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Ensuring the Future of Australian Satellite Services

A Communications Alliance Satellite Services Working Group Paper

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Purpose of this paper

This paper is submitted by the Satellite Services Working Group of Communications Alliance (SSWG) to stimulate debate between this group and the Australian Communications and Media Authority (ACMA), the Department of Communications and the Arts (DoCA) and other stakeholders on the future of satellite services and the advent of growing demand for spectrum for 5G services from carriers, vendors and users within many industry verticals.

Australia's commercial space operations account for approximately 75% of the nation's space market – worth almost $4 billion in 2015-16 - according to estimates published by the Federal Government's recent review of Australia's Space Industry Capability

This paper examines the approaches being taken in the International Telecommunication Union (ITU) and some regulatory regimes around the world to enable terrestrial mobile services and satellite services to share the spectrum in specified frequency bands where this is technically feasible.

The paper does not necessarily represent the views of the full membership of Communications Alliance, including those of Telstra as a member of the SSWG.

Executive Summary

Bands allocated to the Fixed Satellite Service (FSS) in the International Telecommunication Union (ITU) Table of Frequency Allocations are coming under pressure from the increasing demands of the terrestrial International Mobile Telecommunications (IMT) lobby, primarily for 5G services.

FSS and IMT may be able to coexist (share) in the same frequency band. However, the ability to share is often reduced through simplistic 'single service' spectrum licensing when the band is 're-farmed' (an ACMA term) for Mobile Services. The ACMA should give greater consideration to the potential for shared use where feasible, as spectrum becomes an increasingly scarce commodity that is sought after by various services and applications.

In some circumstances, such as High Density Fixed Satellite Services (HDFSS), sharing is not possible as the location or future locations of FSS terminals is not known. HDFSS is important for the provision of ubiquitous services via satellite. For example, nbn provides high speed broadband services to areas that are not being adequately or economically served by other means. In this case, protected 'core' satellite-only bands are needed which should not be shared with IMT.

Other services, such as the Mobile Satellite Service (MSS) in 2 GHz and 3.6 GHz (uplinks for the L-band MSS service – such as the one for flight tracking) have been affected by 'broad brush' licensing from the ACMA. There are currently a number of MSS systems and space operation facilities that are unable to effectively operate in Australia due to harsh or unnecessary licensing restrictions.

This paper explores these issues and offers options for both spectrum licensing and class licensing. This licensing framework will help Australia's satellite services industry flourish – without causing detriment to other service classes. We also discuss current and future spectrum planning activities both domestically and within the ITU.

The future of satellite

Emerging 5G systems offer new horizons in connectivity to those lucky enough to live in an area where these systems will be deployed. In contrast, modern and emerging satellite systems are able to offer these services, including 5G complementary services, to people living in regional and remote areas. Satellite will also provide such services to those travelling by ship, aeroplane or train where otherwise there would be sporadic or even no connectivity. These services are vital for people who do not live and work in large Australian cities - enabling connectivity to the travelling public and a resultant boost to the economy through increased productivity and/or content sales. In addition to service provision, Earth Stations in Motion (ESIM) will improve the safety and reliability of our mobile platforms by enabling real time system diagnostics, crew communication, communications in flight, and fishing fleet support.

While regulators around the world appear to be highly-focused on terrestrial 5G roll-out, satellite systems continue to evolve and provide increasingly modern innovative services with attractive pricing and bandwidth to people regardless of where they live or where they are going. To continue to be able to viably provide these services the satellite community needs regulators, including the ACMA, to focus some attention away from the desires of the terrestrial mobile providers and onto the existing and future needs of the satellite services community.

VSAT HTS (and HDFSS)

Geo-Stationary Orbit (GSO) FSS Ka-band Satellite Networks

During the past decade many satellite operators have launched High Throughput Satellites (HTS) operating in the Ka-band (20/30 GHz) and/or the Ku-band (11/14 GHz). The main application for these satellites is fast Internet connectivity such as provided by **nbn**'s 'SkyMuster' satellites, Thaicom's IPStar and other FSS operators. Many more such satellites have been ordered and will launch in 2018 and following years. The satellite antennas of these HTSs are characterized by many small beams (up to about 200) with high gain which allows for links to relatively small user terminals. These satellite antennas also allow for multiple frequency re-use resulting in a throughput in the range of 100s of Gigabits per second (Gbit/s). The earth station antennas are typically quite highly directional and co-frequency, co-coverage coordination may be possible with a GSO spacing as little as 2 degrees. Another emerging area of satellite Ka-band services is an expansion of mobility on harsh land environments, and maritime and aeronautical capability, which are not reached or not reachable by terrestrial cellular IMT networks.

