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## **TELSTRA CORPORATION LIMITED**

# **Review of the 1.5 GHz Band - Discussion Paper**

**Public Submission**

**7 June 2022**



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## 01 Introduction

We welcome the opportunity to provide our views to the ACMA's discussion paper on **Review of the 1.5 GHz band** (IFC 16/2022). Additional mid-band spectrum is vital to meet forecast IMT traffic demand by the end of this decade, and L-Band spectrum can assist in meeting that demand. Allocation of L-Band spectrum to IMT should not be an immediate priority for the ACMA, and we consider the appropriate time to progress this band into the preliminary replanning stage is toward the end of the 2023 calendar year or early 2024. This timing will ensure output from the current WRC planning cycle is completed and available for Australian planning considerations, while ensuring adequate time remains to reallocate the band to meet IMT traffic forecasts for the second half of this decade. When the time comes to commence replanning, we consider the 1427-1518 MHz frequency range should be configured for 3GPP compliant wireless broadband (WBB) services and we strongly recommend the ACMA plans interference mitigation techniques to comply with international standards.

Our submission notes it is essential the ACMA put in place mechanisms to protect legacy High Capacity Radio Concentrator (HCRC) systems used to deliver USO services in regional and remote locations until such time as a proven alternate technology solution is developed for USO services and those technology solution(s) have been deployed for customers. However, most point-to-point (PTP) links used for backhauling are at end-of-life and we have plans to replace them with equipment operating in other bands in the next 3-5 years.

We conditionally support the 1518-1525/1668-1675 MHz band being allocated for mobile satellite services (MSS), noting that the Electronic Communications Committee (ECC) has produced a coexistence report that describes interference mitigation techniques that can be used to ensure the 1427-1518 MHz band can be used for 3GPP compliant technologies.

Our submission is structured as follows:

- Section 2 contains our responses to key themes raised in the discussion paper; and
- Section 3 contains our responses to the questions raised in the discussion paper.

## 02 Response to discussion paper

In this section, we respond to key themes contained in the discussion paper.

### 2.1. HCRC delivering USO must be protected, however PTP for backhaul will decline

Telstra currently delivers over 10,000 Universal Service Obligation (USO) services using High-Capacity Radio Concentrator (HCRC) systems.<sup>1</sup> While some of these USO services may be within reach of a mobile solution, the remainder only have satellite offerings as a service solution. In the future, Low Earth Orbit (LEO) satellites could be part of the technology replacement, however this is likely still some time away, and would require changes to current USO arrangements in relation to voice services. As such, we consider it essential that HCRC systems remain under point-to-multipoint (PMP) apparatus licences

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<sup>1</sup> Telstra submission to the Regional Telecommunications Review 2021 Issues Paper, 30 Sept, 2021, p.23.  
<https://www.infrastructure.gov.au/sites/default/files/documents/rtr2021-submission-no-613-telstra-public.pdf>



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and are protected from interference until such time as a proven alternate technology solution is developed for USO services and those solution(s) have been deployed for customers.

It is important to note that the majority of the PTP apparatus licensed services are PTP links used as part of the HCRC system where they serve as repeater-to-repeater links.<sup>2</sup> These services also need to be protected until such time as a proven alternate technology solution is developed.

While the majority of PTP apparatus licences are used to licence HCRC repeater-to-repeater links, the remaining PTP licences in the 1427-1518 MHz band are for legacy bearers. These bearers provide backhaul for a range of services including fixed telephony (from remote exchanges) and mobile base stations. The radio systems delivering these bearers are at end-of-life and we plan to migrate all legacy PTP bearers to new, higher capacity PTP systems operating in the 6, 6.8 or 8 GHz bands over the next 3-5 years. This will clear the majority of the ~870 PTP apparatus licences in the 1427-1518 MHz band, making way for that spectrum to be used for other services.

