

An Analysis of the Australian PCS Auction(s)

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Abstract

During May-April 1998 the Australian Communications Authority(ACA) conducted spectrum auctions in Australia of both 20 MHz at 800MHz(ie the "AMPS" band) spectrum and 45MHz at 1800MHz(ie part of the 75MHz "GSM1800 band). It raised some A\$350million for the Government and saw the allocation of some 65MHz of spectrum over 19 geographic regions in Australia. The auctions were done electronically using the multiple round ascending auction methodology as used in the United States for the PCS auctions held in 1995. In September 1998, the ACA auctioned the unsold lots using an English Outcry auction. The proposed paper will analyse the effectiveness in this auction methodology in allocating spectrum to both incumbents and potential new players into the Australian marketplace. The paper will consider in particular the impact of the auction rules on the process and effectiveness in achieving the desired outcomes for both players and the regulator.

1. Introduction

Market based mechanisms to efficiently allocate spectrum is beginning to feature strongly in spectrum management in Australia. The Radiocommunications Act 1992 permits the allocation of spectrum licenses using price-based market mechanisms. Creating spectrum property rights, relying on defining spectrum access in three dimensions: time (ownership duration), geographical area, and spectrum bandwidth, can be traced back to Ronald Coase in the 1950's¹. With the theory well documented and the practice confirmed with application to the US PCS auctions, the ACA selected the simultaneous ascending bid process to initially allocate spectrum to open up spectrum for new players in telecommunications as well as provide additional spectrum for the current three mobile operators.

A discussion of the ACA's development of a property-like spectrum access right is beyond the scope of this paper, but it is sufficient to say that it centres on the creation of a commodity in spectrum space, with commodity units of space defined in the dimensions of time, area and frequency bandwidth. The auction system is intended to allow market conditions to allocate these commodity units, or arbitrary aggregations of these units, in the preferred configuration of clients, and to support its own attempts to create an "open market" for spectrum licensing through the creation of a unique model of spectrum property rights. This will allow market conditions to ultimately determine spectrum use as well as to determine spectrum users.

In 1998 the Australian Communication Authority (ACA) conducted a spectrum auction in 21 geographical areas in Australia for 22 spectrum bands of varying bandwidth within both the 800 MHz and 1.8 GHz frequency ranges, using the ascending bid multiple round auction process. The PCS auction took place over 89 rounds beginning on the 20th April 1998 and concluding on the 25th of May 1998. Reaction to the PCS auction by the ACA process was described as an "outstanding success". Total revenue (including penalty payments) from this first allocation of spectrum licences totalled **\$350,190,135**. At the first round there were nine participants including; Telstra, Optus, Vodafone, AAPT and a number of other companies representing Australian and overseas investors. However, by the completion of the auction only seven remained. Within the competition policy limits imposed by the Australian Government²³, the participants were free to bid for most of the 227 lots of varying bandwidth located within the total of the 21 areas. Bidding required the use of ACA supplied software, a computer terminal and modem access to the ACA but all information was available to the public on the Internet. The remaining lots were subsequently auctioned by English Outcry auction on the 15th September.

While a broader discussion of the PCS auctions is available⁴, this paper will focus on several specific results of the auction for discussion in this paper.

2. The PCS Auctions in Australia

Convinced by the superiority of the simultaneous ascending auction process, the ACA, Australia's spectrum management regulator decided to use this method of auctioning to allocate spectrum licences in two separate frequency bands simultaneously.

The auction of spectrum licences occurred over 89 rounds between April 20th and May 25th 1998. The auction realised a revenue of about AUD\$350⁵ million dollars for the allocation of 227 lots within 21 geographical areas as indicated in Figure 3.1. Bandwidth of the lots (each identified by a lot number and lot rating) varied in size from 2.5MHz in the 1.8 GHz band and 5 MHz in the 800 MHz band.

¹See: Coase (1959), Coase, et al (1963)

² No bidder could bid for more than 15 MHz in 1.8 GHz band in one region

³ Optus, Telstra and Vodafone were not allowed to bid in the first two bands at 800 MHz

⁴ Coutts(1998) on www.ctin.adelaide.edu

⁵ A subsequent additional \$30.63 million was bid for the unsold lots on the 15th September 1998.

Not all the spectrum was sold during the auction in April/May. The remaining spectrum was auctioned on the 14th September using an English outcry auction held in Canberra and saw all but one lot sold raising another \$30.6 million and the entry of One.Tel into the list of new entrants. It is understood they intend to rollout a GSM1800 network in the capital cities.

