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14 September 2020

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Deputy Chair and
Chief Executive Officer
Australian Communications and Media Authority
PO Box 78
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Dear Ms Chapman

DRAFT SPECTRUM REALLOCATION DECLARATION – 850/900 MHz Bands

I am writing to offer comment as part of the public consultation process regarding draft spectrum reallocation declarations for the **850/900 MHz Bands** of the radiofrequency spectrum.

The period for public consultation has closed. I don't have any comments regarding the draft declarations that the ACMA proposes to recommend that the Minister make. Similarly, I have no concern with the proposed market structure for the allocation. What I see in market design seems defensible and practical to what is on offer; most unlike the proposals for the 26GHz bands that were subject to my letter of 21 August 2020 (my "previous submission").

This letter deals solely with the proposed **allocation method** for the 850/900 MHz bands.

I am not acting for any party. I am simply a concerned taxpayer with experience across the subject matter, responding to a tip-off and trying to guide the ACMA away from another failed radiofrequency spectrum allocation.

In its consultation paper for these bands, the ACMA raises several options for the method of allocation. It settles by default on what I regard as poor design for a "sealed-bid combinatorial auction" (SBCA).

This submission offers:

- a critique of the analysis in the consultation paper that led to this design being recommended – the analysis lacks depth
- a critique of the design, including matters where staff may not have properly briefed the Authority – it is a poor design by any measure; and
- proposals for a better design that I recommend the ACMA investigate.

In making proposals for a better design, I also recommend that the ACMA should adopt a strategic approach. It should aim to implement a **single** design for long term **universal** application.

The idea that the ACMA needs to change allocation methods based on marginal variations in market design is not well founded. It's wasteful and it's inefficient.

In 2020, we know what a "wheel" should look like, and so there is no need to continually reinvent square and octagonal ones.

Moreover, the current non-strategic approach used by the ACMA leads it to list a range of ill-considered options, most of which can and should be dismissed without review. It does this repeatedly. This is a waste of resources. It's make-work verbiage for the sake of it.

A well-selected robust design will serve Australia well no matter what the market configuration provides. To that end, I reiterate simple public policy goals from my previous submission against which designs can be assessed.

Every time the ACMA makes a design change, a significant commitment of publicly funded resources is required to implement the change. This comes at a substantial cost to taxpayers and to industry:

- The design must first be settled after rigorous review – this takes a team of people
- The design must be translated into rules
- The rules must be translated into Australian legalese by lawyerly folk, suitable for delegated legislation that you and your fellow Members will make – that is a *significant* undertaking
- The rules and the design must be "war-gamed" and fine-tuned. This is something that I note from experience in the 3.6 GHz allocation, analysis of this consultation paper, and analysis of the 26 GHz consultation paper that the ACMA fails to do with diligence.

With rules in place, the ACMA requires systems that faithfully implement the design and rules. The ACMA must test these systems for both functionality and for proper interpretation of rules. To the extent that the ACMA relies on contractors for the provision of systems, then this comes at direct cost to taxpayers.

It all represents a substantial commitment of resources of the order of hundreds of thousands if not millions of dollars for each new design adventure that the ACMA undertakes. There is no way that this cost can be recovered from the current level of application fee for spectrum auctions.

What appals me most is that the ACMA keeps coming up with "dodgy" designs that significantly compromise the efficiency of outcomes able to be offered to The People who pay for them.

A lot of it is make-work. Design changes seem to come like changes of underwear. It's wrong.

I have argued in my previous submission that the E-SMR allocation method used in the (failed) 5G 3.6 GHz allocation and proposed for the 26 GHz allocation should be dumped because of its widely documented and well-known exposure defect. It needs to be replaced. Here is the ACMA proposing yet another dodgy design.

Taxpayers deserve better than this.

There is also a significant effort required by applicants to understand each new design; especially in the case of "complicated" designs with hidden traps such as:

- the design used in the first (failed) digital dividend auction where the trap was in the pricing methods that frustrated making meaningful bids, or
- the E-SMR design used in the (failed) 5G 3.6 GHz auction where the trap arose from the well-documented "exposure problem", or
- this proposed design with so many failings it's hard to know where to start.

This industry effort has substantial economic cost that is ultimately passed to consumers.

My message to the ACMA is that now would be a really good time to ***do it well and get it right!***

There have been many designs along our spectrum auction history, some of which have failed. E-SMR is just the latest iteration of failure. The design proposed for this allocation, if adopted, would likely add another plaque to the ACMA hall of shame.

