Development of the 850 MHz expansion and 900 MHz spectrum licencing technical frameworks

Technical Liaison Group Consultation Paper

Version 2.1

February 2021

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# Version Control

|  |  |
| --- | --- |
| **Version** | **Comments** |
| Version 1.0 | Initial release |
| Version 1.1 | Timeline updated (deadline for initial input extended to 5 Feb |
| Version 2 | Updated in accordance with input to Version 1 |
| Version 2.1 | Emission limits added. |

# Introduction

The Australian Communications and Media Authority (the ACMA) commenced a review of arrangements in the 803–960 MHz frequency band (the review) in May 2011, with the release of the discussion paper *The 900 MHz band—Exploring new opportunities* *(*[*Exploring new opportunities*](https://www.acma.gov.au/803-960-mhz-overview)). This was followed in 2012 with a second paper entitled, *The 803–960 MHz band: options for future change* ([*Future options*](https://www.acma.gov.au/803-960-mhz-overview)).

The *Future options* paper sought comment on a range of specific band planning proposals, including options for:

* re-farming the so-called ‘850 MHz expansion’ band[[1]](#footnote-2) for additional mobile broadband services,
* replanning the 900 MHz digital cellular mobile telephone band into 5 MHz blocks (or multiples thereof),
* facilitating the introduction of new and emerging low interference potential technologies; and ,
* overall band planning arrangements to implement these measures.

The ACMA formalised these considerations in the decision paper [*The ACMA’s long-term strategy for the 803-960 MHz Band*](https://www.acma.gov.au/sites/default/files/2019-12/The%20ACMAs%20long-term%20strategy%20for%20the%20803960%20MHz%20band_decision%20paper.docx)*.* The key outcomes of this paper included:

* The identification of 2 x 15 MHz of spectrum from the 850 MHz expansion band (809-824/845-869 MHz) that is optimised for mobile broadband.
* The declaration of the ACMA’s intent to reconfigure the 900 MHz band (890–915/935–960 MHz) to support future LTE applications.
* The potential implementation of a 1 MHz downshift of the existing 850 MHz band (currently 825-845/870-890 MHz, proposed to ultimately move to 824-844/869-889 MHz).
* The potential deployment of a national Public Safety Mobile Broadband (PSMB) capability within the 850 MHz expansion band.

Considerations around how to reconfigure the 900 MHz band have been the subject of subsequent consultations and the PSMB issue has since been managed by the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) in consultation with relevant state and territory government agencies.

Most relevantly, the Minister for Communications recently [announced](https://minister.infrastructure.gov.au/fletcher/media-release/2021-will-be-year-5g) that the 850 MHz expansion and 900 MHz bands would be reallocated for spectrum licensing, which triggers the development of technical frameworks to be considered, initially, by this Technical Liaison Group (TLG). The Minister’s announcement also placed an emphasis on facilitating 5G technologies with the expectation that sub-1 GHz spectrum licence holdings will, over time, be re-farmed to enable the evolution to those technologies. This means that parameters specified by 5G standards (i.e. the 3GPP ’38 series’) should also be accommodated by the frameworks informed by this TLG.

**Terminology**

It is necessary to make some terminology distinctions up front, as changes over time have led to some inconsistencies. What will be discussed in this TLG under the name ‘850 MHz band’ comprises the existing spectrum licensed band of 825-845/870-890 MHz that was originally described as the ‘800 MHz band’. Indeed the technical frameworks that underpin licences in this band are still known as the [800 MHz technical frameworks](https://www.acma.gov.au/800-mhz-technical-framework). However following the clearance of 803-820 MHz as part of the digital dividend and the reorganisation of the 803-890 MHz band (as set out in the decision paper), the term ‘800 MHz band’ now refers to a broader range of frequencies (as described in the [800 MHz band plan (RALI MS 40)](https://www.acma.gov.au/publications/2019-11/rules/rali-ms-40-800-mhz-band-plan)).

Use of the term ‘850 MHz band’ for the range 825-845/870-890 MHz aligns with more contemporary parlance – following allocation of the 850 MHz expansion band, the full (expanded) 850 MHz band will comprise of:

* 809-845 (844 post-downshift) MHz, and
* 854-890 (889 post-downshift) MHz.

For the purposes of this TLG the term ‘850 MHz band’ will be used but please keep in mind that the purpose of this TLG is to inform to update the existing 800 MHz technical frameworks, which are one and the same.

**The Technical Framework**

The ACMA develops a technical framework for every band subject to spectrum licensing. Each framework is a collection of technical and regulatory conditions applicable to the use of radiocommunications devices in the spectrum-licensed band. The purpose of the technical framework is to define the technical conditions and constraints under which a device may be deployed and operated within the specified geographic area and frequency band of the licence.

The technical framework defines the spectrum licence asset and its relationship to other spectrum users. In doing so the framework provides arrangements to manage interference and provide legal certainty about licensee rights.

The objectives of technical frameworks are to:

minimise the negotiation necessary between licensees; and,

maximise flexibility for the deployment of services; and,

maximise the efficiency with which the spectrum is used.

The technical framework of the spectrum licence is developed by the ACMA to fulfil its requirements under the Radiocommunications Act 1992 (the Act). The framework is developed by the ACMA in consultation with industry through the TLG.

This initial paper provides information on the various aspects of the technical framework. We are asking for comment on the proposed parameters for the following basic items of the technical framework:

the reference technologies; and,

the standard trading unit and minimum contiguous bandwidth (MCB); and,

the out-of-area emission limit; and,

the out-of-band emission limits, and

relevant adjacent system characteristics and protection requirements.

