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CRAF Meetings – Report 2

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1 Introduction

The science of radio astronomy plays a key role in increasing our understanding of the environment and the universe in which we live. By its nature it is a passive service, so it never causes interference to other users of the radio spectrum. It is becoming more and more difficult to protect radio astronomy operations from radio interference because of the increasing pressure on the finite resource of the electromagnetic spectrum from active spectrum users. On behalf of European radio astronomy observatories, the Committee on Radio Astronomy Frequencies (CRAF) of the European Science Foundation coordinates activities to protect the frequency bands used by radio astronomy. It works towards this aim by:

- Co-ordinating the case for radio astronomy in Europe in discussions with the major public and private telecommunications agencies.
- Acting as the European voice in concert with other groups of radio astronomers in discussions within the international bodies that decide on the use of radio spectrum.
- Initiating and encouraging scientific studies aimed at reducing interference at its source and the effects of interference.

CRAF has representatives from all European countries in which radio telescopes are operated, and also from a few other countries, which have a particular interest. South Africa, being a part of the ITU Region 1, to which Europe is assigned, also has representation. Also represented on CRAF are a number of international organisations most of which have bases in Europe: ESF, ESA, ESO, IRAM, IVS, SKAO.

CRAF employs a full-time frequency manager who is paid from the contributions made by the participating radio astronomy observatories or national institutes. The frequency manager is the primary representative of CRAF at international spectrum management meetings. In addition to the frequency manager, CRAF members also frequently represent CRAF at international spectrum management meetings.

As an organisation, CRAF is formally accredited to represent the interests of the Radio Astronomy Service in matters of frequency protection at international fora, specifically at a European level at the CEPT and at a global level at the ITU. The individual expert members of CRAF also participate in meetings of their national spectrum agencies. This link between international and national activities is crucial for CRAF's activities. At international meetings national administrations (who have a right to vote whereas CRAF does not) endeavour to support CRAF's activities, and at a national level it is important to show that the international radio astronomy community has a common strategy.

Once or twice per year, CRAF organises face-to-face meetings for its members to report on current interference issues and possible solutions, and to discuss international developments that may have an effect on radio astronomy and how to react to them. RadioNet support is used for the organisation of CRAF meetings and to support CRAF members to attend them, and also to support CRAF members who represent CRAF at international spectrum management meetings.

During the period from 20 November 2018 until December 2020, the following activities have been supported by RadioNet from which short reports are provided in the subsequent sections:

1. 63rd CRAF Expert Committee meeting, 12-14.6.2019, Jodrell Bank/UK

and attendance to the following International Spectrum Management meetings:

2. CEPT/ECC PT1, 10-14.6.2019, Billund/DK
3. CEPT/ECC SE24 #99, 12-15.1.2020, Copenhagen/DK
4. CEPT/ECC PT1#64, 14-16.1.2020 Manchester/UK
5. CEPT/ECC #52, 2-6.3.2020, Tallin/EE

In addition to these, several other meetings organized by CEPT, ITU and CRAF itself have been attended by CRAF delegates without RadioNet financial support. The annex at the end of this report lists the

meetings held in the period January 2019 – December 2020, which have been attended by CRAF members. The list includes meeting name, location and date, main topics of interest for CRAF and participants representing CRAF.

Since March 2020 all spectrum management meetings, expected to be held physically and for which a RadioNet support was planned, have been then converted to virtual meetings due to the COVID-19 outbreak.

It is worthwhile mentioning that the possibility, in the last months, to remotely attend the meetings has allowed a remarkable increase in the number of events attended by CRAF members. This comes together with the new modus operandi of CRAF based on Work Item teams, which started a couple of years ago and nowadays is fully in operation. This mechanism allows a more evenly distribution of the work load of CRAF, which vice versa in the past was in charge of few key people mainly the Frequency Manager and the Chairman. The new activity organization consists of different Work Item teams, each of them constituted by less than 10 CRAF members, with very specific topics to address. The advantage of this approach is that the contribution requested to each member does not require a significant amount of FTE thanks to the increase in the participation of almost all members of CRAF.

Few weeks before the start of the severe restrictions against the COVID-19 outbreak in Europe, it has been possible for several CRAF Members to attend the IUCAF 5th School on Spectrum Management for Radio Astronomy, 2-6 March 2020 (Stellenbosch, South Africa) which was also supported by RadioNet WP3, Training. Unfortunately, other events planned for 2020 requiring a physical attendance, such as the PyCRAF workshop, have been cancelled.

2 63rd CRAF Expert Committee meeting

2.1 Summary

This was the 63rd annual face-to-face meeting of CRAF, where experts in the field of protection of radio frequencies used by the European radio astronomical scientific community met to discuss their common strategy in achieving the mission of CRAF, which includes “to keep the frequency bands for radio astronomical observations free from interference”. In fact, CRAF represents all radio telescopes in Europe in matters of radio frequency protection, which is to the obvious benefit of the entire RadioNet community.

This meeting, which was held at the University of Manchester’s Jodrell Bank Observatory and also the SKAO at Jodrell Bank, was attended by 14 CRAF members plus Harry Smith, a former CRAF Frequency Manager, who has been employed by CRAF as a consultant. Viktor Tóth (ELTE, Hungary) attended by remote access and Vladislavs Bezrukovs (Latvia) was represented at the meeting by Dr. Indra Dedze, Vice-Rector for Research at Ventspils University. Six of the CRAF members attending the meeting were in receipt of RadioNet funding, which was recognised as an invaluable contribution to their expenses. CRAF also welcomed to the meeting Harvey Liszt (the IUCAF Chairman), Gie Han Tan (ESO / ALMA), Federico DiVruno (SKAO), B. Ashley Zauderer (USA NSF – by remote access), Lisa van Zee (Chairman of CORF – by remote access) and Jean-Claude Worms (Managing Director of the ESF). It was noted that Wim van Driel, the former CRAF Chairman from the Paris Observatory, has resigned. Of greater concern was that following the withdrawal of the Dutch representative based at ASTRON almost a year ago, no replacement had as yet been found. The affiliation of the Swiss representative will no longer be ETH, Zürich, but will probably be the Istituto Ricerche Solari in Locarno. The afternoon session of the second day was devoted to a joint meeting between the CRAF members and the Observatory Directors / funding representatives (the Stakeholders forum). In addition to the Latvian director already present for the whole CRAF meeting, eight other directors joined the discussions concerning CRAF’s work and also, of considerable importance, its proposed budgets and current financial situation. At present CRAF is financed by the annual contributions of ten Institutional Members (observatories, national scientific academies and funding

