When replying please quote: 940/15/45/1 RGMcN

29 May 2020 (Commercial in confidence version)
24 August 2020 (Unclassified version)

710-2300 MHz Discussion Document
Radio Spectrum Management Policy and Planning
Ministry of Business, Innovation and Employment
PO Box 2847
Wellington 6140

via email: Radio.Spectrum@mbie.govt.nz

Dear Sir/Madam,

UNCLASSIFIED

Submission: 710-2300 MHz Discussion Document

Great South wishes to thank Radio Spectrum Management for the opportunity to submit on the abovementioned document.

We would be pleased to speak in support of our submission.

Key points

1. Great South (and Venture Southland before) has been actively using spectrum between 2025 MHz and 2290 MHz for space operations at Awarua Satellite Ground Station and Lochiel Satellite Ground Station since 2008, and is experiencing growing demand for this spectrum.
2. Great South's access to 2025 MHz to 2290 MHz for space operations forms the basis of business generating in excess of $NZD 1.5 million per year in "weightless" exports that is forecast to considerably grow in coming years.
3. Great South is establishing a satellite ground station in the Far North of New Zealand, which will also use spectrum between 2025 MHz and 2290 MHz.
4. Uncongested and easy access to the 2025 MHz - 2290 MHz spectrum along with a very low radio noise floor provides New Zealand—and Southland in particular—with a remarkable strategic advantage in providing telecommunications to the space industry for space operations that is envied around the world.
5. Great South is establishing a "virtual" South Pole satellite ground station with partners in South Africa and South America that will be using spectrum between 2025 MHz and 2290 MHz for space operations.

Outcomes sought

Great South seeks:

1. That ITU Region 3 allocations for Space Operations, Earth Exploration Satellite, Space Research and Mobile Satellite services be adopted extant as the primary use for spectrum between 1980 MHz and 2300 MHz.
2. That 2025 MHz to 2290 MHz must be protected for space operations use as a primary service in Southland and Northland.

3. That 2025 MHz to 2290 MHz should be preserved for space operations at Mahia and the Chatham Islands to protect satellite launch operations.
4. That establishing “spectrum protection parks” to safeguard space operations use in Southland, Northland, Mahia and the Chatham Islands would be a satisfactory solution to accommodate any competing demands for terrestrial use of spectrum between 2025 MHz and 2290 MHz.
5. That should 2200 MHz to 2290 MHz be allowed for terrestrial use, it may only be allowed provided that such use does not and cannot interfere with present and future space operations in Southland, Northland, Mahia and the Chatham Islands.
6. That a regulatory mechanism be developed to enable Great South to manage spectrum in Southland and Northland between 2025 MHz and 2110 MHz to minimise spectrum conflicts and reduce potential interference.
7. That Management Rights not be reintroduced as a way to manage 2025 MHz to 2290 MHz.
8. That the 12 cm and 23 cm amateur radio bands be retained as it is.

Background

Great South

Great South is the trading name for Southland Regional Development Agency Ltd, a council controlled organisation owned primarily by Invercargill City Council, Southland District Council, Gore District Council and Environment Southland. It replaces Venture Southland, which was a Joint Committee of Invercargill City Council and the Southland and Gore District Councils.

Amongst other things, Great South operates and hosts third-party satellite ground stations at Awarua, Invercargill and Lochiel in Southland for overseas customers, and is currently in the process of establishing other stations in Southland and in Northland. The Awarua and Lochiel stations transmit and receive in S-Band (2025 MHz - 2290 MHz), as will the proposed Northland station.

In addition, Great South is completing construction of a 3.5 metre S/X-Band antenna which has already been leased to one priority customer who intends to sub-lease it. The antenna will also be used by Great South to support two satellite missions. Work to establish a second such S/X-Band antenna to provide “Ground Segment as a Service” at Awarua is underway.

Great South has ambitions to support the government’s MethaneSAT mission through providing a “virtual South Pole ground station” with allied ground station operators in Australia, South Africa and South America, and is working towards this end. This mission will operate in S-Band for TT&C.

