



PUBLIC NOTICE

Federal Communications Commission
45 L Street NE
Washington, DC 20554

News Media Information 202-418-0500
Internet: www.fcc.gov
TTY: 888-835-5322

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**OET ANNOUNCES CONDITIONAL APPROVAL OF C3SPECTRA'S 6 GHz BAND
AUTOMATED FREQUENCY COORDINATION SYSTEM
AND
SEEKS COMMENT ON AXON NETWORKS' PROPOSED AFC SYSTEM**

ET Docket No. 21-352

Comments on Axon Networks' AFC Proposal Due By: July 29, 2024

By the Chief, Office of Engineering and Technology:

I. INTRODUCTION

1. The Office of Engineering and Technology (OET) conditionally approves C3Spectra to operate an automated frequency coordination (AFC) system to manage access to 6 GHz band spectrum by standard-power unlicensed devices. Under this conditional approval, C3Spectra will not be permitted to begin commercial operation of its AFC system until it completes a rigorous testing process, which may begin immediately. This process will require that C3Spectra's AFC system undergo both lab testing and a public trial. Once C3Spectra's conditionally approved AFC system has successfully completed the testing process, OET will approve the system for full commercial operation.

II. BACKGROUND

1. On April 23, 2020, the Commission adopted a Report and Order and Further Notice of Proposed Rulemaking (*6 GHz Report and Order*) that made broad swaths of the 6 GHz band available for expanded unlicensed operations.¹ The *6 GHz Report and Order* adopted rules for two different types of unlicensed operations—standard-power operations and low-power indoor operations.² Standard-power access points and fixed client devices are required to operate under the control of AFC systems in two portions of the 6 GHz band—the U-NII-5 band (5.925-6.425 GHz) and the U-NII-7 band (6.525-6.875 GHz).³ The U-NII-5 and U-NII-7 bands are also used by licensed fixed and temporary-fixed point-to-point microwave systems.⁴ In addition, the 6.65-6.6752 GHz portion of the U-NII-7 band is used for

¹ *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) (*6 GHz Report and Order*).

² *Id.* at 3860, paras. 17-18.

³ 47 CFR §§ 15.403, 15.407(k)(1); *6 GHz Report and Order*, 35 FCC Rcd at 3860, 3862, 3923, paras. 17, 22, 192. A fixed client device is “intended as customer premise equipment that is permanently attached to a structure, operates only on channels provided by an AFC, has a geolocation capability, and complies with antenna pointing angle requirements.” *Id.* § 15.403.

⁴ *6 GHz Report and Order*, 35 FCC Rcd at 3855, 3865-66, paras. 7, 32.

radio astronomy observations at a limited number of observatories.⁵ The AFC systems will manage spectrum access for standard-power access points and fixed client devices to prevent harmful interference from occurring to fixed microwave systems and certain radio astronomy observatories.⁶

2. On September 28, 2021, the Commission issued a Public Notice requesting proposals from prospective AFC system operators.⁷ In response to the Public Notice, the Commission received fourteen applications to operate AFC systems, as well as eight comments regarding the applications.⁸ One applicant, Amdocs, later withdrew its application.⁹ On November 2, 2022, OET issued a Public Notice (*2022 Public Notice*) conditionally approving the thirteen remaining applicants to operate AFC systems: Broadcom, Google, Comsearch, Sony, Kyrio, Key Bridge Wireless, Nokia Innovations, Federated Wireless, Wireless Broadband Alliance, Wi-Fi Alliance, Qualcomm, Plume Design, and RED Technologies.¹⁰ OET indicated in the *2022 Public Notice* that these conditionally approved AFC systems will not be available for commercial operations until they receive final approval from OET.¹¹

3. On August 24, 2023, OET issued a Public Notice (*2023 Public Notice*) announcing that the conditionally approved AFC systems could commence testing and outlining the testing process.¹² This AFC system testing process consists of two parts, lab testing and a public trial, which the AFC systems must successfully complete before OET will approve them for commercial operation.¹³ OET permits the lab test to be conducted either by an FCC-recognized accredited testing laboratory that has also been approved through the Wireless Innovation Forum's (WInnForum) Citizens Broadband Radio Service Device (CBSD) testing and certification program or by a test lab that has been accredited by WInnForum to conduct AFC system lab testing.¹⁴ The test lab must conduct the tests specified in the AFC system test plan developed by the Wi-Fi Alliance.¹⁵ In conducting these tests, the test lab is required to use a set of

⁵ *Id.* at 3884, para. 87.