agencies). The need for an increase in the annual contributions was proposed and accepted. Following welcomes by the Director-General of the SKAO and also the Director of Jodrell Bank Observatory, both of whom gave brief overviews of the work being undertaken in their establishments, the expert members gave reports on the RFI situation in their observatories and their interactions with their national spectrum. Also presented for discussion and policy determination were the 20 CEPT / ITU meetings that had been / were to be attended by CRAF members during this year of 2019. Of particular note for discussion were the preliminary CRAF positions on some of the contentious Agenda Items for the 2019 World Radiocommunication Conference (WRC-19) of the ITU to be held in Sharm el Sheik in Egypt, a four-week meeting which is to take place during October / November 2019, and at which CRAF representation was discussed and provisionally decided. The afternoon session on the first day concluded with a presentation on the 'Work Items' process by Pietro Bolli, which was initiated at the two previous CRAF plenary meetings by Benjamin Winkel in order to encourage a more even distribution of the spectrum management work amongst CRAF members. This was followed by a discussion of the 'Work Items' successes to date and the need for an even greater work distribution in this area (i.e. the introduction of further 'Work Items'). CRAF normally employs a full-time Frequency Manager, but was advertising for a new Manager at the time of the meeting following the resignation of Talayeh Hezareh at the end of February.

2.2 Agenda of the event

Wednesday, June 12

- Welcome by Prof. Dr. Philip Diamond, Director General of the SKA Organisation.

1st session of the Expert Committee meeting [closed session]

- Opening of the meeting: Adoption of the agenda, Correspondence, CRAF Expert Committee members – changes?
- Evaluation of Minutes of the October 2018 CRAF web-meeting
- Status of action items
- Communications concerning CRAF: CRAF budget (2017, 2018, 2019 & 2020), RadioNet H2020, Preparation for the 3rd Stakeholder Forum meeting
- FM & Consultant Situation + Report by previous FM
- Lunch + Tour of Jodrell Bank Observatory + Photo

2nd session of the Expert Committee meeting [open session]

- Welcome of Guests, round of introductions – JBO Director or representative.
- Overview of the state of the SKA at present and SKA interference work
- Report from CPG Meeting in Stockholm
- Upcoming CEPT/ITU meetings of interest to CRAF and CRAF attendance
- Status of WRC-19 Agenda Items and CRAF positions
- Other issues of concern to the RAS at CEPT/ITU
- Report from WP7D meeting
- Report on the CRAF Studies working group
- Work on SE24 Document submitted
- Possible new Studies working Groups

Thursday, June 13

3d session of the Expert Committee meeting [open session]

- Start on Interference problems in individual countries
- Continue with Interference problems

Stakeholders Forum

- Opening, fixing of Agenda, round-table of introduction of attendees
- Noting of any changes in Institution Membership or their Stakeholders Forum representatives; noting of any changes in Expert Committee membership
- Minutes of last meeting and actions arising
- Status of CRAF Frequency Manager search
- Summary and discussion of CRAF activities in past period
- Presentation and discussion of Expert Committee priorities for upcoming period
- Modus operandi of Expert Committee
- Review of financial status
- Proposed 2019-2020 budget
- Further matters tabled in advance, if any
- Stakeholders Forum chair appointment
- Further discussion matters arising; any other business

CRAF Expert Committee Open Session

- CRAF Newsletter: preparation of newsletters; latest & next
- Attendance at CRAF Meetings
- Feedback from Funders Circle

Friday, June 144th session of the Expert Committee meeting [open session]

- Continue with Interference problems
- Attendance at CPM & WRC
- Continue with Interference problems
- Conclusion of meeting: review of new action items, date and location of next Expert Committee meeting, any other business

2.3 Participants

The following 15 CRAF expert members / representatives took part in the meeting: Pietro Bolli (Italy), Indra Dedze (Latvia), Hayo Hase (IVS), Karel Jirička (Czech Republic), Juha Kallunki (Finland), Michael Lindqvist (Sweden), Christophe Marqué (Belgium), Joe McCauley (Ireland), Christian Monstein (Switzerland), Vincent Piétu (IRAM), Harry Smith (SKAO), Ivan Thomas (France), Peter Thomasson (UK), Vincenza Tornatore (Italy) and Viktor Tóth (Hungary).

In addition to Indra Dedze, the Latvian representative, who received RadioNet support, the eight directors, or their representatives, who participated on 13 June came from seven different countries, two were female, and none received RadioNet support. These were: Stéphane Corbel (INSU, France); Simon Garrington (STFC, UK); John Conway [by remote access] (Onsala Space Observatory, Sweden); Indra Dedze (Ventspils University, Latvia); Tiziana Venturi [by remote access] (INAF, Italy); René Vermeulen (ASTRON, Netherlands); Michael Kramer (MPIfR, Germany); Francisco Colomer (JIVE, Netherlands) and Ritva Taurio [by remote access] Academy of Finland, Finland).

Also participating were the Executive Director of the ESF, Jean-Claude Worms; Harvey Liszt (the IUCAF Chairman); Gie Han Tan (ESO / ALMA); Federico DiVruno (SKAO); B. Ashley Zauderer (USA NSF – by remote access); Lisa van Zee (Chairman of CORF – by remote access).



Figure 1. Meeting picture: the CRAF expert members in front of the SKA headquarter and with the mechanical structure of the 250 ft Lovell Telescope in the background.

2.4 Publications

On the CRAF website, there is a news item under <https://www.craf.eu/the-63rd-craf-expert-committee-meeting/>, but the input and output documents are not publicly accessible, as they concern internal CRAF strategies for the protection of radio astronomy frequencies. In the Minutes of the meeting, RadioNet support is duly acknowledged.

A report from the 63rd CRAF meeting with a mention to the RadioNet support is also present in the 33rd issue of the CRAF Newsletter.

3 CEPT/ECC PT1 #62 meeting

3.1 Summary

The organizing body, the Electronic Communications Committee of European Conference of Postal and Telecommunications Administrations (CEPT/ECC) is responsible for radio communication regulation in European countries. At this meeting of its Working Group PT1, Benjamin Winkel, represented CRAF. ECC/PT1 is responsible for the development of the mobile communication sector in CEPT countries. Among the topics, which were discussed, three are of utmost importance to European radio astronomy: *i*) possible use of 5G mobile/fixed communications network (MFCN) equipment in the 26 GHz band (24.25 - 27 GHz) under a general authorisation regime, i.e. uncoordinated deployment; *ii*) ECC work item (WI) PT1_18, which tasks PT1 to study if MFCN user equipment (UE) could be operated on board drones in one or more of the existing MFCN bands; *iii*) ECC WI PT1_13, which is about a review of ECC Decision (05)05 (2.6 GHz MFCN) to study suitability for an upgrade of the band to 5G technology.

In preparation to the meeting, a large amount of work went into the design of suitable compatibility studies that analyse the necessary conditions of co-existence between the radio astronomy service and the interfering services (in this case the International Mobile Telecommunication Service, IMT).

