Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
University of Utah Request for Waiver of	)	No. _____
the Commission's Citizen's Band Radio	)	
Service Rules to Authorize Use of	)	
Software-Defined Radio Equipment to	)	
Interact with the Spectrum Access System	)	

REQUEST FOR WAIVER

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REQUEST FOR WAIVER

The University of Utah, by counsel, requests a waiver of the Commission's rules to permit it to utilize Software-Defined Radio (SDR) equipment to interact with the Spectrum Access System (SAS) in the Citizen's Band Radio Service (CBRS).[1]

A. SUMMARY

The University of Utah, one of this nation's leading research Universities,[2] located in Salt Lake City, Utah (University) respectfully requests a waiver of Section 96.39 of the Commission's rules to allow it to operate its POWDER platform in the CBRS band. The POWDER platform offers a testbed for wireless research on and around the campus of the University. As the Commission knows, mid-band spectrum, such as the CBRS band, will play a key role in wireless technology development and will be critical to unlocking the potential of 5G and beyond technologies. The POWDER platform can help speed the development and deployment of new wireless technologies by enabling researchers to test innovative wireless solutions for use in the CBRS band. As more fully described below, the University is confident

[1] *See* 47 C.F.R. 1.925.

[2] The University is a member of the Association of American Universities, a collection of leading research universities in the United States and Canada. *See Our Members*, Association of American Universities, https://www.aau.edu/who-we-are/our-members (last visited March 31, 2022).

that the POWDER platform can coordinate control of equipment deployed as part of the platform with an SAS. However, because of the platform's architecture, Citizens Broadband Radio Service Devices (CBSD) being used by the platform will not always fully comply with Section 96.39 of the Commission's rules. Therefore, as described and limited below, the University seeks a waiver of the Commission's rules to permit its POWDER platform to operate under either GAA or PAL authority in the CBRS band.

B. DESCRIPTION OF THE POWDER PLATFORM

The POWDER platform is a research tool operated by the University. Its primary objective is to enable innovation and research associated with wireless systems in general and innovative spectrum use in particular. The platform consists of fixed radio systems (SDRs, RF frontends, antennas) deployed on rooftops and other infrastructure, along with mobile radio systems deployed on University campus shuttles. As such, the POWDER platform can be considered a living laboratory that allows research and innovation in a real-world, spectrum realistic environment.

The Commission designated the POWDER platform as one of the first Innovation Zones.[3] Innovation Zones "provide opportunities for qualified licensees to test new advanced technologies and prototype networks – such as those that can support 5G technologies – outside a traditional small campus or laboratory setting."[4] The POWDER Innovation Zone covers approximately four square miles of Salt Lake City, Utah,

[3] *Office of Engineering and Technology Announces First Innovation Zones for Program Experimental Licenses*, Public Notice, 34 FCC Rcd. 8130 (OET 2019) (Innovation Zone PN).
[4] *Id.* at 8130.

including a section on the campus of the University, a portion of Salt Lake City's downtown, and a corridor connecting those areas.[5]

To facilitate a wide variety of testing by third party researchers, the platform makes significant use of SDRs. Researchers can upload software and firmware that reprograms such radios. This approach enables flexible, remote, low-cost experimentation with all layers of innovative radio systems including, in particular, the physical layer. For example, the platform has been and will likely continue to be used to test new forms of encoding and modulating wireless signals. To maintain control over this system, the POWDER platform operates a sophisticated control framework that monitors and controls the platform's equipment (POWDER Spectrum Control) and will interface with an SAS through a CBRS Domain Proxy.[6]

C. NEED FOR WAIVER

The availability of CBRS channels pursuant to an experimental license on a not-to-interfere basis is increasingly intermittent, and access to the band is likely to become even more limited as PAL and GAA use in the CBRS band expand. As the Commission knows, Innovation Zones were designed to allow the use of experimental licenses on a wider scale.[7] However experimental licenses and special temporary authority authorizations are proving to be insufficient for testing mid-band spectrum. PAL and GAA users are already putting CBRS channels into use, and the band is expected to become more well-used in the future. Urban areas, like Salt Lake City, expect to see significant growth in the use of CBRS spectrum because of the Commission's successful CBRS auction. While this growth in CBRS band use illustrates the

[5] Detailed information regarding the platform's geographic area is provided in **Exhibit A**.
[6] A network diagram of the POWDER platform is attached as **Exhibit B**.
[7] *See* Innovation Zone PN, 34 FCC Rcd. at 8130.

success of the Commission's mid-band spectrum policy, it is making it increasingly difficult for the POWDER platform to conduct mid-band research.