This section describes the spectrum offered for allocation in the PCS spectrum auction. It describes the spectrum parcels that were available, and the areas in which they were available. Each combination of band and area was regarded as a spectrum allocation lot, that is, a lot that was open to bidding in the auction. There were 227 lots on offer in this auction, and applicants were able to bid on any lot or any combination of lots up to their own pre-declared limit (their eligibility), which had to be within the limits determined by the Minister.

2.1. Spectrum Market to be Auctioned

The spectrum to be auctioned was:

- 2 x 20 MHz from 825-845/870-890 MHz in metropolitan areas;
- 2 x 5 MHz from 825-830/870-875 MHz in regional and outback areas;
- 2 x 10 MHz from 835-845/880-890 MHz in regional and outback areas;
- 2 x 45 MHz from 1710-1755/1805-1850 MHz in metropolitan areas; and
- 2 x 15 MHz from 1710-1725/1805-1820 MHz in regional areas.

For the purposes of the auction, the ACA divided Australia into 21 areas determined by considering population distribution, communities of common interest, geography and ability to shield radio signals, and existing radio site usage.

These areas are classified as one of three types of areas, either:

- metropolitan (Brisbane, Sydney, Melbourne, Adelaide and Perth);
- regional (Canberra, Darwin and Hobart, and populated rural areas of Australia);
- outback (these include all remote areas).

The population of each area has been set by the ACA based on an estimate derived from census data collection from 1992. These population figures are provided for the purposes of the auction only.

2.2. Spectrum Parcels for the Allocation

The radio frequency bands on offer were allocated as spectrum lots which may be aggregated through the allocation process to form spectrum licences.

In the 800 MHz band, the ACA allocated 4 parcels, each of 2 X 5 MHz in metropolitan areas (a total of 2 X 20 MHz), and 3 parcels, each of 2 X 5 MHz in regional and outback areas (a total of 2 X 15 MHz).

In the 1.8 GHz bands, the ACA allocated the spectrum in 18 parcels of 2 X 2.5 MHz in metropolitan areas (a total of 2 X 45 MHz) and 6 parcels of 2 X 2.5 MHz in regional areas (a total of 2 X 15 MHz). The Minister has not made a declaration for the re-allocation of spectrum in the 1.8 GHz bands in outback areas.

2.3. Spectrum Allocation Lots

The ACA used a simultaneous ascending bid auction system to allocate the spectrum. The system employed spectrum allocation lots (or "lots"). Lots are like "building blocks" of spectrum. The auction process allocated lots to the applicants who, in economic terms, value them most highly. The lots were then aggregated after the auction to form spectrum licences.

Each combination of *allocation area* and *spectrum parcel* was regarded as a *spectrum allocation lot*. Each lot was numbered sequentially and had a "name" which combines the area name and the band number (e.g. "Sydney-21").

Each lot had a *lot rating* which was a measure of its population coverage and bandwidth. Lot ratings were calculated by multiplying the population of the area of the lot by the bandwidth of one half of the frequency pair constituting the lot (in MHz) and dividing by 100. Lot ratings are rounded down to the nearest whole number. Lot ratings are important to the auction system because they provided a basis for applying activity rules which prevented the auction from stalling.

2.4. PCS Auction Rules

In a simultaneous ascending auction, all bidders are able to bid on all elements of their preferred aggregations at the *same time*. All the lots on offer are auctioned simultaneously, rather than in sequence. Bidders can bid on any lot, or any combination of lots, up to their own pre-declared limit. This limit is expressed as eligibility; a representation of the amount of bandwidth and population coverage the bidder ultimately hopes to win. Bidding is conducted over multiple rounds and the auction closes when there are no new bids on any of the lots in a round in the final stage of the auction.

A key feature of the auction was the application of *activity rules* that encouraged active participation and ensured that the process did not stall. If a bidder had failed to meet their activity requirements, the amount of spectrum that they were eligible to bid on would have been reduced. Bidders could not bid on lots in such a way that their bidding activity would exceed their eligibility.

Applicants also paid an *eligibility payment* set by the ACA to register for the allocation process. This eligibility payment is refundable at the end of the auction if there was any surplus after the deduction of bid withdrawal penalties, and after credit to the balance of the bid price (ie. Winning bids plus bid withdrawal penalties minus the eligibility payment).

Each round of the auction comprised:

- a bidding period when bidders made their bids and any automatic rebids, or withdrew some or all of their current high bids so that they could redeploy their eligibility to pursue different bidding strategies;
- a short period of time for the ACA to calculate the results and make them available for download, and for bidders to consider the results before the next round commenced.

Due to the very large number of permutations of bidder preferences in an auction which offers 227 lots, this auction was run on a computer, and people submitted bids electronically. Bidders submitted their bids using a computer and modem, transmitting bids over the public telephone network or the Internet. Bids were encrypted for security and data integrity.