3.2 Agenda of the event

The 62th meeting of ECC PT1 took place in Billund/Denmark between June 10 to June 14, 2019 and CRAF member Benjamin Winkel (BW) participated. As there were many different topics on the agenda, (sub-)working and drafting groups were meeting in up to four parallel sessions. In some cases, BW had to make a choice between two concurrent sessions based on (subjective) prioritization. However, BW kept close contact with members of the German administration to be informed about on-going work in sessions, which he could not attend. In the following, the three major topics, which were relevant to RAS at this meeting, are discussed in more detail.

MFCN/5G at 26 GHz under general authorization regime

In a letter to the Chairman of the ECC, the European Commission asked the ECC to study the possible use of 26-GHz 5G equipment under a general authorization regime (see document PT1(19)117). Some countries, such as France, submitted input documents to the PT1 #62 with their thoughts about the matter, e.g., which difficulties and potential solutions were identified. From a RAS perspective an uncoordinated use has great dangers, as it would essentially mean that local spectrum agencies or other authorities would have effectively no control over devices that would be operated in immediate vicinity of our telescopes. One potential solution could be a geolocation-based switch in the 5G access points, that wouldn't allow operation in certain areas. However, it seems unlikely that vendors would be willing to implement such functionality, as it would increase the costs. This is also one of the reasons, why vendors and mobile network operators did not support the uncoordinated use of 5G technology at the meeting. As there is not even an ECC work item for this topic yet, PT1 did not work extensively on the matter, but prepared a statement to ECC with the views of the participants and proposals for the further process.

Use of MFCN UE on-board aerial vehicles

Work item PT1_18 is about the possible use of existing MFCN bands (mainly) below 5 GHz by aerial vehicles (AV). The topic was brought up by Airbus and Deutsche Telekom, originally asking for allowing "command & control" (C&C) and wireless payload communication of unmanned aerial vehicles (UAV), aka drones, in existing IMT networks. The PT1 sub-working group A decided at previous meetings, which bands are most favourable and restricted the studies in a draft ECC report (document PT1(19)153) to the bands 700, 800, 900, 1800, 2100, 2600, 3400-3800 MHz. The L-band (1427 - 1517 MHz) is downlink-only in CEPT countries and thus of limited use. The 26-GHz band was allocated in CEPT under the constraint that communication from a base station to UE on a drone is not allowed. While the WI PT1_18 is about UAVs, Airbus is of the view that the studies carried out for the ECC draft report would also apply for manned aircrafts. Therefore, they proposed a liaison statement (LS) to be sent to WGFM, in which the ECC is informed about this and asks for a possible extension of the scope of the WI to include all sorts of aerial vehicles into the WI. As no administration was opposing the proposal, the (slightly rephrased) LS will be sent to WGFM. CRAF had prepared a compatibility study (doc. PT1(19)145) in which the potential impact of MFCN UE onboard AVs is analysed. Lacking information about estimated future deployment densities, for now only a single-interferer worst-case study was performed. Given the large number of potential bands, CRAF decided to look at three RAS bands, 610, 1420 and 2600 MHz – to serve as examples – and use the general spurious emission limit of -30 dBm/MHz to derive separation distances; which are very large for some cases, especially for typical flight heights of aircrafts (>3000 m). BW presented the CRAF study in the UAV drafting group. Unfortunately, it was discussed very controversially. In particular Airbus is of the opinion that the study was not appropriate, as the three RAS bands that were chosen are all separated by at least 90 MHz from the closest IMT band. Apparently, it is unclear out to which separation in frequency one is ought to study the impact of possible spurious emissions, and Airbus claimed that "PT1 does not (and never did) study this". Regardless of this, the 3.4 GHz IMT band is not very much separated from the 3.35-GHz RAS band and the second harmonics of the 700 MHz IMT band falls into the passive 1.4 GHz RAS band – CRAF is of the opinion that both of this should at least be looked at in more detail. Another issue was raised by Airbus, that existing drones use WiFi (2.4 GHz) for C&C and, as RAS has no problems with WiFi spurious emissions, the MFCN won't cause trouble, as well.

However, BW informed them that it is a wrong assumption that WiFi is not a problem for RAS (it is just difficult to have a handle on the problem, as the 2.4 GHz band is uncoordinated). Due to the limited time, the issues could only briefly be discussed and the session was mostly an exchange of arguments between Airbus and CRAF. Although BW asked for inclusion of the CRAF study into the draft report, the drafting group chair, Thomas Konschak (Deutsche Telekom), simply refused this, as there was no consensus reached (Airbus was against it). BW raised the topic again in the closing session of the sub-working group A, but again, as no consensus was reached, the Chair (Michael Kraemer) did not follow CRAF's proposal. Only in the final closing plenary, when BW raised the issue a third time, with support from France and Germany the PT1 Chairman decided to add a placeholder section (for RAS compatibility studies) to the draft report. A newly formed correspondence group is tasked to further study the matter and to solve the open issues in (probably) two web-meetings in July and August before the next PT1 meeting.

MFCN at 2.6 GHz, upgrade from 4G to 5G

In ECC work item PT1_13, a possible update of ECC Decision (05)05 is under study, the aim of which is to analyse if and possibly under what conditions existing 4G MFCN bands could be upgraded to active antenna systems (AAS) equipment (5G). CRAF had carried out and submitted compatibility studies to the previous PT1 meeting (#61). As the new AAS base stations will have out-of-band power levels that are about 14 dB higher than for 4G devices, the necessary coordination zones around RAS stations would be significantly larger. Therefore, France proposes to implement a so-called "additional baseline", which demands much stricter limits in the vicinity of radio observatories. The value of 0 (zero) dBm/MHz (total radiated power), which is on the table, was however strongly opposed by vendors (e.g., Ericsson and Huawei) and several administrations (e.g., Sweden and UK). The opponents expressed the opinion that such strict limits would technically not be possible and thus the additional baseline would make no sense. At the meeting, no compromise could be found. From the RAS perspective, the stricter limits are more favourable, as it would ease the coordination process (with much smaller coordination zone size), but independent of the outcome of this, the latest ECC decision (05)05 draft includes the protection of the RAS.

3.3 Participants

The participants at these meetings are all experts in spectrum management, on technical and/or regulatory aspects. Some represent the national spectrum Agencies of the CEPT member countries, others industry involved in either the proposed new mobile broadband applications, or the numerous potential victim services (broadcasting, fixed services, satellite communications, etc.), and others represent accredited scientific organizations such as CRAF (radio astronomy) or ESA (Earth Exploration Science Service). The attendance list published for this meeting by the ECC/PT1 is not publicly available. About one hundred participants attended the meeting. No conference picture was posted online by the ECC.

