

# ITC Response to “Digital Television: The Principles for Spectrum Planning”

9 April 2002

## **Summary of main points**

### **The basis for planning**

1. The starting assumption in the Government’s consultation on the principles for spectrum planning of digital terrestrial television (DTT) is that, after switchover, it should continue to be based around at least six DTT multiplexes and that, of these, at least two should be available for public service broadcasting. The ITC supports this assumption. The current multiplex allocation should continue to be available – whether to maximise the range of services available or to optimise reception – as a firm planning parameter for operators.
2. Reducing the number of multiplexes would reduce the range of services that could be made available to viewers via DTT, or constrain the ability of operators to improve reception by employing more rugged variants of the transmission specification with reduced multiplex capacity. Either of these could significantly slow down take up. Also, the reaping of any potential spectrum clearance benefits deriving from a reduction in the six multiplex plan would require a radical re-planning of the spectrum with large consequential costs and disruption in terms of set re-tuning, new domestic aerials etc, merely for viewers to continue to receive the reduced DTT offering.
3. Digital switchover will be an inherently complex operation. Like any major transition (e.g. the switch to North Sea Gas in the 1960s and 70s) there is a premium on minimising inconvenience and expense to the public. That premium will be an important factor in weighing the costs and benefits of the different options.

### **PSB Coverage Post-Switchover**

4. The ITC believes that planning should be based on the aim of sustaining at least 95 per cent terrestrial coverage for the PSB services after switchover. In practice, this means adopting “analogue conversions”<sup>1</sup>, which are predicted to be able to increase coverage to 94.5 per cent using only the current 80 DTT transmission sites. If the number of sites is increased to 120, the coverage rises to 96 per cent and a coverage which fully matches analogue (99.4 per cent) can be provided if all 1100 sites are employed.

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<sup>1</sup> An analogue conversion is where a DTT multiplex carrying PSB services takes over a vacated analogue frequency assignment at switchover. This gives improved coverage and excellent reception compatibility and also fits in well with plans for clearing contiguous blocks of spectrum for other uses.

5. This would be one way of ensuring the reception of appropriate PSB services for all UK homes that can currently receive them in analogue. However, it is not necessarily the most cost-effective means. The extra investment needed to roll out DTT on switchover from 80 to 1100 sites is expected to be around £50 million per multiplex. The extent to which it would be more cost-effective to rely on satellite coverage instead for the last few per cent of homes (balancing the extra transmitter costs of DTT against receiver and ongoing conditional access costs for a DSat solution) will depend on a cost benefit analysis nearer the time. It is not possible to know at this stage which way this analysis would go, since we do not have accurate information on how many homes will be affected or on future costs.

6. Thankfully the issue at stake in this consultation – i.e. how much spectrum will be required for PSB delivery after switchover – does not depend on the outcome of this cost benefit analysis, since the “break point” in spectrum requirement terms is 95 per cent coverage. Beyond this, any extension towards universality (99.4 per cent) for DTT can be judged on its cost effectiveness without introducing any extra spectrum demands.

7. Prior to switchover, however, power and interference constraints mean that it would not be feasible to seek to replicate anywhere near the full analogue transmission network in digital. Indeed, the most cost-effective solution prior to switchover is probably to extend the current 80 sites by a further 10-15 sites which represent the best value for money per additional user covered. That is likely to lead to a population coverage by the public service multiplexes of 83-85 per cent (after completion of the current equalisation plan) rising to 95 per cent after switchover on the basis of analogue conversion.

8. The PSBs will need to commit firmly now to invest in these analogue conversions and then to roll out coverage up to or beyond the 95 per cent level. Achieving these coverage levels also requires that switchover be a rolling process so that new digital sites can be switched on, area by area, as the analogue transmitters are shut down.

9. However far DTT coverage is extended, other platforms, notably satellite and cable, will continue to have an important role as pay TV platforms of choice for many viewers and will, post switchover, add marginally to population coverage in areas which the enlarged DTT network does not reach. But the geographic limitations of cable, and the planning and line of sight constraints and ongoing conditional access costs for satellite make them less appropriate than DTT to be the main contributor to ‘universal access’ after switchover. Added to this is the unique role that DTT will play in serving second and third TV sets that are often reliant on set-top aerials.