Overview of ITU Frequency Allocation for Ka-bands.

For frequency allocation and other regulatory purposes, the ITU divides the world into three radio Regions:

Region 1: Europe, Middle East, Russia and Africa

Region 2: The Americas

Region 3: Asia, Australia and Oceania

The Table of Frequency Allocations contained in Article 5 of the Radio Regulations (RR) allocates frequency bands in each of the three ITU Regions to radiocommunication services based on various service categories as defined in the RR. Many allocations have footnotes that specify operating constraints either technical or operational and these usually indicate national intentions.

Terrestrial and satellite services may not share well in the same area, especially in lower frequency bands. However, in Ka-bands and further above in the millimetre wavelengths, sharing may be possible with a small geographic separation, although exclusion zones of hundreds of kilometres would be necessary for the protection of high-gain satellite uplinks. Almost all the Ka-band that is allocated to satellite services is also allocated to the terrestrial Fixed Service (FS) and the Mobile Service (MS), and a number of countries have licensed or are planning to license IMT services in the Ka-band. The ITU-R Task Group TG 5/1 is currently investigating which bands are suitable for IMT services according to those chosen by WRC-15 for study (Resolution 238 (WRC-15)) and the sharing criteria necessary to protect other services. Within the Ka-band, the band 24.25 to 27.5 GHz, which overlaps with 500 MHz of FSS spectrum used extensively in Australia, was chosen for such compatibility studies. Other parts of the Ka-band are not being studied in recognition of the existing satellite use of the band.

Ka-band Frequencies for HTS

Many HTS typically file for 2.5 GHz of spectrum in the following portion of the Ka-band:

27.5 to 30 GHz uplink

17.7 to 20.2 GHz downlink

In some Administrations, the frequency pairing of 20.2 to 21.2 GHz and 30 to 31 GHz is also used. In Australia these are currently allocated to Defence and are apparently lightly used, if at all.

As these bands will become congested, many next generation HTS are being planned in higher bands such as the 40/50 GHz bands.

GSO and non-GSO Satellite Networks

Historically, the great majority of commercial communications satellite networks are GSO networks, which have the advantage of requiring fewer satellites for global coverage (as few as 3) and relatively simple ground equipment. More recently, a number of new HTS non-GSO satellite networks have been launched (e.g. O3b) and/or announced (e.g. OneWeb, SpaceX, LEOSat, etc.) with the avowed intention of connecting the unconnected using a variety of frequency bands. Whereas previous attempts at launching non-GSO networks faced large initial capital costs and nascent broadband demand, the new non-GSO networks are more scalable and are expected to provide high quality, low latency services to a world that now craves always-on broadband. Both GSO and non-GSO networks will play an important and complementary role in bringing affordable broadband to all, either directly or by extending terrestrial fixed and mobile networks to unserved and underserved areas.

Bands identified and bands used for High-Density FSS

RR No. **5.516B** gives the bands identified for high-density fixed-satellite service (HDFSS). These bands allow for the deployment of uncoordinated FSS earth stations under a blanket licence. The only bands that include all Regions are:

29.5 to 30 GHz (uplink) (500 MHz)

19.7 to 20.2 GHz (downlink) (500 MHz)

On the downlink the following Regional identifications for HDFSS are made in RR No. **5.516B**:

17.3 to17.7 GHz (space-to-Earth) in Region 1

18.3 to 19.3 GHz (space-to-Earth) in Region 2

It should be noted that these identifications do not preclude the use of other bands for HDFSS, and that, in Australia, the 17.7 to 18.2 GHz, 18.8 to 19.3 GHz, 19.7 to 20.2 GHz (space-to-Earth) and 28.5 to 29.1 GHz (Earth-to-space) are used for HDFSS by **nbn**'s SkyMuster service.

