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| REPORT FOR TELSTRA |
| 850/900 MHZ allocation limits |
| **23 June 2021** |

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# Contents

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| [**Section 1** Summary 1](#_bookmark0)[**Section 2** Key considerations in the allocation of spectrum 6](#_bookmark2)[Introduction 6](#_bookmark3)[Available capacity is the main driver of overall consumer benefits 6](#_bookmark4)[A framework to identify whether allocation limits are appropriate and, if](#_bookmark7)[so, their optimal design 9](#_bookmark7)[**Section 3** Would the proposed limit promote efficiency? 11](#_bookmark9)[The drivers of intrinsic value for spectrum 11](#_bookmark10)[Operators’ likely need for spectrum 13](#_bookmark12)[Is there a risk of bids being distorted by market power? 21](#_bookmark17)[Risk of inefficient allocation 22](#_bookmark18)[**Section 4** Would the proposed limit promote competition? 25](#_bookmark22)[Is the proposed limit likely to increase competition in the national market](#_bookmark23)[for mobile services? 25](#_bookmark23)[Is the proposed limit likely to lead to greater 5G rollout and greater](#_bookmark24) [competition in rural areas? 27](#_bookmark24)[**Section 5** Would the proposed limit promote consumer benefits and wider](#_bookmark25)[economic benefits? 30](#_bookmark25)[Loss of wider economic benefits 32](#_bookmark27)[**Section 6** Would alternative limits better promote consumer benefits? 36](#_bookmark29) |
| [Annex A: Compass Lexecon and the report authors 40](#_bookmark30)[Annex B: Note on the bright side of relaxing incumbents’ capacity constraints 42](#_bookmark31) |

**Section 1**

Summary

* 1. The Minister for Communications, Urban Infrastructure, Cities and the Arts is considering whether to direct the Australian Communications and Media Authority to impose allocation limits at the 850/900 MHz auction, scheduled for late 2021. The Government is seeking comment on a draft direction which would:
		1. limit any entity from holding more than 82 MHz of spectrum below 1 GHz; and
		2. set aside 10 MHz of spectrum in the 900 MHz band for each of Optus and TPG (with the set aside spectrum included in the limit for that operator, if the set-aside is taken up).
	2. Telstra has requested Compass Lexecon1 to assess the likely effect of the proposed limit on efficiency, competition and end-users as well as to identify whether alternative limits would better promote the interests of end-users. For the purpose of this report, we assume that Optus and TPG will receive the set-asides of 10 MHz each when we make our assessment of the likely effects of the limit on operators’ overall holdings of sub 1 GHz spectrum.
	3. Allocation limits are used to ensure that some operators and entrants have the opportunity to acquire spectrum and, in some cases, this may increase competition. However, there is a potential trade-off in that the limits may prevent spectrum going to the operator(s) that have the greatest need for additional spectrum.
		1. Ongoing rapid growth in mobile data demand makes it critical to ensure that scarce spectrum is assigned efficiently. Historical growth rates and independent forecasts suggest that mobile data traffic is likely to be **over four times higher** in 2026 than 2020 and to continue rapid growth in subsequent years – few other industries must accommodate such growth in demand.
		2. A tight limit which results in an operator facing capacity constraints and high costs to expand capacity through site densification may lead to less competition, higher prices and lower quality than a market in which all operators are positioned to make competitive offers to seek to attract additional subscribers.

1 Background on Compass Lexecon and the authors are set out in Annex A.

* 1. Given these potential trade-offs, determining the optimal level of any allocation limit requires a careful evaluation of the risks to efficiency and competitive dynamics alongside the assessment of the intended benefit.
	2. Low band spectrum is important not only for overall capacity but also to support traffic over wide areas in regional areas. While traffic density is greater in inner metro areas, capacity constraints can also arise in regional areas because of the limited quantity of low band mobile spectrum suitable to cover regional areas, the size of the area covered by each site and the cost of macro towers and backhaul to remote locations.
	3. The forecast growth in mobile data demand implies that **all operators** are likely to need additional capacity over the licence period, just to meet the growing demand of their existing customers.
	4. However, the proposed cap of 82 MHz will impact Australia’s three mobile operators differently. The limit will tightly constrain Telstra’s ability to acquire low band spectrum in the auction, much more so than the other two operators. It will also leave Telstra with less spectrum than it currently has in regional areas even if Telstra is able to acquire spectrum up to the cap, whereas this is not the case for the other two operators. We do not consider that this differential impact is justified given that efficiency and overall consumer benefits will be promoted by spectrum being allocated to where it can be used most intensively.
		1. In metro areas, operators’ share of spectrum is broadly in line with their shares of subscribers and traffic, with Optus holding most spectrum in low and medium bands. All operators can be expected to make efficient use of additional spectrum to meet the growing demand of their customers and yet the proposed limit would make spectrum holdings more asymmetric in Optus’ favour.
		2. In regional areas, Telstra and to a lesser extent Optus have relatively little spectrum relative to their subscribers and traffic. In contrast, TPG holds substantial spectrum relative to its subscribers and traffic in these areas.
		3. In relation to capacity for services which rely on sub 1 GHz spectrum in outer regional and remote areas for which the forthcoming auction is critical, Telstra has much less spectrum relative to its subscribers and traffic than TPG and, to a lesser extent, Optus.
	5. The proposed cap would permit Telstra to acquire at auction a maximum of 20 MHz of low band spectrum in metro areas, and only 10 MHz in regional areas. As a consequence, we consider the likely impact of the cap would be to force Telstra to rely on site densification if it is to meet its customers’ demand for increasing data, which is typically more costly. This would increase Telstra’s cost of providing incremental capacity, with the cost increase being greater in regional areas. We conservatively estimate that, for a given spectral efficiency, a 10% increase in capacity without additional spectrum would cause the national average incremental cost of mobile data for an operator to increase by at least 3%. With data demand growing around 30% a year, relying on sites to increase capacity can significantly impact incremental costs.
	6. The consequences of Telstra facing a higher cost of providing incremental capacity can be expected to be:
		1. Pressure on Telstra to set higher prices to end-users than otherwise to seek to manage customers demand;
		2. As a result of Telstra’s constrained network giving it little incentive or ability to take additional customers and pressure on it to set higher prices, a reduced competitive constraint on Optus and TPG;
		3. Telstra’s network quality deteriorating in regional areas over time, because the impact of the limit in significantly increasing Telstra’s cost of providing incremental capacity in regional areas is likely to result in insufficient investment being justified at national prices; and
		4. Reduced service quality limiting the potential gains to regional businesses and consumers from innovative 5G services that rely on high service quality, particularly mission critical services and enhanced mobile broadband. The more congested an operator’s network, the slower the speeds available to end-users and the less reliable the service. We estimate that the loss of higher quality 5G services to customers reliant on Telstra’s network could put at risk benefits of 5G services in outer regional and remote areas worth around **1.4% of the GDP** of those areas and potentially leave **1.4 million people** who rely on Telstra’s network in outer regional and remote areas **worse off by between $356 to $509 per person per year by 2030** and by **up to $1,210 per person per year by 2035** (all in March 2021 dollars). The total loss to the people in outer regional areas could amount to **$488 million to $697 million by 2030** (in 2021 dollars) and higher in later years.
	7. We have also assessed, using a stylised model of operator competition, what would be the expected impact on consumer welfare of the largest operator in the market with the best coverage becoming capacity constrained. The model is set out in Annex B and solves for the market equilibrium based on each operator’s best response. We find that **the effect is to reduce overall consumer welfare**. This reflects two factors: first, the capacity constraint implies that some consumers will not be able to choose their preferred operator; second, because other operators are at less risk of losing customers, they also increase their prices. This shows that seeking to engineer more symmetric outcomes can be expected to harm consumers where it leads to less consumer choice and relaxes competitive constraints on the other operators.
	8. TPG has relatively large holdings of both total spectrum and sub 1 GHz spectrum relative to its subscriber numbers in both metro and rural areas. As such, we consider TPG is well positioned to meet the growing demand of its existing customers and to grow its market share at relatively low cost, even in the absence of acquiring any more low band spectrum in the auction than the 10 MHz set aside for it. The proposed 10 MHz of 900 MHz spectrum to be set-aside for TPG will also ensure continuity of its 3G services. TPG does not, therefore, need the benefit of an additional sub 1 GHz cap in the auction.
	9. Optus does have relatively little sub 1 GHz spectrum. If Optus is to offer wide area 5G coverage in parallel with 4G services, it is likely to need additional sub 1 GHz spectrum. Optus currently provides 98.3% 4G coverage with 20 MHz of 700 MHz spectrum. Optus can be expected to achieve a similar level of geographic 5G coverage with an additional 20 MHz of sub 1 GHz spectrum (indeed, 5G coverage could technically be provided with 10 MHz of spectrum). If, instead of the proposed 82 MHz cap there was a higher cap of 102 MHz, this would still give Optus the opportunity to acquire 20 MHz of sub 1 GHz spectrum for wide area 5G coverage in addition to its 10 MHz set-aside which Optus could use for either 3G or 5G services (with a total of 30 MHz of spectrum available in the auction for which the limit would continue to restrict Telstra from bidding and excluding the 10 MHz set aside for TPG). We therefore do not consider that a cap lower than 102 MHz is needed to ensure that Optus is able to acquire sufficient spectrum for 5G coverage. At the same time, a lower cap such as the 82 MHz cap proposed will carry greater risks of spectrum being assigned inefficiently with particular risks to service quality in outer regional and remote areas.
	10. A justification provided by the ACCC for the proposed cap of 82 MHz is a concern that Telstra may otherwise acquire spectrum strategically to prevent Optus acquiring spectrum. However, given that a tight cap can carry costs in preventing spectrum being assigned to where it is most needed, it is important to assess what is the risk in practice of Telstra bidding to acquire spectrum so as to prevent the spectrum being acquired by rivals. For this auction, Telstra would have to outbid Optus and pay above its intrinsic value for most of the auctioned spectrum. This would involve a substantial cost to Telstra (particularly in the context of a clock auction). Yet Telstra would obtain no financial gain to offset this cost, given that market prices are determined by competition in metro areas where Optus and TPG are well positioned to continue to compete vigorously on price and quality including for 5G services, regardless of the auction outcome.
	11. A key advantage of auctions is that they can promote the efficient allocation of spectrum which supports lower industry costs and higher industry quality. However, this benefit of auctions requires there to be sufficient competition in the auction. An excessively tight spectrum limit risks reducing competition in the auction and leading to spectrum being allocated inefficiently. We find that a cap of 92 MHz (or lower) risks creating scenarios where participants will bid for packages of spectrum to avoid competing with other bidders, thereby reducing the price they pay for spectrum rather than bidding based on their intrinsic value of different spectrum. Such risk, however, is significantly less with a cap of 102 MHz or higher.
	12. Overall, and assuming the presence of the 2 x 10 MHz set asides for Optus and TPG, we consider the approach involving the least risk of regulatory failure and the least risk to efficiency, competition and the interests of end-users would be to **set no overall cap on sub 1 GHz spectrum for this auction**. However, assuming the Minister is nevertheless minded to set a cap, we have assessed the likely effects of a range of potential cap limits, including the current proposed cap of 82 MHz. [Table 1](#_bookmark1) summarises our assessment with regard to three key factors to determining the best remedy with the lowest risk to end-users.