There were two notably flawed designs leading to failed outcomes before I joined this business in the 1990s, both of which were subject to independent Inquires by the ANU's Professor Dennis Pearce for the embarrassment to Government that they caused. These were for:

- Satellite pay TV licences
- MDS licences.

Some good people had their careers tarnished.

Australia has used simple single-item clock ("English open oral outcry") auctions for radiofrequency spectrum. These are efficient pseudo-second price auctions when used for single items, but the design is known to be unsuitable when there are several elements on offer that are substitutable.

My previous submission noted how the RCA transponder auction in the USA was ruled invalid by the US FCC because of discriminatory pricing that is a natural consequence of this design when used in the way it was. On the other hand, I have run an auction for the former Australian Communications Authority (ACA) using this design. It was appropriate to the offer, and it served well because the lots on offer where leftover fragments from a previous SMR auction. It was simple and cheap for everyone including bidders. The design I propose below can cope with simple market designs like this.

The SMR that I brought to Australia in 1995 based on the US FCC design was known at the time to be prone to the theoretical "exposure problem", although it was also regarded as the "state-of-the-art" and lauded by the economic community. The design emerged from rigorous academic review.

Because of SMR's fundamental economic defect, auction theory always needed to be further advanced. There has been substantial effort towards alternative designs as understanding of the "exposure problem" became clear from observations of auction results. Nevertheless, two follow-on designs adopted by the ACMA, both originating from the same school of thought associated with SMR, have resulted in inefficient failed allocations. Over the decades since SMR's inception many hybrids and bolt-on "enhancements" have been considered, especially by the US FCC. These have included adding predefined packages to the core SMR design. These have attempted to mitigate an economic problem that is inherent to the SMR class and from which no derivative can be immune.

The ACMA has used an Ausubel-Cramton-Milgrom variant from the clock combinatorial auction (CCA)[1] class for the first (failed) digital dividend auction. Systems for that auction were provided by Power Auctions LLC, a firm associated with Larry Ausubel. Theory was contributed by all three authors. The ACMA went back to the future with an "enhanced" SMR auction using systems provided by Innovative Auctions, a firm associated with Peter Cramton. This design was used in the (failed) 5G 3.6 GHz auction. Both these designs inherited theoretical contributions from the original US FCC SMR design, including activity rules attributed to Paul Milgrom and Robert Wilson. These designs are complex, and complexity creates inefficiency, even though the designs aspire to correct for known theoretical problems. Empirical observation suggests they have failed the most important goals for the ACMA of economically and technically efficient outcomes that are contained in the *Objectives* clause of the *Radiocommunications Act 1992*. When observations do not support a theory, science *requires* that we dump the theory and try for a new one.

Each time that the ACMA has adopted a major design change, there has been a requirement to draft dozens of pages of delegated legislation to capture the rules of the design.

This lawyer-fest hoovers-up taxpayer-funded resources for often objectively deficient outcomes.

My message, again: Do it well and get it right!

Consideration of Analysis of Allocation Methods in the Consultation Paper

The assessment of allocation methods for the 850/900 MHz bands appears at pp.29-36 of the consultation paper. The analysis sets out four (4) options, with the fourth having three (3) sub-options, depicted as:

1. Simple clock auction
2. "Classic" SMR
3. "Enhanced" SMR (E-SMR)
4. Package bidding formats, including:
    a. Combinatorial clock auction (CCA)
    b. Combinatorial multi-round auction (CMRA)
    c. Sealed-bid combinatorial auction (SBCA)

In its analysis of these options, the ACMA makes a ***stunning admission*** in the light of my previous submission regarding the 26 GHz bands:

> *Due to the complementarity of contiguous lots and substitutability of the lots on offer across the 850/900 MHz band, we consider that using a non-combinatorial auction format (that is, SCA, SMRA or two-stage auction with generic lots)* ***would generate significant exposure risk****.*[2]

Say that again?

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[1] Larry Ausubel, Peter Cramton, and Paul Milgrom all contributed theory to the design. They have also been the main protagonists of variations to the original SMR at the FCC, including adding package bidding. They are all continually active in the field, proposing new designs.

[2] Australia, Australian Communications and Media Authority (2020) Draft spectrum re-allocation recommendation for the 850/900 MHz band - Consultation paper available from https://www.acma.gov.au/consultations/2020-05/draft-spectrum-re-allocation-recommendation-850900-mhz-band-consultation-142020 p.34

I invite you to please reflect on the analysis of allocation methods in the public consultation paper for the **26 GHz bands** allocation instruments where the ACMA wrote:

> *Given that the ESMRA format **mitigates exposure** and fragmentation **risks**, we consider that it is the more appropriate format for the 26 GHz band auction …*[3]

I hope that you can see how these two statements are devoid of consistency[4].

