

The Auction of Radio Spectrum for the Third Generation of Mobile Telephones



REPORT BY THE COMPTROLLER AND AUDITOR GENERAL
HC 233 Session 2001-2002: 19 October 2001

executive summary

- 1** In April 2000 the Radiocommunications Agency (the Agency) raised £22.5 billion from an auction of five licences for radio spectrum to support the third generation of mobile telephones, (3G). This report examines the reasons for the high proceeds, and the extent to which the Agency have promoted the main auction objectives of the efficient utilisation of the spectrum and the enhancement of competition between operators to the benefit of consumers.
- 2** The radio spectrum is a range of radio frequencies, used by the public and private sector to deliver basic services such as radio, radar, and mobile telephones. It is a finite resource of great and growing economic importance. The mobile telephone industry alone contributed £5.3 billion to Gross Domestic Product in 1999, and supported 164,000 jobs. In the UK, as in the rest of the world, spectrum is in short supply and demand for it from users is increasing, especially in frequencies most suitable for mobile communications. If demand cannot be met spectrum congestion will restrain economic growth and stifle innovation.



- 3** The first generation of mobile phones provided simple voice telephony, while the second, introduced in the UK since 1992, provides additional data facilities such as messaging services and e-mail. The next, third, generation of mobile phones offers full interactive multimedia capabilities (voice, video or data transmission). They offer a greater capacity than current mobile telephones for the fast transfer of data, enabling the provision of innovative services. Governments across Europe, including the United Kingdom, agreed to allocate the same fixed range of spectrum to accommodate 3G services. This, and the use of a common standard across Europe allows consumers to use their telephone handset in any part of Europe, and provides benefits for equipment manufacturers and operators.

- 4 The Radiocommunications Agency are an Executive Agency of the Department of Trade and Industry. They manage the civil radio spectrum throughout the UK by issuing licences to mobile telephone operators and other users of radio. The Government defined their objectives for the auction as, to:
- i Utilise the available spectrum with optimum efficiency;
 - ii Promote effective and sustainable competition for the provision of third-generation services; and
 - iii Subject to the overall objectives above, design an auction that is best judged to realise the full economic value to customers, industry and the taxpayer of the spectrum.
- 5 The Government's overall aim was to secure the long-term economic benefits of 3G services for UK consumers and the national economy. The first and second objectives of the auction, to promote efficient use of the spectrum, and to promote effective and sustainable competition, were of particular importance to achieving this aim. In designing the auction the Agency worked in consultation with the Office of Telecommunications, (OFTEL), which maintains and promotes effective competition in telecommunications markets.