#### Table 1: Assessment of alternative limits on overall sub 1 GHz spectrum

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **82 MHz cap** | **92 MHz****cap** | **102 MHz cap** | **112 MHz cap** |
| **Risk to regional service quality from any operator having low spectrum relative to traffic\*** | High risk of regional losses of$488m-$697m by 2030([C-i-C]) | Medium-high risk of regional losses of$488m-$697m by 2030 ([C-i-C]) | Medium risk to regional service quality([C-i-C]) | Low-medium risk to regional service quality([C-i-C]) |
| **Risk to competition that not all 3 operators obtain at least 20 MHz spectrum for wide area 5G coverage** | Low | Low | Low | Medium\*\* (Optus might face highcompetition) |
| **Risk of inefficient spectrum allocation due to lack of competition in the auction** | High | High | Low | Low |

*Notes: \*Risk to regional service quality is assessed based on the relative risk of different caps of any operator having a significantly lower share of spectrum than its traffic in outer regional and remote areas. Losses to people in regional areas will depend on the range of a potential future scenarios. We have set out the basis for the presented potential loss under a 82 MHz and 92 MHz cap in Section 5 of the report. Higher caps would have smaller probabilities of causing this loss as well as some probability of smaller losses. \*\*Optus is assessed as having a medium risk of not acquiring 20 MHz additional spectrum for 5G under a 112 MHz cap given that Telstra also has strong need for additional spectrum (for capacity). A 112 MHz cap could theoretically leave Optus with only 20 MHz additional spectrum including the 10 MHz proposed to be used, at least initially, for 3G continuity.*

* 1. Whether any allocation limit is imposed on sub 1 GHz spectrum may ultimately depend on how much weight is attached to ensuring that Optus can acquire 20 MHz of additional sub 1 GHz spectrum for 5G coverage, over the risks to regional service quality and the efficient allocation of spectrum. If the Minister considers that a safeguard is required for this purpose, then a **102 MHz cap would achieve this objective while limiting the risks to regional service quality and efficiency**. We find that there would be no additional benefit to competition from a lower cap while there would be costs, particularly in terms of worse mobile service quality for customers in regional areas.

**Section 2**

Key considerations in the allocation of spectrum

**Introduction**

* 1. Radio spectrum is an essential input in the provision of mobile services. The amount, frequency and cost of available spectrum is a key determinant of the quantity, variety, quality and price of services supplied to end-users. Ensuring that spectrum is licensed effectively is critical to meet rapidly growing demand for mobile data services.
	2. Australia was a pioneer in the use of market-based tools to ensure spectrum is allocated efficiently to the maximum benefit of society. A key element of a market-based approach is the use of auctions to allocate spectrum to the users that generate the greatest value to society from its use.

### Available capacity is the main driver of overall consumer benefits

* 1. The efficient assignment of spectrum together with the network investment to utilise the spectrum with more efficient mobile technologies has enabled a large expansion in network capacity. Increased capacity, in turn, has facilitated larger data allowances, increased data usage and rapid falls in price per gigabyte (GB).
		1. The ACCC notes “*a near exponential increase in post-paid data allowances for the period 2015-16 to 2019-20*”.2
		2. Australian mobile data usage per subscription grew 3.72 times between 2016 and 2019, with mobile data use in Australia being 31% above the OECD average.3 The ACCC reports that mobile data traffic grew 47% in the year to December 2019 and still grew 23% in the year to December 2020 despite the temporary impact of Covid of fewer international visitors and people spending more time at home.4 Average annual data growth between December 2018 and December 2020 was 35%.

2 ACCC, Communications Market Report 2019-20, p.35.

3 OECD, Mobile data usage per subscription.

4 ACCC Internet Activity Record Keeping Rule, December 2020 report.

* + 1. The median retail cost per GB of mobile data in 2019-20 was a small fraction of the price five years earlier, implying large benefits to consumers (see Figure 1).

#### Figure 1: ACCC estimates of median retail cost per gigabyte of mobile data

*Source: ACCC Communications Market Report 2019-20, Figure 3.22.*

* 1. Mobile data demand is expected to continue to grow rapidly in forthcoming years. An Analysys Mason report for the ACCC forecasts mobile data usage in Australia to be over 4 times higher in 2026 than 2020 and to continue rapid growth in the years to 2030 (see [Figure 2](#_bookmark5)). Ericsson forecasts mobile data traffic per smartphone to grow 28% annually between 2020 and 2026 for Oceania and South East Asia which would result in mobile data traffic being over 4 times higher in 2026 than in 2020.5

#### Figure 2: Analysys Mason projected mobile data usage



*Source: Analysys Mason, Final benchmark report for the ACCC, September 2020, Figure 17.*

5 Ericsson Mobility Report 2020, p.14.

* 1. Mobile home broadband services also offer the potential to bring network competition to fixed broadband services: “…*MNOs’ ability to offer 5G broadband plans (with comparable speeds, data allowances and prices with those on fixed line networks) means that 5G broadband services could increasingly be considered viable alternatives to fixed line broadband services*.”6 Mobile currently accounts for only around 10% of total data traffic - the pressure on operators’ capacity would intensify if mobile were to capture a larger share of total home broadband traffic.
	2. High forecast demand growth increases the importance of ensuring that spectrum is allocated to where it can be best utilised to deliver services. Where an operator faces insufficient network capacity (including for indoor and wide-area capacity needs), the operator may need to seek to limit data usage (e.g. by ending unlimited data plans, throttling data usage or raising plan prices) with the result that the price per GB increases.7
	3. VHA’s inadequate capacity during the period 2010 to 2012 (in that case from inadequate network investment to meet rising demand) led to serious degradation in customer experience with call drop-outs, no signal and slow speeds. VHA ceased to be an effective competitor with its market share dropping from 27% to 18% between June 2010 and June 20148 and resulting in long-lasting harm to its reputation. Neither consumer interests nor competition would be served by one operator having inadequate capacity to meet the needs of its customers.
	4. From a society-wide perspective, inefficient allocation of spectrum leads to a higher cost to supply mobile services because more sites will be required to supply the same volumes (or equivalently less will be supplied for the same level of prices). This shifts the supply curve to the left resulting in higher market prices and lower market volumes (see [Figure 3](#_bookmark6)).

6 ACCC Communications Market Report 2019-20, p.43.

7 For example, US mobile operators which had been offering unlimited data plans moved to introduce usage-based pricing and throttling to address congestion problems in the period 2010 to 2013 (US Government Accountability Office, *Broadband Internet: FCC should track the application of fixed internet usage-based pricing and help improve consumer education*, November 2014).

8 ACCC Telecommunications Report 2013-14, Figure 2.9.

#### Figure 3: Inefficient allocation of spectrum increases the industry cost in supplying mobile services, increasing market prices and reducing market volumes



* 1. Sub 1 GHz spectrum is particularly important for wide-area coverage and in-building coverage as well as capacity. However, 5G coverage can be achieved with relatively small amounts of spectrum. For example, in the UK 700 MHz auction this year, 3 of the operators acquired 2x10MHz of 700 MHz spectrum (with EE, the largest operator, also acquiring an additional 20 MHz of spectrum for supplemental downlink capacity). Vodafone UK decided not to acquire any 700 MHz spectrum with their CEO noting that they avoided expenditure on low band spectrum in favour of refarming their 900 MHz spectrum over time to carry 5G traffic.9 Where operators face significant wide-area traffic demand, they will need to use more sub 1 GHz spectrum and/or build additional sites.
	2. 5G competition will depend on not only coverage but the quality of the services on offer – this requires operators to have adequate capacity to meet their traffic demand.

### A framework to identify whether allocation limits are appropriate and, if so, their optimal design

* 1. In deciding on their licensing approach, governments should consider potential costs as well as benefits of particular approaches and whether there are other ways of achieving their objectives at lower cost. Key questions are:
1. Is there a market failure that might warrant departing from a market-based approach?
2. What are the benefits and costs (including opportunity costs) of setting a particular allocation limit?

9 <https://newscentre.vodafone.co.uk/press-release/boosts-spectrum-holdings-for-5g-services/>

1. How do these benefits and costs compare with those of alternative limits or other options?
	1. The UK regulator, Ofcom, has followed a similar approach in its spectrum allocation decisions (see [Figure 4](#_bookmark8)).

#### Figure 4: Ofcom’s approach to spectrum allocation



*Source: Ofcom, Digital Dividend Review, December 2007, Figure 5.*

* 1. In this report, we:
		1. consider whether the proposed limit is likely to promote efficiency particularly by assessing each operators’ likely need for additional sub 1 GHz spectrum for capacity and coverage and whether efficient auction outcomes could be distorted by any operator seeking to gain market power in the national mobile services market;
		2. evaluate whether the proposed limit would promote, or hinder, mobile services competition;
		3. assess the likely effect of the proposed limit on end-users and on the wider economic benefits of 5G; and
		4. finally assess whether alternative limits would better promote the interests of end-users.

**Section 3**

Would the proposed limit promote efficiency?

* 1. In this section, we consider:
		1. the drivers of intrinsic value for spectrum;
		2. the evidence as to operators’ likely need for additional spectrum including for (i) overall capacity, (ii) regional capacity; (iii) wide area 5G coverage and (iv) capacity for services in outer regional and remote areas requiring sub 1 GHz spectrum;
		3. whether there is a risk that Telstra may bid for spectrum above its intrinsic value to prevent other operators from acquiring spectrum; and
		4. the risk that the proposed allocation limit itself would lead to an inefficient allocation of spectrum (i.e. regulatory failure).

### The drivers of intrinsic value for spectrum

* 1. A single cellular network site enables services to be supplied within the coverage area of the site with capacity dependent on the spectrum and the efficiency of the mobile technology in use. A mobile network’s total capacity can be approximated by the product of the number of sites, the number of sectors on each site, the amount of spectrum in use and the efficiency of the technology in terms of how much throughput can be transmitted over a given amount of spectrum:10

*Total capacity = sites \* sectors per site \* MHz of spectrum \* spectral efficiency factor*

* 1. The overall capacity of an operator’s network can be increased by:
		1. Deploying more sites and, within technical limits, more sectors on each site;
		2. Deploying more spectrum; and/or

10 See also the discussion in Analysys Mason’s Report for the ACMA, *Mobile network infrastructure forecasts*, 2015.

* + 1. Deploying more efficient mobile technology in the radio access network (noting that each generation of mobile technology has been more efficient than the last, with 5G significantly more efficient than 4G).
	1. As capacity depends on the product of the amount of spectrum multiplied by the number of sites, the capacity gain from investing in additional sites will be higher the greater the operator’s spectrum. Adding spectrum increases the data capacity of a site approximately in direct proportion to the number of MHz available. This implies that an operator with more spectrum needs fewer additional sites to achieve any given increment of additional capacity,

i.e. in most cases, more spectrum leads to lower incremental costs associated with network densification.

