PERGAMON

Telecommunications Policy 25 (2001) 671–688

TELECOMMUNICATIONS POLICY

www.elsevier.com/locate/telpol

Spectrum auctions in India: lessons from experience

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Abstract

Spectrum auctions have been used with significant success in many developed countries. From a regulatory and policy perspective, spectrum auctions ensure the efficient use of spectrum by allocating it to those entities that value it most, while also generating revenues for governments. But auctions may lead to unexpected outcomes due to unanticipated problems with their design leading to unexpected bidder behavior such as collusion and over-bidding. The key challenge before regulatory agencies is to design auctions in such a way as to meet the objective of fostering competition while at the same time ensuring that bidders can effectively use the spectrum for their business. While India was one of the early adopters of spectrum auctions, its success in service provision has been low. This paper critically examines issues in auction design that contributed to this delay and reviews the key elements in the design process namely a coherent regulatory framework, choice of service areas, flexibility for service area consolidation, standards and their role, convergence, managing public service regulation and managing defaults. The paper compares the handling of these elements in auctions in the United States (US), United Kingdom (UK) and Australia with the objective of drawing lessons for Indian policy makers.

Keywords: Spectrum; India; Telecom; Auction design; Public service regulation; Convergence; Standards; PCS; 3G

1. Introduction

With private initiatives increasing in telecom and broadcast service provision, demand for spectrum has increased. Digital technology has increased the scope of applications and created new areas of service provision. Cellular telephony and wireless Internet are examples of such services. Despite technological changes that reduce the demand for spectrum, availability of spectrum continues to be a constraint. In order to allocate spectrum amongst competing service providers, regulatory agencies often use auctions. From the regulatory and policy perspective, spectrum auctions ensure efficient usage by allocating it to those entities that value it most, while

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0308-5961/01/$ - see front matter
PII: S0308-5961(01)00047-7

also generating revenues for governments. But auctions may lead to unexpected outcomes as, for example, when regulatory agencies have inadequate market information, there may be a mismatch between expected and actual bidder behavior, or auctions may be poorly designed (McMillan, 1994). The key challenge before regulatory agencies is to design auctions in such a way as to meet the objective of fostering competition while at the same time ensuring that bidders can effectively use the spectrum for their business.

India was among the early adopters of spectrum auctions. Despite this early start, services have been slow to roll out. This paper critically examines the issues in auction design that contributed to this delay and reviews the key elements in the design process namely a coherent regulatory framework, choice of service areas, flexibility for service area consolidation, standards and their role, convergence, managing public service regulation and managing defaults. The paper compares the handling of these elements in auctions in the United States (US), United Kingdom (UK) and Australia with the objective of drawing lessons for Indian policy makers. While this paper provides examples from a wide variety of spectrum auction examples, it draws heavily on Personal Communications Services (PCS) auctions in US as these were innovative in their design and have subsequently been adopted by several other countries notably UK, Australia, New Zealand and Germany. The UK 3G model is a recent example of adoption of the US model for such services. Appendix A provides an overview of the auction design and results for PCS licences in the US, and 3G in UK.

2. Indian auction design

2.1. Service areas

In India, telecom licences were auctioned for basic and cellular services from 1991 by the Department of Telecom (DoT), the incumbent government policy maker, regulator and service provider. For service provision, the entire country was divided into roughly 20 circles, categorized as A, B, or C depending upon their revenue potential. The circles were mostly co-terminus with the DoT's administrative boundaries and the states. For administrative convenience, the larger states were divided into two circles, while some smaller states were amalgamated together. For cellular services, DoT decided to have two operators per service area, while for basic services there would be one more operator besides DoT in each service area.

2.2. Entry conditions

Potential service providers were required to seek foreign partners, as it was felt that no Indian company had the requisite financial strength and technical know how. For all licences, bidding was a two-stage process, the first being a pre-qualification based on the evaluation of financial net worth (linked to the category of circle and service bid for) and experience in service provision and the second stage involved evaluation of bids. The bids were single stage, with the award going to the highest bidder drawn from those that satisfied the pre-qualification conditions. For cellular licences, Global System for Mobile Communications (GSM) was the

chosen technology and for basic services, a combination of fiber optic and wireless in the local loop (WLL) was selected.

For cellular services, there were separate licenses for the four major metros of Kolkata (Calcutta), Chennai (Madras), Mumbai (Bombay) and New Delhi. The licences for the circles containing the metros excluded these cities. For metro licences, the financial bids were to be evaluated on the rental to be charged to the customer for the first 3 years. (The airtime tariffs were fixed by DoT.) The licensee fee was a flat amount for the first 3 years and then was linked to the number of subscribers, subject to a minimum amount. Subsequent to the bid opening, the rentals were fixed at Rs. 156[1] based on the amounts specified by the winners, even though some winning bids had zero rentals. For cellular services in circles, the rental was analogous to the amount worked out in metros, and bidders were evaluated on an annual licence fee for the duration of the licence, converted to its net present value at a specified discount rate. The second highest bidder had to match the highest bid in order to obtain the licence.