2.5. Bidders

Initially there were nine officially registered applicants, which can be divided into three groups

Table 2.1 - Applicants⁶ for the PCS MHz Auction

Applicant	Initial Eligibility
Telstra	4180970
Optus	1975490
Vodafone	1556120
Hutchison	1433590
AAPT	2407380

⁶ One.Tel was a new bidder in the subsequent sale of the unsold lots. It is understood they intend to roll out a GSM1800 network in the cities with intercarrier roaming with the current operators. One.Tel is currently a Switched Service Provider with Optus.

OzEmail	3147600
OzPhone	2536330
Catapult	18410
Global Mobility	1257875

Telstra was the strongest incumbent attempting to get maximum spectrum in both bands.

Vodafone was interested in spectrum at 1.8GHz to meet future capacity and as a platform for new services in the cities.

Optus was also interested in spectrum at 1.8 GHz to meet future capacity and as a platform for new services in the cities.

OzEmail a leading Internet service provider, also had some interest in the potential for wireless delivery and bid in the early phases of the auction at 800MHz before withdrawing when the prices had escalated above their valuation.

Global Mobility was and still is a mystery company, and we have no reliable source of detailed information about the company, but it is known that Global Mobility Networks Inc are based in the United States of America. Industry rumour was that Global Mobility was involved in putting together license applications working for interests associated with TDMA technology, including apparently a major US telecommunications and a major world equipment supplier. They did not actually participate in the PCS auction process, however they deposited an initial payment and were eligible to bid for licenses.

OzPhone was created to bid in the Australian spectrum auction and originally it was believed that Spectrum Networks, National Australia Bank and Lendlease, in association with Qualcomm comprised the consortium. However, Qualcomm has secured the granted licences and has stated that they are the sole owner of OzPhone stock⁷. OzPhone's initial eligibility was sufficient to acquire at least 15MHz in the metropolitan areas and 10MHz of spectrum in all other areas. The current company is called Leap Wireless.

Catapult is a Silicon Valley based company specialising in the delivery of test systems for digital wireless and satellite products, such as GSM, SS7 and Intelligent Networks. Catapult's initial eligibility was sufficient to acquire 5MHz of spectrum in a small regional area, like Cairns.

⁷ .Source: Communications Day 3 June 1998 (www.decisive.com.au)

3. Values Achieved for Spectrum from the Auction?

Placing an actual dollar value on spectrum licences depends on business case valuation by respective bidders and depends on many factors. The Australian Telecommunications market is undergoing a great deal of change and uncertainty associated with the industry deregulation, post 1997, as well as the final Government decision(s) around “AMPS closure”. The need to allocate spectrum efficiently amongst potential operators, with sound regulatory and competitive auction and deployment rules will have a profound impact on spectrum price.

In Fig 3.1 shows the final winners of the spectrum auction as of May 1998 where there were a number of lots had be auctioned later as mentioned earlier. Clearly Telstra was the major purchaser of spectrum contributes nearly half of the total amount raised at the auction.