We do not foresee any need for an increase in the number of HCRC systems, as the forecast for these services is largely unchanging (neither increasing nor decreasing) going forward until such time as an alternate technology solution is developed.

## 2.2. 1427-1518 MHz should be allocated to IMT, but not immediately

Demand for spectrum in Australia to support International Mobile Telecommunications (IMT) continues to increase. AMTA's policy position paper Spectrum for 5G and Beyond<sup>3</sup> highlights the need for long term planning for spectrum for IMT, not only to ensure there is adequate spectrum available to meet traffic demand, but also to ensure it becomes available in a timely manner. AMTA's position paper demonstrates why the Australian Government should set a target of 8 GHz total spectrum for IMT across low-, mid- and high-bands by the end of this decade based on increasing traffic demand resulting from the digital transformation of industries, increased use of streaming services, the move to working from home, and anticipated adoption of bandwidth-hungry emerging use cases such as gaming and augmented/virtual reality.

AMTA's position paper also uses a report prepared by Coleago Consulting Ltd<sup>4</sup> to specifically highlight the need for mid-band spectrum in the second half of this decade. Based on a standardised approach used globally to estimate mid-band spectrum needs, the report shows that around 1,400 MHz of mid-band spectrum is required in Australia's two largest capital cities (Melbourne and Sydney) in the 2025-2030 timeframe to meet traffic demand. This is around double the 703 MHz of mid-band spectrum currently allocated. While much of this additional spectrum will come from the 3.6 GHz band and possibly from the 6 GHz band, 90 MHz of L-Band spectrum will further assist in meeting the demand.

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<sup>2</sup> HCRC base stations act as add-drop multiplexers that insert voice calls into spare time slots at repeaters spaced at around 50 km separation along a bearer of up to ~600km long. See article *The Digital Radio Concentrator System*, published in Journal of Telecommunications and the Digital Economy (JTDE) Vol 7 No 4, Dec 2019. <https://telsoc.org/journal/jtde-v7-n4/a242>

<sup>3</sup> **Spectrum for 5G and Beyond**. AMTA, Nov 2021. <https://amta.org.au/wp-content/uploads/2021/12/AMTA-Policy-Position-Paper-Spectrum-for-5G-and-Beyond-Nov-2021.pdf>

<sup>4</sup> **IMT Spectrum Demand: Estimating the mid-band spectrum needs in the 2025-2030 time frame in Australia**. Coleago Consulting Ltd, 15 Nov 2021. <https://amta.org.au/wp-content/uploads/2021/12/Coleago-Report-Demand-for-mid-bands-spectrum-in-Australia.pdf>



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WRC-15 identified the 1427-1452 MHz and 1492-1518 MHz frequency bands for IMT worldwide. Since that time, EU Implementing Decision 2018/661<sup>5</sup> required that “*No later than 1 October 2018, Member States shall designate and make available, on a non-exclusive basis, the 1 427-1 452 MHz and the 1 492-1 517 MHz frequency bands, or a portion thereof, for terrestrial systems capable of providing wireless broadband electronic communications services...*”. The Decision also requires Member States to “... ensure that such spectrum portion primarily constitutes together with the 1 452-1 492 MHz frequency band a contiguous frequency band.” These requirements ensure the entire band of 1427-1518 MHz is allocated to IMT.

The EU is Region 1, not Region 3, and so the Implementing Decision has no jurisdiction in Australia. Nevertheless, the Decision shows an alignment for this band for IMT use for a major portion of the world. This will bring with it a device ecosystem (both network elements and consumer devices) that will be able to be imported into Australia, and it is important that Australia is able to leverage the scale of overseas markets to ensure consumer devices remain affordable.

As such, we consider the most appropriate use for the 1427-1518 MHz band is for 3GPP compliant wireless broadband (WBB) and IMT services. Allocating this band to 3GPP compliant uses will supply additional spectrum for IMT that will be required before the end of this decade.

