

# **Spectrum Auctions Enabling 3G Mobile Communications?**

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## **Summary**

The use of auctions to efficiently allocate radio spectrum for commercial use where demand exceeds supply has moved from theory to accepted policy in just over 10 years and its application to 3G auctions in Europe in the last 2 years has raised contentious debate. This paper discusses the evolution of spectrum auctions through several distinct stages and considers the elements that contribute to the value of spectrum in this current stage for Third Generation (3G) mobile technology based services. Discussion follows on how the values achieved at these 3G auctions contributed to or were affected by the “telco industry meltdown” over the last 12 months. It is concluded that spectrum auctions are an effective spectrum rationing approach for demand for new radio services such as mobile but does carry the risk of Governments seeking revenue maximisation rather than efficient spectrum allocation.

## **1. Introduction**

The raging debate about the potential future opportunities versus the high uncertainties of Third Generation Mobile (3G) services, coupled with the very high prices paid for spectrum licences through auctions in several markets, poses the alternative question: whether auctions will enable 3G or will impose an impossible debt burden on 3G. This paper examines the factors affecting the prices paid for 3G spectrum and the business case for 3G.

With the theory well established [Coase, R. H. 1959, Coase, R.H., Meckling, W., & Minasian, J. R. 1963], New Zealand was the first to allocate spectrum by auction for mobile use in the early 1990's with mixed results [Coutts, 1993]. The methodology was confirmed more successfully with the US PCS auctions in 1996 [Nelson et Al 1996] and after a “trial” at 500MHz [Nelson, 1997] Australia selected the simultaneous ascending bid process for broader application in Australia to allocate spectrum where demand exceeded supply, such as for mobile services. The first mobile spectrum auction in Australia in 1998 opened up entry for new mobile players in telecommunications as well as providing additional spectrum for the current three mobile operators [ACA 1998]. The results of these auctions have been described by the author [Coutts, 1999]. A further auction of 1800MHz spectrum was held in early 2000 that resulted in much higher prices being paid than previously. Spectrum auctions had become accepted in the US, Australasia and now many countries in Europe as the way to allocate spectrum for 3G licences at 2.1 GHz starting with the UK in March 2000. An overview paper on the

factors that affect the spectrum values paid for mobile (including 3G) is described in a TJA paper by the author. [Coutts, 2001]

This paper will first review the progress of the application of auctions where each country approaches the allocation in different ways. The broad approach of defining commodity units separate from an operator or carrier licence is quite different to the approach taken in the United States and Europe and is a unique feature of the Australian regime. The paper will discuss the mobile related spectrum auctions held in Australia since 1998 and the subsequent “3G” auctions held in the UK, Netherlands, New Zealand, Germany and Italy with the aim of understanding the value and effectiveness of the spectrum auction process. The paper will go on to evaluate the value drivers for spectrum, which can be seen from the experience to date to have implications for Government in planning such auctions and for intending bidders for spectrum.

Finally, the paper will give the author’s view, based on the evidence of events in the market place through 2000 and 2001, as to how the high prices paid in some European market spectrum auctions are related to the financial down turn in the industry with implications for 3G in particular.

## **2. Application of Spectrum Auctions**

### **2.1 General**

While spectrum auctions have been written about since the 1950s and have been used since 1990<sup>1</sup>, the emergence of auctioning as an accepted methodology worldwide developed in 3 phases.

Phase 1 represented the “breaking new ground” phase with auctions in New Zealand and Australia<sup>2</sup>, which, while achieving their primary purpose of efficient allocation, highlighted the need for thorough evaluation of the potential risks of practical application of auction methodologies. The lessons learnt from these early auctions were built into the rules for the subsequent auctions in the US and Australia. Thus by the time of the auctions in Australia in 1998 several key issues were appreciated including:

- The weakness of some methodologies such as “highest bidder pays second highest price” to thin markets
- The need for deposits and thorough rules regarding “associated bidders”
- The risks of deferred payments

Phase 2 represented the “consolidation” phase with the PCS auctions in the US and the auctions in Australia in 1988. Phase 2 auctions were the pre-cursor to the international trend to use auctions to allocate spectrum where the demand exceeds supply. This phase

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<sup>1</sup> New Zealand were the first with the mobile spectrum which highlighted the weaknesses in a “thin” market of “highest bid pays second highest price” methodology

<sup>2</sup> These were the MDS auctions which highlighted the need deposits and “associated” bidders rules

demonstrated that the auction methodology could be improved<sup>3</sup> to overcome the early deficiencies to ensure policy outcomes. The innovation of multiple round auctions, conducted on-line developed and applied in the US, was further refined and applied successfully in Australia. Europe and Asia at this time were still unconvinced by the auction approach.

