

# STUDY TO REVIEW THE CONFIGURATION OF THE 450-470MHz BAND IN THE UK

**Note:** Please state whether you want to be attributed to the response or any part or all of the interview or the response to remain confidential and/or non-attributable.

**Date of Interview:**

**Interviewer:**

**Organisation:**

**Interviewee:**

**Position in Organisation:**

**Telephone:**

**E-mail:**

**Interviewees' main responsibilities:**

## **Purpose of this Questionnaire**

The information provided from key stakeholders as a result of this questionnaire will be used by Ofcom to develop future spectrum policy for the UHF2 band.

This questionnaire shall be used to assist Mott MacDonald in assessing the cost benefit analysis to provide Ofcom with options on gaining the highest value use of the band. The options will be based in the context that spectrum currently used by the emergency services will become vacant which presents an opportunity to review the future configuration of this band. Please see attached Letter of Introduction from Ofcom, which authenticates the study and provides further clarification.

Mott MacDonald will be conducting a number of face to face interviews and telephone interviews, and distributing questionnaires. The structure of the interviews and questionnaires has been agreed with Ofcom, and we encourage you to provide your input to the study. If you have any questions regarding this process please contact Mark Redman Tel: 0161 9264048, or e-mail [mark.redman@mottmac.com](mailto:mark.redman@mottmac.com).

If you are representing a trade association or a number of stakeholders, please provide a consolidated view on the questions. Your responses are required by the **9<sup>th</sup> November 2007**, e-mailed to [saul.friedner@mottmac.com](mailto:saul.friedner@mottmac.com).

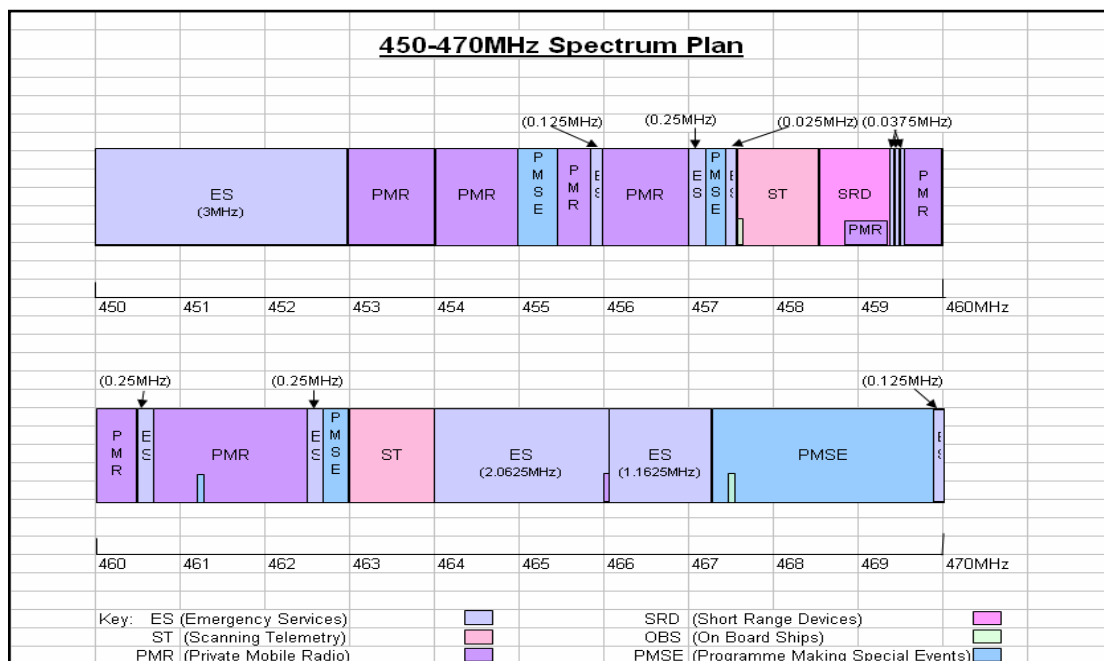
# 1. Questions for current UHF2 Licencees