Reallocation of L-Band spectrum to IMT should not, however, be an immediate priority for the ACMA (as per our submission to the Five-Year Spectrum Outlook – FYSO) but will be required by decade's end. In the interim period, it is essential that allocations in adjacent band(s) do not compromise the ability to deploy 3GPP compliant services. We strongly recommend the ACMA plans interference mitigation techniques to ensure the 1427-1518 MHz band can be configured for 3GPP compliant services.

### **2.3. Digital Sound Broadcast, Aeronautical Mobile Telemetry and Earth Exploration**

The Discussion Paper observes that since 1996, arrangements have been in place to preserve the option for possible terrestrial and satellite audio broadcasting services in the 1452–1492 MHz band. Trials were carried out in Australia during the 1990s and 2000s, however the Digital Sound Broadcast (DSB) allocation has remained unused. The ACMA states it is not aware of any demand domestically for access to this spectrum to support DSB use, and our understanding from talking with industry stakeholders aligns with the ACMA's understanding.

The Discussion Paper also observes<sup>6</sup> that Defence have indicated an ongoing need for aeronautical mobile telemetry (AMT) operations in the band, including a request for the entire frequency range to be retained for AMT operation at select Defence ranges and bases. We have no visibility of these requirements and consider that if this requirement is to be met, details of the telemetry services will need to be supplied to a Technical Liaison Group (TLG) to ensure proper coordination measures are developed to mitigate possible interference between AMT operation and other users of the band.

Defence have also indicated interest in identifying a suitable sub-section of the band to support mobile high-capacity networking for domestic operations. We see no obstacle to Defence acquiring spectrum through the normal market mechanisms available to all spectrum aspirants.

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<sup>5</sup> Commission Implementing Decision (EU) 2018/661, 26 April 2018. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018D0661&from=EN>

<sup>6</sup> Discussion Paper, p.12.



In the following sections, we recommend spectrum licensing for metro and regional areas, and area-wide licensing (AWLs) for remote areas, noting that this is our preliminary view only. As we have noted above, any mobile use of the band should be for 3GPP compliant equipment.

Earth Exploration Satellite Services (EESS) and other scientific services use the adjacent 1400–1427 MHz band, and we agree that unwanted emissions into this band must be limited to protect these services. As the ACMA notes, ITU-R Resolution 750 (Rev. WRC-19) defines unwanted emission limits in the 1400–1427 MHz frequency range for mobile devices operating in the 1.5 GHz band and we fully support technical arrangements for WBB/IMT complying with these arrangements.

#### 2.4. Spectrum license 1427-1518 MHz in SDL configuration in metro and regional areas

We have already noted reallocation of 1427-1518 MHz should not be an immediate priority for the ACMA. However, the Discussion Paper solicits stakeholder views on possible planning arrangements, and as such, our preliminary view is the band should be made available using spectrum licensing and in an SDL configuration for metro and regional areas (ACMA Scenario 1). We stress this is a preliminary view, and our rationale for recommending this arrangement for metro and regional areas is as follows.

**Spectrum licensing.** While both AWL and spectrum licensing can provide certainty of tenure (both can be issued for up to 20 years), and while both regimes can have a technical framework that equally protects WBB/IMT, we nevertheless consider spectrum licensing to be a superior alternative in this case and certainly should be the allocation mechanism in metro and regional areas. Firstly, demand is likely to exceed supply, and spectrum licences are allocated through a price allocation, rather than administrative methodology thereby allowing price discovery. Secondly, spectrum licensing confers certain property-like rights on the licence holder, which in addition to tenure and the technical framework, is an important foundation to underpin investment.

**SDL format.** The asymmetric nature of WBB and IMT traffic (the downstream volumes far exceed upstream for most user traffic, although the reverse is true for some IoT applications) means that overall spectrum efficiency can be increased if this band is allocated under the SDL configuration in metro and regional areas. Even accounting for the possibility of guard bands to protect frequency adjacent services, we believe that up to 80 MHz of new downlink spectrum could be made available in this arrangement. Allocation of additional spectrum in SDL configuration in a lower-frequency band (1.5 GHz) has the benefits of reasonably good building penetration in metro and residential areas and good coverage in regional areas.

