



Interim Results of the Mid-band Coexistence Survey

Working Document WINNF-TR-5010

Version V1.0.0
September 15, 2023



TERMS, CONDITIONS & NOTICES

This document has been prepared by the Mid-band Sharing Working Group to assist The Software Defined Radio Forum Inc. (or its successors or assigns, hereafter “the Forum”). It may be amended or withdrawn at a later time and it is not binding on any member of the Forum or of the Mid-band Coexistence Working Group.

Contributors to this document that have submitted copyrighted materials (the Submission) to the Forum for use in this document retain copyright ownership of their original work, while at the same time granting the Forum a non-exclusive, irrevocable, worldwide, perpetual, royalty-free license under the Submitter’s copyrights in the Submission to reproduce, distribute, publish, display, perform, and create derivative works of the Submission based on that original work for the purpose of developing this document under the Forum's own copyright.

Permission is granted to the Forum’s participants to copy any portion of this document for legitimate purposes of the Forum. Copying for monetary gain or for other non-Forum related purposes is prohibited.

THIS DOCUMENT IS BEING OFFERED WITHOUT ANY WARRANTY WHATSOEVER, AND IN PARTICULAR, ANY WARRANTY OF NON-INFRINGEMENT IS EXPRESSLY DISCLAIMED. ANY USE OF THIS SPECIFICATION SHALL BE MADE ENTIRELY AT THE IMPLEMENTER'S OWN RISK, AND NEITHER THE FORUM, NOR ANY OF ITS MEMBERS OR SUBMITTERS, SHALL HAVE ANY LIABILITY WHATSOEVER TO ANY IMPLEMENTER OR THIRD PARTY FOR ANY DAMAGES OF ANY NATURE WHATSOEVER, DIRECTLY OR INDIRECTLY, ARISING FROM THE USE OF THIS DOCUMENT.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the specification set forth in this document, and to provide supporting documentation.

This document was developed following the Forum's policy on restricted or controlled information (Policy 009) to ensure that that the document can be shared openly with other member organizations around the world. Additional Information on this policy can be found here: http://www.wirelessinnovation.org/page/Policies_and_Procedures

Although this document contains no restricted or controlled information, the specific implementation of concepts contain herein may be controlled under the laws of the country of origin for that implementation. Readers are encouraged, therefore, to consult with a cognizant authority prior to any further development.

Wireless Innovation Forum TM and SDR Forum TM are trademarks of the Software Defined Radio Forum Inc.

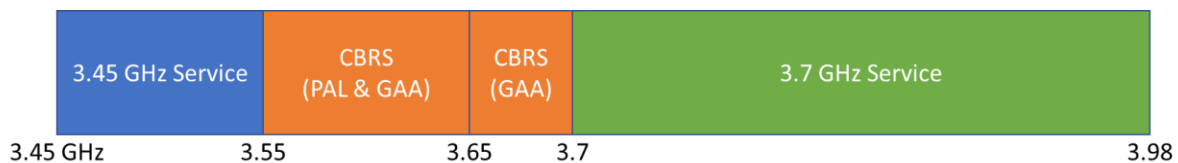
Table of Contents

TERMS, CONDITIONS & NOTICES.....	i
1 Introduction.....	1
1.1 Disclaimer.....	2
2 Statistical Results.....	3
3 Comments from the Respondents.....	7
3.1 Some Responses from CBRS GAA Operators.....	7
3.2 Some Responses from CBRS PAL Operators.....	8
3.3 Comments from 3.45 and 3.7 GHz Service Operators.....	8
4 Additional Observations.....	9
5 Next Steps.....	11

Interim Results of the Mid-band Coexistence Survey

1 Introduction

The 3 GHz mid-band spectrum in the U.S. is a diverse ecosystem of commercial services operating in immediately adjacent spectrum bands, but under different service rules. These include the 3.45 GHz Service in 3450-3550 MHz, the Citizens Broadband Radio Service (CBRS) in 3550-3700 MHz, and the 3.7 GHz Service in 3700-3980 MHz. The disposition of the 3100-3450 MHz band is still being determined, but it's likely that some amount of commercial service will be deployed in the future.



In the 3.45 GHz Service rules, the FCC requires licensees to share TDD timing information with any requesting CBRS operator,¹ but otherwise there are no rules that govern coexistence among the various mid-band services.

