

The logo for Optus, consisting of the word "OPTUS" in a bold, teal, sans-serif font.

Submission in response to
ACMA Consultation Paper

**Expiring spectrum
licences: stage 2**

**Information gathering, and
views on uses of
frequency bands and
alternative licence
conditions**

Public Version

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Section 1. EXECUTIVE SUMMARY

- 1.1 Optus welcomes the opportunity to provide feedback to the Australian Communication and Media Authority's (ACMA) consultation paper on its *Expiring spectrum licences: stage 2 Information gathering, and views on uses of frequency bands and alternative licence conditions* (the Consultation Paper).
- 1.2 The purpose of this consultation is for the ACMA to gather information from stakeholders that will inform its preliminary view on whether arrangements governing the use of spectrum under expiring spectrum licences (ESLs) remain fit for purpose as well as to inform advice to the Minister on alternative licence conditions and network resilience and disaster response objectives in the context of ESLs.¹
- 1.3 Mobiles services are essential services, and mobile infrastructure is critical national infrastructure. Many vital services rely on mobile networks, including emergency services, banking, and everyday work. While the Government and the ACMA recognises telecommunications as an essential service, no reference is made to the essential nature of mobile services in the context of ESLs; and there remains no presumption of renewal for ESLs. This jeopardises the safety and security of our communities and is the single largest risk to the predicted economic and job growth.
- 1.4 Existing arrangements for access to spectrum under ESLs have delivered unrivalled public benefit for the Australian economy and broader society. The annual economic uplift due to 5G mobile services amounts to \$30-60 billion in 2030.² Ongoing access to ESL spectrum is required for mobile network operators (MNOs) to continue to deliver the economic, social and public safety benefits of mobile services.
- 1.5 Access to ESL spectrum has resulted in Australia being a leader in 5G, with MNOs having deployed over 9000 5G base stations that supply data throughputs that rank among the best in the world.³ Optus 5G network now reaches 80.5% of the population across 4000 sites.⁴ Optus' 5G service performance consistently leads the market in terms of speed and customer experience.⁵ Since the last ESL process, Optus rapidly deployed its 4G mobile network across regional and into remote parts of Australia.⁶
- 1.6 ESL renewal will be in the era of IMT-2030 or "6G" and "ubiquitous connectivity", when mobile and satellite are able to seamlessly connect – making early certainty of renewal at a nominal price essential to ensure Australia realises these benefits.
- 1.7 Renewal of ESLs will enable MNOs to continue to supply essential public communications services and deploy networks and equipment to respond to ongoing increases in demand for data. It will enable Optus to continue to innovate in services and invest in critical infrastructure that underpins our future economy and security.

¹ Michelle Rowland MP to ACMA Chair Nerida O'Loughlin PSM; 14 December 2023

² AMTA, 2021, 5G Unleashed; Optus, 2021, 5G Impact; PwC, 2020 Global Impact of 5G; CSIRO, 2018; BCAR, 2018, Impacts of 5G on productivity and economic growth.

³ ACCC Mobile Infrastructure Report 2023, p.3

⁴ [Optus reports stable earnings and mobile growth in FY24](#)

⁵ [Australia, April 2024, Mobile Network Experience Report | Opensignal](#)

⁶ [Network \(optus.com.au\)](https://www.optus.com.au)

Existing ESL arrangements will continue to deliver public benefit to Australia

1.8 The use of ESL spectrum for mobile services will remain central to meeting the communications needs of all Australians. Optus' planned use of ESL spectrum promotes the long-term public interest and:

- (a) **Facilitates efficient use of the spectrum** – ESL spectrum is already efficiently allocated and mobile technologies are the optimal users of spectrum. There is no evidence that alternative uses produce greater public benefits. Mobile services deliver unparalleled economic uplift, access to essential services, and support broader investment and innovation across the Australian economy.
- (b) **Promotes investment and innovation** – Optus has invested billions in acquiring spectrum to support the deployment of its national multi-billion-dollar mobile networks and services.

Optus is highly innovative in its use of spectrum – our recent agreement with SpaceX promotes the use of our national FDD spectrum in previously unserved areas and hints at the potential of a “single network future” of seamless connectivity between terrestrial and non-terrestrial networks. A decision to not renew or only partially renew Optus' national FDD ESL spectrum would undermine our ability to deliver this innovative solution to Australia's remote connectivity needs.

Our regional Multi-Operator Core Network (MOCN) agreement with TPG Telecom (TPG) involves sharing spectrum to enable the delivery of enhanced capacity, speed and service quality to TPG and Optus customers and accelerate the rollout of 5G services in regional Australia.

- (c) **Enhances competition** – Optus is the only mobile network challenger to Telstra outside metro areas of Australia. The past thirty (30) years of mobile competition has delivered new and innovative services to millions of Australians, driving productivity improvements across the economy. A decision to not renew or only partially renew Optus' ESL spectrum would undermine our ability to compete with Telstra in the national mobile market. Carving up our spectrum holdings for new entrants would undermine regional network sharing agreements, lessen competition and disrupt the supply and quality of Optus mobile services.
- (d) **Balances public benefits and impacts** – mobile services are essential services delivering Australians more than just economic benefit by facilitating social connections and broader societal benefits including access to other essential services. Ongoing access to spectrum is crucial to ensuring continuity of supply of mobile services and network resilience, particularly critical during emergencies and in parts of Australia where there may be limited alternatives. The potential disruption of essential services that may result from a change to existing arrangements, weighs heavily in favour of offering MNOs the opportunity to renew ESLs.
- (e) **supports relevant policy objectives** – including those set out under the final Ministerial Policy Statement (MPS) Instrument.⁷ In particular, renewal of our ESL spectrum will support service continuity, facilitate opportunities to collaborate with LEO satellite (LEOSat) service providers to deliver

⁷ Radiocommunications (Ministerial Policy Statement – Expiring Spectrum Licences) Instrument 2024

connectivity across the country, helping to Close the Gap and deliver improved services in regional areas. It will also promote competition and provide the certainty of long-term spectrum access necessary for sustained investment in critical national infrastructure.

Uncertainty of ESL renewal undermines investment in Australia’s digital future

- 1.9 Optus welcomes the ACMA’s statements that continued support for wireless broadband (WBB) use of ESL spectrum bands is “likely conducive to promoting the long-term public interest” and that the ESL process is not a “greenfields” or “from the ground up” exercise in spectrum planning but “should instead review whether existing uses promote the long-term arrangements” (public interest).⁸ Optus also welcomes the recognition of continuity of service and the need to support sustained investment as key considerations in the ACMA’s decision-making.⁹
- 1.10 Despite this, there remains significant uncertainty as to whether the spectrum licensing arrangements that have underpinned billions of dollars in network investment, and the delivery of key safety and essential services will remain the same following their expiry.
- 1.11 This submission demonstrates that there is overwhelming evidence that existing uses of ESL spectrum do and will continue to promote the long-term public interest. The essential nature of spectrum to essential mobile networks and services means that the ACMA should adopt a highly cautious approach to any calls for intervention into ESL spectrum space. Any change risks the ongoing supply of essential services and access to emergency services, banking and everyday economic activity.
- 1.12 Optus is concerned that the ACMA is adopting far too low a threshold for change to existing arrangements. In particular, Optus disagrees with the view that “an absence of submission from (prospective licensees) would not necessarily lead to preliminary or preferred views favouring renewal of ESLs”.¹⁰ The ACMA’s approach raises the prospect of changes to existing arrangements without clear evidence of unmet demand for the spectrum, risking regulatory failure. This is particularly so given that the existing secondary market for spectrum access continues to enable efficient outcomes. Rather, we consider that a lack of submission from a prospective licensee must weigh in favour of ESL renewal.
- 1.13 Optus reiterates its request that the ACMA issue a very clear and robust preliminary view (Stage 3) on whether or not it is disposed to renew all ESLs and on what terms, particularly in relation to price and licensing, at its earliest opportunity. The ACMA’s preferred view (Stage 4) should give as close to certain a position as possible on what the ACMA’s decision on a renewal application may be. To this end, Optus urges the ACMA to consider how its new administrative powers may enable the ACMA to reduce uncertainty in the lead up to the application window.¹¹

⁸ Consultation Paper; p.2

⁹ [New Ministerial Policy Statement for expiring spectrum licences | Ministers for the Department of Infrastructure](#)

¹⁰ Consultation Paper; p.14

¹¹ For example, the issuance of spectrum access charges determination for each ESL well in advance of the application window (section 294 of the Act); issuing a licence renewal notice to spectrum licensees well in advance of the application window, which would result in a deemed application on payment of the renewal fee (section 77C(10)). While these steps do not in and of themselves guarantee renewal, they reduce the uncertainty that the ACMA will not renew.

Approaches to examining use must reflect the realities of mobile network deployment

- 1.14 Optus raised a number of concerns about the general approaches to examining spectrum use set out in the ACMA's "Stage 1" consultation paper.¹² We cautioned that too granular an assessment runs the risk of being meaningless given national network deployment considerations. We recommended that levels of previous and planned investment be given considerable weight in decision making and suggested that the ACMA have recourse to existing information to reduce administrative burden.
- 1.15 Optus welcomes the ACMA's confirmation that it intends to examine use based largely on publicly available information – including the coverage maps that Optus and other MNOs are required to supply to the ACCC under its Infrastructure RKR. However, we note that the ACMA has also identified a number of perceived deficiencies which "limit the extent to which coverage maps alone may inform the design of potential changes to licence conditions, such as licence boundaries".¹³
- 1.16 To support the ACMA's examination of use, Optus refers the ACMA to the Radiofrequency National Site Archive (RFNSA) administered by AMTA. The RFNSA shows where a base station has been deployed and activated. In other words, where the spectrum is being used to make mobile services available to Optus customers. The RFNSA also provides the user with detail on the progress of base station deployment over time. Optus submit that RFNSA data, in combination with coverage maps, should be sufficient to demonstrate current and planned (near-term) use of ESL spectrum.
- 1.17 Conversely, Optus submits that a lack of uptake or evidence of site data in a particular area should not determine that the spectrum is not being used, or certainly that it will not be used in the future, by an ESL holder. Such an approach fails to reflect the dynamic nature of mobile usage by end-users and the importance of "unused" spectrum to the cost-effective deployment of network infrastructure.
- 1.18 Optus notes the ACMA's reservations about the utility of coverage maps, however, we maintain that a granular assessment of use will not be a fair representation of the use of spectrum in network planning decision-making. We encourage the ACMA to adopt an approach to examining spectrum use that reflects the realities of mobile network deployment.
- 1.19 Optus considers that too granular an examination of use may constitute an unreasonable new condition on our use of ESL spectrum, imposed after ESLs were issued. When applied to ESLs, the effect may be akin to a "specified circumstances" renewal statement, enabling the ACMA to refuse to renew ESL spectrum due to "insufficient" use. We submit any retrospective assessment of "sufficiency" or "adequacy" of the use to which a licensee made of its ESL spectrum is not within the scope of the ESL process. We also note that "renewal statements" only apply to spectrum licences issued after the Modernisation Act.¹⁴

¹² ACMA, Stage 1 Consultation Paper, p.28

¹³ Consultation Paper, p.17; in summary the ACMA states that coverage maps (a) are modelled on "predicted coverage" rather than a representation of "actual coverage" (b) "do not directly indicate spectrum utilisation or interference potential considerations" (c) "based on a variety of inputs that may vary between operators and years, limiting direct comparison" (d) "Do not indicate total bandwidth used but do generally indicate which frequency bands have been used" (e) "Do not generally indicate where coverage is planned, or where there may be difficulties providing coverage"

¹⁴ See further section 65A(1) and section 65A(5) of the Act – Optus submit that this restriction must extend to any implied condition on renewal of a licence issued prior to the commencement of section 65A.

The unintended consequences of carving up ESL spectrum will outweigh any benefits

- 1.20 The spectrum licenced to MNOs is deployed to service a wide variety of users, use cases, and applications with a limited amount of spectrum. There is no other comparable use of spectrum serving such a diverse range of use cases. MNOs economies of scale also reduce the cost for alternative users wishing to utilise our networks to innovate and solve “local” problems. Existing ESL arrangements provide the investment certainty required to support the deployment of 5G advanced and 6G that will enable even greater levels of public network utility.
- 1.21 Partial re-allocation of spectrum will create new licence boundaries, introducing cost and complexity into interference management, resulting in permanent underuse of spectrum. These new boundaries will create new “dead zones” where there is no service within the spectrum space, undermining licensees ability to use their spectrum. In other words, partial re-allocation would risk the delivery of essential services, including emergency calling, to the affected area.
- 1.22 Existing mechanisms of access to spectrum via the secondary market remain fit for the purpose of promoting efficient use of ESL spectrum, while minimising the risk of harmful interference. Any reduction in the geographic extent and amount of spectrum available to MNOs will limit options to innovate. For example, fragmentation of national FDD spectrum licences would undermine the potential of LEOSat direct to mobile services.¹⁵ Optus has prepared a number of case studies highlighting the inefficiencies of fragmenting ESL spectrum – see Section 7.
- 1.23 The “out-sized” impact of carving up spectrum space is most clearly illustrated by low-band spectrum. Cost effective network deployment in regional areas depends on access to suitable low band spectrum. Fragmenting MNOs low band holdings to enable local entry in regional Australia will only serve to undermine existing and future coverage and performance of public mobile services. As the ACMA noted in its submission to the Senate Committee:

“there are constraints on increasing the number of operators using low-band spectrum: Any approach to increase the number of operators using this spectrum is challenging as the ‘wide area’ benefits of the band can be lost by disaggregation into smaller frequency blocks of spectrum. ...Therefore, minimising the number of boundaries and avoiding boundaries through or near population centres is important to maximising the overall utility of the spectrum.”¹⁶
- 1.24 The introduction of new ‘alternative’ licence conditions, such as rollout obligations and “Use-it-or-lose-it” (UIOLI) and “Use-it-or-share-it” (UIOSI) provisions, will dramatically change the investment environment that has underpinned the billions of dollars of network investment Optus has made to date. There is no market failure that would justify such an intervention. Existing ESL arrangements have delivered Australia world leading levels of population coverage and existing mechanisms of spectrum access underpin our regional MOCN services agreement and our collaboration with SpaceX on direct to

¹⁵ The fact that geographically fragmented spectrum is not suitable for LEO satellite deployment is recognised by the FCC in its report and order and further notice of proposed rulemaking of March 2024 stating that it will enable the Supplemental Coverage Services (SCS) “only where a single terrestrial licensee holds all the spectrum access rights in a given channel in an entire geographically independent area.” (Source FCC 24-28 p. 3)

¹⁶ “Connecting the country: Mission critical”; Inquiry into co-investment in multi-carrier regional mobile infrastructure; House of Representatives Standing Committee on Communications and the Arts; para 2.24; p.17

mobile services. These arrangements promise to help deliver improved connectivity services for end users in regional and remote Australia.

The ESL process can support a number of Government policy objectives

- 1.25 Renewal of Optus' ESL spectrum will enable Optus to provide essential services across metro and regional Australia; to continue to innovate and to deploy new networks and services that in turn will help the Government deliver on communications policy objectives. Certainty of renewal will enable Optus to help Close the Gap via satellite direct to mobile services and to deliver improved regional connectivity services via our regional MOCN services agreement.
- 1.26 The ACMA is considering how it can use the ESL process to deliver a range of communications policy objectives. However, adjusting spectrum licence arrangements is not the best way, or the only way, to address policy concerns.
- 1.27 For example, to promote regional connectivity, rather than intervene to re-allocate ESL spectrum to new use cases, the Government should prioritise reform of the Mobile Blackspot Program and the Regional Connectivity Program. These reforms should be designed to level the playing field for all MNOs to receive Government funding and/or mandate access to all publicly funded sites.
- 1.28 Other communications policy objectives that Optus considers are not directly relevant to the ESL process are network resilience and temporary disaster roaming which are being dealt with via other avenues.¹⁷ Of course, the renewal of ESLs will support these objectives by ensuring ongoing delivery of national mobile networks and essential services. Renewal of ESLs will support our MOCN services agreement, which will deliver a second regional 5G mobile network and preserve separate core networks for TPG and Optus, thereby promoting network resilience.

ESL spectrum should be renewed at a nominal price rather than re-auctioned

- 1.29 The ACMA has reiterated its preference for spectrum auctions to resolve "rivalrous demand".¹⁸ Optus is concerned that the ACMA appears to suggest that in such cases, allocation exercises (price-based or administrative) are the "optimal way to expose and test demand".¹⁹ Optus submits that auctions are not appropriate for ESL renewal.
- 1.30 There is a fundamental difference between awards of new spectrum and reallocating ESLs – ESL renewal fees do not need to be set to encourage efficiency, because the spectrum has already been efficiently allocated. Further, the availability of a secondary market means that incentives to maintain and improve efficient spectrum use already exist. The attached expert report prepared for Optus by Dr Chris Doyle explains that there is no need to re-auction ESLs to promote efficiency.
- 1.31 The annual cost²⁰ of spectrum to industry has grown from \$241 million in 2015 to \$818 million in 2024. This has a material negative impact on the ability to invest in mobile infrastructure. Few if any industry sectors pay such sizeable upfront licence fees, with no link to future revenue or profits generated from use of those licences. In the broader context of the sector's financial health and in the interests of sustainable market

¹⁷ E.g. the Government's Network Hardening program and Disaster Resilience Innovation Program as well as its response to the ACCC's recommendations on temporary roaming

¹⁸ Consultation Paper; p.15

¹⁹ Consultation Paper; p.15

²⁰ Amortisation of spectrum licence payments

competition and investment, high spectrum costs are unjustifiable and is directly counter to government policy.

- 1.32 High renewal prices, while attractive to Government revenue, undermine investment in 5G and 6G networks and limit downstream innovation. It is without doubt that the broader economic benefits of mobile use from low spectrum fees far exceed the benefits of increased Government revenue from higher spectrum fees.²¹ Seeking short-term revenue gains is inconsistent with the objectives of the Act. Optus urges the ACMA to eschew the short-term benefit of higher renewal fees to public finances in favour of supporting the broader long term economic benefits that will flow from lower renewal prices²².
- 1.33 Optus maintains that ESLs should be offered for renewal at a nominal price given that ESL spectrum is used to supply critical and essential services. We recognise that the ACMA has indicated that it "would not normally consider that cost recovery-based pricing promotes efficient use of the spectrum".²³ It follows that where the spectrum is already efficiently used, a cost recovery price may be justified.
- 1.34 Any price above a nominal level could be regarded as an inefficient tax that will need to be recouped through lower spending/investment or higher end user prices. The attached expert report from Coleago Consulting clearly sets out the public benefits of nominal pricing for ESL renewal relative to other pricing methodologies.

Optus' approach to responding to the Consultation Paper

- 1.35 Optus sets out its response to the ACMA's Consultation Paper below, guided by the information provided by the ACMA. Our responses are structured to address the individual sections of the Consultation Paper as well as to highlight general themes and considerations relevant to the ACMA forming its preliminary view. Certain points are repeated for emphasis and to highlight the interdependencies of the considerations raised by the ACMA's questions.

²¹ Hazlett & Munoz, 2009, A welfare analysis of spectrum allocation policies, RAND Journal of Economics, Vol. 40, No. 3, pp. 424–454

²² Optus submission in response to ACMA's draft Five-year spectrum outlook 2023-28 and 2023-24 work program Public Version May 2023

²³ ACMA's Final framework document, December 2023

Section 2. ESLs ENABLE OUR DIGITAL FUTURE

- Providing mobile network operators (MNOs) with sufficient certainty that ESLs can be renewed will promote the long-term public interest to be derived from ESL spectrum.
- There is no need to change existing arrangements governing ESLs – national mobile networks will deliver up to \$94 billion uplift to Australia’s GDP by 2030 and are relied upon to deliver critical services like emergency calling services.
- MNOs need ESL spectrum to continue to supply essential services, meet demand for 5G and to deploy digital infrastructure and services critical to Australia’s future.
- Geographic segmentation of ESL holdings will create coverage “dead zones” which will prevent supply of essential services and prevent Australians from calling for help in times of need.
- There is no evidence to support any change to existing licencing arrangements for ESL spectrum. Any change will cause material public detriment and is not consistent with Act.

Use of ESL spectrum for essential mobile services delivers long term public benefits

- 2.1 The GSMA has observed that “the core objective of spectrum management is...to enable spectrum to be used in a manner that will bring the greatest benefits to society”.²⁴ The link between effective spectrum management and the realisation of public policy goals is increasingly acknowledged, with the US National Spectrum Strategy recognising the importance of a comprehensive and collaborative strategy to make the “most efficient use possible of this vital national resource”.²⁵
- 2.2 Mobile networks supply essential communications services to Australians across the country, providing access to emergency, education, banking, health, social, commercial and government services.²⁶ Mobile services keep us connected with work, family and friends, providing convenience and improving productivity. Mobile networks are a critical component of Australia’s digital infrastructure, connecting government, businesses and consumers, enabling new vertical industries and supporting the realisation of key Government policy objectives for an inclusive, secure and prosperous Australia.²⁷
- 2.3 Mobile networks are national networks with wide area coverage and large customer bases which leads to economies of scale and highly efficient use of spectrum. There were 28.7 million prepaid and postpaid mobile plans across Australia in December 2022, up 1.4 million from the previous year.²⁸ The role of spectrum in a network is to connect user devices and equipment to network equipment and enable data transmission.

²⁴ Maximising the socio-economic value of spectrum – a best practice guide for the cost-benefit analysis of 5G spectrum assignments; January 2022; p.4

²⁵ The White House, National Spectrum Strategy; 13 November 2023; p.1

²⁶ [Albanese Government to improve safeguards for telco consumers experiencing financial hardship | Ministers for the Department of Infrastructure](#)

²⁷ The broader socio-economic benefits of mobile networks and services are well documented. GSMA research “Mobile technology: two decades driving economic growth”, 2020, shows that the baseline economic impact of mobile services increases when upgrading from one generation of mobile technology to the next (15% from 2G to 3G and 25% from 2G to 4G).

²⁸ [Trends and developments in telecommunications 2022-23 \(acma.gov.au\)](#), p.5 where the ACMA notes that “there were 39.6 million mobile services in operation...2.8 million more than June 2022. It includes prepaid and postpaid mobile plans, mobile broadband services and machine-to-machine connections”.

Therefore, spectrum is essential to the function of a mobile network and the supply of essential mobile services to end-users.

- 2.4 In terms of the economic benefits of 5G, the GSMA predicts the continued use of low band spectrum for 5G mobile networks will contribute \$130 billion to global economic growth in 2030.²⁹ BCG predicts that by 2030, 5G will have contributed from US\$1.4 to US\$1.7 trillion in US economic growth.³⁰ Deloitte calculates that 5G will increase Australia's GDP by \$67 billion in 2022 dollars by 2030 and further accelerating 5G adoption could uplift this forecast by \$27 billion.³¹
- 2.5 Realising the broader public benefits of mobile networks requires a regulatory framework governing access to spectrum for mobile services that is sufficiently supportive of the investment required to deploy infrastructure, densify networks and deliver sufficient bandwidth at a competitive price. National mobile operators benefit from economies of scale and scope that mean they are best placed to support these industry policy objectives and boost productivity, as long as they have the spectrum needed to do so.
- 2.6 The radiocommunications sector remains highly dynamic, with new equipment and devices continuing to deliver improvements in speed, performance and user experience. New commercial opportunities created by the arrival of LEOSats present the opportunity of a "single network future". Future innovation should not be hindered by regulatory changes to the spectrum licence arrangements that have supported the rapid deployment of networks and services to date.
- 2.7 While there may be calls for regulated access to ESL spectrum from some prospective licensees now, intervening to facilitate this access would be short-sighted, undermine the innovative potential of public networks and disproportionately impact MNOs long term network planning and deployment. MNOs must be assured of sufficient access to spectrum of sufficient quantity and quality to support the ongoing supply of essential services, deployment of critical digital infrastructure and more readily enable the benefits of Australia's digital future.

MNOs will need ESL spectrum to meet accelerating demand for 5G data services

- 2.8 Global demand for data continues and the uptake of 5G is accelerating.³² Global 5G subscriptions jumped approximately 600 million (1 to 1.6 billion) between December 2022-23.³³ Over 300 operators in 113 countries have launched commercial 3GPP-compatible 5G services and there are at least 1964 commercially available devices, with 5G devices increasing by 39% from Dec 2022.³⁴ By 2029, 5G networks will carry 76% of the world's mobile data traffic and cover 85% of the world's population.³⁵
- 2.9 Australians were early adopters of 5G and the ACMA reports that 5G services are now available to more than 85% of the Australian population.³⁶ Australia maintains leading

²⁹ GSMA, 2023, Socio-Economic Benefits of 5G – The importance of low-band spectrum

³⁰ Val Elbert et al of BCG; Accelerating the 5G economy in the US; 17 April 2023

<https://www.bcg.com/publications/2023/accelerating-the-5g-economy-in-the-us>

³¹ Deloitte Access Economics, March 2022, 5G Unleashed, available here: https://amta.org.au/wp-content/uploads/2022/03/5G-Unleashed-Final-Report_combined-v2.pdf

³² ACMA draft FYSO 2024-29, p.18

³³ Ericsson Mobility Report, November 2023; available here: [Ericsson Mobility Report | Read the latest edition](#)

³⁴ GSA, January 2024, 5G Ecosystem January 2024 Summary, available here:

<https://gsacom.com/paper/5g-ecosystem-january-2024-summary/>

³⁵ Ericsson, November 2022, *Ericsson Mobility Report* cited at p.16 of FYSO 2023-28; latest Ericsson Mobility Report November 2023 is available here: [Ericsson Mobility Report | Read the latest edition](#); p.12

³⁶ [Trends and developments in telecommunications 2022-23 \(acma.gov.au\)](#); p.16

subscriber penetration rates, with GSMA reporting over 35% of Australians use 5G capable devices that access 5G networks – the second highest “5G availability” rate in selected Asia Pacific and European markets.³⁷ Australia remains a leader in 5G deployment (deploying over 9000 5G base stations by early 2023).³⁸

- 2.10 Optus continues to deploy its 5G network across Australia. As at March 2024, Optus has a total of 4273 5G enabled sites, with 3511 of these being macro sites. Under our MOCN deal with TPG, we will accelerate our 5G deployment by fast-tracking the number of 5G sites in the regional MOCN area (which covers approx. 17% of the population – from 81.5% to 98.4%) to 1500 sites by 2028 and 2444 sites by the end of 2030.³⁹ We remain the leader for recorded download speeds (208.7 Mbps) and overall user experience.⁴⁰
- 2.11 To date, the deployment of 5G networks has largely been focused on the consumer market with the pace of deployment assisted by the fact that it has largely been “non-standalone” deployment, using the existing 4G core network. The deployment of 5G standalone, with a dedicated 5G core network, is underway, and offering increased performance potential via “network slicing”, which allows a single physical network to deliver multiple networks, with specified levels of reliability, capacity and security. In effect, MNO networks will become highly efficient spectrum sharing platforms for a wide variety of use cases, including massive machine type communication, smart city, virtual mobile private networks and more.
- 2.12 Dedicated private wireless networks have been identified as having an emerging role to play in realising the public benefits of 5G and ushering in “Industry 4.0”.⁴¹ The GSMA has identified three broad categories of private 5G networks, reflecting different levels of customisation, control and cost factors⁴²:

Figure 1 Private 5G network deployment scenarios

Standalone enterprise-led	Standalone operator-led	Hybrid (based on operator's public 5G network)
<ul style="list-style-type: none"> Can be built by enterprises or mobile operators Uses allocated new 5G spectrum Meets stringent reliability, security, availability and latency requirements Costly and requires dedicated operational personnel 	<ul style="list-style-type: none"> Built by mobile operators on behalf of enterprises Uses the operator's licensed 5G spectrum Meets stringent reliability, security, availability and latency requirements Benefits from the operator's long-standing experience in network management 	<ul style="list-style-type: none"> Based on a 'slice' of an operator's public network Uses the operator's licensed spectrum Shares use of the operator's public 5G resources (e.g. RAN, core, cloud) to varying levels Quicker and easier to set up and manage than standalone variants

Source: GSMA

³⁷ [GSMA | 5G in Asia Pacific: Deployment Momentum Continues - Membership](#) under “South Korea sets the pace as 5G networks expand across the region”

³⁸ ACCC, Mobile Infrastructure Report 2023; p.12

³⁹ [TPG Telecom and Optus sign network sharing agreement marking new era of mobile services for regional Australia](#)

⁴⁰ OpenSignal's latest Mobile Network Enterprise report; CommsDay 30 April 2024, p.8

⁴¹ ACMA Market Analysis; Private wireless networks using 4G or 5G in Australia, market study; September 2023; p.5

⁴² GSMA Intelligence; Exploring 5G private network opportunities in Asia Pacific; February 2023; p.10

- 2.13 The ACMA states that there are approximately 50 private wireless networks in Australia largely seeking to address the same market as public mobile network hybrid solutions. As the ACMA has observed “*from an equipment and technology perspective, there is no difference between a public and a private wireless network. The crucial difference is exclusive access to spectrum and complete control over network performance*”.⁴³ It is the capability to provide dedicated network capacity that is considered the main point of differentiation to attract applications that demand high levels of network reliability.⁴⁴
- 2.14 The ACMA has also observed that while the market for private wireless networks will grow nearly 30% annually to be worth \$695 million by 2027 (from \$130 million), the public mobile network services market is expected to grow from \$12.4 to \$14.7 billion – twenty times the estimated benefit of private wireless networks.⁴⁵ Put simply, private wireless networks do not promote the public interest to the same degree as national public mobile networks. Spectrum allocated to a private user can only be used by that private user. By contrast, MNO 5G networks are effectively sharing platforms that enable multiple downstream use cases and applications via the public network, including access to essential services.
- 2.15 Network slicing of public network spectrum further promotes efficient use of that spectrum compared to carving it up into new licences for dedicated use in private networks. Slicing also represents a more viable means of achieving the spectrum efficiency objectives sought by the proposed alternative licence conditions. This is because the MNO is best placed to manage the risk of interference to our networks.

Allocation to local area WBB services risk stranding valuable low band spectrum

- 2.16 Optus is aware that some prospective licensees argue that the use of national/regional spectrum licensing for low-band spectrum is a major barrier to the cost-effective deployment of local area WBB and private wireless networks with mid-band deployments becoming unviable to provide the target coverage area, particularly in regional Australia.⁴⁶
- 2.17 However, as the ACMA states “while spectrum licensing or a single Australia-wide apparatus licensing arrangement is generally not suitable for the use cases of localised providers there is the possibility of third-party access to spectrum licence bands through agreement with the spectrum licensees”.⁴⁷ We reiterate that none of these prospective local area or private wireless network stakeholders have approached Optus seeking commercial access to our spectrum via the secondary market. While there may be some public benefit to be served by supporting local area WBB use cases and/or private wireless networks this should be done via 3.8GHz AWLs or similar dedicated apparatus licences, rather than at the expense of public mobile networks access to ESL spectrum.
- 2.18 Optus will need ongoing access to its ESL spectrum to supply 5G services and to enable cost effective deployment, including under our MOCN agreement. For bands not planned for 5G use in the medium term, such as 700MHz and 1800MHz, Optus will need to retain access to enable ongoing supply of 4G/LTE services. The criticality of our low band spectrum, particularly 900MHz, to the cost-effective supply of affordable and competitive national 5G mobile services across a sparsely populated country like

⁴³ ACMA Market Analysis; Private wireless networks using 4G or 5G in Australia, market study; September 2023; p.5

⁴⁴ GSMA Intelligence; Exploring 5G private network opportunities in Asia Pacific; February 2023; p.10

⁴⁵ ACMA Market Analysis; Private wireless networks using 4G or 5G in Australia, market study; September 2023; p.5

⁴⁶ Pivotal submission to ACMA’s draft FYSO 2023-28; p.3

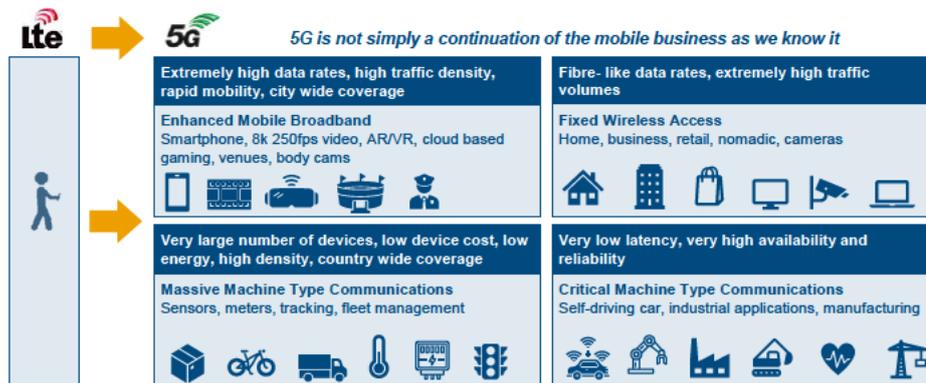
⁴⁷ Spectrum options optimised for local area wireless broadband services; Information paper; August 2023; p.5

Australia means that the interference potential created by carving up low-band holdings will disproportionately affect Optus' ability to supply essential public mobile services. This interference risk outweighs the need to adjust existing ESL arrangements to accommodate prospective WBB licensees.⁴⁸

MNOs will need all ESL spectrum and more to deliver advanced 5G and IMT-2030 (6G)

2.19 The development from 4G (LTE) to 5G (IMT-2020) already saw an expansion of requirements to cover a wide range of use cases and applications. While 4G can be thought of as a best effort mobile data service for smartphones, 5G addresses a wide range of use cases and with new capabilities such as low-latency, network slicing, and ultra reliability. The following diagram illustrates the expansion of use cases with 5G:

Figure 2 The evolution of 4G to 5G Use Cases



Source: Coleago

2.20 The ACMA already anticipates “that growing demand for data will drive spectrum demand for 5G uses” and is assessing the need for additional spectrum bands for mobile to ensure future 5G demand can be served.⁴⁹ If additional spectrum is not made available, particularly in denser urban areas of high demand, delivering 5G capabilities may require levels of cell site density that may be cost prohibitive. For example, the *AMTA Policy Position Paper: Spectrum for 5G and Beyond* identified the need to set a target for an additional 8GHz in total spectrum for mobile services by 2030.⁵⁰ Such forecasts highlight that, over the longer term, MNOs will need additional spectrum beyond their existing ESL spectrum to meet future demand.

2.21 Demand for data will extend beyond 5G and come from new use cases, including critical technologies such as quantum computing, autonomous systems and robotics, Artificial Intelligence (AI) and advanced manufacturing. “Mature” 5G and then eventually 6G networks and services will need to deliver a fibre-like experience with 100 Mbit/s

⁴⁸ See ACMA FYSO 2024-29, where ACMA states at page 17 that “Reviewing arrangements for access to bands already licensed for WBB is important to ensure existing allocations are efficient and can cater for new technology developments, such as 5G. *This has to be balanced with the need to manage interference with other licensed services*” (emphasis added).

⁴⁹ For example, the draft FYSO 2023-28 p.19, notes objectives to progress arrangements for 3.4-4.0GHz across various parts of Australia, and determining whether replanning the 40GHz and 47GHz bands for possible 5G is appropriate. In the draft FYSO 2024-29, the ACMA has indicated that it intends to consult on the future approach to the upper 6GHz band identified for potential IMT use at WRC-23

⁵⁰ AMTA, 2021, 5G Unleashed; p.29 Analysis undertaken by Coleago for AMTA has found that in Sydney, Melbourne and Brisbane there is expected demand for mid band spectrum out to 2030 that exceeds what is currently available for MNOs.

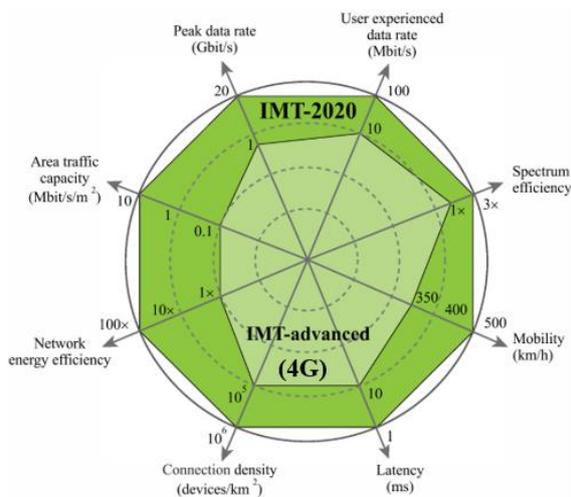
downlink as well as low latency, catering for higher traffic densities.⁵¹ Looking at user and application trends, the ITU notes that:

“Applications and services enabled by IMT-2030 are expected to connect humans, machines and various other things together...it is expected that IMT-2030 provides a wide range of use cases while continuing to provide, inter alia, direct voice support as an essential communication...IMT-2030 technology is expected to drive the next wave of digital economic growth, as well as sustainable far-reaching societal changes, digital equality and universal connectivity...further enhance security and resilience.”⁵²

2.22 This graphic from an ITU_R report compares the requirements of 4G, 5G and 6G:

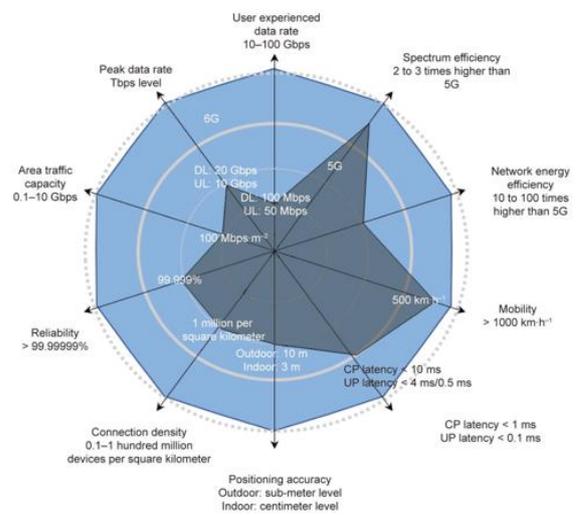
Figure 3 Comparison of 4G, 5G and 6G requirements

IMT 2020 (5G requirements)



Report ITU-R M.2.441-0 (11/2018)

IMT 2030 (6G) requirements



The SOLIDS 6G Mobile Network Architecture: Driving Forces, Features, and Functional Topology, Guangyi Liu et al, Sep 2021, p44

Source: ITU_R

2.23 The ITU observes that “no single frequency range satisfies all the criteria required to deploy IMT systems and the same is expected to apply for IMT-2030” adding that:

“New generations of IMT may expect new spectrum for increasing data rates, capacity, new applications and to provide for new capabilities. IMT-2030 is envisaged to utilize a wide range of frequency bands ranging from sub-1GHz up to frequency bands above 100GHz. Low bands will continue to be crucial to enable nationwide coverage, in particular addressing the digital divide and expanding deep indoor coverage. Mid bands provide a balance between wide area coverage and capacity.”⁵³

2.24 The shutdown of 3G networks will enable the refarming of spectrum to support further 5G deployment. However, the capacity and quality of service demanded of mobile networks under 5G will only accelerate with 6G. To be able to cater for higher traffic

⁵¹ In essence, a mature 5G network is a platform which addresses all present use cases. 6G further develops the capability of mobile networks to service increasing demand and new use cases, taking into account anticipated developments over the next decade and beyond.

⁵² Recommendation ITU-R M.2160-0; p.6

⁵³ Envisaged frequency bands, Recommendation ITU-R M.2160-0; p.11

densities and deliver standalone 5G, and the commercialisation of 6G, mobile operators will need access to the right type and amounts of spectrum, operating under the right licence conditions.

- 2.25 Optus submits that even a conservative assessment of the potential future demand means that MNOs must, at the very least, be able to retain all existing ESL spectrum for the foreseeable future. We believe that all the ESLs currently held by Optus should be offered for renewal to allow the continued provision of WBB services. A reduction in the spectrum currently allocated to IMT would compromise 4G and 5G service delivery and hamper the development of 6G services into the future.

Increasing capacity demands means access to contiguous spectrum blocks is crucial

- 2.26 The bandwidth requirements of 5G and then 6G mean that contiguous blocks of spectrum will be crucial to promoting efficiency. “Contiguous” blocks of spectrum enable better network performance by delivering a greater overall bandwidth for transmission of data from a base station to an end-user. The wider the band in which 5G and then 6G services are deployed, the higher the spectral efficiency.
- 2.27 For example, deploying 5G in a 100MHz wide channel in upper mid-band spectrum delivers a 7% higher spectral efficiency compared to deploying it in only 20MHz. Spectrum utilisation is less than 100% for all 5G NR channel bandwidth options because the resource blocks do not fully occupy the channel bandwidth. Not renewing all spectrum in a band where an operator already has 100MHz or close to it, reduces overall efficiency as shown below.⁵⁴

Figure 4 Spectral Efficiency of Differing 5G Channel Bandwidth

Channel BW	Number of resource blocks	Transmission BW (MHz)	Lost BW (MHz)	Utilisation
100 MHz	273	98.280	1.720	98.3%
80 MHz	217	78.120	1.880	97.7%
60 MHz	162	58.320	1.680	97.2%
50 MHz	133	47.880	2.120	95.8%
40 MHz	106	38.160	1.840	95.4%
20 MHz	51	18.360	1.640	91.8%

Source: ECC Report 287

- 2.28 In turn, quality and quantity of spectrum have a direct impact on the cost efficiency profile of an MNO’s network deployment. Augmenting mobile base-station sites with more spectrum, particularly contiguous spectrum, is the most efficient way to add capacity to public mobile networks.⁵⁵ The following graphic compares a “spectrum rich” and a “spectrum poor” MNO, highlighting that spectrum is a key ingredient for MNOs to control site numbers:

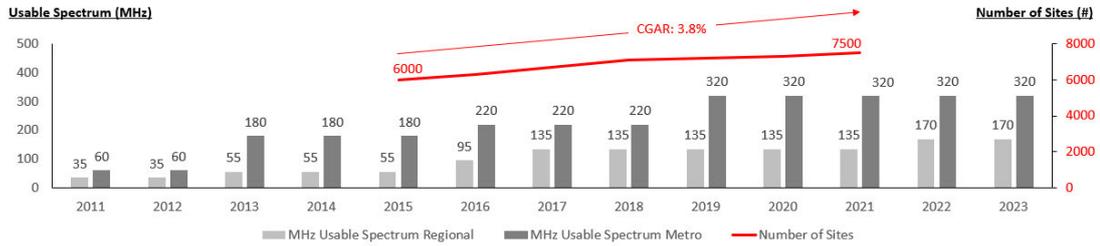
⁵⁴ As cited by Coleago: ECC Report 287, Guidance on defragmentation of the frequency band 3400-3800 MHz, October 2018, p.41

⁵⁵ [Optus \(Statement of Steven Turner\) - 20.10.22 - PR VERSION - MA1000021 Telstra TPG.pdf \(acc.gov.au\)](#)

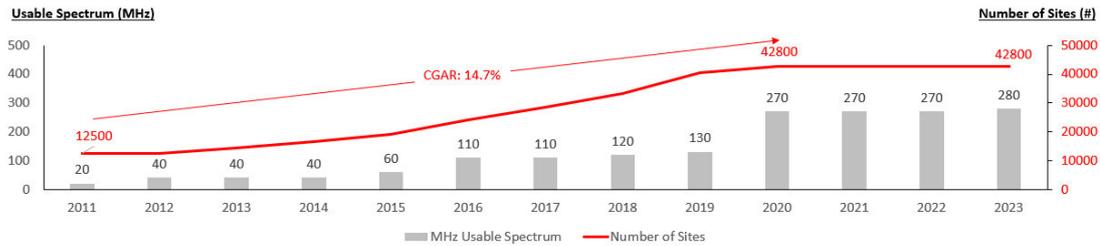
Figure 5 The Effect of Spectrum Resources on Site Counts

Spectrum is the most important ingredient for MNO to control site numbers.

Example of a Spectrum Rich MNO



Example of a Spectrum Poor MNO



Source: Telco-Economics for Optus

Optus will need its ESL spectrum to help deliver the “single network future”

- 2.29 Satellite services are an increasingly important complement to terrestrial mobile networks with advances in satellite technology and improved interoperability between terrestrial and non-terrestrial networks (NTN) offering the potential for seamless connectivity and a “single network future”.
- 2.30 To deliver the “ubiquitous connectivity” envisaged by IMT-2030, MNOs will need spectrum access across the entire Australian landmass. However, given that there will always be large parts of Australia’s land mass that will not get terrestrial based mobile coverage,⁵⁶ non-terrestrial deployment is really the only economically feasible solution by which Australian MNOs can deliver ubiquitous coverage. As recognised by the ITU:

“The interworking of IMT-2030 terrestrial network with its non-terrestrial networks (NTN), including satellite communications, high altitude platform stations as IMT base stations (HIBS), is expected to enhance achieving required connectivity objective.”⁵⁷

- 2.31 The potential socio-economic benefits of extending mobile network coverage are significant and the redundancy afforded by a fallback satellite based mobile service could be game changing during disasters. The Government, through the LEOSat working group, has recognised that advances in LEO satellite technology offer an

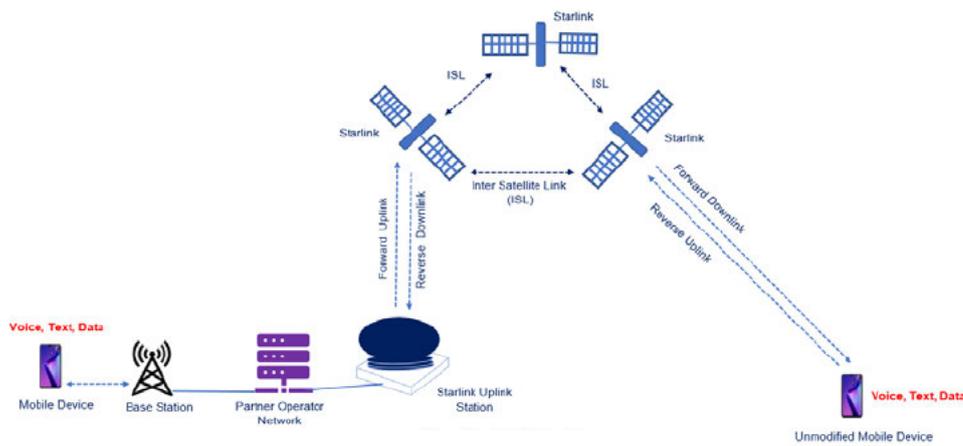
⁵⁶ Consultation Paper, p.42, footnote 44 where ACMA cites Telstra submission to the 2021 Regional Telecommunications Review. Optus has calculated that Telstra network covers approximately 28% of Australian land – Telstra’s 4G network (external antenna) covers approx 2,179,182 million km2 of geographic area (ACCC Infrastructure Report 2023) and Australia is 7,688,287 km2

⁵⁷ Recommendation ITU-R M.2160-0 states that key objective of IMT-2030 (or 6G) is “ubiquitous connectivity”; p.10

opportunity to bridge the Digital Divide and deliver essential connectivity services to previously underserved or unserved areas of Australia.⁵⁸

- 2.32 These benefits can start to be realised in the near future via IMT satellite DTM services.⁵⁹ Mobile handsets are nearly ubiquitous, which means the time to (mass) market for IMT satellite DTM services is shorter than alternative MSS options that do not have such a well-established device ecosystem. Optus collaboration with SpaceX will deliver mobile services direct to Optus 4G compatible devices across Australia using Optus <<CIC begins>><<CIC ends>> ESL spectrum licence. Optus plan to launch SMS from late 2024 and voice services in late 2025.⁶⁰
- 2.33 IMT satellite DTM services can only be effectively delivered via FDD spectrum due to the need to maintain sufficient frequency separation between uplink and downlink. The following illustrates the general configuration of an IMT satellite DTM service:

Figure 6 Mobile coverage using LEOsats



Source: Coleago

- 2.34 An IMT satellite DTM service can, when designed correctly, promote the efficient utilisation of FDD spectrum, particularly in areas outside the existing public mobile network footprint. This development means that Australian MNOs will be able to use their nationally licenced spectrum across the entire Australian landmass to effectively “supplement” or extend mobile coverage across the entire country using LEOsats.⁶¹
- 2.35 On 14 March, 2024, the US Federal Communications Commission (FCC) issued a Report and Order and Further Notice of Proposed Rulemaking (Order) adopting world first rules governing “supplemental coverage from space,” or “SCS”.⁶² The FCC intends that the new SCS regulatory framework will facilitate a “single network future”, fostering collaboration between satellite operators and terrestrial service providers to provide ubiquitous connectivity directly to consumer handsets using spectrum previously allocated only to terrestrial services.⁶³

⁵⁸ [Low Earth Orbit Satellite Working Group—2023 Chair’s Report—February 2024 \(infrastructure.gov.au\); p.7](https://www.infrastructure.gov.au/infrastructure/infrastructure-reports/2023-chair-report)

⁵⁹ See further 3GPP Releases 17 and 18

⁶⁰ [Optus | SpaceX](https://www.optus.com.au/newsroom/optus-space-x)

⁶¹ other than excluded geographic areas such as the Radio Quiet Zone (RQZ) in WA

⁶² Single Network Future: Supplemental Coverage from Space; Report and Order and Further Notice of Proposed Rulemaking GN Docket No. 23-65 and IB Docket No. 22-271; [DOC-400678A1.pdf \(fcc.gov\)](https://www.fcc.gov/document/DOC-400678A1.pdf), p.2

⁶³ [DOC-400678A1.pdf \(fcc.gov\)](https://www.fcc.gov/document/DOC-400678A1.pdf), p.3

- 2.36 In the Order, the FCC expressed several public interest goals for the SCS framework, including expanding “the reach of communications services, particularly emergency services,” into more rural areas, positioning the United States as a global leader in space-based technology, and continuing to “promote the innovative and efficient use” of the spectrum.⁶⁴
- 2.37 In the near future, direct to device technology may be operable across all mobile devices, with new technical standards establishing network architectures that facilitate seamless connectivity between terrestrial and non-terrestrial networks. In such a scenario, MNOs are best placed to manage the service end-to-end, via nationally licenced spectrum. A future “universal infrastructure/service provider” may more effectively coordinate the supply of the end-user service with the satellite station operator and limit the potential of harmful interference.
- 2.38 In the future, Optus’ collaboration with SpaceX offers the potential of nationwide mobile coverage via our national FDD ESL spectrum. This collaboration is the first of its kind in Australia and presents the real opportunity to deliver connectivity to areas without terrestrial coverage and to Close the Gap.

Geographic segmentation of ESL holdings will undermine the potential of FDD DTM services

- 2.39 An MNO can only provide a seamless DTM service via FDD spectrum that is assigned and available nationally. Changing the geographic scope of a spectrum licence increases (co-channel) interference risk due to the increase in licence boundaries. Interference can result in coverage loss beyond the carved-out area. Carving out spectrum licences at a regional or local level would create significant problems and may even render some spectrum useless for IMT satellite DTM deployment.
- 2.40 The unsuitability of geographically fragmented spectrum for supplemental (mobile) coverage from space via LEOSat deployment was recognised by the FCC, stating that it will “*enable SCS only where a single terrestrial licensee holds all the spectrum access rights in a given channel in an entire geographically independent area.*”⁶⁵

New technologies complement established practice in future spectrum management

- 2.41 In its recent draft Five Year Spectrum Outlook 2024-29 (FYSO) the ACMA expresses openness to supporting industry-led trials of Dynamic Spectrum Access (DSA) or other non-traditional spectrum sharing methods.⁶⁶ Similarly, in its October 2023 discussion paper “Spectrum management for next generation wireless broadband”, OfCom expresses the view that “flexibility and spectrum sharing will be required to support Next Generation Wireless Broadband (NGWB) network demand and deployment”, noting that:

“Technical developments offer the potential to move beyond simple sharing arrangements based on geographic separation, signal to interference thresholds and conservative coverage /propagation models. A toolkit of technologies can be used to improve service quality and spectrum efficiency. These include spectrum sensing and machine learning to characterise spectrum use and autonomous and cooperative algorithms to dynamically assign spectrum resources.”⁶⁷

⁶⁴ [DOC-400678A1.pdf \(fcc.gov\)](#); p.2

⁶⁵ On March 14, 2024, the US Federal Communications Commission (FCC) adopted a Report and Order and Further Notice of Proposed Rulemaking (Order) adopting world first rules governing “supplemental coverage from space,” or “SCS”; [docs.fcc.gov/public/attachments/DOC-400678A1.pdf](#); p. 3

⁶⁶ Draft FYSO 2024-29; p.62

⁶⁷ [Spectrum management for next generation wireless broadband: a discussion paper - Ofcom](#); p.5

- 2.42 Optus recognises that increasing demands on spectrum from new entrants/use cases mean there may be increased interest for spectrum sharing and flexible access arrangements. However, support for new sharing/flexible access technologies, such as DSA, needs to be approached with caution and should avoid undermining the certainty of access required to support network investment. Optus also considers that the adoption of such technologies may lead to less dynamic forms of sharing such as contemplated under proposed “Use-it-or-lose-it” (UIOLI) and “Use-it-or-share-it” (UIOSI) alternative licence conditions being canvassed by the ACMA in this Consultation paper.
- 2.43 Optus also notes that many of the new sharing technologies, including DSA, remain unproven in real world scenarios. In this context, Optus generally considers that dynamic shared access or similar schemes will not provide a workable solution as segmentation of spectrum between use cases will cause inefficient fragmentation.
- 2.44 Further, while the FCC’s “Citizen Broadband Radio Service” (CBRS) has been lauded by some as a success of spectrum sharing, in reality, significantly low power levels, higher site counts, and small licence sizes limit use cases. There is also complexity in spectrum coordination and planning as capacity is not guaranteed when incumbents require use of the frequency and radio channel assignments can vary. Applying CBRS to other bands and in different contexts is at “best a complicated and uncertain project”.⁶⁸
- 2.45 We reiterate that, from a public interest perspective, MNOs are highly efficient spectrum sharing “engines” with 5G stand-alone and future 6G mobile networks offering the ability to service all use cases and applications and ubiquitous delivery of essential services. In this way, public 5G and 6G networks offer the opportunity to promote efficient spectrum use at the edge of the public network.

Existing market mechanisms facilitate efficient spectrum use

- 2.46 Optus notes the ACMA’s comment in its recent FYSO that “spectrum sharing in its traditional form is a core component of managing access to spectrum – all users ‘share’ the spectrum either through coordinated access (by working around other users on a time, frequency and/or spatial separation basis) or uncoordinated access, where interference potential is understood and accepted and/or mitigated by technology (for example, under the LIPD class licence).”⁶⁹
- 2.47 Optus consider that the objectives of spectrum sharing/flexibility, namely the promotion of efficient spectrum use, can be delivered via existing market mechanisms rather than regulatory intervention. Secondary market trading, spectrum leasing and geographical licence separation currently provide traditional sharing opportunities to meet existing needs, while allowing the incumbent licensees to control and determine additional uses within their spectrum licence areas. These arrangements can better deliver the efficiency objectives of proposed new “alternative” licence conditions, by not increasing the interference risk and avoiding costly unnecessary disputation.
- 2.48 For example, it is increasingly common for network operators to conclude network sharing agreements to improve the cost efficiencies of network deployment. In a MOCN arrangement, the whole of the radio access network (antennas, transmitters, receivers,

⁶⁸ [Lessons learned from the CBRS spectrum experiment — Rysavy | Fierce Network \(fierce-network.com\)](#); 28 April 2022

⁶⁹ Draft FYSO 2024-29; p.62

baseband signal processors etc) is shared, as well as the spectrum deployed. The carriers connect their own separate core network to the common RAN.⁷⁰

- 2.49 Our MOCN deal with TPG includes an agreement to share regional spectrum that will enable Optus and TPG to deliver improved mobile coverage and service performance to their customers in regional Australia. This arrangement will deliver increased spectral efficiency and promote competition against a spectrum rich Telstra by enabling Optus to accelerate our 5G deployment to deliver 2,444 5G sites in the MOCN area by the end of 2030.

New interference management techniques should not undermine investment

- 2.50 Co-existence, coordination and cooperation are fundamental to facilitating the efficient use of spectrum. The ACMA's existing licensing regime incorporates established spectrum management practices to deliver workable co-existence. For example, Technical Liaison Groups (TLGs) and consultation to support band harmonisation and design spectrum licence technical frameworks. Cooperation and coordination to deliver effective Device Boundary Criterion (DBC), guard space or agreed registrations.⁷¹
- 2.51 Optus recognises that no licensee is entitled to operate in a completely interference free environment. The public benefits of co-existence arrangements must be carefully and transparently weighed against the potential negative impact on investment. Carefully designed technical frameworks along with traditional⁷² and, if proven, modern interference resolution techniques (e.g. Automated Frequency Coordination) may all be necessary to support co-existence, minimise interference potential and ensure efficient spectrum utilisation.
- 2.52 In this context, Optus note the ACMA's statement in its recent FYSO that "While spectrum licences may be 'technology flexible' in that they do not explicitly preclude any use, they are designed and optimised with a likely technology in mind to maximise the efficiency of these licences for their expected use, consistent with co-existence requirements of other spectrum uses/users".⁷³
- 2.53 Optus agrees with this statement to the extent that co-existence and coordination with other licence holders is a fundamental principle of effective spectrum management. We also note that the relative flexibility afforded to spectrum licensees within the spectrum space is central to enabling innovation, such as our SpaceX collaboration.
- 2.54 The existing mechanisms for third party authorisation under the Act provide a balance between enabling access and innovative spectrum use, while ensuring adherence to the relevant spectrum licence technical framework. Maintaining responsibility for interference management with a single licensee helps ensure that the task of delivering effective co-existence is clearer and more straightforward, thereby lessening the administrative burden of compliance on all stakeholders.

⁷⁰ In contrast to a Mobile Operator Radio Access Network (MORAN) arrangement, the whole of the radio access network is shared as in a Mobile Operator Core Network arrangement, except the spectrum deployed is different for different carriers. In Mobile Operator Radio Access Network, the carriers in the arrangement can have different coverage and capacity. Optus and Vodafone entered this type of sharing arrangement in 2004, to share more than 2,000 base stations nationally; ACCC Regional Mobile Infrastructure Inquiry; Final Report; 30 June 2023; p.50

⁷¹ As per section 145 of the Act

⁷² Other technical measures, such as, geographical separation distances between systems, physical shielding, filtering, interference coordination and power limits may also be considered.

⁷³ Draft FYSO 2024-29; p.63

Optus plans to use all its ESLs to continue to supply essential mobile services

- 2.55 Optus has set out a vision of Australia’s digital future, and the role of mobile services in realising its potential. This provides some context as to how access to ESL spectrum will be crucial to enabling Optus to help facilitate Australia’s future competitiveness and prosperity. Of course, the use of spectrum will also be essential to ensuring the ongoing supply of existing mobile services.
- 2.56 Optus understands that the ACMA is seeking information on “planned” use of ESL spectrum for the purposes of its assessment. The ACMA has also indicated a preference for non-confidential information. Optus has provided the ACMA with its coverage maps and access to the RFNSA database.
- 2.57 The RFNSA contains planned site and technology information. This information is indicative only. The database is used as a deployment tool so active planned sites which do not have a candidate location selected will not be in the database. Conversely, candidate locations which may not be progressing may still be listed.
- 2.58 Coverage maps represent only a snapshot in time, which means that they do not allow for future states of demand-driven deployments of coverage and capacity, with coverage coming first on low-band spectrum, followed by higher frequency spectrum as traffic demand dictates. In combination with RFNSA data, coverage maps will give sufficient evidence of our historical and current “use” of ESL spectrum.
- 2.59 In regard to future use, coverage maps, even enhanced with RFNSA information, is not guaranteed to deliver the ACMA the full view of where spectrum is, or may be, used for any given band or combination of bands. The time taken to deliver new sites (small cells, roof top, macro, inbuilding solutions) or upgrade site varies depending on the level of difficulty and the cost. Typical timeframes are well in excess of 12 months and can be multi-year process. Some priority sites are more difficult to progress with the possibility of Development Approval (DA) application rejection or other delays. Site deployment can be an iterative process when new candidate sites need to be selected due to an inability to progress preferred candidates. Some sites can remain on the priority list for 5+ years and not proceed due to difficulties in land access and approvals.
- 2.60 Further, while actual plans may be more medium term in nature, once a site is deployed and activated, spectrum may be “in use” indefinitely. Even with a technology upgrade or change, such as the decommissioning of our remaining 900MHz 3G sites to upgrade to 5G NR9, spectrum will generally be re-farmed for the purposes of supplying the upgraded services. In this context, coverage maps and data from the RFNSA and RRL will remain highly relevant to the ACMA’s assessment of “planned” use of ESL spectrum. This is because Optus plan to continue to use all its ESLs to supply 4G, 5G and in the longer term, 6G services.
- 2.61 Given the potential 20-year licence period for spectrum licence issued through the ESL process, the ACMA must adopt a long-term approach to assessing the potential future public benefits to be derived from use of ESL spectrum. The Australian mobile sector is characterised by high initial fixed cost investment but low marginal cost – therefore the investment case is inherently long term. Depending on the infrastructure deployed, the time taken to earn a return on that investment could well be the potentially 20-year term of a renewed ESL licence.
- 2.62 Similarly, innovation in the sector remains dynamic. Therefore, the potential future uses of spectrum are unknown, particularly over a 20-year period. Rather than the ACMA intervening to disrupt the investment environment which has supported deployment of national mobile networks over the last 30 years, Optus submit that the secondary market for spectrum remains the most efficient means of supporting innovation as it arises.

- 2.63 A clear case in point is our collaboration with SpaceX which offers the potential for seamless connectivity between terrestrial and non-terrestrial networks. Satellite direct to mobile services are nascent in their development, yet few could have predicted the rapid pace at which NGSO constellations have been deployed. Rather than requiring new bespoke licensing arrangements, our collaboration with SpaceX is enabled by the technological flexibility and certainty of access provided by the existing spectrum licence framework.
- 2.64 Optus is Telstra's only national mobile infrastructure-based competitor. However, the economics of continuing to deploy competitive infrastructure in regional and remote areas are increasingly challenging.⁷⁴ Our regional MOCN agreement with TPG, and particularly the sharing of spectrum, presents a real opportunity to facilitate an acceleration of our 5G network deployment and deliver sustainable infrastructure-based competition for the long-term benefit of regional Australia.

