Expiring Spectrum Licences: Stage 2 Consultation

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

Public submission

5 June 2024

Executive Summary

We welcome the opportunity to provide our submission to the Australian Communications and Media Authority's (ACMA's) Stage 2 consultation on Expiring Spectrum Licences (ESLs).

Mobile networks and services are integral to our daily lives and are deemed as critical infrastructure under the SoCI Act.[1] They play a pivotal role in underpinning our economy and provide life-saving emergency calls to Triple Zero. Mobile networks support teleworkers, field workers and people who travel for work, EFTPOS terminals and secure access to business systems and banks through two-factor and multi-factor authentication. Our submission demonstrates that the ongoing use of ESL spectrum by the incumbent licensees is the optimal use of the spectrum. Further, the removal of even just a portion of this spectrum will have an adverse impact on service continuity, meaning that there will be an immediate degradation in the quality, reliability and resilience of services that consumers and businesses currently enjoy and rely on. Consequently, continued use of the spectrum by the existing licensees manifestly and completely satisfies the public interest criteria along with meeting the Minister's policy objectives and priorities.

The key points of our submission are:

- Mobile networks are the **optimal use** of ESL spectrum and fully satisfy the public interest criteria and the objectives of the Ministerial Policy Statement.

- Where ESL spectrum is actively used, or is demonstrably planned to be used by Mobile Network Operators (MNOs), the incumbent licensee **must** be offered the opportunity to renew their licences (should they so choose) at a sustainable market price. Not doing so will have an enduring adverse impact on service continuity.

- The benefits arising from allowing incumbent ESL licensees to renew their spectrum are predictable and likely to occur, as are the adverse effects on service continuity if the licences are not renewed. In contrast, the potential benefits from new entrants and / or alternative uses are much less certain. While it is appropriate for ACMA to consider whether there are alternative new cases that could plausibly have higher value than the current use, any such assessment should place greater weight on benefits associated with continuity of use that are certain than uncertain and hypothetical benefits associated with new use cases.

- The innovative and emerging use cases that we have identified would be most efficiently provided either as dedicated applications on public mobile networks or through direct commercial partnerships with primary spectrum holders, and do not require separate access to ESL spectrum.

- Where an incumbent ESL licensee elects not to renew their spectrum, or the spectrum is unused with no demonstrable plans to use it (making it ineligible for renewal), the spectrum should be reallocated promptly using a market mechanism (auction). Competition limits on spectrum acquisition should be reassessed and relaxed for ESL Spectrum that is reallocated, as there is otherwise a risk that the spectrum lies fallow, providing no benefit to Australians.

- We support the use of the use it or lose it (UIOLI) alternative licence condition on renewed ESL licences to drive better quality and coverage of services in rural and regional Australia.

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[1] Section 9(1)(a), *Security of Critical Infrastructure* (SoCI) *Act (Cth) 2018*.
https://www.legislation.gov.au/C2018A00029/latest/text

Satisfying the ACMA's Public Interest Criteria

Our mobile network's use of the ESL spectrum satisfies each of the five Public Interest Criteria set out by the ACMA:

1. Our network deployment is designed to maximise allocative, dynamic and productive efficiency through our constant refresh of technology and solutions such as small cells and active antenna systems, which allow us to deliver higher data rates and better quality services;

2. Our use of spectrum promotes investment and innovation, as evidenced by our commitment to regional and rural Australia and by the number of Mobile Virtual Network Operator (MVNO) partners supported on our network;

3. Mobile network operators facilitate retail competition, as evidenced by the myriad mobile service providers and competitive mobile plans.[2, 3] Telstra facilitates this competition through the wide array of customisable attributes we provide our MVNO partners on our wholesale mobile platform. This enables them to tailor solutions for different demographics and markets, fostering strong competition at the retail level;

4. Renewing our use of spectrum maximises public benefit while minimising impact. Reducing MNO spectrum in any way would immediately adversely impact end users by degrading quality, reliability and resilience of mobile networks. We have not identified any conceivable use of the spectrum that could exceed the public benefit MNOs provide nor mitigate the immediately adverse impacts of non-renewal (including an attempt to introduce a fourth operator or neutral host operator); and

5. We fulfil the relevant policy objectives and priorities of the Government through the provision of mobile communications services and our considerable investment in regional and rural Australia, including projects specifically for First Nations people as part of the National Agreement on Closing the Gap Target 17.

Satisfying the Ministerial Policy Statement

Stage 2 of the ESL process is where the five objectives set out by the Minister in her Ministerial Policy Statement[4] (MPS) will be tested, and incumbent licensees are best placed to fulfill the objectives, provided the correct decisions are made:

1. Continuity of service, particularly where no alternative is available, is an important first objective. Any reduction in MNO spectrum would have an adverse impact on continuity of service, which would worsen over time as traffic continues to grow. Where ESL spectrum is actively used, or is demonstrably planned to be used, the incumbent ESL licensee must be afforded the opportunity to renew their existing holdings. We strongly caution against geographic sub-division of low-band spectrum without the licensee's direct participation;

2. MNOs are best placed to facilitate innovative use cases, including LEO satellites, because of their existing infrastructure and ability to integrate with existing services. Continuity in spectrum portfolios will help MNOs plan and facilitate these new use cases, providing a high

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[2] WhatPhone, **Mobile Data in Australia is Some of the Cheapest in the World**, 9 April, 2024. Available at: https://whatphone.com.au/guide/mobile-data-in-australia-is-some-of-the-cheapest-in-the-world

[3] Cable.co.uk, The cost of 1GB of data in 237 countries. Australia ranks 39th globally (hover mouse over Australia on the map). Accessed, 5 June 2024. Available at: https://www.cable.co.uk/mobiles/worldwide-data-pricing/

[4] Radiocommunications (Ministerial Policy Statement – Expiring Spectrum Licences) Instrument 2024. Available at: https://www.legislation.gov.au/F2024N00367/asmade/text

and certain public benefit from renewal of ESL spectrum. In contrast, reflecting the maturity of the mobile market, the potential public benefits that might flow from the launch of a new entrant (for example a fourth MNO) are uncertain but more likely to be low;

3. Telstra has an excellent track record of regional investment. While investment in expanding the coverage of regional terrestrial networks, including co-investment, is reaching a point of diminishing return, we consider LEO satellites are well placed to expand regional coverage through direct commercial agreement with MNOs, in order to ensure seamless customer experience;

4. Consistent with the third Public Interest Criteria, we consider MNOs already substantially promote competition; and

5. Consistent with the second Public Interest Criteria, we consider MNOs have an excellent track record of sustained investment, and despite increasing economic pressure on investment returns, subject to spectrum renewal costs and certainty, we consider investment will continue well into the future as we begin deploying 5G Advanced imminently and 6G at the end of this decade.

Current and planned use of ESL spectrum

Stage 2 requires incumbent licensees to demonstrate how they plan to use the spectrum in the future, and we address this in chapter 5 of our submission. While mobile network traffic growth has slowed from the exponential growth rates of circa 50% year-on-year in the 2010s, the anticipated absolute increase in traffic over coming years is still substantial; in FY23, we saw traffic grow at 30% year-on-year. We also see a significant role for LEO Satellites with Direct-to-Mobile services shortly, and 6G at the end of this decade.

We continually optimise the way we use spectrum to ensure it is used efficiently, and to continue to grow our provision of megabits per megahertz per geographic area ratio. We already do this through a variety of techniques available today, including cell densification and the deployment of small cells, technology and protocol advances, and through the use of AI to optimise our networks and use of the spectrum. In this regard, given what we know today about potential alternative use cases or uses of the spectrum that may arise in the future, renewing the ESLs is clearly the approach most likely to ensure the spectrum is used efficiently and effectively to satisfy the public interest to the greatest extent possible.

Regarding future use, we oppose the reservation or allocation of dedicated spectrum for bespoke use cases, a fourth operator or a neutral host. We are concerned that dedicated spectrum will lead to inefficient and suboptimal use of the spectrum for a variety of reasons including underutilisation, slow or no uptake of technological advances, cost, and the possibility of interference if the bespoke use case is not compatible with adjacent use. We note that allocating spectrum to a new use case or entrant carries a low certainty of public benefit (there is a risk the new use case / entrant is unable to deliver a benefit) whereas there is a high certainty of degraded public benefit should spectrum be removed from MNO use. With respect to solutions for public and private use cases seeking dedicated mobile spectrum, we consider prioritised traffic solutions (such as Telstra's LANES® Emergency or Telstra Dedicated Networks) to be a far more efficient solution than building new networks.

Secondary trading has allowed the market to adapt and make more efficient use of spectrum, which is a sign of a healthy spectrum market and of healthy competition at the infrastructure level. We provide examples of secondary trading in section 6.2.

ESL spectrum use by MNOs could be further optimised through defragmentation within bands and across bands, as this would facilitate wider contiguous blocks of spectrum. Alignment of expiry dates on some of the ESL bands would help in achieving this outcome, and we provide three examples in section 6.3.

[C-I-C begins]

[C-I-C ends]

Alternative licence conditions

Due to the scarcity of spectrum, it is our strong view that spectrum must not be allowed to remain unused or under-used. If there is the potential for spectrum to go unused or under-used, a UIOLI condition on a renewed ESL licence will encourage the optimal use of the spectrum, leading to improved, especially in rural and regional areas. We support the introduction of a UIOLI licence condition on renewed ESL licences.

[C-I-C Begins]

[C-I-C Ends]

It is important that any conditions placed on renewed ESL licences are specific and measurable, and we consider there is ample precedent internationally to identify measurable conditions related to deployment and coverage that could be used to assess a UIOLI condition.

We consider other policy objectives such as resilience obligations and temporary disaster response equipment and solutions are best satisfied through direct commercial incentives and not through alternative licence conditions, as these policy objectives do not address fundamental use of the spectrum, and licence conditions should only be about use of the licence. We do not support UIOSI, as sharing models have proven to be unwieldy and inefficient in practice.

Pricing and valuation

While pricing and valuation are not explicitly part of Stage 2, we continue to advocate for a broad and balanced approach to pricing. We propose there are two key principles the ACMA should adopt in determining valuation and setting renewal prices. Firstly, the valuation and pricing methodology must be rigorous and transparent, and stakeholders must have the opportunity to provide input to the development of the methodology. Secondly, as there will be uncertainty in any methodologies to estimate the market value, prices must be set conservatively, as the risks associated with incorrectly setting prices are asymmetric, i.e., the negative implications of setting too high prices (e.g., spectrum being left fallow) are greater than setting prices too low.

Regarding methodologies, there are a range of reliable, mainstream approaches, including valuation models based on market determinants and international benchmarking. We continue to consider international benchmarking that is cognisant of, and adjusted for, unique market factors and global trends in the reduction of spectrum prices (i.e., reduction in $/MHz/pop) to be the best approach. Industry affordability and sustainability must also be factored into renewal valuation and pricing.

Finally, in setting renewal prices, the Government must take a holistic approach to all the requests it makes of the telco industry, including improving cyber-security, network resilience, supply-chain security in response to geopolitics, coverage and service quality, and regarding spectrum renewal as a source of revenue for the Commonwealth. The government must also consider that spectrum renewal costs are ultimately borne by the consumer and businesses.

Global ecosystems, standards and technologies

We provide information on ITU-R processes, device ecosystems, and other information that demonstrates a robust approach to planning and use of the bands that are the subject of ESL. It shows the rigour that goes into developing IMT services that are globally applicable and universally accepted, so that mobile services can be deployed and accessed anywhere on the planet, and achieve global economies of scale.

The ACMA's preliminary views on public interest

The ACMA provides its preliminary views on the public interest for the different purposes to which it is currently allocated, namely wireless broadband (WBB), Rail Safety and Electronic News Gathering (ENG). We agree with the ACMA's view on the public interest for WBB and Rail Safety, and we would welcome the opportunity to participate in further conversation on how the 2.5 GHz mid-band gap can be used to best fulfil the Public Interest Criteria.

Our submission concludes with several appendices to assist the ACMA's deliberations.

Contents

1 Introduction

We welcome the opportunity to provide our submission to the Australian Communications and Media Authority's (ACMA's) Stage 2 consultation on Expiring Spectrum Licences (ESL). Stage 2 of the ESL process is the information gathering stage, where views on uses of frequency bands and alternative licence conditions are being sought.

We agree with Minister Rowland's sentiments in her letter on 14 December 2023 to the Chair of the ACMA, where she said, "*In this regard, the ESL process presents an opportunity to examine the effectiveness of existing licensing arrangements in promoting efficient use of the spectrum.*" With around 80% of spectrum-licensed bands coming into consideration within a brief five-year window at the end of this decade, this is not just *an* opportunity to examine the effectiveness, it is a rare and even a once-in-a-generation opportunity to undertake such a comprehensive review. We welcome this review, and the opportunity to demonstrate to the government and all other stakeholders that mobile network operators (MNOs), and Telstra in particular, represent *the most efficient and effective* use of this spectrum, that we *satisfy the public interest criteria*, and therefore, represent the *optimal use* of this spectrum. Our submission demonstrates that the critical and indispensable service mobile networks provide to the Australian public manifestly and completely satisfies the public interest criteria, uses spectrum efficiently and effectively, fosters innovation and competition, and meets the Minister's policy objectives and priorities.

Our submission is structured as follows:

- Section 2 commences with a reminder of several important outcomes for the ESL process, presented in the context of the critical and indispensable nature of mobile telecommunications.

- Section 3 demonstrates the ways in which mobile networks currently satisfy the ACMA's Public Interest Criteria, and shows how they will continue to satisfy the Public Interest criteria into the future.

- Section 4, in a similar vein to section 3, demonstrates the ways in which mobile networks satisfy the objectives of the Ministerial Policy Statement (MPS), both now and into the future.

- Section 5 on planned use, looks at our existing capacity for sustained investment in mobile networks, and sets out how we plan to use spectrum in the future, including continuing to allow third-party access to the ESL spectrum we own.

- Section 6 outlines several ways in which the utility of renewed ESL spectrum could be maintained and potentially improved. We explore why allocating spectrum to bespoke use cases introduces uncertainty that risks compromising the utility of the spectrum. We also look at mechanisms to improve the utility, including secondary trading, alignment of expiry dates, and the benefits to regional and remote communities could enjoy if competition limits are reimagined.

- Section 7 explores alternative licence conditions, including build/coverage obligations, UIOLI, UIOSI, resilience and temporary disaster recovery.

- Section 8 contains some preliminary views on pricing and valuation. While pricing and valuation are not an explicit component of Stage 2, it is important to be mindful of these considerations in this stage, and we briefly look at global perspectives on pricing, industry affordability, and the impact of pricing on end users.

- Section 9 explores the global environment, the role of international bodies such as the ITU and 3GPP, and looks at the maturity of equipment ecosystems. It also contains our response to the ACMA's "Analysis and Frequency band use views".

- Appendix A contains a table that maps each key point of our submission to the five public interest criteria, as a "ready-reckoner" and consistent with Appendix A of the consultation paper.

- Appendix B is a brief tutorial that explains the ways we use technology and deployment techniques to ensure we use spectrum efficiently today, including densification using small cells, and technological aspects such as Multiple Input, Multiple Output (MIMO) antennas.

- Appendix C illustrates the historic defragmentation of the 1800 MHz band, as an illustration of how industry worked together to improve the efficient use of the spectrum. We include this example as it demonstrates MNOs working collaboratively together to achieve the public interest without the need for intervention through licence conditions.

- Appendix D contains data showing the number of MNO base stations by ABS statistical area and band, to illustrate utilisation of ESL spectrum across Australia.

2 Important outcomes for the ESL process

The critical and indispensable nature of mobile communications has been stated by incumbent licensees several times now, so we won't labour the point again here. However, we do wish to reiterate three key themes associated with the critical and indispensable nature of mobile communication at the commencement of our submission. This is so they remain "top of mind" with the reader while reviewing our submission. Stage 2, the "information gathering" phase, will result in a lot of information being presented, and keeping these high-level outcome objects foremost in the reader's mind is important.

Incumbent licensees must be given the option to renew existing holdings they are actively using, or plan to use. ESL spectrum is essential for mobile networks, and removing even just a portion of this spectrum will have an adverse impact on service continuity. Reducing MNO spectrum in any way would adversely impact end users by degrading quality, reliability and resilience of mobile networks.

The process for licence renewal must be transparent, robust and equitable. This applies to both the renewal terms and the determination of the renewal price, and we appreciate the transparency the ACMA has provided through the early stages of the ESL four-stage process.

Spectrum that is not renewed must be auctioned expeditiously. ESL spectrum might not be renewed for two possible reasons. Firstly, the spectrum is not being used, and the incumbent licensee has no plans to use it.[5] Secondly, the incumbent ESL licensee elects not to renew their spectrum. Regardless, spectrum that is not renewed must be reallocated promptly, and using market mechanisms, i.e., an auction. A market mechanism is the best method for allocating vacant spectrum, as this approach ensures the spectrum is allocated to its optimal, and most economically efficient use.

Competition limits need to be relaxed for ESL Spectrum that is reallocated. If there is ESL spectrum to be reallocated, it will potentially be in regional and remote areas, as spectrum in metro areas and major regional centres will be fully utilised. Competition limits on holdings of national spectrum licences have been derived with metro geographies in mind. It does not make sense for the same limits to be applied in regional or remote areas if the outcome is that the spectrum remains fallow. That is not in the public interest. As such, a re-think of the way competition limits are developed and applied must occur. We consider that limits and rules in regional areas must be treated differently to metro areas, so that better quality mobile services can be provided to regional and remote geographies more effectively, and so that spectrum does not remain fallow.

New use cases are best served within ESL spectrum, rather than dedicated spectrum. Dedicated spectrum for bespoke purposes carries a strong risk of under-utilisation of the spectrum. This results in the spectrum being inefficiently used. Bespoke networks also result in duplication of network infrastructure costs. New innovative and emerging use cases are more efficiently handled either as dedicated applications on public mobile networks or through direct commercial partnerships with primary spectrum holders.

Early certainty of renewal is required. Spectrum licensees must have the ability to request renewal at the start of the Renewal Application Period, which means they must have the necessary information well in advance. We appreciate the ACMA plans to provide all necessary and relevant information required for an incumbent licensee to apply for renewal prior to the Renewal Application Period

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[5] We note that spectrum that is unused with no demonstrable plans for its use is more likely to be in regional and remote areas, and we consider that people living and working in these areas would benefit from spectrum that is unused, or under-used, being put to good use in delivering services. This will not only increase the efficient use and utility of the spectrum, but it will also raise the level in which the public interest is served and satisfied.

commencing. Licensees require time to consider the terms and conditions accompanying a renewed licence and to make informed business decisions about future investment in the spectrum. The ACMA's current project timeline will only supply this information for the early renewal bands (850 MHz and 1800 MHz) immediately prior (weeks or perhaps only days prior) to the commencement of the Renewal Application Period, which leaves insufficient time for making informed business decisions. We request that greater notice is provided on subsequent ESL bands, and note that GSMA's Licensing Best Practice Guide recommends incumbent licensees should have the necessary information five years before the licence expires.[6]

2.1   Integrity of administrative decision-making process for spectrum licensees is critical

The Act, the Ministerial Policy Statement and the ACMA's current process for ESLs establish the substantive criteria for the ACMA's exercise of its discretion on renewal. In order for the process and subsequent decisions to be of legal effect, it will be necessary for the ACMA to rely appropriately on evidence provided by stakeholders. Further, where stakeholders make claims about current or alternative spectrum use, the veracity of the evidence supporting these claims should be considered by the ACMA. In particular, it is important to acknowledge the inherent asymmetry in certainty between the benefits of renewal for existing licensees and those of non-renewal or partial renewal generated by alternative users. The ACMA needs to explicitly take into consideration the elevated risk associated with non-renewal when assessing these benefits. To the extent that the rights and interests of existing spectrum licensees may be impacted by the ACMA relying on particular stakeholder claims, for example as a basis upon which the ACMA proposes to deny renewal of part or the entirety of an ESL, the existing licensee should be given an opportunity to review and respond to the information being relied upon.

In summary it is critical that the ESL process be conducted with appropriate procedural regard for the rights and interests of existing spectrum licensees, to ensure the integrity of the process and the certainty of its outcomes.

2.2   Mobile networks are integral to our lives, and are deemed as critical infrastructure

Without question, mobile telecommunication networks are today seen as the "lifeblood" of our modern society, serving a critical service. Bushfire Royal Commissions,[7] parliamentary flood inquiries,[8] and other parliamentary inquiries into regional mobile infrastructure,[9] all recognise and highlight the importance of mobile telecommunications networks.