* 1. Additional spectrum enables operators to offer unlimited data and/or additional service at lower cost. Additional spectrum and the resulting additional capacity reduce the risk of congestion and results in faster data speeds at peak times.11 Consumers are willing to pay to avoid facing reductions in their data speeds.12
	2. In a context of rapid growth in data demand, all operators will need to expand capacity sooner or later. The more subscribers an operator has and the higher their growth in data usage, the more they will need to increase their capacity. When an operator has large holdings of spectrum relative to its existing traffic, it will have relatively low costs in supporting additional traffic. This is because large spectrum holdings provide the capacity to grow traffic and reduce the need for additional sites from existing sites being congested. On the other hand, operators which have less spectrum per subscriber will require additional spectrum or face higher costs in seeking to expand capacity through new sites.
	3. The relationship between capacity, spectrum and site numbers implies that to expand the capacity of the network by 10% without new spectrum would require an operator to increase its site numbers by roughly the same percentage (assuming traffic is uniformly distributed). Given high costs attached to building new sites, this will translate into an increase in the incremental cost of providing data.13 We estimate that, for a given spectral efficiency, a 10% increase in capacity without additional spectrum would cause the incremental cost of data to

11 See Section 5.

12 For example, Telstra and Optus offer plans with differing levels of data allowances and speeds capped at 1.5 Mbps once the allowance is exceeded. By paying for a plan with a larger data allowance, customers enjoy more data at faster speeds.

13 In this regard, we are abstracting from the cost of the spectrum licence itself. Depending on whether operators regard the spectrum licence cost as a fixed cost or variable cost it may be less likely to affect pricing in the short to medium term than incremental network costs. High incremental network costs are also of concern because they could lead to inadequate network investment.

increase by at least 3%.14 With data demand growing around 30% a year, relying on sites to increase capacity can significantly impact incremental costs. Further, the operators that need to increase their capacity the most will face the highest increase in their incremental costs if they do not gain additional spectrum.

* 1. Incremental costs are a key determinant of prices for customers. In particular, operators will only want to supply additional volumes if the revenues they earn from those volumes cover their incremental costs.
	2. In sum, spectrum will be most valuable to operators that have the greatest need for additional capacity. This, in turn, depends on operators’ subscriber numbers and data usage as well as their existing spectrum. Without additional spectrum, operators will face increasing incremental costs and this can be expected to flow through into higher prices for consumers (e.g. in the form of price increases, less value for the same price and/or reduced or delayed price decreases).

### Operators’ likely need for spectrum

* 1. We assess operators’ likely need for additional spectrum with respect to:
		1. overall capacity in metro areas;
		2. overall capacity in regional areas;
		3. indoor and wide-area coverage; and
		4. capacity for services that require sub 1 GHz spectrum to be supplied.

#### Overall capacity needs in metro areas

* 1. To understand overall capacity needs of each operator, we look at the drivers of supply and demand for capacity.
	2. In metro areas, operators’ overall low and medium band spectrum holdings (i.e. spectrum up to 3.5 GHz range) is the major determinant of their ability to support additional traffic volumes

14 This is conservatively based on Ofcom’s LRIC model showing that site costs account for about 26% of the incremental cost of 4G data in the UK (i.e. 0.208 pence of 0.8 pence per MB) so that if 10% additional sites are required the incremental cost of 4G data would be about 3% higher. We expect the impact on cost of increasing the number of sites to be larger in Australia (with lower population density) than in the UK. A study by Analysys Mason for the ACCC shows that changes in spectrum holdings can have a much larger impact on costs in less densely populated countries. For example, Australia’s population density is closer to that of Sweden than the UK. Analysys Mason reports that reducing the spectrum allocation by 2×5MHz of 1800MHz spectrum and 2×10MHz of 2500MHz spectrum increases unit costs by 1% in the UK and 9% in Sweden (See, Analysys Mason, *Benchmarking the cost of providing MTAS in Australia*, 2020).

at reasonable cost. In particular, where operators face areas of high demand, the ability to install equipment to utilise low and medium band spectrum can provide additional capacity at lower cost than investing in extra sites. High population densities in metro areas imply that spectrum up to 3.5 GHz can be economically deployed across the areas.15

* 1. In metro areas, Optus has significantly more low and medium band spectrum (39% of the total) than Telstra (32%) or TPG (29%).
	2. An operator’s need for additional spectrum will be determined by not only their existing spectrum and network infrastructure, but also on the demand they face.
	3. Customers’ demand for traffic will depend on the prices they face. Operators with more available capacity will be better positioned to offer large or unlimited data allowances at relatively low prices. Overall consumer outcomes are likely to be best where each operator has the ability and incentive to not only meet their existing customers’ demand at relatively low prices but to also price to seek to acquire additional customers from rivals.
	4. To assess operators’ traffic needs, it is informative to consider both existing subscribers *and*

traffic of each operator.

* + 1. An operator will only be able to offer lower data prices if it can accommodate the extra traffic that will be stimulated from both its existing subscribers and new subscribers joining.
		2. Competition will be greatest where operators have the ability to take customers from each other. In this regard, an operator’s additional capacity needs will depend on the data usage of its rivals’ customers rather than its own.
		3. Customers with lower usage today may grow their usage faster than customers with higher current usage (e.g. parents and grandparents shifting from only calling and messaging to watching YouTube videos on their phones).
		4. We only have access to each operator’s average data traffic per user on a national basis. Thus, the estimated traffic in metro and regional areas may be distorted if there are differences between these areas in traffic usage. This is another reason to not assess capacity needs only by reference to traffic.
	1. [Table 2](#_bookmark13) shows each operators’ share of subscribers and traffic in metro areas. Telstra’s share of subscribers ([C-i-C]%) is greater than its share of spectrum ([C-i-C]%) in metro areas. In contrast, Optus and TPG have shares of subscribers ([C-i-C]% and [C-i-C]% respectively)

15 Operators have also recently acquired 26 GHz spectrum. While 26 GHz spectrum will also support 5G services, its high propagation loss requires a different network deployment and more localised use. mmWave was launched in the USA in 2019 but customers spend less than 1% of the time connected to mmWave 5G and it has been described as more similar to public WiFi than other cellular technologies (OpenSignal, *Quantifying the mmWave 5G experience in the USA*, 2021). As such, we do not consider it as part of the assessment of overall capacity for general traffic demand.

lower than their shares of spectrum in metro areas ([C-i-C]% and [C-i-C]%). Optus and TPG are likely to be somewhat better positioned than Telstra to offer larger data allowances to their customers. Consistent with this, TPG launched unlimited mobile data plans in 2020.16

#### Table 2: Operators’ share of spectrum, customers and traffic in metro areas [C-i-C]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Telstra** | **Optus** | **TPG** |
| **Share of low and mid band spectrum metro areas** | 32% | 39% | 29% |
| **Share of subscribers metro areas** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Indicative share of traffic metro areas** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and subscriber share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and traffic share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |

*Notes: Metro shares calculated with reference to shares of spectrum in Sydney, Melbourne, Brisbane, Adelaide and Perth. 900 MHz to be cleared is excluded, except for the 10 MHz reserved as set-asides for Optus and TPG. Share of subscribers in Sydney, Melbourne, Brisbane, Adelaide and Perth, based on information provided by Telstra based on Roy Morgan March 2020 data. Data weights are based on GB/month based on* [*Tefficient*](https://tefficient.com/wp-content/uploads/2021/04/tefficient-industry-analysis-1-2021-mobile-data-usage-and-revenue-FY-2020-per-operator-13-April-2021.pdf) *industry analysis as of Dec 2020 for Optus and Vodafone, and based on Telstra’s information for Telstra. Source: CL based on data from Telstra.*

* 1. In metro areas, Telstra’s share of traffic is similar to its [C-i-C]% share of spectrum. Optus has a higher share of traffic than spectrum while TPG has a smaller share of traffic than spectrum. Overall, while TPG seems to be somewhat better positioned than its rivals, we do not find large imbalances between spectrum and traffic demand in metro areas.
	2. With mobile data growing at around 30% a year, **we consider that it would be efficient for all operators to gain additional spectrum in metro areas**. In particular, this would limit the extent to which any operator faces higher incremental costs and support more competitive prices across the market.

16 “TPG Telecom CEO Iñaki Berroeta calls ‘unlimited’ data like Vodafone Infinite ‘the future’”, 27 October 2020.

#### Overall capacity needs in regional areas

* 1. Next, we consider capacity needs in regional areas. In regional population centres both Telstra and Optus make significant use of 1800 MHz spectrum and TPG, with relatively few regional subscribers, makes more limited use of the 1800 MHz band. There is also some use of 2100 MHz in regional areas while higher frequencies are used much less, reflecting the shorter propagation distances of higher frequencies. To assess overall capacity needs in regional areas, we consider operators’ share of spectrum up to and including 2100 MHz in regional areas and ignore the very limited use of higher bands in regional areas (we consider services that rely on sub 1 GHz spectrum in the next section).
	2. In [Table 3,](#_bookmark14) we compare shares of regional spectrum up to 2100 MHz (inclusive) with operators’ share of subscribers and an estimate of their share of traffic in regional areas.

