals. Current equipment does not offer a full audio frequency response, cutting off at 15Khz, instead of the 20Khz of analogue devices, and taking account of the 200Khz bandwidth needed by digital radio mics using 16QAM modulation, it is not possible to accommodate more of them in each 8Mhz UHF channel than the analogue devices they are intended to replace. They will therefore not solve the problems caused by a significant reduction in the spectrum available to PMSE users.
20. Another aspect of the technology that needs further development is the modulation system. The current, early, generation of digital radio mics use single-carrier 16QAM modulation, which works well in static situations, but is prone to error and failure when there is movement between the transmitter and receiving point – a common situation in PMSE applications. Manufacturers and suppliers are still exploring whether, for example, Phase Shift Keying modulation on FM carriers might be more robust, and until these technical issues are definitively resolved, practitioners and hire companies are reluctant to invest significant sums in re-equipping.
21. It is significant that no European manufacturer has yet offered digital versions of their analogue radio mics, in part because of the technical uncertainties, and take-up among prospective purchasers has been very limited.
22. Another problem with digital radio mics highlighted by our members is the issue of latency – the audio delay inherent in digital signal processing. The limited range of digital mics currently are right at the top of the price range, and until the chipsets which are likely to appear lower down the price band

improve with further development, this delay, if longer than 10-20 milliseconds, will cause difficulty in many situations where, for example, digital microphones are being mixed live alongside cabled mics, or at events like concerts where foldback monitoring is in use. Musicians cannot cope with noticeable delays in their foldback, a problem that will be exacerbated if their in-ear monitoring is also digital, and on live broadcasts inaccurate lip synchronisation would be apparent to viewers.

23. The other mooted technical solution, allocation of microwave spectrum to the PMSE sector, has caused serious health and safety concern among operators and performers. In the entertainment and broadcasting environments, radio devices are, by their nature, operated in close proximity to the bodies of those who are fitted with concealed radio mics and talkback sets. There is no body of research into the scale of any radiation hazard that would be presented to performers by transmitters operating at frequencies which are significantly above the UHF band, and, notably, higher than the bands used for GSM and 3G mobile telephones, which have at least been subject to some analysis of health risks. Without adequate scientific assurances about the safety of higher frequencies, practitioners will continue to view the use of channels above the UHF area with great concern.
24. Although spectrum is assigned across Europe for higher-frequency radio mics, from 1.785 Ghz to 1.8Ghz, it is worth noting that no equipment for use in this band has been produced due to exactly these concerns about non-ionising radiation.
25. On another health and safety note, concerns have also been expressed about the predictable consequence of the number of radio mic frequencies being curtailed - namely the reappearance of cabled microphones at many entertainment events. One of the incidental benefits of radio microphones has been the elimination of electrical shocks caused to performers by cable connectors and metal microphone stands. While using radio mics, performers have no direct electrical connection to any mains-powered equipment and are immune to electrocution through that route.
26. Although electrical safety standards have generally improved at venues and ad hoc locations, and the technical staff involved try to work to the highest standards, the risk of electrocution is always present, for example due to equipment faults or irregularities in local power supplies or generators. Performers and sound operators alike feel much more secure using radio mics, and would deeply regret any future incidents caused by the enforced use of cabled, rather than radio, microphones. Cabled microphones also present a significant trip hazard, both to artistes and back-stage or behind-camera staff, not matter how much care is taken over rigging.
27. Whatever the eventual allocation of spectrum to the PMSE sector, BECTU believes that it should continue to be managed on behalf of professional users by a central authority issuing licences and coordinating frequency usage on the current model. In our view it is highly unlikely that PMSE users themselves

could create a vehicle to bid for, and then operate, part of the spectrum. The sector is extremely diverse, encompasses thousands of individual, often freelance, operators, and includes a number of organisations like broadcasters who are in direct competition with each other.

28. Equally, the prospect of a commercial third-party devising a bid for spectrum with the intention of selling licences for PMSE usage is as alarming as it is implausible. The potentially-high transaction costs which OFCOM has correctly identified would be a serious deterrent to any profit-led bidder, and even if interest were still shown, there is great concern about a situation where a single owner would commercially let frequencies without a detailed regulatory framework which takes account of the social value of PMSE activity, imposes price controls on the monopoly provider, and provides an objective mechanism for resolution of disputes.
29. Taking together BECTU's serious concerns about the future of PMSE spectrum, we believe that:
 1. PMSE users should continue to have access to dedicated UHF bandwidth, preferably on a scale similar to the interleave space available now;
 2. Channel 69 should remain a licence-operated band restricted to professional users;
 3. At the very least Channel 69 should be supplemented by channels 67 and 68, plus 36 and 38 for low-power use;
 4. Any allocation of spectrum for PMSE use should be centrally-regulated, and not subject to the proposed auction;
 5. Consultation should be continued beyond March 20 to allow detailed discussion on the future of PMSE radio usage;
 6. Interleave space should continue to be available to PMSE users beyond digital switchover.

HIGH DEFINITION TELEVISION

30. BECTU believes that more emphasis should be put on use of the freed-up UHF channels for HD TV services on the free-to-air DTT platform Freeview. We do not accept that this use of spectrum can be dismissed on the basis of just one survey, as implied in the consultation document.
31. Since its inception, TV broadcasting in the UK has been based on the concept of public service channels being universally available (as far as practicable) and free-to-air. If, as we believe is likely, the general public gradually migrates across to HD receivers over the coming years, the only free-to-air platform, Freeview, will eventually become a poor relation of cable and satellite if it offers no HD services. It would risk becoming a diminished Standard Definition reception system for households, which cannot afford subscriptions to other distribution platforms.
32. We note that BSkyB currently offers a number of services clear-to-air via its Astra transponders, to viewers who are prepared to go to the trouble of buying their own receivers. However, the company is under no obligation to do so,

provided the “must carry” channels appear in all packages on offer to subscription payers.

