5 The cost of calls to mobile phones

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Introduction

5.1. This chapter discusses issues related to and methods for determining the costs of incoming calls. It sets out the principles involved in cost allocation, including the issues related to adopting an LRIC as opposed to an FAC approach for determining the cost of calls to mobile phones. It describes the cost allocation models developed by OFTEL, by Cellnet and by Vodafone, and also the model developed by the MMC. It discusses projections of future costs. Finally, it considers issues relating to the setting of a price control on incoming calls; and the possible effect of such a control on the MNOs.

Comparison of the performance of Cellnet and Vodafone

5.2. Chapter 3 shows the financial position of the four MNOs. Tables 5.1 and 5.2 compare the profit and loss accounts of Cellnet's and Vodafone's mobile operations, and their equivalent revenue and expenditure in ppm for 1997/98. Both were profitable and cash generative. One2One and Orange both provided us with equivalent data but we do not reproduce it here, as it is commercially confidential and is not essential for an understanding of our conclusions. Vodafone recovered average revenues per overall call minute (incoming and outgoing calls) of 26.5 ppm compared with some 32 ppm for Cellnet. Vodafone's profit before tax amounted to 12 ppm compared with some 4 ppm for Cellnet.

TABLE 5.1 **Comparison of revenue and costs of Vodafone and Cellnet, 1997/98**

	*Vodafone**	*Cellnet†*
		£ million
Outgoing calls revenue	*Figures omitted. See note on page iv.*	
Incoming calls revenue		
Other income		
Subscriptions and other income, net of discounts		
Total income		
Operating costs		
Marketing and incentives		
Earnings before interest, tax and depreciation	707	✂
Depreciation	–122	
Interest and lease payments	17‡	
Profit before tax	602	
		bn minutes
Analysis of traffic		
Incoming calls	*Figures omitted. See note on page iv.*	
Outgoing calls		
Total traffic		
Number of subscribers at year end (m)	3.4	3.1

Source: MMC, OFTEL and submissions from the companies.

*Figures are closely comparable with the published results of Vodafone Limited.

†Cellnet's figures are from its management accounts for the group. The profit before tax differs from the reported profits because of timing differences in the recognition of exceptional items. Cellnet group consists principally of the mobile operation.

‡Interest received.

[Details omitted. See note on page iv.]

TABLE 5.2 **Comparison of revenue and costs of Vodafone and Cellnet, 1997/98**

	ppm	
	Vodafone	*Cellnet*
Outgoing revenue (per outgoing call minute) Incoming revenue (per incoming call minute) Other income and subscriptions (per minute)	*Figures omitted* *See note on page iv.*	
Pence per minute (based on total traffic) Total revenue Total costs Earnings before depreciation, tax and interest Depreciation and interest Profit before tax		
Total costs per minute (including depreciation)	15.0	26.8
Total costs per minute (including depreciation and interest)	14.6	28.0

Source: MMC and submissions from the companies.

5.3. Vodafone's cost was around 15 ppm; Cellnet's was about 28 ppm. The depreciation and interest costs were 2 ppm for Vodafone and 6 ppm for Cellnet. It should be noted that the traffic figures (supplied by the DGT) included calls made by overseas visitors roaming on Vodafone's and Cellnet's networks. Such calls are not made by Cellnet's or Vodafone's customers, but they are handled by their networks, so it is appropriate to include them in comparisons of costs per minute. The revenue from such calls is included in 'other income'.

Cost allocation

5.4. There are two distinctive features of a telephone network, whether of fixed or mobile phones.

5.5. First, the costs of providing and operating a network are determined almost entirely by the network designer's decisions on the capacity to be provided (which is broadly the capacity required to handle all the traffic expected in the busiest hour), quality of service and the level of coverage to be provided (both the area of geographical coverage and the depth of coverage to be provided in urban areas) at a given time. Once a network has been constructed, the short-run marginal network cost of a single additional call is close to zero, except that the operator will have to pay a termination charge on outgoing calls to other networks. Secondly, the network is used to provide different services—in particular, it provides the ability to make calls and the ability to receive calls.

5.6. Determining the costs of an incoming call is, therefore, a matter of finding an appropriate methodology for allocating costs, a large proportion of which are fixed, over the services provided and identifying the proportion which is to be allocated to incoming calls.

5.7. All the MNOs told us that they did not, at least for their normal commercial activities, carry out this kind of allocation. Prices were set, they told us, not by reference to a notional cost plus margin, but by the need to recover the totality of costs through the available revenue streams (including connection charges, subscription charges, charges for outgoing calls and termination charges to other networks). The levels of, and balance between, these streams were driven by marketing considerations, not costs.

5.8. Nevertheless, there are occasions when cost allocations are undertaken, in particular in the determinations of termination charges by the DGT. The MNOs told us that most of their work on cost allocation had been carried out in response to requests from the DGT for information to determine termination charges, or from BT for information as a basis for agreeing termination charges.

5.9. The DGT first made a determination of termination charges, and hence investigated cost allocations, in the mobile phone sector in August 1991—when Mercury (now part of CWC) objected to the level of charges proposed by Cellnet and Vodafone—and has made others since.

5.10. The principal costs to be allocated are the various aspects of operating expenditure. A view also has to be taken on the appropriate level of return on capital investment (the WACC is relevant in this context) and how it should be allocated.

Operating expenditure

5.11. Cellnet and Vodafone gave us a breakdown of their operating expenditure into the following categories:

— cost of sales;

— network operating costs;

— overheads; and

— marketing costs.

The detailed analysis of costs was different. Depreciation, whilst not strictly speaking an operating cost, was treated as such for the purpose of allocation.

5.12. For Vodafone, the cost of sales was principally the termination charges paid to other network operators (POLOs). Cellnet also included its service provider incentives in this category; Vodafone treated service provider incentives as marketing expenditure but deducted service provider discounts from gross turnover to arrive at a net turnover figure. Cellnet included engineering costs and depreciation within network operating costs, while Vodafone placed the former in overheads and accounted for the latter separately.

Cost of capital

5.13. Network operators undertake a continual programme of capital expenditure mainly to improve and expand their networks. Capital is also expended on upgrading old equipment and on replacing out-of-date technology with new, more cost-effective, units. Both Cellnet and Vodafone told us that they planned to spend several hundred million pounds a year over the coming years to these ends. They expected that the expansion of coverage of GSM networks would be virtually complete by 2001/02 and that, from that point forward, additional roll-out expenditure would be for increased capacity. The existing GSM networks were likely to continue to provide a commercial service until at least 2008 and possibly up to 2013 when satellite and UMTS systems might supersede GSM.

5.14. In addition to continued expenditure on GSM, all the operators were considering bidding for UMTS licences, which are to be awarded in 1999. The infrastructure to support a UMTS service will need to be developed from 2000 ready for the launch of the service in 2002. The investment required, in terms of licence fees and capital expenditure, will be very substantial.

5.15. Termination charges for incoming calls need to take into account not just operating expenditure (including depreciation) but also a reasonable rate of return on this capital investment. We assessed this by applying the appropriate rate of return to the relevant assets. However, neither Cellnet nor Vodafone accepted this approach. Cellnet said that it was inappropriate in an industry where the risk that the business could be unsuccessful was significant. Vodafone said that it was wrong to apply the same rate of return to each group of assets in situations where marginal cost pricing did not cover fixed costs.

5.16. In his March 1998 Statement, *Prices of calls to mobile phones*, the DGT said that he considered the range of the nominal pre-tax cost of capital for the Vodafone Group to lie between 16.5 and 19.0 per cent. The DGT's assessment of the cost of capital had been made in the course of updating his determination of interconnection of CWC with Vodafone and Cellnet, for which purpose the DGT used the mid-point of the range indicated; that is, 17.75 per cent. The DGT made his calculation using the CAPM with a beta for Vodafone of 1.29. No data were available on Cellnet's

beta as betas are available only for companies which are directly traded on the stock market. However, the DGT said that Cellnet's cost of capital could be assumed to be the same as that of Vodafone as the two companies were similar. In his evidence to us the DGT confirmed his use of a pre-tax nominal WACC for Vodafone and Cellnet of 17.75 per cent. The DGT told us that he had made no estimate of a cost of capital for Orange or One2One, but that his best estimate was that it would be similar to that of Vodafone.

5.17. Vodafone told us that its own best estimate of its WACC was 13 per cent post-tax (or 18.5 per cent pre-tax). Although Vodafone had eventually accepted the cost of capital put forward by the DGT of 17.75 per cent, it told us that it disagreed with a number of the input assumptions and methodologies used by the DGT. Cellnet also took a different view on a number of the assumptions used by the DGT. It told us that, taking into account the implications of the DGM, 20 per cent in pre-tax nominal terms was a more reasonable figure for its cost of capital than the 17.75 per cent derived by the DGT. Orange and One2One also supplied us with estimates of their WACC.

5.18. In the course of our inquiry the DGT told us that, as the most recent published data on Vodafone gave a beta of 1.03 (compared with the 1.29 he had used earlier), he had revised his estimate of Vodafone's WACC from 17.75 to 15.5 per cent.

Long-run incremental cost and fully allocated cost approaches

5.19. An FAC cost allocation examines the capital actually invested in networks and the cost of operating the network and allocates the costs to each of the services offered by the network (for example, the making and receiving of calls) retrospectively. A forward-looking LRIC, on the other hand, considers only the costs that are caused by the provision of a defined increment of output. The DGT said that, in his approach, the relevant increment was the whole of the output of the service. That is, for termination on mobile networks the relevant increment was all incoming calls.

5.20. Until the end of 1997, MNOs' licences provided that, where the DGT determined interconnection charges, these should cover all relevant costs, including the FAC attributable to the services to be provided. However, the DGT told us that he believed that the most appropriate and economically efficient basis for assessing the charges for incoming calls was LRIC. Such an approach had already been in place for BT since 1 October 1997 and he wished to move to LRIC for the MNOs as soon as possible.

5.21. His view was that because LRIC relied upon forward-looking costs, and emphasized current rather than historical valuation of assets, it would ensure that charges were set on a basis that more accurately reflected the cost of resources consumed by the provision of such services. Moreover such charges would correspond with the level that could be expected if a market was properly competitive. He said that he would like to see incoming call charges fall to LRIC-based levels over four years.

5.22. In April 1998 the DGT appointed consultants to examine the application of LRIC to the building and operating of mobile networks. They did this in two ways: a bottom-up approach, designed to calculate the cost of a network from its elements; and a top-down approach, based on allocating current cost accounting costs to the services provided. The incremental cost per unit of demand was calculated for three services (access, outgoing calls and incoming calls). Details of the analysis are given in Appendix 5.1.