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[6]   The GSMA's **Mobile Spectrum Licensing Best Practice Guide**, Feb 2022 notes that "*A minimum period for a licence renewal decision should be 5 years ahead of renewal date*." p.11. Available at: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2022/02/Mobile-Spectrum-Licensing-Best-Practice.pdf

[7]   Royal Commission into National Natural Disaster Arrangements, Final Report, 28 Oct 2020. Paragraph 9.7, p.237, "*Essential services are the systems that we rely on for our everyday needs. They include, but are not limited to, electricity, communications, water and transport*." (emphasis added).
Available at https://www.royalcommission.gov.au/natural-disasters

[8]   NSW Independent Flood Inquiry, Final Report Volume 1, 29 July 2022. Recommendation 9, p.19. "... *to minimise disruption to essential services, including outages which compromise basic communication coverage*, ...".
Available at https://www.nsw.gov.au/nsw-government/engage-us/floodinquiry

[9]   The House of Representatives Standing Committee on Communications and the Arts titled their final report, "**Connecting the country: Mission *Critical***", (emphasis added) and continues to describe mobile networks as "critical" throughout the

Mobile networks play a very important role in various aspects of daily life and emergency situations. They enable health and safety, economic activity, education, and social connectivity. The final report from the Bean Inquiry into the outage of the Optus network on 8 November 2023 observed, "*The outage interrupted critical services for consumers and businesses as well as essential government, public health, and safety infrastructure.*"[10] The report goes on to observe, "*The outage is estimated to have affected around 10 million customers and nearly half a million businesses.*" The outage highlighted the breadth and economic impact arising from a major network outage. When communication networks fail, the ripple effects are felt across the entire economy, and these effects are magnified in a society that heavily relies on digital transactions. Businesses are unable to transact because EFTPOS terminals are offline, and consumers are unable to conduct banking transactions requiring two-factor authentication (SMS code). Similarly, businesses with remote workers are unable to function, because two-factor or multi-factor authentication is offline meaning remote workers cannot log into corporate IT systems. Hospitals and public transport systems are also affected.

Mobile networks are also classified as national critical infrastructure under the *Security of Critical Infrastructure* (SoCI) *Act (Cth) 2018*.[11] The SoCI Act places a wide range of responsibilities on Carriers and Carriage Service Providers in relation to cyber-security, "notifiable events", maintaining asset registers, risk management programs, and more, all of which are commensurate with the critical nature of telecommunications services within our society.

These items show the important role telecommunications networks, including mobile networks, play. Mobile networks need spectrum to operate. Importantly, they need *sufficient* spectrum to ensure they operate without congestion and deliver the expected customer experience. This becomes especially critical during times of natural disasters when mobile networks often experience a surge in usage. During these times, people heavily rely on their mobile devices to seek vital information, stay updated with the latest news, and, most importantly, to connect with their loved ones. This increased demand can put a significant strain on the network, potentially leading to congestion and degraded service[12]. Therefore, ensuring that mobile networks have sufficient spectrum is not just about providing a good customer experience under normal conditions; it's also about ensuring networks can handle the increased load during emergencies and continue to provide reliable service when people need it the most.

2.3   The benefits of renewal are known; the benefits of new use cases are less certain

The benefits of renewal are, relatively speaking, well-known and highly likely to happen. Incumbent MNO ESL licensees have a longstanding track record of using the spectrum efficiently and effectively to deliver mobile services that satisfy the public interest criteria.

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report. For example, paragraph 1.45, p.11 "*Reflecting the **critical nature** of **mobile connectivity**, particularly in regional and remote communities*". Available at: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Communications/Mobileco-investment/Report

[10]   Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) Review into the Optus outage of 8 November 2023 (the "**Bean Review**"). Final Report, p.12. Available at: https://www.infrastructure.gov.au/department/media/publications/review-optus-outage-8-november-2023-final-report

[11]   Security of Critical Infrastructure (SoCI) Act 2018. See clause 9(1)(a), clause 8E(2)(a) in relation to a **critical telecommunications asset**, and clause 8D(a) for the designation of the communications sector more generally. Available at https://www.legislation.gov.au/C2018A00029/latest/text

[12]   Department of Infrastructure, Transport, Regional Development, Communications and the Arts, Telecommunications in emergencies and natural disasters. Available at https://www.infrastructure.gov.au/media-technology-communications/phone/communications-emergencies/telecommunications-emergencies-natural-disasters

In contrast, and reflecting the maturity of the mobile industry in Australia, the potential public benefits that might flow from the launch of a new entrant (for example, a fourth MNO or a bespoke application such as PSMB) are low and uncertain. It is necessary to consider actively used spectrum and unused spectrum independently.

Where spectrum is actively used, providing spectrum to a new use case necessarily means recovering some spectrum from an incumbent MNO, who has an active customer base. Taking spectrum away, even a small portion, will result in an immediate degradation in the quality, reliability, and resilience of services that consumers of that MNO currently enjoy and rely on. In this case, the deleterious effects can be empirically estimated using existing traffic profiles to determine increased likelihood of congestion and other degradation effects resulting from reduced spectrum. In contrast, any proposed benefits of reallocating the spectrum to a new user are theoretical at best, as they rely on speculative predictions of market share, user types and traffic projections from an unknown customer base.

Where spectrum is not actively used, there is (obviously) no empirical data of existing use on which to quantify the detrimental effects of taking the spectrum away. In this case, it is important to consider future use plans. Where an incumbent MNO has demonstrable plans to use the spectrum, which could include using the spectrum for non-terrestrial delivered services (i.e., LEO satellites), we contend that MNOs are still best placed to use the spectrum effectively and efficiently based on their track record. Thus, renewal of existing licences to the incumbent licensee has greater certainty of delivering benefits that are in the public interest, as opposed to reallocating the spectrum to a new user or use case that is untried. We also consider that where there are no demonstrable plans for an incumbent licensee to use the spectrum, the spectrum should not be renewed, or if it is, it should have a UIOLI condition attached, and we discuss this point further in sections 2.4 and 7.1.1.

We strongly recommend the ACMA's assessment of whether to renew, or only partially renew ESLs should explicitly factor in the uncertainty of benefits from new users or use cases. There is a clear and demonstratable opportunity cost to not renewing the licences, especially where the spectrum is actively used. Any decision to not to renew, or to only partially renew licences should be based on solid evidence that the benefits are likely to be substantially larger for reallocation to a new purpose than for renewal.

2.4   Reallocating under-used, or unused spectrum as part of the ESL process

Mobile network operators are responsible stewards of licensed spectrum and are commercially driven to deliver the most efficient use of their holdings as demand for capacity and coverage increases.

The consultation paper notes[13] that some stakeholders expressed views that there is unused or underutilised spectrum in ESLs that could be used to provide better connectivity in the regions, particularly regarding low band spectrum. The ACMA also observes[14] that Recommendation 19 from the ACCC's Regional Mobile Infrastructure report says, "*To the extent that **regional-focused operators** can develop alternative means of providing mobile coverage in regional Australia, there may be benefit*

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[13]   Consultation paper, p.43, in reference to comments made in the final report from the House of Representatives Standing Committee on Communications and Arts' inquiry into co-investment in multi-carrier regional mobile infrastructure.

[14]   Referenced in the ESL Consultation paper, p.43, footnote 52.

in providing those operators with access to [currently allocated, and particularly low-band] spectrum, particularly where the spectrum may be not currently used."[15] (emphasis added).

We consider Telstra is the preeminent "*regional focused operator*" in Australia. We have invested billions of dollars to bring the opportunities presented by new technologies to life for regional and remote Australian communities, and remain committed to continuing to playing our part in a thriving future for regional Australia. We are working to support delivery of the connectivity to support the National Agreement on Closing the Gap Target 17,[16] we have invested billions of dollars to create a world-leading mobile network that covers 99.6% of the population, and through our T25 strategy we will deliver an additional 100,000 km^2 of coverage. We are also a major employer in the bush,[17] and we supply much of the infrastructure that keeps regional Australia connected. While the ACCC's comments in its submission to the Regional Mobile Infrastructure Inquiry we clearly intended towards operators who only operate in regional areas, we consider the position expressed by the ACCC equally supports the view that there is likely to be benefit from providing Australia's primary regional focused operator, Telstra, with access to currently allocated spectrum, particularly low-band spectrum, that is not currently being used.

We are very strongly of the view that incumbent licensees should have the right to renew all their existing holdings where they are actively using the spectrum, or have demonstrable plans to use the spectrum. However, where ESL spectrum is not actively being used and the licensee has no demonstrable plans to use it, we consider it in the public interest for the incumbent licensee to not be offered automatic renewal, and for the spectrum to be made available to alternative users via auction (i.e., reallocated).

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[15]   ACCC Regional Mobile Infrastructure Inquiry – Final Report, July 2023. See Recommendation 19, p.81. Available at:
https://www.accc.gov.au/system/files/Regional%20Mobile%20Infrastructure%20Inquiry%20final%20report.pdf
[16]   Closing the Gap Target 17 – Targets and Outcomes. Available at:
https://www.digitalinclusion.gov.au/digital-inclusion-and-target-17
[17]   Telstra is also part of the local community, with stores and employees spread across the country, including in regional Australia.

3 Satisfying the Public Interest Criteria

This section outlines the ways in which Telstra, as an incumbent ESL licensee, satisfies the five public interest criteria established in Stage 1 of the ESL process.

3.1 Facilitates efficiency

For the first of the public interest criteria, the ACMA seeks information on **productive**, **allocative** and **dynamic efficiency**, illustrating the evolving use of the spectrum over the current and potential future licence term. The ACMA also seeks details where current planning, licensing or technical arrangements prevent efficient use of the spectrum. Below, we set out our views demonstrating the ways in which MNOs achieve these efficiency criteria and call out examples where matters such as planning and technical arrangements impede efficient use of the spectrum.

3.1.1 Productive and Dynamic efficiency

Productive efficiency is a measure of how effectively a system is operating, essentially, how effective that system is at producing a good or service. Productive efficiency is maximised when the system reaches the constraints and limitations of current capacity and technology, such that there cannot be any further increase in production. In other words, no part of the system is idle. Dynamic efficiency is the ability to improve productive efficiency over time.

MNOs have a strong track record of investing in the latest mobile network technology and re-farming spectrum to the latest generation, as illustrated in Figure 1. This achieves both productive and dynamic efficiency. As can be seen, low-bands (below 1000 MHz, which provide coverage), typically change technology-use every 15-20 years or so (GSM on 900 MHz was ~25 years). Mid-bands, (above 1000 MHz which provide capacity), change more quickly at about 10-year intervals. It makes sense to leave low-band spectrum in place for a longer time. Changing the technology used in the coverage layer (low-band) forces the community to upgrade their devices if they haven't done so already (as evidenced by the current closure of 3G networks), and low-bands are generally only upgraded when the traffic on that generation has reduced to a trickle (our 3G network currently carries around 1 percent of the total traffic on our mobile network). Mid-band spectrum can be upgraded more frequently, and devices that match that generation can utilise the benefits of the newer capabilities.
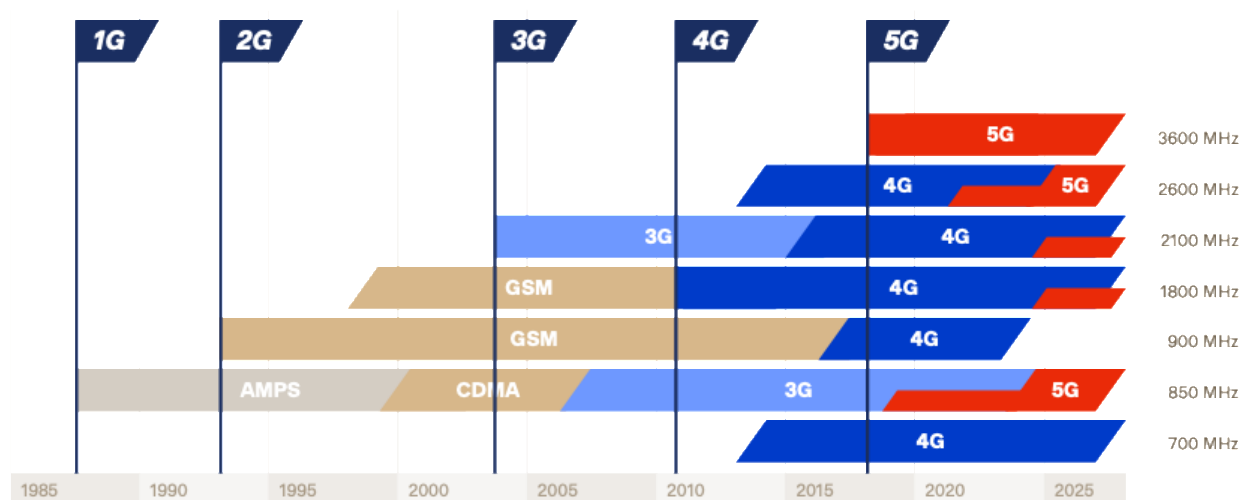
Figure 1: Re-farming mobile spectrum to newer technology generations.

The technological capability behind each generation of mobile network evolves rapidly. Each new generation delivers significant incremental gains in spectral efficiency, as can be seen in Figure 2. This means the spectrum becomes more productive (more efficiently used) with each new generation.
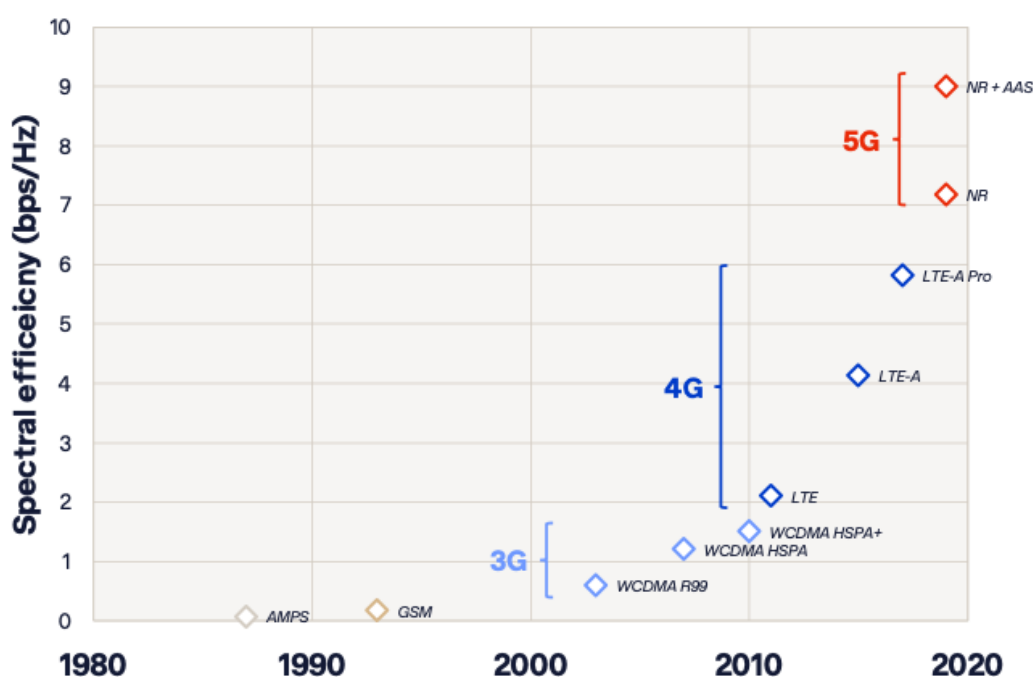
Figure 2: Improvements in spectral efficiency with each mobile network generation.

Today's 5G networks are more than:

- 140x more spectrally efficient than the original AMPs (1G) and GSM (2G) mobile networks introduced in the 1980s;

- 15x more spectrally efficient than 3G networks; and

- 4x more spectrally efficient than early 4G networks.

Another factor is that holistic telecommunications service providers — that is, service providers that use a range of technologies to provide a range of services, rather than just utilising one technology to provide one service — are uniquely placed to make the fullest and most efficient use of spectrum. Other operators see spectrum as a resource for their specific niche technology or application. We use a range of spectrum bands and technologies, including point-to-point links, point-to-multipoint delivery systems, satellites and terrestrial mobile solutions to deliver an array of connectivity solutions and services including Fixed Wireless, USO, payphones, enterprise services, public safety solutions, and of course, mobile services. Use cases that are stuck on older technologies, for example, GSM-R, result in spectrum being used inefficiently, thereby denying the spectrum from reaching its maximum **productive efficiency** and hence, utility.

Along these same lines, a near-term future consideration will be assigning the Upper 6 GHz band for International Mobile Telecommunications (IMT) use. We appreciate there is a reasonable amount of incumbent use, as well as other interest vying for the spectrum, but despite these challenges, we consider the public interest is best served, and the spectrum will realise its optimal use, by allocating it to IMT. Further work needs to be done to ensure a pipeline of future spectrum, and accelerating the study of new bands identified for IMT2030 at the recent ITU-R WRC-23 meeting is an important piece of work that must be progressed expeditiously.

3.1.2 Allocative efficiency

The bands that are the subject of ESL were originally allocated many years ago. Indeed, some have already gone through their first renewal round, and are now coming up for their second renewal round.[18]

Public networks, as opposed to private (closed) networks, are the most efficient allocation of spectrum. While we have no inherent objection to bespoke interests such as PSMB or private networks acquiring spectrum through either over-the-counter or new market allocations, we wish to highlight that such use cases are often *inefficient users* of spectrum. Operationally, mobile networks require a minimum allocation of spectrum, which in the 5G-era is 5 MHz for TDD or 2x5 MHz for FDD. Depending on traffic types, this could potentially support thousands, or tens of thousands of users on a 24 x 7 operational basis. Bespoke interests are unlikely to generate traffic profiles with this type of demand, thereby resulting in the spectrum being inefficiently used. We consider that bespoke interests such as public safety or private network applications in metropolitan or major regional centres, can be best accommodated using user/traffic prioritisation for critical user groups on shared public infrastructure, rather than quarantining spectrum for bespoke use cases. The GSMA report, *The Impact of Spectrum Set-Asides on 5G*,[19] provides further information and insights on the consequences of setting aside spectrum for private network interests relevant to the ACMA's deliberations on ESL renewal.

Bands that are the subject of ESL were allocated as far back as two decades ago. We contend that where substantial current or planned use can be demonstrated, **allocative efficiency** is best maintained today by allowing incumbent licensees the opportunity to renew *all* their existing spectrum holdings at a sustainable market price.

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[18] Between 2009 and 2012 the broad parameters of the process for renewal of the 800 MHz, 1800 MHz, 1900 MHz and 2100 MHz bands were determined. Then between 2013 and 2017, the bands were renewed. Submissions were invited from incumbent licensees, and these submissions were used to inform the Minister's consideration of the public interest and making of the Radiocommunications (Class of Services) Determination 2012.

[19] GSMA and Aetha Consulting. The Impact of Spectrum Set-Asides on 5G. See section 4.2, p. 29, for a summary. Available at: https://aethaconsulting.com/wp-content/uploads/2023/03/Impact-of-Spectrum-Set-Asides-on-5G.pdf

3.1.3　Matters that impede efficient use of the spectrum

We provide here a short summary of matters that are relevant to the ESL process and may impede efficient use of spectrum. Most of the examples in the list below are historic, but they provide important examples of the types of changes or constraints that can easily result in a reduction in the efficient use of spectrum. These are also important examples to consider when developing licence conditions to attach to renewed licences. We discuss conditions on renewed licences, including alternative conditions, in section 7. The matters that impede efficiency are:

- Changes in the technical characteristics for use of the spectrum after the spectrum was originally allocated. For example, the re-allocation of Two-Frequency Fixed Links (TFFL) and Trunked Land Mobile Service (TLMS) to the guard band between the 700 MHz and 850 MHz IMT Bands.

- Specific technology constraints imposed by the regulator. For example, transmitter power limitations in the 3.7 GHz band to protect radio altimeters (despite no confirmed evidence of interference) or registration requirements for higher-powered user terminals in the 700 MHz band.

- Dissimilar geographical / frequency licence boundary, which cause dead zones to avoid interference between licence holders. For example, the 3400 MHz and 3600 MHz bands.

- Allocating spectrum for specific, bespoke use cases such as rail safety, public safety mobile broadband or to a neutral host provider.[20]

- Competition limits which deny an MNO from obtaining sufficient spectrum to efficiently serve its customer base, but instead provide an enduring and inefficient surplus of spectrum to MNOs with far fewer customers in significant parts of their licence area.

