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August 31, 2023

Czech Telecommunications Office (CTU)
Poštovní Přihrádka 02,
225 02 Prague 025
Czech Republic

Re: Call for comments on the update of the Radio Spectrum Management Strategy

Dear CTU -

The Dynamic Spectrum Alliance (DSA)[1] respectfully submits these comments to the Czech Telecommunications Office (CTU) in response to the "Call for comments on the update of the Radio Spectrum Management Strategy" (Consultation).[2] We appreciate the opportunity to offer our perspectives on how CTU can implement dynamic spectrum sharing to support "innovations, economic development and quality communications services for all citizens and undertakings in the Czech Republic" and to enable "a broadening of the availability of other parts of the radio spectrum for these services, both for licensed and non-licensed utilisation of broadband access networks."[3]

The DSA welcomes CTU's efforts to identify "general principles that will contribute to the development of society, the economy, science, innovation, international cooperation or the automation of spectrum management in the future."[4] We believe that wireless networks play a critical role in economic development and that the availability of spectrum is a key enabler.

The DSA and our members work with regulatory authorities around the world to promote new and innovative approaches to spectrum management to increase spectrum access options and extend connectivity. Such innovative approaches include the adoption of new licensing frameworks that incorporate licensed, unlicensed, and license-by-rule access options. In addition, the DSA promotes

[1] The DSA is a global, cross-industry, not for profit organization advocating for laws, regulations, and economic best practices that will lead to more efficient utilization of spectrum, fostering innovation and affordable connectivity for all. Our membership spans multinationals, small-and medium-sized enterprises, as well as academic, research and other organizations from around the world all working to create innovative solutions that will benefit consumers and businesses alike by making spectrum abundant through dynamic spectrum sharing. A full list of DSA members is available on the DSA's website at dynamicspetrumalliance.org/members.
[2] Available at https://www.ctu.eu/radio-spectrum-management-strategy.
[3] https://www.ctu.eu/call-comments-update-radio-spectrum-management-strategy.
[4] Id.

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the use of automated dynamic spectrum management systems (DSMS) to make more efficient use of spectrum and support a wide range of commercial services, including wide-area mobile and fixed broadband networks, as well as local and private networks, use cases and applications. We believe that these concepts and tools should be key components of CTU's Radio Spectrum Management Strategy.

The DSA and our members are available to discuss these comments and provide any additional information and insights on dynamic spectrum management and how it can assist CTU in its efforts to increase spectrum access options to support quality communications services for all citizens and undertakings in the Czech Republic.

Respectfully submitted,

Martha SUAREZ
President
Dynamic Spectrum Alliance

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DSA
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DSA COMMENTS

I. Introduction to the DSA and Automated Dynamic Spectrum Management Systems

Today, we have the technical capability to automate frequency coordination, which lowers transaction costs, uses spectrum more efficiently, speeds time-to-market for new services, protects incumbents from harmful interference with greater certainty, and generally expands the supply of spectrum for wireless connectivity that is fast becoming, like electricity, a critical input for most industries and economic activity.

To maximize the efficient use of spectrum and provide a variety of access options, the DSA recommends that regulators worldwide implement automated Dynamic Spectrum Management System (DSMS) solutions and innovative licensing frameworks. In the whitepaper entitled "Automated Frequency Coordination - An established tool for modern spectrum management,"[5] the DSA explains that the use of databases and other informing capabilities to coordinate spectrum assignments has evolved significantly since its first introduction, but at its heart, is nothing new. The basic steps are the same as in a manual coordination process or where a regulator assesses the opportunities for local licensing on a case-by-case basis. The developments driving DSMS include:

- Surging consumer demand for wireless connectivity leading to the need to intensively share underutilized frequency bands;
- Significant improvements in the computation power to run advanced propagation analysis efficiently and rapidly and coordinate devices and users in near real-time; and
- Availability of more agile wireless equipment that can interact directly with dynamic frequency coordination databases.

Automated DSMS tools, such as those developed for the TV White Spaces (TVWS), the 3.5 GHz Citizens Broadband Radio Service (CBRS), and for unlicensed devices operating in the 6 GHz Band at Standard Power, share similarities. Technical and service rules for incumbent operations and new entrants are converted into algorithms, which are used together with information obtained via a database query or other informing capability to provide a list of available channels and maximum power for that location back to a device seeking to access the band. Differences between the automated DSMS tools for the TVWS, CBRS, and the 6 GHz bands are driven by the type of incumbent operations that require protection in each band.

[5] Available at http://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf.