#### Table 3: Operators’ share of spectrum (up to 2100 MHz inclusive), customers and traffic in regional areas [C-i-C]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Telstra** | **Optus** | **TPG** |
| **Share of spectrum up to 2100 MHz** | 50% | 26% | 25% |
| **Share of subscribers regional areas** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Indicative share of traffic regional areas\*** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and subscriber share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and traffic share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |

*Notes: \*Traffic is estimated using national averages for usage per subscriber for each operator which may overstate usage in regional areas, particularly for Optus and TPG which have customer bases more focused on metro areas. 1800 MHz spectrum holdings computed as the average across regions by operator. 900 MHz to be cleared is excluded, except for the 10 MHz reserved as set-asides for Optus and TPG. Share of subscribers based on information provided by Telstra based on Roy Morgan March 2020 data. Data weights are based on GB/month based on* [*Tefficient*](https://tefficient.com/wp-content/uploads/2021/04/tefficient-industry-analysis-1-2021-mobile-data-usage-and-revenue-FY-2020-per-operator-13-April-2021.pdf) *industry analysis as of Dec 2020 for Optus and Vodafone, and based on Telstra’s information for Telstra. Source: CL based on data from Telstra.*

* 1. In regional areas, Telstra’s share of subscribers is [C-i-C]% higher than its share of spectrum and its indicative share of traffic is also significantly higher than its share of spectrum. In the case of Optus, both the share of subscribers ([C-i-C]%) and its indicative share of traffic are relatively aligned with its share of spectrum ([C-i-C]%). Finally, TPG’s share of spectrum ([C-i-C]%) is well above both its share of subscribers ([C-i-C]%) and its share of traffic in regional areas.
	2. In sum, when comparing shares of spectrum up to 2100 MHz (inclusive) with subscribers and traffic, **Telstra and then Optus are in most need of additional spectrum in regional areas while TPG has substantial spectrum relative to its subscribers and traffic**. In the context of the rapid increase in data consumption (e.g. independent forecasts for mobile data traffic in

2026 to be 4 times traffic in 2020), if they are unable to acquire additional spectrum for capacity in regional areas Telstra and to a lesser extent Optus are likely to face significant increases in incremental costs and pressure to increase prices and/or risk service quality falling if the required investment cannot be justified.

#### Indoor and wide-area coverage

* 1. Coverage is an important dimension to competition between mobile operators.
	2. Sub 1 GHz spectrum is important to provide coverage cost effectively. However, geographic coverage can be achieved with relatively low amounts of spectrum, especially in rural and remote areas outside regional population centres where population density is low:
		1. Optus’ 4G coverage extends to 98.3% of the population. This has been achieved with its 20 MHz of 700 MHz spectrum. We therefore expect Optus could achieve a similar level of 5G coverage with an additional 20 MHz of sub 1 GHz spectrum. As noted earlier, two of the UK’s four operators are using 20 MHz of 700 MHz spectrum for 5G coverage. We understand that technically 5G coverage could be provided with as little as 10 MHz of spectrum.
		2. TPG has significant holdings of sub 1 GHz spectrum and has already started to deploy 5G in 700 MHz which will support wide area coverage of its 5G services.
		3. Telstra has 40 MHz of 700 MHz which is used for 4G and 20/30 MHz of 850 MHz which is used for 3G.17 Telstra could seek to refarm some of this spectrum for wide area 5G coverage, although it will also have to manage the large existing demand on the spectrum from current generation users.
	3. Thus, to ensure all operators can offer wide area 5G coverage, we consider that **Optus may need an additional 20 MHz (i.e. 2x10 MHz) of sub 1 GHz spectrum and that this would be sufficient for Optus to provide near-ubiquitous 5G coverage**.18 A sub 1 GHz allocation limit of up to 102 MHz is likely to facilitate this outcome, as there would be at least 40 MHz of spectrum in the auction from which Telstra is restricted from bidding, and which TPG is not likely in need of for coverage or capacity purposes.

17 Telstra also has 900 MHz spectrum which it will lose access to and, unlike Optus and TPG, will not receive a set-aside of 900 MHz spectrum.

18 The 20 MHz for 5G would be in addition to the 900 MHz set-aside which we assume Optus would use for 3G services for several more years (although as the licences do not start until 2024, Optus may use the set-aside for 5G even from 2024).

#### Capacity for services that require sub 1 GHz spectrum to be supplied

* 1. Services that require sub 1 GHz spectrum to be supplied are particularly likely to be services supplied in rural and remote areas outside regional population centres:
		1. The geographic scope of these areas in Australia is vast. Sub 1 GHz spectrum is good for covering long distances. Coverage using 1800 MHz or higher is unlikely to be economic in these areas, because of the short propagation distances of the higher frequencies.
		2. Sub 1 GHz spectrum also provides for deep inbuilding coverage, which is more relevant in built-up metro areas. However, WiFi offload helps substantially in managing inbuilding capacity needs. For example, CISCO estimates that 59% of global 4G traffic and 71% of global 5G traffic will be offloaded to WiFi by 2022.19
		3. Providing additional capacity through additional sites is also challenging in regional areas given the costs of macro towers, backhaul and electricity to remote sites as well as the difficulty of locating sites to avoid ‘black-spots’ when customers are unevenly spread out over a wide area.
	2. An Analysys Mason report for the ACMA estimated that low frequency bands which provide wide area coverage should be able to carry about 20% of the traffic in the area to ensure that cell edge users are properly supplied (see [Figure 5](#_bookmark15)). In regional areas, Area A could be equated to the centre of regional population centres with Area B being outlying areas including areas well away from regional centres. The implication of the analysis is that while high frequency spectrum can help provide capacity in more densely populated areas, operators also need to have sufficient low frequency spectrum to provide capacity for their customers located outside population centres.

#### Figure 5: Areas covered by low and high frequency spectrum

A: Area served by high frequency spectrum

B: Area served by low frequency spectrum

19 [https://wifinowglobal.com/news-and-blog/new-cisco-vni-numbers-predict-bright-future-for-wi-fi-towards-](https://wifinowglobal.com/news-and-blog/new-cisco-vni-numbers-predict-bright-future-for-wi-fi-towards-2022/) [2022/](https://wifinowglobal.com/news-and-blog/new-cisco-vni-numbers-predict-bright-future-for-wi-fi-towards-2022/)

*Source: Analysys Mason, Mobile Network Infrastructure Forecasts, Updated final report for the ACMA, 2015.*

* 1. It is difficult to estimate each operators’ capacity needs with respect to services reliant on sub 1 GHz spectrum. This is because the capacity needs should exclude traffic in regional *centres*, which can be economically supplied by higher frequency bands (e.g. the 1800 MHz and 2100 MHz bands considered in Table 3 above). However, Telstra has not only somewhat higher 4G population coverage than the other operators but also much high 4G land coverage ([Table 4](#_bookmark16)). This suggests that Telstra is likely to have a high share of the subscribers who are located outside regional population centres. While we do not have access to the highly granular data required to precisely calculate subscriber numbers outside regional population centres, we do have each operator’s share of subscribers who are located outside metro and inner regional areas, i.e. the customers in the areas the Australian Bureau of Statistics classifies as outer regional, remote and very remote20 (labelled as ‘outer regional and remote’ in this report). We use this data as an estimate of the customers who use services that can only be supplied using sub 1 GHz spectrum.

#### Table 4: Operators’ 4G population and land mass coverage and share of sub 1 GHz spectrum, customers and traffic in outer regional and remote areas [C-i-C]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Telstra** | **Optus** | **TPG** |
| **Population coverage** | 99.4% | 98.3% | 95.3% |
| **Land mass coverage** | >25% | 14% | 5.5% |
| **Share of sub 1 GHz spectrum in regional/remote areas\*** | 47% | 20% | 33% |
| **Share of subscribers located in outer regional/remote areas** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Indicative share of traffic in outer regional/remote areas** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and subscriber share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |
| **Difference between spectrum share and traffic share** | [C-i-C]% | [C-i-C]% | [C-i-C]% |

*Notes: \*Share of sub 1 GHz in regional areas, excluding 900 MHz spectrum to be cleared but including proposed 10 MHz set asides for Optus and TPG.*

*Source: Data supplied by Telstra.*

* 1. [C-i-C]. We deduce that Telstra’s higher share of subscribers in outer regional/remote areas than in regional centres and metro areas is likely to reflect reliance by customers in these areas on Telstra’s more extensive network, because they live and/or spend significant time in locations where Optus and TPG’s network have poor coverage. In metro areas where all operators have good coverage, Telstra, Optus and TPG’s subscriber shares are much closer to each other.

20 Although noting that there are also significant population centres such as Darwin which are classified by the ABS as an outer regional area.

* 1. Given pricing by the operators is set on a national basis (see paragraph 3.37 below) and given Optus and Telstra’s subscriber shares [C-i-C] (see Table 2), the extent to which Telstra has a higher share of subscribers in outer regional/remote areas than Optus’ share [C-i-C] is likely to provide a reasonable indication of the number of customers in those areas who depend on Telstra’s network for coverage / quality. On this basis, we estimate that [C-i-C] in outer regional and remote areas, some 1.4 million customers, are reliant on Telstra’s network for mobile services in these areas. The interests of these end-users may be negatively impacted by an allocation limit which prevented Telstra from acquiring sufficient low band spectrum in the auction to deliver adequate capacity to provide good service quality in outer regional and remote Australia.
	2. As well as shares of subscribers in outer regional and remote areas, we have also shown in Table 4, indicative shares of traffic in these areas based on the available data for national average data usage per subscriber for each operator.21 In addition, we show each operator’s share of sub 1 GHz spectrum in regional areas (including the proposed 10 MHz set-asides of 900 MHz for Optus and TPG).
	3. [Table 4](#_bookmark16) shows that:
		1. Telstra has very low amounts of sub 1 GHz spectrum relative to its subscribers and traffic in outer regional and remote areas;
		2. Optus’s share of sub 1 GHz spectrum is in line with its share of subscribers and somewhat below the estimated share of Optus’ traffic in outer regional and remote areas;
		3. TPG has a much higher share of 1 GHz spectrum relative to its subscribers and traffic in outer regional and remote areas.
	4. Another relevant indicator of the likely need for additional sub 1 GHz spectrum is the extent of use of the existing holdings by each operator. While Optus and Telstra appear to be extensively using their 700 MHz and 850 MHz holdings, TPG is to date still making limited use of its 700 MHz spectrum.
	5. Based on the analysis in this section, we conclude that:
		1. **Telstra has a much greater need for sub 1 GHz spectrum for capacity in outer regional/remote areas than TPG while Optus’ spectrum is not significantly out of line with its traffic**.22 By contrast, the proposed limit will prevent Telstra from acquiring any more than 10 MHz of low-band spectrum for use in outer regional and remote areas,

21 As noted earlier, this may overstate traffic in regional areas, particularly for Optus and TPG, which have customer bases more focused on metro areas.

22 Further, we have noted that there is a justification for Optus to acquire an additional 20 MHz of sub 1 GHz spectrum for 5G coverage. If Optus were to do so, then this spectrum would also significantly help meet Optus’ future capacity needs in outer regional areas.

whereas Optus could acquire as much as 60 MHz (50 MHz plus the 10 MHz set aside); and

* + 1. **A significant risk of the proposed limit is that spectrum is acquired by TPG in regional areas but that the spectrum remains poorly utilised** given they already have substantial spectrum relative to their subscribers in outer regional/remote areas and that they are to date making limited use of their 700 MHz holding. The proposed limit would allow TPG to acquire up to 30 MHz of low-band spectrum in regional areas (plus the 10 MHz set aside) and, as we explain at para 3.43 below, TPG may be able to acquire 20-30 MHz of this spectrum facing little competition.