- State stamp duty on trades of spectrum licences which add significant additional cost to licensees engaging in defragmentation of spectrum or one-way trades to realise more efficient use, and sometimes may altogether frustrate such trades.

- Deployment costs, including land acquisition and rent, and costs associated with obtaining planning permission from local councils.

- Other legislated deployment matters, including powers and immunities under Schedule 3 of the Telecommunications Act.

3.2　Promotes investment and innovation

Telstra's current (and planned) use of spectrum promotes investment and innovation in multiple ways.

Access to spectrum licences provides us with the certainty we require to conduct our business. Over the seven years to the end of FY23, we have invested over $11 billion in our mobile network with $4 billion of this being spent in regional areas (figures are inclusive of spectrum expenses). As at the

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[20]　Dense Air were allocated 60 MHz of 3.5 GHz spectrum in October 2022 by the New Zealand Government to establish a neutral host capability in New Zealand. Less than six months later in March the following year, Dense Air exited the New Zealand market. A media release from the New Zealand Government at the time noted that "*Dense Air New Zealand, which is a current interim holder of 3.5GHz spectrum rights and had previously been in negotiations with the government for long-term rights to the 3,5 GHz spectrum, has since decided to withdraw from the process.*"
October 22 announcement: https://www.beehive.govt.nz/release/kiwis-benefit-accelerated-5g-roll-out
March 23 update: https://www.beehive.govt.nz/release/govt-speed-5g-rollout-regional-towns

end of January 2024, our mobile network comprised over 11,800 mobile sites — this is the largest mobile network in Australia, covering more than 2.7 km^2 and reaching 99.6% of the population.[21] Our coverage footprint is around 1 million km^2 more than any other operator, an area nearly as large as NSW and Victoria combined, and this delivers benefits to all end-users (irrespective of their carrier) in terms of enabling access to Triple Zero emergency calls in many areas where mobile coverage is otherwise unavailable. Our investments in the mobile network have been made on the expectation that we will have ongoing access to spectrum resources needed to operate the network.[22] Indeed, significant investment is directed towards the modernisation of our sites with the advent of each successive generation of mobile technology — this is evident with the expansion of our 4G footprint ahead of 3G closure (via the upgrading of 3G only sites), and in the continued rollout of 5G (which is also supported by the re-farming of our spectrum resources, in particular our 850 MHz spectrum).[23] Supporting our mobile sites, but largely out of sight, is another critical investment, namely our high-capacity, high-speed fibre cable backbone which stretches over 270,000 kilometres.

It is important to note that the evolution of Telstra's mobile network and improvements over time in performance, capacity, and reach (for the ultimate benefit of our customers) results from a sustained focus on network leadership and innovation. As at the end of March 2024 Telstra had pioneered 58 mobile technology world firsts — some of our recent firsts, which will all end up benefiting our customers, include the completion of a 100 km long-range 5G data call on a mid-band Time Division Duplex (TDD) Advanced Antenna System (February 2023), achieving a new global record for 5G uplink speed of 340 Mbps in partnership with Ericsson and Qualcomm Technologies (February 2024) and together with Eutelsat OneWeb, commencing the world's largest deployment of LEO backhaul with the first voice call completed (also February 2024). An important enabler for our ongoing innovation in mobile technology world firsts is our access to spectrum. Looking ahead, with ongoing access to spectrum we anticipate a continued focus on the use of these assets for best effect in terms of service capability and connectivity, with our attention extending beyond mobile alone to include fixed wireless, LEO satellites and potentially other future delivery platforms like drones and HAPs.

The value and utility of Australia's mobile networks is well illustrated by a recent study, which forecast $94 billion in total economic benefit being delivered by these networks in the nine years to 2030 if Australia retained its global position for 5G adoption.[24] Beyond 2030 6G will arrive, bringing with it new and additional capabilities, delivering benefits for end users. We anticipate 6G enabling massive increase in bandwidths, efficiency and near zero latency via the use of higher frequency bands. 6G will also reduce the cost and energy usage per unit of data delivered, enable step-jump advances in network and data security and support convergent Terrestrial-Air-Space networks to provide near universal coverage. Realisation of the benefits associated with 6G will ultimately depend on the availability of spectrum resources for use by mobile network operators, with spectrum resources in turn utilising (and benefitting from) investments in terrestrial mobile infrastructure which have already been made.

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[21] Telstra Exchange Blog, **Our mobile network has been awarded 'Best in Test' in Australia for the fifth year in a row**. 14 Nov, 2023. See https://www.telstra.com.au/exchange/our-mobile-network-been-awarded--best-in-test--in-australia-for-#:~:text=We%20continue%20to%20expand%20regional,South%20Wales%20and%20Victoria%20combined.

[22] This equipment is expected to have a life of between 10-25 years, depending on the nature of the equipment, on the expectation we will have continued access to the spectrum.

[23] At the end of January 2024, 5G had been activated on over 5,000 mobile sites with the associated coverage reaching over 85 per cent of the population.

[24] AMTA, 5G Unleashed: Deloitte Access Economics, 2022. Available at https://amta.org.au/5g-unleashed-deloitte-access-economics/

3.3 Enhances competition

The ACMA's third public interest criteria explores how a decision to renew ESLs would enhance competition into the future. In this section we outline the ways in which the mobile industry enhances competition today. This support for competition is in our economic interest (for example, it is in our interest to support our MVNO partners, as they can target demographics we cannot easily target with our main brand), and therefore, we are confident this competition will continue going forward.

3.3.1 Competition can, and does, occur at all levels in the telecommunications supply chain

Retail competition occurs through both MNOs and MVNOs. There are dozens of MVNOs supplying services in Australia.[25]

Between 2013-2016, we undertook a structural separation to separate the retail and wholesale parts of our business, to provide greater autonomy and accountability to our wholesale business in serving our wholesale customers. Today, we support more than 20 MVNO partners through our wholesale business, including well-known brands such as ALDImobile, Everyday Mobile (Woolworths) and Tangerine. Together, these MVNO partners sell over 2 million services to a range of consumer and business customers, comprising over 15 percent (nearly one-sixth) of the total mobile services on Telstra's network. The MVNOs we partner with through our wholesale business, actively and effectively compete in the market to deliver differentiated customer solutions and services that meet the needs of numerous communities and customer demographics.

Importantly, our wholesale offering to our MVNO partners provides a vast array of customisable attributes, allowing them to develop competing service offerings to target different market segments. Some of the customisable attributes include:

- Pre-paid and post-paid accounts;
- Online and SIM-only ordering versus a traditional physical store sale experience;
- 4G only service versus 4G plus 5G;[26]
- Data-sharing and data-banking options, where data can either be shared amongst a small cohort of users (e.g., a family) or unused data at the end of the month can be carried over ("banked") for use in the following month;
- Options for how an exhausted data allowance is handled, including shaping, pay-as-you-go or purchase of "data blocks" options;
- Inclusion of different call types (domestic, international, mobile), with the ability to customise how different call types are included (for example, a range of international roaming "packs" such as "top-20 international destinations" versus specific rates for each destination country); and
- International roaming options, such as only roaming onto specific mobile generations (3G, 4G, etc), and use of VoLTE when roaming overseas.

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[25] AMTA's 3G Closure website conveniently contains a list of Retail Mobile Service Providers, available at: https://amta.org.au/3g-closure/service-providers/

[26] For example, Tangerine Telecom, a Telstra MVNO partner, offers "4G-only" plans, as well as "4G+5G plans", where the former are at lower price points than the latter. See https://www.tangerinetelecom.com.au/mobile/sim-only-mobile-plans.

In addition, competition in the supply of infrastructure inputs occurs in the mobile industry. Further, it has been enhanced through the divestment of Mobile Network Infrastructure Providers (MNIPs) such as Amplitel,[27] Indara,[28] and Waveconn.[29] MNIPs offer a range of services to their clients, which facilitates infrastructure sharing on towers, and competitive development of new sites.

3.3.2 "Primary licensee" status is not required to facilitate competition

While access to spectrum is a necessary element for an entity wishing to build a radio network, we contend that *direct* access to spectrum (i.e., "primary licensee" status) is not a prerequisite. Obviously, there will be situations where a network operator is the direct licensee of spectrum, through apparatus licences such as PMTS Class B licences or Area Wide Licences (AWLs), and these licences can be readily obtained in bands that are not spectrum licensed nation-wide, such as 1800 MHz, 2100 MHz or the bands in 3400-3800 MHz.

Beyond that, Telstra welcomes the opportunity to provide, and already has provided, third-party spectrum access to private network deployments in areas where we own spectrum licences.

This demonstrate two important facts; firstly, our willingness to allow other service providers access to our spectrum-licensed spectrum where we are not using it, and secondly, that primary licence ownership is not required to facilitate competition or innovative use cases.

3.4 Balances public benefits and impacts

In Australia's increasingly digital environment, sufficient access to spectrum will assist in expanding the deployment and coverage of telecommunication networks and supply the increasing demand for data services. MNOs support a range of online applications, transforming how people access and use resources, extending the impact of spectrum into a range of sectors including (but not limited to) health, transportation, education, agriculture, employment, government, and financial services. As such, it is essential that spectrum management ensures uninterrupted access to spectrum and interference-free conditions for MNOs. MNOs require a regulatory environment that provides certainty, along with flexibility to enable them to invest in their networks and develop new wireless technologies to maximise the long-term public interest derived from spectrum.

3.4.1 Spectrum provides benefits to the broader population

Wireless technology is the most common way to access the internet worldwide — in Australia fixed broadband dominates at a household level due to the NBN rollout, but mobile traffic still accounts for ~43% of total web traffic. On average Australians spend 4 hours and 54 minutes using smartphones daily. Moreover, 2 hours and 59 minutes (51%) of that time is spent browsing the internet.[30] Mobile technology offers attributes to consumers that are unique and not available or feasible via a PC or wired connection. These include the ability to use the service almost anywhere and use location-based services including maps and platform-based transport services; and to capitalise on sensor-based

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[27] See https://www.amplitel.com.au/who-we-are

[28] See https://indara.com/about/

[29] See https://waveconn.com/about-us/

[30] Red Australian Mobile Data Usage Statistics 2023, available at https://www.redsearch.com.au/resources/mobile-data-statistics-australia/

inputs including sound, vision, and orientation, augmented by online information and artificial intelligence.

The importance of mobile and internet networks during disasters has been increasingly obvious. Telecommunications services play a central role in natural disaster preparedness, response, recovery, and resilience. For example:

- State disaster agencies use apps, text messages, and social media platforms to communicate warnings to the community;[31]

- Telstra supports essential service providers across the country by providing priority access through our LANES® Emergency product.[32] For more detail on LANES® Emergency, see section 6.1; and

- Mobile phones are used by community members to call for help and coordinate rescues and fixed wireless broadband services are used in emergency control rooms.

3.4.2   Spectrum supports service continuity for end-users

Spectrum is a scarce resource, and societal benefits are maximised by policies that promote the efficient use of spectrum. Setting prices too high or choosing not to renew spectrum for incumbents can carry significant overall costs to end-users. Non-renewal, even of only a portion of our spectrum, would have an adverse impact on end-users, degrading service quality through a reduction in data speeds, and potentially coverage if low-band spectrum is geographically subdivided. It would also affect the investment decisions of MNOs as they will need to build more sites to cope with capacity needs, increasing capital costs which will flow to consumers in the form of higher prices. If licence holders are given the opportunity to renew spectrum and renewal prices are set at fair levels, it can help maximise the benefits of spectrum usage for end users, aid government revenues through the fees paid for spectrum (direct) and through increased GDP and taxation revenue it generates.[33]

Usage is the main cause of the economic spillover effects attributed to telecommunications services, and the lever that regulators can help to increase through efficient management. Wireless networks are often the most cost-effective way of reaching regional and remote areas, especially with the advent of technologies that use lower frequencies with a wider reach.[34]

Spectrum that is inefficiently allocated usually translates to insufficient mobile telecommunications infrastructure and investment, inadequate coverage for end users, lower quality services and higher prices.[35] This will reduce availability (thus impacting the possibility of universal access), and result in reduced demand for telecommunications services.[36] Efficient spectrum allocation provides MNOs with

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[31] An example is the targeted weather and flood warnings from the Bureau of Meteorology which are often delivered via text messages and apps.

[32] Telstra LANES® Emergency. See https://www.telstra.com.au/business-enterprise/industries/public-safety/lanes-emergency

[33] GSMA, 2017, Effective Spectrum Pricing: Supporting better quality and more affordable mobile service, available at https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2017/02/Effective-Spectrum-Pricing-Full-Web.pdf

[34] ITU, World Bank, 2022, Spectrum management: Key applications and regulatory considerations driving the future use of spectrum, available at https://digitalregulation.org/spectrum-management-key-applications-and-regulatory-considerations-driving-the-future-use-of-spectrum/

[35] Ericsson, 2020, What you need to know when approaching spectrum licensing, available at https://www.ericsson.com/en/blog/2020/11/spectrum-licensing-what-you-need-to-know

[36] ITU, World Bank, 2022, Spectrum management: Key applications and regulatory considerations driving the future use of spectrum, available at https://digitalregulation.org/spectrum-management-key-applications-and-regulatory-considerations-driving-the-future-use-of-spectrum/

the incentives to invest in their network infrastructure, expanding network coverage, improve service delivery and enabling MNOs to lower prices for consumers.

Competition on quality has driven significant ongoing investment in mobile networks providing service continuity for end-users and restraining prices.[37] Competition has helped deliver widespread 4G and 5G coverage and has been supported by public policy interventions such as the Mobile Blackspot Program.

Access to spectrum, particularly low band spectrum, is essential to deliver 5G and is a driver of digital equality,[38] due to its superior propagation characteristics and in building penetration[39] (i.e., low-band spectrum allows an MNO to provide more reliable indoor and outdoor coverage over larger distances with less infrastructure, making it more economically viable). It will assist in reducing the gap between urban and regional and remote areas by continuing to deliver affordable connectivity. The availability of sufficient spectrum is the key to ensuring that end users living in regional and remote areas will continue to have access to the latest digital technologies and satisfactory service performance.

3.4.3   Reclaiming spectrum for a fourth operator or neutral host is not in the public interest

In our view, reclaiming or reserving spectrum to pave the way for a fourth nationwide operator would not be an efficient use of the spectrum as the economics of rolling out a new network simply do not stack up. Establishing a new mobile network requires significant capital investment which is not viable in the Australian market which is already saturated. The expense of building a new network is ultimately passed on to consumers, either directly or indirectly through higher prices or hidden taxes if deployment is government funded or facilitated through de facto subsidies, such as provision of low priced set-aside spectrum. This is not in the public interest.

TPG and Vodafone's merger back in 2020 proves this point.[40] TPG had spent $1.26 billion on the spectrum needed to build a mobile network. However, the merger between TPG and Vodafone was allowed to proceed because the Federal Court declared the merger would not substantially lessen competition because it was believed that TPG was unlikely to roll out its own mobile network.

What history has consistently demonstrated is that a fourth operator is simply not viable. While such an introduction may initially lead to transitory gains to consumers via unsustainable price competition, this will ultimately reduce revenues for the entire industry, thereby diverting from much needed investment in upgrading network and enhancing regional and remote coverage. This is clearly not in the public interest.

Reallocation of spectrum to neutral hosts is also not recommended because geographic subdivision to free up spectrum outside the footprint of the largest MNO is risky and can lead to potential interference issues, making it challenging to provide a seamless service. Furthermore, the need to

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[37]   Ofcom, 2022, Ofcom's future approach to mobile markets and spectrum Conclusions paper, available at https://www.ofcom.org.uk/__data/assets/pdf_file/0036/248769/conclusions-mobile-spectrum-demand-and-markets.pdf

[38]   Digital equality is the concept of ensuring that people living and working in regional and remote areas have access to digital services at an equivalent level to those living in metropolitan areas, and is required to resolve Closing the Gap Target 17, which we discuss further in section 3.5.

[39]   GSMA, 2023, Socio-Economic Benefits of 5G   The importance of low-band spectrum, available at https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/11/Socio-Economic-Benefits-of-Low-Band-Spectrum.pdf

[40]   Federal Court allows TPG-Vodafone merger | ACCC. Available at: https://www.accc.gov.au/media-release/federal-court-allows-tpg-vodafone-merger

provide the supporting infrastructure such as transmission is costly and may limit any benefit that may theoretically result from enabling a neutral host.

In short, the negative impact on the public interest from reallocation of any spectrum to facilitate a fourth operator or a neutral host outweighs the benefit.

3.5   Supports relevant policy objectives and priorities

The ACMA seeks input on the ways in which current and planned use of the spectrum supports relevant government policy objectives and priorities. There is particular interest in understanding how this usage supports regional and remote connectivity, investment, and competition.

Telstra has invested $4 billion in regional and remote areas over the seven years to end FY23[41] to improve network coverage and reliability for our customers. We also made significant investments before this time, with ongoing investment critical for meeting ongoing growth in end user demand.

Telstra's current and planned use of the spectrum it holds provides significant connectivity and benefit to regional and remote communities. Our mobile network provides more than 1 million additional square kilometres of coverage compared to our next closest mobile network competitor,[42] and our mobile network provides fixed-line services to customers including our 4G-based fixed wireless solution. There are also around 57,000 emergency Triple Zeo (000) calls each year in the areas where unique Telstra coverage exists, and in this capacity the Telstra network is supporting all Australians, irrespective of who their carrier is.

Our spectrum assets have also allowed us to be an active participant in various Government-supported co-investment programs going back many years. In terms of mobile infrastructure, under the Rounds 1 and 2 of the Regional Connectivity Program (RCP), Telstra is investing around $55 million to improve regional connectivity. Under these first two rounds of RCP, through co-investment with the Federal Government and third-party stakeholders, we are delivering 40 projects that are located in First Nations communities across the NT, QLD, WA, and SA.[43] These initiatives are working towards the Closing the Gap Digital Inclusion Target 17.[44]

Telstra's participation in co-funding programs to expand and enhance connectivity in regional and remote parts of Australia demonstrates our support for Government policies around providing quality communications services to all Australians, regardless of where they work or live.

However, it is not just the simple use of radio spectrum that demonstrates our commitment to regional and remote communities around Australia; it is the way we deliver our services and infrastructure, the support we provide during emergencies and times of crisis, and the way we work with, and support communities across our vast nation. To this end, in December 2022 we announced[45] that we would

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[41]   https://www.telstra.com.au/exchange/investing-millions-on-regional-rural-and-remote-coverage

[42]   Telstra, Our Network Coverage. https://www.telstra.com.au/coverage-networks/our-network

[43]   See Page 26 of Telstra Reconciliation Action Plan - July 2022 – July 2025

[44]   Closing the Gap Target 17 – Targets and Outcomes. Available at:
https://www.digitalinclusion.gov.au/digital-inclusion-and-target-17

[45]   Telstra Exchange Blog, **More boots on the ground in regional Australia, and more support for customers**, 7 Dec 2022.
Available at https://www.telstra.com.au/exchange/more-boots-on-the-ground-in-regional-australia-and-more-support-for-customers

double the number of locally based Regional Engagement Managers and triple the number of Regional Network Advisors we employ around the country.

For First Nations people, we have established our First Nations Connect[46] phone line to assist First Nations dedicated to helping Aboriginal and Torres Strait Islander customers, respecting culture and community. This phone service has access to interpreter services for approximately 50 different First Nations languages and dialects.

The consultation paper makes specific reference[47] to the *House of Representatives Standing Committee on Communications and Arts' inquiry into co-investment in multi-carrier regional mobile infrastructure* (the **Co-Investment Inquiry**), and observes the first two recommendations in the final report[48] are relevant to the ACMA's spectrum management function.

As the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) noted in their submission to the Co Investment Inquiry, "*Interference concerns may present a challenge for the sharing of low-band spectrum, but this would depend on the geographic areas where spectrum sharing is proposed and to what extent coverage overlaps or is adjacent to existing carrier deployments.*"[49] This is an important insight. We support UIOLI as a licence condition on renewed licences, and where surrender of "unused" portions of a licence does not result in the creation of interference to the pre-existing, or other adjacent licensees. We expand on our views on UIOLI in section 7.1 of our submission.

Given our commitment to improving connectivity in regional areas and long experience in the delivery of regional communications, Telstra sought to be a constructive participant in the recent House of Representatives Standing Committee on Communications and Arts' inquiry into co-investment in multi-carrier regional mobile infrastructure.

With respect to recommendation 1 of the Committee, Telstra's position on UIOLI provisions is discussed in section 7.1, noting that the AWL mechanism has already been introduced.