The out-of-area (in band) and out-of-band emission limits, together with the frequency and geographic boundaries, make up the core conditions of the spectrum licence as defined in Section 66 of *the Act*. This discussion paper examines each of these items of the framework, considering the specifications of the reference technologies, the arrangements in place overseas, and proposed arrangements to be put in place in Australia. An outline of the reasoning leading to selection of the proposed values for each item is provided.

Given the commonality between both the technologies used and physical characteristics of adjacent and near-adjacent spectrum licenced bands, it is intended that some aspects of the technical frameworks will essentially carry over from relevant existing frameworks (e.g. 800 MHz band). These aspects include device boundary criteria (DBC) and associated levels of protection (LOPs) and propagation models for making DBC assessments.

As with all TLG papers, this is a discussion paper only and the views and suggestions of the members of the TLG are sought as to the relevance and suitability of the proposed values. It is also intended to be a ‘living’ document that evolves with input from the TLG membership, so the first iteration of this paper can be considered as a starting point.

**TLG Outcomes**

There are two key bodies of work that will be informed by outcomes of the TLG process:

* Development of the 850 MHz expansion technical framework, by:
* Reviewing the 2012 850 MHz[[2]](#footnote-3) technical framework, which comprises of:
* the [s.145(4) determination](https://www.acma.gov.au/800-mhz-technical-framework) on unacceptable levels of interference,
* the [Radiocommunications Advisory Guidelines (Managing interference from Spectrum Licensed Transmitters)](http://www.comlaw.gov.au/Details/F2012L01775) (the ‘RAG tx’), and
* the [Radiocommunications Advisory Guidelines (Managing interference from Spectrum Licensed Transmitters)](http://www.comlaw.gov.au/Details/F2012L01774) (the ‘RAG rx’)
* the [*Radiocommunications (Trading Rules for Spectrum Licences) Determination 2012*](https://www.legislation.gov.au/Details/F2018C00564) (the Trading Rules determination)

to incorporate the 850 MHz expansion band within their scope;

* Developing the licence conditions for the 850 MHz expansion band;
* Development of a new 900 MHz band technical framework (ie. developing licence conditions, and a new s.145(4) determination, RAG tx and RAG rx). This will also include adding the 900 MHz band to the Trading Rules determination.

## Scope

This TLG paper will propose initial arrangements for the 850MHz expansion band and the reconfiguration of the 900 MHz band. Allocation of spectrum for PSMB and effecting the 850 MHz band downshift\* are not within the scope of this TLG process, however arrangements for those frequency segments will be included in the frameworks developed in this TLG. In other words, should the government allocate a segment of the 850 MHz expansion band for PSMB, PSMB network operations will be subject to the same provisions and conditions as operators in other segments of the band.

While the PSMB spectrum was originally within scope of the TLG – the reallocation declaration only applies above 814/859 MHz but we thought it prudent to develop technical arrangements for the lower 5 MHz pair as well – no PSMB interests have registered for the TLG. So at this stage it is likely that technical conditions for (eventual) PSMB use will be developed separately from this TLG (the lower lot has hence been excised from the scope of the TLG’s consideration in the below frequency ranges).

\*The 2 x 1 MHz that is proposed for the 850 MHz downshift is within the scope of this TLG, however the means for effecting it, if it is to occur before the 2028 expiry date, are not within scope (this is a matter for negotiation between current and prospective licensees).

This means that the in-band frequency ranges within scope of the TLG are:

* 814 MHz to 825 MHz (base rx);
* 859 MHz to 870 MHz (base tx);
* 890 MHz to 915 MHz (base rx); and
* 935 MHz to 960 MHz (base tx).

Regarding the 1 MHz downshift, this will occur no later than the expiry date of the current 850 MHz spectrum licences in 2028 (or earlier if agreement can be obtained from incumbent licence holders). The work of this TLG assumes that that downshift is *not* in place – technical frameworks can be updated later to take account of the downshift when it occurs.

This also means that compatibility between services above and below the 890 MHz boundary will continue to be an issue. This TLG does not aim to solve that issue – new lower 900 MHz deployments will simply need to protect existing 850 MHz registrations in accordance with the frameworks that will be put in place. The downshift (when it does occur) will ease, but not eliminate, these coexistence issues. How this affects the allocation/valuation of 900 MHz lots is not a matter for this TLG.

Device boundary criteria (DBC) for service deployments will be considered within this TLG, which are relevant to managing interference across geographic boundaries. however any consideration of geographic spectrum lot configurations is not within the scope of this TLG.

Lastly, the device and emission characteristics that are proposed for consideration in developing these frameworks have, with some exceptions, been based on the 3GPP ’38 series’ standards that specify 5G new radio (NR) systems and devices. While technical frameworks developed to support spectrum licensing are deliberately technology-flexible, they are generally optimised for the most evolved technologies available at the time of their writing. Parameters are also necessarily tempered if/where necessary to enable coexistence with incumbent services – while 3GPP standards are instructive they do not always translate directly into parameters for entry into technical frameworks.

It may be some time until 5G technologies are deployed in the frequency bands being considered by this TLG, however optimising the frameworks in this way will enable a smooth transition to these technologies at the appropriate time, and is not expected to constrain previous generation (eg, 3G, 4G) technology deployments in the interceding period.

Thus the reference technologies proposed in the first version of this paper referred to 38 series technologies. The out-of-band emission limits initially proposed were based on the extant 850 MHz frameworks, essentially as a starting point to elicit feedback on what limits might be appropriate, and have been updated in response to member feedback.