In Regions 1 and 3 the use of the band 17.3 to 18.1 GHz by geostationary-satellite systems in the fixed-satellite service (Earth-to-space) is limited to feeder links (i.e. Earth-to-space) for the broadcasting-satellite service (RR No. **5.516**). However, in Region 1 the band 17.3 to 17.7 GHz (400 MHz) may also be used for FSS downlink, provided that it does not claim protection from the broadcasting-satellite service feeder-link earth stations nor shall it put any limitations or restrictions on the locations of the broadcasting-satellite service feeder-link earth stations anywhere within the service area of the feeder link (see RR No. **5.516A**). This is not a serious restriction since there is a very limited number of BSS feeder link stations.

VHTS satellite requirements

Current HTS systems – both GSO and non-GSO – use a variety of frequency bands within the C-, Ku- and Ka-bands to meet the growing demand for bandwidth. In addition, several next-generation Very High Throughput Satellite (VHTS) systems have been announced that will require more spectrum to meet anticipated growth in demand for broadband.

The expected increase in demand for broadband, coming from the advent of 5G and consumers who cannot be served by any technology other than satellite, will require the use of additional spectrum in higher frequency bands. Specifically, next-generation VHTS systems being planned or constructed include the use of the higher Q/V bands in 37.5 to 42.5 GHz (space-to-Earth), 47.2 to 50.2 GHz (Earth-to-space), and 50.4 to 51.4 GHz (Earth-to-space)1, to support or complement the 2 x 2.5 GHz of Ka-Band now in use by VSAT segments. This growing bandwidth demand indicates the necessity for an accommodative regulatory environment for ubiquitous VSAT deployment in the 27.5 to 30 GHz (Earth-to-space) and 17.7 to 20.2 GHz (space-to-Earth) bands. Existing arrangements, expressed in the *Radiocommunications (Communication with a space object) Class Licence*, allow for use of about half of these bands for ubiquitous VSAT deployment. This is sufficient for the current HTS satellites but will not suffice for the coming generation of VHTS satellite technology and of connectivity demands.

EARTH STATIONS IN MOTION (ESIM), Global Continuous Broadband Connectivity

Satellites have long provided communications on the move, such as to ships and aircraft. From basic safety-of-life and commercial services in the L- and S-band frequencies to broadband services using the C-, Ku- and Ka-band, satellites ensure that people remain connected even when they travel beyond the reach of terrestrial networks.

For example, when ships are in the open sea and aircraft overfly the oceans, they are beyond the reach of any terrestrial network. For aircraft overflying land, there are some air-to-ground-based networks currently in operation or planned in some regions, including Europe, but some areas can expect to remain without terrestrial networks to serve aircraft whilst ESIM systems can provide continuous broadband connectivity.

Satellite solutions have been and are being deployed by multiple satellite operators to serve all segments of the aeronautical and maritime markets, which have differing bandwidth requirements. Airline passengers increasingly expect to connect to inflight Wi-Fi, communicate, and catch up on email and social media channels (see Table 1). As 'inflight Wi-Fi' connectivity becomes the norm, especially for business travellers, the ability to operate such systems 'gate-to-gate' will become vital.

[1] WRC-19 Agenda item 9.1.9 is studying the feasibility of an additional allocation to the FSS in the immediately adjacent 51.4 to 52.4 GHz, limited to the gateway segment of GSO satellite networks

TABLE 1

Expected annual growth of connected aircraft

Region	Connected aircraft in 2015	Connected aircraft in 2025	Annual growth (%)
North America	3 940	7 710	6.9
Latin America	44	1 529	42.6
Europe	455	5 465	28.2
Middle East	491	2 131	15.8
Asia & Oceania	356	6 256	33.2

A similar requirement exists for passenger ships, the largest of which can accommodate several thousands of passengers. Satellites deliver scalable broadband bandwidth to maritime platforms, including off-shore energy platforms and cruise ships, ranging from the 10's or 100's of Mbit/s to 1.5 Gbit/s for large cruise ships with bandwidth requirements that can rival those of a small township. Advances in ground antenna technologies are also enabling high-speed services to be delivered to ever smaller vessels, including fishing boats and ferries. Ships also require broadband communication for managing the ship's operations, such as transmitting engine diagnostics and accessing the company's corporate network, and for crew communications to keep in touch whilst at sea for weeks on end. Growth in maritime connectivity similarly tracks the new and better options for connected aircraft. The number of maritime vessels in connected service grew by almost 25% between 2012 and 2013. In 2014 more than 20,000 vessels were satellite connected and this number is expected to increase to around 50,000 vessels over the next few years.