With respect to recommendation 2 of the Committee, Telstra does not support the use of licence conditions on mobile network owners and other spectrum licensees pertaining to: a) mandated open access and/or b) the use of active sharing solutions. The measures in Recommendation 2 are not well suited for the connectivity challenges in Australia, especially those in regional areas. These particular licence conditions are blunt instruments, and if adopted they could limit rather than support the pursuit of policy objectives. They could risk, for example, removing incentives for investment in new coverage and better technology, an outcome which would be detrimental to Australian mobile customers, especially those living in regional and remote areas.

Any use of open access regulatory measures is likely to dampen and distort market incentives, and we consider this approach is unlikely to lead to better outcomes for consumers than market-based alternatives. It is broadly recognised that for many regional and remote areas across Australia the lack of coverage primarily reflects economic factors – establishing coverage in regional areas can be expensive, with the financial returns limited due to sparse populations. Implicitly, open-access

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[46] See https://www.telstra.com.au/first-nations-australians

[47] Consultation paper, p.43.

[48] House of Representatives Standing Committee on Communications and Arts' inquiry into co-investment in multi-carrier regional mobile infrastructure, Final Report, "**Connecting the country: Mission critical**", Nov 2023. Available at https://www.aph.gov.au/Parliamentary_Business/Committees/House/Communications/Mobileco-investment/Report

[49] DITRDCA submission to House of Representatives Co-Investment Inquiry, p.5. Available at https://www.aph.gov.au/Parliamentary_Business/Committees/House/Communications/Mobileco-investment/Submissions

measures require participation (and corresponding investment) to alter any market status quo, but this may not always be forthcoming.

As we noted in our submission to the Committee, Telstra does not support the use of mandated roaming, and nor do we support other prescriptive forms of active sharing (such as neutral host requirements), which we believe would deliver an inferior experience in terms of both deployment speed and the quality of customer experience outcomes. Overall, we believe any use of mandated solutions will be detrimental to the objective of improving regional mobile connectivity over time.

In our view the best outcomes for regional communities are achieved by allowing operators commercial freedom to select the most suitable deployment and/or sharing arrangement on a case-by-case basis. In some situations, there may be a case for improving terrestrial coverage in locations which are effectively non-commercial — in these instances we consider Government support for any required investment would be preferable to the use of licence conditions mandating certain coverage outcomes.

A further point relevant to the ACMA's consideration of the merits associated with potential licence conditions is the expected arrival of direct-to-mobile (DTM) services in Australia from late 2024/early 2025. This development will enable coverage over close to 100% of the Australian landmass, and while capabilities will be limited at the outset these will improve over subsequent years. Because of its inherent availability characteristics, the arrival of DTM technology (and the maturation of the LEO sector more broadly) will not only alter future decisions around deploying terrestrial mobile infrastructure, it will also reduce the potential benefits associated with the use of licence conditions targeting specific coverage and/or competitive outcomes. As such, we believe the current market dynamics are working and any intervention should be minimal.

4 Satisfying the Ministerial Policy Statement objectives

The Ministerial Policy Statement (MPS) sets out five policy objectives for the ACMA to consider through the ESL process — these are:

1. Supporting service continuity for end users, particularly where no alternative service is available;

2. Facilitating opportunities for new entrants and use cases, including for low earth orbit satellites;

3. Connectivity and investment in regional areas to deliver improved services to end users;

4. Promote competition; and

5. Capacity for sustained investment and innovation.

In this section we outline the ways in which renewal of our existing ESLs will allow us to fulfil the MPS, and also identify risks, where failure to offer incumbent licensees the opportunity to renew all their ESLs could have unintended consequences such as reduction in existing coverage.

4.1 Supporting service continuity for end users

We're pleased to see the first of the Minister's objectives in the MPS is for service continuity, particularly where no alternate service is available. We have already noted the importance of telecommunications in section 2.2, and we agree with the Minister that service continuity is a key imperative of the ESL process.

ESL spectrum is essential for mobile networks, and removing even just a portion of this spectrum will have an adverse impact on service continuity. Reducing MNO spectrum in any way would immediately adversely impact our customers in metro, regional and remote areas by degrading quality, reliability, and resilience of mobile networks. We consider the opportunity for incumbent licensees to renew existing licences where they are actively using the spectrum, is essential for service continuity.

In addition, we consider geographic subdivision could also cause harm to service continuity, and we explain this next in section 4.1.1, firstly regarding low-band spectrum, and then mid-band spectrum.

4.1.1 Geographic subdivision of low-band spectrum will harm service continuity

Low-band spectrum is pivotal to maintaining service continuity, especially in regional areas. Low-band spectrum is important for service provision in regional areas due to its ability to propagate over long distances and penetrate buildings effectively. As the ACCC notes in its Regional Mobile Infrastructure Inquiry (RMII) Final Report, "*Typically, mobile network operators will use low-band spectrum in remoter areas as it is able to reach longer distances, and thereby provide a wider coverage area around a base station.*"[50] Indeed, it is not just typical that MNOs *will* use mobile spectrum in remoter areas, but MNOs *must* use low-band spectrum, as it is the best spectrum for providing wide-area coverage.

Subdividing spectrum geographically increases the complexity of spectrum management and coordination efforts, especially in low-band spectrum. Where signal strength is weak, even a weak signal from another operator is likely to cause interference, thereby denying coverage.

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[50] ACCC Regional Mobile Infrastructure Inquiry Final Report, 23 October, 2023. p.53. Available at: https://www.accc.gov.au/inquiries-and-consultations/regional-mobile-infrastructure-inquiry-2022-23/final-report

Geographic subdivision of low-band spectrum must be at the MNO's absolute discretion. If an MNO decides that it has low-band spectrum in regional areas it does not wish to renew, it must firstly work with the ACMA to define a set of appropriate boundary conditions, and only once those have been established, should it be at the incumbent licensee's discretion to decide the specific geographic regions it will not renew. It must not be at the ACMA, or the government's discretion to determine the boundaries.

4.2 Facilitating opportunities for new entrants and use cases, including LEOs

The second of the Minister's policy objectives relates to Facilitating opportunities for new entrants and use cases, including LEOs. In section 2.3 we explained why we consider the benefits of reallocating spectrum to new users or use cases are inherently uncertain, and that the benefits arising from spectrum use are far more certain where incumbent ESL licensees are afforded the opportunity to renew their licences. Then in section 3.3.2, we outlined examples where we subleased our spectrum-licensed spectrum to third-parties to allow them to provide private network solutions, and further down in section 6.1 we explain how bespoke use cases such as PSMB are better delivered on public networks using techniques such as traffic prioritisation. In short, we consider bespoke use cases are best satisfied either by delivering the use case on a public network, or where dedicated spectrum is absolutely required, then via a third-party authorisation. It should not be performed by reallocating ESL spectrum directly to other users or use cases.

In addition, to help facilitate opportunities for new entrants and use cases, we observe the ACMA has already made available:

- a substantial quantity of mid-band spectrum (3800-3950 MHz in metro areas and 3750-3950 MHz in regional and remote areas) under AWL licensing for wide-area deployment use cases; and

- a further quantity of mid-band spectrum (3400-3475 MHz in urban areas and 3950-4000 MHz Australia-wide) for highly-localised wireless broadband solutions, such as university campuses, industrial parks, local councils, etc.

While the mid-band spectrum in the two examples above is not part of the ESL spectrum, we note there is a substantial quantity (the 200 MHz described above is one-third of the total 600 MHz available between 3400-4000 MHz) of spectrum set aside for innovative new use cases in the prime mid-band spectrum. We contend that it would be prudent to see how this is adopted and used before considering withholding ESL spectrum from incumbent licensees to further augment innovative new use cases.

We next turn our attention to LEO satellite solutions, as this is specifically mentioned in the Minister's second policy objective.

4.2.1 LEO Satellites

Telstra is excited about the potential of LEO satellites to deliver services to Australians in regional and remote locations. LEO satellites are already providing high quality fixed broadband, and in March 2024, Telstra commenced selling fixed voice and broadband through our partnership with Starlink.[51] In

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[51] Telstra Satellite home internet with Starlink is here. 25 March 2024.
https://www.telstra.com.au/exchange/telstra-satellite-home-internet-with-starlink-is-here---here-s-w

addition, we are also working with Lynk Global to explore and test direct to mobile satellite technology (DTM) as a potential way to extend mobile connectivity beyond our current terrestrial footprint[52].

As detailed in section 5.4, current satellite DTM service providers are targeting customers with 4G / 5G handsets by utilising existing terrestrial spectrum. MNOs, as the primary spectrum licensee, provide spectrum access to satellite operators in areas beyond the terrestrial coverage footprint by way of a commercial inter-operator agreement. This approach yields a well-integrated satellite / terrestrial customer experience and simplifies global operations for the satellite operator. This means that MNOs require access to spectrum sufficient to cater to both terrestrial and satellite use, with bandwidth to match aggregate capacity demand.

Satellite DTM services are expected to be immensely beneficial for Australia. Transcending the existing limitations of terrestrial mobile networks in some geographical areas, LEO satellites will offer complementary mobile communication to Australians living and working in the remotest parts of our nation where today the only option is traditional satellite services. Satellite DTM has the potential to improve the way people in remote areas communicate, access information, and conduct business, in a manner that complements the existing terrestrial network. Satellite DTM services also have the potential to deliver improved disaster response capabilities and calling for help in an emergency. All these are an exciting prospect for Australia's future, and we welcome the opportunity to play our part in bringing this technology to Australians.

We envisage that satellite DTM will complement the terrestrial network that already delivers coverage to 99.6% of the Australian population, by providing almost[53] ubiquitous coverage across the entire landmass. This is potentially useful to the 0.4 % of the population not covered by our terrestrial network, as well as for those cases where customers find themselves in more remote areas away from population centres. DTM has the potential to promote digital inclusion by providing access to on-line services such as telemedicine, financial services, and remote education.

The close partnering relationship between MNOs and satellite operators will, we expect, also facilitate improved outcomes for network resilience and recovery. As LEO satellite services are developed over the coming years, we expect that in the event of a natural disaster, MNO owned spectrum may be able to be switched to satellite based delivery quickly, subject to not causing interference to unaffected (operational) parts of the network. DTM satellite services will also facilitate access to the critical communication channels needed by first responders, rescue services and isolated communities in the event of a natural disaster.

In section 5.4, we describe how future satellite DTM services will require access to existing mobile spectrum, such as the spectrum that is the subject of ESLs.

4.3   Connectivity and investment in regional areas to deliver improved services

A thriving regional Australia is important to Telstra. We are one of its biggest supporters and investors, a major employer, and we supply much of the infrastructure and services that keep regional Australia connected. Telstra has chosen to invest more heavily in extending our mobile network further into

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[52]   MWC: Telstra To Test Texting Via LEO Satellites – channel news, 20 February 2024,
https://www.channelnews.com.au/telstra-to-test-texting-to-satellite-by-lynk-global/

[53]   Excluding radio quiet zones.

regional and remote Australia than any other MNO. We agree with and support the Minister's policy objective to consider ways to support existing and new investment in regional and remote areas.

As we have already stated, offering incumbent licensees the opportunity to renew their existing licences (where they are actively using them, or have demonstrable plans to) is the simplest and most effective way to fulfil the Government's policy objectives. Allowing licensees the opportunity to renew their licences will provide certainty for infrastructure investment leading up to the expiry of the licences, and underpin investment after their renewal. Only where the spectrum is not actively being used, and there is no demonstrable plans to use it should the spectrum be made available for other users, i.e., reallocated by auction.

With regards to service offerings, section 3.3 of our submission covers the promotion of competition public interest criterion. We explained how incumbent MNOs facilitate competition at all levels of the supply chain, allowing for an increased availability and choice of services for end users. This includes increased availability and choice for end users with limited infrastructure diversity, as and where MVNO partners choose to offer services.

In many regional and remote areas, the economic incentives for MNOs to make new investments in terrestrial mobile infrastructure are often relatively poor. This has been recognised by successive Governments (at both Commonwealth and State level), and numerous co-investment programs (and rounds of these) have been run in recent years to support the extension of terrestrial mobile coverage to areas where it might not otherwise of been delivered. As noted in section 3.5, Telstra has been a strong supporter of these programs and through the Mobile Blackspot Program for example we've invested more than $300 million to build approximately 1,000 new sites across the country. While these programs have not always delivered multi-carrier outcomes, this is primarily a function of economic considerations coupled with varying industry preferences for investment — spectrum access (or lack thereof) has not been a substantive issue.

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[C-I-C Ends]

We have also outlined our support for First Nations communities in section 3.5.

4.4   Promoting competition

Mobile markets in Australia, including the consumer mobile market, business mobile market, fixed wireless broadband market and the market for IoT connectivity are already competitive, both at an infrastructure level and at a retail level. At the infrastructure level, historic policy decisions have resulted in three separate mobile networks in Australia that today deliver a good level of infrastructure competition, especially in metropolitan areas, although there are signs that the industry is under stress meaning network infrastructure sharing (such as the proposed MOCN agreement announced by TPG-T and Optus) is far more likely than the entry of a new (fourth) infrastructure operator. At the retail level, there is vibrant competition, as we have already outlined in section 3.3.1.

Despite the challenges of being a sparsely populated country with a large landmass and population heavily concentrated in coastal areas, Australia has some of the best mobile networks in the world. Competition between the three MNOs created an environment that led to these services being developed and delivered to the Australian consumer. An example is the coverage of our 4G and 5G networks for carrying IoT traffic, where we are able to provide an additional one million square

kilometres coverage for our NB-IoT product.[54] It is competition that drives us to look for new technologies and ways to configure our network (we have a specific configuration for IoT which allows low-speed devices to be connected at greater distances from our base stations), and our IoT coverage is an excellent example.

Although 5G lowers the cost of delivering data overall, it still requires large capital investment and ongoing operating costs. MNOs need to acquire new spectrum, densify their networks by building more mobile towers, and ensure transmission infrastructure can support delivery of new services (see Appendix B for an explanation on the way we do this in our network). Investment risk directly influences network investments; the lower the perceived risk, the higher the level of investment.[55] In countries such as Australia, which tend to be classified as low risk, this means that investments can afford to be more marginal in terms of their return on investment vis-à-vis other markets. What this means that even minor deviations in policy direction can turn a positive business case negative. Thus, a capricious policy environment in a market where business decisions are more marginal, will dramatically reduce investment confidence. Providing transparent principles and certainty regarding spectrum renewal can increase investment by MNOs and direct revenues from the sector.

In addition, we see no compelling evidence that additional infrastructure competition, such as a fourth network operator, will deliver further competition benefits such as cost reduction and innovation to consumers. From an infrastructure competition perspective, we consider the industry is likely to be at a "saturation" point. Aligned with this observation, research conducted by GSMA found that competition policy that favours a higher number of market players can cause efficiency losses related to costs, network quality and deployment by failing to give the appropriate weight to the long-term effects of investment and innovation on consumer welfare. Based on their research findings, GSMA recommended that policy makers take a balanced approach when considering the effects of mergers on dynamic competition incentives and investments. Their research found that in three key areas additional competition did not result in increased consumer welfare.[56]

    i.   Investment: The GSMA report found that countries in Europe with a higher number of players did not generate the optimal conditions for investment. From 2015 onwards, operators in European three-player markets invested more per connection than those in four-player markets, delivering faster download and upload speeds.

    ii.   Price effects: In the same report, there was no robust evidence found to suggest that Europe's four-player markets have produced lower prices than three-player markets in the past decade.

    iii.   Innovation: Market consolidation can accelerate the transition between technology cycles in the mobile industry, leading to improvements in the quality and innovation of services.

Increasing the number of MNOs in the marketplace does not necessarily result in better outcomes for consumers. Price levels, investment in infrastructure and innovation do not necessarily improve as incumbent MNOs have economies of scale and scope that are difficult for new entrants to replicate in a

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[54] The Telstra Cellular IoT Advantage. The Telstra cellular LPWAN IoT Network covers around 3 million km^2 for LTE-M and around 4 million km^2 for NB-IoT. Available at: https://www.telstra.com.au/business-enterprise/products/internet-of-things/capabilities/iotadvantage

[55] Telenor, 2020, Maximising benefits of spectrum to society, available at https://www.telenor.com/about/public-policy/maximizing-benefits-of-spectrum-to-society/

[56] GSMA, 2023, Competition Dynamics in Mobile Markets in Europe, An assessment of the effects on network investment and quality in Europe, available at https://www.gsma.com/gsmaeurope/news/competition-dynamics-in-mobile-markets-in-europe/

cost-effective way and may in fact be detrimental to consumer welfare. The EU is in fact considering reducing barriers to mergers between network operators recognising that operators need scale (and agility) to keep pace with the technology revolution occurring in the sector.[57] Based on the evidence, we consider there is unlikely to be any enhancement to competition (at either the infrastructure level, or at the retail level) arising from the ACMA setting aside spectrum for potential new entrants to increase infrastructure-based competition, as existing licensees are already facilitating efficient outcomes in the market. In addition, the possible benefits which may accrue from setting aside spectrum for a new entrant are uncertain compared to the reduction in benefits arising from taking spectrum away from incumbent ESL licensees, which we discussed in section 2.3.

4.5 Capacity for sustained investment and innovation

Telstra has a long history of investment and innovation utilising its spectrum assets. Over the 7 years to end FY23 we invested $11 billion in our mobile network nationally with $4 billion of this being invested in our regional mobile network.

A key driver for our continued mobile investment has been the ongoing evolution of mobile technology. As shown in Figure 1, Telstra has deployed successive generations of mobile technology in Australia since the early 1990's. With the evolution from 2G to 3G to 4G and now 5G, the technical capabilities of mobile technology have continually improved, and today, some devices with 5G standalone capability can access bandwidths that are up to 1 GHz in size. This means they can get more out of their mobile connectivity experience than ever before, with many users making their mobile devices a major means of communication for both personal and work purposes. As each successive generation of mobile technology is more efficient than its predecessors, this evolution has been critical for meeting continued growth in end user demand, and to this end — as outlined in this submission — the prudent use of our scarce spectrum resources has been particularly important, especially the re-farming of spectrum (for example, from 3G to 5G as with our 850 MHz resources) as the usage of different mobile technologies has shifted over time.

A key benefit arising from sustained investment is the benefit that investment delivers to Australia's economy and Gross Domestic Product (GDP). According to Deloitte Access Economics, if Australia can maintain its current global leadership in terms of 5G adoption, the productivity benefit would be an $27 billion additional economic benefit over the next eight years to 2030 to the Australian economy.[58] That additional economic benefit is predicated on Australia maintaining third position globally for 5G adoption, however, according to statistics gathered by the GSMA Intelligence, Australia has already slipped to eighth place globally in the number of 5G-connected devices per person.[59] The implications for key Australian industries are significant. 5G will bring significant benefits overall to key industries such as health care, financial services, advanced manufacturing, and consumer entertainment. Over the next eight years, the productivity benefits of 5G are forecast to be $31 billion for health care, $14 billion for smart cities and $7 billion for manufacturing in 2022 dollars.[60] The introduction of digital

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[57] Ibid

[58] AMTA, 2022, 5G unleashed, 5G Unleashed: Deloitte Access Economics, available at https://amta.org.au/5g-unleashed-deloitte-access-economics/

[59] GSMA Intelligence, 2023, Mobile Operators and Networks, Region in Focus: Asia Pacific, Q4 2023, available at https://data.gsmaintelligence.com/research/research/research-2024/region-in-focus-asia-pacific-q4-2023

[60] Ibid

technologies to agriculture in Australia, many of which are enabled by 5G, would result in an increase of $15 billion to the sector.[61]

Industry-specific 5G use cases, such as greenhouse automation in agriculture, remote stock monitoring in manufacturing, data analytics for patient outcomes in healthcare, and traffic monitoring for smart cities, are specific examples of where 5G technology can generate productivity gains for business. This is notably different from earlier generations of mobile technology when uses such as mobile networking, data, apps, etc., were more broadly applicable to the economy. Organisations in professional services and information, media, and telecommunications have the greatest degrees of industry readiness for 5G.[62]

Returning then to the capacity for sustained investment, Telstra's ability to continue to sustain investment in deploying 5G, which in turn delivers innovation in these industries, is predicated on renewal pricing that is at a sustainable level. Higher renewal prices leave less capital for network operators to invest in deployment and in delivering new, innovative capabilities, and industry sustainability is an important consideration, which we come to in section 8.3.

Mobile network operators have also demonstrated sustained innovation by constant evolution through new mobile network generations, as shown in Figure 3.