3.4 Publications

This meeting will not result in scientific publications. CRAF's input to CEPT/ECC meetings consists of technical compatibility studies on the protection of the radio astronomy service from other services, technical advice, and contribution to CEPT or ECC texts (recommendations, reports, etc.). The input and output documents are publicly available on the ECC web site.

4 CEPT/ECC SE24 #99 meeting

4.1 Summary

This was a spectrum management meeting related to technical issues. At this meeting of Working Group SE24, Ivan THOMAS (Paris Observatory) and Waleed MADKOUR (CRAF Frequency Manager) represented CRAF. ECC/SE24 is responsible for the Short Range Devices (SRD) Issues. Among the topics, the two relevant for CRAF and for which contributions were presented were WI70 and WI71. None of the others items considered in the SE24 meeting were relevant for CRAF and Radio Astronomy.

SE24_70: HD-GBSAR within the 74-81 GHz band

The aim of this item is to output a report about the “feasibility of spectrum sharing between High Definition Ground Based Synthetic Aperture Radar (HD-GBSAR) application using 1 GHz bandwidth within 74-81 GHz and existing services and applications”. This report of SE24 will be use by SRDMG group of CEPT to consider the regulatory framework of SRD and update ECC and EC decisions. The report includes a single-entry worst case compatibility study with radio astronomy proposed by Switzerland. Scientific input parameters have been proposed by CRAF. All RAS material have been discussed and validated during correspondence group meetings in the end of 2019.

Five contributions on WI 70 have been considered by the meeting: contributions from ZF, the Rapporteur and Ericsson not related to the RAS study and the latest version of the draft ECC Report on WI 70, provided by the Rapporteur, for consideration by the meeting.

The ECC report has been finalized by merging the content of the contributions and fixing the remaining issues including some editorial changes. Finally, the revised version of the draft ECC Report on WI 70 was agreed to be forwarded to WG SE for approval for public consultation. The results of the draft report for the RAS, in the conclusion and in the executive summary, are the following:

- For radar in 74-75 GHz, 76-77 GHz and 77-78 GHz bands and RAS operating in adjacent bands: Despite the probability of interference is extremely low, report propose the adoption of a circular exclusion zone for HD-GBSAR around the radio astronomy stations with a radius of 6.3 km.
- For 76-77 GHz and 77-78 GHz in-band sharing: “A reasonable protection criteria is represented by the definition of a circular exclusion zone for HDGBSAR around the radio astronomy station with a radius of 157 km”.
- The list of radio astronomy station in CEPT countries operating in the 76-81 GHz frequency range, for which the exclusion zone shall be respected is in an annex.

Actions for CRAF: to follow the report during the public consultation process; to consider the regulatory process in the SRDMG group for implementation of the exclusion zones.

SE24_71: UWB radiodetermination in the range 116 - 260 GHz

The aims of this item is to output a report about the “Radiodetermination applications in the frequency range 116 - 260 GHz”. This report of SE24 will be used by SRDMG group of CEPT to consider the regulatory framework of SRD and update ECC and EC decisions. The draft report includes a single-entry worst-case compatibility study with radio astronomy proposed by CRAF and some complementary material from ZF. The RAS material has been discussed during the correspondence group meetings in the end of 2019. ZF have brought some new elements to the study by a new contribution to the SE24#99 meeting. These news elements have been included in the draft report as preliminary elements and need to be discussed. The report includes also an issue for RAS concerning emissions in RR 5.340 bands. Nine input contributions, including the draft ECC report on WI 71, submitted by the rapporteur, were considered by the meeting. The documents related to RAS were:

- SE24(20)015 from SIKORA AG proposed minor adjustments of technical parameter and to extend the upper frequency limit from 190 GHz to 260 GHz for type C RDI-S application (Radiodetermination systems for industry automation in shielded environments), considering the scope of ETSI TR 103 498. These were accepted. CRAF opposed to extend studies for bands covering the RR 5.340 bands. This opposition was not considered by the group and administrations because this is related to a regulatory issue and have to be considered in the related group SRDMG and WGFM. The scope of the SE24 is to do the studies whatever the regulatory issues.
- SE24(20)020 from CRAF with two parts: *i)* The first part to ask for removing the RR5.340 bands from the studied band for type C RDI-S applications The meeting agreed to carry out the studies as far as possible with the available protection requirements. The decision on how to treat these specific protected bands for the particular application of RDI-S is proposed to be referred to the WGSE and/or WG FM. It should also be noticed that: CRAF has submitted an input contribution to the SRDMG 15-17 January meeting asking to remove passive RR 5.340 bands from bands for type C radars (RDI-S applications). Some emissions have already been allowed at European level in RR 5.340 bands, for ultra-wideband devices in 2007, by two decisions: CE-DEC-2018/785 and ECC-DEC(07)01. This special case has not to be considered as a precedent. *ii)* The second part that brings some details about the atmospheric model and the calculation method to get the effective EIRP. There was an opposition by ZF to consider high-latitude model for NOEMA. “High-latitude” word is conserved in the report but CRAF has to provide to ZF some inputs to “prove” the validity of this model. The calculation examples were accepted and example 3 about TRP is not need.
- SE24(20)024 from ZF provides a lot of new material that have not been discussed during the correspondence group meeting and that CRAF have discovered. Some materiel could have real impact on the CRAF study. This material has been included in the draft report staying subject to discussion. Some question and opposition were raised by CRAF:
 - Validity of the recommendation 2108 for the clutter loss in rural cases:
 - to consider different zones around the RAS sites with status between rural/midurban/urban;
 - to consider model case 3.3 (high elevation considered) and not 3.2 (terrestrial);
 - to not extrapolate the model in ITU-R Recommendation P.2108-0 and to use the upper frequency limit for the evaluation.
 - Consideration of private road not in the IGN road database.
 - If statistical clutter loss is considered, aggregation of car radar also has to be taking account (studies are invited).
- Draft report update: The inside-vehicle type C radar application case have been removed from the report because of the lack of shielding evidence raised by CRAF and the lack of support from an industrial.

By considering the status of the work on the draft ECC report on WI 71, the meeting agreed to request WG SE for an extension of the deadline of WI71 for two meetings. The new target date would then be May 2021.

Actions for CRAF: to continue iterations with ZF about atmosphere model for NOEMA and clutter loss; to consider a strategy for RR 5.340 bands; to consider the regulatory process in the SRDMG group for implementation of the exclusion zones.

Next meetings: SE24-WI71#5 Webmeeting, 24 march 2020, 10H-12H; SE24#100 meeting, 20-22 April 2020, Copenhagen, ECO; SRDMG#79 meeting, 22-24 April 2020, Copenhagen, ECO.

4.2 Agenda of the event

The Agenda is considered by Work Items and by additional contributions. CRAF have been involved in two ECC draft reports for WI70 and 71 and have contributed by the document SE24(20)020.