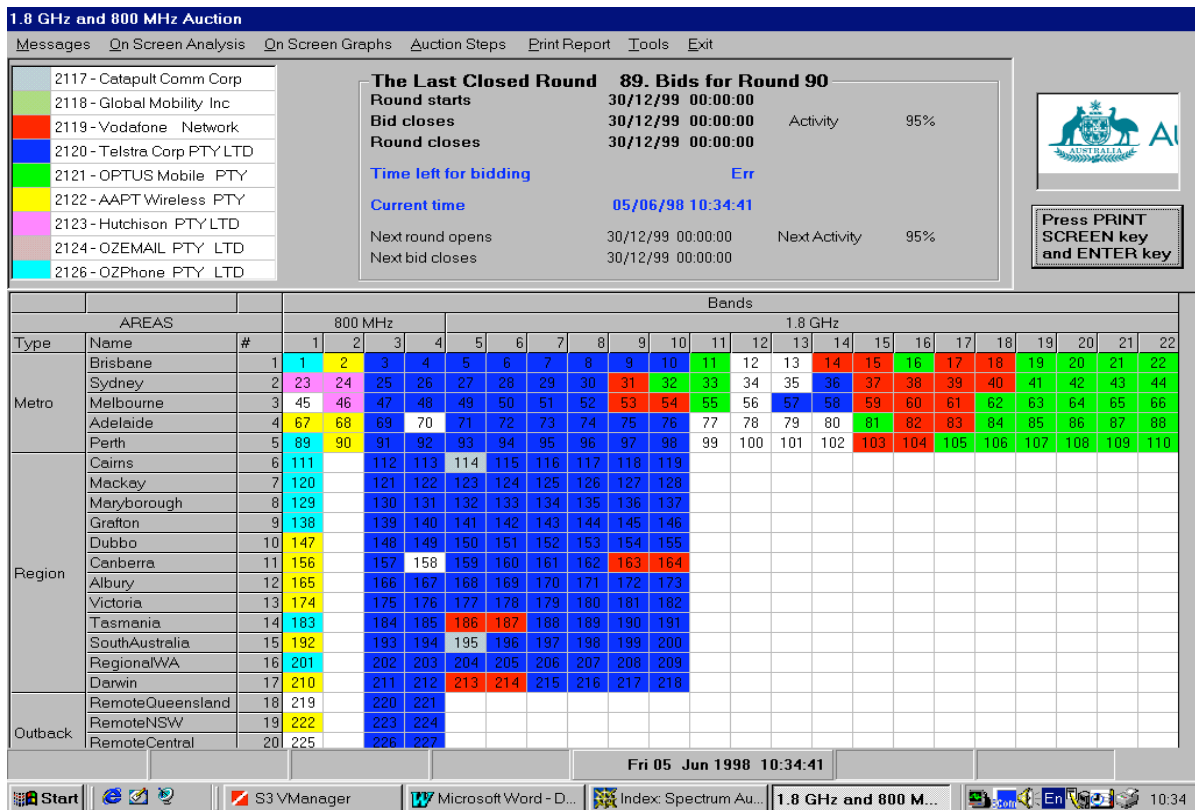


Fig 3.1 – Final Winners at the Auction at Round 89

The Australian PCS Auction was not complete in a final sense as there were unsold lots in some areas which were subsequently sold. For example, one 5 MHz lot [800 MHz band] in Melbourne has been withdrawn at the nearly \$16 million level. In the 1.8 GHz band, spectrum is still available in Sydney, Melbourne, Brisbane, Adelaide, and Perth. As was subsequently found, the most valuable unsold lot in Melbourne was sold at a “dropped price” – \$14 million dollars and all other unsold lots except for Remote Central-1 were sold at below average lot prices and the ACA raised another \$30.6 million dollars. The total revenue was \$381 million dollars for all the PCS spectrum sold.

Table 3.1 summarises average spectrum value \$/Pop/MHz for each region and band⁸.

Table 3.1 – Assessment of Relative values of the Spectrum Lots

Area	Area #	Population	Area Type	Spectrum (MHz)	Dollar value	Spectrum (MHz)	Dollar value	1.8 GHz \$/Pop/MHz	800 MHz \$/Pop/MHz
Brisbane	1	1735500	M	20	\$28,400,000	45	\$14,829,500	0.21	0.82
Sydney	2	4265500	M	20	\$96,080,000	45	\$69,289,000	0.41	1.13
Melbourne	3	3246700	M	20	\$48,840,000	45	\$50,606,000	0.39	1.0
Adelaide	4	1094900	M	20	\$4,938,500	45	\$3,831,900	0.1	0.30
Perth	5	1189100	M	20	\$5,109,200	45	\$4,160,800	0.1	0.21
Cairns	6	368200	R	15	\$884,600	20	\$754,400	0.10	0.16
Mackay	7	305100	R	15	\$701,500	20	\$457,620	0.07	0.15
Maryborough	8	769100	R	15	\$2,153,200	20	\$1,153,200	0.07	0.19
Grafton	9	395000	R	15	\$1,066,500	20	\$592,500	0.08	0.18
Dubbo	10	273900	R	15	\$765,800	20	\$410,820	0.07	0.19
Canberra	11	505200	R	15	\$1,014,200	20	\$808,200	0.08	0.20
Albury	12	477800	R	15	\$1,336,800	20	\$716,400	0.07	0.19
Victoria	13	719900	R	15	\$2,014,400	20	\$1,079,400	0.07	0.19
Tasmania	14	482500	R	15	\$1,113,000	20	\$965,800	0.10	0.15
South Australia	15	308600	R	15	\$770,900	20	\$617,260	0.10	0.17
Regional West	16	201800	R	15	\$403,200	20	\$322,880	0.08	0.13
Darwin	17	107600	R	15	\$225,960	20	\$232,370	0.11	0.14
Remote QLD	18	124400	O	15	\$124,400	0			0.07
Remote NSW	19	152700	O	15	\$244,320	0			0.11
Remote Central	20	127600	O	15	\$127,600	0			0.07
Remote West	21	289000	O	15	\$289,000	0			0.07

In summary the Sydney and Melbourne markets generated nearly 80% of the auction revenue in the 1.8 GHz band and 74% at the 800MHz ; Sydney alone generated nearly 50% of the auction revenue. Metro areas generated more than 93% of the auction revenue in both bands. Table 3.1 illustrates revenue and average \$/Pop/MHz for each band and area. The higher prices for the 800MHz lots is discussed later.