5.23. The results of the bottom-up analysis are summarized in Table 5.3, which shows the cost of providing these services for a GSM 900 network and a PCN 1800 network. It shows a lower cost of an incoming call than the FAC equivalent. It also indicates a higher cost for operating the PCN network compared with the GSM network. The top-down analysis produced different results for both GSM and PCN networks but we have not included them in our report because the DGT submitted that they were confidential and we did not consider their inclusion to be necessary for a proper understanding of our findings.

TABLE 5.3 **Results of the DGT's bottom-up analysis of LRIC for mobile phone networks, 1998/99**

Network	*Per customer per year*	*Per incoming call minute*	*Per outgoing call minute*	*Per PRS call minute*
GSM 900	£2.00	7.0p	5.6p	0.4p
PCN 1800	£2.80	8.3p	6.2p	N/A

Source: OFTEL.

5.24. The consultants noted that, while they 'believed that the model, the data that it contains and the results it produces are all extremely credible as they stand',[1] further refinement of the model and the data within it was likely to be required before precise and robust LRIC figures were produced. The report also indicated that the results were very sensitive to the decision on how to allocate the costs of coverage.

5.25. The MNOs were concerned about the DGT's approach. They argued that an LRIC model would need to be much more comprehensive than the FAC models used to date; that an LRIC approach required considerable judgment on cost drivers for which empirical evidence was not yet available, particularly in a rapidly developing industry; and that fundamental issues, such as the size of the increment, had not been addressed. They said that much more time would be required for agreement on the methodology than the DGT anticipated, citing the time taken to develop and implement an LRIC approach for BT's network. Cellnet said that it was inappropriate to apply an incremental price to a core service such as terminating incoming calls. LRIC was only an appropriate methodology if the prices for incoming calls were to include a mark-up for common costs, in which case there was no fundamental difference between LRIC and FAC other than the use of forward-looking prices for the former. Vodafone said that it was concerned that the DGT was mistakenly applying to mobile networks the experience of developing an LRIC model for setting fixed network interconnection charges with BT. It said that technical and economic differences meant that this was not sensible, even disregarding the fact that there were four MNOs, each with a different cost profile. Orange said that it had significant difficulties in principle with the DGT's proposals, particularly the application of LRIC to an operator still in its investment stage in a relatively new market. One2One said that LRIC was totally inappropriate for the mobile market. It had been developed to overcome barriers to entry in the fixed market, in which BT was dominant and there were historical inefficiencies. These factors did not exist, it said, in the UK mobile market.

5.26. For the reasons given in paragraphs 2.193 to 2.195, we based our assessments of the costs of Vodafone and Cellnet on FAC and, in the remainder of this chapter, we use only FAC.

General principles of cost allocation

5.27. The DGT told us that he allocated costs in a very detailed manner and, in doing so, he adopted the principle of cost causality. That is, wherever possible, costs were allocated to the services which caused or required the costs to be incurred. We noted that, while this is normally the same factor that determines the level of expenditure (usually known as the 'cost driver'), there are cases where these are different. The DGT allocated costs to the different services in proportion to the requirement of each service using an objective measure of the requirement wherever possible. For example, the cost of a processor might be allocated to incoming call minutes and outgoing call minutes on the basis of the average processor time required for each.

5.28. For some cost items, objective, quantifiable cost drivers could be found. For others, the drivers were either less readily identifiable, or not easily quantified. In such cases, the DGT used what he saw as being the most objective and reasonable allocation method available.

[1] *Long-Run Incremental Costs of UK Mobile Networks*, September 1998, p1.

Payments to other licensed operators

5.29. As POLOs were charges for terminating outgoing calls to other networks, all the parties allocated them to outgoing calls.

Network costs

5.30. The cost of infrastructure for a mobile network is driven by a number of key factors (see Chapter 3 for further details). These factors are:

— *the number of subscribers*—this affects the size of certain of the network elements such as the HLR, the billing system and the number of SIM cards that need to be purchased;

— *the call traffic volume in the busy hour*—this is the key variable in determining the capacity that the network must support. The number of lines and the number of radio channels, as well as most of the other supporting network infrastructure, will be designed to support this level of traffic. Decisions on how much capacity is provided also determine some aspects of the quality of service that the network provides;

— *the number of incoming and outgoing call attempts*—the MSCs within the mobile network must be able to cope with call attempts including those for unsuccessful incoming calls; hence the amount of processing capacity in the MSC is driven by the total number of call attempts as well as the total traffic in the busy hour;

— *the traffic on the transit layer in the busy hour*—the cost of the transit layer, which includes the TSCs and all the associated lines, is driven by the traffic it must carry; and

— *the coverage provided*—the area covered and the depth of coverage (in particular, the quality of coverage inside large buildings) are the principal drivers determining the number of cell sites that the network uses (the other being the call traffic in the busy hour as cells can also be added for capacity reasons). To provide equivalent coverage for an 1800 MHz network (Orange and One2One) requires more cell sites than a 900 MHz network (Cellnet and Vodafone).

5.31. Table 5.4 shows the main cost drivers for each of the network elements. It can be seen that, for some elements of the network, there is more than one cost driver.

TABLE 5.4 **Network elements and their cost drivers**

Network element	*Cost driver(s)*
Cell sites/BSC/BTS	Call traffic in busy hour
	Coverage
MSC	Call traffic in busy hour
	Call attempts in busy hour
	Coverage
HLR	Number of subscribers
TSC	Transit traffic in busy hour
Interconnect payments	Outgoing call minutes
SIM cards	Number of subscribers

Source: MMC.

5.32. In practice, the cost allocations submitted to us were not based on the direct cost drivers. First, the traffic in the busy hour is a cost driver for several of the network elements. However, in allocating costs, the DGT used total call minutes per year instead, as busy hour call traffic information was not available, and we have done likewise. We recognize that the ratio of incoming to outgoing call minutes in the busy hour may differ from the ratio applying across all call minutes in a year. However, under an FAC approach, we believe it is appropriate to allocate the costs between different groups of consumers according to the overall use they make of the network elements involved.

5.33. Secondly, the allocations of costs submitted or generated in the course of the inquiry generally did not use the number of subscribers or coverage as cost drivers. The number of subscribers affects the costs of the HLR and the purchase of SIM cards, which are a very small portion of network costs. Coverage is determined by commercial decisions taken by the operators and, hence, is commercially rather than service driven. Nevertheless, it does drive costs; indeed the DGT's consultants used coverage as a driver in their analysis of LRIC (see Appendix 5.1).

Overheads

5.34. For some overhead costs, such as buildings and staff, allocation may be more difficult. Costs are driven by a number of factors, some of which include the network cost drivers (for example, more network infrastructure will require more engineering support staff), but can also be driven by an operator's own discretionary decisions. The majority of overheads relate, in some way, to the overall network. Engineering costs vary with the size of the network, as do the costs of housing the network infrastructure itself. In general, overheads were allocated on the basis of call minutes. Whilst call minutes do not act strictly as the cost driver, this has the merit of recognizing that both subscribers and incoming callers make demands on the staff and infrastructure included in the overhead costs.

Marketing and service provider incentives

5.35. Costs incurred in marketing are the result of discretionary decisions by the management of the networks and are not, arguably, a direct cost of any of the services provided. Moreover, the causes and beneficiaries of these items of expenditure are matters on which there was no consensus. They raise specific cost allocation issues, in particular the question of the extent to which externalities should be taken into account, which are discussed further in paragraphs 5.78 to 5.89 and in Appendix 5.2.

Cost allocation models

5.36. OFTEL developed a cost allocation model for the purposes of determining the termination charges made by Cellnet and Vodafone to CWC. Cellnet and Vodafone also developed models, although these were not used in the course of their commercial activities for the purposes of setting prices. A description of Cellnet's own model is given in Appendix 5.3C,[1] together with the detailed results of the application of the OFTEL and Vodafone models to Cellnet's 1997/98 costs. Vodafone's own model and the results of applying OFTEL's model to Vodafone's 1997/98 costs are given in Appendix 5.3V.[2] Vodafone said that it had developed its methodology in response to the DGT's requests. It did not believe that it represented the best way to model its costs. It added that it had not developed a model but a set of calculations, but we refer to it as a model for convenience.

5.37. In broad terms, all the models involved three stages, in line with the general principles outlined above. First, the appropriate services that are provided have to be identified; second, appropriate allocation procedures have to be identified for each cost item; third, the costs for each service are then calculated.

5.38. OFTEL's model and the Vodafone version of it were very similar. The key differences lay in the number of services that the networks were considered to provide, and hence to which services costs were allocated, and the allocation of marketing costs and service provider incentives.

5.39. The DGT identified four services which, he said, mobile networks provided:

(a) incoming calls;

(b) outgoing calls;

[1]Appendix 5.3C does not form part of the Vodafone report.
[2]Appendix 5.3V does not form part of the Cellnet report.

(c) PRS (see paragraph 3.46); and

(d) access.

'Access' related to the notional service of giving customers the ability to make and receive mobile calls, even if they did not actually do so. (See paragraphs 5.47 to 5.49.)

5.40. Having allocated certain costs to access, the DGT then allocated the remainder to incoming calls, outgoing calls and PRS, using a range of factors as the basis for the allocation.

5.41. Vodafone rejected the notion of access and allocated all costs to incoming calls, outgoing calls and PRS. However, in most respects (with the notable exception of marketing costs and service provider incentives), the individual cost categories used, the basis for allocation and many of the precise allocation details (other than the issue of access) were similar to the DGT's.

5.42. Cellnet, too, rejected the concept of access and allocated all costs to incoming and outgoing calls only. However, its model was rather different and the basis for allocation depended upon what it termed 'routing factors', which were specific to its network (see Appendix 5.3C[1]). One consequence of this was that, while OFTEL's and Vodafone's models were readily applicable to other networks, Cellnet's was not. Cellnet said that its model was developed in response to requests from BT for information on which to base termination charges, but also to give it a broad understanding of cost causation across the different types of call it handled.

5.43. Table 5.5 shows the proportions of costs allocated to the different services in the OFTEL model and in the companies' own models. It also shows the result of applying Vodafone's model to Cellnet, but not the converse (see above).

TABLE 5.5 **Allocation of costs in the models, for 1997/98**

per cent

	Access	*Incoming calls*	*Outgoing calls*	*PRS*
OFTEL model applied to				
Vodafone	30	22	48	0*
Cellnet	43	22	35	0
Company models				
Vodafone	0	30	69	1†
Cellnet	0	42	58	0
Vodafone's model applied to				
Cellnet‡	0	32	68	0

Source: OFTEL, Cellnet and Vodafone.

*Actual is 0.4 per cent.
†Actual is 0.6 per cent.
‡MMC calculation.

5.44. Table 5.6 shows the cost of incoming calls for 1997/98 in each of the models. It also shows the result we obtained when we applied Vodafone's model to Cellnet's costs and traffic volumes.