Experimental access to the CBRS band is critical to ensure continuing innovation. Demand for spectrum resources has exploded in recent years, and demand growth is expected to continue. New and more efficient wireless technology will be needed to support ever greater use of the country's wireless spectrum. As a key national testbed for wireless innovation, it is important for the POWDER platform to support mid-band wireless testing and experimentation.

While nothing currently precludes the POWDER platform from becoming a GAA or PAL user of the CBRS band, the platform's architecture raises several questions regarding compliance with the CBRS rules. In general, the University would expect any CBRS operations conducted using the POWDER platform to comply with the Commission's rules, but several provisions of Section 96.39 raise concerns. Specifically, Section 96.39(c) requires CBSDs operating in the CBRS band to "register with and be authorized by an SAS prior to its initial service transmission" and to provide certain information to the SAS.[8] Likewise, Section 96.39(e) requires a CBSD that receives a range of available frequencies or channels to "promptly report to the SAS which of the available channels or frequencies it will use,"[9] and Section 96.39(a) requires CBSDs to connect with an SAS to provide geo-location information. However, the equipment that will serve as a CBSD for the platform will not directly connect to or register with an SAS. Therefore, as detailed below, the University requests waiver of Sections 96.39(a), (c) and (e) to allow the POWDER platform to operate between an SAS and CBSDs deployed as part

[8] *See* 47 C.F.R. § 96.39(c).

[9] *Id.* at § 96.39(e).

of the platform.[10] In the alternative, the Commission could clarify that the POWDER platform constitutes a CBSD with multiple nodes or a network of nodes in which network management and communications with the SAS is accomplished via a single network interface.[11]

The POWDER platform also may not be fully capable of complying with Section 96.39(d). That section requires CBSDs to report "received signal strength in its occupied frequencies and adjacent frequencies, received packet error rates or other common standard metrics of interference for itself and associated End User Devices as directed by an SAS."[12] The POWDER platform will be used by third party experimenters. Therefore, the availability and accuracy of signal level reporting required by Section 96.39(d), specifically levels associated with received signal strength in an occupied frequency and received packet error rates, cannot be guaranteed. To be clear, the platform would report as much signal level information as possible to an SAS, but the experimental nature of the platform's use may lead to circumstances in which signal level information cannot be provided.

Finally, Section 96.39(g)'s requirement that CBSDs must protect against modification of software and firmware by unauthorized parties may preclude the use of the POWDER platform's SDRs. Even if the University were authorized to modify the POWDER platform CBSDs' software and firmware via SDRs, a wide variety of third-party researchers also utilize the platform. The platform maintains a high degree of control over changes to its network through the POWDER Spectrum Control center, but flexibility and access to the platform by researchers are necessary to fully realize the platform's potential. Therefore, the University seeks waiver of

[10] Information required by Section 96.39(a), (c), and (e) will be provided via the CBRS Domain Proxy that interfaces with an SAS.

[11] *See* 47 C.F.R. § 96.3 (defining CBSDs).

[12] *Id.* at § 96.39(d).

Section 96.39(g) to allow both University personnel and other users of the platform to modify the software or firmware of a CBSD being used as part of the POWDER platform.

D. REQUEST FOR WAIVER

Waiver of Section 96.39(a), (c), and (e)

The University respectfully requests waiver of Section 96.39(a), (c), and (e) of the Commission's rules. As noted above, not every radio device that may be configured for use in the CBRS band will register and communicate with an SAS. Instead, the University would plan to register the POWDER platform CBRS subsystem with an SAS. The platform would operate a CBRS Domain Proxy server to interface with the relevant SAS and POWDER Spectrum Control, which would, in turn, communicate with local RF Control and Monitor systems co-located with each SDR being used as a CBSD by the platform. Spectrum grant/relinquish/change messages received by the CBRS Domain Proxy will be relayed to POWDER Spectrum Control, which will require the platform user to adjust its transmission parameters within 50 seconds. If the user does not adjust its transmission, POWDER Spectrum Control will terminate further transmission. The University will also operate an alternative stop buzzer procedure as part of POWDER Spectrum Control.[13]