In comparison, ACMA Scenario 2 (configuration as a full TDD band) is less attractive as currently there is no ecosystem for 3GPP band 50, and the prospects of one developing are not good. Further, for technical reasons, it is increasingly unwise to configure bands below 2 GHz as TDD. This is because radio signals propagate further at lower frequencies, and in TDD systems, that creates network self-interference problems that can only be mitigated by increasing guard-time periods between transmit and receive bursts. That in turn increases network latency and decreases spectral efficiency which runs counter to the objectives of good and efficient spectrum management. Finally, ACMA Scenario 3 (configuration as an FDD band) would result in only around 30 MHz paired becoming available, once guard bands are introduced to protect frequency adjacent services and wastage of spectrum in the duplex gap. 30 MHz paired as a total allocation in this band is insufficient for the mobile industry, as it is likely that in a competitive allocation process no bidder would secure more than 10 MHz paired, severely compromising the utility of such an acquisition, and making the deployment economics marginal.



We also note that SDL configuration is in accordance with EU Implementing Decision 2018/661 which observes downlink-only use is important for addressing data traffic asymmetry by enhancing the downlink capability of wireless broadband systems, including for the provision of 5G services. Therefore, we have a reasonable basis for confidence that the ecosystem for bands 75 and 76 will grow and support 5G (n75/n76).

However, we are also aware of emerging technology developments such as dynamic TDD, which may prove beneficial for this band, should it be technically possible to implement as envisaged. As such, while we are advocating for SDL at this time, we are firmly of the view that a TLG needs to be conducted to identify the best configuration for this band, and our advocacy for SDL is preliminary only and based on available information at this time.

## **2.5. AWL license 1427-1518 MHz in FDD configuration in remote areas**

We anticipate there will be demand for both mainstream Mobile Network Operator (MNO) services and private / enterprise services in this band in remote areas. The discussion paper also notes Defence have indicated interest in a sub-section of the band to support mobile high-capacity networking for domestic operations. We acknowledge the existence of these other use cases, and while MNOs would likely prefer this band in SDL configuration (certainly in metro and regional areas), additional use cases in remote areas are likely to require two-way communication, and therefore, SDL may not be a viable option. Of the two bidirectional options outlined in the ACMA's consultation paper, time division duplex (TDD) and frequency division duplex (FDD), we propose FDD is the better of the bidirectional alternatives, for two reasons. Firstly, at 1.5 GHz, there are reasonably long propagation distances. As noted above, TDD configuration requires guard-time periods between transmit and receive bursts to accommodate round-trip delay between the base station and user terminal. The longer the propagation distance to a user terminal, the longer the guard-time period, which results in lower efficiency in the use of the spectrum. Secondly, FDD configuration (our preference for metro and regional areas) would create fewer coordination issues at a geographic boundary with SDL compared to TDD configuration operating on the other side.

That said, end user devices supporting bidirectional communication in this band may be harder to obtain, given many jurisdictions are aligning to SDL as the band-plan configuration. We recommend consideration is given to the availability of user equipment capable of operating in TDD or FDD configuration before consigning this band to a particular configuration. While there is some device ecosystem in 3GPP bands 11 and 21 (FDD configuration, but for 4G only to date) there is currently none in band 50 (TDD configuration). This also serves as a justification for not immediately progressing this band to the preliminary replanning stage, but rather, waiting until later in 2023 or early 2024 to observe the evolution of user devices. If devices capable of operating in TDD or FDD mode are not readily available, the band should be configured for SDL in remote areas as well. This particular technical matter (whether this band should be implemented nationwide as SDL, or a different band configuration could be used in remote areas compared to metro and regional areas) should be one of the matters dealt with by a Technical Liaison Group at the appropriate time.

