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cc BG
DVP

K01902

Prime Minister

Not essential reading this weekend, but you may want to have a first glance at this material. You will want to note X, although it would not be easy in diary terms.

MR GRAY
Prime Minister's Office

RRC6 18/3

MISC 128: ADDITIONAL PROGRAMME SERVICES

MISC 128 will be meeting on Monday 28 March to resume consideration of additional TV programme services in the light of the technical studies that have now been completed. The main paper by the Official Group (which will be circulated early next week) will inevitably be dense and complex. I am therefore sending you the attached advance copy of the sections of the paper that will give a factual description of the range of technical options. The final version of the paper will contain various additional material on the decisions that need to be taken, including difficult ones that bear on the relationship between broadcasting and telecommunications policies.

2. If the Prime Minister has time to glance at this over the weekend, she will find the most useful summary at Annex 1, which I have placed at the top of the bundle.

X 3. A short presentation of this material by DTI officials could easily be arranged if the Prime Minister would find it useful. Perhaps you could let me know her wishes after the weekend.

Yes please

A.J.L.

A J LANGDON

Mark!
18 April 1988

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Annex 1

ADDITIONAL TELEVISION DELIVERY MECHANISMS

UHF FIFTH CHANNEL (MAP A)
One channel only. 70% coverage from 1992 (limited coverage earlier). Cost per household £30 (for an additional aerial). National or regional programming. BUT international negotiations could reduce coverage and/or delay start. Costs of relocating existing users from channels 35/37 to be met by franchisee. Most VCRs and some home computers would need to be re-tuned. Difficult to re-house/ provide for growth of broadcast ancillary services now in Ch 35.

UHF SIXTH CHANNEL (MAP B SHOWS 40% COVERAGE)
One channel only. Further study needed but 40% coverage perhaps 1990/91. Cost per household £30 if new aerial required. National or regional programming. BUT international negotiability believed difficult. Puts at risk one or more existing service to some 10,000 viewers. Reduces scope for broadcast ancillary services. A different approach giving over 50% coverage without putting existing users at risk may be possible mid 1990s but could mean expensive relocation costs of existing users to be borne by franchisee.

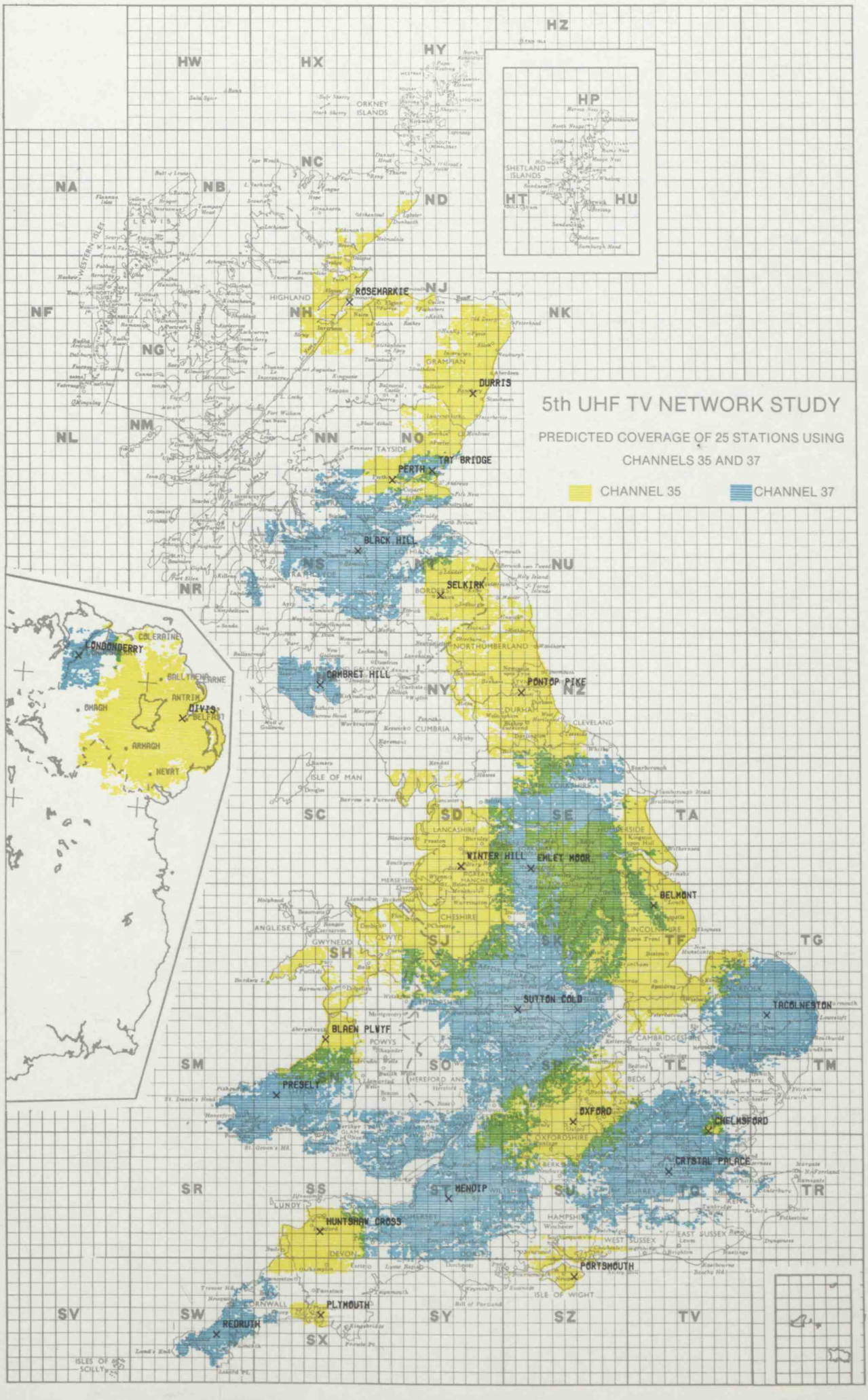
VHF FIFTH/SIXTH CHANNEL
One channel only. Maximum 40% coverage from 1992. Cost per household £100 (for new aerial and frequency converter). National or regional programming. BUT probably ruled out by potential harmonic interference to aircraft navigational aids and communications. UK mobile radio lobby and international neighbours seriously upset by policy reversal on these bands. Adjacent conurbations eg: Birmingham /Manchester, could probably not both be served. Serious interference early evenings May, June, July from sporadic-E. Return to large H aerials probably required. Probable interference to mobile radio services now occupying VHF broadcasting sites.