- a. Briefly describe the current services/applications that are deployed within your service that use UHF2 radio spectrum?
- b. What spectrum are you licensed? Do you use it all, if so, on what basis?
- c. Would another technology or service make the use more efficient? Explain?
- d. What are the benefits of the service facilitated by UHF2 spectrum to your business?  
e.g. save on fuel and cellular costs for logistics services such as taxis, deliveries.
- e. Would you consider trading your spectrum? If so, on what grounds?
- f. When are you considering upgrading your radio equipment/what is the life expectancy?
- g. When was the last time you upgraded your radio communications equipment?
- h. Why do you have a private communications network and not use a public network?  
*What are the benefits?*  
*What is the cost comparison?*
- i. Are you considering changing your communications network or would you like to?  
Is this to another technology, which and why?
- j. What impact on your business would any re-configuration of the spectrum have, and if possible attempt to quantify in financial terms? Please outline the main costs and risks?
- k. If Ofcom were to re-configure part of the band that involves your licensed spectrum what terms, if any, would encourage you to participate, examples below:
1. Recovery of cost of the change, with rights to spectrum to provide the equivalent service in the new reconfigured UHF2 band.
  2. There are no circumstances in which you would participate in re-configuration for a number of given reasons.

## 2. Future demand and potential benefits if spectrum was made available

Future Demand and benefits:

It is likely that contiguous or 10MHz duplex split spectrum will be of highest economical value, therefore upon most of the ES spectrum becoming vacant, the spectrum that will be of most interest for a quick gain is 454-457MHz paired with 464 – 467MHz and 460-463MHz and 450-453MHz band . See diagram below:



This section is trying to understand the benefits that would accrue from the release of spectrum in different configurations.

a. If the Emergency services spectrum (in the diagram above) was made available in its current configuration, what technology would you consider using and what services would you now be able to provide?

b. If the Emergency services spectrum (in the diagram above) was made available in a re-configured arrangement what technology would you consider using and what services would you now be able to provide? What configuration would be most suitable and how much spectrum is needed? How much more is this worth to your business e.g. 5 times more?

- c. Please explain the benefits to your business/customers and the UK economy to your answer to the above?
- d. Based on the services that could be enabled by the award of the spectrum (in your answer to above), what are the likely projected revenue streams (in terms of Average Revenue Per User - ARPU) that could be earned through the use of the spectrum over the next 15 years? What are the key revenue drivers for these services?
- e. What, in your opinion, are the other factors that will influence the value of your preferred spectrum, i.e. availability of terminals, other spectrum bands (TV bands), demographics?
- f. Please provide separate revenue estimates for each service identified or at least a description. These could be provided as a 'low', 'medium' and 'high' projection?

### 3. Costs of re-configuration of the spectrum

a. Please provide your views on the estimates of typical user costs of spectrum realignment calculated by PA Consulting (2004 report to Ofcom, attached to this questionnaire). Do these estimates need to be revised or changed in any way? Are there any additional costs that need to be included? In addition to your views on the total cost estimate, please provide, if possible, your views on the cost estimates in each of the cost categories identified by PA Consulting:

- The costs of modifying or replacing base station and mobile equipment
- The cost of site engineering – re-tuning or replacement of filters and combiners that are specific to the current frequency arrangements
- The cost of antenna re-planning, and special site engineering that might be needed to overcome interference, blocking or inter-modulation when the frequencies are changed
- The cost of providing temporary parallel infrastructure to enable continuity of service or long-term migration of a large pool of end-user equipment (to include cost of site, equipment, installation and removal and interim running costs)
- The project management that will be needed to plan and co-ordinate the changeover
- Potential re-training of technicians or end-users in the case that new equipment is deployed
- Any costs associated with hiring equipment or services to maintain service during equipment downtime
- The cost of providing additional staff to cover temporary outages of critical systems and to perform the re-configuration of central network control systems
- Cost of replacing stock or spares that is obsolete by the band alignment process and must be replaced to ensure continuity of maintenance provision
- (For public network operators) Any loss of revenue from customers who move to an alternative either during the changeover, or permanently.

## **4. Future Requirements**

a. How is the service/technology that you provide to your users likely to change from now until 2020 and what are the implications of these changes for the way you use radio spectrum, and how much you will require?

1. What are the key technologies that are likely to be in play? [inc. changes in capacity/applications]

2. What constraints are you likely to face in terms of adoption?

b. What risks might this future present from a spectrum point of view?

1. What might the impact on Service Level Agreements (SLAs) be?

c. How would UHF2 spectrum realignment with Europe affect your services in the future?

d. What are the risks of not aligning with Europe?

e. What would be your preferred method of accessing 450-470MHz spectrum going forward?