## **2.6. Allocation of 1518-1525/1668-1675 MHz to MSS**

We conditionally support 1518-1525/1668-1675 MHz being allocated to MSS. However, as we have pointed out above, we consider the most appropriate use for the 1427-1518 MHz band is for 3GPP



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compliant wireless broadband (WBB) and IMT services, and it is important that interference management measures are established to protect 3GPP compliant equipment operating below 1518 MHz. In all likelihood, this means that MSS services will have to suppress (mute) the 200 kHz channels in the bottom 2 MHz of 1518-1525 MHz near airports and sea terminals where IMT is likely to be operating up to 1517 MHz. We acknowledge that WBB/IMT services using the top 5 MHz block (1512-1517 MHz) may also need to operate at reduced power or have other technical constraints to avoid causing interference to MSS higher up in the 1518-1525 MHz band. It is also incumbent on the MSS terminal to have adequate receiver blocking performance, and as we have previously noted, the detailed coordination and coexistence arrangements need to be developed through a Technical Liaison Group (TLG).

## 2.7. A 3 MHz guard band appears to be optimal

We support a 3 MHz guard band between 1517-1520 MHz to minimise the risk of interference between IMT and MSS operating on either side of the 1518 MHz boundary. Electronic Communications Committee (ECC) Report 263<sup>7</sup> is a compatibility study between IMT and MSS at this boundary and considers three possible “frequency separations” (i.e., guard-bands) of 1 MHz, 3 MHz, and 6 MHz. These separations are deliberately chosen to align with the proposed band plans for both IMT and MSS operating on either side of 1518 MHz. As the report notes, 1 MHz is insufficient frequency separation to avoid interference (due to receiver blocking) without reasonably substantial geographic separation (“several kilometres”). However, this reduces to around 1 km with 3 MHz separation and several hundreds of metres for 6 MHz separation. Based on this assessment, our preliminary view is that a 3 MHz guard band appears to be optimal, although we hasten to add that coordination mechanisms need to be developed as part of a formal TLG.

The ACMA's discussion paper on 1.5 GHz does not make mention of ECC Report 299.<sup>8</sup> ECC Report 299 considers the timing and steps to introduce IMT into 1427-1518 MHz without harming MSS.

## 2.8. Move the 1.5 GHz band to *Preliminary Replanning* after WRC-23

A key goal driving the discussion paper is helping the ACMA form a view on when to progress this band from the *monitoring* stage to the *preliminary replanning* stage in the ACMA's band-planning process. The ITU is further considering co-existence between IMT below 1518 MHz and MSS above. ITU WP 5D and WP 4C are working on an ITU Report and an ITU-R Recommendation on coexistence between the two services in response to WRC-19 Resolution 223. While this work is not formally part of the WRC-23 conference, the target timeframe for completion of the work is in time for the conference, and it would be of great benefit to planning decisions in Australia if this report were completed to better inform band planning decisions.

We suggest no further public consultation is required following on from this discussion paper as the ACMA should receive all the requisite stakeholder views through this round. We also suggest that progressing the band into the preliminary replanning stage need not occur immediately, but rather, could

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<sup>7</sup> ECC Report 263: **Adjacent band compatibility studies between IMT operating in the frequency band 1492-1518 MHz and the MSS operating in the frequency band 1518-1525 MHz.** 3 March 2017. <https://docdb.cept.org/document/967>

<sup>8</sup> ECC Report 299: **Measures to address potential blocking of MES operating in bands adjacent to 1518 MHz (including 1525-1559 MHz) at sea ports and airports.** 8 March 2019. <https://docdb.cept.org/document/9066>



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occur toward the end of 2023 (calendar year). This will allow for output from the current WRC cycle to be completed and is still in plenty of time to progress the band through to reallocation in a timely manner to meet IMT traffic demands requiring additional spectrum in the second half of this decade.