Phase 3 represented the “maturation” phase with auctions now being accepted as a legitimate and effective means to allocate spectrum for high demand sectors and the mobile communications industry in particular.

This phase has seen in general a significant escalation of the value of spectrum, combined with a broader acceptance of the methodology, while grappling with the potential industry consequences of such high values for spectrum. The key risks to this phase are:

- The high prices paid, while generally treated as a sunk cost, will have an impact on the financial sustainability of some of the mobile operators. In some cases an equipment vendor has provided vendor financing which has helped new entrants to bid against incumbents. If such a new player were to falter this could flow through to the associated vendor.
- Policy distortion or change by Government away from the original primary objective of efficient allocation to revenue maximisation that has been overt in some of the auctions in Europe. Such policies could distort industry competitiveness.

Some would suggest that we are at Phase 4, where expectations of extremely high spectrum valuations are finished. Only after the current industry low is passed can this question be addressed.

## ***2.2 Review of Recent Spectrum Auctions***

One can now review the recent spectrum auctions, particularly with respect to 3G, to examine the policy objectives and auction results and to make some observations. When comparing the prices raised in the various auctions the conventional normalisation with respect to population (proxy for market size) and bandwidth is used.

### ***2.2.1 Australia***

In May 1988 the ACA auctioned 2 bands simultaneously as both were suitable for mobile services. The 800MHz band previously used by Telstra for its AMPS service<sup>4</sup> and 45MHz of the potential 75MHz available for GSM1800 was auctioned. The details of this auction have been previously described by the author [Coutts, 1999] and would mark the end of Phase 2 of the evolution of spectrum auctions. The more recent auctions held in early 2000 for the remaining GSM1800 spectrum marked the beginning of Phase 3.

This paper will concentrate on these more recent auctions in Australia since they proved to be the forerunner for the 3G auctions in Europe and were driven by the similar

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<sup>3</sup> The Block C auctions in the US during this period however had a number of problems arising primarily out of their “political origins”, thereby nearly discrediting auction methodology.

<sup>4</sup> The AMPS network was being closed from 2000 as part of Government policy.

strategic imperative of global reach and wireless internet. This auction was for the remaining 30MHz (paired) of GSM1800 spectrum which was expected to raise A\$200million but raised A\$1.3 billion. The reason for the dramatic price escalation was that two winners<sup>5</sup>, One.Tel<sup>6</sup> and Hutchison, saw this spectrum as having equivalent utility to support 3G like services and both were expanding global reach. Both Hutchison and One.Tel have been members of consortia bidding for 3G spectrum in Europe.

The incumbents did not bid heavily in the auction as they had acquired sufficient GSM1800 spectrum in the previous auction in 1998. The equivalent value can be seen in Table 2.1.

In March 2001 the ACA auctioned spectrum suitable for 3G services (2.1GHz band). The values paid were in line with the greatly reduced values paid near the end of 2000 in Europe. These figures are also summarized in Table 2.1.

### ***2.2.2 United Kingdom***

The UK first considered the use of spectrum auctions in 1990 at the time of licensing PCN but did not proceed as it was considered too risky a policy at the time. The UK had been considering the auction process for 3G since 1996.

In March 2000, Third Generation (3G) operating licenses with spectrum allocation were auctioned by the radiocommunications agency with particular unique features. One policy objective was to see a new entrant in the UK mobile market. To this end, the 60 MHz of available paired spectrum was divided between the five licenses on offer as two lots of 15MHz and three of 10MHz. The four incumbents were unable to bid on one licence with a 15MHz allocation, ensuring at least one new entrant with a bandwidth advantage.

The UK auction was highly contested and resulted in a US\$35.25 billion windfall. While the four current incumbents purchased spectrum, a new operator, TIW<sup>7</sup>, was licensed. TIW will have intercarrier roaming rights until it establishes its own roll out as required under the licence.