[1]Appendix 5.3C does not form part of the Vodafone report.

TABLE 5.6 **Cost of incoming calls for 1997/98 for each of the models**

	ppm
OFTEL model applied to	
Vodafone	10.6*
Cellnet	16.5*
Company models	
Vodafone	14.4*
Cellnet	30.5†
Vodafone's model applied to	
Cellnet‡	24.4*

Source: OFTEL, Cellnet and Vodafone.

*Cost of capital used is 17.75 per cent.
†Cost of capital used is 20 per cent.
‡MMC calculation.

The MMC model

5.45. Having considered the various approaches, we decided to develop our own cost model. We commissioned consultants in telecommunications engineering to assist us in this task. Our model drew on the approaches of the parties. We also provided all four MNOs with copies of the OFTEL and Vodafone models and (where they had provided us with sufficiently disaggregated data) a provisional version of our model incorporating their own 1997/98 costs. We took into account the comments of the MNOs in developing our final model. The remainder of this section sets out the main issues we addressed, describing in detail those that were the subject of disagreement between the MNOs and the DGT. Further details of our model can be found in Appendix 5.4. For the reasoning underlying our assumptions see paragraphs 2.196 to 2.257.

5.46. The main issues we addressed were:

— what services are provided by a mobile phone network;

— how should operating costs be allocated between these services;

— how should we allocate marketing costs and service provider incentives, and what, if any, externalities should be taken into account; and

— what is an appropriate return on capital.

We now address each of these items.

Services provided

5.47. The DGT considered that there was a separately identifiable service of access, as for fixed networks, and that identifiable costs should be allocated to it. His view was that customers attributed a value to the ability to make and/or receive calls at any time and in any location (for example, subscribers who used their mobile phone only for emergencies). Consequently they would be willing to pay for this service, irrespective of whether they actually made or received calls. He concluded that such costs related to a service provided to subscribers to the network and should not be borne by callers from other networks.

5.48. He said that the facilities necessary to provide the access service consisted primarily of the minimal geographic network needed to give the potential to make and receive calls, together with the handset (which is owned by customers, not the MNOs). The costs of providing these should, he said, be met by the network's own subscribers.

5.49. Both Cellnet and Vodafone rejected the notion of access as a service, and allocated all costs to incoming and outgoing calls (and to PRS, for Vodafone).

5.50. We allocated costs on the basis of which services were provided to subscribers to the network, an, which to callers to the network. Accordingly, we allocated costs to incoming calls, outgoing calls, and, for Vodafone only, the PRS service (see paragraph 3.46). We did not allocate costs to access as a separate service (see paragraphs 2.205 to 2.208).

Specific allocation issues

5.51. There were many items of network costs and overheads where there was general agreement between the parties on the basis for allocating costs and generally we accepted these bases. For others, however, there was disagreement. The main such items were:

— voicemail services;

— location updates;

— switching costs;

— the use of the transit layer;

— Cellnet's network specific routing factors; and

— customer care costs.

These issues are discussed in turn.

Voicemail services

5.52. Both Cellnet and Vodafone offer voicemail services on their analogue and GSM networks. These services allow callers to a mobile phone to leave a message for the mobile subscriber they are trying to contact should that subscriber be unable to answer the call for whatever reason. The mobile subscriber can then retrieve the call at his convenience. A voicemail service is therefore a type of answerphone where the actual 'answering machine' is part of the network, although the mobile networks' voicemail services are considerably more sophisticated than fixed-line answerphones. For an answerphone the user purchases the answerphone itself but then listens to messages without charge, though a small amount of electricity is used to power the answerphone. For a voicemail service, the subscriber does not make a down payment (although some higher-use customers pay a small monthly charge for a higher-capacity service). Instead, the subscriber pays to retrieve calls.

5.53. Vodafone's voicemail service is provided by VVAS (see paragraph 3.58). Payments to VVAS for the service in 1997/98 amounted to £22 million. Cellnet on the other hand has integrated its service into its network and does not itemize the cost separately. We were unable to determine a precise amount for Cellnet's costs so, in order to reconcile them with Vodafone's, we derived an approximation by taking a proportion of the Vodafone cost of £22 million to reflect the difference in traffic volume, giving £16.4 million.

5.54. Vodafone argued that, as the voicemail service provided by a mobile network was considerably more sophisticated than that of a fixed-line answering machine (for example, because it alerted the user to the fact that messages were waiting as soon as the handset was switched on or came back into coverage, thereby reducing the time taken for a message to reach its recipient), it was worth more to calling parties than an answerphone. It allocated voicemail costs to incoming and outgoing calls in proportion to the number of minutes of deposits and retrievals. Deposits were regarded as incoming calls and retrievals as outgoing.

5.55. Cellnet believed that voicemail was a service that was used by, and was of benefit to, customers making incoming calls. It said that it was a genuine cost of the business that should be reflected in termination charges. It added that if it were reflected only in charges made to subscribers to the service, it would imply a form of called-party-pays. It would also result in anomalies, since messages could also be retrieved from fixed phones (indeed, this was the only way for a subscriber to retrieve messages when overseas). Cellnet effectively allocated voicemail costs to incoming and outgoing calls, as the costs were included in other categories which were allocated in this way.

5.56. We concluded that the calling party should not bear part of the cost of the voicemail service for the reasons set out in paragraphs 2.218 to 2.222. Therefore, we allocated the cost of the voicemail service wholly to outgoing calls.

Location update

5.57. A mobile phone updates its associated mobile network with details of its location when:

— it is switched on or off;

— it senses that it has moved between location areas (location area boundaries are determined by the MNOs); and

— after a pre-set period (the period is determined by the MNO).

5.58. These updates take up processor time on the MSCs in a similar manner to incoming and outgoing calls. The information from the location updates feeds into the HLR. However, it is not the cost of the HLR that is at question (as it is very small in comparison with the rest of the network) but the allocation of the cost of the MSC, or at least that proportion of the MSC cost that is driven by processor time.

5.59. As indicated in paragraphs 3.41 to 3.43, the purpose of location update is to enable incoming calls to be routed more efficiently (both in terms of time and cost). As such, Vodafone argued that the cost of the location update should be wholly allocated to incoming calls. An alternative view of the purpose of location updates is that it reduces the overall cost of a network by reducing the amount of network infrastructure required and is thus an efficiency measure impacting on the cost of both incoming and outgoing calls. A third approach is to say that the major cost driver for location update is subscriber numbers so the cost should be allocated wholly to subscribers. The DGT took this view. He allocated the cost to access.

5.60. Having considered the arguments, we concluded that, while subscriber numbers were undoubtedly the main driver of costs, it was incoming calls that caused the costs to be incurred. It was, therefore, appropriate that the cost of location updates should be borne by incoming callers and we allowed the additional processor time of 11.97 milliseconds per incoming call attempt to be allocated to incoming calls (see paragraph 2.212).

The allocation of switching costs

5.61. As indicated in paragraph 5.30, MSCs (and BSCs) have two principal cost drivers. One of these is the call traffic in the busy hour (for which we are using the alternative of total annual call minutes—see paragraph 5.32). The second is the number of call attempts in the busy hour (as the MSCs have to perform enquiries of the HLR on each attempt). These two cost drivers are similar to those which determine the cost of using switch capacity in the fixed network environment, where OFTEL has agreed with BT that the proportion of switch costs which is driven by call minutes is 23 per cent and the proportion which is driven by call attempts is 77 per cent. This apportionment was deemed (in the CWC determination) to be appropriate for the MSCs (and BSCs) of a mobile network.

5.62. Vodafone argued, however, that using only the number of call attempts was not accurate, as incoming and outgoing calls used different amounts of processor time in the MSCs, and that the number of incoming and outgoing call attempts should be weighted by the amount of processor time

that each call required. Vodafone provided evidence from manufacturers that the time required to process an outgoing call (and a PRS call) was 19 milliseconds but for an incoming call it was 49.4 milliseconds. The DGT accepted these figures. We also accepted them, and allocated costs accordingly.

Use of the transit layer

5.63. The DGT argued that, since Vodafone had moved to near-end handover (the changes to call routing had become effective by April 1998), it no longer used its transit layer for the majority of outgoing calls. It would, therefore, have excess capacity and hence excess costs in its transit layer. He said that it was inappropriate for incoming callers to pay for such excess costs and these costs should not be allocated to incoming calls on the basis of transit minutes but on the basis of call minutes instead. Vodafone said that it had taken steps to eliminate surplus capacity (by returning leased lines to BT at no cost and re-using equipment where possible) and that volume growth would rapidly eliminate any residual surplus.

5.64. Between 1996/97 and 1997/98 the cost per total call minute of Vodafone's transit layer fell by 26 per cent so the change had had significant cost benefits. Moreover, allocation on the basis of transit minutes reflects more accurately the use of the transit layer. Accordingly, as set out in paragraph 2.226, we accepted that transit costs should be allocated on the basis of transit minutes.

Routing factors

5.65. Cellnet's cost model used routing tables in order to apportion the costs of the various elements of the network (and overhead costs) between incoming and outgoing calls. Cellnet believed that the MMC model did not represent the costs of incoming calls as accurately as its own since it did not take these into account.

5.66. As shown in paragraph 3.55 and Table 3.1, most incoming calls on Cellnet's network use two transit switches, whereas outgoing calls use only one. The same applies to the MSCs as, in most instances, both a VMSC and a GMSC will be used for an incoming call but only one MSC for an outgoing call.

5.67. Hence, the average number of MSCs and the average amount of the transit layer used for an incoming call is more than for an outgoing call. Cellnet argued that this factor should be reflected in all costs which were allocated on the basis of call minutes, particularly engineering where the effort expended was in proportion to the network usage and not just the number of call minutes.

5.68. In allocating the costs of MSCs, however, we had already accepted the need to take into account the processor time taken to deal with each type of call. As indicated in paragraph 5.62, we assumed that an incoming call attempt required 49.4 milliseconds of processor time, but an outgoing call attempt only 19 milliseconds, a ratio of 2.6:1, which is greater than Cellnet's suggested 2:1. Hence, although routing factors were not used in our model, we regard the effect as having been taken into account.

5.69. Similarly, as shown in paragraph 3.54 and Table 3.1, an incoming call uses Vodafone's transit layer once but an outgoing call uses it only once in five times. This again indicates that the effects of routing factors have been fully taken into account, as we reflect the physical use made of the transit layer rather than apportioning costs simply on the basis of call minutes.

5.70. Cellnet agreed that both an incoming and an outgoing call used BSCs and BTSs only once, so there was no dispute on these items.

5.71. Accordingly, we considered that the routing factors suggested by Cellnet would be fully accounted for when allocating Cellnet's costs if, in addition to weighting the costs of MSCs in

proportion to processor time, we used transit minutes as the basis for allocating the costs associated with the transit layer.