While there may not be an immediate need for the mobile industry to gain access to the 1.5 GHz band for mobile service, the ACMA also needs to be mindful that there may be very few other spectrum bands made available for IMT in the remainder of the 2020s. After the proposed 3.4-3.8 GHz auction in 2023, there is no concrete timeline for any additional spectrum releases for the mobile industry. The only potential candidates appear to be:

- 600 MHz – which could only be made available once a suitable alternative arrangement is identified for TV broadcasters and they have migrated to that solution and the spectrum is cleared. This is anticipated to be a long and complex clearance process, comparable to the first digital dividend (700 MHz reallocation), pushing out the potential availability date;
- 6 GHz – the quantum of spectrum which could be made available is uncertain since there is also a push for more spectrum in this band to be allocated to WiFi (RLANs). We need to wait until after WRC-23 to see how the global views on this band develop;
- 10.0-10.5 GHz – is currently occupied by Defence with Australia-wide licences and is also currently occupied globally by NATO and by passive and active EESS; and
- 43.5 GHz band (39-46 GHz) – which is a low priority after the allocation of 26 GHz spectrum in 2021. mm-wave spectrum provides a very different utility to all other IMT spectrum bands, and the existing mm-wave spectrum should be embedded in mobile networks and used more heavily before additional mm-wave spectrum needs to be considered.

When considering those options, the potential importance of 1.5 GHz spectrum to the mobile industry is clear. It therefore should be 'preserved' until there is more clarity about whether it becomes the only feasible new spectrum option for mobile network operators in the second half of this decade, or whether other options emerge and become more attractive. It is simply too early to make that call now.

When the band is progressed to the preliminary replanning stage, a technical liaison group (TLG) should be convened to determine coordination arrangements before an allocation is made for WBB/IMT services. This TLG should specifically explore coordination arrangements for WBB/IMT with HCRC used to supply USO services to ensure there is no disruption to these services. It is also important that coordination arrangements with the Defence Aeronautical Mobile Telemetry (AMT) service, stratospheric scientific research balloons, and other passive services including Earth Exploration Satellite Services (EESS) in 1400-1427 MHz are developed.



## 03 Responses to questions

This section contains our responses to the five questions posed by the ACMA in the Discussion Paper.

### 1. Are there any international arrangements or technology trends that the ACMA should be aware of?

We observe through Europe there are recommendations to allocate the 1427-1518 MHz band to IMT use in SDL configuration. We consider this is an important development for Australia to be aware of, as it is likely to drive equipment ecosystem development (network equipment and user devices) with good economies of scale Australia could leverage. We expand on this in sections 2.2 and 2.4 in the body of our submission.

### 2. What is the demand for access to the 1.5 GHz band for WBB, MSS and broadcasting services? Are there any other new services that should be considered?

Demand for spectrum in Australia to support WBB and IMT continues to increase, and the 1427-1518 MHz band is an important band that can work toward satisfying this demand in the second half of this decade. AMTA's policy position paper *Spectrum for 5G and Beyond*, and the associated Coleago Consulting report provide insight and justification for this demand, and we expand on this in section 2.2 of this submission. We also consider the most appropriate configuration for this band in metro and regional areas is the SDL configuration, and we expand on this in section 2.4.

We are not aware of any plans in Australia to use 1452-1492 MHz for digital sound broadcast (DSB) and consider there is no longer a need to preserve this allocation for that use case.

We are aware of requirements from the satellite industry to use the 1518-1525/1668-1675 MHz band (so called "extended L-Band") for Mobile Satellite Services (MSS), and we conditionally support this band being allocated for MSS use, noting that technical coordination arrangements at the 1518 MHz must be established to ensure 3GPP compliant devices operating below 1518 MHz can operate without undue interference.