Ongoing uncertainty of renewal will undermine investment in Australia's digital future

- 2.65 There remains a significant degree of uncertainty about the ACMA's preferred approach to ESL spectrum. The lack of certainty surrounding renewal of ESLs risks future investment in critical infrastructure underpinning Australia's digital future and potentially jeopardises the long-term supply of essential mobile services. The ACMA's approach creates a very real risk to the continual supply of essential emergency and safety services. The single largest risk to the ongoing delivery of essential mobile services over the long term is a lack of certainty around ongoing spectrum availability. It is a risk that must be addressed as a priority.
- 2.66 Optus has made submissions to the ACMA and the Department since 2020,⁷⁵ regarding the lack of certainty over spectrum renewal risks undermining future mobile network investment and underutilisation of spectrum assets. Without clarity as to Optus' rights to access spectrum, the context in which Optus can undertake future planning for network investment becomes all the more complex and uncertain. There is the added risk of under-investment during the latter years of the ESL licence term.
- 2.67 Spectrum in and of itself is not valuable, but the use to which it can be put is key to promoting its publicly beneficial use. Early certainty is needed to deliver the investor confidence necessary to invest in the digital infrastructure necessary to realise Australia's digital future. Spectrum licences lasting 15-20 years are required to make large capital investment decisions. Investment decisions take into account the length of time that network equipment is depreciated over, according to standard accounting practices.⁷⁶ This is in order that equipment is not written off prematurely, to provide investor confidence in the final years of the licence and to ensure continued investment in the band.
- 2.68 In addition, sufficient lead time is required to implement any alternative spectrum layering strategies to move network traffic from one band to another that may result from the ACMA refusing to renew ESL spectrum. Relinquishing and refarming spectrum has significant impact to coverage, capacity and end user experience. The device ecosystem now and in the future needs to be considered. This is not a trivial exercise as witnessed in the current process of moving 3G traffic and simultaneously upgrading end user devices to the future technology.

⁷⁴ ACCC Regional Mobile Infrastructure Inquiry, Final Report; 30 June 2024; p.56

⁷⁵ Optus submission in response to DITRDC Consultation Paper July 2020, pp.3,17,18

⁷⁶ Optus submission in response to DITRDC Consultation Paper July 2020, p.18

- 2.69 Further, providing certainty on spectrum renewal outcomes as early as possible, at least 4-5 years in advance of licence expiry provides sufficient time to redirect investment to other spectrum assets, or to invest further in the renewed spectrum.⁷⁷ If only 2 years notice is provided, at the time of the spectrum band application window and if neither the ACMA's preliminary view (Stage 3) nor its preferred view (Stage 4) can be relied upon, this provides insufficient time and risks spectrum either being underutilised or not utilised at all with a disorderly exit from the spectrum band.
- 2.70 As with any new investment decision, spectrum renewals will also require commensurate corporate governance, due diligence, strategic planning and investment planning. More importantly, should the loss of spectrum assets that underpin existing mobile networks occur, then this would detrimentally impact on overall network operations and without sufficient contingency planning, lead time for changes to take place, and access to additional funds for network reconfiguration, this could result in the significant loss of services to end users⁷⁸.
- 2.71 Until incumbent licensees are provided with certainty of renewal, there remains an unacceptable level of uncertainty as to spectrum access to justify further large and long-term network investments required to support Australia's digital future. This in turn jeopardises the myriad of associated and external benefits that mobile networks and services deliver to the Australian economy, delaying Australia's digital future. Ensuring the ESL process supports the ongoing economic and social benefits of mobile services must a key consideration in the ACMA's decision making.

⁷⁷ Optus submission in response to DITRDC Consultation Paper July 2020; p.19

⁷⁸ Optus submission in response to ACMA's draft spectrum management work programme Draft Five Year Spectrum Outlook 2021-2026 Public Version May 2021; and Optus submission in response to ACMA's draft Five-year spectrum outlook 2022-27 and 2022-23 work program Public Version May 2022

Section 3. RESPONSE TO ASSESSMENT CRITERIA

- Australia has world leading mobile networks – these have been delivered by the flexibility and certainty of access provided by existing arrangements governing ESLs.
- Optus current and planned use of ESL spectrum facilitates efficiency, promotes investment and innovation, enhances competition, balances public benefits and impacts and supports relevant policy objectives and priorities.
- Prospective use cases must demonstrate greater public benefit than incumbent use.
- A requirement to demonstrate “local area” use does not reflect the realities of network deployment and constitutes a retrospective application of a condition on ESL renewal.
- The public benefits of maintaining existing arrangements for use of ESL by wide area WBB outweigh any benefits of carving up spectrum to support shared or local access to ESL spectrum, particularly given the risks to continuity of essential public mobile services to a significant number of Australians.

- 3.1 The focus of this Consultation Paper is on gathering information from stakeholders about their current and planned use of ESL spectrum to inform the ACMA’s assessment of whether existing arrangements governing this spectrum remain fit for the purpose of promoting the public interest to be derived from the spectrum.
- 3.2 Optus has provided the ACMA with access to our coverage maps and the detailed site registration information contained on the Radiofrequency National Site Archive (RFNSA) in response to the ACMA’s information request. Optus submit that RFNSA data, in combination with coverage maps, should be sufficient to demonstrate current use of ESL spectrum.
- 3.3 Optus sets out its response to each of the ACMA’s public interest criteria below. Optus’ responses address the sub-headings set out under each of the criterion in the Consultation Paper and are also guided by Appendix A of the Consultation Paper.
- 3.4 We welcome the ACMA’s confirmation that it intends to publish submissions as soon as possible after the consultation closes and to then open a three week “reply to comment” period. While we strongly support this decision, we seek confirmation that the ACMA will take into account responses provided through the reply to comment process in preparing its preliminary view.

Existing ESL arrangements promote the long-term public interest

- 3.5 Spectrum licences are afforded a high degree of exclusivity and certainty under the Radiocommunications Act 1992 (“the Act”).⁷⁹ This has made the licence type suited to the long-term investment required for multiple generations of mobile network deployment. As a result, the Australian mobile market is one of the world’s leading markets in terms of penetration and speeds. Australia is served by multiple advanced 4G

⁷⁹ For example, sections 60B, 105 and 138 of the Act support the relative exclusivity of spectrum licences by limiting the ACMA’s power to issue class and apparatus licences (respectively) that overlap with spectrum licences while certainty of access is implied in the long-term duration of spectrum licences under s.65 of the Act and the protections afforded to licensees regarding variation or resumption of spectrum licences by the ACMA (chap 3)

and 5G mobile networks, supplying data throughputs that rank amongst the best in the world.

- 3.6 Optus is currently using all of its ESLs to supply 4G and 5G public mobile services. Mobile services, supplied using long term spectrum licences, enable greater productivity growth and result in more jobs throughout the whole economy. Mobile services are essential services. Use of ESL spectrum for mobile services enables social connectivity, public safety and security and the supply of critical services.
- 3.7 Existing arrangements for access to spectrum under ESLs have facilitated unparalleled public benefits for the Australian economy and broader society. When initially allocated via auction and tradeable via the secondary market, an allocation of spectrum can be taken to be efficient. Optus submits the current allocation of ESL spectrum to wide area mobile networks is efficient with no evidence of a higher value alternative use. Renewal of Optus ESL spectrum will enable Optus to continue to innovate and invest in mobile networks and services that underpin Australia’s digital future.
- 3.8 As outlined in section 2, the evidence is clear that the renewal of ESL spectrum to existing licensees will help deliver ubiquitous connectivity and realise the single network future, helping to address some of Australia’s perennial communications policy objectives, including to Close the Gap. While new use cases may help assist in realising these objectives and facilitate “Industry 4.0”, such use cases need not be enabled by carving up access to ESL spectrum, but rather should be supported by dedicated allocations of spectrum.

Prospective use cases must demonstrate greater public benefit than incumbent use

- 3.9 The ACMA is required to allocate spectrum in a manner that results in the highest public benefit. There is very strong evidence that the allocation of ESLs to the mobile industry has led to very large public benefits; and that continued use of the ESLs for existing mobile networks and services will continue these large public benefits.
- 3.10 Should the ACMA wish to test whether there are alternative users or uses of ESL spectrum that could give rise to greater benefits, it is incumbent on the ACMA to demonstrate this through robust evidence and facts.
- 3.11 Optus is concerned over the ACMA statement that an “absence of submissions from (prospective licensees) these stakeholders would not necessarily lead to preliminary or preferred views favouring renewal of ESLs” with the ACMA also stating that “there is no particular burden of proof” on prospective alternative (use case) licensees”.⁸⁰
- 3.12 Optus acknowledges that that the ACMA does not intend the public interest criteria as a “test”, but rather to capture key elements of the public interest considerations. However, with respect, given the nature of the exercise involves a weighing of competing claims for spectrum against the criteria, the ACMA is in a sense, ‘testing’ each claim against these criteria with a view to determining which may best serve the public interest over the long term. It follows that a lack of a submission from a prospective licensee must weigh strongly in favour of renewal.
- 3.13 We also understand that prospective licensees are not able to substantiate current use of ESL spectrum. However, given the significant impact on incumbents of a loss of spectrum, as well as the flow on effects for the public, it appears unreasonable that prospective licensees do not bear responsibility for demonstrating that the public interest

⁸⁰ Consultation Paper, p.15

is better served by their proposed use of ESL spectrum.⁸¹ A prospective licensee's claim for spectrum access must show that the re-allocation of ESL spectrum is, on balance, of greater public benefit than renewal of that ESL spectrum, having regard to all relevant materials.

- 3.14 Given that the ACMA encourages stakeholders to highlight interactions between ESL and non-ESL spectrum,⁸² Optus suggests that prospective licensees should be required to substantiate their use and deployment of available non-ESL spectrum and demonstrate why this spectrum may not be sufficient for their particular use case. In this context, Optus welcomes the statement in the final MPS to the effect that the ACMA should consider past, existing and potential future investment by licensees, "*as well as known market demand for spectrum and the capacity for other prospective licence holders to make the investment required to deploy and maintain an effective service with the spectrum.*"⁸³ Consideration of the viability of new entry should help reduce the likelihood of potentially speculative claims for access being rewarded.

ACMA's approach to assessing use is a departure from the last ESL process

- 3.15 The ACMA notes that submissions to the last ESL process "were used to inform the Minister's consideration of the public interest and making of the Radiocommunications (Class of Services) Determination 2012, which identified where re-issue of a licence would be in the public interest if the licence had been used by the licensee in the provision of the services identified for the relevant frequency band".⁸⁴
- 3.16 Optus does not agree with the ACMA's view that its approach to consideration of the public interest is "broadly consistent with the previous ESL process".⁸⁵ Over and above the fact that the ACMA is also considering use by prospective licensees, Optus considers that the level of granularity that the ACMA appears to be contemplating in its approach to examining use for this ESL process is a significant departure from the previous renewals process. We note the ACMA has set out a number of reservations about the utility of coverage maps in determining use and has hinted at using its information-gathering powers under section 284S and section 77A of the Act.⁸⁶
- 3.17 More specifically, the ACMA has indicated that it intends to "examine information about how incumbents are using their spectrum in certain geographic areas" in developing its preliminary views.⁸⁷ This approach is far more granular than the previous ESL renewal process, which required MNOs to provide "proof of use" data for each of their individual ESL licences – the test for last renewal process was for an incumbent to prove use of the licence itself and not potentially have to prove use within every area within every

⁸¹ We note that the ACMA's guidance material states that the ACMA will have regard to whether an "incumbent would be significantly compromised if the licence were not renewed and potential flow on effects" when assessing the public interest of renewing a licence (for 10 years or longer) – see ACMA, Our approach to licensing and allocation guidance document, 2021, p.25-26.

⁸² Consultation paper, p.10

⁸³ Section 10, final MPS Instrument 2024

⁸⁴ Consultation Paper, p.10; Optus note that the "use" test for the previous ESL process was essentially whether or not the spectrum licences had been used "to provide mobile voice and data communications services" or "wireless broadband services" (access or backhaul). The evidence provided to establish this was registrations in each spectrum licence and statements about planned future use.

⁸⁵ Consultation Paper, p.10

⁸⁶ Consultation Paper, p.18

⁸⁷ ACMA; Expiring spectrum licences, Finalised framework and response to submissions, December 2023, p.9

spectrum licence.⁸⁸ There was also provision for renewal in “special circumstances” where technical reasons, such as a lack of equipment or the licensed bandwidth, may have meant that the spectrum could not be used (e.g. 3.4GHz).⁸⁹

- 3.18 Optus submit that MNOs could reasonably have assumed that the same test would be applied for this ESL process. The apparent level of detail that the ACMA may examine in assessing use this time is a new threshold against which incumbents are to be measured. Optus submits that if the test of use for renewal had been known at the commencement of each ESL licence, it could be reasonably assumed that different investment decisions may have been made. For example, knowing that use may be assessed at a more granular level may have provided greater impetus to deploy in non-economic areas to ensure licence retention and/or that the spectrum was not lost/shared for the rest of the new renewed licence.
- 3.19 In our view, too granular an examination of use may constitute an unreasonable new condition on our use of ESL spectrum, imposed after the licence was issued. When applied to ESLs, the effect of too granular an assessment may be akin to a “specified circumstances” renewal statement, enabling the ACMA to refuse to renew ESL spectrum due to “insufficient” use. Notwithstanding the ACMA’s broad discretion to assess the public interest in renewal, Optus consider that any retrospective assessment of “sufficiency” or “adequacy” of the use to which a licensee made of its ESL spectrum is not within scope. We also note that “renewal statements” only apply to spectrum licences issued after the commencement of the Modernisation Act.⁹⁰
- 3.20 Optus also note that, if the ACMA proceeds with a more localised approach to examining use as part of its assessment process, then this would likely unfairly advantage Telstra. This is because Telstra have deeper financial reserves to use to deploy in areas that the ACMA may consider are unserved or underserved prior to expiry of their ESLs. Optus also refers the ACMA to Section 6.

Optus responses to ESL public interest criteria

- 3.21 Optus sets out its response to each of the ACMA’s public interest criteria below. Optus’ responses seek to address each of the sub-headings set out under each of the criterion in the Consultation Paper and are also guided by Appendix A of the Consultation Paper.

Question 1 – Public interest criterion 1: facilitates efficiency

How does your current and planned use of the spectrum facilitate efficiency?

- 3.22 Optus’ current use of its ESL spectrum facilitates efficiency from both an economic and technical perspective. Mobile services are predicted to increase Australia’s wealth by \$37 billion each year in 2030. There are more than 29 million mobile services in operation.⁹¹ Mobile networks deliver essential connectivity to Australians and underpin the increasingly mobile social and economic activity of the nation.

⁸⁸ In 2013, Optus provided the ACMA with evidence of use that demonstrates that as per s.82(1) of the Radiocommunications Act 1992, the licences have been used for the provision of ‘wireless broadband services’ a relevant class of services identified in the Radiocommunications (Class of Services) Determination 2012. (2300MHz)

⁸⁹ Letter from Optus to the ACMA dated 14th January 2015 (3400MHz)

⁹⁰ Section 65A of the Act was introduced by the 2020 reforms to the Act and provides that a spectrum licence issued after the commencement of the section must include a renewal statement.

⁹¹ ACCC Communications Market Report – 2022-23; p.26

- 3.23 Providing wide area mobile coverage at a cost that end users are prepared to pay requires economies of scale. MNOs are large scale businesses and realising the potential of “ubiquitous connectivity” accentuates the need for scale in the future.
- 3.24 Efficient use of spectrum is inseparable from achieving economies of scale. If production costs are too high, this will prevent some use cases from materialising due to cost. Given large economies of scale, MNOs have delivered ever lower prices per GB, higher speeds, and wide area coverage. Carving out spectrum for a single user or use case will never benefit from the same economies of scale and would be inherently less efficient.
- 3.25 Australia’s digital future and competitiveness will depend on enabling the efficiency benefits of new mobile technologies and sustainable supply of essential public mobile services. The digitalisation of industries, services and supply chains across the economy will depend significantly on the availability of ubiquitous connectivity. Realising the potential of these technologies will require operators to have access to spectrum of sufficient quantity and quality. Optus’ ongoing use of ESL spectrum will continue to facilitate efficient outcomes to a greater extent than any alternative use case for our spectrum.

Optus’ current and planned use of ESL spectrum facilitates productive, allocative and dynamic efficiency

- 3.26 Economic efficiency is when resource allocation is such that well-being is maximised, implying there does not exist another allocation that makes one or more persons better off without harming the well-being of at least one other person.⁹²
- 3.27 In assessing whether the current or planned use of ESL spectrum facilitates efficiency, the ACMA is applying a standard approach, relying principally on economic concepts of efficiency (which incorporate considerations of technical efficiency).
- 3.28 Optus submit that its current and planned use of ESL facilitates productive, allocative and dynamic efficiency for the following reasons, among others:
- (a) Public mobile networks and services do the heavy lifting in meeting Australians’ demand for data via wireless networks, with capacity increasing year on year in response to demand. Using the amount of traffic passed through spectrum as a proxy for socio-economic value generated from spectrum, then mobile services are the most productively efficient users of spectrum.
 - (b) Existing arrangements for ESL spectrum have facilitated market competition. This has driven cost efficiency into network deployment, most evident by the need to share infrastructure to deliver infrastructure-based competition to regional areas.
 - (c) MNOs continue to have incentives to use their spectrum efficiently to optimise the balance between the number of sites and maximum coverage. Establishing new sites will always be more costly and time consuming than deploying unused spectrum. As a national carrier, Optus enjoys significant economies of scale relative to smaller operators. This means that network deployments can be delivered more cost effectively.

⁹² In economics this interpretation of efficiency is referred to as Pareto efficiency and is: “attained when individuals in society maximise their utility, given the resources available in the economy”, see Productivity Commission (2013) [‘On efficiency and effectiveness: some definitions’](#) Productivity Commission Staff Research Note May 2013.

- (d) Longer term, technologies such as network slicing will enable public mobile networks to effectively become a shared resource for all use cases, avoiding the higher risks of harmful interference arising from fragmentation.
- (e) Australia's spectrum management framework facilitates allocatively efficient outcomes through the existence of a secondary market for spectrum and given that ESL spectrum has been previously allocated via auction processes and/or a previous renewal.⁹³ Therefore, it has already been exposed to incentives for efficient use and it is reasonable to assume that the current allocation of spectrum is efficient unless there is significant and credible evidence to the contrary. Optus refers the ACMA to the attached expert reports from Dr Chris Doyle and Coleago Consulting in support of this view.⁹⁴
- (f) Optus has utilised existing market mechanisms to deliver innovative and productive collaborations such as with SpaceX and our MOCN agreement with TPG.
- (g) Non-mobile operators have not sought to acquire or access Optus spectrum, and, in our experience, trade or access transactions tend to come from MNOs acquiring spectrum from non-mobile operators (e.g. Dense Air, Vivid Wireless, Qualcomm).
- (h) The need to take active measures to ensure efficient spectrum allocation in the ESL process is much weaker than at initial allocation. A further spectrum auction is inappropriate for ESL renewal and will not yield a more efficient use of the spectrum – rather it is likely to drive prices up for spectrum needed to supply essential mobile services, amounting to a form of tax on MNOs. In our view, an auction will likely lead to the spectrum being acquired by either the same MNOs who already owns it, or Telstra which would result in further market consolidation.
- (i) Mobile networks are already highly efficient users of spectrum. The technological evolution to 5G advanced and 6G deployment will deliver to even more shareable networks. Competing national networks will become platforms for an array of new use cases, solving local area problems. The economies of scale and scope of these networks will reduce the cost of innovation and better promote dynamic efficiency than by fragmenting ESL spectrum to artificially engineer access for prospective licensees or niche use cases.

Optus evolving use of the spectrum over the ESL term demonstrates efficient use

3.29 Optus has spectrum licences in the 700MHz, 900MHz, 1800MHz, 2100MHz, 2300MHz, 2600MHz, 3.4GHz, 3.6GHz, 3.7GHz and 26GHz bands. All these spectrum licences are

⁹³ Initial ESL Spectrum Allocation as follows: 850MHz auction held 1998, renewed in 2013. 700MHz auction held 2013 and unsold lots in 2017, 1800MHz metro auctions held in 1998/1999/2000, renewed in 2013. 1800MHz regional auction held in 2015/2016. Additional residual 1800MHz was auctioned in the multiband auction in 2017. 2100MHz auction held in 2001, renewed in 2015. Additional residual 2100 MHz was auctioned in the multiband auction in 2017. 2300MHz auction was originally allocated as MDS apparatus licences and then converted to 15-year spectrum licences and a conversion payment was made in 2000. Additional residual 2300MHz spectrum was auctioned in 2011. 2300MHz was renewed in 2015. Residual 2300 MHz was auctioned in the multiband auction 2017. 3400MHz auction held in renewed in 2000 and renewed in 2015. 00 Additional residual 3400 MHz was auctioned in the multiband auction 2017. 3600MHz auction held in 2018.

⁹⁴ See further Doyle; Dr Chris; Renewing expiring spectrum licences: 24 May 2024; p.4 and Coleago Consulting; ESL Pricing Paper; 15 March 2024; p.8

ESLs except for our 900MHz (2 x 25MHz national licence accessible from 1 July 2024), 3.7GHz (20MHz licence in regional QLD and rural northern NSW) and 26GHz mmWave (600-800MHz in metro and regional licence areas).

- 3.30 Optus refers the ACMA to our coverage maps and the RFNSA as key sources of information on current services deployed over our ESL spectrum holdings. Optus currently has well over 9 million mobile services in operation. Our mobile network is currently accessible by 98.5% of Australia's population and we will deliver a second 5G network to regional Australia by 2030.
- 3.31 Since the previous renewal of ESLs, Optus has used its 2100MHz spectrum (and 900MHz assigned apparatus licences) to supply 3G services. In the lead up to the 3G shutdown, Optus has "re-farmed" all of its 2100MHz spectrum to supply 4G and 5G services.
- 3.32 Optus has used all its ESL spectrum (other than 3.4GHz) to supply 4G services and uses 1800MHz and 2600MHz spectrum solely for this purpose. Optus initiated our 5G deployment using our 3.4GHz ESL spectrum and have now extended 5G to all ESL spectrum, as well as 900MHz and our 26GHz (mmWave) spectrum.
- 3.33 We do not currently use 700MHz and 1800MHz for 5G as these bands are heavily utilised for 4G services. The shutdown of our 3G network will free up capacity for 5G over 900MHz, which will convert to spectrum licensing from 1 July 2024. We also use our spectrum via apparatus licences (1800 in rural areas, 2100MHz in regional and rural areas) and AWLs (3.4GHz, 3.8GHz and 26GHz) in regional/rural areas to supply public mobile services in local areas and mobile private networks to enterprise where this does not cause undue interference to our public mobile network.
- 3.34 An overview of Optus' ESLs and the licensed spectrum space is set out in the table below. Optus also has apparatus licences in 1800MHz, 2100MHz and AWLs in the 3.4GHz and 3.8GHz bands in remote areas of Australia and 26GHz in regional areas.
- 3.35 Optus has also prepared a more detailed table at Appendix A providing a breakdown of Optus current and planned spectrum use for all our licensed spectrum, including technology and bands used, geographic availability and whether used to provide coverage or capacity/capability. We also include information regarding the latest 4G and 5G site numbers for each band.

Figure 7 Optus spectrum assets

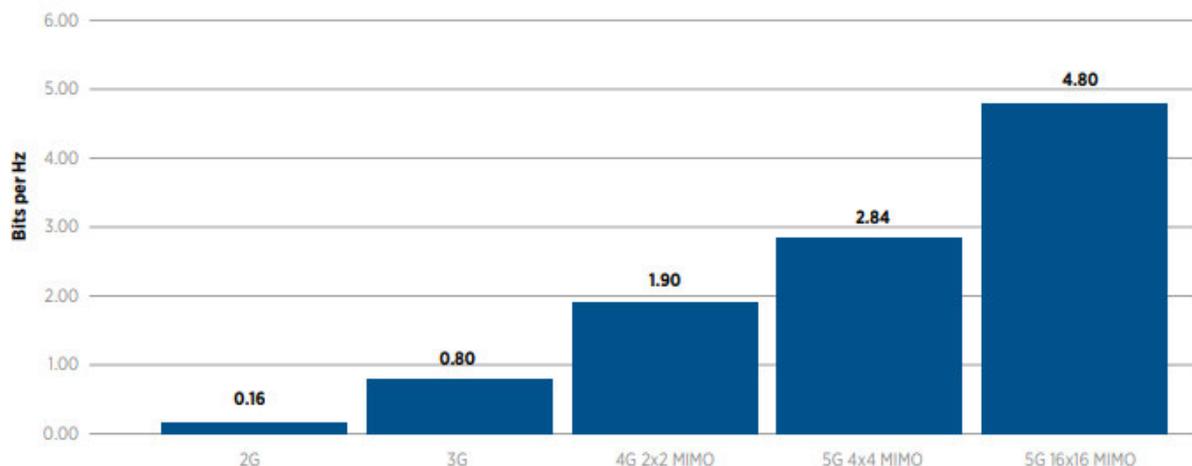
Band	Optus Licence number(s)	Licensed area	Licensed bandwidth
700MHz (FDD)	9469858	National	2 x 10MHz
1800MHz (FDD)	9263448	Metro	2 x 15MHz
1800MHz (FDD)	10231258	Regional	2 x 20-25MHz
2100MHz (FDD)	10143562	Metro Regional	2 x 20MHz 2 x 5MHz
2300MHz (TDD)	9460720, 9460721, 9460722; 10424532; 9448618, 9448620, 9448621	Metro	98MHz (unpaired)
2600MHz (FDD)	9469864, 9469870	National	2 x 20MHz
3.4GHz (TDD)	11286124, 11286125	Metro (+ Canberra and Lorne)	65-100MHz
3.4GHz (TDD)	11286123	Regional and rural WA	32.5-65MHz
3.6GHz (TDD)	10917462	Regional and rural	30-35MHz

Source: Optus

- 3.36 Optus plans to continue to use its ESL spectrum for the purpose of deploying mobile networks and supplying mobile services to millions of Australians. Driven by the need to compete and maintain quality of service for our customers, Optus remains a highly efficient user of spectrum, promptly investing in refarming of our spectrum to the latest generations of the technology with better spectral efficiencies.
- 3.37 The following diagram from GSMA⁹⁵ illustrates the increased spectral efficiencies achieved by each successive generation of mobile technology. Of course, these efficiency gains are offset by continued increases in demand for data.

⁹⁵ GSMA; 2019; see here <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2019/06/Benefits-of-Technology-Neutral-Spectrum-Licences.pdf>

Figure 8 Average Spectral Efficiencies



Source: GSMA

- 3.38 We plan to continue to invest in updating our network as required to support new generations of mobile technology, including 5G advanced and 6G, which will both potentially fall within the licence term of any renewed licence (i.e., post 2030).
- 3.39 Optus has prepared a number of graphs that demonstrate our ongoing investment in network infrastructure (see Figure 11 and Appendix B). These graphs show that Optus has used spectrum to deliver successive generations of mobile technology. The graphs highlight that this is done by repurposing spectrum bands as needed.

Third party or sharing arrangements and other secondary market activity

- 3.40 Optus has been an active participant in the secondary spectrum market. Optus seeks to cooperate with other operators to promote the efficient use of its spectrum and has provided spectrum access to a number of access seekers for a diversity of use cases in the past. For example, Optus has
- (a) Provided shared access to our 2.3GHz spectrum to a third party in the past (see detail on our spectrum arrangements at Section 7).
 - (b) Traded blocks of 2.3GHz and 3.4GHz spectrum with NBN Co to promote defragmentation.
 - (c) Provided 3G roaming to TPG in regional Australia.
 - (d) We are also working with further third-party organisations to facilitate shared access to ESL spectrum, though details remain commercial-in-confidence.
 - (e) Adopted spectrum sharing solutions, including via network slicing, that will increase opportunities to share our spectrum in the future.
- 3.41 More recently, Optus has proactively sought collaborations that offer the potential to dramatically change Australia's communications landscape. Our recent collaboration with SpaceX offers the potential to bridge the digital divide and Close the Gap via satellite direct to mobile (DTM) services that utilise our <<CIC begins>><<CIC ends>> spectrum licence. Optus collaboration with SpaceX, facilitated through existing spectrum

licensing arrangements, clearly aligns with the objective in the MPS to facilitate new entrants and use cases, particularly of LEOsats.⁹⁶

- 3.42 Optus plans to initially launch SMS followed by call services to areas that have been previously, and will likely remain, unserved by terrestrial networks. This is an efficient use of our national spectrum licences that delivers a long-term public benefit. Optus has provided more technical detail on this collaboration at Section 7 of this submission.
- 3.43 The use of national spectrum licences has also facilitated the delivery of network sharing arrangements for regional Australia. On 29 April 2024, Optus announced a MOCN agreement with TPG. Under the agreement Optus will supply MOCN services in the MOCN coverage area using <<CIC begins>>
- 3.44 <<CIC ends>> to supply MOCN services.

Issues with the current planning, licensing or technical arrangements that prevent efficient use

- 3.45 In our submission to the ACMA's Stage 1 consultation process, Optus identified a number of issues with the planning, licensing and technical arrangements affecting certain ESL bands. Optus refers the ACMA to this submission for further details.
- 3.46 Optus would also like to take the opportunity of this consultation to elaborate on our concerns with the 3.4GHz ESL spectrum and to highlight some specific lessons that Optus considers can be learnt for the purposes of the ESL process. We also reiterate previous concerns about a potential "dilution" of spectrum licence rights that may flow from increased demands for co-existence with apparatus and class licensed services with specific reference to the 700MHz ESL band.

Catering to a diverse range of use cases can undermine efficient spectrum use

- 3.47 The Band n78 – by which we mean the 500MHz between 3300 and 3800MHz – has been recognised as a pioneer band for 5G. 3GPP standards recommend minimum contiguous bandwidths of 100MHz to deliver the potential spectral efficiency enhancements of 5G cost effectively. The wider the band in which 5G is deployed, the higher the spectral efficiency.
- 3.48 Deploying 5G in a 100MHz wide channel in upper mid-band spectrum delivers a 7% higher spectral efficiency compared to deploying it in only a 20MHz channel bandwidth. Spectrum utilisation is less than 100% for all 5G NR channel bandwidth options because the resource blocks do not fully occupy the channel bandwidth. However, the utilisation decreases with the channel bandwidth for 30kHz sub-carrier spacing (as shown in Figure 4).⁹⁷
- 3.49 Optus has long advocated for harmonisation across the entirety of the 3.4-4.0GHz band and more specifically, for allocation of at least 100MHz of contiguous mid-band spectrum for each MNO and NBN Co, consistent with 3GPP standards as per the following high level band configuration:⁹⁸

⁹⁶ Section 7, final MPS Instrument, 30 April 2024

⁹⁷ Taken from ECC Report 287, Guidance on defragmentation of the frequency band 3400-3800 MHz, October 2018, page 41

⁹⁸ Optus submission to ACMA consultation on proposed spectrum re-allocation declaration for the 3.4GHz and 3.7GHz bands; May 2022

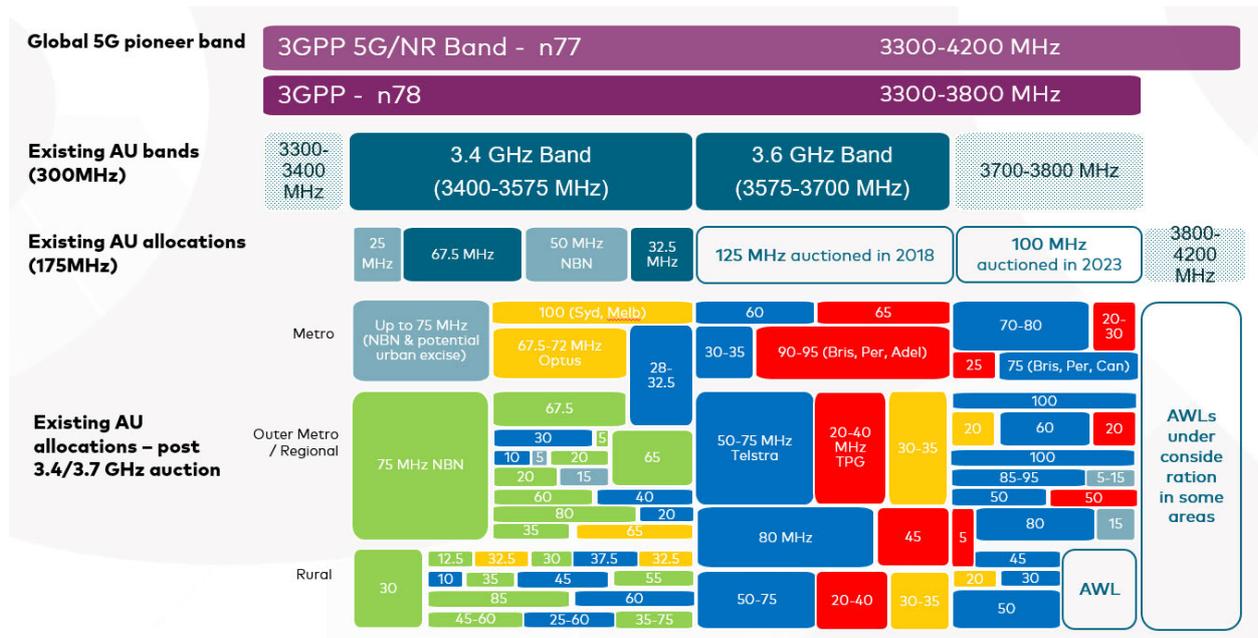
Figure 9 3400 – 4000 High Level Band Configuration



Source: Optus

- 3.50 However, the ACMA's approach to this spectrum has been piecemeal, with multiple different allocation processes and diverse licence types and conditions being used to cater to different use cases and scenarios. The 3.4 to 3.8GHz band is already highly fragmented – with different geographic areas in different parts of the band undermining the tradability of the spectrum. The following highlight the disparate activities that the ACMA has taken to the allocation of this spectrum:
- (a) (Partial) defragmentation activities in 3.4GHz and formalisation of the licence variations completed. This only addresses current issue in the 3.4GHz band between mix of NBN PTS apparatus licences and the 3.4GHz spectrum licences,
 - (b) Differences in 3.4GHz and 3.6GHz licence areas hamper current usability of the spectrum. There also remain possible co-existence issues across geographic boundaries and this issue has been further entrenched by 3.4/3.7GHz allocations.
 - (c) Presence of WISPs in some 3.6GHz licence areas. These regional licences remain encumbered until 2025, limiting the ability of MNOs to deploy and utilise licences in affected areas. Further detail is provided at Section 7.
 - (d) Results from the recent 3.4/3.7GHz auction highlight there may be future need for defragmentation given that there were unsold lots (7 lots in each of the bands).
 - (e) The ACMA's ongoing administrative processes to allocate 3.8GHz spectrum to AWLs in outer metro, regional and remote Australia.
 - (f) The imposition of limitations on the use of spectrum between 3.7 and 4.2GHz band in and around airports
- 3.51 In Optus view, the end result of the ACMA's approach to 3.4GHz to 4.0GHz spectrum has been to create a complex and highly fragmented spectrum landscape that ultimately undermines the potential utility and efficiency of the spectrum.
- 3.52 In particular, the channel sizes for 5G mid-band deployment are generally limited to between 30 and 60MHz and the geographic areas covered by 3.4GHz and 3.6GHz and 3.7GHz licences do not align. There is no restriction in the band that causes this; rather it is a result of allocation decisions by the ACMA.
- 3.53 The fragmentation of spectrum products is further compounded by the imposition of restrictions on the use of spectrum above 3.7GHz around airports to protect old radio altimeter equipment used on aircraft. The following diagram illustrates the inefficient levels of fragmentation:

Figure 10 Overview of the 3.4-4.0 GHz band



Source: Optus

3.54 As a result of a range of allocation decisions by the ACMA, this band is not optimised for 5G. The resultant defragmentation will be hard to resolve via market mechanisms alone. Optus consider that a key insight from this experience for the ESL process is to avoid designing multiple allocation processes to support too wide a range of use cases and to minimise the number of licence boundaries, so the spectrum is optimised for use.

Workable co-existence – Avoid policies that dilute spectrum licence rights

- 3.55 Optus has also raised concerns about the potential for a “dilution” of spectrum licence rights. Optus takes the opportunity to reiterate these concerns in the context of the ESL, and notes that the ACMA’s proposals to adjust arrangements at the upper edge of spectrum licensed 700MHz band provides a recent example in this regard.
- 3.56 The Australia wide spectrum licences in the 700MHz band were acquired at auction in 2013 on the basis that the band was unencumbered other than arrangements made for legacy digital terrestrial television broadcasting (DTTB) services. The relative exclusivity that this afforded spectrum licensees was key to ensuring that the 700MHz band was then heavily utilised by mobile carriers to deploy national 4G mobile networks, which have delivered significant public benefits to Australia.
- 3.57 Given the propagation characteristics of this spectrum it will remain key spectrum to deliver 4G, 5G and 6G mobile coverage in the future. Furthermore, the very propagation characteristics that make this band so useful in supporting current and future wide-area service provision render it extremely difficult to coordinate across co-channel spectrum boundaries. The inter-site distances required to prevent harmful interference for licensees on either side of any spectrum boundaries need to be extremely large, significantly undermining spectrum efficiency and utilisation.
- 3.58 The 700MHz spectrum licences are due to expire on 31 December 2029. Any erosion of MNOs capacity to utilise this low band spectrum for the long term via renewed 700MHz ESL, appears, in Optus view, to be inconsistent with the ACMA and the Government’s expectations regarding mobile and telecommunications network operator’s role as suppliers of essential services. Because 700MHz is crucial to coverage, any refusal to

renew or a decision to carve up this band, would compromise Optus' ability to provide wide area coverage and undermine continuity of service objectives across Australia.

Market mechanism are most effective at facilitating efficient use of spectrum

- 3.59 More generally, with regard to facilitating new entry and use cases for ESL spectrum, the ACMA should be guided by the need to let market forces deliver economically efficient use of spectrum. The Act establishes a secondary market for spectrum access, including via third party authorisation such as our arrangement with SpaceX or via spectrum trading (as we recently completed with NBN Co in 2.3GHz and 3.4GHz bands largely for the purpose of promoting spectrum efficiency).⁹⁹ As highlighted by the global spectrum expert Dr Doyle, an effective secondary market delivers economically efficient allocation of spectrum rights and usage.¹⁰⁰
- 3.60 As noted in our response to the Department's consultation on the draft MPS Instrument,¹⁰¹ Optus is concerned about the lack of objective rationale for encouraging the ACMA to "explore future arrangements that reduce barriers to entry" to ESL spectrum, recommended by the ACCC.¹⁰² To proceed without clearly establishing market failure creates a heightened risk of regulatory failure, which in turn could strand spectrum and undermine its efficient use.
- 3.61 While Optus readily concedes that the mobile sector is characterised by high barriers to entry due to the high cost of spectrum and high cost to deploy, the ACCC's recommendation is not based on a formal analysis of the current state of competition in the national mobile market. Further, as accepted by the ACCC and the Competition Tribunal, access to spectrum is but only one barrier to entry faced by potential entrants. It is highly doubtful that discriminatory access to spectrum for new entrants would actually result in new entry.¹⁰³ We refer the ACMA to Section 5 (Alternative licence conditions) and Section 7 (case studies) of this submission for further information.
- 3.62 In the circumstances, any change to existing spectrum licence arrangements to support local entry into the national mobile market should be treated with a high degree of caution. Recent history would suggest that any further entry at a national level is highly unlikely. While there have been numerous open auctions in recent years for mid and low band spectrum, none has demonstrated any real demand by new national entrants.¹⁰⁴

⁹⁹ Sections 68 and 85 of the Act

¹⁰⁰ Doyle, Dr Chris of Cambridge Economic Policy Associates Pty Ltd (CEPA); Renewing expiring spectrum licences: By Dr Chris Doyle for SingTel Optus Pty; 24 May 2024; p.4

¹⁰¹ Optus submission; April 2024

¹⁰² ACCC submission, ACMA Stage 1 consultation paper

¹⁰³ Australian Competition Tribunal; Applications by Telstra Corporation Limited and TPG Telecom Limited (No 2) [2023] ACompT2; ACT 1 of 2022; 21 June 2023; para 335; p.124-125

¹⁰⁴ Spectrum has never been reserved for a new entrant in a spectrum auction in Australia presumably because it could never be justified in the highly competitive mobile market. There has been no sustainable new entrant who has acquired spectrum in Australia since 2013. The only examples of a new entrant acquiring spectrum in a low or mid band auction since 2013 are TPG and Dense Air, however neither were sustainable as individual entities and either merged or were acquired by an existing MNO. TPG acquired 2x10MHz of 2600MHz in 2013 and 2x10MHz of 700MHz in 2017, however this resulted in a merger with an existing MNO, Vodafone which commenced in 2018 and was finalised in 2020. In 2018, Dense Air acquired 3.6GHz metro spectrum, however they traded the 3.6GHz spectrum for 2.6GHz spectrum with TPG in 2021 and were later acquired by Telstra in 2023. The rest of the low/mid band auctions resulted in the spectrum being acquired by the existing MNOs.

Any policy decision that aims to promote inefficient entry is likely to reduce the public benefit of spectrum use.¹⁰⁵

- 3.63 There is also scant international precedent for using an ESL process to introduce local area or regional private mobile licences. Rather, the more common approach (for the currently few examples) is to consider new releases of spectrum.¹⁰⁶ Optus support this approach and note that the ACMA has successfully made 3.8GHz AWLs available for prospective users via administrative allocation processes. We also note the success of OfCom's Shared Access Licence in meeting demand for private networks via the 3.8-4.2GHz band with OfCom observing that "the popularity of the 3.8-4.2 GHz band reflects its suitability for a range of newer 5G use cases, with a developing 5G ecosystem and significant bandwidths available".¹⁰⁷ By contrast we note the limited uptake of OfCom's Local Area Licence designed to enable access to MNO spectrum.¹⁰⁸
- 3.64 To the extent that the ACMA considers that existing spectrum access arrangements do not provide sufficient support for new entry into the Australian market, the ACMA should consider non-ESL spectrum bands, such as the 3.8GHz band. LEOSat services and other new entrants and use cases can also operate in spectrum outside of bands allocated and optimised for WA WBB, avoiding the inefficiencies created by licence boundaries.
- 3.65 Our SpaceX collaboration highlights the effectiveness of existing mechanisms of spectrum access to deliver the benefits of new entry and use cases in WA WBB spectrum space. Optus has authorised SpaceX to use our national ESL spectrum to deliver direct to mobile services to customers in underserved geographic areas of Australia. Our arrangement respects the relevant technical framework, promoting efficient use of this spectrum and helping to deliver regional connectivity goals.
- 3.66 This collaboration was also enabled by the flexibility afforded to licensees under the existing spectrum licence regime. In our view, an important benefit of using a third-party authorisation arrangement is that the (terrestrial) spectrum licence holder remains ultimately responsible for interference management, lessening the burden on the ACMA and any affected adjacent licensees. Such arrangements may prove attractive to overseas Non-Geostationary Satellite Operators (NGSO) such as SpaceX who might seek to reduce the administrative burden of cross-jurisdictional filing and licensing requirements.
- 3.67 Maintaining responsibility for interference management with a single licensee, via third party authorisation arrangements or otherwise, helps ensure that the task of delivering effective co-existence is clearer and more straightforward, thereby lessening the administrative burden of compliance on all stakeholders. In this way, existing mechanisms allow for coordinated access to spectrum that enables new use cases or operators while maintaining the operating integrity of the existing mobile networks that avoid the problems of geographic boundaries outlined elsewhere in this submission (see case studies at Section 7).

¹⁰⁵ With some notable examples of failed set asides to facilitate new entry being the 2008 Canadian Advanced Wireless Spectrum auction and German 3.5GHz auction in 2019 – (see [Spectrum-Set-Asides-Germany.pdf \(gsma.com\)](#))

¹⁰⁶ In the UK, over 650 licences have been issued for shared access in 3.8-4.2GHz since 2020

¹⁰⁷ [Evolution of the Shared Access Licence Framework \(ofcom.org.uk\)](#), which states that more than 850 Shared Access Licences have been issued since 2019 and the adoption of a similar approach for local licences in the 3.8GHz-4.2GHz band in France and Norway; p.6

¹⁰⁸ Consultation Paper, p.50 notes that only 27 (now 28) Local Access Licences have been issued. We note that none of these are in low-band spectrum – see also [Local Access Licences Chart \(ofcom.org.uk\)](#),

Question 2 – Public interest criterion 2: promote investment and innovation

How does your current and planned use of the spectrum promote investment and innovation?

- 3.68 Optus' historical, current and planned use of ESL spectrum promotes investment and innovation, helping realise the long-term public interest to be derived from ESL spectrum. Optus sets out more detailed reasoning for this below.
- 3.69 Optus also provided a number of comments on the importance of renewal of ESL spectrum to the long-term investment required to deliver Australia's digital future in our submission to the ACMA's Stage 1 consultation process. We refer the ACMA to this submission for further details.

Successive generations of mobile technology deliver vast economic benefits

- 3.70 The Australian economy is increasingly the digital economy. Mobile connectivity is essential to modern life, underpinning communication with friends and family, access to news and entertainment, and an ever-growing list of services and applications. Mobile connectivity is crucial to businesses and to lifting productivity and driving innovation and economic growth. Mobile services, supplied using long term spectrum licences, enable greater productivity growth and result in more jobs throughout the whole economy. In addition to economic benefits, sustained investment in mobile networks will be crucial to network resilience and security of critical infrastructure.¹⁰⁹
- 3.71 GSMA research shows that the baseline economic impact of mobile services increases when upgrading from one generation of mobile technology to the next (15% from 2G to 3G and 25% from 2G to 4G).¹¹⁰ The positive spillover effects of mobile technology upgrades on the broader economy are widely recognised, which will continue with 5G.¹¹¹ With 5G MNOs can now provide a platform for a wide variety of use cases, including massive machine type communication, smart city, virtual private network by means of network slicing and more.¹¹²
- 3.72 The spectrum licenced to MNOs is deployed to service a wide variety of users, use cases, and applications with a limited amount of spectrum. In effect, MNOs are highly efficient spectrum sharing platforms. There is no other comparable use of spectrum serving such a diverse range of usage. Moreover, economies of scale in the MNOs network reduce the cost of innovation for alternative users wishing to share.
- 3.73 5G advanced and 6G deployment imply a radical shift to more shareable networks, in which competing national networks become platforms for an array of new use cases. The economies of scale and scope of these networks will reduce the cost of innovation and better promote dynamic efficiency than by fragmenting ESL spectrum. Similarly, the costs of interference management will be minimised by an MNO able to more effectively ensure coordinated third-party access that preserves the quality of end-user services.

¹⁰⁹ Draft FYSO 2024-29; p.6

¹¹⁰ "Mobile technology: two decades driving economic growth", 2020, p 3; GSMA working paper; accessible at <https://data.gsmaintelligence.com/api-web/v2/research-file-download?file=121120-working-paper.pdf&id=54165922>

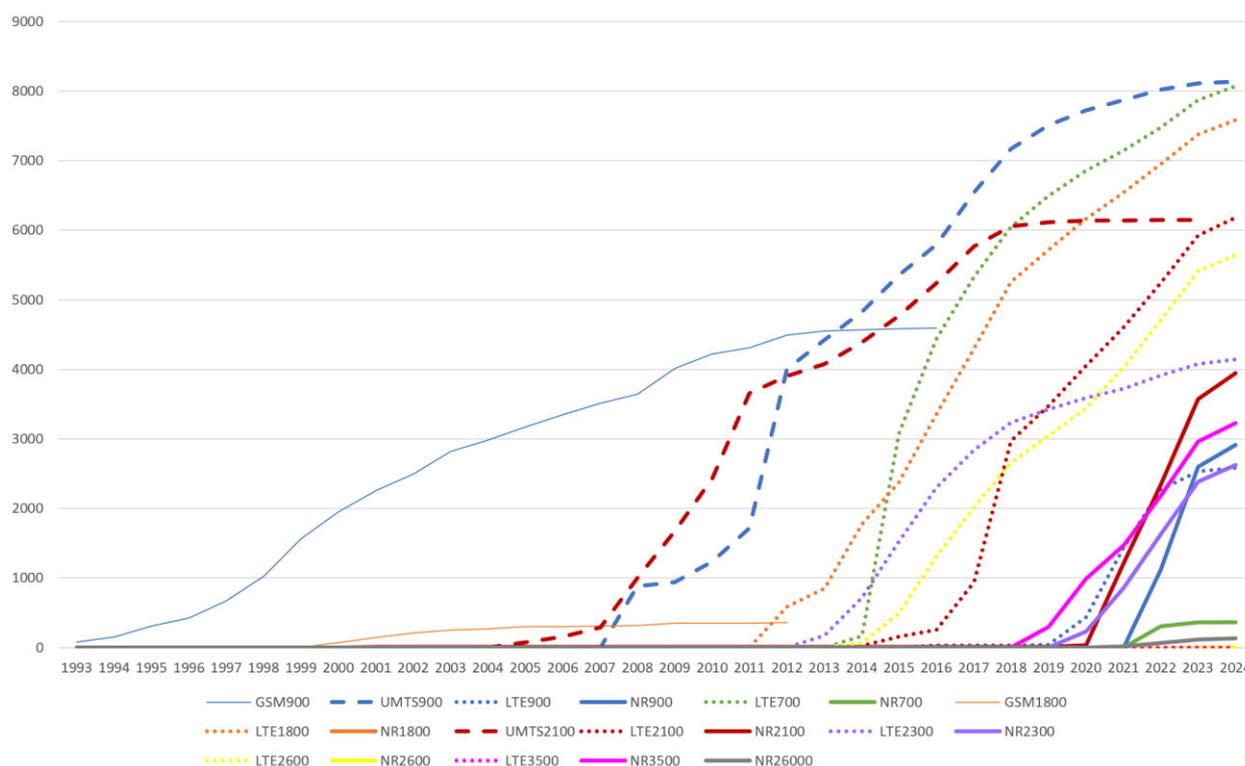
¹¹¹ The Mobile Economy 2021, GSMA Intelligence, 2021; The Global economic impact of 5G, PWC, 2020

¹¹² With regard to users and use cases, the development from 4G (LTE) to 5G (IMT-2020) already saw an expansion of requirements to cover a wide range of use cases and applications. While 4G can be thought of as a best effort mobile data service for smartphones, 5G addresses a wide range of use cases and with new capabilities such as low-latency, network slicing, and ultra reliability. In essence, a mature 5G network is a platform which addresses all present use cases.

3.74 Given their significant economies of scale to efficiently use ESL spectrum, MNOs remain best placed to invest the necessary capital – but the right investment environment is needed. Access to spectrum of sufficient quantity and quality at a price that maximises the ability of operators to invest in network deployment will be crucial. Offering to renew all Optus ESLs on the same terms at a nominal price will best promote the long-term public benefit derived from ESL spectrum.

3.75 Figure 11 shows the number of technology units per band deployed in the Optus network from 1993 until 2024 and represents Optus levels of investment in the network. This graph clearly demonstrate how Optus network investment and use of spectrum bands aligns with successive generations of mobile technology. Note that these numbers may differ slightly from the RKR data.

Figure 11 Optus Deployment of technologies on sites per year



Source: Optus

Optus' current use of ESL spectrum promotes investment and innovation

- 3.76 The Australian mobile sector has invested billions of dollars in spectrum licences and deploying network infrastructure. This investment has delivered new generations of mobile technology, with better service performance that has enabled downstream investment and innovation in new products and services.
- 3.77 Over the past 30 years, Optus invested some \$45 billion in infrastructure, in turn allowing other companies to connect, sell, and thrive in today's digitalised economy. Optus now typically invests over \$1.5 billion in capital expenditure annually in its mobile network and services. Optus also invests very heavily in spectrum, having acquired and renewed licences worth a combined \$1.9 billion in the last five years alone and over \$4 billion since 2013, including the 900MHz and 26GHz acquisitions in 2021 and the 3.7GHz spectrum in 2023.
- 3.78 This investment has delivered and maintained national 2G, 3G, 4G and 5G mobile networks used by millions of Australians on a daily basis. The deployment of successive

generations of mobile technology has supported downstream investment and innovation in new technologies and applications. The wide availability of high-quality mobile networks has supported industry changing innovation in the transport sector (Uber), remote work and education (especially post-COVID) and Government services, among others.¹¹³

- 3.79 Optus has been the major competitive force in the market that has created price and service innovation tension across communications markets. Optus coverage maps and the RFNSA data demonstrate the extent of our network investment during the ESL licence period. Notwithstanding an increasingly difficult investment environment, Optus has exceeded its FY24 Greenfields 5G macro rollout target <<CIC begins>><<CIC ends>>.
- 3.80 However, investment plans can change to accommodate changes in priorities. A combination of historic low industry returns, market imbalances in spectrum and the significant costs and market distortion created by the 5G Huawei security decision (which imposed considerable costs on Optus and TPG but not Telstra) have made it difficult for Optus to maintain its high levels of network investment.
- 3.81 Optus has continued to invest in competitive infrastructure across Australia. Our MOCN agreement with TPG will deliver cost efficiencies enabling us to further accelerate our 5G deployment to 2444 sites in the MOCN area by 2030. Optus continues to invest and innovate in new 5G products and services, including via collaborative 5G standalone solutions for the Government and enterprise market.¹¹⁴
- 3.82 Optus continues to target the 5G network opportunities presented by growth in digitisation and automation to deliver solutions to customers that demand the precise positioning and high-performance deliverable by 5G standalone infrastructure, including to support applications that improve safety in human-robot collaborations, track and trace asset utilization and boost productivity and efficiency. <<CIC begins>><<CIC ends>>.¹¹⁵

Delivering Australia's digital future requires a supportive investment environment

- 3.83 In their report on the "State of the Telecommunications Industry", Venture Insights observes:

"In a global economy where capital is mobile, private capital investment cannot be sustained unless returns meet industry benchmarks. Nations that create attractive investment environments for telecommunications investors will reap the benefits of better digital infrastructure and a stronger digital economy. Nations that do not will be laggards, forced to rely on public injections of capital that will inevitably be constrained."¹¹⁶

- 3.84 The need to support investment in critical digital infrastructure and uptake of 5G is increasingly recognised as a policy priority of Government and stakeholders across the wider economy. In its recent pre-Budget submission, the Tech Council of Australia (TCA) recommended that the Federal Government "Invest in the digital infrastructure that underpins our modern economy, including initiatives that enable 5G adoption and development" observing that "The digital transformation of our society and industries is

¹¹³ ACMA Market Analysis; *Private wireless networks using 4G or 5G in Australia*, market study; September 2023; p.2

¹¹⁴ [5G Innovation Hub \(optus.com.au\)](https://www.optus.com.au/5g-innovation-hub); the 5G Innovation Hub is an innovation space for Australian enterprises and government to explore, test and co-create new 5G technology and use cases.

¹¹⁵ [Optus Connected Car | Optus Enterprise](#)

¹¹⁶ [REPORT: State of the Australian Telecommunications Industry - Venture Insights](#)

underpinned by enabling digital network infrastructure. Fixed and mobile network connectivity, such as that provided by 5G networks, are an important backbone of our economy and society”.¹¹⁷

- 3.85 The productivity benefits of investing in digital infrastructure, particularly for regional Australia, have been recognised by the Productivity Commission which also identified internet speed (and a lack of skills) as the biggest barriers to adoption of digital technology by Australian businesses.¹¹⁸ Telecommunications and digital infrastructure projects, feature prominently on the Infrastructure Australia Priority List.¹¹⁹ Insufficient support for ongoing investment in mobile infrastructure risks network resilience, lower productivity, underperforming industries and economic competitiveness, lower levels of innovation and a slower energy transition.
- 3.86 The billions of dollars of investment made by industry in spectrum and network deployment were made on the basis of the spectrum licences providing sufficient certainty and exclusivity of spectrum access over the term of the licence.¹²⁰ Changes to these arrangements risk undermining the business case for deploying digital infrastructure essential to Australia’s future. Given the criticality of spectrum to the supply of services, the re-allocation of ESL spectrum would introduce significant service migration costs and risk potential stranding of network assets.

Nominal pricing for ESL renewal promotes the long-term public interest derived from use

- 3.87 There remains a high risk that Australia is facing a “digital investment gap” due to long term declines in ROIC and the high levels of investment required to densify 5G networks.¹²¹ Optus continue to face a challenging investment environment with our ROIC at below 2% and well below our cost of capital. Barrenjoey research shows that industry ROIC has halved since 2017, and sites well below costs of capital.¹²²

¹¹⁷ [TCA-2024-25-pre-budget-submission-vF.pdf \(techcouncil.com.au\)](#); Recommendation 1F; p.8

¹¹⁸ [Volume 4 - 5-year Productivity Inquiry: Australia’s data and digital dividend \(pc.gov.au\)](#); Report No. 100 - & February 2023; p.21 and 34

¹¹⁹ [Infrastructure Priority List \(infrastructureaustralia.gov.au\)](#)

¹²⁰ ACMA document - Our approach to radiocommunications licensing and allocation, Implementing the Radiocommunications Legislation Amendment (Reform and Modernisation) Act 2020, March 2021, p.6.

¹²¹ [REPORT: State of the Australian Telecommunications Industry - Venture Insights](#); 13 June 2023

¹²² Choi, Eric & Annie Zhu; Barrenjoey; “Will Singtel sell a partial stake in Optus?”; Equity Research update, Sector Report, Telecommunications Services; 14 March 2024, p.2

Figure 12 Industry ROIC

Figure 1: B* Industry ROIC calculations

	Units	FY17	FY18	FY19	FY20	FY21	FY22	FY23	CY23
Telstra									
EBIT ex NBN payments	A\$m	4,856	3,891	2,089	2,031	2,190	2,665	3,392	3,565
NOPAT	A\$m	3,399	2,724	1,462	1,422	1,533	1,866	2,349	2,496
Invested capital	A\$m	29,840	29,295	29,257	31,991	30,538	29,696	32,234	32,856
ROIC (NOPAT / IC)	%	11.4%	9.3%	5.0%	4.4%	5.0%	6.3%	7.3%	7.6%
Optus (Mar-YE)									
EBIT ex NBN payments	A\$m	1,146	1,101	950	188	(128)	180	286	267
NOPAT	A\$m	802	771	665	132	(90)	126	200	187
IC ex goodwill	A\$m	9,515	10,893	11,102	12,671	11,533	11,761	11,982	11,982
ROIC (NOPAT / IC)	%	8.4%	7.1%	6.0%	1.0%	(0.8%)	1.1%	1.7%	1.6%
Merged TPG + VHA									
EBIT	A\$m	828	883	755	608	436	267	472	403
NOPAT	A\$m	580	618	529	426	305	187	330.4	282.1
IC ex goodwill	A\$m	4,516	5,734	5,938	7,534	7,763	7,548	7,162	7,930
ROIC (NOPAT / IC)	%	12.8%	10.8%	8.9%	5.6%	3.9%	2.5%	4.6%	3.6%
Industry									
EBIT ex NBN payments	A\$m	6,830	5,875	3,794	2,827	11,862	3,112	4,150	4,235
NOPAT	A\$m	4,781	4,113	2,656	1,979	8,304	2,178	2,905	2,965
Invested capital	A\$m	43,871	45,922	46,297	52,196	49,834	49,005	51,378	52,768
ROIC (NOPAT / IC)	%	10.9%	9.0%	5.7%	3.8%	16.7%	4.4%	5.7%	5.6%

Source: Company data, Barrenjoey Research estimates. * TPG ROIC may vary depending on IC definition (e.g. is goodwill included, net debt incl & excl leases)

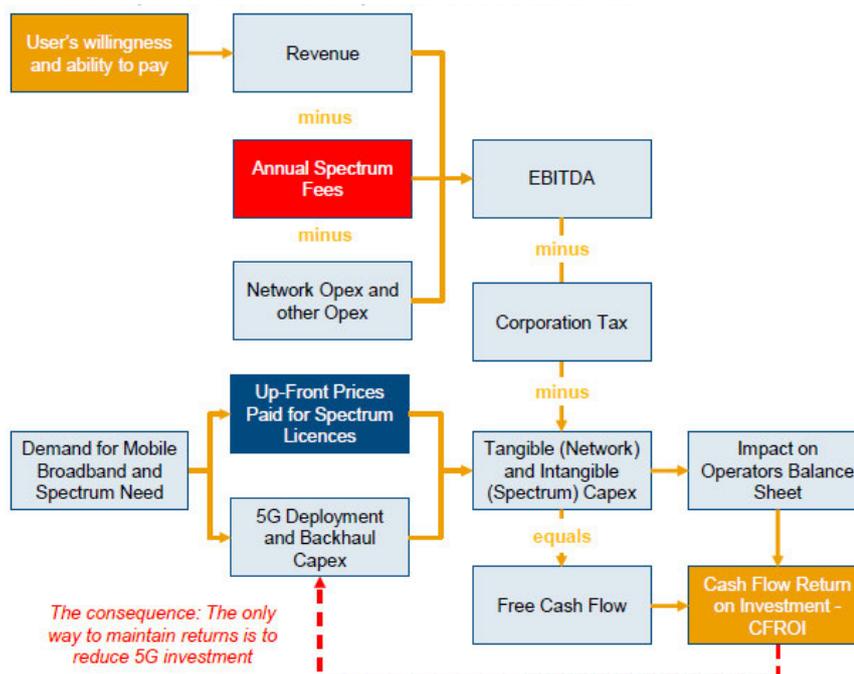
Source: Analyst report

- 3.88 The Australian mobile sector is characterised by high fixed cost investment and low variable costs to. Industry has paid billions to acquire and then renew ESL spectrum. The annual cost to industry has grown from \$241 million in 2015 to \$818 million in 2024. The annual cost¹²³ of spectrum to Optus in Australian financial year 24/25 will be <<CIC begins>><<CIC ends>> including the recent 900MHz, 26GHz and 3.7GHz acquisitions.
- 3.89 Few, if any, industry sectors pay such sizeable upfront licence fees, with no link to future revenue, cost savings or profits generated from use of those licences. Revenue generation from existing mobile broadband services has become more challenging worldwide, over the last 10 or 15 years. As the GSMA has observed, “countries that persist with excessive pricing... risk experiencing a widening gap in quality and pricing of the mobile services available”.¹²⁴
- 3.90 Mobile operators fund spectrum acquisition fees, renewal fees and network investment from the same investment pool. High spectrum prices reduce the funds available to invest in network and customer experience. The following diagram illustrates the mobile operator business model with the tangible (network) /intangible (spectrum) capex coming from the same investment pool and directly impacting cashflow.

¹²³ Amortisation of spectrum licence payments

¹²⁴ NERA, Effective Spectrum Pricing: Supporting better quality and more affordable mobile services, Report for the GSMA, February 2017, p.13

Figure 13 Spectrum licence fee impact on network investment



Source: Coleago

- 3.91 Lower spectrum renewal pricing enables mobile operators to fund investment in 5G and future 6G infrastructure and deliver digital transformation. If the price of spectrum is “ineffective”, then there is a risk that the spectrum will not be allocated. In a competitive market, low spectrum prices can be passed onto end users through lower retail prices and superior networks.¹²⁵
- 3.92 Spectrum licence fees are a significant fixed cost for mobile operators and the fixed cost, including the cost of capital for the initial and ongoing investment, has to be recovered over the life of the licence/s for a sustainable industry. Absent retail price increases for services – which may be competitively difficult and have a knock-on effect on acquisition and retention of customers– operators have limited options to reduce tangible capital expenditure.
- 3.93 In short, high spectrum prices make the business case for future investment in 5G and beyond less viable and sustainable. Renewal fees should be set at a level that provides appropriate incentives for operators to continue to invest in providing mobile services. In the context of the need to support investment in Australia’s digital future and the broader benefits to GDP and sustainable market competition, high spectrum costs are unsustainable. The renewal of ESLs at a nominal price would best support sustainable market competition and investment for the long-term public benefit.