On the one hand the ACMA argues that non-combinatorial auctions (i.e. including SMR/E-SMR) generate significant exposure risk due to the complementarity and substitutability of lots, and yet in the Consultation Paper for 26 GHz band auction ***where the level of complementarity and substitutability across a two-dimensional matrix of 12 x 29 lots is significantly higher***, the ACMA said that ESMR *mitigates* exposure risk!

Say what?

*This is a staggering **contradiction** by the ACMA!*

It suggests to me that ACMA staff just "makes this stuff up" as they go along, citing "buzz-words" without understanding the issues that are at stake. It concerns me too that no one in the ACMA chain-of-management had the wherewithal to capture this logical inconsistency before it went to print.

Correctly, though, the ACMA goes on to rule out the options marked above as 1, 2 and 3.

Rightly so. The SMR and its derivative designs (like E-SMR) contain an intractable flaw.

I go further to apply the ACMA's own logic to the 26 GHz auction proposals, where in my previous submission, I set out in some detail why the E-SMR design should be dumped due of its inherent design defect. My previous submission recommended that SMR and E-SMR both should be abandoned in Australia, forever. I will not retreat from that recommendation.

Imagine my delight to now see the ACMA agreeing with the fundamentals of my argument.

I set out in my previous submission how the SMR allocation family and its derivates including the E-SMR method are flawed.

I described for the ACMA the precise mechanism of the flaw and I cited the specific rules in the ACMA's draft determination that create it.

Here for you, again: the flaw arises because bidders are only permitted to bid only on item-components of their business case, and control over whether they can secure all of these is taken out of their hands. The rules of the design make clear that a bid may be partially accepted or rejected by the ACMA by reference to aggregate demand on individual products. There is a non-withdrawal rule. That leaves package bidding formats as the only suitable alternatives.

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[3] 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

[4] let's use plain English: the two statements ***directly contradict each other***.

I am deeply embarrassed for the ACMA by the light-weight analysis as the Consultation Paper works through the remaining sub-options from the package-bid class. There is no sense at all that the ACMA has developed criteria against which options can be assessed. The narrative is therefore absent of context about what the ACMA is trying to achieve.

The most confronting issue to me is that once again the ACMA has conflated the Ausubel-Cramton-Milgrom "clock combinatorial auction" (ACM-CCA) that was used for the first (failed) digital dividend auction as being representative of the whole clock-combinatorial class.

To do this is also bereft of intellectual rigour.

As I noted in my previous submission, there are other designs from the wider clock-combinatorial class that are simple, efficient, and devoid of all the rule-bound complexity of the ACM-CCA design. Other designs from this class can permit multiple parallel bidding trajectories when the ACM-CCA permits just one.

A design that I have recommended for investigation by the ACMA is quite correctly called a "clock combinatorial design" because that is its underlying operating mechanism. This design comes from Dr David Porter as lead author. Dr Porter is a leading exponent of combinatorial theory. This design boasts a Nobel Laureate in experimental economics, Dr Vernon Smith, as a co-author.

I reiterate the lament in my previous submission that the work of the Caltech school on combinatorial theory has also been ignored by the ACMA. How can the ACMA be so remiss in failing to recognise a significant body of work in combinatorial theory that finds real-world application supporting allocation of scarce valuable resources to space exploration?

Thankfully, the ACMA does dismiss the ACM-CCA design. I support this dismissal. I have been a bid adviser in an auction of this type, and it is a "shocker" for bidders (with all due respect to Peter, Paul, and Larry). As the ACMA notes:

> *The pricing and auction rules in a CCA are highly complex and less transparent, and the format can be unfavourable to weaker bidders (like new market entrants). Pricing in a CCA is dependent on other bids placed. In addition, there are issues relating to the extent to which the CCA provides incentives for truthful bidding, which may reduce the justification for the added complexity.*

The design is dismissed from further consideration. There is no need for me to launch an essay about its flaws from a bidder perspective.

The ACMA provides only a simplified description of the CMRA format (option 4[b]), but it offers no analysis of the merit or otherwise of the design[5]. To save the ACMA some work (and me another essay), I reviewed the Information Memorandum[6] for the Danish auction. It is rightfully dismissed in my assessment on the grounds of *complexity*.

I can only wonder why the ACA raised this option, other than as a "strawman" to dismiss.

In the ACMA's analysis, there is only one option remaining. Let's then review what has being proposed by the ACMA staff. It's a shocker.