Customer care

5.72. Cellnet argued that there was an indirect linkage between failed incoming calls and calls to its customer care facility, as an incoming caller who failed to reach the Cellnet customer would eventually tell the customer about the problem. The customer would then call the customer care facility and whilst the call would be made by the Cellnet customer, it would have been driven by an incoming call. It added that customer care was there to sort out problems that were generated for whatever reason, and as such improved the service to both incoming and outgoing callers.

5.73. The DGT argued that, if an incoming caller failed to contact a mobile subscriber, then he would ring his own operator's customer care facility and not that belonging to the mobile subscriber. The calling party may not even know which network he was calling, and even if he did, it would be most unlikely that he had the number for the customer care facility of that network. Furthermore, if a mobile customer knew that someone had attempted to call him but had failed, he would call the person back and would be unlikely to call customer services. As such, the DGT believed that customer care costs should be allocated to access.

5.74. Vodafone regarded customer care as a service to its own customers and allocated the costs to outgoing calls. We agreed with Vodafone that customer care is a service primarily of benefit to mobile subscribers and we also allocated customer care costs to outgoing calls.

The allocation of network costs and overheads

5.75. We used the same categorization of network costs and overheads as the OFTEL and Vodafone models (as noted earlier, the Cellnet model was not readily applicable to other networks). We allocated these costs in five different ways. These were:

— some costs were allocated entirely to outgoing calls;

— some costs were allocated to incoming calls, outgoing calls and PRS in proportion to the call minutes for each;

— some costs were allocated to incoming and outgoing calls only, in proportion to the call minutes for each;

— some costs were allocated to incoming calls, outgoing calls and PRS in proportion to the transit minutes for each; and

— some costs were allocated to incoming calls, outgoing calls and PRS on the basis of the processor time required for each.

For Cellnet, the second and third mechanisms were identical, as it did not provide PRS.

5.76. Table 5.7 summarizes the decisions we made on which allocation mechanism to use for each category of network costs, overheads and depreciation. In only one cost category (voicemail) did our allocation mechanism not accord with that of either OFTEL or Vodafone.

TABLE 5.7 **Comparison of the methodologies for allocating network costs, overheads and depreciation in the different models**

Cost category	*Method of cost allocation*		
Network costs and overheads	*Vodafone model*	*OFTEL model*	*MMC model**
Transit lines	Transit minutes	Call minutes	**Transit minutes**
Other leased lines	Call minutes except PRS	Call minutes except PRS	Call minutes except PRS
Transit depreciation	Transit minutes	Call minutes except PRS	**Transit minutes**
MSC/BSC depreciation	Processor time†	Processor time	Processor time†
Radio depreciation	Call minutes except PRS	Call minutes except PRS	Call minutes except PRS
General depreciation	Call minutes	Call minutes	Call minutes
Voicemail	Divert/retrieve minutes	Access	**Outgoing call minutes**
Transit running	Transit minutes	Call minutes except PRS	**Transit minutes**
MSC/BSC running	Processor time†	Processor time	Processor time†
Cell site running	Call minutes except PRS	Call minutes except PRS	Call minutes except PRS
Frequency licence	Call minutes except PRS	Call minutes except PRS	Call minutes except PRS
Customer care	Outgoing call minutes	Access	**Outgoing call minutes**
Charge rate order	Outgoing call minutes	Access	**Outgoing call minutes**
Engineering	Call minutes	Call minutes	Call minutes
Billing	Outgoing call minutes	Access	**Outgoing call minutes**
Administration	Call minutes	Call minutes	Call minutes
Operations	Call minutes except PRS	Call minutes	**Call minutes**

Source: MMC.

*Items in bold show cost categories where the MMC model differed from the allocation methods on the Vodafone or OFTEL models.

†Includes the processor time required to provide location updates.

5.77. Table 5.8 summarizes the percentages of costs we allocated to each service for Vodafone and Cellnet for each method of allocation. Detailed results for Cellnet for 1997/98 can be found in Appendix 5.5C.[1] Similar details for Vodafone are in Appendix 5.5V.[2]

[1]Appendix 5.5C does not form part of the Vodafone report.

[2]Appendix 5.5V does not form part of the Cellnet report.

TABLE 5.8 **MMC allocation of network costs, overheads and depreciation**

per cent

	Incoming calls		*Outgoing calls*		*PRS*	
	Vodafone	*Cellnet*	*Vodafone*	*Cellnet*	*Vodafone*	*Cellnet*
Outgoing calls allocation Voicemail Customer care Charge rate order Billing	0	0	100	100	0	0
Call minutes allocation General depreciation Engineering Administration Operations	36.2	37.8	62.4	62.2	1.4	0
Call minutes (excluding PRS) allocation Other leased lines Radio depreciation Cell site running Frequency licence	36.7	37.8	63.3	62.2	0	0
Transit minutes allocation Transit lines Transit depreciation Transit running	72.3	54.9	24.9	45.1	2.8	0
Processor time allocation MSC/BSC depreciation MSC/BSC running	62.0	60.6	37.0	39.4	1.0	0

Source: MMC.

Marketing costs and service provider incentives

5.78. These were particularly contentious areas**.** The DGT told us that service provider incentives did not constitute part of the incremental costs of inbound calls and were driven more by the number of subscribers than call volumes. Hence, they should not be recovered in call charges but should be set against revenues from contractually committed connection charges and access subscriptions with any balance being allocated to calls in proportion to call minutes. For marketing costs, the DGT argued that these costs were incurred to gain additional customers and that such costs should not be recovered from customers of other networks when they made calls to mobile networks but should be recovered from charges to a mobile network's own customers.

5.79. Cellnet said that it believed it would be more appropriate for marketing costs and service provider incentives to be allocated across all calls. They were, it said, core costs of providing a mobile network service and incoming calls were a core product of such a network service. It also argued that those making incoming calls did receive benefit from such costs as both service provider incentives and marketing activities sought, as their objective, to increase subscribing customer numbers and hence to increase the number of call minutes, allowing prices to fall.

5.80. Vodafone said that marketing costs and service provider incentives were not a direct cost of either outgoing or incoming calls but were incurred in order to generate profits. Accordingly, it allocated costs across call types on the basis of prime margin (that is, total revenue less avoidable costs). The prime margins for incoming, outgoing and PRS calls in 1997/98 were in the ratio 24:75:1. It added that, given the need to recover these costs, any approach should be consistent with economic efficiency (Ramsey pricing) and also take account of externalities.

5.81. An externality is a cost or benefit that flows from a decision where this cost or benefit is not taken into account by the decision-maker. One example of an externality in the case of mobile phone networks is what is known as an option externality, which is the benefit to fixed-line subscribers (and existing mobile subscribers) when a new subscriber joins a mobile network. There is a benefit because

all of these people now have the option of contacting the new subscriber at times when previously they could not. The benefit to the fixed-line caller is an external benefit because it is one which does not per se enter into the decision-making of the new subscriber to the mobile network when deciding whether to become a subscriber or not. This decision is presumed to depend only on the costs and benefits of becoming a mobile owner that accrue directly to the subscriber him- or herself (ie the internal costs and benefits). We noted at least four other potentially relevant externalities during the inquiry: call externality; an externality that is associated with updating the HLR; one that is associated with voice-mail; and a scale externality (see Appendix 5.2).

5.82. We asked Vodafone and the DGT if they could give any quantification of the value of the option externality. Vodafone estimated the value of this externality at between £77 million and £529 million (4.3 to 29.4 ppm when allocated to incoming call minutes). Vodafone told us that it was not proposing that these estimates should be used to represent the value of its marketing and service provider incentive costs that should be allocated to the termination of incoming calls. Rather, the estimates should be seen as a test of the reasonableness of the £[✂] million (accounting for [✂] per cent of its service provider incentives and marketing costs) that it believed should be allocated to incoming callers. Essentially, Vodafone submitted that the externality was, in practical terms, impossible to quantify, and that that was one reason why a regulator should be loath to adopt any price control which either disregarded the externality or sought to quantify it. Instead, Vodafone submitted that the regulator should, if at all possible, rely on the market (through trial and error) to arrive at an efficient method of recovering the value of the externality. Vodafone's views on, and its estimates of, externalities are set out in Appendix 5.2.

5.83. The DGT stated that, whilst he accepted that externalities might exist, he believed that termination charges should be based on costs. The DGT provided us with estimates of the value of externalities. He estimated that the option externality by itself could justify increasing incoming call costs by between 0.4 and 1.4 ppm, but that the option and call externalities together could be used to justify changing the cost of an incoming call by anything from an increase of 0.8 ppm to a reduction of 0.8 ppm. However, the DGT said that, as these estimates were subject to such a large degree of uncertainty, there was insufficient evidence to support an adjustment to take account of externalities and that a much more detailed study would be necessary to obtain robust results and independent estimates of the relevant parameter values before any such adjustments should be contemplated. Appendix 5.2 sets out in more detail the DGT's views on, and his estimates of, externalities.

5.84. We concluded (see paragraph 2.241) that, in terms of cost causation, there are no grounds for allocating any marketing costs or service provider incentives to incoming calls. However, we considered in more detail the arguments put forward, particularly by Vodafone, on the value of externalities.

5.85. We decided to produce our own estimates of the value of externalities. We used a simplified version of the DGT's approach to produce our own estimates of the option externality (see Appendix 5.2 for details). We first estimated the lowest figure currently available for acquiring and being able to use a handset. We based this on the cost of a prepay package (including bundled minutes) and the minimum number of call vouchers required to be able to continue making calls over a certain period. The average cost over an assumed time horizon of three years is approximately £73 a year, or £58 a year over five years. We adopted, therefore, a figure of £65 a year though this is likely to be an overestimate of the offers most recently available.

5.86. We next needed to estimate the externality adjustment factor. We did not think it reasonable simply to regard the values of one and two as extremes. Prima facie, the benefits to callers to mobiles of being able to contact new subscribers and be contacted by them, at times when this would not previously have been possible, might be thought no different from the benefits which new subscribers would obtain. There are, however, two asymmetries; the subscriber has acquired a mobile phone whereas, currently, the great majority of callers to mobiles have not. This might suggest that the benefits to subscribers are greater than to callers to mobiles. Second, subscribers can use their mobile phones at any time they choose for outgoing calls. Callers to mobiles will be able to be in contact with subscribers only if the subscriber has decided to switch on his phone. Both factors suggest that a figure

of less than two, and perhaps substantially less, for the externality adjustment factor is appropriate and, for illustrative purposes, we used a range of 1.3 to 1.7.

5.87. Finally it is necessary to include elasticity figures. We were not in a position to estimate these ourselves from price and demand data; but estimates from fixed-line telephony and figures referred to by some of the MNOs suggested that relatively low values would be appropriate. Vodafone used what it regarded as plausible estimates of elasticities of –0.1 and –0.2 and an upper bound of –0.5. The DGT in his estimates used –0.2 to –0.4. We, therefore, used a range of –0.1 to –0.5.