Land vehicles which may use ESIM include trains, coaches and motor homes. Most vehicles have connectivity requirements that can be met satisfactorily by terrestrial networks but some, particularly those which travel in countries which currently have significant areas without coverage by terrestrial networks, rely on satellite systems to provide or supplement the connectivity. Current broadband communication requirements are driven primarily by the need for communications with the satellite link providing the backhaul between the vehicle and terrestrial network.
In addition to the above, there are ESIM applications for government users and aid organisations (e.g. for disaster recovery) which have additional broadband communication needs for land vehicles, ships and aircraft.

For some ESIM users, especially those on-board ships and aircraft, the required geographic coverage may virtually be the entire Earth, since ships operate on almost any sea and aircraft operate over almost any location over land and sea. This leads to a requirement for ESIM systems to provide continuous, harmonised and consistent service with very wide or global geographic coverage. For example, the continuous availability of satellite-delivered broadband on ships while in international and territorial waters and in port is fast becoming a competitive advantage for countries seeking to attract more cruise ship visits.

As '5th Generation' mobile systems are seeking to provide much higher terrestrial network data bandwidths to users in the future – up to 1 Gbit/s – the connectivity requirement for some individual passengers could be expected to track higher in sympathy in the future, leading to the need for higher capacity satellite backhaul. The growing demand for broadband satellite communications to mobile platforms has led several satellite operators to develop systems to address the need. There are some services provided in C-band (Earth Stations on board Vessels, ESVs) and Ku-band (ESVs and Aeronautical Mobile Satellite Service, AMSS - relating to safety and regularity of flights), but the Ka-band frequencies have been identified for the provision of ESIM services and some of the Ka-band frequencies are also the subject of WRC-19 agenda item 1.5 (in the bands 17.7 to 19.7 GHz and 27.5 to 29.5 GHz). There are several factors which have led to the Ka-band frequencies being a primary focus for new systems:

- New Ka-band systems are capable of providing high capacity per satellite ('High Throughput Satellite' (HTS) systems). HTS systems typically use multiple small spot beams to allow the efficient re-use of frequencies many times on the same satellite;
- The large bandwidths available in Ka-band for service links allow for the larger bandwidths to be available to individual terminals; and
- The GSO orbital arc in Ka-band is relatively uncongested compared with the C-band and Ku-bands, giving greater scope to deploy new satellites with the required geographic coverage.

Flexible access to spectrum

From WRC-15, the frequency bands 19.7 to 20.2 GHz and 29.5 to 30 GHz are expected to be available to ESIM operating in accordance with Resolution **156 (WRC-15)**. These bands are shared with terrestrial services in a limited number of countries (see RR No. **5.524** and RR No. **5.542**) and therefore may accommodate ESIM operations with relatively unfettered technical and operational constraints. The frequency bands within the scope of WRC-19 Agenda Item 1.5 (17.7 to 19.7 GHz and 27.5 to 29.5 GHz) are allocated to a number of different services and parts of these bands are used by non-GSO FSS satellite systems, including feeder links for non-GSO MSS systems. The necessary sharing constraints are more complex than in the bands 19.7 to 20.2 GHz and 29.5 to 30.0 GHz and consequently the use of ESIM in some parts of the bands 17.7 to 19.7 GHz and 27.5 to 29.5 GHz may not be feasible in some geographic locations due to use by other services where the current use and future availability needs to be protected.

To ensure continuity of service and meet user requirements, ESIM operators deem it critical to have the flexibility to operate within the bands 17.7 to 19.7 GHz and 27.5 to 29.5 GHz, so that they can seamlessly access the spectrum they need to provide the intended service.