Memorandum of Understanding between Great South and MBIE

Great South and MBIE signed a Memorandum of Understanding in relation to the provision of ground station services on 10th September 2019. The MoU informs the working relationship between the two parties, and in particular for MBIE to provide guidance and advice to Great South relating to risks and information of relevance to Great South.

Great South’s space obligations

Venture Southland is the implementing authority on the New Zealand Government side of the *Arrangement between the European Space Agency and the Government of New Zealand on the Setting Up and Use of Telemetry and Tracking Facilities for the Purpose of the Agency’s Launcher Programmes and Activities*, (Paris, 23 May 2007). Venture Southland’s role is to be novated to Great South.

Venture Southland has entered into a number of International Trade in Arms Restrictions (ITAR) agreements with United States customers relating to space related technologies.

Great South's interest in the space sector

In conjunction with the French Space Agency (CNES), Venture Southland established the Awarua Satellite Ground station—between Invercargill and Bluff—between 2004 and 2008 to support the European Space Agency's (ESA) Ariane 5 ATV missions to resupply the International Space Agency from 2008 to 2014. ESA gifted the facilities to Venture Southland in 2008 as a way to encourage space development in New Zealand and since 2014 Venture Southland has hosted ground stations (antennas and electronics) for, amongst others, the world's best-known small-sat satellite operators.

In 2015 Venture Southland established a second ground station facility at Lochiel, between Invercargill and Winton, and then a UHF station in Invercargill to support Rocket Lab's launches. The disparate stations are required to resolve spectrum management issues in the UHF band.

All our customers are overseas based and our revenue will exceed $1.5 million in the coming financial year, noting that all our revenue comes from "weightless" exports. We have a full order book and expansion continues. To meet demand, we have committed ourselves to Stage II development of the Awarua Satellite Ground Station for which we have resource consent to erect 23 antennas.

Currently we have six antennas of 2.7 metre or more aperture on the Awarua site, with another antenna under construction and two more about to begin. We estimate that the value of the equipment at Awarua Satellite Ground Station exceeds $NZD 4.5 million, which would have contributed around $NZD 230,000 in GST collection as it entered the country.

In 2018, Venture Southland submitted a very detailed bid to establish a centre for near real-time satellite Earth observation in Invercargill under the then government's Regional Research Institute initiative. This would have seen a 5 metre S/X-Band commercial ground station established for wider "New Zealand Inc" use. Although shortlisted, for undisclosed reasons the bid was unsuccessful. However, the detailed work undertaken during the bid preparation confirmed that there is an urgent and strategic need for a competent institute in New Zealand to deal with Earth observation in real-time. Accordingly Great South is working to establish a suitable multi-mission multi-satellite ground station with its international partners to direct-download commercial earth observation satellites and to support overseas satellite launches. When executed, the proposed Awarua station will be extremely valuable for earthquake reporting, maritime disaster monitoring, volcano monitoring and suchlike in real-time, especially as such services are currently unavailable in New Zealand.

Last year Great South was successful with the University of Auckland to gain Catalyst-Strategic funding to establish a Multi-mission Operations Centre in Invercargill. Progress has been delayed somewhat by Covid-19, but it will be operational in 2021. This will further enhance Great South's and New Zealand's space capability.

Great South holds the radio licences for our customers.

Great South's relationship with Radio Spectrum Management

Venture Southland and then Great South has enjoyed a very cordial relationship with Radio Spectrum Management ever since 2004 when engineering work for the ESA ATV launch campaigns began. We have always found RSM to be helpful, friendly and accommodating; we are not surprised to find that this happy view is shared by those of our overseas colleagues who have also dealt with RSM.

We have had several meetings over the years with RSM staff addressing access to S-Band and possible developments for access to S-Band after 31st March 2021, amongst many other things.

Views represented

In preparing this submission we have conferred with our colleagues in Deutsche Zentrum für Luft- und Raumfahrt e.V (DLR), Kepler Communications, Kongsberg Satellite (KSAT), Leaf Space, Planet Labs, Rocket Lab and Swedish Space Corporation. All have significant and useful experience to share in space operations around the world and (with the exceptions of Rocket Lab, Leaf Space and Kepler Communications) have been active for decades. They all have intimate knowledge and understanding of using S-Band for space operations.