Optus current and proposed uses of the spectrum align with the objectives in the MPS

- 3.94 Optus’ current and planned uses of ESL spectrum align with all the objectives in the MPS and in particular, we note that our SpaceX collaboration and MOCN agreements are both highly aligned with the Government’s regional connectivity policy objectives.
- 3.95 Our collaboration with Space X to deliver direct to mobile handset services via our national ESL spectrum presents an opportunity to Close the Gap by solving perennial

¹²⁵ Ibid, p.15

problems of delivering connectivity to areas that have been “too hard to serve” by terrestrial networks. This collaboration, and others that may contemplate ubiquitous and seamless connectivity between terrestrial and non-terrestrial networks particularly align with the MPS objectives of:

- (a) Supporting service continuity for end users, particularly where no alternative service is available,
- (b) Facilitating opportunities for new use cases, including for low earth orbit satellites,
- (c) Connectivity and investment in regional and remote areas to deliver improved services to end users.

3.96 Our MOCN services agreement with TPG will enable Optus to more cost effectively deploy a competitive 5G network in regional Australia in part as result of the cost efficiencies afforded by sharing ESL spectrum. The presence of a sustainable network alternative to Telstra will deliver improved connectivity services and network resilience to regional Australia. Therefore, our MOCN agreement clearly aligns with the MPS objectives of

- (a) Connectivity and investment in regional and remote areas to deliver improved services to end users,
- (b) Promote competition,
- (c) Capacity for sustained investment and innovation.

3.97 More generally, with respect to capacity for sustained investment – Optus note that the above collaborations have been enabled by the existing mechanisms for third party authorisation under section 68 of the Act.

3.98 Providing Optus with the option to renew all our ESLs on the same core licence conditions will provide the certainty of long-term spectrum access necessary to support our sustained investment in innovative connectivity solutions for the long-term public benefit of Australians.

Question 3 – Public interest criterion 3: enhances competition.

How does your current and planned use of the spectrum enhance competition?

3.99 Optus’ historical, current and planned use of ESL spectrum enhances competition in the national mobile market. The long term public interest to be derived from Optus ESL spectrum will be promoted by offering to renew Optus ESLs as this will help ensure that Optus can continue to compete effectively in relevant downstream markets for mobile services.

3.100 Optus uses its ESL spectrum to:

- (a) Compete effectively in the national mobile market (retail and wholesale) as well as the market for Government and Enterprise services,¹²⁶
- (b) Deploy a 4G network in metropolitan, regional and remote areas of Australia that currently reaches 98.5% of Australia’s population,

¹²⁶ [5G Optus Campus Network](#)

- (c) Invest over \$45 billion over the last 30 years and now typically invest over \$1.5 billion annually in competitive mobile infrastructure,
- (d) Deploy a 5G network that currently reaches over 80% of Australia's population;
- (e) Consistently deliver 5G services that rank first for speed and performance,¹²⁷
- (f) Offer retail plans that are highly competitive in terms of value for money and at a significant reduction to Telstra's price premium.

3.101 Optus' investment in its mobile networks and services has placed competitive pressure on the incumbent, driving Telstra to innovate and invest. Optus is the only real infrastructure-based competitor to Telstra outside metro areas.

3.102 Optus' planned use of ESL spectrum will continue to enhance competition in the national retail and national wholesale mobile markets and associated Government and Enterprise markets. Maintaining economies of scale of spectrum holdings, for example in our 2.3GHz and 3.4GHz bands, have provided Optus with the scale needed to compete on 5G service quality and speed, particularly in metro. The sharing of ESL spectrum under our MOCN services agreement with TPG promises to go a significant way to levelling the playing field with Telstra's regional spectrum holdings, thereby enhancing infrastructure-based competition in regional Australia for the long-term.

3.103 The ACMA has also noted that "a relevant consideration of the public interest is circumstances where spectrum holdings across ESLs are not creating or incentivising a competitive environment, or where there is evidence of entrenched end-user demand that the market is not addressing".¹²⁸ However, Optus submits that:

- (a) Any unmet end-user demand, particularly outside terrestrial mobile network footprints will be best addressed by maintaining existing ESL arrangements, including secondary market mechanisms,
- (b) There is no evidence that the secondary market has failed – while it may be thin this does not mean that it is not efficient – prospective licensees have not approached Optus about access to our ESL spectrum,
- (c) There are three MNOs all with national licences – accordingly there is opportunity for access to all three MNOs spectrum on commercial terms where access is needed,
- (d) MNOs are incentivised to trade or provide access to their unused spectrum where it does not cause disproportionate levels of harmful interference to their public mobile networks – a key incentive for TPG in entering the MOCN agreement with Optus was to monetise its regional spectrum.
- (e) There is a Digital Divide to the extent that regional Australia has not received the benefits of competition to the same extent as metro areas – however our MOCN services agreement with TPG promises to deliver sustainable infrastructure-based competition for the long term, changing the dynamics of the supply of mobile services in regional Australia.

¹²⁷ Optus 5G services rank highly in OpenSignal's "Mobile Network Experience Report", consistently recording the fastest 5G download speeds and recently winning the "Consistent Quality" and 5G Games Experience awards

¹²⁸ Consultation Paper, p.40

- (f) While spectrum is a barrier to entry, deployment costs for a national network are even greater – spectrum is only one barrier to entry and there is no realistic possibility of a new national entrant given the maturity of the mobile market, the high fixed costs, industry ROIC, and the dominance of Telstra who extracts most of the industry’s profits.
 - (g) Optus and other MNOs use national spectrum to deploy national networks – mandating localised entry, via regulatory intervention such as new licence conditions, raises the significant risk of disproportionate harmful interference to public mobile networks – introducing costs into network deployment that will only increase the cost of downstream services – such public detriment would substantially outweigh any, largely private not public, benefit of enabling local entry,
 - (h) MNOs can and do supply services to the Enterprise and Government services market that meet the needs of these customers in terms of performance and reliability and can also provide hybrid (MOCN) and standalone network solutions.
- 3.104 Changes to existing arrangements governing Optus’ ESL spectrum will adversely affect Optus’ ability to compete in the national mobile market. It will also jeopardise the MOCN services agreement, undermining the opportunity it presents to improve regional mobile competition and consumer outcomes for the long term. Removing spectrum to support localised entry will have an outsized impact on the operation of national networks, undermining competitive tension in the national retail and wholesale mobile services market.
- 3.105 Optus provided some comments on the importance of renewal of ESL spectrum to enhancing competition in the national mobile market in our submission to the ACMA’s Stage 1 consultation process. We refer the ACMA to this submission for information and also set out further detailed responses to the ACMA’s questions in this Consultation Paper below – guided by the issues for consideration set out under this criterion and Appendix A of the Consultation Paper.

The nature of competition in mobile markets

- 3.106 Competition is not an end, in itself, but is the process by which best consumer outcomes, both in terms of price and quality, are achieved. Market structure is important in achieving beneficial consumer outcomes. Concentrated markets rarely deliver good consumer outcomes, particularly when a market is dominated by a single player with inherent scale and supply advantages. Competition drives innovation and investment in new technology.
- 3.107 Mobile competition includes infrastructure and service-based competition.¹²⁹ Infrastructure based competition is characterised by greater levels of differentiation, particularly in terms of coverage and performance, and therefore more intense competition that leads to greater downstream benefits for consumers.
- 3.108 The relevant markets are the national (retail or wholesale) mobile services market and fixed broadband services market. In addition to the retail and wholesale mobile market, MNOs also supply home broadband services and services to the Government and

¹²⁹ (i) Infrastructure based competition describes competition on coverage, capacity, and capability of services, which depend upon the underlying network infrastructure. (ii) Service based competition occurs within the confines of available network infrastructure: MNOs compete on, for example, price and inclusions (including data and content)

Enterprise. NBN Co has ESLs in the 2.3GHz and 3.4GHz bands which it uses to supply NBN fixed wireless access (FWA) services.

- 3.109 The three MNOs, Optus, Telstra and TPG compete in the supply of public mobile services and apply national pricing to their mobile offerings. There are also mobile virtual network operators (MVNO) that acquire wholesale mobile services from the MNOs to provide retail services to consumers. The MNOs also operate sub-brands (e.g., Belong, Felix and Amaysim) that compete directly with the MVNOs for the more price sensitive segment of the retail market.¹³⁰
- 3.110 The mobile sector remains the only sector of the telecommunications industry that has successfully embraced competition. This has been delivered through effective and fierce infrastructure competition which has driven one of the fastest 5G rollouts in the world.¹³¹ Infrastructure competition is most effective in metro Australia. The ACCC has stated that “In urban areas, Telstra, TPG and Optus each have strong network infrastructure and they exert competitive pressure on each other to densify their networks, deploy 5G technology upgrades and invest in spectrum and fibre.”¹³²
- 3.111 A key reason for this is because MNOs have largely similar metro spectrum holdings. A refusal to renew or only partially renew ESL spectrum in metro areas will undermine competition and in particular, limit MNOs ability to respond to future capacity demands. Indeed, a recent report from Coleago Consulting concludes that it is more likely that further mid-band spectrum will be needed to cost-effectively respond to predicted capacity demands in metro areas.¹³³ Renewal of Optus ESLs will continue to enhance competition in metro areas and promote the public interest derived from use of ESL spectrum.

Telstra’s spectrum holdings entrench its market power, particularly in regional Australia

- 3.112 A key criterion for effective competition in mobile markets is access to spectrum. Without access to sufficient spectrum, MNOs cannot provide a service.¹³⁴ Access to spectrum of comparable quantity and quality is crucial to promoting competition in mobile markets.¹³⁵
- 3.113 The ACCC has observed that “asymmetry of spectrum holdings could raise competition issues if it constrains the ability of specific operators to compete in the relevant market.”¹³⁶ Large spectrum holdings can confer a competitive advantage on the licensee. This is because access to spectrum is the cheapest way to improve capacity of

¹³⁰ Following the TPG/VHA merger and the Optus/Amaysim transaction, the ACCC considers there to be 3 ‘tiers’ of providers of retail mobile services. These are (i) the MNOs flagship brands, (ii) the MNOs own sub-brands and subsidiary MVNOs, and (iii) independent resellers and MVNOs.

¹³¹ Deloitte Access Economics, 5G Unleashed; AMTA; 2022; p.iii

¹³² Regional Mobile Infrastructure Inquiry 2023; June 2023; p.86

¹³³ IMT spectrum demand; Estimating the mid-band spectrum needs in the 2025-2030 time frame in Australia; Coleago Consulting, 15 November 2021, p.1

¹³⁴ ACCC; Reasons for Determination; Application for merger authorisation lodged by Telstra and TPG in respect of the proposed MOCN commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.17

¹³⁵ For example; Peha, Jon M; Cellular Economies of Scale and Why Disparities in Spectrum Holdings are Detrimental; Carnegie Mellon University; Telecommunications Policy Journal, Elsevier, 2017; p.1 where it states that “any Pareto optimal assignment will split the spectrum fairly evenly among competing MNOs. This is not simply a method of ensuring that there are many competitors; spectrum should be divided fairly evenly regardless of whether the number of competitors is large or small. A large disparity in spectrum holdings may yield poor results with respect to both objectives, i.e. the lower cost-effectiveness of a larger number of MNOs, and the lower competitive pressure of a smaller number of MNO”

¹³⁶ ACCC, Allocation limits advice for the 850/900MHz spectrum allocation, March 2021, p.10

a mobile network while densification or deployment of improved technology (to improve spectral efficiency) are more expensive.¹³⁷

- 3.114 Historically, Telstra’s national low band holdings have been significantly greater than Optus and will only finally become comparable on 1 July 2024, when Optus gains access to our 2021 acquisition of 2 x 25MHz of 900MHz spectrum. Although mid band spectrum holdings in metro are generally comparable among MNOs, Telstra’s regional mid band spectrum holdings continue to far outstrip both Optus and TPG Telecom across all bands.
- 3.115 The following table is an indicative representation of MNOs current regional (excluding Canberra and Darwin) and rural spectrum holdings following the recent 3.4GHz and 3.7GHz spectrum auctions:

Figure 14 Australian MNO Spectrum Holdings

Band (Total available)	Telstra	Optus	TPG
3.4GHz - 3.7GHz (400MHz)	135 – 183MHz	0 – 65MHz	20 – 90MHz
2.6GHz (2 x 70MHz)	2 x 50MHz	2 x 20MHz	0MHz
2.3GHz (98MHz)	0 – 98MHz	0MHz	0MHz
2100MHz (2 x 60MHz)	2 x 10MHz or 2 x 20MHz*	2 x 5MHz or 2 x 20MHz*	2 x 5MHz or 2 x 20MHz*
1800MHz (2 x 75MHz)	2 x 35-40MHz	2 x 20-25MHz	2 x 10-20MHz
900MHz (2 x 25MHz)	0MHz	2 x 25MHz	0MHz
850MHz (2 x 20MHz)	2 x 15MHz	0MHz	2 x 5MHz
850eMHz (2 x 10MHz)	2 x 10MHz	2 x 1MHz**	2 x 5MHz
700MHz (2 x 45MHz)	2 x 20MHz	2 x 10MHz	2 x 15MHz

* in Hobart and Darwin; ** “downshift” spectrum

Source: Optus

- 3.116 The economics of Telstra’s network deployment benefit from its superior regional spectrum holdings across all bands other than 900MHz (from 1 July 2024). This has all led to Telstra having a material coverage advantage in 5G – primarily through upgrading its regional network sites, which still include a large number of sites originally built through Government funding.¹³⁸

¹³⁷ *Vodafone Hutchinson Australia v Australian Competition and Consumer Commission* [2020] FCA 117, at [159]

¹³⁸ The ACCC in its Mobile Infrastructure Report 2021 noted that “outside of Major Cities, Telstra had significantly more sites than the other MNOs between 2018 and 2021...Telstra had 75% more sites than Optus compared with 3% more sites in Major Cities. Compared to TPG, Telstra had 15% more sites in Major Cities but over 300% more sites outside of Major Cities.”

3.117 Optus remains Telstra's only real infrastructure-based competitor in regional Australia. Optus has invested more than \$45billion in its network over the last 30 years and over \$4billion on spectrum acquisition and renewal since 2013. Optus now typically invests over \$1.5 billion in capital expenditure annually in its mobile network and services. Optus investment has been the major competitive force in the market that has created price and service innovation tension in the Australian communications landscape.¹³⁹ The ACCC has stated that:

“investment decision (including the threat of potential future investment) by Optus is a material influence on decisions by Telstra to make investments in its own network...the lessening of this competitive pressure could be expected to reduce the incentives for Telstra to invest to improve elements of its network such as coverage, quality of innovation”¹⁴⁰

3.118 This investment has been enabled by access to ESL spectrum. However, Australia's geographic expanse and low population density outside metro areas limits the commercial viability of infrastructure investment. It is recognised that the comparatively less intense competition in “regional” and “remote” Australia has contributed to a “Digital Divide”.¹⁴¹

Optus' and TPG Telecom's MOCN services agreement can deliver sustainable infrastructure-based competition in regional Australia

3.119 Telstra dominates regional spectrum holdings, and its scale and legacy network advantages means that it has a distinct competitive advantage in delivering services to regional and remote Australia. Industry ROIC remains at historic lows. There is a need for a strategic reset in the design of schemes to facilitate incentives for collaborative industry sharing through multi-carrier solutions.

3.120 Given the disproportionate effect that localised entry would have on public mobile networks and services, Optus submit that the main competition policy objective of the ESL process should be to support “sustainable infrastructure competition”, particularly in regional Australia, for the long term. If it is approved, Optus' and TPG's MOCN services agreement will go a significant way to delivering sustainable infrastructure-based competition in regional Australia by facilitating the deployment of a second 5G mobile network by 2030.

3.121 Telstra currently holds 2 times and 3.1 times the individual spectrum bandwidths of Optus and TPG, respectively, in the MOCN coverage area. The sharing of spectrum under the MOCN agreement will help mitigate the significant spectrum advantage that Telstra holds in regional Australia. The following map provides a high-level illustration of the extent of the MOCN Coverage area <<CIC begins>>

¹³⁹ ACCC, Regional Mobile Inquiry, Final Report – finding at page 86-87 that “Telstra and Optus have made significant investments in regional, rural and remote areas, despite the challenges, to differentiate themselves on geographic coverage”

¹⁴⁰ ACCC; Reasons for Determination; Application for merger authorisation lodged by Telstra and TPG in respect of the proposed MOCN commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.vii

¹⁴¹ House of Representatives Standing Committee on Communications and the Arts; Inquiry into co-investment in multi-carrier mobile coverage; submission by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts – Communications and Media Group; November 2022; p.8

Source: Optus

3.122 <<CIC ends>>

3.123 In brief, Optus submit that the MOCN agreement will deliver the following benefits, among others:

- (a) Cost reductions and improved efficiencies for Optus network deployment,
- (b) Enhance consumer choice,
- (c) Improved incentives to invest, particularly exerting greater pressure on Telstra to invest over the longer term,
- (d) Improved incentives for Telstra to compete on price,
- (e) Improved incentives and ability to compete in the wholesale market, as services of both Telstra and “MOCN” are improved,
- (f) Improved network resilience – will provide an alternative network to Telstra’s in the MOCN coverage area and Optus and TPG Telecom will continue to operate separate core networks.
- (g) Support wholesale market competition, particularly relative to the TPG MOCN deal with Telstra.

3.124 TPG will also gain access to 2,444 Optus mobile network sites in regional Australia, increasing its current national 4G coverage from around 400,000 square kilometres to around 1,000,000 square kilometres. Customers and communities will also benefit from Optus’ commitment to accelerate its 5G rollout in the regions, fast-tracking the number of 5G sites in the regional MOCN to 1,500 by 2028 and 2,444 by the end of 2030.¹⁴²

3.125 The sharing of spectrum for the supply of MOCN services will enable both Optus and TPG to deliver enhanced capacity, speed and service quality to TPG and Optus customers in regional Australia. It enables Optus to more cost effectively deploy its 5G network and deliver a real alternative to Telstra, paving the way for a new era of choice and competition for customers across regional Australia. It also enables TPG to compete more effectively in retail and wholesale markets.

3.126 This is in large part because the spectrum sharing helps level the playing field with Telstra’s regional spectrum holdings. The MOCN arrangements mean that Optus will have access to TPG’s mid-band spectrum, enabling both Optus and TPG to compete more effectively with Telstra on capacity and service quality.

3.127 The presence of a viable alternative network in regional Australia will also alleviate any congestion that Telstra is currently facing, both by enabling customers to transfer to competitive Optus or TPG Telecom offerings and acting as an incentive for Telstra to invest in upgrading its network in those areas.

¹⁴² [TPG Telecom and Optus sign network sharing agreement marking new era of mobile services for regional Australia](#)

- 3.128 The MOCN arrangements have an initial term of 11 years and include an option for TPG Telecom to extend the agreement for a further five years. The renewal of ESL spectrum underpinning this agreement will be crucial to its success and the delivery of improved connectivity to regional Australians.
- 3.129 Optus ability to meet the 2030 deployment timeframe and to continue to provide competitive mobile services in the MOCN Coverage area clearly depends on access to ESL spectrum. If the agreement is allowed to proceed (i.e. found not to raise competition concerns), then the ACMA should adopt a preferred view that any ESL spectrum can be renewed upon application.

Optus need ESL spectrum to continue to compete with Telstra regardless of MOCN

- 3.130 Regardless of whether the MOCN services agreement is approved, Optus submit that renewal of Optus ESL holdings is in the long-term public interest. Any reduction in Optus spectrum holdings will undermine Optus ability to continue to effectively compete with Telstra in the national mobile market.
- 3.131 In this context, other competition considerations that the ACMA should have regard to in developing its preliminary and preferred view are:
- (a) The impact of Telstra’s spectrum advantages - Telstra dominant regional spectrum holdings add to the significant cost advantages it has in deploying networks in regional Australia. The ESL Process should not enable Telstra to acquire via auction more spectrum in the bands that are expiring than it already has – i.e. ESL spectrum should be renewed rather than auctioned.
 - (b) Telstra’s financial strength undermines the efficiency of any auction – Should the ACMA chose to auction ESL spectrum, Telstra is financially well placed to acquire more spectrum thereby further entrenching its market power. If the MOCN Services agreement is not approved, then the ACMA must impose restrictive allocation limits to limit the further market distorting effects of Telstra spectrum dominance.
 - (c) Promoting competition while maintaining a three-player market: The Australian mobile market has proven that it is not able to sustain more than three MNOs. Given historically low ROIC there is no prospect of new entry at the national level. In this context, any support for new localised, niche, single-use, dedicated spectrum users or entry of smaller operators into ESL spectrum to meet “unmet demand” must be treated with caution.

As highlighted in detail below, facilitating new localised entry into ESL spectrum space raises the risk of significant interference and disruption to national network deployment, or potential stranding of spectrum should the new operator’s business fail. Optus consider the likelihood of a speculative acquisition of spectrum (from a non-MNO) resulting in underuse and eventual consolidation by an existing MNO, is very high based on the recent Dense Air experience, where Telstra acquired its 2.5GHz spectrum.

- 3.132 In Optus’ view, offering to renew ESL spectrum at a nominal price will best promote sustainable competition in mobile services and ensure continuity and quality of service for the tens of millions of Australian mobile customers.

Changing ESL arrangements for new entrants is unjustified and disproportionate

- 3.133 Optus note that the ACCC has called for the ACMA to “explore future arrangements that reduce barriers to new entry” stating that:

“Since the merger of TPG and Vodafone in 2020, there has been limited prospect of new entry. Without spectrum management policies favourable to new entrants, the likelihood of one emerging in the near future is very low. This has competition implications in the market...While the ACCC is not currently aware of any potential new entry into the mobile services market, we consider the ACMA’s process could investigate the possibility of new entrants”.¹⁴³

- 3.134 This recommendation has been supported by the Minister in the final MPS Instrument.¹⁴⁴ The ACMA is also seeking feedback from stakeholders on “spectrum related barriers to being able to compete effectively in downstream markets, and encourage competition in regional, rural and remote areas”.¹⁴⁵
- 3.135 Optus has expressed its concern about the lack of a clear rationale for the inclusion of this objective as a consideration in the ACMA’s decision-making. In Optus’ view, any regulatory intervention must be based on very sound and considered evidence that (i) there is a problem to be addressed, (ii) existing market mechanisms are not fit for purpose and (iii) any benefit of mandating entry outweighs any public detriment.
- 3.136 Optus readily concedes that the mobile sector is characterised by high barriers to entry. However, the high cost (and relative scarcity) of spectrum is only one among a number of barriers to entry to the national mobile services market, including (i) large up-front sunk capital investment required, (ii) economies of scale, (iii) brand perception and (iv) phase in technology cycle (first mover advantage).¹⁴⁶
- 3.137 We note that the ACCC’s recommendation for the ACMA to investigate the possibility of new entrants, including by possibly reserving spectrum at auction,¹⁴⁷ is not based on a formal analysis of the current state of competition in the national mobile market. More specifically, there does not appear to be any assessment of whether existing legislative mechanisms are in fact unfit for the purpose of enabling the desired spectrum access for new entrants or niche market players or any consideration of the extent of the negative technical impact on the MNOs would be.
- 3.138 Optus submit that it is not in the public interest to intervene to enable new entry into ESL spectrum. Existing mechanisms of spectrum access already promote efficient spectrum use. New entry, either via re-allocation of the spectrum or entry by way of the introduction of “alternative licence conditions”, will distort investment - decision-making, carve up spectrum space by introducing new boundaries which will have a disproportionate impact on the performance of mobile services in that area.
- 3.139 Mandating access will also distort the market by undermining incentives to invest, either by encouraging licensees not to invest, or to undertake inefficient investments simply to maintain their licences (i.e., UIOLI/UIOSI scenarios). We explain our concerns about the possibility of “alternative licence conditions” in further detail in Section 5.

¹⁴³ ACCC submission to ACMA Stage 1 Consultation “Approach to Expiring Spectrum Licences”, August 2023

¹⁴⁴ Section 7 of the final MPS Instrument “Facilitating opportunities for new entrants and use cases, including for low earth orbit satellites” states “the Government supports the position expressed in the ACCC’s submission...namely, that the ACMA should explore future arrangements that reduce the barriers to entry for new users of spectrum for either new use cases or existing uses, as a dynamic and competitive communications market is most likely to promote the public interest”

¹⁴⁵ Consultation Paper, p.13

¹⁴⁶ Australian Competition Tribunal; Applications by Telstra Corporation Limited and TPG Telecom Limited (No 2) [2023] ACompT2; ACT 1 of 2022; 21 June 2023; para 335; p.124-125

¹⁴⁷ ACMA’s Approach to Expiring Spectrum Licences, ACCC submission, August 2023, p.4

The secondary market for spectrum promotes efficient outcomes

- 3.140 As noted in our response to “Public interest criterion 1: facilitates efficiency”, market mechanisms are most effective at facilitating efficient use of spectrum.
- 3.141 The Act enables spectrum licensees to trade the whole or part of a spectrum licence as well as to authorise third parties to operate radiocommunications devices under a spectrum licence.¹⁴⁸ As the ACMA notes “flexible and tradeable licences are recognised as a means to facilitate innovation and competition, after an initial allocation”.¹⁴⁹ The attached expert report from Dr Chris Doyle confirms that the presence of a secondary market for spectrum access coupled with the fact that ESL spectrum was initially auctioned (or renewed) weighs heavily in favour of finding that the current allocation of spectrum is efficient (because it has been exposed to the market).
- 3.142 Optus agrees that the secondary market for spectrum licences may be characterised as “relatively thin” – however, we note that the market is for assets for which the acquirer has paid considerable sums of money. We are also not aware of any “entrenched” end-user demand that cannot be addressed either by MNOs or via existing market-based mechanisms of spectrum access. Optus submits that the following points highlight that the secondary market for spectrum continues to promote efficient outcomes:
- (a) The ACCC has observed that network access agreements “can enable the acquiring MNO to offer higher service coverage and quality than they could using only their own networks, but typically do not allow the acquiring MNO to improve or differentiate their services as much as they could had they invested directly in their own network infrastructure.”¹⁵⁰ Optus’ MOCN services agreement with TPG includes a non-discrimination obligation on Optus to ensure that it supplies TPG with MOCN services using the same spectrum that it uses to supply its own services. We also note that preserving separate core networks allows for service differentiation.
 - (b) Trades to facilitate defragmentation are still trades – that can be “mutually beneficial, and typically results in both (or all) parties to the trade holding the same quantum of spectrum in the same areas as they did before the trade, but in more efficient contiguous blocks”.¹⁵¹ Optus has recently undertaken spectrum trades of 2.3GHz and 3.4GHz spectrum fragments with NBN Co., largely for the purpose of facilitating defragmentation and band optimisation.
 - (c) TPG sold its holdings in the 2.5GHz band to Dense Air Networks Australia, and concurrently bought Dense Air Limited’s licences in the 3.6 GHz band¹⁵² and had a spectrum access agreement in place with the sub-national MNO Pivotel, allowing Pivotel access to licensed ‘LTE’ spectrum. A key incentive for TPG to enter its proposed MOCN Services Agreement with Telstra was that it provided the opportunity to monetise its regional spectrum.

¹⁴⁸ Section 85 and 68 of the Act respectively

¹⁴⁹ Consultation paper, p.40, citing Cave, Doyle and Webb

¹⁵⁰ ACCC; Reasons for Determination; Application for merger authorisation lodged by Telstra and TPG in respect of the proposed MOCN commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.vii

¹⁵¹ ACCC; Reasons for Determination; Application for merger authorisation lodged by Telstra and TPG in respect of the proposed MOCN commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.20

¹⁵² In Optus view, the Dense Air spectrum acquisition (via auction) appears to have been localised and highly speculative at best, resulting in most of the spectrum being subsequently traded on the secondary market and eventually consolidated by Telstra.

- (d) The availability of the secondary market was a relevant consideration in the ACCC's decision to reject the TLS/TPG MOCN proposal in 2023 noting:

"TPG has an incentive to monetise its underutilised spectrum assets under any counterfactual where TPG does not seek to build out its regional network to the full extent of Telstra's. To the extent that there are other potential users of the spectrum that TPG might seek to monetise, *the ACCC considers that secondary trading may occur and this would enable use of the spectrum by a new entrant or an MNO other than Optus and Telstra, or a fixed operator such as NBN Co, or for other innovative uses such as neutral host services or satellite services such as direct-to-handset connectivity. Further, as the availability of spectrum presents a very large barrier to entry for new firms, the potential availability of TPG's spectrum on the secondary market may induce demand for it in a way that the Proposed Transaction does not allow*".¹⁵³
(emphasis added)

Cost and resource implications of increased interference management

- 3.143 While we recognise that there may be growing opportunities in the market for local area and private wireless networks, we consider that mandating access to ESL spectrum, via re-allocation, alternative licence conditions or otherwise, will cause disproportionate risk of interference to the surrounding public network and disruption to the supply of essential mobile services.
- 3.144 Carving up ESL spectrum for new entrants would also create uncertainty in spectrum access, undermining investment and introducing further costs and resource burdens into operations and planning for MNOs that will need to be recouped.
- 3.145 The certainty of spectrum access afforded by existing ESL arrangements enables Optus to develop network plans to deliver various deployment objectives such as coverage expansion, coverage infill and capacity relief. These plans will either identify new greenfield site requirements or site upgrades which are underpinned by spectrum availability. Deployment activities and site decisions can then be based on the delivery of these requirements.
- 3.146 The impact of a lack of certainty on operations is illustrated by Optus 2300MHz band in metro or apparatus licences in regional/remote areas. Depending on the outcome of the Accredited Person (AP)'s initial assessment, site designs may need to be altered in order to balance the spectrum coordination requirements against the site objectives. For instance, is it better to mitigate a site design for ACMA registration or should the coverage and capability of the site be reduced.
- 3.147 These questions result in multiple design modifications which increases the costs to Optus. In addition, Optus must also invest in complex compliance auditing practices to manage the tilts and power mitigation required. For Optus, the most complex bands to manage are 2300MHz and 3.4GHz. Apparatus licences in the remote/regional space also require regular auditing, particularly on sites which have non-standard configurations. This highlights the cost and resource implications of greater interference management burden that will result from changing existing ESL arrangements to enable new entry.

¹⁵³ ACCC; Reasons for Determination; Application for merger authorisation lodged by Telstra and TPG in respect of the proposed MOCN commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.x

3.148 Enabling non-MNO's ESL spectrum to supply dedicated services considerably increases the risk of harmful interference to the surrounding public network. This is illustrated more clearly in the case studies set out in Section 7.

Private wireless network operators should not be offered dedicated ESL spectrum

3.149 GSMA states that “Measures to address the spectrum needs of private networks should be carefully considered. While private networks are an integral part of 5G, supporting their growth does not have to mean resorting to asymmetric spectrum carve outs or set asides. Such measures are an aggressive regulatory tool with a huge economic cost...there is no one single approach to best meet the spectrum needs for private 5G in all markets”.¹⁵⁴

3.150 Allocation to mobile private wireless network use cases does not deliver a public benefit from the use of the spectrum, but rather excludes spectrum from use for public benefit and transfers it directly to private commercial control. The supply of public mobile networks and services delivers incalculable network externalities and public economic and social benefits.

3.151 The ACMA has already made provision for local area and private wireless networks in outer metro, regional and remote Australia via administrative allocation in the 3.8GHz band. The arrangements in 3.4GHz spectrum highlight the inherent inefficiencies of spectrum fragmentation that result from catering to too wide a range of use cases in the band. Apparatus licences are also available in 1800MHz and 2GHz bands.

3.152 We also note that wireless indoor or campus connectivity is playing an increasing role and is important for delivering Industry 4.0. However, there is no need to carve out scarce IMT spectrum for this purpose. It is precisely for local and campus use that spectrum is identified for R-LANs (Radio Local Area Networks) with WiFi being the most common R-LAN technology. With the most recent addition of 500 MHz in 5925 – 6425 MHz the spectrum available for R-LAN in Australia now amounts to 500 MHz in lower 6GHz band, 83.5 MHz at 2.4GHz, and 575 MHz at 5GHz, i.e. 1,158.5 MHz in total in below 10 GHz.

3.153 There is no evidence that private local networks require IMT spectrum rather than implementing their network using unlicensed spectrum. The new Wi-Fi 6, or IEEE 802.11ax, with an extended version, Wi-Fi 6E, that adds the 6 GHz band provides a massive improvement in performance including data speed, reduced latency, reduced interference, and improved reliability. In other words, Wi-Fi 6E using unlicensed spectrum is an excellent solution for local private networks. Optus note that there are already some smaller operators using unlicensed 60GHz spectrum (known as V-band) and the WiGig standard to supply local area internet services.¹⁵⁵

How current and proposed uses of the spectrum align with the objectives of the MPS

3.154 If ESL spectrum is renewed, Optus business strategies and proposed use of spectrum will enhance competition in downstream mobile markets and align with the objectives of the MPS to:

- (a) promote competition, Optus use of its ESL spectrum has promoted competition in the national retail and wholesale mobile services market. Optus

¹⁵⁴ GSMA report on Exploring 5G private network opportunities in Asia Pacific; p.27; GSMA has also noted the failure of spectrum set asides to promote entry in recent auctions such as the German 3.5GHz auction in 2019 – see further [Spectrum-Set-Asides-Germany.pdf \(gsma.com\)](#)

¹⁵⁵ [Australian ISP Move Up Internet to launch Meta-developed Terragraph gigabit technology - DCD \(datacenterdynamics.com\)](#)

has invested billions in its networks and spectrum, to deploy national 3G, 4G and 5G networks. Optus 5G services consistently rank highly for speed and performance (Opensignal). Optus' planned use of its ESL spectrum for our MOCN services agreement will help deliver sustainable 5G infrastructure-based competition in regional Australia for the long-term public benefit.

- (b) facilitate opportunities for new entrants and use cases, Optus' proposed use of ESL spectrum for our collaboration with SpaceX is a first of its kind agreement in Australia – use of our national FDD ESL spectrum, with access enabled via existing mechanisms for third party authorisation, helps to reduce barriers to entry for new LEOSat use cases in regions of Australia that have never, and will likely never, be served by terrestrial mobile services.

- 3.155 Optus note that other key MPS policy considerations that weigh in favour of renewal of ESLs are the need to promote continuity of service, innovation and sustained investment and to carefully consider “existing investment by licensees, as well as known market demand for spectrum and the capacity for other prospective licence holders to make the investment required to deploy and maintain an effective service with the spectrum”.¹⁵⁶ Failure to properly interrogate the claims for access and unmet demand, or to consider alternative spectrum to support an identified demand, raises the risk of failed regulatory intervention.

Existing ESL spectrum arrangements can support inter-operability between terrestrial and satellite services

- 3.156 The use of national spectrum licences to enable terrestrial and non-terrestrial network interoperability was a primary focus of the FCC's Order to establish a regulatory framework for a Supplemental Coverage Service (SCS). Seamless connectivity between terrestrial and non-terrestrial networks to deliver ubiquitous coverage is the potential offered by MNOs retaining control over national spectrum space.
- 3.157 Upcoming 3GPP Releases 17 and 18 will provide for new network architectures that enable interoperability and possible connectivity with all standard mobile devices.¹⁵⁷ Given the ubiquity of mobile phones, the potential of such technological development to address perennial problems of hard to serve areas is clear.
- 3.158 The entry of LEOSats offers opportunities to bridge the Digital Divide and Close the Gap. An ‘IMT’ satellite direct to mobile (‘Sat DTM’) service uses the terrestrial mobile spectrum to transmit between existing user equipment (mobile handsets) and satellite, thereby complementing terrestrial mobile network coverage.
- 3.159 Optus has provided an early glimpse of this via its collaboration with SpaceX to deliver ‘IMT’ DTM services using our national FDD ESL spectrum. This collaboration is facilitated by the existing spectrum licence framework. The technological flexibility of the spectrum licence framework allows licensees to repurpose spectrum for other uses, provided there is compliance with the technical framework and applicable regulations.
- 3.160 ITU Member States have recently resolved, under Agenda Item 1.13 at WRC-23, to undertake “studies on possible new allocation to the mobile-satellite service for direct connectivity between space stations and International Mobile telecommunications (IMT)

¹⁵⁶ Section 10, Final MPS Instrument

¹⁵⁷ 3rd Generation Partnership Project (3GPP) [Release 17 \(3gpp.org\)](#) and [Release 18 \(3gpp.org\)](#)

user equipment to complement terrestrial IMT network coverage” in time for WRC-27.¹⁵⁸ In this context, Optus considers that it is appropriate that IMT satellite DTM services initially operate on a “no-interference, no-protection” basis.¹⁵⁹

3.161 Optus refers the ACMA to our February 2023 submission to the ACMA’s consultation on “satellite direct to mobile services: regulatory issues” for further information.

Question 4 – Public interest criterion 4: balances public benefits and impacts

How does your current and planned use of the spectrum balance public benefits and impacts?

- 3.162 Mobile networks supply essential communications services to Australians across the country, providing access to emergency, education, banking, health, social, commercial and government services among others. Being connected and having access to a reliable and affordable phone and internet service has become crucial for many people to work and connect to education, health, public safety and government services.¹⁶⁰ A loss of service can have serious personal and public consequences.¹⁶¹
- 3.163 The ACMA has recognised telecommunications as essential services and that access to these services has become even more critical since the COVID-19 pandemic.¹⁶² The Communications Minister has noted they are “a necessity to support ... access to critical services”.⁸ The Government’s Statement of Expectations confirms that the ACMA “has an important role to support industry and consumers in delivering and accessing essential communications services”.¹⁶³
- 3.164 Optus current and planned use of ESL spectrum for mobile services “balances public benefits and impacts”. While mobile services are “commercial services” they contribute to the overall public benefit and deliver more than just “economic outcomes”.¹⁶⁴ Optus ongoing access to ESL spectrum is crucial to:
- (a) ensuring continuity of supply of essential mobile services and network resilience, particularly in parts of Australia where there may be limited alternatives.
 - (b) providing Australians with access to other essential services, in particular, public safety and emergency services, across Australia
 - (c) enable two-factor and multi-factor authentication (via SMS) for Australians to gain secure access to a range of other services, including banking
 - (d) enabling hybrid and flexible working arrangements

¹⁵⁸ Resolution COM6/9; pg 567-568 of the Provisional Final Acts“ provides for “studies on possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU-R M.1036;” and “studies on spectrum requirements and on technical, operational and regulatory matters related to the implementation of the mobilesatellite service for direct connectivity to the IMT user equipment to complement the terrestrial IMT network coverage”

¹⁵⁹ As per ACMA’s FYSO 2023-28 and as provided by ITU-R Regulation No. 4.4

¹⁶⁰ [ACMA calls on telcos to improve support for customers in hardship | ACMA](#)

¹⁶¹ Australian Government Response to the Bean Review Final Report; Review into the Optus outage of 8 November 2023; April 2024; p.1

¹⁶² ACMA, What consumers want – Consumer expectations for telecommunications safeguards A position paper for the telecommunications sector; July 2023.

¹⁶³ Government’s Statement of Expectations, December 2022

¹⁶⁴ Consultation paper, p.41

- (e) facilitating social connections, cohesion and broader social and psychological benefits
- (f) supporting environmental policy objectives – to meet carbon reduction and net zero emission targets, operators need sufficient spectrum to avoid unnecessary site densification.

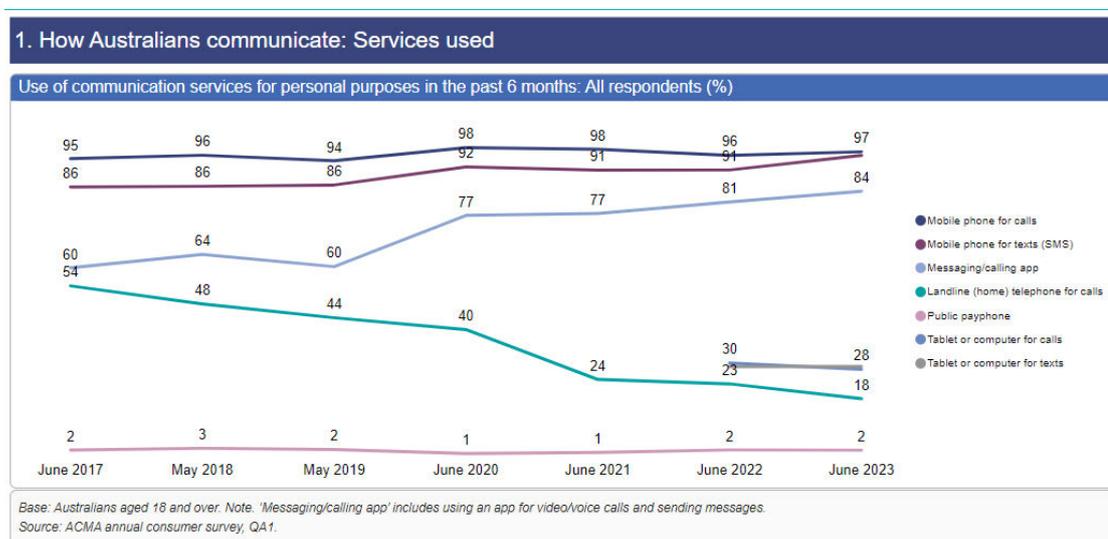
3.165 Having regard to the need to maintain supply of these broader “non-commercial” public benefits of mobile services, Optus submit that continuity of service objectives must feature prominently in the ACMA’s decision making. In particular it is clear that a decision to not renew ESL spectrum may adversely affect the supply of essential services and “put at risk the delivery of services to a significant number of people”.¹⁶⁵

Reflects issues and guidance on “balances public benefits and impacts”

3.166 As highlighted elsewhere in this submission, the use of ESL spectrum for mobile services has and will continue to deliver vast economic and productivity benefits to Australia. Optus submit that these are clearly public benefits, given that there are over 9 million mobile services in operation (SIOs) over Optus’ network, across Australia.

3.167 As the ACMA notes, commercial services deliver more than economic outcomes, facilitating social connections and broader societal benefits. Mobile phones are ubiquitous and critical to our daily lives. They enable us to contact essential services, including emergency services at times of need, interact with family and friends and engage on social media. The prevalent use of mobile services for personal communications is clearly demonstrated in the following from the ACMA’s research:¹⁶⁶

Figure 16 Communication Services used by Australians for personal purposes



Source: ACMA

3.168 Mobile services are vital to businesses and consumers. Maintenance of these services is crucial to business continuity – end-users have invested in devices with the reasonable expectation that services will continue to work on the existing spectrum bands to provide

¹⁶⁵ MPS instrument, section 6

¹⁶⁶ [Communications and media in Australia: How we communicate | ACMA](#); states that “Mobile phone calls have long been the most widely used way to communicate, but in 2023, mobile text messages came close. Messaging is also growing in popularity via apps such as Facebook Messenger and WhatsApp”

consistent or improving coverage, capacity and customer experience. A degradation or loss of mobile services can cause financial, health and security harms.

- 3.169 At the extreme, disruption to mobile services will cause the loss of access to the emergency call service and access to SMS-based emergency alerts under the National Emergency Warning System (NEWS), which can have significant adverse consequences on mobile service users.
- 3.170 The availability of sufficient spectrum will be crucial to ensuring we can continue to deliver reliable and ongoing access to Australians when they most need it. Certainty of spectrum renewal will enable operators to continue to invest in ensuring the highest levels of network reliability and resilience in times of disaster.
- 3.171 MNOs are tasked with a range of responsibilities and programs to improve network resilience, protect national critical infrastructure, ensure network security, access to emergency services, SMS-based emergency alerts under NEWS and network integrity. The use of ESL spectrum is also crucial to the quality and reliability of our mobile services to deliver access to other essential services, most notably the emergency call service (“000”). We note that mobile private networks are not required to provide access to emergency calling; and unlike PMTS networks, many do not support such a feature.
- 3.172 For the same reasons as set out elsewhere concerning the impacts of carving up ESL spectrum space, Optus do not consider that a public safety mobile broadband service should be provided over dedicated spectrum. Many critical services such as first responder networks are transitioning to using a network built by MNOs. For example, in the US, AT&T operates the First Responder network in 700MHz spectrum which is also used for AT&T’s customers when the capacity of the band not needed by first responders. First responders would simply not have the funds to deploy a network with the coverage AT&T can provide.
- 3.173 Mobile telecommunications networks are also designated as critical national infrastructure.¹⁶⁷ Accordingly, MNOs are subject to numerous obligations to ensure the security of their networks.¹⁶⁸ This underscores the nature of mobile services as essential to the Australian public. Disruption to our services may undermine compliance with our security obligations.

Optus comments on public interest served by other ESL (non WBB) bands

- 3.174 Optus recognises that some ESLs, such as rail safety use of the 1800MHz band, provide expressly “public” or non-commercial benefits. However, the current Global System for Mobile Communications – Railway (GSM-R) standard is expected to reach its end-of-life around 2030.¹⁶⁹ In ACMA’s Replanning of the 1800-1920MHz band, Optus agrees with the approach to introduce arrangements for RMR uses between 1900-1910MHz for the Future Railway Mobile Communications System (FRMCS) which is to supersede the GSM-R.
- 3.175 Optus reiterates the importance of co-existence considerations with adjacent spectrum-licensed bands (such as 1.8GHz and 2.1GHz) and submits that any new assignment in the 1.9GHz band should not cause interference with the adjacent bands, nor should it mandate any new deployment restrictions in the adjacent bands.

¹⁶⁷ Telecommunications (Carrier Licence Conditions—Security Information) Declaration 2022 and Telecommunications (Carriage Service Provider—Security Information) Determination 2022

¹⁶⁸ under Part 14 of the Telecommunications Act and other security laws, including the Security of Critical Infrastructure Act and associated regulatory instruments under the Telecommunications Act.

¹⁶⁹ <https://www.ericsson.com/en/press-releases/3/2023/moving-ever-closer-to-5g-on-trains>

3.176 We note that both rail licensees and MNOs have similar requirements of providing coverage along rail corridors. Deutsche Bahn (DB), Ericsson, O2 Telefónica and Vantage Towers are working together in Germany to establish extensive 5G mobile communications along train tracks and develop proposals and cooperation models for the rail and mobile communications industries and tower operators where towers could be shared for 5G and FRMCS (with its dedicated 1900MHz band) without distorting competition.

Question 5 – Public interest criterion 5: supports relevant policy objectives and priorities

How does your current and planned (including regional, rural, and remote connectivity, investment and competition)?

- 3.177 As highlighted elsewhere in this submission, Optus' current and planned use of ESL spectrum delivers significant public benefits. The renewal of ESL spectrum will help provide continuity of service to Optus mobile customers, particularly in areas of Australia where there are few alternative services. Existing secondary market mechanisms continue to facilitate efficient use of spectrum and new use cases.
- 3.178 Offering renewal with the same conditions as existing ESLs will also provide the investment certainty necessary for Optus to continue to deploy competitive networks and services that will ultimately help the Government deliver on numerous policy objectives, including those set out in the MPS Instrument relating to improved connectivity for Australians in regional and remote areas.
- 3.179 Opus reiterates its view that many other policy objectives, including those directed at improving network resilience or temporary disaster roaming are best addressed through other Government policy programs. Furthermore, as the ACMA's Consultation Paper acknowledges, regional connectivity and Closing the Gap goals will not be addressed solely through the ESL process and will require reforms to the wide array of policies and programs that the Government has implemented over the years, including the Mobile Black Spot Program (MBSP), Regional Connectivity Program (RCP) and Universal Service Obligation (USO). Optus directs the ACMA to our recent submissions and engagement on these matters with the ACMA and Department for further information.

Renewal of ESL will enable Optus to deliver improved connectivity to regional and remote Australia for the long term

- 3.180 Telstra's legacy network advantages have provided it with a significant first mover advantage across most generations of mobile technology, which is even more acute with the roll-out of 5G. Indeed, Telstra has stated that its 5G network will reach 95% of the population by 2025. Telstra is able to continue to build on its network presence as a result of receiving the vast majority of government co-contribution funding.¹⁷⁰ Its 5G advantage has also been aided by government security decisions.
- 3.181 While price continues to be a significant driving factor for consumer decisions, non-price factors have gained greater prominence in consumer decision-making.¹⁷¹ Telstra's legacy advantages enable it to differentiate itself in the market on the basis of coverage and performance, bolstering its market share. This has led to the establishment of "pockets of market power", particularly in outer regional and remote Australia, where

¹⁷⁰ In its 2021 Mobile Infrastructure Report, the ACCC noted that "As at 31 January 2020 and 31 January 2021, Telstra had deployed 629 and 735 sites respectively with the assistance of funding from this co-contribution program. This is significantly more co-funded sites than Optus (93 and 126) and TPG (60 and 60) combined"

¹⁷¹ ACCC Communications market report, 2021-22, p.9

Telstra is the only network operator.¹⁷² Outside of metropolitan areas, Telstra's market power increases significantly.

- 3.182 Telstra has little commercial incentive to agree to share physical infrastructure. Telstra's wholesale network covers only 98.8% of the population – the same coverage offered to TPG under the MOCN deal and approximately the same extent as Optus mobile network. Government funded programs that have focused on funding “new” coverage provide Telstra with further commercial advantages and differentiation, further limiting the ability of challenger networks to compete.
- 3.183 While Optus has been the main infrastructure challenger to Telstra, a combination of historic low industry returns, market imbalances in spectrum and the significant costs and market distortion created by the 5G Huawei Security Guidance (which requires Optus and TPG, but not Telstra, to replace legacy government sanctioned 4G technology to be able to deploy 5G technology) have made the regional and remote investment case even harder. History has shown that where infrastructure competition is weak the dominance of Telstra grows and outcomes for consumers are poorer. As a consequence, regional consumers are likely experiencing significant detriment relative to metro consumers.¹⁷³
- 3.184 Without Optus' ongoing network deployment in regional Australia, there will be little competition to Telstra and regional communications will continue to experience a Digital Divide. While Telstra's legacy network advantage mean that it may be able to more cost-effectively deploy, Optus MOCN service agreement will ensure sustainable 5G infrastructure-based competition for regional Australia.
- 3.185 Our SpaceX collaboration, and other potential IMT satellite direct to mobile services, also offers the potential to realise other policy objectives related to bridging the Digital Divide, including the delivery of emergency communications to provide mobile phones in areas affected by disaster, especially where terrestrial networks are disrupted. In the longer term it may also deliver reliable mobile network connectivity to remote communities across Australia, helping to Close the Gap. Promoting use of spectrum in areas that are hard or uneconomic to serve via terrestrial networks can only be a positive development and one that should be supported by way of ESL renewal.
- 3.186 Given the significance of spectrum as a key underlying network input for the provision of a mobile service, any significant reduction in an operator's core spectrum holding is likely to be detrimental to ongoing network operation and deny any public benefit that could be derived from the use of the spectrum. It therefore follows that a failure to re-issue existing ESLs to incumbent licensees, would have negative consequences for infrastructure investment and threaten the billions of dollars of economic activity that is dependent on mobile networks.

Alternative uses for spectrum

- 3.187 Optus welcomes the opportunity to provide further comment on possible alternative uses for ESL spectrum. We also welcome the ACMA's decision to provide a 3 week “reply-to-comment” period following this consultation. Optus will provide further detailed comments in response to other submissions at that time.

¹⁷² Optus submission in response to ACCC market inquiry – Telstra and TPG application for merger authorisation for proposed spectrum sharing in regional Australia; (CIC version) June 2022; para 3.27; p.21

¹⁷³ See for example, 2021 Regional Telecommunications Review, p.26, p.41, p.43 and p.99

3.188 In Section 7, Optus sets out a number of case studies that highlight the consequences of intervening in ESL spectrum to allow for new entry. The key issue is that carving out spectrum from ESL holdings, creates new boundaries, undermining efficiency of the ESL spectrum and its use by MNOs to deliver public networks. Optus submit that on balance this is likely to be a cost that outweighs any benefit of enabling entry.

Question 6 – Resilience and temporary disaster responses

We would welcome feedback from stakeholders concerning resilience and temporary disaster responses that arise in the context of spectrum licences and the ESL process .

3.189 Optus understand that network resilience and temporary disaster responses are important communications policy priorities for the Government, particularly in the wake of numerous natural disasters. Optus does not consider that these topics raise questions directly relevant to the ESL Process, other than to the extent that certainty over ESL renewal will provide the investment environment necessary to continue to maintain and upgrade our networks to deliver improved network resilience and redundancy in the case of disaster. We reiterate that the nature of a MOCN configuration is that it preserves separate core networks, thereby promoting resilience and will deliver a sustainable second 5G network to regional Australia.

Section 4. VIEWS ON USE OF FREQUENCY BANDS

- Optus welcomes the ACMA’s initial view that continued use of ESL frequency bands for WBB use is “likely to promote the long-term public interest”.
- Optus considers that continued use of all ESLs for wide area mobile networks and services is in the public interest, particularly given the following considerations:
 - Low-band (sub-1GHz) spectrum is essential for in-building and wide area coverage. Removing even a small amount would significantly impair quality of service for end users reliant on mobile services provided over these bands.
 - Mid-band Frequency Division Duplex (FDD) spectrum can be used for LEO satellite deployment whereas TDD spectrum cannot.
 - Mid-band Time Division Duplex (TDD) spectrum, namely ESLs in the 2.3GHz and 3.4GHz bands, are the only bands which enable MNOs to deploy in a 100MHz wide channel. This is essential to deliver the area traffic capacity required for 5G in cost effective manner and the high speed to deliver an improved customer experience.
- Considerable uncertainty remains as to the ACMA’s preferred view on future use of ESL spectrum and Optus requests that the ACMA deliver its preferred view across all bands at its earliest opportunity.

Continued use of ESLs for wide-area WBB services promote the long-term public interest

- 4.1 Optus welcomes the ACMA’s initial views at Stage 2 on the general use of frequency bands subject to this ESL process and in particular support the greater certainty provided by the ACMA’s statement that “continued WBB use of the 700MHz, 850MHz, 2GHz, 2.3GHz, 2.5GHz and 3.4GHz bands is likely to promote the long-term public interest”.¹⁷⁴
- 4.2 We also support the ACMA’s views relating to use of 1800MHz band, though consider the public interest in use of the spectrum could be promoted if the band were optimised for 5G services. We also welcome the statement that “further consideration needs to be given to whether WBB use is an alternative or complementary use” of the 2.5GHz “mid-band gap”.¹⁷⁵
- 4.3 As the ACMA notes, “where possible, the ESL process should not be a ‘greenfields’ or ‘from the ground up’ exercise in spectrum planning”.¹⁷⁶ Optus agree that the international WBB use of 700MHz, 850MHz, 1800 MHz, 2GHz, 2.3GHz, 2.5GHz and 3.4GHz is well supported domestically and internationally through international harmonisation (ITU) and industry standardisation (3GPP). We also agree that there is considerable WBB equipment availability in these bands, which has facilitated widespread take up of mobile services in Australia.
- 4.4 GSMA highlights that keeping Australia’s spectrum allocation aligned with international standards will be important for harmonisation with global networks.¹⁷⁷ There are clear

¹⁷⁴ Consultation Paper, p.22

¹⁷⁵ Consultation Paper, p.22

¹⁷⁶ Consultation Paper, p.19

¹⁷⁷ 5G Spectrum: GSMA Public Policy Position

benefits to aligning spectrum at an international level, including making it easier to use 5G enabled equipment and compatibility of devices, minimising interference with other countries, leveraging economies of scale and reducing costs of spectrum, and supporting a more competitive economy.

- 4.5 In regard to any consideration by the ACMA of the need for regulatory intervention to facilitate new entry or use cases in ESL spectrum space, Optus reiterate our view that the overall objective of promoting efficient spectrum use and the long-term public benefit derived from the use of ESL spectrum can already be delivered effectively via existing mechanisms under the Act.
- 4.6 Given the overwhelming public benefit that Optus and other MNOs deliver via their use of ESL spectrum for wide-area subscriber networks, we consider that it is incumbent upon prospective licensees and/or the ACMA to establish that existing mechanisms are failing to deliver on the relevant objectives before intervening in ESL spectrum space.

The ITU has harmonised ESL spectrum bands and will identify more spectrum for IMT

- 4.7 The International Telecommunications Union (ITU) provides guidance on the use of spectrum for IMT and has periodically published recommendations on how it expects future technology to develop and what spectrum is appropriate to support the delivery of new services. In 2015, ITU-R Recommendation M.2083 set out expectations for 5G services, including that IMT traffic will grow 10-100 times in 2020 to 2030, which would require additional spectrum and contiguous and broader channel bandwidths.¹⁷⁸
- 4.8 More recently, as standardisation of 6G technology is commencing, the ITU has published ITU-R Recommendation M.2160 which addresses the service concepts and technology enhancements expected for 6G (or IMT-2030). It notes that IMT-2030 is expected to use a wide range of frequency bands ranging from Sub 1GHz bands up to frequency bands above 100GHz.
- 4.9 The ITU also emphasised the need for spectrum harmonisation which has benefits of "... facilitating economies of scale, enabling global roaming, reducing complexity of equipment design, improving spectrum efficiency including potentially reducing cross border interference. Harmonization of spectrum for IMT would lead to increased commonality of equipment and is desirable for achieving economies of scale and affordability of equipment, thus promoting digital inclusion."¹⁷⁹
- 4.10 It is against this backdrop that the most recent World Radiocommunications Conference (WRC-23) met to consider global spectrum management. The conference considered the needs of IMT in particular and it concluded on the need for:
- (a) Global harmonisation of spectrum bands identified for IMT to include 3.3-3.8GHz and 6.425-7.125GHz in all ITU regions,
 - (b) Identification of further spectrum in the range 470-694MHz for IMT,
 - (c) Resolution that several bands in the range 102 to 275GHz should be used for investigation of 6G technology and service development,
 - (d) Formulation of agenda items for WRC-27 to include consideration of 4400 to 4800MHz, 7125 to 8400MHz and 14.8 to 15.35GHz for IMT.

¹⁷⁸ ITU-R Recommendation M.2083

¹⁷⁹ ITU-R Recommendation M.2160

- 4.11 In Optus' view, this international activity emphasises that for the ESL process in Australia:
- (a) Demand for spectrum for IMT services is increasing with traffic growth, higher data speeds and the introduction of innovative technologies,
 - (b) Existing bands assigned for IMT use in Australia are harmonised internationally and are particularly important for roaming and facilitating economies of scale,
 - (c) Additional spectrum as identified at WRC-23 is required for future development of IMT technology and the provision of services that support digital inclusion.
- 4.12 Device manufacturers design devices and equipment based on international frameworks in order to service global, large-scale markets and deployments. Australia is too small a market to diverge from the prevailing international standardised approach and bespoke solutions will add further cost and delay to the supply of downstream connectivity services.
- 4.13 Accordingly, we believe that all the ESLs currently held by Optus should be renewed to allow the continued provision of WBB services. A reduction in the spectrum currently allocated to IMT would compromise 4G and 5G service delivery and hamper the development of 6G services into the future.

Other WBB use cases can be supported via existing ESL arrangements

- 4.14 Given the ACMA's initial views on continued use of frequency bands for WBB being "likely to promote the long-term public interest", Optus is reassured that the ACMA is not contemplating a complete rearrangement of the spectrum bands that underpin the supply of essential mobile services in Australia.
- 4.15 However, we note that there remains considerable uncertainty about the ACMA's preferred approach. As the ACMA has highlighted, "a notable difference" between this and the previous ESL process is that the ACMA is also "seeking submissions from prospective alternative licensees to assist our consideration of whether alternative users and uses may promote the long-term public interest".¹⁸⁰
- 4.16 The ACMA also confirms that it is yet to form views about specific use cases and notes in particular that "WBB can include a range of use cases that vary with the services to be provided to end-users, users and business cases, technologies utilised, and scale of deployment. This could include mobile and fixed WBB, wide area and local area deployments, industry verticals or private networks".¹⁸¹
- 4.17 In its recent draft FYSO, the ACMA states that it generally recognises "3 broad categories of WBB use-cases", namely
- (a) "wide-area subscriber networks" (or 'conventional' telecommunications carrier fixed or mobile broadband operations
 - (b) "more limited market subscriber networks over smaller, localised areas" (e.g., Wireless Internet Service Providers or "WISPs")

¹⁸⁰ Consultation Paper, p.10

¹⁸¹ Consultation Paper, p.19

- (c) “business, government or non-commercial enterprise services operated or controlled by an entity within the confines of their own premises or land estate” (‘mobile private networks’)
- 4.18 The ACMA then adds that “Our planning, allocation and licensing activities seek to support a range of regional communications use-cases and users. This is particularly relevant for WBB services, where there are multiple types of service offerings, users and deployment models, resulting in a diverse range of spectrum needs in regional Australia.”¹⁸² Support for new use cases must be balanced with the interference risk to incumbent services.
- 4.19 As highlighted elsewhere in the submission, as well as in our response to the ACMA’s Stage 1 consultation process, changes to existing ESL arrangements will create a number of significant risks for incumbent licensees, that, in our view outweigh any benefit of accommodating new use cases. These are expanded upon throughout this submission, with the risks to public mobile services clearly illustrated in the case studies (Section 7). In summary, Optus consider that:
- (a) Imposing sharing requirements on spectrum licences, beyond how spectrum is allocated and shared across geographical boundaries will introduce many coordination issues and is unproven as a viable option to provide additional utility and efficiency to spectrum that is already licenced and in use.
 - (b) Changing the core conditions of a licence to support new entry, particularly in the absence of any alternative expressed demand for ESL spectrum, risks regulatory failure and stranding spectrum where there is no viable business case – such an outcome is ultimately inconsistent with the long-term public interest to be derived from use of the spectrum.
 - (c) Any retrospective application of varied spectrum boundaries into national or large area spectrum licences creates complexity and additional cost in terms of interference management, introduces inefficient spectrum use and fragments spectral and geographical holdings, therefore reducing the utility and efficiency of the spectrum to incumbent and prospective licensees alike. This fragmentation undermines the value of spectrum licences in the secondary market if the spectrum products are inconsistent and can, in turn, undermine longer term investment in networks. This is illustrated in the case studies provided in Section 7
 - (d) The introduction of new licence types for use of ESL spectrum, for example from spectrum licences to Area Wide Licences (AWLs), also creates a disproportionately high risk due to the increased likelihood of harmful interference and/or significant disruption to services delivered in surrounding spectrum licensed space.
- 4.20 In summary, Optus considers that the possible approaches to “freeing up” access to ESL spectrum being considered by the ACMA are unnecessary and disproportionate to the risk to public mobile services. Optus submit that any such impacts on incumbent services would weigh heavily against converting any of the existing spectrum licences in any of the geographical areas into AWLs.¹⁸³

¹⁸² Draft FYSO 2024-29, p.18

¹⁸³ Section 100(4) of the Act provides that the ACMA “must have regard to...the effect on radiocommunications of the proposed operation of the radiocommunications devices that would be authorised under the licences”

- 4.21 They also risk unintended outcomes such as consolidation of spectrum holdings resulting from third-party authorisations or sale of stranded spectrum assets to the dominant operator, poor spectrum efficiency, sub-optimal consumer and business customer outcomes and failure to deliver on regional connectivity and the economic benefit of 5G. Optus suggest that any of these outcomes would constitute a regulatory failure.
- 4.22 The ACMA's ongoing allocation of AWLs to assist rollout of localised wireless broadband including 5G and mobile private networks in the 3.8GHz band highlights how new entry can be facilitated without causing disproportionate disruption to public mobile networks and essential mobile services. This allocation process implicitly recognises that support for new use cases can be effectively delivered outside of ESL spectrum space. The ACMA should not seek to extend the use of AWLs below this spectrum band due to the risks of creating further complexity in the management of 3.4GHz band spectrum.
- 4.23 Optus repeats that the provision of mobile services through the ESLs has resulted in billions of dollars of extra economic activity and public benefits. The burden lies with the ACMA to demonstrate that the public benefits of any change to existing ESL arrangements outweigh the public benefits of existing use of ESLs.
- 4.24 Optus urge the ACMA to develop a preliminary view that, to the greatest extent permitted by the Act, promotes certainty for ongoing investment, having a comparable effect, or at least, intent, to the Class of Services Determination issued during the previous renewals process which precipitated significant investment in national 4G mobile networks. In other words, the ACMA's preliminary view should communicate that the renewal of all ESLs is in the public interest.
- 4.25 Optus sets out further detail on band specific considerations that we consider the ACMA should have regard to in determining its preferred use case for ESL spectrum.