1. What do you currently do to ensure appropriate access to spectrum is provided by Ofcom and other relevant agencies?

2. What else would you like to see done in terms of consultation and allocation?

3. In terms of understanding the aims of the study, what are the key risks to your company in any follow-on activities and actions by Ofcom?

f. Do you think that the spectrum trading market for UHF2 will assist in refarming spectrum to its highest value use?

## **5. Any other comments?**

Any other thoughts or observations on this study?

# Ofcom

Typical user cost for 450-470MHz band  
alignment

Executive Summary

10 June 2004

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Typical user cost for 450-470MHz band  
alignment

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10 June 2004

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## ***FOREWORD***

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This document is the Executive Summary of the Final Report of the PA Consulting Group (PA) study for Ofcom into the Typical User Cost for 450-470MHz Band Alignment. The study is in response to Invitation to Tender AY 4543 issued by the Radiocommunications Agency (RA) on 27 October 2003.

As agreed with Ofcom, this version of the Executive Summary is suitable for publication. It is not subject to the confidentiality restriction that applies to the full document, as it has been modified to ensure that our prediction of the cost to any individual user cannot be deduced. Necessarily this means the level of detailed cost breakdown has been reduced compared with the full version of the report supplied to Ofcom.

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## **EXECUTIVE SUMMARY**

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This document is a summary of the Final Report of the PA Consulting Group (PA) study for Ofcom into the Typical User Cost for 450-470MHz Band Alignment, in response to Invitation to Tender AY 4543 issued by the Radiocommunications Agency (RA) on 27 October 2003.

### ***Overview***

The study provides an independent assessment of the total cost of UHF2 band alignment using a robust methodology based on consultation with users and industry players combined with bottom-up cost modelling. Assuming that alignment of each user will take place with a single frequency change, we estimate the total cost of band alignment will be between £260M and £310M.

### ***Band alignment is controversial***

Ofcom (formerly the Radiocommunications Agency) has been considering re-organising the 450-470MHz band (UHF2) since the early 1990s. The aim is predominantly to bring the UK in line with continental Europe's use of the band. This should reduce the risk of current and future interference and Ofcom believes this will also provide access to lower cost equipment due to economies of scale.

There is also an opportunity to rationalise the use of the spectrum in this band which might free up some 3MHz of spectrum, giving long term economic benefit. General spectrum scarcity in UHF arising due to constraints introduced by recent changes to the Fylingdales radar system is an increasingly important driver for change in the UHF2 band.

While the concept of re-aligning the band has been discussed for some time, there has been significant recent unease among user groups as to the high cost associated with this exercise and the potential mismatch with benefits to users. The aim of this study is to provide an independent assessment of the likely cost for different users of the band – accumulating into the total cost of the band alignment process. This report will enable a more informed discussion to take place between Ofcom and the industry.

The scope of the study is limited to assessment of the costs of band alignment. Development or optimisation of Ofcom's present 12-stage frequency transition plan is outside the scope of the study. However, we have assumed that it will be possible to develop a practical migration sequence where all frequency assignments are changed only once during the migration. The potential impact of using "parking frequencies" (where users are moved to a temporary holding allocation and later to the final allocation) is discussed briefly.

Determining the value of any benefits and to whom they accrue is a separate important exercise that is outside the scope of this study. Furthermore, the study includes no assessment of the current European interference issues or the potential interference threat arising from future continental adoption of new services in the 450-470MHz band.

