**Before the**

**FEDERAL COMMUNICATIONS COMMISSION**

**Washington, DC 20554**

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| --- | --- | --- |
| In the matter of  2019 World Radio Communications Conference Advisory Committee | )  ))  ) | IB Docket No. 16-185 |

**COMMENTS OF INTEL CORPORATION**

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# Introduction

Intel Corporation (“Intel”)[[1]](#footnote-1) welcomes the opportunity to respond to the Public Notice seeking comments on the draft recommendations (Public Notice Attachment A) provided by the WRC-19 Advisory Committee (WAC) as well as the draft proposals that have been provided by the WAC for information as they did not reach full consensus by the membership (Public Notice Attachment B). [[2]](#footnote-2) Intel respectfully submits these comments regarding various World Radiocommunication Conference 2019 (WRC-19) agenda items (AI) as well as proposals for WRC-23 agenda items.

# WRC-19 Agenda Items

## AI 1.13 Priority Bands

As one of the global leaders in 5G, Intel recognizes that the most promising “high band” tuning ranges for 5G user devices to facilitate economies of scale and enable global roaming are 24.25-29.5 GHz and 37-43.5 GHz. To date, the U.S. has not provided WRC-19 agenda item 1.13 proposals for the 24.25-27.5 GHz and 37-43.5 GHz frequency bands. Intel would like to stress the importance of providing WRC-19 agenda item 1.13 proposals on these frequency bands to CITEL PCC II as soon as possible for consideration at the April 2019 meeting.

## AI 1.13 re: 45.5-47.2 GHz (WAC/082)

WAC/082 provides two views regarding a potential identification to IMT in the 45.5-47.2 GHz frequency range under WRC-19 agenda item 1.13. Domestically, the FCC decided in November 2017 to make the 47.2-48.2 GHz band available for UMFUS use.[[3]](#footnote-3) However, the U.S. is the only country that has made this spectrum available for 5G use to date. Recently, the United States decided to propose an identification to IMT for the 47.2-48.2 GHz frequency band, while declining to identify the 48.2-50.2 GHz frequency bands for IMT. As product development in “high band” spectrum is a lengthy and costly process, the identification of additional spectrum within the radio tuning range would facilitate economies of scale for user devices. Therefore, an identification to IMT of spectrum near 47.2-48.2 GHz within a radio tuning range would benefit American consumers due to economies of scale and global roaming.

Furthermore, View B opposes identification to IMT in this frequency range on the grounds that sharing studies were not performed. However, View B fails to acknowledge that characteristics were not received from the relevant working parties for all but one of the services in these frequency bands; no characteristics were provided for the Radionavigation Service, Radionavigation Satellite Service, Amateur Service, or Amateur Satellite Service.[[4]](#footnote-4) Penalizing a potential new entrant for not performing sharing studies against services for which no characteristics were provided (or even attempted to be provided) could set a precedent of simply not providing characteristics to avoid sharing with new entrants. The Mobile Satellite Service (MSS) was the only service for which any characteristics were provided. The liaison statement from ITU-R Working Party 4C (WP 4C) states “These parameters are not based on any operational system; they are derived values and may be envisaged for a typical future GSO MSS system operating in the MSS allocated bands. WP 4C is continuing to consider the applicable interference criteria that should be used in the studies, and would provide further information on these parameters once it becomes available.”[[5]](#footnote-5) No additional information was ever received from WP 4C. Sharing studies between IMT-2020 and MSS were performed and submitted to Conference Preparatory Meeting (CPM) 19-2; these studies utilized the same methodology as other bands as well as the characteristics provided by the expert groups. The results of these studies concluded that sharing was feasible with a large margin in the uplink direction and small separation distances in the downlink direction. Based on the reasons presented above, Intel supports View A seeking an identification to IMT in 45.5-47.2 GHz.