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The DSA anticipates that regulatory authorities worldwide will need to rely increasingly on automated DSMS tools to handle surging demand for wireless connectivity by sharing underutilized frequency bands. Significant improvements in computation power are enabling more efficient and rapid advanced propagation analysis capability, which in turn enables coordination of devices and users in what is close to real-time. Application of artificial intelligence techniques, such as machine learning for spectrum sensing and for signal classification, also can support improved spectrum management.[6] In addition, more agile wireless equipment is being developed that can interact directly with DSMS tools, increasing opportunities for even greater efficiency and scale.

A) Automated Spectrum Sharing in the U.S. 3.5 GHz CBRS Band

One of the best examples of a successful implementation of an automated DSMS and novel licensing framework is the U.S. 3.5 GHz CBRS band (3550-3700 MHz). Authorized by the Federal Communications Commission (FCC) in January 2020, CBRS has been a shining example of the myriad benefits of automated spectrum sharing.

Under the CBRS regulatory framework, the Spectrum Access System (SAS) coordinates CBRS frequency use and manages coexistence among the three tiers of access:

1) Incumbent (e.g., navy radar and commercial fixed satellite services);
2) Priority access license (PAL); and
3) General authorized access (GAA).

An environmental sensing capability (ESC) network detects incumbent naval radar use of the band and alerts the SAS to move new terrestrial commercial operations to non-interfering channels. The SAS also interfaces with the FCC's Universal Licensing System (ULS) to obtain information about fixed satellite service (FSS) incumbents and grandfathered fixed wireless systems. Using this information, the SAS can calculate aggregate interference from new commercial users to incumbents and enforce protection of these systems. In the more than three years of commercial operational experience, no incumbents have reported interference from new CBRS users, demonstrating the effectiveness of SAS management of the band.

Commercial users in the CBRS band have multiple options for accessing this 150 MHz of spectrum:

- Acquisition of a PAL in the FCC's 2020 CBRS auction where use-or-share rights for county-based licenses were made available;
- Use of the GAA tier, which does not require an individual license to operate, but does require use of certified equipment and connectivity to a SAS to

[6] Body of European Regulators for Electronic Communications (BEREC), "Draft - BEREC Report on the impact of Artificial Intelligence (AI) solutions in the telecommunications sector on regulation," BoR (22) 191, Dec. 2022, pages 24-26. Microsoft Word - BoR (22) 191 Draft Report on challenges and benefits of Artificial Intelligence (AI) solutions in the telecomm (europa.eu).

receive a spectrum grant for operations with a particular transmit power and antenna orientation at a specific location and height; or

- Leased rights from a PAL license holder.

Based on the type of device (i.e., base station category), license status (PAL or GAA), geo-coordinates and height, operating parameters, and incumbent protection criteria, the SAS calculation engine determines the list of available channels and maximum permissible radiated power for that specific device.

As described above, the SAS not only coordinates protection of incumbent users from new commercial operations, but also manages the assignment of frequencies to PAL and GAA users, protection of PAL operations, and co-existence among GAA users to maximize spectrum efficiency and provide deterministic access for all users. The automated SAS process provides near real-time management of the CBRS band, speeding time-to-market while minimizing uncertainty and administrative burdens.

Through this automation of shared spectrum, a whole host of new services has emerged. In addition to densification of the nationwide public mobile networks, and use of these frequencies by rural wireless Internet service providers (WISPs), a wide variety of private networks are also using the CBRS band. From business to leisure, hundreds of smart office, airport and stadium private networks have been deployed using CBRS as the result of having access to spectrum without the need for an individual license. In fact, today there are over 360,000 CBRS cell sites deployed across the United States, with the vast majority using the GAA tier.

Examples of such private wireless network deployments using the CBRS GAA tier include:

Military logistics:
https://www.fiercewireless.com/private-wireless/federated-demo-dod-highlights-benefits-shared-spectrum

Energy management:
https://www.fiercewireless.com/private-wireless/schneider-electric-adds-private-wireless-smart-factories

Retail:
https://www.druidsoftware.com/2019/11/15/cbrs-ongo-at-american-dream-entertainment-retail-complex-nj-usa/

Municipal government:
https://www.fiercewireless.com/private-wireless/motorola-and-harris-county-build-private-lte-network

https://www.fiercewireless.com/private-wireless/cox-launches-cbrs-pilot-city-las-vegas

Transportation:
https://www.fiercewireless.com/wireless/boingo-deploys-trial-cbrs-network-at-dallas-love-field-airport

Education:
https://www.csrwire.com/press_releases/747561-private-wireless-helps-schools-close-digital-divide

https://www.fiercewireless.com/private-wireless/fort-worth-isd-builds-sustainable-cbrs-network

https://www.fiercewireless.com/private-wireless/samsung-amdocs-deploy-private-cbrs-network-howard-university