Band specific considerations – optimising ESL spectrum for wide area 5G services

- 4.26 Optus uses all its ESLs for the provision of wide area public mobile networks and wireless broadband services. Optus sets out its use of ESL spectrum in Appendix A.
- 4.27 The ESL bands fall into the general categories of low, mid-band FDD and mid-band TDD spectrum with the following considerations relevant to the ACMA's ESL assessment:
- (a) Low-band (sub-1GHz) spectrum is essential for in-building coverage and wide area coverage. The total amount of low band spectrum is small relative to all spectrum and does not support higher orders of MIMO. Removing even a small amount of spectrum, say 2 x 5MHz would significantly impair quality of service for end users reliant on distant coverage or in-building service from these bands.
 - (b) Mid-band Frequency Division Duplex (FDD) spectrum can be used for LEO satellite deployment whereas TDD spectrum cannot (this is all ESL bands other than 2.3GHz and 3.4GHz-3.7GHz spectrum)
 - (c) Mid-band Time Division Duplex (TDD) spectrum, namely ESLs in the 2.3GHz and 3.4GHz bands, are the only bands which enable MNOs to deploy in a 100MHz wide channel. This is essential to deliver the area traffic capacity required for 5G in cost effective manner and the high speed to deliver an improved customer experience.
- 4.28 As noted in Section 2 of this submission and in more detail in Appendix B, national public mobile networks have been built based on the spectrum resources Optus has acquired and renewed over the last 30 years. Removing one spectrum band or reducing

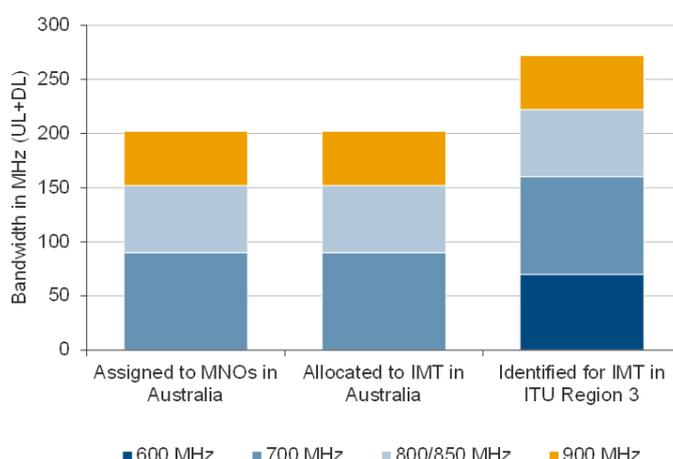
the amount of spectrum in a band would negatively affect network performance and hence have a significantly detrimental impact on millions of end-users. Optus also provided feedback in relation to band specific considerations in response to the ACMA's Stage 1 consultation paper. Optus reiterates these below, adding further comments for the ACMA to consider when assessing whether existing arrangements governing use of ESL spectrum remain fit for purpose.

Low-band – Optus 700MHz ESL

- 4.29 Optus has ESLs in the 700MHz (703-713MHz/758-768MHz) and 850MHz¹⁸⁴ bands and together with its 900MHz apparatus licenses, the bands are used for the provision of 3G, 4G and 5G services. Its 900MHz apparatus licences will convert to spectrum licences, commencing 1 July 2024
- 4.30 The 700MHz band is FDD spectrum widely used for the provision of WBB services in urban centres and regional areas. The band has been used primarily for 4G services by Optus and will have continuing importance for delivery of deep in-building coverage in built-up areas. Its propagation characteristics enable also cost-effective wide-area rural coverage. It is harmonised across ITU Region 3 and is therefore crucial for international roaming.
- 4.31 The 700MHz band is strategically important low band spectrum currently heavily utilised by all mobile operators. Given the propagation characteristics of this spectrum it will remain key spectrum to support the supply of 5G and 6G mobile and WBB services on a national basis in the future. Any changes to the use of this band or the core conditions of existing national spectrum licences will have potentially significant consequences for the costs of deployment and ultimately the quality and geographic scope of these services and therefore must be very carefully considered.
- 4.32 Furthermore, the very propagation characteristics that make this band so useful in supporting current and future wide-area service provision render it extremely difficult to coordinate across co-channel spectrum boundaries. The inter-site distances required to prevent harmful interference for licensees on either side of any mooted spectrum boundaries would be need extremely large, significantly undermining the efficiency and utilisation of the spectrum in this highly valuable band.
- 4.33 The following graph shows low band allocation in Australia and ITU Region 3:

¹⁸⁴ Optus is licensed to use 2x1 MHz of the 850 MHz which is due to expire in June 2028. From 1 July 2028, the 850 MHz downshift is expected to occur and new licensing arrangements commence for Optus in the 900 MHz band.

Figure 17 Low Band Spectrum – Australian Assignment, IMT Allocation and Region 3 Identification



Source: Optus and Coleago

1800 and 2100MHz (mid-band FDD) Optus ESLs

- 4.34 Optus has ESLs in the 1800MHz band (ESLs for 1755-1770MHz/1850-1865MHz) and 2100MHz band (ESLs for 1940-1960MHz/ 2130-2150MHz in metro and 1960-1965MHz/2150-2155MHz in regional areas). Optus uses 1800MHz ESL for 4G and 2100MHz for 4G and 5G services. Both are FDD spectrum bands.
- 4.35 The 1800MHz band is FDD spectrum is usually deployed as capacity layer, where low band is present. Given Optus relatively limited low band (700MHz) holdings (until 1 July 2024) Optus has used 1800MHz as a supplementary 4G coverage layer in regional and rural areas to supplement our low band spectrum. 1800MHz also penetrates relatively well into buildings which is important because there is limited sub-1GHz spectrum available and the additional capacity provided by the 1800MHz band is essential to deliver adequate user experience indoors.
- 4.36 This band is not spectrum licenced nationally and in remote Australia is subject to an apparatus licence regime. This fragmentation and the restrictions on apparatus licences means that the band cannot be used for national LEO satellite deployment. Remote 1800MHz apparatus licences have 2 x 30MHz available to non-MNOs (a maximum of 2 x 10MHz is available per licensee) and is currently being used for private wireless networks and this solution appears ideal for small, localised networks with low level demand outside public mobile network coverage.
- 4.37 The 2100MHz band is FDD spectrum and is an important capacity resource. Optus considers that the 1800MHz and 2100MHz bands are close functional substitutes. The efficient, nationally optimised use of these bands is undermined by complex and inconsistent licence boundaries. The need to coordinate and manage potential interference at multiple boundaries undermines the efficient utilisation of the spectrum, adding to operational complexity and cost.
- 4.38 The need to coordinate and manage potential interference at multiple boundaries undermines the efficient utilisation of the spectrum, adding to operational complexity and cost. The 1880-1920MHz band is subject to a mix of apparatus and class licensing arrangements across Australia that creates significant complexity. In particular, point-to-point links in remote areas are undermining efficient use of this spectrum. For example, the 14MHz bandwidth links which have 15km protections up to the 2nd adjacent lot. This

effectively prevents PTS registrations as it impacts up to 70MHz of spectrum (i.e., 28MHz +14MHz +28MHz)

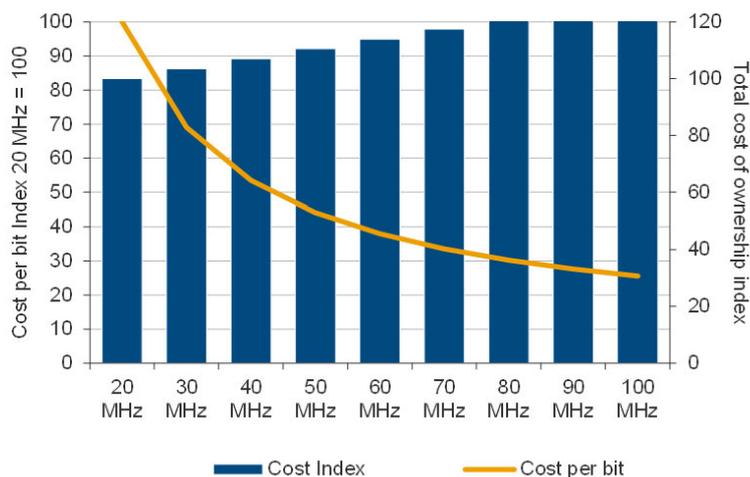
- 4.39 Optus has indicated previously that it does not oppose the expansion of the band arrangements in regard to the use of railway mobile radio (RMR) (between 1900-1910MHz). Optus reiterates that any new assignment in the 1.9GHz band should not cause interference with the adjacent bands, nor should it mandate any new deployment restrictions in the adjacent bands. Ultimately, Optus considers that the spectrum would be better utilised if the 1800MHz band was harmonised for 5G mobile services.

2300MHz (mid-band TDD) Optus ESLs

- 4.40 Optus has ESLs in the 2300MHz (or 2.3GHz band) (ESLs for 2302-2400MHz in all metro except Canberra where we have 70MHz due to protection for Tidbinbilla). Optus faces ongoing issues of managing interference with NBN Fixed Wireless access (“FWA”) services in this band. The 2.3GHz band is a TDD band. Optus has 98MHz of 2.3GHz which it uses for 4G/5G services in metro areas (Sydney, Melbourne, Brisbane, Perth and Adelaide) and uses 70MHz in Canberra.

- 4.41 The amount of spectrum that can be deployed in a single radio is a key determinant of the cost of producing area traffic capacity. The following graph shows that the closer a mobile operator gets to achieving spectrum holdings approaching the maximum channel bandwidth, the lower their cost of producing area traffic capacity.

Figure 18 Cost per Bit by Available Bandwidth



Source: Coleago

- 4.42 Deploying 5G in a 100MHz wide channel in upper mid-band spectrum delivers a 7% higher spectral efficiency compared to deploying it in only 20MHz. Spectrum utilisation is less than 100% for all 5G NR channel bandwidth options because the resource blocks do not fully occupy the channel bandwidth.
- 4.43 To deliver 5G economically, MNOs require a wide allocation of TDD spectrum, ideally a contiguous 100MHz block. Reducing the available contiguous bandwidth drives up network complexity and costs, making it more difficult to efficiently deliver 5G user experience data rates of 100 Mbit/s DL and 50 Mbit/s UL in an economically feasible manner. Therefore, Optus urges the ACMA to use the ESL process to renew our current allocation in the 2.3GHz band and optimise the band by offering Optus the additional 2MHz (2300-2302MHz) by administrative assignment.

2.5GHz (mid-band FDD) Optus ESLs (including mid-band gap)

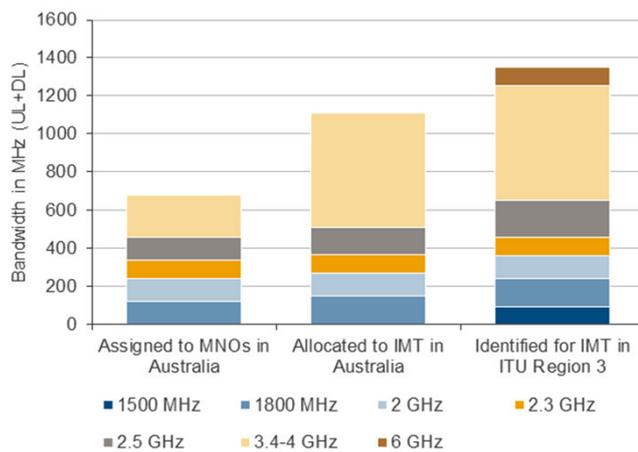
4.44 The 2500MHz band is the only FDD mid-band spectrum subject to national spectrum licences, with Optus holding 2 x 20MHz in this band (ESLs for 2550-2570MHz / 2670-2690MHz).

4.45 <<CIC begins>><<CIC ends>>

3400 – 3800MHz (mid-band FDD) Optus ESLs

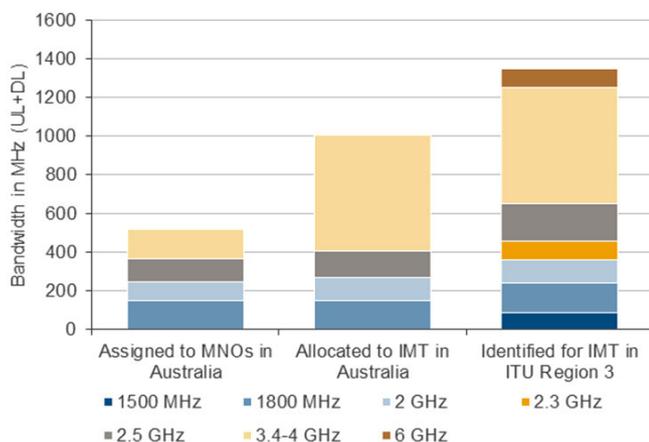
4.46 The 3.4GHz TDD band is a 5G pioneer band. Optus has ESLs in the 3.4GHz, 3.6GHz and 3.7GHz bands. Optus refers to Appendix A for further details. An important distinction between this and the 2.3GHz band is that the 3.4GHz band can be deployed with a higher order of MIMO giving it a higher spectral efficiency compared to 2.3GHz. Therefore the 3.4GHz is required alongside 2.3GHz to produce the capacity density (Mbit/s/m²) required for 5G. The following diagrams set out mid-band allocations in Australia metro (top) and regional (below) as well as ITU-Region 3:

Figure 19 Mid Band Metro Spectrum: Australian Assignment, IMT Allocation and Region 3 Identification



Source: Optus and Coleago

Figure 20 Mid Band Regional Spectrum: Australian Assignment, IMT Allocation and Region 3 Identification



- 4.47 The regional licences in the 3.6GHz are still subject to a reallocation period which does not conclude until March 2025. This has delayed the use of this band for mobile services as it has prevented licence holders from switching on sites due to the risk of interference with incumbent services. This band serves as an example of the negative impact of disproportionately long re-allocation periods on spectrum use.
- 4.48 Optus has raised concerns about the fragmentation resulting from the ACMA's allocation of the 3.4GHz band. Optus views on this are expanded on in response to the Assessment criteria ("facilitates efficiency") under Section 3.

Section 5. ALTERNATIVE LICENCE CONDITIONS

- Alternative licence conditions are not necessary or proportionate for Australia given levels of mobile coverage, the ongoing effectiveness of existing mechanisms of spectrum access and the high risks and consequences of regulatory failure in design and implementation.
- There is no evidence of market failure, which should be a pre-requisite to any regulatory intervention.
- The ACMA should consider other approaches to supporting efficient use and further deployment objectives.

- 5.1 The ACMA is seeking feedback on the effectiveness of “alternative licence conditions” in achieving certain policy objectives, particularly in relation to delivering “broader coverage and more efficient spectrum use”, for the purpose of preparing advice to the Minister.¹⁸⁵ In particular, the Minister has asked the ACMA to consider:
- (a) Rollout obligations and their effectiveness in achieving broader coverage.
 - (b) Use-it-or-lose-it (UIOLI) and Use-it-or-share-it (UIOSI) conditions and their effectiveness in achieving more efficient spectrum use.
- 5.2 The ACMA seeks feedback on a number of issues relevant to the design and implementation of alternative licence conditions.¹⁸⁶
- 5.3 The ACMA notes a number of alternative mechanisms of achieving policy objectives and the fact that the Minister has indicated that “the unique challenges of the Australian context mean that these alternative licence conditions may not be the most effective mechanism to deliver improved outcomes”.¹⁸⁷

Alternative licence conditions are not necessary or proportionate for Australia

- 5.4 National mobile networks require national spectrum licences. The framework for sustainable investment in a national mobile network, requires certainty of access to spectrum. Existing arrangements governing ESL have delivered billions in network investment and world leading coverage and network performance for Australia.
- 5.5 The proposed alternative licence conditions would fundamentally alter the spectrum access arrangements that have supported industry investment to date. While there may be demand for bespoke network solutions – these should not be at the expense of access to national spectrum for national public networks.
- 5.6 In this section, Optus sets out our general view that alternative licence conditions are not necessary or proportionate to the Australian mobile market. This is not only because of our unique geography and low population densities outside metro areas. It is because:

¹⁸⁵ Michelle Rowland MP to ACMA Chair Nerida O’Loughlin PSM; 14 December 2023

¹⁸⁶ ACMA has stated that “consideration is largely confined to how they may be designed and might be implemented through the ESL process and under the spectrum licensing framework as licence conditions” and “under the Act more generally”

¹⁸⁷ Consultation paper, p.26

- (a) There are existing mechanisms to access ESL spectrum, including via spectrum trading and third-party authorisation, that facilitate efficient use of ESL spectrum;
 - (b) Australia has, by international standards, achieved one of the fastest deployments of 5G in the world;
 - (c) While the secondary market for spectrum access may be characterised as “infrequent” or “thin”, given the high value of the assets, the level of activity is reflective of an efficient market;
 - (d) No clear rationale or justification for regulatory intervention has been established;
 - (e) There is low likelihood of designing regulated access conditions that function more efficiently than commercially negotiated access or sharing agreements – and attempts to do so raises the real prospect of regulatory failure.
 - (f) The implementation risks, including the distortion of investment incentives and the risk of harmful interference to public networks, outweigh any benefit of creating a scheme to facilitate localised private access – there is a high “potential divergence between ex-ante commitments and ex-post outcomes”.¹⁸⁸
 - (g) Ensuring such conditions can be operationally effective, from a compliance and enforcement perspective, will be complex and risks disproportionate regulatory burden (of compliance) and ineffective and/or heavy-handed penalties (from enforcement);
 - (h) The conditions are likely to have an anti-competitive effect given that Telstra’s competitive advantages mean that it will be less likely to be adversely impacted – the result would be to further entrench Telstra’s dominance in the national mobile market.
- 5.7 Overall, when considered in the context of the public benefit to be delivered via the ongoing use of ESL spectrum for mobile services, the real risk of regulatory failure weighs heavily against introducing alternative licence conditions.
- 5.8 Optus encourages the ACMA and the Minister to consider the broader context of the ESL decision-making framework, including optimisation of ESL bands, as well as relevant communications policy objectives, including reform of the USO, to deliver the stated objectives.
- 5.9 Optus acknowledge the ACMA’s questions on “alternative licence conditions”. As outlined above, Optus consider that existing arrangements are fit for the purpose of delivering the identified deployment and efficiency objectives. In our view, there is no need for alternative licence conditions to be introduced into any renewed ESLs.
- 5.10 Further, there are also real concerns about the rigour of the analytical process that we understand has given rise to the ACMA’s questions. The position outlined by the ACCC in its submission to the ACMA’s Stage 1 Consultation Paper is not based on an assessment of the state of competition to the level that would be expected to justify intervention into the national mobile market.

¹⁸⁸ Pogorel, Gerard; Spectrum 5.0 – Re-Thinking Spectrum Awards for Optimal 5G Deployment; 5 October 2018; p.18

5.11 Accordingly, Optus has set out our general views on the implications of the matters raised in the ACMA's questions rather than responding to each question individually. Optus also refers the ACMA to its response to the public interest criteria "facilitates efficiency" set out under Section 3, particularly in regard to the fitness of existing market mechanisms. We also refer the ACMA to the case studies in Section 7 of this submission, which clearly demonstrate the impact on the performance of national mobile networks and services that will flow from carving up spectrum space that would result from alternative licence conditions.

Existing market mechanisms facilitate efficient use of spectrum

5.12 Optus agrees with the ACMA that "flexible and tradeable licences are recognised as a means to facilitate innovation and competition, after an initial allocation".¹⁸⁹

5.13 In Optus' experience, the secondary market for ESL spectrum is working efficiently. Optus has utilised the existing market-based mechanisms set out under the Act to collaborate with SpaceX on satellite DTM and, if approved, to share regional spectrum with TPG. Other recent secondary market spectrum activity includes:

- (a) TPG sale of 2.5GHz spectrum to Dense Air and concurrent purchase of Dense Air's 3.4GHz spectrum licences in August 2021
- (b) TPGs spectrum access agreement with Pivotel
- (c) TPG and Telstra's spectrum access agreement in the 3.4GHz band in metro areas¹⁹⁰
- (d) Telstra's purchase of Dense Air's 2.5GHz spectrum in late 2023

5.14 Spectrum trading activity is also regularly used for the purposes of spectrum defragmentation. For example, Optus has recently traded fragments of 2.3GHz and 3.4GHz spectrum with NBN Co for defragmentation and band optimisation purposes. Other examples include TPG and Telstra trading equivalent blocks of 2GHz and 1800MHz spectrum to facilitate defragmentation.

5.15 While the market may be characterised as "thin" it concerns high value assets, which in most other contexts, do not trade that frequently. Further, trades for the purpose of defragmentation also clearly facilitate efficient spectrum use. We also note that while network footprints between the MNOs differ, many spectrum holdings are national. Therefore, the secondary market for spectrum access is by nature competitive and should enable access seekers to obtain access on fair and reasonable terms.

5.16 However, access seekers must actually seek access to the spectrum from the spectrum licence holder to secure these terms. Optus have not been approached about access to its spectrum, despite numerous public comments from prospective licensees that suggest MNOs are blocking access. This would suggest there is either a lack of demand for spectrum access, or more likely, a lack of demand for spectrum access on commercial terms that would include compliance with co-existence requirements.

5.17 Optus invites prospective licensees to negotiate commercial terms for spectrum access if they wish to do so. We note that a failure to make use of existing mechanisms is not evidence of market failure, and any public benefit of new entry must be well established

¹⁸⁹ Consultation paper, p.40, citing Cave, Doyle and Webb

¹⁹⁰ ACCC, Reasons for Determination, Application for merger authorisation lodged by Telstra and TPG in respect of the proposed Multi-Operator Core Network commercial arrangements and spectrum sharing Authorisation number: MA1000021; 21 December 2022; p.20

and outweigh the costs to existing public mobile network performance of carving up spectrum space. A pre-requisite to intervention should be clear evidence and analysis that the status quo is not delivering desired outcomes. To proceed without clearly establishing market failure creates a heightened risk of regulatory failure, which in turn could strand spectrum and undermine its efficient use.

This consultation cannot form a sufficient basis for the contemplated regulatory intervention

- 5.18 The ACMA has itself acknowledged that “alternative licence conditions” would constitute a “substantial regulatory intervention” into the national mobile market.¹⁹¹ The assessment of whether to intervene in a market to promote competition generally involves careful analysis of whether the current state of the market may be hindering competition, by for example, enabling one operator to take unfair commercial advantage of its market position. For example, the ACCC must follow a regulatory process set out under legislation before it can declare that a specified eligible service is a declared service under Part XIC of the *Competition and Consumer Act 2010* (Cth).¹⁹²
- 5.19 Optus submit that the ACMA’s inquiries via this Consultation Paper, prompted by the Minister’s December 2023 letter, do not satisfy the standard of inquiry necessary to determine whether to introduce alternative licence conditions. Optus submits that the ACMA must clearly substantiate the case, including clear evidence of market failure, before recommending to the Minister that such conditions be implemented.
- 5.20 Dr Darryl Biggar, in querying whether the concept of “market failure” remains relevant to modern public policy decision-making notes that:
- “There is a broad consensus amongst economists that, where they operate effectively, no human institution is better able to deliver economic welfare in the long run than well-regulated competitive markets. This is not intended as an ideological assertion but rather as a pragmatic observation which sees: “... *the primacy of the market neither as an ideal nor a necessary evil, but as the best pragmatic solution to a wide range of economic problems.*”
- 5.21 He notes that the traditional economic approach to public policy takes this observation as a starting point and asserts that government intervention in markets can be limited to situations where conventional competitive markets do not operate effectively.¹⁹³ In Optus’ view there is no evidence that the secondary market for spectrum access is no longer fit for purpose. Optus and other MNOs actively engage in the secondary market for spectrum, including via sharing, third party authorisations or trading. There is no market failure, or any other reason, to justify the imposition of alternative licence conditions, particularly given the disruptive and distortionary effects that would flow on from such intervention.
- 5.22 In this context, Optus are also concerned about the analytical rigour underpinning the ACMA’s exploration of “future arrangements that reduce barriers to new entry”, the impetus for which came from the ACCC’s submission to the ACMA’s Stage 1 ESL Consultation Paper, which was then referred to in the Final MPS Instrument as a matter to which the ACMA is to have regard in its ESL decision-making.¹⁹⁴

¹⁹¹ Consultation Paper, p.28

¹⁹² As required under section 152AL(3) of the CCA; see further ACCC; Public inquiry into the declaration of the domestic transmission capacity service and fixed line services; Final Report, March 2024; p.9

¹⁹³ Biggar, Dr Darryl; Public policy for regulators: Is “market failure” passe? Network; Issue 85 December 2022; p.1 accessible here: [Network \(acc.gov.au\)](https://www.accc.gov.au/network)

¹⁹⁴ Section 7; Final MPS Instrument 2024; 30 April 2024

- 5.23 Optus submits that the ACCC's statements cannot be interpreted as reflecting a formal view on the state of competition in the national mobile market and/or the need for regulatory intervention to change existing ESL arrangements. This and other statements that might suggest that market competition is softening¹⁹⁵ are not based on a formal assessment of the state of market competition.
- 5.24 As Optus has highlighted on numerous occasions and has been recognised again recently by the ACCC, Telstra's enduring competitive advantages in regional areas raise barriers to expansion for rival MNOs.¹⁹⁶ Rather than considering whether to facilitate new entry through changes to existing arrangements governing ESL, Optus suggest that the ACMA should focus on ensuring the sustainability of a three-player mobile market by offering to renew Optus ESLs.

Australia has globally competitive levels of mobile coverage

- 5.25 Intense infrastructure-based competition has resulted in population coverage that ranks among the highest in the world.¹⁹⁷ The market has delivered greater mobile coverage than in smaller jurisdictions that have imposed deployment obligations.
- 5.26 It is true that international experience, as highlighted in the examples set out in the Consultation paper, does show that deployment obligations can lead to beneficial extensions in coverage. However, it is notable that coverage in Australia, without the use of rollout conditions, exceeds coverage in many of the countries when obligation were imposed, which was often at initial allocation rather than renewal. For example, rollout obligations (NZ and Canada) were imposed at a time when (3G) coverage was limited and certainly much less than Australia's present population coverage of 98.5% for Optus 4G and 99.5% of population for Telstra 4G coverage.
- 5.27 For context, the Productivity Commission found that Australia performs comparatively well on coverage and while internet speeds (capacity) performance lags, this was mainly in fixed services rather than mobile, where Australia ranks 18th in the world.¹⁹⁸ For our part, Optus has rapidly deployed successive generation of mobile technology to compete with Telstra. Our 4G coverage exceeds our 3G coverage as set out below¹⁹⁹:

Figure 21 Optus' 4G Outdoor Geographic Coverage as a percentage of 3G Outdoor Geographic Coverage by ABS Remoteness Area

	2018	2019	2020	2021	2022	2023
Major Cities of Australia	100.6	99.2	99.4	n/a	n/a	102.7
Inner Regional Australia	91.4	83.8	85.2	n/a	n/a	107.4
Outer Regional Australia	82.7	70.8	72.0	n/a	n/a	114.7
Remote Australia	71.2	59.1	59.9	n/a	n/a	128.1
Very Remote Australia	62.0	54.7	48.2	n/a	n/a	142.3
Total	80.9	70.6	70.7	n/a	n/a	119.2

Source: ACCC

¹⁹⁵ ACCC Communications market report 2021-22, p.9

¹⁹⁶ ACCC, Regional Mobile Inquiry, Final Report, 30 June 2023, p.86-87

¹⁹⁷ [Australia's multibillion-dollar 5G opportunities | Austrade International](#)

¹⁹⁸ [Advancing Prosperity - 5-year Productivity Inquiry report - Productivity Commission \(pc.gov.au\)](#)

¹⁹⁹ ACCC, Regional Mobile Inquiry, Final Report, 30 June 2023, pp.86-87

- 5.28 We continue to deploy our 5G network to compete with Telstra. Our MOCN services agreement with TPG will allow Optus to deliver sustainable 5G infrastructure-based competition for the long-term benefit of regional Australia. Our future IMT satellite direct to mobile services offer the potential to deliver connectivity across the country. These commercial agreements were both facilitated by the flexibility afforded by existing arrangements governing ESL.
- 5.29 While Australia's unique geography and highly urbanised population make the investment case for regional and remote areas challenging, MNOs do not need rollout obligations imposed on renewed ESLs. Rollout obligations will not be as effective in achieving broader coverage or even technological upgrades to Australia's mobile networks than what is already achievable under existing arrangements. As we have highlighted in submissions to other Government consultation process, Optus encourage the Government to reform the many funding programs directed at delivering wider coverage or to mandate access to publicly funded infrastructure.

Implementation risks outweigh any public benefit

- 5.30 Alternative licence conditions run a high risk of failing to strike the right balance between efficient access and the promotion of network investment. It seems very unlikely to Optus that such conditions could be designed and implemented in a manner that will deliver more efficient outcomes than can and already are being delivered via the market. In Optus view, licensees remain best placed to:
- (a) assess the risk and manage the design and implementation of measures to mitigate the interference that will arise from increased sharing.
 - (b) respond to market demand and make financially sustainable investment decisions about network deployment.
- 5.31 Replacing market mechanisms with regulatory mechanisms places significant pressure on designing the framework correctly, raising the risk of regulatory failure in the form of higher costs, spectrum fragmentation and/or long-term underuse of spectrum. For example, we note that in 2021 OfCom rejected calls to include UIOLI conditions in 700MHz and 3.6-3.8GHz spectrum licences on the grounds that:
- (a) Such conditions are very difficult to make workable in practice because of the problem of defining what constitutes 'use' and therefore what the trigger for an enforced trade or revocation would be;
 - (b) There may be entirely legitimate reasons for spectrum remaining unused – the licensee may be holding back until it sees a suitable commercial opportunity or until the technology it wishes to use is ready; and
 - (c) Imposing such an obligation also has the potential to distort and/or chill the incentives to invest in the spectrum, and so reduce consumer benefits.²⁰⁰
- 5.32 We also note the relative success of OfCom's Shared Access Licences for 3.8-4.2GHz spectrum in meeting demand for private networks in the UK since 2019, compared to the uptake of its Local Area Licences, of which there are only 28 current licences, none of which are in low-band spectrum.²⁰¹ If not designed correctly, alternative licence conditions may have adverse flow on effects on innovation and investment, continuity of

²⁰⁰ [Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands \(ofcom.org.uk\)](https://www.ofcom.gov.uk/consult/condocs/700/700_statement_2021.pdf); p.186

²⁰¹ [Local Access Licences Chart \(ofcom.org.uk\)](https://www.ofcom.gov.uk/consult/condocs/local-access-licences-chart/2021-local-access-licences-chart.pdf)

services, competition in the national mobile market and the overall financial health of a sector crucial to Australia's digital future.

Risks to innovation and investment

- 5.33 Optus note that certain overseas approaches that seek to accommodate a degree of flexibility as to how a condition may be met, though well intentioned, may also introduce uncertainty into the nature and scope of the compliance obligation.²⁰²
- 5.34 For example, UIOLI/UIOSI licence conditions will involve complex decisions about incumbent "use" and when an alternative use might be preferable – Optus submits this will inevitably lead to greater disputation and reductions in spectrum utility and efficiency.
- 5.35 Given this, and the distortionary effect such conditions may have on investment incentives,²⁰³ Optus consider that the introduction of alternative licence conditions in a mature market is an unnecessary and disproportionate response to any policy concern to be solved. Introducing uncertainty into licensees' access to national FDD spectrum risks undermining innovation, including in nascent IMT satellite DTM services.
- 5.36 Optus strongly objects to any proposal to vary any in-force spectrum licence, particularly without the agreement of a licensee.²⁰⁴ Changing the conditions upon which the licence was issued, particularly without agreement, sets a poor precedent for the ESL process and undermines investment.

Risk to sustainable competition in the national mobile market

- 5.37 Optus consider that alternative licence conditions will favour Telstra, as it has the widest geographic coverage and is "using" the most spectrum. Given this, the implementation of alternative licence conditions is likely to have anti-competitive effect, as Optus and TPG face a potentially disproportionate compliance burden.
- 5.38 Optus consider that UIOLI/UIOSI obligations are highly likely to harm the sustainability of competition in the national mobile market. Telstra's market power and relative financial strength mean that it can more readily absorb the costs of any regulated access (as opposed to commercially negotiated access). Given the extent of its coverage, it is also more likely that Telstra would be found to be "using" its spectrum, which means that it is less likely to have to "lose it" or "share it" than Optus.
- 5.39 Ultimately alternative licence conditions risk distorting the market in favour of Telstra and the marginal business cases of prospective licensees to the detriment of competing MNOs.

UIOLI/UIOSI conditions dilute spectrum licence rights

- 5.40 The rationale for alternative licence conditions is to address concerns about lack of use or "underuse" of spectrum under ESLs. As the ACMA recognises, there are legitimate reasons, from a network planning and deployment perspective, for spectrum to remain

²⁰² Walden, Ian et al; *Telecommunications Law and Regulation; Fifth Edition; Oxford; 2018*; p.235 citing the FCC requirement that carriers provide "substantial" service upon renewal – the service level is deliberately "unspecific" as it takes into account the nature and scope of communications services that have developed in the radio band – but as a result is also unclear.

²⁰³ For example, the FCC has noted that "keep-what-you-serve" and "use or offer" could create "an adverse incentive for licensees to serve the most desirable areas within the licence area and leave the rest unserved" Wireless License Renewal and Service Continuity Reform Second Report and Order and Further Notice of Proposed Rulemaking, WT Docket 10-112; 13 July 2017; p.41

²⁰⁴ Section 73 of the Act

unused.²⁰⁵ Given the underlying impetus is to promote spectrum sharing, UIOSI as well as UIOLI effectively raise the same technical interference concerns that we have raised elsewhere in this submission about possible re-allocation or new techniques of sharing to manage interference. Any notion that “opportunistic access” via a UIOSI regime can be implemented without “risking harmful interference or undermining the deployment plans of primary licensees” should be treated with a high degree of caution.²⁰⁶

- 5.41 In our view, the major issue with UIOSI or UIOLI provisions is that they logically degenerate into retrospectively applied spectrum licence boundaries for incumbent licensees. The first step is to determine use and how that can be measured. If such a lack of use is demonstrated and accepted by the ACMA, the next issue is to determine how “sharing” is defined and implemented. As shown in Section 2 and Section 3, the MNOs currently successfully operate in an environment where traditional sharing methods are applied.
- 5.42 Once the ACMA has determined that spectrum is unused, the areas of the spectrum to be released for other users will need to be determined. This is an activity fraught with potential issues and unintended consequence. As demonstrated in Section 7, the introduction of these boundaries will lead to dead zones where co-channel interference between licensees will result in a lower utility and less efficient use of the spectrum. Even if genuine use or future need can be properly evaluated, the ACMA must also consider the costs “UIOLI/UIOSI” conditions can impose.
- 5.43 Optus therefore strongly opposes the introduction of UIOLI or UIOSI provisions in any ESLs as they represent the gateway to the application of retrospective spectrum licence boundaries, with their incumbent inefficiencies for spectrum use and potential to cause harmful interference into established networks, undermining the public benefit derived from them.
- 5.44 To highlight the need for caution, we note that the restrictions in the Act on the ACMA issuing overlapping licences are there for good reason. While the limitations on new licences within existing spectrum licence space do mean that the services that can be so licensed are very limited,²⁰⁷ they are specifically “designed to provide certainty and protection to incumbent spectrum licensees”.²⁰⁸
- 5.45 As the ACMA notes, “alternative licence conditions would represent a substantial regulatory intervention” into the market.²⁰⁹ In Optus’ view, requiring a licensee to authorise access involves an unprecedented degree of regulatory intervention into a spectrum licence holder’s use of spectrum, thereby severely diluting the utility of spectrum licences as a means of promoting long term network investment.

Compliance and enforcement

- 5.46 From a practical perspective it also introduces a high degree of complexity in implementation, particularly with respect to the (lack of) “use” threshold that might trigger the obligation as well as any process used to assess third party proposals. The ACMA has not specifically considered how compliance with new conditions might be assessed

²⁰⁵ Consultation paper, p.27; as the ACMA acknowledges “there may be reasons for a licensee not to use, or only lightly use, their spectrum at a given time, such as acquiring spectrum for future capacity or deployment, or to lower interference management costs. Spectrum utilisation can also be sporadic, responding to dynamic demand”

²⁰⁶ Calabrese; Michael A; Open Technology Institute at New America; 48th Research Conference on Communication Information and Internet Policy; TPRC48; February 17-19, 2021

²⁰⁷ Consultation paper, p.33

²⁰⁸ Item 38 and 80 of the Explanatory Memorandum to the Modernisation Bill; p.32

²⁰⁹ Consultation Paper, p.28

– however, in Optus view this is a threshold question as to whether or not such conditions would be effective. Given that an area that may be the focus of such a condition is likely to be “harder to serve”, it is too simplistic to assume that a condition will result in either an existing licensee expanding their current deployment or an area being “served by another entity planning to provide new or improved services”.²¹⁰

- 5.47 Enforcement of UIOSI/UIOLI will ultimately result in carveouts to spectrum licences, which will in fact undermine the efficiency objectives they were intended to promote. The threat of enforcement risks incentivising inefficient investment by incumbents in an effort to demonstrate use. Such consequences are particularly concerning given the absence of any rigorous analysis of the problem to be addressed.
- 5.48 Optus strongly objects to any application of UIOLI that would involve a comparison of the suitability of a new entrant’s service to meet the needs of a niche downstream use case, against the service offering of an incumbent licensee if the incumbent is making that service available. Optus notes that such an assessment would risk failing to properly take into account the interference risks, including costs to manage such risk, created to the surrounding public mobile network.

Other approaches to supporting efficient use and network deployment

- 5.49 As the ACMA has noted, there are other barriers to the delivery of stated policy objectives, including “infrastructure deployment, financial incentives and land planning issues”.²¹¹ A number of these issues have been canvassed in the inquiries that have been undertaken recently by the ACCC and the Standing Committee regarding regional connectivity.²¹²
- 5.50 Rather than risk the market distortions and harmful interference that would flow from alternative licence conditions, Optus urge the ACMA and the Government to consider other approaches to promoting efficient and deployment objectives.
- 5.51 In regard to efficiency objectives, Optus advocate for optimisation of technical frameworks and defragmentation of spectrum holdings as important steps to maximising market outcomes. Where spectrum is substitutable, such as mid-band FDD, Optus encourages the ACMA to consider how it may design spectrum products in a manner that is most conducive to trade. This includes seeking to align licence duration, geographic areas and to the greatest extent practicable, non-core conditions or external policies that may affect licence use.
- 5.52 In regard to deployment, the most effective mechanism to deliver infrastructure to “non-commercial areas” will be direct Government subsidy or co-funding schemes. In particular, Optus reiterate calls for reform to the Governments Mobile Blackspots program and Regional Connectivity Plan to ensure a level playing field in access to Government blackspot funding. Optus also supports the ongoing consideration of reform to State and Territory planning laws and urges the Government to set out a plan to abolish the USO and redirect the funding to support the uptake of new LEOSat solutions, such as Optus DTM service, to be deliver connectivity outside the terrestrial mobile footprint.

²¹⁰ Government of Canada, [Decision on New Access Licensing Framework, Changes to Subordinate Licensing and White Space to Support Rural and Remote Deployment \(canada.ca\)](#), January 2024, para 29

²¹¹ Consultation paper, p.34

²¹² ACCC, Regional Mobile Infrastructure Inquiry, Final Report, 30 June 2024 and Connecting the country: Mission critical – Inquiry into co-investment in multi-carrier regional mobile infrastructure; House of Representatives, Standing Committee on Communications and the Arts; November 2023

Section 6. EXAMINATION OF USE SHOULD REFLECT THE REALITY OF NETWORK DEPLOYMENT

- Coverage maps and RFNSA data are sufficient to establish “use of spectrum” for the purposes of the ESL process.
- To granular an approach to examining use will not reflect the realities of network deployment decision-making and may constitute an unjustifiable retrospective application of a condition on our use of ESL spectrum.

- 6.1 In addition to the ACMA’s request for information on current and planned use, the ACMA is also seeking feedback from stakeholders on approaches to examining use under existing spectrum licences.²¹³
- 6.2 Optus raised a number of concerns about the general approaches to examining spectrum use set out in the ACMA’s “Stage 1” consultation paper.²¹⁴ Optus cautioned that too granular an assessment runs the risk of being meaningless given national network deployment considerations. We recommended that levels of previous and planned investment be given considerable weight in decision making and suggested that the ACMA have recourse to existing information to reduce administrative burden.
- 6.3 The ACMA has provided a general outline of how it intends to examine use of spectrum for the purpose of assessing the public interest in its “Finalised framework and response to submissions document” issued in December 2023 as well as this Consultation Paper.²¹⁵ Optus welcomes the ACMA’s confirmation that it intends to examine use based largely on publicly available information – including the coverage maps that Optus and other MNOs are required to supply to the ACCC under its Infrastructure RKR. However, we note that the ACMA has also identified a number of perceived deficiencies which “limit the extent to which coverage maps alone may inform the design of potential changes to licence conditions, such as licence boundaries”.²¹⁶
- 6.4 The ACMA’s approach to examining use of spectrum under ESLs is important to the ACMA’s view on whether or not existing arrangements for ESL spectrum are fit for purpose or whether changes are needed to support alternative uses of ESL spectrum. The ACMA’s approach will form the basis for its decision on whether to renew, partially renew or refuse to renew an ESL. Accordingly, we have prepared this section of our submission to respond directly to the ACMA’s request for feedback and to assist with the ACMA’s assessment. We provide further explanation as to the utility of coverage maps used in combination with RFNSA data to establish use. We also provide a brief explanation of how spectrum is used by MNOs in deployment decision-making with a

²¹³ Consultation Paper, p.3

²¹⁴ ACMA, Stage 1 Consultation Paper, p.28

²¹⁵ See pages 9 and 37 of Finalised framework document and

²¹⁶ Consultation Paper, p.17; in summary the ACMA states that coverage maps (a) are modelled on “predicted coverage” rather than a representation of “actual coverage” (b) “do not directly indicate spectrum utilisation or interference potential considerations” (c) “based on a variety of inputs that may vary between operators and years, limiting direct comparison” (d) “Do not indicate total bandwidth used but do generally indicate which frequency bands have been used” (e) “Do not generally indicate where coverage is planned, or where there may be difficulties providing coverage”

view to helping ensure that the ACMA's approach to examining use reflects the operational realities of network deployment.

Coverage maps and RFNSA data sufficiently establish historical and current use

- 6.5 Optus uses all its ESLs to supply more than 9 million mobile services over our 3G, 4G and 5G mobile networks. Optus 3G services are currently supplied via our 900MHz apparatus licences, which will convert to spectrum licensing from 1 July 2024. When Optus shuts down its 3G network, our 900MHz spectrum will be "re-farmed" to supply 5G services.
- 6.6 We have provided the ACMA with access to our coverage maps and access to the detailed site registration information contained on the Radiofrequency National Site Archive (RFNSA) in response to the ACMA's information request. The RFNSA provides more detail on our spectrum use than the ACMA's Register of Radiocommunications Licences (RRL). The RFNSA shows where a base station has been deployed and activated. In other words, where the spectrum is being used to make mobile services available to Optus customers. The RFNSA also provides detail on the progress of base station deployment over time.
- 6.7 In Optus view, the RFNSA is more indicative of the actual state of deployment as the RRL does not demonstrate where an operator may have attempted to deploy but been delayed. There may be various reasons for delays to deployment, including land access, planning and approval delays, community opposition to a site and the need to connect a site to power and backhaul.²¹⁷ By depicting sites that are "in-flight", the RFNSA more accurately represents an operator's near-term deployment plans and therefore spectrum use.

Optus response to ACMA's comments on use of coverage maps

- 6.8 The ACMA has also made a number of comments on how it will use coverage maps for the purposes of examining use of spectrum. For example, the ACMA states that
- "we will use (coverage maps) as one input into forming preliminary views about the overall use of spectrum licensed bands, and the public benefit derived from the use of the spectrum. We will use coverage maps to examine the uses to which overall spectrum holdings have been put, and the geographic areas where services have been indicated as available to the public in considering the public interest derived from that spectrum".²¹⁸
- 6.9 While we agree that coverage maps should not be solely relied upon to determine spectrum usage, we consider that RFNSA data, in combination with coverage maps, provide "evidence of strong support for a particular use or uses of a band" in an area and should be sufficient to demonstrate current use of ESL spectrum. The ACMA has also identified a number of perceived deficiencies with coverage maps as a tool for assessing spectrum use – Optus responds to each below:
- (a) maps are modelled on "predicted coverage" rather than a representation of "actual coverage" –
- Optus agrees with this statement. However, we submit that it is the same for all coverage maps. Measurements of "actual coverage" are unreliable due to

²¹⁷ See Chapter 4 of ACCC Regional Mobile Infrastructure Inquiry; Chapter 4

²¹⁸ Consultation Paper, p.14

the statistical significance of the samples collected and the methods by which the collected data is managed.

For instance, drive data is a snapshot in time. The performance of a network changes depending on the traffic load. Serving cells may alter due to localised network outages or signal strengths may be reduced due to near fields blocking (for example, a large truck blocking the signal from the mobile cell site and drive test car).

Crowd sourcing data also has issues as there is no information on where the test samples are taken from. For example, the signal strength vary significantly depending on whether the handset is located outside or inside a building. It will also vary depending on the performance of the handset. Similarly, it is not possible to collect coverage measurement data over the entire extent of any mobile network.

Any measurement of “actual coverage” represents only a snapshot in time and cannot necessarily be relied upon to represent coverage into the future, especially in areas of development or subject to seasonal change.

Propagation models and their underlying mapping and terrain data are extensively used and represent the best manifestation of coverage provided by mobile networks, given the differences and limitations presented by end user equipment, environment and other variables that are beyond the control of the spectrum licensees.

- (b) maps “do not directly indicate spectrum utilisation or interference potential considerations”

As set out above, Optus consider that the data sought can be sufficiently gathered from the RFNSA and/or the ACMA RRL, in combination with coverage maps, to indicate whether or not spectrum is used or intended to be used. We note that the interference potential question is dealt with under s145 of the Act, using the Device Boundary Criteria (DBC).

- (c) maps are “based on a variety of inputs that may vary between operators and years, limiting direct comparison”

There are some differences between the way that MNOs predict and present their coverage maps. The underlying terrain and clutter data will vary between all parties predicting coverage according to the source and currency of the data used. These data sets are expensive to purchase and keep up to date due to ever-changing clutter and landscape as determined by changes to land use and urban expansion.

All MNOs strive to produce maps that are as accurate and reliable as possible so as to manage customer expectations and provide service where it is claimed to be available. Comparisons between coverage maps on a large scale are generally reasonable and indicative of the coverage landscape. However, comparing on very small scales (pixel-by-pixel) will yield unreliable, wildly variable and ultimately inaccurate results for whose network coverage is “best”.

- (d) Do not indicate total bandwidth used but do generally indicate which frequency bands have been used

Where a band is deployed it is typically deployed in full, according to the technology in use and supported channel bandwidths. This information will not be included in any coverage map, but the configuration of the spectrum and

bandwidth is an input into the coverage predictions. This changes the power spectral density (PSD), which, in turn influences coverage. It is not possible to determine how much spectrum has been deployed in a specific band from the extent of the coverage provided by that band.

- (e) Do not generally indicate where coverage is planned, or where there may be difficulties providing coverage

Optus agree and this is why an examination of “use” should involve reviewing coverage information as well as the detailed site related information on the RFNSA and ACMA RRL. These data supplement and complement each other to provide a more complete picture of where spectrum is, and is intended to be, deployed.

MNOs need flexibility and certainty of spectrum access to deploy national networks

- 6.10 The ACMA has also indicated that it intends to “examine information about how incumbents are using their spectrum in certain geographic areas”.²¹⁹ In other words, the ACMA appears to be considering a localised examination of use of spectrum under existing licences. Optus notes that this is a significant departure from the previous renewals process under which licensees were only required to demonstrate use of the licence itself. We also consider that too granular an examination of use may constitute an unreasonable retrospective application of a new condition on our use of ESL spectrum, after licence issuance (see further discussion under Section 3)
- 6.11 Existing ESL arrangements provide spectrum licensees with the flexibility of use and certainty of access that underpin the billions of dollars of investment required to deploy networks that will deliver Australia’s Digital Future. Optus strongly caution against an approach that does not take into consideration the realities of how spectrum is used in network deployment decision-making and the supply of national public mobile services.
- 6.12 For example, a lack of uptake or evidence of “usage data” in a particular area should not determine that the spectrum is not being used, or certainly that it will not be used in the future, by an ESL holder. Such an approach fails to reflect the dynamic nature of mobile usage by end-users and the importance of “unused” spectrum to the cost-effective deployment of network infrastructure. We encourage the ACMA to adopt an approach to examining spectrum use that reflects the realities of mobile network deployment.
- 6.13 The availability of the network in a particular area is crucial to customer experience. Too granular an assessment of usage data will not give a fair indication of “use” of spectrum given that there may be areas where consumers simply do not take up a service. If consumers choose not to use our network in certain areas this says nothing about potential future usage. Ultimately changes in usage data inform investment decision-making – where it is evident that there is sustained increased use in an area, then a decision to upgrade or build out the network may follow.
- 6.14 To further illustrate how spectrum may be used in network decision-making, we note that the different propagation characteristics and the amount of bandwidth available at a particular frequency will influence how an MNO chooses to deploy their network.²²⁰ It will

²¹⁹ ACMA, Expiring spectrum licences; Finalised framework and response to submissions; December 2023, p.9

²²⁰ For example, “low-band” (sub-1GHz bands) can carry signals over long distances making it useful for providing a “coverage” layer, particularly in sparsely populated regional areas; (a) “mid-band” (spectrum 1 to 6GHz) does not carry signals as far as low-band, but because there is more spectrum made available, the wider bandwidths enable a higher capacity and “capability” service (i.e., a “capacity layer”) and “high

also impact the variability in capacity and speed that customers experience the areas serviced by those sites. However, the deployment layering strategy for low, mid and high band spectrum is highly differentiated. Low band spectrum (700/850/850e/900) provides a coverage layer and tends to be deployed ubiquitously and this can also apply for mid band spectrum when there is no low band coverage layer e.g., Optus deployed 1800MHz as the coverage layer for 4G prior to the deployment of 700MHz and 3.4GHz.

A lack of site or mobile coverage data is not determinative of a lack of use

6.15 Optus supports the ACMA's comments:

"There is a general assumption that unutilised or underutilised spectrum does not result in an output or benefit to the public and is, therefore, an inefficient use or allocation of the spectrum. There can be productive, allocative and dynamic dimensions to this perceived inefficiency, such as when a licensee is acquiring spectrum for future capacity or deployment, or to lower interference management costs. We also note that spectrum utilisation can be sporadic, responding to dynamic demand, and that efficient uses of certain spectrum may not exist at a given time."²²¹

6.16 Our submission to the ACMA's Stage 1 Consultation paper explains that the mobile operator's role is to provide the mobile network where customers need it and the customers choose to use the available network in a particular location (registering usage on a particular site deployed) or in the future. With the key issue being that the site is available for customers to use if they choose to. Ultimately usage on a particular site is dependent on customers and is not under the control of the MNO. Mobile operators deploy their expensive spectrum assets in line with their customers' needs and their network deployment strategy to provide capacity and coverage to their customers unless there are regulations that prevent them from doing so (e.g., reallocation periods, interference issues).²²²

6.17 An absence of current use (whether by geography or bandwidth) cannot be taken as an absence of need to access spectrum in the future. Adequately capturing plans for use will be critical in determining spectrum utilisation and the ACMA should consider appropriate means for determining this. Optus strongly endorses the ACMA's comment that:

"holding unused spectrum can also potentially provide licensees utility by providing greater flexibility to deploy or adjust services on a needs basis in the future, particularly in bands where significant new releases of spectrum are not expected over the term of a licence. In such cases, the length of time that the spectrum has not been used, or underused, would need to be considered in connection with technology and investment cycles, and anticipated future use of the spectrum".²²³

6.18 An example of where erroneous conclusions for spectrum utilisation may be drawn would be for the 3.6GHz band, where an excessively long reallocation period of 7 years for incumbent WISPs has hamstrung Optus' ability to deploy in some regional towns. Similarly, a slowly developing network or device ecosystem may stymie a licensee's

band" (spectrum bands above 13GHz, e.g., mmWave) – does not travel as far as "mid-band" spectrum but has more capacity and can deliver faster speeds due to the very high bandwidths available

²²¹ Consultation Paper, p.27

²²² Optus submission to Stage 1 consultation paper; p.45

²²³ ACMA Stage 1 Consultation Paper, p.20

desire to utilise spectrum efficiently or in a manner it desires, for example the lack of available iPhone mmWave devices currently available.

- 6.19 A lack of site or coverage data is not determinative that spectrum is not or will not be used. Optus should not be required to provide usage data as it will not give a fair indication of “use” of spectrum given that there may simply be areas where consumers simply do not take up a service.

Optus is using our ESL spectrum for critical network infrastructure and essential services

- 6.20 In addition to the coverage maps and RFNSA data that Optus has provided to the ACMA, we note that there is significant other publicly available information to inform the ACMA’s assessment of use. For example, the following tables from the ACCC’s Mobile Infrastructure Report 2023, which are based on the data collected from MNOs via the annual Infrastructure RKR, demonstrate at a high level that Optus is using all its ESLs to supply 4G and 5G public mobile services.²²⁴

Figure 22 Number of 4G and 5G sites deployed by MNOs to 2023

Table 3.10: Total number of 4G sites by MNO & radiofrequency spectrum deployed – 2018 to 2023

	2018	2019	2020	2021	2022	2023
Optus						
700 MHz	5,590	6,271	6,639	6,895	7,196	7,425
900 MHz	33	36	40	542	1,531	533
1800 MHz	4,519	5,340	5,751	6,140	6,522	6,786
2100 MHz	1,053	3,014	3,486	4,037	4,656	5,154
2300 MHz	2,984	3,253	3,426	3,575	3,701	3,768
2600 MHz	2,235	2,795	3,139	3,489	4,093	4,745
3500 MHz	-	-	-	1	-	-

Table 3.11: Total number of 5G sites by MNO & radiofrequency spectrum deployed – 2020 to 2023

	2020	2021	2022	2023
Optus				
900 MHz	-	-	-	982
2100 MHz	-	208	956	2,579
2300 MHz	-	291	988	1,677
3500 MHz	426	1,006	1,596	2,225
26000 MHz		4	25	72

Source: ACCC

²²⁴ ACCC, Mobile Infrastructure Report 2023; November 2023; p.21-22

Section 7. CASE STUDIES ON THE IMPLICATIONS OF CHANGING EXISTING LICENCE BOUNDARIES

- 7.1 Optus has prepared a number of case studies to highlight the consequences of creating new licence boundaries that would result from the potential new entry into existing ESL spectrum space contemplated in the ACMA's Consultation Paper. Cross-references to these case studies are included throughout the submission.
- 7.2 In summary, new boundaries lead to a greater need to manage interference risk, which in turn leads to more "dead zones" or wasted spectrum. Such inefficient spectrum outcomes are the opposite of what the ACMA is tasked with giving effect to under the Act and ostensibly seeking to deliver via the ESL Process.
- 7.3 At any co-channel spectrum boundary, under the existing spectrum licence technical frameworks, the licensees are required to comply with the device boundary criterion set out in Section 145 of the Act. This is to ensure that the licensees are afforded the necessary protections to operate their network without harmful interference from their geographical neighbours. Previous decisions regarding the proposed and implemented boundaries in at least two bands should be at the forefront of the ACMA's thinking when deciding whether this course of action should be considered for any of the ESLs.
- 7.4 As previously described, the adoption of any UIOLI or UIOSI would represent an inevitable slide into a scenario where retrospective spectrum licence boundaries will need to be introduced in order to realise any purported benefits. Optus argues that this would, for all case studies, represent a reduction in the utility and efficiency of use for the spectrum.
- 7.5 Furthermore, as shown in the case studies below, the introduction of retrospective boundaries will have the effect of undermining relevant policy objectives, including those set out under the final MPS Instrument.²²⁵

²²⁵ Radiocommunications (Ministerial Policy Statement – Expiring Spectrum Licences) Instrument 2024

Figure 23 Scenarios Leading to Spectrum Licence Boundary Changes and Policy Failure

Case Study	Policy objectives not met
Pilbara	<ul style="list-style-type: none"> • Sustained investment and innovation • New use cases incl. LEOsat • Regional connectivity and investment • Promoting competition
The Interference Impact of Introducing Spectrum Boundaries for 850/900MHz Bands	<ul style="list-style-type: none"> • Service continuity • Regional connectivity and investment • Promoting competition
The Effect of Incumbents on 3.6GHz Spectrum Licensees	<ul style="list-style-type: none"> • Regional connectivity and investment • Promoting competition • Sustained investment and innovation
Prospective Licensees too close to MNO public network boundary	<ul style="list-style-type: none"> • Service continuity • New use cases incl. LEOsat • Regional connectivity and investment • Promoting competition
Space X and Direct to Mobile Services	<ul style="list-style-type: none"> • New use cases incl. LEOsat • Regional connectivity and investment • Promoting competition • Sustained investment and innovation
Urban Excision	Cautionary – efficiency, utility and public benefit reductions
The Negative Effects of Retrospectively Introduced Spectrum Licence Boundaries	Cautionary – efficiency, utility and public benefit reductions

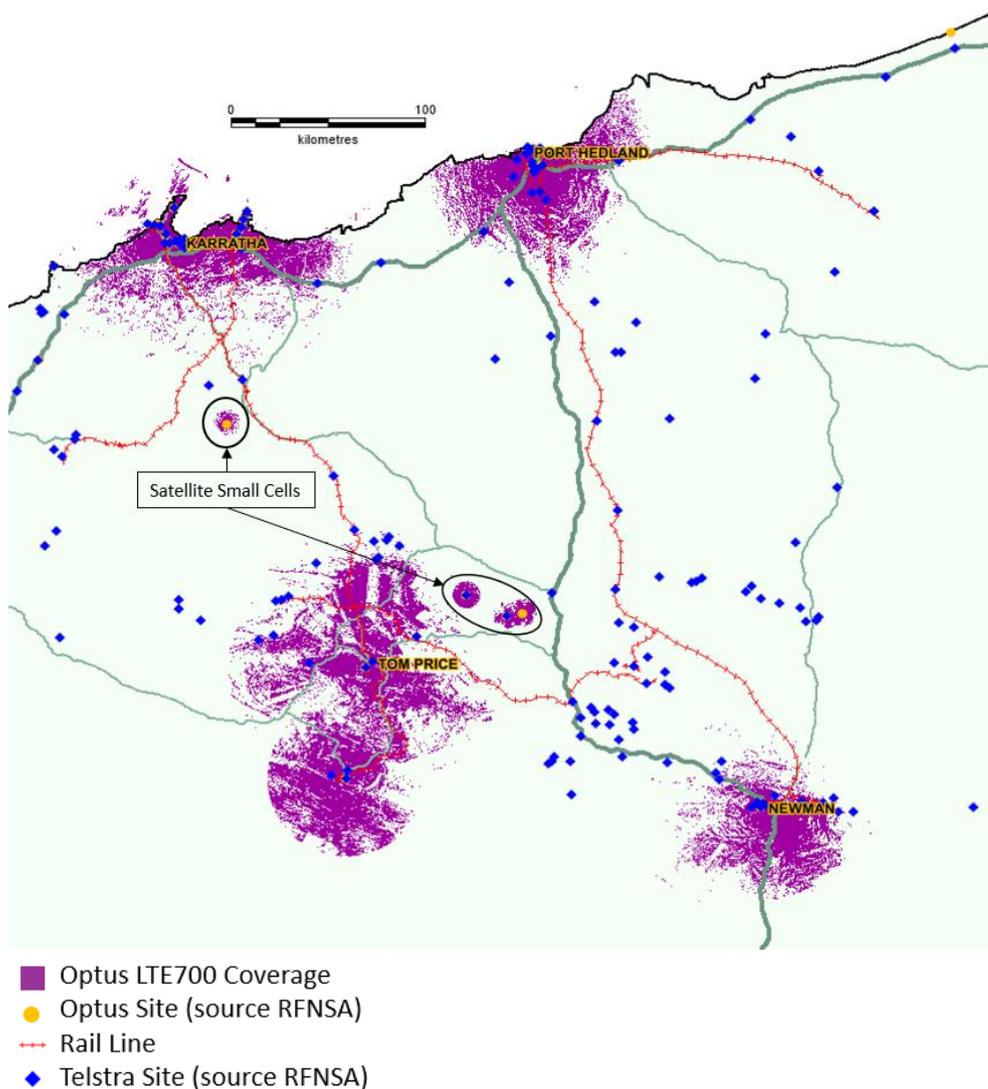
Source: Optus

CASE STUDY: Pilbara

Spectrum licences facilitate competition, innovation and allow, under the right commercial terms, for the provision of services into under- and un-served areas

- 7.6 The Pilbara region in WA is often presented as an example of an area that is underserved or unserved in terms of mobile coverage. The region has low population, and its remote location makes the delivery of services both difficult and costly.
- 7.7 Optus has invested in network infrastructure in the towns in this region, namely Port Hedland, Karratha, Tom Price and Newman. Currently, there are Optus coverage gaps along the main roads and in areas outside the towns. This is illustrated in Figure 24:

Figure 24 Map of Pilbara WA showing Optus sites and low band coverage and Telstra sites



Source: Optus analysis

- 7.8 Port Hedland has a population 4,081 (source ABS 2021). Optus has limited market share in this region. Most of the Optus traffic is from tourism and FIFO workers in the mining industry. To support these customers Optus has deployed 5 macro sites in Port Hedland to deliver coverage, capacity and capability.