### ***2.2.3 New Zealand***

New Zealand was the first to implement spectrum auctions in 1990 and 1992, resulting in the entry of Bell South<sup>8</sup> and Telstra as the winners of GSM900 spectrum at the time.

Following a great deal of public debate including a legal claim by its indigenous population, New Zealand proceeded with its 3G auction. It was unusual in that the Government auctioned both GSM1800 spectrum and 3G spectrum nationally at the same auction, amounting to 100MHz of bandwidth.

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<sup>5</sup> Primus pulled out, stating that the market business case would not support these prices!

<sup>6</sup> One.Tel has subsequently in June 2001 gone into liquidation in part because of the huge debt incurred in buying this spectrum.

<sup>7</sup> TIW is a consortium of Hutchison, KPN of the Netherlands and NTT DoCoMo.

<sup>8</sup> Now owned by Vodafone Group

The auction went extremely slowly and the amounts bid, as can be seen from Table 2.1, are very low by any comparisons. It would appear that New Zealand has not learnt the lessons of previous auctions.

#### ***2.2.4 Netherlands***

The Dutch 3G auctions were held after the UK auctions with a successful policy objective of introducing a fifth player to the market. However, a number of bidders withdrew before the auction and relative prices were well below those achieved in the UK, though still higher than for 2G spectrum. There were also reports of “unfair play” by certain bidders which arguably contributed to a lessening of competition and therefore to the lower prices.

#### ***2.2.5 Germany***

In Germany there were four incumbents in the market. The government elected to split the 60MHz into 12 blocks of 5MHz, with the policy objective of allowing at least one new entrant, such that three of the five winners would gain 10MHz and two would gain 15MHz of paired spectrum.

A further policy objective was to maximise revenue. To the surprise of many commentators both policy objectives were successful – the auction raising close to DM 100 billion, on par with the UK, and introducing not one but two new players. The six licence winners each gained 10MHz of paired spectrum.

The value of the German auction was driven by the opportunity for players to gain a 5MHz advantage. This is clearly seen in the end game of the auction as two bidders, T-Mobile and Mannesmann, continued to raise prices in an effort to achieve the 5MHz advantage. With no bidder dropping out of the auction, the final result was that the final six bidders each settled for 10MHz, with each paying an additional DM 2.5 billion as a direct result of competition between two bidders. Also apparent in the German auction was a question of transparency of process, in particular the issue that only the winning bid on each lot in each round was reported.

The outcome of the German auction is interesting as the money “on the table” reflected an assumption that there would be five, not six, UMTS operators in the German market, including two new entrants who will have to use whatever means necessary to gain market exposure.

#### ***2.2.6 Italy***

Italy’s 3G licensing process, held in October 2000, began as a beauty-contest but evolved into a two-phase process of beauty-contest prequalification followed by auction. One bidder, Anthill, was rejected early in the beauty contest phase, and a second bidder, Tu Mobile, was rejected before the start of the auction process, as it had not provided the required guarantees of finance.

The Italian process is most similar to the UK except that the five licences with 10MHz (paired) + 5MHz (unpaired) on offer were considered to be “equal”, the bidders were therefore bidding for one of five licences rather than a specific licence. New entrants had the additional incentive of being able to purchase an additional 5MHz (paired) at a discounted rate.

However, there were a number of issues that led to the auction being less successful than the UK or Germany, even though Italy is a key market in Europe:

- Until recently there had been minimal support for the new entrants which meant that new players did not have significant market share compared to the incumbents. This would on the one hand make the new licence more attractive but could mean one of the new entrants might sell out to an incumbent, a factor that might have reduced the competition in the auction.
- Unlike the other European markets, Italy had two very new 2G players, Wind and Blu. Italy’s auction terminated prematurely with the withdrawal of Blu, which had neither the depth of financial resources nor the will to enter the market given the similar price pressures that will no doubt be experienced in Germany.

### 2.3 Comparisons

One can now compare the normalised price for equivalent spectrum from a number of auctions for 3G or “similar” spectrum.

Table 2.1 summarises the total revenue raised from recent mobile spectrum auctions, normalised for the amount of spectrum auctioned and the total market population. As can be seen there is a wide variation between a number of the markets but the UK and Germany stand out.