### Is there a risk of bids being distorted by market power?

* 1. The ACCC has raised a concern that, without allocation limits, bids might be distorted by an operator seeking to gain market power by outbidding rivals for spectrum:

“…*companies with a strong existing market position will value spectrum, and the amount they will bid, based on both the spectrum’s technical and commercial value, that is, its value in providing cost-effective services to customers and the value to be gained by keeping it from competitors. This can detrimentally affect competition and the quality and price of services for mobile services customers*”.

* 1. To assess whether this is a real risk, it is necessary to consider whether any operator would have the ability and incentive to bid above the intrinsic value that they can derive from the spectrum to attempt to gain pricing power in the national mobile services market.
		1. As discussed in Section 4, the evidence shows that the Australian mobile market is generating vigorous competition including an average price per GB amongst the lowest in the OECD and ongoing significant price falls, amongst the fastest mobile speeds in the world and ongoing rapid growth in data volumes.
		2. Mobile pricing in Australia is driven by customers in the metro areas where the bulk of the population lives. That pricing and competition takes place nationally is recognised by the ACCC’s finding the relevant market is the national mobile services market and their earlier statement “*While consumers have limited choice of providers in some regional areas, they still benefit from competition in the wider national market due to uniform national pricing*.”23
		3. In metro areas, Telstra and Optus have a similar share of subscribers and Optus has a larger share of traffic (Table 2). Optus also has the largest share of spectrum in metro areas. There is no basis to expect the absence of limits in the auction to give Telstra the ability to price above competitive levels or risk monopolisation of spectrum. In fact, the

23 ACCC, Measures to address regional mobile issues, p.23.

proposed limit would perversely enable Optus to increase its share of spectrum in metro areas further above Telstra.

* + 1. Optus and TPG will also gain spectrum through the set-asides. These set-asides will be able to be used for 5G in forthcoming years in addition to the use of TPG’s large holdings of sub 1 GHz spectrum and, in metro and regional centres, the operators’ higher frequency spectrum.
	1. While Telstra would not gain any pricing power from acquiring spectrum in the auction to prevent Optus from gaining the spectrum, it would bear a large cost to do so.
		1. Given that the ACMA is not considering disclosing the identity of bidders after each round, Telstra would not be able to know if its bids were displacing TPG or Optus.
		2. To seek to prevent Optus from obtaining even 20 MHz of spectrum, Telstra would need to pay above its intrinsic value for 50 MHz of the available spectrum. Bidding for more lots than required based on intrinsic valuations would significantly increase the spectrum price faced by Telstra. In a context of a clock auction, this price increase would be multiplied by the number of lots demanded, leading to a large financial cost.
	2. The spectrum to be auctioned in the upcoming auction represents a smaller share of total spectrum available for mobile services than auctions in the past (when less spectrum overall was allocated for mobile services). Thus, it is less likely than in the past for spectrum acquisition to foreclose competition in mobile services. Further, no evidence has been presented24 that this type of bidding behaviour has occurred previously in Australia.
	3. Such a bidding strategy would come at a substantial financial cost to Telstra, [C-i-C]. However, the analysis of ability and incentive shows that it would not be rational for Telstra to adopt such a strategy.

### Risk of inefficient allocation

* 1. As discussed in the last section, auctions generally promote the efficient allocation of spectrum. To achieve this requires bidders being able to express their preferences for incremental spectrum. However, the proposed allocation limit would severely constrain the extent to which operators can bid for spectrum. This raises the risk that spectrum will be allocated inefficiently.

24 None is referred to in the ACCC’s “Allocation limits advice for the 850/900 MHz spectrum allocation”, March 2021 nor in any of the public submissions to the ACCC’s consultation and we are not otherwise aware of any such evidence.

* 1. For example, the ACMA has put forward an example where each bidder decides to bid only in one band.25 In this case, the auction design together with the current proposed allocation limit and set-asides could mean that the regulator (rather than competition in the auction) would largely determine the auction outcome. This is because:
		1. Based on the current licence boundaries and proposed allocation limit, Telstra would have incentives to bid in the 850 MHz band, to be able to acquire more spectrum in metro areas.26
		2. TPG and Optus might have incentives to bid in the 900 MHz to complement their set- asides in that band. Both Optus and TPG would be able to demand up to 3 and 2 additional lots in this band respectively, with 3 available in total. In a context of a clock auction, and regardless of the information policy adopted in the auction, both bidders could theoretically have incentives to settle the auction early to avoid driving up their prices for infra-marginal units.
	2. In this example, there would be a risk that the spectrum is not allocated to the user with the highest intrinsic value for the spectrum. Moreover, the auction could result in unsold 850 MHz spectrum in regional areas.
	3. On the other hand, given that TPG holds 850 MHz spectrum, it may want to bid in both bands to acquire the 850 MHz spectrum that Telstra is not allowed to bid for. Without competing at all for spectrum (*i.e.* bidding at the reserve price) TPG might be able to acquire 10 MHz of 900 MHz spectrum nationally, and 10 MHz (regional) of 850 MHz spectrum. It may also acquire an extra 10 MHz lot by outbidding Optus in the 900 MHz band for 1 lot. The clock auction format may facilitate Optus giving up one 900 MHz block to avoid driving up its prices.27 This could happen if, given the auction limit, Telstra and Optus were to bid in a single band. In this case, TPG would increase its regional holdings by 20-30 MHz despite its relatively small market share and area covered and already significant spectrum holdings relative to its regional subscribers.

25 See page 29 of “Draft instruments for the 850/900 MHz band auction. Consultation Paper”, April 2021, ACMA.

26 We note that, as of the date of this report, we did not have access to any confidential information about Telstra’s intention to bid in the auction or bidding strategy. The scenarios discussed in this section are entirely based on our own analysis of the available facts.

27 Consider a situation where TPG wants to acquire 10 MHz of 900 MHz additional to its set-aside, but its willingness to pay for this lot is considerably lower than Optus’ marginal value for its 4th lot of 10 MHz (including the set-aside). In the context of a clock auction, Optus might theoretically consider demanding 3 lots in total to pay the reserve price for all its lots, rather than fighting with TPG for an additional lot and increase its price of all 4 lots.

* 1. To conclude, we consider that the proposed auction limit of 82 MHz risks the inefficient allocation of spectrum, by increasing the risk of regulatory failure (relative to no limit or a higher limit) of the spectrum not being allocated to where it would deliver the greatest value to society.

**Section 4**

Would the proposed limit promote competition?

* 1. The rationale for the proposed limit is that there is a disparity in sub 1 GHz spectrum holdings between operators and that “*if this disparity is not addressed, or asymmetry in sub 1 GHz band holdings further increases it could constrain the ability of some MNOs to compete effectively in the downstream consumer mobile market*”.28 The ACCC’s advice to the Minister states “…*there is a risk that Optus may not be able to roll out 5G technology widely and efficiently in Australia in the absence of more sub-1 GHz spectrum*.”
	2. In this section, we address the following questions:
		1. Is the proposed limit likely to increase competition in the national market for mobile services compared with a higher cap or no cap?
		2. Is the proposed limit likely to lead to greater 5G rollout and greater competition in rural areas?

### Is the proposed limit likely to increase competition in the national market for mobile services?

* 1. Evidence shows that with the current spectrum holdings, the national mobile services market is working well for consumers including:

28 Exposure draft – Explanatory Statement.

* + 1. 17%-24% falls in annual feature adjusted prices and 26%-50% falls in the price per GB29 with Australia having amongst the lowest mobile data prices in the OECD30;
		2. 35% annual average growth in data demand over December 2018 to December 202031; and
		3. Australia having amongst the fastest mobile speeds in the world (nearly double the global average) with Optus overtaking Telstra in having the fastest median 5G download speed.32
	1. These outcomes are particularly driven by customers in metro areas (where 72% of the population lives) having the choice of three strong operators as well as a host of MVNOs. Roy Morgan Research found that the top two reasons for switching mobile operators are price and data inclusions,33 which explains the strong price competition.
	2. National offers ensure that customers across Australia benefit from the same prices and data allowances.
	3. As found in Table 2, in metro areas, Optus has a larger share of traffic than Telstra, a similar share of subscribers and a larger share of spectrum (noting that operators in metro areas compete using their overall spectrum holdings). TPG already has more spectrum per subscriber and per GB than Telstra. Constraining Telstra’s ability to acquire spectrum would not increase competition in the national market. The impact of the proposed limit would be to make overall spectrum holdings more asymmetric in Optus’ favour, not less.
	4. Strong price competition requires each operator to have the incentive and ability to price competitively to seek to acquire additional customers. This depends on operators’ costs of supplying incremental capacity. As discussed in the last section, operators’ incremental costs will be impacted by their spectrum holdings as the more spectrum an operator has, the greater the addition to capacity from each additional site. This means that the cost of an increment of capacity is lower because fewer sites would be needed to achieve any given increment.

29 ACCC Communications Market Report, December 2020. We note that an ACCC media release of 21 June 2021 suggests that the mobile operators have increased their prices, although it . does not adjust for increases in usage/quality benefiting customers. An examination of Telstra’s 1H21 Results shows that Telstra’s mobile ARPU (across postpaid, prepaid and mobile broadband data cards) declined 9% between H118 and H120 and declined 4% between FYJun20 and H120 – the declining ARPU has been at the same time as data usage has increased.

30 [Cable.co.uk](https://www.cable.co.uk/mobiles/worldwide-data-pricing/) reports Australia with the seventh lowest mobile data prices in 2021 among OECD members (after Israel, Italy, Chile, France, Turkey and Poland).

31 ACCC, Internet Activity RKR data.

32 <https://www.speedtest.net/global-index> and [https://www.speedtest.net/insights/blog/5g-speeds-](https://www.speedtest.net/insights/blog/5g-speeds-australia-q1-2021/) [australia-q1-2021/](https://www.speedtest.net/insights/blog/5g-speeds-australia-q1-2021/)

33 ACCC Communications Sector Market Study Final Report, 2018, p.41.

* 1. Restricting Telstra’s ability to acquire additional spectrum would increase its incremental cost of capacity. We estimate that having access to an additional 20 MHz of spectrum in metro areas would avoid increasing Telstra’s unit cost of providing data by at least 2%.34
	2. In a three operator market, competition will be strongest where all operators have incremental costs which enable them to constrain rivals’ prices to competitive levels. Imposing a cost disadvantage on one operator by restricting its access to spectrum would increase pressure on it to raise prices (and/or reduce or delay price reductions) or equivalently reduce data allowances. Reducing the competitive constraint on the other operators can also be expected to lead to them setting higher prices than otherwise.
	3. We conclude that, in constraining Telstra’s ability to acquire spectrum at auction, the proposed limit would **not increase competition in the national market**, and indeed is **likely to reduce competition** by reducing the competitive constraint on Optus and TPG that Telstra can exert.