5.88. Our calculations utilized these estimates, and were based on Vodafone's subscriber and call minute data for 1997/98. Having calculated the value of the option externality we explored two ways of financing it; the first through equi-proportionate recovery across all services (this follows the DGT except that it assumes the same elasticity for all services); and the second, entirely from calls-to-mobiles. The results are shown in Appendix 5.2. The mid-point estimates for the two financing methods are 0.22 ppm and 0.73 ppm respectively.

5.89. These estimates take no account of any call externalities. Inclusion of these would offset some of the value of the option externality and could, depending on the assumptions made, offset all of it or more. Appendix 5.2 refers to a range of other potential externalities, which to some extent favour subscribers and to some extent fixed-to-mobile callers.

Cost of capital

5.90. We discuss general issues relating to cost of capital and the views of the parties in paragraphs 5.13 to 5.18. We decided what would be a reasonable rate of return for Cellnet and Vodafone by reference to their cost of capital, which we concluded should be 16.5 per cent (see paragraph 2.289 and Appendix 5.6). This return on relevant assets was then allocated between incoming, outgoing and PRS categories, using the same method of allocation as for the expenditure relating to the assets (see Table 5.7) and in the same proportions (see Table 5.8). Details of the allocation for Cellnet are given in Appendix 5.5C,[1] and for Vodafone in Appendix 5.5V.[2]

Projecting future costs

5.91. The sections on cost allocation above describe how the cost of receiving a call on a mobile network may be established. We now consider the factors affecting future trends in costs.

5.92. In a rapidly growing market such as mobile telephony, the main factors affecting trends in costs are:

— the growth in volume, which will require capital investment and increased operating expenditure;

— efficiency gains, particularly from technological developments; and

— decisions on marketing and other discretionary expenditure.

5.93. The impact of these factors, particularly volume growth, has, historically, resulted in very sharp falls in the unit cost of calls to and from mobile phones. All the parties expected overall unit costs to continue to fall, although Vodafone added that the fall would not necessarily be smooth and that UMTS might cause some discontinuity.

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[1]Appendix 5.5C does not form part of the Vodafone report.
[2]Appendix 5.5V does not form part of the Cellnet report.

5.94. We noted, as an illustration of these expectations, that Vodafone had agreed to reduce termination charges to BT for the period to 2001 by RPI–6. Likewise, Cellnet had agreed an RPI–6 formula with CWC, subject to that being no less than the reductions offered to other FNOs.

Volume projections

5.95. We projected the number of subscribers, the number of incoming call minutes and the number of outgoing minutes for the market as a whole for 2001/02. In this section, we are not concerned with PRS as the future predictions we received did not cover these.

5.96. Before making our own projections we asked the MNOs and the DGT to produce their projections for subscriber numbers and traffic volume. While the MNOs provided us with their projections, the DGT felt that OFTEL was not in a position to estimate traffic projections. We were also provided with a number of analysts' reports that included projections for the number of subscribers.

5.97. Table 5.9 shows the projections of the total number of subscribers by City analysts and by the MNOs.

TABLE 5.9 **Projections of number of subscribers**

Analysts' estimates	*2001 m*
Goldman Sachs (Feb 97)	14.6
CIT Research (May 97)	13.0
Strategy Analytics (July 97)	12.7
Dataquest (July 97)	17.7
SBC (Dec 1997)	16.3
HCIB Ltd (July 98)	18.7
HCIB based on more optimistic assumptions	20.0
MNOs' estimates	*2001/02*
MNO 1	[redacted]
MNO 2	
MNO 3	
MNO 4 — Low	
— Medium	
— High	
MNO 4 weighted average based on 10% low, 60% medium and 30% high	
Average of MNOs' estimates to MMC*	16.8

Source: MMC, the MNOs and analysts' reports.

*Includes MNO 4 weighted average.

5.98. The later analysts' projections in Table 5.9 on the whole show higher figures than the earlier ones. The break in the projections appears to have taken place after the middle of 1997. The projections of Dataquest are more consistent with the later projections than with those reported in the middle of 1997 or earlier. We compared the later analysts' projections with those of the operators. It should be noted that the analysts' projections were for the year ending December 2001. Of the mobile operators, only one of the projections was for the same period. The projections for the other mobile operators were for the year ending March 2002. This should mean, all other things being equal, that we would expect to find the projections of the operators to be higher than those of the analysts. [

Details omitted. See note on page iv.

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5.99. There are many ways of producing estimates of traffic projections. We used combinations of the companies' own projections to produce our estimates. We produced high, medium and low estimates. Based upon our comparisons of the operators' projections with those of the later analysts' projections our high projections use MNO 1's projections for the total number of subscribers and our low projections use the average estimates of the operators. Our medium projection is the mid-point of the high and low projections. Our estimates were derived in the following stages:

(a) estimate the total number of subscribers;

(b) use the companies' own estimates of their market shares of subscribers, adjusted so they sum to 100 per cent, to estimate the number of subscribers for each operator;

(c) use the companies' own estimates of their minutes per subscriber to estimate the number of minutes (incoming and outgoing) for each operator;

(d) sum the estimates of incoming and outgoing minutes to produce the estimate of total minutes; and

(e) calculate the growth rate for the number of total minutes from 1997/98 to the year end (2001/02).

5.100. Table 5.10 compares the MMC's projections for 2001/02 with those of the MNOs. It shows that our projections are similar to those of the MNOs. The average projections by the MNOs are slightly lower than those shown in Table 5.10 when their estimated shares of subscribers are adjusted to sum to 100 per cent. Taking this into account, our medium projections lie towards the upper end of the average projections by the MNOs.

TABLE 5.10 **A comparison of the volume projections for 2001/02 by the MNOs and by the MMC**

	MMC	*MNOs*
Total number of subscribers (m)	16.8–20.4	13.6–20.4
Total minutes used to derive the growth factors (bn)	35.9–43.6	40.6
Annual average growth factors (%)		
Low	27.7	
Medium	30.6	
High	33.3	
MNOs' projections		31.5*
Total incoming and outgoing minutes (bn)		
Low	38.7	
Medium	42.3	
High	45.9	
MNOs' projections		43.6*

Source: MNOs and MMC.

*Derived by aggregating the respective MNOs' traffic projections.

5.101. Table 5.11 shows our projections of traffic in 2001/02. On our medium scenario, the total UK market would grow from 14.6 billion minutes in 1997/98 to 42.3 billion minutes in 2001/02, an increase of 190 per cent.

TABLE 5.11 **Traffic projections for the UK market in 2001/02**

	Inbound	*Outbound*	*Total*	*Subscribers*
Low scenario				
Minutes (bn)	13.36	25.32	38.68	
Subscribers (m)				16.8
Medium scenario				
Minutes (bn)	14.60	27.68	42.32	
Subscribers (m)				18.6
High scenario				
Minutes (bn)	15.88	30.08	45.96	
Subscribers (m)				20.4

Source: MMC calculations based on data provided by the operators.

5.102. An operator with 25 per cent of the call traffic would, on our medium scenario, see its UK volume grow from 3.65 billion minutes in 1997/98 to 10.58 billion minutes in 2001/02.

Operating expenditure

5.103. In assessing the impact of future volume growth on operating expenditure, we used a CVE. A CVE represents the proportional increase in cost resulting from an increase in volume. That is, for a CVE of 'e', then, for each 1 per cent increase in call minutes, we would expect to see an increase of 'e' per cent in costs. For a given volume change of 'v' per cent (which can be positive or negative), a CVE of 'e' and an initial unit cost of Ci, then the resultant unit cost, Cr, is given by:

$$C_r = C_i \frac{(1+ve)}{(1+v)}$$

5.104. There was considerable debate among the parties about the appropriate CVE to use, and whether a short-term modest change in volume would give the same CVE as substantial growth over a longer period (this latter point is discussed further in paragraph 5.117)**.** In order to determine a suitable CVE for projected future operating costs, we examined past trends and the five-year business plans of Cellnet and Vodafone, which gave their projections of the growth in the number of subscribers and call volumes together with their assessment of future costs. Details are given in Appendix 5.5C[1] for Cellnet and Appendix 5.5V[2] for Vodafone. We considered that the CVE for the total of network costs, overheads and depreciation would be most appropriate for our purposes. We ignored cost of sales in our calculations, as we allocated all of these to outgoing calls only and we treated discretionary expenditure such as marketing separately.

5.105. A wide range of CVEs was submitted to us by the parties or was implicit in their future planning. The DGT initially proposed a CVE of 0.75 in the range 0.6 to 0.8, based on earlier work in fixed networks. His consultants derived LRIC-based CVEs of 0.6 for a GSM 900 network and 0.35 for a PCN 1800 network (see Appendix 5.1).

5.106. Cellnet's historic CVE was 0.77. In its future plans, its view of its CVE ranged from [✂] (in the 'high' case) to [✂] (in the 'low' case). Its medium case gave an elasticity of [✂]. We considered that the medium case was rather pessimistic. An outcome which we regarded as more likely (see Appendix 5.5C[3]) implied an elasticity of 0.5.

5.107. Vodafone's historic CVE was 0.6. Its business plan implied an elasticity of 0.48. However, Vodafone said that there was no simple relationship between cost and volume. It also argued that our approach was flawed, as our calculation for 2001/02 was based on a hypothetical market share of 25 per cent of call volume (see paragraph 2.329). As Vodafone's subscribers made fewer calls per

[1]Appendix 5.5C does not form part of the Vodafone report.
[2]Appendix 5.5V does not form part of the Cellnet report.
[3]Appendix 5.5C does not form part of the Vodafone report.

year than the industry average, it would have to have more than 25 per cent of subscribers to obtain 25 per cent of calls. This would entail a higher level of costs than indicated in its business plan. We examined the additional costs that would be incurred and calculated that allowing them would be equivalent to using a CVE of 0.51, rather than 0.48.

5.108. In addition, Vodafone argued that the traffic profile resulting from the addition of the profiles of a number of different operators would not be the same as that for Vodafone alone, and might result in a busy hour peak exceeding that for which Vodafone's network was designed. This would also incur additional costs and hence entail the use of a different CVE.

5.109. The addition of a number of operators' call minute figures would effectively smooth out any peaks unless such peaks occurred during the same period. The busy hours of Orange and One2One do not coincide with those of Vodafone and Cellnet and hence the busy hour peak produced when averaging the call minutes across all MNOs would not significantly exceed that expected by either Vodafone or Cellnet. Again, any impact on cost would require at most a small increase in the CVE.

5.110. Clearly, an element of judgment is required in determining which CVE it would be appropriate to take. On balance, we concluded that, taking all the above into account, a CVE of 0.55 was appropriate.