## Timeline

The ACMA is working towards allocating the 850 MHz expansion band and 900 MHz band in Q4 2021.

1. TLG anticipated process timeline

| Key steps | Proposed Date |
| --- | --- |
| TLG process:  Initial release of TLG paper  Deadline for submissions/comments on initial TLG paper  Revision to TLG paper and recirculation  Deadline for submissions/comments on revised TLG paper  Second (final) revision to TLG paper and recirculation | 17 Dec 2020  12 Feb 2021[[3]](#footnote-4)  26 Feb 2021  19 Mar 2021  26 Mar 2021 |
| Public consultation on the draft updates to the following technical framework instruments (the consultation will also include a draft 850 MHz ‘expansion’ band & 900 MHz marketing plan):  Draft marketing plan (including draft spectrum licence); and,  Draft *Radiocommunications (Unacceptable Levels of Interference) Determination;* and,  Draft *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters);* and  Draft *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers);* and,  Draft update to *Radiocommunications (Trading Rules for Spectrum Licences) Determination 2012;* and  Draft updates to relevant RALIs | April 2021 |

## Legal Review

Currently there are no draft instruments. Initial drafts (when released) may not have undergone any legal review and are therefore indicative only and may be subject to change.

Under the current timeline, draft instruments will be provided for comment in April 2021.

# Proposed technical frameworks & subsequent parameters

A technical framework consists of three interlocking regulatory elements provided for under the Act:

The conditions specified on the spectrum licence—in particular, the core conditions that define the spectrum space (both frequency and geographical area) and the level of emissions permitted inside and across the frequency boundaries of the licence (section 66 of the Act).

A determination of unacceptable interference for the purpose of device registration in each band (section 145 of the Act). This defines permissible levels of emissions across geographical licence boundaries and can also define various deployment constraints.

Radiocommunications advisory guidelines (RAG) that provide assistance and advice for coordination with stations in other services when and where required (section 262 of the Act). This includes detailing interference management criteria with incumbent apparatus and other spectrum licences.

A more comprehensive explanation of spectrum licence technical frameworks is provided in the document [*Know your obligations—Spectrum licensees*](http://www.acma.gov.au/theACMA/Library/Industry-library/Spectrum/know-your-obligationshelp-for-spectrum-licensees). As described above, the outcomes of this TLG will inform the development of a new technical framework for the 900 MHz band and an update of the existing 850 MHz framework to incorporate the 850 MHz expansion band spectrum.

This section of the paper considers the development of each of these components along with the standard trading unit and minimum contiguous bandwidth.

## Conditions on spectrum licences

Each spectrum licence includes both core conditions and statutory conditions specified under relevant sections of the Act. The Act also provides that other specific conditions may be included by the ACMA.

**Core conditions**—required under section 66, these conditions define the spectrum space within which the licensee is authorised to operate radiocommunications devices under the licence, and the maximum permitted level of radio emissions inside and outside the band. These conditions are included in all spectrum licences.

**Statutory conditions**—required under sections 67 to 69A, these conditions include information about payment of charges, use by third parties, residency, registration of transmitters and devices exempt from registration. These conditions are included in all spectrum licences.

**Other conditions**—conditions placed on licences under section 71 generally provide for the efficient management of the spectrum and administration of the Act. These conditions may vary from one band or licence to another.

The core conditions of a spectrum licence form the fundamental building blocks for operation of a spectrum-licensed device, and for managing interference with adjacent frequency bands and geographic areas. Section 66 of the Act states spectrum licences must specify the following core conditions:

the part or parts of the spectrum in which operation of radiocommunications devices is authorised under the licence (frequency range of operation)

the maximum permitted level of radio emission, in parts of the spectrum outside the frequency range specified on the licence, that may be caused by operation of radiocommunications devices under the licence (outside-the-band emission)

the area within which operation of radiocommunications devices is authorised under the licence (geographic area of operation)

the maximum permitted level of radio emission that may be caused by the operation of radiocommunications devices under the licence (outside-the-area emission).

When developing conditions on the spectrum licence it is proposed to use those on the 700 MHz and 800 MHz spectrum licences as a starting point.

## Standard Trading Unit and Minimum Contiguous Bandwidth

A spectrum licence may be traded in whole, or in part, by geographic area or frequency or both. Under section 88 of the Act, the ACMA may determine the rules that apply to trades under spectrum licensing. These rules are contained in the [*Radiocommunications (Trading Rules for Spectrum Licences) Determination 2012*](https://www.legislation.gov.au/Details/F2015C00469)(trading determination).

The trading determination specifies the smallest parcel of spectrum space that can be traded (the standard trading unit) and the minimum contiguous holding of spectrum space required by a licensee after the completion of a trade. This minimum holding is a combination of frequency and geographic requirements. Where:

the frequency requirement is equal to the minimum contiguous bandwidth (MCB),

the geographical requirement is equal to the geographical component of the standard trading unit (STU).

The minimum quotas of frequency and area that can be traded are defined by the STU. The definition of a STU is contained in the trading determination.

The STU that applies to the 850 MHz expansion and 900 MHz band (and every other spectrum licence band) is defined as a parcel of spectrum space that consists of:

a geographic area equal to a Level 1 HCIS cell of the 2012 Australian Spectrum Map Grid (ASMG)[[4]](#footnote-5)– approximately a 9×9 kilometre in size

a frequency band where the lower and upper frequency limits of each segment are integers when described in Hertz

This means the frequency component of the STU is defined as 1 Hz for both bands and all other spectrum licence bands. This provides licensees with flexibility in the quantum of spectrum that may be traded, subject to the value of the MCB. The minimum area is referenced to the ASMG mapped consistently in five-minute increments by latitude and longitude.