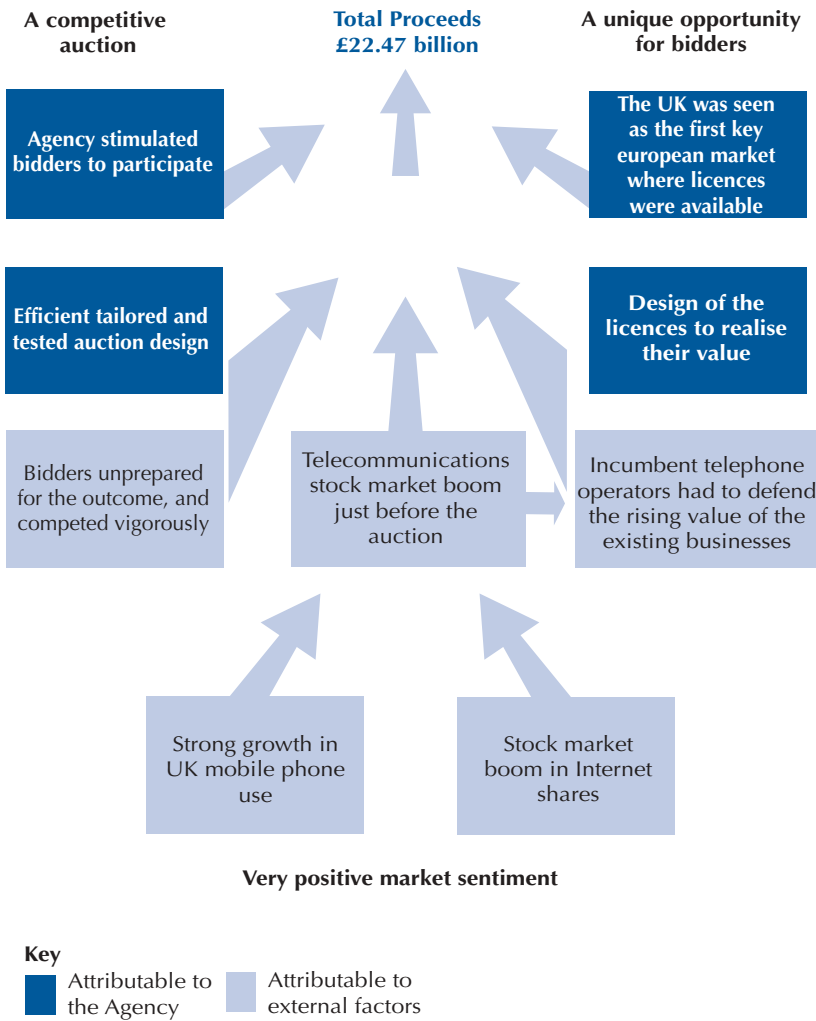
Realising full economic value

- 6 We deal with this subsidiary objective first in our report because the reasons for the high level of proceeds provide evidence with which to assess the achievement of the two other objectives. This objective was worded so as to make it clear that the interests of the industry and consumers should be taken into account, rather than to mean simply maximising the proceeds for the taxpayer. It recognised that a strong and competitive industry would generate economic growth and receipts from taxation. Any reduction in the take-up of the 3G services due to increased costs would have a compounded negative impact on the economic benefit gained in terms of taxation and employment. Therefore, the Government's aim was not to use an auction in order to maximise the level of proceeds. They decided to assign licences in this way following advice from economics consultants that auctions provide a sound economic basis for the allocation of spectrum. They considered the use of an auction to be consistent with their other objectives because by awarding licences to the highest bidders, spectrum would be allocated to the mobile telephone operator that valued it most and would be more likely to exploit it to



greatest advantage. The proceeds raised by the auction were subsidiary to the economic benefit to be derived from assigning the spectrum to those who would value it most. In this the Agency sought to strike a balance between the needs of the industry, consumers and taxpayers.

- 7 The auction raised greater proceeds than the Agency, bidders or external commentators had expected. Proceeds per head of population exceeded those in each subsequent allocation of spectrum in other countries. This outcome arose from the strong convergence of several positive factors, some of which were attributable to the actions of the Agency and others of which originated from external causes. These are summarised in the Figure below.



- 8 It was fundamental to the outcome of the auction that the five licences on offer attracted nine potential new entrants in addition to the four incumbent mobile telephone operators, Vodafone, BT Cellnet, Orange and One 2 One. This was almost twice as many bidders as in the next most competitive auction in Europe, in Germany, where seven bidders took part and secured six licences. The Agency stimulated this intense competition by:
- Offering one more licence than there were incumbent operators, so confirming that there would be at least one new entrant. If only four licences had been offered, the four incumbents, keen to protect the future of their businesses, would have been likely to use their competitive advantages from their existing market position to outbid and exclude potential new entrants;
 - Addressing some of the barriers to entry that the new entrant would encounter, for example by ensuring that the entrant's consumers would have a right to roam on incumbents' existing second generation networks while the entrant built their own 3G network; and
 - Intensively marketing the commercial opportunity of 3G to potential bidders through their advisers N M Rothschild and Sons, whom they incentivised through an appropriate success fee.
- 9 The timing of the auction was especially conducive to strong competition for the licences. The government had emphasised that early implementation of 3G in the UK would be advantageous for operators and consumers alike. Vodafone told us that winning the first licences to be made available in a key European market was important to bidders because:
- it enabled winners to approach equipment suppliers with realistic requirements before operators in other countries placed orders, allowing the licensees in the UK to influence the shape of the products and to secure supplies; and
 - it provided them with a stronger basis on which to bid for licences in other countries, whether allocated through auctions or through beauty contests.
- 10 Bidders told us that many European telecommunications companies had seen success in the UK auction as important to qualifying to be one of a small number of pan-European operators in the next decade. Bidders expected a process of consolidation in the industry. The auction also coincided with a period of very positive sentiment in global financial markets towards high technology industries, and an all-time peak in the share values of telecommunications companies. This inflated the prices that bidders were willing to pay in the auction. The values of the incumbent companies were expected to fall back if they had failed to win a licence and become vulnerable to loss of business to new entrants offering a superior 3G product. Also, the enthusiasm of the financial markets for telecommunications companies appeared to indicate a ready supply of capital with which licensees could finance their new networks.
- 11 The design and operation of the auction itself was efficient in realising this value. The Agency only selected the format for the auction once it was clear that the design of the licences would attract more bidders than licences. The format of transparent, ascending bids, as opposed to one-off sealed bids, gave the bidders greater confidence in bidding higher, since they were able to see that their competitors were doing likewise. Bidders drew assurance that their competitors shared their view of the importance of 3G telephony for the future of their industry. Also, a simultaneous ascending auction spread over seven weeks gave the bidders ample time to revise their initial budget constraints through authorisation from their top management and external financiers. Learning from US experience, the Agency required bidders to lodge initial