## ***The study process was based on industry consultation***

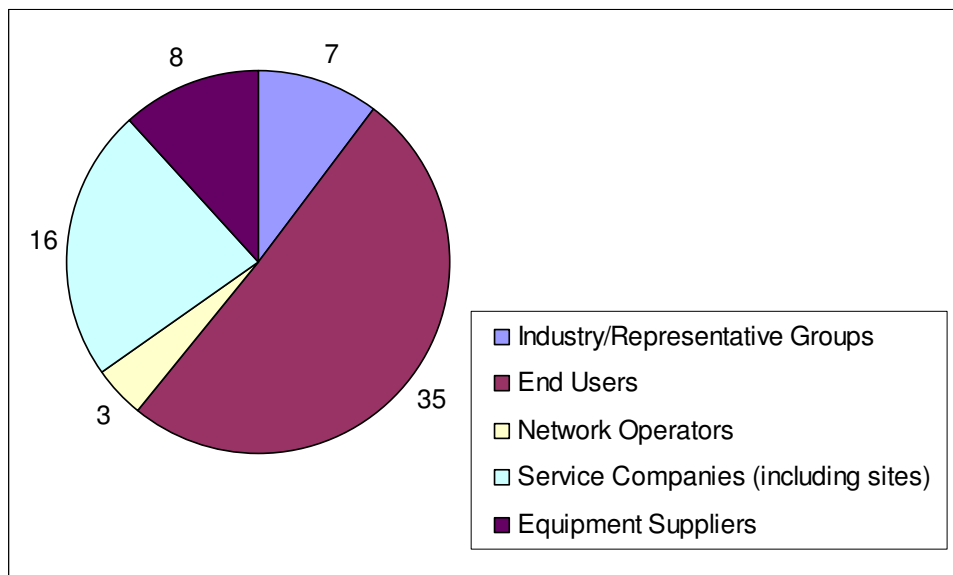
The study methodology was designed around industry consultation, in order to obtain industry buy-in to the results, and flexible cost modelling, in order that the sensitivity to various input assumptions could be tested.

There are many different user types in the affected band:

- Basic Private Business Radio (PBR) – including councils, retailers, industrial complexes, on-site security, event venues, etc.
- Wide Area Paging – mainly hospitals and universities
- Programme Making and Special Events (PMSE) – including radio and TV broadcasters, studios, theatres, etc.
- Scanning Telemetry (ST) – mainly water and energy utility companies
- Network Operators providing managed mobile data-only services.

The targets were chosen for interview in order to ensure they collectively covered the full range of users and requirements. This included a mix of national/regional/on-site use, handheld/vehicle-mounted/embedded terminals, high/medium/low number of terminals, 24/7 or weekday-daytime service availability need.

Most users outsource their radio system maintenance to suppliers and these organisations were also targeted to provide information for costing purposes. Figure 0-1 shows the distribution of organisations that participated in the study. The contribution of the participants to the successful conclusion of the study is acknowledged in Section 0.



**Figure 0-1 Breakdown of organisations participating in the study**

For most user segments, inputs from the industry were largely in agreement. As a result we had to make only limited changes to inputs from interviewees in order to build a common framework to the cost model for each user category. We provided extracts of the results to a subset of key interviewees in order to obtain their feedback. As a result, we believe we have a baseline cost and sensitivity ranges for band alignment of each segment and an overall figure which should be accepted across the full range of users.

***Database analysis was used to quantify affected users***

User categories and quantities were determined for later cost analysis through analysis of databases supplied by Ofcom and by the companies that manage parts of the spectrum on Ofcom’s behalf (JFMG, CSS, JRC).

Not all users in the UHF2 band will be affected by band alignment. Of the total of 36,094 allocations, 16,280 are affected by band alignment. Overall we estimate that around 5,000 individual organisations will be affected by band alignment.

On the basis of the licensees subject to band alignment, the following categories were used in the cost model. Table 0-1 provides a summary of the number of users in each category and the estimated number of base station and terminal equipments.

User Type	Number of licensees	Number of base stations	Number of terminal equipments
PBR	4334	12650	~350,000
Paging	226	290	~60,000
PMSE	397	~500	~3,500
Telemetry	~100	~800	~20,000
Network Operators	2	~250	~64,000

**Table 0-1 Summary of User numbers affected by Band Alignment**

One of the most complicated aspects of band alignment implementation is the issue of RF engineering considerations on shared sites, or sites with multiple frequencies. The costs associated with this were determined. Of 10,656 sites, only 401 are shared between more than one user. 7,692 sites have only one user and one frequency.

## ***The full range of cost elements have been included***

### **Common Issues**

There are a range of issues that will be faced in the migration process, many of which were covered in the 2003 RA consultation responses and have been raised again by users during our study. While each user segment faces specific issues, the following are the key issues, generic to all user types:

- Need for equipment re-tuning or replacement
- Coordinating multi-user sites – where users on one site or within an area might be planned to re-align at different times
- Maintaining continuity of service necessary for business purposes
- Logistics of the equipment changes – limited of resources to do re-tuning
- Business uncertainty – inability to plan or compete with confidence.