**There is no proposed change to the STU.**

The current MCB for the 825–845/870–890 MHz band is 1 MHz, however it is proposed to change this to 5 MHz. This means that any trades in this band must not result in a licensee holding a contiguous bandwidth less than 5 MHz in any area. Noting the *Channelling arrangements* discussion below, the same MCB is proposed for adoption in both the 850 MHz expansion and the 900 MHz band.

**Feedback from TLG membership was largely supportive of a 5 MHz MCB for both 850 MHz expansion and 900 MHz spectrum licence bands. This will be incorporated into draft instruments for public consultation.**

## Technical settings

### Relevance of existing frameworks

Unlike a ‘greenfield’ spectrum allocation and deployment, pre-existing deployments in both the 850 MHz and 900 MHz bands mean that some existing parameters will not need to be derived. Moreover, in the case of the 850 MHz expansion band, many of the characteristics will necessarily be aligned with those of the existing 850 MHz band.

For example, device emission limits, levels of protection (LOP, to inform device boundary criteria) and system models used to determine those characteristics can be informed by those encapsulated in existing frameworks. Accordingly, unlike previous TLG papers, system models and derivations of LOPs have been omitted from this paper. This does not mean that proposed technical settings carried over from relevant existing frameworks are ‘locked in’ – the TLG can inform (and has informed) whether those settings remain relevant or suggest amendments if necessary (noting that the ACMA will consider views from existing 850 MHz spectrum licensees on any proposed changes which would affect their licences). Responses to the first paper were consistently in favour of updating the current 850 MHz in-band and out-of-band emission limits (to apply to both 850 and 900 MHz bands) to incorporate 5G technologies, as well as expressing separate guidance to support future advanced antenna system (AAS) deployments.

Furthermore, given the commonality of technologies and characteristics between both the 850 MHz and 900 MHz bands, it is expected that many of the elements developed for the (update to the) 850 MHz frameworks will translate across to the new 900 MHz band frameworks. This was reinforced by TLG inputs that noted that 5G technologies should form the basis for limits/conditions to apply to both bands.

### Reference technologies

The proposed reference technologies that will be specifically considered in the development of the framework are:

1. Reference Technologies

| Technology Identification | Technology Mix | Duplexing Methodology | Service Model(s) | Applicable standards and reports |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| LTE  (E-UTRA) | Current | Two frequency (FDD) | Fixed and mobile | ITU-R Report M.2039-2, 3GPP TS 36.101, 3GPP TS 36.104, 3GPP TS 36.942 |
| 5G NR | Current | Two frequency (FDD) | Fixed and mobile | ITU-R Recommendation M.2101, 3GPP TS 38.101, 3GPP TS 38.104 |

This does not exclude other technologies from being used under the framework; rather, it is proposed that the framework will be developed with specific reference to these technologies. As there has been little interest in the use of TDD systems in these bands in Australia, only FDD technologies are being considered. The proposed framework will be optimised to support FDD in line with band arrangements developed by the AWG for FDD.

Note that the first paper included 3GPP 25 series (3G) technologies as a reference technology, but most respondents favoured basing conditions on 5G technologies, with some support for retention of 4G. As per the above point, it is expected that basing frameworks on 4G and 5G technologies will not be preclusive the operation of legacy 3G services.

**Most TLG members favour identification of 38 series 5G technologies as the reference technology for the development of technical frameworks. AMTA supported the retention of 36 series 4G technologies, while Telstra agreed with the original proposal. The ACMA will draft the frameworks based on 36 and 38 series technologies, with some minor variations to ensure ongoing compatibility with existing services.**

## Channelling arrangements

The 900 MHz band has long been a cornerstone in the delivery of cellular communications services in Australia, first through the deployment of the 2G Global System for Mobile (GSM) and now 3G Universal Mobile Telecommunications System (UMTS) and 4G Long Term Evolution (LTE) technologies. LTE can operate using a range of different channel sizes, being: 1.4, 3, 5, 10, 15, and 20 MHz, however LTE is more spectrally efficient in channels of 5 MHz or multiples thereof.

Increases in channel size (in 5 MHz increments) up to a 20 MHz channel increases throughput but results in only incremental gains to spectral efficiency. While LTE can operate using channels smaller than 5 MHz, this is generally avoided as efficiency suffers and the level of throughput adds little to the overall capacity of a network. Therefore, bands for 3G and 4G technologies are predominately planned based on a minimum block size of 5 MHz.

The 850 MHz expansion band will consist of 3 paired channels of 5 MHz on both the upper and lower limit (Figure 1), given that it is expected that most end-use stakeholders will be using FDD technologies. The potential for licensees to re-farm holdings to enable future (5G) NR deployments is preserved by using a baseline of 5 MHz blocks.

Proposed channelling arrangements for the 850 MHz expansion band

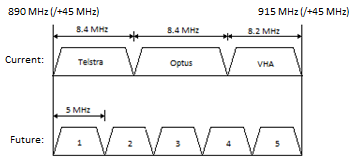
Diagram

Description automatically generated

If an allocation is made for PSMB in the 850 MHz expansion, it is anticipated that it will be limited to channel 1. Whether PSMB is ultimately allocated a part of the 850 MHz band is a decision for government – however is it anticipated that this capability will be LTE-based technology, allowing for a single unified technical framework to be developed across all band segments.

The 900 MHz band is intended to have the following channel arrangements within the base receive segment (Figure 2). The 900 MHz band (890–915/935–960 MHz) is currently apparatus licensed to Telstra, Optus, and Vodafone Hutchison Australia (VHA) in 8.4 and 8.2 MHz blocks. Figure 2 shows the lower (base-receive) part of this band, with the current licensing arrangements shown at the top of the diagram.