## AI 1.13 re: 50.4-52.6 GHz (WAC/083)

WAC/083 provides two views regarding a potential identification to IMT in the 50.4-52.6 GHz frequency range under WRC-19 agenda item 1.13. As mentioned above, an identification to IMT of spectrum near 47.2-48.2 GHz would benefit American consumers due to economies of scale and global roaming. In the case of 50.4-52.6 GHz, passive services operate at the lower (50.4 GHz) and upper (52.6 GHz) edges of the frequency range. With respect to the lower edge, RR No. 5.340.1 applies:

5.340.1 The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands.

With respect to the upper edge, there is currently a co-primary allocation to the Mobile Service, which does not have any WRC Resolution 750 restrictions; IMT is an application of the Mobile Service.  It should be noted that any significant WRC Resolution 750 restrictions could negatively impair or prevent development of equipment capable of operating in this band.

View B opposes identification to IMT on the grounds that the spectrum needs for IMT in this frequency range have already been exceeded by other U.S. proposals. However, studies in ITU-R Working Party 5D provided spectrum needs values for several different approaches; the 6.1 GHz cited in View B only takes into account the “application-based approach” while the other two approaches both have higher spectrum needs in this frequency range which would not be exceeded if this band were also identified for IMT.[[6]](#footnote-6)

Furthermore, View B states “This band is also being utilized by the Fixed Satellite Service for the deployment of both gateways and user terminals. Additionally, studies have shown the sharing is not feasible between FSS user terminals with undetermined locations and ubiquitous IMT.” However, there is currently no allocation to the FSS in the 51.4-52.4 GHz band. Studies under WRC-19 Agenda Item 9.1/Issue 9.1.9 which consider new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) are limited to FSS feeder links for geostationary orbit use, not user terminals. [[7]](#footnote-7) The results of these sharing studies, in which the FSS is seeking a primary allocation for use by feeder links under Issue 9.1.9 within this band, seem to be at odds with the assertion that sharing is not feasible within this band under WRC-19 agenda item 1.13; the results under Issue 9.1.9 find that “required separation distances for BS and UE are similar, and ranging between 260 to 330 metres” for worst-case analysis and “These distances reduce to 30 m and 70 m for IMT-2020 BS and UE, respectively, when improved FSS antenna sidelobe performance is taken into account.”[[8]](#footnote-8) Based on the reasons given above, Intel supports View A seeking an identification to IMT in the 51.4-52.6 GHz frequency range if overly stringent out of band emission limits are not imposed.

## AI 9.1/Issue 9.1.9 (WAC/088)

WAC/088 considers the possible allocation of 51.4-52.4 GHz to the FSS limited to feeder links. As stated above regarding WAC/083 addressing potential IMT use of the same band, Resolution 162 limits FSS use of the band to feeder links for geostationary orbit use; these restrictions must be maintained in any potential proposal supporting an allocation to the FSS in this band.

There also seems to be substantive differences between what was studied for sharing and compatibility with different services. According to the ITU-R studies, FSS baseline parameters provided in Table 1-1 only included 13.5m antenna while “additional parameters” also considered 4.5m antennas. For example, sharing studies between FSS and the fixed service, radio astronomy service and Earth exploration satellite service considered these Table 1-1 FSS parameters to derive results. However, studies with the Mobile Service (i.e. IMT-2020) utilized a different set of FSS technical characteristics to derive the sharing study results; “This study considers the parameters given in Table 4-1 represent a more realistic deployment of FSS gateways in the potential new FSS band 51.4-52.4 GHz.”[[9]](#footnote-9) It should be noted the FSS technical characteristics used for studies with IMT-2020 as opposed to those used for other services (Fixed, Radio Astronomy, EESS) included different carrier bandwidth, antenna diameter, antenna gain, radiation pattern, minimum elevation angle, e.i.r.p., e.i.r.p. density, and uplink power control for the FSS ES transmit parameters, while the antenna diameter and G/T were different for the FSS satellite receiver parameters. Discussions within IWG-3 included proposals to include possible antenna size restrictions of 2.4 meters or 1.8 meters. However, as the sharing and compatibility studies for most of the primary service were conducted with Table 1-1 FSS characteristics with antenna diameters of either 13.5m or 4.5m, the example article 5 footnote in the CPM Report mandates a minimum antenna diameter of 4.5 meters.[[10]](#footnote-10)