Some (if not all) of these organisations are independently submitting on this discussion document and we have asked them to review our submission. We are confident that our views accurately represent their views and their advice has been incorporated in our submission.

Great South has also taken an interest in, and attended occasional meetings of the Commercial Smallsat Spectrum Management Association (CSSMA), which has helped shape our thinking.

Submission

We have chosen not to directly answer the questions presented in the discussion document: most of the questions do not concern us and we feel that we can better explain our position to guide policy development than by answering the questions that we do have strong views on, i.e. Questions 4 and 6-11.

S-Band

ITU Region 3 allocations for space activities

It is clear that the international space sector is developing very wide-ranging interests in using all spectrum between 1980 MHz and 2300 MHz. The sector, naturally, expects that New Zealand has adopted the ITU Region 3 allocations for space use, i.e. the Space Operations, Earth Exploration Satellite, Space Research and Mobile Satellite services, and presume that they will be able to operate in New Zealand on that basis. Because space activities are not the primary use in New Zealand, this has been problematic for us and on occasions has required meetings with RSM staff, our Approved Radio Engineer and others to even consider licencing transmitters.

In addition, our customers expect that the ITU Region 3 allocations would mean that spectrum for receiving spacecraft telecommunications is protected. This is not the case and it is only by good fortune that we have not experienced problems.

While we have no direct experience in this spectrum outside of the space operations sub-band, we are currently supporting Kepler Communications, who intend to use spectrum between 1980 MHz to 2100 MHz for spacecraft telecommunications at Awarua SGS, and shortly Leaf Space. It is likely that we will have further missions wishing to use other spectrum between 1980 MHz and 2300 MHz.

As an example of the interest in the wider ranges in question, we note that the ITU's Advanced Publication Query System and the FCC Advanced IBFS Search platform have six missions the range 2025 – 2110 MHz and one mission in the range 2200 – 2290 MHz.

Given the rapidly growing interest in space activities and the imaginative uses space is being put to (who would have imagined ALE's micro-meteorites as a commercial possibility 6 years ago?), we urge RSM to adopt the ITU Region 3 allocations extant for space activities as the primary service between 1980 MHz and 2300 MHz, if not throughout New Zealand, then at least in protected spectrum parks (discussed later).

Space Operations

In the commercial space operations community, S-Band is considered to comprise:

- 2025 MHz – 2110 MHz for Earth-to-space communications
- 2200 MHz – 2290 MHz for space-to-Earth communications.

This is the main spectrum which concerns us and our operations to date, and in which we have direct experience; for the remainder of this submission references to “S-Band” mostly refer to this spectrum.

Other spectrum

Outside of 1980 MHz to 2300 MHz and the 23 cm amateur radio band (1240 MHz – 1300 MHz, discussed later) we have no interest in the remainder of the spectrum under consideration in the discussion document.

Use of the term “Paired Spectrum”

We are shy of using the term “paired spectrum” in S-Band planning as “pairing” implies that for each transmitting frequency there will be a corresponding receiving frequency in the same band. This is often not be the case for space operations, where there may not be a terrestrial transmitter in New Zealand, or the downlink frequency may be in another band entirely (usually X-Band).

Importance of S-Band use for Space Operations

S-Band is the ‘workhorse’ spectrum for space operations as it provides a ‘sweet spot’ where gain antennas can be conveniently used that are of size to be sufficiently directional to enable reasonably high data throughputs, but not so directional as to be demanding on spacecraft attitude and orbit control systems. This is very important during launch and early operations phase (LEOP) for satellites, for launch vehicles where good state vectors are not always available, and for small-sat satellites which often do not have good attitude and orbit control.

As a result, most low Earth orbit (LEO) spacecraft used for Earth observation, and many others, use S-Band for their core telemetry, tracking, and control (TT&C). This can be unidirectional (space-to-Earth) with no telecommand from Earth, or bi-directional, in which case the uplink frequency will nearly always be in S-Band and the downlink frequencies will be in either S-Band, or X-Band. Generally spacecraft payload data downlinking is commanded from Earth in S-Band and then downlinked in X-Band where much higher bandwidths are available. The spacecraft may be programmed to automatically downlink to certain ground stations, or pre-programmed from an Earth-to-space link by another country in advance of the pass.