deposits of £50 million, rising to £100 million for bids of £400 million or more to protect the auction from frivolous bidding or default. Provision might usefully have been made for deposits to increase still further if bids went higher than expected. Reserve prices were put at a sensible level that did not deter participation. Our specialist adviser on auctions, Professor Cramton of the University of Maryland, considers the design and conduct of the auction to have been generally excellent. Bidders told us that they considered the Agency had managed the auction process very well.

- 12 The scale of the proceeds has heightened concerns that the auction will reduce the economic value of 3G services to consumers and the industry, and ultimately to the taxpayer through reduced economic activity and taxation. This issue is integral to the examination of the Agency's competition objective in paragraphs 15-22 and 27-29 below.

Utilising the spectrum with optimum efficiency

- 13 As a general principle the Agency is concerned that radio spectrum should be intensively used and that users do not allow it to lie fallow. Where users do not pay for spectrum they have no economic incentive to invest in more efficient equipment and surrender surplus spectrum. The Agency are seeking to extend the principle of charging public and private sector users for spectrum, which may be used by technically inefficient equipment and not exploited to its full potential. Intensive use of the spectrum made available for 3G services will depend on the number of mobile telephone subscribers who wish to use these services, and the extent to which these consumers use advanced services such as video and data transfer rather than simple voice or text messages. Advanced services require more spectrum than voice messages.
- 14 The Government recognised that the incumbent companies' existing networks and customer base are major barriers to new entrants, who would have to build their own networks over several years during which their service could be inferior and unattractive to consumers. The Agency allocated more spectrum for the new entrant in order to strengthen its business. Extra spectrum allows operators to reduce their investment in infrastructure, and to sell surplus capacity to other companies who wish to offer telephone services under their own brands. This is inefficient in technical terms because the new entrant, Hutchison 3G UK, starts with no existing base of customers, and the extent to which its spectrum will remain under-utilised depends on how quickly the company attracts customers and gets them using advanced, non-voice services. The Agency and OFTEL however, saw efficiency in wider terms, considering that a new entrant would roll out 3G services quickly and exert competitive pressure on the four incumbent companies to do likewise. This reduced the risk that the incumbents might otherwise defer their investment in 3G services while exploiting their spectrum only for less intensive voice telephony. The incumbents regarded the allocation of more spectrum for a new entrant as unnecessary, whereas most of the potential new entrants regarded it as helpful to their business cases and therefore their participation in the auction. Most new entrants did however bid extensively on licences with less spectrum.

Promoting effective and sustainable competition

- 15 The objective to promote sustainable and effective competition for 3G services reflected the Government's wish to see sustained competition between operators not just on price, but on the range of innovative services that could be provided. Before the auction, in July 1999, a review by OFTEL had concluded that the UK mobile telephone market was not yet fully competitive. This view is not shared by mobile telephone operators, who cite contrary

evidence that their industry is competitive compared to other sectors of the economy. The Agency, OFTEL and the Department of Trade and Industry shared a concern that competition in the early years of 3G could be dampened by defensive behaviour by incumbents, particularly if they bid for 3G licences primarily to protect their existing second generation businesses (paragraph 14).