As stated above, Intel supports ensuring that the footnote remains consistent with the scope of the Resolution regarding the limitation to feeder links for Geostationary orbit (GSO) use only. In addition, explanations will be needed on why different FSS characteristics were utilized for sharing studies with IMT-2020 than used for other services and any resulting implications regarding feeder link antenna size.

# WRC-23 “Future Agenda Item” Proposals

With respect WRC-19 agenda item 10 proposals for WRC-23 future agenda items, Intel believes the following questions should be considered when evaluating whether the U.S. should support and/or propose individual topics for inclusion as a WRC-23 agenda item:

* Is the proposal important with respect to national priorities?
* Does the proposal address the same bands being pursued by different applications simultaneously (i.e. overlapping bands)?
* Are there other proposals for different applications of the same service in other bands?
* Could the work could be done via other mechanisms (e.g. Report or Recommendation) instead of a future agenda item?

In particular, there are numerous proposals for WRC-23 agenda items for various applications in the FSS in numerous bands including the following:

* NGSO-GSO Links in 27.5-30 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz (**WAC/089)**
* FSS (Earth-to-space) in 37.5-39.5 GHz, (**WAC/090)**
* GSO ESIMs in 10.7-10.95 GHz, 11.2-11.45 GHz, 12.75-13.25 GHz, (**WAC/091)**
* NGSO operation in 18.6-18.8 GHz (space-to-Earth), (**WAC/092)**
* NGSO ESIMs in 17.7-20.2 GHz (space-to-Earth), 27.5-30.0 GHz (Earth-to-space), 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), (**WAC/093)**
* NGSO operation in 71-76 GHz (space-to-Earth) and 81-86 GHz (Earth-to-space), (**WAC/094)**

This list alone includes six different proposals covering five different types of operation in twelve different frequency bands as well as three overlapping frequency bands, effectively limiting potential agenda items from other services.

Intel notes that none of these future agenda item proposals include any consideration of spectrum needs within the agenda item proposal. For example, ESIMs already have access to 4.55 GHz of spectrum with an additional 4 GHz under study as part of WRC-19 agenda item 1.5; an additional 12.5 GHz of spectrum would be under consideration in the future agenda item proposals above for ESIM use without having ever establishing any spectrum needs for ESIMs.

Future agenda items for FSS could also have an impact on future availability and operating conditions for terrestrial services. The mobile industry continues to drive technological innovation to provide the most widely-used forms of communication on the planet. Imposing rigid operating conditions for terrestrial services in numerous bands based on today’s technologies could preclude future innovation. For example, while considering new FSS applications at the recent CPM 19-2 meeting, some delegations proposed to remove the clause “*and shall not affect the future development of these services*”[[11]](#footnote-11) despite the fact that the relevant Resolution explicitly considered the future development of these terrestrial services.[[12]](#footnote-12)

Furthermore, Intel recommends that the U.S. not consider any of the proposed agenda items addressing the 27.5-29.5 GHz band until Preliminary Draft New Recommendation ITU-R M.[MS-RXCHAR-28] is approved. (Documents which propose consideration of the 27.5-29.5 GHz band include WAC/089 and WAC/093.) Without this Recommendation, which is the only ITU-R document providing Mobile Service characteristics in the band, the U.S. cannot have any degree of confidence that the protection of mobile services will be adequately considered. Although this Recommendation was initiated by the U.S. in November 2016 and includes characteristics of Mobile Service systems deployed in the U.S., the Recommendation has still not been approved.  Until this Recommendation is approved, Working Party 5A will not be able to provide Mobile Service characteristics in this band for use in sharing studies for any new agenda items.