⁶ 47 CFR § 15.407(l), (m); *6 GHz Report and Order*, 35 FCC Rcd at 3862, para. 22.

⁷ *The Commission Begins the Process for Authorizing 6 GHz Band Automated Frequency Coordination Systems*, ET Docket No. 21-352, Public Notice, 36 FCC Rcd 14098, 14098, 14101-02, 14103, paras. 2, 7, 10 (2021).

⁸ See the 14 applications to operate AFC systems filed in ET Docket No. 21-352 between October 28, 2021, and November 11, 2021. APCO International; the Utilities Technology Council and Edison Electric Institute; Wi-Fi Alliance; Dynamic Spectrum Alliance; Verizon; AT&T Services; Apple, Broadcom et al.; and the Fixed Wireless Communications Coalition (FWCC) filed comments in ET Docket No. 21-352 on December 21, 2021.

⁹ Letter from Robert A. Silverman, Counsel to Amdocs, Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 21-352, at 1 (filed Mar. 25, 2022).

¹⁰ *OET Announces Conditional Approval for 6 GHz Band Automated Frequency Coordination Systems*, ET Docket 21-352, Public Notice, 37 FCC Rcd 13071, 13071, para. 1 (OET 2022) (*2022 Public Notice*).

¹¹ *Id.* at 13073-74, para. 5.

¹² *OET Announces Commencement of Testing of the 6 GHz Band Automated Frequency Coordination Systems*, ET Docket 21-352, Public Notice, DA 23-759 (OET Aug. 24, 2023) <https://www.fcc.gov/edocs/search-results?t=advanced&daNo=23-759> (*2023 Public Notice*).

¹³ *Id.* at 1, 3-7, 12-13, paras. 1, 6-18, 36; *see also 6 GHz Report and Order*, 35 FCC Rcd at 3871, para. 49; *2022 Public Notice*, 37 FCC Rcd at 13090-92, paras. 41-47.

¹⁴ *2023 Public Notice* at 5-6, paras. 11-12. A list of FCC recognized accredited testing laboratories can be found at <https://apps.fcc.gov/oetcf/eas/reports/TestFirmSearch.cfm>. A list of WInnForum-approved CBSD test labs can be found at <https://cbrs.wirelessinnovation.org/cbsd-certification-program>. The WInnForum accreditation process can be found at *Wireless Innovation Forum Authorized AFC System Test Lab Requirements*, Version 1.0.0, Aug. 4, 2022, <https://6ghz.wirelessinnovation.org/assets/WINNF-TS-5009-V1.0.0%206%20GHz%20AFC%20System%20ATL%20Requirements%20Specification.pdf>.

¹⁵ *2023 Public Notice* at 3-4, paras. 7-8; *see Wi-Fi Alliance AFC System (SUT) Compliance Test Plan Version 1.5*, available at <https://www.wi-fi.org/discover-wi-fi/6-ghz-afc-resources>.

test vector inputs and corresponding test vector outputs jointly developed by the Wi-Fi Alliance and the WiInnForum.¹⁶ The AFC applicant is required to submit a test report created by the test lab describing the results of each test performed.¹⁷

4. For the public trial, the AFC system applicant is required to make its AFC system available on the Internet to provide any interested member of the public an opportunity to test the AFC system functionality.¹⁸ The Internet-based test portal must permit the user to specify test locations anywhere within the United States and return a list of the frequency ranges on which a standard-power device at that location would be able to transmit and the corresponding maximum power level for each frequency range.¹⁹ The test portal must also provide a means for users to submit challenges to the AFC system applicant if the user believes that the available frequency ranges and power levels are not in compliance with the Commission's rules.²⁰ The Internet-based test portal must be available for a minimum of forty-five days with challenges accepted for fifteen days after the forty-five day period concludes.²¹ After the public trial is complete, the AFC applicant is required to submit a public trial report describing the public trial, including statistics on the number of public tests conducted, a summary of each challenge received, and an explanation detailing why each challenge did or did not raise a valid concern with the functionality of the AFC system, along with a description of any actions it took in response to any challenges.²²