10. The White Paper ‘*A new future for communications*’ recognised the need to reflect new forms of delivery of public service broadcasting. Subsequent work on the draft Communications Bill is developing the necessary statutory underpinning. The fundamental public policy ‘deal’ remains the same: a body undertakes certain public service obligations in return for privileged access to spectrum, guaranteed carriage on

other platforms and ‘due prominence’ in electronic programme guides. The Government will want the flexibility to provide for new forms of public service (whether this involves extra channels, interactive enhancements to current channels, or both) on this basis. That means either reserving additional spectrum for such use (which has an opportunity cost against other uses of the spectrum) or taking the necessary powers to re-allocate flexibly capacity from within the existing DTT spectrum, where that ‘gifted’ capacity is not being used by an existing public service broadcaster for the purposes for which the original allocation was made. The former can be done within existing powers (although as noted above at an opportunity cost); the latter would require modest change in the Communications Bill to give the Government that flexibility. The ITC believes this flexibility to be worth having so that digital television can improve services to the viewer both through market based choice and access to a wider range of public services.

### **‘Safe’ versus ‘radical’ re-planning**

11. The core aim of future spectrum planning for the 470-862 MHz Band is to get to switchover. A necessary switchover precondition is for a robust signal with high population coverage. A ‘safe’ planning assumption (i.e. 12 or 14 channel release for other uses at switchover) would allow for two or three analogue conversions and hence terrestrial coverage for the PSB services post-switchover of 95 per cent plus. This option would also allow for the limited deployment now of ‘mini-multiplexes’. These could be used either:

- to add new services; or
- to increase coverage/signal robustness.

The ITC believes that the priority is to increase DTT signal robustness in areas already covered; with coverage increases as a secondary objective. New services, although desirable, come further down the list: theoretical availability of services is of little benefit to viewers who cannot get an adequate signal.

12. The trade-off for Government is a ‘radical’ plan offering the possible release of more spectrum (20 channels) but lower terrestrial coverage for the PSB services after switchover and a lower probability of getting to switchover; or a ‘safe’ plan which offers less spectrum (12 or 14 channels) but a higher probability of getting to switchover and thus being able to release them.

13. Both costs and benefits of different planning strategies must, at this stage be subject to wide margins of error. But orders of magnitude can be offered:

- A ‘safe’ planning scenario – releasing 14 channels (29-35, 37, 63-68) would be likely to involve conversion costs of £275m (£220m to broadcasters, £55m to viewers).

- A ‘radical’ scenario – releasing 20 channels (35, 37, 51-68) would be likely to involve conversion costs of at least<sup>2</sup> £815m (£350m to broadcasters, £465m to viewers).

Included as conversion costs here are those for the broadcasters in changing transmission frequencies to clear spectrum for other uses and for viewers in replacing aerials in order to receive DTT after switchover. We have not included for this purpose the costs of buying and installing receivers for converting the final “rump” of households to digital. However, in this respect also the radical scenario would be more costly than a safe scenario since its lower DTT coverage would result in fewer homes being able to adopt a free-to-air “digital adapter” solution. For example, on the basis of 66 per cent digital penetration by 2006, these receiver costs might range<sup>3</sup> from £475m to £2880m for a safe scenario to £560m to £3460m for the radical scenario.

14. The clearest estimate of benefits lies in channels 63-68. Frequencies in this range are being used in Germany for mobile digital broadcast services and internationally they are the channels most readily able to be redeployed for 3G mobile use. Values for this use will depend upon market conditions at the time. Two measures can be used:

- (i) The £150m per MHz realised in the UK and German 3G auctions.
- (ii) The more conservative £20m per MHz realised in other continental auctions in 2001 (ie, between the top of the market and its current trough).

The value of these six channels alone ranges from £7 billion under (i) to £1 billion under (ii).

15. It is not clear at this stage whether there will be sufficient demand for these channels to generate values at the high end, since the ITU identified in 2000 over 450MHz of extra spectrum for 3G development over the next 10 years without needing to encroach on these broadcast channels. Furthermore the mobile industry is showing more interest in developments involving higher frequencies than these, which allow smaller antennas and smaller cell sizes. This underscores the need to wait until nearer the time before being able to judge spectrum market values with any precision. In the meantime, an independent study carried out for the ITC, described in more detail in the confidential Technical appendix, adopts the £20m per MHz figure in its modelling.