MVDS
Up to six channels at 2.5 GHz or twelve at 12 GHz. At 2.5 GHz equipment is cheaper (cost per household £250) and available off the shelf, but no spectrum available for later expansion beyond six channels or to extend coverage to meet market demands. At 12 GHz equipment is more expensive (cost per household £300-£500) at least initially, but some commonality with DBS equipment also at 12 GHz may reduce costs; better prospects of further spectrum for later expansion beyond twelve channels or to extend coverage to meet market demands; pressure on spectrum for alternative uses generally less at 12 GHz than at 2.5 GHz. With both 2.5 GHz and 12 GHz early start possible, with 70% coverage or more from 1992. National, regional or local programming. BUT up to 30% of households within coverage areas might not receive usable signal because of shielding by buildings, terrain, etc. Large dish aerials (2 foot) would need to be mounted at or above roof-top level. Could be difficult to re-house outside broadcast links at 2.5 GHz and at 12 GHz.

DBS
Up to fifteen additional channels but international negotiability uncertain. Potentially universal coverage. Cost per household £300-£500 (BSB optimistically say £200). (For dish aerial and frequency converter). Dish aerial smaller (perhaps one foot) and less obtrusive (could be mounted under eaves, at ground level or behind a window). BUT could preclude MVDS at 12 GHz. Could be difficult to re-house outside broadcast links at 12 GHz.

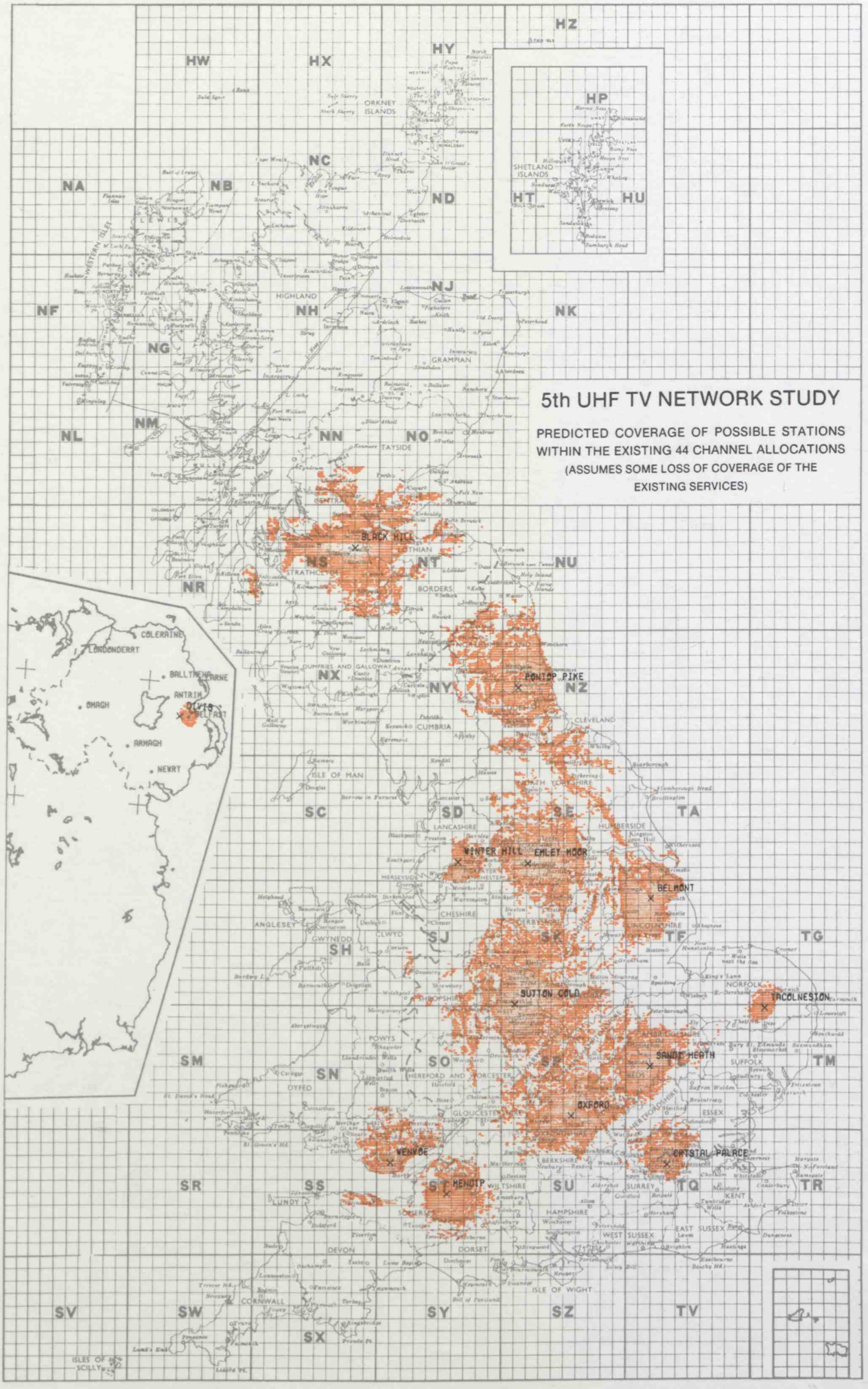
ISSUED BY BBC RESEARCH DEPARTMENT TADWORTH SURREY
SERVICE PLANNING SECTION

MAP A



ISSUED BY BBC RESEARCH DEPARTMENT TADWORTH SURREY
SERVICE PLANNING SECTION

MAP B



5th UHF TV NETWORK STUDY

PREDICTED COVERAGE OF POSSIBLE STATIONS WITHIN THE EXISTING 44 CHANNEL ALLOCATIONS (ASSUMES SOME LOSS OF COVERAGE OF THE EXISTING SERVICES)

BBC

ADDITIONAL PROGRAMME SERVICES

PART A: THE TECHNICAL OPTIONS

1. This paper sets out the results of the studies into the technical feasibility of providing additional television services in the UHF band and using MVDS which were commissioned by MISC.128. The UHF study was subsequently extended to cover possible use of VHF bands I and III, but the opportunities at VHF have proved in practice to be strictly limited. We have also looked at the possible scope for additional DBS channels. The studies therefore cover the main parts of the frequency spectrum and the delivery mechanisms (apart from cable) that might be used for the provision of additional television services.