1. Opening of the meeting
2. Adoption of the Agenda
3. Report and the activities since the 98th meeting
 - 3.1 Report from WG SE SE24(20)002
 - 3.2 Report from SRD/MG SE24(20)003
 - 3.3 Report from ETSI TG28 SE24(20)004
4. Issues in progress, SE24 work items
 - 4.1 SE24_60: Wireless Power Transmission systems
 - 4.2 SE24_61: Additional studies on NBN SRDs operating in the band 915-921 MHz
 - 4.3 SE24_63: Updated UWB regulatory framework
 - 4.4 SE24_69: Co-existence studies between SRDs in data networks and other SRDs
 - 4.5 SE24_70: HD-GBSAR within 74 - 81 GHz
 - 4.6 SE24_71: UWB radiodetermination in the range 116 - 260 GHz
 - 4.7 SE24_72: Urban rail-FSS in 5925-5935 MHz
5. Possible new work items
6. Date and venue of next meeting(s)
7. Any other business
 - 7.1 Joint SE24 – SRD/MG Meeting
8. Closure of the meeting

4.3 Participants

It applies the same information reported in 3.3.

The attendance list published for this meeting by the ECC/SE24 is available on the meeting website (Document SE24(20)033 Annex 1).

4.4 Publications

It applies the same information reported in 3.4.

5 CEPT/ECC PT1#64 meeting

5.1 Summary

At this meeting of Working Group PT1, Federico Di Vruno and Benjamin Winkel, represented CRAF. As described in Section 3.1, ECC/PT1 is responsible for the development of the mobile communication sector in CEPT countries. Among the topics, which were discussed, two are of utmost importance to European radio astronomy: *i*) possible use of 5G mobile/fixed communications network (MFCN) equipment in the 26 GHz band (24.25 – 27.5 GHz) under a general authorisation regime, i.e. uncoordinated deployment; *ii*) ECC work item (WI) PT1_18, which tasks PT1 to study if MFCN user equipment (UE) could be operated on board drones in one or more of the existing MFCN bands.

This was the third meeting of ECC/PT1 that covered these topics and CRAF representatives participated in every one of them. In preparation to these meetings, a large amount of work went into the design of suitable compatibility studies that analyse the necessary conditions of co-existence between RAS and the

interfering services (in this case the International Mobile Telecommunication Service, IMT), as well as into drafting contributions (so-called input documents) to be included in ECC Reports on these matters.

5.2 Agenda of the event

The 64th meeting of ECC PT1 took place in Manchester, UK between January 14 to January 16, 2020 and CRAF members Federico Di Vruno (FDV) and Benjamin Winkel (BW) participated. In the following, the two major topics, which were relevant to RAS at this meeting, are discussed in more detail.

MFCN/5G at 26 GHz under general authorization regime

In a letter to the Chairman of the ECC, the European Commission asked the ECC to study the possible use of 26-GHz 5G equipment under a general authorization regime (see document PT1(19)117). Some countries, such as France, submitted input documents to the PT1 #62 with their thoughts about the matter, e.g., which difficulties and potential solutions were identified. At PT1 #63 and #64 work on a draft ECC report began (WI PT1_25). From a RAS perspective an uncoordinated use has great dangers, as discussed in Section 3.2 of this report. There were only few input documents for this topic received, and administrations could not yet agree to finalize the draft report. Therefore, a correspondence group was initiated, with a webmeeting scheduled for Feb. 14 2020 the aim of which is to finalize the document. Once the document is finalized it will be distributed for public consultation. Under this item there was also a discussion to answer a letter from the EC about “the impact of the WRC-19 outcome on the harmonized technical conditions for the 26 GHz band” regarding limits to protect passive services in 23.6-24 GHz, and the consequential possible need to review EU regulations. PT1 was tasked to consider the questions from the Commission and report its findings to the March ECC meeting. There are differing views on whether CEPT could confirm that 5G equipment will comply with certain limits (this is a question for manufacturers) and on the appropriate timing and limits for the second step in a two-step approach. PT1 agreed to report on the discussions to the ECC.

Use of MFCN UE on-board aerial vehicles

Work item PT1_18 is about the possible use of existing MFCN bands (mainly) below 5 GHz by aerial vehicles (AV). See also Section 3.2 of this report for other background information. CRAF had prepared a compatibility study (docs. PT1(19)145, PT1(19)230) in which the potential impact of MFCN UE on-board AVs is analysed, for both the single-interferer case and for aggregation scenarios. In particular the 2nd harmonics of LTE700 and LTE800, which fall into the 1400–1427 MHz and 1660–1666 MHz RAS bands are a great threat to radio observatories operating in the L-band, as the potential harmonic emission can have up to –30 dBm/MHz spectral power output, thus large separation distances would be required. This topic was heavily debated at the previous meetings in Billund (PT1 #62) and Riga (PT1 #63) and Airbus in particular was fighting hard to avoid the inclusion of the CRAF studies into the ECC Draft Report. However, at PT1 #63 a compromise was achieved. In the report it is now recommended that administrations who want to protect their RAS stations could do this via some kind of “no-fly” zones around the radio telescopes, but only for primary RAS allocations. Nevertheless, some issues were identified with the wording in some parts of the Draft Report, which could lead to situations in the national regulation process, where it would be unclear how (and if at all) RAS protection would be necessary. CRAF managed to find some compromise with the Airbus representatives regarding the wording, such that the Draft Report – which is now going into public consultation (PC; Document PT1(20)048 Annex 8 & 9) – is less disputable. There are a few minor points left, which CRAF may want to address in the public consultation phase. Another relevant development regarding this topic is that France requested a new work item to produce a new ECC decision on the regulatory aspects of the aerial MFCN usage. If ECC adopts this work item, CRAF should actively participate in the drafting process.

5.3 Participants

It applies the same information reported in 3.3.

The attendance list published for this meeting by the ECC/PT1 is available on the meeting website (Document PT1(20)048 Annex 2).

5.4 Publications

It applies the same information reported in 3.4.

6 CEPT/ECC #52 meeting

6.1 Summary

At the 52nd ECC plenary meeting (Tallinn, Estonia) CRAF was represented by Vladislavs Bezrukovs. Among the topics, which were discussed, three are of utmost importance to European radio astronomy.

Iridium NEXT satellites, measurements in Leeheim (Update)

Additional measurements: The WG FM chairman reported that WG FM, at its meeting in February 2020, had been informed by WG SE about on-going activities and measurements of the Iridium NEXT out-of-band emissions. WG FM had agreed to the FM44 proposal to update the 2015 questionnaire on Iridium's licences in CEPT to provide a better view of the situation. A draft questionnaire will be considered at the next WG FM meeting in June 2020. It was also recalled during the latest WG FM meeting that out-of-band measurements were initially requested by WG FM in order to check compliance with RAS protection levels and to consider the enforcement actions described in ECC Decision (09)02 before CEPT countries renew the Iridium's licences.

