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**UNIVERSAL MOBILE TELEPHONE STANDARD (UMTS)**  
**LICENSING:**  
**RECENT EUROPEAN EXPERIENCE AND THE SOUTH AFRICAN**  
**CASE**

By

Nicolas Theopold

University of Cape Town

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# 1 Introduction

The telecommunications industry was long regarded to be one of “natural monopoly”<sup>1</sup>. Technological development has, however, changed the situation in the industry fundamentally: with the introduction of digital wireless telephony (also called “GSM<sup>2</sup>” or “second generation (2G)”<sup>3</sup>), competition could effectively be introduced into the industry, as the new networks rely on antennas instead of fixed cable networks. This made it possible, and in the presence of large numbers of subscribers necessary, to build multiple mobile telephone networks in one country.

The presence of competition, and a completely new set of telephone usage instances made possible by small GSM handsets, created new market opportunities and business models in the telecommunications sector. The impact of this has been so strong that nowadays, there are more mobile telephone subscribers in South Africa than there are fixed-line telephone users<sup>4</sup>.

Technological development has progressed even further, leading to a new generation of mobile telecommunication networks, commonly named “Third Generation (3G)” or UMTS<sup>5</sup>. These new networks will, once they are rolled out, be capable of much higher data transmission rates than current networks. Expectations in the industry are such that 3G networks, combined with even more sophisticated telephone handsets, will be able to offer consumers endless new uses of their mobile telephones. At this moment, it is still unclear what the main uses of the bandwidth (i.e. data transmission capacities) of 3G networks will be. It is expected that a lot of new multimedia products (e.g. downloading music or videos from the internet), or services based on the location of the users, such as restaurant recommendations or city guides will be

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<sup>1</sup> Natural Monopoly: a monopoly situation that is caused by the existence of very large fixed cost, which makes it wasteful to have more than one company servicing the market

<sup>2</sup> GSM: Global Standard for

<sup>3</sup> Analogue wireless telephony, at the time mostly used in cars due to its physical size, is largely regarded as “first generation” mobile telephony

<sup>4</sup> (2001), Phone power

<sup>5</sup> Universal Mobile Telephone Standard

offered to consumers. In addition to consumer markets, there may be a lot of uses for companies, especially when employees do not always work in the same location.

Third Generation mobile telephone networks need “slices” of the radio spectrum to operate. As the frequency band is limited, it is only possible to introduce a fairly small number of competitors into the market. Licenses to operate a 3G network thus hold a high economic value and have generated interest from different groups other than potential 3G network providers.

Policy makers have shown interest in UMTS licensing due to the large value of the licenses and the possibilities for government revenue generation. Mathematical economists found this licensing exercise interesting, since it represents a high-value, non-monopoly franchise bidding exercise: there are no incumbents present in the market and companies do not bid for a monopoly. Hence this posed a possibility of applying a comparatively new method of license allocation more extensively, namely auctions. These promised a more efficient allocation process than the old concept of “beauty contests”, which used to dominate licensing.

Like the telecommunications industry, South Africa has experienced fundamental change in the recent past, albeit in a very different manner. The change from an apartheid government to democracy introduced a new set of values in policy making. Government is seeking to reduce the large income differences between different groups in society and between different regions of the country with a wide range of empowerment and redistribution programs.

The large value of 3G licenses and the unique situation of the South African economy raise the question of how their allocation should be dealt with.

Recent developments, especially those in European economies, have brought a lot of new insights into the opportunities and challenges of radio spectrum licensing. As the licensing processes developed, difficulties associated with each stage emerged. It is thus the main thrust of this paper to examine recent experience and to tie this in with theories of licensing. This creates an analytic framework that allows the analysis of the South African UMTS licensing process in view of special policy variables that have not been significant elsewhere.

In section 2, I will give an outline of the macroeconomic and telecommunications policy of the South African government to date and the licensing methods that have

been used in the past. Section 3 will be concerned with a review of theory and experiences of the use of auctions in telecomm licensing.

Section 4 will then investigate the issues of the South African licensing situation, before concluding the paper in section 5.

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## **2 South African Macroeconomic and Telecommunications Policy Objectives**

As discussed in section 1, most licenses have thus far been allocated in highly developed countries. South Africa, on the other hand, in its role as a developing country, holds a different set of challenges and objectives for the licensing process. Naturally, policy objectives will have a strong influence on the licensing process, as its design will reflect what policy makers wish to achieve with it. Hence it is vital to analyse the objectives pursued by the government on the macroeconomic level, the telecommunications level and with respect to state asset privatisation.

South Africa's situation results from the combination of legacies, which need to be addressed in license design, and policy objectives, which may be further reaching than in other countries. Mechanisms used in other less unique economic environments may thus fail in this context, making a careful adaptation to local circumstances vital.

### **2.1 General Policy Objectives**

With the election of the ANC into government, there was a major change in the direction of macroeconomic policy. In the preamble of the first macroeconomic strategy formulated, the Reconstruction and Development Program<sup>6</sup>, Nelson Mandela states the objective of macroeconomic policy to be to “effectively address the problems of poverty and the gross inequality evident in almost all aspects of South African society.” The general aim of redistribution was aided by a series of macroeconomic measures aimed at growth and stability: deficit reduction, an increase in capital expenditure, reprioritisation to avoid an increase in deficits and human resource development.

In 1996, a more precise program was formulated with GEAR<sup>7</sup>. Here, the measures for an increase in the long run growth rate were more precisely identified and unified in what the paper calls a “multi-pronged approach”. These included:

- A budget reform to strengthen redistribution

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<sup>6</sup> Republic of South Africa (1994), The White Paper on Reconstruction and Development p.4

<sup>7</sup> Republic of South Africa (1996), Growth, Employment and Redistribution: A Macroeconomic Strategy p.3

- A fiscal deficit reduction programme
- An export oriented exchange rate policy
- Tight monetary policy to avoid inflation
- A reduction in tariffs to reduce input prices
- Tax incentives to promote private sector investment
- Infrastructure programmes
- Labour market flexibility
- Stimulation of foreign direct investment (FDI)
- And state asset restructuring

An important aspect of GEAR was the restructuring of state assets, which had four objectives: firstly, proceeds from privatisations could be used for deficit reduction purposes, hence giving the government more budgetary flexibility whilst maintaining a sustainable PSBR (Public Sector Borrowing Requirement). Secondly, state asset restructuring was to free up capital for social infrastructure projects, aimed at the eradication of apartheid inequalities. Thirdly, introducing the private sector to the services was understood to improve efficiency of services. Lastly, asset restructuring was aimed at job creation downstream through increases in productivity and subsequently improved growth prospects.

Although not completely intuitive, 3G licensing does represent a form of state asset privatisation: radio spectrum designated for the use of UMTS is a scarce resource to which the government holds the rights. The process of assigning usage rights thus represents a form of transferring an economic resource from the public to the private sector. Privatisation policy thus becomes integral to the South African licensing process.

Ayogu and Hodge<sup>8</sup> note that “by 1999, the government had only managed to sell a 30% equity stake in the telecommunications operator, the airports company and off-load a small airline, Sun Air.” Furthermore, they note that the telecommunications

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<sup>8</sup> Ayogu and Hodge (2000), *The Socio-Economic Context and Institutional Foundations of Privatisation and Regulatory Reform in South Africa* p.6

regulator had suffered a loss in credibility due to the handling of some disputes and its dealings in the allocation of a third GSM license.

In August 2000, the ministry of public enterprises thus launched a policy framework to clarify the objectives in the restructuring process<sup>9</sup>, called “An Accelerated Agenda Towards the Restructuring of State Owned Enterprises”. The objectives stated in the document are summarised in the second chapter of the policy framework (p.19):

- To facilitate growth
- To achieve wider ownership in the South African economy coupled with redistribution
- Mobilising private sector capital and expertise
- Reduction of the PSBR
- Creation of effective market structures in sectors dominated by SOEs
- Attraction of foreign direct investment
- Enhancing the efficiency of SOEs
- To finance growth and the requirements for competition
- Accessing globally competitive technology

Ayogu and Hodge (2000) note the differences in objectives to GEAR: firstly, there is an increased emphasis on the empowerment of historically disadvantaged people. It has been noted by the policymakers that attempts to empower have been very limited in their success and that they often suffered from a lack of capital to finance their share in public enterprises. The emphasis of the empowerment drive has thus shifted towards affirmative procurement, employment and training. It is seen as a much more realistic and meaningful vehicle to achieve a broader participation of previously disadvantaged people in the economy. Consequently, any licenses that will be awarded for Third Generation mobile phone services will have an empowerment requirement, be it that they may be awarded through a beauty contest or an auction.

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<sup>9</sup> Republic of South Africa (2000), An Accelerated Agenda Towards the Restructuring of State Owned Enterprises: Policy Framework

Secondly, it is noted that there is a shift in the assessment of government interest in the restructuring process. Where previously there was an emphasis on revenue generation for fiscal purposes, the government now sees itself as a shareholder maximising its returns from their holdings of the companies. This means that a SOE may not be completely privatised if the present value of dividend streams exceeds the proceedings from privatisation. The implications of this change in emphasis are twofold. On the one hand, government will tend to privatise less aggressively, especially if valuations of state owned enterprises are low. Secondly, policy should tend to be biased towards less competition and more towards the protection of the interests of SOEs, thus protecting the shareholding interest of the government. A government, which had already maximised equity from the complete sale of a SOE, would, on the other hand, not be biased against competition in the market. In the licensing context, this translates into reduced competition in 3G markets. A government pursuing the interests of its stake holdings, in this case Telkom and thus Vodacom, aggressively, would tend to license fewer companies to ensure superior value of its state owned enterprise.

Thirdly, despite the implications of the second change in emphasis, the accelerated agenda postulates that competition is to be introduced in areas that are currently dominated by SOEs or their descendants. This measure hopes to improve efficiency in these areas, with the positive effects on growth and employment in mind. Industries in which competition cannot be meaningfully introduced, such as the water supply, effective regulation is seen as the tool of choice. Hence competition considerations will also play a role in the design of a UMTS licensing framework for South Africa.

Overall, the policy framework postulates a coherent set of aims and tools with which state asset restructuring aids general macroeconomic aims. It does appreciate the different interests involved when stating that “different stakeholders will seek to emphasise different objectives at the expense of others”<sup>10</sup> and the shortcomings of previous attempts at redistribution through state asset restructuring, noting that “black economic empowerment has been built on pyramid-type ownership frameworks, ... , there have been severe disappointments and even some failures.”(p. 63)

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<sup>10</sup> Ibid. p.22

The licensing process will thus have to follow the aims set out by the policy framework and choose the appropriate measures which will be influenced by the environment variables of the industry and economy.

I will now highlight the most important aspects South African Telecommunications policy, as laid out in the White Paper on Telecommunications Policy<sup>11</sup>, in the context of GEAR and the Accelerated Agenda Towards the Restructuring of SOEs. These will have an impact on the South African UMTS licensing process from the policy making side.

## **2.2 Telecommunications Policy**

### **2.2.1 The Universal Service Obligation**

Apartheid economic policy implied uneven service provision to different racial groups in society. The White Paper on Telecommunications notes that “[n]owhere else does such disparity of access exist side by side with a developed communications technology sector. Nowhere else are both access and ownership so heavily concentrated in one population group. These imbalances, which are the legacy of apartheid, must be urgently redressed”<sup>12</sup>.

In the initial stages of telecommunications policy, before the White Paper of 1996, the GSM network rollout of MTN and Vodacom initially comprised the obligation to provide community service telephones<sup>13</sup>. It became clear, though, that this system was not optimal, since the cellular companies placed them where it was economically useful rather than socially desirable. Consequently, the so-called Universal Service Authority (USA) was set-up next to the regulator. This agency was to work together with the regulator, concentrating on keeping Universal Service “at the heart of telecommunications policy” (p.20) and to introduce telecommunications components into development projects. To finance these projects, cellular providers have to pay a share of their turnover into the Universal Service Authority’s fund, which then redistributes the money into the projects. Hence although contracts were not a

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<sup>11</sup> Republic of South Africa (1996), The White Paper on Telecommunications Policy

<sup>12</sup> Ibid. p.19

<sup>13</sup> Department of Posts and Telecommunications (1993), Issue of Licenses to Provide National Cellular Telecommunications Services p.9

complete failure in the insurance of Universal Service, the use of an authority which decides on the allocation of funds for universal service projects is now preferred.