16. The timing of international clearance for re-use of channels 51-62 is more uncertain. Their re-use is likely to require the UK to await digital switchover in all neighbouring countries and international clearance, and so it could be many years

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<sup>2</sup> We have assumed here that a radical frequency re-plan is feasible without having to adopt a new network of transmitter sites. This is unproven, and if incorrect the costs would be much higher.

<sup>3</sup> The lower figures assume a halving of receiver costs from current prices and one receiver per household. The higher figures assume today’s prices and the national average of four receivers per household.

after UK switchover before they could be re-used. This will substantially reduce their NPV.

17. The ITC's conclusion therefore is that the 'safe' planning option has much to commend it:

- The costs and disruption for viewers of transition are much lower.
- The probability of achieving switchover and releasing spectrum is higher.

Even on 'conservative' assumptions about the value of the spectrum released at switchover, the benefits substantially outweigh the conversion costs (leaving receivers out of the equation).

### **Local Television**

18. The Government's consultation asks whether long-term spectrum tenancy should be made available for local television services.

19. There is no doubt that the current Restricted Service Licensees have felt disadvantaged by their relatively short-term tenancy of spectrum. If viable community/business models can evolve, local TV could add significantly to the public good for local communities and the reach of public services and information to parts of the population who would not otherwise have access to the Internet or Broadband. This is ultimately a public policy decision for Ministers and Parliament, against other potential uses for the spectrum.

20. Were Government minded to go down this route, the logical channels to allocate to local television, post-switchover, would be channel 35 and/or channel 37, currently occupied by Channel 5. These are the channels likely to have the lowest alternative re-use value since they do not form part of a large contiguous block of spectrum.

## **Detailed Responses to Questions**

*Q1. Our working assumption is that planning will continue for six multiplexes, as today. However we would also be interested in views on the costs and benefits of a more radical re-planning. This could be either reducing or increasing the number of multiplexes by one. Do you have views on this?*

1. The ITC agrees with this working assumption.
2. In theory, using the assumptions employed in the consultation, one fewer multiplexes would require five<sup>4</sup> fewer frequency channels to be dedicated to DTT after switchover. This implies that five more channels (i.e. an additional 40 MHz) might be able to be released at switchover. However, in order to realise such a benefit there would need to be a radical re-planning of the remaining five multiplexes to squeeze them into even fewer frequency channels. From the viewers' perspective, this would give rise to large consequential costs and disruption in terms of set re-tuning, new domestic aerials etc, merely for viewers to continue to receive the reduced DTT offering.
3. However, there could be further cost implications of reducing the number of multiplexes. With fewer multiplexes the DTT platform would be more constrained in its ability to provide viewers with a wide variety of services (whether free-to-view or pay programming or interactive support). This could slow down digital take-up and thus delay switchover – or for a fixed switchover date imply a lower digital penetration.
4. Considering a possible increase in the number of multiplexes is on the other hand something that should be pursued, within the constraints of Government decisions on spectrum clearance. Given the limited capacity and coverage of DTT, the planning of more multiplexes would be worthwhile where possible in order to help drive take-up of digital TV and thus accelerate switchover.
5. One option for the use of additional multiplexes before switchover would be to provide more services, another would be to enable an improvement in reception. As an example of this second option, the use of a more rugged variant of the transmission specification to reduce the capacity of each of the current multiplexes from 24 Mbit/s to 18 Mbit/s would be equivalent in terms of reception reliability to an increase in transmission power of around 4dB. This might be a feasible technical option if the lost capacity could be made up by the planning of extra multiplexes.
6. As soon as Government has made a decision on the rules of the game for spectrum release at switchover, we believe that any further interleaved capacity that can be exploited within the constraints of these rules (e.g. for so-called “mini-multiplexes”) should therefore be licensed. We believe that the “safe option” of

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<sup>4</sup> This assumes that the multiplex to be sacrificed is one that carries purely commercial services, rather than a PSB multiplex requiring higher coverage, and that planning remains based on the current network configuration.

releasing 14 channels represents the maximum that can be released while still giving some scope for extra multiplex capacity to be squeezed in before switchover.

