Submission to Public Consultation

Instruments for the Proposed 26 GHz Allocation of Spectrum Licences

Executive Summary

There are many ways that the design for this allocation can be improved to the benefit of Australia and for prospective bidders.

The bandwidth of lots offered in the allocation should be increased to 400 MHz. There should be one national market defined for the allocation. Detailed arguments to support these changes are presented. The doctrine that compels fragmentation of the market is inappropriate to this allocation. One reason for that is an economic defect in the E-SMR allocation method.

The wider 400 MHz bandwidth is an emerging trend around the world and supports the most efficient deployment to handsets that operate at up to 800 MHz RF bandwidth. A single national market is consistent with this being a 5G mobile telecommunications band, because we have national mobile network operators (MNOs) in this country. The changes will partly mitigate the defect in the proposed E-SMR allocation system.

The E-SMR allocation system proposed for the allocation contains an intractable economic defect well known to theory and practice. In the literature, it is referred to as the **exposure problem**. The ACMA acknowledges the presence of this defect but does nothing to mitigate it. Rather it exacerbates the effect by deploying an overly granular market definition. The E-SMR method should be abandoned and replaced with a contingent package bid design which is immune to the economic defect.

Clear evidence of failure due to this defect in E-SMR is manifest in the outcomes of the (failed) 5G 3.6 GHz auction and the loss of many tens if not hundreds of millions of dollars to Australia.

Alternative simple contingent package bid designs are available in Australia today. I can demonstrate a version with live on-line systems.

The ACMA is presented with simple choices to improve the outcome for Australia:

- It can continue the process using E-SMR, but it will need to minimise exposure risk by simplifying the market to offer a 400 MHz lot size in a single national market; or
- if the ACMA feels that it must pursue its goal of *flexibility* to permit opportunities for all, small and sundry, then it needs to abandon E-SMR in favour of a contingent package bid allocation system to negate the exposure problem; or
- ideally it should do both, i.e. simplify the market design and migrate to a better simpler more efficient allocation system for better outcomes all round, and into the future.

If public policy dictates that a bidding cap is necessary, then the bidding cap should be expressed in integer multiples of 400 MHz consistent with the recommendation to move to 400 MHz allocation lots.

The Minister on 13 August 2020, however, set a cap of 1000 MHz (not an integer multiple of 400 MHz). This cap when combined with 200 MHz allocation lots and an E-SMR allocation method creates a significant **exposure trap** to the extent that anti-competitive outcomes are more likely. The simple math of the exposure trap is explained.

A cap of 1000 MHz may lead to allocations that are beyond the radio performance of the most advanced chipsets being supplied to handset manufacturers (i.e. 800 MHz).

Such a cap opens the way for inadvertent anti-competitive outcomes, because in a zero-sum game, additional spectrum to one party must reduce the amount available to others, harming their ability to market a competitive product to consumers.

In addition to the practical chipset limitation, advice from a field deployment questions whether more than 800 MHz will ever be necessary, notwithstanding that there are multi-carrier aggregations defined in the standard for up to 1200 MHz.

Since 800 MHz RF bandwidth is the current limit within the available chipsets, an important question for public policy arises about whether to abandon the auction altogether and instead allocate 3 x 800 MHz national licences to the existing three MNOs using s.60(1)(c) of the *Radiocommunications Act 1992* that provides for allocation of spectrum licences for a predetermined or negotiated price.

Perversely, this might offer a more *pro-competitive* outcome than relying on the mandated 1000 MHz bidding cap in an E-SMR allocation, because it would limit the possibility of diminished marketability for at least one and possibly two other mobile network operators. Using 12 x 200 MHz lots and a 1000 MHz cap and noting the RF bandwidth limits of the chipsets, the outcome may be 5:4:3 or 5:5:2 with anything greater than 4 x 200 MHz = 800 MHz denoting an inefficient surplus.

If the auction proceeds with opening demands of 5:5:5 then at least one party will be caught in an **exposure trap** to be left with either 3 or 2 x 200 MHz. It could well become a contest to see who blinks first. This potential outcome will likely have compromised utility compared with the price paid that would be based on the synergy value of 4 x 200 MHz. Rational bidders will hedge against this possibility. This will lead to poorer outcomes for Australia overall.

It's just a bad way to go about this allocation.

An allocation by pre-determined or negotiated price could use a price benchmark from the ACMA Radiocommunications Licence Fee formula, extrapolated to net present value over a 15-year term using Treasury assumptions for inflation and an appropriate discount rate. The Government could also justifiably add a premium for the privilege of uncontested award.

In terms of public administration, the submission recommends that the ACMA modernise its archaic inefficient business practices, especially to meet COVID-safe protocols.

The submission recommends adopting web-forms for data collection and digitally signed documents instead of pen-and-ink witnessed documents. This would substitute for the forest-felling 97-page paper forms booklet used in 2018.

The submission describes business models and technologies to enable this with models that I use today. Many of these are available to be demonstrated (by appointment) on live systems.

Clearly, the ACMA has a deal of work to do to better serve the Australian people. The case for postponing the allocation to provide time for the ACMA to redefine its approach to market and is also explored. It makes a deal of sense.

Now is not the time for these kinds of adventures. There is no real urgency in this band due to technical issues being reported in the deployment of mmWave technology around the world.

Moreover, people are not roaming around CBDs to take advantage of all this bandwidth to be provided. They are working from home in the lower population/communication density areas of

suburban Australia. Data connectivity to enable work-from-home has already been enhanced in response to COVID-19.

Work-from-home is likely to become a new normal, affecting communication density in CBDs where mmWave might once have been compelling.

There is little risk in delaying, adopting a wait-and-see approach and providing headroom to make improvements to the allocation design for the benefit of Australia.

So, let's begin …

Bandwidth

Recommendation: The bandwidth of lots offered in the allocation be increased to 400 MHz.

A 200 MHz option when combined with an E-SMR allocation system and fragmented area market structure offers the prospect of suboptimal outcomes for bidders across *two* market dimensions due to a well-known economic defect inherent to all SMR auction derivatives.

400 MHz lots reduces this risk.

400 MHz will be consistent with the dominant international trend.

400 MHz lot bandwidth will be more technically efficient in delivering the bandwidth of mmWave to match the 800 MHz RF bandwidth of handset chipsets (see below).

Background

400 MHz is the most prevalent channel configuration in current mass-market deployment of 5G-NR mmWave technology in the 24.25 to 29.50 GHz range (i.e. 5G-NR bands n257, n258 and n261).

These three bands overlap to various extents and align with national spectrum availability in different regions, but they essentially form a common technology block with common standards for the radio interface.

The standards define four (4) channel options:

- 50 MHz
- 100 MHz (accounting for about 40 % of world-wide deployments[1])
- 200 MHz; and
- 400 MHz (accounting for about 60% of deployments).

Many configurations for multi-carrier aggregation are described in the standards. Two-carrier aggregation (2CA) of 400 MHz channels into 800 MHz is supported in 3GPP Rel. 15 and is in deployment today in band n257. 800 MHz RF bandwidth is supported in handset chipsets, including the specification for the imminent release of the iPhone 12, which is expected to use the Qualcomm X60 modem-to-antenna chipset.

The 200 MHz proposal appears to be deployed only infrequently in its native configuration. It will most likely be used as a building-block towards multi-carrier 400/800 MHz aggregations.

Given the trend towards 800 MHz RF processing, the ACMA risks little by simply "biting the bullet" and moving to 400 MHz allocation lots (the maximum in the standard), to be done with it.

One of the potential outcomes in an allocation that combines the E-SMR allocation system with more granular 200 MHz lots across multiple markets is that quite different quantities may be awarded to a bidder in different markets, *whether that is their business case or not*. Combinations include 200/400/600 up to 800 MHz aggregations.

This may complicate network deployment and the vendor solutions that can be supplied.

[1] Source: https://halberdbastion.com/technology/cellular/5g-nr/5g-frequency-bands/n257-28-ghz

The potential for these varying allocations across markets arises when three factors collide:

- a bidder seeking a multi-lot assembly (i.e. multiples of 200 MHz) for 800 MHz
- the exposure problem inherent to all SMR derivatives including E-SMR
- and a budget constraint.

There are two parts to the exposure problem. The first is that bidders may only bid on components of their preferred allocation as discrete independent units. The second is that the E-SMR does not permit withdrawal of bids, as explained by the ACMA:

> *Bid withdrawals are not compatible with the ESMRA format because they would introduce a significant gaming risk. Bidders could submit bids only to drive the price high, then withdraw all their bids, leaving their competitors to pay the high prices[2].*

Instead the E-SMR format provides for *decrease bids* that may be *partly accepted* or *rejected*[3] by the E-SMR system under the rules.

In plain English: *when a bidder makes a bid in an E-SMR auction, the allocation system takes the control of its business decisions out of its hands!*

There can be no easy terminal strategy available to bidders in response to a budget limit.

Business decisions by a bidder are at the mercy of a bureaucratic process and the decisions of others rather than the preference of the bidder that is *risking its capital*.

That is simply bad public policy.

A bid on a product will be *partly accepted* or *rejected* by the vendor if it would lead to an outcome where remaining aggregate demand on the product (determined by the actions of other bidders that cannot be predicted) would be less than available supply.

It is feasible that a bidder seeking 800 MHz and needing to withdraw due to budget constraints might still be forced to take 600 MHz, 400 MHz, or 200 MHz allocations across different markets.

This is because in E-SMR each market operates *independently* of others, and the exposure problem operates on *both* dimensions (frequency and geography) of the market matrix.

The math behind this is simple to demonstrate using a scenario:

> *Assume that aggregate demand for a product is 13 x 200 MHz blocks (i.e. 13/12 demand/supply) and a bidder contributing to that aggregate demand is bidding for four units (4 x 200 MHz = 800 MHz to support optimal delivery to handsets). The bidder's preferred strategy requires this in all markets.*

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2 Australia, Australian Communications and Media Authority (2020) *Draft allocation instruments for the 26 GHz (25.1–27.5 GHz) metropolitan and regional lots auction - Consultation paper* available from https://www.acma.gov.au/sites/default/files/2020-07/Consultation%20paper_Draft%20allocation%20instruments%20for%20the%2026%20GHz%20metropolitan%20and%20regional%20lots%20auction.docx, p.22

3 See the provisions on Part 2 of Schedule 1 - Rules for the primary stage of the auction contained in the *Draft Radiocommunications (Spectrum Licence Allocation — 26 GHz Band) Determination 2020*, subject to consultation.

The bidder encounters a budget constraint and needs to withdraw from the auction altogether, or perhaps more likely to withdraw from this one product to redeploy its financial capacity to other more valuable products in the matrix.

*In this situation the bidder will be forced by E-SMR to continue to hold (and to pay for, at prices that it had bid up) 3 x 200 MHz = 600 MHz, because 13 - 4 = **9** and this is 12- **9** = 3 units short of the number of units offered.*

*The "decrease bid" to withdraw from the market will be only **partially accepted** by the E-SMR system according to the rules, down to the supply level (12), forcing the bidder to retain 3 x 200 MHz = 600 MHz which may not be either an efficient allocation for its business or good value at the price that would be based on the synergy in acquiring 800 MHz.*

The bidder in this situation must retain 3 x 200 MHz = 600 MHz by default in an E-SMR allocation.

This mechanism has been tested, observed, and confirmed on the ACMA's own E-SMR systems and the rules.

It is the mechanism that created the economic failure in the 5G 3.6 GHz auction.

In some previous auctions, the ACMA attempted to mitigate this effect by providing a "minimum spectrum requirement"[4] (MSR) in the rules. An MSR cap of 2 x 200 MHz = 400 MHz could (in some limited circumstances) protect a bidder seeking a 400 MHz allocation and needing to withdraw, but it is of no practical use if the bidder's business plan is predicated on using 800 MHz in the scenario described above. To provide protection in that case, the MSR would need to support 800 MHz, and it is at this point that the issue descends into absurdity. Who other than a bidder knows its own business case and its own spectrum needs?

MSR does nothing to correct the fundamental defect of E-SMR, as the scenario above and the multiple examples offered by the (failed) 5G 3.6 GHz auction clearly demonstrate.

The issue arises not so much from the 200 MHz proposal, but from an intractable economic defect inherent to all SMR-class auctions including E-SMR, when faced with granular markets with high synergies. For the record, I take personal responsibility for introducing the original SMR design to Australia in 1995.

The theoretical foundation of the defect (described in the literature as the **exposure problem**) has been known for decades and will be further explored below. The ACMA is aware of it to the extent that it refers to it in its discussion papers, yet it persists with an allocation system that creates the problem and avoids designs that are immune to it.

If 400 MHz bandwidth lots are offered, then the potential of the exposure problem across both dimensions of the market is lessened when the reasonable expectation that MNOs will seek 800 MHz each is factored.

The original ACMA proposal of 100 MHz lots raised a potential for more problematic outcomes than a 200 MHz option, because it opened the prospect of 100, 200, 300, 400, 500, 600 and 700 MHz aggregations all possibly defaulting out of different markets as a function of the exposure problem.

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[4] See for example s.28 of the *Radiocommunications (Spectrum Licence Allocation — 3.6 GHz Band) Determination 2018*

All these options can all be supported using various configurations of multi-carrier aggregation in the standards, but that is of little benefit for equipment configuration and sourcing from vendors if different configurations across different markets are forced by the outcome of the auction.

On this issue alone, 400 MHz lot size is the simplest option for Australia if E-SMR is used as the allocation system.

ACMA's Original Proposal

The ACMA discussion paper relating to a draft recommendation to the Minister to make a Spectrum Reallocation Declaration initiated discussion about ACMA's preferred bandwidth offer[5].