Competition with Telstra

- 7.9 Telstra has market dominance in this area and this has enabled them to expand their network. This can be seen by the significantly greater number of Telstra sites in the region, particularly outside of the towns. Further investment by Optus is very difficult to justify due to the low population and high deployment costs. Further investment would be driven by Optus customers who would expect similar performance in this area to that of the metropolitan areas.

Innovation – Satellite Small Cells

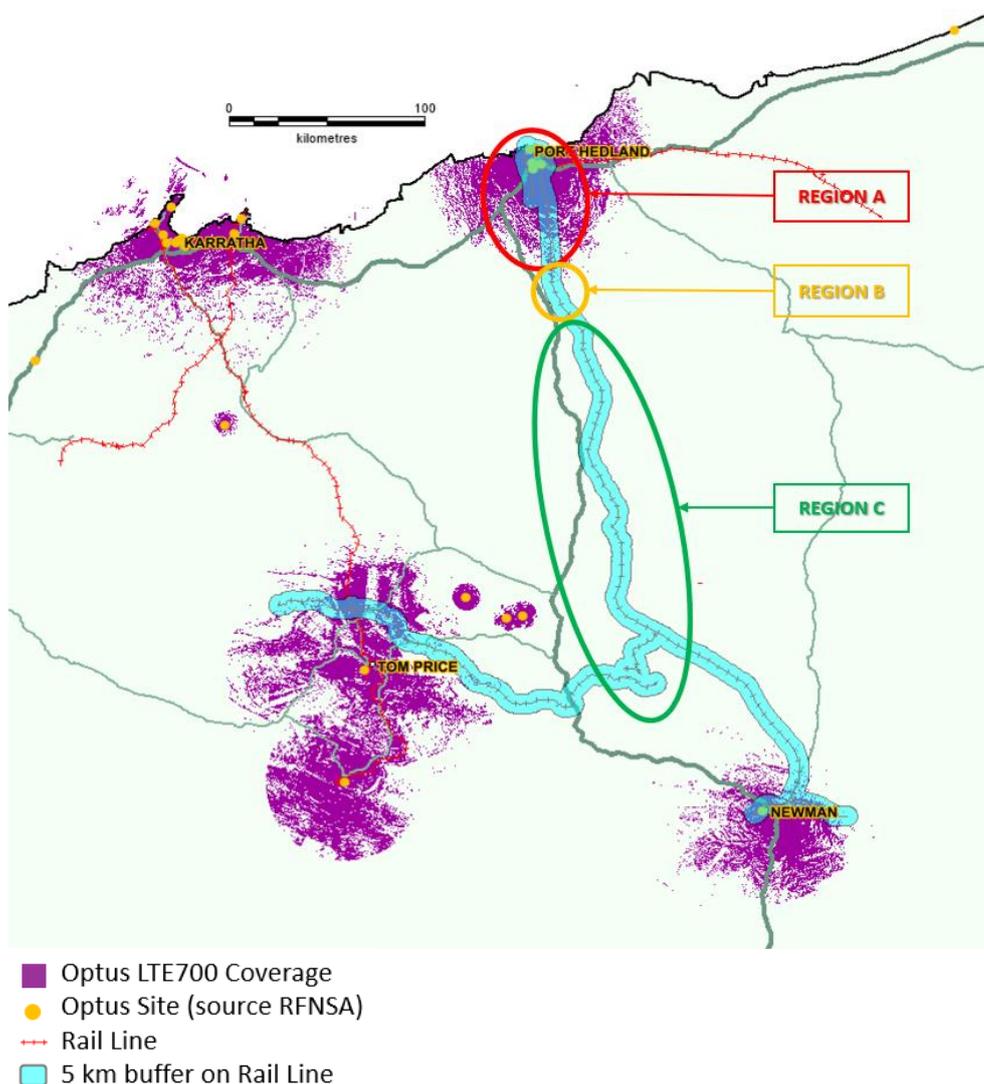
- 7.10 Optus has deployed 4 satellite small cells in the Pilbara region, Millstream Homestead, Karijini Eco Resort, Karijini Visitor Centre and Karijini Campground. Small cells are small units which provide the potential for an inexpensive and flexible alternative to traditional mobile towers, and when used in conjunction with satellite connectivity and backhaul, provides the combined benefits of expanding mobile broadband coverage in a concentrated local area in rural, remote and previously unserved locations.
- 7.11 The small cells boost mobile coverage for locals and travellers and can deliver mobile phone coverage up to a 3 kilometre radius depending on the spectrum bands deployed and the surrounding topography.
- 7.12 As Optus is well established as a provider of satellite networking technology and as a terrestrial network provider we were able to develop and implement this innovative solution which improves customer experience. Optus began deployment of these site types in 2017 and these have been successful in providing mobile and satellite solutions for our customers across the country.
- 7.13 Optus deployed 3G services on these satellite small cells in March and April 2018 and upgraded the Karijini sites to 4G late 2019. Telstra deployed similar satellite services in the Karijini area in 2022²²⁶. This is another example of Optus driving innovation and competition into the market.

Private Network Options – Dedicated Spectrum

- 7.14 There is known demand for low band spectrum using MNO national ESL spectrum , particularly from the mining industry in this area. The mining companies operating in the Pilbara have claimed a need to deploy low band on private LTE networks to enable automated train operations. This could result in spectrum being unavailable for public mobile networks. However, mid band spectrum, particularly 1800MHz and 3.8GHz is also a viable option which can also meet these needs.
- 7.15 Exclusive access to low band spectrum is claimed to be the most cost-effective solution due to the propagation characteristics and their need to cover the hundreds of kilometres of track. A demand for exclusive access to 2 x 10MHz is typical for these types of use cases.

²²⁶ Source: RFNSA Database

Figure 25 Map of Pilbara WA showing Optus sites and low band coverage in Rail Line Regions



Source: Optus analysis

- 7.16 Figure 25 illustrates the likely coverage requirement on a rail line from the Pilbara into Port Hedland. There are 3 key scenarios for network consideration assuming 2 x 10MHz of Optus 700MHz spectrum is used.
- 7.17 Region A is the area in and around Port Hedland where Optus has existing low band coverage providing LTE using the 2 x 10MHz of Optus' 700MHz spectrum. In this example the removal of the entirety of Optus' 700MHz spectrum from the public mobile network in these areas, in preference for a private mobile network will directly and negatively impact existing Optus customers.
- 7.18 Region B is a buffer zone. Co-channel Interference between the Optus network and private LTE network will make the entire Optus 700MHz Band unusable for both Optus and a private LTE network in this area. A very conservative estimate of the range of the buffer zone area (i.e. from the edge of the Optus 700MHz network to the edge of the private network) is ~50km but this could be larger depending on the site configuration. Carving out low band spectrum and introducing new spectrum boundaries results in large areas where no services are available for Optus customers.

- 7.19 A private co-channel network in Region C is unlikely to have impact on the current Optus network. However, there are significant drawbacks with this approach including:
- (a) No public benefit for customers.
 - (b) No ability to make emergency calls.
 - (c) No competition to Telstra.
- 7.20 In this scenario, a request for exclusive 2 x 10MHz of Optus 700MHz Spectrum would generally fail due to the negative impact on the Optus existing network (Region A).

Hybrid Solution

- 7.21 In any commercial request for spectrum, Optus requires that there be no significant negative impact to the Optus public network.
- 7.22 Optus Enterprise Business has a hybrid solution product available, which offers pre-determined dedicated 5G resourcing for a private network, operating alongside the Optus public network. The hybrid model allows for both private and public radio networks to co-exist using the same spectrum. This solution does not require spectrum coordination and so delivers capacity to both public and private networks simultaneously. Further enhancements will be available via network slicing which is planned FY26.
- 7.23 Hybrid networks and network slicing solve the co-existence issue in Regions A and B in Figure 25. These solutions have the ability to deliver on both the MPS objectives, connectivity in regional and remote areas along with facilitating opportunity for new use cases.
- 7.24 To date, private network suppliers have rejected this solution as they seek spectrum which they wish to operate exclusively on their own network.
- 7.25 Where it is demonstrated that a request for access to spectrum may cause harmful interference to our public network, Optus will place priority on maintaining and expanding our public consumer network to benefit Australian end users (consumers, small/medium businesses, wholesale and enterprise customers), rather than diverting spectrum and impacting the coverage and capacity of the existing network to support private use cases.

Conclusion

- 7.26 Small mobile private networks that are allocated dedicated spectrum have a disproportionately detrimental effect on MNOs and at-scale services. This has the effect of denying access to spectrum, reducing spectrum and spectral efficiency and harming customer experience on the public network. This, in turn, has the effect of eroding the public benefit that can be derived from that spectrum.
- 7.27 Private network suppliers' objectives can be best delivered by the existing licences as a partnership between the MNO and corporates rather than between the MNO and a private network supplier.
- 7.28 In order to facilitate this, the existing licences need to be offered for renewal without alteration.

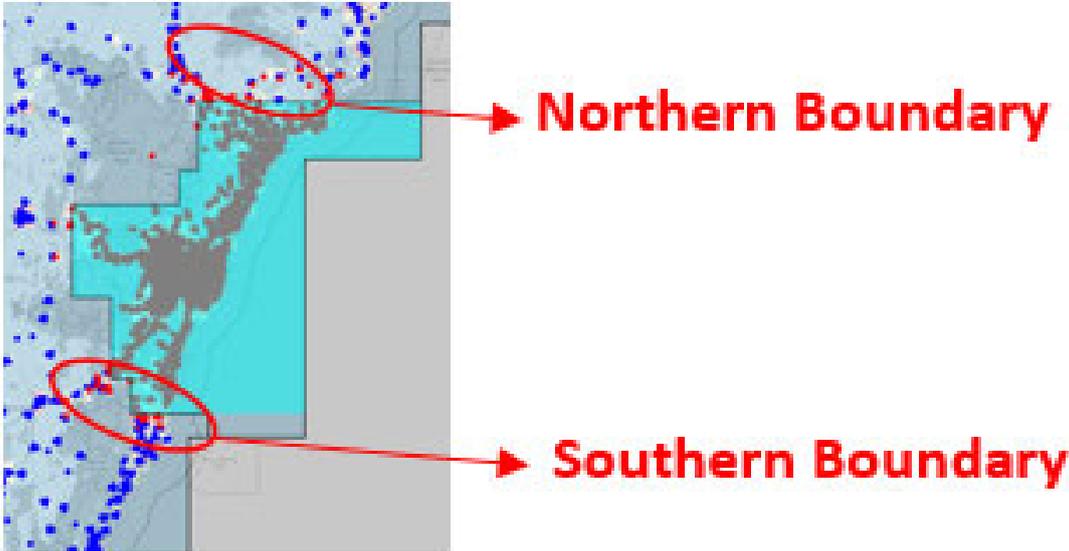
CASE STUDY: The Interference Impact of Introducing Spectrum Boundaries for 850/900MHz Bands

- 7.29 This case study presents the impact analysis performed by Optus in its response submission to ACMA Tune Up on “850/900MHz Product Configuration” in June 2021, whereby ACMA was considering adopting new Metro and Regional licenses for both 900MHz and 850MHz lots for the December 2021 auction.
- 7.30 This case study demonstrates that, introducing new spectrum boundaries over an existing network will create large areas of unusable spectrum. This inability to deliver services undermines the Government policy objective of promoting regional connectivity.

Sydney Metro/Regional Example showing Impact of Existing Boundaries

- 7.31 There is currently an existing low-band spectrum boundary in the 850 MHz Band between Telstra in regional and TPG in metro. The boundary was in place prior to site deployments and therefore site designs can be optimised in order to meet the coordination requirements. The importance of delivering low-band services means that MNOs will endeavour to deploy this technology on all sites.
- 7.32 Figure 26 shows the 850 MHz band Sydney metro/regional licence boundary. Telstra registered 850MHz sites are displayed where blue are 15MHz BW, regional, red 10MHz BW regional and grey 10MHz BW Metro. The sites in red are the sites which could not be registered for the full 15MHz allocation and this represents the area where the 5MHz of co-channel 850MHz is not utilised.

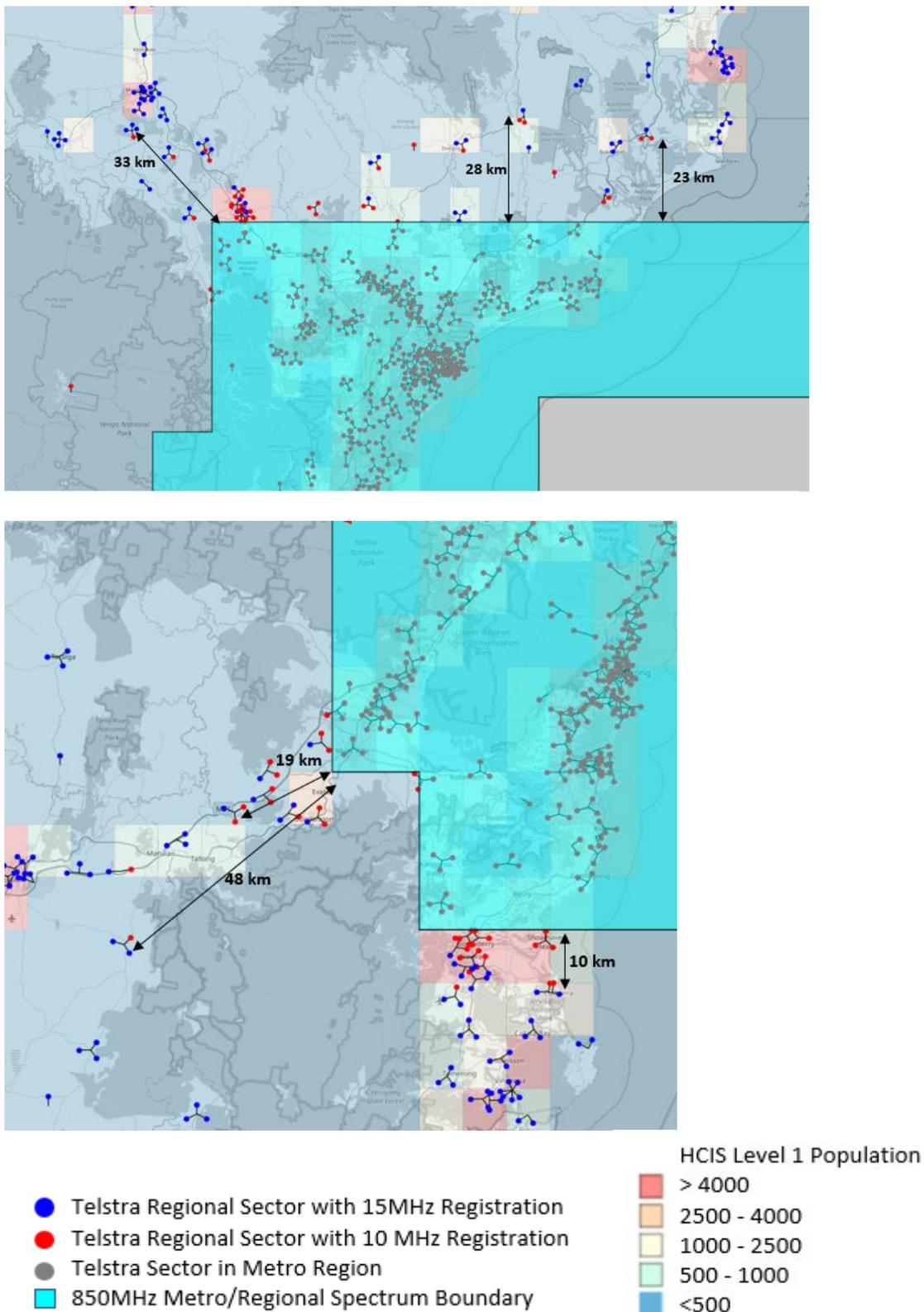
Figure 26 Telstra sites around 850MHz Sydney Spectrum Boundary



Source: ACMA RRL Database, Optus analysis

- 7.33 The northern and southern boundaries are analysed in more detail below.

Figure 27 Telstra site configurations in detail around 850MHz Sydney North and South Spectrum Boundary



Source: Optus analysis

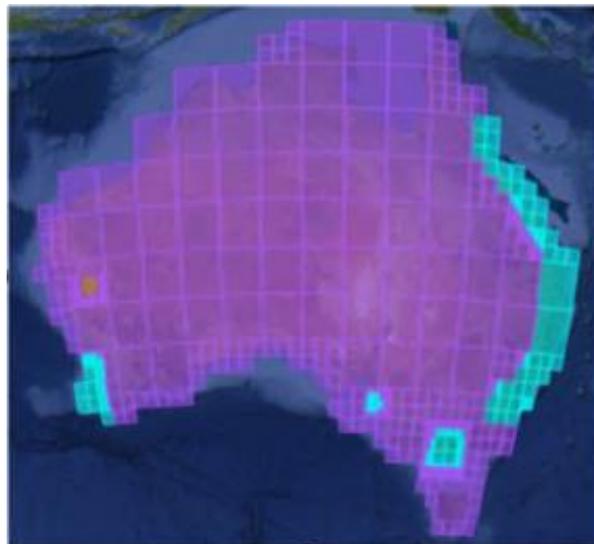
7.34 Figure 27 highlight the sectors (red in the regional areas) that are unable to utilise the full spectrum available in order to manage interference across the licence boundary. The distances from the boundary impacted sites also vary due to different site configurations and terrain profiles.

- 7.35 Importantly, these maps demonstrate that boundaries can impact the deployment of 850MHz services up to 30-50 km outside the metro boundaries. It follows that the more 'regional' the area, the larger the area which is compromised. The same effects will be observed in the 900MHz band if sub-national spectrum boundaries are introduced.
- 7.36 Optus also notes that similar impacts will occur in the reverse direction. However, in metro environments, sites can be deployed closer to boundaries due to the smaller site spacing requiring lower site heights. The Sydney-Wollongong boundary is an example of this more metro environment where sites are impacted up to 10 km from the boundary.

Introducing Boundaries has Significant Negative Impact on Regional Coverage

- 7.37 The ACMA proposed 2 scenarios which would introduce new boundaries on the national 900MHz network. For simplicity, Scenario B which is a combination of existing 850MHz Boundaries with a new Metro/Regional split, will be presented in this case study.

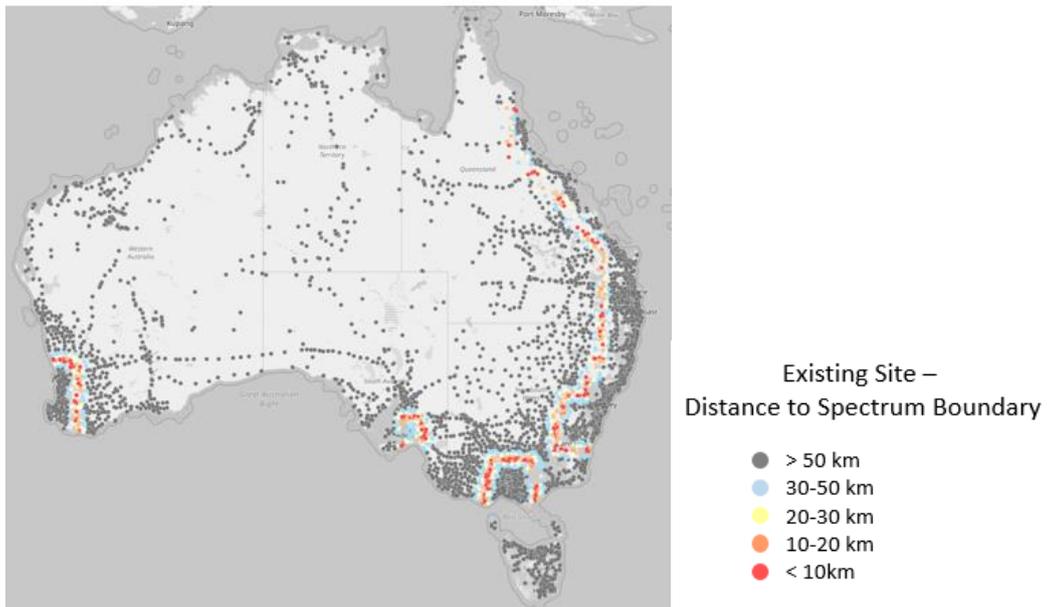
Figure 28 Scenario B: Combination of Existing 850MHz Boundary and Metro/Regional Split



Source: ACMA Tune Up on 850/900MHz Product Configuration

- 7.38 The results from the Sydney 850MHz boundary example were used to quantify the potential impact of the introduction of boundaries. Optus sites were categorised into distances from the new boundary to assess the potential impact to existing services.

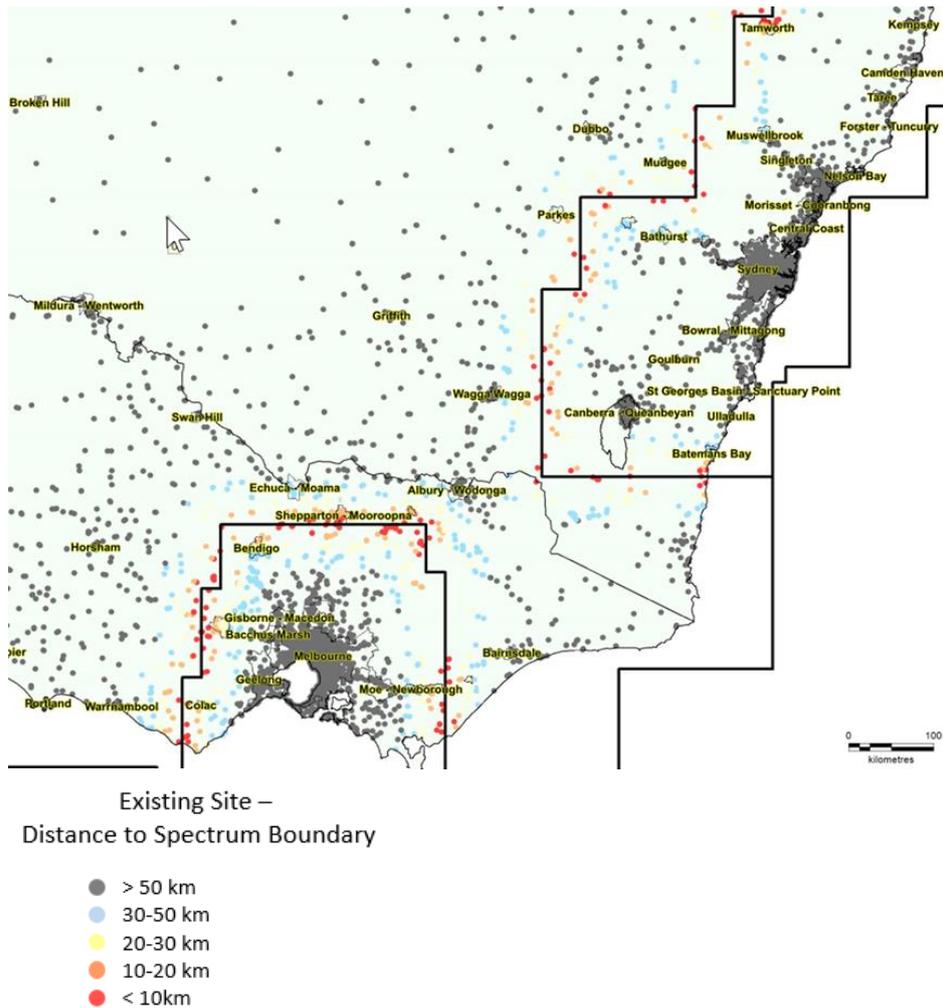
Figure 29 Optus sites within 10km and 50km distance of Scenario B proposed 900MHz boundaries



Source: Optus analysis

- 7.39 Optus sites were categorised from closer than 10km up to 50km from the proposed boundary. Using the less than 10km and less than 50km site lists, this analysis show that 12% to 20% of sites would experience coordination issues that would prevent Optus from registering sites. This covered between 400,000 to 830,000 consumers across regional Australia and Tasmania. This represents between 15% and 30% of the regional population.

Figure 30 Optus Sites and distance to ACMA proposed 900MHz boundary Scenario B



Source: Optus analysis

7.40 Figure 30 illustrates some of the areas in Victoria and New South Wales where Optus would expect to experience interference effects due to the introduction of the licence boundaries under analysis.

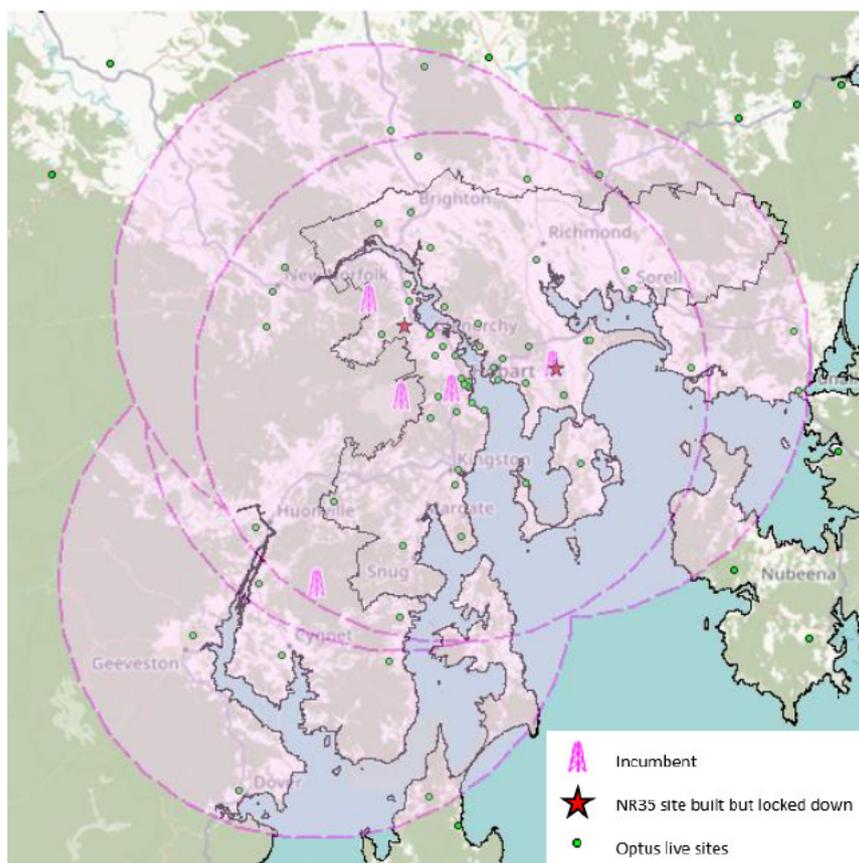
Conclusion

- 7.41 Spectrum boundaries create significant interference ‘dead zones’ where the spectrum is unusable.
- 7.42 It is important to note that the same effects will be observed no matter where any regional boundaries are drawn. In other words, there are no locations where a new boundary could be drawn that would not have negative impacts on existing sites or consumer experience.
- 7.43 The onus should be on licensees to manage secondary uses or access by third parties and not by licence design. This will encourage the most efficient use of the spectrum allocated and will benefit the long-term interest of end-users.
- 7.44 For the reasons presented above, Optus strongly opposes the introduction of retrospective spectrum licence boundaries as part of the ESL process, whether directly applied as a change to the ESL core conditions or as a consequence of rollout, UIOSI, UIOLI, change of licence type or any other conditions under consideration by the ACMA.

CASE STUDY: The Effect of Incumbents on 3.6GHz Spectrum Licensees

- 7.45 This case study examines the effect of incumbents on Spectrum Licensees. The example taken is in Tasmania where Jettech Networks Pty Ltd and the State Fire Commission registrations are still present. Optus is unable to fully deploy its 5G network using 3.6GHz spectrum in Tasmania due to the presence of incumbents which have until 27th March 2025, when they are obliged to relinquish their apparatus licences and vacate the spectrum. The reallocation period for 3.6GHz is 7 years which commenced from March 2018.
- 7.46 The Optus regional 3.6GHz spectrum was acquired at auction in 2018, and the spectrum licences commenced in 2020, however, as stated above Optus has not been able to deploy 5G using this spectrum in significant population centres of Tasmania to date. Optus has diverted 5G deployment resources to other geographical areas without incumbents. Optus has deployed equipment of providing 5G service on the 3.6GHz spectrum in some areas of Tasmania, however the equipment will not be activated until the incumbents vacate or after 27th March 2025.
- 7.47 During the last 7 years, Optus has already upgraded and refreshed some of these sites in order to meet public mobile demand for coverage and capacity. These sites will require a re-visit and additional upgrade work and cost to Optus to activate 5G services.

Figure 31 Incumbent Registrations impacting Optus in Hobart (Population 238,375)



Source: Optus analysis

- 7.48 Figure 31 illustrates the area in Hobart where the remaining 5 incumbent registrations have prevented Optus from deploying NR35. This has impacted 67 Optus sites and a population of 240,000.

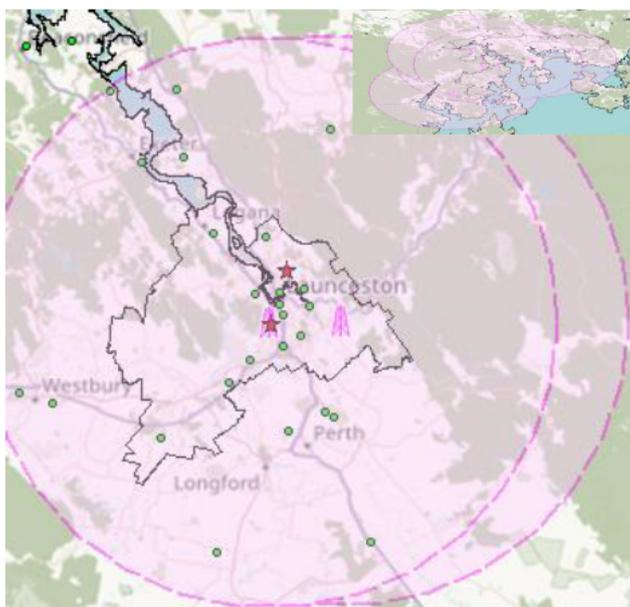
7.49 Figure 32 and Figure 33 illustrate the areas in Burnie-Ulverstone, Devonport and Launceston where Optus is unable to activate 5G NR35 due to incumbents. This has impacted 28 sites in Burnie to Devonport and 29 sites in Launceston, with a total overall population of 182,000.

Figure 32 Incumbent Registrations impacting Optus in Burnie-Ulverstone (Population 49,232) and Devonport (Population 47,283)



Source: Optus analysis

Figure 33 Incumbent Registrations impacting Optus in Launceston (Population 85,242)



Source: Optus analysis

7.50 Spectrum access is denied to spectrum licensees and 5G networks are not able to be deployed to meet public demand in areas as wide as 30km radius from the incumbent sites in order to mitigate interference. Incumbents that are unable or unwilling to vacate the spectrum, have held spectrum licensees to ransom in this case for 7 years.

- 7.51 This demonstrates the negative impact that a small number of obstructive incumbents can have by depriving large populations and areas access to the latest technology.
- 7.52 In allowing the long reallocation time on the 3.6GHz the ACMA has hampered the deployment of 5G in these areas, to the detriment of public interest. The larger population of Australian public in these areas is deprived of advancement in mobile technology for the sake of a handful of localised private users.
- 7.53 Carving out spectrum for small use cases will have a similar impact as the incumbent scenario. Optus advises that the ACMA should not consider the addition of retrospective boundaries to spectrum licences as this will negatively impact spectrum utility and the public benefit derived from the use of the spectrum.
- 7.54 The table below lists the 10 incumbents that have registrations affecting the deployment of NR35 on Optus sites within a 30km radius of the incumbents. These low site count of the incumbents affect large amounts of spectrum licensee sites and area where technology updates are denied to the general public.

Figure 34 Remaining RRL Registrations in the Optus 3.6 GHz Band

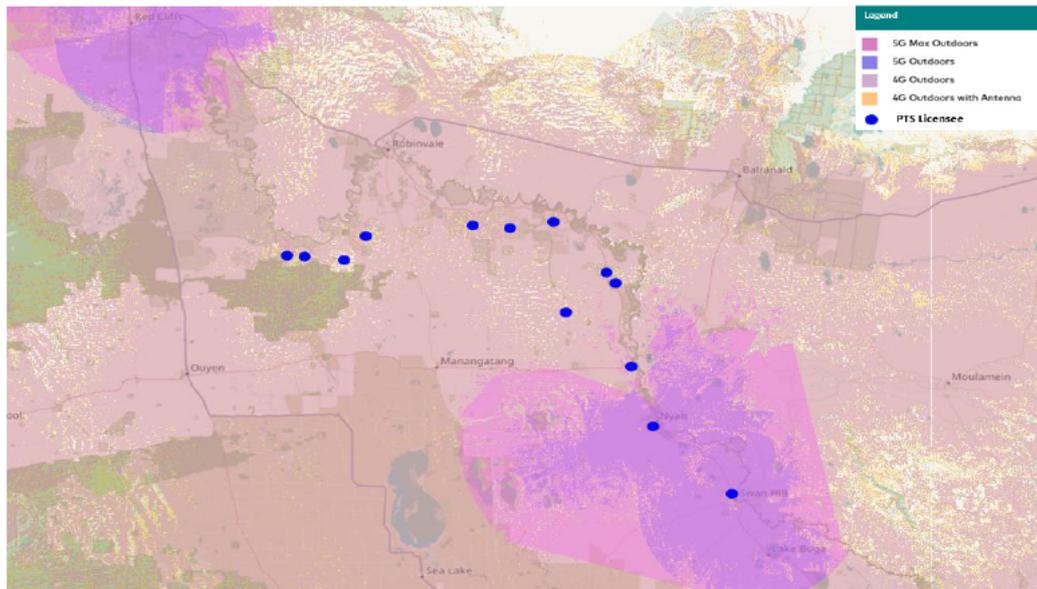
Existing 3.6GHz Incumbents	Site Count	Number of Optus Sites within 30km radius
JETTECH NETWORKS PTY LTD	6	109
Spirit Telecom (Australia) Pty. Ltd.	6	200
Department of Transport and Main Roads	4	104
Isaac Regional Council	4	9
State Fire Commission (TAS)	4	95
CountryTell Management Pty Ltd	2	19
Anglo Coal (Dawson Management) Pty Limited	1	1
Michael Parnell Pty. Limited	1	29
ORIGIN NET PTY. LTD.	1	50
Toowoomba Regional Council	1	39

Source: ACMA RRL Database; Optus analysis

CASE STUDY: Prospective Licensees too close to MNO public network boundary

- 7.55 This case study examines the location of current PTS licensees in correlation to unserved and underserved areas.
- 7.56 The example in Regional Victoria shows that non-MNO PTS licensees (examples) tend to be in areas that are already served by MNOs. The PTS licensees in this region are located in areas with or at the very least close to Optus 4G/5G coverage.

Figure 35 PTS Licensees in Regional Victoria and Optus' 4G/5G coverage



Source: Optus analysis

- 7.57 The locations favoured by the business cases for mobile private networks in regional Australia are generally immediately adjacent to areas with mobile coverage or in areas with unreliable MNO coverage. The location of these registrations would indicate that these are the target markets for at least some of the prospective licensees who have made their views known.
- 7.58 The proximity of these registrations to MNO coverage, if operating on the same spectrum as an MNO, would render both the MNO network and the prospective licensee's network inoperable due to interference. As with all instances of retrospective boundary application to ESLs, if small mobile private networks are allocated dedicated spectrum this would have a disproportionately detrimental effect on large numbers of MNO customers in order to service relatively small numbers of private network customers. This has the effect of denying access to spectrum, reducing spectrum and spectral efficiency and harming customer experience. This, in turn, has the effect of eroding the public benefit that can be derived from that spectrum.

CASE STUDY: Space X and Direct to Mobile Services

- 7.59 In July 2023 Optus announced an agreement with SpaceX to deliver mobile connectivity to cover 100% of Australia using SpaceX's Starlink satellite constellation.
- 7.60 Through this agreement with SpaceX, Optus will work to expand the reach of our mobile network outside the terrestrial footprint to the remainder of Australia's land mass. The solution aims to bring the coverage capabilities of satellites direct to compatible mobile handsets without the need for customers to buy additional equipment. This will be achieved through a phased rollout of SpaceX's satellite capability, starting with SMS in late 2024, with voice and data to follow in late 2025.
- 7.61 Australia's vastness and terrain can make it difficult for any operator to provide mobile coverage everywhere it is needed – especially in remote or hard-to-reach locations where the traditional terrestrial site deployment model does not deliver adequate return on investment.
- 7.62 Direct to mobile (DTM) solutions are an exciting development in the technology roadmap which has the potential of delivering a real solution for connectivity for all Australians.
<<CiC begin>><<CiC end>>
- 7.63 As TDD spectrum is not suitable for LEOs, ²²⁷ without access to a flexible, national FDD spectrum licence, Optus and SpaceX could not even contemplate a solution of this nature. The key factors in enabling this solution under the spectrum licence are:
- (a) Technology flexibility: Whilst the ACMA optimises spectrum licences in order to deliver key objectives, these have been deliberately made technology agnostic. This flexibility enables innovation into new areas such as DTM and also supports new generations of mobile services and applications.
 - (b) Protections from interference: The interference protections give certainty to not only the licence holders but also to adjacent users of the spectrum. Regardless of the use case, known limits of interference must be adhered to and the ACMA have sound processes upon which spectrum holders rely in case of dispute.
 - (c) National extent: National licences are important for these types of solutions. Without a national licence, the Optus/SpaceX DTM offering would be severely constrained by the extent of the spectrum licence area available and the coordination criteria at the edge of that licence. Any boundaries of this nature will erode the utility of a DTM solution.
 - (d) Long term certainty of licences: In order to support the significant amount of investment in delivering this solution, long term licences are required. Arrangements of this nature are reliant on this certainty.
- 7.64 As the ACMA contemplates the options available when considering granting renewal for ESLs, it should take careful note of the implications and possible curtailing of future innovation that, uniquely, national spectrum licences and licensees that can operate at very large scale can deliver.

²²⁷ With FDD, the transmit and receive signal can happen simultaneously whereas with TDD they are separated in time on the same frequency band. The round trip delay on the satellite for TDD would be too long therefore inefficient.

Licence Types

- 7.65 Apparatus licences and AWLs are inherently unsuitable for this solution due to the specific nature of the registrations under those licence types and the lack of flexibility conferred to the licensee. Similarly, class licences do not provide licensees with the necessary protections or certainty of operation to be suitable for this type of solution.
- 7.66 This places spectrum licences as the only viable licence type available to the ACMA to enable and encourage such ground-breaking and innovative solutions to overcome the tyranny of distance and isolation that prevails in the provision of telecommunications services to remote and regional Australia.

Large Geographies

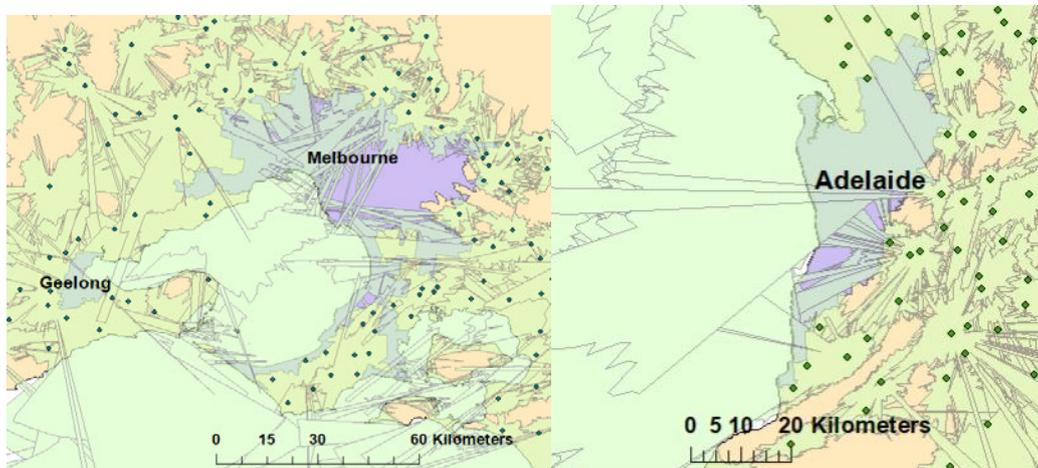
- 7.67 The key advantage of the Optus/SpaceX DTM solution is that it aims to seamlessly combine the existing terrestrial Optus network with the SpaceX satellite solution in areas with no current Optus coverage. There are no issues with managing interference as it is run as one network and so the full geographical area of the spectrum licence can be used.
- 7.68 Carving up spectrum licences (whether national or large area) to facilitate prospective licensees and their use cases is a poor outcome for Australians. This course of action would generate “dead zones” or areas of interference where no services can be delivered and hence fail Australians living in these areas. It would also stifle innovations such as the Optus/SpaceX DTM which require very large scale to be viable, especially in the context of delivering national service. It is crucial that the existing national licences remain intact to provide options for future DTM developments particularly since this technology is still in its infancy.
- 7.69 The only way national service of this nature can be provided is by using a national spectrum licence.²²⁸ Spectrum licences covering very large areas will allow for a large area of service for satellite DTM, but the areas will likely only be on the fringes of the locations where terrestrial coverage is already available, with the last 0.5% - 1% of the population, along with unpopulated areas left without satellite services.
- 7.70 By the very nature of spectrum licence boundaries, the utility of a large area spectrum licence would be diminished at its edges. The licensee would need to comply with the core conditions of the licenses for the spectrum in use, including the DBC. This would require a service area necessarily smaller than the full extent of the licence area to ensure that the s145 DBC is met at the edge of the licence. This has the effect of diminishing the utility of the licence in terms of are served.
- 7.71 The only reasonable conclusion to be drawn is that a national FDD spectrum licence is the only licence suitable to enable a national service. Recourse to smaller licence areas will deliver nothing but a patchwork of small networks with large areas of interference-limited “dead zones” between licensees. This would be a poor outcome from the perspectives of public interest and efficiency of spectrum use.
- 7.72 Optus therefore contends that all spectrum licence boundaries and other core conditions should be left unchanged by the ACMA, and ESLs offered for renewal to existing licensees, at a reasonable and sustainable price, upon receipt of applications for renewal.

²²⁸ This is also the FCC’s position as outlined in its March 2024 Notice of Proposed Rule-making and order

CASE STUDY: ACMA's Analysis in the 3400 – 3575MHz band Demonstrating License Boundaries Restricting Spectrum Utility

- 7.73 The ACMA conducted their own analysis of artificially placed spectrum boundaries as part of *IFC-12-2019-Options-Optimising arrangements for the 3400–3575MHz band*.
- 7.74 As part of the Optus, NBN 3.4 GHz defragmentation project, NBN's PTS licences were converted into spectrum licences. This resulted in new spectrum boundaries being defined in metro areas. The ACMA commenced an analysis on the potential coordination requirements needed to utilise the spectrum areas unused by NBN.
- 7.75 Typically, spectrum licences are coordinated via the existing framework which uses S145 DBC assessments. The ACMA's undertook a detailed analysis on this basis. They concluded, as part of the formation of the Urban Excision areas, that existing s145 DBC is insufficient to provide the necessary protections to users and requires a varied approach to harmful interference mitigation.
- 7.76 As a result of this study, the ACMA has not included this spectrum in the October 3.4/3.7GHz spectrum auction due to the difficulties in defining an acceptable alternative to the current s145 DBC that allows for efficient and effective use of spectrum.
- 7.77 Figure 36 below sets out excerpts from that paper and show the extent to which the DBC restricts the use of spectrum inside the Urban Excise areas, rendering the spectrum unusable for WBB or other traditional, high value uses.
- 7.78 It is evident that inefficiencies will inevitably be introduced by implementing co-channel licence boundaries. They should therefore be avoided at all costs when considering ESLs.

Figure 36 S145 DBC predictions for Urban Excise Areas in the 3.4GHz band



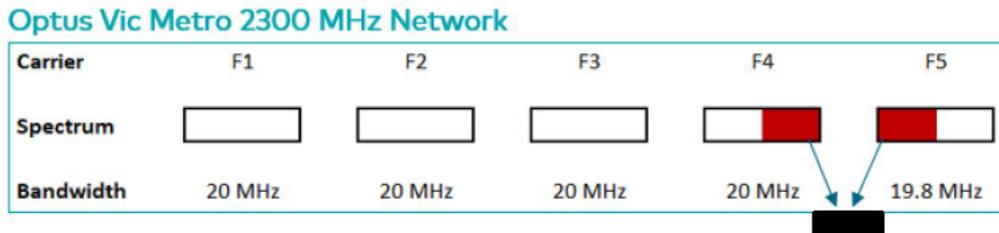
Source: ACMA: *IFC-12-2019-Options-Optimising arrangements for the 3400–3575MHz band*

- 7.79 The ACMA analysis also notes that “the ACMA generally avoids defining area-wide licence boundaries that cross through or are too close to large population centres”.
- 7.80 Such an outcome (the introduction of new spectrum boundaries for existing licences), for ESL, would not be acceptable to Optus as it would represent a significant erosion of spectrum licence rights and protections and result in reduced spectrum efficiency for spectrum users on both sides of any mooted boundary.

CASE STUDY: The Negative Effects of Retrospectively Introduced Spectrum Licence Boundaries

- 7.81 The retrospective introduction of spectrum licence boundaries will lead to a reduction in spectrum efficiency and utility, negatively impacting customer experience and network performance for licensees on both sides of the introduced boundary.
- 7.82 This case study deals with a spectrum lease to a third party operating a co-channel network using part of Optus' 2.3GHz in the northern and eastern parts of Melbourne. The location of the channel in the band is shown in Figure 37.

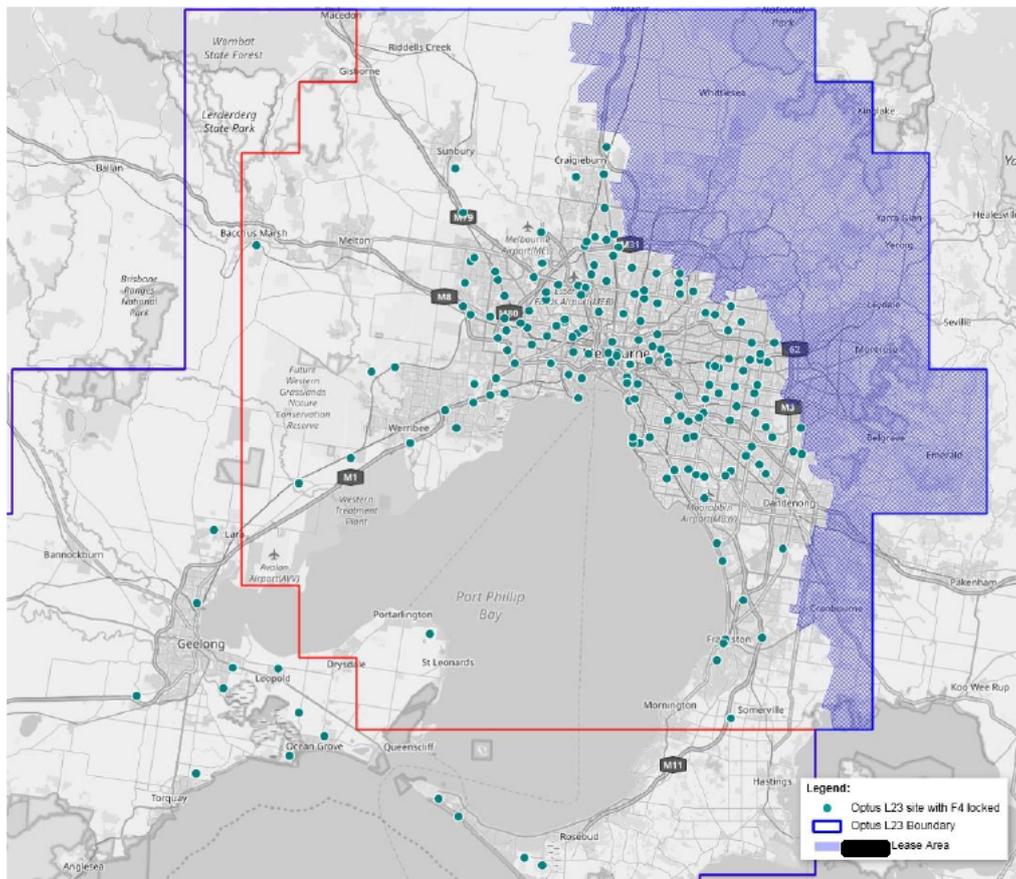
Figure 37 Previous 2.3GHz band arrangement in Melbourne



Source: Optus

- 7.83 The spectrum lease was inherited by Optus upon acquisition of Vivid Wireless in 2013 and was terminated in September 2023. Figure 38 shows the physical extent of the lease area within Optus' 2.3GHz spectrum licence area in Melbourne along with the locations of the Optus base stations that were negatively impacted by the presence of the third party spectrum lessee's sites within the lease area, operating on the channel shown in Figure 37.

Figure 38 Optus L23 sites with some spectrum unusable due to interference with the spectrum lessee



Source: Optus analysis

- 7.84 This example illustrates the effect of retrospectively introduced spectrum boundaries on a licensee’s ability to utilise spectrum within its licence area. This is contemplated in the ACMA’s consideration of carving up national or sub-national spectrum licences to facilitate access to spectrum for prospective licensees in areas immediately adjacent to the areas that would remain for incumbent licensees if such a scenario were to materialise as part of the ESL process.
- 7.85 The blue area described in Figure 38 denotes the spectrum lease area, with the sites identified within the Optus area of operation having compromised access to part of the band due to the requirement to manage interference *into* the lessee’s lease area. The boundary between the leased area and that to the west of it is analogous to and has the same effect as a retrospectively applied spectrum licence boundary.
- 7.86 The combination of the 20MHz portion of the band leased, the physical extent and location of the lease area and the lessee’s network design denied Optus access to the upper ~40MHz of the 98MHz in its 2.3GHz band holdings on a significant number of sites distributed across a wide area of Melbourne. With some sites up to 50km from the spectrum lease boundary being impacted.
- 7.87 In the operation of this spectrum lease agreement and management of boundary issues, Optus and the lessee both experienced interference into each other’s networks due to the technology, network design and equipment constraints with the lessee’s WIMAX network.
- 7.88 Due to the need to prevent harmful interference from Optus sites into the lessee’s network, Optus suffered spectrum denial on >480 sites in the Melbourne metropolitan

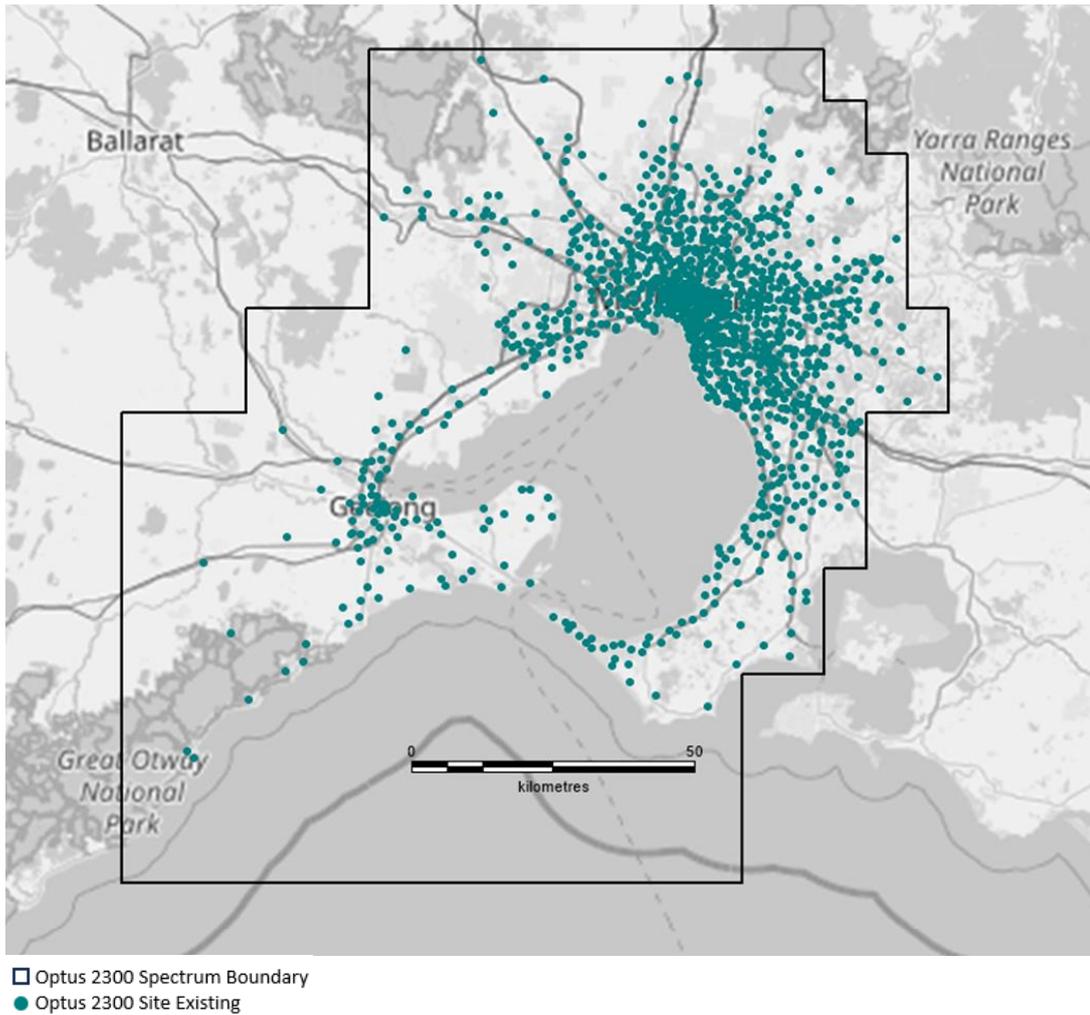
area, where at least 20MHz of spectrum was being denied to 4G, including outside the spectrum lease area, as denoted by the teal dots in Figure 38.

- 7.89 Additionally, Optus experienced interference from the lessee's network into its 5G network operating in the 2.3GHz band, adversely affecting customer experience and speed on sites up to ~50km away from the spectrum lease boundary.
- 7.90 The termination of the lease agreement in September 2023 resulted in Optus being able to make optimal use of the 98MHz of spectrum in the 2.3GHz band to provide service in Melbourne and into the area where the spectrum was originally leased, resulting in a better Optus customer experience and speed outcome on our 4G and 5G networks in this region.
- 7.91 Within the lease area and the 5km zone immediately adjacent to it, vacation of the band resulted in an improvement in customer experience on 27% of Optus' NR23 network in Victoria introducing a performance improvement of 25-35% in NR23 downlink speed. Within the greater Melbourne area the lessee's vacation of the band resulted in Optus being able to deliver NR23 downlink performance improvements on ~394 5G nodes, representing 65% of the Victorian NR23 network, of up to 15%.
- 7.92 It should be noted that the spectrum denial suffered as a result of the imposition of this interference boundary impacted only part of Optus' spectrum in Melbourne in this instance. If the ACMA contemplates taking this approach across an entire ESL band, the effect on spectrum availability could be catastrophic.
- 7.93 Optus believes that this example conclusively demonstrates that introducing new spectrum licence boundaries into existing spectrum licences delivers no efficiency or spectrum utility gains. Rather, it clearly results in the denial of spectrum to one or both parties on either side of the boundary and clearly reduces the spectrum efficiency and fails the public interest test due to worse customer experience outcomes.

Managing interference at existing spectrum licence boundaries can be achieved, but it requires compromise and careful planning

- 7.94 A clear distinction is needed between circumstances where a boundary is imposed *after* a network has been deployed and those where a network is designed and built around a known spectrum licence boundary.
- 7.95 Under the latter circumstances, the licensees on either side of the boundary are able to coordinate to manage interference and design their respective networks to accommodate the constraints that the licence boundaries impose. This is not the case where a new boundary is imposed on an existing licence. Examples of how co-channel licensees can mitigate the effect of a (well located) spectrum licence boundary if the boundaries are known before the networks are designed are shown in Figure 39 which illustrates the location of Optus LTE/NR 2300 Sites in the Melbourne area.

Figure 39 Optus LTE/NR23 sites locations (Source: RFNSA May 2024)



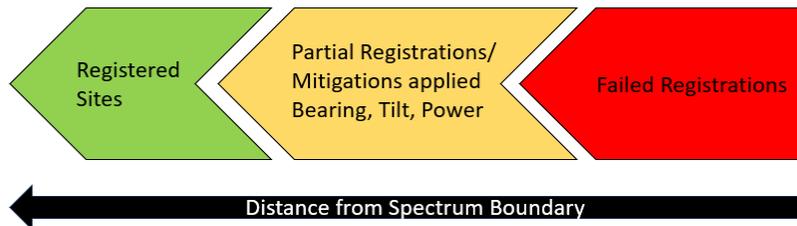
Source: Optus analysis

- 7.96 When spectrum boundaries are created prior to site deployment as is the case with the Optus 2300MHz boundary, then site configurations can be optimised in order to deliver more capability whilst still meeting the coordination requirements of the licence. In order to meet the coordination requirements of the licence, sites which are deployed close to spectrum boundaries are difficult to design and necessitate a compromise on coverage. The utilisation of the spectrum in these areas is reduced by these variations. Sites which are very close to boundaries typically fail the interference assessment. Sites further out from the boundary can have mitigations applied to meet the coordination requirements. These include:
- (a) Partial registration: only those sectors pointing away from the boundary are registered and activated.
 - (b) Azimuth modifications: sectors may be rotated to avoid pointing directly at the boundary.
 - (c) Tilt or power restrictions. Tilts are typically very effective in managing interference requirements for passive antennas. Power restrictions is typically used for active antennas however it has a very limited application.

- (d) Guard space registrations: these have been used extensively by Optus APs to register sites. This mainly includes the consideration of clutter data in the assessment to register.

7.97 Figure 40 illustrates the typical site configurations near spectrum boundaries. As the distance increases from spectrum boundaries, fewer mitigations are required to register sites. The application of these techniques has meant that Optus has successfully implemented sites very close to the boundary. Optus typically has 3 sectors per site.

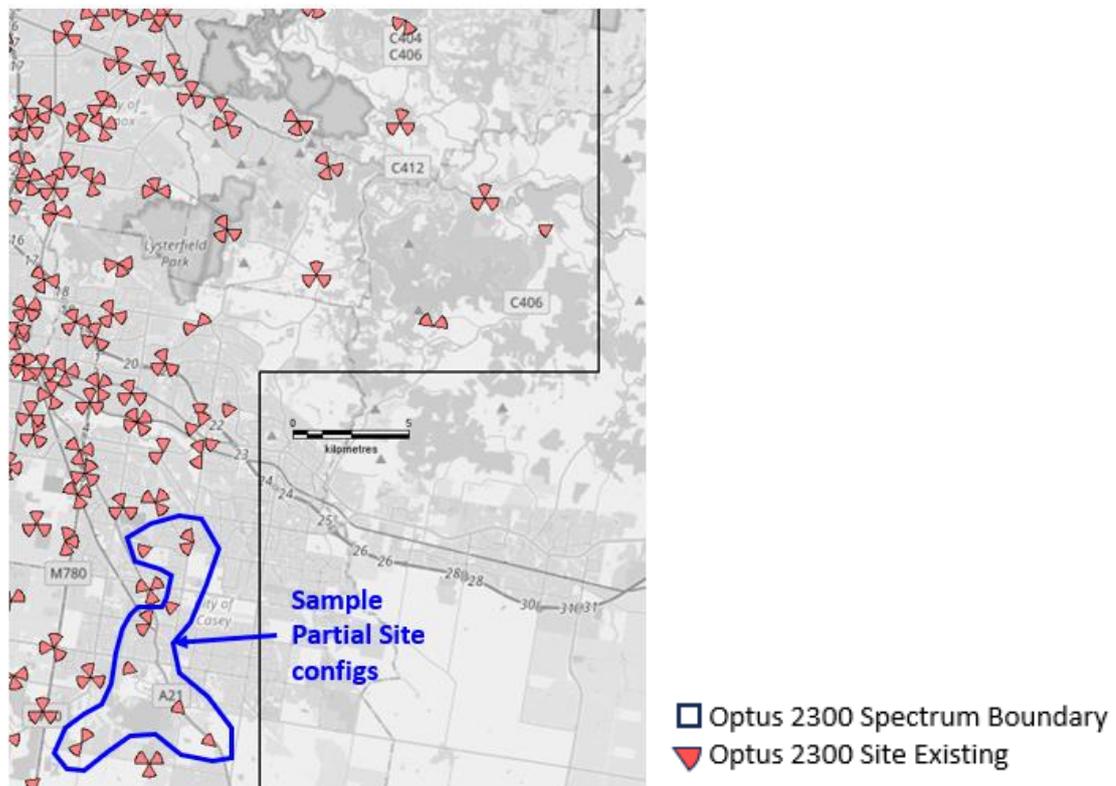
Figure 40 Typical Site configurations near Spectrum boundaries



Source: Optus analysis

- 7.98 Figure 41 illustrates the sector configuration of Optus LTE/NR 2300 Sites on the eastern edge of the spectrum boundary. The sites close to the boundary are configured with 1 or 2 sectors and the other sectors would have failed registration. There are also tilt/power mitigations used extensively in this area as well.

Figure 41 Optus LTE/NR23 sector configurations (Source: RFNSA May 2024)



Source: Optus analysis

Section 8. A LONG TERM APPROACH TO PROMOTE THE PUBLIC INTEREST

- A long-term approach to spectrum pricing will best promote the long-term public interest to be derived from ESL spectrum.
- The long-term socio-economic benefits of lower spectrum pricing outweigh the short-term benefits to Government finances of high prices.
- Allocations of ESL spectrum are already efficient as the spectrum has been previously auctioned/renewed and the existence of a secondary market for spectrum promotes efficiency.
- The two attached expert reports from Coleago Consulting and Dr Chris Doyle provide expert evidence that renewal of Optus ESL at a nominal price will promote the long-term public interest to be derived from ESL spectrum.

- 8.1 Optus welcomes the ACMA’s publication of its ESL “Finalised framework and response to submissions” document in December 2023 in which it sets out its decision-making framework and response to Stage 1 submissions, including in relation to pricing matters.
- 8.2 We note that the ACMA is not seeking any further specific comment in relation to pricing at Stage 2 and has instead indicated that its Stage 3 preliminary view on “spectrum value, pricing [including \$/MHz/pop values] and potential payment terms, if licences in the band are renewed” will be informed by information gathered through this consultation “along with other inputs”.²²⁹
- 8.3 Optus has previously provided comments in response to the ACMA’s discussion of proposed approaches to valuing spectrum and payment arrangements set out in the ACMA’s Stage 1 consultation paper.²³⁰ Optus refers the ACMA to those comments to the extent that they remain relevant to the ACMA forming its preliminary view.
- 8.4 To assist the ACMA to develop a “robustly informed” preliminary view on pricing and spectrum value matters, Optus has engaged two expert consultants; Dr Chris Doyle of Cambridge Economic Policy Associated (CEPA) and Coleago Consulting; to prepare the two attached reports. In summary:
- (a) Dr Doyle finds that holding spectrum auctions for ESLs is not appropriate as the spectrum is already efficiently allocated as all spectrum bands have been allocated by spectrum auction and/or previous renewal and subsequently have been exposed to the spectrum secondary market,
 - (b) Coleago Consulting concludes that a nominal or suitably low price for spectrum will best promote the long-term public interest to be derived from the spectrum relative to other methodologies – and is most appropriate for ESL renewal given the existing allocation must be assumed efficient.