In the alternative, the University requests that the Commission clarify that the POWDER platform's use of a CBRS Domain Proxy, which will fulfill the requirements of Section 96.39(a), (c), and (e), meets the definition of a CBSD and is eligible to register with an SAS. The definition of a CBSD contemplates that a CBSD could be comprised of "multiple nodes or

[13] POWDER partners with the Utah Education and Telehealth Network (UETN) to provide a 24x7 network operations center (NOC). POWDER and UETN have established a set of procedures whereby UETN NOC operators can operate the stop buzzer process when requested by an SAS. Contact information will be prominently displayed on the POWDER website and directly communicated to SAS providers.

networks of nodes" with management and communications with the SAS "accomplished via a single network interface."[14] Under such a system, CBSD requirements apply to each node in the network, but the SAS interface can be accomplished through a common command and control point. The POWDER platform contemplates a similar network architecture with the CBRS Domain Proxy/POWDER Spectrum Control acting as the interface with an SAS. To the extent the POWDER platform, operating in this manner, satisfies the definition of a CBSD comprising multiple nodes, waiver Section 96.39 (a), (c), and (e) may not be necessary, but the University would appreciate clarification that the platform meets the definition of a CBSD in Section 96.3 of the Commission's rules.

Waiver of Section 96.39(d)

The University requests waiver of Section 96.39(d) of the Commission's rules to allow the POWDER platform to operate as a GAA or PAL CBSD without reporting signal level information to an SAS. As noted above, the CBRS Domain Proxy/POWDER Spectrum Control will interface with an SAS, maintain robust control over SDRs operating as CBSDs or nodes, and terminate any transmissions that violate SAS authorization. In addition, the platform will report as much signal level information as possible to an SAS; however, because of the experimental nature of the platform, signal level information may not always be available.

Waiver is justified because the small amount of signal level information generated by the POWDER platform will not increase the risk of harmful interference or limit SASs' ability to update their propagation models. In adopting Section 96.39(d), the Commission found that signal level reporting could be used to help an SAS "tune or update its predictive propagation models

[14] *See* 47 C.F.R. § 96.3.

and detect realistic interference issues once CBSDs are deployed."[15] Thus, section 96.39(d) serves primarily to help an SAS prospectively improve interference detection and resolution, but even if the POWDER platform reported no signal level information, SAS operators will still have access to sufficient signal level data to update propagation models. Finally, as noted above, the platform will quickly terminate any transmission that is not authorized by an SAS.

Waiver of Section 96.39(g)

It bears repeating that the platform will be monitored and controlled at all times by the CBRS Domain Proxy/POWDER Spectrum Control. That system will interface with an SAS and will communicate with equipment being used by the platform through RF monitoring and control systems co-located with each POWDER radio/SDR. Any transmission in violation of SAS specifications will be promptly terminated. In addition, the POWDER platform partners with the Utah Education and Telehealth Network (UETN) to provide a 24x7 NOC. POWDER and UETN have established a set of procedures whereby UETN NOC operators can operate the stop buzzer process when requested by an SAS. Contact information will be prominently displayed on the POWDER website and directly communicated to SAS providers.

The University requests waiver of Section 96.39(g) to allow it and researchers using the POWDER platform to update software and firmware for the CBSD equipment (or CBSD nodes) using SDRs. Testbeds, like POWDER, depend on flexibility to give researchers the ability to conduct a wide variety of experiments. Utilizing SDRs gives the POWDER platform the flexibility its researchers need. While the Commission contemplated a wide variety of uses and users for CBSDs in the CBRS band, access to the POWDER platform is necessarily limited.

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[15] *In re Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd. 3959, ¶ 235 (2015).

Unlike many potential CBRS users, the domain experts using and operating the platform are uniquely qualified to operate SDRs within the permissions granted by an SAS. Indeed, the changes would include reconfiguring the platform from an experimental setup outside the CBRS band to a configuration in the CBRS band. The flexibility enabled by SDRs is a key to what makes the POWDER platform a powerful research tool, but it would be unduly burdensome to require each researcher that uses the platform to seek approval of an SDR configuration in the CBRS band before conducting a test. Therefore, a waiver of Section 96.39(g) is appropriate.

E. PUBLIC INTEREST

Granting this waiver will help expand use of CBRS band by enabling the POWDER platform to effectively support experimentation in mid-band spectrum. Wireless communication has become a key part of the country's economic and social infrastructure. Demand for access to spectrum resources continues to grow rapidly among consumers and businesses alike. To keep up with this demand, the wireless industry will need innovative, new ways to use spectrum, and the research conducted using the POWDER platform gives researchers the ability to develop those new wireless technologies.