Since the formulation of the White Paper, there have been important changes in the South African telecommunications environment. Nowadays, there are more mobile telephone subscribers in South Africa, namely about 8 million, than there are fixed telephone lines<sup>14</sup>. The implications for basic Universal Service are quite striking: it is now possible to provide many poorer or remote regions with access to telecommunications, as the rollout of GSM networks progresses further, new or second hand terminals become more affordable and pre-paid telephony removes the need for a bank account.

With the introduction of Third Generation licenses, the circumstances of the Universal Service regulation are going to change. Now the same number of social projects can be distributed onto a larger number of players in the market. Their contributions will therefore need to be smaller than under the present circumstances.

Despite the distribution of universal service contributions onto more players, there will be changes in the outcome: increased costs for network providers may well create a higher market price under the oligopolistic competition the UMTS market will present. Higher prices would also mean that fewer subscribers would be willing to migrate from the close substitute of GSM networks. A smaller number of subscribers would also imply that fewer downstream services, such as specialised content provision, become profitable and hence there would be reduced opportunities in this new sector of the economy, potentially making Third Generation Services less of a success.

The question whether or not to introduce Universal Service contributions into Third Generation license conditions revolves around a trade-off between growth and distribution. It need not be treated as an either or case, since it would be possible to postulate a gradual introduction of universal service fees, based on the notion that the GSM providers and fixed line companies have a considerable advantage over UMTS entrants in that they no longer have the large upfront investments to finance, but only

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<sup>14</sup> (2001), Phone power

have to maintain and develop their networks further. It might thus be viable to grant UMTS providers a preferred treatment, such as to boost their development initially.

In the licensing process, authorities will have to weigh-up the importance of the different factors and base their decision on their objectives and economic rationale.

## **2.2.2 Economic Empowerment**

As mentioned above, economic empowerment projects through state asset restructuring have been a limited success. The pyramid type ownership structures initially envisaged were hampered by a lack of capital and the cost of acquiring it<sup>15</sup>. Most notably the privatisation of Sun Air had an empowerment component included which failed later on in the process. Empowerment share options in Telkom and the Airports Company also suffered from similar difficulties. The Accelerated Agenda hence explores new possibilities for the empowerment of disadvantaged groups in society.

The first vehicle explored is that of widening ownership through investment vehicles such as the National Empowerment Fund (Republic of South Africa 2000) p.68 , which has stake holdings in SOEs and offers those at discounted prices to underprivileged groups in society. Should the policy makers choose to use this vehicle, then it might be the case that some part of license winners' companies will have to be set aside for investment in such schemes. Secondly, the Accelerated Agenda proposes the use of operational empowerment, which means the preferred treatment of disadvantaged groups in training, management, outsourcing and procurement (p.73). Lastly, there is a proposal for the use of employee share ownership programs, as pioneered by some US companies such as United Airlines, Starbucks and Wal-Mart. All these programs are to be used to improve the results from empowerment programs. The implications for the licensing process are the following.

As the current policy stands, an economic empowerment proposal will have to be an integral part in any license application, independent of the mode of administration. What effects this will have on the efficiency and effectiveness of network operators is

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<sup>15</sup> Republic of South Africa (2000), An Accelerated Agenda Towards the Restructuring of State Owned Enterprises: Policy Framework p.65

difficult to determine. On the one hand, empowerment programs, with their focus on previously disadvantaged groups will tend to reduce income and human resource inequalities in the workforce, hence increasing overall human capital in the economy. On the other hand, the employees on an empowerment program will have to undergo a process of learning, which makes them likely to be less effective initially.

One would thus expect efficiency in the network operators and their sourcing partners to be lower, having adverse growth impacts. These effects will be countered by an overall improvement in the economy, which would mitigate or reverse the negative effects described above.

With a lot of the telecommunications sourcing being high-tech, and thus a very small sector of the economy, the question remains whether all license applicants will be able to secure the cooperation of an empowerment partner or whether they would be hampered by scarcity, should operational empowerment become an important aspect of license allocation. Should there be sufficient empowerment partners available, though, there may be above market prices for empowerment partnerships, which aids the notion of redistribution envisaged by the government.

The above impacts suggest that the inclusion of empowerment criteria in the license conditions will reduce competition for the licenses. When designing the licensing process, authorities will therefore have to balance the different conflicting objectives.

### **2.2.3 Competition**

As mentioned by Ayogu and Hodge, competition in newly privatised sectors is an important objective of the licensing process. The rationale for this are the beneficial effects that can be gained from increased competition: lower prices for consumers, increased product innovation and consequently faster growth of the sector, due to increased affordability and availability of different product variations. The precise framework showing the effects of competition on price will be laid out in a later section.

During the licensing process, competition considerations will be one of the aspects taken into consideration. The government's set of objectives, however, includes further issues, such as empowerment, universal service, risk of failure, product innovation and service quality. It is not necessarily the case that the licensing

authority will choose the most competitive solution, should other models serve their objectives more closely.

I will now review licensing policy in the mobile telecommunications to date in South Africa.

### **2.3 South African Cellular Licensing to Date**

So far, there have been two major rounds in the assignment of GSM licenses in South Africa. In 1993, Vodacom and MTN secured a GSM license. In 1997, SATRA, the South African Telecommunications Regulatory Authority, initiated a beauty contest for a third GSM license. This has not been awarded to date due to litigation by competitors against the recommendation made by SATRA to the minister of communications.

I will now give a brief outline of the characteristics of beauty contests, the allocation mechanism used to date.

#### **2.3.1 Comparative Hearings (Beauty Contests)**

Beauty contests, the popular name for comparative hearings, are the oldest and most established way of assigning a license. Here, the government invites applications by companies for the licenses and then allocates them according to pre-defined criteria. In the case of South Africa's third GSM license, the evaluation criteria were: empowerment proposals, technical aspects, business plan and implementation strategy, universal service and the impact on the industry and consumers.

The above criteria show one of the main advantages of using a beauty contest: it is possible to include numerous objectives in the license allocation process and the proposal nature makes it possible to develop an impression of how different license criteria will be handled in the future. Especially parts like empowerment cannot be easily forced on licensees through legislation, but rather need to be developed by the companies themselves to achieve the most efficient outcomes from their empowerment programs. Furthermore, an advantage of beauty contests is that license winners do not have to put up a large up-front investment as they have to do in the case of an auction. In a situation where the license winners may be capital constrained, more funds will be available for the implementation and running of the networks.

On the other hand, comparative hearings are not so good at identifying the most efficient user of spectrum. Firstly, proposals can almost never be complete contracts, which makes it a possibility that applicants exaggerate their proposals so as to secure the license. Once the license has been allocated, the license winners are in a good position to renegotiate, since reallocating the license is costly both economically and politically.

Secondly, license applications and evaluations can never be completely objective. Even when decision makers are completely impartial and keen to achieve the most efficient outcome, they may not be as well equipped to judge the situation as the competitors themselves, as they have a different information set regarding the possibilities and costs entailed in the proposals.

A beauty contest gives the policy maker a large degree of control over the license conditions and the eventual outcome of the process. It will, however, not necessarily be the case that a beauty contest will identify the most efficient users of radio spectrum, since the process may not have the right incentive signals for the identification of the best user.

### **2.3.2 The First Round of Cellular Licensing: MTN and Vodacom**

In 1994, the first two GSM providers received their licenses for South Africa<sup>16</sup>. These two licenses were awarded through a beauty contest with substantial license fees and additional license conditions. A third license was to be introduced later and has been tendered for, but has not yet been awarded due to reasons mentioned above. The phasing-in of network operators was to allow the profitable building of a market before the introduction of more pronounced competition, seeing that at the time of introduction, there was considerable uncertainty about the potential of GSM networks. Furthermore, the duopoly situation made the financing of license fees and additional license conditions possible, since lower competition meant a higher mark-up on cost.

Government charged a substantial license fee of R 100 million to each of the license winners and a further fee of 5% of net operational income per annum. Additionally,

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<sup>16</sup> Department of Posts and Telecommunications (1993), Issue of Licenses to Provide National Cellular Telecommunications Services

Vodacom and MTN entered into obligations to participate in the joint economic development plan (JEDP) and to contribute to the Universal Service Authority's fund. The JEDP<sup>17</sup> details the obligations by MTN and Vodacom towards the economic development of the telecommunications sector in South Africa. The license holders committed themselves to spending R 2,5 billion over a ten-year period. The objectives of the JEDP, as formulated by SATRA, are threefold:

- To benefit the entire South African through developing the country's manufacturing capability in the areas of telecommunications and electronics
- To enhance distribution and related services in the telecommunications sector
- To facilitate the development of opportunities for the hitherto disadvantaged sectors of South African society<sup>18</sup>

SATRA continues to point out the beneficial impact it hopes this will have on the international competitiveness of South African manufacturing. Seen as particularly important are empowerment components entailed in the employment of people from disadvantaged communities. Lastly, SATRA also details the tools with which it expects the JEDP objectives to be achieved: research and development in telecommunications, exports of locally produced hardware and equipment, the use of the local workforce in the production of these products, the training of South African citizens, participation in international projects and finally foreign direct investment.

In addition to the license fees and the contributions to the JEDP, the GSM operators have to pay a share of their turnover towards the Universal Service Authority's fund as specified in the White Paper on Telecommunications Policy<sup>19</sup>.

Overall, MTN and Vodacom had to pay license fees, enter into the JEDP and contribute to the Universal Service Fund, for which they were awarded a duopoly for a limited period of time. Later decisions by the regulator have, however, shown that there is a certain preference towards new entrants.

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<sup>17</sup> <http://satra.gov.za/about.htm>

<sup>18</sup> *ibid.*

<sup>19</sup> Republic of South Africa (1996), The White Paper on Telecommunications Policy p.20

In 2000, the incumbents applied for additional spectrum in the GSM 1800 band to extend their bandwidth. ICASA refused their applications<sup>20</sup> on the grounds of potentially inhibiting the development of future license holders who might need the spectrum for their licenses.

More recently, the reputation of SATRA has been dented in the licensing of the Third Cellular Network.

### **2.3.3 The Licensing Process of the Third GSM Operator**

In June 1999, nine applications for a third GSM license were received by SATRA, following its license tender through the use of a beauty contest. The license winner was to be determined by judging five different criteria, namely empowerment, technical feasibility and planning, the business model and rollout strategy, universal service and the envisaged impact on the telecommunications industry and consumers.

Out of the nine applications, one was disqualified and one withdrew, leaving seven potential license winners<sup>21</sup>. Once again, substantial weight was laid on universal service and empowerment issues, as was done in the case of MTN and Vodacom.

By June 2000, SATRA had concluded its deliberations and elected to recommend Cell C as the license recipient to the minister of communications. Even before the minister could make the announcement of the winner, in which she would presumably have followed the recommendation by the regulation authority, Nextcom gained a judicial interdiction<sup>22</sup> that prevented the announcement of the winner. These events had followed the protests of Nextcom as they viewed the decision process to have been flawed and the actions of SATRA (which has in the meantime been replaced by ICASA, the Independent Communications Authority of South Africa) to have been in bad faith<sup>23</sup>.

In the allocation, SATRA chose Cell C over Nextcom, although Nextcom and Five Mobile Networks were the only applicants to comply with all license criteria. It was

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<sup>20</sup> SATRA (2000), ICASA Responds to 1800MHz Frequency Spectrum Application by MTN and Vodacom

<sup>21</sup> SATRA (2000), 3rd Cellular License

<sup>22</sup> Business Day (2000), Cell licence in limbo again

<sup>23</sup> ICASA (2001), ICASA Files Answering Affidavit in Third Cellphone Court Case

on this basis that Nextcom claimed that Cell C had been chosen independently of the quality of its proposal and that every effort had been made to ensure that the licensing was won by Cell C.