²²⁹ Consultation Paper p.9-10

²³⁰ Optus submission; August 2023

Renewal of ESLs at a nominal price will best promote the long term public interest

- 8.5 Optus acknowledges that the ACMA has indicated that it “would not normally consider that cost recovery-based pricing promotes efficient use of the spectrum”.²³¹ However, Optus submit that where the allocation is already efficient, then cost-recovery based pricing is appropriate. Optus reiterate that renewal pricing and allocation methods should be designed to enable the economic benefits of 5G and 6G to be bestowed on the Australian economy and society. Erring on the side of lower prices is consistent with the Act, given the long-term economic benefits that will flow from greater spectrum utilisation in the form of more infrastructure deployment occurring earlier.
- 8.6 In view of the long-term socio-economic benefits of lower spectrum prices, such as significantly increased network quality and usage, there is a strong case for the ACMA to renew ESL spectrum for a nominal fee that recovers the administrative costs of ESL spectrum management to the ACMA. Renewal confirmation and price certainty, across all ESL bands, will also be crucial for any individual ESL spectrum band valuation due to the inter-related spectrum band layering strategies that exists in all Australian mobile networks. Each spectrum band deployed in mobile networks has an impact on the value of other spectrum bands.
- 8.7 Other points that Optus wish to highlight for the ACMA to consider in its development of its preliminary view to ESL pricing, valuation and payment terms are:
- (a) There is no use case for ESL spectrum that provides greater public benefit than mobile services or WA WBB or fixed wireless access (i.e., there is no “higher value use”).
 - (b) High spectrum prices undermine sustainable competition and investment in 5G and 6G – any short-term benefit of higher renewal fees to public finances should not override broader long term economic benefits that will flow from lower spectrum renewal prices in the form of increased and earlier network investment.
 - (c) Revenues per MHz are falling, so spectrum prices per MHz need to fall in order to ensure a sustainable mobile industry.
 - (d) The more capital spent on spectrum, the less capital is available for network investment, undermining Government objectives for the sector.
 - (e) Market-based allocation mechanisms are only relevant for new spectrum allocations to allow spectrum to be allocated to those who value it the highest (i.e., the most efficient use).
 - (f) Where spectrum allocations have already been allocated by market-based mechanisms and are therefore already efficient, there is no role for market-based allocation mechanisms. For operators that require the retention of their existing spectrum and if there is no change in use, any spectrum fee above administrative cost (nominal cost) recovery is a stealth tax that decreases the public benefit of use.
 - (g) An administrative based price for spectrum, reflecting the cost of administration, should be the default approach to pricing where ESL renewal is deemed to meet the public interest, is of HVU and any alternative interest expressed is for lower value use cases.

²³¹ ACMA “Finalised framework” document, December 2023, p.37

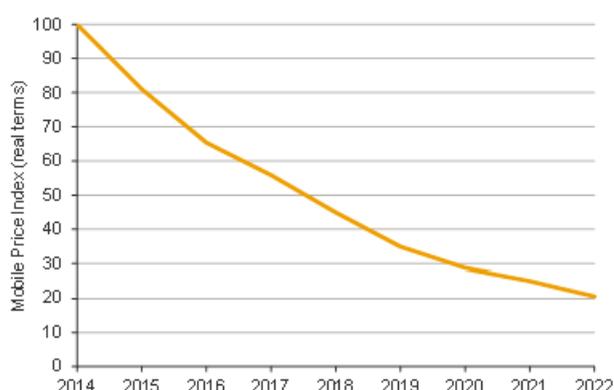
- (h) Nominal spectrum pricing enable lower mobile retail prices to continue to be offered for the benefit of end users.
- (i) Spectrum pricing and allocation methods should be designed to enable the economic benefits of 5G and 6G to flow to the Australian economy by ensuring fair, reasonable and suitably certain long-term access to spectrum.

8.8 The continual use of mobile services is estimated to result in \$37 billion in public benefits each year by 2030. These public benefits assume that mobile operators can continue to invest to deliver the network services needed to drive digitalisation. High spectrum fees undermine this assumption and threaten the realisation of these public benefits.

Lower prices support industry sustainability and help avoid a digital investment gap

8.9 The need for a long-term view is all the more important given the unsustainable financial state of the sector and the emergence of a “digital investment gap”.²³² Data from the ACCC Communications Market Reports shows that between 2014 and 2022 mobile services retail prices in Australia declined by 79% in real terms (see also Figure 42).²³³ During the same period operators’ Return on Invested Capital (ROIC) did not increase. In fact, Optus’ ROIC at 2% is well below its cost of capital. This demonstrates that the value of additional spectrum accrues to end users (consumers, small/medium businesses, wholesale and enterprise) and not to MNO investors.

Figure 42 Mobile retail price decline in Australia since last renewals process



Source: Coleago analysis

8.10 A lower cost per bit allows operators to pass on the benefit of additional spectrum to mobile users in the form of lower retail, wholesale and enterprise prices per bit and higher data speeds. Lower prices per bit reflect the dramatic increases in average usage have allowed more efficient spectrum utilisation. As a result, additional spectrum delivers socio-economic value, far more than private value to operators and far more than revenue to government. A range of academic papers support the view that the benefit from spectrum allocation is derived from its use and not the revenue raised at allocation.

²³² Venture Insights; State of the Telecommunications Industry; June 2023

²³³ See also [Spectrum Pricing April 2024 | GSA \(gsacom.com\)](https://www.gsacom.com) compiling auction data from 60 countries since 2014 and also page 38 of Coleago’s “ESL Pricing Paper”, dated 15 March 2024

- 8.11 Analysts have highlighted that industry revenues have really halved over the last 10 years.²³⁴ However, a situation where the returns are consistently below the cost of capital is not sustainable. Investment will decline and the Australia market will become less competitive. This is a very real danger for Australia. Mobile services have delivered enormous public benefit to Australia and its economy over the last 30+ years. This alone should mean that ESL spectrum should be renewed. Any erosion of the scope of the rights afforded to spectrum licensees to accommodate new use cases must be justified on the basis that such alternative use cases will deliver greater public benefit.
- 8.12 Where this is not established, the ACMA should renew the ESL spectrum at a nominal price. To charge more than this may amount to a tax on incumbent licensees. Such charging is implicitly discouraged under the Act.²³⁵ In the circumstances, and given existing allocations remain efficient, Optus urge the ACMA to reject the use of market-based allocation methods for renewals of ESLs that are already in use. The GSMA note that: "While auctions can work well for initial spectrum assignments, they are almost always inappropriate in the case of renewing mobile spectrum licences that are expiring".²³⁶

²³⁴ [Consumers furious over telco price hikes that are set to continue due to inflation and rising operating costs - ABC News](#)

²³⁵ section 297 of the Act

²³⁶ GSMA, Auction Best Practice, p.5

Appendix A. OPTUS SPECTRUM ASSETS

Figure 43 High level breakdown of Optus current and planned spectrum use for all licensed spectrum

Band	Licence number(s)	Licensed Bands (Frequencies)	Current use	Current availability	Planned use	Planned availability	Number of radio sites (April 2024)
700MHz (FDD)	9469858	2 x 10MHz (703-713MHz/ 758-768MHz)	4G coverage	National	4G coverage	National	7,848
900MHz	1136358 (apparatus)	2 x 8.4MHz (898.4-906.8MHz/943.4-951.8MHz)	3G/4G coverage	National			7,729
900MHz (Early Access)	Multiple PTS licences	2 x 8.4MHz (890-898.4MHz/935-943.4MHz)	5G Coverage	Selected			2,656
900MHz (FDD)	Spectrum licence (1/7/2024)	2 x 25MHz (890-915MHz/935-960MHz)	5G coverage	National	5G coverage	National	
1800MHz (FDD)	9263448	2 x 15MHz (1755-1770MHz/1850-1865MHz)	4G	Metro (5 main capital cities)	4G	Metro (5 main capital cities)	7,226
1800MHz (FDD)	10231258	2 x 20-25MHz (1750-1775MHz/ 1845-1870MHz) 25MHz most	4G	Regional (incl. Darwin,	4G	Regional (incl. Darwin, Tas and Canberra)	As above

Band	Licence number(s)	Licensed Bands (Frequencies)	Current use	Current availability	Planned use	Planned availability	Number of radio sites (April 2024)
		areas except 20MHz in Vic, Tas, Canberra, WA)		Tas and Canberra)			
1800MHz	10278519	Apparatus licence (15MHz max)	4G	Remote Australia (excl RQZ)	4G	Remote Australia (excl RQZ)	As above
2100MHz (FDD)	10143562	2 x 20MHz (1940-1960MHz/ 2130-2150MHz)	4G/5G	Metro (incl Hobart, Darwin, Canberra)	4G/5G	Metro (incl Hobart, Darwin, Canberra)	5,908
2100MHz (FDD)	10143562	2 x 5MHz (1960-1965MHz/2150-2155MHz)	4G/5G	Regional	4G/5G	Regional	As above
2100MHz (FDD)	10094267, 10094268, 10094269, 10094270, 10094271, 10094272	Apparatus licences (Max 10MHz)	4G/5G capacity	Regional and remote	4G/5G	Regional and remote	As above
2300MHz (TDD)	9460720, 9460721, 9460722; 10424532; 9448618, 9448620, 9448621	98MHz (2302-2400MHz) (except Canberra 2330-2400MHz)	4G/5G	Metro (incl Canberra with 70MHz)	4G/5G	Metro (incl Canberra with 70MHz)	4,125

Band	Licence number(s)	Licensed Bands (Frequencies)	Current use	Current availability	Planned use	Planned availability	Number of radio sites (April 2024)
2600MHz (FDD)	9469864, 9469870	2 x 20MHz (2550-2570MHz/ 2670-2690MHz)	4G	National	4G	National	5,439
3.4GHz (TDD)	11286124, 11286125, 11286123	65-100MHz (3475-3575MHz – Sydney and Melbourne) (3475-3547MHz – Adelaide) (3475-3542.5MHz – Brisbane, Perth, Canberra) (3510-3575MHz – ACT west/south and Lorne)	5G	Metro (incl Canberra and Lorne, Vic)	5G	Metro (incl Canberra and Lorne, Vic)	3,067
3.4GHz (TDD)	11286123	65MHz (3510-3575MHz – Regional 32.5MHz (3542.5-3575MHz – Rural WA)	5G	Regional and rural WA	5G	Regional and rural WA	As above
3.4GHz	12250870	Area Wide Licences (AWLs) (3520-3580MHz) (max 60MHz except Pilbara with 40MHz)	5G	Remote	5G	Remote	As above
3.6GHz (TDD)	10917462	30-35MHz (3665-3700MHz except regional and rural SA + NSW with 3670-3700MHz)	5G	Regional and Rural (except WA)	5G	Regional and Rural (except WA)	As above

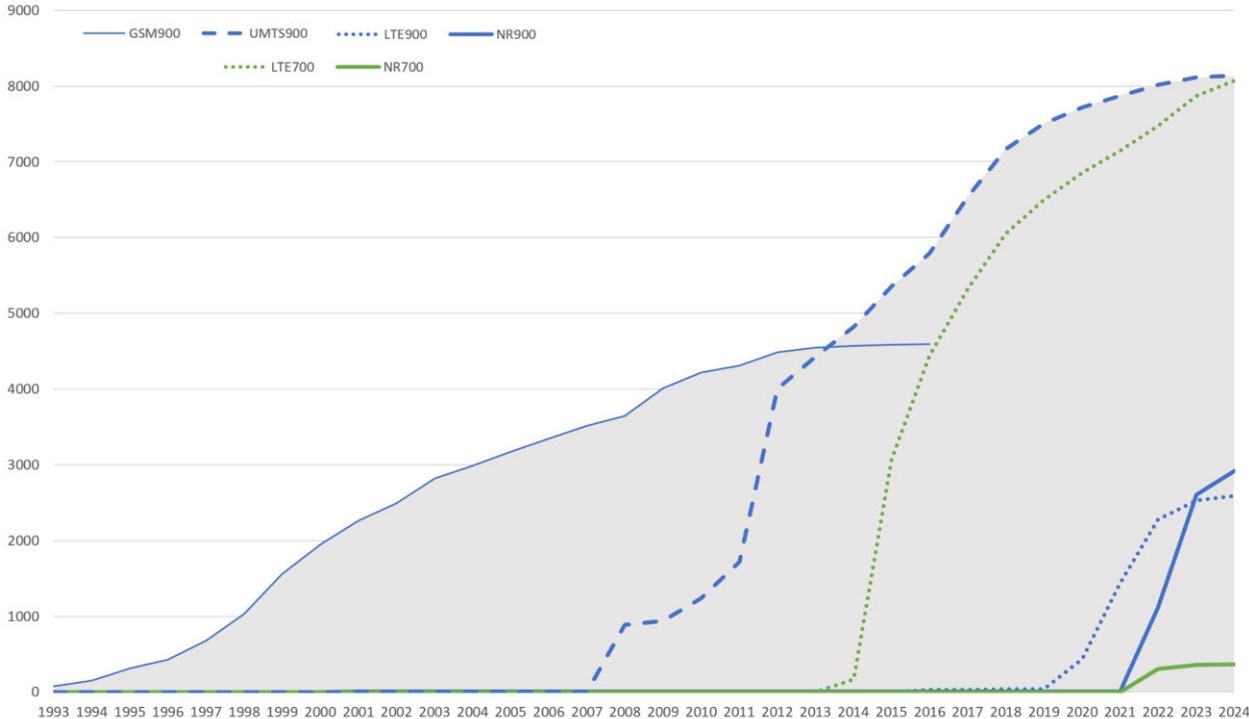
Band	Licence number(s)	Licensed Bands (Frequencies)	Current use	Current availability	Planned use	Planned availability	Number of radio sites (April 2024)
3.7GHz (TDD)	12289656	20MHz (3700-3720MHz)	5G	Toowoomba, Regional QLD, Rural north NSW/South Qld	5G	Toowoomba, Regional QLD, Rural north NSW/South Qld	As above
26GHz and 28GHz mmWave (TDD)	11275967	800MHz (26.7-27.5GHz) (except Perth 26.1-26.9GHz Hobart 25.1-25.7GHz Margaret River 25.1-25.7GHz Launceston 26.7-27GHz)	5G	Metro	5G/6G	Metro	123
26GHz and 28GHz mmWave (TDD)	11290216	Area Wide Licences (AWLs) 400MHz	5G	Regional	5G/6G	Regional	As above

Appendix B. OPTUS ESL NETWORK INVESTMENT

Figure 44 shows the number of technology units per low band deployed in the Optus network from 1993 until 2024.

Low band is important to deliver coverage and this is typically deployed on all sites. The maximum site counts can be used as an estimate on the number of sites in the network. Using 900MHz as an example, the network has evolved from 2G (GSM) to 3G (UMTS) to 4G (LTE) to the current rollout of 5G (NR). This can also be seen on the 700MHz band. The 700MHz LTE layer has reached the 900MHz UMTS site counts as Optus prepares for the 3G Shutdown later in 2024. The maximum site counts can be used as an estimate the total sites in the network which is marked as the grey area under the curve.

Figure 44 Optus Low band (700 MHz and 900MHz) technology site count

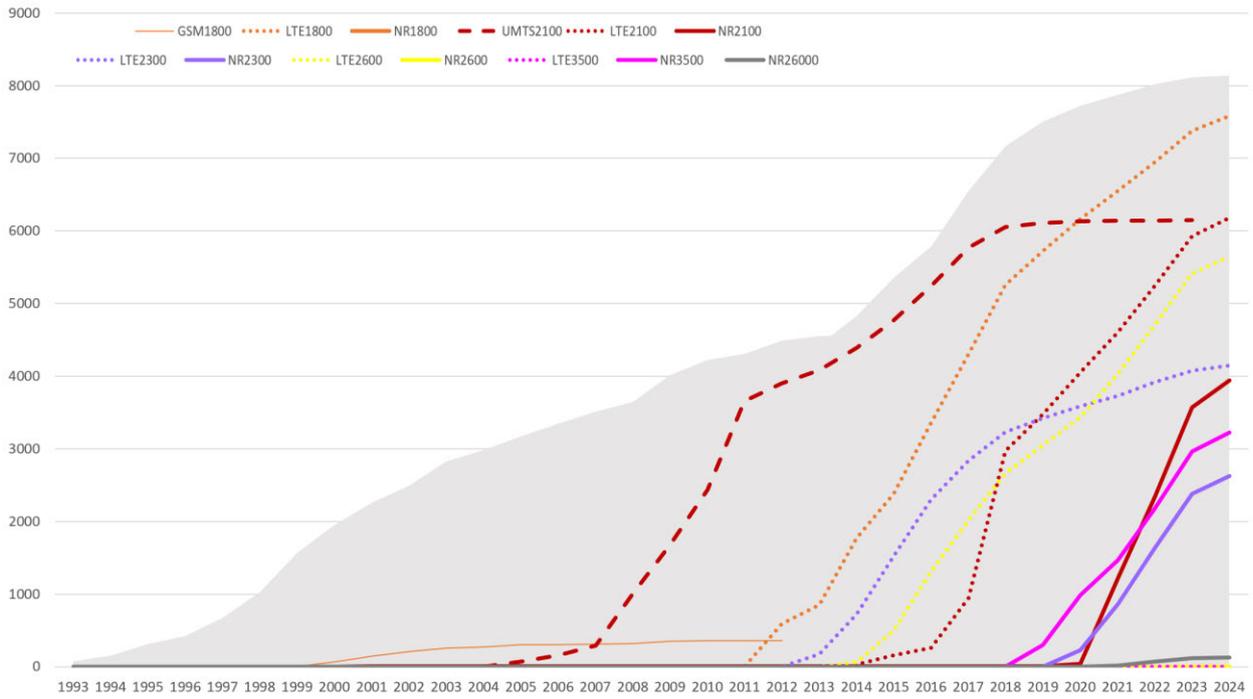


Source: Optus

Figure 45 shows the number of technology units per mid and high band deployed in the Optus network from 1993 until 2024. As with the low band the introduction of new technology can be seen across the years.

The site counts are typically less than low band because (i) Spectrum licences are not national (except for 2600) so there are fewer sites available and (ii) Mid and high band propagation characteristics will limit the available coverage so these bands may not be suitable for sites which are too far away from the mobile traffic. Regional highway sites are a good example of this.

Figure 45 Optus Mid Band and High Band technology site counts



Source: Optus

Appendix C. EXPERT REPORTS

To assist the ACMA to develop a “robustly informed” preliminary view on pricing and spectrum value matters, Optus has engaged two expert consultants; Dr Chris Doyle of Cambridge Economic Policy Associates (CEPA) and Coleago Consulting.

In summary:

- Dr Doyle finds that holding spectrum auctions for ESLs is not appropriate as the spectrum is already efficiently allocated as all spectrum bands have been allocated by spectrum auction and/or previous renewal and subsequently have been exposed to the spectrum secondary market,
- Coleago Consulting concludes that a nominal or suitably low price for spectrum will best promote the long-term public interest to be derived from the spectrum relative to other methodologies – and is most appropriate for ESL renewal given the existing allocation must be assumed efficient.

The two separate expert reports that form part of this submission include:

Attachment 1: CEPA report

Cambridge Economic Policy Associates (CEPA), Renewing expiring spectrum licences: By Dr. Chris Doyle for SingTel Optus Pty Limited, 24 May 2024

Attachment 2: Coleago Consulting report

Coleago Consulting, ESL Pricing Paper, 15 March 2024

Renewing expiring spectrum licences:

By Dr. Chris Doyle for SingTel Optus Pty Limited



24 May 2024

FINAL

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EXECUTIVE SUMMARY

This short paper addresses an important issue forming part of the ACMA's process regarding expiring spectrum licences (ESLs). A significant number of licences within the ESLs are held by mobile network operators, with the first set of licences in the 850 MHz and 1800 MHz frequency bands due to expire on 17 June 2028. The earliest date incumbent licensees can apply to renew spectrum licences is two years before the date of expiry.

The ACMA has three options in arriving at its decisions with regard to any renewal applications: (i) renew an ESL without varying the spectrum access conditions, (ii) partially renew whereby an ESL is renewed with substantive changes to the spectrum access conditions – that is, the frequency bands and geographic area included in the licence, and (iii) refuse to renew which could result in a reallocation of the spectrum frequencies

Under the Radiocommunications Act 1992 (the Act), the ACMA has the object of managing spectrum in the long-term public interest. In this paper I assess the three options set out above against this criterion, and also opine on whether the use of auctions in a renewal process is in the long-term public interest.

In my opinion, where existing spectrum licence holders have made long term investments and the spectrum assets are being used to provide services in the market, there is no basis to reallocate spectrum licences. In other words, the current allocation of licences is in the long term public interest. This is further enhanced where there is an effective secondary market in place – so that alternate users of the spectrum (whether national or sub-national) have the opportunity to acquire spectrum during the existing licence term.

I find that the frequencies used by the incumbent mobile network operators are not being sought by challengers. Indeed, the most recent challenger to the incumbents in the Australian telecoms market, Dense Air, sold its business to Telstra in 2023 and previously sold its 3.6GHz assets to TPG in 2021. And in the 2023 auction for frequencies in the 3.7 GHz band, the only bidders and winners were the incumbent mobile network operators. Further, the possibility to exchange spectrum rights facilitates efficiency enhancing trades among the ESL licensees. I also note that the existence of alternative licence types (like area wide licences (AWLs)) could be used by prospective licensees to enter markets.

Additionally, there is little to suggest that technological change will have a marked effect on how low and mid-band frequencies are used by incumbent mobile network operators. If anything, rising demand for mobile data will continue to put pressure on the incumbent mobile network operators to demand more spectrum and to densify further their networks.

As there is no obvious uncertainty about future usage of the frequencies in the ESLs, and given the highly unlikely emergence of new challenger networks, reallocation by auction would serve largely to amplify uncertainty and delay investments. Given the incumbent mobile network operators can trade spectrum rights, it is unlikely any reallocation would be superior to current holdings.

I observe that there have been some calls for auctions to be used to 'test' the market and ensure that the current allocation of spectrum is efficient. The argument is that auctions are a way of ensuring allocative efficiency; those who value spectrum most receive spectrum. However, secondary trading of spectrum allows efficiency gains to be achieved after initial allocation by auction. Therefore the primary argument in favour of an auction of the ESLs rests on whether there are challengers who could deliver higher long-term public interest. There is no clear evidence to suggest the latter.

Dr. Chris Doyle, May 2024

1. INTRODUCTION

Radio spectrum is an essential resource and its use contributes significantly to well-being and value added in Australia.¹ Its use for mobile broadband and related services is critically important in helping to drive forward economic growth and social cohesion.²

Competition for radio spectrum in many frequency bands and the possibility of harmful interference between uses and users requires spectrum management in every country. In Australia this is performed by an independent Commonwealth statutory authority the ACMA (Australian Communications and Media Authority).³

In managing radio spectrum, the ACMA oversees use and users across frequency bands through a policy of licensing. The procedures the ACMA follows for allocating radio spectrum licences are set in the [Radiocommunications Act 1992](#) (the Act). Section 60 of the Act gives the ACMA considerable discretion; licences can be allocated by auction, tender, for a pre-determined price or a negotiated price, by direct allocation or by a combination of these. Notwithstanding, the allocation procedures followed by the ACMA must be framed with the object of promoting “the long-term public interest”, as set out in section 3 of the Act.

Most in-force spectrum licences in Australia used for mobile broadband and related services are due to expire between June 2028 and October 2032. The ACMA is currently undertaking a review and consultation on addressing these expiring spectrum licences (ESLs).

In 2020 the Act was amended by the [The Radiocommunications Legislation Amendment \(Reform and Modernisation\) Act 2020](#) (the Modernisation Act), introducing new provisions for dealing with ESLs. In the ACMA’s Five-year spectrum outlook 2023–28 (FYSO 2023–28)⁴, it identified progressing activities relating to ESLs expiring between 2028 and 2032 as a key priority. These ESLs cover a range of bands, and are used to deliver wireless broadband, rail safety communications and certain electronic news gathering for broadcasting services.

Any uncertainty surrounding renewal applications of the ESLs is likely to impact adversely on public well-being and nationally economic value-added – in other words, the long-term public interest. In this short paper I emphasise how uncertainty regarding the renewal of ESLs is costly and if a policy decision were made to reallocate and auction the frequencies, this would damage investment incentives and adversely affect the long-term public interest.

To help mitigate uncertainty, the ACMA started its review of the ESLs five years before the first licences were due to expire. Notwithstanding, decisions with regard to licence renewal applications can only be made up to two years prior to the date of expiry of an ESL, so at the earliest from June 2026 onwards for the 850/1800MHz spectrum bands. Incumbent licensees therefore face a possibility that applications for renewal may be refused and current frequencies be reallocated by auction. This presents additional uncertainty and is likely to have a profound “chilling” effect on business decisions, especially on longer-term investment decisions. The ACMA is in a position to address this uncertainty, for example, by presenting a clear policy statement in regard of the use of auctions for licence renewals.

¹ In Commonwealth of Australia (2015) “[Spectrum Review](#)” it was noted radio spectrum’s “role as an economic driver, and the value it returns to society, is increasing.”

² For a good discussion on the impact of mobile services in Australia see Deloitte Access Economics (2022) “[5G Unleashed: Realising the potential of the next generation of mobile technology](#)” for the Australian Mobile Telecommunications Association. On the importance of radio spectrum in a modern economy more generally, see Frontier Economics (2022) “[Ensuring optimal value from spectrum](#)”, a report for DSIT (Department of Science, Innovation and Technology), UK government, June.

³ See <https://www.acma.gov.au/>

⁴ See https://www.acma.gov.au/sites/default/files/2023-10/five-year_spectrum_outlook_2023-28.docx

The additional uncertainty regarding the ESLs and renewal is taking place against a backdrop in which mobile network operators are facing challenging conditions. Although increasing use of data by consumers on mobile networks⁵ may imply a healthy commercial environment for mobile network operators, in recent years networks have experienced declines in average revenues per user⁶ and in many cases reductions in the return on capital employed (ROCE)⁷ significantly below the weighted average cost of capital (WACC). In the submission made by Optus to the ACMA in the first stage of consultation on the ESLs, it was shown that the return on invested capital (ROIC) has declined for all three main mobile networks in Australia since 2017.⁸ Some commentators have also expressed caution about the period over which networks will recover the costs of investing in new 5G networks.⁹

In my opinion, any probability of licence renewal application refusal only serves to undermine incentives for longer-term investments

I discuss why it would be in the long-term public interest to renew the ESLs and not to reallocate the frequencies by auction, and to make this a policy goal as soon as possible. In managing risk, it would be in the long-term public interest to make clear that the ESLs used for public mobile services will be renewed.

This short paper has the following sections. In section 2, I set out the spectrum strategy framework and spectrum management in Australia. I discuss in brief the duty for ACMA to pursue policies consistent with the long-term public interest. In doing this, I discuss how the ACMA applies a public interest test in which the focus is the attainment of economic efficiency. I set out what economic efficiency means and how the ACMA chooses its policies to reflect this.

In section 3, I discuss spectrum auctions, spectrum trading and the public interest. In this section I argue that auctions do have a role to play, but in the allocation of *newly released* frequencies rather than frequencies already in efficient use. I also make clear that the complementary policies of spectrum trading and spectrum leasing, both of which are part of the Australian spectrum management landscape, are necessary to ensure that initial efficient allocations achieved by auction remain efficient over time.

Section 4, looks at the option of setting renewal prices by auction and argues that this is not a good public policy for the ACMA. The purpose of auctions is to achieve efficient spectrum allocations and not revenue maximisation for government. In section 5, I present a short discussion on how the possibility of auctioning frequencies in the ESLs could lead incumbent mobile network operators to play a costly wait-and-see strategy. This risk can be mitigated by the ACMA announcing that it will renew the existing ESLs.

I conclude the paper by reaffirming my position that auctioning the frequencies in the ESLs is not in the long-term public interest and the ACMA should announce sooner, rather than later, a policy to renew all the ESLs.

⁵ Ericsson (2023) "[Ericsson Mobility Report](#)" November forecasts that globally, average monthly mobile data usage per smartphone is set to rise from 21 GB in 2023 to 56 GB in 2029 (see Figure 9: Global mobile network data traffic, page 12). Sarwat Zeeshan, a Telecom Analyst at GlobalData, has commented in regard of data usage and forecasts in Australia: "The average monthly mobile data usage in Australia is expected to increase from 14.4 GB in 2023 to 28.7 GB in 2028", see [Advanced Television \(2024\)](#) 26 March 2024.

⁶ Telecoms.com "[Telecoms revenue per user is falling despite 5G and fibre rollouts](#)" 13 October, 2022 Recently Ericsson (2024) "[Ericsson Mobility Report: Business Review](#)" has noted that globally ARPU has grown at a CAGR of 1.7 percent per year, or over 5 percent in total, since 2020. However, this increase in ARPUs reflects in part surging inflation over the period.

⁷ Ericsson (2024) "[Ericsson Mobility Report: Business Review](#)" notes "the financial landscape is hardening, with surging inflation and increasing costs of operating and maintaining networks. The economic situation is putting pressure on margins,..." p.5. For example, in the United Kingdom the regulator Ofcom has calculated that ROCE has been static or has fallen for the mobile operators since 2019, see Figure 6.2, p.60 in Ofcom (2022) "[Ofcom's future approach to mobile markets](#)" Discussion paper, 9 February.

⁸ See Figure 1 in Optus (2023) "Approach to expiring spectrum licences", submission to ACMA consultation paper, Public Version, August.

⁹ For example, a number of commentators express concerns in "[Operators' 5G investments show no clear signs of paying off](#)" Light Reading, 13 December 2022.

2. STATUTORY FRAMEWORK AND SPECTRUM MANAGEMENT

The ACMA is responsible for managing use of and access to radio spectrum in Australia. Under the Act and the Modernisation Act the ACMA has a duty:¹⁰

“to promote the long-term public interest derived from the use of the spectrum by providing for the management of spectrum in a manner that:

- a) facilitates the efficient planning allocation and use of the spectrum
- b) facilitates the use of the spectrum for:
 - a. commercial purposes; and
 - b. defence purposes, national security purposes and other non-commercial purposes (including public safety and community purposes); and
- c) supports the communications policy objectives of the Australian Government.”

In short, the object of the Act is the promotion of *the long-term public interest*. However, the Act does not define the long-term public interest. In practice it is understood economic efficiency is equivalent in general to the long-term public interest. Economic efficiency is when resource allocation is such that well-being is maximised, implying there does not exist another allocation that makes one or more persons better off without harming the well-being of at least one other person.¹¹

2.1. PUBLIC INTEREST TEST

In respect of the ESLs the ACMA proposed in ACMA (2023a) five criteria in regard of the public interest and the ESLs:¹²

1. Facilitates efficiency
2. Promotes investment and innovation
3. Enhances competition
4. Balances public benefits and impacts
5. Supports relevant policy objectives

The ACMA set out in detail its reasoning for the above criteria in stage 1 of the ESL process.

Facilitates efficiency

The ACMA applies a standard approach to describing efficiency, relying on economic concepts. In alignment with earlier guidance provided by the Productivity Commission (see footnote 11), the ACMA uses three relevant concepts for economic efficiency:¹³

- **“Productive efficiency** – occurs when inputs such as spectrum, equipment, capital and labour are deployed in a manner that generates the most output for the least cost. Technical efficiency is related to productive efficiency as it seeks to achieve the least spectrum used to provide the most output.

¹⁰ Section 3 of the Act.

¹¹ In economics this interpretation of efficiency is referred to as Pareto efficiency and is: “attained when individuals in society maximise their utility, given the resources available in the economy”, see Productivity Commission (2013) ‘[On efficiency and effectiveness: some definitions](#)’ Productivity Commission Staff Research Note May 2013.

¹² Pages 18-21, ACMA (2023a), *op cit*.

¹³ Pages 18-21 ACMA (2023a), *op cit*.

- **Allocative efficiency** – occurs when inputs (such as spectrum) are allocated in a manner that generates the most value or benefit for society. This is generally achieved at the initial time of allocation, but may change over time as consumer demands and technologies change.
- **Dynamic efficiency** – a spectrum management regime promotes dynamic efficiency if it enables technologies and allocations to change so that allocation and productive efficiency are maintained over time as technology and preferences change.”

When awarding licences and managing the use of spectrum, the ACMA will take account of both static and dynamic efficiency. Static efficiency is satisfied when spectrum is allocated to the highest value uses (allocative efficiency) and users (the licensees) provide services at lowest possible costs (productive efficiency) – with competition among users ensuring that prices paid by consumers for services tend towards cost (allocative efficiency).

Dynamic efficiency is satisfied when spectrum users undertake desirable investments in spectrum related technologies and processes ensuring that consumers have good quality services at the lowest possible prices. It is enabled by competition in the market for services and more generally in the capital markets providing the source of funding for investments.

The ACMA affirmed the public interest criteria and provided stakeholders with greater detail on each criterion. On the allocation of licences the ACMA stated:

“For allocating licences, we typically use a range of instruments, including guidelines, where we have expressly decided to make spectrum available by issuing apparatus or spectrum licences. These allocation exercises – especially for spectrum licences – are often price-based, where the ACMA has formed the view that the most efficient allocation of the spectrum resource is likely to be achieved by the market. In such circumstances, the Act provides for making and establishing a variety of tools (procedures, marketing plans, applicant information packs and auction guides) to assist prospective licensees to participate in a competitive allocation process.”¹⁴

It was made clear that should ACMA receive a request to renew a licence for 10 years or more it must “be satisfied that it is in the public interest to do so.” In assessing the public interest, the ACMA retains discretion to consider a wide range of matters, including the long-term public interest, the potential impact on competition and downstream markets, and the planned future use of the spectrum.

In deciding whether to renew a spectrum licence, ACMA must have regard to the matters it considers relevant to the renewal, and the effect that the renewal will have on radiocommunications. Subsection 77C(8) outlines in further detail what ACMA may have regard to, including any outstanding liability to pay an apparatus licence tax, spectrum licence charge, spectrum access charge or interim tax, compliance with conditions of the licence, and previous licence history for both the applicant and any third-party users. However, these serve only as an example, with ACMA also having the discretion to consider matters such as the potential impact on competition and downstream markets, whether renewal of the licence would be in the long-term public interest, the planned future use of the spectrum, or any additional matters it considers relevant.

¹⁴ Pages 15-16, ACMA (2023b), *op cit*.

3. AUCTIONS, SPECTRUM TRADING AND THE PUBLIC INTEREST

As stated above, the ACMA makes use of various interventions to determine how best to allocate radio spectrum resources. Modern spectrum management involves interventions ranging from command and control through to market mechanisms, as enshrined in section 60 of the Act.¹⁵ The ACMA usually auctions licences for newly allocated frequencies suited for public mobile services.¹⁶ Many of the ESLs used for public mobile services were initially allocated by auction.¹⁷

Auctions for newly released frequency bands are used by the ACMA because, while it is known there is competition for the spectrum, the agency does not know what amounts of newly released frequencies should be allocated to competing prospective users by geographical area to ensure an allocation is in the long-term public interest. Further, demand and the willingness to pay for newly released radio spectrum are not readily apparent and auctions are an effective way for both productive and allocative efficiency to be achieved.^{18,19}

In a well-designed spectrum auction, where bidders benefit from price discovery, each winning bidder pays a price no higher than their willingness to pay. Significantly, unsuccessful bidders reveal they are not willing to pay the closing prices in the auction process. More often than not, auctions adopt or incorporate in their design a second price rule where the winner pays the maximum willingness to pay of the second placed bidder – this calculates the opportunity cost of spectrum and ensures an efficient outcome. This means spectrum is allocated, at the end of an auction, to those who are willing to pay the most. This outcome is efficient and in the public interest.²⁰

The use of spectrum auctions by the ACMA can be interpreted as the application of mechanisms (i.e., a set of rules) designed to yield an efficient allocation of spectrum licences and achieve the long-term public interest. Spectrum auctions are regarded by economists and policymakers as the most effective way in the presence of competing users to achieve efficiency when awarding licences for *newly released* frequencies.

However, circumstances may change after an auction has concluded and an allocation that was efficient at the time of an auction may no longer be efficient. To maintain efficiency and the long-term public interest, modern spectrum management makes use of complementary policy tools to ensure that spectrum licences won in auctions are, over time, held by those who deliver the highest value. The primary tool is spectrum trading: allowing licensees to exchange in part or full licences with others. For example, if users' valuations change over time and/or technology changes, trading allows for welfare improving reallocations and is in the long-term public interest.

¹⁵ Spectrum management is discussed at length by Cave, Martin, Doyle, Chris and William Webb (2007) *Essentials of Modern Spectrum Management* Cambridge University Press.

¹⁶ See CEPA (2023) [Spectrum Auctions: Thirty years in the making](https://www.acma.gov.au/spectrum-auctions), CEPA Briefing Paper and <https://www.acma.gov.au/spectrum-auctions>

¹⁷ Several of the ESLs have been previously renewed subsequent to their allocation by auction.

¹⁸ Radio spectrum is a resource that commands value, but unlike other commodities it does not feature a high-volume secondary market. This means that market spot and forward prices for different frequencies are not directly observable.

¹⁹ On auctions and efficiency see Zhan, R.L. (2008). *Optimality and Efficiency in Auctions Design: A Survey*. In: Chinchuluun, A., Pardalos, P.M., Migdalas, A., Pitsoulis, L. (eds) *Pareto Optimality, Game Theory And Equilibria*. Springer Optimization and Its Applications, vol 17. Springer, New York, NY. https://doi.org/10.1007/978-0-387-77247-9_16

²⁰ In economics this outcome is formalised in what is known as the First Fundamental Theorem of Welfare Economics, which asserts that in a competitive economy, not subject to distortions, market determined prices will lead to decisions that result in a Pareto optimal outcome (in the sense that no further exchange would make one person better off without making another worse).

Spectrum trading is an example of a policy consistent with the Coase Theorem in economics. This states that under ideal economic conditions (specifically full information), where there is a conflict of property rights (e.g. use of spectrum by one party imposes a cost on the use of spectrum by another party) the involved parties can bargain or negotiate terms that will accurately reflect the full costs and underlying values of the property rights at issue, resulting in the most efficient outcome.

For efficiency to be maintained over time, the Coase Theorem suggests that it must be possible for parties to bargain or negotiate trades in spectrum licences. For example, a licence holder successful in an auction might choose to sell some or all of its spectrum licences to another party at some future date. Such spectrum trading is possible in law and has occurred in Australia.²¹

Indeed, it is relatively straightforward to broker a spectrum trade or arrange a spectrum lease in Australia, as the ACMA has a well-organised set of procedures in place.²² There have been a range of trades which have included all the large national spectrum licensees – Optus, Telstra, TPG Telecom and NBN – as well as Dense Air. While many of these trades were for the purposes of defragmentation (e.g., recent trade between NBN Co and Optus of 2.3GHz and 3.4GHz spectrum), it is still evidence that market mechanisms can and are used to promote efficiencies. It is also to be remembered that while the market may be characterised as relatively "thin" in term of volume, these are trades of high value assets, access to which informs significant downstream investment decisions by the licensees. The trading activity is itself evidence of a secondary market that moves spectrum towards its highest value use. The low volumes of trades suggest that the allocation is largely efficient.²³

Given the ease by which spectrum can be traded in Australia, the limited number of spectrum trades involving frequencies used for public mobile services indicates that the allocation of spectrum licences at the time of auctioning has achieved efficiency and these allocations remain efficient. Further, as demand for frequencies to support public mobile services has grown in Australia year on year and data use on all networks has continued to rise,²⁴ it would seem unlikely that trades involving these frequencies would yield overall net gains. There are some exceptions where reauctioning may be justified, however, for example where the original allocation is no longer fit for purpose and has resulted in complex arrangements that inhibit gains from trade because of 'transaction

²¹ In November 2023 it was reported that Telstra had acquired radio spectrum licences held by Dense Air (see <https://insidetowers.com/telstra-acquires-dense-air-australian-operations/>), including nationwide licences in the 2.6 GHz band that Dense Air acquired from TPG in exchange for city licences in the 3.6 GHz band in August 2021 (see <https://denseair.net/dense-air-acquires-new-spectrum-to-build-neutral-host-shared-wireless-networks-in-australia/>).

²² See <https://www.acma.gov.au/trade-your-spectrum-licence> and <https://www.acma.gov.au/buy-or-lease-spectrum-someone-else>

²³ See further ACCC discussion at p.20 of ACCC determination in TLS/TPG MOCN - which characterising the market as thin, but does not list defragmentation trades and notes that "TPG by contrast has disposed of spectrum licences in the secondary market, selling its holdings in the 2.5 GHz band to Dense Air Networks Australia, and concurrently buying Dense Air Limited's licences in the 3.4 GHz band. TPG (as Vodafone) has also historically had a spectrum access agreement in place with the sub-national MNO Pivotel, allowing Pivotel access to licensed 'LTE' spectrum. TPG and Telstra also have a separate spectrum access agreement in the 3.4 GHz band, with Telstra operating equipment at greater bandwidths than are licensed to them in selected capital cities."

²⁴ Reported data use on mobile phone services in Australia has risen every year since 2018, see Figure 23 in ACCC (2023) "[Communications market report 2022–2023](#)", December 2023.

costs'.^{25,26} Where there is inefficient spectrum fragmentation, priority should be given to reducing the costs that prevent efficient trading of this spectrum before using an auction to re-allocate.

The policy environment needed to ensure spectrum allocations are efficient – which lies at the core the long-term public interest – requires:

- i. Competitive auctions to oversee initial allocations of *newly released* frequencies; and
- ii. Spectrum trading and spectrum leasing/sharing arrangements to enable parties to negotiate gains from reallocations.

Australia has this policy environment in place which I believe means there is no benefit to re-auction the ESLs. However, the re-auctioning of the ESLs would make sense if technological change has rendered the current licensees as inappropriate holders of the frequencies. I do not see any evidence to suggest that this type of technological change has or is taking place or will in the future.

²⁵ A transaction cost is the cost associated with making an economic trade when participating in a market, and is entirely separate from production costs. Where frequency allocations have resulted in complex arrangements with potentially many primary and secondary users holding one or both of spectrum licences and apparatus licences, bargaining and negotiating trade involving potentially many parties can be time consuming and resource intensive (these would be the transaction costs). See Williamson, Oliver (1979) “Transaction-cost economics: The governance of contractual relations” *Journal of Law and Economics*, 22, 233-261.

²⁶ The ACMA has previously undertaken consultations on some frequency bands where apparatus and spectrum licences coexist and where past allocations have led, as a result of technological progress, to subsequent fragmented holdings and the presence of a multitude of licences and licensees which present substantial transaction costs militating against obtaining more efficient allocations. For example, the ACMA consulted in 2019 on optimising arrangements for the 3400–3575 MHz band, see [Options Paper](#), April 2019. In the Options Paper (p.11) the ACMA noted that such complexities may inhibit efficiency enhancing efficiency gains: “Under current arrangements in the band, any trades to support a defrag would require at least one licensee to trade all or part of a spectrum licence for an apparatus licence (and vice versa). Most licensees value the flexibility and tenure of a spectrum licence over that of an apparatus licence and will not make such a trade, particularly if the move is to site-based apparatus licensing arrangements. This issue appears to be what is inhibiting the use of third-party authorisations to affect an equivalent outcome. It is likely that the use of third-party authorisations would only be considered by licensees as a stop-gap solution if a defrag of actual licence holdings to the same or equivalent licence type is guaranteed to occur in the future.” For the frequencies concerned, the ACMA concluded that an auction was the best course of action in the 3.4 GHz band and this occurred in 2023, see [auction results](#). The licence term was set at approximately 7 years, to align with the 13 December 2030 expiry date of existing spectrum licences in the 3.4 GHz band. Thus these licences fall within the ESLs.

4. LICENCE RENEWALS PRICING THROUGH AUCTIONS

Spectrum licences allocated in Australia and those allocated in many other countries tend to be awarded on a fixed-term basis although some are in perpetuity.²⁷ Towards the end of a fixed-term, a process starts which determines the policy of renewal – this policy may or may not be known ahead of the renewal period. In some countries, it may be stated that there is a ‘strong presumption of renewal’ (e.g. Canada and United States).

However, when considering the renewal of licences, there is always an option to re-allocate frequencies by auction. The case for doing this rests on evidence that the current allocation of frequencies is inefficient, as discussed above. In Australia this would amount to strong evidence showing an inefficient allocation among current users, or the existence of prospective users or uses that would deliver higher benefits than current users. In my view neither of these conditions are apparent.

If the current allocation were inefficient, spectrum trading and leasing, as well as spectrum sharing, ought to enable licensees to exploit gains from exchange and trade. If new uses were evident, there would have been clear instances of new entities outbidding incumbent MNOs in spectrum auctions in Australia and elsewhere.²⁸ As concluded above, in my opinion there is no evidence to support claims that auctions are required to ensure ongoing efficient use of spectrum assets.

However, it might be argued by some that reallocating spectrum by auction usefully identifies the market price that should be paid by incumbent licensees. The only justification for such an argument in the presence of the spectrum management policy environment would be to raise revenue.

But if the purpose of an auction is to discover prices with a view to raising revenue for government, this goes directly against the long-term public interest. This is because the initial allocation and the availability of mechanisms to support secondary market activity, and the fact that there have been few trades and limited effect of technological change (i.e., it can continue to be used to upgrade to next generation mobile technology) on the future use of ESL spectrum means the allocation of spectrum within the ESLs is efficient.

Further, given the spectrum in the ESLs is efficiently allocated, it would be a challenge to design an auction process for the ESLs that would easily reveal prices or valuations. This is because bidders would very likely bid on lots identical or very similar to what they previously held and this would result in little competition at the margin. This has occurred in a number of recent auctions, including Ofcom’s 2021 auction for frequencies in the 3.6-3.8 GHz band.²⁹

The views above have also been echoed in GSMA (2014), in which the authors set out international best practice in relation to the renewal of mobile spectrum licences.³⁰ While they recognised that auctions can be useful where there is uncertainty over the best use of the spectrum, they argue that auctions may bring unnecessary costs where

²⁷ Most countries allocate fixed-term spectrum licences, with varying terms up to typically no more than 25 years. The United Kingdom is an exception, it grants indefinite licences having an initial term (often as long as twenty years) and beyond the initial term the spectrum manager Ofcom applies spectrum charges in the form of annual licence fees. See Ofcom (2024) [Review of Ofcom’s market-based approach to mobile spectrum management: Response to Government](#) 11 January. However, Ofcom proposes to depart from indefinite spectrum licences in mobile in future spectrum awards.

²⁸ In all mature economies where spectrum auctions have occurred in recent years, spectrum has been acquired by incumbent licensees. For example, see <https://www.spglobal.com/marketintelligence/en/news-insights/research/upcoming-global-spectrum-auctions-to-diversify-mid-band-options-for-5g>

²⁹ In the simultaneous multi-round ascending price auction, Ofcom offered 24 5 MHz lots in the 3.6-3.8 band and set a reserve price for each lot of £20 million. Four incumbent mobile operators qualified as bidders. Three bidders succeeded after limited competition, each winning 8 lots. Two bidders paid £21 million per lot and one bidder paid £22.05 million per lot. See Ofcom auction 2021 [results](#).

³⁰ GSMA (2014) “[Best practice in spectrum licence renewals: A toolkit for licensing authorities](#)”, December.

it is clear that the existing licence holders with established networks and customer bases value the licences more than others and if the best use of the spectrum is certain (which it is) then there is no need.

More recently the GSMA (2021) reiterated this position on the auctioning of renewal licences, stating that³¹ “While auctions can work well for initial spectrum assignments, they are almost always inappropriate in the case of renewing mobile spectrum licences that are expiring. The key focus for renewals should be to provide the predictability licence holders need to invest heavily in their networks throughout the term of the licence. If expired licences may be re-auctioned – and thus operators may lose access – then it becomes rational to limit investment in the network in the years preceding expiry. This can in turn negatively impact mobile coverage and broadband speeds and if the operator ultimately loses the spectrum can lead to sudden drops in network quality. Auctions are suitable for expired licences if the licensee does not want to renew the spectrum or if they have breached the terms of the licence. In cases where spectrum assignments are deemed to be unbalanced or inefficient then the market should be allowed to correct itself by facilitating spectrum trading. Laws which prevent expiring licences from being automatically renewed should be revised to better protect network investment and quality of service.”

Rather than auction and reallocate the frequencies in the ESLs, a better approach would be for the ACMA to determine the appropriate price when renewing the ESLs.

³¹ GSMA (2021) “[Auction Best Practice: GSMA Public Policy Position](#)”, September.

5. AUCTIONS AND THE COST OF WAIT-AND-SEE

The ACMA is currently leaving open the possibility of reallocating the frequencies in the ESLs by auction, either as consequence of a decision to partially renew or refuse to renew an ESL. This inevitably presents uncertainty for the mobile network operators, as there is a probability spectrum assets held by a mobile network operator would be lost at auction. This risk could lead to operators playing a *wait-and-see* strategy before committing substantial spectrum related irreversible investments, resulting in lost consumer surplus and hence against the public interest.

This response on the part of incumbent operators is echoed in the academic literature, which predicts that as uncertainty grows firms' business conditions become increasingly unclear, causing them to anticipate higher future cash flow dispersions (Bernanke, 1983; Dixit & Pindyck, 1994).³²

Biljanovska *et al.* (2017)³³ present a thesis that this form of uncertainty makes corporate decisions less likely to be implemented today, as firms fear that uncertainty increases the probability of costly mistakes.³⁴ Understandably in the face of elevated uncertainty, firms prefer to adopt a wait-and-see approach and withhold (perhaps even indefinitely) critical business decisions that can be postponed until much of the uncertainty is resolved.³⁵

Dreyer and Schulz (2022) argue “highly irreversible capital expenditure, hiring, and share repurchase decisions tend to experience sharp declines in periods of uncertainty”.³⁶ In a recent detailed econometric assessment of around 25,000 manufacturing plants in the US, Bloom *et al* (2022) conclude “investment is strongly and robustly negatively associated with higher uncertainty, with a two standard deviation increase in uncertainty associated with about a 6% reduction in investment”.³⁷

If the ACMA were to adopt a policy of auctioning the frequencies in the ESLs, this would present risks for the incumbent operators that would be managed by playing a wait-and-see strategy. The consequence of this would be to undermine the long-term public interest.

By contrast, if the ACMA were to renew the frequencies in the ESLs on terms to be settled, the risk of losing frequencies would largely be eliminated and there would be little need for the incumbent operators to play a wait-and-see strategy.

³² Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical investment. *Quarterly Journal of Economics*, 98(1), 85–106. <https://doi.org/10.2307/1885568> and Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty*. Princeton University Press.

³³ Biljanovska, N., Grigoli, F., & Hengge, M. (2017). Fear thy neighbor: Spillovers from economic policy uncertainty. International Monetary Fund.

³⁴ Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica*, 77(3), 623–685 presents an empirical validation.

³⁵ Many papers have emphasized this aspect of real option theory, for example see Grenadier, S. R., & Malenko, A. (2010). A Bayesian approach to real options: The case of distinguishing between temporary and permanent shocks. *Journal of Finance*, 65(5), 1949–1986. <https://doi.org/10.1111/j.1540-6261.2010.01599.x> and Schwartz, E. S., & Trigeorgis, L. (2004). *Real options and investment under uncertainty: Classical readings and recent contributions*. MIT press.

³⁶ Dreyer C, Schulz O. Investor horizons and corporate policies under uncertainty. *Rev Financ Econ*. 2022; 40: 5–19. <https://doi.org/10.1002/rfe.1129>

³⁷ Nicholas Bloom, Steven J. Davis, Lucia S. Foster, Scott W. Ohlmacher and Itay Saporta-Eksten (2022) “[Investment and Subjective Uncertainty](#)” NBER Working Paper Series number 30654.

6. CONCLUSION AND RECOMMENDATION

The debate surrounding ESLs has been framed around identifying public interest criteria. These were set out by ACMA in December 2023 following public consultation in May last year. The Minister has also endorsed the criteria and emphasised that “the ACMA explore future arrangements to reduce the barriers to entry for new users of spectrum for either new use cases or existing uses, as a dynamic and competitive telecommunications market is most likely to promote the public interest.”³⁸

In both instances, auctioning the ESLs is not given and there is an open question about public interest objectives regarding competition and entry versus continuity of service. In March 2024, the ACMA have invited prospective licensees “to supply their own market intelligence and analysis...(and) frame their submissions with reference to the public interest criteria and relevant guidance”. The final Ministerial Policy Statement Instrument published on 30 April 2024, to which the ACMA is to have regard in its decision-making on ESLs, recognises “the importance of the expiring spectrum licences to continuity of existing service coverage, the ACMA should consider where there may be scope to strengthen service offerings by enabling access for new entrants, smaller providers or innovative applications.”³⁹

In my opinion, unless compelling evidence were presented to suggest otherwise, I do not see any long-term public interest gain by refusing to renew the ESLs and choosing to reallocate frequencies by auction. Australia’s spectrum management policy environment is entirely consistent with an efficient allocation of the frequencies in the ESLs, making a reauction of the frequencies in the ESLs pointless.

Further, the cost of auctioning the ESLs could be substantial because of the risk associated with additional uncertainty. This risk can be mitigated by the ACMA if it clarified its policy regarding renewal applications and committed to a process of renewals.

I also see no merit in using auctions to discover renewal prices. Instead, the ACMA would do better to determine appropriate renewal fees based on the principle of at least covering its cost of administering the licences.

³⁸ Section 7, [Ministerial Statement Radiocommunications \(Ministerial Policy Statement – Expiring Spectrum Licences\) Instrument 2024](#), March 2024.

³⁹ Section 7, Ministerial Statement (2024) *op cit*.

Table 1: Summary of ESLs

Band	Licensees	Current primary use	Renewal application period begins	Expiry
850 MHz	TPG, Telstra (original band) Optus (downshift)	WBB	18 June 2026	17 June 2028
1800 MHz	TPG, Telstra, Optus RailCorp (NSW); VicTrack; Queensland Rail; Department of Planning, Transport and Infrastructure (SA); Public Transport Authority of Western Australia	WBB Rail safety and communications	18 June 2026	17 June 2028
2.5 GHz	Telstra, Optus	WBB	1 October 2027	30 September 2029
2.5 GHz mid-band gap	ABC, Channel 7, Nine Network, Network 10	ENG (for example, television outside broadcast)	1 October 2027	30 September 2029
700 MHz	TPG, Telstra, Optus	WBB	1 January 2028	31 December 2029
2.3 GHz	NBN, Telstra, Optus	WBB	25 July 2028	24 July 2030
3.4 GHz	NBN, Telstra, Optus, TPG	WBB	14 December 2028	13 December 2030
2 GHz	TPG, Telstra, Optus	WBB	12 October 2030	11 October 2032

UK

Queens House
55-56 Lincoln's Inn Fields
London WC2A 3LJ

T. **+44 (0)20 7269 0210**

E. **info@cepa.co.uk**

www.cepa.co.uk

 **cepa-ltd**  **@cepald**

Australia

Level 20, Tower 2 Darling Park
201 Sussex Street
Sydney NSW 2000

T. **+61 2 9006 1308**

E. **info@cepa.net.au**

www.cepa.net.au

ESL Pricing Paper

15 March 2024

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Authors

 **Ade Ajibulu, MBA**
Managing Consultant,
Coleago Consulting Ltd



 **Alison Hancock, BA, ACA**
Partner,
Coleago Consulting Ltd



 **Ken Pearson, MBA**
Managing Consultant,
Coleago Consulting Ltd



 **Stefan Zehle, MBA**
CEO,
Coleago Consulting Ltd



1 Executive summary

Background to this report

The ACMA started the Expiring Spectrum Licence (“ESL”) process for licences in seven mobile spectrum bands with the publication of a Consultation Paper on its “Approach to expiring spectrum licences” (ESL Consultation) in May 2023¹. The seven bands will expire between June 2028 and October 2032 and comprise 700 MHz, 850 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2600 MHz and 3400-3600 MHz.

This paper sets out preliminary views on renewal pricing for ESLs. While the ACMA did not publish a separate consultation on renewal pricing, pricing issues were raised in outline in its initial ESL Consultation and December 2023 ESL Finalised Framework², and have been taken into account in this paper.

Renewal pricing is important because there are different pricing methodologies that can be considered for spectrum renewal. Each offers different investment incentives, which may support different policy outcomes, and will have different downstream implications for end-users.

The paper sets out a compelling argument for using “nominal pricing” for ESL renewal in the context of the ACMA decision making framework for ESL – i.e. the long-term public interest – and the role of mobile as an essential service in Australia. It also sets out why renewal prices should be set conservatively given that high renewal prices undermine the socio-economic benefits of efficient spectrum allocation.

The long-term public interest guides the ACMA’s approach to renewing ESLs and setting renewal fees

To renew a spectrum licence for more than 10 years, the critical assessment that the ACMA has to make under the Act is whether renewal is in the long-term public interest, according to Section 77C(5) of the Radiocommunications Act 1992. The ACMA proposed five criteria to guide its considerations: efficiency; investment and innovation; competition; balancing public benefits and impacts; and supporting relevant policy objectives.

These public interest criteria will also guide the ACMA’s approach to pricing, including assessment of which approach is most appropriate for setting renewal fees.

The degree to which the existing allocation of ESLs may be efficient is critical and affects the assessment of the options for renewal pricing

There is a fundamental difference between awards of new spectrum and reallocating ESLs, which affects the assessment of the options for ESL pricing against the long-term public interest, in particular the criterion of efficient spectrum use.

Global mobile markets including the Australian mobile market, are now mature, having gone through several rounds of consolidation and achieved high levels of coverage and performance (as recognised by the GSMA regarding 5G³). As a result, since ESLs have already been assigned by auction, and provided ESL spectrum is still in productive use, the allocation of the spectrum should be considered efficient by default, barring exceptional circumstances.

¹ <https://www.acma.gov.au/consultations/2023-05/proposed-approach-expiring-spectrum-licences>

² <https://www.acma.gov.au/sites/default/files/2023-12/Expiring%20spectrum%20licences%20-%20Finalised%20framework%20and%20response%20to%20submissions.docx>

³ https://www.gsma.com/get-involved/gsma-membership/gsma_resources/5g-speeds-in-australia-are-almost-twice-the-global-average/

Further, there is little evidence to suggest that the underlying competitive dynamics in the industry have fundamentally changed since the previous allocations, or that a sustainable new market entry is possible. Nor is there any evidence that other uses of the spectrum may be more efficient than mobile given the outcome of the Australian mobile spectrum auctions since the last ESL process in 2012.

Hence, ESL renewal fees do not need to be set to encourage efficiency, because strong incentives to maintain and improve efficient spectrum use already exist through competition, the need to meet growing data demand, and rapid advances in technology. Moreover, a further auction to promote efficiency would be unnecessary. In effect, any price above a nominal level could be regarded as an inefficient tax that will need to be recouped through lower spending/investment or higher prices.

This implies that renewal pricing may depend significantly on the importance the Government places on raising revenue versus delivering higher quality mobile services. Therefore, renewal fees could be set anywhere on a continuum between:

- Nominal pricing: A minimum charge needed to provide an ongoing incentive for operators to continue to use spectrum efficiently; and
- Enterprise value: An amount that would fully extract the incremental economic value of the spectrum to a representative operator.

The structure of the rest of the paper is as follows. First, four main approaches for renewal pricing are assessed against the public interest, in light of the view that the current allocation of ESL is efficient by default:

- Nominal pricing (Public interest pricing);
- Cost avoidance (plus and minus);
- Enterprise value; and
- Price benchmarking.

Second, another implication of the view that ESL spectrum is already efficiently allocated is that it is unlikely to be in the public interest to re-auction ESLs.

[A nominal \(public interest\) pricing approach to renewal fees would take into account the overall return to the community from both fees and the socio-economic impact of mobile.](#)

In the ESL Consultation (May-August 2023), the ACMA raised the principle of renewal prices taking into account public interest considerations and noted some examples of such pricing in the re-issue of spectrum licences for rail safety purposes. The ACMA also stated in the ESL Finalised Framework that it would not normally consider that cost recovery pricing promotes efficient spectrum use.

However, the scope of nominal (public interest) pricing is much broader than indirect benefits such as rail safety and is conceptually different from cost recovery pricing. In fact, public interest pricing reflects that spectrum is a public resource and should secure the best overall rate of return to the community from its use, i.e. support the Government in meeting community service obligations more broadly.

For ESLs, the rate of return depends not only the benefit to public finances arising from the level of “tax” raised directly through renewal charges, but also the broader public benefit to the community through the economic and social value generated from high quality, affordable services.

Hence, this pricing approach should take into account the benefits to the community relating to all the public interest criteria: investment; innovation (e.g. digital transformation through 5G and 6G); and competition will be particularly important. These criteria are part of the ACMA’s policy and decision-making framework as set out in the ESL Consultation: such as Criterion 4, “balances public benefits and impacts”.

[Low spectrum charges enable greater mobile network investment](#)

High spectrum prices make the business case for mobile network investment less viable, since operators face a trade-off between acquiring/retaining spectrum licences (which is a significant expense), capital expenditure on network infrastructure and/or retail pricing for end customers.

The potential conflict between high spectrum fees and the overall return to the community from mobile is even more pronounced given the substantial investment requirements that may be needed to deliver advanced 5G to support innovation and the digital economy of the future. This could coincide with a period in which operators face other significant challenges to earn their costs of capital.

Moreover, the risks to the public benefit are asymmetric, being greater for higher spectrum fees than lower, e.g. evidence from auctions when the fees were too high risk the spectrum being unsold and not used. Hence, the public benefits of ESL could be increased by setting nominal renewal fees.

[EU markets demonstrate that low spectrum charges contribute to high socioeconomic benefits](#)

An inverse relationship between annualised spectrum fees and average mobile data consumption (taken as a proxy for socio-economic benefit) was identified across 12 EU countries. Strikingly, Finland – which has pursued an approach to spectrum assignment that has led to proportionately much lower spectrum fees than elsewhere – leads most countries in terms of both low spectrum costs and high socio-economic benefits. For example, monthly usage was 16x higher in Finland than Germany, and mobile data much cheaper, whereas annualised spectrum fees as a proportion of mobile revenue were much lower in Finland (1.4%) than in Germany (9.5%).

[In Australia, lower renewal fees could also promote market competition, by reducing Telstra's historic competitive advantages](#)

Telstra maintains significant market share across the country and particularly in regional Australia. Telstra's legacy network advantages have delivered it economies of scale (network and customers) which has led to superior financial performance compared to Optus and TPG over the last 30+ years.

The ACMA has identified competition as a public interest criterion in its ESL decision making framework. Competitive intensity will also be affected by the level of renewal charges, especially given the challenges of maintaining effective competition in Australia, due its geography and the predominance of fixed costs. High renewal charges would significantly increase the share of fixed costs in relation to total costs in Australia since the amount of spectrum to be renewed between 2028 and 2032 is substantial. This would amplify the disparities in the economies of scale of the three MNOs and weaken competitive intensity, especially in rural and regional areas.