- 16** OFTEL strongly supported the Agency's intention to achieve a fifth competitor in the market. In their view a new player should act as a further catalyst to achieving a fully competitive mobile market and by so doing provide significant benefits to consumers, by increasing the availability of new services and driving down prices.
- 17** The extent to which the increased competition from the new entrant will be sustainable depends on whether the UK market will sustain five operators in the long term. Other countries such as Spain and France have issued fewer licences, and only in the much larger German market did the authorities issue six. Given uncertainty about the likely revenues and costs of 3G services, the sustainability of five operators cannot be assumed. The new entrant, Hutchison 3G UK, faces a difficult task given that the four incumbents have already signed up two thirds of the UK population for existing mobile services. But there are indications that the company is positioned to compete effectively, for example:
- It is backed by the resources of a major international conglomerate, Hutchison Whampoa;
 - It has an arrangement for strategic co-operation on European 3G operations with NTT DoCoMo, Japan's largest mobile communications company and KPN Mobile the leading telecommunications company in the Netherlands, allowing each party to extend substantially its customer base across Europe whilst sharing development costs. DoCoMo has successfully pioneered innovative mobile telephony services including the world's first commercial trial of 3G services, in Japan; and
 - It has negotiated £3.6 billion of finance for rolling out its services, raised from shareholders, banks and equipment manufacturers, and has negotiated deals with owners of masts to install its equipment.
- 18** The other licences were won by the four incumbent operators in the United Kingdom market: Vodafone, British Telecom Cellnet, One2One and Orange. All four have already built nationwide mobile phone networks in the United Kingdom and either own or are linked to groups with an international customer base. Telecommunications Industry analysts have forecast each to survive as separate entities in the future. Most UK licensees have announced that services should be launched in 2002.
- 19** The Agency and OFTEL have various powers to preserve the increased competition that the auction has promoted. Licences are granted to the five named companies and are not transferable. One company cannot own or operate two 3G licences and, in the case of a merger or an acquisition, the Agency can revoke a licence and transfer the rights and obligations, through a new licence, to a new operator.
- 20** The process of auctioning licences in the UK and other European countries has contributed to the increasing indebtedness of major telecommunications companies. Commentators have expressed concerns that the cost of the licences has undermined the ability of operators to invest in their 3G networks, slowing development and increasing costs to UK consumers. Although the bidders who responded to our enquiries acknowledged that they, not the Agency, had decided what the licences should fetch, they considered that the final prices were driven in part by the view of some bidders that it was essential

for the future development of their businesses to obtain a licence in the UK. They told us that the level of proceeds from the auction had made financing significantly more difficult.

- 21** Since the auction telecommunications companies have experienced a more difficult climate for investment in the next generation of networks, with finance becoming scarcer and costlier. The major European mobile telephone groups' debt broadly doubled or tripled during 2000. This has been due to a combination of factors that, as described by City analysts, include regulatory pressures, operators seeking growth by borrowing to acquire other companies, as well as acquiring licences and investment to build networks. In the case of British Telecommunications plc, only one third of the company's £27.9 billion debt by March 2001 represented the £9.4 billion cost of licences in the UK, Germany and Holland. The remainder comprised mainly the cost of acquiring interests in other companies.
- 22** Although most major telecommunication companies, including the 3G licensees in the UK, have experienced greater difficulty in raising finance, Hutchison, One 2 One, Vodafone and Orange have already arranged funding for their new UK networks. Vodafone and Hutchison told us the high cost of their licence gave them an added commercial incentive to roll-out 3G services more quickly than if the spectrum had been given away. Difficulties that remain to be overcome for roll-out to proceed are mainly technical, for example the development of suitable base station and hand-set equipment. We have therefore found no strong evidence that the level of proceeds of the auction will have a negative impact on the wider economic benefit of 3G in terms of taxation and employment in the UK.