The lengthy court battle that has ensued means that there are considerable economic consequences as well as a loss of credibility of the regulator. SATRA and its descendant ICASA are now seen as unreliable and incompetent, due to the inability to conclude the beauty contest without one of the applicants taking legal action against its ruling. In future beauty contests, ICASA could have difficulty defending its decisions due to its bad track record in this field.

The macroeconomic- and telecommunications policy formulated by the government are unique. Not only does the government have precise aims it wishes to achieve with this policy framework, but experience from the Third Cellular license and the importance of UMTS for further economic development mean that the success of this program is very important. It will be important to choose the correct tools to achieve the ends, which will be manifested in the design of the license. The most important part about the license design will be the way in which they are awarded.

There are two further allocation mechanisms known to policy makers, namely lotteries and auctions. Lotteries were used for a brief period in the United States to reduce the backlog on license allocation, aiming to let the market reallocate the licenses to the most efficient users, but were then quickly discarded when it became apparent that there were large windfall gains given away by the government and that the roll out of some services was slowed by the reallocation necessary. McMillan points out that 400,000 applications were received for cellular licenses in the United States during the 1980s<sup>24</sup> and leading to huge windfalls for companies and individuals that never intended to run a cellular network. He quotes an example where Southwestern Bell paid \$ 41 million for a cellular license to serve the Cape Cod area to RACDG Partnership.

Given the brevity of use, lotteries never really established themselves and thus do not present a serious alternative to the use of a beauty contest. Auctions, on the other

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<sup>24</sup> McMillan (1994), *Selling Spectrum Rights* p.146-147

hand, have seen increasing use in license allocation over the past decade. It is thus useful to investigate the pros and cons of the use of this allocation mechanism.

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### **3 The Use of Auctions in Airwave Licensing**

As mentioned in section 3.3, beauty contests used to be the prevailing mechanism for the assignment of radio spectrum. In early 1990s, however, the New Zealand government decided to auction off radio, television and cellular phone licenses rather than administering them through the classical comparative hearing system<sup>25</sup>. Since then, there have been numerous auctions used to allocate radio spectrum to companies, most prominently in the FCC (Federal Communications Commission) auctions of the United States in 1994-96 and the licensing rounds for Third Generation (3G) licenses in Europe and the rest of the world.

#### **3.1 Types of Auctions Used**

The history of auctions is long and so is the list of different auction types in existence. License auctions tend to be multi object auctions, meaning that more than one license is usually up for tender, making it fundamentally different from classical franchise bidding. Here, bidders are competing for the right to serve part of the market which has to be established, unlike in monopoly franchise bidding, which allows the winner to keep an established market as a monopolist.

There are two basic ways in which several licenses can be allocated: the auction can either be sequential, meaning each license will be auctioned after another. The alternative to this is a simultaneous auction, in which the auctioneer accepts bids for several objects at the same time. In the following sections, I will review the features and merits of each of the auction styles in turn.

##### **3.1.1 Sequential Auctions**

Sequential auctions are often the method of choice when many objects, such as plots of land or works of art are auctioned. Here, each single object is auctioned after the other, closing the bidding on a single object before starting on the next one.

The main attraction of this auction system is its administrative simplicity. It is much easier to auction single objects than multiple objects for two reasons: on the one hand,

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<sup>25</sup> Ibid. p.148

a single object auction will not be difficult to bring to an end. When the bidding ceases on the object at stake, the auctioneer will call the close of the auction. In multi object sequential auctions, however, there is considerable uncertainty about when the auction should close. This, however, will be discussed in more detail in the next section.

The second advantage of a sequential auction, as McMillan<sup>26</sup> describes, is that the bidders do know which license has already gone to which bidder, and which licenses are still available. This advantage is mitigated by an important property of radio spectrum licenses, though: they are both substitutes and complements at the same time. When bidding for a combination of licenses, adding another license adds to the value of the license holdings, but should the license be unavailable, another one will be a possible substitute for it. The fact that licenses are dependent among each other means that the valuation that bidders attach to them change during the course of the auction: should a bidder fail to secure a second license, the price paid for the first one may no longer be appropriate.

A further area of inefficiency noted by McMillan is the fact that predatory pricing may occur under sequential auctions: a strategic bidder may drive up prices for early licenses such that bidders may not be able to compete for the later objects in the auction.

One prerequisite for efficiency is that identical objects, in this case licenses of equal value, sell for the same price. McAfee and McMillan<sup>27</sup> describe that this is not always the case in sequential auctions: when Cable TV licenses were auctioned in Israel in 1987-1990, the price of licenses acquired later was higher than the price of those bought earlier on in the process. This was attributed to inter-license complementarities, meaning that the same license auctioned later was worth more to those who already held a license than to those who didn't yet hold a license. Consequently, the condition for efficiency was violated under the use of a sequential auction.

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<sup>26</sup> Ibid. p.153

<sup>27</sup> McAfee and McMillan (1996), *Analyzing the Airwaves Auction* p.162

### **3.1.2 Simultaneous Auctions**

As described in the earlier section, simultaneous auctions allocate multiple objects at the same time rather than sequentially. There are two major types of auctions that we have to distinguish: single round auctions and multi round auctions. As the names suggest, in a single round auction, there is one round of bidding which will decide the winner of the auction. Under multi round auctions, the bidding continues for several rounds until the auction is closed under some rule imposed by the auctioneer.

By the nature of single round auctions, they are necessarily closed, or sealed bid auctions, implying that the bidders do not know what the others have bid for the objects. Under multi round auctions, there are once again two subtypes, one where bidding information is revealed at the close of each round, hence being “open”, and one where bidding information remains private and the bidder only knows whether he is the winning bidder or not.

I will now discuss the different types of auctions in turn.

#### **3.1.2.1 Single Round Simultaneous Auctions**

The use of single round sealed bid Vickery auctions was pioneered by New Zealand in its sale of radio spectrum in 1990. The regulator chose to auction under a so-called second price auction, where the highest bidder receives the license, but at the price of the bid the second highest bidder put in. This deliberate reduction in the sums paid was chosen to combat the biggest weakness of sealed single round auctions, namely that of the “winner’s curse”. The winner’s curse means that due to the fact that bidders know not what others have bid for the license and consequently how they value the license, they will have to bid the maximum that they expect the license to be worth. The winner of the license will thus be the bidder that overestimated the value of the license by the greatest amount, leaving him “cursed” with an overpriced license. Hence when a bidder puts in a high bid for the license, awarding the license to him at the price of the second highest bid reduces the potentially detrimental overpayment.

The New Zealand auction showed that this second price mechanism, whilst maintaining some sort of security against the winner’s curse, can be politically costly

when the number of bidders is small: McMillan<sup>28</sup> cites a case where the highest bid was NZ \$100,000, but the licensee ended up paying only NZ \$6, the second highest bid. This kind of embarrassment may have been avoided through more careful design of the auction, namely through the imposition of minimum reserve prices. The details of auction design will be discussed in a later section, though.

It is important to note that the single round mechanism is prone to license overvaluation by the license applicants, since they do not have the opportunity to increase their information set about the value of the license during the course of the auction. When considering the 3G case, it becomes evident that this would pose a particularly heavy toll on the quality of the auction. The new technology allows for a completely new set of products and services, the revenues of which are still extremely uncertain. This would imply that the potential for over-valuation would be much higher in the case of the 3G auction than in an established market with more certain revenues. Secondly, the number of bidders for national mobile telephone licenses will most likely be relatively small. This means that the difference between the first and second highest bids may be considerable. The functioning of the second price mechanism would not be guaranteed, as it only tries to approximate the result from perfect information about the license anyway.

### **3.1.2.2 Multi Round Simultaneous Auctions**

In more recent auctions for radio spectrum in the United States and Europe, simultaneous ascending auctions have been the method of choice: here, multiple objects were auctioned simultaneously and over several rounds.

To illustrate more precisely, let's take the British example: there, 5 UMTS licenses were auctioned simultaneously in early 2000. The auction lasted more than 100 rounds of bidding, and at the end of each the bids from each contender were made public. This format was chosen to allow the bidders to collect as much information about the value of licenses as possible, through the observation of the rivals' bidding behaviour. We therefore speak of an "open" multi-round simultaneous auction.

Although the theory is quite clear about the superiority of simultaneous auctions in general, they have been criticised for the difficulty in working them. Whilst it is quite

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<sup>28</sup> McMillan (1994), *Selling Spectrum Rights* p.148

clear when a sequential auction closes, this is not necessarily the case for a simultaneous auction. There two basic possibilities brought forward. The auction could either close for each license individually when the bidding on the license ceases or the auction could close for all licenses when bidding ceases on all licenses. Upon inspection, the former mechanism reveals itself to be a sequential auction in disguise. The natural choice would therefore be to close the auction when bidding ceases on all objects. This system can quickly run into difficulties, though: when there are many objects up for auction, the length of the auction can be extended into infinity by delaying the pace of the auctions. Milgrom<sup>29</sup> identifies a major motive for the delay of a multi object auction in budget constraints. When competitors are budget constrained and the information about this constraint is private they will benefit from holding back and therefore not revealing their potential to pay until competitors have committed most of their budget to some of the licenses. It is therefore necessary to introduce a mechanism that will lead to a timely conclusion of the auction.

The developers of the simultaneous ascending auction hence introduced the notion of activity rules. There are different types of these used. At the FCC auction, bidders had to bid on a minimum proportion of the licenses they wanted to be eligible for. This means that in the first stage, they had to bid on at least one third of the licenses they wanted to be eligible for, in the second stage on two thirds of the licenses, and in the final stage of the auction, they had to bid on the whole number of the licenses they wanted to be eligible for. The auctioneer was to decide on the start of a new stage, doing so when the auction began to slow down and bidding became passive. Bidding on a license in this context meant that the contenders had to put a higher bid at a minimum bid increment defined by the auctioneer, unless he was already the highest bidder on the object he was bidding on.

A second type of activity rule was used in the German UMTS auction: there, license applicants bid on abstract “license blocks”, being allowed to bid on three of these 2 x 5 MHz blocks to pursue a “large” license, but needing to acquire at least two blocks for a valid license. The activity rule in this case was such that bidders could only bid on a non-increasing number of blocks: if they had started out bidding for three blocks and reduced their bid to two blocks later on, they could not return to bidding for three

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<sup>29</sup> Milgrom (2000), Putting Auction Theory to Work: The Simultaneous Ascending Auction p.259

blocks anymore. This condition, in addition to a minimum bid increment meant that the bidding process had a finite time horizon.

The fact that incumbents generally benefit from the delay of the auction, both through the delayed introduction of services and the revelation of information by competitors means that activity rules are crucial to the success of multi object auctions.

The great advantage of simultaneous auctions, the fact that bidders are able to extend their understanding of the value of the license during the auction, can at the same time be its greatest disadvantage: if bidders are able to learn who is bidding what during the auction, then it makes it much easier for them to enter into collusive arrangements. This fact lead to considerations during the FCC license auctions whether to keep bidding standings private or whether to publicise the results at the end of each round. The solution found was to make the results anonymous, hence revealing how other firms were bidding, but not revealing the bidding strategies of single firms.<sup>30</sup>

Turning back to the German UMTS auction, the regulators decided to make the results of each bidding round public, but placed stringent restrictions on the communications by bidders: every company was placed in a separate room with only one phone and one fax line they could use to transfer information to their headquarters. Furthermore, an official from the regulation authority was present in the room of the bidder at all times. Bids were submitted through a computer interface, attempting to minimize the amount of communication and hence the potential for collusion between bidders.

Despite all these precautions, firms tried to communicate during the auction using the bids they submitted for license blocks: one bidder, D2, owned by Vodafone/Mannesmann, on some occasions submitted bids above the minimum increment to include the digit "6" in their bids, a fact that was seen by observers as an offer to accept a so-called "small" license of 2x10 MHz instead of continuing to seek a "large" license of 2x15 MHz. The only other competitor still seeking a large license, T-Mobil, owned by Deutsche Telekom, "declined" the offer and proceeded to bid for a large license, thus making a timely conclusion of the auction impossible. The lack of cooperation raised another DM 30 billion for the government, since the attempts for

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<sup>30</sup> McMillan (1994), Selling Spectrum Rights p.153

co-operation were introduced when the total license fee stood at about DM 70 billion. The end result was that the two companies seeking large licenses did in the end have to settle for a small license, but at a much higher price than had been possible previously. Assuming that the license winners will be able to provide the same level of service as in the case of less expensive licenses, and assuming that pricing follows the Cournot model of oligopolistic competition, this outcome is preferable to the government: service levels and prices will be the same, but the government will have maximised its revenue, thus reducing the level of supernormal profits derived from the license.