In ECC(20)007, WG SE informed ECC that after initial measurements in May 2019, additional measurements were conducted in November 2019 unilaterally by BNetzA and a significant increase of the level of emission in the RAS band was recorded. This point was discussed by SE40 that drafted a factual description of the situation. WG SE agreed to raise this question to ECC level based on SE40 elements. CRAF in ECC(20)032 proposed in particular that ECC would set a deadline not exceeding 6 months and would review the licensing of Iridium in Europe. Iridium confirmed in ECC(20)INFO04 that the compliance to RAS protection is expected in June 2020 and will keep ECC updated on progress through its report to SE40. The Netherlands noted the statement from Iridium in ECC(20)INFO04 that the level of OoB emissions to protect RAS is planned to be fulfilled in June 2020 and expected updated information on this topic during July 2020 ECC meeting. Switzerland noticed the band agreed by FCC for GMDSS deviates from the frequency band agreed during WRC-19. In accordance with the WGSE progress report, the WG SE Chairman pointed out the question of funding the additional measurement to check this conformity after June 2020. Funding issues are not under the scope of WG SE. ECC noted that funding issues are also outside of its scope. ECC will include in the agenda of its July 2020 53rd ECC meeting this topic to take into account the progress on measures to prevent the Iridium NEXT constellation from causing interference to RAS and ensure protection.

Sat MoU

The ECO introduced document ECC(20)018, a compendium of the responses from WG FM, WG SE and the Sat MoU Management Committee regarding three questions asked by the ECC #51 to facilitate the ongoing discussion on the future of Satellite Monitoring within CEPT. Mr. Tschannen (SUI) introduced ECC(20)INFO 01 explaining that Switzerland considered there were benefits of CEPT measurement campaigns through Sat MoU but that the burden/cost should have a reasonable degree of distribution

within CEPT so that individual contributions are not too high. If at the end of 2020 reasonable financing of Sat MoU is not agreed Switzerland will unfortunately have to withdraw from the Sat MoU. Mr. Deedman (ESOA) introduced document ECC(20)029, summarising that the satellite industry sees a continuing need for satellite monitoring pointing on the situations in Q- and V-band, mega-constellations in Kaund Ku-band, on the C-band where FSS shares with MS, and on the WRC-23 agenda items touching topics of relevance for the operation of satellites. Document ECC(20)032 was introduced by Mr. Bezrukovs (ESF-CRAF), as well as document ECC(20)025 by Mr. Tristant (EUMETSAT/ESA) highlighting the relevance of satellite monitoring for these publicly financed activities of these LoUs partners. Some administrations that see the need for satellite monitoring at a CEPT level expressed their support for the continuation of satellite monitoring as is undertaken today and invited other administrations to contribute to this CEPT activity. Others indicated that they did not see a need for satellite monitoring at a CEPT level. Elements around the financing of satellite monitoring were discussed, including the possibility by industry and/or other organisations as suggested by the UK. Germany and France felt that the neutrality of measurements would need to be maintained if CEPT observers (e.g. private companies / stakeholders) were to contribute to the financing. Germany underlined that the SatMoU will expire by the end of 2021 and that the main question is, whether or not CEPT wishes to have the possibility to monitor satellites in future. The second step, if the answer would be yes, would be to respond to the question, how to finance that. It is unlikely that Germany as the operator of the satellite monitoring station in Leeheim will provide measurements for CEPT free of charge after 2021. It was clarified, that there may not be the possibility for CEPT, in particular WG FM 44 or SE 40, to task Leeheim with measurements after 2021. The United Kingdom considered that the issue of CEPT needs for satellite monitoring is not wholly separate from the funding of Sat MoU, particularly as this whole discussion was initially prompted by the Sat MoU Management Committee themselves. Spain noted that they had withdrawn from Sat MoU and did not think that it should be generally funded by CEPT. Russia noted that it has its own satellite monitoring facilities and this is only funded by the Russian administration. It was highlighted that further information would be helpful concerning the explicit needs for satellite monitoring for the foreseen activities and tasks of the ECC and its subordinate groups. It was also suggested that further information could be sought from the Sat MoU regarding funding options, for example from external parties. It should be noted that there is already some information provided in document ECC(20)018. ECC invited administrations to further consider whether or not they consider CEPT should do satellite monitoring in future, based on their expectations of the future activities and tasks of ECC and its subordinate groups. Contributions are invited on the explicit needs for satellite monitoring for the existing and foreseen activities and tasks of the ECC and its subordinate groups.

Interference to C-Band meteorological radars

ECC(20)INFO 05 was presented by EUMETNET concerning the interference from 5 GHz RLAN to Meteorological radars issue, stressing the continuation and increase of interference cases in Europe, despite the ECC action plan initiated at the Dublin ECC Meeting (March 2017). EUMETNET stated that, in their view and at current stage, they considered there was a lack of on-going activities within EC and ECC. It was noted that activities are ongoing in ADCO, EG RED, TCAM, as well as in FM 22 and WG FM. Administrations were asked to consider the interference issues and to contribute to the next meeting where this item will be included on the agenda. The Counsellor from the European Commission, Mr Andreas Geiss, informed the meeting that he will further discuss the issue within EC.

6.2 Agenda of the event

The main subjects of the agenda for the 52nd ECC Meeting are listed below.

- Opening of the meeting
- Adoption of the Agenda, Schedule of work
- (Procedure for) Appointment of Chairman: CPG Chairman, WG FM Chairman, WG NaN Chairman, ECC Vice Chairman
- Reports on ECC and other activities
- Report from RSCOM, RSPG and TCAM / EG RE

- Report from ETSI
- Draft ECC Decisions
- CEPT Reports in Response to EC Mandates
- Other EC mandates: Update of EC Decision on SRDs, Update of EC Decision on UWB
- Other ECC deliverables for decision
- ECC deliverables in progress, newly proposed or under review and other issues from the subordinate
- WRC-19 follow-up activities
- Work Programme of the ECC and its subordinated bodies
- ECC Strategic Plan
- SAT MoU
- Matters related to European Communications Office, ECO
- Remaining issues from the CPG, WG FM, WG SE, WG NaN, ECC PT1
- Correspondence received
 - European Commission question on ERC/REC 74-01
 - Status of road ITS technologies coexistence development
 - Protection of L-band maritime satellite communications
 - Interference to C-Band meteorological radars
- Contacts and co-operation with outside bodies
- Schedule / Date and Place of next meetings
- Any other business
 - European Spectrum Management Academy
 - Remote attendance for upcoming meetings
- Approval of the minutes of the 52nd ECC meeting
- Closure of the meeting

6.3 Participants

The ECC had its 52nd plenary meeting in Tallinn (Estonia) from 3 – 6 March 2020. It gathered approximately 90 participants representing 31 CEPT administrations and observers. The participants at these meetings are all experts in spectrum management, on technical and/or regulatory aspects. Some represent the national spectrum Agencies of the CEPT member countries, others industry involved in either the proposed new mobile broadband applications, or the numerous potential victim services (broadcasting, fixed services, satellite communications, etc.), and others represent accredited scientific organizations such as CRAF (radio astronomy) or ESA (Earth Exploration Science Service). The attendance list published for this meeting by the ECC/Chairman is available on the meeting website (Document 09/03/20 ECC(20)055 Annex 29 List of participants for 52nd ECC).