Balancing the three objectives

- 23** The Agency faced trade-offs, when designing the licences and the auction, between the three objectives for efficient use of the spectrum, promoting competition and realising economic value. Sometimes a design feature to address one objective could detract from another objective, and the optimum balance was not entirely clear to the Agency at the time. Realising full economic value for the taxpayer, industry and consumer was not paramount. The objectives had to be balanced in terms of the key decisions the Agency made when designing the licences and the auction.
- 24** Deciding the number of licences was particularly significant and was a difficult judgement, with many opposing views being expressed, by advisers, the industry and in government. Because there were already four incumbent operators, four licences might have deterred participation by bidders wanting to be new entrants, probably leading to reduced bidding for licences and lower proceeds, as well as yielding no addition to competition and consumer choice in mobile telephony. Parcelling up the spectrum into just four licences would have provided each with enough spectrum to reduce the technical risks of a low quality of service. In the longer term however, four licences may have been less efficient because without the pressure of a new entrant offering 3G services the four incumbents may not have exploited the spectrum as intensively. Five licences reversed these advantages and disadvantages of four licences. Six licences would have intensified still further the advantages and drawbacks of issuing five licences, but it is not clear that operators would have found this more crowded market place commercially sustainable in the UK, and the resulting smaller licences, all of 10 Megahertz (MHz), might have prevented higher bandwidth services such as video from being developed.

- 25** The other key feature of the allocation was the distribution of the limited amount of spectrum available between the five licences. For technical reasons, it was not possible to create five licences of the same size. Only two licensees could be allocated 15 MHz of paired (transmitting and receiving) spectrum, which was important because this larger amount of spectrum would make it easier for operators to provide a full range of 3G services. The three other licences would only consist of 10 MHz. The Agency reserved one of the larger licences for the new entrant in order to promote competition in the 3G market. In doing so they accepted the risk that this might lower proceeds, although the premium that the incumbents placed on a larger licence could not be predicted in advance. In the event the bidding indicates that BT, the second largest incumbent in terms of customers, would have valued the reserved larger licence higher than did the new entrant. The new entrant paid some \$100 million per MHz less for this licence than the incumbents paid for each of the four unreserved licences. This may not have been the case had incumbents been able to bid for both the larger licences. The other larger licence was open to bids from incumbents and was won by the largest incumbent, Vodafone. Orange told us that they would have preferred on competition grounds an allocation of one, still larger, 20 MHz licence for the new entrant, with four licences of equal size for the incumbents.

Conclusions

- 26** The use of sophisticated auction techniques is innovative in the public sector in this country, and there is scope for other public bodies to learn useful lessons from this example. The reasons why such high proceeds were generated, equivalent to some £560 per mobile telephone in use, are more to do with the high demand for the licences caused by the strategic ambitions of bidders, further stimulated by the Agency's marketing, than with the auction process itself. The auction was well designed and efficient in realising this value. The Agency obtained high proceeds, but did not maximise them because, in pursuit of their objectives for 3G licensing, they reserved more spectrum for a new entrant to promote increased competition in the 3G market. In the event, bidding demonstrated that potential new entrants did not feel that a large licence was essential. It is also significant that the licence reserved for a new entrant, which TIW won in the auction for £4.3 billion, was subsequently acquired for some £6 billion by Hutchison Whampoa.
- 27** There has been widespread concern about the position of telecommunications companies in the aftermath of auctions in the UK and other countries. The high level of proceeds for licences, notably in the UK and Germany, undoubtedly added to a general trend of much increased indebtedness in the companies, and to a downturn in confidence in these companies' ability to develop 3G services. The operators will suffer to the extent that they have paid for spectrum, which in previous generations of telephony the government allocated to them at negligible cost. Their rates of return on their investments, and the value of their businesses, will be lower than they would otherwise have been. The operators' share values have fallen back to the pre-boom levels they reached in 1998. Some of the burden of licence costs will be transferred to other parts of the telecommunications industry, such as equipment manufacturers providing operators with low cost financing in return for work on 3G.