When looking at the more recent auctions for radio spectrum, it becomes clear that simultaneous ascending auctions are the method of choice nowadays. Although there are dangers relating to the degree of communication between the bidding parties involved, and careful consideration has to be placed on activity rules to make the time horizon finite, the beneficial effects on the discovery of the true license value outweigh the impediments by the above.

## **3.2 The Rationale for the Use of Auctions**

### **3.2.1 Efficiency**

The government, acting in the interest of the whole population, is seeking to maximise economic efficiency when auctioning-off licenses for Third Generation Mobile Phones. In this context, we can view efficiency from two perspectives: Jehiel and Moldovanu<sup>31</sup> identify the sum of producer and consumer surplus as the measure for efficiency in the market. They further note that since the consumers do not partake directly in spectrum auctions, it is difficult to achieve a measure of consumer surplus achieved through the use of an auction. The argument hence continues that under standard oligopoly situations, which mobile phone markets with a relatively small number of licenses reflect, efficiency and consumer surplus are increasing in the amount of competition and hence the amount of participants in the market can serve as a proxy for efficiency. This in turn implies that the number of participants in the

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<sup>31</sup> Jehiel and Moldovanu (2000), A Critique of the Planned Rules for The German UMTS/IMT-2000 License Auction p.2

market ought to be maximised for as long as entry is technically and economically viable.

A Cournot model of oligopolistic competition, as found in Church and Ware<sup>32</sup>, supports the prediction made by Jehiel and Moldovanu. There, assuming that firms are symmetric in their cost structure and have equal market shares, the former being a useful assumption for the analysis of license allocations, too. The Cournot model then predicts that the mark-up over marginal cost will be decreasing in the number of firms in the market:

$$\frac{P^C - MC}{P^C} = \frac{1}{\epsilon N} \quad (1)$$

Here,  $P^C$  is the price charged by the Cournot oligopolist,  $MC$  is the marginal cost of production,  $\epsilon$  is the industry elasticity of demand and  $N$  is the number of firms competing. Clearly, as  $N$  goes to infinity, the right hand side (RHS) of the equation tends to 0 and so does the difference between price and marginal cost.

Mobile telephony is, however, characterised by large fixed costs. The first contracts for the development of 3G networks have been awarded in Germany, Ericsson and Siemens being awarded contracts of € 500 million each by D2<sup>33</sup>, one of the license winners in Germany. This will not be the complete costs of building a network, though, since these contracts are well below the € 1,6 billion Mobilcom, one of the other winners of a German UMTS license, paid for its contract with Ericsson<sup>34</sup>.

Considering there are very substantial fixed costs involved in the building of 3G networks, there will be a limit on the number of competitors the market can absorb: should the price be pushed below long run average cost (LRAC), then entry would not be beneficial anymore.

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<sup>32</sup> Church and Ware (2000), *Industrial Organisation, A Strategic Approach* p.241

<sup>33</sup> Bertrand (2000), Siemens, Ericsson win 3G deal

<sup>34</sup> Ibid.

The number of licenses, and hence entry conditions are, however, not dependent on the use of auctions for the allocation of radio spectrum, but are a choice made by regulators irrespective of the allocation mechanism chosen.<sup>35</sup>

The second dimension of efficiency which is relevant in assigning property rights to the radio spectrum: apart from introducing the “correct” number of license holders into the market to maximise surplus and hence efficiency, it is the aim of the allocation process to identify the most efficient users of radio spectrum. These are the firms that will be able to use the spectrum in the best manner. In a market context, this means that those firms that will be able to make the highest profits from the activity should hold the licenses.

Assuming profitability approximates efficiency, firms are better able to identify opportunities from the use of a radio spectrum license than the regulators are, due to private information about cost structures and revenue potential of the companies. Consequently, regulators are fairly ill equipped to determine the best users of the radio spectrum. When companies are bidding for the spectrum comparatively, they will gear their bids to the value set of the regulator, not necessarily revealing the true potential of their operations, or on the other hand making exaggerated proposals which they might have to revoke after the license allocation.

When bidding competitively for a license, bidders will have to put “their money where their mouth is”. This means that companies must be willing to put real resources on the line now to obtain the licenses, rather than making promises about future actions. Should bidding conditions be competitive, companies ought to be willing to commit the net present value of above-normal profits they envisage as the license fee. Hence those bidders who are willing to pay the most for the license will arguably be the most efficient ones.

Milgrom formalises this in his 2000 paper<sup>36</sup>. He likens the auction process to the classical “tatonnement” mechanism, in which an auctioneer tries to approximate efficiency by proposing prices and bidders making what Milgrom calls “tentative”

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<sup>35</sup> It has to be added that only the auction mechanism allows for an endogenous number of licenses in the allocations process, whereas beauty contests and lotteries must have a fixed number of licenses ex ante.

<sup>36</sup> Milgrom (2000), Putting Auction Theory to Work: The Simultaneous Ascending Auction p.249

bids, i.e. bids without a commitment. Two main differences immediately arise between the tatonnement mechanism and ascending auctions: first, prices are strictly increasing in the auction environment, and secondly the bids submitted are real resource commitments rather than tentative bids. Milgrom then proceeds to prove the existence of a competitive equilibrium in three steps.

First, he defines the indivisible licenses for sale as  $L=[1,\dots,L]$ , a subset of which is denoted by  $S$ . A bidder  $i$  acquiring the set  $S$  then derives a utility of  $v_i(S)-m$ , where  $m$  is the amount of money paid for the set of licenses. The vector of prices is defined to be  $p$ , and the total price paid for the set of licenses  $p * S$ . The resulting demand function is of for  $D_i(p) = \operatorname{argmax}_S \{v_i(S) - p * S\}$ . Milgrom further introduces notion of holding the current high bid during the auction. The bidder demands the set of licenses  $T$  at price vector  $p$ , i.e.  $T \in X(p)$ , if a demand of  $S \in D(p)$  exists such that  $S \supset T$ .

Given the activity rule present in simultaneous ascending auctions, the price for the  $l$ -th license will be  $p_l + \epsilon$ , for some  $\epsilon > 0$ . Theorem 1 states that if for bidder  $j$ , after round  $n$ , the personalised assignment is  $S_j \in X_j(p^j)$ , where  $p^j$  is the personalised price vector introduced through the minimum bid increase. If  $j$  bids straightforwardly then his assignment at the end of round  $n + 1$  would be  $S'_j \in X_j(p'^j)$ ,  $p'^j$  being the personalised price vector at the end of round  $n + 1$ . The theorem then states that the profits would always be non-negative, a requirement for efficiency. The proof of which is described in (Milgrom 2000) p.252 .

The second theorem states that the final assignment will maximise the value of total license to within a single bid increment, the proof of which is also to be found on page 252 of the above paper.

The third theorem claims that a competitive equilibrium exists, and is proven using theorem two (Milgrom 2000) p.254 .

Auction mechanisms will therefore reveal more accurately and reliably those companies that are the most efficient bidders than a comparative hearing could achieve.

### 3.2.2 Revenue Generation

Some of the recent UMTS license auctions in Europe have been a big success from the point of view of revenue generation: the UK auction of 5 licenses raised £23 billion (€38.5 billion), translating into €126<sup>37</sup> for a license per head of population. In Germany, the regulator received DM98.8 billion for six 2x10 MHz licenses, equalling a price of €102 per license and head of population. Considering the sheer size of money combined with the fact that “[I]ike diamonds, budget pressures are forever”<sup>38</sup>, revenue generation has gained in importance.

This risen importance is reflected by the experiences of two other European countries, namely Spain and France: the Spanish government had decided to license 3G frequencies through a beauty contest which had been completed early in 2000. The revenue generated in the UK and Germany, however, lead to the government considering the introduction of a yearly fee of €150 million for each license in addition to the €130 million license fee raised during the beauty contest. This would translate to license fee of €52 per head of population and license over the duration of the licenses<sup>39</sup>.

France, on the other hand, decided to put a high reserve price on its licenses despite using a beauty contest: there, every license will cost FF 32.5 billion, equalling €56 per head of population and license (again, normalised to a 2x10 MHz license). This is, by economic theory, arguably the worst solution to the licensing problem, since it combines the financial risk of an auction with the disadvantages in selection of a beauty contest. In addition to this, the license applicants will not have the same level of information about their competitors' valuation of the licenses since they do not reveal themselves in multiple rounds of bidding as they would in a simultaneous ascending auction. The French government thus may impose a “winners curse”, by which the winners of the licenses may be the eventual losers since they overestimated the value of the license, by inhibiting them from using informational advantages of an

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<sup>37</sup> For a 2 x 10 MHz license. This normalisation was chosen due to different license sizes.

<sup>38</sup> Noam (1998), *Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism. Taking the Next Step to Open Spectrum Access* p.774

<sup>39</sup> UMTS Forum (2000), *IMT-2000 Licensing Conditions & Status: a selected regional overview* p.4-5

auction, which can, as will be shown in later sections, reduce the risk of the winner's curse.

Whilst pointing out the enormous revenue potential of Third Generation mobile phone license auctions, an early caveat is necessary: a lot of other auctions in Europe were seen as a failure in part due to the lack of attracting entry and especially when they failed to raise the expected amounts of revenue for the government. In Austria, license winners had to pay €14 per license and head of population, in the Netherlands €37 and in Italy €42. These shortcomings in revenue generation can be attributed to design flaws in the different countries which will be discussed in a later section.

It is important to note, though, that the use of an auction by no means guarantees that the auctioneer will be able to raise large revenues.

### **3.2.3 Transparency**

As the quote from Noam's paper makes clear, beauty contests are prone to be a highly politicised process and thus open to the influence of pressure groups. Although it might seem easy to make a comparative hearing transparent through the use of well-defined criteria, there is still scope for the discretion by the policy maker. Especially in countries which have a bad track record on corruption, or those where the regulator does not have a great deal of credibility, the efficiency of allocation by beauty contests is questionable, as the South African case has shown. It is in those countries especially where the transparency advantages of an auction will be beneficial: tying the hands of the regulator by making the allocation mechanistic will aid efficient and impartial allocation of licenses. Discretion of the policy maker is thus restricted to the first stage of the allocation process, the design of the licenses and the auction, rather than also controlling the eventual allocation of the licenses themselves.

Even if a beauty contest is made more mechanistic, it will still fall short of the transparency of an auction mechanism. Mathematical economists have created very strong cases for certain models of license auctioning, which, if followed, should lead to efficient license allocations. In beauty contests, on the other hand, the setting of criteria by the governing body will always be unclear to some degree, since it will always involve discretion to what should be achieved in license allocation. In auctions, on the other hand, such criteria are not used.

### **3.3 Dangers in Auctioning Licenses**

#### **3.3.1 Design Intricacies**

##### **3.3.1.1 Reserve Prices**

McMillan<sup>40</sup> provides an intuitive and compelling reasoning for the introduction of reserve prices when auctioning radio spectrum: citing the New Zealand auction of radio spectrum discussed previously, he remarked that one license was given away for free to a student bidding NZ \$1 for a city's television license due to the lack of bidding competition. Furthermore, in another license bid, the high bid was NZ \$7 million and the second highest bid NZ \$50,000. These perversions of the auctioning process were caused by the lack of sufficient bidding competition. The public perception was, however, that it was wrong to give the licenses away for next to nothing when bidders obviously valued them much higher.