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5 See ref #2 at p.32

6 Available here: https://ens.dk/sites/ens.dk/files/Tele/information_memorandum_june_2016.pdf

Sealed-Bid Combinatorial Auction (SBCA)

The SBCA is the recommended option in the consultation paper, by default[7].

The mechanism is described by the ACMA as follows:

> *The sealed bid combinatorial auction (SBCA) format requires bidders to submit bids for all the possible combinations of lots they are interested in, in 'one shot'. That is, they submit all bids at once, with a single price associated with each bid.*[8]

What is proposed appears to me to be a bastardised version of a Vickrey-Clarke-Groves auction[9], without the most compelling feature of that design that makes it so important to theory; a mechanism for economically efficient "second pricing". The ACMA instead favours a "first price" ("pay-your-bid") approach, as the ACMA writes:

> *Pricing in such an allocation can be either first price, where the winning bidder pays their bid, or second price, where the winning bidder pays the highest value that other bidders were willing to pay for the spectrum. First price provides for a simple pricing rule, but creates incentives for bidders to **shade** their bids, where a bidder places a bid that is below their true valuation. Alternatively, second pricing runs into the same issues identified above in the discussion on the CCA (creating incentives for strategic bidding and disadvantage weaker bidders). A first price rule is likely to be optimal where **simplicity** is an objective, or where complexity is a serious issue, making second pricing unsuitable.*

While I favour a "second-price" approach (and so should the Government, because bid-shading will compromise both efficiency and revenue outcomes for Australia), I do note that both of these concerns (i.e. *simplicity* and *avoidance of bid-shading*) can be addressed simply by incorporating a mechanism of **iterative price-discovery**. Just as in an English open oral outcry auction, pay-your-bid as the last bidder standing is effectively a second-price auction. That cannot hold true in a sealed-bid process.

Further, the one-shot first-priced approach leads to a significant conceptual defect when applied specifically to radiofrequency spectrum.

Before addressing that, however, it is worth quickly noting that this is a mathematically complex design for **bidders**. With seven (7) products proposed to be offered, each bidder will face 127[10] unique **packages** that need to be **priced**[11] as would normally be implied in a Vickrey-Clarke-Groves design**.**

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7 The ACMA sets out a limited list of "strawman" options and proceeds to dismisses them so that this is the last one left standing. That is intellectually lazy.

8 See ref#2 at p.32.

9 https://en.wikipedia.org/wiki/Vickrey%E2%80%93Clarke%E2%80%93Groves_auction

10 Mathematics holds that the number of combinations is 2^n-1 and 2^7 = 128. Zero (0) is not considered, leaving 127.

11 "price" can be zero ($0.00), to denote "I do not want this, ever", but every option must be considered methodically by bidders.

If I assume that the ACCC goes "bolshie" [12] with its recommendations over bidding limits, then a typically bureaucratic cap might end up being something like 2 x **21** MHz (i.e. 3 x 2 x 5 MHz plus 1 x 2 x 6 MHz)[13].

A 2 x 21 MHz cap will exclude any combination that contains more than any four (4) of the seven (7) items offered, but even under such a cap, there are still **ninety-eight** (98) discrete packages that need to be priced by each bidder.

That's a lot.

The ACMA writes:

> *The SBCA format is likely to be suitable in a relatively simple auction where the number of lots on offer is **reasonably low** so that the number of possible combinations of lots requiring bids is also low.*

I guess it comes down to how one defines ***reasonably low*** because the number of combinations is 2^n-1, where *n* is the number of items. Thank goodness there are not 10 items with 1023 combinations to be priced, or worse, 20 items generating 1,048,575 combinations!

Don't take my word for it. Count them up for seven items. I have included at Attachment A the list of all 127 possible combinations of seven items, with those that offend a 21 MHz cap denoted in *greyed italics*.

The ACMA staff might retort that a bidder need not price every package (even though this is not implied from the quote above), to which I simply respond:

> *Do you **really** want to be the leader of the bid team that failed to price a package that might have fit into a winning solution?*

Get real!

They all need to be priced.

This is a *dumb design* from a bidder perspective.

Let's go further and assume three bidders[14] each discretely pricing 98 packages. The ACMA might then be faced with finding the best solution by revenue from 3 x 98 = **294** packages, with no bidder represented more than once and the solution being valid against supply constraints.

In practical terms, this is a simple integer programming problem, but it does require some computing horsepower because it has an absolute search space of 2^[294] -1 combinations[15].

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12 *Sorry, Rod.*

13 The options need to be considered in terms of the size of the available lots, so the number series will be 6,11,16,21,26,31 and "no cap". Anything less than 16 will likely result in a failed market. Anything more than 26 is to all intents and purposes "no cap".