The S-Band ground station antennas are always steerable gain antennas with full-motion tracking. Typically, the antennas will begin a LEO satellite pass at 5° horizon elevation and for launcher tracking we have sought to provide a 0° horizon elevation. Depending on the orbit and nature of the pass, LEO satellite passes take between four to eight minutes from acquisition of signal to loss of signal, i.e. from horizon to horizon.

From a space operations perspective, New Zealand is very fortunate as far as S-Band is concerned: of the Management Rights covering S-Band (MR98, MR 100, MR 102), only MR100 was ever used for the intended 3G cellular deployment in Southland, by former Woosh Wireless. While negotiating use of these Management Rights has not been without its frustrations, our operations have always been acceptable to the Management Right owners and we have been able to access any frequencies we need (for a price). This is in stark contrast to many other administrations around the world, where S-Band is often very congested because of non-space use and licencing spectrum for space operations is usually fraught. Further, where S-Band is available for the North Pole satellite ground stations, harmful interference from competing ground stations in other administrations can be problematic. It goes without saying that the lack of S-Band use in Southland makes for a very quiet background radio noise floor, which often surprises our customers and is very much appreciated by them.

Licences currently held by Venture Southland Trust for Space Operations include those shown in Figure 1, which also shows the Management Rights in which they fall.

[REDACTED]
Figure 1. Indicative Awarua S-Band uplink spectrum use. COMMERCIAL IN CONFIDENCE

S-Band space operations spectrum use

Spacecraft operators usually file their ITU or FCC applications years in advance of launch. Finding frequencies for their spacecraft that will not cause interference to other spacecraft, or ground stations and terrestrial users in all other parts of the world is difficult; typically the to and fro involved in finding a frequency will take two years. Until there is a substantial shift in worldwide thinking for spacecraft transmitter and receiver design and licencing, this is not going to change.

The upshot is that when one of our customers requests us to provide ground segment support for a mission, the frequency and modulation for the mission is fixed and change cannot be countenanced. This gives us no flexibility to accommodate local spectrum use should there be a conflict. That said, no other ground station around the world is in a better position to negotiate frequencies; as mentioned above, obtaining transmitting licences can be problematic for these other stations because of the congestion they experience and so the ease of obtaining almost any S-Band frequency in Southland provides a very strong, competitive advantage to us. This, in no small way, helps promote New Zealand to be—as the New Zealand Space Agency puts it— “Open to Space”.

The lack of flexibility in choosing radio frequencies currently is not a problem for us, but should another ground segment provider establish themselves in Southland or Northland (assuming that S-Band is reserved for space operations), the need for coordinating spectrum use in S-Band becomes apparent. The difficulty is that space is a competitive industry and spacecraft owners sometimes are very reluctant to let their competitors know their intentions. We are often be privy to information regarding missions well in advance of launch and in complete confidence.

As far as we can ascertain it is not possible to reserve spectrum well in advance without obtaining a licence. If a regulatory mechanism could be developed that would allow us to manage S-Band spectrum to minimise present, future and potential conflicts, this would go a long way to minimise these difficulties.

Spectrum protection parks

We appreciate that there may be suppressed demand for terrestrial use of S-Band in New Zealand. We certainly understand that there is an interest in “white space” radio spectrum use for telecommunications and that the rapid progress in software defined radio technology means that future terrestrial radio telecommunications will be remarkably frequency agile. In this light, we anticipate that in the coming years there will be renewed interest in utilising S-Band for terrestrial use. This could jeopardise our operations if undertaken in an *ad hoc* manner.

We believe that terrestrial demand could be accommodated by establishing spectrum protection parks in Southland, Northland, Mahia and Chatham Islands. Because space operations adhere to well-defined band plans with separation between the uplink and downlink spectrum, we would not be adverse to terrestrial use of the Earth-to-space spectrum as a secondary service and so long as licencing of Earth-to-space transmission remain unfettered, provided that there is no radiation from the terrestrial transmitters above 5° elevation to interfere with spacecraft reception.

