

Federated Wireless Inc. Comments

**Australian Communications and Media Authority
“Spectrum sharing: Overview and new approaches”**

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Executive Summary

Federated Wireless, Inc. (Federated Wireless) hereby submits comments in response to the Australian Communications and Media Authority (ACMA) consultation paper entitled, “Spectrum sharing: Overview and new approaches” in which ACMA explores how non-traditional spectrum sharing models can be developed in Australia.

Federated Wireless commends ACMA for its recognition of the importance of unlocking opportunities for improved spectrum utilisation. We appreciate the opportunity to share our experience in implementing commercial 4G (and soon 5G) services on a shared basis in the 3.5 GHz and 6 GHz bands in the United States and offer our perspectives on how:

- Dynamic shared spectrum technology can be readily deployed to assist ACMA in achieving its goal of increasing spectrum access through more flexible licensing arrangements; and
- An automated database approach can be implemented quickly, will lead to a vibrant innovative eco-system, enable efficient use of spectrum, and be future-proof.

A. Background on Federated Wireless and Dynamic Spectrum Sharing

Federated Wireless is a U.S.-based wireless technology company that specializes in dynamic shared spectrum access solutions. We develop cloud-based, automated database solutions that enable spectrum sharing amongst a variety of users and across a variety of frequency bands. Our dynamic spectrum sharing solutions perform the following functions on a highly scalable, automated basis:

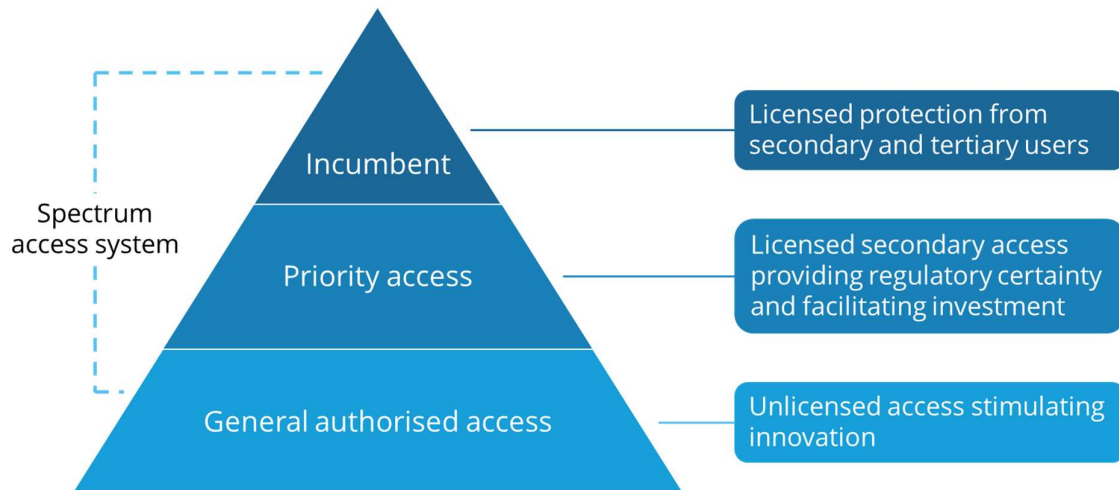
- Register and authenticate the identity, location and technical characteristics of new devices;
- Determine the available frequencies at a given geographic location;
- Determine the maximum permissible radiated transmission power level at a given location;
- Enforce protection of incumbent or higher tier users;
- Manage co-existence amongst new users;
- Facilitate secondary market spectrum transactions.

These dynamic spectrum sharing solutions, when implemented on a scalable, automated basis, can assist regulators to introduce efficiently new services in bands already occupied by incumbent services, maximize spectrum access for new users, and ensure protection of incumbent services today and if/as they change over time.

For example, the Federated Wireless dynamic spectrum sharing technology has been deployed to assist the U.S. Government and industry to launch new wireless broadband services in 3550-3700 MHz, known as the Citizens Broadband Radio Service (CBRS or 3.5 GHz) band. Our technology is managing dynamic sharing of these frequencies between incumbent military and commercial uses as well as between different tiers of commercial uses on both a licensed and unlicensed basis.

