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CSIRO submission to consultation on 2 GHz MSS technical parameters and demand considerations

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Background

CSIRO welcomes this opportunity to comment on the Australian Communications and Media Authority (ACMA)'s consultation paper relating to the preliminary technical design and allocation considerations for the proposed deployment of a terrestrial-based Complementary Ground Component (CGC) in MSS-allocated bands at 2 GHz in support of the satellite components IMT-2020.

CSIRO is responsible for the management and operation of the Canberra Deep Space Communication Complex (CDSCC) and other NASA facilities in Australia under a government-to-government treaty between Australia and the USA as well as a Cooperating Agency Agreement between CSIRO and NASA. CSIRO is also responsible to manage the operations of the European Space Agency (ESA) space research activities in Australia, including the operation of the Space Research Services (SRS) earth station at New Norcia in W.A. under the provisions of a long-standing Treaty between the Australian government and ESA. CDSCC and New Norcia are both integral and vital parts of the respective global networks represented as NASA's Deep Space Network (DSN) and ESA's tracking network (ESTRACK), respectively. Each provide ongoing and invaluable contributions to international space exploration. They both comprise substantial earth station assets developed over 50 years of cooperation including very large antennas at the NASA CDSCC facility and ESA New Norcia facility, enabling tracking of dozens of international Near-Earth and Deep-Space missions representing spacecraft assets in excess of \$35 Billion dollars. Additionally, both NASA and ESA continue to invest substantial sums of money in expansion and upgrade projects to maintain a world leading space research and exploration capability in Australia. The capability for these stations to continue their space research work, under local management by CSIRO, is critically dependent on the ongoing interference-free access to the requisite radiocommunications frequency spectrum, as has been the case for over 50 years.

Furthermore, CSIRO builds and operates national facilities for radio astronomy, which is recognised, for the purposes of spectrum management, as a radiocommunication service by the ITU and the Radiocommunications Act 1992. CSIRO is a key contributor to the construction of the 1 Billion Euro Square Kilometre Array telescope, with the low frequency component built on Inyarrimanha Ilgari Bundara, our Murchison Radio Astronomy Observatory (MRO) managed by CSIRO.

These facilities represent substantial national and international investment and involve international commitments to controlling interference by spectrum management. Research in support of technology for these services has led to new technologies such as WiFi and improved antenna designs for the wider radiocommunications industry.

CSIRO also uses radio equipment, under apparatus or class licences, for research measurements such as meteorological radar, and for day-to-day operation of facilities including safety of staff.

We therefore have an interest not only in protecting our existing facilities, but in facilitating the introduction of technologies which are more efficient in their use of spectrum. We appreciate the

need to manage spectrum efficiently, as well as the challenge in finding the right balance between flexibility and certainty for incumbents.

Introduction

CSIRO appreciates the opportunity to review and comment on the ACMA’s discussion document titled “**Technical design features and allocation considerations for the 2 GHz MSS band**

(1980–2005 and 2170–2195 MHz)” noting that this document is a precursor to a future technical framework formal consultation addressing the matter of licensing and deploying the terrestrial-based Complementary Ground Component (CGC) in MSS-allocated bands at 2 GHz in support of the satellite components of a broader IMT-2020. The stated purpose of this discussion paper is to (additional to the comments from proposed licensed CGC operators) address coexistence arrangements with other spectrum users in 2 GHz and adjacent bands. CSIRO is therefore pleased to contribute comments from the perspective of long-term licensed users in (and adjacent to) the 2 GHz band to ensure current and planned science-based operations are not compromised and the technical framework criteria is adequate to assure this outcome from the review planned for Q3 2024.

Comments submitted below address the views of CSIRO operators/users at 2 GHz from the perspective of requisite protection of the Space Research Service operations and plans and the protection of the Radio Astronomy operations and plans. Both are very long-term endeavours and require extraordinary levels of interference protection critical for their ongoing operations and fulfillment of their multi-billion-dollar investment endeavours in scientific research and exploration.

CSIRO response to the Questions

CSIRO notes that the vast majority of the consultation questions are directed to prospective implementers and operators of the CGC terrestrial components supporting the IMT-2020 systems, addressing a broad range of MSS related technical criteria, coordination requirements and regulatory considerations. Accordingly, CSIRO is pleased to submit the following observations, comments and concerns related specifically to the ongoing protection of existing science services systems.

1.1 Space Research Service

In addressing the “Coordination requirements: 2 GHz MSS with other services (questions 7 and 8). CSIRO is primarily interested in protection of the near-Earth SRS earth station receivers at CDSCC operating and licensed in the 2200-2290 MHz band from unwanted/OOB emissions and also ESA’s ongoing operations within the 2 GHz band at New Norcia from MSS in 2170-2195 MHz (referred to as “2 GHz MSS”).

Additionally, the close proximity of the shared narrowband MSS for low data rate services (such as IoT) at 2195 – 2200 MHz will likely need to be addressed in due course, but appears out-of-scope of this paper.