### **Potential Costs**

There is a wide range of potential costs that must be considered in the model. The following list was developed by PA and agreed with Ofcom and refined as a result of the user interview programme:

- The costs of modifying or replacing base station and mobile equipment
- The cost of site engineering – re-tuning or replacement of filters and combiners that are specific to the current frequency arrangements
- The cost of providing temporary parallel infrastructure to enable continuity of service or long-term migration of a large pool of end-user equipment
- The user project management needed to plan and co-ordinate the changeover
- Potential re-training where new equipment is deployed
- Any costs associated with hiring equipment or services to maintain service during equipment downtime
- The cost of providing additional staff to cover temporary outages of critical systems and to perform the re-configuration of central network control systems
- Cost of replacing stock or spares that is obsoleted by the band alignment process and must be replaced to ensure continuity of maintenance provision
- Any loss of revenue from customers who move to an alternative either during the changeover, or permanently.

For the purposes of the study, we determined that the cost to be included in the model should be “the minimum of the cost of switching to new equipment and the cost of re-working existing equipment, which at least maintains existing service capabilities”.

Cost estimates have been made on the best information available, but there are many unpredictable factors which will increase the cost above that which we have identified. As a consequence, we have included a contingency margin of 20%. This covers factors such as uncertainty in database information, wasted engineering effort in cases where vehicles or terminals are not available for conversion or there are problems with site access, the cost of delays arising due to technical problems at sites and increased labour costs due to the market demand for engineers.

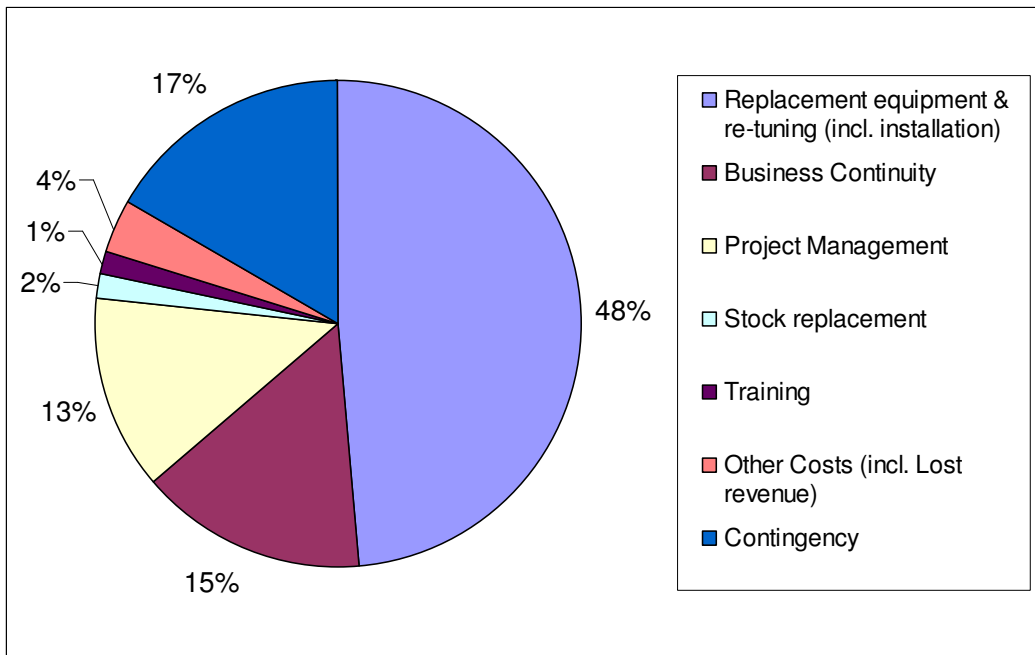
In addition to the costs to individual users, there will be further costs associated with the band alignment project (many falling to Ofcom) including database preparation, migration planning and alignment coordination and enforcement.

***Total costs for alignment are between £260M and £310M***

We estimate the total cost of band alignment to be between £260M and £310M, with the baseline total around £277M. These figures are obtained by summing the costs for the user categories with the cost of site engineering and applying statistical analysis to estimate the likely range. Figure 0-2 provides a summary of the total baseline costs and the split between cost categories.

Note that it is not possible in this document to present the exact balance of costs between user segments as some of this information is confidential to users.