- 28** It is not evident that the cost of the licences will increase the price of 3G services to UK consumers. Mobile telephone services in the UK are habitually priced according to market conditions, as opposed to simply passing on costs. As the major European operators undergo consolidation and restructuring, some licence costs are expected not to stay with mobile subsidiaries but to be held with their "fixed line" parent companies. Each of the UK licensees also holds licences in several other European countries. Bidders and our advisers consider that licensees would tend to average their licence costs across each of the markets in which they operate.
- 29** It was the bidders, not Government, who decided the price that was paid. In this case bidders considered wider factors than the value to them of 3G in the UK, a value which was highly uncertain at the time of the auction, and remains so. BT and Vodafone have since stated that they overpaid. But all the licensees except BT have already announced how they will fund their 3G infrastructure. The operators face major uncertainties about the costs and performance of the new networks, what services will be provided and the extent to which consumers will pay for them. But there are indications that in the UK the potential additional competitive pressure created by a fifth operator should be sustainable. The new entrant, Hutchison, appears to be a strong one, and the four incumbents are key international players in the future of this important industry.

Recommendations

On management of the Radio Spectrum

- 1 Public sector users of radio spectrum need incentives to make efficient use of it, such as being charged for it or by disposing of surplus spectrum in consultation with the Radiocommunications Agency. Disposal through auctions should be considered.
- 2 The Agency, DTI and OFTEL should continue to be cautious in responding to pressure from the industry to reduce regulation of competition in the light of the sums paid, or calls from commentators for refunds of licence fees in recognition of the challenges facing the industry. This might open them to the risk of legal challenge from unsuccessful bidders. Bidders freely decided what they should pay, and concessions could risk unfairness to unsuccessful bidders and establish a dangerous precedent if future bidders interpreted this as encouragement to bid irresponsibly in the future.
- 3 The Agency and OFTEL can however help the operators by being receptive to proposals for network sharing. The regulators should welcome proposals for sharing "passive" infrastructure such as sites and masts, and accede to proposals for sharing of active elements such as transmitters where the alternative would be no coverage or a more limited range of services. This would be subject to competition law and the conditions of operators' licences.
- 4 Auctions can only allocate spectrum efficiently to the extent that bidders can reliably forecast the likely success of their businesses. Some licensees will be more successful than others, so an efficient allocation of spectrum will require flexibility for it to be transferable. The Agency should take early steps to make use of impending changes in European Union Directives which will allow the trading of spectrum in the future.

On the use of auctions in the public sector

- 5 Departments should recognise that auctions are a useful mechanism for allocating resources in many situations, particularly where demand for items outstrips supply; where there are likely to be more bidders than lots; and little information exists about their worth, though they are capable of being independently valued. Compared to other methods of allocation auctions can be more transparent, objective and relatively cheap to administer, and how bidders become winners is easier to understand. However, each economic environment requires an auction design and associated policy framework that is tailored to that environment - one size does not fit all.
- 6 Getting a good ratio of bidders to lots is fundamental to the success of any auction. Proactive and expert marketing of the opportunity is therefore vital, as was achieved in this case. Where there are barriers to entering the market departments may need to design specific incentives to attract new entrants. Departments and their advisers should counter pre-auction media speculation that proceeds could be high, which could deter bidding.
- 7 The single ascending bid method used in this auction is suitable when the seller expects an adequate number of serious bidders to participate and compete. An "Anglo-Dutch" method, in which the auction finishes with sealed bids, could be considered when less interest is expected.
- 8 Where lots are identical, Departments might wish to consider "combinatorial" auctions in which bidders decide how much of the asset they want, by bidding for and combining smaller pieces, as was done in the spectrum auctions in Germany. This extends the principle of letting the market decide what is an efficient allocation. In this case the Agency were right to fix the size of the licences themselves - it ensured that there would be a new entrant. And bidders welcomed the certainty of knowing exactly what bands of spectrum they were bidding for.
- 9 Requiring bidders to pay substantial deposits at the outset as insurance against default provides protection for the seller and acts a deterrent against ill-considered bidding. Departments should provide for these deposits to increase as the value of bids rises beyond the levels expected.
- 10 Departments should pay particular attention to the level of reserve prices in an auction. Where they expect sufficient competition for lots reserve prices should be set conservatively to avoid deterring interest and to minimise the risk of leaving lots unsold, but no lower than the level at which prices would have been set without an auction.