5. On February 23, 2024 OET issued a Public Notice (*2024 Public Notice*) approving seven AFC operators for commercial operations.²³ These seven AFC operators successfully completed the testing program, as directed by OET, which included both lab testing and a public trial.²⁴ The results from this testing indicate that these seven AFC systems operate in conformance with the Commission's 6 GHz band (5.925-7.125 GHz) unlicensed rules, which are designed to prevent harmful interference from standard power access devices and fixed client devices to licensed microwave receivers and certain radio astronomy observatories in the 6 GHz band. These seven AFC systems are now permitted to manage access to spectrum in the U-NII-5 (5.925-6.425 GHz) and U-NII-7 (6.525-6.875 GHz) portions of the 6 GHz band for standard power access points and fixed client devices in accordance with the Commission's rules.

6. The *2024 Public Notice* also sought comment on C3Spectra's proposal to operate an AFC system.²⁵ The *2024 Public Notice* requested that comments be provided by March 15, 2024. The Commission received no comments regarding C3Spectra's AFC system proposal. On April 23, 2024

¹⁶ *2023 Public Notice* at 4-5, paras. 8-9; see *AFC System (SUT) Compliance Test Vectors v1.2*, Wi-Fi Alliance, available at <https://www.wi-fi.org/discover-wi-fi/6-ghz-afc-resources>.

¹⁷ *2023 Public Notice* at 5, para. 9.

¹⁸ *Id.* at 6, para. 13.

¹⁹ *Id.* at 6, para. 14.

²⁰ *Id.* at 6, para. 15.

²¹ *Id.* at 7, para. 17.

²² *Id.* at 7, para. 18.

²³ *OET Announces Approval of Seven 6 GHz Band Automated Frequency Coordination Systems for Commercial Operation and Seeks Comment on C3Spectra's Proposed System*, ET Docket 21-352, Public Notice, DA 24-166 (OET Feb. 23, 2024) (*2024 Public Notice*).

²⁴ *Id.* at 10, para. 19.

²⁵ *Id.* at 10, para. 20.

C3Spectra provided supplemental information regarding its AFC application in response to a set of questions provided by OET.²⁶

III. CONDITIONAL APPROVAL OF C3SPECTRA'S AFC SYSTEM

7. Based on review of the C3Spectra's AFC proposal and the supplemental information it submitted, OET conditionally approves C3Spectra's pending application to operate an AFC system, subject to the conditions described below. C3Spectra has sufficiently demonstrated that it has the technical capability and knowledge to operate an AFC system and may now move to the testing phase of the AFC system approval process. Our approval of C3Spectra's AFC system application is subject to the following conditions:

- C3Spectra must comply with all current and future Commission rules, instructions, and procedures.
- C3Spectra must comply with all instructions issued by OET pursuant to section 0.241(k) of the Commission's rules.²⁷
- C3Spectra must attend workshops and meetings convened by the Commission or OET. Workshop or meeting topics may include: (1) AFC system development and operations; (2) AFC system testing and certification procedures; or (3) other topics relevant to the ongoing development of the AFC systems.
- If C3Spectra relies on third party or proprietary specifications or protocols for its AFC system, these specifications or protocols must be consistent with the relevant Commission rules. All such specifications and protocols must be provided to, and will be reviewed by, OET to ensure consistency with the Commission's rules.
- C3Spectra must undertake steps to have its AFC system undergo lab testing as described in the *2023 Public Notice*.²⁸
- C3Spectra must undertake steps to have its AFC system undergo a public trial as described in the *2023 Public Notice*.²⁹
- C3Spectra must respond to all inquiries from OET staff during OET's examination of the testing data and make any modifications to its AFC system requested by OET staff as part of the testing process;
- C3Spectra must promptly respond to any requests for information or direction from the Commission, including the Enforcement Bureau.³⁰
- C3Spectra may not make its AFC system available for commercial operations until it receives final approval from OET.

IV. C3SPECTRA'S AFC PROPOSAL

8. C3Spectra's AFC proposal and supplemental information provide a strong basis for concluding that C3Spectra's AFC system will comply with the Commission's 6 GHz unlicensed rules. C3Spectra indicates that its AFC system will fully adhere to the *Functional Requirements for the U.S. 6 GHz Band under the Control of an AFC System* specification developed by the WINNF.³¹ This specification details how the AFC systems will calculate the available frequencies and power levels for

²⁶ *Response to Questions from OET on C3Spectra's AFC Proposal*, C3Spectra, ET Docket No. 21-352, filed April, 23, 2024 (*C3Spectra Response*).