2.3. Results of the auctions

Prior to the bidding, no ceiling on the number of circles that could be awarded to a single entity had been specified. Subsequent to the receipt of bids for basic services, it was found that a single company had won nine circles and had bid very high. Consequently, there was speculation regarding its ability to pay the licence amount in all the circles, were it to be awarded all of them. The payment requirements were $15 billion over 15 years while its annual turnover at that time was $0.06 billion. The government "allowed" the winning bidder to "choose" three circles, as it felt that by awarding all nine circles to a single company, it would be replacing public monopoly by a private one. By allowing the company to choose and not letting it withdraw on its own, the government lost the "minimum reserve price" that such withdrawals would have generated as per the bidding conditions. Five circles received extremely low and single bids. There were a variety of problems including the issue that some of the C circle bids were at least as high as those in B. Consequently, 15 circles were put up for re-bidding for basic services with the government specifying a "reserve" price. There was in essence very poor response, there were few bidders with a general perception that the reserve price was too high—nine circles remained without any service providers. Subsequently, only six providers signed the licence agreement. Basic services providers had to sign an interconnect agreement with the DoT, while cellular service bids had no such preconditions and were required to negotiate the same with the state level DoT units.

Despite relatively fewer problems with the award of cellular licences, the services were slow to take off, due to the high bids, slow clearances for frequency allocations and lack of a suitable framework for managing the interconnect arrangements. Initially, the DoT provided only for a single point of interconnection in a circle, as this was the most commercially viable situation from its perspective but one that caused several problems to cellular service providers. In addition, when the DoT increased the interconnect rates, the cellular operators went to court which directed the government to set up a regulatory agency. As a

[1] 1 US $ was approximately equal to Rs. 20 at that time.

consequence, the Telecom Regulatory Authority of India (TRAI) was established in 1997. TRAI had limited powers with respect to dispute resolution vis-à-vis DoT, as the former treated itself as the licensor and thus outside TRAI's authority. Moreover, TRAI had the mandate to deal with service providers only.

2.4. National Telecom Policy 1999 and its consequences

Despite these initiatives, service roll out continued to be slow. The government then set up a group on telecom (GOT), that consisted of top-level bureaucrats, industrialists and professionals to evolve a future policy framework for the sector. This was presumably effected outside the DoT as the government felt that the DoT might not be able to conceive a radically different roadmap or might thwart the involvement of the private sector or produce a regulatory framework crafted in the DoT's vested interest. The GOT drafted the National Telecom Policy in 1999,[2] (NTP 99) which presented a roadmap for resolving the impasse. All existing licence holders could "migrate" to a new regime that involved a one time payment as entry fee and an annual revenue share with the government, provided that all operators withdrew their court cases against the government on a variety of issues such as delays in clearances. The entry fee was based on a percentage of the total amount of the original bid. This change greatly facilitated private sector participation and several operators subsequently commenced services. As a part of the package, the operators also agreed to allow the government to increase the number of players in their service areas.

2.5. "The wireless in the local loop with limited mobility" issue

In 1999, the DoT permitted technological neutrality, in order to facilitate the roll out of the incumbents network with CDMA technology. There were rumors that the CDMA lobby which had lost out earlier when the government had adopted the GSM standard, was trying to enter the market by influencing the policy makers to allow the existing basic service operators (BSO) to provide "wireless in the local loop with limited mobility" (WLL(LM)) using CDMA technology. The service would essentially allow cellular service without roaming. Since (i) only about 10 percent of users used the roaming facility, (ii) BSOs were allowed to keep 60 percent of the long distance revenue that they generated (cellular operators, in contrast, could keep only 5 percent), and (iii) no additional licence fee would require to be paid. Thus, such a service would be more profitable than the GSM cellular. After several rounds of decision making, the service conditions of both cellular and fixed service providers were rendered virtually equitable (Jain & Sanghi, 2001). This resulted in valuations of cellular services declining due to impending competition. This could also result in lower bids for the fourth licence in cellular that the government is planning to offer for bidding. (The DoT had drafted the conditions so that the incumbents had the right to be the third operator.) (DoT Guidelines for Issue of Licence for Cellular Mobile Telephone Services, 2000).

[2] http://www.trai.gov.in/npt1999.htm.

2.6. Auction design for the fourth cellular operator

The bidders could apply for any number of service areas, subject to the fulfillment of the specified entry conditions. The existing licensees could not bid for the same service area. Rollout obligations would be imposed on the winning bidders such as covering at least 10 percent of the district headquarters in the first year and 50 percent within 3 years of the effective date of the license. Having been criticized for the single round highest bid mechanism that caused inflated licence fee in earlier rounds, the government produced a bidding process which it called the informed ascending bidding process. The bidding process would have three rounds. The highest pre-qualified offer in the first financial bid would be treated as the reserve price for subsequent rounds of bidding. The lowest bidder in any round would not be allowed to participate in the next round, provided there were four or more bidders in any round. In case there were only two short listed bidders, both would qualify. The highest bidder in the third round would be declared successful for the grant of a licence.