Current and proposed channelling arrangements for 900 MHz band



These details were provided for information only – no comment was requested.

## Emission Limits

### *In-band emission limit*

The value initially proposed for the in band (otherwise referred to as out-of-area) emission limit was based on existing 850 MHz limits, being the maximum in-block limit identified in the European arrangements with an additional factor of 5 dB added to cover future technological developments that may occur over the period of the licence. Based on feedback from TLG members, the ACMA has decided to propose a specific in-band conducted and total radiated power (CP and TRP) limit for non-AAS and AAS respectively. There was broad support for an in-band EIRP of 49 dBm/30 kHz, so assuming a typical non-AAS gain of 16-18 dBi (and selecting 16 as the lowest) this translates to a per-transmitter conducted power of 33 dBm/30 kHz.

We are also prepared to prescribe a higher overall (per sector) TRP as suggested by respondents. Recent technical frameworks have included an additional 9 dB allowance based on 8-port systems, however it is not yet clear how prolific large-array AAS will be in low band deployments. As a starting point we consider it appropriate to allow up to 6 dB additional per sector for the 850 and 900 MHz bands to allow deployment of 4 port AAS without any additional per-port constraints.

**It is proposed that draft frameworks will include a maximum in-band per-transmitter conducted power of 33 dBm/30 kHz (based on EIRP of 49 dBm/30 kHz) for non-AAS operation, and a maximum in-band per-sector TRP of 39 dBm/30 kHz.**

**The latter (TRP) figure is based on a 4-port AAS – is there any evidence to suggest higher-order AAS will be deployed in sub-1 GHz frequency bands?**

*Unwanted emissions limit*

Another core condition of the licence sets the unwanted emission limits outside the band. These limits control emissions outside the frequency boundary of the licence. Unwanted emissions may affect licensees in adjacent holdings as well as spectrum uses outside the spectrum licensed band. Unwanted emissions consist of out-of-band emissions (OOBEs) and spurious emissions.

OOBEs are unwanted emissions immediately outside the allocated bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions.

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

Note that prescribed OOBE and spurious limits would apply to all devices operating under a spectrum licence in the expanded 850 MHz and 900 MHz bands. Devices which are exempt from registration (e.g. mobile handsets) are not exempt from the core conditions of the licence under which they operate.

Given the contiguity with the upper-adjacent 850 MHz band, the proposed out-of-band limits will apply to both the 850 MHz and 850 MHz expansion bands as a whole. So the out of band limits proposed are based on band filter edges at 814/845 MHz segment paired with 859-890 MHz segment (to be later adjusted to upper edges of 844 and 889 MHz once the 1 MHz downshift of the 850 MHz band is brought into effect).

For both the expanded 850 MHz band and 900 MHz band, it was proposed that the current 850 MHz OOBE and spurious limits (described in sections 6 through 12 of Schedule 2 – Core Conditions on the [current 850 MHz licence](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=9263429)) act as a starting point for eliciting input.. However, TLG respondents were universally in favour of replacing the existing unwanted emission limits with those set out in recent 3GPP standards.

While the ACMA sees the obvious flexibility benefits of this proposal, it can’t come at the expense of increased interference potential to services operating on adjacent or near-adjacent frequencies. One submission suggested that the current limits are too stringent for 5G deployments – again in principle there seems to be some logic in this, any relaxation must be considered against any increased protection level. So we took the view that, as a starting point, we would endeavour to base unwanted emission limits on those set out in 38 series standards, subject to consideration of the potential impact on near/adjacent frequency services (this additional consideration necessitated delaying reporting these outcomes to the TLG in the 2nd version of the TLG paper).

Having considered this matter in some depth, it is now proposed that 3GPP OOB (spurious and non-spurious) emissions as specified in the standard can be adopted, but with no additional allowance for AAS (as mentioned above, the additional allowance is being made for in-band, but not out-of-band). This measure will mitigate the risk of interference and/or spectrum denial to other licenced (or prospective licenced) services in while still providing a migration path to NR technologies. It also aligns with arrangements being considered in Europe (see ECC report 297) where it has been assessed that established compatibility between LTE and adjacent services can be extended to NR (although this is specifically in the context of coexistence with >960 MHz aeronautical services) – this assessment does not however extend to NR with an additional OOBE allowance for AAS.

It is important to note that this proposal is not intended to preclude AAS use in the band – again the extra allowance is afforded to in-band emissions and we intend to express the OOBE are as TRP in the core conditions. It just means that higher power (eg.macro) base stations already operating at/near peak OOBE limits would need to implement additional filtering if they were to introduce AAS. Lower power base stations operating below the permitted OOBE limits would be able to migrate to AAS without implementing such measures, so long as the specific maximum OOB TRP is observed.

**Proposed non-spurious unwanted emissions outside the 850 MHz and 900 MHz bands are contained in Tables 1 and 3 of Attachment A**

**Proposed spurious unwanted emissions outside the 850 MHz and 900 MHz bands are contained in Tables 2, 4 and 5 of Attachment A.**

**Other conditions of the licence**

It was initially proposed that spectrum licences would be subject to most (if not all) of the existing conditions on the current 800 MHz and 700 MHz spectrum licences that are also relevant to the 850 MHz expansion and 900 MHz band. Submissions recommended updating elements of the technical framework to reflect contemporary standards.

It is also proposed to include a licence condition to protect incumbent services during the reallocation period. Proposed protection requirements are further discussed in the *Radiocommunications advisory guidelines (RAGs)* section.