CBRS began deployment in 2019, the 3.7 GHz Service began deployments in 2021, and the 3.45 GHz Service began deployments in 2022. Build out of the services in these bands is ongoing. For example, the 3.45 GHz Service must complete coordination with DoD before deploying in various Cooperative Planning Areas (CPAs), and that coordination process is under way.² Limited 3.45 GHz Service deployment is occurring within CPAs pursuant to this coordination process and deployment is also occurring outside of the CPAs. Regarding the 3.7 GHz service, voluntary agreements are now in place near airports³.

As the number of mid-band deployments increases, the possibility for interference to occur between services, as well as between systems in the same service, will also increase. However, short of complaints being filed with the FCC, there is no record of any perceived interference that occurs. Therefore, it is not known if interference is a problem, and it is not known if any efforts need to be taken to help mitigate the likelihood of interference. For example, if interference is significantly disrupting one or more of the services, perhaps the Wireless Innovation Forum (WinnForum) can consider convening a multistakeholder working group to produce industry recommendations on how to avoid, mitigate, and/or resolve the interference.

To that end, WinnForum launched an online survey⁴ in January 2023 to solicit feedback from 3.45 GHz, CBRS, and 3.7 GHz operators to understand the extent to which they were experiencing

¹ [47 CFR 27.1607](#)

² [47 CFR 27.1603](#)

³ See Letter to Marlene Dortch, Secretary, FCC, from AT&T Services, Inc., T-Mobile, UScellular and Verizon, GN Docket No. 18-122 (March 31, 2023)

⁴ <https://www.surveymonkey.com/r/midband-coex>

interference, or not. The link to the survey was distributed to all 3.45, CBRS PAL, and 3.7 GHz Service licensees (based on contact data in the FCC license databases), as well as to CBRS GAA operators through WISPA. WinnForum also issued a press release, and encouraged anyone to forward the survey link to others who may have relevant input.

The purpose of this Technical Report is to present the current results of the survey, which can be used to inform WinnForum members and others as to the extent of coexistence challenges in mid-band spectrum. As of July 2023, WinnForum has received 105 responses to the survey, which are the basis of this version of the Technical Report.

The survey remains open indefinitely and operators are encouraged to complete the brief survey whether they are or are not experiencing interference. They are also encouraged to take the survey again if their experience changes over time.

This Technical Report will be updated when a significant number of new responses are received.

1.1 Disclaimer

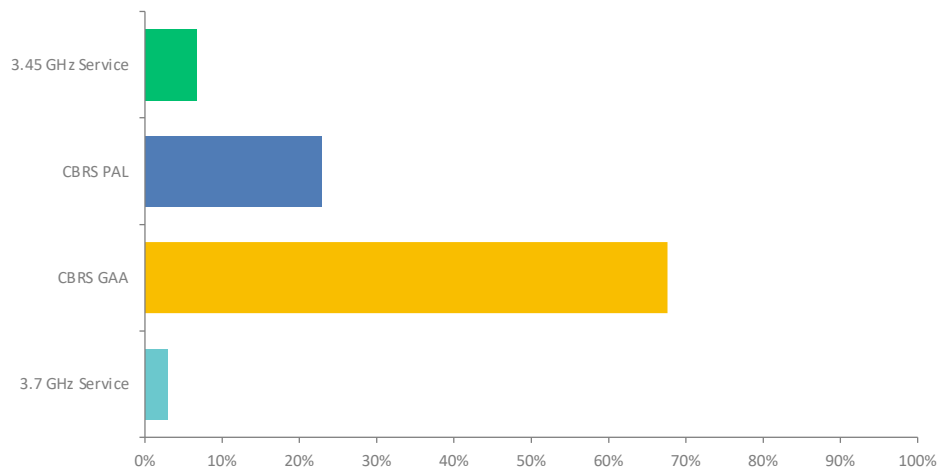
The members of the WinnForum believe that some of the 3.45 and 3.7 GHz respondents could have misidentified themselves, and might actually be CBRS operators. However, this is a small number (5) of the overall responses. The statistical results do not attempt to correct for any perceived misidentifications.

2 Statistical Results

This section presents the results of the survey. The responses to each survey question are shown first in bar chart format, then the same data are presented in tabular form. Note that for questions that allow multiple selections, the percentages presented are of the total answers received, so the sum of the percentages could exceed 100%.

Q1: Which mid-band service are you operating? If you operate more than one of the services, please submit a separate response for each.

Answered: 105 Skipped: 0



Powered by  SurveyMonkey

Q1: Which mid-band service are you operating? If you operate more than one of the services, please submit a separate response for each.