3. Analysis

3.1. Gaps in the regulatory framework

The absence of clear separations in DoT's responsibilities for policy, regulation and operations led to several delays and lowered the credibility of the government. Like all incumbents, it saw its position threatened by impending private participation and set impediments in the service roll out, whereas in its role as a policy maker, it was required to design the auctions to facilitate service provision. Confusion in DoT was also evident from the manner in which it handled the interconnect issues. Managing the caps on the number of circles or delays in clearances after the bids were opened showed a lack of adequate preparation in the auction design process. The establishment of TRAI and NTP 99 brought about major changes to the licensing process and converting the licence fee to a revenue sharing regime signaling the governments changing perspective and willingness to bear a part of the market risk. Subsequently, an interconnect framework has been put in place (although problems persist) and service provision has accelerated.

In designing the mechanisms for private participation, regulatory agencies need to address the contextual issues that would facilitate service provision and not limit themselves to just allocation of rights to provide the service. Unlike the Indian case, the UK 3G auction recognized this and took the necessary steps to design the auction appropriately. In the UK, there were already four established mobile players that had 2G licenses covering nearly 97 percent of the area and 90 percent of the population. Incumbents who won a 3G license, could provide roaming services over the existing 2G network to new 3G customers. In contrast, a new entrant needed to establish a roaming arrangement with the incumbent 2G providers. The incumbents could thwart competition by denying or delaying roaming facilities to the new entrants. The government felt that new entrants needed certainty regarding their ability to be able to provide roaming over the existing networks and, therefore, mandated that incumbents would have to provide roaming to the new entrants. Such a mandate necessitated a change in the existing licences that was

undertaken for the dominant providers. The incumbents sought several changes to the originally proposed roaming conditions which would be to their advantage. Further details regarding the roaming conditions are provided in Appendix A.

3.2. Lack of clarity in policy for spectrum allocations

Given the importance of appropriate pricing for spectrum, the government set up the Spectrum Management Committee of the GOT and Spectrum Pricing in May 1999.[3] The Spectrum Management Committee considered those examples of auctions that had not been so successful such as the defaulting PCS C block licensees (Appendix A) to determine whether auctions were appropriate. The Spectrum Pricing Committee examined various approaches to pricing spectrum and suggested that "auctions, transferable and flexible spectrum rights, and well-designed fees can enable a number of the benefits of a market approach to be realized. Fees can promote efficient use of the spectrum provided that they incorporate the correct economic incentives and are not set so low as to be negligible in the eyes of spectrum users or so high as to exceed what a market would set, in which case spectrum will sit idle and generate no benefits". The Committee recognized the problems in evaluating the various fee components but was not specific about how these could be dealt with in India. TRAI also recognized the role of auctions in the allocation of spectrum (it being a scarce resource) (www.trai.gov.in/recom.htm) and the need to use auctions across different services in the future. Due to lack of clarity regarding the present situation, there are different mechanisms for allocating spectrum for various services. For the fourth cellular operator, spectrum would be auctioned, while those providing "WLL (LM)" are to obtain the spectrum based on a fixed entry fee and allocated on a first come first serve basis subject to completion of roll-out conditions. This would result in two services that both require spectrum (incidentally in adjacent bands) to be treated differently.

The Spectrum Committee's view and TRAI's hesitance in choosing auctions, while agreeing in principle regarding the appropriateness of the method, is difficult to understand. There is a wide variety of experience in different parts of the world where auctions have been used successfully and this experience could be effectively leveraged.

In contrast to the Indian situation, in New Zealand, UK, and the US spectrum auctions had been legislated in 1989, 1990 and 1993, respectively. The FCC, the Radio Communications Agency that conducted the 3G auctions in UK and Oftel (the UK regulator) went through a detailed public discussion involving industry, academia and other interested parties in designing the auctions. This allowed regulatory agencies in these countries to auction spectrum for all services rather than having to choose allocation mechanisms separately for various services.

3.3. Identification of service areas

Two critical areas in auction design are those of choosing an appropriate unit of bidding or service area while at the same time incorporating flexibility to allow the bidders the ability to consolidate over the service areas. The service areas must be commercially attractive to bidders so

[3] http://www.nic.in/got/report/
http://www.dotindia.com/wpcc.spectrum-home.htm.

as to enhance the value of the spectrum while at the same time fulfilling the governments' objective of enhancing competition and faster roll out even in smaller cities and villages.

3.4. Unit of bidding

In India, the DoT's choice of "circles" as the bidding unit was based on administrative convenience rather than on the commercial interests of the bidders. The "circle" approach limited the participating bidders to large corporate entities, due to the high investments required (as several states had population and area larger than many European countries) and net worth conditions set out in the pre-qualification round. The high bid amounts that successful bidders paid resulted in the licensees covering the more commercial and revenue yielding cities and towns, leaving the semiurban and rural areas virtually uncovered in the early years.

In comparison, the diffusion model for cable TV operations is different. Small independent cable service providers, with little investments in capital operate within geographically small areas. The spread of cable TV has been very rapid. It has reached a level of almost 60 million connections in the course of a decade compared to the nearly 35 million direct exchange lines laid by DoT in almost a century. Cable operators did not have to acquire a licence. Unlike a telecom system, they do not require to interconnect, provide two-way connectivity or billing. This model of small entrepreneurs providing services over a limited area was not adopted for telecom, as the DoT's licence areas were based on its administrative convenience. Had this model been adopted over time, the smaller telecom operators would have consolidated under competitive pressure. In order to make such entry commercially viable, the government might have allowed such operators to keep a greater amount of the revenue share commensurate with the investments made by the local access provider. (Currently, the revenue share across different services is almost similar.)