2. Paragraphs 6-19 below describe briefly each of the possibilities examined for additional services. Each possibility is described in greater detail at Annex 6. Paragraphs 20-24 show how the relative merits, disadvantages, costs and constraints of each compare, whilst Annex 1 (to follow) seeks to compress these comparisons into tabular form. The various blocks of spectrum under discussion are shown at Annex 5 whilst the probable population coverage that could be achieved by each of the possibilities is shown in ~~Annexes 2-4.~~ the maps.

3. The possibilities at paragraphs 6-19 below are to an extent mutually exclusive. Thus in the upper half of the 12 GHz broadcasting band, it would be possible to seek to accommodate either (subject to international negotiation) ten additional DBS channels each providing universal coverage, or twelve MVDS channels each covering perhaps 70% of households, but not both.

4. Although the UHF and VHF options are not mutually exclusive in the same sense, a fifth network at UHF coupled with a sixth network at either UHF or VHF would substantially escalate the problems of accommodating displaced users and of providing for the expected growth in those services. A sixth network at UHF would probably be somewhat less of a problem than one at VHF.

5. Similarly, if VHF and MVDS at 2.5 GHz were both to be used for new television services we should have pre-empted two key areas for meeting the growth in demand for both national and international mobile radio services once the VHF Band III allocations have become exhausted.

UHF Bands IV and V

6. These bands cover the 44 channels currently used to provide four television services to more than 99% of the population. They also include four channels at the lower end of Band IV (channels 35-38) which are used in the UK for other purposes. Our studies have shown that channel 35 (currently assigned to the programme making activities of the broadcasters, independent programme makers and theatre radiomicrophones) and channel 37 (currently used, together with channel 36, by aeronautical radar) could be used to provide a national (or series of regional) network(s) covering 65-70% of the population. The new service should be feasible from the beginning of 1992 without risk to aircraft safety.

7. There would be costs. These would include the re-equipment costs of relocating existing users to alternative spectrum, which could probably be recovered from the successful franchisee. Most video recorders and some home computers would need to be re-tuned to avoid interference to and from the new broadcast services. This would clearly involve inconvenience and some cost to many households unless special arrangements were made. There would also be the opportunity costs of channels 35 and 37 to other users who might have wanted them.

8. There would also be uncertainties and other difficulties. We shall need to negotiate the new transmitters and the new arrangements for aeronautical radars with neighbouring Administrations and this could prejudice both a 1992 start date (though we would not expect it to do so) and the full coverage we hope for. The costs of concessions we might have to make in these negotiations should be added to those in paragraph 7 above.

It will prove difficult to provide alternative spectrum for existing users displaced from channel 35 and for potential users of this and channel 37. A proportion of viewers (perhaps 3/4) would need to equip themselves with a second UHF aerial and a simple mixing circuit. This would account for most of the estimated average cost per household of £30-£50 for an additional (non-subscription) UHF TV service. An alternative approach is to make a more intensive use of the 44 channels currently used for broadcasting. Coverage by this means might approach 40% but only at the risk of depriving up to 10,000 viewers (in Hammersmith and Chingford) of one or more existing services. This approach is much less attractive than that described above in terms of a fifth TV network, but could probably, subject to further study, form the basis of a sixth network if that were to be required. It is possible that, in the somewhat longer term, a sixth network at UHF might achieve better than 50% coverage, without depriving viewers of existing services, by making use of one or more of channels 36, 38 and 69 though these possibilities would need to be the subject of further study.

9. We believe that UHF channels 35 and 37 represent much the most attractive option for a fifth terrestrial TV network. We further believe that if a sixth terrestrial network were to be required, UHF probably offers more potential and fewer disadvantages than VHF.

VHF Bands I and III

10. These bands were formally used to transmit 405-line black and white television but were reclaimed from the broadcasters to allow for the much needed expansion of mobile radio services used by business. They are, however, still available under International Radio Regulations for broadcasting use. We have concluded that there is insufficient spectrum in Band III, not already in use or committed, to provide even a very limited service unless it were to be based on advanced and very expensive bandwidth compression techniques and even then there could be problems of compatibility with adjacent mobile and MoD services. In Band I it would in theory be possible to construct a network covering some 60% of the population but in practice a more

restricted network with a coverage of at best 40% of the population is all that would be achieved if potentially severe interference from adjacent mobile radio services is to be avoided. Such a service might commence by 1992. Even then there would be a number of serious constraints, disadvantages and costs.

11. We should have to co-ordinate the use of frequencies with our French and Irish neighbours in particular. Since we ceased VHF TV broadcasting, the French and Irish have registered substantial additional broadcasting use. We might well now be unable to negotiate the use required to achieve as much as 40% coverage and the negotiations could prejudice a 1992 start date. Additionally, the optimum transmitting sites are probably those used by the old VHF TV service. But they are now extensively occupied by private mobile VHF radio services which could suffer severe interference if VHF TV broadcasting were to be re-introduced from those sites.

12. However, perhaps the most serious problem is a form of interference to Band I frequencies known as sporadic-E. During the summer months, particularly during the early evening period, atmospheric conditions enable transmissions between 1000 and 2500 km away, completely obliterating the wanted signal. Such interference may last for lengthy periods of time, often up to an hour or more. We judge sporadic-E to be a significant inhibition to the re-introduction of broadcasting in Band I, especially now that viewers take for granted the relatively interference-free reception provided by UHF. An environmental disadvantage is the return to large H aerials that would very likely be required. The cost of such an aerial together with a set-top converter to convert the incoming VHF signal to the UHF frequencies on which existing TV receivers operate represents the bulk of the estimated capital cost per household of around £100 of establishing a VHF TV service.

Microwave Video Distributions Systems (MVDS)

13. MVDS (sometimes also called MMDS or MDS) employs essentially the same techniques as existing terrestrial broadcasting but uses frequencies in the range above 1 GHz. At these higher frequencies spectrum becomes progressively more plentiful but the range of transmitters reduces, thereby requiring a larger network of transmitters to achieve a given level of coverage. Additionally, the technology becomes progressively more difficult and, initially at least, more expensive. Timescales for the introduction of the service consequently become extended.