For a comparison of the value of spectrum realised from the auction compared with the revenues raised by the administrative process, the estimate is based on the previous administrative apparatus licence fees over 15 years, allowing for interest (7%). It would be enough to compare the final results only. As described in a previous paper [Nelson, 1996] the GSM license price for 1 MHz of spectrum nationally per year is \$740,000(average). The total amount of spectrum sold in metro areas was 65 MHz (20 MHz in 800 MHz band and 45 MHz in 1.8GHz), so altogether this spectrum would have generated in the first year: \$789,500 x 65 = A\$51.3 Million. Based on the assumption of unchanging license fees, the NPV over 15 years with a 7% interest rate⁹ is \$467 million which is 25% higher than that paid (\$350 million including withdraw penalties) at the auction.

However, the straightforward approach of projecting GSM spectrum value onto sold PCS spectrum has some limitations. We would not expect that incumbent operators Telstra, Vodafone and Optus would need to buy as much spectrum at the PCS auction as it was additional to their previous allocation. Ideally they would like to apply for spectrum in 5 or 10 MHz blocks over time to meet demand. On the other hand incumbents were forced to buy extra spectrum in advance because

⁸ The average \$/Pop/MHz calculations exclude spectrum that was not sold.

⁹ However for NPV calculation an investor might adopt a higher discount factor, then presented in the report.

the auction was the best time to purchase and to limit the potential of greater competition. In terms of revenue generated per extra spectrum, all incumbents have a clear advantage over the newcomers, because of economies of scale based on their existing network infrastructure.

A new entrant's spectrum value estimation depends on their market estimates and costs of network deployment. However the average price they have paid for spectrum in Australia is comparable with or less than, the US figures depending on market and band intensity. Valuation may also reflect short term benefit estimates of traffic the spectrum may carry (and associated revenue), or a strategic assessment of the impact spectrum acquisition may have on a float, or future technology developments.

There are a number of factors which should be taken into account when considering spectrum value:

- much less than a full 65 MHz was available *nationally*. In regional areas there was at most 30 MHz available which would reduce the money which would have been expected to have been raised administratively
- Comparing the 1.8 GHz band with the 800 MHz band, one should include a discount due to the different propagation characteristics, with 1.8 MHz being inferior and requiring many more base stations.
- The spectrum, particularly the 1.8 GHz band, was being sold heavily encumbered which would significantly reduce its utility in the short term. Again a discount factor would be needed.

Therefore we believe that all parties involved in the PCS auction, both ACA and applicants, should be happy with the auction results, because applicants have obtained spectrum at a very competitive price and a 20% ACA discount which is quite fair given the market uncertainty over a 15 year period and given that the licence is likely to be re-auctioned at the end of the 15 years.

4. Analysis of Value Escalation

It is very important for the bidder to know the real demand on lots in the particular area with respect to the number of lots for sale. With knowledge of real demand the bidder can adjust its spectrum requirements to prevent price escalation. The starting assumption for analysis in this section is that the rate of value escalation of the lots is related to the difference between supply and demand. The increase in the lot value with successive rounds is shown in Fig 4.1 which shows the minimum, maximum and average lot value over the 18 lots for 1.8GHz band.

Let us assume that we have N available lots in the area and real demand is M lots. If M is equal or less than N then we have a trivial situation, i.e. a lack of competition. However, when M exceeds N there is a lot shortage, K equals M-N. So, each bidder should reconsider their demand and accordingly reduce spectrum requirements, otherwise the auction process leads to a continuous price escalation. A secondary driver of demand is the variance in lot value across the band so that players, even without a lot shortage, would bid for lower value lots but run a risk of a withdrawal penalty.