Replacement equipment & re-tuning (incl. installation)	£134,533,440
Business Continuity	£41,803,303
Project Management	£36,393,170
Stock replacement	£4,649,940
Training	£3,650,577
Other Costs (incl. Lost revenue)	£9,887,393
Contingency	£46,183,565
Total Cost	<b>£277,101,387</b>



**Figure 0-2 Total Cost of Band Alignment**

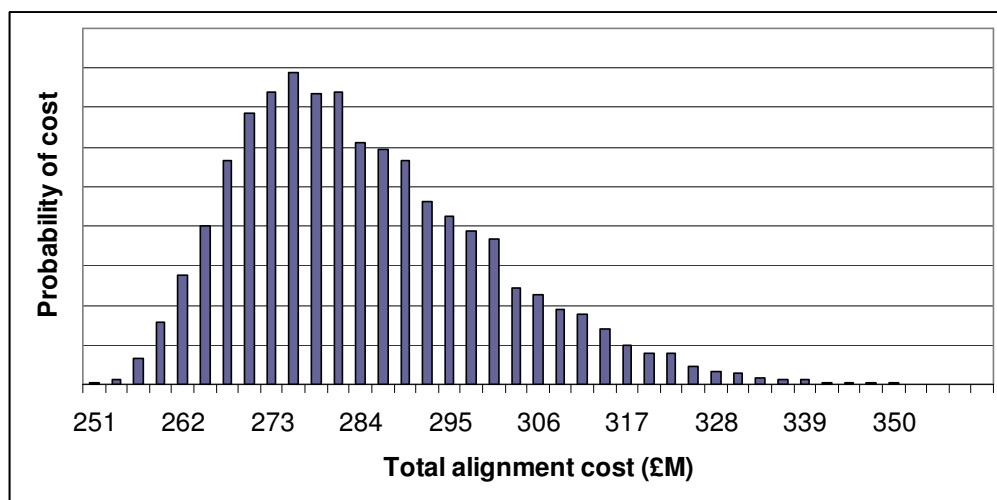
The following important observations are relevant to the calculated costs:

- Major components are PBR users, Network Operators and costs associated with RF re-engineering on complex sites.
- While PBR represents around 70% of end-user equipment affected by band alignment, its share of the costs is lower than this because the majority of PBR equipment in the field is capable of re-tuning and competition between dealers ensures reasonably low costs for re-tuning or replacement equipment.
- The two network operators face significant challenges as their businesses are based on providing services to end-customers and their alignment plan must ensure continuous service while minimising inconvenience to customers.
- The site engineering costs are relatively high due to the bespoke, channel-specific nature of the equipment, the need to provide duplicate system operation for many users and practical implementation difficulties. We have assumed that sufficient site database preparation and RF interference planning is performed that there will be minimal issues with interference that affect user service performance.
- While the telemetry sector contributes only 8% of the total, the cost for the largest utility licensees can run into several million pounds. This is due to the need for site visits, the embedded equipment and the need to ensure continuous service.
- The PMSE sector is specialised, which leads to a slightly higher cost per equipment. While the re-alignment costs are relatively significant for the organisations affected, the low equipment numbers in the sector as a whole lead to it contributing only 5% to the total.

- As for PBR, dealer competition applies to the paging sector and with fewer equipments and lower equipment costs, this contributes only 3% of the total. Our high-level estimate is that Ofcom will bear an additional cost of less than 10% of the total alignment cost to cover database preparation, migration planning and management and enforcement of the alignment process.

### ***The uncertainty in the total cost has been estimated***

The parameters in the detailed, bottom-up costing were flexed to determine the sensitivity of the total costs to the assumptions. With the exception of the contingency margin, most individual parameters have a limited impact on the total cost, leading to a change in total cost of less than £10M. To estimate the likely uncertainty range, we performed a statistical analysis where several key parameters were varied in combination. The resulting distribution of total cost is shown in Figure 0-3, which leads us to believe that the total cost will be between £260M and £310M.



**Figure 0-3 Probability distribution of total alignment costs**

If the migration plan involved parking frequencies within the UHF2 band, the cost would be increased by around £180-200M if all licence allocations were changed twice. If the parking frequencies were in a different part of the spectrum, we would expect the alignment costs to be more than doubled to over £500M.

The baseline costs have not included Network Rail because the current plan is for migration of its affected system to GSM-R.