7. We support Government's view that decisions about the use of released capacity after switchover, including whether further DTT multiplexes should be licensed at that stage, should be made nearer the time. It should be clearer then, for example, whether higher definition services, more linear or interactive services, dedicated services for mobile users or even services not yet thought of would yield greatest benefit for the released spectrum.

*Q2. What do you see as the costs and the benefits of maintaining the current basis for network configuration compared with those for adopting a configuration using fewer frequency channels?*

8. The consultation document makes the following technical assumptions which underlie this question:

- (i) For multiplexes capable of providing 90 to 95 per cent coverage – **five** frequency channels per multiplex are required (on average) for the current network configuration, while only **four** if a new configuration were to be used.
- (ii) For multiplexes capable of more than 95 per cent coverage – **six** frequency channels per multiplex are required (on average) for the current configuration, while only **five** if a new configuration is used.

The suggestion is therefore that by using a new network configuration, one fewer frequency channels would be required per multiplex after switchover and thus for a six-multiplex plan six additional frequency channels (48 MHz) could be cleared.

9. A new network configuration implies a **radical re-planning** of the multiplex frequencies in order to squeeze them into fewer channels, and also the use of **a different network of transmission sites**, perhaps more evenly positioned geographically than the current network, in order to allow more efficient frequency reuse.

10. A key uncertainty here is whether the move to a new network of transmitter sites really is required in order to carry out the radical re-planning that would release the extra frequency channels in question. A move to new sites would introduce substantial new infrastructure costs and would cause viewer costs to escalate through more new aerials being needed, and should only be used as a last resort where there is no other way to achieve a more “condensed” frequency plan.

11. This issue is considered in more detail in the response to questions 9 and 10. It is concluded there that the benefits of radical re-planning are doubtful even without a new network of sites. If a new network does prove to be necessary, then our view is that the benefits are very substantially outweighed by the costs.

*Q3. Do you agree that we should continue to plan on an interleaved basis to support regional services?*

12. Yes, we consider that regional and national services must still be supported. They are a distinctive and important feature of the terrestrial transmission system and are an integral part of PSB service provision. To plan for DTT after switchover in a way that supported only UK-wide services would sacrifice this key feature of the technology, and would seriously deprive viewers of important local information. In any event, as explained below, we believe that from a technical perspective an interleaved plan is the most appropriate technical choice, even for services that are not regionally differentiated.

13. The technical alternative to an interleaved network (also known as a “multi-frequency network” – MFN) is a “single frequency network” (SFN) in which all sites in a given area transmit the exactly same services using the same frequency. Recent studies by the BBC have confirmed that a SFN would have reduced coverage compared to a MFN, due to the uneven spacing of the transmitter network. Thus more transmitter sites would be needed to get matching coverage for a SFN approach, with adverse consequences including planning permission, public concerns about the effects of radiation from new sites, environmental impact, and most importantly the need for an almost universal replacement of domestic aerials. Furthermore less data capacity would be available with a SFN than MFN because a longer “guard interval” is required. Finally a SFN requires very precise timing synchronisation, and so the current “relay” transmitter system would have to be replaced by a fibre-optic or satellite distribution network.

14. A regional SFN is possible in principle, in which the area of single frequency operation would be confined to a region rather than the whole of the UK. This would permit the provision of regional services, but would require adjacent regions to use different frequencies and would thus offer little if any benefit in terms of frequency reuse compared to a more conventional MFN. The disadvantages set out above would still apply, however.

15. If planning is considered on a European rather than a UK basis, then even a UK-wide SFN could be considered as “regional”. Adjacent countries would need to use different frequencies, and so the overall spectrum reuse benefits of a SFN approach would in fact be limited.

*Q4: To what extent should the future planning of this spectrum take account of the provision of local services?*

16. There is no doubt that the current Restricted Service Licensees have felt disadvantaged by their relatively short-term tenancy of spectrum. If viable community/business models can evolve, local TV could add significantly to the public good for local communities and the reach of public services and information to parts

of the population who would not otherwise have access to the internet or broadband services. This is ultimately a public policy decision for Ministers and Parliament, against other potential users of the spectrum.