14. The study by Touche Ross Management Consultants has concluded, on the basis of R Division's assessment of the maximum amount of spectrum that it might be possible to make available, that up to an additional twelve television services could be provided to geographical areas covering some 70% of the population (though within these geographical areas a significant minority of viewers might not be able to receive an adequate signal) by 1992. Because the range of MVDS transmitters, particularly at higher frequencies, is substantially less than that of UHF or VHF transmitters, it may be possible for an MVDS service to cover areas such as the south coast, which additional UHF or VHF services would probably be unable to reach because of international coordination problems.

15. There are a variety of ways in which MVDS might be used. First, spectrum for a six-channel MVDS system could probably be made available in the band around 2.5 GHz. Equipment is available virtually off the shelf from the US where such systems already operate. The capital cost per household (largely for the dish aerial and frequency converters) is estimated at £200 to £250. It is widely felt that MVDS at 2.5 GHz would offer a highly attractive commercial opportunity. There might need to be some geographical constraints to protect some existing users, whilst others - notably TV outside broadcast channels - would need to be re-housed elsewhere. It is possible that the 2.5 GHz band will be selected by international agreement to meet the long term needs of mobile and mobile satellite services.

16. The 12 GHz band is already internationally allocated to broadcasting and there is scope there for a twelve channel MVDS system, probably also by 1992. Because this is the band in which DBS also operates, there could be at least a degree of commonality between MVDS and DBS receiving equipment but the capital cost per household of MVDS at 12 GHz might be between £300 and £500 which is comparable with that for DBS and ASTRA. This is up to twice as expensive as MVDS at 2.5 GHz, and its commercial attractiveness is reduced thereby (though costs may fall if and when a mass market develops).

17. It has also been argued that MVDS could be used to assist the spread of cable services. MVDS could be used to provide a limited number of channels quickly and at low capital cost throughout a cable franchise area. The resulting customer base, and revenue generated, could improve the investment profile of cable and the prospects of a more satisfactory eventual level of cable build in the area. The use of MVDS would be progressively withdrawn in line with the required rate of cable build but the substantially more attractive investment and revenue profiles of MVDS could, unless carefully managed, act as a disincentive to cable operators to continue with the extensive task of cabling for interactive services. The general use of MVDS, and its restricted use to help cable, would appear mutually incompatible at least within the same timescale.

18. The dish aerials for MVDS reception are likely to be about 2 feet in diameter and will have to be mounted as high as possible, generally at or above the roof line, in order to achieve line-of-sight to the transmitter. This constrasts with the dish aerials needed for DBS reception which may be only about half the size and can be mounted at ground level, under the eaves, or even behind the window.

Additional DBS Channels

19. It may be possible, if we act quickly, to provide additional television services by acquiring one or more further blocks (each of five channels) of DBS channels currently

unallocated under the international plan. One of these blocks might be in the lower half of the 12 GHz band in which the UK already has five channels (three of which have been awarded to BSB). The remaining blocks would be in the upper half of the 12 GHz band and would rule out the possible use of MVDS services at 12 GHz. Depending on which blocks we were successful in securing, viewers might receive the additional services on the same equipment as will be needed for the BSB channels, or they may need either a steerable dish or a second fixed dish. DBS services can achieve virtually universal coverage but the cost per household of the receiving equipment may be £300 - £500 (BSB optimistically estimate £200) and the initial capital required to establish the service is very high.

Comparative Features of Technical Options

20. Of the four options considered, UHF offers one additional channel with 70% coverage, plus the possibility of a second channel (see below). VHF offers one channel with perhaps 40% coverage whereas MVDS and DBS each offer the prospect of a number. DBS coverage should be virtually universal, whilst with MVDS about 70% of UK households should be within range of a transmitter. However, a significant minority - perhaps 20-30% - might be unable to receive a usable signal because of screening by buildings, trees or high ground. If no more than a fifth channel is sought for the time being, the UHF option has a number of clear advantages. It can provide a better level of coverage than VHF (70% as against a maximum of 40%); the cost to viewers is much lower (£30-£50) as compared with £100 for VHF; international clearance of the necessary frequencies is likely to be more easily achieved than at VHF, and less costly in terms of negotiating concessions; although many viewers would need an additional aerial, it would be of the existing UHF variety and not the large H aerials likely to be needed by almost all VHF viewers; many viewers would be able to receive the new service without any additional expenditure at all; and UHF does not suffer from the serious interference problem of sporadic-E which affects VHF Band I (which is also more susceptible than UHF to other forms of interference). The only significant disadvantage with UHF is the need for many VCRs, and

perhaps some home computers to be retuned to avoid interference to and from broadcasting in channels 35 and 37. It would be suitable for an advertising, subscription or mixed channel. If a sixth channel at either UHF or VHF is to be considered, in most respects UHF would have the same advantages over VHF for a sixth channel as it has for a fifth, though international clearance of a sixth UHF channel may be no easier than at VHF. Subject to that proviso we are clear that UHF could match the VHF coverage of 40% (though a small minority of households - up to 10,000 - would be at risk of losing one or more existing service). And it is possible though this would need further study, that over a somewhat longer timescale a UHF sixth channel could be extended to cover over 50% of households without loss of existing services.

21. MVDS and DBS will both cost the viewer (or the service provider) considerably more money for the equipment needed to receive them (generally estimated at £300 - £500 for DBS - though BSB optimistically claim £200 - and for MVDS at 12 GHz; £250 for MVDS at 2.5 GHz). For this money, however, he will receive not one but several additional channels, with DBS initially three rising to five, but with the potential for a further five or even ten if we seize the opportunity now of laying claim to additional allocations and are successful in the subsequent international negotiations; with MVDS six or perhaps twelve. Coverage of MVDS could, as with UHF be about 70% of UK households though within this coverage area there would be likely to be more pockets with poor or no reception. DBS would provide something approaching 100% coverage, though it lacks the flexibility of the terrestrial systems to provide regional services if required. Both MVDS and DBS will require dish-type aerials (MVDS at 2.5 GHz could use open lattice or mesh dishes; MVDS at 12 GHz and DBS will require solid dishes). But whereas MVDS dishes will be large (50-60 cm) and will need to be mounted at or above roof-top level, DBS dishes will be smaller (30-45 cm) and can be mounted lower and less obtrusively (eg: under the eaves, on the ground, or even behind a window).