Figure 2. Conference picture was posted online by the ECC.

6.4 Publications

It applies the same information reported in 3.4.

7 Acronyms

CEPT	Conference of European Post and Telecommunication
CPM	Conference Preparatory Meeting
CRAF	Committee on Radio Astronomy Frequencies
ESA	European Space Agency
ESF	European Science Foundation
FM	Frequency Manager
HartRAO	Hartebeesthoek Radio Astronomy Observatory
IMT	International Mobile Communications
ITU	International Telecommunication Union
MFCN	mobile/fixed communications network
RAS	Radio Astronomy Service
SKAO	Square Kilometre Array Organisation
WRC-19	World Radiocommunications Conference 2019

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Annex: List of meetings attended by CRAF members in the period 01/2019 – 12/2020

As already stated in the Introduction of this report, CRAF Members have attended a large number of meetings related to spectrum management. Besides those described in the previous sections, which have been supported by RadioNet, this annex lists all meetings held in the period January 2019 – December 2020, which have been attended by at least one CRAF members. The meetings are grouped in four different categories: internal meeting (mainly CRAF meetings), International spectrum management meetings with other stakeholders of the radio spectrum organized by CEPT and ITU respectively and finally scientific conferences where CRAF contributed to promote the protection of radio astronomical frequency bands. In total around 70 CEPT meetings and 10 ITU meeting have been attended by CRAF members covering a large variety of threats to RAS.



Category	Name	Location	Date	Main topics for CRAF	CRAF Participants
Internal meetings	63rd CRAF meeting	SKA Organisation, Jodrell Bank, UK	12-14.6.2019	CRAF matters	All CRAF members
	64th CRAF meeting	Virtual meeting	2.10.2019	CRAF matters	All CRAF members
	65th CRAF meeting	Virtual meeting	6.5.2020	CRAF matters	All CRAF members
	66th CRAF meeting	Virtual meeting	30.11-1.12.2020	CRAF matters	All CRAF members
CEPT/ECC meetings	<u>PT1 CG 2.6 GHz</u>	Virtual meeting	3.1.2019	MFCN upgrade to 5G @ 2.6 GHz	Winkel
	<u>PT1 XO meeting 2.6 GHz</u>	Mainz, D	7.2.2019	MFCN upgrade to 5G @ 2.6 GHz	Hezareh, Winkel
	<u>PT1 CG 2.6 GHz</u>	Virtual meeting	13.2.2019	MFCN upgrade to 5G @ 2.6 GHz	Winkel
	<u>FG on Wind turbines</u>	Virtual meeting	18.3.2019	ECC Report WT vs. RAS	Winkel
	<u>CPG19-8</u>	Sweden, Stockholm	20-24.5.2019	Conference Preparatory Group (CPG) meeting in preparation for WRC19	Lindqvist
	<u>SE40 CG Iridium</u>	Virtual meeting	24.5.2019	Iridium NEXT satellites	Winkel
	<u>CEPT/ECC PT1 #62</u>	Billund, DK	10-14.6.2019	MFCN for UAS, MFCN upgrade to 5G @ 2.6 GHz	Winkel
	<u>PT1 CG MFCN/UAS #1</u>	Virtual meeting	24.7.2019	MFCN for UAS	Smith, Winkel, Thomas
	<u>SE24 CG WI71#2</u>	Virtual meeting	1.8.2019	Radiodetermination at 116-260 GHz	Winkel
	<u>PT1 CG MFCN/UAS #2</u>	Virtual meeting	23.8.2019	MFCN for UAS	Smith, Winkel, Thomas
	<u>SE40 #65</u>	Mainz, D	3-5.9.2019	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU	Jessner, Madkour, Winkel
	<u>PT1 #63</u>	Riga	10-12-9.2019		Thomas, Smith
	<u>SE24 CG WI71#3</u>	Virtual meeting	7.10.2019	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
	<u>PT1 CG MFCN/UAS #3</u>	Virtual meeting	15.10.2019	MFCN for UAS	Winkel
	<u>FG Wind Turbines</u>	Virtual meeting	22.10.2019	ECC Report WT vs. RAS	Winkel
	<u>SE24 CG WI70 #3</u>	Virtual meeting	3.12.2019	HD-GBSAR	Winkel
	<u>PT1 CG MFCN/UAS #4</u>	Virtual meeting	10.12.2019	MFCN for UAS	Winkel
<u>SE24 CG WI71#4</u>	Virtual meeting	13.12.2019	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel	

<u>SE40 #66</u>	Mainz, D	18-20.12.2019	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU	Winkel, Jessner
<u>SE24 #99</u>	Copenhagen, DK	12-15.1.2020		Thomas, Madkour
<u>PT1 #64</u>	Manchester, UK	14-16.1.2020	MFCN for UAS, ECC Decision 5G @ 26 GHz	DiVruno, Winkel
<u>ECC#52</u>	Tallinn, EE	2-6.2.2020	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU, Interference to C-Band meteorological radars	Bezrukovs
<u>WI71 ANFR-CRAF-ZF</u>	Virtual meeting	7.2.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
<u>SE40 CG Iridium</u>	Virtual meeting	22.1.2020	Iridium NEXT satellites, measurements in Leeheim (Update)	Winkel
<u>PT1 XO 26 GHz</u>	Virtual meeting	14.2.2020	26 GHz authorisation schemes	Winkel
<u>SE24 CG WI71#5</u>	Virtual meeting	24.3.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu
<u>SE40 CG S-PCS<1GHz</u>	Virtual meeting	27.3.2020	S-PCS below 1GHz	Winkel
<u>FM44</u>	Virtual meeting	31.3.2020		Madkour
<u>SE24 CG WI71#6</u>	Virtual meeting	7.4.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
<u>SE40 #68</u>	Virtual meeting	15-17.4.2020	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU, OneWeb/Starlink, S-PCS below 1GHz	Winkel, Di Vruno
<u>SE24 #100</u>	Virtual meeting	20-22.4.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
<u>SRDMG #79</u>	Virtual meeting	22-24.4.2020	Maintenance Group for Short Range Device	Thomas
<u>SE21 CG AAS</u>	Virtual meeting	30.4.2020	AAS Measurement in the Field	Winkel
<u>SE40 CG S-PCS<1GHz</u>	Virtual meeting	14.5.2020	S-PCS below 1GHz	Winkel
<u>WGSE #85 pt2</u>	Virtual meeting	18-21.5.2020	AAS Measurement in the Field, Radiodetermination at 116-260 GHz, S-PCS below 1GHz, Revision of ECC Report 271 (OneWeb/Starlink), FG on Wind Turbines	Winkel