The discussion paper did not consider 200 MHz, but did consider two other options:

- 100 MHz; and
- 400 MHz.

In considering these options, the ACMA noted industry stakeholder expectations:

> *Some stakeholders in response to the options paper commented that as much spectrum as possible should be available for spectrum licensing and that 800 MHz is needed to realise the full potential of 5G mmWave technology.*

I support the industry's reasoning. It is backed by the evidence from current international deployments. It is backed by the specifications of mobile phones that support mmWave technology (below).

The ACMA, however, juxtaposed industry stakeholder expectations with own its doctrine of ***flexibility***:

> *Offering the band in 24 x 100 MHz lots not only enables bidders to obtain smaller parcels of spectrum (which may be attractive for smaller bidders), it also allows for the band to be split in a large number of ways, offering **flexibility** to all bidders. For example, during an auction a smaller lot size enables bidders to express changes in demand more gradually. In addition, smaller lots would also enable greater **flexibility** for the application of any allocation limits.*

The ACMA settled on the 100 MHz option.

The ACMA's desire to facilitate flexibility trumped industry expectations.

After all, what would the industry know?

I return to the ***flexibility*** doctrine below. In general terms I support it, but as its designer, I know its weakness only too well.

This level of flexibility is not easily compatible with the E-SMR allocation method in granular multi-dimensional markets due to the exposure problem that exhibits in all SMR class allocation systems. It is noteworthy that the exposure problem manifest in the (failed) 5G 3.6GHz auction in 2018 and it led to a loss to Australian taxpayers of the order of hundreds of millions of dollars.

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[5] Australia, Australian Communications and Media Authority (2019) *Draft spectrum reallocation recommendation for the 26 GHz band in cities and regional centres - Consultation Paper*, available from https://www.acma.gov.au/sites/default/files/2019-08/IFC-14-2019-Consultation%20paper-Draft%20spectrum%20reallocation%20recommendation%20for%20the%2026%20GHz%20band.docx pp.26-28.

ACMA's Revised and Current Proposals

The current ACMA discussion paper invites comment on draft instruments for the proposed allocation.

The instruments specify a different bandwidth of 200 MHz, purportedly in response to consultation feedback from the earlier proposals. The previous options of 100 MHz and 400 MHz are consigned to history.

The rationale offered by the ACMA for this change is thin:

> *However, in submissions to the consultation, stakeholders expressed a preference for a lot size of 200 MHz to mitigate frequency exposure risk, with little concern about the additional technical conditions proposed for the upper frequency range.* [6]

I offer a deconstruction of this *frequency exposure risk*, below, because it appears poorly understood.

The rationale offered by the ACMA for moving from 100 MHz to 200 MHz (a configuration not in widespread deployment) is otherwise left barren.

On 5 June 2020, the Office of the Minister for Communications, Cyber Safety, and the Arts sought my advice on the minimum amount of spectrum required to operate a business in the 26 GHz band.

In turn, I sought comment from a long-time associate and leader in an international 5G technology innovator and vendor based in the United Kingdom.

The vendor is partnered with Rakuten in Japan. Rakuten is a new full-service mobile network operator (MNO). This partnership services the mass-market **urban hotspot** component of this new and leading-edge technology network. This is a significant mass-market rollout of mmWave technology.

I was provided a data sheet for the product shipped to Rakuten.

The equipment operates using 400 MHz radio channels configured in 2CA to deliver 800 MHz in deployment using band n257.

The deployment illustrates how industry stakeholder submissions advocating 800 MHz bandwidth in Australia are both practical and realistic. This equipment in Japan uses radio channels aligned with the largest bandwidth supported in the standard, i.e. 400 MHz.

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[6] Australia, Australian Communications and Media Authority (2020) *Draft allocation instruments for the 26 GHz (25.1–27.5 GHz) metropolitan and regional lots auction - Consultation paper* available from https://www.acma.gov.au/sites/default/files/2020-07/Consultation%20paper_Draft%20allocation%20instruments%20for%20the%2026%20GHz%20metropolitan%20and%20regional%20lots%20auction.docx, p.14

In response to a question to my informant about the optimal bandwidth configuration for this Australian auction the advice was clear:

> *My view is that the auction should be 400 MHz lots.*

The advice went on to say:

> *Qualcomm base station silicon for mmWave hardware is designed to support up to 800 MHz and this matches the capability 99.99% of mmWave Smartphones.*

In summary, base station silicon, handset silicon, and base station hardware all support 800 MHz bandwidth. By far the most simple and efficient way to secure 800 MHz RF bandwidth is to use the smallest aggregation of the largest channel bandwidth described in the standards i.e. 2 x 400 MHz.

This equipment is in production and in mass-market deployment today.

The ACMA may argue that 800 MHz can also be assembled from 100 or even 200 MHz "building blocks", consistent with its *flexibility* doctrine. This is supported by various configurations of multi-carrier aggregation in the standards.

Nevertheless, this wider argument only holds true if the ACMA deploys an allocation methodology that can support such assembly without exposure risk, because E-SMR opens a possibility of other intermediate configurations.

The E-SMR allocation system exhibits significant exposure risk, as made clear by the rules, and referred to by the ACMA in its consultation papers.

Other families of allocation systems (e.g. combinatorial systems) do not carry this risk.

We'll get to that …

ACMA's "Flexibility" Doctrine

For my sins, I confess co-authorship to this doctrine.

I led the team that developed it and I presented the first public paper espousing the ideas to the Productivity Commission's 1997 *Industry Economics Conference* Plenary Session. As a sidenote, I shared the podium with renowned auction theoretician Professor Paul Milgrom of Stanford University[7].

The origin of this doctrine should be seen in its historical context.

The decade of the 1990s implemented the "micro-economic reform agenda" of the Hawke/Keating governments[8].

Substantially revised laws were made by the Parliament to implement reform objectives. Importantly, the changes enhanced the role of markets in determining the allocation of scarce public resources.

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[7] Hayne, Ian (1997), *Spectrum property rights and practical auction design: the Australian experience*, in Australia, Productivity Commission, Proceedings of the 1997 Industry Economic Conference at https://www.pc.gov.au/research/supporting/industry-economics-conference-1997

[8] In radiofrequency spectrum management, the reform agenda continued to be advanced by the Howard government from 1996.

The *Radiocommunications Act 1992* was an instrument of this reform agenda. It introduced for the first time a market-oriented form of licensing ("spectrum licensing") where spectrum was required to be allocated according to market principles rather than centralist bureaucratic planning and fiat licensing. This required a level of agnosticism about the technology choices of users.

"Spectrum licensing" comes from an idea of private band management and pseudo-property rights proposed in Australia by the Bureau of Transport and Communications Economics[9], where whole bands would be auctioned off, so that they could be managed for reward by private sector interests as opposed to being managed by government agencies using taxpayers' resources.

The idea ultimately proved a bridge too far out of anti-competitive hoarding concerns, but it had then, and it continues today to enjoy powerful theoretical underpinning[10].

During the second half of the '90s decade, as the business systems to underpin spectrum licensing were being developed, there was also intense international competition for dominance over the technologies for mobile telecommunications. For those of us looking on, this time became known colloquially as "the religious wars". On the one hand there was an American flavour of development, building on a foundation of AMPS, through CDMA-based IS-95, CDMA 2000 and so on, and on the other hand, a European tradition evolving from GSM to wideband CDMA under the auspices of the 3rd Generation Partnership Project (3GPP).

The different technology flavours had different spectrum requirements.

To avoid "picking winners" an Australian policy was enacted to be agnostic about these technology flavours to allow spectrum allocation (quantity and configuration) to be resolved by market drivers.

It became necessary to offer spectrum to market in a technology-agnostic way - the "largest common denominator" of the different technology classes would allow potential users to obtain spectrum matched to *their* technical preference without government being unnecessarily prescriptive.

Combined with this idea was a requirement to use a multi-object allocation system, which was very new to theory and practice.

At the time, these ideas were at the leading-edge and the very forefront of international spectrum management.

This is the origin of the *flexibility doctrine* now followed by rote at the ACMA.

It is all so passé.

The "religious wars" were fought and won. The issues were "done and dusted" by the early 2000s (about 20 years ago). The technology issues for mobile telecommunications were resolved via patent licensing and intellectual property transfers, and forward collaborative roadmaps of research and development of which 5G is only the *current* iteration.

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9 Australia, Bureau of Transport and Communications Economics (1990), *Occasional Paper 102 – Management of the Radiofrequency Spectrum – An Economic Analysis*, AGPS, Canberra.

10 For a wide review of history and theory and its evolution, see Hazlett, T.W. (2017) *The Political Spectrum – The Tumultuous Liberation of Wireless Technology from Herbert Hoover to the Smartphone*, Yale, New Haven. See also the BTCE at footnote 9.

Around the world, we enjoy common international standards for mobile telecommunications through 3G, 4G and 4G-LTE and 4G-LTE-Advanced, and now through 5G across a myriad of bands.

The need for *flexibility* has diminished on the *technology* dimension. It only remains in a business/competition policy context.

Flexibility is desirable if there is a market-based allocation system capable of resolving different business requirements. Fortunately, there are methods available that allow this.

Unfortunately, experience has shown that these do **not/not** include the SMR class (including E-SMR) favoured by the ACMA.

The last point of resolution of the mobile technology "religious wars" is that Australia's best path for mobile telecommunications deployment will now *always* align as closely as possible with international trends.

The international trend is towards blocks of 400 MHz to simply aggregate to the 800 MHz that is supported in new 5G handsets.

800 MHz is the most efficient way to deliver bits-per-dollar-invested in infrastructure where this infrastructure is spaced around 150 metres apart.

The best way to configure the spectrum for offer is to provide 400 MHz bandwidth lots.

International Standards vs. Manufacture and Deployment

International standards-making is a precursor to manufacture. It is a detailed (laborious) process to provide the widest accommodation of different sectional interests through a process of *consensus*.

It is typically bureaucratic with different interests being negotiated in committees with consensus a goal. The interests include regulators, vendors, and operators.

The 5G mmWave standards that emerged out of this process provide for 50, 100, 200 and 400 MHz channels and many descriptions of potential carrier aggregations.

Once a version of a standard is settled, however, practicality and industry economics must reign.

Chipsets must be designed and manufactured with economy-of-scale to justify a return on the substantial investment in research and development. Chipsets need to be integrated with both base station and customer equipment, again to satisfy a mass international market.

Handsets then need to be manufactured in simple mass-production lines capable of high volumes at low prices to be destined for international markets.

As my informant advised, and it is worth repeating:

> *Qualcomm base station silicon for mmWave hardware is designed to support up to 800 MHz and this matches the capability 99.99% of mmWave Smartphones.*

Smartphones are being manufactured today for 5G mmWave communication. Examples include the Samsung the Galaxy S10 5G[11] using the Qualcomm SM8150 Snapdragon 855 chipset, the Galaxy S20+[12], and the Galaxy S20 Ultra[13] that use the Snapdragon 865 chipsets. These include Qualcomm Snapdragon X55 5G modem-RF system which specifies 800 MHz RF bandwidth. The datasheets for these chipsets define the mmWave RF bandwidth to be 800 MHz[14] using up to 8 carriers.

The new iPhone 12 is reported to use the Qualcomm X60 modem-to-antenna[15]. The X60 chipset offers 800 MHz bandwidth.[16]

Smartphones are being shipped or are soon to be shipped that all support mmWave 800 MHz RF bandwidth.

This is consistent with the reporting that 800 MHz equipment is being deployed by Rakuten in Japan.

So, why would Australia want or need to deviate from that path?

The ACMA proposal for 200 MHz building blocks is too granular to support this configuration without increased exposure risk when using an E-SMR allocation system. An E-SMR allocation would allow a defaulted assembly of different aggregations of different multiples of 200 MHz lots across different markets.

Under the ACMA proposals for 29 separate markets, a hypothetical worst-case might see a bidder left with a totally mixed bag of allocations that includes 200 MHz, 400 MHz, 600 MHz, and 800 MHz across markets.

On this metric, 200 MHz bandwidth is not the best lot size in an E-SMR allocation.

400 MHz bandwidth is *better*.

Indeed, *800 MHz may be best*, as considered below.

The 5G Mobile Ecosystem – this is MNO Business

5G-NR[17] across all bands is a *mobile telecommunications* technology, whether between people or *things*.

Consumer handsets for 5G-NR mmWave are in production and deployment as part of the *mobile telecommunications* ecosystem. New handsets integrate this 5G-NR mmWave technology into the existing *mobile telecommunications* business with 800 MHz RF bandwidth.

5G mmWave integrates with existing *mobile telecommunications* networks fitting with the common management, billing and CRM that are all part of the long-term business evolution of the MNOs.

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11 https://www.gsmarena.com/samsung_galaxy_s10_5g-9588.php

12 https://www.gsmarena.com/samsung_galaxy_s20+-10080.php

13 https://www.gsmarena.com/samsung_galaxy_s20_ultra-10084.php

14 https://www.qualcomm.com/products/snapdragon-855-mobile-platform
https://www.qualcomm.com/products/snapdragon-865-5g-mobile-platform
https://www.qualcomm.com/products/snapdragon-x55-5g-modem

15 https://www.tomsguide.com/news/iphone-12-will-support-mmwave-and-sub-6ghz-5g-but-the-iphone-13-wont

16 https://www.qualcomm.com/products/snapdragon-x60-5g-modem

17 5G "new radio" – the new radio architecture for 5G that has been designed around 5G service concepts

The most likely deployment of this technology in Australia therefore is by the three existing MNOs – Optus, TPG Telecom and Telstra. The most efficient and therefore most likely deployment of this technology from a business case perspective is as a *marginal-cost* extension to existing *mobile telecommunications* networks to enhance data bandwidth to customer handsets in areas of very high communication density (like CBDs and entertainment/tourist areas).