Some initial comments on the various draft proposals that have been provided by the WAC for information are provided below; it should be noted these are only high level comments as it is still unknown which future agenda items will be supported by the U.S.

## WAC/085 (ENG in 150 MHz-2 GHz)

WAC/085 considers a future agenda item for Electronic News Gathering (ENG) applications. This proposed future agenda item is not necessary as work on this topic is already permitted and proceeding under Resolution 59-1, Recommendation ITU-R BT.1871 “User requirements for wireless microphones”, and Report ITU-R BT.2069 “Tuning ranges and operational characteristics of terrestrial electronic news gathering (ENG), television outside broadcast (TVOB) and electronic field production (EFP) systems”. Furthermore, given the broad 150 MHz-2 GHz frequency range proposed for study, any work under this proposal may need to be done in a Joint Task Group due to the numerous services potentially impacted including ITU-R Study Groups 4, 5, 6, and 7.

## WAC/089 (NGSO to GSO links in 27.5-30 GHz, 47.2-50.2 GHz, 50.4-51.4 GHz)

WAC/089 considers a future agenda item for NSGO to GSO links in 27.5-30 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz. Any consideration of NGSO to GSO links, which by their very nature are satellite to satellite links, should be done via allocations to the Inter-Satellite Service or to a space service in the space-to-space direction. The expansion of the definition of the Fixed Satellite Service to include new applications has already presented challenges due to ESIM operations (a mobile satellite service done as an application of the FSS[[13]](#footnote-13)) and should not be further compounded by repeating the same mistake to allow ISS links to operate as an application of the FSS. This is the equivalent of a mobile cellular system asking to be deployed in other terrestrial service bands such as the Fixed Service. Simply put, NGSO to GSO links should be limited to bands allocated to the Inter-Satellite service or to a space service in the space-to-space direction.

As can be gleaned from the ESIM experience, a FSS “application” being introduced in a small number of bands merely sets a precedent to widen the applicability. Although ESIMs in 29.5-30 GHz might not have been very challenging sharing scenario as the band is not shared with terrestrial services, we are currently considering GSO ESIM in bands shared with terrestrial services at WRC-19, along with a proposal to study NGSO ESIM in six bands for WRC-23. Similarly, the NGSO to GSO links proposal started with one band and has already spread to three bands in the future agenda item proposal along with proposed consideration of at least one other band (5925-6425 MHz).

As shown by sharing studies conducted in TG5/1, sharing results between terrestrial services such as IMT-2020 can lead to different (and more challenging) results for ISS as compared to FSS. Although studies on the topic on NGSO to GSO links have been initiated in WP4A and WP4C and have been communicated to the Director of the BR, information regarding these studies have never been liaised to a single terrestrial service working party.

Furthermore, *Resolves* *2* of the proposed agenda item does not include protection of “current and planned stations of the Fixed and Mobile service” nor any consideration of not constraining the future development of Fixed and Mobile Service systems in these bands. As stated above, Intel recommends that the U.S. not consider any of the proposed satellite agenda items addressing the 27.5-29.5 GHz frequency band until Preliminary Draft New Recommendation ITU-R M.[MS-RXCHAR-28] is approved in order to ensure consideration of protection of Mobile Service systems in this band.

Based upon the reasons above, Intel recommends that the U.S. not support inclusion of NGSO to GSO links as an application of the Fixed Satellite Service under the Director’s Report at WRC-15 or as a future agenda item; NGSO to GSO links should be limited to bands allocated to the Inter-Satellite service or to a space service in the space-to-space direction.