Timing

22. A fifth network at UHF could be planned with a fair degree of certainty to commence operating from the beginning of 1992 and possibly, for at least parts of the country, in 1991. A lot more uncertainty would attach to a start date for a sixth network at either UHF or VHF. International negotiations on the frequencies would be likely to be particularly difficult and could take two to three years. No detailed planning of the network or ordering of equipment could commence until the negotiations were complete. Additionally, to optimise coverage, a fifth and sixth network at UHF should be planned together, and this could delay the start of a fifth network. For a pre-1992 start date, MVDS at 2.5 GHz offers the best prospects in terms of equipment and spectrum availability, but a pre-1992 start date at 12 GHz might also be possible. Detailed planning for an MVDS network could commence within about six months of a decision by Ministers with little uncertainty of international negotiability.

Spectrum Costs

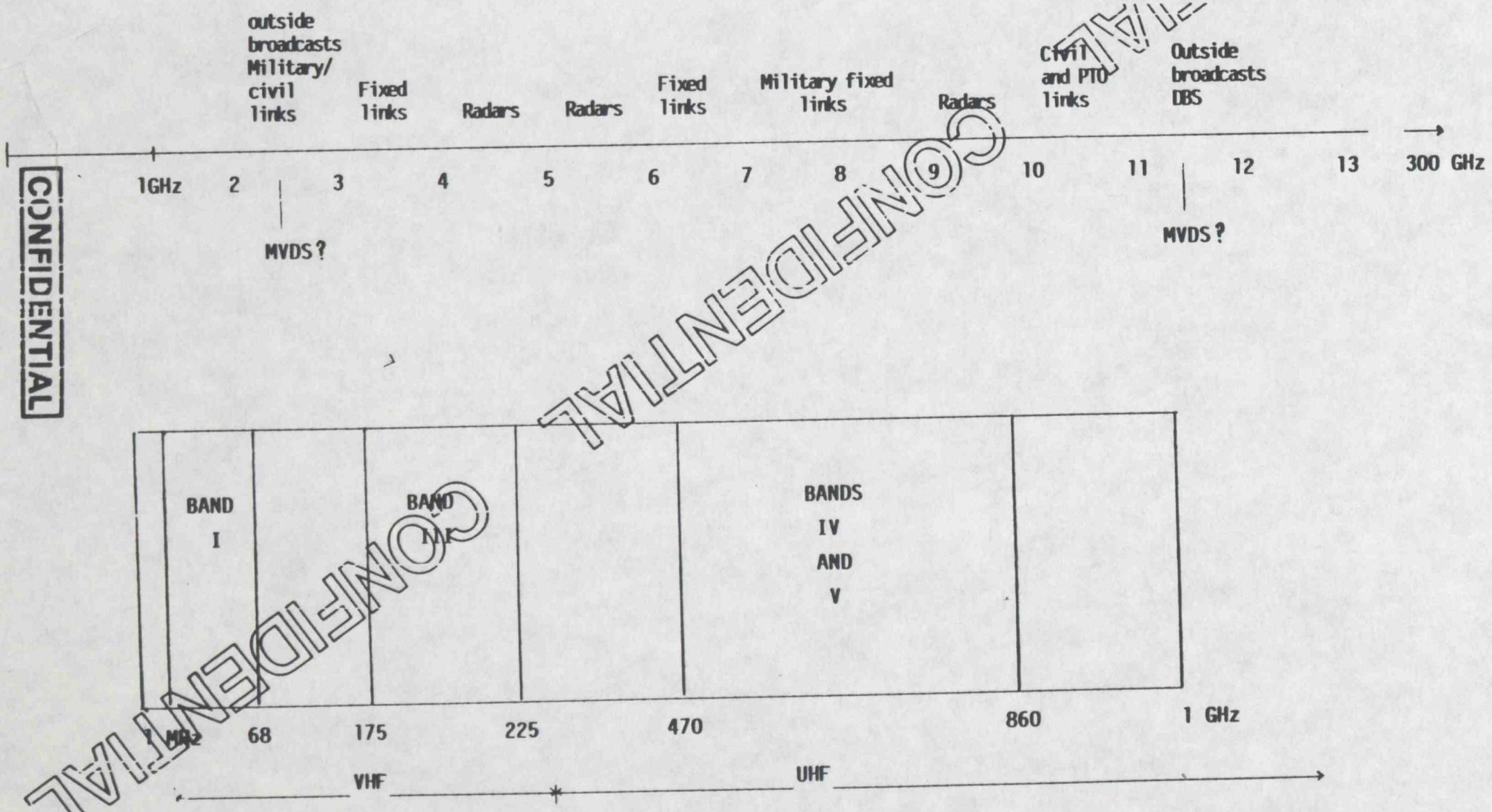
23. None of these options is free from costs in spectrum terms, though DBS is much the most spectrally efficient means of achieving national coverage of a broadcasting service. All the options - with the possible exception of certain additional DBS allocations - leave us with difficult problems of re-housing existing users. The UHF option is especially problematic because the operational needs of the existing users require allocations below 1 GHz where spectrum is extremely scarce. VHF band I is less sought after because of the interference problems already referred to, but its value to mobile users is likely to increase significantly as allocations within band III become progressively exhausted. An MVDS service at 2.5 GHz would be occupying spectrum which may become much in demand during the 1990s for international mobile services, but we believe that the UK's foreseeable mobile radio needs could possibly be accommodated without recourse to this spectrum. MVDS at 12 GHz could substantially reduce the prospect of additional DBS channels and could tie the UK's hands in any future negotiations to replan the DBS band (for example, to accommodate High Definition Television).

24. For the reasons described in paragraphs 4 and 5 above, these problems would be intensified if it were decided to make use of more than one of the options identified for the new services. A particular concern if both a fifth network at UHF, and a sixth network at either UHF or VHF were to be permitted is that the programme making activities of the broadcasters and independent programme makers could not be provided with suitable alternative spectrum. Nor would there be any scope for the additional demand for programme making facilities generated by the new services.

25. It can be argued that to make available all the spectrum identified for new services at VHF and UHF for MVDS and DBS, and to leave it to the market to decide which options to pursue would be in accordance with fundamental Government philosophy. But if demand for so much new television proves not to exist the result would be the effective sterilisation of a considerable amount of spectrum which could otherwise have been put to productive use. Since spectrum is a most valuable national resource, it would be wasteful to make available substantially more of it for new television services than the market can reasonably be expected to demand. In addition therefore to the consequences of additional television services for existing services such as cable and independent television, and for our commitments to DBS, Ministers will wish to consider how much additional spectrum they wish to make available to new broadcasting services, bearing in mind the competing claims of, in particular, mobile radio and ancillary broadcasting services.