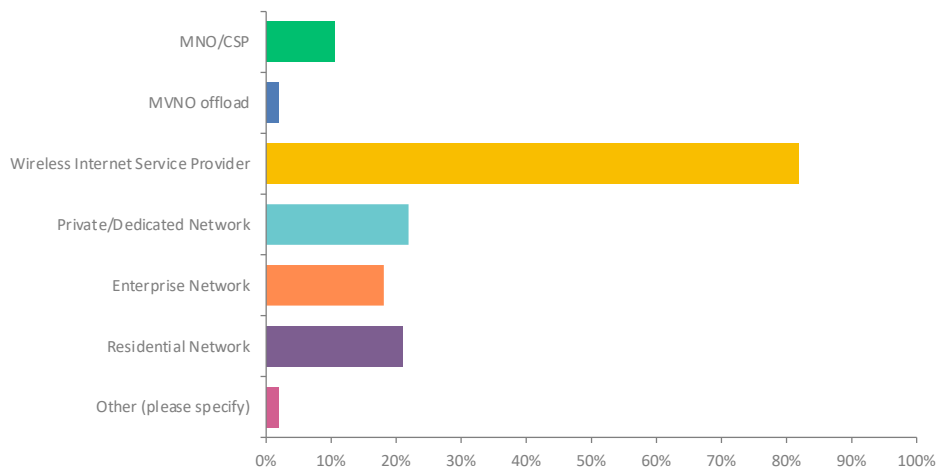
Answered: 105 Skipped: 0

ANSWER CHOICES	RESPONSES	
3.45 GHz Service	6.67%	7
CBRS PAL	22.86%	24
CBRS GAA	67.62%	71
3.7 GHz Service	2.86%	3
TOTAL		105

Powered by  SurveyMonkey

Q2: What market do you serve (check all that apply)?

Answered: 105 Skipped: 0



Powered by  SurveyMonkey

Q2: What market do you serve (check all that apply)?

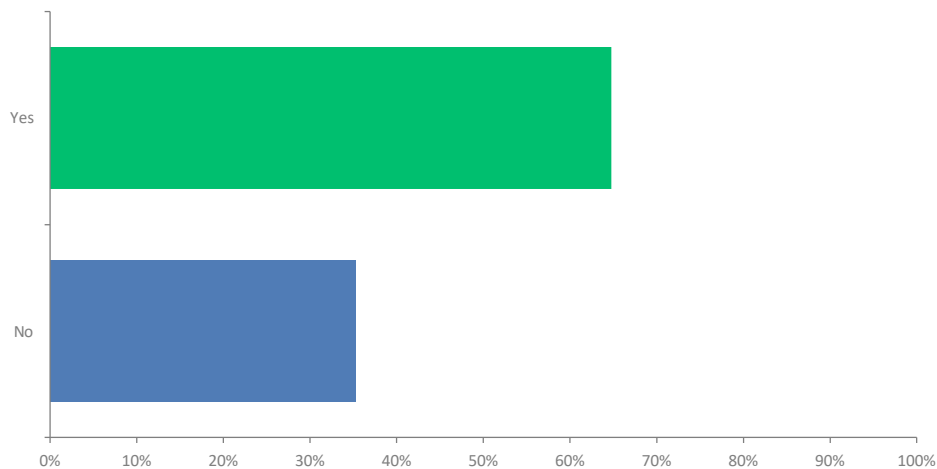
Answered: 105 Skipped: 0

ANSWER CHOICES	RESPONSES	
MNO/CSP	10.48%	11
MVNO offload	1.90%	2
Wireless Internet Service Provider	81.90%	86
Private/Dedicated Network	21.90%	23
Enterprise Network	18.10%	19
Residential Network	20.95%	22
Other (please specify)	1.90%	2
TOTAL		165

Powered by  SurveyMonkey

Q3: Are you encountering interference that you believe is coming from either the same or another mid-band service? If yes, four more brief questions will be asked. If no, pressing "Next" will complete the survey for you.

Answered: 105 Skipped: 0



Powered by  SurveyMonkey

Q3: Are you encountering interference that you believe is coming from either the same or another mid-band service? If yes, four more brief questions will be asked. If no, pressing "Next" will complete the survey for you.