As well as promoting competition, lower renewal prices would free up more funds for investment in regional and remote areas (given the challenging investment environment for the sector), a policy objective specifically highlighted in the ESL Finalised Framework paper.

[Cost avoidance pricing is not necessary to promote efficient spectrum use for ESLs and would not be in the long-term public interest](#)

Cost avoidance approaches such as calculating Optimal Deprivation Value (ODV) seek to estimate the value of spectrum in terms of the additional costs operators would incur if they did not have access to a certain amount of spectrum. Typically, the rationale for using cost avoidance to set spectrum fees is to incentivise efficient spectrum use. As explained above, since the main function of pricing is to promote efficient use of the spectrum and the existing allocation of ESL spectrum is likely to remain efficient, the justification for renewal pricing other than nominal pricing approaches, is weak.

Moreover, cost avoidance has significant methodological drawbacks, for example:

- Cost avoidance does not produce one unique spectrum price and setting a uniform price may lead to material unintended consequences;
- Cost avoidance is a theoretical construct which does not reflect actual business practice in a number of important ways which undermine its legitimacy as a regulatory instrument;
- The assumption that operators can continue to densify their networks with no limit is likely to be invalid, due to geographical or planning and timing constraints.

[Enterprise value pricing generates major disincentives for investment, innovation and efficiency and is not in the public interest](#)

Enterprise valuation estimates the total discounted value of future cash flows that are made possible by holding spectrum over the licence duration. Setting prices this way would capture the full value from holding spectrum. If spectrum prices were set higher than this level, an operator would go out of business.

Enterprise value pricing for ESL is not in the public interest for several reasons. It penalises success because anything that increased the value of an operator, e.g. more intense use of spectrum or service innovation leading to higher revenues, would ultimately be clawed back through higher spectrum fees. As a result, incentives to innovate and invest would be low.

Another disincentive arises because enterprise value pricing does not take into account downside risks to operators. Operators would not achieve a return on their investment if the underlying forecasts for the enterprise valuation were not met. Hence, operators may scale back investment in spectrum and network if market conditions are uncertain.

[Auction price benchmarking is also not an appropriate method for setting renewal fees and is not in the long-term public interest.](#)

Benchmarks seek to estimate spectrum prices by comparing a sample of representative spectrum fee information, usually auction prices, from other countries and within a certain time period and adjusting where necessary for factors such as licence duration and frequency differences.

Using benchmarks from prices paid for spectrum at auction in other countries in the past to assess the value of spectrum in Australia is misguided because:

- Essentially benchmarking relies on calculating an average price paid in different countries, at different times, by different operators under different conditions. The vast majority of prices are for new spectrum awards and not renewals, so they do not take into account the specific circumstances of renewals.
- Prices paid at auction are in a large part driven by spectrum public policy which can vary considerably from country to country and over time. Coleago's analysis of auction prices shows that spectrum prices tended to remain round the same level over the last 15 years for any particular jurisdiction, while prices fluctuated much more between jurisdictions.
- Moreover, Coleago's analysis of spectrum auction prices found no discernible upward or downward trend in over the last 15 years. This runs counter to Telstra's response to the ESL Consultation which argues that benchmarking can accurately reflect its view of the spectrum market that per MHz spectrum prices are falling and due to the rapid expansion of the supply of spectrum in recent years.
- Prices paid at auction are rarely the equivalent of spectrum value to a representative operator, e.g. reserve prices may be set too high resulting in unsold spectrum (often where competition in an auction is limited – allocation limits or genuine lack of demand), the supply of spectrum may be artificially restricted by the spectrum manager.
- Furthermore, benchmarking is backward looking, hence not appropriate for the (2028-2032) timeframe of ESLs and lacks objectivity given the need to standardise the data and potential exclusion of outliers.

An additional implication of the view on efficiency is that it is unlikely to be in the public interest to re-auction ESLs.

Given mobile markets are now mature and the strong link between low spectrum fees and socio-economic benefits as set out above, the role of auctions is being questioned by some regulators for spectrum renewals or even new spectrum. In the context of ESLs, re-auctioning the spectrum is unlikely to be in the public interest given that:

- There is little evidence that re-auctioning ESLs is necessary to secure the efficient use of spectrum – provided that the spectrum continues to be in productive use.
- Similarly, the justification for setting aside spectrum to support new entrants or innovation is questionable given doubts around the sustainability or efficiency of new market entry.
- Re-auctioning ESLs could impose significant economic costs in terms of further entrenching the incumbent's (Telstra) dominance, distorting competition and the risk of unexpected and unintended auction outcomes. The uncertainty created from re-auctioning could also have a chilling effect on network investment.
- The spectrum is expected to either remain with the incumbents or not be fully allocated if the reserve/competitive price is too high and therefore this would result in a failure of the auction/s as part of the renewal process, with no further opportunity for efficiency gains.

In conclusion, offering ESLs for renewal to existing holders combined with nominal (public interest) pricing will maximise the public interest.

Auctioning ESL spectrum is not in the public interest. In determining the renewal price, it is recommended that the ACMA have regard to, among other matters, that mobile is an essential service and critical to society; the productivity benefits of mobile services to the economy; and that sustainable competition at a retail and infrastructure level will benefit consumers in the long term. Having regard to the ACMA's public interest criteria, it is recommended that all ESLs be offered for renewal to the existing spectrum holders and that ESL pricing is set at nominal administrative levels.

2 The regulatory context

2.1 Purpose of this report

The ACMA started the process for the renewal of licences in seven mobile spectrum bands with the publication of a Consultation Paper on its "Approach to expiring spectrum licences" (ESL Consultation) in May 2023⁴. The seven bands will expire between June 2028 and October 2032 and comprise 700 MHz, 850 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2600 MHz and 3400-3600 MHz.

The ACMA set out a 4-stage approach in the ESL Consultation in May 2023:

- Stage 1: design and consult on the proposed process (that is, this consultation)
- Stage 2: finalise the process and request relevant information from incumbent licensees to assist in developing an assessment framework
- Stage 3: consult on preliminary views on a range of ESL and spectrum matters, such as planning and licensing arrangements, licence conditions, pricing and issues affecting the relevant band
- Stage 4: finalise and undertake the renewal application and decision-making processes. This stage is specific to the consideration of individual licences.

In December 2023, the ACMA updated the approach in the document "Expiring spectrum licences, Finalised framework and response to submissions" (ESL Finalised

⁴ <https://www.acma.gov.au/consultations/2023-05/proposed-approach-expiring-spectrum-licences>

Framework)⁵ which brought forward some elements of Stage 2 – ACMA responses to submissions to the ESL Consultation, and confirmation of the overall ESL process and the framework based on the proposed public interest criteria. The document also set out a revised timetable:

- Stage 2: start Q1 2024
- Stage 3: consult on preliminary views Q4 2024
- Stage 4: respond to submissions 2025; renewal applications and decisions 2026-32

Hence, stages 1–3 and the first part of stage 4 (response to submissions) will have been completed before the first renewal application period for the 850/1800 MHz spectrum (that is, in advance of Q2 2026),

This paper specifically relates to Stage 1 in responding to issues raised in the ACMA’s initial ESL consultation paper and the ESL Finalised Framework, and feeds into Stage 2 information gathering which will inform the ACMA’s development of preliminary views on the future arrangements for ESL, including pricing, in Stage 3. The ACMA states that, in developing its preliminary views, “we will consider information provided by incumbent licensees and other stakeholders in stage 2 and other sources. We will examine ... spectrum value and pricing - identifying the value of spectrum and payment terms, if licences are to be renewed” Optus expects to provide further input on pricing and other issues in response to the ACMA’s information requests and consultations in Stages 2, 3 and 4.

The paper seeks to identify the best option for ESL pricing within the framework set out in the ESL Consultation, i.e. which option will lead to the greatest public benefit through the long-term public interest.

2.2 Considerations for ESLs and pricing

Criteria for determining the approach to ESLs and pricing

The regulatory framework for spectrum licence renewal is set out in the Radiocommunications Act 1992 (the Act)⁶ and the ACMA’s public interest policy and decision-making framework.

Broadly speaking the ACMA has the power to decide whether to offer ESL holders the opportunity to renew licences on payment of a charge determined by the ACMA, or to not renew the licences and re-assign them, most likely by auction⁷. However, the Minister for Communications, Urban Infrastructure, Cities and the Arts can provide guidance on relevant policy objectives through Ministerial Policy Statements (MPS).

To renew a spectrum licence for more than 10 years, the critical assessment that the ACMA has to make under the Act is whether renewal is in the long-term public interest, according to Section 77C(5) of the Act. The public interest is broadly defined in the Act as “providing for the management of the spectrum in a manner that:

- facilitates the efficient planning, allocation and use of the spectrum;
- facilitates the use of the spectrum for:
 - commercial purposes;
 - defence purposes, national security purposes and other non-commercial purposes (including public safety and community purposes); and
- supports the communications policy objectives of the government.”⁸

⁵ <https://www.acma.gov.au/sites/default/files/2023-12/Expiring%20spectrum%20licences%20-%20Finalised%20framework%20and%20response%20to%20submissions.docx>

⁶ Section 77C on the ACMA’s power to renew a spectrum licence

⁷ The ACMA could also decide to partially renew licences to the existing holders

⁸ Section 3 of the Act as revised by the Modernisation Act 2020

The ACMA consulted on and then finalised a set of five public interest criteria that constitute its policy and decision-making framework for ESLs:

- facilitates efficiency (allocative, productive and dynamic efficiency);
- promotes investment and innovation (also encouraging and dynamic efficiency);
- enhances competition⁹;
- balances public benefits and impacts;
- supports relevant policy objectives.

The ACMA has also provided some high-level explanation and context for the criteria to guide stakeholders on how they may frame their responses to Stage 2 and how the ACMA may approach its preliminary views at Stage 3.

Section 294 of the Act gives the ACMA the power to set charges for spectrum licences and provides the ACMA with considerable discretion on how to set those charges. Furthermore, the Minister has the power to give directions to the ACMA on setting charges and this may cover include setting charges that “reflect the amount that the Minister considers to be the value of the spectrum”.

[The long-term public interest is the relevant measure for determining the best approach to setting renewal fees.](#)

The options for ESL pricing, assuming that existing licence holders are offered the option to renew their licences, will be assessed against the above criteria to determine which best meets the long-term public interest.

Structure of the paper

In the following sections, this paper:

- Examines the crucial difference between the ESL process and awards of new spectrum in terms of the need to incentivise efficient spectrum use;
- Defines and assesses the options for ESL pricing – public interest pricing, price benchmarking, cost avoidance and enterprise value – against the long-term public interest, assuming the ACMA offers the existing licence holders the option to renew the ESLs; and
- Discusses a related issue arising from the differential need to incentivise efficiency for ESLs compared to new spectrum awards, i.e. whether it is likely to be in the long-term public interest to use auctions to renew ESLs in Australia.

⁹ Taking into account the potential of the Australian market to support a limited number of sustainable operators, the maintenance of effective competition, and the realistic prospect of sustainable entry

3 Efficiency incentives differ significantly between ESLs and new spectrum awards

Promoting optimal spectrum use, i.e. allocative efficiency, is important for new awards of spectrum but is a less of a requirement for ESLs as already auctioned licences are efficient by default – this has far reaching implications for renewal pricing

Over the last 30 years or so, auctions have become acknowledged as the best mechanism to allocate new releases of spectrum efficiently¹⁰ (where there are competing demands on its supply). Together with spectrum trading, this marked a shift to relying on the market to identify who valued spectrum the most as opposed to administrative allocation.

However, the need to take active measures to ensure efficient spectrum allocation in the ESL process is much weaker. Since ESL spectrum has already been assigned by auction and or a previous renewal, it has already been exposed to incentives for efficient use. Therefore, the distribution of mobile spectrum should be considered efficient by default unless there is credible evidence to the contrary. This assumes that spectrum continues to be in productive use (the information gathering exercise in Stage 2 will verify this) and excludes exceptional circumstances – e.g. the emergence of new uses with a potentially higher value for the spectrum – which can be assessed if evidence is presented during the ESL process.

Moreover, there have been multiple rounds of spectrum auctions in Australia which have provided opportunities for the market to respond to any inefficiencies in the allocation of spectrum between mobile operators that might have developed in the interim. Along with technology neutral spectrum licences, the opportunities to acquire spectrum in new bands have promoted not only allocative efficiency, but also dynamic efficiency – i.e. responding to the changes in technology and promoting innovation.

Additionally, mobile communications are the most valuable use of this spectrum given that it is very unlikely a user would be prepared to pay more for ESLs for a non-mobile use case. In fact, mobile communications has proven to be the most valuable use for these and similar spectrum bands in competitive awards around the world, and there is no evidence to suggest the contrary.

Individual mobile operators also face continuing incentives to use their spectrum efficiently

It is also unnecessary to incentivise efficient spectrum use in terms of the distribution of spectrum within the mobile market. First, the scope for significant misallocations of spectrum to arise is limited, because:

- Mobile has become an essential service with high levels of coverage in developed countries, where network investment is focused on supporting cycles of enhancements and innovation rather than revolutionary change.
- Markets have also consolidated¹¹ and a consensus has formed that markets can support three or four sustainable and profitable networks, while maintaining effective competition, depending on the population density of the country. The low population density in parts of Australia has meant that even sustaining three national operators faces challenges

Second, the secondary market provides the means to trade spectrum if another party values the spectrum more highly. It thus exposes operators to the opportunity cost of the spectrum. Hence, following the initial assignment of spectrum, the secondary

¹⁰ Here allocatively efficient is meant in the sense that the way spectrum is distributed generates the maximum economic benefit from its use

¹¹ Similarly, in its ESL Consultation submission, Telstra cites the 2020 merger of TPG Telecom and Vodafone Hutchinson as evidence that a fourth operator is not viable in Australia.

market transmits price signals which ensure that the assignment of spectrum remains efficient over time. Licences can be traded by frequency and geography enabling a fine-tuning of spectrum in response to market and technological change. This can promote allocative and dynamic efficiency as the ACMA recognised in the ESL Finalised Framework.

Spectrum trading has been applied in many countries and there are many examples which support the view that the secondary market is facilitating efficient mobile spectrum use in Australia, particularly in recent years (and the ACMA has not published evidence to the contrary, i.e. of operators refusing viable trades of spectrum):

- Hutchison's acquisition of AAPT's unused 800 MHz spectrum in 2007;
- Optus' acquisition of Qualcomm's unused 2100 MHz spectrum in 2010;
- NBN Co's acquisition of Austar's 2.3 and 3.4 GHz spectrum in 2011;
- Optus' acquisition of Vividwireless in 2012, which was primarily driven by the desire to acquire its 2300 and 3400 MHz spectrum;
- Dense Air's acquisition of nationwide 2600 MHz spectrum from TPG in 2021;
- TPG's acquisition of metro 3600 MHz licences from Dense Air in 2021;
- TPG's acquisition of Sydney/Melbourne 26GHz (200MHz) from Dense Air in 2022;
- Telstra's acquisition of Dense Air in November 2023, which gave it additional nationwide 2600 MHz spectrum.

One limitation of the secondary market is that complex transactions involving multiple parties – such as a substantial defragmentation of a spectrum band (for example, c-band) – are less likely to arise. This is because the costs of forging an agreement, e.g. negotiation and coordination, may exceed the benefits. However, complex band realignments can and have been addressed administratively. It is not necessary to re-auction whole spectrum bands to resolve such issues.

Third, given that mobile spectrum is scarce, the profit motive provides a strong incentive for operators to use their spectrum efficiently in order to minimise their costs (which is the counterpart of profit maximisation). For example, maximising the utilisation of spectrum helps lower unit costs and maximise profits. Operators will also want to deploy their spectrum resources effectively so that they can provide a competitive level of network performance to their customers.

Conclusions

Renewal charges do not need to be set at the economic value of the spectrum for the allocation of ESLs to remain economically efficient¹². As a result, any charge for ESLs that exceeds the administrative costs associated with the licence is essentially a “tax” on the use of the spectrum resource¹³. There is no other economic rationale for its imposition. Moreover, this tax may ultimately be borne by the public if passed on to retail prices for end customers.

Instead the rationale for renewal charges should stem from the fact that spectrum is a public resource. Indeed, the COS Determination from the previous renewal process of 2012, mentions the criterion of “determining an appropriate rate of return to the community” alongside other public interest criteria, which are still very relevant today and similar to those proposed in the ESL Consultation:

- Promoting the highest value use;

¹² Similarly, NBN's ESL Consultation submission notes that where spectrum is already allocated to its highest value use, there is no efficiency benefit from setting renewal prices above cost recovery

¹³ And according to section 297 of the Telecommunications Act, a spectrum access charge (determined by the ACMA) must not be such as to amount to taxation

- Investment and innovation;
- Competition; and
- Consumer convenience.

As a result, when determining an appropriate rate of return to the community, it is not only the amount of “tax” raised that matters. The public interest criteria above *also* provide a return to the community through the economic and social value generated from high quality and affordable services and the key question becomes how to maximise the overall rate of return to the community.

Optus, Telstra, TPG and NBN, in their ESL Consultation submissions, all stress the importance of considering the rate of return to the community (including the public benefit from mobile services) when setting final renewal prices.

4 Options for ESL pricing

A range of different pricing methodologies can be considered for spectrum renewal. Each offers different investment incentives, which may support different policy outcomes, and will have different downstream implications for end-users. In this report, four main options for renewal pricing are assessed against the long-term public interest, namely:

- Nominal (Public interest) pricing;
- Cost avoidance;
- Enterprise value; and
- Benchmarking.

These four options were chosen for detailed review because: they have all been used as inputs to valuing spectrum by leading regulators; depending on the specific context, they can each have economically beneficial properties; and they demarcate an upper and lower band for setting economically rational spectrum prices.

On balance, the public benefit of low (nominal) spectrum renewal prices in the ESL context outweighs any benefit from the other approaches and their likely higher renewal prices. Cost avoidance, enterprise value and benchmarking, which attempt to calculate an economic value for spectrum, are not valid for ESL because, as explained in the previous section, the rationale for basing renewal prices on economic value is not justified. Furthermore, cost avoidance and benchmarking may not accurately measure the economic value of ESL spectrum in any case due to methodological issues analysed in this section.

Other issues arise in spectrum valuation which were not considered relevant to ESLs and therefore were not considered in detail:

- “Revenue protection” i.e. the value associated with being able to provide the capacity and quality needed to maintain market share and thereby maintaining revenues is not considered because substitutable spectrum is available and network densification is also an alternative to maintain service levels.
- Option value is particularly important when a company has flexibility in how it can use assets, particularly when a market is volatile. The option to scale back or accelerate deployment, if available, confers a benefit. However, options values are private and difficult for regulators to estimate. It would also be difficult to separate the option value of ESLs from the other spectrum that operators hold. Further, ESL spectrum has already been deployed, so the value of flexibility is limited to potential future redeployment, e.g. to new technologies.
- Strategic value is also private to the operator and depends on commercial objectives and future market positioning. As such, strategic value is not directly observable and difficult for external parties to estimate.

4.1 Nominal (Public interest) pricing

In the ESL Consultation, the ACMA raises the principle of renewal prices taking into account public interest considerations and notes some examples of such pricing arrangements including the minister previously directing the ACMA on pricing for the re-issue of spectrum licences for rail safety purposes.

In this context, the public interest refers to potential wider benefits to consumers and/or industry beyond those accruing to the spectrum user. Clearly rail safety has direct wider benefits to the public over and above the operation of the railway.

However, the scope of public interest pricing is much broader than indirect benefits such as rail safety. Public interest pricing must also take into account the importance of mobile communications as an essential service to participate in society today and as a driver of digital transformation and socio-economic development through 5G and 6G

(as recognised by the ACMA¹⁴) over the next ten to twenty years, the time period under consideration for the renewal of ESLs.

[A public interest pricing approach to renewal fees can take into account the overall return to the community from both fees and the socio-economic impact of mobile.](#)

Depending on the relative priorities attached to generating tax revenue for the government on the one hand, and investment, innovation and competition on the other, a (standardised¹⁵) renewal charge could be set anywhere on a continuum between:

- The minimum charge needed to provide an ongoing incentive for operators to use the spectrum; and
- The amount that would fully extract the incremental economic value of the spectrum to the existing licensee who valued spectrum the least, typically the one with the least market share. Arguably, the assignment of ESL spectrum is efficient, so this is the theoretical maximum a regulator might consider. Above this level, the existing licence holder operator with the lowest value would actually give up spectrum to the detriment of its ability to maintain service levels. There is no economic principle, however, to suggest that charges should be set at this maximum, and although it would maximise the tax revenues from renewal it would have a detrimental impact on public benefit.

The following sections assess nominal (public interest) pricing against the relevant criteria of investment and innovation, competition, and supporting relevant policy objectives relating to rural, regional and remote areas (assuming that the existing allocation of ESLs is likely to be efficient). In addition to the ACMA's policy objectives, other considerations may also be relevant, e.g. under a Ministerial Policy Statement. An important piece of evidence in this assessment is the strong relationship between lower spectrum fees and higher public benefit for mobile in terms of its socio-economic benefits, i.e. because of the potential for greater capital investment into mobile networks, as discussed in the next section. This strongly implies that the balance of the public interest lies in setting renewal charges conservatively, towards to lower end of the continuum.

[Research indicates a strong relationship between low spectrum charges and the public benefit of mobile.](#)

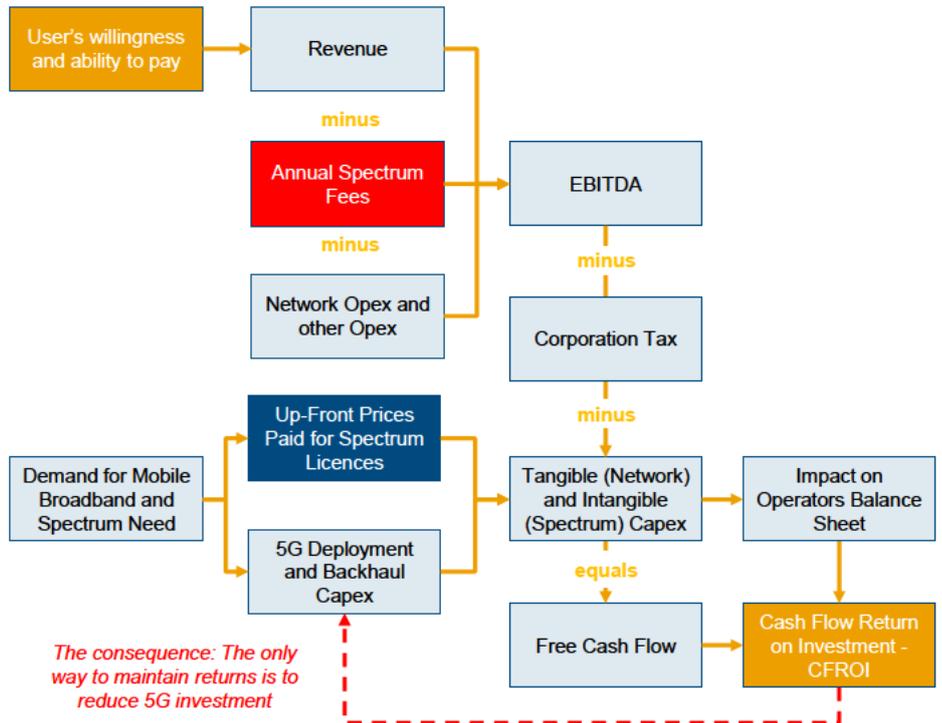
In general, spectrum licence fees are a significant cost for mobile operators. In most countries spectrum is auctioned and operators have to make large up-front payments for spectrum. The cost has to be recovered over time, including the cost of capital for the initial investment.

Operators need to generate cash to compensate investors or they would not be able to finance the investment in spectrum and network. Apart from raising retail prices – which may have a knock-on effect on market share or usage – the only other lever open to operators is to reduce tangible capital expenditure. I.e., operators could invest less in the network to bring overall capital expenditure to a level that can be financed. The diagram below illustrates these trade-offs.

¹⁴ ESL Finalised Framework (p20)

¹⁵ The ACMA would probably set a reference price per unit of spectrum per head of population which could be adjusted according to each licence

Exhibit 1: Spectrum licence fee impact on network investment



Source: Coleago

In short, high spectrum prices make the business case for mobile network investment less viable. This is all the more important because the outlook for investment in mobile is challenging in most countries given the ongoing pressure to expand capacity in line with fast growing demand and deliver innovative services over 5G and beyond. This is particularly challenging for non-incumbents due to the high level of fixed costs in the industry. Further, financially healthy and sustainable competitors are critical to constrain the incumbent's capacity to raise prices towards monopoly levels.

In addition, the risks to the public benefit are asymmetric, being greater for higher ESL renewal fees than for lower¹⁶. For example, if the spectrum prices are too high, spectrum risks crowding out investment, or being unused (evidence from spectrum auctions supports this, as set out in section 5). On the other hand, the efficiency losses if ESL prices are low are limited given the existing incentives on MNOs for efficient spectrum use¹⁷. This reinforces the argument to set spectrum fees conservatively.

The value of spectrum accrues to society and not to investors in mobile operators

A fundamental fallacy is to equate the prices operators paid for spectrum with the value of spectrum without stating to whom the value ultimately accrues. In a competitive market, prices decline to the point where operators just earn their cost of capital. There is no evidence that low spectrum prices increase enterprise value.

However, data from the ACCC Communications Market Reports shows that between 2014 and 2022 mobile services retail prices in Australia declined by 79% in real terms. During the same period operators' Return on Invested Capital did not increase. In fact, Optus' ROIC at 2% is well below its cost of capital. This demonstrates that the value of additional spectrum accrues to consumers and not to investors.

A situation where the operator returns are consistently below the cost of capital is not sustainable. Investment will decline and the Australian market will become less competitive. This is a very real danger for Australia.

¹⁶ As also noted by TPG and Telstra in their ESL Consultation submissions

¹⁷ Hence, TPG's concern in its ESL Consultation submission, that lower ESL prices may lead to inefficient spectrum use, is misplaced if there is evidence that ESL spectrum is in use

[Setting renewal prices conservatively can deliver substantial public benefit through innovation and investment in essential services, particularly mature 5G and 6G](#)

The potential conflict between high spectrum fees and the public benefit of mobile is even more pronounced given the substantial investment requirements that may be needed to deliver digital development in the future. As 5G matures through enhancements such as Standalone 5G, and as the commercialisation of 6G begins, mobile networks will provide even higher performance and a range of new services, some of which may be difficult to extrapolate from present trends. This is relevant as the licence periods of ESLs will fall into the early years of 6G.

Whilst forecasting precisely what the world of mobile communications will look like in 2030 is difficult, it may be quite different from what is currently envisaged in operator business plans. The design requirements for mature 5G are likely to include delivering a fibre-like experience with 100 Mbit/s downlink as well as low latency and cater for high traffic densities. A scenario where operators sell speed-based tariffs and compete on quality of service is plausible. If this is the case, then operators will have to cater for far higher traffic densities than today.

All this could require considerable investment at a time when operators are under significant financial pressure to earn their costs of capital, i.e. the PMP (“price per MHz Pop” of spectrum), including renewal prices, should fall to enable the major innovations that are expected to occur in 5G and 6G.

Furthermore, the new mobile use cases that will be supported by 5G/6G+ may be transformational in areas such as manufacturing and health services. For example, supporting low latency, massive machine type communications will facilitate smart cities that improve the quality of life for citizens and may deliver significant environmental benefits e.g. through supporting energy efficiency, environmental monitoring, precision use of pesticides in agriculture and connected cars.

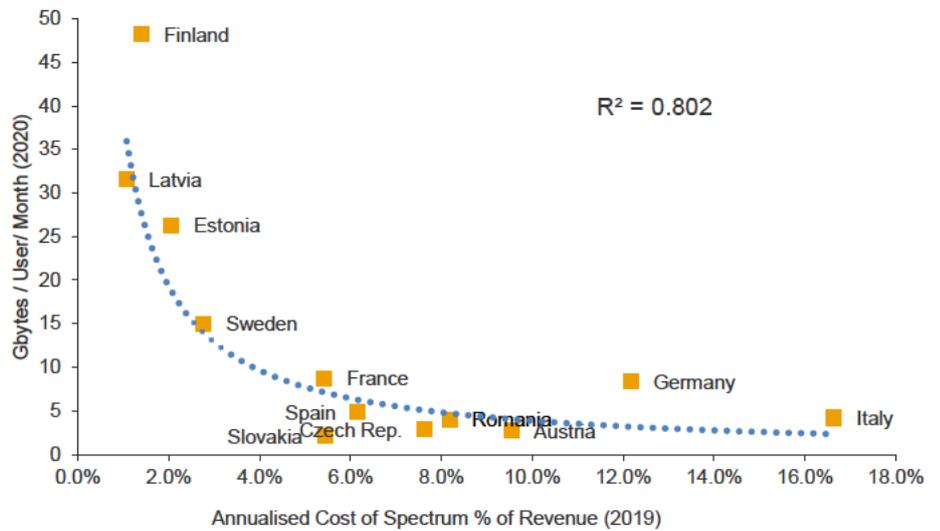
As a result, there is a strong public benefit in aiming to keep spectrum fees as low as possible, and allocate as much spectrum to the market as possible.

[The experience of Finland suggests that low spectrum charges have considerable socio-economic benefits.](#)

The Finnish approach to spectrum assignment has led to spectrum licence fees being proportionately much lower in Finland than other countries as shown in the graph below – annualised spectrum fees as a proportion of mobile revenue were significantly lower in Finland (1.4%) than in many comparable EU countries, e.g. Germany (9.5%) and in Australia (6.9%). This reflects setting relatively low reserve prices in Finland and a policy to maximise the amount of spectrum available to operators thus reducing excess demand.

The graph below shows the impact of setting relatively low spectrum of mobile data use. Across the 12 EU countries in the sample, it shows an inverse relationship between annualised spectrum fees and average mobile data consumption, with 80% of the variation in data consumption between countries explained by differences in the annualised cost of spectrum. Mobile data consumption per head is a good proxy for the socio-economic value generated from spectrum. Hence, Finland leads most countries in terms of both low spectrum costs and socio-economic benefits.

Exhibit 2: Cost of spectrum and mobile data traffic (EU & Australia)



Source: Coleago. For Australia the data is 2022 revenue and cost of spectrum

The difference between Finnish and German performance is even more pronounced considering that Germany has a much larger population of 80 million compared to Finland's 5.5 million. As a result, German operators can achieve much better economies of scale. Secondly, Germany has a much higher population density compared to Finland, making it less costly to build coverage. Australia is similar to Finland in this respect, with a low population density. Finland has a large land mass with a population concentrated in major coastal cities and correspondingly low population density. As a result, economies of scale are poor and national coverage is more costly to provide. This also limits the number of viable competitors that the market can support, as discussed in section 5.

As well as higher data usage, the three Finnish operators also deliver 5G at more favourable prices given their lower spectrum costs. As the exhibit below shows, mobile users in Finland get unlimited 5G data and voice for €31.90 (AUD 43 excluding VAT) per month. German mobile users have to pay €84.95 (AUD 119 excluding VAT) per month for unlimited usage. Even for a mere 6 Gbytes, at €39.95, Germans still pay more than Finns pay for unlimited data.

Exhibit 3: Cost of spectrum and impact on consumers

Finland, annualised cost of spectrum 1.4% of operator revenue

elisa Unlimited

Carefree 5G 300M

- 300 Mbit / s maximum speed
- Unlimited internet: Finland, Nordic, Baltic countries
- 24 GB / month in the EU
- Unlimited speech and messages
- 5 Group Bonus

31.90 € / month 34.90 € / month
+ opening fee € 6.90

Germany, annualised cost of spectrum 9.5% of operator revenue

MagentaMobil XL

unbegrenzt

✓ 5G-Netz inklusive

Tarifdetails
Produktinformationsblatt (PDF)

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Unlimited 5G in Germany costs 166% more than in Finland

Source: Coleago

Lower renewal fees will also generate public benefit through strengthening competition

The level of competitive intensity in Australia will also be affected by the level of renewal charges. As noted in section 3 above, the tendency of mature mobile markets to consolidation, due to the predominance of fixed costs, combined with the

geographical challenges of providing mobile coverage in Australia makes maintaining more than a three MNO mobile market in Australia a challenge.

High renewal charges would significantly increase the share of fixed costs in relation to total costs in Australia since the amount of spectrum to be renewed between 2028 and 2032 is substantial. This would amplify the fixed cost problem and the disparities in economies of scale of the three network operators. As a result, the market would be further skewed towards Telstra and competitive intensity would weaken, especially in rural and regional areas.

How might such a weakening of competitive intensity affect end-users?

The following types of negative impacts on service provision, network performance and consumer benefits from mobile can be expected:

- Telstra's (incumbent) rivals may be forced to try recouping high spectrum charges through increasing retail prices (subject to the impact on their market share) – so any tax on spectrum becomes a tax on the wider public if prices rise overall;
- TPG and Optus will also exercise less of a competitive constraint on Telstra, so it is likely that overall retail prices will go up in any case. Put differently, the price premium Telstra enjoys over other operators will increase because lower unit costs will translate into better financial performance and enable Telstra to increase its brand strength by investing more in its network, marketing and sales;
- Instead of increasing retail prices, TPG and Optus may be forced to divert fewer resources to network investment in order to earn their cost of capital. Again, this would predominantly affect regional and rural areas. Over time, network performance would decline and congestion increase. An operator may find this preferable to increasing prices in the short term because it is generally harder for end-users to compare differences in network performance than price. However, in the longer term, such a strategy would have an impact on market share. Two related actions to reduce costs could be to:
 - Deploy new technologies more slowly than they otherwise would and be more risk averse in their attitude to innovation;
 - Consider again options for network and spectrum sharing, such as the TPG-Telstra deal that was rejected by the ACCC and then this decision was upheld by the Competition Tribunal in 2023, with attendant risks to competition;
- Finally, if the main effects of high spectrum fees were concentrated in regional and rural areas, whether on prices or service quality, the digital divide could potentially increase.

Nominal (Public interest) pricing properly applied is unlikely to lead to inefficient spectrum hoarding.

Concerns over using pricing to incentivise efficient use or to disincentivise inefficient spectrum hoarding are also largely misplaced in the renewal context, particularly where the secondary market provides ongoing incentives for efficiency. Moreover, under-utilisation of spectrum in the short term does not necessarily indicate spectrum hoarding. Operators may strongly expect that the spectrum resource will be needed in the future as data demand increases in general or to cater for an expected increase in technology specific traffic, e.g. as the uptake of 5G capable end-user devices grows.

Hence, the risk of hoarding is likely to be low¹⁸. Moreover, if the ACMA were to set higher spectrum fees to combat hoarding, any benefit is likely to be outweighed by the negative impact on competition. If further protection against hoarding is considered necessary, it can be addressed through the ACMA's current ESL framework.

¹⁸ The risk of hoarding will also vary with the size of the operator because the opportunity cost of hoarding is likely to be proportionately higher for smaller operators than larger incumbents.

Specifically, the information gathering exercise in Stage 2 should provide the ACMA with the evidence to assess if spectrum is being hoarded.

Similarly, although windfall gains could in theory arise under public interest pricing, the fact that renewal is judged as being in the public interest means that such licences are essential to meeting existing and future demand for services and are unlikely to be resold unless market conditions change. Further, as stated above, there are asymmetric risks attached to the level of spectrum prices. Hence, concerns that public interest prices could be “too low are significantly outweighed by the benefits of taking into account the overall return to the community in setting renewal prices.

In contrast, operators will need to carry out spectrum valuations to assess whether to take up offers to renew spectrum. Operators will calculate the incremental value of spectrum on the business applying discount risk factors to the value, however, this does not imply that renewal fees should be set on the same basis for the reasons set out in this section and in the discussion of cost avoidance pricing in section 4.2 below.

Furthermore, It is essential that operators know which spectrum is able to be renewed and which is not, prior to conducting any internal valuations. This is because value of one spectrum allocation critically depends on the other spectrum resources that an operator holds. With potentially seven bands to consider, the number of combinations would be considerable and unmanageable – the risk operators under or over value spectrum would be correspondingly huge in this scenario.

Conclusions

In summary, reissuing ESLs and setting renewal charges conservatively, on the basis of nominal pricing, will maximise the overall return to the community by promoting network investment, network performance, competition and efficient spectrum use. Hence, nominal pricing for ESL will best satisfy the long-term public interest.

Since ESLs were exposed to incentives for efficient spectrum use when initially allocated and face ongoing incentives e.g. through spectrum trading, it is unnecessary to duplicate these incentives by setting ESL prices according to economic value. ESL allocation should be considered efficient by default.

ESL prices should therefore be set as low as possible given that low spectrum fees drive higher network investment and mobile usage, as shown by the leading performance of countries that pursued low spectrum fees as part of public policy such as Finland in relation to their European peers.

Other research also shows that the public benefit from mobile communications will be significantly higher in terms of mobile data usage and that network performance (data speeds and quality of experience) will be better with lower spectrum fees:

- A 2016 NERA Consulting report demonstrated that, lower spectrum fees in Australia would forego \$18USD/pop but would result in \$83USD/pop increase in consumer welfare¹⁹.
- Academic research shows that the welfare benefits of allocating spectrum to the market at lower costs outweighs any foregone government revenue²⁰.

It is also important to note that the risks in ESL pricing are asymmetric. Setting prices “too high” risks crowding out the investment that delivers wider public benefits to the community. In contrast, the risks of hoarding and inefficient spectrum use if ESL prices are set “too low” are limited given the various incentives for efficient spectrum use.

Competition will be healthier and more sustainable. This will help reduce the digital divide in regional and rural areas as well as reduce the risks to competition in the challenging domain of delivering of 6G services.

¹⁹ NERA, Effective Spectrum Pricing: Supporting better quality and more affordable mobile services, Report for the GSMA, February 2017, p.35

²⁰ Hazlett & Munoz, 2009, A welfare analysis of spectrum allocation policies, RAND Journal of Economics, Vol. 40, No. 3, pp. 424–454

Moreover, the government finances will benefit substantially from the tax revenues brought in by the additional economic activity that setting renewal charges at a similar level to Finland would stimulate. Hence the longer-term socio-economic benefits from setting low renewal charges significantly exceed any short-term benefits of high renewal charges for the public finances.

4.2 Cost Avoidance – capacity and/or coverage

Cost avoidance approaches such as calculating Optimal Deprival Value (ODV) seek to estimate the value of spectrum in terms of the additional costs operators would incur if they did not have access to a certain amount of spectrum. Typically, the rationale for using cost avoidance to set spectrum fees is to incentivise efficient spectrum use.

However, because the allocation of ESL spectrum is already likely to be efficient, there is no justification for basing renewal fees on willingness to pay in order to incentivise efficient spectrum use.

Consequently, setting renewal fees on the basis of cost avoidance pricing is unlikely to be in the public interest. In addition, there are two major practical downsides of a cost avoidance approach.

- The cost avoidance methodology does not produce one unique spectrum price;
- Cost avoidance is a theoretical construct which does not reflect actual business practice in a number of important ways which undermine its legitimacy as a regulatory instrument.

Absence of a unique price under cost avoidance

Spectrum value as determined by cost avoidance depends on a number of factors, hence if a cost avoidance methodology is applied to each operator, it will produce a different result. These factors include the following forecasts of:

- Number of cell sites and site density;
- Existing spectrum holdings and possible future acquisitions of spectrum;
- Spectrum utilisation;
- Size of the customer base;
- Network traffic
- Technology/technology specifications
- Use cases
- Economies of scale of the network;
- Network coverage
- Commercial strategy and market positioning;
- Equipment vendor costs.
- Weighted average cost of capital

The interaction between these factors is complex and may work in different directions for any one operator. For example, larger operators may have greater economies of scale and lower unit costs than smaller operators – this might reduce cost avoidance. However, larger companies might position themselves as providing higher network coverage and quality which could work in the opposite way in terms of cost avoidance. Additionally, most of this information is confidential, operators are likely to be unwilling to share it with a regulator, and are likely to be subject to contractual restrictions to maintain confidentiality from vendors.

Another complication is that fees based on cost avoidance should be specific to each operator if the objective is to replicate the outcome of a competitive spectrum market (though such an aim is not valid for renewal fees). However, asymmetric pricing could

be challenged on the grounds that it is unfair and discriminatory for spectrum licence renewal. It could also lead to perverse outcomes where an operator is penalised for success by incurring higher renewal fees. For example, high data usage could lead to higher network utilisation which could increase the level of network densification required to compensate for a loss of spectrum in the cost avoidance calculation and thus a higher renewal fee.

One approach would be to calculate a uniform renewal fee based on the cost avoidance for a “standardised” operator. Although some operators would arguably benefit more than others in terms depending on how they related to the standard operator. However, this introduces a great deal of subjectivity in the design of the standard operator and could lead to unintended consequences. For example:

- If an average of the industry players is chosen as the standard, the renewal fee may be too high for the smallest operator to have a viable business case for renewed spectrum (though given the complexity of the calculation this is not certain).
- The standard could also be that of a (reasonably) efficient operator taking into account the economies of scale in the network. If the reasonably efficient operator were based on Telstra, this could intensify Telstra’s competitive advantage and in turn widen disparities between the operators’ economies of scale. Taken to its logical conclusion, this could over time force the other operators to exit the market leading to a Telstra monopoly. Clearly this would result in a failure in public policy with no competition, higher retail prices for consumers and less infrastructure investment and resilience.

To illustrate the differences in economy of scale, the table below shows two high level indicators of the economies of scale for all three operators in Australia using the number of subscribers per MHz and per site (presented as an index for easier comparison). Each measure is a proxy for the unit cost of serving customers, hence the higher the index for subscribers per site or per MHz, typically the lower the unit cost and the higher the economies of scale/cost advantage enjoyed by the operator. The table therefore provides evidence to support the view that setting spectrum prices on a cost avoidance approaches carries significant risks for competition due to the fact that Telstra’s economies of scale are much higher than those of Optus and TPG.

Exhibit 4: Economy of scale measures

	TPG	Optus	Telstra
Index: subscribers / MHz	100	112	233
Index: subscribers / site	100	126	151
Spectrum excluding mmWave (metro areas)	225	380	280
Sites	5,728	8,632	11,002
Mobile subscribers	4,719,740	8,959,652	13,695,000

Source: Coleago, Optus, Mobile infrastructure Report 2022, ACCC

The limitations of cost avoidance as a theoretical construct

Commonly used methods used by regulators to calculate fees based on cost avoidance such as optimal deprivation value (ODV) are theoretical constructs which do not reflect business decisions taken by companies in the real world.

Hence, there is no guarantee that setting prices based on cost avoidance will have the desired effect on efficiency or maximising the benefit from use of the spectrum and it may have unintended consequences.

To examine this in more detail, it is necessary to consider the key elements of an ODV calculation. ODV asks what would be the impact of taking away an increment of an operator’s spectrum holding.

- Removing spectrum that is being productively used by an operator is unlikely to be in the public interest as this would reduce network quality. Operators can in theory densify their networks (deploy more sites) in the medium term, but quality would be affected until new sites came on stream. The company's ability to compete would also be damaged. There may be exceptional cases where the business case is unsustainable, but if the operator is at risk of failure, the best solution may be for spectrum or the entire business to be traded to another operator.
- Operators may not be able to densify their network. In (dense) urban areas, it may not be possible to deploy new sites to replace lost spectrum – there may be a lack of suitable sites, particularly in dense urban areas, and it may not be possible to gain permission to access those sites that are suitable (planning rules are making it increasingly harder to deploy sites in many urban areas). Deployment could be constrained and have a negative commercial impact on the operator.
- If spectrum is removed from one operator, who should the spectrum go to and what would the impact on the market? In the case of the 2nd and 3rd operators, it is most likely that any clawed back spectrum would go to the market leader (often the incumbent) further reducing competition. In Australia, this would further Telstra's spectrum holdings and entrench Telstra's market power.
- The impact depends on the size of each operator's spectrum holdings which may differ. For example, removing 2x5 MHz of 700 MHz spectrum would represent a much lower share of Telstra's spectrum holding (2x20 MHz) than Optus' (2x10 MHz) Therefore, the impact on Telstra would be much smaller than Optus in terms of the reduction in network capacity and the cost to Telstra for deploying additional sites in order to make up for the hypothetical reduction in spectrum would also be lower as a result.
- Densification allows the operator to re-establish quality in the medium term, but it also has a cost and the cost is typically even higher than the spectrum price if the spectrum price is based on cost avoidance. This would exacerbate fixed cost issues and could further undermine competition in Australia.

The auction avoidance variant is also unlikely to be in the public interest

An extension of the cost avoidance option – auction avoidance – has similar disadvantages to cost avoidance and its own specific downsides. Auction avoidance involves estimating the value to the licensee of ESLs and adding the value of avoiding the uncertainty and the potential costs of gaining access to the spectrum via an auction.

Since auction avoidance sets prices above the economically efficient price, it is effectively extracting a monopoly rent from ESL holders based on sunk costs of their existing infrastructure as discussed by NBN in their ESL Consultation submission.

Furthermore, as Optus noted in its ESL Consultation submission, operators do not inherently place any value on avoiding an auction, as auction participation will always carry the risk of incurring high auction prices. It also seems counter-intuitive to recognise that auctions have negative economic impacts, such as delays and disruption to investment due to uncertainty over future spectrum holdings, and that this could be avoided by setting spectrum renewal prices at a premium. Finally, Optus noted that the use of set-asides priced at a premium according to this methodology failed in the 2021 900 MHz auction as no operator took up the set-aside option.

Additionally, the prior application of the auction avoidance methodology in the 2012 renewal process was very unsatisfactory, as Telstra highlight in their ESL Consultation submission. Inviting operators to make confidential sealed bids (setting some prices on the basis of the highest sealed bid) was economically inefficient and the use of valuation modelling by Plum Consulting was opaque. However, even if the methodology were improved, setting renewal prices with reference to the overall return to the community will better satisfy the long-term public interest than the auction avoidance approach.

4.3 Enterprise value

An enterprise value or full enterprise valuation of spectrum estimates the total discounted value of future cash flows that are made possible by holding the spectrum over the duration of the licence. Setting prices this way captures the full value from holding spectrum. If spectrum prices were set higher than enterprise value, an operator would go out of business.

Future cash flows can be estimated by projecting forward end-user traffic demand and revenues and the associated network operating and deployment costs needed to serve them and comparing the value of the business with and without spectrum²¹. An alternative approach is to disaggregate the market capitalisation of business into its component parts (e.g. mobile, fixed, satellite) and attribute the value across spectrum and the other assets of that business component.

Similar to cost avoidance, enterprise valuation will not be in the long term public interest for ESL pricing because the allocation of ESLs is already efficient which removes the need to set ESL pricing to promote economic efficiency. There are also a number of specific reasons why enterprise value is not in the public interest.

Firstly, applying enterprise valuation to ESL penalises success, since anything that increases the valuation of the business, for example more intense use of spectrum or service innovation leading to higher revenues, ultimately feeds through into higher spectrum fees. If all the extra profit is simply clawed back through a spectrum fee, incentives to innovate and invest are low. Competitive intensity may also be lower as the profits from any competitive advantage would also ultimately be appropriated by spectrum fees.

Another disincentive to arises because enterprise value pricing does not take into account downside risks to operators. Operators would not achieve a return on their investment if the underlying forecasts for the enterprise valuation were not met. Hence, operators may scale back investment in spectrum and network if market conditions are uncertain.

Enterprise value pricing may also disincentivise efficient spectrum use. If enterprise value exceeds cost avoidance, operators would have an incentive to substitute additional sites for spectrum. Although it would lower their total costs, it would be highly wasteful and inefficient as it is very unlikely there would be a higher value use of the spectrum.

Finally, enterprise valuation can be challenging if a detailed financial modelling exercise is undertaken, given the complexity and uncertainty in predicting future cash flows such as future technology and demand trends. Disaggregating market capitalisation is also challenging because a number of subjective assumptions need to be made to divide the value of a business across its tangible and intangible assets.

4.4 Price Benchmarking

Benchmarking seeks to estimate spectrum prices by comparing a sample of representative spectrum fee information, usually auction prices (as renewal prices are not always available), from other countries, within a certain time period and adjusting where necessary for factors such as licence duration and frequency differences.

[There are major difficulties in using historical global \(or domestic\) price benchmarking to set future renewal prices.](#)

Renewal pricing is often unavailable and only auction pricing is public to be benchmarked so in fact benchmarking auction prices to determine renewal prices is inaccurate. Benchmarking renewal prices in other countries would be more appropriate.

²¹ Assuming there would be a subsequent ESL process at the end of a renewed licence term, it would not be necessary consider the terminal value of the business.

Further, operator spectrum valuation in an auction situation often does not only include cost avoidance, but can also include terminal value, revenue protection, incremental revenue (new use cases) while taking to account the operator financial situation and option value. These values also can be discounted by execution risk, operator margin, financial situation/affordability scale back to ensure share price and financial situation is not negatively impacted by the acquisition/renewal.

Benchmarked auction prices also do not take into account other elements of the overall return to the community such as investment, innovation and competition, there are a number of other challenges to benchmarking, both in general and in its application to renewal pricing.

Another reason why auction prices can be misleading is that speculative or new entrant bidding using the full enterprise value usually has little basis on operator values. For example, in the 2017 auction of unsold 700 MHz spectrum, TPG paid \$1.26bn for 2x10 MHz at a PMP of \$2.75. This was more than double the PMP of \$1.25 paid by Vodafone in the same auction (totalling \$286m for 2x10 MHz), or the reserve price of \$1.36 that Telstra and Optus paid for the 700MHz spectrum in 2013. Pro-rating or averaging the PMPs makes little sense and merely smooths out the extremes.

Additionally, using benchmarking to set renewal prices is also problematic because it is backward looking and hence not appropriate to use for pricing spectrum licences with licence terms extending forward from 2028²².

Benchmarking requires a large number of subjective assumptions to be made

Using benchmarks from prices paid for spectrum at auctions in other countries in the past to assess the value of spectrum in Australia is misguided. Essentially benchmarking relies on calculating an average price paid in different countries at different times, but the value of spectrum in a particular set of circumstances says nothing about the value of spectrum in another set of circumstances.

As a result, benchmarking lacks objectivity and a number of essentially arbitrary decisions have to be made on how benchmarks should be adjusted and used:

- Addressing differences in value arising from the number of sites deployed because the more sites deployed the lower the value of additional spectrum and the more existing spectrum available the lower the value of additional spectrum;
- Whether to benchmark outputs against the arithmetic mean or the median;
- Inclusion or exclusion of outliers and exclusion criteria, e.g. 3 standard deviations from the mean;
- Adjusting for macroeconomic factors such as GDP and exchange rates;
- Adjusting for licence specific factors such as duration, payment by instalment or lump sum, coverage obligations and technical licence conditions;
- Adjusting for difference in auction rules such as allocation limits.

Prices paid in spectrum auctions are in a large part driven by domestic market context

In addition to the many country specific factors listed in the previous sub-section, prices paid at auction are also highly driven by national spectrum policy/public policy factors. The Australian 3.4/3.7 GHz auction of 2023 illustrates the impact of spectrum policy decisions on prices paid..

- In the 3.7 GHz auction, most of the lots (77%, 200 out of a total of 260 lots) were sold at reserve price with 7 lots left unsold. As a result, the final auction price was largely set by the government in the form of the reserve price rather than the value placed on it by the operators. The lack of demand was driven by many factors, including the quantity of substitutable spectrum already allocated, allocation limits,

²² Conversely, backward looking and current data are more useful in considering whether spectrum has been in productive and efficient use and whether it is in the public interest to re-issue ESLs to the holders, as TPG suggest in their ESL Consultation submission

and the financial status of the participants. The only competition was in high population areas of Sydney, Melbourne, and expansion Brisbane, which are highly served markets by all three operators. There was no competition for spectrum in un/under-served markets.

- In the 3.4 GHz band, nearly half of the lots were sold at reserve price and nearly all were sold either at reserve or in round 1, again with 7 unsold lots.
- In the 3.7 and 3.4 GHz auctions, new entrants showed no demand for spectrum at the reserve price in either auction in under-served markets.

To summarise, this recent Australian example demonstrates that spectrum sold at reserve price is an outcome of public policy with the reserve price set by the regulator/government. Spectrum sold at reserve price demonstrated the reserve price was too high to encourage competition in the auction, with only one bidder willing to pay the reserve price. This was mainly Telstra who was only limited by the allocation limits.

Unsold spectrum is a sign that the reserve price was too high for any bidder. It should also be noted that Telstra, dominated the 3.7 GHz auction, acquiring 79% of all lots, spending 77% of the total auction price and acquiring up to the maximum of their allocation limits in nearly all products. In the 3.4 GHz auction, Telstra and NBN Co acquired all the spectrum.

To use auction benchmarks partially based on outcomes with significant public policy failures, where spectrum is unsold and high reserve prices have choked off competition for spectrum (allowing the incumbent to dominate the auction), distort efficient spectrum use and is not appropriate for setting ESL renewal prices.

Italy provides another example of intervention in spectrum prices. Italian operators paid three to seventeen times more for the 700 MHz spectrum than operators in Finland. Adopting the Finnish approach to making spectrum available for a near nominal price would in effect mimic spectrum policy in Finland, whereas adopting the Italian approach to maximise auction revenues would align Australia with spectrum licence fee policy in Italy. Calculating an average of the two is pointless.

In this way, price benchmarking depends heavily on the benchmarks used and runs the high risk of failing to reflect the context in which the spectrum is being allocated. The pricing of ESL spectrum must reflect careful consideration of how ESL spectrum can promote the long-term public interest for Australia.

Other public policy choices that have an impact on auction prices, hence complicating the use of benchmarking are as follows:

- Allocation limits (competition caps) have a significant impact on the final price, as seen in the 3600 MHz 2018 auction in Australia when regional spectrum sold at a price / MHz / population (PMP) many multiples higher in regional than in metro which went at reserve price, because one operator was not allowed to bid in metro. This was a direct impact of public policy and had little relationship with value.
- Technological specification and technology maturity also has a significant impact on PMPs. For example, TDD spectrum was priced at a PMP of \$0.03 in 2012 prior to specification for 5G, but was multiple times higher in the 3.6 GHz auction in 2018, post 5G specification.
- Reserving spectrum for new entrants can create artificial scarcity that can result in inflated prices for the operators and low prices for the new entrants, again as a result of public policy.

Prices paid for similar spectrum show a wide variation. There is an over 100-fold difference between the lowest and highest prices paid for similar spectrum. Even within a relatively homogenous set of countries spectrum prices for the same band in the same timeframe vary by a factor of 73. To calculate and average is meaningless.

Benchmarking is not appropriate to set renewal prices in Australia.

The Australian Government has a policy of developing digital Australia and recognises connectivity as a key tool to achieve this societal goal. Using benchmark prices from past spectrum auctions in countries which may not have, or still do not share, Australia's policy objectives is not appropriate.

If the ACMA decided that a benchmark were to be used, it should be that of Finland, where very low spectrum prices in combination with indefinite licence terms delivered four times higher data usage per capita compared to its peers which charged considerably higher fees for spectrum licences.

5 Re-issuing ESLs will further the public interest more than re-auctioning ESLs

This section discusses the reasons why the case for re-auctioning ESLs is weak and that the current allocation is likely to remain the most efficient use of spectrum.

5.1 Incentivising the efficient use of ESL spectrum through auctions is unnecessary

As stated above in section 3, ESLs have already been auctioned so their assignment should be presumed efficient by default, barring exceptional circumstances and provided spectrum is actually in use – i.e. it is unnecessary to re-auction ESLs to promote efficiency. Thus, ESLs are qualitatively different from new releases of spectrum for which auctions have become the default over the past 30 years and are seen as the best way to promote economically efficient spectrum assignment.

Exceptional situations could include a need for detailed replanning or defragmentation of one or more relevant bands, e.g. to consolidate assignments into larger contiguous blocks. However, even in these cases, an auction might not be the most appropriate mechanism:

- It would be much faster and more cost effective for the ACMA to work with industry to replan / defragment a band, and this could commence now and not wait until stage 4. While spectrum trading may help in very simple cases, in cases such as C-band, this is unlikely. For example, the many variations in spectrum boundaries between 3.4, 3.5, 3.6 and 3.7 GHz will make it difficult to reach a commercial solution to defragmentation and intervention will be necessary.
- Attempting to replan one or more spectrum bands through an auction might require a highly complex auction design to cover all the possible combinations of spectrum on which each participant might want to bid. There are limits to the extent to which auctions can effectively handle such levels of complexity and they increase the risk of auction failure²³.

Furthermore, as set out in section 3, the secondary market can also incentivise efficient spectrum use with the mobile market. Hence, there is little justification for re-auctioning ESLs from an efficiency standpoint given the existing incentives on MNOs to use spectrum efficiently.

[The extent to which auctions are essential to maximising the public benefit of mobile has changed in light of mobile market maturity and consolidation](#)

Although auctions have become widely used for mobile spectrum awards, mobile is much more mature now compared to when 3G networks were rolled out 20 years ago. Mobile networks in advanced countries have achieved high levels of coverage. Although the pace of technology change has not dimmed, it is now more a matter of long-term network investment supporting cycles of network enhancements and innovation rather than revolutionary changes to the network.

Similarly, markets have consolidated over the past 30 years and a consensus has developed (in terms of the outcome of merger control decisions. e.g. in Europe and America) that the number of players that best balances effective competition with the sustainable and profitable networks is three or four, depending on the population density of the country. Hence, while maintaining effective competition is important, spectrum assignment is seldom used directly to engineer new market entry.

²³ For example, package auctions – the type that would be needed to allow bidding on multiple combinations of bids – give rise to the so-called threshold problem. This refers to the difficulty for multiple small bidders to coordinate their bids in an auction. Although they collectively may value spectrum more than a single large player, they cannot express this in the auction and the spectrum ends up misallocated.

Further, mobile phone ownership is now near ubiquitous and is the primary means by which people communicate, consume social media, access government services and pay for goods. Mobile services are increasingly transforming business processes from agriculture to manufacturing to logistics. In other words, mobile communications has become an essential service for individuals and society.

Given that mobile communications markets have substantially changed since spectrum auctions were first introduced, the extent to which they remain essential to achieving the maximum public benefit from assigning new mobile spectrum has been challenged. This evolution in preferred methods of spectrum assignment is illustrated in the diagram below.

Exhibit 5: Evolution of mobile spectrum assignment approaches

	1985	1995	2005	2015	2025
Market demand		Mobile services are expensive used by the few	Mobile services affordable for all		Mobile services are an essential tool
Spectrum assignment focus		Focus on facilitating new market entry	Focus on additional spectrum for existing operators		Focus on licence renewal & additional spectrum
Operator profitability		Mobile networks are highly profitable	Mobile network profitability declines due to competition		Low profitably drives consolidation among operators
Assignment method		Comparative tenders (beauty contests) are common	Auctions dominate		Auction orthodoxy is being challenged

Source: Coleago

Finland is one example where regulators have taken a different approach when assigning new spectrum. Although auctions are used in Finland, promoting sustainable investment and maximising the socioeconomic benefits from mobile data are key public policy priorities. This is manifest in the setting of relative low reserve prices and reducing spectrum scarcity by releasing as much spectrum as possible per auction (which also tends to reduce competition for spectrum) in line with public policy. For example, in 2020, significant amounts of spectrum – 800 MHz – were auctioned in the 26 GHz band, and the licences were sold at the reserve price at the lower range of international prices on a like for like basis. Similarly, the 700 MHz licences auctioned in 2016 were also sold at the reserve price.

5.2 Re-auctioning ESL may exacerbate competitive distortions

Mobile markets are characterised by high levels of fixed cost which dominate the overall cost of providing services²⁴. In such markets, it is difficult to sustain more than a limited number of competitors because total fixed costs will increase for each firm in the market, but total revenues will stay the same. After a point, total revenues will cease to cover total costs. As a result, mobile markets tend towards concentration as they mature. Three or four players is widely regarded as striking the difficult balance between effective competition and enabling sufficient investment in networks and services to deliver digital economy objectives.

Australia, with a population of 26.3 million, is a relatively small market with a relatively high urban population across a large land mass: significant differences population density have manifested in distinct differences in levels of commercial investment and competition between urban and regional areas.

Areas of low population density exacerbate the fixed cost problem so that it is particularly difficult for operators with a lower market share to earn their cost of capital.

²⁴ According to Coleago Ltd. Research, the ratio of fixed to variable costs is 70:30 for a typical mobile operator

They enjoy lower economies of scale than their larger rivals and hence they suffer a competitive disadvantage.

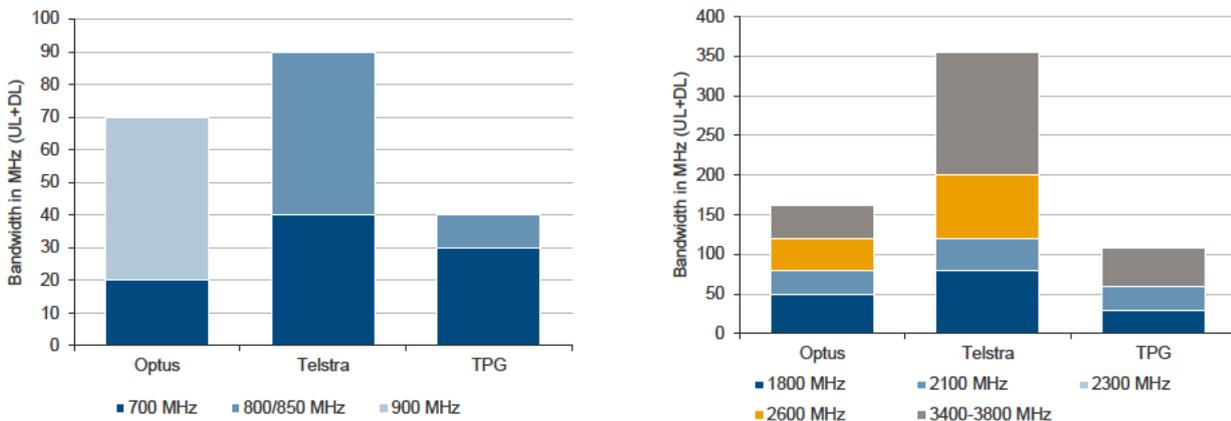
It is unlikely to be sustainable to support more than three mobile network operators in the Australian market in the long term. The history of consolidation in the sector over the last twenty years supports this view. However, while the Australian market supports three MNOs, Telstra maintains significant market share and enduring market power in the national mobile market.

Telstra has significant legacy network advantages, maintains more than 50% of useable spectrum in many regional areas and has been the recipient of the greatest proportion of Government funding directed to improving regional network coverage. Telstra is able to leverage these advantages to benefit from significant economies of scale, which enable it to charge a premium on its retail price without affecting market share²⁵.

The rejection of the MOCN arrangements was not a lost opportunity for regional Australia – if implemented, the agreement would have entrenched Telstra’s dominance in the 80-98.8% coverage zone, unconstrained by TPG which would have effectively become a Telstra reseller unable to effectively differentiate its service offerings. Policy should seek to address the distortionary effects of Telstra’s network advantage and promote improved coverage quality within the existing competitive footprint.