17. Were Government minded to go down this route, the logical channels to allocate to local television, post-switchover, would be channel 35 and/or channel 37, currently used for analogue transmission by Channel 5. These are the channels likely to have the lowest alternative re-use value since they do not form part of a large contiguous block of spectrum.

*Q5. What factors would have to be taken into account in order to plan to support mobile broadcasting services?*

18. Mobile multimedia broadcasting is of particular interest as a potential complement to 3G mobile telecom services. Already manufacturers and service providers are studying the possibilities offered by combined 3G/DTT receivers, which would offer individual personalised data over the 3G network and “bulk” common-interest data over a much higher capacity DTT broadcast network.

19. A network designed specifically to support mobile broadcasting of this kind would have the following characteristics:

- (i) Transmission sites located so as to cover main roads and railway lines
- (ii) Single-frequency networking to ease hand-over from one “cell” to the next
- (iii) High field strengths to ensure reliable reception with very small receiver antennas

In technical terms this means that mobile broadcast services would be much more suited to sharing sites with the 3G network than with the current TV broadcasting network.

20. This suggests two parallel approaches:

- (i) **The conventional DTT transmission network** (especially following power increases) – although not ideal – would provide some “opportunistic” mobile reception capability of the current TV-dominated multiplex services which are provided mainly with fixed and portable reception in mind
- (ii) **A new mobile DTT network using cleared spectrum after switchover** would be the best approach for a dedicated mobile service. This would have a cellular structure and would probably share the sites used for 3G services. The services carried on this new network would be

targeted specifically at mobile users, with more of a bias towards data and internet-style services rather than linear television.

21. The “half-way house” of seeking to re-engineer the current DTT multiplexes for mobile reception after switchover would give the worst of both worlds. It would lead to all the difficulties and costs set out above in paragraph 13 for a new transmitter network, while not providing the right service mix for the mobile user.

22. A further advantage of the “mixed economy approach” set out in paragraph 20 above is that decisions do not need to be made now on the as-yet-uncertain mobile application. Mobile multimedia broadcasting would merely be considered as one of the potential uses for cleared spectrum after switchover, when the market should be able to determine whether its costs are justified.

*Q6. Does this analysis of coverage potential and associated costs adequately inform those taking decisions about the level of coverage by terrestrial means that should be required for public service broadcasters?*

23. The analysis in the consultation covers the relevant DTT coverage issues well, although inevitably further detailed planning will be needed before final cost-benefit analyses can be made. We would emphasise, however, that the predicted “coverage” figures discussed in the consultation do not equate to practical reception figures in most cases due to the inadequacies of many existing aerial installations for receiving digital services. An important exception here are the figures related to the current analogue frequency plan, which do equate adequately to practical reception since those frequencies are what current aerials are primarily being used to receive.

24. For digital satellite, the consultation draws on the technical studies carried out by the ITC. These encompass only rooftop line-of-sight coverage issues, and further analysis is required before relating this work to practical reception potential.

25. For example, more information and analysis will be needed for multiple dwelling units (MDUs), which represent around 20 per cent of UK households. In the case of satellite, the availability of line-of-sight from the building roof (the factor considered in the ITC study) does not mean that all households within the MDU can actually receive the service. This will depend on the use of SMATV distribution systems, or on the local attitude to the mounting of dishes for individual dwellings. (Similarly, although to a lesser extent due to the use of set-top aerials and terrestrial MATV systems, DTT reception is not guaranteed to a nominally “covered” MDU without further costs). The document issued recently by the DCMS entitled “Digital TV Information for Landlords” is very helpful in making a start to address these issues.

26. Another factor that could affect reception is the imposition of local planning restrictions (particularly relating to satellite dishes, although in some cases also to

roof-top terrestrial aerials). These restrictions also need to be factored into the final equation, perhaps ruling out satellite in some cases and requiring loft or set-top aerials for DTT.

27. Finally there is the issue, again primarily one for satellite, of the need for owner permissions in rented housing, which might again render it impractical for a household technically “covered” to practically receive a service. We understand that currently about 15 per cent of the UK population live in rented accommodation.