14 With three mobile network operators vying for mobile telecommunications spectrum, it's a reasonable assumption to make.

15 The vast majority will be pruned from assessment along the way using a branch-and-bound technique, but it's still a significant computing problem. The "absolute" search space must be

That's 3.18287E+88 combinations.

Please, try to write that number out long hand as an integer. *I'll have a beer while you to do that*.

The ACMA will not be solving this problem on the back of envelope!

Let me say this again for crystal clarity: *this is a dumb design.*

While the math behind the solution is easily surmountable, the far greater issue in a one-shot design is that radiofrequency spectrum **has no value,** so it is inappropriate to deploy a one-shot first-price process in the absence of a price-discovery mechanism.

Price-discovery is a simple gentle progressive mechanism to expose *private* values to *public* view. *Private* values come from *private* business plans.

In the ACMA's proposed design, bidders have no option than to bid "blind" in a one-shot process. The ACMA already notes the prospect of "bid shading" in response to this.

The public record will show that I have been arguing that spectrum has no "value" as far back as the first (failed) digital dividend auction in 2013. Alongside the Minister, the Hon Paul Fletcher MP, and former Prime Minister the Hon Malcolm Turnbull, we argued against "dumb" reserve prices that had been directed be applied by former Minister Conroy on the inept advice from officials.

In advising Messrs Fletcher and Turnbull[16], I reflected on work by Professor Tom Hazlett, former Chief Economist at the US FCC. You will find my review of the concept of spectrum "value" including references to Professor Hazlett's work at the referenced link[17] in submissions that I made at the time to the Department of Broadband, Communications and the Digital Economy (DBCDE) [as it was then].

Radiofrequency radiation is all around us all the time. It comes from the sun, from space, from living organisms and from atmospheric phenomena like lightning; indeed, anything that creates acceleration of charged particles will do the trick. The "radiofrequency spectrum" is just a human-conceived abstraction to describe this naturally occurring physical phenomenon on a continuum.

Criticism of spectrum "value" starts from the idea that spectrum has to be "abstracted" by governments into an authority of use (a licence). In general terms, one is not permitted to "use" spectrum to create (or receive) radiation until and unless it is mandated under this wholly artificial abstraction. The sun is not licenced. Space is not licensed, although we do licence devices to listen to space to protect them from other human-induced sources of radiation.

The best example for my point lies with the class-licensed bands. In these bands there is no "value" in the spectrum *per se*, because use is free to use by everyone within rules abstracted by the regulator (i.e. in Australia, the ACMA). Despite this, Wi-Fi creates huge economic value for the community. The economic value of this band comes from its ***utilisation*** via free access. In licensed bands, this works in much the same way. The abstraction authorises a person to use the resource in a way defined by a licence and they create economic activity and value.

Until spectrum is defined into a licence and allocated to someone to use, it has no value.

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approached very methodically. There are algorithms that do this. I wrote one, so it can't be too hard.

16 They were in Opposition at the time.

17 https://www.market-dynamics.com.au/Company/Pages/Publications.aspx

The lack of value of spectrum ***in the hands of regulators*** comes about because the radiofrequency spectrum is ***infinitely renewable*** across the dimension of ***time***. If it's not allocated to be used, then there is an opportunity cost (in fact a "negative value") to the community in terms of economic activity that is forgone.

The ACMA has in the past applied phony "reserve price" values for spectrum. Minister Fletcher is aware of this because he prosecuted the arguments against it in the media.

"Reserve price" has a specific meaning in economics to be the "vendor utility" of an item. Logically, there can be no vendor utility to the ACMA in holding spectrum unallocated and unused and being infinitely regenerated in time[18].

To illustrate this simple point, I ask you rhetorically:

> *What is the ACMA going to do that creates economic value for Australia from spectrum that has not been abstracted into licences and allocated to users and that will generate economic activity and employment?*[19]

As my learned colleague Professor Hazlett and I have discussed more than once, this understanding distils to a remarkably simple proposition:

> *It is better for spectrum to be given away for "free" than it is for regulators to withhold it from access.*

Spectrum has no value. My team understood this in the late 1990s[20]. *Perhaps the institutional knowledge has been forgotten, over the years*.

Regulators tend to withhold spectrum from access by either design (e.g. via planning decisions) or through inadvertence (e.g. by applying mind-numbingly stupid "reserve" prices that result in failed allocations such that spectrum is passed in – for example, as occurred in the first (failed) digital dividend auction).