Country	Normalised price (US\$/MHz/pop)	Comments
Australia	\$0.75 \$0.25	30MHz paired GSM1800 spectrum in 2000 60MHz paired 3G and unpaired spectrum.
UK	\$5.00	60MHz paired 3G spectrum in 2000
NZ	\$0.07	100MHz paired 3G and GSM1800 spectrum in 2000
Netherlands	\$1.30	60MHz paired 3G spectrum in 2000
Germany	\$4.75	60MHz paired 3G spectrum in 2000
Italy	\$1.40	55MHz paired 3G spectrum (5MHz by application) in 2000

**Table 2.1 – Achieved (Estimated) Spectrum Prices<sup>9</sup>**

<sup>9</sup> These prices do not take into account the differences from country to country of:

- Licence tenure and conditions
- The ability to pay in phases rather than all up front
- The clearance policy of spectrum incumbents

When Australia achieved the values in 2000 for the GSM1800 spectrum given in Table 2.1, both the industry and observers were surprised at the relatively high values. The values bid in the UK for 3G soon after were staggering and the following section will discuss the reasons for this escalation of prices in what can be termed Phase 3 of spectrum auctions.

### **3. Value Achieved for Spectrum Auctions?**

Prior to the 3G auctions, the prices paid for spectrum in Australia and the US were less than about 15% of the expected network infrastructure capital requirement. The value placed on spectrum by a player was usually dependent on the ability to achieve business case milestones in the market.

The more recent prices reflect a key new milestone in the development of the mobile communications sector in that players are investing to:

- Expand global reach of the business. Particular examples include Vodafone expanding into the US and Europe and Hutchison into Asia and Europe.
- Expand with a high bandwidth wireless platform (e.g. third generation 3G) to capture the future potential market of the wireless internet.

That is the value placed on spectrum in the recent 3G auctions has been fuelled by an additional market dynamic of emerging global market players (and aspirants) against national market incumbents.

Thus a valuation approach that has been used here is primarily based on “comparable transactions”, modified by characteristics peculiar to the particular market at the time such as:

- General global market / economic conditions and perceived market demand for wireless internet (e.g. .com factor!) and telecommunications
- Regulatory factors (e.g. inter-carrier roaming and mobile number portability)
- Availability of appropriate multi sourced technology
- Level of scarcity and/or spectrum alternatives (e.g. 3G spectrum or GSM1800)
- Level of competition in the market and its “strategic” value

The key to a “successful” auction is having more earnest bidders than spectrum available. While this depends on the above factors, it can be enhanced by the auction rules and the specific spectrum rights:

- Reserving spectrum for new players as in the UK or offering additional spectrum in the cases of Germany and Italy
- Competition limits such as spectrum caps
- Clearance of incumbents
- The period of licence tenure (e.g. 15 years in Australia versus 20 years in the UK)
- Payment stages (e.g. the UK uses two stages payment)
- Vendor finance, which was a significant factor in the large European markets

These are of secondary impact to the market dynamic of many earnest bidders. When this dissipates (as in Italy) the auction comes to a close.

### *General Market Conditions*

Certainly a key factor affecting the value of spectrum is the prevailing view of the mobile sector and the Telecommunications industry in general. In recent years telecommunications has experienced to some degree the over-valuation aspects of the “.com” companies. The emergence of “wireless internet”, with developments such as WAP, iMode, GPRS etc, has been seen to promote a new lease of value creation in the valuation of mobile assets.

However, since mid 2000 this factor has decreased and Telecommunications stocks generally have been falling in value.

### *The Market*

The strategic value of the market as a regional lead market for mobile internet in addition to the level of competition are important factors, particularly for those players expanding their global reach as referred to earlier.

Thus the UK, which is one of the largest markets in Europe, is definitely seen as the lead market for Europe and has minimal barriers for foreign entry by European standards. Italy on the other hand, while large, has not been as open to foreign investment.

### *Regulatory Factors*

There are a number of regulatory factors that are peculiar to a market. The key issue is the degree to which the regulatory rules are known and transparent, as these will affect any new player effectively trying to compete in the market. These include:

- Intercarrier roaming rights
- Interconnect regime
- Site acquisition regime

A very significant issue is any coverage requirement of a licensee and whether intercarrier roaming is supported by the regulator. This would allow a new player to roam onto the networks of incumbents to allow earlier access to market share.