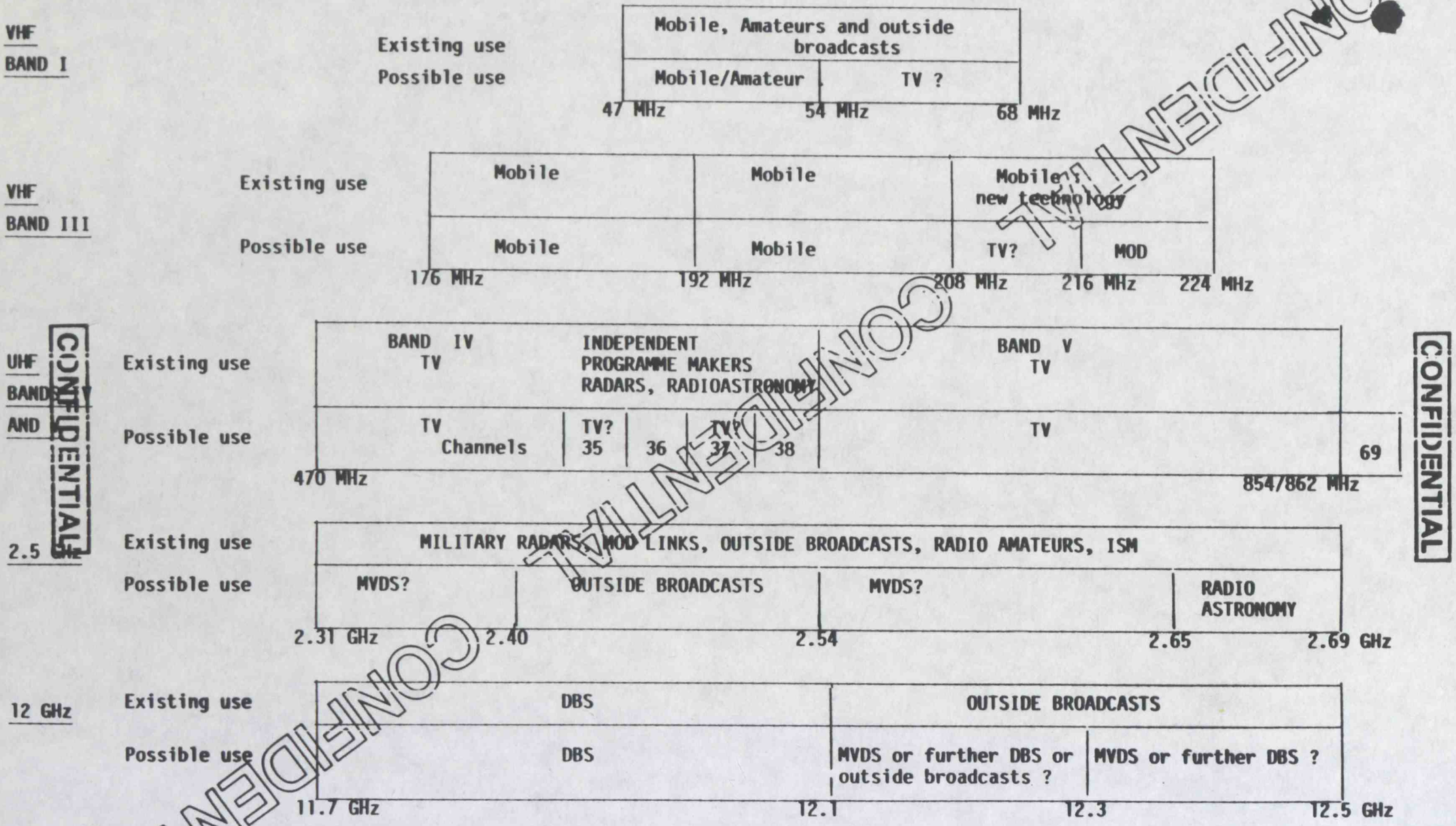
26. We have found that there are very considerable difficulties in re-introducing even the most limited broadcasting service at VHF. If, nevertheless, Ministers wish to establish whether the spectrum in VHF band I that could be made available for broadcasting would be more valuable if used for that purpose or for private mobile radio services, one way would be to hold an auction subject to any restrictions which might need to apply to either service.

THE RADIO SPECTRUM



ANNEX 4

TECHNICAL OPTIONS: EXISTING AND POSSIBLE USE OF SPECTRUM



ANNEX 6

DESCRIPTION OF TECHNICAL OPTIONS

UHF

1. These bands cover the 44 channels currently used to provide four television services to more than 99% of the population. They also include four channels at the lower end of band V (channels 35-38) and one channel (69) at the top of band V which are available internationally for broadcasting but are used in the UK for other purposes including aeronautical radar. Our studies have shown that channels 35 and 37 could be used to provide a national (or series of regional) network(s) covering 65-70% of the population. The new service should be feasible from the beginning of 1992 without risk to aircraft safety. There would be costs, and some uncertainties, but this approach has unquestionably produced a far more attractive option for a fifth TV service than has the parallel study on VHF bands I and III.

2. Channel 35 is currently assigned to the programme making activities of the broadcasters, independent programme makers and theatre radiomicrophones. Channel 37 is used by aeronautical radar. The re-equipment costs of moving these existing users to alternative spectrum and of protecting radioastronomy installations in channel 38 are relatively modest, and could probably be recovered from the successful franchisee. Most video recorders and some home computers would need to be retuned to avoid interference to and from the new broadcast services, and would clearly involve inconvenience and some cost to many households unless special arrangements were made. Less tangible are the opportunity costs of channels 35 and 37 to other users who might have wanted them and concessions we might have to make to neighbouring administrations, notably France and Ireland to secure agreement to the use of these frequencies for broadcasting.

3. We shall need to negotiate the new transmitters and the new arrangements for aeronautical radars with neighbouring administrations. A 1992 start date could depend on the progress of these negotiations (though we would expect to complete them well within

this timescale). We might not, however, be able to negotiate the full coverage we hope for. It will prove difficult to find alternative spectrum for existing users displaced from channel 35, and for potential users of this and channel 37. One use of channel 35 is to provide the only exclusive nationwide allocation available to independent programme makers for radiomicrophones. In the past production units have made unauthorised use of pmr frequencies for this purpose, which is unsatisfactory both for them and for authorised channel users. Channel 35 has become the cornerstone of our long standing attempts to regularise the activities of the independent programme makers and to introduce a co-operative frequency management regime for them. Its loss at this stage would represent a major setback. Additionally, the needs of independent programme makers are likely to grow rapidly if further television networks are authorised, and as a result of Government pressure on the existing broadcasters to source more programmes from the independents. A further caveat is the (perhaps unlikely) possibility of claims for compensation in the courts from displaced users (eg: theatres outside London) or even from VCR and home computer users.