5.111. In addition, we allowed for inflation over the period from 1997/98 to 2001/02 at 3 per cent a year (12.55 per cent for the period).

Differences between Cellnet and Vodafone

5.112. Before applying these various factors to determine the cost of call termination on Cellnet's and Vodafone's networks, we first look at the nature of, and possible reasons for, the differences in their operating expenditure.

Comparison of operating expenditure

5.113. The differences between the operating expenditure of Cellnet and Vodafone are summarized in Table 5.12. It should be noted that the two companies did not use identical categorizations of costs.

TABLE 5.12 **Comparison of operating expenditure of Cellnet and Vodafone, 1997/98**

		£ million
	Vodafone	*Cellnet**
Operating costs		
Cost of sales	[✂]	[✂]
Network costs and overheads		
Total operating costs		
Marketing and incentives		
Depreciation		
Total operating expenditure	758	
		billion minutes
Traffic		
Incoming calls	[✂]	[✂]
Outgoing calls		
PRS		
Total traffic		
Ratio of Vodafone's traffic to Cellnet's	1.38	-
Overall operating cost per minute (p)	15.0	(✂)

Source: The companies and OFTEL.

*These figures are for CGL. They include the roaming cost of sales (£[✂] million), incentives (£[✂] million) and some bureau costs (£[✂] million) which were excluded from Cellnet Network figures. Excluding these costs gives a total of [✂] million.

[Details omitted. See note on page iv.]

[Details omitted. See note on page iv.]

5.114. Table 5.12 shows that, despite the similarity of the operations, Cellnet's costs were higher than Vodafone's, the largest difference being in marketing and incentive costs. When call volumes were taken into account, the differences were greater; Cellnet's overall operating cost per minute at [✂]p was [✂] per cent higher than Vodafone's at 15.0p. We examine the reasons for these cost differences below.

Volume differences

5.115. The traffic carried by Vodafone and Cellnet in 1997/98 is shown in Table 5.13, together with the difference between them and a 25 per cent market share. The figures include calls made by overseas visitors roaming on Cellnet's and Vodafone's networks.

TABLE 5.13 **Volume differences between operators, 1997/98**

Operator	*Incoming call minutes m*	*Outgoing call minutes m*	*PRS call minutes m*	*Total call minutes m*	*Difference from 25% market share %*	*Difference from Vodafone's share %*
Vodafone	1,831	3,157	71	5,059	+37.9	-
Cellnet	1,399	2,300	N/A	3,699	+0.8	–26.9
25% market share	1,257	2,393	18	3,668	-	–27.5

Source: MMC calculations from OFTEL data.

5.116. To measure the impact of the volume difference, we applied a CVE to calculate what Vodafone's costs would have been with Cellnet's 26.9 per cent lower level of call minutes.

5.117. The CVE which we used for the long term, 0.55, includes two effects—direct effects caused by the economies of scale brought about by an increase in volume and the efficiency gains brought about by decreasing technology costs over time. The DGT argued that in applying a one-off volume adjustment we should determine the CVE relating purely to the volume effects and not to the longer-term efficiency gains. If 'e' is the long-term CVE, including both volume effects and efficiency gains, 's' is the elasticity corresponding only to the volume effect and 'p' the efficiency gain, then, for a volume change of 'v', 's' is given by:

$$s = \frac{ev - p}{v(1 + p)}$$

5.118. The volume effect on unit cost is then given by a similar equation to paragraph 5.103 with 's' replacing 'e'.

5.119. Vodafone said that it was neither easy nor realistic to separate volume and efficiency effects, and was not sure how relevant this was to its cost structure. Cellnet said that such a refinement would entail choosing one adjustment from a range of equally plausible figures, and that any appearance of extra accuracy would be spurious.

5.120. For a volume difference of (minus) 27 per cent (ie 'v'), our assumption of a long-term CVE of 0.55 (ie 'e') would, after discounting the effect of an efficiency gain of 3 per cent a year (ie 'p') which we regarded as a reasonable target for the network operations of the MNOs, equate to a short-term volume effect of 0.64.[1] Applying this to Vodafone's costs indicates that, if Vodafone had had the same volume as Cellnet, then its cost of an incoming call for 1997/98—which, on the MMC model, was 11.48 ppm (see Appendix 5.4)—would have been 1.45 ppm higher. We considered that this reflected the unavoidable additional unit cost of receiving an incoming call on Cellnet's network, compared with that of Vodafone's, which resulted from the former's lower volume of traffic.

5.121. Cellnet agreed that the CVE of 0.55 reflected the average changes in network costs over a period as volumes grew. However, it believed that a CVE of 0.19, as derived by its own consultants, was a more accurate basis for reconciling the cost differences between it and Vodafone than 0.64. This would suggest that the difference in volume accounted for around 3.3 ppm for 1997/98.

Efficiency issues

5.122. We considered differences between the ways that Cellnet and Vodafone had designed and operated their networks. For a given level of service, an efficient network is designed to carry the traffic which occurs during the busiest hour of the day at that level of service, with an appropriate margin to provide resilience and allow for short-term growth. Designing to meet a peak demand inevitably leads to there being spare capacity outside the peak period. We compared Cellnet's utilization of its capacity with that of Vodafone, by looking at each of the elements of the network in turn.

Transit switching centres

5.123. We were unable to make a detailed comparison for the transit layer because Cellnet and Vodafone operate their transit layers in fundamentally different ways (see paragraphs 3.53 to 3.57). We did, however, undertake a rudimentary analysis of the use of the transit layer, taking account of the differences.

5.124. In early 1998 Vodafone reorganized its transit layer such that all calls were handed directly to BT from its MSCs, thereby bypassing its TSCs for 80 per cent of outgoing calls. We calculated what the utilization of Vodafone's TSCs would have been, both if the change had taken place at the beginning of the financial year (ie with near-end handover throughout) and if it had not taken place at all. The results are shown in Table 5.14. They include the effect of routing factors so the number of transit minutes handled by the TSCs for Cellnet (and for Vodafone without near-end handover) is greater than the total number of call minutes, as each incoming call uses the transit layer twice.

[1]This is equal to ((0.55 × (–0.27)) –0.03)/(–0.27 × 1.03) = 0.178/0.278 = 0.64.

TABLE 5.14 **Comparison of TSCs between Cellnet and Vodafone, 1997/98**

	Vodafone with near-end handover	*Vodafone without near-end handover*	*Cellnet*
Number of TSCs Transit minutes (m) Transit minutes per TSC	*Figures omitted. See note on page iv.*		

Source: MNOs.

5.125. With near-end handover Vodafone's TSCs would have supported an average of [✂] million call minutes per year per unit, whereas Cellnet's supported [✂] million. In this case, Cellnet's use of the transit layer would appear to have been significantly more efficient. Even without near-end handover, Vodafone would only have carried the equivalent of [✂] million call minutes per TSC, compared with [✂] million for Cellnet. Overall, therefore, Vodafone's transit layer would appear to be used 17 per cent less efficiently than Cellnet's. A significantly more complex analysis would be needed to quantify the effect precisely.

The radio layer

5.126. For the radio layer and the MSCs, we conducted a detailed comparison of the capacity of the networks and the level of traffic. Table 5.15 shows the difference in radio capacity between the two networks. In order to calculate the overall capacity, the number of transceivers was multiplied by 7.5 (to represent the number of voice channels per transceiver) and then by the number of minutes in a year (ie 525,600).

TABLE 5.15 **Comparison of the radio capacity between Vodafone and Cellnet between 1997 and 1998**

Year ending	*Transceivers (average for year)*	*Overall capacity (call minutes) m*	*Actual call traffic* (call minutes) m*	*Network utilization %*
Vodafone April 1997 April 1998 *Cellnet* April 1997 April 1998		*Figures omitted. See note on page iv.*		

Source: MNOs.

*Excluding PRS calls as these do not use the radio transceivers.

5.127. Table 5.15 shows that Vodafone's transceivers had a higher utilization than Cellnet's (ie each radio transceiver in Vodafone's network carried more traffic than its Cellnet counterpart). In 1996/97, Vodafone carried 14 per cent more traffic per transceiver and, in 1997/98, 18 per cent more.

5.128. The number of call minutes used in our analysis related to both the analogue and the GSM networks whereas the number of transceivers related to the GSM network only. As long as the proportion of TACS and GSM capacity is similar on both networks, this has minimal impact. As the number of TACS and GSM MSCs is similar for Cellnet and Vodafone (see Table 5.16), this would appear to be the case. The fact that the proportion of calls on the GSM network increased between the two years partly accounts for the decrease in utilization.

Mobile switching centres

5.129. Table 5.16 shows the number of MSCs, the total number of call minutes carried and the number carried for each MSC in 1997/98. It shows that Vodafone's MSCs carried around 12 per cent more traffic than their Cellnet counterparts.

TABLE 5.16 **Comparison of MSCs between Cellnet and Vodafone, 1997/98**

	Vodafone	*Cellnet*	*Difference from Vodafone %*
Number of TACs MSCs	26	23	
Number of GSM MSCs	27	21	
Total number of MSCs	53	44	
Call minutes (m)	5,059	3,699	–27
Call minutes per MSC (m)	95	84	–12

Source: MNOs.

Base station controllers

5.130. Cellnet and Vodafone supplied us with figures for the traffic which could be supported by their installed BSCs as at the end of March 1998. Vodafone's BSCs could potentially carry [✂] simultaneous calls. Cellnet had [✂] BSCs at the end of the same period comprising two different models. Despite the differences, the information supplied to us by Cellnet suggested that each BSC could support around 128 simultaneous calls making a total installed capacity of [✂] simultaneous calls. Cellnet's BSCs had almost identical capacity to Vodafone's yet carried 27 per cent less traffic. It appears, therefore, that Cellnet's BSC layer is used less efficiently than Vodafone's.

Overall utilization

5.131. The results of our analysis of the capacity differences between Cellnet and Vodafone for 1997/98 are summarized in Table 5.17. It also shows how much lower Cellnet's costs would be if any additional capacity were removed assuming a one-off volume adjustment CVE of 0.64 (see paragraph 5.120).

TABLE 5.17 **Comparison of Cellnet's and Vodafone's capacity utilization, 1997/98**

Network element	*Vodafone minutes per unit per year*	*Cellnet minutes per unit per year*	*Vodafone compared with Cellnet %*	*Cost implication if Cellnet operated as efficiently as Vodafone %*
TSC*				+11
MSC		*Figures omitted.*		–8
BSC		*See note on page iv.*		–17
Transceivers				–11

Source: MMC.

*Without near-end handover.