**It is proposed that licence conditions, including guidelines, statutory and other conditions will be updated to reflect contemporary standards.**

## Unacceptable levels of interference (s.145 determination)

Spectrum licensees are required to register a radiocommunications transmitter in the Register of Radiocommunications Licences before they may be operated under the licence. The only exception to this is if there is a condition on licences that exempts certain types of transmitters.

Subsection 145(1) of the Act gives the ACMA the power to refuse to register a radiocommunications transmitter if it is satisfied that the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices. Under subsection 145(4) of the Act, the ACMA can make a determination (referred to as a section 145 determination) that sets out what is considered unacceptable levels of interference for each spectrum-licensed band.

A section 145 determination sets out the circumstances in which devices are deemed to cause unacceptable levels of interference. These circumstances typically include:

if the levels of emissions from a device at the geographical boundary of a licence exceed a defined level; or

if the operation of the transmitter will cause a breach of a core condition of the licence; or

if the deployment of the device is outside any deployment constraints defined for the band.

It is proposed that, as a result of the TLG, the current 850 MHz s.145 determination will be updated, and a new s.145 determination will be made for the 900 MHz band.

Under normal circumstances, a TLG will consider relevant elements of the device boundary criteria (DBC) to be reflected in the s.145 determination. This usually includes definitions and/or calculations of system models, propagation models and device levels of protection (LOP) that underpin the DBC.

Once again, given the pre-existence of the 850 MHz frameworks, it is proposed that those existing frameworks be referred to as a starting point for these considerations (for both the 900 MHz and 850 MHz expansion bands), rather than seeking to develop a new suite of metrics. We expect these to be updated somewhat through the TLG process but reiterate that the amendment of any values associated with conditions on existing 850 MHz band licences will need to be agreed by existing 850 MHz licensees. Some aspects of the s.145 determination that may require updating were floated in the 1st version of this paper and all respondents that provided comment on these aspects were in favour of:

updating to a 3 second digital elevation model (DEM);

excluding propagation paths that lie outside the ASMG and/or territorial sea boundaries from needing to comply with DBC; and

revision of DBC calculation resolution (from 500m down to 100m); and

revision of the definition of a transmitter from the current definition in section 9(e).

**It is proposed that some general aspects of the 850 MHz s.145 determination be amended as follows:**

**> implement a 3 second digital elevation model (DEM);**

**> exclude propagation paths that lie outside the ASMG and/or territorial sea boundaries from being required to comply with DBC;**

**> revise DBC calculation resolution from 500m to 100m; and**

**> revise the definition of a transmitter from the current definition in section 9e to align with definitions in more contemporary s.145 determinations.**

**It is further proposed that all aspects of the updated 850 MHz s.145 determination, including the LOP proposed below, be replicated in a new 900 MHz s.145 determination**

Regarding the LOP, it is generally a compromise between the level of emissions over the geographic boundary of the licence and the anticipated protection requirements of receivers. The LOP must be met at or within the geographic boundary of the licence following the device boundary criterion methodology of the section 145 determination.

For the purposes of these frameworks and given the interrelationships between the 850 MHz existing and expansion bands, it was considered that the existing 850 MHz LOP would be a useful starting point for both the 850 MHz expansion and 900 MHz band frameworks, being:

– 111 dBm/MHz for base-transmit frequencies, and

– 115 dBm/MHz for base-receive frequencies.

Responses from TLG members favoured a less stringent LOP based on current 3GPP standards, along with a separate (higher) LOP for AAS operation. The higher AAS LOP is to reflect the probabilistic nature of interference across boundaries when implementing beam-forming – 8 dB has been added to previously-developed frameworks for this purpose.

**It is proposed that the level of protection for coexistence between spectrum licensees be revised to -100 dBm/MHz for non-AAS operation and -92dBm/MHz for AAS operation *specifically when being used for beam-forming.***

## Radiocommunications advisory guidelines (RAGs)

**Amendments to 850 MHz RAGs**

Further guidance on interference management with other licensed services is provided in Radiocommunications Advisory Guidelines (RAGs) made under section 262 of the Act. RAGs can refer to any aspect of radiocommunications or radio emissions.

Generally, RAGs include provisions to help assess the possible interference between spectrum-licensed devices and services operating under spectrum, apparatus, or class licences. Potentially affected services are identified in the RAGs to enable licensees to assess and mitigate the risk of interference between these services.

It is important to note that where a case of interference arises between a spectrum-licensed device and another licensed device, the ACMA will refer to the provisions of the RAGs in resolving the matter. In general, affected licensees also can negotiate their own arrangements to manage interference. Such arrangements will be considered when resolving any interference disputes.

The following 850 MHz RAGs will need to be updated as a result of this TLG:

[*Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters - 800 MHz Band) 2012*](http://www.comlaw.gov.au/Details/F2012L01775) (the RAG tx), and

[*Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers - 800 MHz Band) 2012*](http://www.comlaw.gov.au/Details/F2012L01774)(the RAG rx).

These updates are expected to be relatively minor given the adjacent band services will remain the same (only the lower frequency edge will change from 825/870 MHz to 809/854 MHz):

Trunked land mobile services (TLMS) will remain lower-adjacent to both the base-transmit and base-receive segments of the expanded 850 MHz band;

Single-frequency links (including sound outside broadcast) will remain upper-adjacent to the base-receive segment of the expanded 850 MHz band; and

The 900 MHz band wireless broadband will be upper-adjacent to the base-transmit segment of the expanded 850 MHz band.