Used by MNOs, 5G-NR can also provide a *fixed* component to provide radio access to support in-building Wi-Fi connectivity or can itself be deployed in-building. It operates in the same way as MNOs today offer broadband connections using 4G-LTE Advanced modems that bridge to Wi-Fi and that provide an alternative to fixed NBN services. This is integrated into their customer management and billing business systems.

This *fixed* part of the business leverages existing mobile telecommunications core networks and business back-ends.

5G mmWave is a natural and integrated extension of the busines of *mobile telecommunications* operated by MNOs.

Without an anchor using bands that support mobility below 6GHz, the prospect of emergent mobile competition in the 26 GHz band is limited.

Let's accept that practical reality.

Deployment Density

Another factor in favour of the role of MNOs in mmWave and working against the prospect of new competition even at the local level is deployment density.

The evidence from the Rakuten roll-out in Japan is that the mmWave part of the network requires higher build density than any mobile technology deployed in the past:

> *The real-world LOS ranges are 100-150m, and reflections operating at 20-30m. Indoor penetration is a few meters in almost all cases. It's like a switch.*

Forget the marketing hype about 1,000 metre range. In real world deployment, it is proving to be less.

5G mmWave technology has short-range propagation and poor in-building penetration. It will require high roll-out density simply to provide coverage of *open* spaces – densely trafficked open spaces.

It makes sense, therefore, that operators seek the maximum utility that can extracted from every piece of equipment deployed. Channels of 800 MHz provide the highest bit density to customers at the lowest cost-per-bit.

800 MHz is efficiently achieved via 2 x 400 MHz lot bandwidth.

Facilitating Competition

The communications bureaucracy (Department and the ACMA), the ACCC and the Minister and Government are all advocates for vibrant telecommunications competition.

I am an advocate for vibrant competition.

Some see this band playing a wider role in facilitating competition. I don't, and it is for purely practical reasons.

The theme of advancing competition is reflected in the earlier spectrum reallocation discussion paper by the ACMA:

> *There is a range of possible users for the 26 GHz band. A lot configuration with smaller lots would enable more users to potentially obtain spectrum in the allocation, including those interested in relatively small amounts of spectrum such as* ***local network operators****.*

The mmWave technology should be viewed instead as an incremental *extension* to existing mobile networks, not a place for new competing *local network operators* that will lack the underlying business synergies of the MNOs that make this band commercially sustainable.

The *local network operators* envisaged by the ACMA will be competing for spectrum against the three MNOs. The MNOs can:

- leverage their entire integrated mobile telecommunications business
- use the technology incrementally and seamlessly in conjunction with their existing 4G/5G networks because this is a *mobile* technology
- extend a service delivered directly to customer handsets that are already part of their business ecosystem.

New *local network operators* enjoy no such synergy.

Further, new *local network operators* face a dense and costly infrastructure build.

For example, based on the quoted LOS performance being observed in deployment in Japan, it would take at least four (4) x units just to provide coverage of Martin Place between George Street and Macquarie Street in Sydney, and quite likely more. The equipment has about 9kg mass and a façade that is around 0.4 h x 0.2 w metres. It is a bit bigger than Wi-Fi up a pole, and it's not nearly as cheap.

Let us be pragmatic: this is a *mobile* band to deploy 5G *mobile* standards to extend existing *mobile* networks with *mobile* 5G-NR technology, delivering services to *mobile* handsets.

And … we have three *mobile* network operators in Australia.

In my time in this industry we have all seen repeated opportunities to introduce more competition[18], yet the industry structure remains stable around three MNOs.

This band does not have the technical characteristics to facilitate change to that equilibrium.

A Possibility – An Opportunity for Government

Noting these dynamics, the most efficient technical and economic solution in the *national interest* would be to abandon the dream of new competition in this particular band and simply award an 800

[18] Initially there was Telstra, Optus, Vodafone (now part of TPG Telecom) and then One.Tel (gone), Primus (withdrew), Hutchison (now part of TPG Telecom), Unwired (now with Optus), Qualcomm (not active to deployment), TPG (now part of TPG Telecom), Dense Air (withdrew from the 5G 3.6 GHz allocation) and possibly more along the way, as some applicants never featured to win licences.

MHz licence to each of the three MNOs under the provisions in the Act that provide for award of spectrum licences by pre-determined price or a negotiated price![19]

The ACMA, though, seems committed to follow a costly time-intensive process to extend *contestability* when the odds favour that this is unlikely to be observed in the outcome.

The overhead cost to Australia of the auction path includes the administrative costs of ACMA's hard-peddling uber-bureaucracy beavering away for the next 7 or 8 months to end 1Q21, plus transfers to the ACMA's foreign E-SMR systems and consulting providers at a time of national economic weakness.

As a taxpayer, I object!

The *Radiocommunications Act 1992* provides alternative avenues to facilitate the dreams of *local network operators* in this band, including via mechanisms originally conceived by the BTCE[20] for private band management. These are the provisions in the Act for "third-party authorisation", that allow small *local network operators* to sub-lease access to spectrum from a spectrum licensee.

It might be difficult for an MNO to refuse this type of access because it could be an unreasonable restraint on trade. This is especially the case if the ACMA offers national markets as argued below that it should. The MNOs cannot be everywhere, and are unlikely, noting the characteristics of this band, to be anywhere other than the most-densely trafficked areas. By adopting national markets there will be scope of local entrepreneurs to fill gaps in the MNO coverage, just as the law provides, and that the original concepts of spectrum licensing envisaged.

There is little to describe this opportunity or how it could offer an alternative for *local network operators* in the ACMA discussion papers.

The ACMA has also proposed to offer class-licensed and apparatus licenced options in adjacent bands that could provide scope for these local network operators.[21]

Nevertheless, if the Government[22] is determined to proceed with an auction as currently planned by the ACMA, then a 400 MHz channel will allow aggregations of 800 MHz to be constructed simply, easily and with reduced exposure risk to the participants.

A 400 MHz channel raw channel will still have utility. It will be more efficient than 2 x 200 MHz for the equivalent 400 MHz outcome.

The ACMA may be able to justify offering the granularity of a 200 MHz bandwidth, but only if it adopted an allocation system that negated exposure risk. E-SMR does not do this.

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19 These provisions are at of s.60(1)(c) of the Radiocommunications Act 1992 and sit parallel with the provisions regarding procedures for auctions.

20 See footnote 9.

21 Consultation paper on the Spectrum Re-Allocation Declarations at p.4.

22 This really should be a matter of public policy based on a cost-benefit analysis with Treasury input, determined by the Government and given effect by the Minister giving a direction to the ACMA that it use the provisions of the Act at s,60(1)(c) instead of the provisions at s.60(1)(a) [for auctions]. The power of Direction by the Minister is clear and was used by former Minister Conroy, although both the current Minister and I argued this was done inappropriately. It is very clearly a matter of public policy whether to spend taxpayers' money on what will likely be a wholly unnecessary and wasteful auction. Alas, the ACMA seems programmed by rote to use auctions. I write this noting that I am widely known to be one of the loudest public advocates for spectrum auctions. Oh, the irony!

Bidding Limits

A separate dimension to competition policy relates to anti-hoarding and anti-monopoly concerns that are typically addressed via bidding limits.

The Minister may give written directions to the ACMA in relation to the exercise of the ACMA's power to determine procedures to impose a limit on the spectrum able to be acquired by a person.[23] The ACMA is restrained from applying limits unless directed by the Minister to do so. The Minister might make such a Direction after receiving recommendations from the Australian Competition and Consumer Commission (ACCC) and advice from the Minister's Department.

The law is clear. It can be done. The question is whether it should be.

Classic administrative theory holds that if a power is created by law, bureaucrats will want to use it, for what else justifies what they do?

And so, it came to pass, that on 13 August 2020, the Minister for Communications, Cyber Safety, and the Arts issued a media release[24] advising that he had directed the ACMA to implement a bidding limit of 1000 MHz for this allocation.

The decision is mathematically predicated on the 200 MHz allocation bandwidth proposed in the draft instruments. It's therefore predicated on something subject to public consultation.

It is curious that this decision was made in advance of public consultation about the marketing plan concluding (I was granted an extension to 21 August, and the Office of the Minister knows this). Proper consultation processes require rigorous consideration of issues raised during consultation, but if the issues are pre-empted, then what is the point? It's just a waste of taxpayers' money.

I hope this point is well made.

As a free-market advocate, I do not favour market interventions like bidding limits.

I do note, however, that in my time managing spectrum auctions that there was a genuinely held concern about the asymmetric market power of the former monopoly telecommunications provider, Telstra.

We are now 23 years into an open telecommunications market. Telstra has had its business "clipped" in several ways since. It is a publicly listed company. It has reduced shareholder returns and had its share value cut in the market. The "800-pound gorilla" of old seems to have been placed on a diet. On share price alone, it has lost about "400 pounds".

Nevertheless, I accept that bidding limits are a matter of public policy, decided by the Minister on a range of inputs including from the Australian Competition and Consumer Commission who do this stuff. They do competition policy. I do auction policy.

All that I can do is alert competition policy and potential bidders to the traps in various options.

I have described above a mechanism where a bidder seeking 800 MHz may, by default, be forced to acquire a sub-optimal allocations of 200 MHz, 400 MHz or 600 MHz in some areas as a consequence of the exposure problem inherent to the E-SMR allocation system.

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23 S.60(10) of the *Radiocommunications Act 1992*.

24 https://www.paulfletcher.com.au/media-releases/media-release-bidding-limits-set-for-australias-next-5g-spectrum-auction

The mechanism is clear from the rules Determination currently subject to consultation and verified on the ACMA's own systems.

I now describe how a 1000 MHz bidding cap when used with 200 MHz lot bandwidth in an E-SMR allocation sets up the conditions for an **exposure trap** that has anti-competitive outcomes contrary to the spirit and policy intention of applying bidding limits.

The cure is no better than the disease.

I understand from discussions with the Office of the Minister that bidding caps such as 600 MHz, 800MHz, and 1000 MHz were all floated at various times. It was an issue on which my advice was sought.

The 600 MHz option should be summarily dismissed. It would likely result in a failed allocation and leave spectrum unallocated. It is likely that each of the MNOs will seek 800 MHz in the allocation, because that matches the capability of handset chipsets in the mass-market. This is the deployment that offers them the least-cost bits-per-dollar invested in infrastructure.

Quite obviously a 600 MHz cap would prevent the most technically efficient and most likely deployment.

800 MHz Proposal

800 MHz could be supported as a bidding cap, because it is consistent with the dominant 400 MHz channel deployment emerging around the world. It would permit each of the three MNOs to acquire the optimal 800 MHz bandwidth.

It is consistent with the handset chipset specifications.

Larger options than 800 MHz Proposals

Noting that handset chipsets have an RF bandwidth limit of 800 MHz, it is unlikely that an operator will actually need to deploy 1000 MHz or 1200 MHz allocations other than for *anti-competitive* reasons (in a 3-way contest over 2.4 GHz), even though there are carrier aggregations of this size supported in the standards. I note that the standards provide in-band backhaul options from Rel.16 that might justify a requirement for extra spectrum, but my point still holds. If one operator needs more spectrum to support in-band backhaul, then so to do they all. Equally divided, the spectrum supports 800 MHz to each of three MNOs.

Concerns about larger bandwidth also arise from vendor observations of the Rakuten deployment, quoted:

> *Large channel sizes (800 MHz) are really pushing the envelope on what the band can deliver. I don't see anyone interested in 1 GHz channel or above.*
>
> *Co-Channel interference when this stuff is deployed at Street level is also easy to manage. An **extra 200 MHz**, or a double allocation of say 1.6 GHz **offers little benefit**. (my emphasis)*

If an acquisition of more than 800 MHz offers little benefit, then the 1000 MHz cap may force a bidder into a configuration of less than 800 MHz, compromising the bandwidth that this competitor can offer customers.

Spectrum allocations meet the technical definition of a *zero-sum game*. In this allocation, it is proposed to offer twelve (12) x 200 MHz objects and no more. A gain to one must come at a corresponding loss to others.

Any asymmetry provides a clear *marketing* advantage to a bidder acquiring 1000 MHz, whether they can use all the spectrum acquired or not. It is always the goal of anti-hoarding provisions to restrain this market conduct.

For example, the holder of 1000 MHz can produce marketing material claiming that they can deliver more bandwidth than their competitor(s) which will be factually correct in respect of the MNO left with the smallest allocation.

The math to show this is simple. In a scenario with:

- 200 MHz lots
- 12 lots x 200 MHz = 2.4 GHz on offer
- a 1000 MHz cap
- three MNOs competing
- handset technology supporting 800 MHz bandwidth
- opening demand of 5:5:5 (15/12)
- an E-SMR allocation system that prevents aggregate demand falling below supply

then the only possible configurations that can emerge are:

- 4:4:4; or
- 5:4:3; or
- 5:5:2

An opening demand at the application stage of 5:5:5 is typical in a spectrum application process[25] with sensible starting prices. The auction will proceed. It will immediately set an **exposure trap** for the operator that is ultimately left with the residual (3) or (2) x 200 MHz at a budget limit.

Considering that 800 MHz is the RF limit in the handset chipsets, the ratio between the largest allocation and the smallest in terms of deployed bandwidth will be either 4:3 or 4:2.

This presents an obvious asymmetric marketing advantage to the bidder(s) holding 1000 MHz, because they will be able to claim being able to deliver 33% or even 50% more bandwidth to their customers than competitors can. Ouch.

Make no mistake: this potential arises through a defective auction methodology combined with an inappropriate bidding cap. In a true open market setting, the "loser" would be able to walk away rather than be caught in an exposure trap, but at least that would be their business decision.