### Is the proposed limit likely to lead to greater 5G rollout and greater competition in rural areas?

* 1. The ACCC has raised a concern that Optus requires access to additional 850/900 MHz to roll out 5G technology widely and efficiently.
	2. The Australian mobile market has delivered as good coverage as other markets, despite Australia’s low population density making commercial deployment of coverage challenging. Telstra provides 4G population coverage of 99.4% and Optus’ 4G coverage extends to 98.3% of the population. The ITU reports average 4G population coverage in 2000 in developed countries of 97%.35
	3. Australia’s 5G population coverage is also rapidly increasing, with Telstra expected to reach 75% population coverage by mid-2021 and TPG targeting 85% of the population of the top six cities by the end of 2021.36 TPG also have access to significant sub 1 GHz spectrum to support wide area 5G coverage outside metro areas. Optus currently has more than 1200 5G sites covering over 830,000 households in Australia.37

34 This estimate is based on the number of unique 4G and 5G sites, and total low and mid band frequencies based on RNFSA data provided by Telstra. In metro areas, the number of sites is relatively even across operators, making overall spectrum holdings the key determinant of capacity. In metro areas, an extra 20 MHz would imply an increase in capacity of around 7%, considering Telstra’s current spectrum holdings of low and mid band. We estimate the 2% increase in unit incremental costs using the methodology described in footnote [14.](#_bookmark11)

35 <https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2020.pdf>

36 <https://www.rcrwireless.com/20210115/5g/telstra-5g-network-reaches-50-australian-population>

37 [You don’t need Australia’s fastest 5G…until you do (optus.com.au)](https://www.optus.com.au/about/media-centre/media-releases/2021/04/You-dont-need-Australias-fastest-5-until-you-do)

* 1. As noted in the previous section, Optus gaining access to 2x10 MHz of sub 1 GHz spectrum for 5G would support Optus’ widespread deployment of 5G. With access to 20 MHz of spectrum for spectrum, Optus can be expected to compete in 5G for 98.3% of the population (i.e. the same reach as its 4G coverage).
	2. The final 1.7% of the population live in the most remote parts of the country where the economics for any operator to provide coverage are very challenging. For Telstra to cover an additional 0.9% of the population compared to Optus, Telstra has to cover almost twice the land mass covered by Optus. That is a substantial expenditure on additional sites and related costs for relatively few subscribers. The economics would be even worse if instead the subscribers in the area were split between two or more operators.
	3. The quality of 5G services on offer will also depend on operators having sufficient network capacity. As shown in Table 4, Telstra has less sub 1 GHz spectrum in outer regional and remote areas relative to its subscribers and traffic than TPG or Optus. With forecast ongoing rapid growth in Australia’s mobile data traffic, Telstra’s network can be expected to come under increasing pressure. TPG, and to a lesser extent Optus, would have a better ability to accommodate increasing demand given their spectrum holdings and smaller customer bases in regional areas.38
	4. Despite the fact that Telstra has the smallest quantity of sub 1 GHz spectrum relative to its subscribers in outer regional and remote areas, the proposed limit would result in Telstra’s post auction share of sub 1 GHz spectrum in regional areas being reduced compared with its pre-auction shares. At most, Telstra’s share of sub 1 GHz spectrum after the auction will be 40%. Currently, Telstra’s share of sub 1 GHz spectrum (including its 900 MHz spectrum) is 48%.
	5. The effect of Telstra being deprived of spectrum in regional areas would be to require Telstra to rely heavily on site densification, if it is to provide the required additional capacity. This is likely to significantly increase Telstra’s incremental cost of capacity. For services reliant on sub 1 GHz spectrum, an additional 20 MHz spectrum would allow Telstra to increase its sub 1 GHz spectrum holdings by 29% and hence its capacity by a similar amount. In the absence of this spectrum, an equivalent increase in capacity would require Telstra to increase its sites by a similar proportion. Based on Telstra’s 4G and 5G sites used with sub 1 GHz spectrum in outer regional areas and Telstra’s average cost per site, relying on site densification to achieve the same capacity as an additional 20 MHz of spectrum would require Telstra to incur capex of [C-i-C]39 in outer regional areas.

38 The traffic figures in Table 4 show that Telstra has [C-i-C] the traffic of Optus and [C-i-C] the traffic of TPG in outer regional/remote areas. Thus, assuming that the traffic of each operator grows by the same percentage, Telstra would need to increase its capacity by [C-i-C] as much as Optus would and by [C-i-C] as much as TPG would.

39 [C-i-C].

* 1. The resulting high incremental cost of traffic for Telstra in regional areas **may mean that the investment is not justified at national prices**. In this case, Telstra would instead face congestion and declining quality. This is likely to directly harm customers reliant on Telstra (as we discuss in the next section). It would also be likely to harm competition and overall consumer outcomes. In particular, when one operator is constrained, it will have less incentive to price to acquire customers. Indeed, it may need to raise prices or limit usage to ration demand.
	2. We have also assessed, using a stylised model of operator competition, what would be the expected impact on consumer welfare where the largest operator in the market with the best coverage becomes capacity constrained. The model is set out in Annex B and solves for the market equilibrium. We find that **the effect is to reduce overall consumer welfare**. This reflects two factors: first, some consumers will not be able to choose their preferred operator; second, because other operators are at less risk of losing customers, they also increase their prices. This shows that it is wrong to assume that engineering more symmetric outcomes will benefit consumers. What determines prices and consumer outcomes depends on the incentives and constraints faced by each operator. Constraining one operator from being able to acquire additional customers weakens, rather than strengthens, market competition.
	3. **No cap or a significantly higher cap** than the proposed cap of 82 MHz would reduce the risk of Telstra being capacity constrained, hence **better support strong 5G competition and rollout** through all operators being positioned and incentivised to compete for additional 5G subscribers against each other.

**Section 5**

Would the proposed limit promote consumer benefits and wider economic benefits?

* 1. In this section, we assess the likely effect of the proposed limit on consumers and on the wider economic benefits of 5G in regional areas (where sub 1 GHz spectrum is of key importance).
	2. Spectrum holdings have a direct relation with network quality. The larger the number of users in a network, for a given amount of spectrum, the lower the average speed for users. In particular, (a) the amount of spectrum determines peak speeds, and (b) network speeds decrease as the number of active users in the network increases. In Australia, 4G speeds at the busiest times in 2019 were 37% slower than at the quietest times (i.e. 31.5 Mbps versus

50.3 Mbps).40 Greater congestion in other countries results in significantly slower speeds than in Australia.

* 1. In relation to sub 1 GHz bands:
		1. Peak speeds are mainly driven by the amount of spectrum available in each single sub 1 GHz band.
		2. If an operator holds spectrum in more than one band, this will improve the ability to maintain good speeds as the number of active users increases, but will not increase peak speeds materially, as the latter is driven by the amount of contiguous spectrum in a single band.41
		3. [Table 5](#_bookmark26) provides illustrative figures on the relation between speeds and spectrum in sub 1GHz bands.

40 OpenSignal, *The 5G Opportunity*, February 2019.

41 *See* Table 5 and the sources for the Table.

#### Table 5: Throughput/user speeds (Mbps) by combinations of Sub 1 GHz spectrum and number of active users per cell

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Spectrum downlink/ throughput** | **1 user** | **2 users** | **10 users** | **20 users** | **30 users** |
| **10 MHz (850 MHz)** | 9 Mbps | 7 Mbps | 3 Mbps | 2 Mbps | 1 Mbps |
| **20 MHz (850 MHz)** | 17 Mbps | 14 Mbps | 6 Mbps | 4 Mbps | 3 Mbps |
| **20 MHz (850 MHz) +****20 MHz (700 MHz)** | 20 Mbps | 17 Mbps | 9 Mbps | 6 Mbps | 5 Mbps |

*Source: Based on a M/G/1 processing sharing rate formula provided by Telstra based on A. Kherani, “Stochastic models for throughput analysis of randomly arriving elastic flows in the Internet”, Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings. IEEEVolume: 2 and J. Salo, “LTE Radio Load versus user throughput”. For 20 MHz of 850 MHz and the numbers of users ‘U’, throughput is calculated as equal to 20\*1.25\*(1-(U/1/(U/1+1)))/(U/1/(U/1+1))\*LN(1/(1-(U/1/(U/1+1)))).*

* 1. [Table 5](#_bookmark26) shows that an operator with 10 MHz and 10 active users in a cell served with 850 MHz spectrum is likely to achieve similar speeds than another operator with twice the amount of downlink spectrum and twice the number of subscribers.
	2. We have found that in regional areas where sub 1 GHz spectrum is critical, Telstra has a much larger share of users and traffic than the other operators. To handle a larger number of active users, Telstra’s network requires a larger amount of spectrum in regional areas than the other operators. In this context, the proposed limit significantly increases the risk of congestion impacting Telstra’s services (while giving more opportunity to acquire spectrum to Optus and TPG despite their much lower risk of congestion).
	3. With reference to the example discussed in paragraph [3.44,](#_bookmark21) under the proposed cap, TPG would be able to acquire 10 MHz of 850 MHz spectrum and 10 to 20 MHz of 900 MHz spectrum facing little competition. This outcome would leave TPG with 60-70 MHz (30% and 35% share of total sub 1 GHz spectrum) in regional areas, where its share of subscribers is less than [C-i-C]%. In contrast, Telstra, whose share of subscribers in regional areas is [C-i-C]% would need to supply services to those subscribers with only 40% of the sub 1 GHz spectrum.
	4. TPG already has substantial spectrum in regional areas to both grow its share of subscribers and provide high speeds. Further, it has relatively limited network infrastructure in regional areas to date, leaving its regional spectrum unused in many locations. As such, there would be little, if any, benefit if the proposed limit resulted in TPG gaining additional spectrum in regional areas. Optus’ spectrum is more balanced relative to its subscribers and traffic in regional areas suggesting that it is not at a high risk of congestion but that it could generate value from some additional spectrum.
	5. In contrast, the proposed limit significantly increases the risk of Telstra’s subscribers suffering congestion. For example, [C-i-C].42
	6. While congestion in Telstra’s network might lead to some customers switching to TPG, this will not be an option for customers in the regional areas where TPG has poor or no coverage. Further, as discussed in Section 4 and Annex B, degrading the quality of Telstra’s services would likely lead to worse overall consumer outcomes compared with all operators having the spectrum required to compete at low price and high quality.
	7. While it is also possible to gain additional capacity through site densification, in regional areas this would require the costs of macro towers and backhaul to remote sites and the challenge of locating sites while minimising blackspots where customers are distributed unevenly across wide areas. Further, where an operator has less spectrum, it means that they get less additional capacity for each additional site they deploy. These constraints imply a high cost of achieving incremental network capacity in such circumstances which may not be justified based on national prices determined in metro areas.
	8. In short, in a context of rapid increase in data consumption, the proposed limit carries a significant risk of reduced network speeds, poorer quality services and a poorer customer experience.