	2G	3G	4G	5G	5G	5G
	Voice	Voice	Voice	Voice	Voice	Voice
	Messaging	Messaging	Messaging	Messaging	Messaging	Messaging
		Data	Data	Data	Data	Data
			Video	Video	Video	Video
Carrier BW:	200kHz	5 MHz	20 MHz	60 MHz *	800 MHz *	1 GHz *
Throughput:	90kbps	42 Mbps	2 Gbps	2.3 Gbps [a]	4.5 Gbps [b]	6 Gbps c
Latency:	500 ms	100 ms	30 ms	20 ms d	<15 ms e	< 10 ms f
Aggregation:			5 X 20Mhz	5G & 4G bands		
Modulation:			64 QAM	256 QAM		
MIMO:			4x4	Massive (64x64)		
	1993 - 2016	2005 - 2024	2011	2019	2021	2023

Figure 3 The evolution of mobile technology in Australia - Telstra, 1993-2023 [63]

While the technology evolution shown above has primarily been enabled by the technical standards and spectrum assignation work of the 3GPP and the ITU/WRC respectively, Telstra in parallel has pioneered 58 supporting mobile technology world firsts with its industry partners since 2006 — 9 world

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[61]   House of Representatives Standing Committee on Communications and the Arts (2020) The next gen future: inquiry into the deployment, adoption and application of 5G in Australia, https://www.aph.gov.au/Parliamentary_Business/Committees/House/ Communications/5G/Report.

[62]   GSMA, 2023, Socio-Economic Benefits of 5G   The importance of low-band spectrum, available at https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/11/Socio-Economic-Benefits-of-Low-Band-Spectrum.pdf

[63]   Diagram notes: * Largest 5G carrier bandwidth in carrier aggregation combo for peak speed; a) 1st generation handset peak speed; b) 2nd generation handset peak speed + 800MHz mmWave; c) 3rd/4th generation handset peak speed + 1000MHz mmWave; d) 5G Non-standalone mode; e) 5G Non-standalone mode with latency reduction features and sub-regionalisation of packet core under NE2020; f) 5G Core Standalone mode.

firsts were achieved with 3G, 20 with 4G and to date there have been 23 with 5G.[64] These world firsts — which include achievements such as the first 3G 200 km call range on a commercial broadband network (February 2007), the first LTE Advanced commercial trial of 4G carrier aggregation (July 2013) and the first 5G 5Gbps speed record on mmwave using 5G carrier aggregation (January 2021) — are all important innovations that show Telstra has been at the forefront of technology validation and implementation globally, leading the way in mobile technology innovation and investment.[65]

Telstra's history of investment and innovation, as mentioned in section 3.2, has delivered Australia's largest mobile network with around 1 million km^2 more than any other operator. Our coverage delivers significant benefits to our customers as well as to the customers of other carriers in terms of enabling access to Triple Zero emergency calls in many areas where mobile coverage is otherwise unavailable. Telstra's investments to date have been central for allowing Australian end-users to enjoy world leading mobile services, despite the investment challenges posed by our vast geography, and this has been recognised by the GSMA.[66]

Looking ahead, we expect 6G (also called IMT-2030) to arrive in Australia around 2030. There are several important market drivers behind the development of another 'G' including ongoing demand growth (which will be partly met through 6G's improved spectral efficiency) and greater energy efficiency. Significantly, 6G will also help address scenarios which are not well served by technology available today. One of these is Australia's coverage challenge, which 6G will help address via a convergence of terrestrial and satellite protocols — this will enable a merging of satellite technologies (and potentially other air-based technologies) with terrestrial mobile networks to deliver near-universal coverage, something that will be particularly beneficial for Australia's regional and remote areas. Another scenario where 6G will also be useful, drawing upon the convergence referenced above, is ushering in a fully connected world where autonomous vehicles and remote surgery become safer and more feasible as latency approaches zero and coverage extends everywhere. Other beneficiaries of a more fully connected world include environmental monitoring systems, smart cites, connected robotics and digital twins for manufacturing sectors, with corresponding shifts in the way that customers interact and observe the world around us.

Importantly, to capture and maximise the benefits that 6G will offer, it is vital that the ACMA ensure sufficient and suitable spectrum bands are made available for use by MNOs to support the transition to 6G in a timely and coordinated manner. In addition to ensuring there is new spectrum, mobile network operators cannot afford to lose any of their existing spectrum, and where they are actively using, or have demonstrable plans to use that spectrum, they must be afforded the opportunity to renew their existing ESL holdings as well.

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[64] There has also been one world first in Edge compute, and five in the area of Transmission.

[65] Our 5G Innovation Centre on the Gold Coast, which opened in FY18, serves as a focal point for our mobile technology innovation and demonstration activities.

[66] Australia has been the leader of the GSMA's Connectivity Index, which measures performance against key enablers of mobile internet adoption: infrastructure, affordability, consumer readiness, and content and services, multiple times, see 2023 – GSMA Mobile Connectivity Index. The GSMA has also noted that Australia has consistently ranked as a one of the speediest countries in the world for mobile download speeds, see GSMA | 5G Speeds in Australia are Almost Twice the Global Average - Membership.

5 Planned spectrum use

This section outlines our current and future use of ESL spectrum. The consultation paper[67] invites stakeholders, including incumbent licensees, to articulate the ways in which they plan to use the spectrum, including "alternative uses" of the spectrum.

The primary use for spectrum in a mobile network is keeping up with the ever-increasing demand and expectation for reliable high-quality services. Traffic continues to grow relentlessly; as described in earlier sections, MNOs constantly upgrade technology to improve spectral efficiency, but traffic growth continues to outpace it.

While it is difficult to precisely predict how technology and traffic will continue to evolve over the upcoming 20-year licence term, we can say that 5G and 5G-Advanced will require renewal of all existing spectrum to keep pace with traffic demand growth, while new services promised by 6G will need access to additional spectrum (for example in spectrum in the 4, 6, 8 and 15 GHz bands). We noted some examples of third-party access previously in section 3.3.2, and we welcome future opportunities to provide third-party access to spectrum where we are not using or do not have plans to use it.

In the remainder of this chapter, we describe how traffic continues to grow, and the ways in which the evolution of existing use cases evolves towards new use cases. We talk about the changes in technology that we can see coming, and we talk about the way in which optimisation in and across the bands (such as alignment of expiry dates) will facilitate the entry of new technology and new, alternative use cases.

Appendix B outlines some of the techniques we use when deploying mobile networks to maximise the efficient use of the spectrum, including, Advanced Antenna Systems (AAS), Multiple Input, Multiple Output (MIMO) antennas, small cells, optimising Inter-Site Distances (ISDs), cell placement, in-building coverage, and more. These techniques are necessary because we do not have enough spectrum to satisfy demand without these "efficiency multipliers". If we were deploying our mobile network using the 3G technology and capabilities that were introduced some 20 years ago, our network would be woefully incapable of serving our customers and would no longer best serve the public interest.

5.1   Forecast demand (traffic)

The need for mobile spectrum is fundamentally driven by increasing data usage, moderated by industry improvements in spectral efficiency and further densification of mobile networks. We have seen mobile network growth rates come down from ~50% per year in the 2010s (driven by adoption of smartphones, social media and video content) to ~30% per annum in recent years. While demand growth has slowed, it is nonetheless substantial, and at a level that exceeds the pace of technological improvement of spectral efficiency, and the capacity of the industry to invest in further network densification. The excess demand growth therefore necessitates more, not less, spectrum. Thus, affording incumbent licensees the opportunity to renew all their existing ESL licences is essential. The consequence of not doing so is that there will be an immediate reduction in the continuity of the quality of service end users currently experience.

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67   Consultation paper, p.14.

Moreover, new use cases are arising:

- More and more customers opt for fixed-wireless data services for their fixed broadband needs. While the number of fixed-wireless broadband customers is small compared to mobile customers, the average data consumption of each one equates that of ~25 mobile users. This fixed-wireless traffic has therefore already led to substantial additional traffic growth on our network.

- Applications such as ultra-high-definition streaming services, cloud-based on-line gaming and video conferencing will continue to drive demand for broadband services.

- We expect that there will also be a large increase in the use of connected devices. Examples include wearables for health/fitness monitoring, smart appliances, augmented/virtual/mixed reality uses cases, AI based use cases, telepresence and robotics, Integrated Sensing and Communication (ISAC) applications, and connected/self-driving cars. To expand on this point, certain applications (particularly those using AI systems) will require real-time data processing. This requires secure and reliable high bandwidth connectivity.

- [C-I-C starts]   -[C-I-C Ends]

Given the tenure of renewed licences could be up to 20 years, it is very likely that other innovative uses cases needing even more bandwidth will emerge.

5.2   Keeping pace with technology

The optimal use case for ESL spectrum is mobility. Almost all the spectrum we use for the provision of mobile services is licensed on an exclusive use basis. With the launch of our 5G network in May 2019, mobility services are now provided via three networks (i.e., 3G, 4G and 5G). We have announced our 3G network will be closing in August 2024, and this will lead to our 4G and 5G networks being tasked with meeting all capacity and coverage demands ahead of 6G's arrival around 2030.

Beyond mobility, use cases for our licensed spectrum may include private networks and first responder connectivity. As the 5G-Advanced equipment ecosystem and 5G standalone (5G-SA) deployment matures, we anticipate adoption of new use cases including massive IoT services such as smart metering and sensor networks, mobile augmented and virtual reality applications, increasing e-Sports and gaming, and critical IoT services such as automated controls and real-time telematics (especially in mining, transport and industrial sectors).

While we expect 6G to see further enhancement of these use cases, new more demanding use cases such as network-enabled robotics, multisensory extended reality, ambient IoT[68] and integrated sensing and communication will be developed. These technologies will rely on mobile networks and are likely to be configured to operate on specific mobile band(s). The 6G business case will depend upon access to new spectrum, in addition to current spectrum, to accommodate these new services while continuing to cope with ongoing growth of existing services.

Spectrum used for the provision of mobile services could also support increased fixed-wireless services in the future. 5G's maturation will underpin many future use cases, but 4G networks will still play an important role in the medium term.

History has demonstrated that mobile network operators serve as good stewards of licensed spectrum and are commercially driven to deliver the most efficient use of licenced spectrum as demand for

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[68]   Ambient IoT. See https://en.wikipedia.org/wiki/Ambient_IoT and https://www.wiliot.com/ambient-iot

capacity or greater coverage increases. Operators constantly re-farm spectrum to move to new technology generations and this is a significant driver of evolving networks from 4G to 5G, and in the future, 6G.

Mobile operators need to take care to manage re-farming in a way that maximises the use of legacy technologies while seeding the network with devices capable of newer technology. This optimises overall capacity available in the network with the outcome of most efficient use of the available spectrum. It is the underlying planning for this that requires the certainty of supply offered by spectrum licences. The re-farming of mid-band spectrum from 4G to 5G use highlights this and we expect to see the same drivers motivating the transition of spectrum use from 5G or 5G-Advanced use cases to 6G use in existing and new spectrum holdings.

There have been historical examples, both domestically and globally, where spectrum allocated for dedicated or bespoke use is not fully utilised or refreshed as efficiently, for example, rail safety use of 1800 MHz in Australia. The same use cases can be accommodated using quality of service and prioritisation mechanisms inherent in 4G and 5G public networks. Public safety and rail communications are prominent examples of this globally.

5.3   Changes to licence conditions and technical frameworks to support alternative use

With each generation of mobile technology, there is a clear trend towards needing wider bandwidths to deliver the higher data throughputs possible with that generation.

In some cases, our spectrum licenced bands are fragmented in terms of geography, frequency and licence tenure. While we understand that some of these factors are related to the historical development of the respective band-plans, there may be scope to align some of them to allow for more efficient use of the available spectrum now, and well into the future.

The defragmentation of any band can, to some extent, be achieved through trades and other commercial arrangements between spectrum licensees. We provide some examples of how this process has worked in Appendix C. One of the key aspects to consider in any 'trade' is the substitutability of one spectrum block for another. For example, in the 3.4 GHz band, there is disparity between the technical conditions that apply to spectrum licensed transmitters in the 3.4 to 3.7 GHz band and those in the 3.7 to 3.8 GHz band (e.g., protection of radio altimeters). Misaligned boundaries are also an issue for 3.4 to 3.8 GHz. On the other hand, it could be argued that any of the spectrum blocks licensed bands below 1 GHz (i.e. 700 MHz, 850 MHz and 900 MHz) have quite similar propagation characteristics and could potentially be substituted for one another. Here, a barrier to efficient trades is the differing technical frameworks (e.g., device registration exemptions, protection of TFFL and TLMS), and disparate licence tenures. A similar argument could be applied to the lower mid-band spectrum licenced bands at 1.8 GHz and 2.1 GHz.

Telstra submits that as part of the ESL process, the ACMA has an opportunity to address some of these issues and maximise the utility of the IMT bands for the next generations of mobile technology. The easiest disparity for the ACMA to tackle is licence expiry dates. Aligning licence expiry dates will help facilitate spectrum trades by enabling any given quantity of spectrum to be valued identically in terms of its longevity. This is discussed further in section 6.3.

Some of the other alignment issues regarding the technical framework are clearly outside the scope of the ESL process. These require in-depth discussion in TLG forums but could be prioritised by the ACMA to have the outcomes of those fora used a blueprint for the new licences.

Mobile network operators can probably come to commercial agreement on licence boundaries, if they are not too disparate.

5.4 LEO satellites

In section 4.2.1 we described the exciting role we see LEO satellites playing in fulfilling Government policy objectives, including the MPS objective of facilitating new entrants such as LEO satellites. We noted that MNOs will need renewed access to ESL spectrum in support of both current terrestrial networks and future complimentary satellite DTM services.

In terms of forecasting potential future demand for use of ESL (and other) spectrum, there are two types of spectrum that can be used for satellite DTM — LEO satellites can operate using a portion of an existing Mobile Band(s) including ESL spectrum,[69] or they can operate using bands traditionally used for mobile satellite services (MSS bands). The benefit of the former is there is no need to upgrade mobile handsets (the satellite operates on the mobile bands handsets already use); the benefit of the latter is it doesn't require MNOs to forego existing mobile spectrum for use by the LEO.

Satellite DTM services will be delivered in partnership with global multi-national companies who are not interested in becoming direct owners of domestic spectrum in each market they serve. They will form symbiotic relationships with MNOs and will work in close partnership to complement the terrestrial network without causing interference.

This view is supported by two of the key players in the satellite DTM segment as evidenced in their submissions to the recent consultation by ACMA on Satellite Direct to Mobile Services (SDMS) Regulatory issues.[70] Lynk Global made the following points:

- *"SDMS satellite architectures can differ both technologically and with respect to spectrum, so it is imperative that prospective providers first demonstrate their systems under experimental licenses in full view of co-channel and adjacent users. SDMS systems meeting these technical requirements and showing no harmful interference should be commercially licensed in their demonstrated range of frequencies and geographies, but service should be conditioned on operations under a business arrangement with one or more existing terrestrial licensees."* (p.2)

SpaceX also made similar comments in response to the same consultation:

- *"This framework designs clear incentives for spectrum license holders to balance commercial, legal, and regulatory implication of additional services deployed in its band, such as Starlink Direct-to-Cell. By doing so with minimal regulatory intervention, the spectrum license requirements properly set incentives for commercial operators to leverage their own due diligence and contractual obligations to manage compliance centered on the consumer, rather than on which technology is connecting them."* (p.3)

We expect a close partnering between Australian MNOs and satellite operators will facilitate improved outcomes for network resilience and recovery. Importantly, this will be best achieved where the satellite is already operating in an IMT band in partnership with an MNO. Should the terrestrial mobile

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[69]   It is worth noting that LEOs cannot use a Time Division Duplex (TDD) band without selecting a completely different frame structure. The frame structure currently used terrestrially in Mobile Bands assumes the handset is a maximum of 15 km from the base station, and LEO satellites are 500km or more from the ground. In other words, the round trip delay for the LEO is too great for the current frame structure.

[70]   https://www.acma.gov.au/consultations/2023-11/satellite-direct-mobile-services-regulatory-issues#submissions

network suffer an outage due to a natural disaster, DTM should be more easily able to make use of the spectrum on a temporary basis, simply by removing geo-fencing (if the LEO is operating on the same frequencies outside the terrestrial use of the spectrum), or by extending the bandwidth the transmitter is operating on (if the LEO is using a portion of the MNO's spectrum across the full landmass). If that partnership does not exist (e.g., because the LEO satellite is allocated its own spectrum from a portion of the ESL spectrum), it will be more difficult to achieve a seamless change-over to satellite use of the spectrum during a crisis.

Commercial agreements between satellite and MNOs enable dynamic spectrum sharing agreements in which the boundary between space and terrestrial use can be shifted in consideration of terrestrial coverage footprint changes, traffic demand changes and improvements in technology. On this last point, early satellite 4G DTM services are likely to require large "dead zone" boundaries between satellite and MNO use to avoid interference issues. Improvements in 5G are likely to permit smaller dead zones, while further improvements anticipated in 6G are likely to approach seamless interworking between terrestrial and space networks. A rigid licence-based separation could not offer the same level of flexibility, diminishing spectrum utilisation.

Another factor to consider is the close working relationship between MNOs and handset vendors. For a satellite-based service to deliver maximum benefit to the public, it is important that handsets have the capability to interwork with both conventional terrestrial mobile networks, as well as any new non-terrestrial platforms. Given the size of the Australian market compared to the global handset market, it is imperative that mobile network operators, satellite providers and the vendor community maintain relationships to ensure our customers benefit from the latest technology.

In order to preserve and maximise the value of radio spectrum, it is important to avoid any adverse impacts to existing terrestrial networks due to mismanagement of any new satellite-based services. Telstra's view is that the MNOs must have full control over the spectrum held under their spectrum licences, and that satellite operators providing complementary services must have cooperative sharing agreements in place (in addition to appropriate technical measures) to avoid interference between the two services. This will help maximise the public benefit from allowing these new services into the Australian market.

6 Maintaining and improving the utility of renewed ESL spectrum

In this section of our submission, we outline several ways in which the utility of renewed ESL spectrum can be maintained and could be improved. In some subsections, such as the subsection on secondary trading, we point to historic examples that could be repeated in the future if the conditions are amenable, which leads to our subsections on alignment of expiry dates, and the benefits to regional and remote communities could enjoy if competition limits are reimagined. We commence this section with why it is important not to allocate spectrum to bespoke use cases.

6.1 Dedicated spectrum for bespoke use cases risks uncertainty

Dedicating radio spectrum for specific purposes like Public Safety Mobile Broadband (PSMB) can be inefficient for several reasons:

1. **Underutilisation**: Dedicated spectrum can remain idle when not in use by the designated service. This creates inefficiency because the spectrum could potentially be used by other services when not in use by the bespoke application.

2. **Multiple bands may be required**: Some bespoke use cases, especially applications like PSMB, require multiple bands (across low-band and mid-band spectrum) to be more effective and improve resilience. Servicing bespoke use cases with dedicated spectrum across multiple bands will consume a lot of spectrum.

3. **Technological Advances**: Bespoke use cases are less likely to keep pace with technological advances that improve the efficiency of spectrum utilisation.

4. **Interference Concerns**: Spectrum allocated for a specific purpose may cause, or suffer from interference issues, where it is immediately adjacent to mobile spectrum (i.e., in the same band) and where the technology for the bespoke application differs[71] from that being used for mobiles. This interference can degrade the quality of service and limit the effectiveness of either, or both, users.

Telstra has products which can support PSMB-type use cases, without any spectrum set-asides — these are LANES® Emergency and Telstra Dedicated Network (TDN).

Our LANES® Emergency product[72] is used by emergency services organisations (ESOs) in NSW, Queensland, Victoria, Western Australia, along with the Federal Police and the Defence Force. NSW Telecommunications Authority, Qld Govt Wireless network and Networking Tasmania that use it for backhaul for Land Mobile Radio (LMR) public safety radio (usually as a failover for fixed backhaul but sometimes primary for mobile LMR). The 700 MHz band (i.e., low-band spectrum) is crucial for LANES® for coverage, however all bands are used for our LANES® product.

Our TDN product[73] is a similar offering, although not quite to the same "critical service" levels required by ESOs. TDN is delivered over Telstra's 4G and 5G network (therefore, not requiring dedicated radio spectrum) and incorporates Service Level Agreements (SLAs), cyber-security, and managed services capabilities from our Telstra Purple managed services team. Importantly, the traffic prioritisation,

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[71] Different "technologies" could be as simple as different mobile generations. For example, the bespoke application is running 3G when the mobile is running 4G.