An open market outcome can only be assured in an allocation design that does not contain an exposure defect. A bidding cap can be applied with much lower risk of adverse outcomes like this by using alternative designs that do not suffer the exposure problem.

Against this background, it is difficult to understand how a bidding limit of 1000 MHz can advance the purported reason of promoting competition policy.

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[25] Applicants typically nominate for everything they can at opening prices because this secures for them the highest number of eligibility points under the E-SMR arbitrary point-based activity rules, and this provides more strategic flexibility.

It seems no less anti-competitive than the results likely in an unrestrained market.

Faced with such a disadvantage created by the **exposure trap**, there is a prospect that one of the MNOs might not even be willing to participate in the allocation.

If the ACMA adopts a 400 MHz lot size as this submission advocates, a bidding cap would need to be expressed in integer multiples of 400 MHz, with the next level at 1200 MHz. A bidding cap of 1200 MHz would permit a 3:2:1 or 3:3:0 outcome amongst the 3 MNOs in addition to the equilibrium 2:2:2 outcome.

The potential outcomes of 1200 MHz raise similar issues of competition policy described above for the 1000 MHz cap, but these are less likely, because the party (or parties) that pursue 3 x 400 MHz will need to pay a substantial price premium for the privilege.

The **exposure trap** seems to create more likely adverse outcomes in an environment of 200 MHz lots and a 1000 MHz cap.

It is not so long ago that an MNO refused to participate in the (failed) first digital dividend auction on a purely commercial assessment. It is also not long ago that a bidder refused to engage the (failed) 5G 3.6 GHz auction because it understood how it would be caught in an **exposure trap** and made the only appropriate commercial assessment available.

It really is a matter for the ACCC to consider whether any acquisition of spectrum greater than the 800 MHz that can be delivered to handsets triggers competition policy concerns in a zero-sum game.

It triggers all my boxes, but I don't work for the ACCC.

The alternative outcome from 400 MHz lots is a 2:2:2 outcome. This neatly maps to 3 x 800 MHz allocations; one to each of the three MNOs that operate in Australia.

Finally, I do not see any need for measures to specifically promote *new* competition in this band because of:

- deployment issues inherent with mmWave which make it problematic for all but the three MNOs and
- mmWave capability being built into mobile phone handsets
- which means it is most efficiently able to be delivered by the three MNOs, and
- "fixed" deployments that may provide some competition in that market segment are most likely to be serviced by the MNOs anyway, because they have the core mobile network capability that can be extended by mmWave as a marginal-cost increment.

Taken altogether, this lends support to my proposal for the Government to reconsider the current process and guide the ACMA to simply allocate 3 x 800 MHz spectrum licences to the MNOs using the provisions of s.60(1)(c) of the *Radiocommunication Act 1992*.

It would waste fewer resources by both the vendor and by prospective bidders, for what is likely to be the same outcome.

Market Areas

Recommendation: that there be just one **national** market defined for the allocation.

The fragmentation into 29 (down from 34) market areas when combined with the E-SMR allocation creates multiple exposure traps. It offers the prospect of inefficient outcomes and potentially compromised business plans for bidders.

Bidders may be left with different configurations in different markets. They may be left with sub-optimal allocations that are not compatible with their business plans.

With 29 markets on offer, the risk is multiplied by 29.

The ACMA proposal is one of the most geographically fragmented markets ever offered by the ACMA or its predecessor organisations, when for so many reasons (such as it being a 5G mobile band) compel the *least* fragmentation.

5G mmWave is part of the *national* mobile telecommunications ecosystem that operates with *mobile telecommunications* handsets held by consumers around the *nation*.

Australia has three (3) *national* MNOs that can leverage 5G mmWave technology as a marginal extension of their existing *national* networks.

For that reason alone, a single *national* market area makes sense.

Background

Noting the limited propagation being observed, 5G mmWave technology is likely to be suitable to be rolled out only in the most densely occupied parts of Australia, for example around the CBDs and the entertainment precincts of major cities. Operators will need to cherry pick carefully where the infrastructure is located. The market areas defined by the ACMA extend significantly beyond these areas, and so the definitions are largely useless anyway. There are cow-pastures within some of the areas.

In my experience, 29 markets will likely be too granular if the ACMA persists with the economically defective E-SMR allocation system. Such granularity can only be supported if the ACMA uses an allocation system where exposure risk is negated.

The ACMA acknowledges in its discussion paper a *frequency exposure risk*[26], without ever acknowledging that the same risk applies in precisely the same way across the other market dimension of area coverage.

This appears to be a lapse of diligence and disclosure by the ACMA.

The exposure risk is the same. It comes from the same theory – it just operates on the second dimension of the two-dimensional market.

Exposure risk is intrinsic to all SMR and derivative allocation systems. It is difficult to avoid.

It is difficult to avoid because bidders may only bid on *component items* of their preference without any guarantee that their full preference can be secured[27]. Business decisions are taken out of the hands of bidders risking their capital.

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[26] See the reference at footnote #6.

[27] The rules of E-SMR provide for partial acceptance or rejection of bids by the vendor.

Combinatorial allocation systems do not suffer this defect.

Here is a hypothetical that illustrates the area-related exposure risk inherent to the ACMA proposals.

> *Imagine that a bidder, ("X") seeks to assemble spectrum nation-wide from the 29 markets on offer. X needs the same amount of spectrum in every market to accommodate the common equipment it proposes to source.*
>
> *X's business case is anchored on acquiring Sydney and Melbourne and then to a lesser extent, the other capital city markets.*
>
> *Noting the propagation characteristics of the band, X understands that without securing these core high-density markets, there can be no business, for only these markets can provide the critical mass to sustain the fixed capital investment required to introduce the technology. The smaller markets will always be marginal-cost increments.*
>
> *In E-SMR, bidders are compelled to bid by activity rules, and once they decrease activity, their eligibility to bid cannot be restored. This means that bidders must develop a "wind-back" strategy, but in an E-SMR allocation, they surrender control over their business decisions to execute that strategy.*
>
> *After a succession of bidding rounds (price-rises), demand stabilises on the smaller regional markets (due to exposure risk and activity rules, where bidders typically junk the low value lots to redeploy their diminishing eligibility to the truly valuable lots). Even as a marginal-cost addition to the network these markets cannot be sustained by everyone. Let's say X continues to "hang-in".*
>
> *At this point of equilibrium, X can no longer withdraw from these lower value markets.*
>
> *After further rounds, enthusiasm wanes for lesser capitals like Canberra – they become too expensive for some other bidders to sustain the marginal-cost capital investment which is predicated on the common infrastructure core where investment is justified by the major markets.*
>
> *Further bidding leaves just Sydney, Melbourne (and perhaps Brisbane)[28]. Bidding continues, but X (like all bidders) is operating within a budget constraint.*
>
> *When X meets its budget constraint, it must leave the auction – it knows when to hold 'em and when to fold 'em[29]. X laments that the business case cannot be sustained at the price levels being set by the auction for the major cities.*
>
> *E-SMR, however, does not permit bidders to withdraw to quit the auction altogether. Bidders cannot withdraw their bids on products if the aggregate demand on these products would fall below the level of supply.*

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[28] One of the observations of SMR auctions and their derivatives is that the most valuable markets tend to resolve last – they are where the "big money" decisions are most critical. This feature should have alerted the ACMA to the defect in the 3.6 GHz auction, because that is the reverse of what occurred for the metro markets. The activity rules (based on arbitrary points) compel bidders to sacrifice eligibility as price rises within a budget, so a typical scale back strategy sacrifices the least valuable lots to the business so that eligibility can be redeployed to sustain the most valuable markets to the business.

[29] This reference should not be taken to infer that I am fan of either kind of music.

X is therefore locked into its holdings in lesser markets, but without the large high-density core markets that make the business worthwhile.

X may be able to stop bidding on the high value/high demand major city markets and have its demand soaked up by the demands of others. It may be able to withdraw cleanly or it may still be caught in an exposure trap on the frequency dimension of the market. Whatever the path to exit, X will be locked in to purchasing the lesser markets where demand/supply is already settled, without having the critical mass of business to justify the whole network capital cost as the most critical part of the business is lost.

This is the "exposure risk" inherent in granular markets in an E-SMR allocation.

It is the same "exposure risk" created by excessively granular frequency blocks.

Granularity in the ACMA offer (*flexibility*) *can* work, but only when using an allocation system that negates the exposure problem.

The ACMA can on the one hand offer fine granularity of allocation units to provide flexibility and contestability, or it can have an E-SMR auction, but it cannot realistically do both without risk to the business plans of all prospective bidders.

Moreover, bidders will have to hedge against this risk, leading to less efficient outcomes overall.

This is the consequence of the intractability of the E-SMR exposure problem.

It costs Australia money.

Unlike some other forms of auction, the exposure risk in the E-SMR design operates on ***every*** cell in the matrix of bands and areas ***independently***. It is possible that the rich granularity of the ACMA market proposals in an E-SMR allocation will render different outcomes from the selection of 0, 200, 400, 600 and 800 MHz across the full range of 29 markets.

What a bloody mess!

If the ACMA persists along its current path, it will risk the same economic failure that plagued the (failed) 5G 3.6 GHz auction in 2018 which likely cost Australia hundreds of millions of dollars.

The simple alternatives for the ACMA are to:

- Continue with E-SMR, but remove the current product granularity to offer just *400 MHz* blocks (consistent with growing international practice and the chipsets in deployment) and *national* markets (consistent with this being an offer as part of a *national* business); or
- Continue with granular flexible market offerings, but instead move to a *combinatorial auction* that negates exposure risk.

The E-SMR allocation system can only serve this allocation (and other allocations) when the exposure problem is mitigated to the greatest extent by offering simplified *product* offerings.

National markets (for national 5G business) avoid complexity in the allocation, including the need to create special rules for certain spectrum bands in certain areas to allow coordination with other spectrum users.

It will be simpler in radiofrequency spectrum management terms to simply specify a geographic area where these special rules apply within a nationally defined area market.

Simplified Assignment

A single national market will greatly simplify the assignment of licences, although the short-range propagation and separation between markets mean there is little need for frequency coordination across market boundaries. A simple price-based packing order solution can be considered for each market in isolation. Easy.

The number of solutions required is further reduced in an allocation with a national market[30] and so expressing preference for one option over another will be so simple that it could probably be consigned to the "back-of-an-envelope" and done once with a sealed-bid second price tender.

Compare this with the voluminous verbiage on assignment set out in the draft *Radiocommunications (Spectrum Licence Allocation — 26 GHz Band) Determination 2020*[31] that are predicated on the ACMA draft Marketing Plan.

National markets for a national mobile telecommunications market make better sense and provide simpler solutions to allocation and assignment. Nevertheless, there will need to be a packing order solution for assignment, even under the option to allocate three licences using the mechanism of pre-determined or negotiated price.

The solution to this problem is simple to express in plain English:

- describe the 6 packing order solutions (there would only be 6 for 3 winners)
- invite them to express their preferences with money – either using a one-shot or ascending price method
- highest valued solution wins, and the winners proportionally pay the second price (which would be inherent to an ascending price approach)

How hard do we have to make this stuff?

Allocation Method

Recommendation: That the E-SMR allocation method proposed for this allocation by the ACMA be *abandoned* and substituted with a more robust method.

It is known to be and shown to be defective due to an intractable economic problem: i.e. the ***exposure problem***.

It should be consigned to history.

Instead, I recommend a simple package bid auction that:

- negates the ***exposure*** problem; and
- negates the ***threshold*** problem attributed to some combinatorial designs; and
- diminishes a problem that I call the ***complexity*** problem which creates voluminous burdensome rules that bidders tend to hedge (if not actively "game") and that then create inefficiency.

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30 The number of solutions is calculated as n! (n factorial). With three winners, there are just 6 solutions. With four winners there will still only be 24.

31 See *Schedule 2—Rules for the assignment stage of the auction* at p.57.

It is no secret that sophisticated bidders around the world engage consultants to advise on complex auctions to avoid the traps created in the rules; rules that so often are created by those same or related consultants.

I offer an alternative design that allows unsophisticated bidders to play on the same terms as everyone else without the need for expensive advice.

This recommendation draws on my 25 years' experience with spectrum auctions as a designer, architect, builder, manager, bid adviser, vendor adviser and critic across both the public and private sectors, and around the world including for organisations like the World Bank.

I describe a robust combinatorial approach derived from theory that has been shown to be *relatively* efficient by experimental economics[32].

Even on the most cursory evaluation, it will be more efficient than E-SMR, noting how the exposure problem has played out in previous auctions, costing Australia hundreds of millions of dollars.

Such a system is available for review in Australia, *today*.

Australia does not need foreign advisers and their systems to be paid for by the Australian taxpayers.

We have fine Universities in this country that teach economics and game theory. We have outstanding software developers walking the world stage (e.g. Atlassian). We have people in this country who have walked-the-walk.

Going for Australian solutions [33] is especially desirable under our currently depressed economic outlook that stems from the COVID-19 virus. Going Australian is consistent with national economic policy exhortations that respond to the crisis.

Surely, we have unemployed people in this country who do some game theory and programming.

Changing allocation design should be possible within the proposed timeline for the allocation (1Q21), although it will require the allocation Determination to be re-drafted and submitted to a fresh round of consultation. On the other hand, there should be no great urgency surrounding this allocation, noting the immaturity of mmWave technology and the issues arising in overseas deployments[34].

There is plenty of time for a root-and-branch review of the ACMA's proposals, and indeed for a wider policy review about whether an auction is necessary at all and whether it could be substituted with an allocation for pre-determined or negotiated price.