Despite the problems with the "circle" model, the DoT and TRAI continue to provide the bidding guidelines in terms of circles placing the focus on administrative convenience and inertia. While smaller bidding units could reduce economies of scale and scope for some bidders, the facility for geographical aggregation can be incorporated in the auction design stage. This would introduce more complexity into the design and would require working on an appropriate method of identifying the service areas.

An approach that incorporated market interests at the design stage was adopted by the FCC in the US for the PCS auctions in dividing the country into 51 Major and 493 Basic Trading areas based on the Rand McNally 1992 Commercial Atlas and Marketing Guide. (Some additions and exceptions were made to address commercial interests.[4])

3.5. Scope for consolidation

In India, the bidding process did not allow companies to bid for a group of contiguous circles. The subsequent changes in the ownership patterns in India in which significant consolidation has taken place in the cellular mobile industry shows that bidders may have preferred to bid for contiguous circles.

[4] http://www.fcc.gov/oct/info/maps/areas/welcome.html.

For example, AT&T, Wireless Co and PCS Prime Co. all large companies, were able to win licenses, which could be aggregated nationwide.

The FCC PCS auction design provided a mechanism for bidders to group licences together during the bidding process. In all the auctions, large companies were able to win licences that could be aggregated or provided complementarily with their existing licences.[5] While the auction rules restricted current cellular holders from participation in the auctions, would-be bidders were permitted to join together. While merging enabled companies to obtain larger geographic coverage, derive economies of scale, and facilitate roaming, it reduced the number of bidders and the prices paid. The FCC put a 45 MHz ownership cap on the combined cellular and PCS frequencies of a licence holder, effectively preventing cellular licence holders from providing PCS services in their service areas.

In some of the developing countries, combinational bids comprising a profitable area and an area with lower revenue potential area, have been used to extend universal service obligations. The FCC used a similar mechanism for service provision in the wake of direct broadcast services. It mandated that all direct broadcast services awarded after January 1996 needed to cover Alaska and Hawaii "where such service is technically feasible".[6]

Regulators put some constraints on participation, so as to increase competition. From the bidders' perspective there was resultant loss in achieving economies of scale and scope. Several companies consolidate for service provision in the wake of the bidding process. From the governments' perspective, a pre-bid consolidation as exhibited in the US auctions, leads to lower bids, and hopefully lower prices for consumers. On the other hand, the absence of pre-bid consolidation could drive licence prices higher, resulting in greater revenue for the government. Subsequent consolidations could further increase the licence price although the government may not be a significant gainer in such processes. This could also lead to reduced competition in service provision and hence higher prices for subscribers. However, since similar services could essentially be provided over different networks, such as voice calls provided either over fixed line, cellular or satellite, regulators need to view the competition issues not in terms of the service that is being licensed but for all services that could be alternatively provided. This would imply that allowing for pre-bid consolidation in the auction design could create the necessary incentives for the bidders to jointly provide services, while at the same time competition amongst services would ensure lower prices for customers.

4. Standards

Today more than 60 percent of the digital wireless market is based on GSM,[7] enabling lower cost of products and equipment. The specification of GSM standards in cellular has enabled Indian service providers to acquire lower cost technology. Subsequently, the DoT adopted a policy of technological neutrality, but despite this chose the CDMA standard for the WLL (LM)

[5] For example, AT&T, Wireless Co and PCS Prime Co. all large companies, were able to win licenses, which could be aggregated nationwide.

[6] http://www.fcc.gov/Bureaus/International/orders/1995/fcc95507.txt.

[7] http://www.gsmworld.com/news/press_releases_10.html.

services, thus reversing on own policy. Although the incumbent had choices of alternative technologies, it chose to use the GSM standard for its cellular services, in order to be able to provide connectivity with the rest of the network, without the subscriber having to invest in a more expensive dual mode handset. For the new cellular licence in the 1800 MHz band, the guidelines were technologically neutral. This flip-flop policy of the government with respect to standards, led to delays as investors were reluctant to invest until the decision on standards was finalized as these had major cost implications in terms of handsets, interconnection and roaming.

While European agencies have been specific about standards, the FCC has not been clear about its own policy stance. Unlike cellular services where the FCC had mandated the Advanced Mobile Phone System (AMPS) analogue standard in 1982, decided not to specify the standards or types of services to be provided for PCS. This would allow market forces to allocate frequencies for optimal technology usage.[8] One of the consequences has been the slower growth of cellular markets in the US compared with that of Europe—the latter having adopted a single standard—the GSM. The adoption of multiple standards has caused several impediments to the development of the industry. Evidence suggests that bidding companies have not overwhelmingly preferred any one of the PCS standards: NA TDMA, CDMA, or GSM (Goodman, 1998). The presence of several technologies, each with a consequent smaller scale of operation, did not allow the US vendors to provide cost-effective solutions as in the single standard scenario. Vendors have had to develop multi-mode handsets (PCS Week March 4, 1998) and interfaces between various service areas in order to facilitate roaming services. Variegated technologies within the same network also require development of interfaces. For example, Qualcomm, owner of the proprietary CDMA technology, had undertaken research and development to integrate GSM with CDMA. Designing various interfaces has increased the cost of service provision.