Entertainment:
https://inbuildingtech.com/venues/connectivity-wireless-jma-stadium-cbrs/

Hospitality:
https://www.thefastmode.com/technology-solutions/24585-airspan-networks-deploys-5g-cbrs-private-network-for-hospitality-industry

Manufacturing warehouse/supply chain:
https://www.fiercewireless.com/private-wireless/calchip-connect-emerges-key-player-private-wireless

https://www.fiercewireless.com/private-wireless/mxd-adds-second-private-wireless-network

Agriculture:
https://www.fiercewireless.com/private-wireless/three-day-deployment-makes-tractors-autonomous

https://enterpriseiotinsights.com/20220607/smart-farm/how-robot-tractors-and-a-private-network-came-together-at-a-smart-vineyard

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B. Automated Frequency Coordination Unlicensed Standard Power Devices in the 6 GHz Band

Another notable example of automated spectrum sharing is the 6 GHz Band, where regulators worldwide are enabling unlicensed WLAN/RLAN use on a shared basis with incumbent services using the following approach:

1) Authorizing up to 1200 MHz (5925-7125 MHz) of the 6 GHz Band for unlicensed use; and

2) Authorizing one or more of the following categories of unlicensed devices:

(i) Very Low Power (VLP) devices across the entire authorized frequency range

(ii) Low Power Indoor (LPI) devices across the entire authorized frequency range, and

(iii) Standard Power (SP) devices that can operate both outdoors and indoors under the coordination of an automated database management system, known as the Automated Frequency Coordinator (AFC), where the authorized frequency range depends on the nature of the incumbents.

Several countries are actively deploying LPI devices on an unlicensed,[7] shared basis in the 6 GHz Band, leveraging wider channel availability (up to 160 MHz with Wi-Fi 6) to increase spectrum efficiency while maintaining the ability to share spectrum with incumbents and other unlicensed deployments. In the future, Wi-Fi 7 will be able to accommodate 320 MHz channels, which will further improve latency, throughput, reliability, and quality of service.

For SP operations, AFC systems have been designed to provide channel availability information to unlicensed devices, while ensuring that incumbent systems, including fixed point-to-point microwave links, are protected from interference. When an authorized and authenticated SP device queries an AFC for spectrum availability, the AFC will assess which incumbent fixed link receivers have the potential to receive excess energy from the unlicensed device based on its location and potential transmit power. The AFC calculates the maximum transmit power for that device's location on each 6 GHz channel and provides a list of options for the device to select. The device must check in with the AFC daily to determine if any changes to incumbent use of the band have occurred that would alter the channel and transmit power options available to it.

Building on the experience and lessons learned from the use of SAS in the CBRS band and TVWS database described below, several DSA members have developed AFC systems for the 6 GHz Band and have applied to become AFC system operators in the United States and Canada. It is expected that the FCC and ISED will certify multiple AFC system operators and permit unlicensed SP devices to begin using the 6 GHz band in 2023. DSA anticipates that

[7] While the U.S. and some other countries use the term unlicensed spectrum, other countries use terms such as license-exempt, license-free, or free spectrum to describe a similar concept.

many of these same AFC system developers will also seek to operate in other countries, such as Brazil, Korea, and Saudi Arabia, that are in the process of finalizing their regulations for AFCs that will provide access to unlicensed SP devices seeking to operate in the 6 GHz Band.

C. TV White Spaces

A third example of an automated DSMS capability, one that pre-dates both the SAS and AFC, is in the TVWS, where automated spectrum management systems – TVWS databases -- facilitate unlicensed access to unassigned and unused TV band channels. Rules governing database-coordinated access to TVWS for fixed and personal/portable devices were finalized in 2008 by the FCC and have been updated several times. Similar regulations have been adopted by a growing list of countries since then.

TVWS database systems ingest current technical and operational parameters on incumbents (e.g., broadcast television stations, radio astronomy facilities, wireless medical telemetry service facilities, and others) operating in the broadcast TV bands from the regulatory authority's licensing databases. They also receive additional information regarding 'reservations' for licensed wireless microphones operations made via an online portal and combine this with geolocation information and operating parameters received from the White Space devices to receive a list of available channels and the maximum power of each available channel at that location.

II. Recommendations for CTU's Radio Spectrum Management Strategy

The DSA encourages CTU to implement both innovative licensing frameworks and DSMS tools and technologies to expedite and streamline sharing of currently occupied bands. Innovative licensing frameworks include licensed, unlicensed, and license-by-rule access options.

For licensed/licensed-by-rule bands, the DSA recommends considering tiered approaches that offer protection for incumbent services while also offering multiple access options for new users. These automated DSMS solutions and tiered licensing approaches need not be complex. Rather, they need only ensure protection of incumbents and enable the type (or types) of spectrum sharing desired by policy. Ideally, simple automated DSMS and licensing approaches are preferrable.