Fortunately, the rules behind what I propose as an alternative to E-SMR are simple, easy to understand and will occupy only a portion of the wordage of the complex voluminous rules on an E-SMR system.

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[32] Indeed, one of the co-authors of the theory behind what I propose has been recognised in the field of experimental economics with a Nobel Prize.

[33] "*How good is Australia?"* our Prime Minister, the Hon Scott Morrison MP might proclaim, but this seems not to hold true if you do spectrum auctions at the ACMA where American thought seems to rule. At the training for the 5G 3.6 GHz auction, bidders were briefed by representatives of Innovative Auctions https://www.innovativeauctions.com/. The firm is associated with Professor Peter Cramton with roots in the USA.

[34] A Google search of the term "problems with mmWave deployments" will yield a host of reports.

This is because many of the E-SMR rules and complexities surrounding eligibility and partial bid acceptance are simply not required in the class of design that I describe.

Th proposed alternative method will be simpler for the vendor and for bidders alike. It will be more economically efficient. It will be *much* faster to give a result, because its simplicity allows high numbers of rounds per day from initiation. It negates the exposure risk inherent to the E-SMR system and will therefore allow the continued use of granular product offerings if the ACMA continues to hold this as being necessary.

The design avoids a "threshold" problem that is described in the theory about some combinatorial approaches by providing incremental unit-price guidance. It will allow large and small bidders alike to compete against one another on a genuinely level playing field with low risk to both.

The design allows bidders to simultaneously explore several different trajectories through multiple XOR[35] package bids.

It will be transparent and predictive of price movements for bidders.

It will have simple, easy-to-follow rules that are largely immune to just about every "gaming" strategy that I have ever seen (or used), and I have used a few.

E-SMR does none of these things well.

E-SMR – some background

"Enhanced" SMR inherits from the original SMR that I brought to Australia in 1995 based on the original US FCC implementation.

With theory from the US, I designed, built, and wrote the prototype software for the deployment of the original SMR system in Australia. I translated the algorithms, concepts, and business processes into rules. I managed a series of auctions using the systems until I left the former ACA, so I am familiar with the intricacies of the design, having interpreted it into software code and into the rules Determinations first used in Australia.

Over 25 years I have explored this design, its derivatives, and many alternative designs.

Let's be clear: E-SMR inherits all the flaws and complexity of the original SMR except one; E-SMR separates allocation from assignment which is an improvement (and hence worthy of the moniker "enhanced"). It then adds a flaw or two.

This enhancement solves what the ACMA describes in its consultation paper as "fragmentation risk"[36]. I saw plenty of evidence of "fragmentation risk" in the last auction that I ran for the former ACA. I also applied (with a great deal of vigour) the "fragmentation risk" against other bidders in a later auction as a consulting adviser to earn a happy client and appropriate reward.

E-SMR offers improvement on the fragmentation risk metric, but it still retains all the features that create the **exposure problem** described in the literature, and it retains much of the complexity and rules burden of the original SMR.

This is exacerbated by the complex multi-dimensional product offerings typically created by the ACMA in its quest for ***flexibility*** and market contestability.

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35 These are eXclusive "OR" bids, for example "I want this package, or that package, but not both."

36 p.22 of that consultation paper

The exposure problem has been well known to theory for more than the 25 years that I have been doing this stuff. At the time I started reviewing theory and practice, there was already criticism of the SMR design, and an alternative approach was being advocated (the "combinatorial auction" class). At the time, though, the combinatorial auction class was in its infancy (as too was SMR), and the class was considered by many to be mathematically complex. I felt so too at the time.

Nevertheless, it was understood by theory then, as it is now, that a contingent package bid[37] combinatorial design[38] is required to negate exposure risk.

The exposure problem has been shown in Australia to be a serious a defect in E-SMR, resulting in losses accounting to possibly hundreds of millions of dollars. It demands to be taken seriously.

The ACMA once in the past used a package-bid auction design. The ACMA used an Ausubel-Cramton-Milgrom "clock-combinatorial auction" (CCA) design for the first (failed) digital dividend auction in 2013. The design inherited many mechanisms from SMR favoured by its designers, including an adaption of the original Milgrom-Wilson[39] activity rules used in the US FCC SMR design.

This created an overlay of complexity that compelled bidders to hedge against what I call the "complexity" problem. Not everyone is as clever as a Professor of Economics.

This CCA fell out of favour with the ACMA, yet it is just one design out of the wider class of package-bid combinatorial designs.

It is shallow to tar them all with the same brush.

The CCA used in the (failed) first digital dividend auction was a poor choice then, and when coupled with unhelpful Ministerial interventions[40] it delivered a poor outcome for Australia. One of the major MNOs declined to participate.

These outcomes were predicted in advance, including by the current Minister, the Hon Paul Fletcher MP.

That version of CCA, however, is not representative of the wider clock-combinatorial family of designs. There are other variants.

E-SMR Failure

I was an adviser in the (failed) 3.6 GHz 5G auction held in 2018. This allocation used E-SMR as the allocation method.

As part of the bidder familiarisation using the ACMA's E-SMR auction system and during a mock auction, the bid team detected, verified within the rules, and then tested the effects of the fatal economic defect in the E-SMR allocation method.

This defect would have forced an ultimately non-winning bidder to bid against themselves for what would likely be technically inefficient and even unviable allocations.

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37 all-or-nothing

38 the best combination of bids

39 Named for Paul Milgrom and Robert Wilson of Stanford who described activity rules for US FCC auction. See https://uvammm.github.io/docs/milgrom.pdf

40 Former Minister Conroy, on poor advice, issued a Ministerial Direction to the ACMA to implement an unsustainable "reserve" price that killed demand.

The defect was confirmed by testing using the ACMA's own systems.

The defect is a consequence of the exposure problem written so widely into the literature.

The exposure problem creates a commercial risk to ***every*** bid team.

There was no prospect that the risk could be mitigated within the rules and the system design. The bid team had no option than to retreat to an allocation that it would have been forced by the exposure trap to take anyway, but to do this at starting prices rather than prices that the bidder had bid up.

Consequently, the most valuable markets in Australia, despite being over-subscribed at application all cleared at starting prices:

- the starting price was of the order of **$0.08**/MHz/pop.
- the closing price of less valuable regional markets *averaged* around **$0.74**/MHz/pop.

This points to the true cost to Australia of the economic defect in E-SMR. Consider the value to Australia if the metropolitan markets had been able to be bid to sustain just $0.50/MHz/pop.

This provides a simple warning to all bidders seeking to participate in this 26 GHz auction if E-SMR is used:

> ***You may be forced in an E-SMR auction to take partial allocations of spectrum at prices that you yourself bid up, but that you cannot deploy efficiently.***

In the (failed) 5G 3.6 GHz auction, the E-SMR rule that provides for *partial acceptance* or *rejection* of bids forced all the major metropolitan markets to clear at starting prices. That is a truly perverse outcome, and a genuine economic inefficiency.

The other observable outcome was deep technical inefficiency in a valuable band for Australia's mobile telecommunications development, because the allocation left technically unviable (1 x) blocks in the **two most valuable markets** in Australia.

Technically unsuitable configurations were also allocated in the other capital city markets, including allocations of (6) x and (7) x 5 MHz units, when the bidder sought integer multiples of 4 x 5 MHz = 20 MHz radio channels (i.e. leaving less usable compromised residuals of 2 and 3 blocks).

The outcome was poor when considered against the statutory objectives of radiocommunication spectrum management. The outcome was both technically and economically inefficient when the Act specifically requires "efficiency" as an objective of regulation.

All this happened because the ACMA used an allocation method that contains an economic defect that is rooted in a well-documented theoretical problem.

Extraordinarily, the ACMA acknowledges the existence of this exposure problem in multiple references in its public consultation papers relating to the 26 GHz allocation[41].

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[41] Consultation paper ref: footnote #5, at pp.23,25,27 and
Consultation paper ref: footnote #6, at pp.14,22
It cannot be said that the ACMA does not *know* about the exposure problem.
It just does nothing to overcome it, which is simply bad public policy.

The exposure problem has been meticulously described in the literature at least back to the time that I brought SMR to Australia.

Back then, though, we had few alternative designs to choose from.

Combinatorial auctions were immature.

The Root of the Exposure Problem

The E-SMR design creates ***exposure risk*** because bidders are permitted to bid *only* on *components* of the package they require, yet when they make a bid, they have *no guarantee* they will secure all the components of the package.

All lots are *independent* of one another, with their own demand/supply/price vectors. Bidders, however, may only follow a single evolving trajectory of bidding towards their preferred package with cascading fall-back positions along that single trajectory, where every fall-back raises an ***exposure trap*** at the level of individual markets.

The exposure trap snaps shut when a bid is attempted that would take aggregate demand below the level of supply.

As the trap shuts, E-SMR will *reject* of *partially accept* the bid and then that market is mostly locked-in unless future demand restores.

The proposed ACMA market design creates 29 x 12 = 348 *independent* exposure traps to be faced by bidders. It is a mistake to think that the exposure problem applies to the "market" as a singular entity. Rather, the problem acts independently on every cell in the band vs. geographic matrix.

This not only delivers poor outcomes in the final analysis, but it also forces sensible bidders to hedge against this risk, leading to less efficient (and coincidentally lower revenue) outcomes overall for Australia.

This was demonstrated clearly in the outcomes of the (failed) 5G 3.6 GHz allocation.

As bidders may not be able to fulfil their requirements, they can be left with and be forced to pay for fragment configurations with little business utility and contrary to their business plans.

Who said "Success"?

In bureaucratic tradition worthy of the legendary Sir Humphrey Appleby, the ACMA created a mythology that the 3.6 GHz auction was a success.

It propagated this myth to the Minister who repeated it. [42] [43]

The Minister and his Office have been briefed on this falsehood.

It was not a success.

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[42] "*This follows the successful sale of Australia's first 5G spectrum in the 3.6 GHz band by the Morrison Government in December 2018*." Quoted from https://www.paulfletcher.com.au/media-releases/media-release-opening-up-more-5g-spectrum.

[43] The ACMA used a similar tactic in Senate Estimates Hearings on 29 May 2013 in the face of the (failed) first digital dividend auction. The former Chairman of the Australian Communications and Media Authority said in evidence before the Committee that in relation to the process, the ACMA "…executed flawlessly". See Australia, *Senate Committee Hansard - Environment Communications Legislation Committee*, Estimates 29 May 2013, p.188.

By any objective measure, the auction failed, and it failed against the objectives of radiofrequency spectrum management set out in the *Radiocommunications Act 1992*[44].

There is not just a failure of outcomes here, but also a failure of good governance.

Post-Implementation Review

The ACMA was less than diligent in its post-implementation review (PIR) of that allocation.

Despite being known to members of the auction management team[45], and them knowing that I was advising a bidder, at no stage was I contacted to seek understanding for what was observed in the 3.6 GHz auction.

After the auction closed and after confidentiality obligations had been discharged, I extended an opportunity for an informal briefing with ACMA staff to discuss the existence of the economic flaw in the auction, and to explain how it was detected and how it was verified.

I wrote:

> *We need to talk about auction design, since it will not have escaped you that the current ACMA approach has a substantial and damaging economic flaw.*
>
> *You will have observed this flaw killing the market in all of the major capital city markets in 5G – to a cost of hundreds of millions of dollars to the taxpayer, and to business interests of bidders.*

I received a reply:

> *Thank you too for your views on auction design, I will ensure it* (sic) *is included in the feedback on allocation processes.*

There was never any follow-up.

Case closed.

I was astounded to read in the current discussion paper:

> *Given that the ESMRA format mitigates exposure and fragmentation risks, we consider that it is the more appropriate format for the 26 GHz band*

Let us be clear for the public record:

- E-SMR does **not/not** mitigate exposure risk as evidenced by the (failed) 5G 3.6 GHz auction: and
- It is **not/not** the most appropriate format for the 26 GHz band.
- Staff of the ACMA were offered an opportunity to understand **why** that is the case.
- And they **declined**.

Someone should be held accountable, because another uncorrected iteration with the same problem is now being proposed.

Used in the 5G 3.6 GHz auction, E-SMR created an exposure risk that caused a bidder to withdraw.

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44 See s.3 of the *Radiocommunications Act 1992*.

45 I once led the Team, but 20 years ago, yet some of the faces remained the same in 2018.

If it had not withdrawn, in the E-SMR design, it would have been bidding against itself towards ultimately sub-optimal allocations.

The ACMA has demonstrated a failure to understand, let alone mitigate, this exposure risk[46].

In the discussion paper recommending to the Minister that he make the spectrum reallocation declarations for this allocation, the ACMA wrote:

> *The ESMRA format performed well in the 3.6 GHz auction and participants provided positive feedback on the auction system.*

I find the ACMA's claim **laughable**, and contemptuous of diligent inquiry.

For the public record: The E-SMR formal did **not/not** perform well. It **failed.**

The ACMA has shown itself to be closed to honest feedback like an Ostrich in a sand-dune.

Taxpayers of Australia deserve better from our officials than to forgo hundreds of millions of dollars through poor execution of a theoretically unsound design, and to then mislead Ministers with nonsense claims of success.

Despite clear obvious evidence of something being "off" with the allocation (i.e. the most valuable markets in Australia clearing at starting prices), ACMA has made little effort to explore why that was, and today remains head-in-the-sand about the implications of an economic defect that cannot be overcome in any derivative of SMR.

In frustration at the disinterest of the ACMA to understand the flaws in its methods, I raised the matter in private correspondence with the Minister.

A member of the Minister's personal staff was tasked to explore my allegations. Many pages of detailed briefing on theory and process and about the defective mechanism and how it played out were provided.