## WAC/090 (FSS in 37.5-39.5 GHz)

WAC/090 considers a future agenda item for FSS (Earth-to-space) as shown in WRC-23 preliminary agenda item 2.4. However, the CPM Report states the following with respect to this proposed future agenda item: “With a positive decision by WRC-19 on issue 9.1.9 and allocation of the frequency band 51.4-52.4 GHz for the FSS (Earth-space, limited to FSS feeder links for geostationary orbit use) the current spectrum requirements of the GSO FSS feeder links (Earth-to-space) can be fully satisfied. The intensive use of the frequency band 37.5-39.5 GHz by fixed service stations and outcome of WRC**-**19 on agenda item 1.13 should be considered.”[[14]](#footnote-14) Based on this information, this agenda item does not appear to be needed any longer. Furthermore, the proposal to revise WRC Resolution 750 is not appropriate as modifications to this Resolution for the protection of passive services should be limited to bands subject to RR No. 5.340.

## WAC/091 (GSO ESIMs in 10.7-10.95 GHz, 11.2-11.45 GHz, 12.75-13.25 GHz)

WAC/091 considers a future agenda item for GSO ESIMs in 10.7-10.95 GHz, 11.2-11.45 GHz, and 12.75-13.25 GHz. Although the overarching concerns about the proposed number of FSS agenda items remains, it should be noted that this proposal is limited to Aeronautical and Maritime ESIM, which is a positive development as it avoids the sharing challenges presented by Land ESIM. It should also be noted that the language in the *Further Resolves* appears to draw conclusions about the outcome of the studies and may need to be amended if this proposal goes forward.

## WAC/092 (NGSO in 18.6-18.8 GHz)

WAC/092 considers a future agenda item to permit NGSO operations at lower apogees than previously studied, while retaining the pfd limits to protect terrestrial operations as established for GSO operations. This emphasizes the importance of ensuring that pfd limits for the protection of terrestrial services which are being considered for various WRC-15 agenda items are based upon receiver characteristics; otherwise terrestrial operations risk suffering from interference from new and/or different space service operations.

## WAC/093 (NGSO ESIMs in 17.7-20.2 GHz, 27.5-30 GHz, 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, 50.4-51.4 GHz)

WAC/093 considers NGSO ESIMs in 17.7-20.2 GHz, 27.5-30 GHz, 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz. In addition to questions raised regarding all agenda item 10 proposals, this proposed future agenda item has multiple areas of concern including the following:

* It includes all types of ESIM including Land ESIM, the most challenging use case in terms of sharing scenarios;
* NGSO ESIM pose even more of a challenge than GSO ESIM due to the aggregate effect as well as the increased likelihood of uplink transmissions at low elevation angles, which increase EIRP towards terrestrial services operating in the bands.;
* It addresses multiple frequency bands utilized in the U.S. for “5G” which could lead to confusion as to U.S. priorities at WRC-19 ;
* Any work under this proposal should be done in a Joint Task Group due to the numerous services potentially impacted including ITU-R Study Groups 4, 5, and 7;
* There does not appear to be adequate consideration of the protection of other services. For example, *Resolves 3* which proposes potential regulatory actions to enable ESIMs does not include consideration of the results of sharing studies in *Resolves 2*.

As stated above, Intel recommends that the U.S. not consider any of the proposed satellite agenda items addressing the 27.5-29.5 GHz band until Preliminary Draft New Recommendation ITU-R M.[MS-RXCHAR-28] is approved in order to ensure that Mobile Service systems in this band will be considered in the development of protection measures.

## WAC/094 (NGSO in 71-76 GHz and 81-86 GHz)

WAC/094 considers NGSO operation in 71-76 GHz and 81-86 GHz. In addition to the questions raised above regarding all agenda item 10 proposals, this proposed future item seems to imply that fixed and mobile services are entitled to lower levels of protection than other services. For example, the text in *Resolves 2* regarding the protection of fixed and mobile states “studies of technical and operational issues and regulatory provisions for the operation of non-GSO FSS satellite systems” while the text in *Resolves 6* regarding the protection of the Radio Astronomy Service states “studies towards ensuring protection of the radio astronomy frequency bands 76-86 GHz from non-GSO FSS transmissions”.