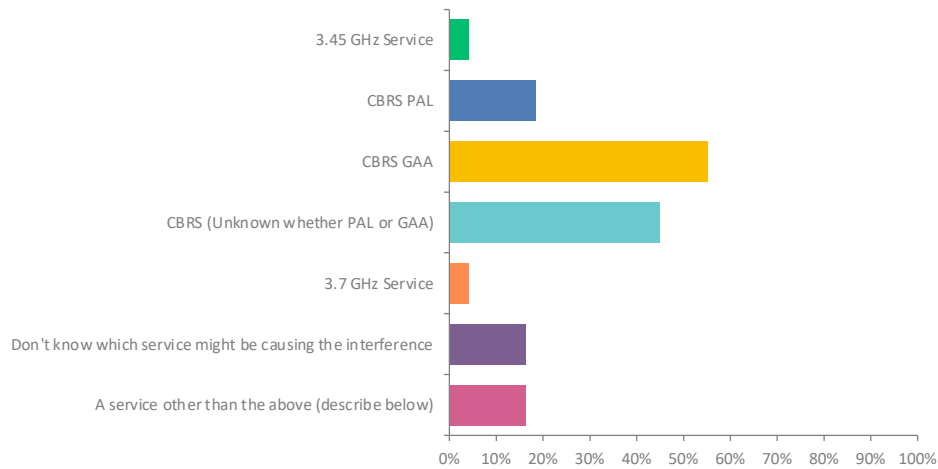
Answered: 105 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	64.76%	68
No	35.24%	37
TOTAL		105

Powered by  SurveyMonkey

Q4: Which service (or services) do you believe to be causing interference? Please select all that apply.

Answered: 49 Skipped: 56



Powered by  SurveyMonkey

Q4: Which service (or services) do you believe to be causing interference? Please select all that apply.

Answered: 49 Skipped: 56

ANSWER CHOICES	RESPONSES	
3.45 GHz Service	4.08%	2
CBRS PAL	18.37%	9
CBRS GAA	55.10%	27
CBRS (Unknown whether PAL or GAA)	44.90%	22
3.7 GHz Service	4.08%	2
Don't know which service might be causing the interference	16.33%	8
A service other than the above (describe below)	16.33%	8
TOTAL		78

Powered by  SurveyMonkey

3 Comments from the Respondents

In the response to question 4 (“Which service or services do you believe to be causing interference?”), respondents could provide a text response to the follow-up question “Please explain why you believe the interference is arising from the indicated service(s). Any details about the interference would be helpful, regardless of where it is coming from (such as frequency, strength, etc.). Also please comment on the impact or severity of the interference. If you have no further information, please mark N/A.” Some representative and/or notable responses are presented here. Some of the comments were edited for clarity or to remove mention of specific companies; such edits are indicated by [square brackets].

3.1 Some Responses from CBRS GAA Operators

When reading the comments from GAA operators, please note that FCC CBRS rules do not provide the requirement or authority for SASs to enforce GAA coexistence. Some industry participants are working on coexistence guidelines,^{5,6} although any such adopted guidelines are voluntary.

- Using the [SAS administrator 1] and [SAS administrator 2] web sites along with spectrum analyzers we are able to document where these transmitters and that they are registered in the SAS. Because the SAS does not let us identify the user we visit locations to identify as far as possible who the co-channel users are. We have seen the SAS assign co-channel frequencies literally across the street from each other. We operate in rural area and in

⁵ [Reference WF TRs and OGA TS-2001]

⁶ [OGA ref TS-2001; and note that updated standard under development]

almost every market we have had manually frequency plan around other GAA transmitters in the market. In other cases we have unsuccessfully asked the SAS providers to mitigate the interference. We work in extremely rural markets and we are still seeing overlap with other users and have no way to coordinate with them directly. In a few cases we have seen rogue transmitters which we have identified and have been successful to get turned down or we have worked around them.

- We have rogue operators in the area on same frequency we were assigned
- A new WISP started broadcasting in our area not knowing really what to do and is causing our established customers massive interference
- Another WISP in the area regularly makes arbitrary channel changes that cause interference for ourselves and other WISPs operating. The offending WISP uses a different SAS provider, though I don't think even using the same SAS provider would matter since everyone is running GAA
- Significant and consistent. The current tools are useless for finding a clean channel and for channel planning. I have to do research outside of the SAS to contact other operators and create channel plans.