<u>SE24 CG WI71#7</u>	Virtual meeting	28.5.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
<u>PT1 CG MFCN/UAS #5</u>	Virtual meeting	2-3.6.2020	MFCN for UAS - PC resolution	Winkel
<u>WG FM #96</u>	Virtual meeting	8-12.6.2020		
<u>ECC PT1 #65</u>	Virtual meeting	15-18.6.2020	MFCN for UAS, ECC Decision 26 GHz, 5G@43 GHz	Thomas, Winkel
<u>CPG23-1</u>	Virtual meeting	22-23.6.2020		Madkour
<u>SE40 #69</u>	Virtual meeting	23-25.6.2020	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU, OneWeb/Starlink, S-PCS below 1GHz	Winkel, Di Vruno
<u>ECC #53</u>	Virtual meeting	29.6-3.7.2020	MFCN for UAS, ECC Decision 26 GHz	Winkel
<u>SE24 CG WI71#8</u>	Virtual meeting	9.7.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
<u>SE24 CG WI71#9</u>	Virtual meeting	21.7.2020	Radiodetermination at 116-260 GHz	Thomas, Winkel
<u>PT1 CG 43 GHz</u>	Virtual meeting	11.8.2020	5G@43 GHz	Smith, Winkel
<u>SE24 CG WI71#10</u>	Virtual meeting	31.8.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu
<u>SE24 CG WI73#1</u>	Virtual meeting	3.9.2020	Radiodetermination for vehicle in 77-81 GHz	Thomas, Pietu
<u>PT1 #66 pt1</u>	Virtual meeting	1-3.9.2020	5G@43 GHz, WRC-23 Preparation	Smith, Winkel
<u>PT1 #66 pt2</u>	Virtual meeting	9-11.9.2020	5G@43 GHz, WRC-23 Preparation	Smith, Winkel
<u>SE7</u>	Virtual meeting	15.9.2020	Private LTE networks @ 2.5 GHz, UAS C&C @ 5 GHz	Bolli
<u>SE24 #101</u>	Virtual meeting	14-16.9.2020	Radiodetermination at 116-260 GHz, Vehicular radar @77 GHz	Thomas, Pietu, Winkel
<u>SRDMG #80</u>	Virtual meeting	16-18.9.2020	Maintenance Group for Short Range Device	Thomas
<u>SE40 #70</u>	Virtual meeting	17-22.9.2020	Iridium NEXT satellites, measurements in Leeheim (Update), Sat MoU, OneWeb/Starlink, S-PCS below 1GHz	Winkel
<u>FG Wind Turbines</u>	Virtual meeting	23.9.2020	ECC Report WT vs. RAS, resolution meeting	Winkel

	ECC - CPG-PTC#1	Virtual meeting	9.2020	Aeronautical and Maritime WRC23 agenda items	Madkour
	ECC - CPG PTD#1	Virtual meeting	9.2020	UHF agenda item 1.5	Madkour
	ECC - CPG PTA#1	Virtual meeting	9.2020	Science agenda items WRC23	Madkour
	WGSE #86	Virtual meeting	28.9-2.10.2020	Iridium NEXT satellites + software, S-PCS below 1GHz, AAS Measurement in the Field, Radiodetermination at 116-260 GHz, FG on Wind Turbines	Winkel
	SE24 WI71#11	Virtual meeting	9.10.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu, Winkel
	SE7 (2.5G & UAS)	Virtual meeting	15.10.2020	Private LTE networks @ 2.5 GHz, UAS C&C @ 5 GHz	Winkel
	SE24 WI71#12	Virtual meeting	30.10.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu
	SE24 CG WI73#2	Virtual meeting	12.11.2020	Radiodetermination for vehicle in 77-81 GHz	Pietu, Thomas
	SE24 WI71#13	Virtual meeting	17.11.2020	Radiodetermination at 116-260 GHz	Thomas, Pietu
	SE7	Virtual meeting	24.11.2020	New terrestrial applications at 2483.5-2500 MHz	Winkel, Bolli, Bautista
	PT1 CG 43 GHz	Virtual meeting	27.11.2020	5G@43 GHz	Smith, Winkel
	SE40	Virtual meeting	2-7.12.2020	OneWeb/Starlink, S-PCS below 1GHz	DiVruno, Winkel
	PT1 CG 43 GHz	Virtual meeting	10.12.2020	5G@43 GHz	Smith, Winkel
	SE7	Virtual meeting	11.12.2020	New terrestrial applications at 2483.5-2500 MHz	Winkel
	ECC CPG23-2	Virtual meeting	8-11.12.2020	CEPT WRC23 preparations	Madkour
	SE24 #M102	Virtual meeting	14-16.12.2020	WI71, WI73, WI74, WI63	Thomas, Pietu
	FM44	Virtual meeting	16-18.12.2020	Aggregate interference to RAS	Madkour, Di Vruno
ITU meetings	WP7D	Geneva, SW	28-31.5.2019	Working Party 7D - Radioastronomy	Thomas
	WRC19	Sharm El-Sheikh, Egypt	28.10-22.11.2019	- IMT2020 - GMDSS - HAPS - Services above 275 GHz	Lindqvist, Madkour

	WP7D	Virtual meeting	14-18.9.2020	Working Party 7D - Radioastronomy	Lindqvist, Madkour, Thomas, Thomasson
	ITU SG7	Virtual meeting	23.4.2020	Study Group 7	Madkour, Di Vruno
	ITU WP5B	Virtual meeting	7.2020	Aeronautical and Maritime WRC23 agenda items	Madkour
	ITU WP7B	Virtual meeting	9.2020	WRC23	Madkour
	ITU WP7C	Virtual meeting	9.2020	WRC23	Madkour
	ITU TG 6/1 agenda item 1.5	Virtual meeting	10.2020	Agenda item 1.5 - UHF	Madkour
	ITU WP5B	Virtual meeting	11.2020	Aeronautical and Maritime WRC23 agenda items	Madkour, Di Vruno
Other conferences	IAA Symposium	Virtual meeting	25.03.2020	Moon Farside Negotiations	Thomas
	URSI-GASS2020	Virtual meeting	29.08-5.09.2020	Radio Astronomy Spectrum management - The Impact of WRC19	Madkour