In 2015, the U.S. Federal Communications Commission (FCC) established rules to allow use of the CBRS band by commercial broadband service providers, while protecting the incumbent shipborne and land-based U.S. Department of Defense radars, commercial Fixed Satellite Service (FSS) receive earth stations, and commercial terrestrial fixed point-to-multipoint systems (see Figure 1 below). Federated Wireless is one of the entities authorized by the FCC to deploy and administer a Spectrum Access System (SAS) to enable dynamic spectrum sharing of the CBRS band.¹ This standards-based SAS is implemented as software as a service in the cloud for efficiency, scalability, reliability, and ease of deployment.

Figure 1 – CBRS Tiered Sharing



The priority of spectrum access and protection of higher tier users in CBRS band is governed by the SAS, which maintains a database of all commercial CBRS devices (both base stations and outdoor access points) and works with environmental sensors, known as the Environmental Sensing Capability (ESC), to mitigate possible interference to the incumbent users.

While the FCC’s rules for CBRS are specific to the United States and its incumbent users, the Federated Wireless SAS is readily adaptable to new frequency bands and challenges. Once protection criteria (or boundary conditions) for incumbent users are established and a database of these incumbent users is updated with the most current information, it is straightforward to adapt the dynamic shared access system developed for CBRS to operate in other frequency bands and enable new opportunistic uses.

The FCC noted the myriad benefits of a dynamic sharing approach when it established the CBRS rules and framework:

“This regulatory adaptability should make the 3.5 GHz Band hospitable to a wide variety of users, deployment models, and business cases, including some solutions to market needs not adequately served by our conventional licensed or unlicensed rules. Carriers can avail

¹ In addition to Federated Wireless, the FCC has conditionally approved the following additional SAS administrators: Amdocs, Inc., Comsearch, Google, Inc., Key Bridge, and Sony Electronics, Inc. All conditionally approved SAS Administrators were required to submit their systems for compliance testing before final approval and the imminent launch of commercial services.

themselves of “success-based” license acquisition, deploying small cells on a GAA [General Authorized Access or unlicensed opportunistic] basis where they need additional capacity and paying for the surety of license protection only in targeted locations where they find a demonstrable need for more interference protection. Real estate owners can deploy neutral host systems in high-traffic venues, allowing for cost-effective network sharing among multiple wireless providers and their customers. Manufacturers, utilities, and other large industries can construct private wireless broadband networks to automate processes that require some measure of interference protection and yet are not appropriately outsourced to a commercial cellular network. Smart grid, rural broadband, small cell backhaul, and other point-to-multipoint networks can potentially access three times more bandwidth than was available under our previous 3650-3700 MHz band rules. All of these applications could share common wireless technologies, providing economies of scale and facilitating intensive use of the spectrum.”²

In addition to the CBRS band, the FCC has proposed allowing new unlicensed devices to operate in the 6 GHz band on a shared basis using automated dynamic sharing technology (referred to as an Automated Frequency Coordinator or AFC) to minimize interference, ensure protection of incumbent commercial users, and maximize spectrum access for new unlicensed services. Federated Wireless has developed a working 6 GHz AFC prototype, leveraging our CBRS SAS technology and experience, that will facilitate the introduction of new users in the 6 GHz band.

As ACMA considers options for new licensing approaches, dynamic spectrum access technology can be a powerful spectrum management tool to harness additional spectrum for a variety of new services. We believe that the lessons learned in the development of the 3.5 GHz CBRS sharing model and ecosystem, which is currently the largest LTE ecosystem in the world with over 30 equipment vendors supporting myriad new use cases, as well as the 6 GHz AFC may be instructive.

B. Dynamic Shared Access Technology Can Facilitate Introduction of New Licensing Arrangements

Federated Wireless believes that the use of dynamic shared access technology will assist ACMA to increase spectrum efficiency and open more spectrum to new services and users. By harnessing the power of automated dynamic spectrum sharing technology, ACMA can readily implement its vision for the new licensing approaches, given that such technology: a) is available today; b) is easily adapted for new bands and/or incumbent protection criteria; c) will maximize the use of available spectrum more quickly and broadly than a manual or static approach; and d) will avoid significant administrative burdens on ACMA, incumbents, and new licensees alike.