5.132. Table 5.17 shows that, with the exception of the transit layer, typically at least 10 per cent of Cellnet's costs could be eliminated if its spare capacity were brought into line with Vodafone's. This figure is subject to a number of potential inaccuracies, as described above. However, it supports Cellnet's own view, based on an analysis undertaken on its behalf by consultants of the differences in costs, that it had network inefficiencies of 10 per cent when compared with Vodafone. It seemed to us, therefore, that this was a realistic evaluation of the difference in efficiency. It equates to 1.28 ppm.

5.133. The above analysis suggests that there is more excess capacity on Cellnet's network than on Vodafone's. Hence, Cellnet's costs are higher, for a given volume of traffic, than Vodafone's. There are several possible reasons why such excess capacity may exist including:

— Cellnet may wish to offer a higher level of service to its customers than Vodafone as the greater the capacity of a network, the greater the likelihood that any given call will succeed.

— Cellnet may have planned for a higher level of traffic growth than has actually been achieved, thereby leaving unused capacity.

— Cellnet, as the company with the smaller market share, may have kept more spare capacity on the grounds that it was more likely to require additional capacity to meet increases in market share.

— Cellnet's engineers may have planned the network in a less efficient manner than Vodafone's.

5.134. We saw no evidence that the level of service offered by Cellnet was higher than that of Vodafone (see paragraph 3.60).

Further differences

5.135. Networks with the same level of total call minutes might have very different costs if the pattern of usage during the day and week ('the traffic profile') were very different since the more evenly spread the usage, the lower the required capacity. However, for Cellnet and Vodafone the traffic profiles were very similar. Table 5.18 shows the proportion of traffic that the two operators carried during weekday daytime, weekday evening and weekend periods in 1997/98. It can be seen that these figures are very similar and that, in particular, the proportion of traffic carried in the daytime, when the busy hour occurs, differed by only 1 per cent. It is possible that the traffic in the busy hour may be different between the two networks as it accounts for only one hour within the total daytime period, but we do not believe that this would have a significant impact.

TABLE 5.18 **Comparison of traffic for Vodafone and Cellnet in 1997/98***

per cent

Operator	*Daytime*	*Evening*	*Weekend*
Vodafone	73	18	9
Cellnet	72	16	12

Source: Cellnet, Vodafone.

*Excludes international calls.

5.136. Likewise, differences in coverage would affect costs. However, the coverage provided by Cellnet and Vodafone was similar, both claiming coverage of 99 per cent of the UK population (see paragraph 3.61).

5.137. There were differences in the treatment of voicemail costs since, as indicated in paragraph 5.53, Vodafone itemized its voicemail costs separately while Cellnet did not. We calculated that the effect of removing our estimate of these costs (that is, allocating them to outgoing calls) would have been to reduce the cost of incoming calls on Cellnet's network by 0.44 ppm.

5.138. There were also differences between Cellnet and Vodafone in respect of overheads which, on our model, amounted to 1.78 ppm on incoming calls over and above that accounted for by volume differences. We did not carry out a detailed analysis of overheads, but such evidence as we saw did not lead us to the view that there were unavoidable differences in overhead costs.

5.139. Other differences between the cost of incoming calls indicated by the parties, such as assumed differences in the cost of capital and in the allocation of costs, have been discussed in the appropriate sections earlier in this chapter.

Summary of comparison between Cellnet and Vodafone

5.140. Applying the MMC cost model to Cellnet's costs for 1997/98 gave a cost for incoming calls of 17.62 ppm (see Appendix 5.4). Subtracting 0.44 ppm to reflect the costs of Cellnet's voicemail service reduces this to 17.18 ppm. Applying our model to Vodafone's costs for 1997/98 gave an efficiently incurred cost of an incoming call of 11.48 ppm (see Appendix 5.4). On our analysis, most of the difference of 5.70 ppm is likely to be explained by the factors outlined above. That is:

— 1.45 ppm due to volume differences (see paragraph 5.120);

— 1.28 ppm due to network inefficiencies (see paragraph 5.132); and

— 1.78 ppm due to higher overheads (see paragraph 5.138).

5.141. This left 1.19 ppm which we were unable to account for. However, we saw no evidence which indicated to us that there were further unavoidable costs which we should take into account. In summary, therefore, it appeared to us that all the non-volume-related differences between Cellnet's and Vodafone's costs were either discretionary (for example, marketing costs) or due to differences in efficiency. Accordingly, we concluded that the efficiently incurred cost (excluding marketing costs and service provider incentives but including an appropriate rate of return) of an incoming call for Cellnet would be 12.43 ppm, once the effect of volume was taken into account.

Results of the MMC analysis

5.142. In summary, we derived the efficiently incurred cost of an incoming call on the basis of the following assumptions:

— no allocation of POLOs to incoming calls;

— the allocation of network and overhead costs as set out in Appendix 5.4;

— 0.5 ppm marketing costs and service provider incentives allocated to incoming calls, in recognition of externality factors;

— a cost of capital of 16.5 per cent; and

— that Cellnet and Vodafone have different economies of scale by virtue of their different traffic volumes.

Details of how we arrived at these assumptions can be found in the relevant sections of Chapter 2.

5.143. We took 1997/98, the latest year for which audited accounts were available, as our base year. For the reasons set out in paragraph 2.329, we took, as our benchmark costs, the level of costs which would apply to a network operator with a 25 per cent share of the market.

5.144. Taking our assumptions on network costs and overheads, marketing costs and service provider incentives, and cost of capital, we considered that Vodafone's efficiently incurred cost of an incoming call in 1997/98 was 11.48 ppm (see paragraph 5.140). For a 25 per cent market share, there would be an adjustment to reflect the lower volume calculated in the same way as before (see paragraph 5.120) of 1.5 ppm, giving 12.98 ppm, as shown in Table 5.19.

TABLE 5.19 **Benchmark cost of an incoming call, 1997/98**

	ppm
Cost of sales	0.00*
Network costs and overheads	9.42
Cost of capital	3.06
Marketing and service provider incentives	0.50
Total	12.98

Source: MMC.

*All allocated to outgoing calls.

5.145. We then repeated this analysis for 2001/02. We calculated network costs, overheads, depreciation and return by applying our CVE of 0.55, using the 112 per cent volume increase that Vodafone would require to have a 25 per cent share of our projected market for 2001/02 (see paragraph 5.102). We added to this 0.5 ppm of marketing costs and service provider incentives in recognition of externalities and RPI inflation of 3 per cent a year, to give a benchmark for 2001/02 of 9.98 ppm in out-turn prices, as shown in Table 5.20.

TABLE 5.20 **Benchmark cost of an incoming call in 2001/02, at real (1997/98) and out-turn price levels**

ppm

	Benchmark cost	
	Real prices	*Out-turn prices**
Cost of sales†	0.00	0.00
Network cost and overheads	6.04	6.79
Cost of capital	2.33	2.63
Marketing and service provider incentives	0.50	0.56
Total	8.87	9.98

Source: MMC.

*Assuming the rate of inflation is 3 per cent a year.
†All allocated to outgoing calls.

5.146. We next calculated a trajectory for the falling costs. Our approach was based on two decisions: first, we began the trajectory from the most recent available actual data (that for 1997/98); second, we assumed that the anticipated volume and cost changes would be smooth, to give a more robust cost reduction trajectory. On the assumption that costs fall from 12.98 ppm in 1997/98 to 8.87 ppm in real terms in 2001/02, the cost reduction per year is 9.09 per cent. The intermediate figures are shown in Table 5.21, in real terms, together with the out-turn costs.

TABLE 5.21 **Annual benchmark costs, 1997/98 to 2001/02**

ppm

	1997/98	*1998/99*	*1999/2000*	*2000/01*	*2001/02*
Cost benchmark (real prices)*	12.98	11.80	10.73	9.75	8.87
Cost benchmark (out-turn prices)†	12.98	12.15	11.38	10.66	9.98

Source: MMC.

*The fall in average cost between years is 9.09 per cent in real terms.
†Assumed rate of inflation is 3 per cent a year. The out-turn average cost is determined by multiplying the respective real cost by an inflation factor.

5.147. We used the above analysis to determine X under an RPI–X formula, where X represents the fall in costs in real terms, over the period to March 2002. As an alternative, we could have estimated the costs of incoming calls and the consequent X for each year to 2001/02 separately. However, the individual years' estimates would have required a greater degree of subjective judgment than the method we adopted.

Unanswered and diverted calls

5.148. We asked Cellnet and Vodafone to tell us the value and volume of unanswered and diverted calls on their networks in 1997/98. Both companies told us that they did not monitor these as a matter of routine and the information supplied to us was based on samples.

5.149. Cellnet calculated its figures from a one-day analysis of single representative GSM and TACS MSCs carried out in April 1998. It measured the number of unanswered calls on both networks, but was able to measure the number of diverted calls only on the GSM network. However, it assumed that the number on the TACS network was negligible, as it was small on GSM and GSM customers were more likely to use call diversion than TACS customers.

5.150. From these figures Cellnet calculated that 21.6 per cent of calls were unanswered and 1.3 per cent diverted. On the assumption that the user listened to the entire message, it calculated that unanswered calls represented 2.8 per cent of incoming call minutes and diverted calls represented 0.3 per cent. As we considered it unlikely that all callers would listen to the entire recorded announcement each time that they heard it, these figures may well overestimate the number of call minutes involved.

5.151. Vodafone had previously carried out a special investigation into two recorded announcements ('subscriber has not responded' and 'subscriber is switched off') in response to a request for information from the DGT. This took the form of a one-week sample in May 1997. Vodafone repeated this for a one-week sample in April 1998.

5.152. Based on these samples, Vodafone calculated that the percentage of calls terminating in recorded announcements fell from 29.3 to 20.6 per cent over the period and that the percentage of incoming call minutes that this represented fell from 3.1 to 1.5 per cent (an average over the year of 2.3 per cent). Vodafone attributed this fall, at least in part, to the increasing popularity of its voicemail service. However, it, like Cellnet, was unable to supply data on historical trends.

5.153. Cellnet estimated that recovering the cost of unanswered and diverted calls from successful calls would increase the cost of the latter by 0.75 ppm. Vodafone's estimate was 0.50 ppm.

5.154. We noted that these figures are based on samples and, therefore, subject to a margin of error. We noted Vodafone's view that the proportion of unanswered and diverted calls was falling and its belief that wider use of voicemail services was a contributory factor to this. We considered also that improved coverage would have an impact. We noted that Cellnet's assumption that callers listened to the entire announcement was likely to overestimate the number of minutes involved. On balance, we took the view that a reasonable estimate would be to take the average of the Cellnet and Vodafone figures; that is, to assume that 2.7 per cent of call minutes related to unanswered and diverted calls. On this basis, the benchmark cost of successful calls would rise by a factor of 1/0.973, or 0.32 ppm in 1999/2000.

5.155. It should be noted that not charging for such calls, but recovering the costs from successful calls instead, would have no overall financial effect on the companies.