The FCC's earlier involvement with specifying standards had led to delays of nearly two decades, as exemplified by its choice of an analogue standard for cellular telephony, which had become outdated by the time it reached the market. On the other hand, its decision to allow multiple standards as in the AM stereophonic broadcast system[9] led to several litigations, delays, and lack of investment. Subsequently, the FCC reversed its decision in 1993–1994 when it specified a single standard. Similarly, the UK government mandating only a few features and leaving the choice of the rest to the industry was a major cause of failure of the telepoint industry (Goodman, 1998).

While direct involvement of the regulatory agencies in standards specifications could lead to delays and inappropriate technology standards, the market choice of standards led to insufficient coordination and inhibited the externalities required to make the industry competitive. There is a need to provide regulatory interventions for coordination in markets with externalities, and to do so in a timely manner with appropriate technological standards. From this perspective, in specifying GSM, regulators in Europe followed a more effective decision-making model than that of the FCC in developing the standards with industry support. The single standard allowed companies in Europe to exploit inherent economies of scale. In the UK, the 3G licencing adopted the Universal Mobile Telecommunications System (UMTS) standard—the European

[8] Three PCS technologies were prevalent at that time: Time Division Multiple Access–North American (NA-TDMA), Code Division Multiple Access (CDMA), and Global System for Mobile Communications (GSM).

[9] http://www.fcc.gov/mmb/asd/bickel/amsterco.html.

contribution to International Mobile Communications 2000. UMTS has been standardized by the 3G Partnership Project, of which the European Telecommunications Standards Institute is a member. A coordinated and participative approach among the regulators, standards institute and service providers, has led to the adoption of UMTS standards across Europe. Such a regulatory framework supports the commercial interests of 3G service providers by offering access to larger markets which facilitates roaming.

The European model is consistent with the emerging trend in several other industries where the role of the traditional standards body is being superseded by industry fora (Blackman, Cave, & David, 1996; Curtis, 1997). Since standards increasingly play a competitive role (David, 1996), active industry participation helps in faster acceptance of standards. One could argue whether this model allows for optimal technological choices but the market's choice of standards is no guarantee that optimal technology choices will evolve.

5. Convergence

5.1. Services

The issue of WLL (LM) led to cellular operators renegotiating their licences and seeking similar terms as basic service providers in terms of lower revenue share, interconnect charges and higher shares of revenue generated from long distance calls than their original licence terms. While advances in technology have led to a convergence between traditionally fixed and mobile services, the Indian licences were based on type of service such as basic or cellular. This led to contentions regarding regulatory parity between these services. Since competing and complementary services may be provided using the same infrastructure, TRAI should have used this opportunity to move away from service licenses to separation of licenses into infrastructure and service licenses. This would have reflected its understanding of the emergent convergence scenario in which competing and complementary services may be provided using the same infrastructure and hence need separate licensing arrangements. It would have also provided regulatory parity with guidelines for competition in the domestic long distance segment which recognizes two types of providers: infrastructure and services. By not doing so, and inviting bids for new cellular and basic services separately, TRAI would be faced with similar issues in the future.

5.2. Sectors

While the Indian government had gained significant experience in dealing with auctions in the telecom sector, it was unable to apply this learning to broadcast sector licences. In the broadcast sector, the highest-bidder-wins approach was used for allocation of FM channels. This resulted in high bids and post-bid negotiations. Possibly, by embedding a revenue sharing approach, as in the telecom sector, such post-auction negotiations could have been avoided.

In the longer run, there is also the possibility of competition in the broadcasting sector from traditional public switched telecommunications networks (PSTN). For example, Hong Kong Telecom (HKT) provides TV signals over its local access loops. The Indian telecom licensing conditions specifically forbid carriage of broadcast signals on telecom networks. But the new

Internet Service Provision (ISP) policy allows connection to the end subscriber and thus provides a mechanism for voice services. Differential approaches to regulation could mean asymmetrical service conditions for the same service using different infrastructures.

The convergence of telecom, cable, and Internet services, requires an examination of regulatory policies in the broadcast and telecom sector (Jain, 1999b; Tadayoni & Skouby, 1999). Broadcasters have traditionally obtained the spectrum free, in return for content regulation as governments have seen broadcasting as a mechanism to reach the population. The lower levels of content regulation in the Internet are likely to put pressures on regulatory agencies to lower content supervision over broadcasting, thereby questioning the basis of free spectrum. For example, spectrum for broadcast in the US was allocated free owing to the "public interest" component embedded in such services. According to the 1996 Telecommunications Act, Congress directed the FCC to issue licences for digital TV to incumbent television broadcasters, in return, the licensees were required to provide "free" programming and their public interest obligations were extended in the digital era (Thierer, 1996; Streeter, 1996). While the incumbent TV broadcasters have acquired the spectrum free, telecom service providers have had to pay huge amounts in licence fees for spectrum. In the UK, Independent Television Commission has offered radio spectrum to existing service providers to simultaneously broadcast their services using both analogue and digital transmission.