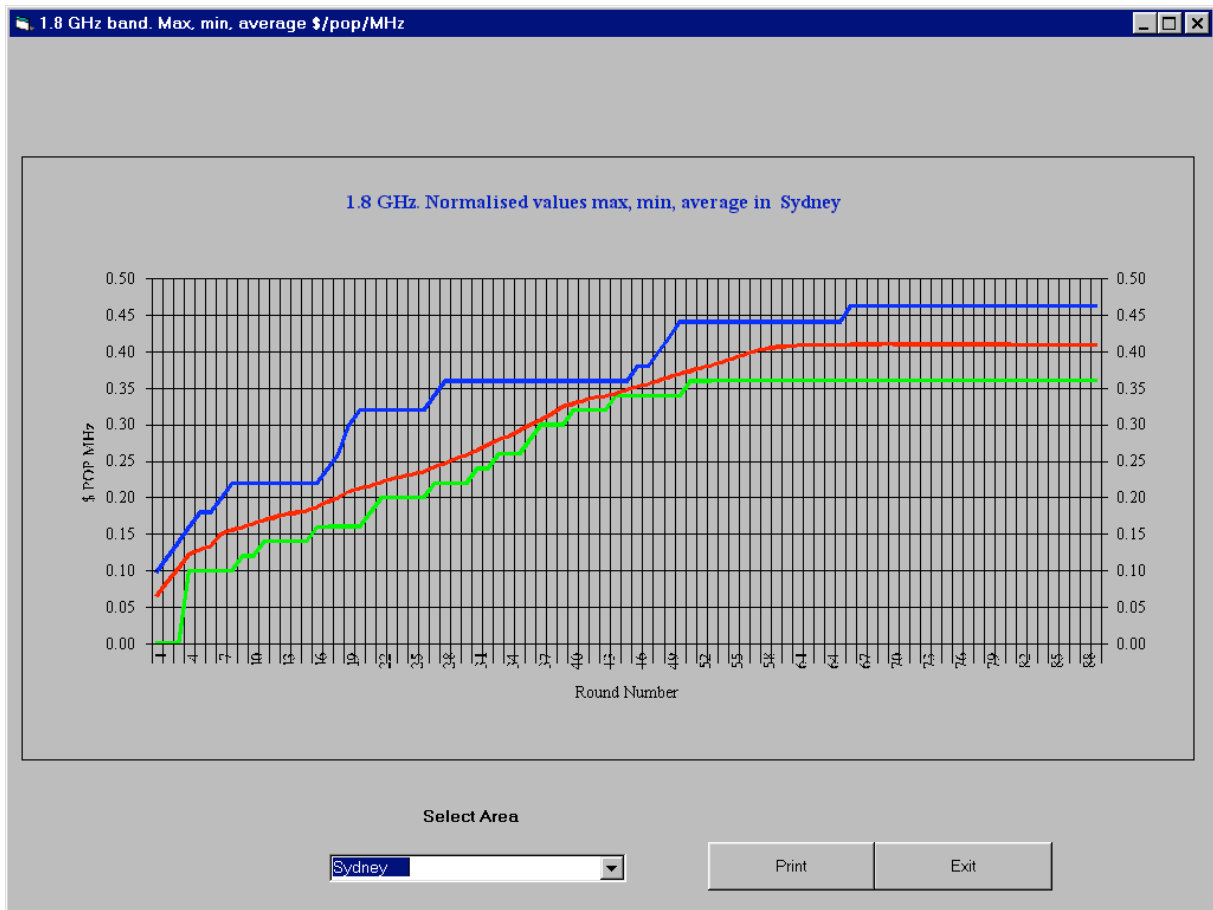


Fig 4.1 Escalation of Lot Value in Sydney

To support lot shortage analysis the CTIN software tool generates a sloped incremental graph for each area. Axis X is a round number and axis Y is the average lot increment value for the round in cents/Pop/MHz