At the date of lodging this submission, I have not had any hint of refutation of the theoretical or factual element of my analysis, despite offering the office an opportunity to do so for the record.

I take that as acceptance that my assessment has not been able to be faulted.

Despite this, the ACMA persists with its defective design and offers a complex overly fragmented market specification that only exacerbates the exposure problem.

<sigh>

An Alternative Approach

It would be churlish to "pay out" on the ACMA without offering the prospect of a better alternative for it to investigate.

I stopped advocating SMR-derivative auctions in 2001 and turned instead to explore combinatorial designs. It has taken a while (and a lot of experiment) to find one that appears to work without all the rule-bound hoopla of CCA and E-SMR which goes to create a *complexity* problem that is every bit as severe as any direct economic problem.

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[46] But as noted, this does not stop the ACMA acknowledging this risk in its consultation papers. Don't just talk about it! Fix it!

The design is not perfect, but then it overcomes so many of the deep imperfections and complexities of both E-SMR and CCA that create risk. It is better overall. It is better because it is simpler. It adopts the KISS[47] principle taught in basic systems design.

My embrace of combinatorial designs was triggered by poor outcomes observed in the original SMR system. I saw these flaws play out in the last auction that I ran for the ACA, and I went on to exploit them mercilessly in the first auction where I acted in as an adviser.

The ACMA preference for this E-SMR derivative is not well defended in its discussion papers. For example, the issue of allocation methods was opened for consideration in the earlier discussion paper about the spectrum reallocation declarations.[48]

The discussion did extend to combinatorial auctions but not in any depth.

The ACMA considered and dismissed the "clock-combinatorial-auction" (CCA)[49] that was used for the first (failed) digital dividend auction:

> *Pricing in a CCA is complex, as it uses the Vickrey Nearest Minimum Revenue Core (VNMRC) pricing rule. The price paid by each winning bidder is based on others' bids, with safeguards to ensure winners pay a competitive price. The outcome, however, is that what bidders pay is relatively non-transparent, in that it is not possible for bidders to predict how submitted bids will translate into prices paid.*

I advised in an auction using similar techniques in Ireland and find the criticism valid, but there are other many other criticisms (such as arbitrary points-based activity rules and revealed preference constraints) that I have of this design that make it unsuitable.

This design is rightfully dismissed from consideration.

The ACMA also dismissed a combinatorial design that it called a "Combinatorial Multi-Round Auction" (CMRA) used by the Danish Energy Agency for 1800 MHz spectrum. After reviewing the Information Memorandum for the Danish auction, I concur with the assessment that:

> *The ACMA considers that the application of the Danish CMRA to the 26 GHz band, which may be offered in a geographically and frequency disaggregated manner, may also be highly complex.*

It is a shocker! But then, so is E-SMR!

The ACMA also considered a sealed bid combinatorial allocation:

> *The sealed bid combinatorial auction format is likely to be only suitable in a relatively simple auction where the number of lots on offer is relatively low, so that the number of possible combinations of lots requiring bids is feasibly low. In addition, it is likely to be suitable in*

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47 "Keep it simple stupid" attributed to the famed Kelly Johnson of the Lockheed "Skunk Works"

48 This appears at pp.21-25 of that consultation paper, reference footnote #5.

49 The "CCA" design used by the ACMA as it evolved has its roots in Ausubel, Lawrence M., Peter Cramton, and Paul Milgrom. 2006. *The Clock-Proxy Auction: A Practical Combinatorial Auction Design*. In Combinatorial Auctions, edited by Peter Cramton, Yoav Shoham, and Richard Steinberg, 115–38. Cambridge, MA: MIT Press. The ultimate design came to be known as a "clock-combinatorial auction"
Nevertheless, the design that I favour by Porter, et.al. is also described in the literature as a "clock combinatorial auction" because that is how it functions.

scenarios where the benefits of price discovery are limited, and there are large risks associated with open ascending auction formats.

That's it.

That's the full extent of ACMA's review of combinatorial allocation methods[50].

In my reading of the ACMA's review of combinatorial designs, I noted that it ignored the work of other theoretical schools that I favour, including a design proposed by Porter et. al.[51] which is also described in the literature as a "clock combinatorial auction".

Overall, the ACMA's review of the literature of design for combinatorial auctions lacks depth.

Dr David Porter[52] is a respected contributor to experimental economics and combinatorial auction theory whose designs have been used widely in practice.

One of the co-authors is Dr Vernon Smith[53], a Nobel Laureate in experimental economics.

It is a curious oversight by the ACMA to ignore the work of such distinguished scholars.

I appreciate that it would be an exceptionally long consultation paper to review every design by every theorist in the field, especially noting an explosion of interest in this field since the 1990s, but to ignore a design class and the work of respected scholars in combinatorial theory seems to be a lapse by the ACMA.

Similarly, there are no references by the ACMA to theory and designs that have emerged from the Caltech "school" associated with theorists such as Professor John Ledyard[54] and associated scholars.

The Porter et. al. design was reviewed by Charles Noussair[55]

> *The auction is not cognitively burdensome for bidders[56], who merely send a series of "yes" or "no" messages[57]. The computational burden is light in that solution of integer programs is required only in some cases. Combinatorial bidding overcomes the exposure problem. The fact that prices are posted rather than bidders submitting bids minimizes the communication possibilities between bidders. The pricing of each individual item avoids the threshold problem. The experimental results indicate a strong tendency for the process to generate*

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50 See this single-page review at the reference in footnote #5, p.24

51 Porter, D. Rassenti, S. Roopnarine, A. and Smith, V. (2003) *Combinatorial auction design*, Proceedings of the National Academy of Sciences of the United States of America, PNAS September 16, 2003 100 (19) 11153-11157; https://doi.org/10.1073/pnas.1633736100

52 https://arlingtoneconomics.com/people/david-porter-ph-d/

53 https://en.wikipedia.org/wiki/Vernon_L._Smith

54 http://www.its.caltech.edu/~jledyard/

55 Noussair, C. (2003) *Innovations in the design of bundled-item auctions*, Proceedings of the National Academy of Sciences of the United States of America, PNAS September 16, 2003 100 (19) 10590-10591; https://doi.org/10.1073/pnas.1934705100

56 From my experience on bid teams, the CCA design and the E-SMR design used in Australia are deeply **cognitively burdensome**, in that they require not only an understanding of the current bid, but also the strategy required to evolve the bidding trajectory into preferred packages at every price level and budget constraint into the future. The Porter design negates cognitive burden. Any compromise in efficiency (if there is any able to be shown in the Porter design) is more than compensated by avoiding the risks generated by complexity and cognitive burden.

57 In my adaptation of the core design to provide for quantities of products rather than singular items, binary "yes/no" decisions are substituted with integer decisions and some adaptions are made to fit.

efficient outcomes. The work provides an illustration of how economic experiments can be used to develop systems for use in actual practice and how such development proceeds by devising techniques to mitigate weaknesses of previous designs.

It is high time that the ACMA devised some "…*techniques to mitigate weaknesses of previous designs"* such as the exposure problem.

There is no better candidate for such *mitigation* than E-SMR.

It is best mitigated by being junked.

In terms of test-bed exploration of the Porter design, modified to reflect allocation of quantities of items rather than units, it is probably the simplest design I have worked on in my 25 years in this business.

It is a simple design for everyone, and as Noussair notes, experimental results suggest efficient outcomes.

A briefing, together with a demonstration using live systems on a developmental test bed (in Australia), is available to the ACMA Statutory Office holders by appointment. I'll even configure it to emulate the ACMA market design.

The design is very much "what you see is what you get".

Bidders can explore different potential strategies (packages) in *parallel* because multiple XOR package bids are permitted. In contrast only a single bidding trajectory[58] is permitted by the E-SMR and the CCA designs used by the ACMA. A single trajectory complicates the creation of fall-back positions along that trajectory due to the risk of exposure traps as prices rise.

Pricing is transparent in that it is set by the vendor and announced to bidders, and bidders have no control over it at all. In my interpretation of the design, prices are set programmatically by an easy-to-understand algorithm that offers forward predictability and certainty so that the price doubles each day if there is demand to sustain it, and no matter how many rounds are scheduled to be conducted during the day[59].

The only permitted bidder response to price is to nominate integer quantities of products in each package they wish to define. The total price of each package is calculated and there is no bidder variation of that calculation permitted.

Bidders can theoretically bid for as many packages as they wish[60] at a set of prices in a round.

All packages are contingent package bids – if the package is a winner, then everything in the package is awarded. If it does not win, there is no award and therefore no cost to the bidder. This mechanism completely **negates the exposure problem**. It also negates all the attendant convolutions of rules.

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58 Only one expression of a package is permitted per bidding round in an E-SMR and the CCA previously used here, although the package can be amended during the round.

59 It is a simple inverse compound interest formula, to yield a percentage rate.

60 There can be a practical limit to this, due to the compressed bidding schedule. Bidding decisions are so simple that a compressed schedule of up to 32 rounds per day (one every 15 minutes) is possible. The business assessment for bidders is simple – "can I afford this package at these prices, or not?". Note also that there may need to be a rule-based limit, but the need for that should be tested experimentally.

There is no risk faced by bidders in not securing everything they need to make a business at a known price.

As Noussair notes, complexity is restrained by only applying integer problem solving in limited circumstances[61].

There is no need for activity rules for they make no sense, and therefore there are no points, and therefore no gaming strategies enabled by the arbitrary point-based activity/eligibility system used in E-SMR. There are no rules needed regarding points-loss and eligibility limits. Activity rules would be pointless, because multiple package bids per round may be of different sizes and points-value. For example, a bidder might describe different packages for A, or B or C as standalones, plus AB or AC or BC or finally ABC. Measuring activity makes little sense. It's not needed. There are other mechanisms to assure bidding and disclosure of intent without opening destructive price-running against competitors.

This highlights another weakness in the E-SMR design that has been previously brought to the attention of the ACMA. It relates to arbitrary points-based eligibility. The points-based activity rules in E-SMR must logically diverge between market-price differentials and points-based differentials because prices scale exponentially while points remain constant. This divergence creates the perfect environment to "park" eligibility and thus manipulate price and demand as a *gaming* strategy.

I know this because I have been part of a bid team that has used the technique to good effect.

Past submissions to ACMA that I drafted for a client offered that a better way to overcome this is to use a simple cash-based eligibility model where eligibility is determined by true market relativities, rather than arbitrary points relativities. I have tested the approach and it works well to "keep bidders honest" within the theoretical objectives of the Milgrom-Wilson activity rules.

Given the flaws of E-SMR as evidenced by the (failed) 5G 3.6 GHz auction in 2018 and the predicted issues if E-SMR if used with an unnecessarily granular product offering, it is time to move to a simpler and more effective designs.

The ACMA may be compelled to persist with E-SMR[62], but to avoid the outcome failing in the same way as the 5G 3.6 GHz auction, it would be better to move to 400 MHz lots and national markets.

If, on the other hand, the ACMA feels it necessary to offer market granularity to advance its competition policy goals, then the ACMA will need to adopt an allocation methodology that can avoid the exposure problem.

That means it needs to seriously consider moving to a contingent package bid auction design such as I propose.

It's a simple choice.

A better way is achievable.

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61 Integer problem solving requires assessment of 2^n-1 combinations of all bids, so it does require computing horsepower. Fortunately, there are some optimisation strategies like "greedy" stacking that reduce the number of combinations that are critical to assessment. These significantly reduce the computing burden. Some designs require integer problem solving at every round. This design circumvents that.

62 For reasons that are obscure to me.

Potential Criticism of the Design

There is a potential criticism of the design that flows from my interpretation. The criticism is that it is possible that progressive award might be made at different *unit* prices.

I think the criticism is ultimately misplaced, but it is worth reviewing and is opened for review.

The criticism has its origin in the FCC rejection of the RCA satellite transponder lease auction in 1981 conducted by Sotheby's (New York). The auctioneer used an English Open Oral Outcry auction for each of the seven (7) leases on offer, in sequence. As predicted by theory, the first object sold to the bidder with the highest valuation; the second to the bidder with the second highest valuation and so on.

The prices (US$) obtained were (in order of allocation):

- 1 TLC $14,400,000
- 2 Billy H. Batts $14,100,000
- 3 Warner Amex $13,700,000
- 4 RCTV $13,500,000
- 5 HBO $12,500,000
- 6 Inner City $10,700,000
- 7 UTV $11,200,000

The FCC ultimately held that the prices were discriminatory, and this violated the FCC common carrier regulations[63].

In the proposed design, an award may be triggered when demand is less than supply on some lots, and when there is no surplus demand on any lot (which would simply trigger a price rise on the offending lots leading to fresh round without a solution being attempted).

When the trigger is met, an attempt is made to make an award. The process calculates an integer problem solution from active bids. An award then takes place for a package if and only if it is included in both:

- the list of bids in the current round; and
- the integer problem solution (IPS) that resolves the best combination from all active bids.

If there are no bids made in the current round that are included in the IPS, then the prices on those new bids are logically not sufficient to displace packages in the IPS and so those bids should be subject to a price-rise in the next round. That's what I do, anyway.

If an award is made, however, it reduces the residual quantities available, and this may be to a non-zero amount. Since the price at the time of award is already set to a level where demand has just triggered to be less than or equal to supply, the current price is unlikely to solicit new bids for any residual amounts if it is maintained.

To deal with this issue, prices are reset to work with the new residual quantities, using a "bot" to replay all bids made so far in the auction, rejecting those that breach the new quantity constraints

[63] For a reporting of the issues considered by the FCC, see: https://worldradiohistory.com/hd2/IDX-Business/Magazines/Broadcasting-IDX/1982-Broadcasting/1982-02-01-Broadcasting-Page-0031.pdf

and processing each round in sequence to test whether to apply price increases as would be done round-by-round anyway.