## WAC/097 (Passive Service RFI)

WAC/097 considers passive service interference reporting. Similar to WAC/085, this proposed future agenda item is not needed as the work can and is being done under other mechanisms. For example, the Radiocommunication Bureau has already provided feedback to WP7C on mechanisms to report interference via Appendix 10 as well as through an option the Bureau is making available to upload the reports via a new (SIRRS) application.[[15]](#footnote-15)

# Conclusion

Intel respectfully submits these comments in response to the Public Notice seeking comments regarding the WRC-19 Advisory Committee recommendations and proposals for information. Regarding WRC-19 agenda item 1.13, Intel re-iterates that the most promising bands for global harmonization under agenda item 1.13 are 24.25-27.5 GHz (part of a broader tuning range that includes 27.5-29.5 GHz) and 37-43.5 GHz. Intel also supports identification to IMT of 45.5-47.2 GHz and 50.4-52.6 GHz. Intel also provides some questions and information that might be of assistance in discussions regarding which future agenda item proposals should be supported and/or proposed by the U.S. for inclusion in the WRC-23 agenda.

Respectfully submitted,

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1. Intel, a leader in the semiconductor industry, is shaping the data-centric future with computing and communications technology that is the foundation of the world’s innovations. The company’s engineering expertise is helping address the world’s greatest challenges as well as helping secure, power and connect billions of devices and the infrastructure of the smart, connected world – from the cloud to the network to the edge and everything in between.  [↑](#footnote-ref-1)
2. International Bureau Seeks Comment on Recommendations Approved by World Radiocommunication Conference Advisory Committee, Public Notice, IB Docket No. 16-185, DA 19-172 (rel. Mar.11, 2019) (“Public Notice”). [↑](#footnote-ref-2)
3. GN Docket No. 14-177, *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, Released Nov 22, 2017 (“Spectrum Frontiers 2nd R&O”). [↑](#footnote-ref-3)
4. See Annex 1 to Task Group 5/1 Chairman’s Report. “System parameters and propagation models to be used in sharing and compatibility studies” at https://www.itu.int/md/R15-TG5.1-C-0023/en [↑](#footnote-ref-4)
5. See “MSS parameters for studies under WRC-19 agenda item 1.13” at https://www.itu.int/md/R15-TG5.1-C-0023/en [↑](#footnote-ref-5)
6. “Spectrum needs and characteristics for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz” at https://www.itu.int/md/R15-TG5.1-C-0036/en [↑](#footnote-ref-6)
7. Resolves to invite ITU-R 2 of WRC Resolution 162 “subject to justification resulting from studies conducted under *resolves to invite ITU‑R*1, sharing and compatibility studies with existing services, on a primary and secondary basis, including in adjacent bands as appropriate, to determine the suitability, including protection of fixed and mobile services, of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS feeder links for geostationary orbit use, and the possible associated regulatory actions;” [↑](#footnote-ref-7)
8. See sections 4.3.1 and 4.3.2 of “Preliminary draft new Report ITU-R S.[SPECTRUM\_SHARING] - Sharing with incumbent services in the 51.4-52.4 GHz band and adjacent and nearby bands” Annex 3 of WP4A Chairman’s Report at https://www.itu.int/md/R15-WP4A-C-0826/en [↑](#footnote-ref-8)
9. Ibid, Section 4.1. [↑](#footnote-ref-9)
10. “CPM Report on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019” page 652. [↑](#footnote-ref-10)
11. “CPM Report on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019” page 431. [↑](#footnote-ref-11)
12. WRC Resolution 158 “Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service” [↑](#footnote-ref-12)
13. See Considering a) (*emphasis added*) “that there is a need for global broadband *mobile-satellite* communications, and that some of this need could be met by allowing earth stations in motion (ESIM) to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) “CPM Report on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019” page 874. [↑](#footnote-ref-13)
14. “CPM Report on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019” page 874. [↑](#footnote-ref-14)
15. See 7C/127. “Detection, Reporting and resolution of radio frequency interference to earth exploration-satellite service (passive) sensors” [↑](#footnote-ref-15)