28. On another reception issue, the consultation recognises that the use of scrambling technology on satellite, even for the free-to-air PSB channels, has cost implications relating to the supply of smart cards. A further potential cost issue, however, is that receiver manufacturers have to obtain the necessary licences for the proprietary conditional access technology needed to de-scramble the services. This can add further costs, and can restrict the development of the kind of free and open market in receiver supply (such as is familiar with analogue TV sets) which can drive down equipment costs for consumers.

29. The consultation recognises that in technical coverage terms, cable and ADSL are unlikely to add significantly to DTT or to DSat coverage. We agree with this analysis. Furthermore these technologies are not well suited to serving MDUs. However, they may have a particularly important role in areas with planning restrictions.

*Q7. Our working assumption is that the public service broadcasters should be required to reach a certain minimum percentage of households by the terrestrial platform. However, we would like your views on whether it is right to require a minimum, what that might be and the associated costs and benefits?*

30. The current ITC licensing model obliges the terrestrial broadcasters (analogue and digital) to reach a minimum coverage level by requiring the service to be broadcast from specified transmission sites using specified transmission characteristics. Accepting, as the consultation does, that DTT will be a vital part of the mix of PSB delivery after switchover, we believe that this model will continue to be appropriate for the multiplexes carrying PSB services. Indeed coverage is one of the important positive obligations that makes up the definition of PSB.

31. Concerning what that minimum should be, the ITC believes that planning should be based on the aim of sustaining at least 95 per cent terrestrial coverage for the PSB services after switchover. In practice, this means adopting “analogue conversions”<sup>5</sup>, which are predicted to be able to increase coverage to 94.5 per cent using only the current 80 DTT transmission sites. If the number of sites is increased to

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<sup>5</sup> An analogue conversion is where a DTT multiplex carrying PSB services takes over a vacated analogue frequency assignment at switchover. This gives improved coverage and excellent reception compatibility and also fits in well with plans for clearing contiguous blocks of spectrum for other uses.

120, the coverage rises to 96 per cent and a coverage which fully matches analogue (99.4 per cent) can be provided if all 1100 sites are employed.

32. This would be one way of ensuring the reception of appropriate PSB services for all UK homes that can currently receive them in analogue. (This is a requirement established by Government and the subject of a separate work item (3.6) in the Digital Action Plan.) However, a full roll-out of DTT is not necessarily the most cost-effective means. The extra investment needed to roll out DTT on switchover from 80 to 1100 sites is expected to be around £50 million per multiplex. The extent to which it would be more cost-effective to rely on satellite coverage instead for the last few per cent of homes (balancing the extra transmitter costs of DTT against receiver and ongoing conditional access costs for a DSat solution) will depend on a cost benefit analysis nearer the time. It is not possible to know at this stage which way this analysis would go, since we do not have accurate information on how many homes will be affected or on future costs.

33. Thankfully the issue at stake in this consultation – i.e. how much spectrum will be required for PSB delivery after switchover – does not depend on the outcome of this cost benefit analysis, since the “break point” in spectrum requirement terms is 95 per cent coverage. Beyond this, any extension towards universality (99.4 per cent) for DTT can be judged on its cost effectiveness without introducing any extra spectrum demands.

34. Prior to switchover, power and interference constraints mean that it would not be feasible to seek to replicate anywhere near the full analogue transmission network in digital. Indeed, the most cost-effective solution before switchover is probably to extend the current 80 sites only by a further 10-15 sites which represent the best value for money per additional viewer covered. That is likely to lead to a population coverage by the public service multiplexes of 83-85 per cent (after completion of the current equalisation plan) rising to 95 per cent after switchover on the basis of analogue conversion at the sites in question.

35. The PSBs will need to commit firmly now to invest in these analogue conversions and then to roll out coverage beyond the 95 per cent level. Achieving these coverage levels also requires that switchover be a rolling process so that new digital sites can be switched on, area by area, as the analogue transmitters are shut down.

36. Other platforms, notably satellite and cable, will continue to have an important role as pay TV platforms of choice for many viewers and will, post switchover, add marginally to population coverage in areas in which the enlarged DTT network does not reach. But the geographic limitations of cable, and the planning and line of sight constraints and ongoing conditional access costs for satellite make them less appropriate than DTT to be the primary ‘universal access platform’ after switchover.