Moreover, the unique nature and purpose of the POWDER platform limit any risks associated with waiving Section 96.39 of the Commission's rules. As noted above, access to the platform's SDRs and other equipment is limited, and the team operating the platform and the researcher using it are domain experts. Moreover, the POWDER platform employs a robust monitoring and control system that will disable any transmission that violates SAS authorized specifications. In addition, granting this waiver will not give rise to a large number of similar requests because few organizations operate similar wireless testbed facilities that have the expertise and ability to safely reconfigure SDRs according to the Commission's CBRS rules. In

sum, this waiver is in the public interest because there is little downside risk, and its grant would facilitate precisely the type of wireless research needed to fully realize the potential of the CBRS band, 5G, and future wireless technologies.

F. WAIVER STANDARD

The Commission may waive its rules for good cause shown. "Good cause … may be found and a waiver granted 'where particular facts would make strict compliance inconsistent with the public interest.'"[16] That is the case here.

Section 1.925(b)(3) establishes two grounds for waiver. First, waiver is appropriate where "the underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and that a grant of the requested waiver would be in the public interest."[17] Second, the Commission may waive its rules where "in view of unique or unusual factual circumstances of the instant case, application of the rule(s) would be inequitable, unduly burdensome, or contrary to the public interest, or the applicant has no reasonable alternative."[18] This request satisfies both justifications.

WAIT Radio v. FCC further animates the Commission's waiver consideration.[19] In that case, the D.C. Circuit Court of Appeals emphasized the importance of waiver procedures as part of the regulatory scheme. "The agency's discretion to proceed in difficult areas through general rules is intimately linked to the existence of a safety valve procedure for consideration of an

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[16] *SafeView, Inc.*, 25 FCC Rcd. 592 at ¶ 15 (2010), *citing Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990).

[17] 47 C.F.R. § 1.925(b)(3)(i).

[18] *Id.* at § 1.925(b)(3)(ii).

[19] 418 F.2d 1153 (D.C. Cir. 1969). *See also 2002 Biennial Regulatory Review*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd. 13620 at ¶ 85 n.130 (2003) (citing *WAIT Radio* as "setting out criteria for waivers of Commission rules.")

application for exemption based on special circumstances."[20] Regulations maintained inflexibly without any procedure for waiver threaten the Commission's ability to administer its rules in the public interest.[21] Thus, when a waiver request is made with clarity and supported by supporting evidence, the request must be given a "hard look."[22]

Waiver is warranted because it will not undermine the CBRS rules and enabling expanded use of the CBRS band by the POWDER platform will serve the public interest. The underlying purpose of the CBRS rules is to manage and maximize access to the band by users and to prevent those users from interfering with one another. Because this waiver is limited in scope, CBRS access by the POWDER platform will comply with the vast majority of the CBRS band's technical rules. Moreover, the platform maintains control over any transmitting equipment, including any equipment operating in the CBRS band, and any transmission that violate SAS authorization will be promptly terminated. Indeed, the platform's operators are uniquely qualified to ensure that access to the CBRS band conforms with the authorization granted by an SAS. Therefore, allowing the POWDER platform to access the CBRS band on a GAA or PAL basis pursuant to this waiver will not frustrate the Commission's rules, and the mid-band research enabled by this waiver will serve the public interest.

Waiver is further warranted because of the unique and unusual factual circumstances surrounding the POWDER platform. As an Innovation Zone, the platform is among a limited number of areas in the country where advanced wireless research can be conducted in a spectrum realistic environment. Given the limited risk posed by this request, it would be contrary to the

[20] *Id.* at 1157.
[21] *Id.*
[22] *Id.*

public interest to preclude much needed next generation wireless technology research from taking advantage of the POWDER platform.

Finally, this request fits neatly within the "safety valve" concept articulated in *WAIT Radio*. The requested waiver is in the public interest, not only in terms of benefits to the public, but also in the absence of any likely increase in harmful interference. Thus, the request is entitled not only to the "hard look," but to a grant of the waiver.

G. PROPOSED WAIVER CONDITIONS

1. Service provided using the POWDER platform must be limited to users or researchers authorized by the University.[23]

2. The POWDER platform equipment installation and SDR modifications must be performed by platform operators or authorized researchers and technicians utilizing the platform.