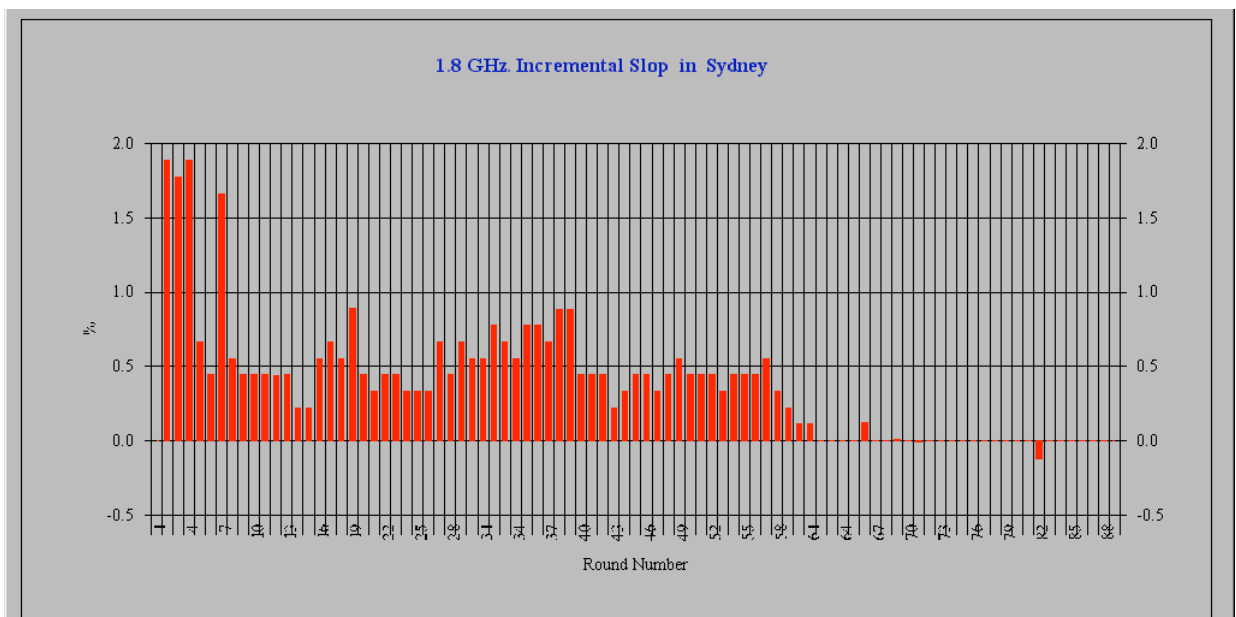


Fig 4.2 Incremental Slope in Sydney

Fig 4.2 shows the effect of lot shortage up to round 60 which resulted in an escalation of value. However, from round 60 there was no escalation of value meaning there was no lot shortage at all! In this round, one of the players (AAPT), a major bidder earlier going for 6 lots, stopped bidding in this band. The magnitude of the slope can be projected to another graph presenting theoretical lot incremental values depending on the lot shortage. This theoretical curve for Sydney and Melbourne has been calculated with the assumption that all applicants followed a minimum bid strategy and bid rationally for these theoretical curves as discussed further below.

Lot shortage could be caused by two reasons: (1) actual¹⁰ shortage when the applicants required more spectrum and (2) "eligibility maintaining" shortage when applicants bid in this area to maintain their eligibility. Thus the rules of the auction which forced bidders to bid to retain their level of eligibility does "appear" as competition particularly in this auction where there were two completely different bands auctioned simultaneously. This effect can also be seen from rounds 29 to 42 where another player (OzPhone), which was not bidding in the 1.8GHz band up to round 29, started bidding here to retain eligibility. It is assumed that they wanted to disguise their true bidding objectives in the 800MHz band until round 42 when it had decided to re-enter bidding. These 13 rounds saw an increased value escalation and certainly contributed to faster escalation of the spectrum prices.¹¹

Figure 4.2 demonstrates that in rounds 1-10 (training period) the bidding was inconsistent as players who were in some cases quite inexperienced in the auction game and were in "learning mode". In rounds 10 - 30 real competition existed and the lot shortage was estimated as five lots. In rounds 30 - 38 there was an increased lot shortage because OzPhone started to bid in the 1.8 GHz band, joining the competition for a short period of time as mentioned earlier. In rounds 39-56 the lot shortage returned to five lots again¹². From round 56 to the end of the auction there was no lot shortage and no escalation of value. This was because AAPT dropped their spectrum demand in the 1.8 GHz band, and the remaining three players could acquire enough spectrum.

Several conclusions can be drawn from this analysis:

- The rate of escalation of lot value from round to round can be estimated from the number of lots in contention, which is the difference between the lots for supply and the total demand of the players in a region.
- Auctioning two different bands simultaneously leads to higher prices due to cross band bidding. The structure of this auction involving auctioning two distinct bands simultaneously means bidders, to retain eligibility disguise their true bidding objectives in a particular band, usually by a cross bid in the other band "artificially" increasing the number of lots in contention which escalates the lot value.
- The ultimate demand for 1.8GHz spectrum was less than supply (45MHz on auction) in all the cities as indicated by the number of unsold lots. However, the auction structure of auctioning both bands created competition for lots which increased values above their starting value (\$0.1). This proposition certainly holds for Adelaide and Perth where a number of lots received no bids. It is less clear that it holds in Sydney, Melbourne and Brisbane where the existence of unsold lots might relate to eligibility problems towards the end of the auction. However, demand at 800MHz exceeded supply and this was seen by much higher prices achieved and the fewer number of unsold lots (with the exception of the major lot in Melbourne¹³).
- Recognition by players of the above escalation effects in bidding strategies could have reduced prices paid. Two of the "true" bidders (Telstra and Vodafone) appeared to recognise this escalation effect of cross band bidding and temporarily reduced the number of lots they demanded. However, this was insufficient to stop value escalation and required one of the other

¹⁰ Actual shortage is the difference between demand and supply at a particular round(price). As would be expected demand would decrease with price.