### Loss of wider economic benefits

* 1. Constrained network capacity available for 5G in regional areas also puts at risk the large potential benefits of 5G from use cases which depend on access to high speeds, low latency and high reliability. These use cases include:
		1. Ultrafast broadband connectivity in regional areas to deliver better services for home and businesses customers including high definition video streaming and video calls;
		2. Handling large numbers of devices which use high volumes of data in localised areas such as drones used in agriculture to help in the movement of livestock; and
		3. Mission critical services that require high reliability, ultra-low latency connectivity with strong security and availability such as telemedicine and remote education as well as the monitoring and control of driver-operated and autonomous vehicles used in agriculture, construction, mining and disaster relief.
	2. IHS Markit has estimated the additional industry output from the application of 5G in different industries ([Table 6](#_bookmark28)). They estimate that 5G could increase global real output by around 5% in 2035. McKinsey estimates that 5G in use in mobility, healthcare, manufacturing and retailing

42 We take as reference the example of 20 MHz (850 MHz) + 20 MHz (700 MHz) for Telstra and 20 MHz (850 MHz) for TPG. We take the latter as a conservative approximation of download speeds for a combination of 15 MHz (700 MHz), 10 MHz (850 MHz) and 5-10 MHz (900 MHz).

could increase expected GDP relating to these industries by 3.5% to 5.5% by 2030.43 The Bureau of Communications and Arts Research in a 2018 study estimated that 5G could deliver additional GDP per capita of A$1,400 to A$2,000 by 2030 (in real 2015-16 terms) and more in later years.44

#### Table 6: Expected increase in economic activity from 5G applications

*Source: IHS Markit, The 5G economy, November 2019.*

* 1. In regional areas, applications in the following industries are likely to be most relevant: agriculture, forestry and fishing, construction, education, health and social work, information and communication, mining and quarrying, public services and transport and storage:
		1. We conservatively estimate that around 23% of the value of 5G activity across these industries are likely to depend on having high service quality in terms of speed, latency and reliability (calculated assuming 100% of mission critical services, 50% of enhanced mobile bandwidth services and 25% of massive IoT services will depend on having adequate capacity to deliver high service quality and based on estimated splits of industry benefits between the 3 types of 5G service).
		2. Further, we estimate that 38% of the benefits in these industries will arise in regional areas (calculated assuming 100% of agriculture, forestry and fishing and mining and quarrying

43 McKinsey, *Connected World: An evolution in connectivity beyond the 5G revolution*, 2020.

44 Bureau of Communications and Arts Research, *Impacts of 5G on productivity and economic growth*, 2018, Table 5.

is in regional areas and 28% of the value for the other industries is in regional areas in line with their share of the population).

* + 1. On this basis, we estimate that around **9% of the overall economic benefits of 5G** will depend on having adequate capacity to support high service quality in regional areas.
	1. We estimate that the value of 5G benefits in regional areas which depend on high service quality could be around $8.6 billion annually by 2035 in 2021 dollars (i.e. 9% of the 5% increase in GDP expected from 5G by IHS ):45
		1. This is equivalent to around **1.4% of GDP in regional areas** each year46 and to **$1,210 per person a year** (in 2021 dollars) in regional areas from 2035.
		2. In earlier years, the benefits would be a proportion of this amount, increasing over time as 5G take-up and applications increase. If we use the Bureau of Communications and the Arts estimate of the gain in GDP per capita from 5G by 2030 and again assume 23% of that gain is dependent on high service quality, this would represent benefits of **between**

**$356 and $509 per person per year** by 2030 (in 2021 dollars) which are dependent on high service quality in regional areas**.**

* + 1. We consider that the 5G benefits which rely on high service quality in outer regional and remote areas are likely to represent a similar percentage of the GDP of those areas and a similar benefit per person.47
	1. We consider the proposed limit puts at risk these 5G benefits in outer regional and remote areas because:
		1. [C-i-C]. The ability to acquire only 10 MHz of spectrum at auction in regional areas significantly raises the risk of congestion (noting also that Telstra will be required to hand back its existing 900 MHz spectrum, leaving it with less spectrum in regional areas that it has currently).
		2. It is unlikely to be economic for Telstra to invest in sites in regional areas to sufficiently compensate for the impact of scarce spectrum on service quality, because the high cost

45 This is based on ABS data on GDP to 4 quarters to March 2021 and effectively assumes that long run GDP will grow at the same rate as the social discount rate.

46 Based on the ratio of regional to national GDP from https:/[/www.s](http://www.sgsep.com.au/assets/main/Publications/SGS-Economics-and-Planning_Economic-)g[sep.com.au/assets/main/Publications/SGS-Economics-and-Planning\_Economic-](http://www.sgsep.com.au/assets/main/Publications/SGS-Economics-and-Planning_Economic-) Performance-of-Australian-Cities-and-Regions.pdf

47 This is because most of the benefits have been calculated based on the share of the population. For agriculture, forestry and fishing and mining and quarrying, we assume that the split of the benefits between inner regional and outer regional/remote is in line with the split of GDP between these areas.

of incremental capacity through site densification in regional areas is not likely to be justified at national prices set in metro areas;

* + 1. The economics for any operator to provide coverage in the most remote parts of the country are very challenging, involving substantial expenditure on additional sites and related costs:
			1. There is no evidence that lack of spectrum is holding TPG back from significantly expanding into outer regional and remote areas, given that they have large regional spectrum holdings relative to their subscribers and traffic.
			2. While Optus can be expected to reach 5G population coverage similar to its 4G coverage, its lower subscriber share in regional and remote areas than in metro areas likely reflects its more limited network investment in outer regional and remote areas. This is likely to limit the extent to which customers will be able to rely on high quality Optus services in these areas, even if Optus is able to acquire substantial additional amounts of low band spectrum in the auction.
		2. Constraints on Telstra’s ability to support high quality 5G services will clearly impact the end-users living in areas only served by Telstra. Based on current 4G coverage, over 1 million square kilometres in regional Australia are only served by Telstra, with these areas containing close to 300,000 people. However, as estimated in Section 3, around 1.4 million people in outer regional and remote areas are likely to rely on Telstra’s network because of the poor coverage of the other networks in the areas where they require mobile service.
	1. In summary, the proposed limit can be expected to reduce the quality of 5G services available in outer regional and remote areas, putting at risk the large potential benefits of 5G in regional Australia. We quantify the estimated value of the harm that may be caused (in 2021 dollars) at **a loss to 1.4 million end-users of $356-$509 per person per year by 2030 and up to**

#### $1,220 per person per year by 2035 or total losses to people in outer regional and remote areas of $488 million to $697 million per year by 2030 and of $1.7 billion per year by 2035.

* 1. No cap, or limit of 102 MHz or more, would significantly reduce this risk, by increasing the opportunity for Telstra to acquire sufficient low band spectrum in the auction to support high quality 5G services in regional and remote areas. Telstra’s network being constrained and with declining quality in regional areas would also weaken the competitive constraint on the other operators in these areas, which could lead to worse outcomes for customers and the economy in regional areas more generally. Again, no cap or a higher cap of 102 MHz or more would mitigate this risk.

**Section 6**

Would alternative limits better promote consumer benefits?

* 1. The evidence indicates that:
		1. Telstra’s need for additional spectrum in the 850/900 MHz auction for capacity particularly in regional areas is greater than that of Optus and TPG; and
		2. no operator, including Telstra, would have incentives to bid more than their intrinsic value for spectrum in the auction.
	2. This suggests that (i) there is no reason to impose allocation limits in the auction, and (ii) the limit currently proposed risks regulatory failure in the form of spectrum being assigned inefficiently with significant harm to competition and end-user benefits, particularly for end- users located in outer regional and remote areas.
	3. If the Minister is nonetheless minded to impose allocation limits, we consider that the interests of end-users will be best promoted if these are restricted to:
		1. the proposed 900 MHz set-asides for Optus and TPG for service continuity reasons; and
		2. a sub 1 GHz limit of 102 MHz, which would:
			1. ensure that Optus has the opportunity to acquire at least 20 MHz of additional low band spectrum for 5G (as well as the 10 MHz set aside), regardless of Telstra’s bids in the auction;
			2. provide Telstra with the ability to acquire 30 MHz of low band spectrum, making it less likely that capacity constraints would negatively impact the quality and cost of its services and the competitive constraint it exerts on the other operators; and
			3. carry a lower risk of spectrum being allocated to TPG in spite of it not being the user with the highest intrinsic value for the spectrum.
	4. In particular, if the Minister attaches a high weight to ensuring that Optus can acquire 20 MHz of additional sub 1 GHz spectrum for 5G coverage, then a 102 MHz cap would achieve this objective while carrying less risk to regional service quality and the efficient allocation of spectrum than a low cap.
	5. Our assessment is based on comparing alternative levels of a sub 1 GHz cap (i.e. 82 MHz, 92 MHz, and 112 MHz), against the three public policy objectives that we consider are most relevant to this choice:
		1. Minimising the risk of harm to service quality in outer regional and remote areas from any operator having low spectrum relative to its traffic;
		2. Promoting competition by ensuring that all 3 operators obtain adequate spectrum for wide area 5G coverage;
		3. Promoting efficient spectrum allocation through competition in the auction and thereby reducing risks of higher industry costs and prices and lower quality.
	6. All three objectives are relevant to overall consumer welfare. Consumer benefits will be higher when the spectrum is allocated to the user that has the highest intrinsic value for it. This relates to objectives (a) and (c) above. In addition, consumers are likely to benefit if all three operators offer wide area 5G coverage. This relates to objective (b).
	7. All of the alternatives for the cap will constrain Telstra to some extent to reach a level of spectrum share consistent with its share of the traffic in outer regional areas. [C-i-C]. All other operators will have an opportunity to exceed their shares of traffic with all the alternatives under consideration. Thus, the first objective suggests using the largest possible cap (or no cap).
	8. In terms of ensuring all 3 operators have adequate spectrum for wide area coverage, there is only a risk with respect to Optus. As found by the ACCC, both TPG and Telstra already have sufficient sub 1 GHz spectrum to launch 5G services in regional areas.48 Optus is likely to have a higher value for additional spectrum than TPG due to its higher market share and lower available spectrum. However, given that Telstra is likely to have a high intrinsic value for spectrum in regional areas, it is theoretically possible that Optus might not be able to acquire 20 MHz of sub 1 GHz spectrum with a cap of 112 MHz (this cap would allow Telstra to buy up to 40 MHz, leaving only 10 MHz available to Optus after subtracting the 2 x 10 MHz set asides for Optus and TPG). A cap of 102 MHz (or lower) would ensure that, regardless of Telstra’s bids, Optus can acquire at least 20 MHz of sub 1 GHz spectrum (additional to the set-aside) in the auction for 5G coverage, and at least 20 MHz of contiguous spectrum in a single band in regional areas.
	9. With respect to achieving the third objective of promoting the efficient allocation of spectrum through competition in the auction, caps of 82 MHz or 92 MHz pose the greatest risk. As discussed in paragraphs [3.42](#_bookmark19) and [3.43,](#_bookmark20) the 82 MHz cap, in combination with the set-asides and the auction design create a risk of inefficient allocation in the auction, where TPG is able to acquire spectrum facing limited or no competition whatsoever. Such a risk does not disappear with a 92 MHz cap. With such cap, to achieve contiguity, Telstra is likely to focus

48 See Table 1 of ACCC’s “Allocation limits advice for the 850/900 MHz spectrum allocation”, March 2021.

on the 850 MHz band, and TPG and Optus are likely to focus on the 900 MHz band, to complement their set-asides. In this scenario, competition in the auction would be limited, and final allocations heavily influenced by the auction set-up. A cap of 102 MHz, however, overcomes this risk. Telstra would be able to bid for 30 MHz in 900 MHz band, which might be a reasonable alternative to having 20 MHz of 850 MHz contiguous to its pre-existing holdings. This is likely to create greater substitution between bands, and to promote an outcome that is based on which bidder values the spectrum the most.