*Q8. Do you agree that the level of coverage provided by the networks supporting the four multiplexes carrying predominantly pay-TV services should be left to the commercial judgement of the operators?*

37. Yes, although not entirely. We consider that the operators carrying non-PSB channels should be free to choose whether or not to increase coverage, but should not be permitted to reduce coverage (in order to ensure that the frequencies involved continue to be used effectively).

38. At present, S4C and Channel 5 are carried on the third (SDN) multiplex and so only three multiplexes are purely “commercial”. To transfer these PSB channels onto the first or second multiplex is not straightforward given the legitimate expectations of the BBC, ITV and C4 with their current guaranteed capacity. We have considered therefore the option of having three PSB multiplexes after switchover, as well as the option for two highlighted in the consultation document.

*Q9. Which channels are cleared will depend on the costs and benefits of different re-planning options. For example clearing 5 channels at the top and bottom of the frequency range is less disruptive to consumers and has lower switching costs than clearing ten at the top end. The benefits, though, will depend on the use to which such freed up spectrum can be put. We would like your views on the costs and benefits of different options.*

*Q10. Which frequency channels should we clear?*

39. Due to the interleaved nature of the planning, the removal of analogue transmissions at switchover will not of itself release any spectrum<sup>6</sup> that is clear on a national basis. The release of clear spectrum at switchover therefore requires the simultaneous re-planning of some of the **digital** transmissions.

40. The “disruption cost” side of the equation when considering spectrum clearance options relates mainly to this digital re-planning process. The different cost factors that need to be taken into account include:

- (i) Broadcasters’ costs for the re-engineering of the DTT network required to move to different frequency channels
- (ii) Viewers’ costs in acquiring new aerials (and disruption in needing to retune their digital reception)
- (iii) Opportunity costs of more limited potential for extra “mini-multiplex” services before switchover

41. On the benefit side, the consultation points out that to maximise flexibility on reuse, the cleared frequency channels should ideally be:

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<sup>6</sup> Except for channels 35 and 37, which are currently used only for analogue TV

- (i) Cleared nation-wide – otherwise only regional applications are possible
- (ii) Contiguous – to allow for smaller and larger licensing packages
- (iii) In the part of the UHF spectrum where it is most likely to be possible to obtain international agreement on reuse.

42. The theoretical analysis in the consultation paper, based on the rule of thumb for post-switchover multiplex spectrum requirements referred to above in paragraph 8, suggests that up to 22 frequency channels might be cleared if the DTT multiplex networks were to be completely reconfigured after switchover, and up to 16 channels if the current configuration were to be maintained. These figures reduce to 20 and 14 respectively if the option of having two multiplexes carrying PSB services to more than 95 per cent of the population is to be allowed for.

43. A meaningful cost-benefit analysis for these different numbers of channels released cannot be carried out without specifying the actual frequency channels that would be cleared. A confidential Technical Appendix, produced in co-operation with the BBC, addresses this issue by analysing seven scenarios for switchover as set out in Table 1 overleaf.

44. These scenarios are intended to explore options both for spectrum clearance and for DTT coverage post-switchover within the same framework. Headline results from the Appendix include:

- (i) Cost figures for two or three analogue conversions are similar. The main difference is that a three conversion route (i.e. where three, rather than two, multiplexes are assumed to carry PSB services and to take over analogue frequencies at switchover in order to achieve coverage of 95 per cent or more) will release only 12 frequency channels rather than 14.
- (ii) The broadcasters' costs for rolling out to the full 1100 transmission sites (for either two or three PSB multiplexes) are of the same order as the extra costs that would need to be met by the broadcasters in providing smart cards and customer management for satellite reception in the otherwise uncovered areas.
- (iii) The radical re-plan scenario would involve substantial viewer costs and disruption in retuning and in installing new aerials (viewer aerial costs of £465 million according to the assumptions set out in the Appendix). This would affect pre-existing DTT viewers at switchover, as well as viewers who at switchover still need to convert to digital.
- (iv) A radical re-plan would not be compatible with mini-multiplexes being introduced before switchover, whereas the other scenarios should allow at least some headroom for this extra resource which could be used either to expand capacity or improve reception.