²⁷ 47 CFR § 0.241(k).

²⁸ *2023 Public Notice* at 3-6, paras. 7-12.

²⁹ *Id.* at 6-7, paras. 13-18.

³⁰ See 47 CFR § 15.407(k)(15)(vi); *6 GHz Report and Order*, 35 FCC Rcd at 3883, para. 83.

³¹ *C3Spectra Response* at 1; *Functional Requirements for the U.S. 6 GHz Band under the Control of an AFC System*, WINNF-TS-1014 V1.4.0, WINNF, (Oct. 6, 2023) (*WINNF-TS-1014*).

standard-power devices in conformance with the Commission's rules.³² It was developed by an industry consortium which included members of the unlicensed community, wireless carriers, and 6 GHz microwave licensees. The specification includes many implementation details such as the microwave receiver antenna patterns the AFC system should use when the actual antenna pattern is not available, how to implement the 95% location uncertainty requirement specified in the rules, and how to model microwave passive reflectors.³³ In most aspects, the WINNF functional requirements specification complies with the Commission's AFC rules.³⁴ The fact that C3Spectra's AFC system will operate in conformance with this technical specification provides a strong indication that its AFC system will comply with the Commission's rules.

9. C3Spectra indicates that it will base its AFC system on software developed by the Open AFC Software Group—i.e. the open AFC code.³⁵ Three of the AFC systems which have been approved for commercial operation use the open AFC code.³⁶ These three AFC systems were approved for commercial operation after undergoing a thorough testing process. Consequently, C3Spectra's use of the open AFC code provides additional evidence that its AFC system will operate in conformance with the Commission's rules.

10. C3Spectra's AFC proposal provides further evidence that it will be able to successfully operate an AFC system. C3Spectra has assembled a team which includes engineers with significant experience in radio propagation and wireless systems.³⁷ C3Spectra explains that it will implement its AFC system to be fault tolerant with operation across multiple hardware servers in a commercial cloud network which will allow switching to an alternative instance of the AFC system in case of interruption to a specific data center.³⁸ It also intends to employ industry standard security protocols within the AFC system.³⁹

11. The information in C3Spectra's AFC proposal and supplemental information provide every indication that its AFC system will operate in compliance within the Commission's rules in a secure and reliable manner. Therefore, we approve operation of C3Spectra's AFC system, subject to the conditions listed above.

³² *WINNF-TS-1014* at 22-23, 24-27.

³³ *WINNF-TS-1014* at 31-32, 26-27, 49-54.

³⁴ One aspect where the WINNF functional requirements document varies from the Commission's rules concerns indoor operation of standard-power access points and fixed client devices. The functional requirements document permits an adjustment of the power received at a microwave receiver from an indoor standard-power access point to account for building loss while the Commission's rules do not permit such an adjustment. *WINNF-TS-1014* at 26. Consequently, C3Spectra's AFC system will not be permitted to take into account building loss for indoor standard-power access points in its calculations.

³⁵ *Application for Approval as an AFC System Operator*, C3Spectra, ET Docket No. 21-352 at 8 (filed Dec. 1, 2023) (*C3Spectra Application*); Telecom Infra Project, Open AFC, <https://telecominfraproject.com/open-afc/> (last visited June 20, 2024).

³⁶ Broadcom Inc. Proposal to be Approved as an Automated Frequency Coordination System Operator at 6; Proposal of Wi-Fi Alliance at 9; Qualcomm Incorporated Application to be Authorized as 6 GHz Band Automated Frequency Coordination System Operator at 6-7; Wireless Broadband Alliance Ltd. Application to Become an Automated Frequency Coordination (AFC) System Operator at 5-7.

³⁷ *C3Spectra Application* at 10-11.

³⁸ *C3Spectra Application* at 12-13.

³⁹ *C3Spectra Application* at 14.

V. TESTING SCHEDULE

12. Now that we have conditionally approved C3Spectra's AFC system, C3Spectra may commence testing its AFC system. Consistent with the process outlined in the *2023 Public Notice*, C3Spectra may conduct the required lab testing and the public trial concurrently.⁴⁰ C3Spectra will be required to submit separate reports describing the results of the lab testing and the public trial to OET for consideration.