The institution of reserve prices therefore plays a double role. On the one hand, they ensure that licenses aren't given away for trivial amounts of money. This is important from a political perspective, since the proceedings are often seen as a proxy for the success of an auction in the eyes of the public. Secondly, reserve prices will ensure that trivial bids are not possible. The example with the university student winning the television license underlines that in some cases, it might be better not to license rather than licensing too cheaply. This claim is founded on the notion that under competitive bidding, licensees will be willing to commit some of the future profits to license fees. A bid of NZ \$1 means that the bidder does not expect to make any profits. Should the market become interesting in the future, then the license holder will most likely be able to extract some rents from a company wishing to run the service. Experiences from reallocations of licenses from the US lottery award system showed that the reallocation of licenses from inefficient users to those being able to use the license efficiently slowed down the rollout of cellular services in the United States. The double function of ensuring the sincerity of bids and substituting for competition in case of lack thereof is served by reserve prices, a fact that makes them a crucial

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<sup>40</sup> McMillan (1994), *Selling Spectrum Rights* p.148

ingredient in a successful license auction in contexts where competition could be small.

Clearly, in the case of UMTS licensing, competition would be high enough to ensure that licenses would not be won with trivial bids. However, in cases where competition for a license could be small, a solution to the problem could be to set the reserve price at an extremely conservative estimate of discounted profits. Creating a process to determine the level of reserve prices could, on the other hand, pose a considerable challenge.

### **3.3.1.2 Default Penalties and Deposits**

When referring to the dangers of missing a default penalty in the design of the auction, McMillan<sup>41</sup> cites the Australian satellite TV license auction. When two licenses were auctioned in 1993, “dark horses” won, outbidding consortia including Rupert Murdoch and Telecom Australia. It then emerged that one of the winning bidders, Hi Vision, only had an issued capital of A \$100 and had bid A \$177 million for the license, Ucom, the other winning bidder, A \$212 million. It quickly emerged that both winners of the bid could not pay for the licenses and proceeded to default on their bid. This action was planned, however, since the design of the auction failed to include any penalty for defaulting on the bid. The winners of the bid had put in multiple bids at A \$5 million intervals and continued to default on their bids until they finally paid A \$117 million for the license and sold it to Australis Media for a A \$21 million profit.

The consequences of a lack of default penalties become clear through the Australian example: when the bids submitted aren't binding, they lose their characteristics of reflecting the ability of the bidder to use the spectrum profitably. Consequently, bids will become trivial and the whole auction outcome perverted.

The FCC auctions hence introduced default penalties: if a bidder withdrew his bid during the auction, he had to pay the difference between his bid and what the license

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<sup>41</sup> Ibid. p.149

eventually was sold for. Withdrawing the bid after the close of the auction meant a further 3% fine<sup>42</sup>.

A further measure to ensure the sincerity of bidders is taken in most auctions: bidders have to deposit substantial sums of money to ensure that they are actually capable of paying for the licenses afterwards and that they are not just bidding trivially. Intuitively, it will prevent occurrences such as the trivial bidding in Australia by imposing the hurdle of having to raise a certain minimum amount of money before the start of the auction.

### **3.3.1.3 Choosing the “correct” number of licenses**

Once it has been ensured that the technical details of the auction do not allow the auction outcome to be trivialised or perverted, the most important question is the number of licenses that ought to be up for tender. On this question, there has been some considerable debate and different countries have chosen to pursue different avenues.

The three factors influencing the number of licenses that should be auctioned are quite intuitive: the size of the market, in terms of population or potential users, may put limitations on the maximum amount of players that may be supported by the market. Secondly, the available spectrum is a limiting factor: the UMTS Forum<sup>43</sup> estimates the requirement per operator at 2x15 MHz of paired capacity (up and downstream) and 5 MHz of unpaired capacity (downstream only). With downstream capacity, users are able to receive data from the network. Upstream capacity is required when UMTS users want to send data to the network. In a telephone conversation or a videoconference, both up- and downstream capacity is needed. For the download of large internet files, such as music, on the other hand, only downstream capacity is required. Paired capacity is thus far more valuable than unpaired capacity.

In the German case, each of the six license winners finally received an allocation of 2x10 MHz and five out of the six license winners received an additional 1x5 MHz of unpaired capacity<sup>44</sup> due to the limited spectrum available. Thirdly, the number of

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<sup>42</sup> Ibid. p.155

<sup>43</sup> UMTS Forum (1999), UMTS Forum Reports 1-6: Executive Summary p.15

<sup>44</sup> UMTS Forum (2000), IMT-2000 Licensing Conditions & Status: a selected regional overview p.5

incumbents<sup>45</sup> plays a vital role in the allocation of new licenses. Intuitively, one would expect the incumbents to hold a higher valuation of the licenses available than a potential entrant, assuming that incumbents and new entrants are equally efficient managerially and have the same access to finance. On the one hand, incumbents have an existing customer base and brand name that should make the acquisition of customers for their new service more efficient and hence more profitable, at least in the short to medium term. Furthermore, incumbents have already invested in infrastructure, which they will be able to reuse at least in part.

These economies of scope make it very unlikely that a new entrant will be able to secure a license in the case where the number of licenses is equal to or smaller than the number of existing 2G operators. This may be undesirable, since rational entrants will realise this problem and will not compete for a license in this case. An auction could then become trivial, as in the case of the Dutch 3G auction<sup>46</sup>. More detail of this auction will be outlined below.

As a consequence, in the British auction, the authorities decided auction five licenses, reserving the largest one specifically for a new entrant. The outcome of this auction was such that the incumbents secured all four of the remaining licenses.

In the case where the number of licenses is fixed, it is possible to decide ex ante what the “correct” number of licenses will be and hence to predetermine whether there will be entry or whether the incumbents will most likely win the licenses.

The effects of such a “mishap” were to be seen in the case of the Dutch UMTS license auction. There, five licenses were for sale matching the number of five incumbents perfectly. The potential new entrants realised that they would not prevail in the auction, hence they all pulled out before the start of the auction or decided to partner with other companies<sup>47</sup>. This left only one potential new entrant, Versatel, participating in the bidding, but this bidder pulled out on the first day of bidding after meeting with one of the competing companies. This led to allegations of collusion from the government, followed by the searching of offices of the meeting parties and legal action.

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<sup>45</sup> “incumbents” in this context means firms already operating in 2G, i.e. GSM, markets

<sup>46</sup> Financial Times (2000), 3G Country Information

<sup>47</sup> Klemperer (2000), The Flaws of a Dutch Auction

In the case of where the market does not allow any further licenses to be issued and hence makes it impossible to entice competition by keeping a license for new entrants, Klemperer in the above article suggests an “Anglo-Dutch” auction as an example. In this model, there would be a number of rounds of open bidding followed by one single and final sealed bid round. The suggested advantage of this mechanism is that new entrants are offered a real chance to outbid incumbents in a single round without the possibility of the incumbent reversing the outcome. As discussed in previous sections, the sealed bid nature of the auction means that there will be considerable uncertainty about the outcome and this might recreate the problem which was to be originally avoided, namely the winner’s curse.

A second model of allocating licenses was chosen in Germany and Austria. There, the number of licenses was endogenous and dependent on the bidding patterns. Instead of bidding for licenses, participants of the auction bid for abstract license blocks of 2x5 MHz paired capacity. The minimum they had to acquire for a license were two blocks, leading to a “small” license, the maximum allowed was for three blocks, a so-called “large” license. Therefore, depending on how many bidders acquired how many blocks, the outcome of the auction could be anything between four and six licenses. In the second round of bidding, unpaired frequency would be allocated among the winners of licenses.

Before the start of the auction in Germany, Jehiel and Moldovanu<sup>48</sup> pointed out that this auctioning mechanism would favour an outcome with four licenses, due to the fact that incumbents had a head start in the market as described above and due to the fact that they had an incentive to protect their profits from 2G networks since any entrant winning a 3G license would be allowed to offer 2G services, too.

It will be useful to review the workings of the Jehiel and Moldovanu model:

Assume there are 4 incumbent firms (as in the German market) and  $m \geq 2$  “new entrants”. It is further assumed that all firms are symmetric in their cost, knowledge and financial possibilities.

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<sup>48</sup> Jehiel and Moldovanu (2000), A Critique of the Planned Rules for The German UMTS/IMT-2000 License Auction

The profits derived from a license are dependent on the number of firms licensed,  $n$ , and the number of blocks the bidder has acquired,  $k$ . Hence the resulting profit is  $\pi_k(n) \geq 0$ . These represent the expected profits from the future 3G market and are increasing in  $k$  and decreasing in  $n$ .

A further variable is the cost to the entrant of building a network, called  $c$ . Since any entrant will be allowed to build a 2G network, too, Jehiel and Moldovanu denote the profits that incumbents expect to lose as a result of this as  $\gamma(n) \geq 0$ . Lastly, the loss of an incumbent in the 2G market if he doesn't acquire a 3G license is denoted as  $\eta(n) \geq \gamma(n)$ .

From this framework, we can derive pay-offs for different outcomes:

<b>Outcome</b>	<b>Pay-off</b>
Incumbent wins a license:	$\pi_k(n) - kb - \gamma(n)$
Entrant wins a license:	$\pi_k(n) - kb - c$
Incumbent doesn't win a license:	$-\eta(n)$
Entrant doesn't win a license:	0

Hence, they proceed to show that if one entrant gets licensed, then all of the incumbents will be, too: the non-negativity constraint on entrants means that  $\pi_k(n) - kb - c \geq 0 \Leftrightarrow \pi_k(n) - kb \geq c > 0$ . If we assume on the contrary that an incumbent does not get a license, bidding less than  $b$  on the blocks, then his payoff becomes  $-\eta(n) \leq 0$ . Further assume a deviation that he bids  $b + \epsilon$  on the blocks, hence his payoff becomes:  $\pi_k(n) - k(b + \epsilon) - \gamma(n) \geq c - k\epsilon - \gamma(n) > -\gamma(n) \geq -\eta(n)$ . This deviation is profitable, contradicting the equilibrium described above. Hence if an entrant wins a license, the incumbents are certain to win a license, too.

The most important result from this paper, though, is shows that it is very unlikely for six firms to get licensed. The proof is as follows: from the above claim, any equilibrium with six licensed firms will include all four incumbents. Entrants will have to have non-negative pay-offs, hence  $\pi_2(6) - 2b - c \geq 0$ . Due to this non negativity,

we get  $b \leq \frac{\pi_2(6) - c}{2}$ . The incumbent will have a payoff of  $\pi_2(6) - 2b - \gamma(6)$ . If an incumbent then deviates on one block by bidding  $b + \epsilon$  on it, then there will be only 5 licenses holders. The resulting payoff for the incumbent will be  $\pi_3(5) - 3b - \epsilon - \gamma(5)$ . Hence for six licenses to prevail, we need  $\pi_3(5) - 3b - \epsilon - \gamma(5) \leq \pi_2(6) - 2b - \gamma(6)$ . This

translates into  $\pi_3(5) + \gamma(6) - \gamma(5) \leq \pi_2(6) + b$ . Due to  $b \leq \frac{\pi_2(6) - c}{2}$ , we get

$\pi_3(5) + \gamma(6) - \gamma(5) + \frac{c}{2} \leq \frac{3\pi_2(6)}{2}$  for the equilibrium with six licenses to exist. For an

equilibrium with five licenses to prevail, Jehiel and Moldovanu show that

$\pi_3(4) + \gamma(5) - \gamma(4) + \frac{c}{2} \leq \frac{3\pi_2(5)}{2}$  needs to be satisfied.

Therefore if the payoff to incumbents decreases substantially upon the introduction of additional firms ( $\gamma(6) - \gamma(5)$  and  $\gamma(5) - \gamma(4)$  respectively) and infrastructure costs are high ( $c$ ), then it is unlikely that there will be competitive entry into the market.

Intuitively, we would expect an outcome in which there are only four licenses being issued: infrastructure costs, as mentioned previously, are significant, the cost of building the network alone without any overhead being several billion Euro. Additional capacity seems to be valuable: Telly-D1 and D2, the two largest incumbents currently controlling about 80%<sup>49</sup> of the market, would have to shed customers due to capacity constraints under a six license outcome. Under such an outcome, they would only be able to service 60% of the market between them, using the full capacity of 2x10 MHz each.