4. A proportion of viewers (perhaps 3/4) would need to equip themselves with a second UHF aerial and a simple mixing circuit. The average cost per household of an additional (non-subscription) UHF TV service would be £30-£50, almost all incurred at the household. This is far cheaper than the cost per household of providing additional television services by any other delivery mechanism. (A six or twelve channel MVDS system could be cheaper per channel, but the initial equipment cost, at £250-£500 per household, would be very much higher.) It is however possible, perhaps even probable, that MVDS, DBS or a subscription service on VHF (or UHF) would be set up in such a way that a subscriber would be provided by the service provider with the necessary equipment in return for which he or she would be required to pay only a weekly or monthly rental (and perhaps a modest initial deposit), thus avoiding the high initial capital outlay that could otherwise deter prospective subscribers.

5. An alternative approach is to make a more intensive use of the 44 channels currently used for broadcasting. Our studies showed that the maximum coverage for a fifth network using these channels would be 17% and London would be excluded. However, if relay transmitters at Hammersmith and Chingford were to be switched off, thereby depriving some 9000 viewers in those areas of one or more of the existing services, the fifth network could then be broadcast from the high power transmitter at Crystal Palace, covering most of London. Coverage would in this way be increased from 17% to nearly 40%. This alternative approach would also pre-empt the plans of the broadcasters to make good existing small gaps in coverage, and incur costs of some £2 million to tighten the frequency stability of some existing transmitters.

A Sixth TV Network

6. The terms of reference of the study did not include the feasibility of a further, sixth, UHF network. However, if the approach outlined in paragraphs 1-4 above were adopted to provide a fifth UHF TV network, the approach in paragraph 5 could probably, if required, be utilised to provide a sixth network. We also considered that a sixth network covering over 50% of the population should not be ruled out as a possibility in the slightly longer term, though further study would be needed to identify the potential more clearly, and its cost could be significantly greater. It would be based on one or more of channels 36, 38 and 69, all of which are currently used for other purposes and may also be crucial to accommodate users displaced from channels 35 and 37 and the expected growth in spectrum requirements for programme making purposes. It might also depend on making some use of the 44 channels as described above. To obtain optimum coverage, the fifth and sixth services would need to be planned together and this would probably delay the introduction of the fifth service beyond 1992. We conclude that UHF represents not only a very much more attractive alternative to VHF for a fifth TV network but that prima facie, it is also the more attractive means of achieving a sixth terrestrial channel, though further study would be needed to establish its technical potential.

VHF Bands I and III

7. These bands were formerly used to transmit 405-line black and white television but were reclaimed from the broadcasters to allow for the much needed expansion of mobile radio services used by business. They are, however, still available under International Radio Regulations for broadcasting use.

Band I

8. Our detailed planning studies have shown that it would in theory be possible to construct a network covering some 60% of the population using two channels of slightly narrower bandwidth than the conventional 8 MHz channels used for UHF broadcasting in the UK. Depending on the necessary international negotiations, VHF broadcasting might commence by 1992. However, in practice such a service would be subject to potentially severe interference from mobile radio sources operating both above and below the broadcasting channels. We conclude that in practice a TV service would have to be restricted to a single 8 MHz channel which might enable the service to reach at best 40% of the population.

9. Even then, there are a number of serious constraints and disadvantages. We should have to coordinate the use of frequencies with our French and Irish neighbours in particular. In the years since we ceased broadcasting at VHF both the French and Irish have registered substantial additional broadcasting use and it is far from clear that we should be able to negotiate the use required to achieve as much as 40% coverage. To obtain maximum coverage, a new service would wish to use the transmitting sites formally used for black and white TV broadcasting. But the re-introduction of VHF TV broadcasting at those sites would cause substantial interference to the private mobile VHF radio services which have extensively occupied them since VHF TV broadcasting ceased. An environmental disadvantage is the return to large H aerials that would very likely be required.

10. However, perhaps the most serious problem relates to a form of interference to band I frequencies known as sporadic E. This is caused by conditions in the upper atmosphere enabling transmissions between 1000 and 2500 km away to be received, completely obliterating the wanted signal. This phenomenon may last for lengthy periods of time, often up to an hour or more, and is at its worst during the summer months and during the early evening. In the days of VHF black and white television the problem generated a large volume of viewers' complaints, so much so that in some areas the BBC's band I transmitter had to be duplicated with another operating on band III frequencies. We judge that the nature and incidence of sporadic E represents a significant inhibition to the re-introduction of broadcasting in band I, especially now that viewers take for granted the relatively interference-free reception provided by UHF. It would reduce the value of band I spectrum to a prospective franchisee. If, despite the many disadvantages, it were to be used for broadcasting, the most suitable option would probably be a service funded by subscription, because the particular relationship which thereby exists between the service provider and his customer would enable some form of recompense for periods of viewing spoiled by sporadic E to be provided. However, sporadic E, and the effect of the high incidence of multi-path reflections in band I, might make the use of pay-per-view subscription at peak viewing hours difficult, since the control data transmitted with the picture could be corrupted or lost as a result of the interference.

11. In addition to the likely need noted above for H aerials, a set-top converter would be required to convert the incoming VHF signal to the UHF frequencies on which existing TV receivers operate. It is estimated that the capital cost per household of establishing a VHF TV service without the additional equipment needed for subscription would be around £100, almost all incurred at the household.

Band III

12. Band III has been divided broadly into three sub-bands. Of these, the middle sub-band has been allocated to a number of major new mobile services, some of which [illegible] and the first of these are

already in operation. It is already clear that demand for these services is set to grow rapidly for the foreseeable future and the lower sub-band was promised from the outset for their continued expansion. Service providers and manufacturers could, and no doubt would, claim that they would not have invested heavily in the technical development and marketing of these services if they had known that they were to be limited only to the middle sub-band. Additionally, mobile transmitters in the middle sub-band would be likely to cause significant interference to adjacent television receivers in the lower sub-band, if that were to be used for broadcasting, whilst high power broadcast transmitters could cause considerable problems for adjacent mobile services. The local oscillators contained in VHF TV receivers or converters, and in existing communal aerial systems, represent a serious potential for interference to VHF TV reception by neighbouring TV receivers, and to mobile radio services. Experience suggests that this could have considerable resource implications for the Radio Investigation Service.