3. The CBRS Domain Proxy/POWDER Spectrum Control must interface with an appropriate SAS to maintain control over the POWDER network and must terminate transmissions in violation of SAS authorization within 50 seconds.

4. The POWDER platform must be monitored 24x7, and a stop buzzer procedure must be available as a safety backup for POWDER Spectrum Control.

5. Waivered equipment must comply with all applicable Part 96 rules except as specifically waived herein.

6. POWDER platform equipment must remain under the control of the CBRS Domain Proxy/POWDER Spectrum Control at all times.

[23] Operations, service, and experiments conducted using the POWDER platform are not available to the general public; therefore, any use of the POWDER platform in the CBRS band would be limited to experimental users or researchers authorized by the University.

H. CONCLUSION

For the reasons set out above, the University of Utah asks the Commission to consider and grant the requested waiver.

Respectfully submitted,

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Exhibit A

Scope of waiver request

Operation under this waiver will be constrained to the POWDER platform and specifically to the geographic area covered by the POWDER FCC Innovation Zone designation. Radio equipment used in the POWDER platform is physically enclosed in locked containers, thus preventing the equipment from being moved to other locations. Further, even if devices were stolen and moved to a different geographic area, they will not transmit without a connection to the POWDER spectrum control system. The POWDER spectrum control system employs secured out-of-band communication channels for this interaction and applies additional security safeguards to ensure communication only occurs to POWDER controlled devices.

The geographic area covered by the POWDER FCC Innovation Zone designation encompasses approximately 4 square miles over three connected areas providing options for testing over a campus (University of Utah), within a downtown area and within a corridor connecting the two.

The University of Utah campus portion of the Innovation zone measures approximate 2.43 square miles in area and is defined as the region between North Campus Drive (in the north), Arapeen Drive (in the east), East Sunnyside Ave (in the south) and 1200 East (in the west). This area is bounded by the following geographic coordinates (NAD83):

Northeast: 40.77309 N, 111.82639 W

Northwest: 40.77313 N, 111.85669 W

Southwest: 40.75076 N, 111.82661 W

Southeast: 40.75096 N, 111.85656 W

The Salt Lake City downtown portion of the Innovation zone is approximately 0.954 square miles in area and is defined by South Temple (in the north), 400 East (in the east), 700 South (in the south) and 200 West (in the west). This area is bounded by the following geographic coordinates (NAD83):

Northeast: 40.76941 N, 111.87971 W

Northwest: 40.76938 N, 111.89692 W

Southwest: 40.75413 N, 111.89696 W

Southeast: 40.7541 N, 111.87971 W

The connecting corridor between the University of Utah and downtown Salt Lake City encompasses an area of approximately 0.46 square miles and is bound by 1st Avenue (in the north), 1200 East (in the west), 200 South (in the south) and 400 East (in the west). This area is bounded by the following geographic coordinates (NAD83):

Northeast: 40.77055 N, 111.85679 W

Northwest: 40.77058 N, 111.87975 W

Southwest: 40.76505 N, 111.87979 W

Southeast: 40.76502 N, 111.85666 W

Exhibit B

Technical Approach

POWDER will ensure compliant operation by: (i) Interacting with a CBRS SAS to obtain/release spectral resources as directed by the SAS, (ii) Employing a localized RF monitoring and control system associated with each SDR-based CBSD/End User Device that can rapidly detect and terminate operation of the device when RF transmission violations occur, and (iii) Operating an emergency shutdown procedure ("stop buzzer" procedure) whereby operation of the platform as a whole can be terminated in case of suspected RF transmission violations.

This approach is described below and depicted in Figure 1.

(i) Interaction with CBRS ecosystem:

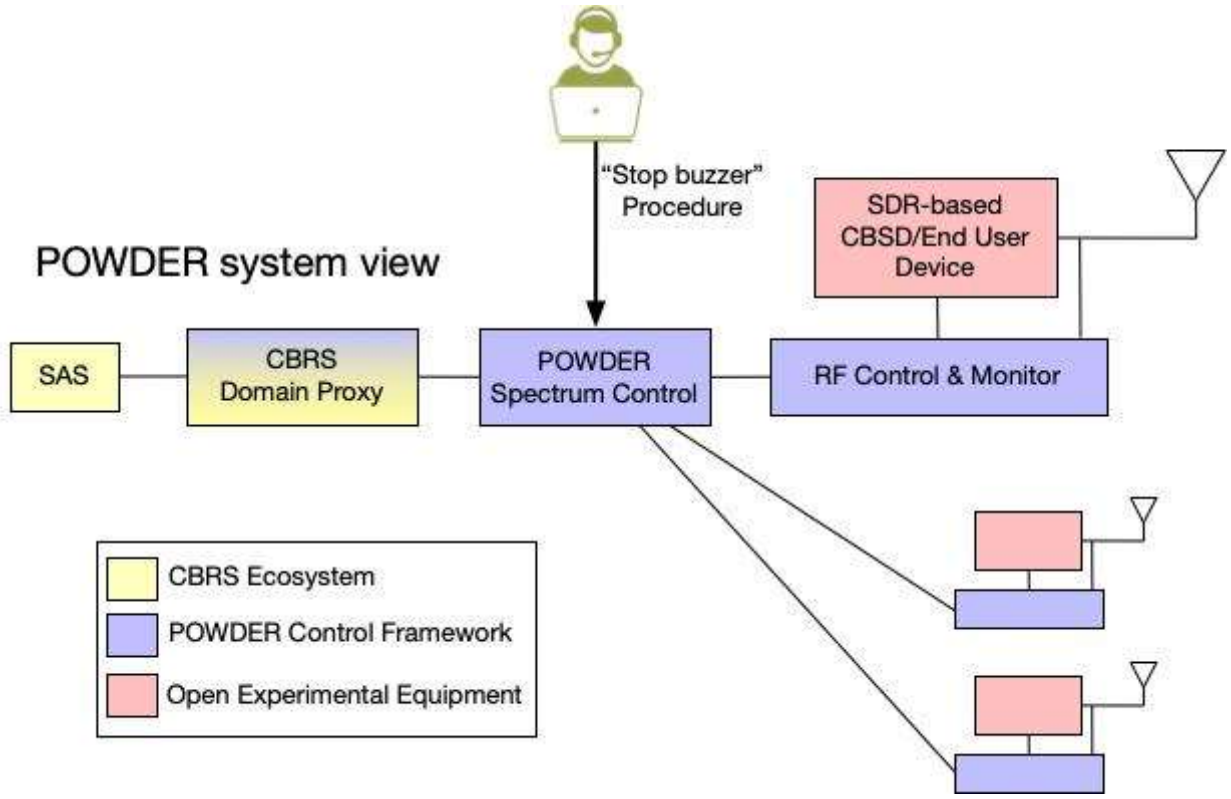

Figure 1: SDR-based CBSD/End User Device operation in POWDER

As shown in Figure 1, a POWDER operated CBRS Domain Proxy interacts with a CBRS SAS. The Domain Proxy interfaces with/is integrated with the POWDER Spectrum Control system, which in turn interacts with the local RF Control and Monitor system co-located with each SDR.

Spectrum grant/relinquish/change messages received by the domain proxy from the SAS are relayed to the POWDER spectrum control system. An SAS spectrum grant makes the relevant frequencies available for use by devices in the platform. Similarly, a relinquish message (or grant expire/deregister event) results in the relevant spectrum no longer being available for use in the POWDER platform. The POWDER spectrum control system also communicates with the local

RF control and monitor system to terminate RF transmission associated with the spectrum indicated in the relinquish message.

To enable CBRS/SAS aware experimentation, any SAS commands associated with changes to power limits and frequency assignments are programmatically communicated to experimental software by the RF control and monitor system. If the experimental system correctly adjusts transmission parameters, within 50 seconds, no further action is taken. If the system does not adjust its transmission, the RF control and monitor system terminates transmission.

(ii) Local RF monitoring and control system

POWDER platform users may request platform resources, including spectrum granted by an SAS, for their testing needs. When allocating the requested spectrum resources for the user, the POWDER spectrum control system communicates the allocated/allowed frequency ranges to the local RF control and monitor system. The RF control and monitor system is directly connected to the transmission path, between the RF frontend and antenna, and continuously scans the complete frequency range of the RF frontend, defined by fixed RF filter hardware. The monitored transmissions are compared with the allowed transmission parameters and any violations result in RF transmissions being terminated by disabling the RF frontend and/or powering off the radio.

TECHNICAL CERTIFICATION

I am a technically qualified individual who contributed to and/or reviewed the foregoing Request for Waiver. I certify that the technical statements therein are correct to the best of my knowledge.

/s/ Jacobus E. Van der Merwe
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