Availability of dynamic shared spectrum technology

Dynamic shared access technology is already available from multiple vendors and has been thoroughly tested through a rigorous process involving multiple government agencies, incumbent users, industry associations and technology providers. It has also been tested in the field with over

² Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, FCC 15-47, Report and Order and Second Further Notice of Proposed Rulemaking, ¶ 6, (2015).

50 trials by large mobile network operators, cable companies, infrastructure vendors, WISPs, etc. It will be neither difficult nor time-consuming to adapt available solutions to other bands. These solutions can readily provide ACMA with a spectrum management tool that offers advantages over more manual and/or static approaches.

These advantages include:

- Speed to market and agility of deployment;
- Seamless protection of incumbent users;
- Increased spectrum efficiency through opportunistic spectrum access on a geographic or time dependent basis; and
- Support for innovative business plans and the creation of a robust and sizeable ecosystem of suppliers and vendors;
- Flexibility to adjust protection criteria (whether more conservative or more liberal) as needed;
- Ability to adjust for future growth of both incumbent and new services.

Adaptability of dynamic shared spectrum technology

Dynamic spectrum sharing technology's strength lies in its ability to adapt quickly to any set of rules in any band. Creating and assigning protection can be fully customized, as can the rules pertaining to prioritization, size, location, duration of spectrum grants, and more. The parameters can be changed if subsequent circumstances warrant, such as the need and/or opportunity to change protection criteria, and typically such changes require little more than changes to software code and importantly with no impact to infrastructure or devices already deployed. Conceptually, so long as the spectrum access sharing system knows the rules for the band, it can assign spectrum and provide protection when and where needed. The sharing system can dynamically adjust spectrum allocations, power limits, and other operational parameters to ensure protection to incumbents and afford spectrum access for new entrants, while also providing regulatory and technological flexibility that allows use cases to develop over time.

Unlike manual, static licensing approaches, an automated shared access system is able to determine available frequencies for multiple prospective users within the same geographic area within a matter of hours, while simultaneously protecting incumbent operations. Such an automated system could also be refreshed on a regular basis, making new frequency assignments available within days or even hours after a particular user is no longer occupying the spectrum or when a new user comes online, making far more efficient use of available spectrum than would a static, first-come/first-served approach.

Furthermore, rather than imposing operating restrictions on new entrants based on worst-case assumptions, such as static separation distances or low power/indoor deployment limitations, Federated Wireless recommends that ACMA allow a dynamic shared access system to take into consideration variables, such as building penetration loss, clutter, and antenna patterns, to more accurately pinpoint what interference protection is actually needed in a given area and thereby improve the efficiency of spectrum use in bands being converted to new uses.

As ACMA considers new licensing approaches, Federated Wireless recommends that it require new devices to register with the automated shared access system in order to:

- 1) Identify the potential impact of those devices on other users in the same and adjacent bands;
- 2) Manage the potential for interference amongst new users; and
- 3) In the case of unexpected interference, identify the devices that may be the cause and take corrective action.

Without knowledge of the device's location, power level, etc. it is nearly impossible to identify the cause of interference should it occur. We consider this functionality to be the "future-proofing" of the licensing approach, enabling both incumbent and new services to adapt and grow, while ensuring there are hooks that enable interferers to be identified and adjustments to protection criteria if real-world operating conditions warrant.

Given its experience, Federated Wireless estimates it would take 3-6 months of engineering work to adapt the SAS developed for the CBRS band to Australia once ACMA has completed the process of establishing protection criteria for incumbent and/or higher tier users in a band identified for shared use. Such adaptation would include incorporating terrain databases, synchronizing with ACMA's databases, eliminating unneeded features, etc.

As mentioned above, Federated Wireless has already shown how its SAS technology can be adapted quickly to other bands. We are actively involved in an ongoing proceeding to allow the introduction of new unlicensed devices in the 6 GHz band through the use of an Automated Frequency Coordinator (AFC) that will enforce protection of incumbent fixed, point-to-point microwave links while maximizing spectrum access by new unlicensed devices – a licensing arrangement not dissimilar from ACMA's proposed Area-Wide License approach. Since the proceeding was launched in October of 2018,³ Federated Wireless has already developed a working 6 GHz AFC prototype, leveraging our CBRS SAS technology and experience. A similar shared access system could be developed to support the introduction of a shared licensing scheme in Australia.