3.2 Some Responses from CBRS PAL Operators

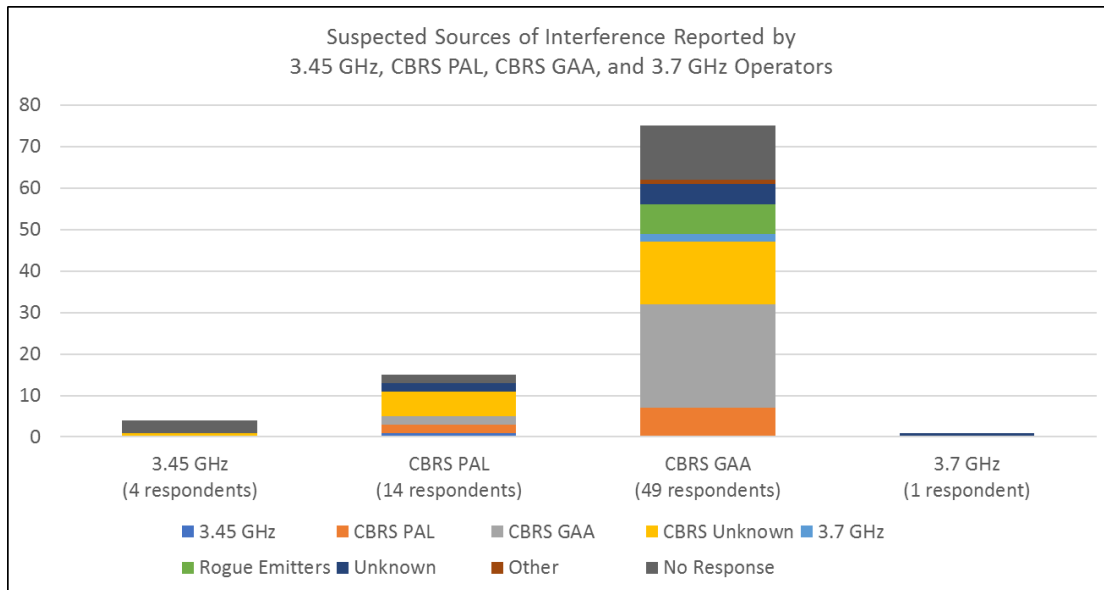
- Some operators not following CBRS rules that include CBSD registration
- Spectrum analysis scans show interference. Some instances, we've tracked it down to operators not following the rules and not registering their device with the SAS. Other instances we've seen the interference due to being near a county border, or a point-to-point link which has end-points in different counties with a different PAL holder, but shoots through our county where we have a PAL. They aren't breaking rules, the rules are simply incapable of regulating every possible permutation of deployment. The severity of the interference varies based on the proximity of the interferer. Sometimes it is minor and sometimes it is debilitating.
- We have a PAL and have meticulously planned for interference, but we did see much more than expected.
- On at least one of our towers, we knew that [Network Operator X] started providing FWA via 5G-NR [in 3.7 GHz] at the beginning of 2022. The same time, we also saw a carrier active in 3.45GHz. Since then, we have seen a steady [decrease] on our SNR likely due to customers gradually getting their service. Co-location features with [CBSD Manufacturer X] have just recently been released and we are currently testing them. The impact it has created on that tower is about a 30% decrease in overall throughput capabilities.

3.3 Comments from 3.45 and 3.7 GHz Service Operators

No significant comments were received from any of the 3.45 or 3.7 GHz respondents.

4 Additional Observations

The following plot shows the suspected sources of interference reported by 3.45 GHz, CBRS, and 3.7 GHz Service respondents. Note that a respondent could indicate more than one suspected source of interference. Respondents were also not required to report any suspected source.



- CBRS GAA users were the largest group responding to the survey (67%, 71 out of 105), and were the majority of respondents reporting interference (72%, 49 out of 68).
- In cases of interference to GAA operators where the respondent provided one or more suspected sources of interference, 57% (32/56) of those sources were reported to be either other GAA operators (44%, 25/56) or suspected rogue operators in the band without CBRS SAS authorization (13%, 7/56).
- In seven out of 49 cases of interference reported by GAA operators, those operators reported suspected interference coming from PAL operators as at least a contributing factor. However, 47 CFR 96.1(b)⁷ states that GAA users “must accept interference from Priority Access Licensees.”
- There are relatively few reports of suspected interference to CBRS from the adjacent band services. Two CBRS operators (one PAL, one GAA) suspect interference from the 3.45 GHz Service, while two GAA operators suspect interference from the 3.7 GHz Service. Altogether less than 4% of reported interference is from adjacent band services based on the current responses.
- Relatively few 3.45 GHz Service or 3.7 GHz Service operators responded to the survey. Of those that did, four of the seven responding 3.45 GHz Service operators and one of the

⁷ [https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-96#p-96.1\(b\)](https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-96#p-96.1(b))

three responding 3.7 GHz Service operators reported suspected interference. Of the four reported cases of interference into 3.45 GHz, CBRS GAA was the suspected source. The other three cases did not report a suspected source. The 3.7 GHz operator reporting interference did not know which service may be causing their interference.

5 Next Steps

The survey remains open and WinnForum will update this Technical Report as a significant number of additional responses are received.