Given Telstra’s market dominance, there is a risk that re-auctioning ESLs would allow it to entrench this dominance and further undermine effective competition²⁶. For example, Telstra’s willingness to pay for spectrum may be increased by the prospect that gaining a higher share of spectrum will consolidate its competitive advantage and enable it to increase the retail price premium it currently enjoys in regional areas. This is illustrated by the 2023 3.4/3.7 GHz auction; Telstra won 79% of the 3.7GHz lots offered, more spectrum than Optus and TPG combined and was responsible for 75% of the total auction fees raised²⁷, acquiring close to the maximum allowed under the allocation limits. The table below illustrates Telstra’s spectrum dominance.

Exhibit 6: Distribution of low and mid band regional spectrum²⁸



Source: Optus

²⁵ <https://www.accc.gov.au/media-release/accc-decides-not-to-grant-authorisation-for-telstra-and-tpg-regional-network-deal>

²⁶ Even Telstra, in its ESL Consultation submission, states that non-renewal of ESLs is likely to lead to an increase in market concentration and weaker competition

²⁷ <https://www.acma.gov.au/allocation-summary-3437-ghz-bands-2023>

²⁸ Note, the 3400-3800 MHz spectrum quantities are an average weighted by the population within each licence area (based on 2021 census). The Telstra and TPG spectrum quantities are adjusted for 3rd party authorisations granted by TPG to Telstra

A reduction in competitive intensity would also have a knock-on effect on investment – the ACCC’s ESL Consultation submission emphasises the importance of competitive dynamics for investment and innovation. The reverse may not be true, i.e. attempting to promote competition and innovation by new entry will not be in the public interest if entry is not sustainable and if it weakens either or both of the existing competitors with respect to the incumbent. Facilitating failed new entry could ultimately result in spectrum remaining unused.

5.3 The justification for re-auctioning ESL to promoting new entrants is weak and will not maximise the wider public interest

The ACCC notes in its ESL Consultation submission that “This expiring spectrum licences process provides an invaluable opportunity for prospective new entrants to potentially access 7 bands of spectrum (for mobile use)”. However, it also states that it is not aware of any potential new entry into the mobile market²⁹.

The ACCC then summarises two examples of where spectrum was set aside, for new entrants to mobile or other uses, from New Zealand and Singapore.

These examples are not compelling. Where companies have successfully entered the market as MNOs, this has mostly been through new awards of spectrum rather than renewals. Further, re-auctions of ESL often fail to lead to new entry, for example the Irish multi-band spectrum auction of 2012³⁰ and the 2015 renewal of 900 and 1800 MHz spectrum in Germany³¹.

In the case of New Zealand, in 2019, 1800 and 2100 MHz licences were partially renewed. 30 MHz of 1800 MHz spectrum that had been in use was not renewed and held back for potentially alternative users or uses. 20 MHz of this spectrum was directly allocated to the Emergency Services Network and not a new mobile entrant. The other 10MHz at 1800 MHz was ultimately renewed to Vodafone³². Hence, the New Zealand renewal process did not lead to a new entrant either, and no evidence of new entrant demand for renewal spectrum emerged.

In the case of Singapore, the 4G auction of a number of spectrum bands (700 MHz, 900 MHz, 2.3 GHz and 2.5 GHz) in 2016 included a New Entrant Spectrum Auction (for frequencies reserved in the 900 MHz and 2.3 GHz bands). This was won by TPG, now trading as Simba (the company was EBITDA positive in financial year 2023 but has a long way to go to catch up with the other MNOs). Although this example shows that new entry may be possible via the re-auction of renewal spectrum, it is specific to Singapore and of limited relevance to Australia – Singapore is a city state and network is much easier, cheaper and quicker than a country the size of Australia where national coverage is king.

In conclusion, the precedents for using ESL to promote new entry appear limited. Furthermore, while the ACMA could reserve spectrum in the hope of encouraging new entry, it would have downsides for the public interest in terms of its impact on investment and service continuity (which would not be in the best interests of consumers). The ACCC has not presented any evidence to show that it would be in the overall public interest, consistent with all ACMA’s public interest criteria, to encourage new entry through ESL spectrum.

29 ACCC ESL Consultation submission, p.4

30 <https://www.comreg.ie/industry/radio-spectrum/spectrum-awards/multi-band-spectrum-award-2012/>

31 https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2015/150619_Frequenzversteigerung.html

32 <https://www.rsm.govt.nz/projects-and-auctions/completed-projects/renewal-of-management-rights-in-1800-and-2100-mhz-bands/>

5.4 Re-auctioning ESLs also risks delaying or reducing investments in 5G and 6G

Another risk from re-auctioning ESLs arises from the potential impact of further developments in 5G and 6G. This may require substantially larger contiguous holdings of spectrum than before, as quality of experience becomes more important. Already some commentators expect that 6G will have to deliver a fibre like experience. However, if an auction carries a strong risk of resulting in a more asymmetric distribution of spectrum and further consolidation, operators that are “underweight” in spectrum might be unable to match the quality of experience their rivals could offer. Hence, competitive distortions would be even greater as 5G and 6G develop.

The ACMA is likely to place allocation limits to mitigate all the above risks, however this is challenging and carries further risks in terms of regulatory failure. Moreover, the lower allocation limits that would be imposed in such an auction, the less competitive bidding is likely to take place and the weaker the justification for holding an auction.

Re-auctioning ESL creates related uncertainty which is not in the public interest and is ultimately not in the best interests of consumers

Re-auctioning spectrum would inevitably create some uncertainty over continued spectrum access, even though the ACMA has taken the decision to start the renewal process five years before the first licence expiry. This will be followed by an extended period prior to any renewal application being accepted since licensees may only apply for renewal two years before expiry of the licences. Further, indicative pricing will be needed for all bands so as to not to add to uncertainty, given the level of substitutability between certain ESL bands

This uncertainty over spectrum access will chill investment (delaying or scaling down plans) because mobile network investment requires long term planning, and there may be knock-on effects on network innovation. This could also affect operator bid strategies in auctions of new spectrum, because acquiring new spectrum while there is uncertainty over ESL renewal would feed into bidders’ valuations.

This brake on investment is particularly important in the context of the high level of investment required to mobile data demand and wider policy objectives for digital development through 5G and 6G networks, which will require substantial additional investment and carry their own technology related uncertainty.

There is also a risk to service continuity and quality because if an operator were to lose access to part of its spectrum holdings, this could impact its ability to maintain a consistent level of service, causing noticeable disruption to consumers in the short term. Operators would seek to respond as quickly as possible to maintain or reestablish service levels to their customers, but this would inevitably take some years to achieve.

Additionally, operators require a portfolio of low, mid and high band spectrum in order to offer a consistent quality of experience to their customers in all environments. Hence, it is important to consider the potential disruption to operators’ ability to provide high quality coverage (low band) as well as providing uncongested network capacity (mid band) and its impact on consumers.

Moreover, if re-auctioning ESL leads to a fragmentation of spectrum holdings, national coverage and service quality will be disproportionately affected to the detriment of consumers. This is because of the potential for increased interference due to the additional boundaries created between licensees. Operators may also cherry pick the most attractive areas, exacerbating fragmentation and further constraining the national network business case.

5.5 Auction design can be challenging and lead to unforeseen consequences: this also applies to ESLs

Auctions are inherently risky for all stakeholders, the ACMA included, as a mechanism for information discovery (about demand) and efficient spectrum allocation. The risk is disproportionate when information about demand is already evident and there are ongoing incentives for efficient spectrum use.

Firstly, if auctions are poorly designed, they carry a high risk of failure, typically characterised by a failure to sell all of the spectrum being auctioned. In a number of auctions, attempts to maximise revenues through high reserve prices have led to most bidders pulling out of the auction leaving most of the spectrum unsold and enabling the remaining bidders to gain a dominant position in the market, e.g. the Nigerian 2.6 GHz auction of 2016, the Indian 700 MHz auction (part of a multi-band award) of 2016.

Secondly, regulatory failure has also happened in auctions where the stated objective has been to promote efficient use of the spectrum, but the result was further consolidation of spectrum in the market, often with the incumbent gaining the greatest share and new entrants being unsustainable illustrating the challenges faced, for example:

- In the Australian 700 MHz auction of 2013, Vodafone did not apply, bid or hence win spectrum in the auction because the reserve price was set too high. This also illustrates how the value of spectrum can vary significantly depending upon the situation of the operators and may not promote competition since Telstra was the only MNO able to afford to buy 2x20 MHz in the auction and the other winner Optus only bought 2x10 MHz leaving 2x15 MHz unsold³³ and unutilised for a number of years.
- In New Zealand in 2014, a three-operator market, the regulator auctioned the 700 MHz, setting a cap of three 2 x 5 MHz blocks per operator. However, reserve prices for the 700 MHz auction were too high for the smallest operator, 2degrees, to acquire its fair share of three blocks. Following a second-round auction, one of the two larger operators ended up with four blocks.
- In the Canadian AWS auction in 2008, 2x20 MHz out of the 2x45 MHz spectrum being sold, was reserved for new entrants. However, most of the new entrants who acquired significant spectrum did not put it to good use: two went bankrupt and one later sold its spectrum to one of the previous incumbents.
- In the 2019 German 5G auction, former MVNO 1&1 Drillisch, a new entrant to the market acquired 3.6 GHz spectrum. However, it failed to meet the regulatory target of deploying 1,000 sites by end 2022, which some commentators believe reflects the fact that it could not afford / paid too much for the spectrum.
- In the Nigerian 2.3 GHz auction of 2013, the spectrum was won by new entrant Bitflux against one other bidder. A high reserve price discouraged others from bidding. However, Bitflux took three years to initiate a very limited rollout and its viability is doubtful given it only operates in a handful of locations.

Regulatory failure in auction design has also had significant consequences for spectrum licence renewal in some countries. Two examples are set out below.

Spectrum renewal in Norway

In 2013, the Norwegian Communications Authority (NPT) sought to renew 900 and 1800 MHz licences as part of a combined 4G auction alongside newly available 800 MHz spectrum. The licence duration was set for 20 years. However, NPT selected a first price, sealed bid combinatorial design for the auction. One of the features of first

³³ Vodafone's decision not to bid given the reserve price was likely also influenced by the fact that it had spectrum at 850 MHz. In contrast, Optus did not.

price sealed bid auctions is that bidders must bid strategically based on their understanding of competitor strategies, rather than on their true value.

This auction design did indeed have dramatic consequences. Tele2, Norway's then third largest mobile operator, won no spectrum at all, while a new entrant Telco Data (now Lyse) won a substantial portion of the spectrum on offer. Tele2 Norway struggled to maintain its competitiveness and exited the market in 2015 when it was bought by competitor Telia.

The new entrant Lyse had achieved a 12% market share by 2022³⁴ and had not established itself on the same level as Tele 2 Norway whose market share was 17% when acquired by Telia³⁵. Hence, competition in Norway has lessened substantially as a result of the poorly designed auction and the exit of Tele2, and consumers have lost out in terms of higher prices and lower service quality.

Spectrum renewal in Ireland

Ireland has consistently used auctions to renew spectrum licences. For example, the 2012 multi-band spectrum award re-auctioned expiring 900 and 1800 MHz licences alongside new 800 MHz spectrum.

A multi-band auction allows operators to determine their optimal holdings across a range of bands when a substantial amount of spectrum is coming to market in the same timeframe as other similar licences are expiring. However, the justification for re-auctioning the 900 and 1800 MHz spectrum in 2012 was weak given subsequent developments. First, new entrants did not acquire any of the re-auctioned frequencies. More importantly, the Irish market consolidated from four to three players soon after in 2013 (while this and spectrum trading might have been sufficient to correct any long term inefficiencies in the distribution of this spectrum between the incumbents).

Leading regulators assume that ESL spectrum use is likely to be efficient by default with the reissue of the licences to the existing spectrum holders as standard

There are several different approaches to renewing mobile spectrum licences internationally, including reissuing licences to the holders, auctions and administrative re-assignments and hybrid approaches. However, the GSMA note that: "While auctions can work well for initial spectrum assignments, they are almost always inappropriate in the case of renewing mobile spectrum licences that are expiring"³⁶.

Moreover, a number of leading regulators with a strong track record for successfully auctioning new spectrum licences (the US, Finland, Canada, New Zealand) take the view, when it comes to renewal, that the public benefit is maximised by reissuing licences to the existing holders. They consider that spectrum assignments are likely to remain efficient by default, provided certain conditions have been met, e.g. that spectrum is in use and licence conditions complied with. Some countries, such as the UK and Japan (where reissue is based on service continuity and compliance with regulatory and licence conditions), effectively make the licences perpetual and they can only be revoked on grounds such as failure to meet licence conditions or for exceptional reasons. This approach is recommended by this paper in Australia.

³⁴ <https://www.mobileeurope.co.uk/norway-s-lyse-to-buy-ice-and-create-convergent-fixed-mobile-operator/>

³⁵ <https://www.teliacompany.com/en/news/press-releases/2014/7/teliasonera-acquires-tele2s-norwegian-operations-and-accelerates-nationwide-4g-roll-out/>

³⁶ Auction best practice, GSMA Public Policy Position, September 2021, p.5, <https://www.gsma.com/spectrum/wp-content/uploads/2021/09/Auction-Best-Practice.pdf>

Exhibit 7: Markets with a strong expectation of licence renewal to existing holders

Country	Renewal expectation	Regulatory objectives and context
United States	Near Automatic	Timely network investment, continuous spectrum use, compliance with licence conditions. Continuous spectrum use is defined as, over any 180 day period, at least one site in the licence area used the spectrum.
Finland	Near Automatic	To promote the supply of digital services, the quality and capacity of broadband networks and efficient spectrum use – renewal if spectrum is in productive use For example, applications to renew 900, 1800 and 2100 MHz licences in 2019 were assessed by beauty contest, focusing on network coverage. Fees were set separately based on the policy of minimising spectrum fees.
Canada	Strong	Investment, the provision of service to customers, long term stable use of spectrum where appropriate, compliance with licence conditions. The government has even stated that re-auctioning of spectrum would only happen in exceptional circumstances such as an overriding policy need ³⁷ .
New Zealand	Moderate	Service continuity, accommodating future growth in mobile demand, efficient spectrum use. The Ministry states that there is an expectation of renewal if spectrum is being actively used and there are no countervailing public policy grounds. Accordingly, most rights for 1800 MHz, and all for 2100 MHz were reissued to the incumbents in 2019 ³⁸ .

Source: Coleago

The central themes from the approaches to renewal summarised above is the importance of continued network investment, continuity, and service quality. They underscore the point that the spectrum management authorities in these countries consider that the public benefit is best served by giving mobile operators a strong or near automatic expectation of renewal.

Even in some countries where expiring mobile spectrum licences have been re-auctioned in the past, approaches are changing. In France³⁹ and Portugal, licences have been reissued to the holders in an administrative process linked to providing commitments to extending coverage. In Spain, legislation was amended to allow 40 year spectrum licences and recently auctioned spectrum has already been awarded for 40 years. The Ministry's rationale was *"to promote the deployment of modern and innovative electronic communications networks, encourage investment and consolidate Spain's leadership in connectivity"*. The Ministry also found that a 40 year licence term *"confers greater stability in the use of these frequencies of the radioelectric spectrum for the operators and allows operators can amortise required investments over a longer time"*⁴⁰.

³⁷ "Framework for Spectrum Auctions in Canada", Government of Canada, <https://ISED-Isde.canada.ca/site/spectrum-management-telecommunications/en/spectrum-allocation/framework-spectrum-auctions-canada#section36>

³⁸ "Cabinet Minute of Decision: Renewal of Radio Spectrum Management Rights in the 1800 and 2100 Megahertz Frequency Bands", New Zealand Cabinet, Feb 2019, <https://www.mbie.govt.nz/dmsdocument/4641-cabinet-minute-of-decision>

³⁹ In 2018, the French government reached a legally binding agreement with MNOs to improve LTE coverage, especially in rural areas and across the road and rail network, in return for reissuing the 900, 1800 and 2100 MHz licences to the incumbents for ten years at unchanged licence fees.

⁴⁰ https://portal.mineco.gob.es/es-es/comunicacion/Paginas/120523_consulta_publica_ampliacion_concesiones_uso_domicilio_publico_radioelectrico.aspx, (1 June 2023)

It is noted that a strong expectation of renewal could be given through the use of renewal statements that were brought in by the Modernisation Act 2020. Moreover, in the last major ESL process in Australia, the minister made the Radiocommunications (Class of Services) Determination 2012⁴¹ (COS Determination), which listed services for particular frequency bands, where, if the licence was used in the provision of that service, it was considered in the public interest for that licence to be re-issued.

5.6 Conclusions

The case for re-auctioning ESLs is weak given the evidence that the current allocation is likely to remain the most efficient use of spectrum and the further disadvantages of auctions compared to reissuing ESLs. The main reasons for this conclusion are as follows:

- Auctioning ESLs is unnecessary since the licences have already been auctioned;
 - The secondary market and profit maximisation also help to maintain efficient spectrum use over time as markets and technology change;
- Mobile markets are now more mature and have undergone significant consolidation which limits the scope for auctions to facilitate sustainable new entry and is leading some regulators to alter their approach to new releases of mobile spectrum. Further, the prospect of sustainable new entry is low as evidenced by the following:
 - The lack of participation of new entrants in recent auctions e.g. 3.4/3.7GHz
 - Very limited engagement by new entrants in the ESL process and responding to the ESL Consultation;
 - Hence, there is no compelling evidence of demand for re-auctioning from potential new entrants, and while the ACCC proposed re-auctioning ESL, it stated it was unaware of any such demand;
- Re-auctioning of spectrum can have unintended consequences and is not risk-free. In particular there is a risk of auction failure/stranded spectrum if reserve prices are set too high, as international experience has shown. “Testing demand” via an auction will have significant business impacts for incumbents and on competition that cannot be easily unwound if an auction fails. For example, it risks:
 - undermining of competition, particularly in a market structurally at risk of distortions of competition such as Australia and further concentration of spectrum in the hands of Telstra could spark pressure for further industry consolidation;
 - uncertainty, which can have a chilling effect on investment and the deployment of new technology;
 - disruption to service continuity, quality and coverage if incumbents lose access to spectrum that is in use since it may take time to bring new equipment or resources on stream to replace lost spectrum;
- Some leading countries which use auctions for initial awards of spectrum recognise this and have instituted a strong presumption of renewal to incumbents for ESLs;
- Moreover, if the spectrum is re-auctioned and the result is that the MNOs reacquire the spectrum this would be a failure of the auction process and public policy with no new use being identified but considerable disruption to the industry (and networks) should not be underestimated. If the auction resulted in further consolidation this would be a failure in competition policy

⁴¹ <https://www.legislation.gov.au/Details/F2012L00235/Explanatory%20Statement/Text>

Appendices: Benchmarking spectrum prices

Appendix A: Summary

Background

Telstra voiced support for benchmarking as the best determinant of market price and stated that benchmark prices show a declining trend. In the following it is shown that prices paid for spectrum licences at auction other countries say nothing about the value of spectrum to operators in Australia. Secondly, it has not been possible to replicate Telstra's finding from Telstra that "spectrum prices are falling".

Prices paid in spectrum auctions are in a large part driven by spectrum policy

Using benchmarks from prices paid for spectrum at auction in other countries in the past to assess the value of spectrum in Australia is misguided. Essentially benchmarking relies on calculating an average price paid in different countries at different times. However, prices paid at auction are in a large part driven by spectrum policy.

For example, in Italy operators paid three to seventeen times more for the same spectrum than operators in Finland. Adopting the Finnish approach to making spectrum available for a near nominal price would in effect mimic spectrum policy in Finland whereas adopting the Italian approach to maximise auction revenues would align Australia with spectrum licence fee policy in Italy. Calculating an average of the two is pointless. Australian policy makers need to be clear as to how they want to deliver the value of spectrum to Australian society.

The value of spectrum accrues to society and not to investors in mobile operators

A fundamental fallacy is to equate the prices operators paid for spectrum with the value of spectrum without stating to whom the value ultimately accrues. In a competitive market, prices decline to the point where operators just earn their cost of capital. There is no evidence that low spectrum prices increase enterprise value. However, data from the ACCC Communications Market Reports shows that between 2014 and 2022 mobile services retail prices in Australia declined by 79% in real terms. During the same period operators' Return on Invested Capital did not increase. In fact, Optus' ROIC at 2% is well below its cost of capital. This demonstrates that the value of additional spectrum accrues to consumers and not to investors.

A situation where the returns are consistently below the cost of capital is not sustainable. Investment will decline and the Australia market will become less competitive. This is a very real danger for Australia.

Using benchmarks to assess the value of spectrum is an unsound methodology

Benchmarking spectrum prices is widely used but it is an unsound methodology to estimate the value of spectrum to operators in Australia. In particular, benchmarking has a number of problems:

- Benchmarking is backward looking and hence not appropriate to use for pricing spectrum licences with licence terms from 2028 to 2042/44.
- The core assumption for benchmarking is that what a mobile operator paid for comparable spectrum in country A in year X is an indication of how much the same spectrum is worth to a mobile operator in country B in year Y. The wide range of prices paid for the same spectrum does not support this hypothesis.
- Benchmarking requires large datasets to be statistically significant. Usually, data from spectrum auctions covering more than a decade is collected and includes a wide variety of countries, local policies, and competitive situation.
- Adjustments need to be made for GDP, exchange rates, licence duration, annual fees, renewal, coverage obligations and other factors; this introduces subjectivity.

- Outputs from benchmarking exercises require interpretation: Should we benchmark against the arithmetic mean or the median? Should outliers be eliminated? Such adjustments create a degree of arbitrariness.
- Benchmarking lacks objectivity as is apparent from the debate on how benchmarks should be adjusted and used. Benchmarking is fundamentally flawed because the value of spectrum in a particular set of circumstances says nothing about the value of spectrum in another set of circumstances.

Prices paid for similar spectrum show a wide variation. There is an over 100 fold difference between the lowest and highest prices paid for similar spectrum. Even within a relatively homogenous set of countries spectrum prices for the same band in the same timeframe vary by a factor of 73. To calculate and average is meaningless.

Benchmarking is not appropriate set renewal prices in Australia

The Australian Government has a policy of developing digital Australia and recognises connectivity as a key tool to achieve this societal goal. The Minister wants the ACMA to “take a proactive regulatory approach, with particular expectations that the regulator promote investment, innovation and the adoption of new and emerging technologies, while continuing to safeguard the interests of consumers and small businesses.”⁴² Using benchmark prices from past spectrum auctions in countries which mostly did not have, or still do not share, Australia’s policy objectives is not appropriate.

If a benchmark is to be used, it is that of Finland, where very low spectrum prices in combination with indefinite licence terms delivered four times higher data usage per capita compared to its peers which charged considerably higher fees for spectrum licences.

Appendix B: Introduction

Spectrum pricing in the context of spectrum policy in Australia

The long-term public interest is the key for the ESL renewal and this policy should inform ESL renewal pricing.

The regulatory framework for spectrum licence renewal is set out in the Radiocommunications Act 1992 (the Act)⁴³ and the Radiocommunications Legislation Amendment (Reform and Modernisation) Act 2020 (the Modernisation Act 2020) which revised the Act.

Broadly speaking the ACMA has the power to decide whether to offer ESL holders the opportunity to renew licences on payment of a charge determined by the ACMA, or to not renew the licences and re-assign them, most likely by auction⁴⁴. However, the Minister for Communications, Urban Infrastructure, Cities, and the Arts can provide guidance on relevant policy objectives through Ministerial Policy Statements (MPS).

The critical assessment that the ACMA must make under the Act is whether renewal is in the long-term public interest. The public interest is broadly defined in the Act as “providing for the management of the spectrum in a manner that:

- facilitates the efficient planning, allocation and use of the spectrum;
- facilitates the use of the spectrum for:
 - commercial purposes;
 - defence purposes, national security purposes and other non-commercial purposes (including public safety and community purposes); and
- supports the communications policy objectives of the government.”⁴⁵

⁴² Minister Michelle Rowland, 12 December 2022

⁴³ Section 77C on the ACMA’s power to renew a spectrum licence

⁴⁴ The ACMA could also decide to partially renew licences to the existing holders

⁴⁵ Section 3 of the Act as revised by the Modernisation Act 2020

The ACMA set out its initial views on how it would do this in its ESL Consultation. Noting that the term public interest was not well defined in the Act, it proposed five criteria to guide its considerations:

- facilitates efficiency (often divided into allocative, productive and dynamic efficiency);
- promotes investment and innovation (also encouraging productive and dynamic efficiency);
- enhances competition;
- balances public benefits and impacts; and
- supports relevant policy objectives.

Section 294 of the Act gives the ACMA the power to set charges for spectrum licences and provides the ACMA with considerable discretion on how to set charges. Furthermore, the Minister has the power to give directions to the ACMA on setting charges and examples of what this may cover include setting charges that “reflect the amount that the Minister considers to be the value of the spectrum”.

The Minister may be minded to proposing spectrum price benchmarking to determine the value of spectrum in Australia. In this paper we provide evidence that looking at what prices were paid for spectrum in the past in Australia and in other countries is inappropriate.

Structure of the analysis

In the following sections we:

- explain that prices paid in different countries are a function the policy objectives of the particular country;
- show that the value of spectrum accrues to society and not to investors and hence placing a high price on spectrum is a form of taxation and provide a specific example showing the how pricing for 700 MHz spectrum in New Zealand harmed competition;
- highlight that using benchmarks is a backward-looking methodology whereas the renewed spectrum licences would cover the period 2028 to 2043 / 2048; and
- outline the rationale for benchmarking spectrum prices and explain the imitations of using benchmarking.

Appendix C: The impact of policy objectives on prices paid for spectrum

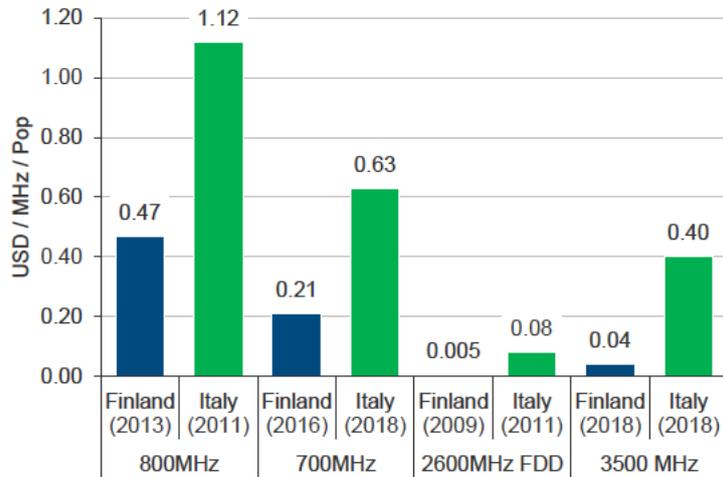
Some countries have an objective to maximise Government revenue from the assignment and continued use of spectrum rights, whereas others aim to make as much spectrum available as possible, as early as possible and at the lowest possible price.

Prices paid for 700 MHz spectrum in Italy vs. Finland serves as an illustration. Policy makers in Italy consistently had revenue maximisation objectives whereas policy makers in Finland did not. As a result, Italian operators consistently paid far more for spectrum than operators in Finland:

- 2.4 times more for 800 MHz spectrum
- 3.0 times more for 700 MHz spectrum
- 17.5 times more for 2600 MHz (FDD) spectrum
- 9.7 times more for 3500 MHz spectrum

Furthermore, spectrum licences in Finland are effectively perpetual, whereas licences in Italy expire after the initial period.

Exhibit 8: Spectrum prices paid Finland vs. Italy



Source: Coleago spectrum auction database

Adopting the Finnish approach to spectrum pricing would in effect mimic spectrum policy in Finland, whereas adopting the Italian approach to spectrum pricing would align Australia with spectrum licence fee policy in Italy. Calculating an average of the two is pointless.

Australian policy makers have clearly stated how they want to deliver the value of spectrum to Australian society. The Australian Government has a policy of developing digital Australia and recognises connectivity as a key tool to achieve this societal goal. The Minister wants the ACMA to “take a proactive regulatory approach, with particular expectations that the regulator promote investment, innovation and the adoption of new and emerging technologies, while continuing to safeguard the interests of consumers and small businesses.”⁴⁶

Therefore, if a benchmark for pricing spectrum is to be used, it is prices paid in Finland (see Exhibit 9 below), where very low spectrum prices in combination with indefinite licence terms delivered four times higher data usage per capita compared to its peers which charged considerably higher fees for spectrum licences (see Appendix A).

Exhibit 9: Benchmark spectrum prices paid in Finland

Band	Year	€/MHz/Pop	AUD/MHz/pop
2600 MHz FDD	2009	0.003	0.005
2600 MHz TDD	2009	0.006	0.009
800 MHz	2013	0.342	0.551
700 MHz	2016	0.199	0.321
3500 MHz	2018	0.036	0.058

Source: FICORA / Traficom

Appendix D: The socio-economic value of spectrum

It is a fundamental fallacy to equate the prices operators paid for spectrum with the value of spectrum without stating to whom the value ultimately accrues. In a competitive market, prices decline to the point where operators just earn their cost of

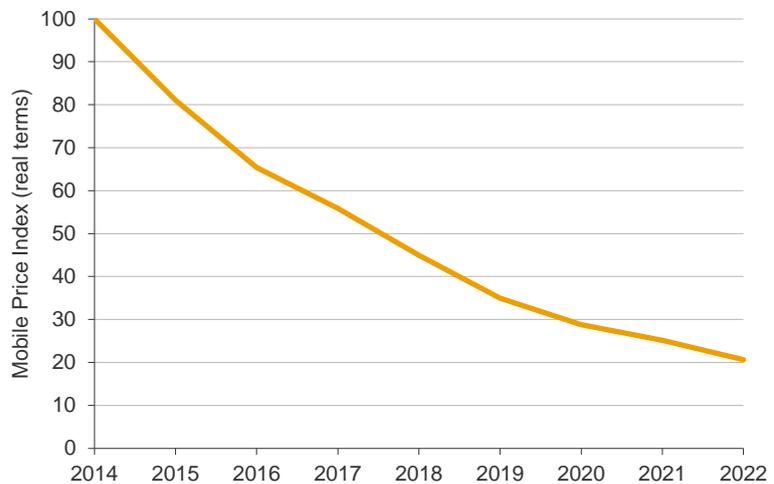
⁴⁶ Minster Michelle Rowland, 12 December 2022

capital. There is no evidence that low spectrum prices increase enterprise value. However, there is ample evidence that the investment to deploy additional spectrum generates consumer benefits. Exhibit 10 shows the decline in mobile retail prices in Australia between 2014 and 2022. The analysis is based on the price declines⁴⁷ reported in the ACCC Communications Market reports covering this period. The price declines are reported in nominal terms. The observation covers eight years and hence we have adjusted prices for inflation⁴⁸ and calculated an index with 2014 = 100.

The data shows that between 2014 and 2022 retail prices declined by 79% in real terms. During the same period operator's Return on Invested Capital did not increase. In fact, Optus' ROIC at 2% is well below its cost of capital. This demonstrates that the value of additional spectrum accrues to consumers and not to investors.

A situation where the returns are consistently below the cost of capital is not sustainable. Investment will decline and the Australia market will become less competitive. This is a very real danger for Australia.

Exhibit 10: Mobile retail price decline in Australia



Source: ACCC Communications Market reports and Coleago calculations

The finding that social gains far outweigh the benefit of any immediate gains from collecting spectrum licence fees has been understood for many years and is well documented in a 2010 paper by Hazlett and Munoz:

*"[T]he ratio of social gains [is of] the order of 240-to-1 in favour of services over licence revenues...Delicate adjustments that seek to juice auction receipts, but which also alter competitive forces in wireless operating markets are inherently risky. A policy that has an enormous impact in increasing licence revenues need impose only tiny proportional costs in output markets to undermine its social utility. In short, to maximise consumer welfare, spectrum auctions should avoid being distracted by side issues like government licence revenues."*⁴⁹

In the past there was still a rationale in spectrum auctions to ensure that new spectrum is allocated efficiently and hence the negative societal impact of high spectrum prices may have been a price worth paying. In Australia's ESL renewal process this rationale does not exist and hence the focus of spectrum pricing should be the value to society.

⁴⁷ Feature-adjusted price changes (%) for the hedonic approach

⁴⁸ All groups CPI and Trimmed mean, Australia, annual movement (%), Australian Bureau of Statistics

⁴⁹ Hazlett and Munoz, What Really Matters in Spectrum Auction Design, 2010

Appendix E: The impact of spectrum licence fees on competition

Spectrum auctions were initially introduced to deliver “efficient” use of spectrum and to ensure that the assignment process was transparent and objective. What do policy makers mean when they talk about “efficiency” in spectrum assignments? An efficient assignment of spectrum means assigning spectrum to those who generate the greatest economic value to society from the use of the spectrum.

*“The key goal of any auction is to guide goods to those who value them the most. Spectrum auctions help identify the highest value use and users”.*⁵⁰

In a spectrum auction which is unconstrained by allocation limits, the value of spectrum from gaining competitive advantage or even driving a competing operator out of business is significant. However, if as a result of such an unconstrained auction a competitor ends up significantly weakened or driven out of the market this does deliver value to consumers.

*“The private value for incumbents includes benefits gained by preventing rivals from improving their services. The value of keeping spectrum out of competitors’ hands could be very high. However, this ‘foreclosure value’ does not reflect consumer value.”*⁵¹

The 700MHz auction in Australia in May 2013 provides an example of how private value differs between operators.

- There was an allocation limit of 2x25MHz. Vodafone and TPG did not bid, which indicates that the value of the spectrum to these operators was less than the reserve price. Optus could have acquired 2x20MHz at the reserve, but only acquired 2x10MHz. The business case of a particular operator and the ability to finance the spectrum acquisition lead to an uneven outcome. Clearly there was no “market price”.
- Telstra had a materially higher market share and hence could achieve a sufficiently high value for 2x20 MHz and had the ability to finance the acquisition. The cost of deploying 700MHz radios does not depend on the amount of spectrum deployed in a radio. Therefore the deployment cost per MHz of spectrum to Telstra is 50% lower than for Optus. As a result of the auction Telstra deepened its cost advantage over Optus. These dynamics mean that competition in mobile network operation may not be sustainable in the long term if the cost of spectrum continues to add significantly to the fixed cost base of an operator.

The 700 MHz auction in New Zealand in 2013 provides an illustration of the negative impact on competition of high spectrum licence fees because it handed competitive advantage to the dominant operator in form of lower deployment costs

Exhibit 11: The 700 MHz auction in New Zealand

New Zealand is geographically a large country with a relatively small population of 4.5 million and hence low population density. In 2013, the mobile market was dominated by Vodafone and Telecom New Zealand, now Spark. The recent new entrant 2degrees Mobile has a small market share and significant coverage and spectrum disadvantage.

In 2013, band 28, consisting of 2 x 45 MHz of spectrum, was put up for auction in two stage auction.

- Stage 1, a spectrum cap of 2 x 15 MHz for each operator; and
- Stage 2, if there is unsold spectrum after stage 1, then end cap is removed.

⁵⁰ New Zealand Ministry of Business, Innovation and Enterprise, May 2013

⁵¹ US Department of Justice, Ex Parte Submission before the FCC, April 2013

The reserve price was set at NZ\$ 22 million per 2 x 5 MHz block were significant (0.40 US\$ / MHz / pop)

In stage 1 of the auction all three operators acquired spectrum at the reserve price:

- Vodafone: Three blocks @ NZ \$68 million
- Spark: Three blocks @ NZ \$68 million
- 2degrees: Two blocks @ NZ \$44 million.

Due to its small size and resulting lack of economies scale, 2degrees' valuation for three blocks was below NZ\$ 66 million and hence it only bid for 2 blocks.

In stage 2 Vodafone and Spark bid for the last remaining block.

- Spark paid NZ\$ 90 million for the last block.

There are two insights from this auction – firstly, with regard to the misleading nature of benchmarks and secondly, with regard to the weakening of competition.

Calculating a benchmark price and using this to assess the value of 700 MHz spectrum does not make sense. The benchmark price is neither representative of the value of spectrum to 2 degrees nor to Spark.

- Total auction receipts for 2 x 45 MHz amounted to NZ\$ 270 million. The average price per 2 x 5 MHz block was NZ\$ 30 million.
- 2degrees did not buy the third 2 x 5 MHz block for NZ\$ 22 million because it was worth less than NZ\$ 22 million to them.
- Spark bought a fourth 2 x 5 MHz block for NZ\$90 million because it was worth at least NZ\$90 million to them.

Source: Coleago research based on data published by Radio Spectrum Management of New Zealand

Given their significantly larger market share Spark and Vodafone, even before the auction, had a significant cost advantage over 2degrees. As a result of the spectrum auction, Spark and Vodafone further extended their cost advantage over 2degrees. The cost of deploying 700 MHz radios does not vary with the amount of spectrum. Spark acquired 40 MHz (four blocks of 2 x 5 MHz) and 2degrees only 20 MHz (two blocks of 2 x 5 MHz). Spark can deploy 40 MHz in one 700 MHz radio whereas 2degrees has only 20 MHz available to deploy in a 700 MHz radio. Therefore, the cost per MHz deployed for Spark is 50% of the cost to 2degrees.

Exhibit 12: Prices paid for 700MHz spectrum in New Zealand



Source: RSM New Zealand

The cost of spectrum licence renewal fees will have a far greater impact on TPG and Optus compared to Telstra. Given its market dominance and ability to extract economies of scale, spectrum licence renewal fees would put the three-player market structure in Australia at risk. The reduction in competition is not in the public interest.

The lower the spectrum licence renewal fees, the lower the risk of Australia losing another facilities based mobile operator.

Appendix F: Benchmarking spectrum prices, uses and limitations

The rationale for benchmarking

The logic behind benchmarking is that if appropriate adjustments are made for population and GDP and assuming some similarities between the cost of setting up and running a mobile operation, in principle the value of comparable spectrum should be similar across different markets.

Benchmarks can be analysed in several ways:

- The arithmetic mean (commonly referred to as an average) is the simplest measure but the measure is distorted by outliers i.e., extremely high or extremely low prices in the data set. However, it could be argued that very low and very high values should be included in when calculating a benchmark average because these values are a reality.
- The median, i.e., the halfway point between the highest and the lowest value, is used primarily for skewed distributions. The median is a better indication of central tendency (less susceptible to the exceptionally large value in data) than the arithmetic mean. In most cases the mean is higher than the median.
- The range is defined as the difference between the highest and lowest number in each data set. The range provides an indication of what prices may be considered realistic, depending on the factors which impact on operator's spectrum valuations in a particular country. There may be reasons for a wide range. For example, as a matter of policy a government might have decided to offer spectrum at a very low price. A high price may be the result of spectrum scarcity in a particular market.

Looking at how much mobile operators paid for spectrum at auctions is widely used to assess how much a spectrum asset may be worth. Prices paid in the past are used as benchmarks. Benchmark prices are calculated on a US\$ per MHz per head of population (\$/MHz/pop). Given that the benchmark dataset includes countries with very different levels of GDP per capita, \$/MHz/pop prices are normalised using per capita GDP or per capita Purchasing Power Parity⁵² (PPP) per capita GDP.

In the past, prices paid for spectrum differed substantially depending on the frequency range. Benchmark prices are calculated separately for low-band spectrum (<1 GHz), lower mid-band spectrum (between 1 and 3 GHz) and upper mid-band spectrum (above 3 GHz).

Further adjustments might be made to account for differences in licence duration, licence obligations such as coverage obligations, demand vs. supply, operator profitability, the auction format and rules, presence of spectrum caps, set-aside from new entrants, or some other material factor.

Benchmarks are backward looking

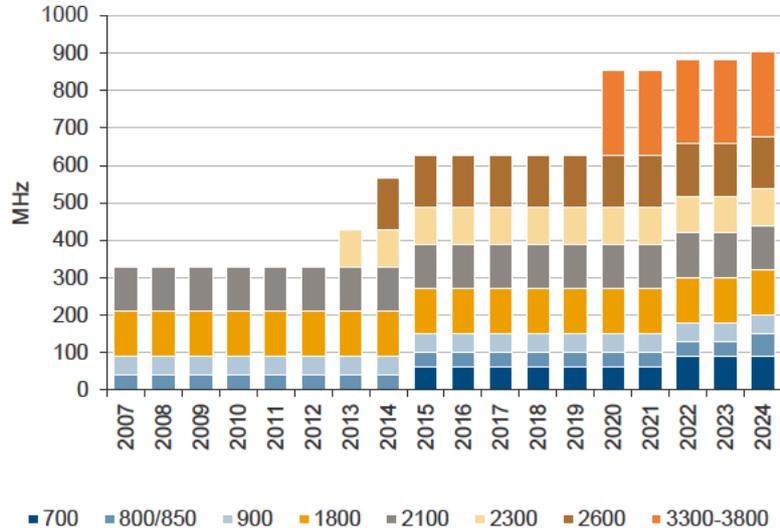
Many regulators use benchmarking to determine the reserve price or the price for an administered assignment or renewal. They look at prices paid in other countries in terms of \$ / MHz / per head of population and adjust, for example for differences in per capita GDP.

Using benchmarking to set spectrum licence fees is not appropriate because it is backward looking rather than forward looking. During the last ten years, the amount of spectrum allocated to mobile has increased and will continue to increase. Exhibit 13

⁵² Purchasing power parity (PPP) The rate at which the currency of one country would have to be converted into that of another country to buy the same amount of goods and services in of the two each country.

shows all low and mid band spectrum allocated to mobile operators in Australia by band in the period 2007 to 2024. In addition, in 2021, 2400 MHz of mmWave spectrum (26 GHz) was acquired by mobile operators.

Exhibit 13: Spectrum licenced to mobile operators



Source: ACMA, excludes mmWave.

Note: The dates are from when spectrum was available to mobile operators nationally or regionally.

The graphs below show how revenue per MHz declined in Australia from 2007 to 2022. They illustrate the challenge for mobile operators to generate an appropriate return⁵³ on capital by expanding the revenue side of the equation.

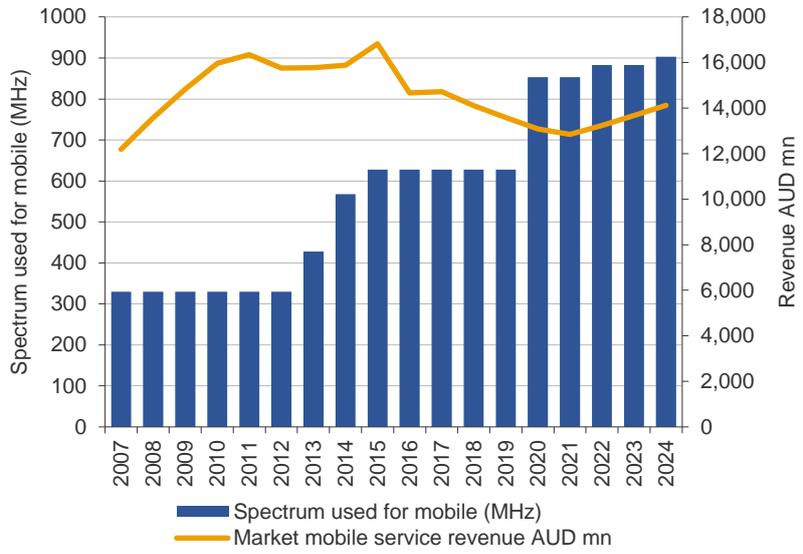
Exhibit 14 shows operator mobile service revenue and the amount of spectrum (excluding mmWave) used to produce that revenue for all mobile operators. Exhibit 15 shows that revenue per MHz used to produce that revenue is declining rapidly. Exhibit 16 and Exhibit 17 show the same data but include mmWave spectrum. The charts show that revenue is increasing marginally but the amount of spectrum used to produce that revenue is increasing rapidly.

This is evidence that additional spectrum does not increase revenue and that operators are passing the benefit of additional spectrum on to consumers and businesses who use mobile services. The need for spectrum is driven by the sharp increase in mobile data traffic. The spectrum is used to increase capacity and reduce the cost per bit. A lower cost per bit allows operators to pass on the benefit of additional spectrum to mobile users in the form of lower prices and higher data speeds. Lower prices may also reflect the fact that dramatic increases in average usage have allowed more efficient spectrum utilisation.

As a result, additional spectrum delivers socio-economic value far more than private value to operators. Furthermore, given that the mobile service revenue per MHz of spectrum used has declined sharply, spectrum renewal fees should in fact be substantially lower, on a per MHz basis, compared to what was paid in the past.

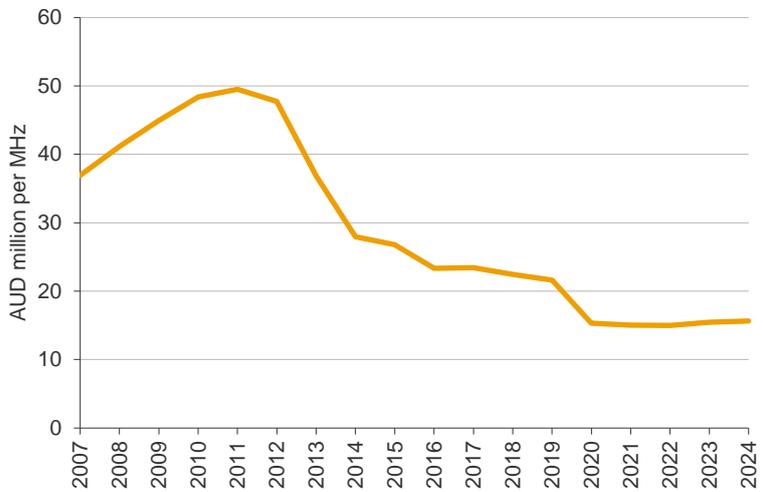
⁵³ We do not seek to quantify what an appropriate return on capital should be here. Rather, the issue is that operators need to generate cash to cover network and spectrum costs plus the cost of capital or they would not be able to compensate investors and finance their investment

Exhibit 14: Spectrum (excl. mmWave) used and mobile service revenue



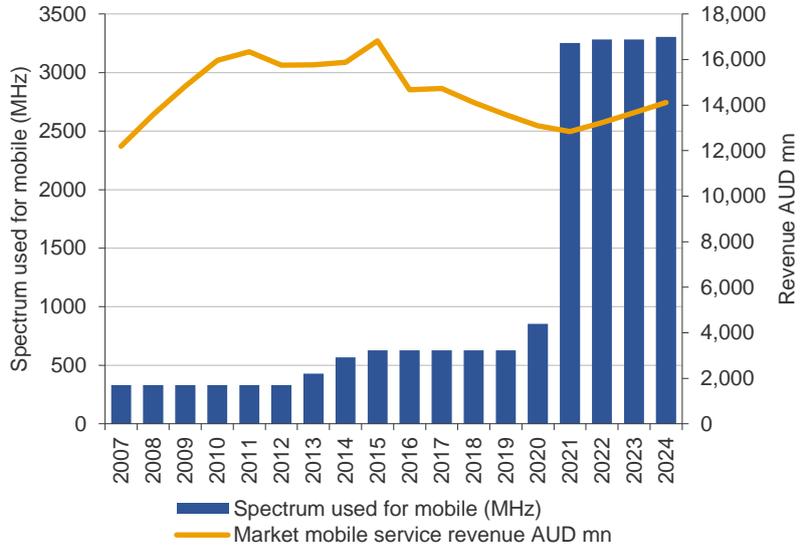
Source: Coleago, based on data from ACMA, Optus, and Bank of America Global Wireless Matrix. 2007 to 2022 are actuals. 2023 and 2024 are forecasts

Exhibit 15: Mobile service revenue per MHz of spectrum (excl. mmWave)



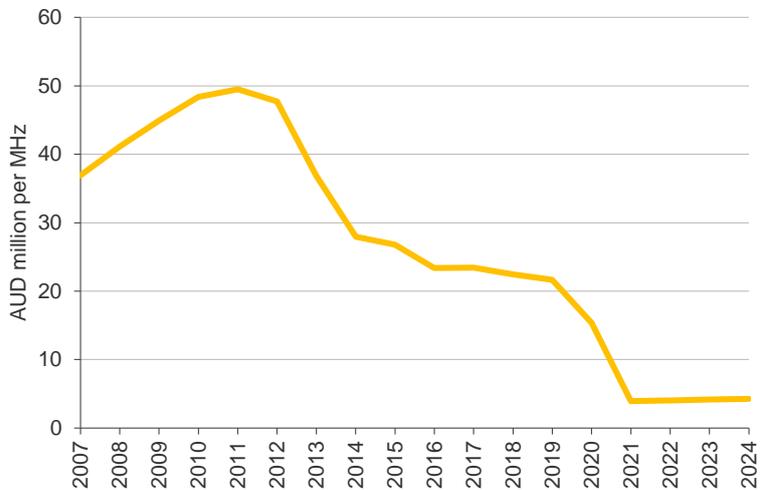
Source: Coleago

Exhibit 16: Spectrum (incl. mmWave) and mobile service revenue



Source: Coleago, based on data from ACMA, Optus, and Bank of America Global Wireless Matrix. 2007 to 2022 are actuals. 2023 and 2024 are forecasts.

Exhibit 17: Mobile service revenue per MHz of spectrum (incl. mmWave)



Source: Coleago

Limitations of benchmarking

The spectrum price benchmark data shown in this report should not be confused with a spectrum valuation exercise. The value of a particular spectrum asset is specific to a particular operator in a particular market and can only be ascertained through business modelling, i.e., what is the impact on cash flow of buying or not buying a particular spectrum asset.

Benchmarking is not a substitute for spectrum valuation. Benchmarks merely show what was paid by an operator in a particular market and set of circumstances but not the value of spectrum to another operator under a different set of circumstances.

There are factors which result in very different outcomes in terms of prices paid and even unsold spectrum. Auction format and rules, allocation limits (often referred to as spectrum caps), supply of spectrum at an auction vs. demand, reserve prices and other conditions, result in differences between prices paid. Set asides for new entrants have created artificial scarcity and auction rules can lead to very different prices being paid in the same auction for blocks within the same band e.g., Denmark's 2600 MHz auction.

Some benchmarking exercises attempt to adjust auction prices for other factors, for example the duration of a licence which can vary from ten years to perpetuity. However, duration is only one of many licence terms and there are many other variables for which an adjustment would be required.

In spectrum auction price benchmarks there is a wide range of auction results for any spectrum band across the world. From our research the outcome is dependent on several variables:

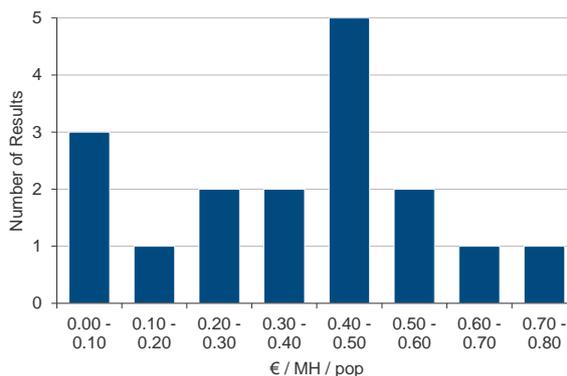
- The relative wealth of the country matters; there is correlation between mobile service revenue and GDP.
- Policy with regard to spectrum reserve prices is a key factor in explaining differences in spectrum auction prices paid between countries.
- Some regulators have deliberately created spectrum scarcity to drive up the gap between supply of spectrum and demand for spectrum, thus driving up prices paid.
- The competitive dynamic in an auction is a key factor in determining prices paid. Where there are more bidders for spectrum this tends to drive prices higher. There tends to be more competition in an initial licence award compared to a renewal award.
- Prices paid for spectrum are impacted by auction design and rules, the approach to spectrum lot packaging by the regulator and the amount of spectrum offered in the auction, whether there are allocation limits as to how much spectrum an operator can acquire, and the presence of set-aside for new entrants.
- The value of a block of spectrum depends on what other spectrum can be acquired with it. This fact is the motivation for using a combinatorial spectrum auction format such as a Combinatorial Clock Auction (CCA) where operators bid for packages of spectrum rather than individual lots.
- The duration of the spectrum licence impacts the results of auctions. Operators will be willing to pay a higher amount for spectrum which is available for a longer period.
- The current spectrum holding of the operator impacts their need for further spectrum and determines the network capital and operating cost avoidance opportunity of acquiring further spectrum.
- The level of fixed annual licence fees in addition to the up-front auction-determined price varies between countries. For example, in Mexico the annual (non-auction dependent) licence fees represent two thirds of the NPV price of a typical ten-year licence. Hence if the up-front auction price paid is a relatively low number, this says nothing about the true cost of the licence to an operator. Due to high annual fees, the cost of spectrum to operators as a percentage of revenue is one of highest in the world.
- In some countries there is an initial licence duration but with a presumption of perpetuity. In other countries there is presumption of perpetuity.
- Some licences have onerous coverage obligations; others do not.

- Most countries allow amortisation of the licence fees, but some do not.
- Some spectrum licences have mandated MVNO access; others do not.
- The timing of an auction is relevant in the context of technology diffusion, e.g., the adoption of 5G and band availability in smartphones.
- The financial situation of operators and their ability to raise funds to finance the spectrum acquisition.
- The weighted average cost of capital (WACC) which is used as the discount rate to value spectrum varies over time and hence operator's spectrum valuations differ over time.
- The need for spectrum by operators varies over time. Demand for spectrum has increased significantly in the last decade as data usage has accelerated. Prior to 2000, spectrum prices were lower than the current levels as less spectrum was required to meet demand for voice usage. However, prices paid during the 2001 dotcom boom for 3G licences have not been replicated in later years.
- Many countries have poorly developed fixed networks and hence Wi-Fi is not available as a substitute to mobile access.

These aspects vary hugely from country to country and year to year. Attempts have been made to adjust for these factors, but this introduces considerable subjectivity. However, there are so many of these factors and regression analysis on a small dataset is inconclusive. and adjustments.

It might just about be plausible to conclude that benchmarking is an appropriate measure if prices paid for the same spectrum were clustered around the mean in the form of a normal distribution. However, clearly this is not the case as can be seen from the result of seventeen European countries for prices paid at auction for 800 MHz presented in Exhibit 2 below: The lowest price paid was €0.01 / MHz / pop and the highest €0.73 / MHz / pop. There is a very wide range, i.e., a factor difference of 73 between the lowest and the highest price paid. Therefore, calculating an average is not at all representative of the data set. In fact, calculating an average is highly misleading because it suggests some meaningful central value.

Exhibit 18: Range of prices paid for 800 MHz spectrum in Europe



Source: Coleago

The same conclusion can be drawn from the larger dataset used from our world-wide spectrum price benchmarking study for low-bands (sub-1 GHz), lower-mid bands (1GHz to <3GHz), and upper mid-bands (3.3GHz to 4GHz). xxx below shows the mean median, maximum, and minimum prices paid at auction in GDP adjusted AUD per MHz

per head of population (AUD/MHz/pop) for the three data sets. The data includes 366 auctions results during the past 15 years

Exhibit 19: Prices paid for spectrum AUD/MHz/pop

AUD/MHz/pop	Low band	Lower-mid band	Upper-mid band
Mean	1.259	0.481	0.302
Median	1.094	0.217	0.141
Minimum	0.064	>0.000	0.009
Maximum	7.335	4.328	3.271

Source: Coleago spectrum auction database

Despite the relative inconclusiveness of calculating an average in a dataset with a wide range, averages are often calculated. However, if an average is calculated to make inferences, then the median is better than the mean because it is a better representation of the central value of a dataset. This is particularly relevant when there is a very wide range in the dataset (as is the case with spectrum price benchmarks) because outliers have a disproportionate effect on the mean. Therefore, if benchmarking against average spectrum prices, then the median rather than the mean is appropriate.

The most appropriate use of benchmarks is to assess where a valuation sits within the range of benchmarks. If a value is at the upper or lower end of the range or even outside the range, this may warrant investigation as to why this is the case.

Erroneous notion of market value of spectrum

Benchmarking is an attempt to ascertain a market value of spectrum. Given the wide range of prices paid, clearly there is no market value, not even within a country. The example of the 700MHz auctions in Australia and New Zealand demonstrate that a particular amount of spectrum has considerably different value, depending on the business case of an operator.

No trend in prices paid at auction

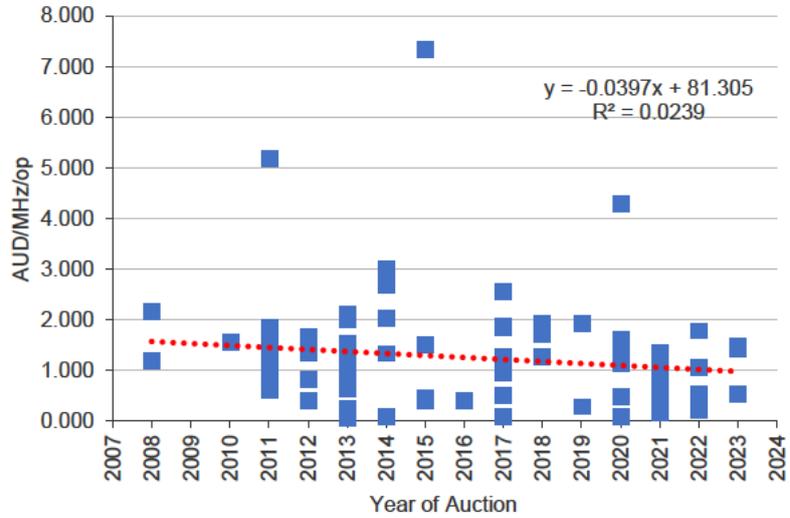
Prices paid for spectrum at auctions during the past 15 years are analysed in this section. The dataset only includes IMT (mobile spectrum) for auctions where data was publicly available for prices paid for particular bands. For Simultaneous Multi-Round Ascending (SMRA) auctions the data is usually available but for Combinatorial Clock Auctions (CCA) the data how much was paid for a particular band is rarely available. Hence most CCAs are not included in our analysis.

We did not discover a clear upward or downward trend. However, there appears to be a constant: Jurisdictions with low spectrum prices consistently have low spectrum prices and those with a high prices consistently have high prices. The comparison of prices paid in Finland vs Italy as shown in Exhibit 8 is a good example of this finding.

Our analysis confirms that policy with regards to pricing spectrum is a key determinant of prices paid at auction. It validates the conclusion that benchmarking spectrum prices is akin to importing the policy decisions of other jurisdictions.

Exhibit 20 below shows prices paid for low-band spectrum (sub-1GHz) in AUD/MHz/ per head of population (AUD/MHz/pop), adjusted for GDP per capita to normalise data to the Australian economy. The dataset includes 84 auctions. A linear trend line shows an R^2 value of 0.02, i.e. time does not explain variations in prices paid, i.e. there is no discernible trend in prices paid for spectrum. The chart also shows that there is a very substantial difference between the lowest and highest price paid in any particular year. These variations are due to Government policy with regards to spectrum pricing as well as the factors listed under 0 above.

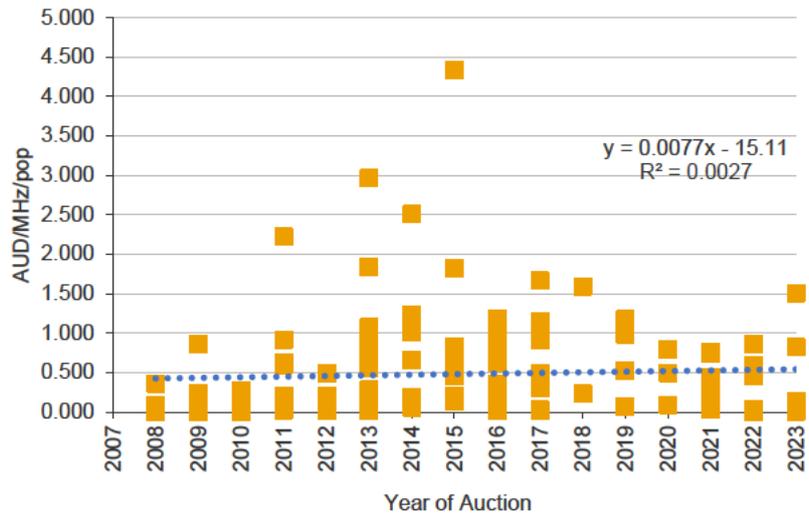
Exhibit 20: Low-band spectrum prices paid at auction



Source: Coleago spectrum auction price database

Exhibit 21 below shows prices paid for lower-band spectrum (above 1GHz but below 3.3 GHz) in AUD/MHz/pop. The dataset includes 134 auctions. A linear trend line shows an R^2 value of less than 0.01, i.e. time does not explain variations in prices paid. Even if high price “outliers” are removed, it is not possible to conclude that prices either increase or decrease over time. As with low-band spectrum, the chart also shows that that there is a very wide range of prices paid in any particular year.

Exhibit 21: Lower-mid band spectrum prices paid at auction

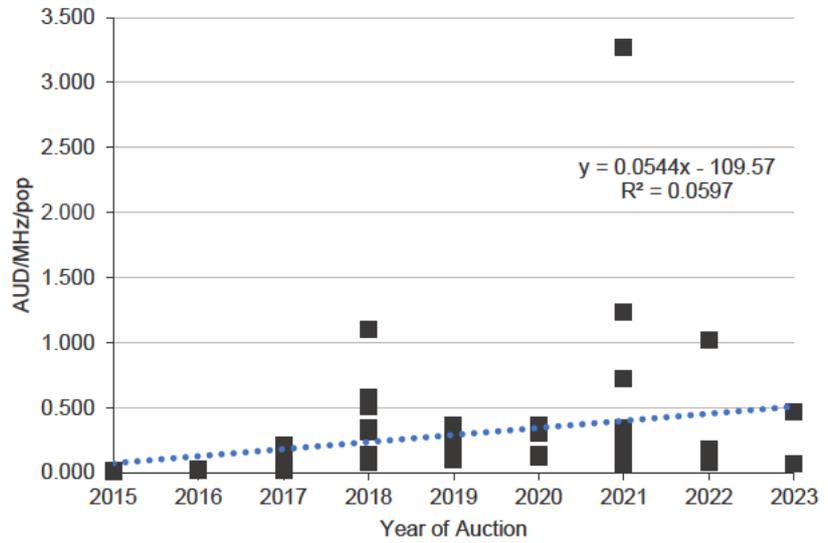


Source: Coleago spectrum auction price database

Exhibit 22 below shows prices paid for upper-band spectrum (above 3.3 GHz, essentially the C-Band) in AUD/MHz/pop. This smaller dataset includes 48 auctions since 2015. A linear trend line shows an R^2 value of less than 0.06, which means time is not a good variable to explain variations in prices paid, i.e. there is no discernible trend over time. Even if high the very price “outliers” is removed, it is not possible to

conclude that prices either increase or decrease over time. As with low-band and lower-mid band spectrum, the chart also shows that there is a very wide range of prices paid in any one particular year.

Exhibit 22: Upper-mid band spectrum prices paid at auction



Source: Coleago spectrum auction price database