Apart from the latter point, which will itself be considered within the scope of this TLG, it is proposed that the existing coexistence arrangements (including protection requirements) between these services and 850 MHz spectrum-licensed services will not be amended. This includes incorporating the coexistence arrangements from Appendix E of RALI FX22 into the RAG rx. Instructions for management of in-band interference will continue to refer to the DBC and associated arrangements set out in the s.145 determination.

Feedback from TLG members highlighted aspects of the existing 850 MHz RAGs that are out of date, including:

References to outdated adjacent band technologies, specifically GSM, including:

Description of the technology itself

Relevant documentation describing protection requirements

Means of authorisation (ie. 900 MHz band is transitioning from apparatus to spectrum licensing)

References to RALIs that are no longer applicable (eg. relevant information from RALI FX 11 is now contained in RALI FX 22)

Need to incorporate specific protection requirements for TLMS no longer specified in RALI LM 08 in the RAG Tx

These aspects were already noted and will be corrected in the draft updates to instruments.

**It is proposed to update the 850 MHz RAGs to reflect contemporary references and information.**

Separately, one unique aspect of the 850 MHz expansion band is that it will be allocated partially encumbered – existing operators will transition out of the band by mid-2024 in accordance with the [*The ACMA’s long-term strategy for the 803-960 MHz Band*](https://www.acma.gov.au/sites/default/files/2019-12/The%20ACMAs%20long-term%20strategy%20for%20the%20803960%20MHz%20band_decision%20paper.docx). To enable temporary coexistence with these services, it is proposed that a simple note will be added to the RAG tx and rx that refers to relevant RALIs (most likely limited to RALI LM 08 for existing TLMS) for the services concerned, so that they can essentially be ‘worked around’ until they have transitioned out. Given the temporary nature of this overlap, we do not see any need to revise coexistence provisions.

In the first version of this paper it was suggested that it may be prudent to place a note in RAGs to take account of registered locations of (in particular) TLMS base stations that will be transitioning from 820-825/865-870 MHz to 806-809/851-584 MHz for coordination purposes. The reason for this is that existing TLMS services should be afforded first-in-time status for coordination purposes and should not be disadvantaged by a decision to allocate the 850 MHz expansion band spectrum encumbered and earlier than originally forecast. It is further proposed that these arrangements are incorporated as a condition on the licence.

Comments advised that the existing RAG rx does not account for wideband IMT or power control to reduce the power of mobile transmitters and that affording protection from TLMS base stations to mobile receivers was not a reasonable requirement from both a licensee and ACMA perspective.

**It is proposed that the notional receiver and compatibility requirement set out in Schedule 1 and 2 respectively of the existing RAG Rx will be revised to be based on 3GPP 38 series performance specifications. Schedule 3 will be reviewed to reflect the use of more modern IMT technologies. Protection of spectrum licensed mobile receivers will be revised.**

**It is further proposed that guidance will be added to the 850 MHz RAGs to manage the transition from TLMS services from 820-825/865-970 MHz to 806-809/81-854 MHz between 30 June 2021 and 30 June 2024. This will include protection of (on not claiming protection from) existing TLMS registrations on their current (until they make the transition) and future (post-transition) frequencies.**

**Development of 900 MHz RAGs**

A new RAG tx and RAG rx will be required for the 900 MHz band. The formats of these will closely follow those of the 850 MHz RAGs that are updated in this TLG. Existing arrangements to enable coexistence between 900 MHz apparatus licenced PMTS services and adjacent band services will be instructive in informing the contents of these guidelines. These services include:

Lower-adjacent 850 MHz wireless broadband services (also within scope of this TLG);

Devices authorised under the Low Interference Potential Devices (LIPD) Class Licence; and

Aeronautical services operating above 960 MHz (predominantly distance measuring equipment (DME)).

As per usual practice, instructions for management of in-band interference will refer to the DBC and associated arrangements set out in the s.145 determination. Feedback from TLG members noted that specific protection requirements beyond provisions of standards would be needed for LIPD services. Similarity, some respondents noted that 3GPP-standarised services already operate in the 900 MHz band without additional constraints on OOBE, so it is expected that upper-adjacent aeronautical services will continue to be protected under updated arrangements. Nonetheless, the transition from apparatus to spectrum licences dictates that protection requirements for aeronautical services be codified in the RAG tx.

**It is proposed to include provisions for adjacent-band aeronautical services but not LIPD services in the 900 MHz RAG tx that codify protection requirements for adjacent services using contemporary 3GPP standards (noting the OOBE limits prescribed in Attachment 1) as the basis for these requirements.**

**Mobile Communications on board Aircraft (MCA)**

The current 850 MHz RAG tx contains provisions for operating mobile communications systems aboard aircraft (MCA). These services are normally operated under PMTS class C licences, however when operating in spectrum-licenced areas/frequencies must be operated under the spectrum licence (either directly or via 3rd party, depending on the operating entity). The provisions set out in the original RAG refer to the conditions for PMTS class C operation set out in the PTS LCD. The intent is to retain these provisions in updates to the 850 MHz frameworks (and extend their applicability across the expanded band) and to reproduce them in new 900 MHz frameworks.

Input was sought on whether MCA provisions in the current 850 MHz RAG tx remained appropriate, noting that these provisions have not been replicated in other technical frameworks for bands that may be used for MCA purposes. One respondent suggested that MCA itself is no longer relevant, given the advent of WiFi on board commercial aircraft. No respondents explicitly supported the retention of these provisions.