CSIRO appreciates recognition of the need to coordinate with the space research Earth stations at CDSCC (Tidbinbilla, ACT) and New Norcia, W.A. as immutable national Treaty obligations with the USA and European Space Agency. The coordination principles summarised under clause 3.5.1 are important, especially for “CGC base station transmitters in 2170–2195 MHz to protect current and future earth stations at Mingenew earth station protection zone, New Norcia and Tidbinbilla”.

In addressing questions 7 and 8, related to coordination requirements, the statement that “ECC Recommendation (10)01¹ sets out an approach for coordination of CGC base station transmitters operating in 2170–2200 MHz with adjacent band earth station receiver.” is noted.

The ACMA-proposed use of ECC Recommendation (10)01 could be considered, noting that this is less stringent than the standard ITU-R protection criteria and may be acceptable. The relevant SRS earth station protection criterion is given in ITU-R Rec. SA.609 (-216 dBW/Hz for $p=0.1\%$ for unmanned missions and $p=0.001\%$ for manned missions). In addition, ITU-R Rec. SA.1743 also specifies a 1% apportionment of the allowable degradation due to unwanted emissions from adjacent band services. It will be important to take both SA.609 and SA.1743 into account when considering the appropriate earth station protection level. The ACMA document proposes to use the methodology in ECC Recommendation (10)01 as the trigger for coordination. The ECC Recommendation is calculated based on the protection criterion SA.609 and applies a 10% apportionment to the unwanted emissions. While the apportionment is less stringent than SA.1743, the ECC Rec. has been used successfully in Europe since 2010.

As an addendum to questions 7 and 8, question 2 (directed to MSS operators) seeks views on the inclusion of active antenna systems (AAS) in the technical framework for 2 GHz MSS. It would be helpful for ACMA to clarify that in the event AAS is implemented, this consequently stipulates that worst case directional gain be strictly applied during coordination studies addressing coordination with the SRS Earth stations at CDSCC and New Norcia.

Concerning the SRS uplink band, the statement that “no protection afforded from existing and future earth station transmitters to be provided to 2 GHz MSS receivers noting the 20 MHz frequency separation (between 2005 MHz and 2025 MHz)” is important.

1.2 Radio Astronomy (RAS)

CSIRO operates and hosts multiple radio astronomy facilities in Australia, including within the Australian Radio Quiet Zone Western Australia (ARQZWA). Each of the telescope facilities is protected from terrestrial interference by coordination zones as described in RALI MS 31 and RALI MS 32.

¹ Guidelines for compatibility between complementary ground components (CGC) operating in the band 2170–2200 MHz and EESS/SOS/SRS earth stations operating in the band 2200–2290 MHz, January 2010.

The Australian radio astronomy community has made major investments to build radio astronomy facilities as far away from civilisation as possible, to avoid man-made radio signals and to prevent radio frequency interference (RFI) to observations of the universe made with these radio astronomical receivers. These receivers are many orders of magnitude more sensitive than commercial off the shelf (COTS) receiver equipment used in e.g. mobile phones and other small, connected devices.

The (already allocated) MSS bands under consideration are 1980 – 2005 MHz for earth to space (E-S) communication, and 2170 – 2200 MHz for space to earth links (S-E).

At the present time, and without knowing detailed characteristics of the transmitting systems, CSIRO can provide the following RAS impact assessment for consideration:

Reiterating the interference limits from RALI MS 31 and RALI MS 32:

- Within the ARQZWA and from 1000 – 2300 MHz, Table 1 from RALI MS 32 stipulates that the received power spectral density threshold should not exceed -230 dBm/Hz.
- For all other facilities listed in RALI MS 31, notification zones of up to 180km (for terrestrial transmitters) are listed for 2200 – 2550 MHz. A detailed assessment with known transmitter characteristics for airborne transmitters will be required to assess the impact on RAS for these sites at the proposed frequencies.

Further to this, consideration of spurious and unwanted emission (RR 1.145 and 1.146) will form an important part of ACMA's assessment of the impact of these MSS allocations on RAS sites in Australia. Because airborne and space-based transmitters above the local horizon at any RAS station are in direct line of sight to the telescope receivers, with many emitting stations potentially visible simultaneously, spurious and unwanted emissions are far more likely to be detected at harmful interference levels in RAS observations than from terrestrial transmitters. Specifically, the impact of MSS systems to be used in these frequency bands should be studied against the criteria detailed in Recommendations ITU-R RA.1513, ITU-R M.1583, and ITU-R RA.1631.

No impact on specific RAS allocations, to include allocations by footnote 5.149, and frequency bands with footnote 5.208B, requiring administration's special consideration as per Resolution 739, is present.

Having noted that, impacts of each of the frequency bands under consideration on Australian RAS resources remain and are listed in Appendix 1.