C. Maximizing Spectrum Access and Ecosystem Development Through Opportunistic Shared Access

Federated Wireless recommends that ACMA consider adopting a tiered licensing approach that includes both licensed and opportunistic (unlicensed) access in the same band. Together, licensed and opportunistic shared access assure the largest possible ecosystem for equipment and devices, resulting in more choice and lower cost for network operators and end users. Furthermore, we recommend that ACMA include leasing rights and a use-or share provision for the licensed access tier to ensure spectrum is put to use as quickly as possible. Dynamic spectrum sharing technology can also be used to facilitate the development of these secondary market provisions.

Tiered licensed and opportunistic access

Federated Wireless recommends a tiered licensing approach to enable both licensed and unlicensed access in the same band. With a tiered licensing approach, manufacturers will build devices to

³ See Unlicensed Use of the 6 GHz Band, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz, Notice of Proposed Rulemaking, FCC No. 18-147, ET Docket No. 18-295, GN Docket No. 17-183 (rel. Oct. 24, 2018).

satisfy both the needs of licensed and unlicensed users, particularly if there is a band-wide interoperability mandate for equipment. Without this combination, a market where equipment is purpose-built for specific customers and their exclusively licensed bands will continue. Limiting the potential size of the equipment and device ecosystem will similarly limit the potential for new and innovative uses of these bands, and it increases the likelihood that these bands will be licensed only by those with sufficient size and capital to drive ecosystem development (e.g., the incumbent MNOs).

Spectrum leasing rights

Federated Wireless recommends that licence conditions for new bands include the right for the licence holder to lease the spectrum to others – whether on a geographic basis (partitioning) or by sub-dividing the spectrum (disaggregating). Once eligibility criteria for lessees as well as protection criteria amongst users are established, a dynamic shared access system can facilitate leasing arrangements by automating the process and ensuring protection criteria are met. Such a secondary market will drive innovation, allow new technology to be deployed by leased spectrum users, and support niche sectors, such as enterprise networks and industrial uses.

In addition, in order to incentivize more efficient spectrum use, we recommend allowing licence holders to include any coverage and deployments undertaken by leased spectrum users to count towards the licence holder's performance obligations. This condition would not be an obligation to lease spectrum, merely an option available to license holders.

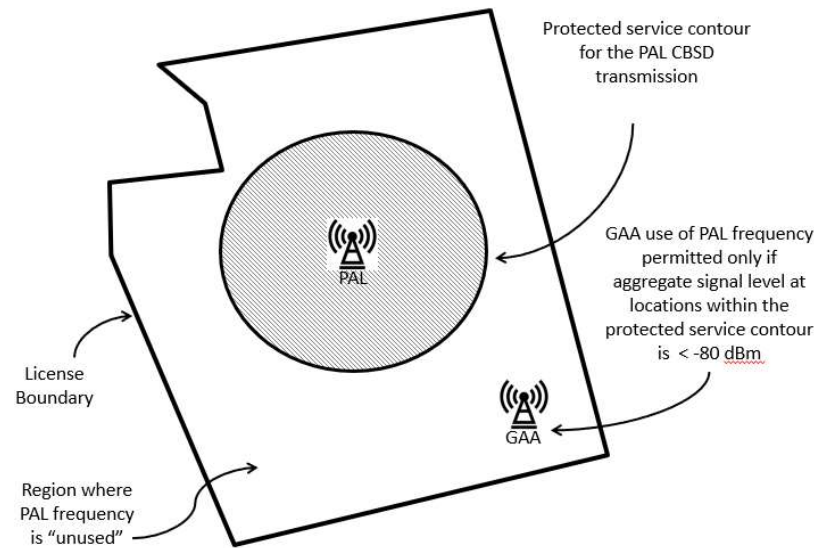
Use-or-Share Rules

In addition to leasing rights, Federated Wireless recommends that regulators consider a licensing approach similar to what the FCC established for the 3.5 GHz CBRS where lower tier users are allowed to access higher tier spectrum if the high tier licensee is not using (use-or-share). By way of background, the FCC intends to auction up to seven, 10 MHz PALs in the CBRS band per county across the United States sometime in 2020. Opportunistic access users, known as the General Authorized Access (GAA) tier, will have access to the remaining 80 MHz of CBRS spectrum whenever incumbent protection does not otherwise restrict spectrum access. GAA users are also allowed to access licensed PAL spectrum in areas where the PAL licensee has not deployed equipment, making the PAL licenses subject to a "use-or-share" condition.