* 1. A 102 MHz cap is the only available option that ranks well in all three dimensions. A 102 MHz cap would allow for all three operators to acquire some additional spectrum, and would better promote consumer benefits by helping each operator to meet the rapidly growing demand of their customers. Telstra would be able to acquire at most 30 MHz of the available 70 MHz of spectrum being auctioned in regional areas.
	2. By enabling Telstra to address its relative shortage of spectrum in regional areas, a 102 MHz cap (or a higher cap) can also be expected to lead to higher speeds and greater network reliability in regional areas. For example, we estimate that Telstra’s peak speeds in hard-to- reach areas could increase by 25%. We also estimate that having access to an additional 20 MHz will allow Telstra to offer a given download speed to approximately 25% more active users in a site than the number of users it would be able to offer that same speed to without the additional spectrum. This can also be expected to support innovative 5G applications, particularly mission critical services and enhanced mobile broadband, which require higher speeds and reliability.
	3. The ACCC has proposed allocation limits on the basis of a concern to ensure that Optus is able to acquire sub 1 GHz for 5G coverage. This concern can be addressed through a 102 MHz cap, without the harm to end-users particularly in regional areas that would result from a lower cap depriving Telstra of needed spectrum. Optus is as large as Telstra in metro areas and will be able to acquire spectrum if it needs to expand its spectrum portfolio. In regional areas, a 102 MHz cap would give Optus the opportunity to acquire at least 30 MHz of spectrum (including the 10 MHz set-aside and an additional 20 MHz) regardless of Telstra’s bids.
	4. Under a 102 MHz cap, no operator would be able to acquire pricing power (which is highly unlikely anyway given that it depends on market power in metro areas) and, as such, bids can be expected to reflect the intrinsic value that each operator is able to generate from the spectrum. Moreover, bidders will have greater flexibility to express their preferences for spectrum in the auction. This will help avoid the risk of inefficient allocations due to artificially depressing demand for spectrum.
	5. By promoting the allocation of spectrum more in line with operators’ traffic needs, a 102 MHz cap can also be expected to avoid any operator facing significantly higher incremental costs of capacity than others. This can be expected to support higher investment as incremental costs of capacity are less likely to exceed the costs able to be recovered at national prices as well as lower prices to consumers at the margin.
	6. For these reasons, we consider that a 102 MHz cap would better promote the overall interests of end-users than a lower cap. However, we note that a focus on efficiency and quality in regional areas would support a higher cap or no allocation limit.

Annex A: Compass Lexecon and the report authors

Compass Lexecon advises on issues related to competition policy, litigation, international arbitration, intellectual property and regulation, across all industries. Established in 1977, Compass Lexecon has over 500 professional staff globally, including 175+ Ph.D. economists in 23 offices. Our experts have advised clients in the most high-profile cases before regulatory agencies and courts in 90+ countries and worked for 49 of the current Fortune 50 companies.

Our practices are led by some of the most respected economic thinkers in the world, including:

* Two Nobel Prize Winners in Economics;
* One former Chief Competition Economist at the European Commission;
* One former Chief Economist at the UK Competition Commission (now the CMA);
* Six former Deputy Assistant Attorney Generals for Economics at the U.S. Department of Justice;
* One former Chief Economist at the Hong Kong Competition Commission;
* One former Chief Economist at the Federal Trade Commission; and
* Two former Chief Economists at the Federal Communications Commission.

Our awards include:

* Named Competition Economics Firm of the Year 2020 by Who’s Who Legal;
* Ranked as the top expert witness firm globally in the Global Arbitration Review’s 100 Expert Witness Firms Power Index in 2018 and 2019; and
* Ranked as a world-leading economic consultancy in the Global Competition Review, described as *“the behemoth among the other consultancies”* and *“the head of the pack by far”.*

Paul Reynolds and Dr Alejandro Lombardi are the lead authors of this report.

Paul Reynolds is a Senior Vice President in Compass Lexecon’s London office. Paul is an expert in the economics of competition law, regulation and damages, with over 25 years’ experience in economic and financial analysis. Paul has assisted firms and lawyers in responding to investigations by national regulatory and competition authorities, the European Commission and in court proceedings and international arbitrations. He has had expert

testimony accepted by the UK Competition Appeals Tribunal and the Australian Competition Tribunal.

Paul has advised extensively on spectrum licensing including being the lead author of a report for the GSMA on best practice in spectrum licensing, acting as an expert for Hong Kong Telecom in cases before the Hong Kong High Court concerning the competition issues in 900 MHz and 1800 MHz licensing and an issue relating to CDMA licensing, advising on spectrum licensing court cases in the UK and on competition limits in the Dutch 2010 auction. Paul was previously a director at the ACCC. His CV and bio are available [here.](https://www.compasslexecon.com/professionals/paul-reynolds/)

Dr Alejandro Lombardi is a Vice President in Compass Lexecon’s Buenos Aires office. Alejandro specializes in the analysis of complex economic problems in the context of economic disputes and regulatory processes. He has advised on issues of regulation, antitrust and competition for governments and private businesses, and the quantification of damages in investment treaties and contractual disputes. Alejandro has also consulted on auction design and bidding strategy in the context of spectrum and broadcasting rights auctions in several countries. He has worked on a wide range of industries, with special focus in the Telecommunications industry. His CV and bio are available [here.](https://www.compasslexecon.com/professionals/alejandro-lombardi/)

## Annex B: Note on the bright side of relaxing incumbents’ capacity constraints

By Salvatore Piccolo, Paul Reynolds and Alejandro Lombardi49

Abstract: In this note we show with a stylized oligopoly model how relaxing the capacity constraint of the largest firm can benefit consumers by enabling more customers to choose products closer to their preferences and by increasing competitive pressure on rival firms leading them to reduce prices to their customers

#### Model Set-up

Consider a market in which three firms (each denoted by 𝑖 = 0;1;2) produce at a constant marginal cost, which we normalize to zero without loss of insights, and compete by setting prices for their differentiated products. All the three firms have a capacity k > 0. Firm 0 is an established incumbent whose product consumers value more than the rivals (i.e., firms 1 and 2), such as a mobile operator offering superior coverage. There is a representative consumer whose preferences are described by a modified version of the standard Shubik-Levitan (1980) quadratic utility function, i.e.,



where 𝜃 ≥ 0 is an exogenous parameter capturing the incumbent’s superior product quality, while 𝑑 ≥ 0 captures the degree of differentiation between products, which may, for example, reflect consumer switching costs.

Maximizing with respect to quantities, we have the following system of first-order conditions:



whose solution yields the following system of demand functions:

49 Salvatore Piccolo is Professor of Economics at the University of Bergamo and an academic affiliate of Compass Lexecon. Paul Reynolds and Alejandro Lombardi are a Senior Vice President and Vice President of Compass Lexecon respectively.



whose solution yields the following system of demand functions:



Firms set prices simultaneously.

#### Model Solution

We first consider the case in which the incumbent is not constrained by its capacity, then we derive the conditions under which the capacity constraint binds and derive the equilibrium in which the incumbent produces at its capacity and the relevant comparative statics.

* 1. *Unconstrained Equilibrium*

Suppose that in equilibrium capacity constraints do not bind. Each firm 𝑖 solves

Max *qi* ( )*pi:*

𝑝𝑖 ≥ 0

It is easy to show that the game features a unique equilibrium such that



With  since consumers’ willingness to pay is higher for the incumbent’s product. Moreover,  is increasing in the incumbent’s quality advantage parameter 𝜃, while the equilibrium price of the rivals 𝑝∗ is decreasing in 𝜃.

𝑖

This equilibrium does not satisfy the capacity constraint *k* when,



that is, when



which is positive if 𝑘 > 1 i.e., capacity constraints do not bind when products are homogeneous

3

( → +∞) and firms are symmetric (𝜃 = 0). Notice that 𝜃∗ is increasing in *k*, meaning that as

the capacity of the network increases, it becomes less likely that the constraint will not be satisfied.

Essentially, 𝜃∗ < 𝜃 implies that the incumbent hits the capacity constraint when consumers’ preference for the incumbent’s product is sufficiently large.

* 1. *Constrained Equilibrium*

Suppose that 𝜃∗ > 𝜃. Hence, given the equilibrium price charged by firms 1 and 2, say 𝑝∗∗

firm 0’s price must solve

𝑞0(𝑝0, 𝑝∗∗, 𝑝∗∗) = 𝑘

This is



Hence,

 (1)

Where instead 𝑝∗∗ must satisfy firms 1 and 2 best reply functions, *i.e.*,

 (2)

Solving (1) and (2) simultaneously, we thus have



And



Notice that *p \*\** and *p\*\** are decreasing in *k* – i.e. the less binding the capacity constraints, the lower prices since the incumbent competes more aggressively with rivals long the vertical differentiation dimension.

*o*

We can then study how *k* affects consumer surplus. Let:



Then



Substituting the equilibrium values into *U\*\** (*k*), we can show the following



Hence, consumers benefit from an increase in *k*. The intuition is as follows: when the capacity constraint becomes less binding, as reflected by a higher *k*, the incumbent can produce more which benefits consumers for two reasons. First, the relaxation of the constraint enables them to choose more of the product they prefer. Second, because of the higher risk of losing customers, rivals reduce their prices, which benefit the consumers that continue to buy the products supplied by firms 1 and 2. Therefore, relaxing the constraint increases overall consumer welfare.