### ***The alignment timescale has limited impact on costs***

It is important that the current planned timescale is kept for notifying users of their new frequencies and the timing of their change. The past delays have added to industry concerns and uncertainty and puts UHF2 users at a disadvantage if they are competing with other systems (such as GSM-based).

The current schedule is for Ofcom to perform migration planning during 2004/5 and to notify licensees of their new allocation at the end of 2005. The migration process will begin in 2006 and continue until 2010.

There are logistics issues that will dictate the pace of the alignment programme. A few users will take several years to migrate (the network operators and largest utilities). Many will take several months (eg. large PBR users). The majority of users will be able to change within a few days, subject to resolution of site engineering issues.

Starting later will mean a higher proportion of equipment should be re-tuneable. We estimate that this effect would reduce costs by only around £10M if the process was delaying by 2 years. There is also the risk that more, non-programmable equipment may enter the market in some sectors, increasing alignment costs. The major cost item of site engineering will not change significantly if the alignment is delayed for a few years.

The more significant factors relating to alignment timescale are external. The move of the Emergency Services to Airwave (towards end 2005/6) is needed for the process to begin. Network Rail are migrating their system to GSM-R, with the plan being to complete migration on the affected lines by 2010.

### ***Migration planning is the most critical open issue***

The biggest open issue surrounds the coordination of alignment of users, particularly in congested urban areas and at multi-user sites. This requires detailed planning and optimisation followed by strong management and robust enforcement procedures. The current 12-step migration plan requires modification to deal with multi-user sites and the need of some users for long-term parallel network operation.

The databases of information that will be required to perform the migration planning are generally of poor quality. This applies to both Ofcom and most site owners. Until good databases of users and equipment are in place, planning cannot be performed to a level that will provide good confidence that the migration plan has a low risk.

### ***PA recommends actions to reduce the risks of alignment***

- Ofcom need to provide clarity to the industry on plans for band alignment, ensuring users are informed as soon as possible whether band alignment will take place and when they will be notified of their new arrangements
- Existing databases must be cleaned-up and (working with other parties such as JFMG, CSS, JRC and site owners) new ones developed, containing the necessary user and site information to facilitate detailed migration planning
- Any tools necessary for optimisation and validation of the migration plan should be developed

- Detailed frequency planning of migration process for all users should be performed, with users notified of their changes at the earliest opportunity
- Ofcom need to plan the management of the migration process, working with the industry to identify the roles and responsibilities of different organisations (Ofcom, JFMG, JRC, CSS, users, site owners, etc.) and the steps to be taken.

## ***Acknowledgements***

The successful completion of this study would not have been possible without the support of the Ofcom project management team and the participation of many end users, dealers, suppliers and representative groups. PA wishes to acknowledge the involvement of the following organisations in the preparation of this report.

900 Communications	Electrolux
Aerial Facilities	Energy Networks Association
Air Radio	Ericsson AB
Anglian Water	Federation of Communication Services (FCS)
Ascom Tele-Nova	Fountain Television
Asda	Gog Magog Golf Club
B&Q	Granada
Banbury School	Gridcom
Banbury Town Council	Intercontinental Hotels
Bancom Communications	JFMG Ltd
BBC	Joint Radio Company Ltd (JRC)
Blick	Key Radio Systems Ltd
BNFL	Liverpool John Lennon Airport
Cambridge City Council	London Communications
Cambridge Water	Luton Borough Council
Chrysalis Radio	Marshalls of Cambridge
Co-channel Electronics	MDS (Microwave Data Systems)
Cogent	Mike Weaver Communications
Commercial Radio Companies Associations (CRCA)	Monarch Airlines
Corus (Construction & Industrial)	Motorola
Crown Castle	Multitone
CSS Spectrum Management Services Ltd	National Grid Transco (NGT)
Direct Communications (DCRS)	National Theatre
EADS Astrium	Network Rail
EARS plcs	Nortech Radio Telephones Ltd
EdF Energy	Northampton Borough Council
	NTL

On Site Communications Association

Radio Communications Ltd

Radio Links Communications

RCS (Midlands) Ltd

Royal Opera House

Siemens VDO Trading Ltd

Sky Studios

South West Water

Stansted Airport (BAA)

Tesco

TK MAXX

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Transcomm UK Ltd

UKAEA

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Vodafone

Vivista

Water Service of N.Ireland

Yaesu