<b>Scenario number and name</b>	<b>No. of DTT sites</b>	<b>DTT coverage</b>	<b>DTT frequency changes at switchover</b>	<b>Released spectrum</b>
<b>1</b> (status quo)	80	86%	none	2 channels (35&37)
<b>2</b> (2 conversions, 80 sites)	80	95%	Analogue conversions for 2 muxes, and other small changes needed to clear spectrum	14 channels (29-35, 37, 63-68)
<b>3</b> (2 conversions, 120 sites)	120	96%	Analogue conversions for 2 muxes, and other small changes needed to clear spectrum	14 channels (29-35, 37, 63-68)
<b>4</b> (2 conversions, 1100 sites)	1100	99%	Analogue conversions for 2 muxes, and other small changes needed to clear spectrum	14 channels (29-35, 37, 63-68)
<b>5</b> (3 conversions, 80 sites)	80	95%	Analogue conversions for 3 muxes, and other small changes needed to clear spectrum	12 channels (31-35, 37, 63-68)
<b>6</b> (3 conversions, 1100 sites)	1100	99%	Analogue conversions for 3 muxes, and other small changes needed to clear spectrum	12 channels (31-35, 37, 63-68)
<b>7</b> (radical re-plan)	80	85%	Major changes to clear large single block of spectrum	20 channels (35, 37, 51-68)

**Table 1 – Switchover scenarios considered in the confidential Technical Appendix**

45. In 1992 frequency bands around 2000 MHz (substantially higher than the TV frequencies which are in the range 470 - 854 MHz) were identified on an international basis for the future licensing of 3G mobile services. The UK auctions that raised £22 bn were for 140 MHz of this spectrum.

46. In May 2000, the World Radiocommunication Conference approved a substantial amount of additional spectrum – to take account of projected 3G needs for 10 years and beyond, in the following three bands:

- (i) 806 – 960 MHz
- (ii) 1710 – 1885 MHz
- (iii) 2500 – 2690 MHz

The total amount of potential extra spectrum here is 519 MHz - nearly four times the amount recently auctioned in the UK.

47. Of this, only 48MHz (806 – 854 MHz), corresponding to channels 63 to 68, is in a band currently used by TV. Consequently, the clearest estimate of benefits for spectrum redeployment after switchover lies in these frequencies. Frequencies in this range are also being used in Germany for mobile digital broadcast services, which represents another potential high value application in the future.

48. Values for the possible 3G use of channels 63 to 68 will depend upon market conditions at the time. Two measures can be used:

- (i) The £150m per MHz realised in the UK and German 3G auctions.
- (ii) The more conservative £20m per MHz realised in other continental auctions in 2001 (ie, between the top of the market and its current trough).

The value of these six channels alone ranges from £7 billion under (i) to £1 billion under (ii).

49. It is not clear at this stage whether there will be sufficient demand for these channels to generate values at the high end, since of the frequencies mentioned in paragraph 46 above these are the ones of least interest to mobile operators. The mobile industry is showing more interest in developments involving higher frequencies than these, which allow smaller antennas and smaller cell sizes. This underscores the need to wait until nearer the time before being able to judge spectrum market values with any precision. In the meantime, an independent study carried out for the ITC, described in more detail in the confidential Technical appendix, adopts the £20m per MHz figure in its modelling.

50. The timing of international clearance for re-use of channels 51-62 is more uncertain. Their re-use is likely to require the UK to await digital switchover in all neighbouring countries and international clearance, and so it could be many years

after UK switchover before they could be re-used. This will substantially reduce their NPV.

51. Our broad conclusions are therefore that a 'safe' planning option (i.e. one which involves the release of 12 or 14 frequency channels) has much to commend it:

- The costs of transition and disruption for viewers are much lower than with the radical option.
- The probability of achieving switchover and releasing spectrum is higher.
- Even on 'conservative' assumptions about the value of the spectrum released at switchover, the benefits substantially outweigh the disruption costs.

52. One further option that is mentioned in the consultation document is the clearance of channels 60 to 68, as an alternative to clearing five channels at the top of the band and five near the bottom. Extending below channel 63 implies that Winter Hill and other sites that employ frequencies high in the available range would no longer be able to use analogue conversions and would therefore need to use a radical re-plan. This option can therefore be considered as a subset of the radical re-planning scenario, with high disruption costs.

ITC

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