Regulators would need to identify how to deal with multiple sets of service providers—telecom, broadcast, Internet—all of whom have experienced different regulation in the past. One mechanism could be that of enhancing property rights over the auctioned spectrum. Currently, most licences are limited to the provision of specific services. However, in New Zealand and Australia, spectrum rights did not limit licensees to any specific telecom or broadcast application.[10] In contrast, in the US such flexibility was usually not provided and in those limited cases where it was provided, licensees were required to seek permission to provide additional services. While it would be difficult to change the regulatory perspective over a short period of time, regulators could establish a presumption of flexibility by allowing licensees to augment or modify services without having to repeatedly seek permission.

India is attempting to address the anomalous treatment of telecom and broadcast licences through legislative changes in the form of a Convergence Bill that seeks to provide coherent frameworks for both broadcast and telecom spectrum management. The bill seeks to set up a single Communications Commission for both telecom and broadcast sector covering licensing and spectrum management.

6. Public service regulation

The ability to provide services in far flung or rural areas, or providing special coverage may form important elements of the licences. For example, Indian telecom licensing conditions had specified 10 percent coverage for rural areas for basic services. However, this coverage was not provided, as the service providers found it more economical to pay the penalty than provide the service. The new cellular service licence mandate specifies target coverage in districts and metros.

[10] http://www.govt.nz/ps/min/com/rsp/dp2a.html.

After the previous experience of non-fulfillment, this time the coverage has been linked to performance guarantees.

Mandatory coverage requirements have been placed on Channel 3/5 services and 3G licenses in the UK. While such conditions are easier to specify, monitoring their implementation may be difficult. Recognizing the problems in spreading the coverage in far-flung areas, Peha (1999) suggests the concept of tradeable milestones for achieving and measuring coverage. This mechanism allows for more realistic assessment of targets and their monitoring, and at the same time, gives flexibility to the service provider in the shorter term while maintaining overall targets. The USOs in the auctions could be set out in a more realistic manner by adopting this approach, although the mechanism to monitor and implement this approach would be more complex.

7. Managing defaults

In India, there were several defaults on the licence fee, as the winners claimed that they had bid too high. In the absence of any linkages between the bid amounts and the financials of the bidder, it would be difficult to prevent defaults. But lack of firmness and prior planning about how defaults would be dealt with led to the delays. The government could have settled for re-bidding in the first instance when the companies were unable to pay the required bid amounts. However, its stated concern was that re-bidding would lead to a loss of investor confidence. The delays resulting from managing the defaults have, in fact, undermined investor confidence.

In order to ensure that only serious bidders were involved, the government had specified a "reserve price" that the companies would forego, if they did not pay up after having won the bid. In practice, however, the companies could let go of the winning bids without bearing any financial consequences. This led to charges of political favoritism and resulted in low government credibility. While in theory, the auction design elements were "right", the political will and an institutional mechanism to ensure proper implementation was lacking. The bidders could have sought recourse to court interventions (as had been done for cellular metro licence), but chose not to do so, probably fearing further delays, and hoping that they could acquire licences at lower prices if the government opted for a re-bid.

In the US, PCS licensees in the designated blocks (Appendix A) were able to seek several postponements for payment of licence fees. Repeated postponements and changes in auction rules possibly made the bidders feel they could negotiate better conditions (Stiglitz, 1998). This implies that the FCC needed to ensure that the bid amounts had some direct relationship with the financial background of the bidders. Despite this, in the subsequent services auctions (e.g., Local Multi-Point Distribution Services), the FCC ruled that, it would not favor asset valuation as a means of evaluating business size because of the problems associated with it (Report WT 97-35, 1997). In the German ERMES auction, the requirement for deposits payable in advance and bank guarantees could handle the problem of defaults on payments successfully; although no licences had specifically been earmarked for designated entities (Keuter & Nett, 1997). In Australia, the Australian Communications Authority imposed limits on the amount of spectrum for which any entity could bid.[11] In the designated bands, the FCC allowed the defaulting bidders to retain

[11] http://www.aca.com.

smaller frequency bands, recognizing the limited investments that designated entities could make. In other services, the FCC itself had recommended smaller frequency bands for designated entities.

A consistent and firm approach to handling defaulting designated entities could lead to greater self-regulation. This was exemplified in the Interactive Video Distribution Systems auctions. The FCC had adopted 25 percent bidding credit for companies owned by minorities and/or women, limiting the companies to one licence per service area in frequency segment A or B but not both. The winning bidder could take the first choice of the frequency segment and, if eligible, avail itself of the discount. Subsequent to the auction, some of the winning bidders who had been awarded bidders credits defaulted, leaving the credit unused. Consequently, other winners who also qualified for the credit requested modification of the licence, to enable transfer of the bidding credit. They felt that the defaulter's bids had been unrealistic and that they had been outbid. The FCC denied these requests stating that petitioners had received what they had bid on. Since their business plan was not contingent on receiving the credit, it contended that "post-auction defaults by high bidders did not warrant providing a windfall to the other winning bidder in the market". The FCC felt that it had attempted to provide sufficient information through seminars and fact sheets to enable bidders to make rational decisions and could not be held responsible for high bids and subsequent defaults.[12]

Auction processes may drive the price high, which makes it imperative that there be a stated upfront mechanism for managing defaults. Due to political pressures, it may not always be practically possible for the regulator to implement such a system, but an explicit system could make it less prone to such pressures.