Like conventional FSS, ESIM have highly directional antennas and are able to share with other services. However, in and around airports these challenges become greater as ESIM and other services may operate in close proximity. Taking into account other demands for the 28 GHz band, the SSWG believes the ACMA should maintain its current stance and reserve this band for coordinated BWA and FSS and in both 26GHz and 28 GHz the ACMA should examine licensing methods whereby FSS can operate alongside these other services without having to negotiate with third parties. The SSWG can assist the ACMA to determine the technical requirements for sharing between FWA and ESIM and to develop a new technical framework that facilitates sharing and could serve as a benchmark for future bands.

MSS S-band satellite spectrum planning

The 1980 to 2010 MHz and 2170 to 2200 MHz bands are allocated by the ITU on a global primary basis for mobile-satellite services, as well as for fixed and mobile services. With a growing number of mobile-satellite systems registered at the ITU (currently over 400, including both geostationary and non-geostationary systems), in the 1980 to 2010 MHz and 2170 to 2200 MHz band, countries are clearly planning to implement satellite services in this band.

However, ACMA Embargo 23 seems to prevent the use of this band for any purpose but 'television outside broadcasting services' (TOB), and specifically prohibits Australia-wide Ancillary Terrestrial Component (ATC) and Complementary Ground Component (CGC) as part of an MSS system, even though The Television Outside Broadcast Service (1980 to 2110 and 2170 to 2300 MHz) Frequency Band Plan 2012 ('TOB Band Plan') specifically states that both the 1980 to 2010 MHz and the 2170 to 2200 MHz bands may be used for mobile-satellite services.

According to ACMA RALI FX 21, after 31 January 2016, 'the bands 1980 to 2010 MHz and 2170 to 2200 MHz will be available for use for TOB services on a shared, non-exclusive basis. TOB licensees will be required to self-coordinate use.' Now is the time for the ACMA to consider long-term use of this band, as the use of TOB is not consistent with international trends and is inconsistent with global spectrum allocations.

Therefore, we encourage the ACMA to take regulatory action now to enable the use of this band by both MSS and ATC/CGC.

In addition to authorizing MSS, the trend in regulation in North America and Europe is to allow both MSS and ATC/CGC to operate in the S-band, which is entirely consistent with the ITU allocations. Licences for hybrid systems using both MSS and ATC/CGC using the S-band have already been granted in Europe, Canada and the United States.

The European Commission Decision of 14 February 2007 on the harmonized use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile-satellite services ('Decision 2007/98/EC') required Member States to designate and make available, by 1 July 2007, the frequency bands 1980 to 2010 MHz and 2170 to 2200 MHz for systems providing MSS. Subsequently, Decision No. 626/2008/EC of the European Parliament and of the Council of 30 June 2008 on the selection and authorization of systems providing mobile-satellite services (MSS) ('the EU Decision') specifies that any complementary ground-based station constitutes an integral part of the mobile-satellite system and should be controlled by the satellite resource and network management system.

Most of the European Union countries have already issued specific licenses for the operation of integrated mobile satellite system composed of MSS and CGC components. Specifically, Germany, France, and The United Kingdom have issued their corresponding specific authorizations for the CGC network, in addition to the previous licenses issued for the MSS component. In these cases, the regulatory authorities conclude on the suitability of use of the S band spectrum for applications associated to provision of in-flight connectivity. Some countries in Europe (such as Ireland) are now finalizing their public consultation processes on adding the aeronautical component to its previously issued Inmarsat MSS/CGC licences, Canada, in its 2014 Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000 to 2020 MHz and 2180 to 2200 MHz, permitted ATC systems offered as an integral part of the MSS. Canada followed the United States as the Federal Communications Commission has integrated MSS/ATC services into its regulatory framework for the past 15 years.

The ITU has developed Recommendation M.2047 that identifies the satellite radio interface technologies of International Mobile Telecommunications-Advanced (IMT-Advanced) and provides the radio interface specifications that detail the features and parameters of the satellite component of IMT Advanced, including the complementary ground component (CGC). While the Recommendation mainly refers to geostationary satellite systems, it also can be applied to MEO hybrid systems. In addition, in Asia, the APT Wireless Group has studied different kinds of integrated MSS systems, as well as system architecture and performance aspects of integrated MSS below the 3 GHz band that include CGC.