13. This leaves only the upper sub-band, which was committed by Ministers for the development of services using new and advanced technology. Much of this sub-band is still in MoD use and will remain so for the foreseeable future. No licences for advanced technology services in this sub-band have yet been granted, but there is insufficient spectrum here for even a very limited service unless it were to be based on advanced and very expensive bandwidth compression techniques and even then there could be problems of compatibility with the mobile services in the middle sub-band or with the MoD services.

Microwave Video Distribution System (MVDS)

14. MVDS (sometimes also called MMDS, or MDS) differs from conventional VHF or UHF terrestrial broadcasting only in the frequencies employed, which are in the frequency range above 1 GHz. At progressively higher frequencies spectrum becomes more plentiful but the range of transmitters reduces, thereby requiring a larger network of transmitters to achieve a given

level of coverage. One potential advantage of this is that it may enable an MVDS service to cover areas such as the south coast which additional UHF or VHF services may be unable to reach because of international coordination problems. Additionally, the technology becomes more difficult and, initially at least, more expensive. Timescales for the introduction of the service consequently become extended.

15. The study by Touche Ross Management Consultants has concluded, on the basis of R Division's assessment of the maximum amount of spectrum that it might be possible to make available, that up to an additional twelve television services could be provided to geographical areas covering 70% of the population (though within these geographical areas a significant minority of viewers might not be able to receive an adequate signal) by 1992. There are several possible scenarios of which three appear to be front runners.

16. First, spectrum for a six channel MVDS system could probably be made available in the band around 2.5 GHz. Because MVDS services at these frequencies are already in operation in the US, equipment is available virtually off the shelf. The capital cost per household would be of the order of £200-£250 incurred very largely at the household and it is widely felt that MVDS at 2.5 GHz would offer a highly attractive commercial opportunity. There are, however, a number of disadvantages. There might need to be a number of geographical constraints to protect existing users, and some existing users, notably TV outside broadcast channels, would need to be re-housed elsewhere. The 2.5 GHz band is a candidate for international agreement to meet the long term needs of mobile and mobile satellite services; and it could prove difficult to reach a common position on frequency allocations in Europe both for MVDS and other services. This band would also provide little or no scope for MVDS expansion to meet demands either for increased coverage or added channels.

17. Second, a twelve channel MVDS system operating in the 12 GHz band could probably also be introduced by 1992. In addition to the larger number of channels that could be made available in this frequency range, the advantages of the 12 GHz band are that it is already internationally allocated to broadcasting (it is the band in which the DBS satellites operate), and there is at least a possibility that some other European countries might also adopt MVDS at 12 GHz thereby widening the potential market. There could be the benefit of some commonality between MVDS and DBS receiving equipment. Disadvantages are that equipment at 12 GHz is at present substantially more costly than that at 2.5 GHz. It has been estimated that the capital cost per household of MVDS at 12 GHz might be between £300 and £500 , ie: as much as twice that of MVDS at 2.5 GHz. This clearly reduces its commercial attractiveness and puts its cost on a par with DBS and Astra. It is thought likely that the costs of 12 GHz equipment will reduce substantially once a mass market develops (Japan already has limited terrestrial broadcasting of 12 GHz and both France and Switzerland have experimented with it), but the timing is clearly difficult to predict. At present that part of the 12 GHz band in the UK not allocated to DBS is used by the broadcasters for outside broadcast links and by BT. These would need to be re-housed and there is no obvious alternative currently in sight. There may also be problems of technical incompatibility between MVDS and DBS services operating in adjacent frequency bands.

18. Third, MVDS could be used on a much more limited basis to help "pull through" cable. Thus MVDS could be used to provide a limited number of channels quickly, and at low capital cost, throughout a cable franchise area. The customer base that would thereby be established, and the resulting revenues generated, in the difficult early days of a cable franchise would, it is argued, both improve the investment profile of cable and the franchisee's prospects of achieving a satisfactory penetration of cable throughout his area. The use of MVDS would be progressively withdrawn over a controlled period in line with the required rate of cable build. The 2.5 GHz band is the obvious choice for cable pull-through because the equipment is readily available, whereas at 12 GHz it is not, and the more limited

frequency requirements for cable pull-through (as compared with those for national coverage at 2.5 GHz) could probably be met quite quickly. Its use in cable franchise areas would need to be carefully regulated and controlled. It is not difficult to envisage the substantially more attractive investment and revenue profiles of MVDS, once authorised, as acting as a disincentive to cable operators to continue with the expensive task of cabling for interactive services. It is likely that the options of national MVDS, and MVDS as cable pull-through, are mutually incompatible at least within the same timescale.

19. Reception of MVDS at either 2.5 GHz or 12 GHz will require a dish aerial about two feet in diameter (though a smaller dish may suffice for households close to the transmitter). The dish could be of mesh or lattice construction at 2.5 GHz, but would need to be a continuous reflecting surface at 12 GHz. Since line of sight to the transmitter is required, aerials will have to be mounted as high as possible, and generally above the roofline. In this they differ from the dish aerials needed for DBS reception which can be at ground level, under the eaves, or even behind a window, and are generally likely to be much smaller (about one foot diameter).

Additional DBS Channels

20. Under the international allocation of channels for DBS in the 12 GHz band the UK has five channels in the lower half of the band, of which three have been awarded to BSB. It is the upper half of the band, at present allocated in the UK to outside broadcast links, which we have identified as a possible home for a twelve channel MVDS system. As an alternative, or possibly even as an addition, to MVDS it may be possible, if we act quickly, to provide additional television services by acquiring one or more further blocks of currently unallocated DBS channels. One of these blocks could be received by viewers using precisely the same equipment that will be needed to receive the three (plus two) BSB channels. Other possible allocations that may be available to us would mean that viewers with a fixed dish aerial aimed at the UK

DBS satellite would need either to replace that with a steerable dish or to add a second fixed dish if they wished to receive the additional channels.

21. DBS services can achieve - at least potentially - 100% coverage of UK households though the cost per household of the receiving equipment is high, say £300-£500 (though BSB optimistically estimate £200) and the initial capital required is substantially greater than that of establishing a terrestrial network covering some 70% of UK households.