However, the spectrum protection parks should absolutely protect space-to-Earth spectrum and no terrestrial transmitters within the spectrum park could be countenanced. We have measured residual noise floor in this part of the spectrum at Awarua to be -143 dBm/Hz for half-hour received maximum noise level, with an average received noise level better than -153 dBm/Hz, and this must not be compromised.

Spectrum protection parks have been successfully established in Germany and have been found to be very useful by the space operations community, especially in Ka-Band.

Management Rights

Although the discussion document notes that the existing spectrum Management Rights will not be renewed after 31st March 2021, it does occur to us that there may be appetite to reintroduce them for the space operations spectrum. Indeed, the concept of a spectrum management park described above would suggest such an approach. Having experienced dealing with all the holders of S-Band Management Rights in Southland, we would not like this system to continue.

Our objections to creating new Management Rights are such:

1. Although using spectrum in S-Band is somewhat profitable, it is not nearly as profitable as it potentially is for cellular operations. There is no way in which satellite ground segment operators could afford to outbid cellular operators for this spectrum, especially knowing that in the past this spectrum has cost between $500,000 to $800,000 for 30 MHz (for New Zealand-wide coverage) and that the spectrum required for space operations is rather bigger.
2. Awarding a Management Right would create a monopoly for a single space operations operator and discourage development of New Zealand's space industry. As it is, some of the spectrum leased from present Management Right holders verges on the unaffordable for our customers and should the new Management Right holder try to extract super profits, the ground segment industry in New Zealand would fail.
3. Arbitraging spectrum would not create value to the space industry; it would only increase its operating costs and decrease its viability.
4. Space missions to be supported in New Zealand are contracted without regard to New Zealand Management Rights and the frequencies sought are randomly distributed. It is only by luck that we have had no customers who have sought a frequency that divides two management rights, though we have had one application that required us to seek permission of an adjacent Management Right owner to allow a sideband to infringe into their spectrum. Should S-Band be managed through multiple Management Rights, the continuing difficulties described would continue.

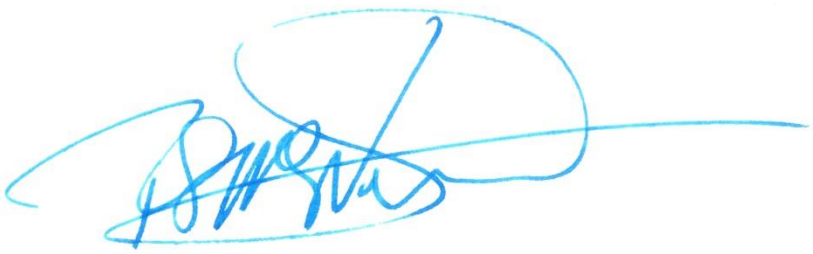
"12 centimetre" and "23 centimetre" amateur radio bands

To date we have not used either the 23 cm (1240 MHz – 1300 MHz) or 12 cm (2395 – 2450 MHz) amateur radio bands. While these band are not under consideration in the review we would like to take the opportunity to reinforce our view that these bands should be left as they are because:

1. We have found access to the amateur radio bands useful for our own technical developments and for building staff skills, noting that a number of staff gained their interest in radio through obtaining amateur radio licences,
2. We believe that amateur radio provides a pathway to encourage students to study radio engineering and, given the scarcity of radio engineers in New Zealand, every encouragement is needed,
3. Amateur radio provides a convenient experimental pathway,
4. Parts of the 23 cm and 12 cm bands are allocated for satellite use for satellites with IARU licences. There is considerable use of amateur bands for university satellite missions and we envisage that as the university satellite groups build capacity, they will increasingly wish to experiment with a variety of bands, including these bands. We would like to be able to support such missions.

We trust that the points raised in our submission are helpful in guiding RSM's policy development and we would be happy to provide any clarification or further thoughts to RSM.

Yours faithfully



Robin McNeill
Space Operations Manager
MNZM, BA, BE(Hons.)(Elect.), FIPENZ, SMIEEE, CPEng, PE(Int.)