The simplest model is a two-tier model, whereby new entrants must protect incumbent users. An example of this is the 6 GHz band where unlicensed devices operating cannot cause harmful interference to licensed operations and cannot seek protection from interference. Depending on the incumbent services in the desired band, a two-tier system where opportunistic users

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operating under a licensed-by-rule regime would have to protect incumbent operations could work as well.[8]

Another model the DSA supports is a three-tier sharing framework, much like that used for CBRS in the 3 GHz band:

> Tier 1 – **Incumbent users** operating in the band have the highest priority in accessing spectrum, with their access always guaranteed during their operations so that their radio equipment need not be aware of other operations sharing the band.
>
> Tier 2 – **Licensed new users** require a degree of certainty in accessing spectrum. To ensure sharing of the band with this tier of users, it is fundamental that the operation of incumbent services is well understood (e.g., operate only in certain areas) and is predictable (e.g., operate at certain times or otherwise offer information about when spectrum needs to be vacated). If such information is not accurate enough or unavailable, then access to the band for Tier 2 users might be greatly reduced or impossible. A use-or-share requirement for licensed spectrum is also important to ensure that spectrum use is maximized.
>
> Tier 3 – **Opportunistic users** can access spectrum on an unlicensed or licensed-by-rule basis. These users may not need access to spectrum over a larger geographic area, may be operating indoors or on a campus, or may be operating in more remote areas where spectrum usage will not be as competitive. In many cases, such networks are deployed in very remote areas where spectrum is largely unused and the risk of interference to higher-tier users is negligible. There might be other cases where there is sufficient spectrum available and the envisioned applications allow QoS flexibility, for example because the band is used to provide additional capacity to networks using other anchor frequencies. In such cases, it is conceivable to have a third tier of users with minimal regulatory barriers and no need for interference protection from other Tier 3 users.

The DSA recommends that CTU also consider streamlined secondary market rights for licensed spectrum. For example, license conditions might include the right for the license holder to lease the spectrum to other users – whether on a geographic basis (partitioning) or by sub-dividing the spectrum (disaggregating). Such a secondary market can drive innovation, allow new technology to be deployed by leased spectrum users, and support various sectors, such as enterprise networks and industrial uses.

The DSA also recommends that CTU consider implementing a "use-it-or-share-it" policy for licensed bands. Conceptually, use-it-or-share-it rules authorize opportunistic access to licensed

[8] Note that over a decade ago concepts such as License Shared Access and Authorized Shared Access (LSA/ASA) were introduced as a potential two-tier sharing models between IMT systems and incumbents that obtained their spectrum through non-commercial means (e.g., Federal spectrum users). LSA/ASA was proposed as an alternative to the three-tier CBRS frameworks but did not allow for opportunistic use. LSA/ASA never took root.

spectrum that is locally unused or underutilized. Until the spectrum is actually put to use in a local area, it should be available for non-interfering use by networks and devices. Licensees lose no rights whatsoever.

A general use-it-or-share-it authorization has a number of affirmative benefits. First, opportunistic access reduces spectrum warehousing in areas where the economics are least attractive for large service providers. It might increase access for operators that are interested in deploying, but who lack needed spectrum access in that local area.

Second, opportunistic access further encourages secondary market transactions by facilitating price discovery on both the supply and demand side. For licensees, it will both identify users interested in a potential lease or partition and provide information on the potential value (i.e., how much is my spectrum worth?). For users, opportunistic use is an opportunity to test the local market and to determine the value of a more secure, longer-term lease or partition agreement (i.e., how much am I willing to pay for spectrum?).

Third, opportunistic access will lower barriers to entry for innovative new use cases by parties that at least initially either cannot afford or do not believe they need to pay for exclusive use and interference protection. The option to deploy, at least initially, without committing to the cost of a long-term lease or license could be particularly useful for small providers and industries.

III. Conclusion

The DSA appreciates the opportunity to provide input on CTU's Radio Spectrum Management Strategy. We believe that innovative licensing frameworks, spectrum sharing, and automated DSMS solutions can help CTU promote the emergence of new radio technologies, services and applications and improve efficient use of radio frequency spectrum. DSMS solutions lower transaction costs, ensure that spectrum is used more efficiently, speed time-to-market for new services, protect incumbents from interference with greater certainty, and generally expand the supply of wireless connectivity that is fast becoming, like electricity, a critical input for most industries and economic activity. The DSA and our members stand ready to work with CTU to build on the success of existing spectrum sharing frameworks, improve spectrum efficiency, spur the deployment of innovative applications and services by new entrants, and ease the perceived spectrum crunch.