[72] Telstra LANES® Emergency. See https://www.telstra.com.au/business-enterprise/industries/public-safety/lanes-emergency

[73] Telstra Dedicated Networks (TDN). See https://www.telstra.com.au/business-enterprise/industries/mining/dedicated-networks

backed by SLAs delivers a service that is equivalent to a dedicated network, without the need to have spectrum set aside and dedicated to that network. This allows the spectrum to be more efficiently and effectively used by a wider range of end users.

6.2   Secondary trading has allowed the market to adapt

As noted previously in Section 5.3, some of the spectrum licenced bands are still fragmented in terms of geography, frequency, and licence tenure. There are some parameters that need regulatory intervention to solve, such as alignment of licence expiry dates and/or tenure. Others however, can be solved to some extent by secondary trading to facilitate more efficient use of the available spectrum.

An excellent example of how this process has been used by all Australian mobile operators to improve the utility of the 1800 MHz band is shown in Appendix C. This was achieved through mutual agreement being reached amongst the three Australian MNOs with a view to optimising the use of what was a very fragmented band. Today, the band is a key part of each MNO's 4G network. Had the band remained in the prior fragmented state it would have been virtually unusable for 4G provision.

The key point is that for the most part, it is possible to trade spectrum under the current arrangements if there is an incentive to do so. The incentive might be to improve the utility of the spectrum by seeking trades that give each licensee larger contiguous blocks of spectrum, or to seek additional spectrum in a particular geographic area that may be of interest to one licensee, but not another.

We also envisage that there will be a need to accommodate larger channel widths to support the sorts of throughputs expected of 6G. This may provide the incentive to look for new trading opportunities as operators seek to maximise the efficiency of their networks. The industry needs to retain the flexibility provided by the secondary trading mechanisms built into the Radiocommunications Act and needs no other additional regulatory support.

6.3   Alignment of future expiry dates could deliver band optimisation

While not an "alternative licence condition" in the same sense that UIOLI or build obligations are an alternative licence condition, alignment of licence term would be helpful towards facilitating defragmentation across different bands. By aligning licence expiry dates across bands that have common characteristics (e.g., TDD vs FDD), operators will be able to consider defragmentation across bands (i.e., "band optimisation) at renewal.

We consider there are three opportunities:

- 1800 MHz / 2100 MHz band renewal dates - this means a 4-year extension for 1800;
- 850 MHz (Band 5) renewal date to align with the Extended 850 MHz (Band 26) end date - this means a 16-year term for Band 5, not 20 years; and
- 3.4 GHz and 3.6 GHz renewal date to align with 3.7 GHz end date - this means a 14-year term, not 20 years.

Setting shorter duration licence terms in these bands provides points in time when future industry-led spectrum trading can be performed, optimising use across the bands by facilitating single, wider channels, thereby allowing the bands to be used more efficiently.

6.4   Competition limits must be relaxed for ESL Spectrum that is reallocated

A possible outcome of the renewal process is that some spectrum is not renewed. ESL spectrum might not be renewed for two possible reasons. Firstly, the spectrum is not being used, and the incumbent licensee has no demonstrable plans to use it, in which case, the incumbent licensee should not be offered the opportunity to renew the licence. Secondly, the incumbent ESL licensee elects not to renew their spectrum. We note that regardless of the reason, so called "returned spectrum" is more likely to be in regional and remote areas, and we consider that people living and working in these areas would benefit from spectrum that is unused, or under-used, being put to good use in delivering services. As we have noted elsewhere in our submission, this will not only increase the efficient use and utility of the spectrum, but it will also raise the level in which the public interest is served and satisfied.

Historically, competition limits on holdings of national spectrum licences have been derived with metro geographies in mind. It does not make sense for the same limits to be applied in regional or remote areas if the outcome is that the spectrum remains fallow. That is not in the public interest. As such, a re-think of the way competition rules are developed and applied must occur. We consider that limits and rules in regional areas must be treated differently to metro areas, so that better quality mobile services can be provided to regional and remote geographies more effectively, and so that spectrum does not remain fallow. This has already occurred with the auctioning of the 3.7 GHz band, where bidders were allowed to acquire more spectrum in regional areas (up to 160 MHz across the entire 3.4, 3.6 and 3.7 GHz bands) compared to metro (where only 140 MHz aggregate spectrum was permitted across the three bands).

6.5   [C-I-C]

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7 Alternative licence conditions

In this section we present our views on alternative licence conditions including concepts such as rollout obligations, use-it-or-lose-it (UIOLI), use-it-or-share-it (UIOSI), resilience and temporary disaster recovery conditions. We explore these concepts as a condition on a *renewed licence*. To be clear, we are not considering these concepts as conditions to be met for an incumbent licensee to qualify for existing licences to be renewed; that is covered in Section 2.4.

7.1 Alternative licensing conditions must drive better outcomes in regional and remote Australia

As we noted in Section 2, we consider leaving spectrum either unused or underutilised is not in the public interest. Spectrum must be put to its optimal use, and we consider that in some instances, it will be best achieved through alternative licence conditions that require a licensee to expand coverage or have unused or under-used spectrum reclaimed by the Government.

Therefore, we support "Use It or Lose It" (UIOLI) as a condition on renewed licences, provided it is implemented with clear, unambiguous parameters and thresholds (which are most likely some form of coverage or build obligation) that do not adversely impact our ability to use any spectrum for which we already have substantive or planned use, and the surrender of unused portions does not result in interference with pre-existing or adjacent licensees. UIOLI can apply to any spectrum licence (which by its very nature is long-term), including licences held by rail safety and television broadcasters.

7.1.1 Addressing future inefficient spectrum utilisation

Recommendation 19 from the ACCC's Regional Mobile Infrastructure report says "*To the extent that regional-focused operators can develop alternative means of providing mobile coverage in regional Australia, there may be benefit in providing those operators with access to [currently allocated, and particularly low-band] spectrum, particularly where the spectrum may be not currently used.*"[74] We are proud to be the operator of Australia's largest mobile network, with around 1 million km^2 more coverage than any other operator (see section 3.2) and a significant investor in regional and remote Australia (see section 3.5).

We consider ourselves to be the most regional-focused operator in Australia. In the 1 million km^2 where Telstra's mobile network coverage exceeds that of our competitors, we carry 100% of total mobile traffic, and yet we have less than half the available low band spectrum which is critical to the supply of services in those areas. Therefore, it disappoints us that there is unused or underutilised spectrum held by other licensees that could easily and affordably enhance services for regional Australians. As such, we support the application of UIOLI conditions on renewed licences as a mechanism to address possible future inefficient use of spectrum.

Safeguards and thresholds must be established to ensure that the UIOLI policy effectively meets its intended policy objectives. We address this issue below.

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[74] ACCC Regional Mobile Infrastructure Inquiry – Final Report, July 2023. See Recommendation 19, p.81. Available at: https://www.accc.gov.au/system/files/Regional%20Mobile%20Infrastructure%20Inquiry%20final%20report.pdf

7.1.2   Suitable safeguards are needed to implement UIOLI / Coverage obligation

As the consultation paper notes,[75] design of any alternative licence conditions will require some thought. At a high level, we consider UIOLI conditions on future spectrum licences (ESL or otherwise) must address the following key issues:

1. **Usage criteria (threshold) must be well defined and aligned to policy objective:** The ACMA will need to establish clear guidelines (thresholds) that define "use" of the spectrum, and this should be established with industry's participation. Ambiguity in the definition of "use" will likely lead to protracted disputes at the time when the UIOLI or build/coverage condition is enforced. It may also be important to factor in changes in the manner in which an incumbent licensee "uses" the spectrum. For example, in the future, spectrum may be "used" by satellites to deliver coverage (at a lower quality of experience).

2. **Determine whether a new "owner" is in a better position to fulfil public interest policy goals**: While reallocating unused or under-used spectrum to a new owner because of the incumbent failing to meet the UIOLI or build/coverage condition may enhance spectrum efficiency, the re-allocated spectrum's subsequent usage could differ from the original licensee's usage. For example, the new owner could use the spectrum for private network deployment. As such, reallocation arising from failure to meet a licence condition threshold may still not result in improving public interest or government policy objectives such as enhancing public mobile network coverage.

3. **Flexibility in meeting requirements**: We agree with the ACMA's proposition that alternative licence conditions should provide licensees the flexibility to develop novel and innovative approaches to satisfying requirements. During compliance checks, substantive planned use should be taken into consideration as well as other legitimate reasons such as interference management. Recognising planned use allows MNOs to develop strategic plans for future deployment, while setting a reasonable threshold for *substantive* planned use avoids spectrum being "land banked". This approach balances the need for immediate spectrum use with long-term strategic planning.

4. **Reasonable minimum time is required to establish usage**: There should be a reasonable minimum time period to determine whether a license is being used. This allows sufficient time for MNOs to deploy their services and make the necessary investments in infrastructure. Setting a reasonable timeframe ensures that MNOs are not unfairly penalised while encouraging timely deployment. This safeguard is crucial in accommodating the complex and time-consuming nature of network deployment.

5. **Compensation for mid-term spectrum loss**: The ACMA discusses potential implementation options for alternative license conditions under the current spectrum framework[76]. The two main options are: incorporating these conditions as part of the license itself or as part of a renewal statement that specifies the conditions must be met for the ACMA to consider renewing the license. If spectrum is lost mid-term due to lack of usage, it is our strong view that license holders should be compensated on a pro-rata basis. This approach ensures fairness and protects the interests of MNOs. Compensation mechanisms can help mitigate the

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[75]   Consultation paper, p.25.

[76]   Consultation paper, p.29

financial impact on MNOs and encourage them to continue investing in efficient spectrum use. Additionally, this safeguard provides a safety net for MNOs, promoting a more stable and predictable regulatory environment.

6. **Sensible geographical boundaries:** As mentioned in section 4.1, the geographical subdivision of spectrum can complicate management and coordination efforts, particularly in the context of low-band spectrum. The establishment of well-planned geographical boundaries is crucial to prevent interference that could impact incumbent license holders. This approach ensures the maintenance of service quality for end-users and optimises spectrum use without disrupting existing services.

7.1.3   Reallocating unused/underutilised spectrum efficiently

When spectrum is returned to the Government because of not meeting a UIOLI or build/coverage licence obligation, it should be promptly reallocated using market mechanisms such as an auction.

As this scenario could only result from the under-utilisation of spectrum, any allocation limits should be relaxed in the corresponding reallocation process to encourage more efficient use of the spectrum. Relaxed competition limits also ensure that spectrum is allocated to those who can make the best use of it.

We do not support the direct allocation of "returned" spectrum to specific use cases, technologies, or private networks, or to new entrants such as a fourth mobile network operator or neutral host (see section 3.4.3). Such allocations could lead to inefficient use of the spectrum. Instead, these needs are better addressed as applications of public mobile networks and / or through commercial partnerships. Allocating spectrum broadly allows for greater flexibility and ensures that it can be used for the most pressing and beneficial applications at any given time. This approach maximises the economic and social benefits of spectrum use.

7.2   UIOSI

While we support UIOLI with appropriate safeguards, we are not in favour of "use it or share it" (UIOSI) schemes. Globally, sharing schemes involving mobile spectrum have led to low spectrum utilisation and high complexity. Spectrum sharing technologies continue to emerge, but these are best implemented through direct commercial agreement between interested parties, rather than as a spectrum licence condition.

A UIOSI licence condition would have several clear disadvantages:

- **Complex administration to manage primary and secondary use of the spectrum**. Some form of online database is required to manage and avoid interference between access seekers.

- **Difficulty in maintaining technology and / or use case neutrality**. Modes of interference tend to be technology and / or use case specific, meaning that interference management provisions would need to recognise intended use. This would reduce spectrum flexibility, limiting future spectral efficiency enhancement opportunities.

- **Complexity in managing edge cases and usage permutations.** To ensure fairness, the UIOSI scheme would need to consider edge cases and permutations of different possible primary and secondary technologies and / or use cases. This would lead to significant complexity, most of which would be unnecessary in individual sharing cases.

We do not support UIOSI as an alternative licence condition because of the disadvantages of the approach.

7.3   Resilience and Temporary Disaster obligations

Resilience and temporary disaster response[77] obligations are also contemplated in the range of possible alternative licence conditions in the Consultation paper.[78] As a telecommunications service provider, we understand the importance of resilience, especially during times of crisis, such as natural disasters. We have provided information and our views to several inquiries about the resilience of telecommunications infrastructure, covering topics such as loss of mains power, limits on the ability to defend against the forces of nature (fire, flood, cyclone), and our responsiveness with temporary infrastructure such as Cells-on-Wheels. Our views and information on these topics are readily available on the public record.

It is unclear if there is any economic or social value in tying a resilience obligation to the renewal of a licence, especially where the term of that licence is measured in decades, as this may increase the risks associated with renewal and hence costs for MNOs. There are several external factors that will need to be considered when costing a resilience obligation. For example:

- climate change is leading to an increase in the frequency and severity of extreme weather events, and the full nature and extent of any future network impacts from extreme weather events is not known with any certainty;

- the cost of meeting resilience obligations is very difficult to accurately predict over the licence period, due to: i) unpredictability of technology development, such as compact off-grid energy generation and storage; and ii) cost of key inputs, such as lithium for battery storage;

- LEO satellite DTM services could provide service[79] when terrestrial networks are disrupted making additional resilience of terrestrial networks less of an imperative; or

We consider that tying an obligation on either resilience or temporary disaster response to the renewal of an expiring licence is imprudent for the following reasons:

- Licensees will estimate the cost of complying with the obligation using assumptions that skew towards worse outcomes when accounting for the external factors, in order to help mitigate the risk of being left with a financial burden;

- If/where alternative solutions or technologies address resilience needs, but the obligation to build resilience as an ESL obligation is not removed, licensees will still be required to fulfill a now superfluous obligation(s), incurring cost for no tangible benefit. This cost is ultimately passed on to consumers;

- the primary cause of network outages — the loss of mains power — is something licence holders themselves are unlikely to be responsible for, noting there are inherent limitations to all temporary power solutions such as batteries and generators which MNOs may deploy across their networks.

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[77]   Temporary disaster responses are measures taken to temporarily restore a disrupted mobile network. For example, the deployment of Cells-on-Wheels, the use of satellite backhaul capability while damaged optic-fibre backhaul routes are repaired.

[78]   Consultation paper, p.16.

[79]   Albeit, with less capacity than a terrestrial network.

As such, we consider the risks (technological, economic and obsolescence) associated with including resiliency and temporary disaster response obligations *as a licence condition* outweigh the benefits, especially given the longevity of spectrum licences. We consider a far more prudent approach to addressing policy objectives such as resiliency and temporary disaster responses is to develop and work through a program of sequential, short-duration (1-2 years) activities or government supported programs, each with specific goals and deliverables. In this way, funding can be considered on a case-by-case basis where specific goals are not financially feasible, and where they are financially feasible, industry can be left to source the latest and most cost-effective technology solution(s) to achieve the policy objectives.

8   Pricing, valuation and returned spectrum

We acknowledge that the ACMA, at this stage, has not requested any input on spectrum pricing. However, given the critical importance of pricing to licence renewal, we take the opportunity here to highlight two key principles that should guide the setting of renewal prices. This section then goes on to outline key positions on matters such as valuation methodologies, industry affordability and sustainable market pricing. Beyond the few short points we make here, we will leave more detailed discussion to a future date.

8.1   Principles to guide setting of renewal prices

We consider there are two key principles that should guide the ACMA's approach to valuation and setting of renewal prices. Firstly, the process for setting the renewal prices must be both rigorous and transparent, ensuring that all stakeholders have clarity and confidence in the methods used, and we note the consultation in Stage 3 will provide transparency and an opportunity for stakeholders to comment on the ACMA's pricing and valuation methodology.

Secondly, the renewal prices should be set conservatively to mitigate the risk of incorrectly estimating inputs into the final chosen valuation methodology. Setting the prices conservatively will also assist in maintain industry affordability and support sustainable market prices to consumers, as well as safeguarding the long-term viability of the sector.

8.2   Perspectives on valuing and pricing spectrum

While there is no established approach for determining spectrum renewal prices, common approaches are to develop a spectrum valuation model to determine the market value (i.e. the value to the marginal bidder), or rely on international historic benchmarks with appropriate adjustments. As there will be uncertainty in any methodologies to estimate the market value (whether it be benchmarking, modelling or other), the prices should be set conservatively. If renewal prices are set too high, there is a risk that operators will not renew some or all their spectrum, leaving it unused. This is particularly relevant in an environment where spectrum prices are falling. As set out in our Stage 1 consultation response, Telstra considers international benchmarking to be more suitable for spectrum valuation in an ESL process than valuation modelling, for a range of reasons (higher transparency, reduced complexity, no reliance on commercially confidential data and less need for subjective assumptions).

The key challenge with regards to the use of *historic* benchmarks is the need for adjustments to ensure that any market values derived from them reflects *current* day market values. Global spectrum prices (in terms of $/MHz/pop) have come down substantially since the mid-2010s. This decrease in pricing has been driven by several developments.

Here we highlight three key ones:

- **Expansion in supply**. In response to growth in mobile traffic, more spectrum has come to market. When the supply of an essential input is increased, it is to be expected that the price per unit will decline. Mobile operators continue to invest heavily in spectrum, but their limited funds are spread across a greater range of frequencies.

- **Mobile traffic growth**: As clarified in section 5.1, mobile traffic growth rates have come down from 50% per year in the 2010s (driven by adoption of smartphones, social media and video content) but

are still running at ~30% per year as at end FY23. The positive growth implies the need for more spectrum, and spectrum valuations must take into account MNOs also needing to acquire more (new) spectrum toward the end of this decade.

- **Industry affordability**: The release of more and more spectrum bands for operators to cope with data traffic growth has led to a very large increase in spectrum costs. In Telstra's case, in the 10 years since financial year 2013, our annual spectrum costs (i.e., the amortisation of our licences) have increased by more than a factor of four, and this trend is set to continue this year and next year with the pending payment for the 850 MHz extension band. Over the same time, revenue from mobile services increased by only 12% in total. As a result, spectrum cost as a share of revenue has increased by a factor of almost four. A continuation of this trend is unsustainable and has contributed to an industry battling with a Return on Invested Capital (ROIC) below its Weighted Average Cost of Capital (WACC). We expand our views on industry affordability below.

In addition to these three developments, a range of other developments have driven the decrease in spectrum prices, e.g., declining industry growth, low returns on invested capital, an improvement of spectrum availability through improved technology, and favourable policy settings.

In summary, the value to operators from a marginal unit of additional spectrum is much lower now, after the completion of 5G era awards, than it was at the end of the 4G era.

8.3 Industry affordability and sustainability

Since around 2010, widespread smart phone adoption, the advent of ubiquitous over-the-top digital services, upgrades to new generations of mobile technology and associated infrastructure investment, and rapid consumer uptake of highly data-intensive services have transformed the relationship between customers and spectrum. In essence, Australian operators must provision vastly more spectrum per customer than 10 or 15 years ago, while at the same time, revenue per customer has been relatively steady.

Mobile networks are expensive to operate and are upgraded around every 10 years. While network utilisation by end users has been soaring, industry profitability has been declining for many years.[80] As Venture Insights observe, the industry has been experiencing a decline in Return on Invested Capital (RoIC). Venture Insights observe, "*One consequence of this trend has been significant decline in ROIC in the telecommunications industry over the last five years. In telecommunications, ROIC is a major driver of long-term profitability. The decline in ROIC is therefore an indicator of reduced capacity to invest in the infrastructure that delivers services.*"[81] Recent research by Barrenjoey corroborates the analysis from Venture Insights. Barrenjoey determined the average ROIC of the three mobile operators in Australia to be 5.6% for CY23.[82] This is well below the industry's WACC.

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[80] Accenture. Pathways to Profitability for CSPs. 26 Sept, 2022. Middle figure on Slide 5. https://www.accenture.com/content/dam/accenture/final/accenture-com/document/Accenture-Comms-Narrative-POV-final.pdf

[81] Venture Insights. State of the Australian Telco Industry. 14 June, 2023. See Figures 7 and 8, p.15 for data on FY17-FY22. While Figure 7 shows EBITDA decline has levelled out in the last two financial years (FY21 and FY22), this is driven solely by NBN; the other three major network operators (thin green line) are still in EBITDA decline. However, ROIC (Figure 8) has levelled out for some operators in the last two financial years. Available at: https://www.ventureinsights.com.au/product/report-state-of-the-australian-telecommunications-industry/

[82] Barrenjoey, "Game of phones: old foes become new allies", Equity Research, dated 29 April 2024. See Fig 4, p.4.