### *Technology Availability and Cost*

A bidder for spectrum must be able to exploit the spectrum as soon as possible and therefore is very conscious of the need for not only infrastructure from multiple suppliers but terminal equipment, which for 3G is a key issue for concern. This can be a reason, in addition to finance, that attracts some bidders to develop an alliance with a key vendor.

The cost of roll out of a technology can also vary in different markets due to population density and coverage issues. An Australian city with low population density is more costly than a European city, for example, let alone non-urban coverage. This latter factor would have increased significance in the case of licence coverage requirements.

### *Level of Scarcity & Alternatives*

In some cases such as 3G in Europe where only UMTS or WCDMA can be utilised in the licensed band auctioned, the bidders “have to” obtain this spectrum to be in the game.



There are no alternatives for the incumbent and any player wanting to be in the European mobile sector must obtain spectrum. This is the key reason why the 3G spectrum in lead European markets are so highly prized. In addition, players in markets with high penetration, such as the UK and Germany, need the spectrum to meet demand.

In countries such as Australia, New Zealand and Hong Kong this degree of scarcity is not the case. There is a choice for some of the players bidding for 3G to employ WCDMA, exploiting a current spectrum band (e.g. 800MHz) for CDMA2000 or just exploiting the GSM1800 band for 3G like services. In addition since the GSM900 operators also have GSM1800 spectrum, they are less pressed for spectrum to meet demand.

In theory, spectrum third party resale of spectrum should minimise the dependence on timing but because particular spectrum (e.g. 3G linked to a technology) is such a strategic asset for the players, such later re-sale is unlikely. The lack of third party resale generally in the market is a concern for the Government as it may mean the spectrum asset is locked up and used as a barrier to entry of new technology and players.

To what degree these factors modify the level of demand versus supply and therefore drive the level of competition at the auction is a matter of judgment at the time because **the** key determinant is the number of prepared enthusiastic bidders on the day. While this can be affected by many factors, timing is critical to capture the fluctuating dynamics of the market in question and worldwide.

#### **4. The Business Case for 3G**

In the final analysis, the bid prices paid for spectrum by the bidders and the industry as a whole must be underpinned by the business case to realize sufficient profitability over the license period. Revenues must cover not only the large capital outlay for the network but the spectrum costs, which have in some cases been very significant compared to the network costs. This was not the case for the earlier auctions in Phase 2.

The reference material for these discussions are the recent documents from the UMTS forum [www.umts-forum.org](http://www.umts-forum.org), two of which (UMTS 2000 and 2001) outline the expected market segments that will be supported by 3G. The point is made that these figures are in total and will vary widely between different country markets. One of the UMTS documents concerns the impact of spectrum costs [UMTS 1998]. An interesting analysis of the view of financial markets to the auction process [Gahnstrom, A. M. E. and Kristensson, S. M. 2001] and the business case analyses done for clients for 3G by the author over several years indicate that the business case for 3G is very different from that for single national markets for cellular (both 1G and 2G), which were primarily based on voice with little value attributed to non-voice services or “global reach”.

In fact until about 2 years ago the potential to realise profitability from data services was very difficult to quantify as the experience from the fixed network has been disappointing for over 10 years and the “mobile data explosion” had continued to evade reality. However, in the late 1990s, in large part related to the internet explosion throwing up new types of services previously not conceived of previously, the short message (SMS)

or “easy to use” text market (with inter network operability) exploded with the mobile youth market. In Japan, the NTT DoCoMo i-mode “always on” data-based service<sup>10</sup> has grown to over 20 million customers in less than two and a half years and offers some promise of a new “mobile data paradigm to reverse the trend of mobile operators experience of falling revenues per customer. This downward trend has been reversed in Japan (and Korea) so that the 3G business case can factor in data based services. The challenge is to determine which services suit different markets where it is unlikely that there will be a “killer application”.

The analysis of the 3G business case by the UMTS Forum shows that the business case can be very critically dependent on a number of regulatory issues much more than earlier cellular services such as:

- Infrastructure sharing including sites, radio and core network access that can significantly reduce fixed costs.
- Intercarrier roaming for new entrants.

The most telling conclusion from the author’s point of view is that prediction of market take up could be quite challenging for data type services and could mean a developed market might only sustain two operators. Note that most markets envisage three to five operators as a result of the licensing process.