Issues related to a price control

Implications of harmonizing retail prices and number portability

5.156. Callers from fixed to mobile phones pay a retail price which reflects both the cost charged by the MNO for terminating incoming calls, and a charge made by the FNO. Mobile operators are required by a condition in their licence to offer MNP by 1 January 1999. Customers of mobile networks will then be able to move networks and take their mobile number to the new network. With current technology and infrastructure, the FNO will, however, not know which network the number has moved to, and to overcome the problem the MNOs and FNOs have agreed that, initially at least, the FNO will charge the call to the ported number as if it was going to the network the number was

originally on. In these circumstances, the DGT considered that because the price actually paid would not necessarily reflect the charges of the network terminating the call, different retail prices would not give sensible economic signals and would be confusing. He considered, therefore, that each FNO should charge the same retail price for calls to both Cellnet and Vodafone. He said that although the issue of Orange's and One2One's prices was not specifically referred to the MMC, he expected that the outcome of the MMC investigation would, in practice, apply to them also. Hence, there would be a single retail price for calling a mobile phone. He argued further that, if retail charges for calls to all mobile networks were to be the same, there was also a case for termination charges to be the same and that this should equate to efficiently incurred costs. The DGT accepted, however, that prices might vary by time of day and that different FNOs could have different sets of prices.

5.157. In practice, this was effectively the case. At August 1998, the termination rates for all the MNOs were around 17 ppm in the day, 12 ppm in the evening, and 5 ppm at weekends. The DGT argued that if MNOs now introduced different termination charges then windfall gains and losses would arise from the FNO's inability to identify that a mobile phone number had moved to a different network (with different termination charges). Appendix 5.7 shows an illustration of this issue.

5.158. If each FNO were to adopt a single set of retail charges for calls to all mobile networks, there would be three potential implications:

(a) any incentive for one MNO to make an overall reduction in its termination charges as a competitive measure would be removed;

(b) MNOs would have no incentive to set different tariff profiles (ie to balance their individual rates for the daytime, evening and weekend differently) so as to compete more effectively in one period to stimulate a different traffic profile and to make more efficient use of their network;

(c) if an MNO were to reduce or reprofile its termination charges, the FNO would either have a windfall gain in its mark-up, if for example its harmonized retail charges reflected the highest termination rate charged in each period of the day or week, or it would average its mark-up across all operators. The latter approach would effectively apply a form of cross-subsidy from calls to MNOs with the lowest termination charges to calls to the networks with higher charges.

5.159. As to the first of these effects, we have concluded that there is currently insufficient competition to constrain termination charges (see paragraph 2.171), and in any event with effect from August 1998 all MNOs have been charging termination rates of around 17 ppm in the day, 12 ppm in the evening, and 5 ppm at weekends. However, for the reasons given in paragraph 2.452, we have concluded that it would be undesirable for the MNOs to be unable to compete on termination charges or to have no incentive to do so, and have proposed a price control which is a price ceiling but not a price floor.

5.160. As to the effect described in paragraph 5.158*(b)*, the DGT expressed concern to us about the ability of MNOs to modify their tariff profiles within a controlled average charge in such a way that there was a confusing proliferation of tariff rates without a real competitive cut in the overall level of these charges. He proposed that individual rates of charge should at least be subject to a sub-price-cap within the average ceiling in average charges. Table 5.22 illustrates the flexibility to modify individual rates that would be available to an MNO with the same kind of traffic profile as Cellnet and Vodafone, assuming that its weighted average termination charge was subject to a ceiling of 11.38 ppm. As this shows, at one extreme, the daytime charge could be set at 15.59 ppm if there were no charge in the evening or weekend and, towards the other extreme, the daytime charge could be reduced to 9.0 ppm but only if charges for the evening or weekend were set at potentially prohibitive levels. Setting tariff profiles at these extremes could seriously damage the efficiency of the networks either by discouraging peak-time traffic to the point where the busy hour capacity is under-used, or by increasing the peak loading, and therefore costs, while substantially under-using capacity outside the busy hour. The real scope for MNOs to manipulate their tariff profiles is therefore likely to be considerably less and, for the reasons given in paragraphs 2.453 to 2.457, we have concluded that

neither the control of individual rates nor a sub-cap to prevent excessive movements in individual rates would be justified.

TABLE 5.22 **Comparison of tariff options for a hypothetical MNO, based on its achieving a weighted average termination rate of 11.38 ppm***

	Day	*Evening*	*Weekend*	*Range between high and low tariffs (ppm)*
Traffic profile† (%)	73	19	8	
Alternative tariff options to achieve an average charge of 11.38 ppm‡				
Option 1	12.78	9.10	4.00	8.78
Option 2	14.00	4.59	3.60	10.40
Option 3	11.38	11.38	11.38	0
Less realistic options				
Option 4	9.00	17.90	17.60	8.90
Option 5	13.03	9.00	2.00	11.03
Option 6	15.59	0.00	0.00	15.59

Source: MMC.

*The weighted average termination charge of 11.38 ppm is the resulting total from multiplying the tariffs for the day, evening or weekend periods by the respective traffic profile percentage. These rates assume Vodafone's 1997/98 traffic profile of 73 per cent (day); 19 per cent (evening); and 8 per cent (weekend) for the purposes of compliance with the weighted average. Cellnet's traffic profile in 1997/98 was 72 per cent (day); 16 per cent (evening); and 12 per cent (weekend).

†Excluding international calls.

‡Figures are illustrative.

5.161. The effect referred to in paragraph 5.158*(c)* raises wider issues about the ability of FNOs to use their mark-up in such a way as to mask differences in the termination charges of individual MNOs. We illustrate in Appendix 5.7 how an FNO might apply its mark-up in relation to different sets of termination charges, and harmonize its retail charges in a variety of ways, without substantially affecting its net revenue. However, further considerations include the need for the FNO to set its retail charges in competition with other FNOs, possible operational reasons for determining its own tariff profile, and the potential benefits to consumers of allowing FNOs to avoid a proliferation of tariffs that differ only marginally. These are matters that we have considered further in our separate report on BT's charges for calls to the Vodafone and Cellnet networks.

Effects of a price control to 2001/02 on Cellnet and Vodafone

5.162. For the purpose of testing our method of assessing the financial impact on Cellnet and Vodafone of any price control, we put to both operators a possible price control ('the illustrative price control'), calculated prior to the formulation of our conclusions. We reviewed the impact on their forecast business performance using a hypothetical controlled price for incoming calls in 1999/2000 of 11.72 ppm, falling by RPI–10 to 10.14 ppm in 2001/02 at out-turn prices.

5.163. As noted in paragraph 2.473, we proposed, in the event, a price control for successful incoming calls for both Cellnet and Vodafone of 11.70 ppm in 1999/2000 prices, falling by RPI–9 to 10.34 ppm in 2001/02 at out-turn prices, assuming retail price inflation of 3 per cent. However, this included an adjustment of 0.32 ppm in 1999/2000 to reflect our view that Cellnet and Vodafone should no longer charge for unsuccessful calls (that is, unanswered calls and diverted calls before they are answered)—an adjustment we expect to be revenue neutral (see paragraphs 5.154 and 5.155). For comparability with the earlier analysis, we disregard this adjustment and consider the effect of a price control based on 11.38 ppm for all calls, falling by RPI–9 to 2001/02. We recalculated the effects of the control on the finances of Cellnet and Vodafone using the model that we had already put to the companies, but with our final price control figures.

5.164. Appendix 5.8C[1] shows detailed forecasts of the impact of the hypothetical price control on Cellnet's finances, and Appendix 5.9C[2] compares the main findings from the detailed forecasts of the main effects of the price control actually proposed. Similarly Appendix 5.8V[3] shows the detailed forecast for Vodafone on the basis of the hypothetical price control, and Appendix 5.9V[4] compares these results with our forecast of the effects of the price control actually proposed. We estimated that our proposed control would reduce Cellnet's incoming call revenues over the three years by £239 million, compared with £199 million for Vodafone, equating to annual reductions of £80 million and £66 million for Cellnet and Vodafone respectively. The difference was because the companies had different forecasts for traffic growth and had made different assumptions about incoming call charges. Cellnet forecast smaller reductions in incoming call charges than Vodafone.

5.165. We also considered the effect of our proposed control in the light of the following performance measurements:

(a) reduction in the companies' incoming calls revenues over the three years compared with their respective total forecast revenues and total forecast incoming calls revenues;

(b) reduction in the companies' forecast cash flows over the three years compared with their total forecast cash flows;

(c) reduction in their cumulative forecast profits before tax, assuming that the companies do not take action to reduce their expenditure budgets; and

(d) effects on the companies' gearing levels, as measured by the ratio of debt to debt plus equity.

5.166. In addition, we also calculated the cash flow reductions as a percentage of the companies' forecast cumulative expenditures on marketing and incentives over the three years and as a percentage of their forecast cumulative marketing, incentives and capital expenditure. This gave us a partial indication of the potential for the companies to adopt cost reduction measures to help absorb any reductions in cash flows arising from their implementation of the proposed price control.

5.167. Vodafone told us that the cash flow reduction we estimated over the three years would be unwelcome but that it would not jeopardize Vodafone's ability to finance its functions.

5.168. Cellnet said that the lost cash we estimated would represent a substantial detriment to its business. We therefore considered the effect on its gearing by reference to its potential market value if quoted, and noted its ability to borrow from BT as its first source of finance.

Implications for Orange and One2One

5.169. We considered what the effect would be if Orange and One2One chose to follow the average charges set under the illustrative price control on Cellnet and Vodafone, and under our actual proposals. We put to the companies the results of our analysis under the illustrative control but they requested that we did not disclose the results in our report. We considered the following effects on Orange's and One2One's business plans to 2001/02:

(a) reduction in the companies' incoming calls revenues over the three years compared with their respective total forecast revenues and total forecast incoming calls revenues;

(b) reduction in their forecast cash flows over the three years compared with their total forecast cash flows;

(c) reduction in their cumulative forecast profits before tax, assuming that the companies do not take action to reduce their expenditure budgets; and

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[1]Appendix 5.8C does not form part of the Vodafone report.
[2]Appendix 5.9C does not form part of the Vodafone report.
[3]Appendix 5.8V does not form part of the Cellnet report.
[4]Appendix 5.9V does not form part of the Cellnet report.

(d) effects on the companies' gearing levels, as measured by the ratio of debt to debt plus equity.

5.170. In the case of One2One, we were also able to consider the effect on its forecast operating profits. We reviewed the companies' debt and expectations on debt repayments to 2001/02. Finally we noted the potential market value of One2One if it was quoted and used the figure as a measure for equity in considering the company's debt to debt plus equity ratio over the period of our recommended price control. We did the same calculation using Orange's actual market capitalization at October 1998.