It is hence on the results of this model that Jehiel and Moldovanu suggested before the auction was held in Germany that “the chosen auction format cannot yield an efficient allocation since it is subtly biased in favour of the four incumbents currently offering second generation services. New entry is practically impossible, even if the design seems flexible enough to allow it.”<sup>50</sup>

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<sup>49</sup> according to <http://www.handytarife.de>, Telly-D1 and D2 together have 40million out of the 48 million subscribers in Germany

<sup>50</sup> Jehiel and Moldovanu (2000), A Critique of the Planned Rules for The German UMTS/IMT-2000 License Auction p.1

It comes as a big surprise, then, that the auction result was very much at odds with the prediction made by the two mathematical economists. The German UMTS auction ended in the sale of six licenses of 2x10 MHz each, two new entrants successfully entering the market. In one of the cases of new entry, Mobilcom, it was not as surprising that there was successful entry, since this company is already active in the fixed line market and as a “virtual” mobile operator and thus already has a customer base and most likely lower costs of building the network and of acquiring customers. The other successful new entrant into the German mobile telephony market was “Group 3G”, a consortium including Telefónica of Spain and Finnish Sonera, so far not represented in the market. This successful entry was certainly more surprising since it did not have the advantages Mobilcom has.

Naturally, the question to ask is why these bidders were able to deny incumbents to keep the status quo. It is certainly difficult to assess this question accurately without further research. There are, however, some factors which were not included in the analysis of Jehiel and Moldovanu and which the author would like to present without any claim of accuracy. Firstly, in the case of Mobilcom, the model certainly overestimated the cost of entry for the company due to the fact that they are already active as a “virtual operator”, thus having an existing customer base and back end structure in place. Secondly, there may be some synergies of being able to offer fixed line, internet and mobile services together, as many of the bigger telecom companies try to place themselves as complete solution providers. These have also been ignored in the specification suggested by the authors.

The above synergies are not applicable to Group 3G, however. This consortium does not have any existing business in Germany, thus making it much more costly for them to acquire customers and to build their own network. There must be other explanations for their success in the bidding process. One explanation that lends itself is that founded upon the role of the German market in Europe: with 82 million inhabitants and its central geographic location, the German market seems to have great strategic importance for telecommunications providers. It may be therefore that the Group 3G may be prepared to buy a license at a price where their operations in Germany will not be profitable, but will create strategic spill-overs that benefits their position in the European market, which may be the more relevant market space to look at.

The puzzle of unexpected entry under expectedly prohibitive conditions remains unanswered even if the tentative explanations offered above are correct. The Austrian regulator chose to auction UMTS licenses very much in the same way as the German authorities. Once again, 12 license blocks of 2 x 5 MHz paired frequency were for sale, a minimum of two had to be acquired for a license and any one bidder could purchase a maximum of three. Six licenses were awarded after two days and 14 rounds of bidding, the bids only totalling €706 million, though, an amount far below expectations.

Next to the incumbents, there was successful entry into the market, although doubts have been voiced already whether a country of only 8 million inhabitants could support this number of UMTS providers. The puzzling thing about this auction is that Austria seems unlikely to have a particularly important strategic role to play in the European market, thus warranting unprofitable entry by competitors.

One explanation for this outcome may lie with the small size of the country: as Austria only has 8 million inhabitants, a 2x10 MHz license is relatively much larger than an equally large one in Germany. Thus there may be a much lower demand for additional capacity by the players. Hence the incumbents did not continue to bid to force the entrants out of the market.

These examples show that choosing the correct number of licenses is a crucial ingredient in the design of the auction. Most importantly, it has to be recognised that the playing field is far from level with the incumbents holding significant advantages over potential entrants. The effects of these advantages may be unclear, and the outcomes from the auctions may not be as uncompetitive as expected, like the German example showed. Mistakes in the choice of the number of licenses can be numerous and the effects tend to be severe.

### **3.3.2 Collusion**

UMTS licenses have proved to be very valuable, extracting large license fees from operators in the markets around Europe. Accordingly, the incentive to reduce the competition for these licenses is large and may lead to collusive behaviour by competitors. It is clearly in the interest of the authorities to ensure that there is no collusive behaviour, and although auction rules forbid it, it is very difficult to prevent.

Experience from the Netherlands<sup>51</sup> and Italy have shown that the occurrence of collusion is by no means hypothetical. In both cases, participating parties of the auction were accused of having acted in a collusive manner and of having inhibited the competitive outcome of the auction.

In the case of German licensing, the measures taken were twofold: on the one hand, severe penalties were proposed in case of discovery of collusive behaviour, and on the other hand, the conduct during the auction was closely monitored.

To avoid any communication between bidders, the bidding parties were put in separate rooms, entering their bids on a computer. Only one phone and fax line was allowed for communication with the head quarters and a representative of the authority was present in the room at all times.

As to the penalties, the rules stipulated<sup>52</sup> that in case of discovery of collusion, the licenses could be revoked and the license fee be kept as a penalty. This would ensure that the payoff of collusion would be significantly reduced and would thus keep incentives low. Even if this penalty may not have been enforceable in its entirety, bidders would have had to expect a very high penalty when being caught, whilst at the same time being faced with a high risk of discovery.

It is difficult to determine whether collusion has in fact taken place, due to the multitude of possibilities for collusive behaviour. In the Dutch case, two competitors met on the morning the auction was opened, triggering an investigation by the authorities into any “illegal” agreements they might have made<sup>53</sup>, since one of the competitors, Versatel pulled out of the race, leaving 5 companies pursuing 5 licenses.

Collusion hence remains one of the biggest dangers for the success of any multi license auction, but also one area in which rules are difficult to set due to the multitude of ways to collude and the difficulty of enforcement. Draconic penalties in the case of discovery might help to prevent some of the collusive behaviour by reducing payoffs to the colluding parties.

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<sup>51</sup> Klemperer (2000), The Flaws of a Dutch Auction

<sup>52</sup> REG-TP (2000), Entscheidung der Präsidentenkammer vom 18.2.2000 über die Regeln für die Durchführung des Versteigerungsverfahrens zur Vergabe von Lizenzen von UMTS/IMT-2000; Mobilkommunikation der dritten Generation p.23

<sup>53</sup> Financial Times (2000), 3G Country Information

### 3.3.3 Risk Related Issues

Prior to the license auctions in Europe, the Third Generation of mobile telephony was hailed as a huge chance for companies to tap new revenue pools, since the much more limited GSM standard already had led to a boom in the telecommunications sector. Once the auctions were completed, however, observers did realise that revenues from telephony services would no longer suffice to cover the huge fixed costs of license fees, especially in the face of increased competition in most countries. The competitiveness of the British and German auctions in particular meant that providers had to rely on revenue models which are very much dependent on proceedings from data volumes. This seems risky, considering that mobile multimedia applications have not yet been introduced and the uptake by consumers is unclear. The UMTS forum, for example, estimates that by the year 2005, the European market will raise revenues of \$10,9 billion through three areas of non-voice service: Mobile Intra-/Extranet Access, Multimedia Messaging Services and Customised Infotainment<sup>54</sup>. As the report points out, “[d]ata services for the mass market are virgin territory for the mobile industry”<sup>55</sup>, hence making predictions about uptake and usage difficult. Potential inhibiting factors, mainly based on user expectations are pointed out thereafter, illustrating that there is considerable uncertainty about future revenues in the industry.

Statements made by NTT DoCoMo about the multimedia capabilities of 3G networks have compounded this. NTT holds a leading role in mobile Internet, since it has already introduced “I-mode” in Japan, a predecessor to full 3G services, and will, in addition to this, be one of the first countries to introduce full UMTS. Mr Enoki, in charge of running I-mode, is quoted as saying: “[t]he conclusion is that we will perhaps offer short video clips of 10 to 15 seconds and previews of music that people can purchase to download at home through their PCs or TVs”<sup>56</sup>, since they deem 3G technologies as unsuitable to offer full delivery of videos and other broadband internet applications. This is in sharp contrast to expectations in Europe, where mobile operators hope to raise a lot of their revenues through such non-voice services.

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<sup>54</sup> UMTS Forum (2000), Report No.9: The UMTS Third Generation Market - Structuring the Service Revenue Opportunities p.81

<sup>55</sup> Ibid. p.95

<sup>56</sup> Roberts and Nakamoto (2000), DoCoMo sounds alarm on 3G

The above examples serve to illustrate the degree of uncertainty about the profitability of the Third Generation mobile services in the face of huge fixed costs. Briefly after the statements made by NTT DoCoMo, the first difficulties materialised for the upcoming providers: Mobilcom of Germany and Hutchinson 3G which is building UMTS networks in the UK and Germany both had difficulty raising the finance for their networks<sup>57</sup>.

Although only very little extra information became known during or after the licensing rounds and the high license costs had been anticipated in the industry, the general public saw the outcome of these allocations as dangerous for the future of many telecommunications companies, and the success of UMTS in general. The reactions in the media may be described as less than rational under these circumstances, and it may thus be valid to include the bounded rationality in planning the licensing process.

Overall, the competitiveness of the licensing process has led to a big increase in the risk associated with telecommunications operations. It even prompted a cautionary mentioning in the Bank of England financial stability report, which warned about the risk downgrading of telecommunication borrowers and the possibility of failures in the industry<sup>58</sup>. Though it seems that the licensing in any single country did not suffice to destabilise multinational operators, the fact that most of the countries of the world licensed their Third Generation mobile networks in the same year may have had enough of an impact to achieve this.

The licensing process, although not responsible for the bidding behaviour by competitors, may have to take into account its effects on the long-term stability of the sector. Accommodation through the modification of payment plans, i.e. by spreading them out over a certain period of time, might help to reduce the risks ex-ante, as more information about the profitability of Third Generation services becomes known in the time closer to market introduction.

Theory has provided reasons for the use of auctions in the allocation of radio spectrum. It remains important, though, to design the licensing process carefully and

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<sup>57</sup> Financial Times (2000), Financial problems at Mobilcom and Hutchison

<sup>58</sup> Willman (2000), Concern at rise in lending to telecoms groups

to adapt it to local market conditions. It is the uniqueness of the South African conditions that make the design of the licensing process a delicate operation and thus has to be investigated more closely.

University of Cape Town

## **4 Designing the South African UMTS licensing process**

South Africa's UMTS licensing process is more complex than that of most other countries. Not only will the policymaker have to deal with the "usual" considerations of whether to use a beauty contest or an auction and how to design these, but also there are further factors that are relevant in this situation. On the one hand, the post apartheid government has formulated a set of objectives for economic empowerment of previously disadvantaged groups in society, and on the other hand, there are marked disparities in infrastructure between different regions and areas that make universal service considerations particularly important.

I will now investigate the different factors affecting the design of the South African UMTS licensing process and their impact on the outcome.

### **4.1 Revenue Generation**

Although the generation of revenue for government is not at the forefront of objectives publicised by policy makers in most countries, the possibility to boost government income has made it a big consideration in the design of the licensing process.

#### **4.1.1 Auction versus Beauty Contest**

From a point of view of pure monetary benefit for the government, a highly competitive auction will certainly raise the highest revenue. This is necessarily the case as license applicants are better able to judge the worth of such a UMTS license than the government, and a well designed auction will reveal the true license value through the bidding behaviour of competitors. The French case has shown that when a government tries to approximate the revenues of an auction in a beauty contest scenario, it will either under-price the licenses and receive sufficient applications or over-price and not receive sufficient applications. There, only two applications were

received for the four license on tender<sup>59</sup>, after the price of the license was put at FF 32,5bn (€4,9bn), payable over a period of 15 years.

As a consequence, the government does not only have to change the license conditions and deal with the delay created by a new beauty contest being started, but it also has to face the loss in credibility caused by having to change its ruling.

In South Africa, delays created by challenges to the beauty contest for the Third GSM license have created enormous financial and reputation costs: on the one hand, the potential operator is foregoing revenue due to the inability to commence service, and on the other hand, investment certainty has experienced a distinctive setback, as investors begin to lose patience with policy makers.