Mobile operators now rely on data volume to generate revenue, however competition in the market has seen increasing data volumes offered to consumers at lower prices.[83] Recent analysis has shown that for consumers, the price of a gigabyte of data has never been lower, leading to an increase in data usage by consumers. For the telecommunications companies this has resulted in higher consumption, but lower revenue per gigabyte; a trend that is being observed worldwide. It is estimated that total mobile service revenue per gigabyte consumed declined by 27% in Australia over the last two years, amongst the largest revenue declines in the world.[84]

Finally, in setting renewal prices and considering industry affordability and sustainability, we consider the Government must take a holistic approach to all the requests upon the telecommunications industry. There are many compliance requirements being placed on the industry, including improving cyber-security, network resilience, supply-chain security in response to geopolitical events, mobile network coverage and service quality. To the extent the industry is paying for spectrum renewal, there will be less capital available to invest in other Government priorities for the industry.

8.4 Spectrum cost is borne by consumers

In the end, spectrum costs are borne by customers, either directly through higher prices, or indirectly through reduced innovation and investments. The GSMA's "Impact of Spectrum Pricing on Consumers"[85] highlights the negative impacts of increased spectrum pricing — a reduction in network coverage and quality, and a moderate correlation with increased downstream prices.

Fundamentally, telecom operators, as other public businesses, are reliant on external parties (equity holders and debt providers) to provide the capital needed to operate and invest. In return, they seek and expect a return commensurate with the risk they undertake by providing the capital, and they will do so in the context of many alternative investment and lending options, and a high interest rate environment. An industry that produces a return on invested capital that is not competitive will have to adjust in order to survive, be it through structural changes, reducing investments, or increasing prices. The recent network sharing initiatives in Australia are illustrative of a structural change to decrease investments. For example, the recently announced Optus/TPG-T MOCN agreement claimed "*the agreement will reduce combined 5G network rollout costs*",[86] at the cost of reduced infrastructure competition in regional Australia.

Given the significant social and economic benefits associated with the use of mobile networks by all Australians, Telstra considers it imperative that the valuation and pricing approaches adopted in future spectrum renewal processes must leave MNOs with sufficient capital for continued investment in both coverage and innovation. Many telecom operators globally have been experiencing low returns on capital, and to the extent operating financial challenges are exacerbated by high costs for obtaining spectrum in the future, this will implicitly impact the capacity of operators for ongoing network investment which meet the public interest criteria.

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[83] Canstar Blue, 2023, https://www.canstarblue.com.au/phone/unlimited-data-phone-plans/

[84] Jungermann, Fredrik, 2023 ARPU Growth Almost Always Slower Than Inflation, Figure 13, p.18.
Available at: https://tefficient.com/arpu-growth-almost-always-slower-than-inflation/#more-6516

[85] GSMA, **The impact of spectrum pricing on consumers**, September 2019. Available at:
https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2019/09/Impact-of-spectrum-prices-on-consumers.pdf

[86] See Optus/TPG-T MOCN agreement, 29 April 2024. https://www.optus.com.au/about/media-centre/media-releases/2024/04/tpg-telecom-and-optus-sign-network-sharing-agreement

8.5   Returned spectrum must be auctioned

There are two possible mechanisms through which spectrum may be "returned" to the Government through the ESL process. Firstly, a licensee may be afforded the opportunity to renew a license, but elects not to renew it, or not to renew a portion of the licence (for example, remote geographies on a nation-wide licence). Secondly, the Government may not afford a licensee the opportunity to renew some or all of a licence (i.e., partial renewal or refusal).

Regardless of how spectrum comes to the point where it is returned to the Government, it is our strong position that any returned IMT spectrum through this ESL process must be reallocated using a market allocation mechanism, namely, an auction. Our submission has made it clear that the greatest public benefit and public interest is served by IMT spectrum being used for public networks. Where there are bespoke applications such as PSMB or private network opportunities, the public interest is best served by delivering those bespoke applications on a public network with appropriate traffic management and prioritisation (see section 6.1).

As such, returned spectrum must be reallocated using a market allocation mechanism, namely, an auction.

9 Global environment, ITU, equipment ecosystems

This section responds to aspects of the consultation paper seeking information on the international ecosystem and environment for standards and equipment.[87]

9.1   International Telecommunication Union (ITU) harmonisation

In addition to the ITU-R Radio Regulations identified in the consultation paper, the ITU publishes recommendations for IMT and has published the framework for the IMT-2030 recommendations (or 6G). These recommendations highlight the need for spectrum harmonisation, and that a range of frequencies are required to meet the objectives of IMT-2030.

ITU Recommendation M.2160-0 "Framework and overall objectives of the future development of IMT for 2030 and beyond" highlights that IMT-2030 systems are envisioned to employ a diverse range of frequency bands, similar to the existing IMT systems. However, these systems may operate with wider bandwidths and at higher frequencies.

The recommendation also recognises the advantages of spectrum harmonisation include promoting economies of scale, enabling global roaming, simplifying equipment design, enhancing spectrum efficiency (which could potentially reduce cross-border interference). Harmonising spectrum for IMT would result in greater equipment commonality and contribute to achieving economies of scale and affordability, thereby fostering digital inclusion.

No single frequency range fully meets all the criteria necessary for deploying IMT systems, Therefore, multiple frequency ranges are necessary to address the capacity and coverage needs of IMT systems and to support emerging services and applications.

9.2   Industry standardisation

The 3rd Generation Partnership Project (3GPP) is an industry-led standards organisation which develops the technical specifications for the delivery of IMT services, separate from the ITU WRC process which deals with spectrum allocations. Since its inception, 3GPP has developed and maintained standards for each mobile generation from 3G onwards.

We have been active in our international engagement with ITU-R and 3GPP — we actively contribute and influence the work in both organisations to support our spectrum ambitions reflecting the needs of the wider Australian landscape.

3GPP processes are contribution driven and consensus based. The result is a standard driven by commercial and market needs. The standardisation of spectrum bands is a result of industry requirements traditionally driven by mobile broadband use case. As global industries use IMT technologies for a wider range of use cases, such as mission critical communications, industrial automation, smart cities, vehicular or satellite comms, the technology standards are developed to accommodate these use cases. This ensures that the return on existing capital investments in spectrum and networks is maximised.

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[87]   Consultation paper, pp.19-23, and specifically, Table 2.

The 3GPP designation of New Radio (NR) bands for the provision of 5G services are important to develop device and equipment ecosystems. The availability of 3GPP specifications are a critical dependency for equipment implementation and testing.

Table 1 below is an extract from 3GPP specification TS.38.101-1, defining the use of the ESL bands for 5G. The same frequencies (excluding n77/78) are defined for 4G (LTE).

NR operating band	Uplink (UL) *operating band* BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) *operating band* BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n26	814 MHz – 849 MHz	859 MHz – 894 MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

Table 1 Reproduction of 3GPP TS.38.101-1 Table 5.2-1: NR operating bands in FR1

While 3GPP defined 5G specifications for usage in spectrum ranges below 7 GHz (Frequency Range 1) and in mmWave bands (Frequency Range 2), the pressing need to meet enhanced MBB data capacity in different global markets drove the definition of individual 5G bands, mainly in mid-band spectrum. The work done by companies in 3GPP reflected the reallocation of C-Band spectrum in North America and the definition of 3.6 GHz as a pioneer 5G band in Europe, China, and Asia-Pacific (APAC) region. Thus, the work in 3GPP reflected the global trends and drivers of spectrum use by mobile operators in North America, Europe, Japan and Korea as well as China.

The way that 3GPP reflects market drivers can also be seen in the definition of new 5G bands for the upper 6 GHz band. This activity was strongly motivated by European operators (with the support of Telstra) and China. Operators in these markets recognised that growing demand for mobile broadband data as 5G matures could not be met with sub 4 GHz spectrum alone. 3GPP also saw activity recently in developing new 5G bands in low-band spectrum, namely the 600 MHz APT band defined in Release 17. While the band is not presently available for allocation in several markets, 600 MHz has been shown to be an important low-band for T-Mobile USA. Its success in the US market and the scarcity of 5G low-band spectrum motivated the definition of this band in the APAC region. Telstra led the activity of defining the best technical requirements framework for 3GPP to develop this band (n105).

Examples such as the C-band experience, the definition of 6 GHz licensed and APT 600 MHz bands, demonstrate how 3GPP can be an effective indication of general interest in the global industry on spectrum usage. By defining their bands based on operator demand, equipment vendors then participate in 3GPP standardisation to define their technical requirements and add support for these bands into their existing product roadmaps.

9.3   Global environment

As mentioned in section 9.2 above, the process in 3GPP is industry led and spectrum ranges are not enabled unless there is an operator requirement to deploy the spectrum. This is particularly true of the spectrum included in the ESL bands, where the bands are used in multiple countries and by multiple operators creating a global ecosystem of devices using the spectrum.

Table 2 below shows the broad global use of the spectrum and is derived from the GSMA Intelligence database.[88] It summarises the number of countries that have licenced the spectrum and the number of networks operating in each band. The table only includes 4G and 5G networks to show the ongoing and future global use of these frequencies, however there are numerous 2G and 3G networks still in operation today, that also use many of these bands.

Frequency (MHz)		700	850	1800	2100	2300	2600	3500
3GPP Band number		28	26, 5	3	1	40	7	78
Number of Countries	4G	71	20	164	83	28	111	10
	5G	31	3	12	21	5	10	46
Number of Networks	4G	173	34	402	159	45	284	13
	5G	46	4	15	32	8	15	95

Table 2: Number of Countries, and Number of Networks occupying ESL Bands (by technology generation)

9.4   Use of ESL spectrum

ESL spectrum has extensive use in Telstra's mobile networks. As at the end of January 2024, our mobile network comprised around 11,000 towers, and since Telstra launched LTE in 2011,[89] we have had over 60 million devices access one or more of these bands, with more than 16 million of these still active today. We have also had over 9 million devices using the bands on 5G. Details of our network coverage can be found at: https://www.telstra.com.au/coverage-networks/our-coverage.

9.5   Equipment availability

The 3GPP specifications include a requirement for devices to have a unique serial number called an International Mobile Equipment Identity (IMEI). The first eight digits of the IMEI is a code that uniquely identifies the device type, called a Type Approval Code (TAC). The GSMA maintains a register of all devices that have been developed and approved, which is available from the GSMA TAC database.[90]

It is possible to derive the number of device types (i.e., TACs) that have been developed globally across all device categories, (phone, modules, MBB, IOT etc). Note a module may be used in multiple different devices, however the TAC database only tracks the module. Publicly available websites, such as GSMArena[91] and the GSA also track the number of devices.

Telstra also tracks devices that we have tested and approved, with over [C-I-C Begins]   [C-I-C Ends] approved over many years by Telstra.

Table 3 below shows the number of devices, identified from the databases and sites mentioned in the preceding paragraphs, noting that a device may support multiple frequencies and so may be in multiple cells in the table. The GSMArena information is for handset formfactor devices only, where the GSMA TAC database and Telstra approved information includes all device form factors.

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[88]   GSMA Database, available at: https://data.gsmaintelligence.com/

[89]   Telstra launched 4G in Australia in 2011. See: https://www.sbs.com.au/news/article/telstra-launches-4g-network/hzk8gl9cb

[90]   For more information on TACs and the GSMA's TAC database, see https://www.gsma.com/solutions-and-impact/industry-services/device-services/tac-allocation

[91]   GSMArena provides public information on different devices, including characteristics about the device (where available). It is possible to search the GSMArena database using a TAC, or make/model of device. See: https://www.gsmarena.com/

[C-I-C Begins – the last two columns of Table 3 are C-I-C]

Band	GSMArena		GSMA TAC		Telstra approved	
	4G	5G	4G	5G	4G	5G
1	3778	940	31731	3723	[C-I-C]	[C-I-C]
3	4091	768	35663	3183	[C-I-C]	[C-I-C]
5	3511	708	27602	3018	[C-I-C]	[C-I-C]
7	3309	435	26541	2121	[C-I-C]	[C-I-C]
26	1143		7227	15	[C-I-C]	[C-I-C]
28	2077	842	4747	3646	[C-I-C]	[C-I-C]
40	3218	476			[C-I-C]	[C-I-C]
78		996		4746	[C-I-C]	[C-I-C]

Table 3: Count of device types from 1) GSMArena, 2) GSMA TAC database, and 3) Tested and approve by Telstra, itemised by 3GPP band.

[C-I-C Ends]

9.6   Analysis and frequency band use views

9.6.1   700 MHz, 850 MHz, 2 GHz, 2.3 GHz, 2.5 GHz and 3.4 GHz

The ACMA notes "*Table 2 identifies that WBB use in these bands is well supported domestically and internationally through international harmonisation and industry standardisation. There is considerable equipment availability in these bands for WBB, facilitating widespread use by industry and end users in Australia and overseas. We consider that these factors are generally conducive to promoting the long-term public interest derived from the use of the spectrum.*"[92]

We agree with the ACMA that international harmonisation and industry standardisation, along with the prevalence of equipment availability does mean these six bands, as well as the 1800 MHz band (see section 9.6.2) are supported, and that this is definitely conducive to promoting the long-term public interest derived from the use of the spectrum.

9.6.2   1800 MHz

In Australia, the 1800 MHz band has been highly utilised by MNOs for the last three decades. Originally, the band-plan was developed for GSM technologies, however since 2011, all MNOs have re-farmed the spectrum for 4G (LTE) services. Given the current and future needs of IMT, along with the desire for wider bandwidths and contiguous spectrum blocks, there may be a case to consider re-farming the spectrum currently used by rail operators for rail safety (GSM-R in 1880-1900 MHz) for mobile.

Re-farming of GSM-R spectrum could be facilitated by the consistent adoption of FRMCS technology in the 1.9 GHz band by Australia's rail industry. The 1.9 GHz band has almost identical propagation characteristics to the adjacent 1.8 GHz band and has the advantage of a national footprint. This spectrum could then be shared by rail operators in both metropolitan and regional areas and would

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[92]   Consultation paper, p.22.

offer seamless coverage across each jurisdiction. It would also release the spectrum currently being used for GSM-R for use by IMT operators.

9.6.3   2.5 GHz mid-band gap

For Electronic News Gathering (ENG), the ACMA observes that while continued ENG use of the 2.5 GHz mid-band gap is likely conducive to the long-term public interest, further consideration should be given to whether WBB would better fulfill the Public Interest criteria. We agree with the ACMA's position.

That said, we have two observations to make on the 2.5 GHz mid-band gap. Firstly, mobile networks operating in the 2.5 GHz band (3GPP Band 7) are required to deploy additional filtering beyond the standard 3GPP requirements to protect ENG services. If a solution could be found for ENG services to reduce the spectrum occupancy and only operate in the middle of the 2.5 GHz mid-band gap, thereby leaving the edges as a guard band, this would save mobile network operators the expense of additional filtering on new base station deployments in the 2.5 GHz band.

Secondly, the 2.5 GHz mid-band gap has been identified by standards bodies such as 3GPP as a TDD band (3GPP Band n38), and some vendors already offer base station hardware that supports operation in this band. As the immediately adjacent 2.5 GHz IMT band uses FDD technology, there are some practical limitations that arise when FDD networks operate in proximity to TDD systems. We note that in some European Union countries, this is solved in part by creating 5 MHz guard bands at the upper and lower edges of the mid-band gap.[93]

To make IMT use of the 2.5 GHz mid-band gap successful, it would be necessary to deploy additional RF filters to limit the out-of-band noise from both base station transmitters. The resultant reduced bandwidth, additional deployment costs, incompatibility with existing base station hardware, plus the need to establish a device ecosystem, places limits the viability of the band for IMT, however the ACMA should not rule out the possibility that IMT use of this band might play some role in increasing the amount of lower-midband spectrum available for IMT applications. To this end, we would welcome the opportunity to participate in further conversations and consideration of how the Public Interest can be best fulfilled for this band.

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[93]   CEPT ECC Decision (05)05, Harmonised utilization of spectrum for Mobile/Fixed Communications Networks (MFCN) operating within the band 2500-2690 MHz, first dated 18 March 2005, and revised 4 March 2022. Available at: https://docdb.cept.org/download/4009

Appendix A: Mapping of Telstra's key positions against the Public Interest criteria

This appendix, commensurate with Appendix A in the ACMA's consultation paper, provides a simple mapping of our key submission positions against five Public Interest criteria.

Public Interest criteria	Telstra's position
Facilitates efficiency	a. MNOs are good stewards of spectrum. We constantly re-farm our spectrum to move to new generations. This delivers more capacity more efficiently (representing more efficient use of spectrum) to better support public demand, new use cases and the public interest. See section 3.1.1. b. Mobile networks use global standards (ITU, 3GPP) to ensure efficient spectrum use and access to global-scale network equipment and user device ecosystems. See section 9. c. Public networks, as opposed to private (closed) networks, allow for the most efficient use of spectrum. Bespoke interests/needs such as public safety can be accommodated most efficiently through user/traffic prioritisation for critical user groups on shared public infrastructure, rather than quarantining spectrum for bespoke use cases. See section 6.1.
Promotes investment and innovation	a. Existing public mobile networks have invested massively over the past 2-3 decades. Renewing ESLs permits this investment to be leveraged, such that further investment can build on the existing infrastructure investment. See sections 3.2 and 4.3. b. The valuation (and pricing) for renewal should leave MNOs with capital to invest in coverage and in innovation. See section 8.
Enhances competition	a. There is active and strong competition at the retail level, facilitated by the three main MNOs and enhanced by MVNOs. Telstra, as supplier of wholesale services to MVNOs, provides a wide array of customisable features, allowing for the creation of bespoke plans to target different market segments and demographics. See section 3.3.1. b. Telstra welcomes the opportunity to supply third parties with access to our spectrum (see section 3.3.2), and to engage in secondary trading to optimise the use of spectrum (see section 6.2).
Balances public benefits and impacts	a. MNOs must be afforded the opportunity to renew all their spectrum (where they are using it or have demonstrable plans to use it). See section 4.2. b. Service continuity can only be maintained where incumbent licensees are afforded the opportunity to renew their licences. See sections 4.1 and 3.4.2. c. The benefits of renewal are predictable and certain, whereas the benefits of reallocating the spectrum to a new user or use case is likely to be uncertain. See section 2.3. d. Mobile networks, as a vital component of Australia's critical infrastructure, underpin the nation's economic prosperity, provide services during emergencies and natural disasters, and deliver social benefits by enabling contact between families and friends. See sections 3.4.1 and 2.2. e. Reclaiming spectrum to facilitate a fourth network operator would disrupt service continuity (sections 4.1 and 3.4.2), and dilute industry revenue and incentives for MNOs to invest, which is not in the public interest. See sections 3.4.3 and 2.3.
Supports relevant policy objectives and priorities	a. Renewing ESLs provides the greatest potential to support numerous Government policy objectives such as greater service for First Nations and remote communities, support for bespoke use cases such as Public Safety, competition, innovation, and investment in improved resilience and response during disasters. See section 3.5. b. Industry sustainability must be factored into valuation and pricing. See sections 4.5 and 8.3.

Appendix B: How we use spectrum

This appendix outlines some of the ways we deploy mobile networks today including Advanced Antenna Systems (AAS), Multiple Input, Multiple Output (MIMO) antennas, small cells, optimising Inter-Site Distances (ISDs), cell placement, in-building coverage, and more. The intention of this appendix is not to give a highly detailed tutorial on mobile network design and deployment, but rather, to give the reader a high-level sense of the myriad techniques mobile network operators employ to optimise use of radio spectrum to deliver the greatest data speeds and user experience to their customers. These techniques demonstrate we are efficient users of radio spectrum, which is in the public interest.

B.1   Band Usage: Frequency Domain Considerations

Broadly, spectrum is categorised into low-band, mid-band and mmWave spectrum. Low-band spectrum has better propagation capabilities (distance from the base station which increases coverage) and better in-building penetration, but there is less spectrum available, so it cannot carry as much data. Some other salient points about our frequency domain considerations are as follows:

Low bands (< 1.0 GHz):
- Can be used for any mobile network generation, i.e., 3G, 4G or 5G;
- provide depth of coverage in urban areas (building penetration and basic coverage in a mid-rise and high-rise built environment) and breadth of coverage in regional areas (i.e., the "hard to reach" places within the network);
- They are almost always primarily delivered by the major macro, high-powered sites;
- Cannot deliver high-capacity solutions (requires support from mid-band and mmWave spectrum); and
- The combination of spectrum acquisition and infrastructure/deployment costs makes them the costliest bands to deliver (i.e., $ per Mbps available to customers)

Lower mid bands (1.0 GHz to 2.2 GHz):
- Can be used for any mobile network generation, i.e., 3G, 4G or 5G;
- First group of bands able to assist with capacity;
- Able to utilise advanced antenna technologies and capacity multiplying functionalities such as Massive MIMO, which helps bring them closer to propagation performance capabilities of low bands;
- These bands still exhibit reasonably good building penetration characteristics;
- Telstra uses the 1.8 GHz band today as the first tier of capacity delivery in regional areas due to its relatively small (~6dB) propagation disadvantage compared to low-band spectrum.
- Can be used on both small cells and in building coverage (IBC) solutions;
- However, the bands as structured today present challenges for IMT2030 (6G) use cases, and would benefit from re-farming- into larger contiguous channels.