33. Recent experience of BSkyB’s dispute with Virgin suggests that the company has little compunction in withdrawing services to selected viewers when dictated by the company’s commercial interest, and we conclude therefore that Freeview is the only platform that can be relied on to provide continuing free-to-air HD broadcasts in future.
34. Given this background, we believe that spectrum planning should be conducted now to allow public-service broadcasters to offer a worthwhile HD proposition to viewers, and that any required bandwidth should not be subject to auction. It should instead be gifted to the Freeview operators, subject to any appropriate obligations concerning the services they carry. Any outcome of the DDR which falls short of this will fundamentally undermine the Freeview platform, since it is likely that the viewers’ perceptions of HD versus SD will be similar to the difference between colour TV and black and white. The number of monochrome licences issued nowadays is negligible.
35. Digital switchover will provide at least some extra – virtual – bandwidth when transmitter power levels are boosted, and the three “public service” multiplexers are switched back to 64QAM modulation, which was abandoned when ITV Digital collapsed to improve coverage.
36. We are advised that this change will offer multiplex operators the opportunity to use bit rates, per Mux, which will typically be between 14.93 Mbit/s, with maximum guard interval of $\frac{1}{4}$, and a code rate of $\frac{1}{2}$, and the theoretical maximum of 31.67 Mbits/s with a $\frac{1}{32}$ guard interval and Forward Error Correction of $\frac{7}{8}$. However, bitrates at the higher end of this range are likely to lead to reductions in coverage, and the same problems of impulsive interference that dogged ITV Digital. After compromises are made, practicable bitrates are likely to be well below 30 Mbits/s.
37. Another technical adjustment that will be possible after DSO is an increase in the number of carriers on each 8Mhz channel from 2,000 to 8,000 (DVB-T 8k), which theoretically provides an increase in throughput. However, the bitrate improvement from this change is expected to be cancelled out completely by the increased level of Forward Error Correction that will be required to maintain coverage.
38. Recent trials of HD from Crystal Palace transmitter using MPEG4 encoding have been conducted at bitrates between 17.0 and 19.5Mbits/s for 1080i pictures and from 14.3 to 19.5Mbits/s for 720p material. Experience of the trials indicated that bitrates in these ranges were the minimum feasible for HD broadcasts. Lower bitrates are prone to picture degradations like pixellation and lag, and some practitioners have recommended that, for material containing fast movement like sports events, it would be preferable to run at bitrates above 20Mbits/s.

39. Comparing the desired bit rates for HD transmissions on Freeview with the capacity likely to be available after DSO, it is clear that the existing six multiplexers, with their theoretical maximum of 31.67Mbits/s each (on a good day as our engineering members have pointed out) will offer limited scope for High Definition services, with each Mux realistically able to offer only two channels.
40. This will obviously constrain the number of HD channels on offer from Freeview across all its Muxes, given the number of SD services currently on the platform, and we believe that such limited availability of High Definition channels will inhibit domestic investment in the MPEG4 set-top boxes that will be needed, as opposed to the MPEG2 STBs currently being rolled out, which are not HD-capable.
41. Thus, it is essential that more spectrum is allocated to DTT, and an early, unequivocal, commitment to HD services, both by Ofcom and the broadcasters, may provide an incentive for manufacturers to offer STBs with MPEG4 chipsets during the process of DSO, instead of creating a situation after 2012 where viewers discover that the boxes they have recently acquired at some cost will need to be upgraded in order to receive High Definition services.
42. HD services on Freeview will also encourage the public-service broadcasters, who are major producers of new-make TV product, to make the necessary investment in acquisition, and post-production, of programmes in HD. This is essential to maintain the UK's position as a leading producer and exporter of audio-visual products, and will also preserve a high quality skillsbase in the industry.
43. BECTU fears that without extra capacity for HD services, the Freeview platform will eventually be unviable, both commercially, and also for public service broadcasters once a significant portion of their audience has been forced to migrate to subscription cable or satellite. Continued operation of the DTT network will be hard to justify if it ends up serving only a small minority of households, and a seventy year tradition of public service broadcasting will end as TV becomes available only through subscription services.
44. Gifting spectrum for HD TV may not significantly deplete the number of channels available for auction if research currently being conducted into the creation of a Single Frequency Network for Freeview bears fruit, and it may be prudent to await the outcome of this work before making a final decision on channel allocation. This should not, however, delay the announcement of a firm commitment to HD by the broadcasters and Ofcom, which is necessary to obviate later confusion in households that are already struggling to understand the implications of DSO.

THE AUCTION PROCESS

45. As will be clear from the above, BECTU is of the view that two essential uses of UHF spectrum, radio microphones, and HD television services, are of such significant public value that they should not be included in any auction process. Further planning work is needed to identify exactly how much spectrum will be required for these applications, and BECTU believes that the proposed auction timetable should be put into abeyance while further consultation is conducted.

46. Given the social importance of these two aspects of DDR that we are most concerned about, we recommend that it is entirely appropriate that Ofcom should eschew a market-led process of spectrum allocation, and adopt a robust interventionist stance.