#### **4.1.2 Open versus Sealed Bid Auctions**

When it comes to auction design to maximise proceedings, a first price sealed auction would be maximising, but certainly not prudent. As discussed earlier, this method of auctioning causes the so-called “winner’s curse” phenomenon, in which the winner is the one that overestimated the license value the most and may thus run into financial troubles, jeopardising not only the success of the Third Generation network rollout, but also the future of the company. Therefore, it is advisable to choose a simultaneous ascending auction, in which bidders will be able to collect information about their competitors’ valuations, hence adding to their information set and minimising the risk of paying a price for the license that is too high.

Within the framework of a simultaneous ascending auction, it will be the aim to attract a large number of serious bidders. On the one hand, the auctioneer will need to ensure that there are no trivial bids, such as in the Australian case, on the other hand, it is beneficial to attract a large number of bidders to the auction to avoid an outcome as in the Dutch or Swiss UMTS auctions<sup>60</sup>, where the number of bidders equalled the number of licenses and made any bidding for the licenses trivial.

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<sup>59</sup> Owen (2001), French consider concessions on 3G payments

<sup>60</sup> Financial Times (2000), Swiss 3G auction ends with a whimper

### 4.1.3 The Number of Licenses

Hence one of the prerequisites for a maximisation of government revenue will be to choose a license number which is different from the number of incumbents. A lower number will certainly spawn great competition for the licenses, but this seems short-sighted, as decreased competition will have negative effects in the market afterwards. When increasing the number of licenses to more than the number of incumbents, the question remains how many licenses to issue. For once, the number of possible licenses is limited by the amount of spectrum available for UMTS<sup>61</sup>, and furthermore, with increasing competition the licenses will lose value, hence decreasing the amount bidders will be willing to pay for these licenses. If the number of licenses should be increased too far, this may actually decrease the revenues to the government, since the value may drop more sharply as more competitors get licensed and there may not be sufficient meaningful bidders to keep the auction competitive.

The last remaining option would be to choose a model similar to the German or Austrian model<sup>62</sup>, where license applicants bid on frequency blocks, leaving it to the bidding behaviour of applicants whether there would be four “large” licenses of 2x15MHz of paired frequency, five licenses consisting of two large licenses and three small licenses of 2x10 MHz, or six licenses of 2x10 MHz of paired frequency.

In both cases where it was used, six licenses were awarded, but these results cannot hide the fact that there is an anti-competitive component in this licensing method, described earlier with the help of the model created by Jehiel and Moldovanu<sup>63</sup>. It may well be the case that in the South African context, a less competitive outcome would prevail, which may have undesired consequences on the competition side.

Apart from the licensing mechanism, in which the auction seems to be the more efficient mechanism in generating revenue, almost all other factors affect the amount of money government will be able to reap from the auction.

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<sup>61</sup> UMTS Forum (1999), UMTS Forum Reports 1-6: Executive Summary p.14

<sup>62</sup> Financial Times (2000), 3G Country Information

<sup>63</sup> Jehiel and Moldovanu (2000), A Critique of the Planned Rules for The German UMTS/IMT-2000 License Auction

#### **4.1.4 Non-Auction Factors**

Firstly, empowerment conditions attached to the license will certainly affect the revenue streams. The more network operators have to invest in affirmative training or sourcing programs, the higher their cost base will be, as it reduces the competition on the sourcing side when sourcing from an empowerment partner makes switching difficult or impossible. Training programs will also increase cost, as empowerment is aimed at disadvantaged people who by definition do not have the same level of training as employees hired on the free market. A higher cost base will reduce the profit that can be derived from a UMTS license, hence reducing the license price that bidders are willing to pay.

A similar argument applies for Universal Service obligations, since there the contributions to the Universal Service Fund or the coverage of uneconomic areas will reduce profitability once again and hence reduce the willingness of bidders to pay.

Therefore a government interested in the maximisation of revenue should design an auction which is competitive and has the “right” number of licenses on offer. All factors that decrease profitability ex-post will reduce the revenue stream that can be generated. It has to be noted, though, that the benefits from increased service levels and higher human capital in the economy may well have a higher net present value for the economy than the extra revenue generated by excluding them.

#### **4.2 Black Economic Empowerment**

As in earlier licensing rounds, black economic empowerment (BEE) will play a role in the licensing process. Should the government choose to license through a beauty contest as it has done before, then the empowerment component will certainly play a crucial role in the assessment of license applications. As, however, many pointers lead us to suggest the use of an auction, the question arises as to how to include an empowerment component in an auction setting. There are several possibilities available.

Firstly, the licensing authority could prescribe some degree of empowerment to any license winner, hence trying to achieve the same results as in a beauty contest. Clearly, it will be inefficient to let outsider decide on the empowerment option, due to differences in company structures and the need to have detailed knowledge about the

company to make empowerment a success. It would only be a matter of time until disputes about the “correct” amount of empowerment would emerge.

Secondly, government could choose to exclude empowerment from the license conditions. Instead, it could choose to collect some money from the license winners and implement some empowerment programs itself. Evidently, the component of transferring human capital through management training would be lost, making this model less attractive in terms of empowerment than the firms implementing it themselves.

Thirdly, it could hold a pre-qualification for the auction, in which applicants would specify their empowerment programs to the licensing authority and then be granted access to the auction should the empowerment plans be sufficient. This would guarantee the inclusion of social objectives in the license conditions and leave the implementation of these to the license winners, hence allowing the best possible use of resources.

Considering the fact that empowerment objectives will certainly play an important role in the license design, a pre-qualification for the auction by way of a beauty contest seems desirable, however there may be credibility problems for the regulator once again, if applicants who are denied access may choose to sue against their exclusion, as the license losers did in the case of the third South African cellular license.

Apart from choosing the best way of administering a chosen degree of empowerment, the licensing body has to be aware of the effects of empowerment issues on the outcome of the auction.

As noted in the discussion of revenue generation, imposing a higher level of empowerment will lead to increased cost and hence decrease revenues from the auction. Furthermore, empowerment programs to date have not only been of the form of sourcing and human resource development. Share ownership plans have also been used. In MTN, the empowerment shareholding is at 21,76%, in Vodacom 5% and for Telkom a 10% empowerment shareholding is envisaged for the future<sup>64</sup>.

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<sup>64</sup> SATRA (1998), Empowerment in the Telecommunication Sector

These empowerment shareholding programs have, in the past, suffered from a lack of capital among the group to receive the empowerment holding or from the difficulty of accessing capital on the open market. In the case of E-TV, for example the empowerment shareholding scheme failed due to a lack of capital.

Lastly, when designing the empowerment program, it may be important to consider the size of the South African capital market and the consequences of the licensing process on it. In Europe there were already concerns about the destabilising effects of excessive lending to the telecommunication sector<sup>65</sup>, voiced in a financial stability review by the Bank of England. If the South African licensing should extract large amounts of capital from the market, then the empowerment shareholders may well find it very difficult to raise funds for their empowerment projects. This situation may well be exacerbated by other privatisations of state owned enterprises. In the process of liberalisation of the fixed line market for example, Telkom will most likely be transferred into private ownership. This type of constellation would lead to further pressure on capital markets, making financing, especially for empowerment programs, more expensive. In this case, careful timing of the capital streams for the licenses and the empowerment shareholding would be important. Alternatively, it would be a possibility to exclude empowerment ownership programs and replace them entirely with sourcing and human resource development programs.

Hence when implementing the empowerment objectives of the licensing process, different conflicting objectives will have to be weighed-up against each other. Larger economic empowerment programs will reduce auction revenues. Furthermore, the manner of implementation is important, as it has a crucial impact on the success of empowerment programs. Lastly the timing of license fee financing is important with respect to share ownership programs, as the flooding of capital markets with telecomm debt may inhibit the successful implementation of empowerment share ownership programs. Thus it seems useful to design empowerment programs with a view to the other sectors of the economy. Should pressure on capital markets have increased due to other SOEs being privatised, then a shift towards more operational empowerment seems useful.

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<sup>65</sup> Willman (2000), Concern at rise in lending to telecoms groups

More operationally focussed empowerment programs could be created by replacing some of the financial aspects with employment and human capital formation programs. Through employment and training of members from disadvantaged black communities, redistribution and empowerment could be promoted without being subject to the pressures of financial markets.

### **4.3 Universal Service Obligations**

Similarly to black economic empowerment objectives, universal service obligations are certain to have an impact on the outcome of the licensing process. Again, they will tend to increase cost for license winners.

There are different models available for the imposition of universal service obligations. As in earlier licenses, it is possible to charge an annual fee on the license which will be used to finance universal service components of community projects. This model will increase the cost base of license holders and hence decrease profitability. Once again, it would mean that auction revenues would be lower than if such universal service obligations were excluded. It is important to note that at the macroeconomic level, the loss in license revenue will be mitigated by increased growth prospects due to improved infrastructure in the country.

Parallel to considerations about the best way of implementing the empowerment agenda, one might suggest that the government should rather concentrate on imposing minimum targets for universal service and leave it up to the network operators as to how to implement them. This would certainly leave some leeway to find the most efficient way of achieving the universal service obligation. On the other hand, it may also lead to a deepening of infrastructure inequalities, since it is difficult to ensure that network operators do not avoid areas where servicing is more costly. SATRA, for example, notes that the community telephone obligations imposed upon MTN and Vodacom did lead to an increase in such facilities but lead to a skewed distribution of community service phones as there was no location spread included as a criterion for servicing<sup>66</sup>.

The question remains, however, whether a universal service obligation is necessary for 3G services or not. The aim of the universal service authority is to provide basic

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<sup>66</sup> SATRA Universal Service Obligations

telecommunications services, which 3G certainly does not represent. It would hence be possible to argue that a universal service obligation is not necessary for this new market, similar to internet service providers: here, there is no universal service obligation for the market.

It quickly becomes apparent that the most efficient way of solving the universal service component may not be the most desirable due to incentive incompatibilities between network operators and the public set of objectives. Administering it more directly may lead to a better outcome from a social point of view, as the loss of efficiency of administrative procedure could be compensated by a socially more desirable distribution of servicing.

Once again, in designing the license the conflict of different objectives becomes apparent. Achieving social goals of infrastructure improvement in under serviced areas will conflict the quest for efficiency and government revenue. The fact that the incentives of network operators and do not coincide with social objectives of universal servicing may lead the licensing body to administer the servicing of underdeveloped areas more closely than in the past. This form of universal service administration would imply that a yearly fee would be raised to finance the planning and a certain number of government specified projects would have to be entered into by network operators.

#### **4.4 Competition Considerations**

Jehiel and Moldovanu have, as discussed in earlier sections, suggested that increased competition will lead to decreased market prices and hence to increased efficiency. It is therefore desirable from a competition point of view to maximise the number of licensees, as long as entry is economically viable. Due to the large fixed costs inherent in a mobile telephone network and the limitations on bandwidth available, there will be a fairly small number of licenses that can be operated economically. In Germany, which has an estimated number of 48 million subscribers<sup>67</sup> at the moment, six licenses were awarded. South Africa, on the other hand, has 8 million mobile telephone subscribers<sup>68</sup>, forecast to grow to 15 million by 2015. Additionally, the big physical

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<sup>67</sup> <http://www.handytarife.de>

<sup>68</sup> (2001), Phone power

size of the country means that possibly only a lower number of operators will be viable. The extent to which entry is economically viable will have to be determined by a more detailed study which is beyond the scope of this paper.

Some caveats have to be voiced, though. When auctioning the licenses, it is important to attract new entrants, as mentioned earlier. This implies that auctioning a number of licenses equal to the number of incumbents, most likely three by then, assuming that Telkom will only be active in the market through its joint-venture Vodacom, will lead to entrants refraining from bidding and the auctioning process becoming trivial. Furthermore, as was also mentioned earlier, having a large number of competitors in the market may lead to lower total revenues, due to the decreasing license value to each individual network provider.