Spectrum only *acquires* economic "value" after it has been allocated to users so that they may create businesses and sell products to consumers and employ people.

It follows that spectrum has no *underlying* value in the way that a bottle of wine or a house might by virtue of the costs of production. In radiofrequency spectrum, the costs of production only commence when the spectrum starts being deployed by licensees, i.e. in the future (private) business plans of licensees. There are no public benchmarks for this.

More widely, spectrum bands are only infrequently offered to market, so there are few relevant contemporary benchmarks to inform sensible decision making.

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18 In the tension between demand, supply and price, something that has infinite supply can only have zero value. Simple math.

19 The polite answer is, of course, "not very much". I have less polite versions in my extended vocabulary.

20 A review of the auction documents produced during my time on the job will show that we used the term "starting prices" and not "reserve prices". My first observation of the misuse of the term "reserve prices" was in the evidence to Senate Estimates by Mr Giles Tanner, then of the ACMA. See https://www.market-dynamics.com.au/Company/PDF/PDFViewer.aspx?Document=5 at p.9.

Across international spectrum markets there is no observable consistency about what bands are "worth" which tends to support my contention, for if there is a genuine non-speculative value, then it will trend towards some commonality across markets[21] – especially for mobile phone spectrum that deploys in the same way around the world with common international standards and mostly common mass-market handsets.

Here's the crux of the matter: forcing bidders to ***guess*** a value to attach to a bid when there are no reliable benchmarks and where value is "rubbery" is quite absurd, and *yet this is precisely what the ACMA proposes* in this design!

At the risk of repeating myself: *this is a dumb design.*

Let's turn briefly to theory for the one last nail for the coffin to which this silly proposal should be confined: blind "guessing" prices in a first-price allocation opens bidders to a specific economic problem called the ***winners' curse***. The concept of winners' curse is not mentioned at all by the ACMA as a risk[22].

Simply stated, this aspect of theory suggests that a winner is "cursed" by having ***over***-valued the asset to the greatest extent. There is a related idea in popular idiom of "buyer's remorse" – i.e. knowing that you might have been able to get a better outcome *if only …*

The ACMA's salvation is that theory also offers a partial mediation to this problem: *a mechanism of gradual price-discovery*.

Another issue is the option to use a "base" price in a one-shot sealed-bid design. I use this term because "reserve price" is inappropriate and "starting price" implies a price-incrementing mechanism.

If one accepts theory and logic that spectrum has no value to the regulator/vendor, then having such a price is absurd. There is no vendor utility to imply value. It is better to give spectrum away for free than not have it awarded due to unrealistic "base" prices.

A consequence of not having a "base" price, though, is that in a one-shot sealed-bid process, the ACMA needs to be alert to the possibility that a solution of bid packages might contain a bid for a peppercorn amount (say $0.01) and **it might win**. After all, the ACMA may have as many as $2^{294}-1$ solutions where such a solution might be hiding.

This sort of thing can happen in one-shot sealed-bid tenders (both first and second price).

I recall that it did happen in New Zealand once, where a company that bid NZ$100,000 for a UHF licence in a second price sealed-bid tender paid just NZ$6.00 for the licence! In a lesson for Minister Fletcher, the New Zealand Government quickly dropped this method after being publicly pilloried (even though it was an economically efficient result – because spectrum has no value).

I am sure that the ACMA would be reluctant to see the Minister being pilloried.

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21 when expressed in US$/MHz/pop.

22 I performed a word search over the document for "winner" and separately for "curse". Winners' curse is one of the best-known theoretical weaknesses of one-shot designs. ACMA failed to note it as a risk.

But here is a thing:

> *if a "base" price is set to counter this effect, then by using this design, there is a risk of **ties** emerging on some solutions at the "base" price for lots, i.e. **ties** that must be **broken** to find a winner(s).*

Both the ACM-CCA and E-SMR allocation methods that have been used by the ACMA employ a pseudo-random "tie-breaker" mechanism[23].

Deciding the outcome of a multi-(b)million-dollar process based on a metaphorical "coin-toss" is **bad public policy**, yet it is a natural requirement inherent to this design if a "base" price is set.

I have established above that the design suggests smart bidders should bid on as many as all 98 alternative packages. If a "base" price is set, it makes sense for bidders to consider applying a "base" price on those options that it favours least just in case the package becomes part of a solution through combinatorial resolution.

In summary and in considering all these matters, I can only conclude that this design was not diligently "war-gamed" by ACMA staff prior to being put to the Authority as a preferred option to release publicly.

So, how do we fix this mess?