Intermediate mid bands (2.2-4.0 GHz)
- Their value as a capacity layer is driven by the much larger channel bandwidths on offer (40-50MHz of FDD and 60-160+ MHz of TDD) compared with lower bands.

- These bands are well suited to delivering high spectral efficiency, high capacity solutions using AAS technology.
- Somewhat poorer ability to penetrate buildings for indoor coverage.
- These bands today are used for 5G delivery, and will continue to fulfill this function until around the middle of next decade. After that they are likely to be re-farmed to 6G and later 7G.

Upper mid bands (>4.0 GHz)

- For example, the upper 6 GHz band (6425-7125 MHz) and new spectrum identified at WRC-23 for IMT2030 (4, 8, 15 GHz);

- These are not the subject of ESL, but will be required in the near future to meet continued traffic demand.

B.2   Band Usage: Geographic Domain Considerations

Deployment of our networks involves many different site types. We use different site types to maximise the efficiency of our networks, as explained below.

Macro (wide area) base station sites:

- Traditional 20-50m tower or roof top sites which are responsible for wide area coverage;
- These sites are placed across the landscape at an inter-site distance (ISD) that balances the traffic demand density in an area with the propagation loss characteristics of an environment;
- In metropolitan areas, ISD is typically 1-2 km to reduce the number of users per cell, with base stations operating at lower power levels to avoid interference caused by too many overlapping cells;
- In regional areas, the ISD expands, depending on population centre (small regional town/city) versus more open broad area coverage. ISDs of 2-5 km in towns and 15-25 km in broad area coverage are more typical.
- Where increased capacity is required, additional mid-bands are deployed rather than building new sites. These carriers take up the load from customers closer to the sites, clearing the way to make more resources available on the lower bands to deliver capacity at a distance.
- In the future, with the take up of 5G and 6G technologies, both the network and customer device ecosystems will be developed enough to make use of high order Massive MIMO delivery solutions on the lower mid bands (1.8 GHz and 2.1 GHz), increasing their value in the service delivery model even more.

Small cell sites:

- In metropolitan areas small cells utilise either the 2.6 GHz band to provide small localised high capacity coverage solutions for traffic hot spots, or low-band (700 MHz or 850 MHz for 5G) to deliver small 0.3-0.5 km diameter cells in suburban/residential areas where building penetration is paramount and planning permission for macro sites is difficult. In addition, small cells can be "interlinked" with the over-arching macro site cells that overlay an area and can deliver aggregated bandwidth in concert with the macro sites.

- This is an example of why treating individual bands in isolation does not necessarily deliver the best outcome for consumers, or the best use of spectrum. More and more, as operators, we use technology solutions that mix spectrum together to address service delivery in ways that address coverage and penetration goals by optimising different cell types and the different characteristics of bands. Considering whether to renew, partially renew, or refuse renewal on part of a band (for example to reallocate spectrum to a different user/use case) without considering how the use of that band interplays with other bands, could have detrimental effects on the delivery of services to existing customers.

- In regional areas, small cells use mostly the 700 MHz and sometimes 1800 MHz bands to provide bespoke low-cost islands of coverage to small communities where the cost of a full-size macro base station is prohibitive.

In building coverage (IBC) solutions:

- IBC solutions arise where there is a need to provide improved quality of coverage indoors and external macro cell penetration is inadequate.

- The high cost of in building systems means long term certainty of spectrum availability is paramount, as IBC systems have long pay-back periods.

- Typical IBC deployments include office spaces, shopping and transport hubs, sports and entertainment stadiums, industrial installations, and car parks and basements.

B.3   Band usage – lifecycle considerations

As described in section 5.2, MNOs periodically re-farm spectrum to newer mobile generations, taking advantage of technological advances. Doing so ensures the spectrum is used to its optimal efficiency based on the most up-to-date technology.

B.4   Capacity management and certainty

When rolling out new coverage for a mobile network, MNOs will always deploy low frequency bands first, to maximise coverage. This explains why low-band frequencies are geographically heavily utilised. When first constructing networks or rolling out new coverage, traffic demand at that location is often low. Later when traffic demand grows and increase in capacity is required, network operators revisit a site, and deploy infrastructure for mid-bands to provide capacity.

This highlights the value of long-term spectrum licensing. Operators pay for the opportunity to use the spectrum at any stage in the term of the licence, at any location, as and when the operator needs to address customer demand. In some locations, it may be several years before some bands are used. Removal of future access to spectrum not only undermines investment certainty, it also results in reduced service experience, as populations and traffic grow over the 20-year life of a spectrum licence.

B.5   Base technology evolution – improving efficiency

In section 9.2 of our submission, we describe 3GPP standards processes that lead to a new mobile "generation" every decade or so. These new "generations" often bring new radiofrequency (RF)

waveforms and techniques for increasing the spectral efficiency of networks, enabling operators to provide greater performance to customers while also accommodating growth in traffic demand.

Operators may have three generations of network operating at the same time for half of the lifecycle of a technology generation. We use this overlap to minimise customer disruption as we transition technology.

Newer generations require new spectrum to enable their delivery (in parallel with re-farming). New spectrum may be higher in frequency, which means greater challenges when in providing wide area coverage delivery. This is a key driver for the re-farming of the valuable lower bands. In this scenario (evolving to a new generation and re-farming low-band) densification is not cost effective, so spectrum availability in the low band and lower mid-band spectrum bands is paramount.

B.6   Technology Disruptors – New uses for existing spectrum

The next decade will see new service delivery capabilities emerge, including LEO satellite solutions, IMT-2030 (6G).

- Initially, we expect LEO satellite solutions will utilise spectrum currently held by MNOs (IMT bands); satellite operators will partner with MNOs to deliver service in underserved areas. This means renewal of regional and remote spectrum is critical.

- In the longer term, we expect the demand (traffic) on LEO satellite services to outstrip the capacity of IMT spectrum available for LEO satellite solutions. One source of additional capacity will be to use "non-terrestrial network" (NTN) 3GPP bands, which today, are allocated for Mobile Satellite Services (MSS), noting that their contribution to capacity will be modest at best.

- New technologies, such as IMT-2030 (6G) are also likely to bring new use cases and innovations. It is difficult to predict what innovations might be with us in ten or twenty years' time, in the same way that ten or twenty years ago, we would not have predicted the ubiquity of streaming video to mobile devices, connected cars, remote working, or advances in mobile telehealth and telemedicine.

- We anticipate new domains will emerge, such as environmental sensing and positioning, massive machine-to-machine, and new offerings based on network slicing, edge compute and artificial intelligence.

B.7   Future Spectrum Demand

We appreciate the focus of the ESL program of work, and this Stage 2 consultation is about existing spectrum licences that are expiring at the end of this decade. However, the spectrum held by MNOs today will not be sufficient to meet demand by the end of this decade, even employing all the techniques outlined in appendix to their maximum extent. Optimisation of existing spectrum, while absolutely *necessary*, is not *sufficient*.

Introducing the new technologies, use cases and innovations described, requires new spectrum to be released and integrated into the mobile telecommunications networks in this country. Foundation bands for 5G Advanced and for 6G may include:

- Upper 6 GHz band –between 6425 MHz and 7125 MHz.

- 600 MHz band – between 617 MHz and 698 MHz.

In addition, new MSS spectrum will need to be found by the early 2030s, which is when we believe NTN satellite services will begin to mature.

Appendix C: Defragmentation of spectrum licensed bands

This appendix provides an example of the use of secondary trading to defragment a band. See also, section 6.2 for our views on the benefits secondary trading can bring.

1800 MHz

Figure 4 overleaf shows how the 1800 MHz band was transformed using secondary trading.

The initial state (January 2013) shows the band in a highly fragmented state, with small 2.5 MHz blocks scattered across the band. Just prior to spectrum licence renewal later that year, MNOs collaborated to achieve an almost perfect defragmentation of the band, which allowed each operator to re-farm the spectrum to accommodate the wider contiguous bandwidths needed for 4G.

Subsequently, ACMA held a spectrum auction to allow operators to further invest in spectrum to serve their customers in regional areas of Australia.

Following that auction process, Telstra and TPG-T (Vodafone) agreed to trade spectrum in some markets so that each operator had access to contiguous blocks of spectrum.

2100 MHz

In Brisbane, Adelaide, Perth, Darwin and Hobart, Telstra and TPG-T have made mutually beneficial trades to allow aggregation of existing holdings to achieve single 20MHz channels.

This enabled both operators to more efficiently deliver capacity to their subscribers at a lower hardware cost point.

2300 MHz

Telstra and NBN undertook a trade in 2023 that provided NBN access to 2.3 GHz spectrum in Darwin

- Telstra traded the block between 2365-2400 MHz in the Darwin area to NBNCo. This benefited NBNCo providing access to a contiguous 98 MHz block of spectrum in the Darwin area.
- In exchange, Telstra received unused NBN spectrum across much of remote Australia. This resulted in Telstra gaining access to 98 MHz of contiguous 2.3 GHz spectrum across much of remote Australia. Telstra's will use this spectrum for private networks in remote Australia, to meet growing demand from private industry (eg mining) for higher bandwidths that might otherwise might not be possible on other bands.

Figure 4: 1800 MHz transformation brought about by secondary trading

Appendix D: Mobile Site locations based on ABS Remoteness Category

The following charts are based on Telstra's 2023 RKR data, as supplied to the ACCC and to the ACMA as part of this consultation. As mobile networks are continually developing, some of the site counts for newly acquired bands such as the 2.3 GHz and 3.6 GHz band may be less than currently deployed at the time of writing, and do not consider any future deployment plans.

The data has been processed to determine in which of the ABS Remoteness Categories the site is located. Since the Remoteness Category is a metric based on the distance from a 'service' centre where individuals might find other facilities like shops, medical centres etc., it is also not unreasonable to use the Remoteness Category to expect that other services such as mobile coverage might also exist.

The Australian Statistical Geography Standard (ASGS) Remoteness Structure[94] defines five classes of relative geographic remoteness across Australia. These 5 classes are:

- Major Cities of Australia
- Inner Regional Australia
- Outer Regional Australia
- Remote Australia
- Very Remote Australia

Figure 5 below shows a colour-coded map of Australia showing the Remoteness Category. Relative geographic remoteness is measured in an objective way using the Accessibility/Remoteness Index of Australia Plus (ARIA+).[95]

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[94] See https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/remoteness-structure/remoteness-areas

[95] ARIA+ is derived by measuring road distance from various populated locations to five categories of service centre, using population as a proxy measure for service availability. ARIA+ uses ASGS Edition 3 Urban Centres and Localities and 2021 Census of Population and Housing data to reflect different levels of service availability based on five defined population ranges. For more information on how ARIA+ is created, please refer to the University of Adelaide website: https://able.adelaide.edu.au/housing-research/data-gateway/aria

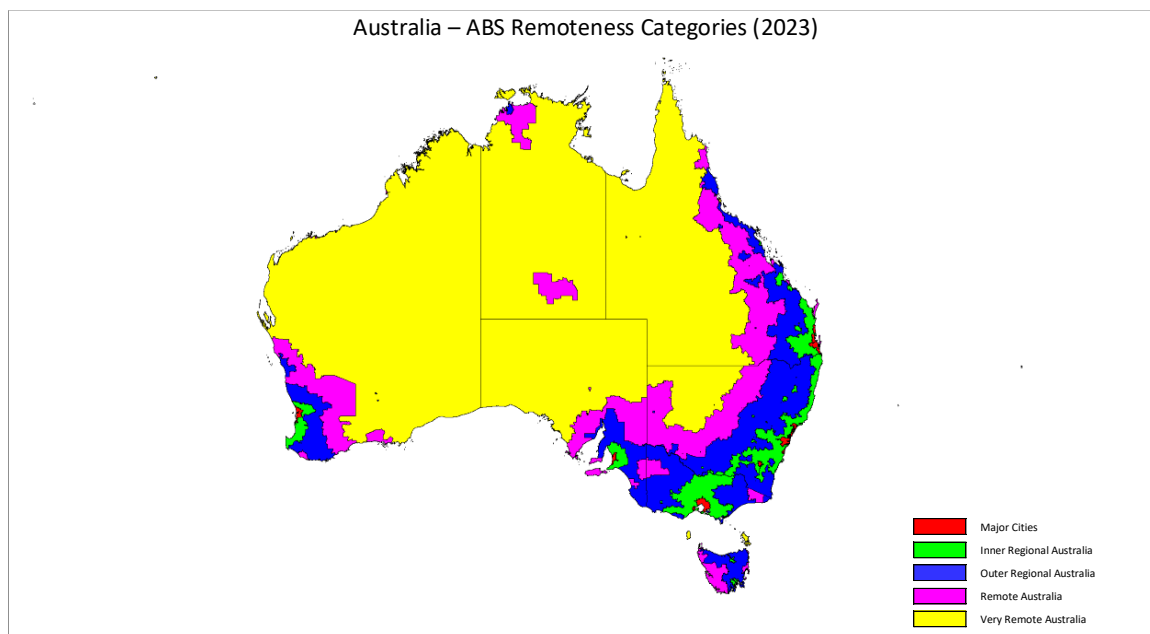Australia – ABS Remoteness Categories (2023)

Figure 5: Map showing Remoteness Category

Figures 6 to 8 below clearly show that the lower frequency bands have wide application across most of the country. As detailed in Appendix B: How we use spectrum, these bands are used as the foundation for the Telstra network. The lower and upper mid-band frequencies are then used to provide capacity where they are needed most – which, in regional and remote areas, is typically in population centres and service hubs. Consequently, the number of sites tends to be much smaller as the population density declines. Sites with one or more 'low band' frequencies (i.e., 700 MHz, 850 MHz or 900 MHz) are aggregated in the charts as low band sites.
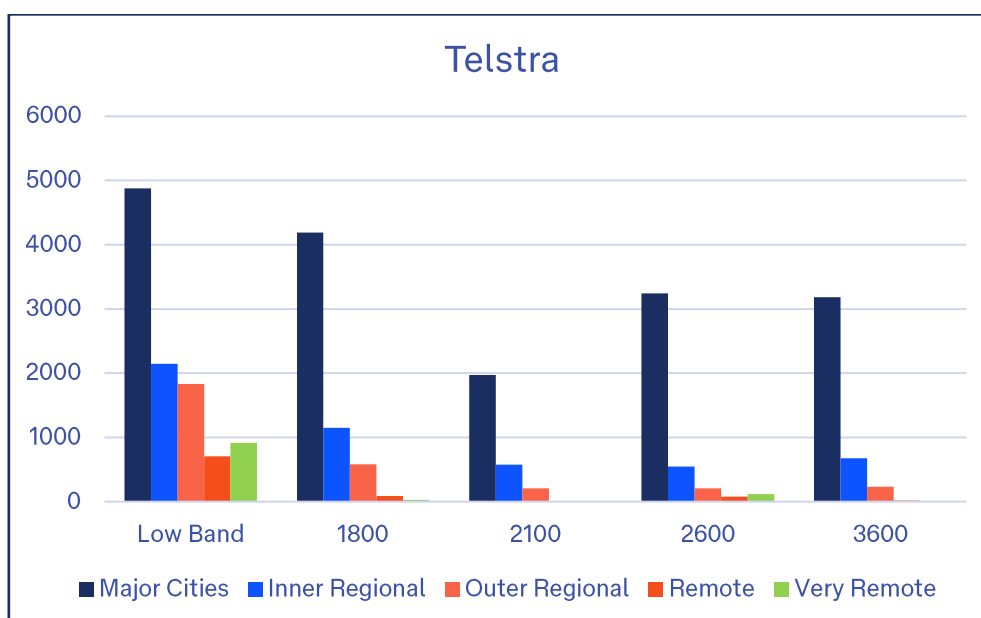

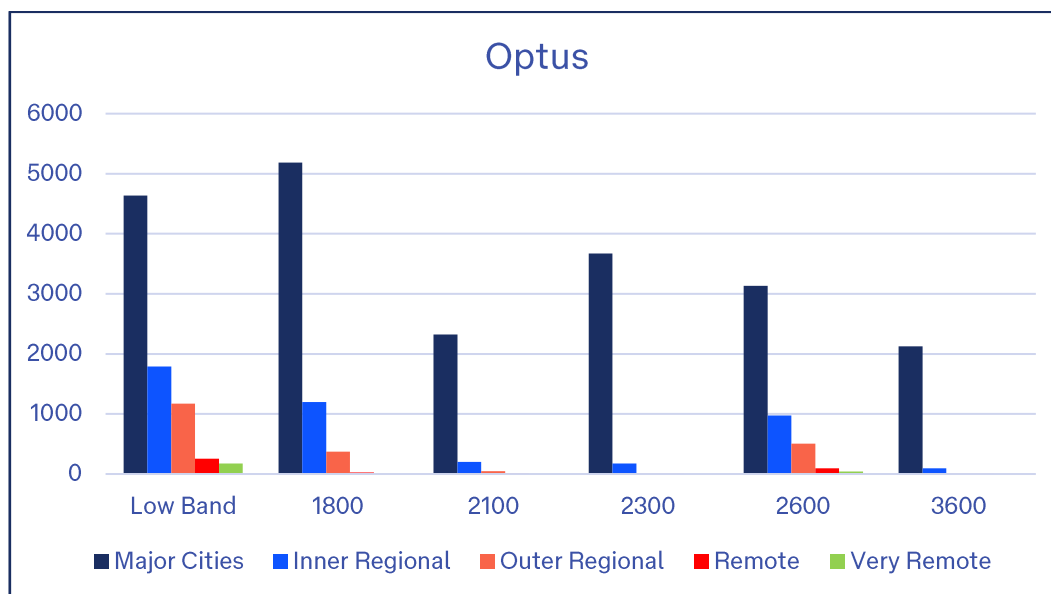Figure 6: Telstra sites by Remoteness Category and Band

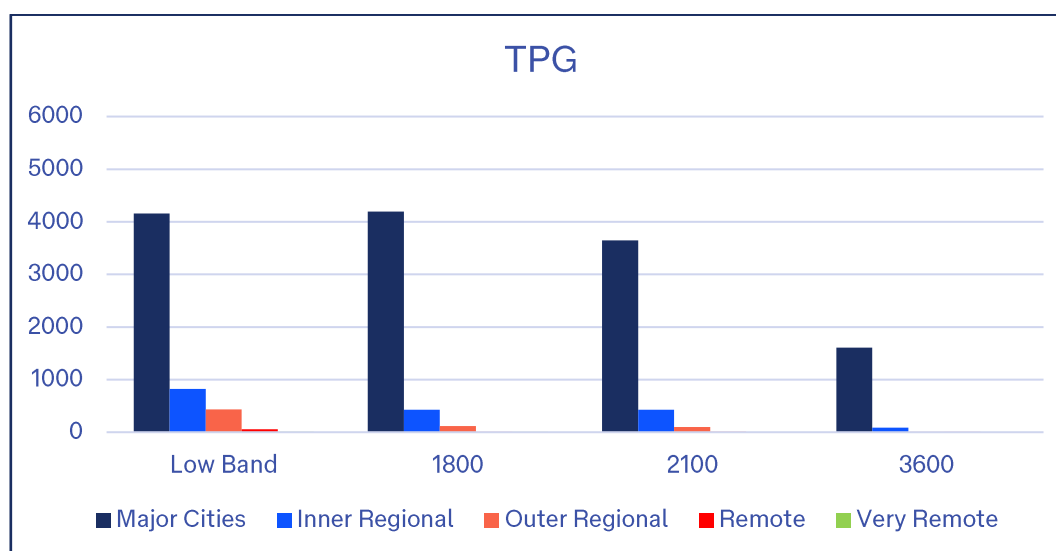Figure 7: Optus sites by Remoteness Category and Band

Figure 8: TPG Telecom sites by Remoteness Category and Band