Bureau of Meteorology Response to the ACMA's Future use of the 3.6 GHz band Options Paper, June 2017

Background

The Bureau of Meteorology (the Bureau) as a 24/7 operational public sector agency delivering high-public-value services in support of safety, security and economic productivity, and with explicit obligations under the *Meteorology Act 1955,* has a requirement for certainty in its ongoing access to certain frequency bands for both active and passive sensing applications, most of which will remain essentially unchanged for the foreseeable future. The Bureau's spectrum needs are largely met by long-term certainty of licences in predominantly internationally harmonised bands, and protected from levels of interference that would impact the effectiveness of the systems utilising these bands.

A November 2016 study by London Economics valued the net economic benefit to Australia of the Bureau's services at $28.6 billion over the next ten years. The largest beneficiaries were the agriculture sector (39%) and the public (27%). The report noted that the net benefit to the aviation sector is actually much larger than the value included in this net figure, given that "*international aviation rules require meteorological advice for airlines to operate*" and that *"...an alternative approach would be to include all activity in the civil aviation sector as an economic benefit enabled by the Bureau.*". The report goes on to say " *This alternative approach would add $166 billion to the ten-year benefit calculation, and an additional $227 billion if flow-on benefits to the tourism sector are included.*".

Responses to Issues for Comment

Issue 8: Is the 5.6 GHz band a viable option for wireless broadband systems?

The Bureau does not support the proposed plan to allow licensed PTMP RLAN/wireless broadband to utilise the 5610-5650 MHz range of the 5600-5650 MHz radar band. This view is based on two aspects of the proposal that do not appear to have been given sufficient and detailed consideration:

1. the impact on Bureau radar receivers from unwanted emissions from RLAN equipment when a radar is constrained to operate in the proposed 10 MHz range between 5600 and 5610 MHz due to one or more incumbent PTMP licensees in the area where it is to be located, and
2. the required size of the exclusion zone around an incumbent radar to protect its receiver.

Radar Receiver Characteristics

The emission designator listed in the ACMA licence database for Bureau radars is, by definition, only relevant for the transmitter characteristics. The designator for the radar receiver is simply a copy of the transmitter designator and does not necessarily reflect the receiver bandwidth characteristics. It is therefore incorrect to assume that the receiver bandwidth is the same as that in the emission designator. In reality the image rejection filter on most Bureau C-band radars is approximately up to 20 MHz wide at the -3dB points. There is further filtering after the LNA, including at the IF level that reduces the bandwidth and acts as an anti-aliasing filter prior to digitisation, but this varies with the radar receiver model and age. The Bureau's modelling of interference from unwanted adjacent band RLAN emissions is based on a radar receiver with an

ideal filter bandwidth of 1 MHz (corresponding to a minimum pulse width of 1 microsecond) and operating with a centre frequency of 5605 MHz, but noting that the actual receiver bandwidth is wider and not ideal. This model therefore only considers the energy from RLANs coming into the receiver's middle 1 MHz, with the actual energy within the receiver's full pass band being somewhat higher.

Impact from Class-Licensed Devices in the Adjacent Band <5600 MHz

The characteristics used for the RLAN device are as follows:

EIRP density	50 mW/MHz (17 dBm/MHz) LIPD Class licence 2015
Channel width	20MHz
Bandwidth	16 MHz
Channel Centre Frequency	5580 MHz (Ch 116)
Emission Mask	ETSI 301 893 V2.0.7; Page 18, Section 4.2.4.2

The Bureau estimates that the power density into this receiver pass band from unwanted emissions from a single RLAN device operating outdoors would require approximately 40km separation to be attenuated to the minimum detectable signal level of -117 dBm over a 1 MHz BW. To achieve an I/N ratio of -6dB, a separation of approximately 80 km would be required. It should be noted that simple free space path loss was used in the calculations so there would be some increase in attenuation with a more accurate propagation model, particularly if building penetration losses (residential indoor operation) of around 14 dB for devices operating in the class licensed band below 5600 MHz are included. A more representative simulation would require a statistical analysis with a mix of differing interference scenarios and RLAN device distributions and channel occupations.