The analysis of the reaction of the financial markets to the succession of licensing of 3G across Europe (both auction and beauty contest) supports the argument that operators were generally caught in a bind. While markets rewarded operators who were successful auctions in countries such as Holland and Italy (medium spectrum prices paid) it penalised operators who won in UK and Germany (very high prices). Consistent with this conclusion, the market penalized Televerkit, the incumbent in Sweden for not winning a 3G license (low price by beauty contest). After the very high prices paid-in the auction in the UK (5 times the Government estimate), Vodafone stated that their share price would have been severely damaged if they had **not** paid the price for the spectrum. It should be noted that the business case (and financial market implications) are very different in Europe than in our region as explained earlier in that non-European operators:

- Have a wider choice of deployment technologies (e.g. 3G at 1800MHz and CDMA2000)
- Are generally are less spectrum-constrained to meet even voice projections alone than single band operators in Europe

Another important benefit of spectrum auctions over a beauty contest is that auctions favour greater participation of global / regional players. Further, while auctions can impose a high cost, beauty contests such as those in France and Sweden are likely to impose a high distortion cost on those markets as a result of the allocations<sup>11</sup>.

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<sup>10</sup> It should be noted that the i-mode service has a low bit rate of 9.6kbit/s which can be met by 2.5G technology such as GPRS and therefore does not require 3G high bit rate (eg 384kbit/s) functionality.

<sup>11</sup> In Sweden the incumbent did not get a licence and in France the incumbent will not be challenged!

For example in Australia, One.Tel's decision not to bid in the 3G auction was similarly seen as foreclosing opportunity and confirmed the market view of their ability to play in the global market. Their position can be contrasted with Hutchison who, having bought 1800MHz for 3G, still bid and won 2.1GHz spectrum. The business case in Australia for 3G spectrum has to be based on a regional long term strategy for data based services (not voice) yet the development of data based services in the market is very limited to date, noting that the announced start dates of service vary widely at the moment!

Over the last 6 months the financial market valuation of both telecom operators and suppliers has continued to fall. Some North American observers put this down to 3G spectrum auction prices and the debt over-hang over both operators and suppliers, who in part financed these auctions. The author offers the additional observations that:

- Only the UK and German auctions resulted in "excess prices" and yet operators not involved in these particular auctions have been adversely affected by the industry down turn, including US operators.
- After the ".com" collapse the financial markets lost confidence in the related telecom sector, noting that this was one of the factors increasing spectrum value.
- The period from 1998 to mid 2000 saw, in the author's view, excessive forecasts of market demand for mobile services exemplified by the "WAP hype"<sup>12</sup> and hard-to-believe market forecasts. This led to over supply all the way down the value chain finally leading to a stop in orders.

Thus the reasons for the collapse of the value of the telecom sector are multi-factorial where certainly the excessively high prices in the auctions between late 1999 to mid 2000 further burdened many key operators and their suppliers.

## 5. Conclusions

Auctions are growing in acceptance as an efficient policy instrument for the allocation of spectrum where demand exceeds supply for commercial use, especially mobile services. This acceptance has developed in three phases from the experimental to the current maturation phase.

However, there are a number of concerns that because of the high prices paid at the 3G auctions in the UK and Germany that Government policy will put greater importance on revenue raised rather than facilitating a strong IT&T sector through efficient spectrum allocation. These large costs borne by the industry may lead to failure in these markets.

The best method to evaluate likely spectrum value where this paper is concerned with 3G spectrum is equivalent transactions. The factors affecting the relative value have been described; noting that auction timing in relation to the local and international market dynamic is critical to the bidding intensity that drives the value.

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<sup>12</sup> WAP is a European/US terminal supplier pushed technology to allow limited data services on mobile phones

Further, while the business case for 3G services that will realize the profitability to pay back the up front costs of spectrum and network capital costs, the business risks are not insignificant. From several studies by the UMTS Forum significant factors bearing on this risk are:

- The regulatory regime around infrastructure sharing
- The degree of meeting market demand.

Thus spectrum auctions used to allocate 3G spectrum have, on balance, been a positive factor to propel the mobile telecommunications sector into a new paradigm of mobile data services driven by the 3G vision.

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