13. Six of the seven AFC operators who previously conducted public trials established a common web portal where members of the public could concurrently submit test locations to all of the AFC systems.⁴¹ These test locations were then distributed by the common web portal to the different AFC systems and the AFC systems returned the corresponding available frequency ranges and permitted power levels to the submitters via email. C3Spectra is a participant in this common web portal.⁴² The common web portal website is designed such that AFC systems may begin public trials on different dates and that each AFC system is provided all queries submitted to the common web portal. Each AFC system is then required to run each of these queries.⁴³ Consequently, we will require C3Spectra to run the test inputs submitted to the common web portal during the previous public trials in its AFC system as well as any new input sets that may be submitted during the public trial period and return the results by email to the original submitter of each test input.⁴⁴ Because running all of these test locations will provide a thorough test of C3Spectra's AFC system consistent with the public testing for all currently approved AFCs, we believe that C3Spectra's public trial can be shortened without any adverse consequences to a minimum of 20 days rather than the 45 days that was required for the previously tested AFC systems.⁴⁵ As with the previous public trials, we will require C3Spectra to file a notice in ET Docket number 21-352 stating when its test portal will become available and provide a URL for accessing it at least one week prior to beginning its public trial period. To ensure that the parties who previously submitted test cases to the common web portal have sufficient time to review C3Spectra's results and submit follow-up test cases, we will require C3Spectra to provide results for these previously submitted test locations to the original submitters prior to filing the notice stating when the test portal will become available. Other than shortening the length of the public trial period and requiring C3Spectra to return results for the test locations previously submitted to the common web portal, we are not changing any of the requirements for the public trial described in the *2023 Public Notice*. C3Spectra will be required to accept challenges to the available frequencies and/or permitted power levels returned by its AFC system for fifteen days after the end of the public trial period, respond to each challenge with an explanation of why it either believes the challenge raises a valid concern or is without merit, and prepare and submit a report describing the public trial.⁴⁶

⁴⁰ *2023 Public Notice* at 3-6, paras. 7-12.

⁴¹ 6 GHz AFC System Public Trial Test Portal, https://docs.google.com/forms/d/e/1FAIpQLSd4QXhP8PABCqjNedzBOq2wCejjOiiDfxJJBbqrANLYOPAag/view_form (last visited June 28, 2024).

⁴² *Id.*

⁴³ *Id.*

⁴⁴ Already approved AFCs are not required to run any new input sets submitted after the date upon which they were approved by the Commission for providing commercial service.

⁴⁵ *2023 Public Notice* at 7, para. 17.

⁴⁶ *2023 Public Notice* at 6-7, paras. 15, 17, 18.

VI. ADDITIONAL AFC SYSTEM APPLICATION

14. The Commission has received an application from Axon Networks to operate an AFC system.⁴⁷ Consistent with the process specified in the *6 GHz Report and Order*, the public will have an opportunity to review and comment on Axon Networks' AFC proposal.⁴⁸ OET requests that any comments regarding Axon Networks' AFC proposal be submitted in ET Docket No. 21-352 by July 29, 2024. OET will examine Axon Networks' proposal along with any comments received and conditionally approve the proposal if it demonstrates that the proposed system would comply with all AFC requirements.⁴⁹ If Axon Networks' proposal is conditionally approved, it may then begin the testing process that OET specified in the *2023 Public Notice*.⁵⁰ Once testing is complete, OET will examine the Axon Networks test report and public trial report to determine if its AFC system can be approved for commercial operations.

15. *Further Information.* Questions regarding this Public Notice may be directed to Nicholas Oros, Office of Engineering and Technology, at (202) 418-0636 or Nicholas.Oros@fcc.gov.

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⁴⁷ Proposal: Automated Frequency Coordination System for Commercial Operation, Axon Networks, ET Docket No. 21-352 (filed June 27, 2024).

⁴⁸ *6 GHz Report and Order*, 35 FCC Rcd at 3871, para. 49.

⁴⁹ *Id.*

⁵⁰ *2023 Public Notice* at 3-7, paras. 6-18; see *6 GHz Report and Order*, 35 FCC Rcd at 3871, para. 49.