**It is proposed that Part 5 of the existing 850 MHz RAG Tx, which solely pertains to MCA use, be removed and not replicated in the new 850 MHz and 900 MHz band RAG Tx.**

## Attachment 1 - Proposed Unwanted Limits for 850 Expansion & 900 MHz

Unwanted limits for transmitters in the upper band (859-890 MHz or 935-960 MHz)

The TRP limits in Table 1 apply to transmitters in the following frequency ranges:

* Inside the range 849-900 MHz for transmitters operating in the frequency range 859-890 MHz.
* Inside the range 925-970 MHz for transmitters operating in the frequency range 935-960 MHz.

|  |  |  |
| --- | --- | --- |
| **Frequency offset of measurement filter ‑3dB point from upper/lower limit of licence** | ***TRP*** | ***Measurement bandwidth*** |
| 0 MHz ≤ foffset< 5 MHz |  | 100 kHz |
| 5 MHz ≤ foffset< 10 MHz | -14 dBm | 100 kHz |
| foffset ≥ 10 MHz | -16 dBm | 1. kHz |

Where: ***foffset*** is the frequency offset from the upper or lower frequency limits for the spectrum licence. The closest -3dB point of the specified bandwidth closest to the upper and lower frequency limits for the spectrum licence is placed at **foffset**.

**Table 1: Upper Band Limits (Total Radiated Power)**

***Source:*** *3GPP TS 38.104 V17.0.0 (2020-12)*

The TRP limits in Table 2 apply to transmitters in the following frequency ranges:

* Outside of the range 849-900 MHz for transmitters operating in the frequency range 859-890 MHz.
* Outside of the range 925-970 MHz for transmitters operating in the frequency range 935-960 MHz.

|  |  |  |
| --- | --- | --- |
| **Frequency range** | ***TRP*** | ***Measurement bandwidth*** |
| **9 kHz – 150 kHz** |  | 1 kHz |
| **150 kHz – 30 MHz** | -36 dBm | 10 kHz |
| **30 MHz – 1 GHz** |  | 100 kHz |
| **1 GHz – 12.75 GHz** | -30 dBm | 1 MHz |

**Table 2: Upper Band Limits (Total Radiated Power)**

***Source:*** *3GPP* *TS* *38.104 V**17.0.0 (**2020-12)*

Unwanted limits for transmitters in the lower band (809-845 MHz or 890-915 MHz)

The TRP limits in Table 3 apply to transmitters at frequency offsets of less than or equal to 25 MHz from the licence edge. ***foffset*** is the frequency offset from the upper or lower frequency limits for the spectrum licence. The closest -3dB point of the specified bandwidth closest to the upper and lower frequency limits for the spectrum licence is placed at **foffset**.

|  |  |  |
| --- | --- | --- |
| **Frequency offset of measurement filter ‑3dB point from upper/lower limit of licence** | **TRP** | **Measurement bandwidth** |
| 0 MHz ≤ foffset < 1 MHz | -13 dBm | 200kHz |
| 1 MHz ≤ foffset < 5 MHz | -10 dBm |  |
| 5 MHz ≤ foffset < 20 MHz | -13 dBm | 1 MHz |
| 20 MHz ≤  **foffset**≤ 25 MHz | -25 dBm |  |

**Table 3: Lower Band Limits (Total Radiated Power)**

***Source****: 3GPP TS 38.101-1 V17.0.0 (2020-12)*

The TRP limits in Table 4 apply to transmitters at frequency offsets of greater than 25 MHz from the licence edge.

|  |  |  |
| --- | --- | --- |
| **Frequency Range** | **TRP** | **Measurement bandwidth** |
| 9 kHz ≤ f < 150 kHz | -36 dBm | 1 kHz |
| 150 kHz ≤ f < 30 MHz | -36 dBm | 10 kHz |
| 30 MHz ≤ f < 1000 MHz | -36 dBm | 100 kHz |
| 1 GHz ≤ f < 12.75 GHz | -30 dBm | 1 MHz |

**Table 4: Lower Band Limits (Total Radiated Power)**

***Source****: 3GPP TS 38.101-1 V17.0.0 (2020-12)*

Unwanted limits for radiocommunications receivers

The TRP limits in Table 5 apply to receivers at frequencies greater than 2.5 x BWoccupied from the upper or lower frequency limit of the spectrum licence. BWoccupied is the occupied bandwidth of the radiocommunications receiver operated under the spectrum licence.

**Table 5: Radiocommunications receiver unwanted emissions limits**

| **Spurious Frequency Range** | ***TRP*** | ***Measurement bandwidth*** |
| --- | --- | --- |
| 30 MHz ≤ f < 1 GHz | -57 dBm | 100 kHz |
| 1 GHz ≤ f ≤12.75 GHz | -47 dBm | 1 MHz |

***Source:*** *3GPP TS 38.104 V17.0.0 (2020-12)* ***Table 7.6.2-1***

1. ‘850 MHz expansion’ band refers to the harmonised International Mobile Telecommunications (IMT) frequencies that are frequency lower adjacent to the existing 850 MHz band and standardised by 3GPP for 3G and 4G technologies (under the band numbers 26 and 27). As its name suggests, it is a downwards expansion of the 850 MHz band. [↑](#footnote-ref-2)
2. Existing 850 MHz band frameworks were made under the name ‘800 MHz band’ [↑](#footnote-ref-3)
3. Ordinarily one month is provided for comment, however additional time has been added to accommodate the holiday period. This was further extended by one week in response to requests from the membership. However, the finalisation date cannot be commensurately pushed back by a week given the need to align with timeframes for finalising other allocation instruments. [↑](#footnote-ref-4)
4. Available at: <http://www.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.docx> [↑](#footnote-ref-5)