One last question with regards to competition considerations is the possibility of phasing-in competition as the market becomes bigger. This has effectively been the policy in South Africa, as MTN and Vodacom had the first licenses and the third cellular license was only to be introduced in 1999. There is a crucial difference between the development of the GSM and the UMTS market, though. When GSM telephony was introduced in South Africa, it was the first time that cellular telephones were becoming small and affordable enough to create a large market. The development of the market did take a longer period of time, since the networks had to be built from scratch and the company infrastructure also had to be created. The UMTS networks, on the other hand, will present an extension to existing services. Telephones might well be downward compatible<sup>69</sup>, such that roaming onto GSM networks may be possible when leaving the coverage area of Third Generation services, and indeed the German license conditions demand this of network providers. In some countries, for example the United Kingdom, where UMTS licenses have already been awarded, new entrants were allowed to roam on other national GSM networks, to secure speedy entry into the market and to reduce incumbents' advantages over new entrants.

The market size that can be serviced through a Third Generation mobile phone license will therefore be considerably bigger from when networks take up their service than

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<sup>69</sup> REG-TP (2000), Entscheidung der Präsidentenkammer vom 18.2.2000 über die Festlegung und Regeln im Einzelnen zur Vergabe von Lizenzen für Universal Mobile Telephone System (UMTS) p.3

in the case of GSM networks. This reduces the need for the phasing-in of competition and strengthens the argument to introduce all competitors at once. Not only will new entrants have less difficulty catching up with GSM incumbents due to the lower market power they have in the UMTS market, not having established themselves there yet. Furthermore, customers will benefit from a more competitive market structure, giving them more benefits in terms of product variety, innovation, choice and price. Especially the big innovation of 3G networks, namely value added services, will be more viable in a larger market. The benefits of licensing all competitors simultaneously and to maximise entry are large and justify the extra risk of failure created through tougher competition.

#### **4.5 Reputation Issues for the Regulator**

SATRA, and its descendant ICASA have had a relatively brief history with respect to mobile telephone regulation. By some assessments, the handling of the third GSM licensing process has destroyed a lot of reputation on the part of ICASA. The fact that the authority was unable to prevent litigation following its ruling on the winner of the beauty contest have raised concerns about the feasibility of using further beauty contests to allocate licenses in the telecommunications sector.

Following the allegations of prejudice and incompetence in the third GSM license debacle, a very transparent allocation process would be beneficial for the industry and the reputation of the regulator. An article in the Sunday Times<sup>70</sup> points out that investors interested in building mobile telephone infrastructure worth R 6 billion are disillusioned by the deadlock created in the GSM licensing issue. Not only has the delay caused large revenue losses for the eventual winner of the license, but also has it created extra costs in the bidding process and left infrastructure providers without the business platform they envisaged when the license winner was about to be named.

The problems mentioned point towards the use of an auction. Should the government choose to license using an auction mechanism, any disputes about the manner of auctioning would have to be resolved before the start of the auction itself. Once this has been achieved, though, it would be possible to allocate the Third Generation licenses in a transparent and impartial manner, which would restore confidence in the

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<sup>70</sup> Gordon and Msomi (2001), Billions at risk as cellphone investors tire of being put on hold

regulator and allow for certainty in the investment climate. This would be important, due to the explicit statement made by the government about its aims of attracting foreign direct investment and the growth possibilities the telecommunications sector holds. Should the government on the other hand choose a beauty contest as in the GSM case, this might cause decreased interest in the licenses, due to the additional costs caused by uncertainty about the timeframe and outcome. This will be the case since companies taking part in the beauty contest will expect the process to fail just as it did in the case of the Third GSM license.

Reputation arguments certainly point to the use of an auction. The track record of South Africa's regulator is not good enough to warrant the use of another beauty contest, risking that UMTS has a bad start.

#### **4.6 Industry Health and Risk Related Issues**

"Fear what you wish for, for it might come true." This Chinese proverb reflects the reactions by policy makers in some European countries. Auctioning mechanisms were much criticised when they failed, but when they succeeded, concerns were also voiced. In the case of Germany and the UK, for example, the competitiveness of the allocation process did lead to such high license fees that operators had difficulty financing their license fees<sup>71</sup> and there was a cautionary report about the effects on financial stability of increased lending to telecomm companies issued by the Bank of England<sup>72</sup>. If South Africa should succeed in creating a competitive licensing mechanism, the macroeconomic effects of this might well mitigate some of the efficiencies introduced.

Borrowing by network operators has caused concerns even in the large European market, hence one might expect effects to be more pronounced in the South African context. Especially since the Asian crisis, capital has tended to flood back to the core from developing countries, reducing liquidity. It is therefore possible that large license fees, caused either by an auction or a high reserve price under a beauty contest, would lead not only to an absolute, but also a relative increase in the cost of capital for telecomm providers.

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<sup>71</sup> Financial Times (2000), Financial problems at Mobilcom and Hutchison

<sup>72</sup> Willman (2000), Concern at rise in lending to telecoms groups

This perceived higher risk may also be based on the situation of the South African economy: being a developing country and having recently undergone major economic and political changes, it is more difficult for investors to gauge the security of the investment environment. Higher risk in comparison to highly developed countries means that there will already be lower revenues from the auctions and less demand for licenses.

Increased capital cost and a higher default risk will have a negative effect on the development of the mobile market, both in the UMTS and the GSM segment. This is caused by the fact that actors in the GSM market are likely to be license winners in the UMTS market, too, as outlined in section 4. The very high costs from auctions in Europe have decreased the flexibility of telecomm companies, since some of them have reached a liquidity constraint<sup>73</sup>, inhibiting them from developing business as actively as they did before. Additionally, the end of Telkom's monopoly will create further demand for financing, as fixed line entrants will need to finance their rollouts, too. A highly competitive situation in the mobile market could therefore crowd out activities in the fixed line business.

The pressure on the financial markets could be eased by phasing license payments over a few years, hence decreasing the shock of increased borrowing on the financial markets. A similar solution has already found its use in the GSM licenses, when MTN and Vodacom had the choice of paying their R 100 million license fees at once or in instalments, where interest was charged on the amounts paid at later dates<sup>74</sup>. This flexibility would reduce some of the risk associated with the uncertainty over future profitability. In case of some of the competitors struggling to pay, the government could allow a delay to avoid the destabilising effects of a failure of one of the UMTS providers. Another possibility for the reduction of risk would be the delay of the auction until reliable data became available from other markets. This would mean, though, that South Africa would be foregoing the possibility to launch into 3G markets early and to benefit from the development of the market.

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<sup>73</sup> Financial Times (2000), Financial problems at Mobilcom and Hutchison

<sup>74</sup> Department of Posts and Telecommunications (1993), Issue of Licenses to Provide National Cellular Telecommunications Services p.6

South Africa's comparatively smaller financial market and the risk related issues that European economies have experienced after the license auctions suggest the inclusion of some cautionary measures in the license design to avoid any shocks or uncertainty problems. The possibility of phasing license payments seems attractive and may even be a welcome addition to other large licensing auctions in the future.

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## 5 Conclusion

South Africa is at the threshold of Third Generation mobile telephone services. This new technology offers great opportunities the entire economy. Network providers may use the new markets to expand and thus further economic growth and employment. Downstream service providers will be provided with new market opportunities similarly to web service companies when the Internet created new markets. Companies from other industries can benefit, too, from the new marketing and transaction possibilities entailed in this new technology. Consumers should also benefit from higher quality telephony and the creation of new value-added services.

Experience from South Africa and many other countries has shown that the starting point which is given to such a new market can impact its development significantly. Thus the design of the licensing process for the UMTS market is very important, putting the definition of objectives to be achieved with the licensing as well as the choice of the licensing mechanism at the heart of the matter.

Four types of license allocation have been used before: giving licenses away to licensees of the policy maker's discretion, distributing licenses by lottery, choosing license winners through a beauty contest or the use of different types of auctions. Most likely, one of the latter two allocation mechanisms will be used in South Africa. Beauty contests have been known and applied for a long time, whereas auctions have become fashionable only relatively recently.

The different mechanisms fulfil the different objectives of licensing with varying success.

The first objective, but in the political process not necessarily the most important objective, of the licensing process is to identify the most efficient users of the radio spectrum on offer and to allocate the licenses to these companies. Economic theory and examples from the USA and Europe have shown that auctions can be more efficient than beauty contests in this respect. The fact that in an auction, the bidders ultimately identify the winners makes this system powerful. Beauty contests will always suffer from the fact that policy makers will have to decide who the winners of such a bidding process are, a task for which they are ill equipped in comparison to the bidders themselves.

Design intricacies pose a threat in the use of auctions, as the wrong choice of a single detail such as the wrong number of licenses or the wrong bidding mechanism may destroy the entire auction. The great number of auctions that has been executed in UMTS licensing until the time of writing does provide potential auction designers with ample guidance to avoid design failures and thus makes it very well possible to implement an auction successfully. Design intricacies should therefore not put off policy makers from choosing an auction as their method of choice.

Apart from the quest for the identification of the most efficient license winners, this paper identified other objectives that influence the choice of the allocation mechanism significantly.

Revenue generation has been at the forefront of many governments, once it became apparent in the UK auction that large sums could be raised for government through the sale of 3G licenses. In this respect, an efficient auction is likely to generate higher revenues than the allocation through a beauty contest, since under a competitive, efficient auction, the price of a license will be equal to the present discounted value of supernormal profits expected. In a beauty contest scenario, the licensing body will be prone to choosing a price that is either too high or too low. Should the price be too high, there will not be sufficient demand for the licenses, and should prices be set too low, revenue to the government would not be maximised.

On the objective of black economic empowerment, the issue is far from clear-cut. If a beauty contest were to be used, then companies would outline their empowerment programs to be implemented upon license acquisition. Although this kind of agreement often is difficult to enforce, it would leave it up to the most efficient parties in the process to implement the black economic empowerment programs, namely the companies themselves.

Was an auction to be used, then the implementation of a black economic empowerment program would be more difficult. Different options for the implementation of black economic empowerment programs have been discussed, and it appears that using a pre-qualification mechanism which would force companies to formulate empowerment programs and to have them approved by the licensing agency would achieve a very similar result to beauty contests in this area.

The next objective on the agenda of policy makers is that of universal service. A universal service obligation would most likely be implemented through a universal service fund, in which the license holders would have to pay a certain amount every year and which would finance government-specified telecommunications programs aimed at universal service. These programs would most likely be concerned with fixed line networks and GSM networks, which in comparison to UMTS networks provide a more “basic” service. This form of universal service contribution has been tried and tested in South Africa before, which means that authorities are likely to choose the model again. Its implementation would mean that the sum eventually paid by license winners would be lower under an auction scenario, but policy makers will be aware that deferred earnings will be received at a later stage.

Competition considerations are going to be important, too. There will be at least three GSM networks by the time UMTS licenses will be awarded. From a competition point of view, licensing the maximum number of competitors is desirable, though it has to be investigated *ex ante* whether it is realistic to license four or five companies. Whether or not companies like Telkom will also be able to bid next to their engagement in Vodacom will determine the number of incumbents, and regulation about roaming in 2G networks will change the value of the licenses to companies not holding a GSM license.

Once the “correct” number of licenses has been established, which will make any kind of allocation mechanism competitive, then the use of an auction is preferable from a competition point of view, as it forces companies to identify the most competitive bidders rather than letting government reach this conclusion.

With regards to reputation issues for the regulator, using an auction is clearly preferable, since it is highly unlikely that the regulator will be able to allocate licenses without being challenged by companies who did not get chosen. Designing a well-functioning auction mechanism under the public eye would help to reinstate a lot of credibility for the regulator and allow telecom licensing in South Africa to move on from the fiasco of the third GSM license.

The last aspect, which might prevent the government from choosing an auction to allocate UMTS licenses, is that of industry health and default risk. Excessive license

payments in Europe, due to the hype associated with 3G networks, have put considerable pressure on the telecommunications sector.

As the South African auction would take place at a later date, prices would most likely be more realistic, given that people have realigned their expectations about the profits to be made from UMTS licenses. Hence the risk of failure and excessive borrowing in the sector would be lower nowadays. Furthermore, employing a model of phased license payments would allow the license winners to borrow less initially and pay the license fees plus some interest at a date when the licenses actually have started to generate revenues.

The South African licensing issue is a unique and complex one due to the many special aspects that differentiate it from other countries. It has been shown that an auction mechanism would serve the South African people and their economy better than using another licensing mechanism, although careful deliberation is necessary to deal with all the details entailed in such a license allocation.

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