Resolution 212 (Rev.WRC-15), Implementation of International Mobile Telecommunications in the frequency bands 1885 to 2025 MHz and 2110 to 2200 MHz, defines the scope of Agenda item 9.1.1 for the 2019 World Radiocommunication Conference (WRC-19) and invites ITU-R 'to study possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT (in the mobile service) and the satellite component of IMT (in the mobile service and the mobile-satellite service) in the frequency bands 1980 to 2010 MHz and 2170 to 2200 MHz where those frequency bands are shared by mobile service and the mobile-satellite service in different countries.' The Australian preliminary view on Agenda Item 9.1.1 is that 'Australia supports ITU-R studies regarding possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT (in the mobile service) and the satellite component of IMT (in the mobile service and the mobile-satellite service) in the frequency bands 1980 to 2010 MHz and 2170 to 2200 MHz. Australia supports no change to the Radio Regulations but encourages the development of appropriate ITU-R Recommendations/Reports to address this issue.' This preliminary view is not incompatible with the implementation of hybrid MSS and ATC/CGC systems because hybrid systems are consistent with the existing Radio Regulations. Given the extensive amount of work on sharing and co-existence with other services that CEPT and its European Communications Commission (EEC) have done, we believe that work conducted under WRC-19 agenda item 9.1.1 will provide little additional information to inform decisions on sharing between the satellite and terrestrial component of IMT within Australia.

Page 71 of the ACMA Five Year Spectrum Outlook identifies bands that are in the initial investigation stage of the process for consideration of additional spectrum for mobile broadband services, including the 2 GHz band. Co-frequency, co-coverage deployment of separate and independent satellite and terrestrial IMT components in the same geographical area is not feasible. Deployment of only mobile broadband systems in the 1980 to 2010 MHz and 2170 to 2200 MHz band would be of significant concern as it would preclude the use of the band by MSS and prevent satellite service providers from providing MSS service in Australia. For this reason, the most spectrally efficient way to utilize the 2 GHz band is to allow both MSS as well as ATC/CGC as this will ensure coverage in isolated and rural areas, as well as improving capacity and quality of service in areas like cities where MSS is unlikely to be used except in emergency conditions when the ATC/CGC may be unavailable. In considering the remarkable power of technological innovation, Australia's legal framework empowers the ACMA to promote infrastructure investment and ensure the efficient and timely assignment of resources to the public for hybrid satellite terrestrial systems. Allowing hybrid satellite-terrestrial systems to provide services in Australia would bring public interest benefits, including:

- promotion of public safety;
- enhanced spectrum efficiency;
- use of the least-cost and least restrictive approach to achieving policy objectives; and
- promotion of certainty and flexibility, while balancing the cost of interference and the benefits of greater spectrum utilisation.

As already mentioned, this approach would also harmonise Australian regulations with those of Canada, the European Union and the United States, while also being recognised by the ITU and the Asia-Pacific Telecommunity. The SSWG encourages the ACMA - a forward-looking regulator - to consider the same type of spectrum-efficient regulatory framework in Australia.

Another issue is that the availability of a class licence should be restored by the ACMA for use of the 1980 to 2010 MHz and 2170 to 2200 MHz bands by the mobile-satellite services as class licences are allowed for other satellite services in Australia. The ACMA has stated in other consultations that there are no licences issued in the S-band segments, but then refers to the lack of satellite use of the band in Australia. However, it is the ACMA's own 1996 Embargo 23 that has prevented the licencing of MSS S-band operation in Australia. The exclusive assignment of S-band for TVOB in Australia was understood to be an interim arrangement near major cities and should not affect the provision of MSS S band services, particularly in rural and remote Australia.

Some Satellite operators are keen to establish an MSS S-band service for low-cost ubiquitous terminals, particularly in rural and remote Australia for M2M and other services that would benefit from the ability to Class License these terminals. The SSWG considers the use of a class licence for subscriber/user terminals encourages low cost adoption of the services by a larger section of the community, reduces regulatory and engineering costs for the ACMA, therefore increases the overall public benefit provided by the proposed services.