From the commentary above, it should be obvious that the ACMA ought to embrace design features such as:

- a ***combinatorial*** contingent package bid process; and
- a ***price-discovery*** process (from a reasonable starting value).

That prescription looks to me very much like designs from the "clock-combinatorial auction" class by its general definition, and not the specific ACM-CCA definition applied in the first (failed) digital dividend auction.

In my previous submission, I suggested a design by Porter et.al. is one that the ACMA should investigate. It meets these expectations for combinatorial package bidding and has a simple clock-based price-discovery process. It is a simple efficient fast design that provides progressive resolution of the allocation problem with no fuss over complicated rules.

In my opinion, the staff of the ACMA need to "get out more" from the Belconnen bunker and start experimenting with different designs[24], assessing them against simple and clearly articulated public policy design goals, and do this well before the organisation commits to the process of writing rules and Determinations.

We have an Australian National University (ANU)[25] here in Canberra that does both public policy and economics. ANU has lots of student "guinea pigs" eager to earn credits by participating in economic

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[23] For an example in an E-SMR process, see s.2A of Schedule 1 - Rules for the primary stage of the auction in the Draft *Radiocommunications (Spectrum Licence Allocation - 26 GHz Band) Determination 2020*.

[24] Especially those that arise in alternative schools of theory.

[25] There is no conflict of interest here. I'm a University of Canberra Alumni.

experiments. I too have a mature testbed based in Canberra where I have been testing designs for a decade.

I implore the Authority to think creatively about this.

In my previous submission, I set out proposals for simple measurable **public policy design goals** that I advocate when evaluating various designs:

- **Simplicity** - to lower *complexity* risk (this tends to exclude ACM-CCA, E-SMR and the original SMR)
- Delivery of outcomes that display both **economic** and **technical efficiency** (which excludes the design proposed here and all SMR derivatives)
- **Combinatorial** resolution of contingent packages - to negate the *exposure* problem and enhance efficiency of outcomes (again, excluding all SMR derivatives)
- Provision of appropriate **information** to allow efficient packages to be described by bidders in a way that avoids the *threshold* problem (this excludes SMR derivatives because they do not permit contingent packages anyway).

I add one more to my previous list: **freedom** from arbitrary determination of winning solutions by pseudo-**random** processes for tie-breaks (see above).

An assessment of some of the designs considered by ACMA in this consultation paper can be simply tabulated:

Criterion	**SMR**	**E-SMR**	**ACM-CCA**	**SBCA**	**Porter et.al.**
Simplicity	✗	✗	✗	✗	✓
Efficiency	✗	✗	✓	✗	✓
Combinatorial	✗	✗	✓	✓	✓
Information	✓	✓	✓	✗	✓
Non-random resolution	✓	✗	✗	✗	✓

Note that when considered against these criteria, the ACMA's preferred option does not perform well.

Please review the explanation of the Porter et.al. design as it was published[26] and marvel at how it solves many of the design issues in a spectrum allocation that justify the assessment above. Any compromise to efficiency in this design is more than offset by the superiority of the approach over other designs that the ACMA has used and which introduced their own inefficiencies that have led to allocation failures in this country.

As a bid-adviser with experience around the world with many different designs, I can assure you that complexity generates risk and that unmitigated risk must be countered by price-shading. The resulting compromised efficiency reduces the prospect of quality outcomes for our nation.

[26] 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

The original Porter et.al. design considered combinatorial package bidding for independent singular items (e.g. an apple, a pear, and an orange). This maps easily and **directly** to the proposed market structure of seven items described at p.24 of the consultation paper for the 850/900 MHz allocation.

The description of the design also notes that the design can be adapted trivially to work with classes of *generic* items with multiple quantities (e.g. two apples, a pear and four oranges). This is the variant that I have live on my development test bed, but which through a simple change to the market definition reverts neatly to work with singular items. All the other algorithms remain unchanged. In this variant, though, there would need to be a separate assignment auction/tender.

It seems to me that this attribute of the design supports the goal of *universality* that I raised on page 2 of this letter, but that is a matter for thorough experiment and exploration.

The Porter et.al. design permits multiple packages to be bid but it does not require all combinations to be bid as the SBCA proposed "one-shot" design implies. Instead, it provides simple incremental price-discovery. The design allows multiple different package trajectories to evolve in response to prices that are revealed during the price-discovery process. It is therefore more *compact* than SBCA for bidders, for it allows packages to be added or discontinued by bidders if the pricing does not reflect the required business utility. It permits multiple packages to be bid in every price round.

In conclusion, there are serious inefficiencies with the SBCA being proposed by the ACMA for this allocation. There are simpler and more efficient designs available that are less likely to lead to substantial economic loss to Australia.