8. Summary and conclusions

Auction design is a complex process that requires both insights into the theory as well as understanding of the market and bidder behavior. This paper critically reviewed the elements in the Indian auction design and implementation and compared it with those in the US, UK and Australia with the objective of drawing lessons for the Indian policy makers.

Adequate emphasis on having an independent regulatory agency to design and implement the auctions and a policy blueprint for spectrum management that focused on efficient and equitable allocation across different services could have led to faster service roll outs. At the auction design level, Indian policy makers need to review the choice of service areas and provide flexibility for service area consolidation. In a developing country context, where growth in service is of prime concern, specification of common standards by a regulatory agency could facilitate growth. However, for choice of standards, regulatory agencies need to work with academic institutes and industry associations. It appears that while the instruments for managing public service regulation and defaults were "right", the supporting institutional mechanisms and the political will for implementing them were not adequate. While the current frameworks have focused on attracting investments, the future focus should be on policies that optimize spectrum usage as that would lead to greater economic benefits.

[12] http://www.fcc.gov/Bureaus/Wireless/Orders/1995/fcc.95479.txt.

Acknowledgements

I would like to thank the referees and the editor for their help.

Appendix A. Overview of PCS and UK 3G auctions

A.1. PCS auctions

A.1.1. Auction design

The available 120 MHz for broadband PCS was divided into six blocks: A, B, C, D, E and F. C and F blocks were kept aside for designated entities (minority groups and women). The licence covered exclusive rights over a particular block in a specified geographic area. The blocks were sequentially auctioned but, within any block, the auction was multiple round and simultaneous over different geographical areas covered by the licence. This allowed for geographical aggregations of licences within a block. All licences were kept open until no higher bid was made for any of them. Bidders could make offers that took account of the higher value of a group of licences. The rules specified minimum bid increments to ensure that auctions took place over a limited time period. Stage wise activity rules, which specified the minimum number of licenses over which a bidder was necessarily required to be active in any round, enabled control of the pace of auctions. Each bidder had complete information regarding identity of bidders, upfront payments, all bids,[13] and eligibility information. The ratio of the population that was covered by the upfront payments to the total population, called the eligibility ratio, indicated roughly the degree of competition for the licence. (See Table 1 for details of auction rules.) (Cramton, 1997).

A.1.2. Results of the auctions

In all the auctions, large companies were able to win licences that could be aggregated or provided complementarily with their existing licenses. While merging enabled companies to get larger geographic coverage, derive economies of scale, and facilitate roaming, it reduced the number of bidders and the prices paid. Despite the similarity between A, B, and C blocks and D and E blocks, there were variations in auction prices across blocks and markets (Cramton, 1997).

Table 2 describes the salient features of these auctions. There was greater competition in the C block as compared to the A and B blocks. Net high bids,[14] including the C block reauction bids, totaled approximately $10.2 billion. Analysis of the bid amounts showed that, overall, C block licensees paid an amount which was higher than that paid by other similar PCS licensees (Cramton, 1997). Despite the relatively higher prices in this category, effective prices were lower as the designated entities could pay the bids over a 10-year period. Possibly, greater competition in this block and improvements in technology subsequent to the A and B block auctions contributed to higher prices (Congressional Budget Office, 1997).

While auctions in A, B, D, and E blocks might be considered successful, those in C and F blocks caused several delays as many of the bidders defaulted on payments. In response to repeated

[13] Upfront payments were based on the population covered by the aggregate licenses that the bidder planned to be active in at any stage and defined the maximum eligibility in any round of bidding.

[14] "Net high bid" means the total amount bid less any bidding credit.

Table 1
Overview of basic auction rules[a]

Rule	Rationale and explanation
Quantity	In order to prevent acquisition of large amounts of spectrum by a few bidders, there were limits on the amount of spectrum a firm could hold in any market. For narrowband, a firm could hold no more than three licences in any market. For broadband, no firm could hold more than 45 MHz in its service area. This limit included the 25 MHz of cellular licenses.
Payments	Payment was required up-front before the bidding to ensure the seriousness of the bidder. Each bidder was required to make an up-front payment based on the largest combination of licences in which the bidder planned to be active in any round. The payments were \$0.02 per MHz-population for the largest combination of licences in which the bidder planned to be active and also defined the eligibility of the bidder. Downpayment of 20 percent of the bid was due within five business days of the close of auction. Final payment of the remaining 80 percent was due within five business days of the award of licence. Firms eligible for instalment payments were eligible for reduced downpayments and would make quarterly payments over a 10-year period.
Minimum bid increments	The auction design specified minimum bid increments between rounds to ensure that auctions were executed in a reasonable amount of time.
Activity	To preserve current eligibility, each bidder was required to maintain a minimum level of activity. Activity was defined as the sum of MHz-population on which the bidder submitted a valid bid or was the highest bidder. In the initial stage, each bidder was required to be active on one-third of its eligibility. In the second stage, bidders were required to be active in two-thirds of current eligibility while in the third stage, bidders had to be active in 100 percent of their entire eligibility.
Closure	All markets closed for bidding if a single round passed in which no new bids were submitted for any licence.
Bid information	Each bidder was fully informed about the identity of bidders, the size of up-front payments, and which bidders qualified as small or minority owned businesses. High bids and bidder identities were posted after each round. All valid bids, bidders' identities, and eligibility were displayed at the end of each round.
Bid withdrawal	After any round, high bidders could withdraw their bids, subject to a penalty consistent with the standard remedy for breach of contract.