Issues affecting satellites in Australia

There is a number of issues affecting satellite services in Australia, but most revolve around access to spectrum and difficulties in accessing spectrum when the bands in question have been allocated via 'single service' spectrum licensing.

Demands on Spectrum

Most FSS bands from C-Band up are being investigated for IMT services in the context of 5G along with the MSS bands around 2 GHz. The ITU Task Group 5/1 is conducting studies on the higher bands which will lead to the identification of at least the 26 GHz band at WRC-15.

Single Service Licence Design

The ACMA generally licenses spectrum for mobile broadband via a spectrum licence - a 15-year 'property right' which is allocated via an auction process. These licences are paired with a technical framework which sets out the technical parameters of the licence. Essentially the same system is being used today as was first deployed in the early 1990s and which usually results in a single service model. Whilst the ACMA states it carries out studies to determine the 'highest value use' of a band, it is difficult to see how a multi-technology/service mix that does not reduce the flexibility of the prime use can be a lower value use than simply the single core service. Unfortunately to date the ACMA has resisted calls to look at multi-technology/service technical frameworks, the most recent such decision being the identification of the 3.6 GHz band for 5G services to the detriment of satellite and fixed broadband wireless access systems.

These technical frameworks make sharing difficult unless financial arrangements can be made with the successful licensee. The weakness in this system is 'rent seeking' by the holder of the spectrum licence, an issue that came to play during the last period where the 26 GHz band was held by a small number of licensees but in effect was never used for the service for which it was intended. This current round of spectrum licensing along with an obsolete technical framework has caused significant issues for FSS operators for a prolonged period of time.

Task Group 5/1 is exploring sharing between the IMT and FSS services along with other services such as the Radio Astronomy Service (RAS). In many cases sharing appears possible, although no sharing scenario has, to date, been subjected to the rigorous sensitivity analyses that would be required to draw this conclusion definitively. Furthermore, once a band is identified for IMT the services allocated to the same band face difficulties domestically when the frameworks for the IMT licences exclude FSS in the interests of simplicity or administrative convenience.

The Regulatory Road Ahead

The Satellite Services Working Group believes there is a better way to allocate spectrum to emerging services while preserving the viability of existing and future FSS systems.

Sharing the Spectrum

The SSWG believes that sharing with IMT is feasible under certain conditions and may be appropriate. As an example, we believe sharing may be possible within the 26 GHz bands (24.25 to 27.5 GHz) but only if the protection requirements of the FSS are recognised and taken into consideration in the design of the technical frameworks. While the FSS community is open to such frameworks and would be willing to participate in their development, we note that a significant stumbling block would be the IMT community's strong preference that IMT spectrum should not be shared (at least not with co-primary licensees of equal status) and its lack of willingness to accept any constraint on IMT use of spectrum. In the absence of the IMT community's willingness to collaborate with regard to the development of technical frameworks which adequately address the needs of the FSS, the only viable solution may be to avoid co-frequency, co-coverage usage of spectrum, i.e. exclude any deployment of IMT within satellite beam footprints operating in 27 to 27.5 GHz.

We recognise that this would require a significantly new approach on technical framework construction requiring the input from a number of sectors, so we offer the expertise of our members to help achieve this.

Certainty for Service Providers

Not all bands can or should be shared, but where they can, a new approach to spectrum licensing as described above could increase certainty for FSS operators and improve service delivery in Australia and its surrounding seas and airspace also via the use of ESIM. In this way, maximum economic opportunity and industry/service development will be achieved, consistent with progress elsewhere in the world. However, where sharing is not possible, such as in the case of ubiquitous High Density Fixed Satellite Systems (HDFSS), then spectrum will need to be identified, providing core bands in which FSS systems can operate exclusively.

Problems with HDFSS and how to solve them

HDFSS are uncoordinated ubiquitous FSS terminals. Their locations are not known. Without a known location or constraint on deployment, sharing with IMT is generally not possible unless significant discrimination is achieved; i.e. FSS terminal on a building rooftop with IMT at street level or indoors. In order to support the valuable services HDFSS offer, some core bands are needed where HDFSS can operate and where sharing with deployed IMT cannot be achieved.