Impact from Proposed Apparatus-Licensed Devices in the Adjacent Band >5610 MHz

The characteristics used for the RLAN device are as follows:

EIRP	4000 mW (24 dBm/MHz)
Channel width	20MHz
Bandwidth	16 MHz
Channel Centre Frequency	5620 MHz (Ch 124)
Emission Mask	ETSI 301 893 V2.0.7; Page 18, Section 4.2.4.2

The proposal to allow a power increase over the LIPD licence limit to 4W EIRP in the 5610-5650 MHz range results in a power density at the radar receiver of -104 dBm/MHz at 80 km separation, 13 dB above the radars minimum detectable signal level. The free space path loss method is more applicable to the operating characteristics of access points and outstations in the proposed PTMP services as their antennas would be located outdoors and in elevated positions where possible to increase range. The antenna types employed for access points and outstations in the PTMP networks are not specified in the ACMA options paper and so are assumed to be omnidirectional with a gain of 0 dBi. The outstations would benefit from a higher gain antenna in which case the actual power radiated towards a radar by a given antenna would depend on its radiation pattern and orientation relative to the radar.

Proposed Coordination

The simplistic scenario presented in the above cases does not account for the collective unwanted emissions from a potentially large number of emitters operating in these adjacent bands within line-of-sight of a radar. Transmitter power control (TPC) may act to mitigate this from class-licensed devices < 5600 MHz band to some degree if employed, although the maximum reduction is 6 dB below the allowed mean EIRP. The main risk of interference is from the proposed PTMP networks, particularly when a radar is constrained to the 5600-5610 MHz band under the proposed coordination principles. This in turn reduces the frequency separation between the radar and the lower class-licensed band, thereby increasing the risk of interference from both adjacent bands.

The proposed 10 MHz band would not allow for the case where the Bureau may need to locate two C-Band radars with overlapping coverage areas and where there are incumbent PTMP licensees within line-of-sight of both radars, as there is not enough bandwidth to separate the radars in frequency and maximise separation from the adjacent RLAN bands.

The Bureau's basic analysis shows that the unwanted emissions from RLAN devices operating in the bands adjacent to the proposed 5600-5610 MHz range for new radars would severely degrade their operation to the point of potentially making expansion of the Bureau's C-band radar network impossible in areas where there are existing PTMP network licences.

The required exclusion zone for co-channel operation of a radar with a PTMP network would effectively need to exceed line-of-sight between the radar and the network's access point(s) and most likely some or all of its outstation sites. Similarly, where it has the need to install a new radar, the Bureau would be limited to locations that are not within line-of-sight of a licensed PTMP network. When coupled with all the other constraints of siting a radar such as optimal coverage, site leasing, land ownership, physical accessibility, and availability of mains power, this constraint would greatly reduce the probability of finding a suitable location.

Summary

The Bureau does not support allowing PTMP networks to operate in any part of the 5600-5650 MHz band. Doing so would impose undue constraints on its current and future C-Band radar network. This band should remain for the exclusive use of meteorological radars Australia-wide.

The Bureau's preliminary study indicates that the ACMA's proposal to restrict new radars on a first-come-first-served basis to the 5600-5610 MHz band would subject radar receivers to harmful interference from unwanted emissions from both consumer class-licensed RLAN equipment below 5600 MHz and from the proposed licensed RLAN equipment operating above 5610 MHz. The proposal to allow an increase to 4W EIRP for the latter would further increase interference levels into radar receivers. The cumulative unwanted emissions from both sources would effectively prevent the Bureau from installing new or relocating existing C-band radars as required, within line-of-sight of areas where licences have been granted to PTMP operators.

One of the primary criteria for assessing potential sites to locate a radar is to optimise its coverage of the surrounding area by minimising blockage of the beam by terrain, buildings and other objects within line-of-sight that may reduce the effectiveness of the radar. Consequently, optimal sites tend to be on the highest terrain, which of course means that the radar's receiver is exposed to interference from any sources within this coverage area. Similarly, point-to-multi-point services will tend to locate access points at the highest possible locations in order to

maximise service coverage, coupled with elevated outstation antennas. This common aim in siting both radars and PTMP antennas acts to increase the probability of interference into radars.

Issue 9: Under what circumstances should apparatus- and class-licensed arrangements be considered for the 5.6 GHz band?

As it has communicated to the ACMA previously, the Bureau does not support allowing class-licensed devices to operate in any part of the 5600-5650 MHz band. Sharing of this band between radars and unlicensed RLAN equipment in Europe has clearly demonstrated the failure of DFS to protect meteorological radars from high levels of interference. The very nature of the class-license means that devices that do not conform to regulations and are causing interference are virtually impossible to locate and shutdown.

Issue 10: If apparatus licensing arrangements are developed for wireless broadband systems in the 5.6 GHz band, are the notional arrangements proposed in Appendix 3 suitable?

As outlined earlier in this document, the Bureau is of the view that the notional arrangements proposed in Appendix 3 are not suitable and will severely constrain necessary expansion and/or reconfiguration of the its C-band radar network. These arrangements would subject any new radars to harmful interference from RLAN devices operating in both bands adjacent to the 5600-5610 MHz range.