### 3. What are the ongoing requirements for incumbent services in the 1.5 GHz band? Are there any viable alternative options?

We strongly emphasise the ongoing requirement to protect High-Capacity Radio Concentrator (HCRC) systems used by Telstra to deliver in excess of 10,000 Universal Service Obligation (USO) services. This is an essential service supplied to members of our community living and working in some of the remotest places in Australia. While we are aware of advances in new technologies such as Low Earth Orbit (LEO) satellites, and that in the fullness of time, these could be part of a technology replacement for USO services, we consider this is still some time away. It will also require changes to current USO arrangements in relation to voice services. Until such time as a proven alternate technology solution is developed for USO services, we consider it essential that HCRC systems remain protected from interference and can continue to be licensed under point-to-multipoint (PMP) apparatus licences.

We also note that some HCRC systems are licensed under PTP apparatus licences, and these similarly need to be protected from interference, and remain available for the delivery of USO services until a proven alternate technology solution is identified. We plan to migrate legacy PTP links used for backhaul purposes from this band to higher-frequency bands over the next 3-5 years. Further details can be found in section 2.1.



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4. What planning scenarios should be considered in the 1.5 GHz band?

We strongly support protection for incumbent HCRC systems used in the provision of USO services, and protection of scientific services such as Earth Exploration Satellite Services operating in the 1400-1427 MHz adjacent band. These considerations should be factored into planning scenarios for the band.

The ACMA notes it plans to engage with Defence on its current and future need to access the 1.5 GHz band. Assuming Defence indicates an ongoing need for the Aeronautical Mobile Telemetry (AMT) service, we consider it is essential that technical details and locations of where this service will be operated are provided to enable a technical liaison group (TLG) to develop appropriate coordination measures to protect both the AMT service and future IMT/WBB users of the 1427-1518 MHz band. Defence have also indicated interest in identifying a suitable sub-section of the band to support mobile high-capacity networking for domestic operations. We see no obstacle to Defence acquiring spectrum through the normal market mechanisms available to all spectrum aspirants.

Beyond these requirements, we consider the most appropriate planning scenario for the 1427-1518 MHz band is for spectrum licensing in SDL configuration in metro and regional areas, and AWL licensing in FDD configuration in remote areas, which we expand on in sections 2.4 and 2.5 above.

5. Comment is sought on the coexistence scenarios identified, including the ACMA's preliminary thinking on these scenarios. Are there any other coexistence scenarios the ACMA should consider?

We support the ACMA's preliminary views on managing co-existence with all the radio astronomy services operating in Australia, including the Square Kilometre Array at Murchison (in the Mid-West Radio Quiet Zone), and CSIRO's facilities at Tidbinbilla and the Square Kilometre Array.

We also support the ACMA's view that scientific services operating in the 1400-1427 MHz band should be protected. See section 2.3 for details.

We note that ITU-R working parties 4C and 5D are studying coexistence between IMT operating in 1427-1518 MHz and MSS operating in 1518-1525 MHz, based on studies already completed by the Electronic Communications Committee (ECC) in ECC Report 263. We strongly recommend the ACMA delay further planning of this band until such time as the ITU-R coexistence studies are completed, notionally<sup>9</sup> by the end of the WRC-23 study cycle. This means there is no urgency to progress the 1427-1518 MHz band into the *Preliminary Replanning* stage until toward the end of 2023. In section 2.8 we offer more detail on the timing of moving the band into *Preliminary Replanning*, and in section 2.7 we offer some thoughts on the likely coordination arrangements at the 1518 MHz boundary based on ECC Report 263 to minimise interference between WBB/IMT below 1518 MHz and MSS above.

We do not offer a position on the ACMA's preliminary views in relation to coordination between MSS and other services such as radio astronomy, weather satellites or stratospheric balloon communications systems.

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<sup>9</sup> Note: This work will notionally be completed by WRC-23, however there is no guarantee, since it is not formally part of WRC-23.