It follows that at the next award, there may be an entirely different collection of price vectors informing unit prices.

Considering the mechanism that is described, there are three refutations of the concern that might flow from the RCA case:

- item prices are irrelevant to the award, because the award generated by the IPS is based solely on the package price relative to other packages and their prices, and not item prices; and
- item prices are simply an information sharing mechanism to defeat the threshold problem– not a determinant of combinatorial outcomes; and
- the rolling series of progress awards can be viewed as a separate collection of discrete sequential auctions that each result in an award.

On balance, there is little reason for the concern of the type that arose in the RCA outcome, but that is subject to review.

Finally, there are many other combinatorial designs around.

All designs should be rigorously evaluated against simple public policy design goals.

I think the most appropriate public policy design goals for a useful design are:

- Simplicity - to lower complexity risk
- Outcomes that display both economic and technical efficiency
- Combinatorial resolution of contingent packages - to negate the exposure problem
- Provision of appropriate information to allow efficient packages to be described by bidders – to avoid the threshold problem.

The design that I describe meets these design goals.

The E-SMR does not.

The ACMA needs to find a better way than E-SMR.

It really is that simple.

Bureau-crazy

Recommendation: The ACMA modernise its business processes, cut the red tape, and align to best practice for the digital age.

Processes should be updated to reflect COVID-safe protocols.

Background

The ACMA's business processes need modernisation. A good dose of administrative prune juice is needed to ease the bureaucratic constipation.

Unnecessarily bureaucratic process cost Australian taxpayers money.

I see so much of the business process today that I implemented at the very beginnings of this business around 25 years ago, yet the world is now on its second "tech" boom.

It is like travelling back through a twisted time-warp to revisit what the ACMA continues to do.

The business processes are replete with bureaucracy worthy of Dickens and suffer bloat, complexity, redundancy and paper-shuffling d'extraordinaire.

Many of the processes are "belt-and-braces" when a "belt" will normally be sufficient to hold up trousers. I see an Emperor with no trousers.

All this bureaucracy might be great for keeping officials in work, ticking compliance boxes and shuffling reams of paper around the office, but seldom considered is the cost on business or the poor hapless taxpayer.

Seldom considered against bureaucratic inertia is how things might be done better.

Let's at least start that debate. The Ship of State won't change course unless you put some force on the rudder.

After serving 20 years in government and understanding its limitations so well, and then another 20 consulting in management and technology, perhaps I may be of assistance?

The processes used by the ACMA today are ill-fitting a modern ***communications*** and ***technology*** bureaucracy and the holders of Statutory Office should be embarrassed.

This issue holds urgency in the age of remote working brought about by the COVID-19 pandemic.

In the (failed) 5G 3.6 GHz allocation our bid team included principals from London and advisers from Prague, Sydney and Canberra, plus a firm-load of Sydney lawyers all assembled for a time in Sydney.

The norms of today mean that we could no longer work as we did. We'd work from home. We'd teleconference. We'd share documents electronically.

We were mostly doing that anyway, except for the ACMA's forms and training and mock auctions.

There were ten (10) separate forms defined for that auction. Together with their instructions for completion, they filled a forms document that was ***ninety-seven (97) pages*** long.

All these forms had to be completed to comply with reams of rules with the execution needing to be witnessed and overseen by legal advisers.

Ninety-seven pages!

All the ACMA forms for that auction were based on paper, requiring them to be printed and to be signed with pen-and-ink. Most were required to be witnessed by another person.

For a document to be witnessed, two-people need to be in proximity, and both are required to handle the document. That is inconsistent with COVID-safe protocols. The virus can purportedly live on paper for up to four (4) days[64].

While COVID-19 creates its own imperative, we are also in the 21st Century.

In the 21st century, we use *web-forms* and *digital signatures* to collect and verify information.

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64 https://www.healthline.com/health/how-long-does-coronavirus-last-on-surfaces#different-surfaces

In a digital signature model of authentication, when a private key is issued and validated (just once), signatures *never* need to be witnessed, because the mathematical validation of the key serves both as the witness and a mathematical proof of authenticity.

The ACMA might retort that some of its required documents have minimum legal requirements for proper execution.

I say in reply: ***get better lawyers*** and get their help to design ***better systems*** that are independent of these bureaucratic strictures.

Pen-and-ink for centuries has been known to be prone to forgery and fraud. Digital signatures are mathematically improbable to forge when private keys are properly protected[65].

In my systems I use the secure and efficient Elliptical Curve Digital Signature Algorithm (ECDSA) with keys of 256 bits in length. I derive random private keys from the Australian National University's quantum random number facility[66].

From a quantum-based genuinely random private key I can generate the unique corresponding public key using the elliptical curve algorithm, and from that public key, I can create a unique public address. The address cannot be reverse engineered to the public key which in turn cannot be reverse engineered to the private key. The public key can be extracted from the signature and the digest of the signed artefact. The public address can be calculated for the public key. A valid match to a person's address that is recorded provides proof of authenticity of the signature.

No rocket science here; just math.

A public key address can be linked in a database to a personal identity that can in turn be authenticated using an on-line identity validation system. This does not need to be separately witnessed with a piece of paper, because the on-line identity check serves that purpose. On-line identity verification services use data-matching available from sources including Australian Government data including the Australian Passport Office. These processes are used by some financial institutions to provide "100 points" of personal identification in a simple on-line process.

Against that background, every document associated with an auction can be created and personalised as a digital document, with data fields populated from collected data. A cryptographic hash or "digest" created from the data can be signed with a private key known to have been linked to a validated identity via its public key address.

The signature on that specific document cannot then be refuted (within the bounds of 256-bit probability).

This is a much more robust approach than pen-and-ink.

The technology is widely and freely available.

The techniques are well known and documented.

The ACMA needs to step up to the 21st Century. It needs to embrace contemporary business processes offered by current technology.

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65 I use KeyPass password safes and AES protected memory sticks to protect my keys. Both allow protection using strong AES-256 encryption. AES-256 has been approved for protecting material up to Top Secret by the US National Security Agency, subject, of course, to secure implementation.

66 https://qrng.anu.edu.au/

Contemporary techniques need to be reflected into improved business processes, so that forms can be adapted to web-based data collection that is validated using digital signatures.

Secure exchange of authenticated data will allow COVID-safe protocols to be observed by limiting personal contact between people and the transmission of viral material on paper.

Demonstration of some of these techniques is available to the Statutory Office holders of the ACMA by appointment.

The Forms Collection

What follows is based on the Forms required for the (failed) 5G 3.6 GHz allocation.

There were ten (10) forms.

The key to modernising the business processes is that forms are always filled in and signed by a natural person, even when the form is executed for a corporate entity.

The ACMA's business processes must firstly be designed around system-based recognition of natural persons.

A web-based system to capture a data for a natural person is trivial, with data including things like name, address, email, telephone etc. This can all be done on-line, and the data maintained in a database. Access to systems by a natural person can then be limited by username, password, and a robust two-factor authentication system.

None of this is challenging. It is also easy to demonstrate.

Identities of natural people can be verified on-line using identity validation providers such as GreenID[67]. These provide the equivalent of bank-grade personal identity verification ("100 points").

Once a user is "known" and independently validated, the person can be allowed to escalate their privileges on a business system so that their personal identity can be linked to a corporate entity as an authorised representative of that entity, subject to some simple further checks described below.

The identity of companies in Australia can by validated on-line by reference to their Australian Business Number (ABN)[68] using application programming interfaces (APIs) that connect directly to the Australian Business Register (ABR) using machine-to-machine data exchanges. This can all be done on-line, keyed by ABN to return company details that can be compared with those entered.

For Australian spectrum auctions, many customers will also be *returning customers*, and so are already registered by the ACMA in its Register of Radiocommunications Licences.

As a matter of general principle, when an entity interacts with a government agency, its details should be captured just once.

Multiple repeat handling of the same data is wasteful and inefficient.

Linking a verified natural person to a corporate entity is the first and only point where a legal requirement for a *paper* form *might* be useful[69]. This would be a form executed by officers of the

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67 See https://www2.gbgplc.com/apac/greenid for an example of such a service

68 https://abr.business.gov.au/Tools/WebServices

69 I note that nothing would prevent requiring corporate office holders (Directors and the Company Secretary) to create a verified personal identity on the system to be linked to their corporate position and for them to hold a signature key pair. None of this is difficult.

corporate entity that authorises a natural person to act on behalf of that entity. The authority could be revoked in the same way.

A legally binding link between a natural person and a corporate entity could be achieved with a single A4 page (with pre-filled data), to be executed in accordance with the Corporations Law by company officers. The form would list the natural persons authorised to act on behalf of the entity and the public key address of a key set issued to each natural person, so that any actions in the name of the corporation digitally signed with the corresponding private key would be irrevocably linked to the corporate entity via that person.

This is just one single A4 paper form executed by Officers of the company applicant and maintained for the record. It could be done as a Deed.

Wear rubber gloves and dispose after use.

An authorised person can then be granted elevated privileges on systems so that they can authorise other natural persons to have bidder privileges on behalf of the applicant, and this too can be done with an on-line process including a digital signature of the approval to be stored for audit integrity.

Again, none of this is especially difficult. It's what I do on my systems.

Further, if the ACMA wants to step out to be truly hip and cool, it could create tamper-proof audit trails using a block-chain. This is not science fiction. The techniques are in use today. It's basic math.

By creating a model like this, applications for spectrum auctions would be able to be completed for multiple successive auctions by authorised persons without voluminous wasteful paper forms.

Applications would instead be able to be pre-filled from the data held on record in a significant efficiency and reduction in double-handling.

All documents (including, for example, invoices) relating to the auction could also be prepared as web-forms with data pre-filled from the data records held by the ACMA and sent as electronic documents in *.pdf format.

This is technology in widespread use today.

This model provides the foundation for significant efficiency improvements in the handling of forms associated with auctions.

This will reduce handling costs for bidders and the ACMA alike.

Application Form (Form 1)

The Application Form is the first simplification that can be made by transitioning to web-forms.

When the application form for an auction is called by a logged-in natural person linked to a corporate entity, the application form would be prefilled with personal and corporate data already held on the system database.

The data can then be assembled into an XML[70] digital form. The XML form data could be passed through a digest algorithm such as the cryptographically secure 256-bit Secure Hash Algorithm (SHA-256).

[70] eXtensible mark-up language. The advantage of XML is that it is both human and machine readable.

The digest could then be signed with the person's private key, with the signature returned to the database and stored with the XML data.

This part of the application form would then be complete, and the nation's forests been saved eight pages of paper.

It is highly secure against tampering and fraud.

Deed of Acknowledgement (Form 2)

The deed of acknowledgement is intended to provide an enforceable undertaking to abide by the rules of the process and it provides a legal mechanism to enforce pecuniary penalties that are applied under the rules in the event of forfeit.

This too can be done simply as a web-form pre-filled with the details of the applicant entity and authorised person. In this case, the approach would be to take the SHA-256 digest created from the application form and hash this against the SHA-256 digest of (say) a *.pdf of the template Deed document, with the resulting hash signed by the applicant's authorised representative using that person's private key.

The form would be digitally signed by the person and "witnessed" by the mathematical proof of the algorithm. The digest and the signature would be saved to the database and can be validated at any time.

There is another fifteen (15) pages saved for our nation's forests.

Deed of Confidentiality (Form 3)

This form is for the most part a belt-and-braces duplication of other measures. Deprecating the requirement will save 7 pages of paper for every person required to complete one. The requirement in the ACMA rules extends to every person who is registered as a bidder and to external advisers; – basically to any natural person who can have knowledge of any matter pertaining to bidding intentions.

However, it is normal in any employment relationship for employees to have a confidentiality obligation. Many organisations require that a breach of this would be *prima facie* grounds for dismissal.

Consulting advisers (like me) also inherit confidentiality obligations to their clients that are almost always contained in a non-disclosure agreement.

Surely, it would be sufficient to require in the rules of the auction, acceded to via the Deed of Acknowledgement, that the applicant must require a confidentiality agreement with all these people and ensure that all of them understand that matters related to the conduct of the auction is confidential information for the purposes of their employment or engagement.

The Deed of Acknowledgement above could be used to specify the minimum terms required.

Why is this not sufficient?

Statutory Declarations (Forms 4 and 5)

These Forms account for 14 pages of A4 paper.

At issue is a declaration regarding affiliations with other applicants or other licensees that have a licence that is relevant to the bidding limits set for the allocation.

The legal requirements relating to making and witnessing a *Statutory Declaration* cannot be met in the on-line context[71].

This opens a question as to whether this is the correct or even a necessary instrument (see below).

The form requires a person making the declaration (a Director) to declare that:

> *I have made my own reasonable inquiries into the identities of the associates of the new applicant, and into whether the new applicant is affiliated with any other applicant or existing relevant band licensee (within the meaning given that term by the Allocation Determination).*

This opens to question what are "reasonable inquiries".

For example, might it have been a *reasonable inquiry* for the Statutory Officers of the ACMA to question staff about the economic defect in the E-SMR system that was manifest in the (failed) 5G 3.6 GHz allocation, and is now being repeated in draft statutory instruments that the *Radiocommunications Act 1992* requires these officers will enact as delegated legislation?

<just asking for a friend>

I think this alone highlights the issue with a *reasonable inquiries* test.

Moreover, it should be a matter for the ACCC to make its own *reasonable inquiries* as to whether there is evidence of a potential breach of the competition policy framework for the auction. The ACCC has access to the corporate details of applicants and access to data-matching capability across a range of Australian Government databases including the public Australian Business Register and the various publicly searchable registers maintained by the Australian Securities and Investments Commission (ASIC).