¹¹ We assume that all bidders bid rationally after the first 10 rounds and did not incorporate price escalation as a bidding tactic.

¹² Our estimation for 5 lots shortage is based on theoretical lot incremental curve

¹³ The unsold lot in Melbourne resulted from the reduced eligibility of the bidders at 800MHz in the last stages and is assumed by the authors to have been a gross error in bidding tactics. This lot was subsequently picked up by Hutchison at the English auction held in September to sell the remaining lots.

two bidders to realise what was happening. It is suggested by the authors that if one of these bidders could have also reduced their demand temporarily, this would have prevented escalation until the strategic intentions of the bidder(s) bidding in both bands had been clarified. This would have required them to also cross band bid to retain eligibility (e.g. Vodafone in fact did this)

The disparity in prices between lots in the 1.8GHz and 800 MHz bands reflects number of factors including the difference in propagation parameters, which impacts on the network infrastructure costs. These factors are:

- Supply factors: Carrier frequency: the higher frequency of 1.8GHz would normally be expected to be cheaper per MHz and one would expect the 5MHz lots to be at least twice the value of the 2.5GHz lots. This would explain a factor of 4 difference alone.
- Demand factors: 800MHz spectrum attracted greater competition in the cities as can be seen so there will be price escalation where this competition occurs.

5. Conclusions

There is now both a strong theoretical background and practical experience to support the multiple round simultaneous ascending auction process as, the most efficient method of allocating spectrum rights where there are multiple interdependent lots to be allocated. The experience with the Australian PCS auctions and the process supports this conclusion for allocation. However, the remaining problem is the process of deciding which bands should be auctioned, how much spectrum and what pre-auction intervention in the rules on players is required. For example, the only significant new spectrum licences have emerged in the bands where the three incumbents were prevented from bidding. This suggest that similar restrictions should apply in future auctions.

In the case of the PCS auction the most of the bidders were able to achieve their desired licence aggregation, whether nationwide or confined to one particular area with the exception of AAPT, Hutchison and OzPhone regarding 800MHz who will likely be involved in post-auction trading. Price variability was evident in a number of areas, particularly in the larger markets of Sydney and Melbourne, and was predominant in both bands. Some areas however experienced little or no price variability between bands, for example, in Darwin.

- Economic efficiency in placing a market value on the spectrum?

The following conclusions assume the time taken as the measure and cannot assume at this stage that there will be no legal delays.

Some of the specific conclusions to be drawn from this auction are:

- i. The simultaneous auctioning of two separate bands leads to cross band bidding to disguise bidding objectives and so in part defeats the intention of the eligibility/minimum bid rules of the auction process. It does however, increase the bidding activity and potentially increase prices. Although both bands were for “equivalent use” for mobile/PCS, they were quite different from a business/technology perspective.
- ii. The existence of fixed links in the 1.8GHz band in different lots did not impact the bidding strategies of players to any degree and all 18 bands were seen as equivalent. Even the technical desirability of achieving maximum efficiency through having concatenated bands¹⁴ does not seem to have been paramount. However, it remains to be seen whether there will be any trading between successful bidders in the 1.8 GHz band
- iii. The restriction on Telstra at 800MHz to only be able to bid in bands 3 and 4 also helped to disguise bidding strategies and is a likely contributor to pushing up the prices in bands 3 and 4 paid by Telstra.

¹⁴ Post auction trading of spectrum licences may be the reason for bidders not to seeking to acquire concatenated bands

- iv. The auction was very efficient¹⁵ in the allocation of a large amount of spectrum across Australia. However, when the total elapsed time is considered including the time to finalise the rules before the auction, the overall efficiency is more debatable.
- v. The values for spectrum paid through this auction process was of a similar order to that being paid for the spectrum under the administrative process.

We believe that the government's objectives: independent spectrum allocation and the promotion of new infrastructure competition were achieved. However apart from Catapult acquiring 2 of the 162 licences at 1800MHz, no new operators acquired 1800 MHz licences at the auction in May¹⁶. At 800MHz Telstra is dominant, holding 40 of 62 licences allocated, with 3 new licensees sharing the remaining 22 licences. And Telstra has now announced its clear intentions to overlay a digital (CDMA) network on its analogue AMPS infrastructure.

In conclusion, the PCS spectrum auction process was both effective from the point of view of the Government in allocating spectrum and a success for the industry in seeing both incumbents and new players receiving sufficient spectrum for their respective business needs.

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¹⁵ Noting the discussion about the definition of efficiency.

¹⁶ The successful acquisition by One.Tel of Spectrum in Sydney, Melbourne, Brisbane, Adelaide and Perth is a more recent development!