Instead of requiring PAL users to predict with any amount of certainty where they will not deploy and where spectrum available could be available to other users for a set time period, the FCC defined PAL protection criteria that SAS administrators, including Federated Wireless, will enforce on a real-time basis. To protect PAL CBRS devices, a SAS must not authorize other CBRS devices on the same channel in geographic areas and at maximum power levels that will cause aggregate interference in excess of -80 dBm/10 MHz channel within a PAL Protection Area. This aggregate co-channel interference level was defined utilizing common inputs and assumptions – including the propagation model and any clutter or terrain assumptions – during the SAS approval process. This approach is consistent with the methods that will be used to model and measure the aggregate interference to protect incumbent FSS earth stations and incumbent Federal radar systems. Said another way, the SAS will authorize GAA use of PAL spectrum so long as the -80 dBm/10 MHz channel protection level is met (see Figure 3 below). If a PAL licensee registers a new CBRS device in its licensed PAL Protection Area that would conflict with the previously authorized lower-tier user,

the SAS will inform the GAA user that it may no longer have access to that spectrum and that it must request a new authorization.

Figure 3 – PAL Protection Area



This use-or-share approach provides higher tier users with enough certainty that the spectrum they have purchased via auction is available to them when and where they need it without having to make business decisions years in advance. It also provides opportunistic access for lower tier users who may only need the spectrum on a temporary basis to support a particular event or who are looking to tailor their network to a specific set of needs, such as Industrial Internet of Things (IIoT) or security.

We anticipate that PAL license holders will opt to lease their unused spectrum to other users rather than allowing GAA users to operate under the use-it or share-it rules. By offering leases to GAA users, the PAL license holders will be able to monetize any unused portions of their licensed spectrum and count the deployments of their lessees towards their own FCC performance obligations. In turn, the GAA users are likely to enter into leases with PAL license holders in order to have greater certainty regarding spectrum access rights. The Federated Wireless SAS will facilitate these secondary market transactions through the automation of spectrum leasing and the elimination of transaction costs and administrative burdens.

Maximizing Spectrum Access for a Variety of Use Cases

As the tiered shared access licensing approach in the CBRS band becomes commercial reality in the United States, we are seeing an unprecedented number of new uses cases emerging as the result of new spectrum access options becoming available. These new use cases include:

IN-BUILDING	PUBLIC SPACES	INDUSTRIAL IoT
<ul style="list-style-type: none">• Education• Military• Hospitality	<ul style="list-style-type: none">• Entertainment• Government• Retail	<ul style="list-style-type: none">• Manufacturing• Mining• Oil and Gas

<ul style="list-style-type: none"> • Healthcare • Multi-family Residential • Office Space 	<ul style="list-style-type: none"> • Smart City 	<ul style="list-style-type: none"> • Power and Utilities • Transportation
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The flexible multi-tier licensing framework lowers the barrier to spectrum and promotes success-based investment for new entrants. While focused on LTE initially, the CBRS band will soon transition to 5G as equipment becomes available, offering cost-effective solutions for both indoor and outdoor applications, opening up new use cases, and encouraging business innovations from old and new players alike.

As ACMA seeks to encourage the introduction of new use cases through non-traditional licensing schemes, we believe a combination of licensed, shared-licensed and unlicensed in the same band will best achieve the goals of encouraging innovation and enabling enterprises and operators the ability to develop new business models, applications, services, products and capabilities.

D. Conclusion

Federated Wireless appreciates the opportunity to share our experience in implementing commercial services on a shared basis in the 3.5 GHz and 6 GHz bands. We applaud ACMA for its efforts to unlock opportunities for improved spectrum utilisation and look forward to working with Australia as it considers the use dynamic shared spectrum technology to increase spectrum access through more flexible licensing arrangements.