While neither RALI MS 31 or RALI MS 32 in theory are applicable to space based or airborne itinerant transmissions, the unprecedented proliferation of transmissions originating from airborne, low, medium, and geosynchronous earth orbits (LEO, MEO, and GSO) at frequencies formerly used for terrestrial services only, CSIRO considers it appropriate to reflect on these allocations' impact on RAS when used from space based or airborne platforms prior to authorising these new services.

CSIRO appreciates ACMA's efforts in seeking input to the planned service deployments and their proposal for coordination to help protect RAS facilities in Australia.

Conclusion

CSIRO values the opportunity to provide input to the consultation process and the development of the technical framework and any subsequent considerations within a technical liaison group that may be formed to progress this matter to a legislative instrument. We thank the ACMA and look forward to continued opportunities for consultation and feedback as this matter progresses.

APPENDIX 1

Using the frequency band 1980 – 2010 MHz (E-S) for airborne MSS use would have the following impact on RAS resources in Australia:

Impact on RALIs:

- RALI MS 31 (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps RALI band 4350.0 - 6700.0 MHz
- RALI MS 32 (Fundamental): 1980.0 - 2010.0 MHz overlaps RALI band 70.0 - 25250.0 MHz
- RALI MS 32 (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps RALI band 70.0 - 25250.0 MHz
- RALI MS 32 (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps RALI band 70.0 - 25250.0 MHz

The following facilities are equipped with RAS receivers that would be affected by MSS operations in the band 1980 – 2010 MHz (E-S):

- Parkes (UWB) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 704.0 - 4032.0 MHz
- Parkes (UWB) (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps facility operating in band 704.0 - 4032.0 MHz
- Parkes (Methanol) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 5900.0 - 7000.0 MHz
- ATCA (L-band) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 1100.0 - 3100.0 MHz
- ATCA (S/X-band) (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps facility operating in band 3900.0 - 12000.0 MHz
- ATCA (S/X-band) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 3900.0 - 12000.0 MHz
- Mopra (L-band) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 1300.0 - 3000.0 MHz
- Mopra (S-band) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 4500.0 - 6700.0 MHz
- Hobart (L-band) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 1100.0 - 3100.0 MHz
- Hobart (AuScope/VGOS) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Hobart (AuScope/VGOS) (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Hobart (AuScope/VGOS) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz

- Katherine (AuScope/VGOS) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Katherine (AuScope/VGOS) (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Katherine (AuScope/VGOS) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (Fundamental): 1980.0 - 2010.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (2nd Harmonic): 3960.0 - 4020.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (3rd Harmonic): 5940.0 - 6030.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz

The following impacts are noted when using the frequency band from 2170 – 2200 MHz (S-E):

Impact on RALIs:

- RALI MS 31 (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps RALI band 2200.0 - 2550.0 MHz
- RALI MS 31 (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps RALI band 4350.0 - 6700.0 MHz
- RALI MS 31 (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps RALI band 4350.0 - 6700.0 MHz
- RALI MS 32 (Fundamental): 2170.0 - 2200.0 MHz overlaps RALI band 70.0 - 25250.0 MHz
- RALI MS 32 (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps RALI band 70.0 - 25250.0 MHz
- RALI MS 32 (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps RALI band 70.0 - 25250.0 MHz

The following facilities are equipped with RAS receivers that would be affected by MSS operations in the band 2170 – 2200 MHz (E-S):

- Parkes (UWB) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 704.0 - 4032.0 MHz
- Parkes (Methanol) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 5900.0 - 7000.0 MHz
- ATCA (L-band) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 1100.0 - 3100.0 MHz
- ATCA (S/X-band) (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps facility operating in band 3900.0 - 12000.0 MHz
- ATCA (S/X-band) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 3900.0 - 12000.0 MHz
- Mopra (L-band) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 1300.0 - 3000.0 MHz

- Mopra (S-band) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 4500.0 - 6700.0 MHz
- Hobart (L-band) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 1100.0 - 3100.0 MHz
- Hobart (S-band) (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps facility operating in band 2200.0 - 2600.0 MHz
- Hobart (AuScope/VGOS) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Hobart (AuScope/VGOS) (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Hobart (AuScope/VGOS) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Katherine (AuScope/VGOS) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Katherine (AuScope/VGOS) (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Katherine (AuScope/VGOS) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (Fundamental): 2170.0 - 2200.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (2nd Harmonic): 4340.0 - 4400.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Yarragadee (AuScope/VGOS) (3rd Harmonic): 6510.0 - 6600.0 MHz overlaps facility operating in band 2000.0 - 14000.0 MHz
- Ceduna (S-band) (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps facility operating in band 2200.0 - 2600.0 MHz
- Tidbinbilla DSS-43 (70m) (S-band) (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps facility operating in band 2200.0 - 2300.0 MHz
- Tidbinbilla DSS-34 (34m) (S-band) (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps facility operating in band 2200.0 - 2300.0 MHz
- Tidbinbilla DSS-36 (34m) (S-band) (Directly adjacent below): 2170.0 - 2200.0 MHz overlaps facility operating in band 2200.0 - 2300.0 MHz

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