[a] Source: Jain (1999a, pp. 60–73).

requests from C and F block licensees for a restructuring of the installment plans, the FCC significantly modified them in order to allow more existing licensees to compete in the wireless market, and provide opportunities to other providers by re-auctioning the surrendered spectrum.

A.2. The UK 3G experience

In early 2000, the UK government decided to auction five third-generation (3G)[15] mobile licences with the objective of utilizing the available Universal Mobile Telecommunications System (UMTS)[16] spectrum with optimum efficiency, promoting effective and sustainable

[15] www.radio.gov.uk.

[16] UMTS is the standard for delivering 3G services being developed under the auspices of European Telecom Standards Institution. It builds on the GSM standards and offers a global wireless standard.

Table 2
Salient features of broadband auctions (Note: Commas after the figures indicate values for the second block in the column)[a]

Feature	Blocks A and B	Blocks C and F	Blocks D and E
Frequency band	1.9 GHz	1.9 GHz	1.9 GHz
Coverage	National	Regional	Regional
Spectrum auctioned	30 MHz, 30 MHz	30 MHz, 10 MHz	10 MHz, 10 MHz
Eligibility ratios	1.9	6.7	Not available
Number of licenses	48 + 3 pioneers preference licenses, 51	493, 493	493, 493
Amount raised ($ billion)	7.7 (for both categories)	10.2, 0.642	1.8 (for both categories)
Spectrum price ($/pop/MHz)	0.51	1.35, 0.33	0.33, 0.33
Technology choices	Technology choice between NA TDMA, CDMA, and GSM		

[a] Source: Jain (1999a, pp. 60–73).

competition for the provision of UMTS services, and providing long-term benefits to UK consumers and the national economy.

In order to facilitate service provision by and provide fair entry terms to the new entrant, the licences of the dominant incumbent providers were changed to facilitate roaming over existing networks of the incumbents. Roaming conditions covered the following key aspects:

- the requirement of roaming would become applicable only when the new entrants network had achieved a 20 percent roll out of services,
- there would be no roaming in those areas where the new entrant had a roll out,
- licence conditions regarding roaming would become applicable only when commercial negotiations were inconclusive,
- roaming conditions would cease to have effect after 2009.

Since BT Cellnet and Vodafone, two of the largest cellular service providers, had agreed for their licences to be modified to include the roaming condition, the government felt that this gave adequate certainty to potential new entrants and did not insist on licence changes of all operators.

A.2.1. Auction design

The available spectrum of 155 MHz was divided into three licences of 2×10 MHz paired spectrum and 5 MHz unpaired spectrum, one licence of 2×15 MHz paired spectrum and one licence of 2×15 MHz paired spectrum, and 5 MHz unpaired spectrum. A band of 15 MHz was kept for licence-exempt use. The largest band was kept reserved for new entrants who would be other than the four established players. The process used was similar to the simultaneous, multi-round process used by FCC, modified to include ratcheting reserve prices to avoid significant differences between winning price for new entrants and existing operators.

In each round, participants could bid simultaneously for any one of the five licenses. Existing operators could not bid for the licence reserved for new entrants. At the end of each round, bidders were advised of all bids made. The highest bidder for each licence was required to remain inactive in the following rounds until outbid.

Table 3
Type of license, winners and bid amount for UK 3G licenses

Type of license	Winner	Bid amount
A: This license offers the best range across the radio spectrum; reserved for a new entrant into the UK market.	Canadian group TIW, which owns UK operator Dolphin	£4,384,700,000
B: Offered the highest bandwidth	Vodafone	£5,964,000,000
C	BT3G	£4,030,100,000
D	One2one	£4,003,600,000
E	Orange	£4,095,000,000

A.2.2. Results of the auctions

Auctions were conducted over 150 rounds that lasted several weeks. The reserve prices for the five licenses totaled £500 million. Thirteen bidders, of which nine were potential new entrants to the UK mobile market, competed in the auction. Licences were awarded for 20 years with the stipulation that licensees cover at least 80 percent of the population by December 31, 2007. There were five winners. Details of type of licence, winners, and the bid amount are provided in Table 3.

While there was greater competition in the early stages, with the bids increasing significantly in value, few players were left by the end. In the penultimate round there were six bidders. Bidding started with £170,000,000 for A, £107,400,000 for B and £89,300,000 for D and E licenses, respectively.

While the government gave the bidders freedom to choose 3G technologies from amongst the International Mobile Telecommunications (IMT) 2000 standards evolved by the International Telecommunications Union, all 13 applicants elected to use IMT 2000 CDMA Direct Spread in the paired spectrum, and IMT 2000 CDMA Time Division Duplex in the unpaired spectrum.

High bids have resulted in the bidders' debts having shot up. BT, for example, had debts of $1.5 billion at the end of 1998 and $43 billion by March 2001. Other firms have similar problems. Investors are concerned about the intense competition and hence lower margins particularly with an uncertain demand scenario for such services (The Economist, March 24, 2001, p. 60).

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