As mentioned above, HDFSS are identified by RR 5.516B, which corresponds to Footnote 516B in the Australian Radio Frequency Spectrum Plan (ARSP). Whilst Region 3 has the lowest amount of spectrum identified for HDFSS, Australia has chosen to not recognise some of this in the ARSP. We submit that in order to ensure the future of HDFSS in Australia the ACMA should recognise the 5.516B identifications in Region 3 within the next edition of the ARSP following WRC-19.

As IMT is identified in more bands e.g. 3.6 GHz and higher frequencies, FSS providers are being squeezed into narrower bands and out of many populated areas. While the SSWG believes that appropriate sharing conditions could be established in most bands we see the need for additional exclusive FSS spectrum. Recently the FCC identified 2 x 2 GHz of exclusive FSS spectrum in the 48.2 to 50.2 GHz and 40 to 42 GHz bands. This identification builds a good base for a new global exclusive identification for FSS and we submit that the ACMA should also set these bands aside exclusively for FSS as 'core' bands into which FSS can resort in areas where sharing with IMT is not feasible.

Recommended actions for the ACMA

It appears, through both actions and comments, that the ACMA has a current tendency to prioritise the needs of IMT over those of satellite services. Indeed, there have been two bands (extended C-band and L-band) reformed or being planned for IMT in the last year alone, both of which are to the detriment of the satellite community. The ACMA positions on Agenda Item 1.13 and at the recent APG19-3 meeting in Perth seem to demonstrate that any 'reasonably clear' band should be simply allocated to IMT without consideration of other services.

While the satellite community embraces sharing with different levels of enthusiasm, the recent actions of ITU-R WP-4A to not provide sharing criteria is showing how fragile the current system is becoming. It is time regulators globally looked away from the blinding headlights of IMT and considered an inclusive spectrum regulatory regime that provided for sharing where possible and spectrum for FSS and MSS where sharing is not possible.

To be viable satellite operators require some access 'everywhere' for ubiquitous services, shared planned access for services such as ESIM and shared via geographical separation for services such as FSS and MSS. In Australia in order to provide a future for both satellite and terrestrial services certain actions are required:

1. The ACMA should quarantine 2 x 2 GHz of spectrum for ubiquitous FSS services in the bands 40 to 42 GHz, 48.2 to 50.2 GHz. IMT should not be considered in these bands. The ACMA should lobby for these bands at 4A and TG 5/1.
2. The SSWG thanks the ACMA for stated plans to preserve the 28 GHz band for individually coordinated Fixed Wireless Access shared with FSS-ESIM. This will allow high grade internet services for terrestrial customers while providing high quality internet access for the travelling public. The ACMA should resist any calls to identify this band for IMT now or in the future.

3. TG 5/1 is using IMT characteristics provided by WP-5D to undertake various sharing studies in the 26 GHz bands and others. These characteristics need to be set in stone, via a possible WRC-19 Resolution and in any technical frameworks the ACMA uses to reallocate the bands domestically. While there is a range of enthusiasm for sharing within the SSWG, the studies use these characteristics and so sharing cannot take place, unless the characteristics are specified for service deployment.
4. The ACMA should revisit the use on the 2 GHz MSS bands and allow the use of these by the MSS community in areas where future deployment of terrestrial 4G or 5G services is unlikely.

Conclusions

The IMT/4G/5G services have been allocated a very large amount of spectrum over the past two decades. This is usually spectrum previously used by the satellite community. The SSWG believes that it is now time for the ACMA to take a more holistic view of spectrum management and look to the needs of the whole communications community, not just the desires of the IMT proponents to maximise available spectrum, so as to minimise spectrum access costs.

The SSWG believes the ACMA should devote at least two experienced planning engineers to, along with the SSWG, study the needs of the FSS/MSS community in Australia and to plan for the future of these services before undertaking new IMT spectrum planning beyond the current 26 GHz band.

Attachment 1

Satellite Services Working Group membership

Australian Private Networks (APN)
Coutts Communications
Foxtel
FreeTV
Inmarsat
Intelsat
Ipstar
nbn
Omnispace
OneWeb
Optus
Orion Satellite Systems
Pivotel Satellite
SES
Skybridge
Space Systems/Loral
Speedcast
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