I am, of course, prepared to volunteer some time to brief a meeting of the Authority to explain key features of what I propose. I can be contacted at the email address above to arrange this.

I publish submissions like this to my own website so that they are accessible to the industry and media.

I am also copying this letter under separate cover to the Minister. He needs to be aware of this because he is accountable to the Parliament for ACMA's misadventures.

My kind regards and

Yours sincerely

<email of transmission to spectrumallocations@acma.gov.au *is digitally signed by: >*

Ian Hayne

List of Possible Unique Combinations of Seven Objects

**Combinations of 5 or more items (2 x 21 MHz cap) are greyed and italic*

	1	**2**	**3**	**4**	**5**	**6**	**7**
1	1						
2		1					
3	1	1					
4	1		1				
5		1	1				
6	1	1	1				
7			1				
8	1			1			
9		1		1			
10	1	1		1			
11	1		1	1			
12		1	1	1			
13	1	1	1	1			
14			1	1			
15				1			
16	1				1		
17		1			1		
18	1	1			1		
19	1		1		1		
20		1	1		1		
21	1	1	1		1		
22			1		1		
23	1			1	1		
24		1		1	1		
25	1	1		1	1		
26	1		1	1	1		
27		1	1	1	1		
28	*1*	*1*	*1*	*1*	*1*		
29			1	1	1		
30				1	1		
31					1		
32	1					1	
33		1				1	
34	1	1				1	
35	1		1			1	
36		1	1			1	
37	1	1	1			1	
38			1			1	
39	1			1		1	
40		1		1		1	

41	1	1		1		1	
42	1		1	1		1	
43		1	1	1		1	
44	*1*	*1*	*1*	*1*		*1*	
45			1	1		1	
46				1		1	
47	1				1	1	
48		1			1	1	
49	1	1			1	1	
50	1		1		1	1	
51		1	1		1	1	
52	*1*	*1*	*1*		*1*	*1*	
53			1		1	1	
54	1			1	1	1	
55		1		1	1	1	
56	*1*	*1*		*1*	*1*	*1*	
57	*1*		*1*	*1*	*1*	*1*	
58		*1*	*1*	*1*	*1*	*1*	
59	*1*	*1*	*1*	*1*	*1*	*1*	
60			1	1	1	1	
61				1	1	1	
62					1	1	
63						1	
64	1						1
65		1					1
66	1	1					1
67	1		1				1
68		1	1				1
69	1	1	1				1
70			1				1
71	1			1			1
72		1		1			1
73	1	1		1			1
74	1		1	1			1
75		1	1	1			1
76	*1*	*1*	*1*	*1*			*1*
77			1	1			1
78				1			1
79	1				1		1
80		1			1		1
81	1	1			1		1
82	1		1		1		1
83		1	1		1		1
84	*1*	*1*	*1*		*1*		*1*
85			1		1		1
86	1			1	1		1

87		1		1	1		1
88	*1*	*1*		*1*	*1*		*1*
89	*1*		*1*	*1*	*1*		*1*
90		*1*	*1*	*1*	*1*		*1*
91	*1*	*1*	*1*	*1*	*1*		*1*
92			1	1	1		1
93				1	1		1
94					1		1
95	1					1	1
96		1				1	1
97	1	1				1	1
98	1		1			1	1
99		1	1			1	1
100	*1*	*1*	*1*			*1*	*1*
101			1			1	1
102	1			1		1	1
103		1		1		1	1
104	*1*	*1*		*1*		*1*	*1*
105	*1*		*1*	*1*		*1*	*1*
106		*1*	*1*	*1*		*1*	*1*
107	*1*	*1*	*1*	*1*		*1*	*1*
108			1	1		1	1
109				1		1	1
110	1				1	1	1
111		1			1	1	1
112	*1*	*1*			*1*	*1*	*1*
113	*1*		*1*		*1*	*1*	*1*
114		*1*	*1*		*1*	*1*	*1*
115	*1*	*1*	*1*		*1*	*1*	*1*
116			1		1	1	1
117	*1*			*1*	*1*	*1*	*1*
118		*1*		*1*	*1*	*1*	*1*
119	*1*	*1*		*1*	*1*	*1*	*1*
120	*1*		*1*	*1*	*1*	*1*	*1*
121		*1*	*1*	*1*	*1*	*1*	*1*
122	*1*	*1*	*1*	*1*	*1*	*1*	*1*
123			*1*	*1*	*1*	*1*	*1*
124				1	1	1	1
125					1	1	1
126						1	1
127							1