As noted below, there is a real question as to whether a Statutory Declaration is a necessary instrument for the purpose, and if not, then surely a single multi-purpose digitally signed form will serve the requirement.

Deed of Financial Security (Form 6)

This form accounts for 9 pages of A4 paper.

This form is typically completed by a bank to provide irrevocable financial security over a default by an applicant.

Here at last is a form that might have some use, *except that …*

… the mechanism goes back to early auctions from 1995, now 25 years ago.

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[71] Australia does not permit an electronic signature for a Statutory Declaration. See: https://www.ag.gov.au/legal-system/statutory-declarations/complete-statutory-declaration

Surely it is not beyond the wit of the financial service sector to invent something a little more contemporary and immediate, for example based on smart contracts, or even requiring funds to be on deposit in a trust account.

There are instructive examples for good process from other types of market.

If one attends an auction for a house, a deposit is usually required on-the-fall-of-the-hammer. The deposit is typically 10% of the sale price and is required in cash, bullion, bank cheque, or some other bearer-instrument that cannot be repudiated.

A spectrum auction should be no different. When the auction closes, a deposit of 10% should be required on the fall-of-the-hammer (i.e. immediately the auction closes).

The best way to do this is to assure that cash is held in a vendor trust account to cover the deposit. This is directly analogous to a bank cheque, where a person's money or their pre-negotiated loan is transferred to the bank's operating account (a trust) so that the bank may honour its own bank cheque.

A bidder would need to lodge funds (from a loan or from its own cash) to do this, irrespective of any Deed of Financial Security, because the call on funds should be *immediate* for winners on the fall of the hammer.

Implementation of a model to do this is comparatively simple:

- It would need a rule in the auction design that a bid with a value greater than 10x of the funds held in trust will be rejected.
- Another rule would provide that bidders would be allowed to "top up" their funds-in-trust to enable higher bids to be made as they approach the limit.
- The final piece of the puzzle would be to provide some forward predictability about price movements over the course of a bidding day.

Banks provide access to real-time gross settlement (RTGS) between banks and accounts. Bidders can make a transfer from their bank to the vendor trust account at virtually any time during banking hours.

Simple. Fixed.

Statement about affiliations for winning bidders (Form 7)

This form accounts for five A4 pages.

The purpose of the form is to provide another pair of braces to the belt and braces already provided by Forms 4 and 5. It goes once again to matters of affiliation between winning bidders and with relevant licensees.

This form, however, is executed as a witnessed form, rather than as a Statutory Declaration like Forms 4 and 5.

This raises an immediate issue of consistency: why is there a need for Statutory Declarations for Forms 4 and 5 when this form serves what is essentially the same purpose at a far more critical time in the allocation process just prior to the award?

The Form uses words that express a similar intention to the other forms, albeit in terms of "winning bidders" instead of applicants.

I have made my own reasonable inquiries into the identities of the associates of the Winning Bidder, and into whether the Winning Bidder is affiliated with any other winning bidder at the auction and whether the Winning Bidder is affiliated with an existing relevant band licensee.

Surely it is not beyond the wit of the lawyers at the ACMA to create a single multiple-purpose form, even if a form is considered necessary for this purpose.

If statutory declarations are not necessary, then a simple single multi-purpose web-form can be prepared with pre-filled data and digitally signed by the approved representative of the applicant in the same way as other forms. This will reduce Forms 4, 5 and 7 to one digitally signed certificate.

Simple.

Nevertheless, it should be the ACCC that is making its own *reasonable inquiries* to the extent of any affiliation.

The ACCC has access to company data and has its own powers of inquisition to do this. It is an intervention that should only be triggered only when there are grounds to believe that there is an association.

Associates forms (Form 8 [Corporate Entities] and Form 9 [Individuals])

The forms extract 14 x A4 pages from the national forest for each applicant, yet all are amenable to web-based data collection and storage in a database.

To the extent they need to be digitally signed, it is trivial to construct a Merkle tree[72] of the digests of each separate data element and have the Merkle root offered for digital signature.

The process could be further simplified by the ACMA publishing a data schema to allow the applicants to prepare the data in a standard template form (say in XML) to upload to the ACMA servers, rather than manually filling out web-forms, or worse, paper forms as is currently required. A completed XML data structure conforming to the schema could also be subject to a SHA-256 hash and signed as an alternative to a Merkle root.

There is, however, a more fundamental issue.

The people and organisations that have the resources to participate in spectrum auctions typically have substantial capital backing and are normally registered as either a public or private company. They will typically have an ABN to participate in the goods and service tax regime.

Form 8 starts by seeking details of office holders (Directors and Secretary) of the applicant entity. This data is already available from existing publicly searchable data resources, for example the register of companies maintained by ASIC.

For publicly listed companies, this is often published on the entity website but on the public share register. Details of statutory corporations are obtainable from public resources, but there are real issues about whether statutory corporations exhibit a competition policy risk. For public companies, I note that there are also rules regarding continuous disclosure of significant shareholdings to the Australian Stock Exchange (ASX).

[72] https://en.wikipedia.org/wiki/Merkle_tree

This form seeks information about related bodies corporate, and their office holders as well, expanding the volume of paper needing to be lodged with the ACMA.

In an auction that I once managed for the former ACA, one applicant delivered two (2) full-to-the-brim lever arch files containing details of its related bodies corporate, most of which were domiciled off-shore and which in turn had other relationships in the international market.

Establishing a chain of relevance in all this documentation to the Australian spectrum auction's bidding caps was spurious make-work for bureaucrats, when on the very plain face of it, there was no link between that bidder and any of the other bidders in that auction. They were then (and remain today) competitors, no collaborators. It was compellingly obvious there was no link, yet the insatiable desire of bureaucracy to do bureaucratic things, paid for by taxpayers, triumphed.

I am sorry to have once been a party to that sham. Taxpayers deserve better.

A simpler approach to all of this would be for the ACCC to make its own *reasonable inquiries* only if there are *prima facie* grounds in the applicant list to suspect that an association for the purposes of circumventing the bidding limits needs to be explored further.

Isn't that how the law normally works?

I argue that for Telstra, Optus and TPG Telecom (all of which are natural competitors for market share) to engage in collusion with each other to circumvent the bidding limits is a hard proposition to sustain.

They should not be required to participate in this bureaucratic mass-debating.

It then is left only for the ACMA/ACCC to investigate any *new* bidders, and then only if they give rise to a *prima facie* assessment of an intent to circumvent bidding limits.

I worked with a new entrant bidder to the Australian market in 2018, and on even the most cursory investigation this bidder was clearly not a stalking horse for any party in the subversion of bidding caps.

If one considers the identity of the past applicants in spectrum auctions in Australia, it is rare for potential circumventions of the bidding limits to be seen anywhere. It is only if they are that *reasonable inquiries* should be initiated by regulators.

There should not be a blanket catch-all regulation which is wasteful of both bidder and government (i.e. taxpayer) resources.

Moreover, once an auction is completed, trading of licences is permitted by law and can only be restrained based on the "substantial lessening of competition test" in wider competition law.

I know of just one example where bidding limits were set (with limits placed on Telstra) and where the identity of an applicant was deliberately opaque (for reasons unrelated to bidding caps). The applicant was a sole Director company, with a paid-up capital of $2.00, and the Director and Shareholder was a Partner of a law firm specialising in Corporations Law and where any investigation beyond that shareholding was protected by Legal Privilege. It had no related bodies corporate. It was not affiliated with any other bidder. It said so.

I note here that the very clever and very honourable lawyer behind it would have been in trouble had he breached privilege or lied.

Whatever the case, when a form is required, it can be easily pre-filled for the applicant from data and presented to a natural person as a web-form with the data representing the artefact being signed.

The data, the digest of the data and the signature of the digest are saved to the database.

Simple.

Eligibility Nomination (Form 10)

Here is another 12 pages of A4 paper potentially saved in our national forest.

This form is required firstly to define an opening bid and then for the purpose of satisfying the suite of rules in an E-SMR auction related to the activity rules and eligibility using an arbitrary points-based scheme. These activity rules follow the general model of the Milgrom-Wilson activity rules.

In other auction designs, including the one I advocate, these rules are deprecated.

Nevertheless, this form does serve as an "opening bid" – an initial declaration of opening demands - from which a decision to proceed with an auction (or not) will be made.

As such, the form can and should be completed as a web-based form. Indeed, in my own systems development it is, and it replicates the general bidding web form. The opening bid in an E-SMR auction variant will require some additional behind-the-scenes calculations to sum the eligibility points and calculate the amount of the eligibility payment.

Nevertheless, this is simple arithmetic; it's school kid programming.

As noted above, I believe it is time to dispense with a fixed eligibility payment and instead move to a floating performance bond that can be topped up by applicants at their own discretion to authorise their higher levels of bidding.

I advocate dispensing with the arbitrary points-based rule for eligibility used in the E-SMR system and move instead to much more rigorous (yet simple) cash-based eligibility if E-SMR is to be continued.

Of course, E-SMR should not be continued and all those rules with it.

In the alternative model that I propose, on the fall of the hammer, the 10% deposit of winning bids would be transferred *immediately* from trust to auction proceeds, and from there would be non-refundable. The amount then serves as a default penalty if the bidder defaults, or a credit to the final invoice when the full amount is honoured.

Refunds of deposit for non-winners can be processed immediately from trust.

Here is another 12 x A4 pages of paper saved for our national forests.

It is in the business processes surrounding forms that substantial streamlining of the ACMA's business processes can be made.

The ACMA can do this by moving to best practice to adopt web-forms signed with digital signatures.

Importantly, these proposed approaches give better alignment to COVID-safe protocols by removing a need for physical handling of paper artefacts and the need for people to be in proximity and to handle documents for the purpose of witnessed execution.

COVID-19 might pass, but there will inevitably be another contagion.

Rules

The rules of the allocation system are complex because the design is complex. The rules also are a long way from the goal of plain English expression. I have detected a change in the tone in the draft Determination compared with when I used to recommend these documents to the former Australian Communications Authority (ACA)[73]. They have regressed from plain English towards legalism and convolution, although that's just my impression of "the vibe".

It's hard to quantify, so I'll not say much on this.

I note that in contrast with my time, one sometimes now requires a combined degree in Law and Economics to understand some of what is required by the ACMA today[74].

The first issue with the rules of the allocation is the complexity of the underlying business process. E-SMR is inherently complex.

Complex systems serve no one well and no amount of legalism can make them simple. Complexity in systems and law compounds the burden on bidders to require external advisers, and it creates situations of ambiguity that can be contested and gamed.

It needs to be kept in mind that complex expression always exacerbates the issue of complex ideas.

Conversely, simple concepts are easy to explain in simple plain-English law.

The ACMA would do well to simplify its allocation systems as a starting point.

The best place to start is by junking E-SMR.

There are auction designs available that allow a great deal of the rule-bound hoopla such as surrounds eligibility and activity rules to be avoided.

Postponement

Recommendation: That the allocation be postponed.

There is no urgency about this allocation, other than to sate the lust for market dominance by a small sector of the industry.

There are issues to be resolved regarding deployment of mmWave technology, due to its limited propagation, adverse multi-pathing and high infrastructure density that only services the most densely trafficked areas.

There is little prospect of much revenue from the allocation because the technology is appealing only in the context of a marginal-cost extension to existing mobile telecommunications networks, and then only in areas with high communication density.

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73 I had the pleasure and honour of instructing one of the foremost exponents of "plain English" legislative drafting who had retired as Principal Legislative Counsel, Office of Legislative Drafting in the Attorney-General's Department. Good law is always best expressed in "plain English".

74 No better example exists than s.8 of Schedule 2—Rules for the assignment stage of the auction in the draft *Radiocommunications (Spectrum Licence Allocation — 26 GHz Band) Determination 2020*.

The prospect of new competing local carriers is low because this 5G technology is designed to dovetail with mobile phone networks and provide enhanced data capacity to mobile phone handsets.

We have three national MNOs in Australia where this is the best market fit.

As this submission elucidates, the economic defect in E-SMR compels a re-evaluation of the current strategy of the ACMA.

ACMA should re-evaluate whether to:

- continue with E-SMR in which case it will need to limit exposure risk by offering the fewest possible markets and the largest possible bandwidth channels (i.e. 400 MHz channels and national markets); or
- continue to pursue its likely fruitless quest for flexibility and contestability, in which case E-SMR poses substantial exposure risk and should be abandoned in favour of a combinatorial package bid design.

The product offering in geographical area terms is the most fragmented market ever offered for a spectrum auction in Australia. This creates a larger exposure risk than any previous allocation. The tragedy here is that ACMA acknowledges a frequency exposure risk, but never explores the corresponding geographic exposure risk.

Whichever path is chosen, the ACMA should conduct a further round of public consultation if its plans are improved.

This submission also raises a policy issue for Government about whether it would be better, cheaper, and more efficient simply to abandon an auction and conduct a price-based allocation for a pre-determined of negotiated price of licences to the three MNOs.

Such an option should be subject to careful policy consideration and coordination from a whole-of-government perspective.

There is no need to rush this.

Let's do it right, not fast.

An Economic Case for Postponement

Australia is currently affected by an international health pandemic. Large sections of the Australian economy are in a forced hibernation. Unemployment is rising. Discretionary income is falling. Business turnover has been reduced and companies are preserving capital.

It is likely that Australia is within the definition of recession.

Now is not the time for large financial transfers from the private sector to the Treasury via spectrum allocations. Indeed, to do that would contradict so much of the current government's economic response to the pandemic which is to keep business sustained ("hibernation" is a term that has been used).

There is no compelling urgency about this allocation, and so postponement presents low risk.

Let's hold off until the world is a better place and we can congregate in mass outdoors to sustain this technology.