European Science Foundation

27 CRAF News

The newsletter of the ESF Expert Committee on Radio Astronomy Frequencies

July 2013

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Editorial

The first time I attended a CRAF meeting was about four years ago in Paris. At that time I was involved in several operational aspects of the Westerbork telescope in the Netherlands. Becoming involved in CRAF meant an expansion of my view of the operational aspects of a radio telescope. When I started to work in radio astronomy at ASTRON, just over ten years ago, I thought that making good observations was a matter of luck: sometimes there was no interference and the observations looked very good; sometimes there was a lot of interference, which resulted in ugly images. I soon learned that the telescope operators could have some influence on the amount of interference by reducing as much as possible the EMC emissions of the observatory equipment and also by avoiding all kinds of transmitters in the vicinity of the observatory. However, at some frequencies there was always so much interference that observations were impossible. When I joined CRAF I learned that, as radio astronomers, we have influence on which frequencies will have little or no interference. Since that meeting in Paris I have learned a lot and now I am writing my first editorial as chairman of CRAF.

As most readers will know, there are many different uses of the radio spectrum, each with its own characteristics, which must be taken into account in any allocations. One can perhaps say that the radio spectrum is the infrastructure that is used by services for the transportation of their goods using different means. Radio astronomy is one of the services with its own allocations, and the goods that are being transported are the emissions that contain information from the cosmic radio sources. Extremely weak and fragile transporters (waves) carry them to their destinations – the radio telescopes. One can compare the radio spectrum situation with one that everybody knows – roads. Many people and goods are travelling every day using various means of transportation: cars, buses, motorcycles, bicycles, etc. or simply on foot. We can imagine cosmic radio waves to be unprotected pedestrians, who are fragile and can be easily overrun by e.g. cars (cf. cosmic signals overwhelmed by active services). If space limitations don't have to be taken into account every means of transportation could have its own lane with a solid fence next to it (unique allocations with a guard band in between). This is by far the safest option. When there is little traffic, then space is usually not a problem. This can be compared with the early days of radio science, when there were not many services and there was space in the radio spectrum for everyone. If there was little traffic in other lanes, then from time to time it was possible to walk outside one's own lane into the lanes of other users (out-of-band observations) without being overrun immediately.

As everybody is aware, traffic on the roads has intensified enormously over the years. The same is true for the radio spectrum and it can be clearly seen that space is not infinite, but is limited. This means that the different road lanes are becoming fuller and fuller, fences are becoming smaller or are even being removed (removal of guard bands) and totally different types of vehicles are having to use the same lanes (sharing). This means that the fragile participants in the traffic such as pedestrians and cyclists can be adversely affected (suffer interference) more easily by the more robust participants through for example exhausts and noise (unwanted emissions). The space for these fragile participants is being compressed or having to be shared because more space is needed for the cars and buses. It also means that it has become much more dangerous for pedestrians to walk in other lanes (out-of-band observations) without being overrun. As you can see there are many similarities between road traffic and radio spectrum infrastructures. Fortunately there are some organisations that try to regulate what is allowed to happen and try to protect the weaker participants. However, protection is something that has to be requested, and if we feel that our safety is in danger, then we have to raise our voice. For the radio spectrum there are the national administrations, the CEPT at the European level and the ITU at the worldwide level. All services, including the Radio Astronomy Service, can have their say about the situation. This also means that the radio astronomy community can also have an influence on the radio spectrum as a whole.

The radio spectrum infrastructure is very important. Joining CRAF taught me that there are many ways in which this infrastructure is endangered, but also many ways in which the damage can be reduced. CRAF tries to maintain the radio spectrum infrastructure for the European radio astronomers. Fortunately there are a number of very good and competent people within CRAF, of whom the contributors to this newsletter are just a small reflection. Only by working together closely with strong support and investments from the whole radio astronomy community can CRAF continue to protect the vital infrastructure that is called the radio spectrum!

Hans van der Marel, *CRAF Chairman*

Report from the 55th CRAF meeting

The 55th CRAF meeting was held at the Institute for Astronomy, ETH in Zurich, Switzerland on 3-5 April 2013. During the afternoon of the 3rd of April, a guided visit to the Observatorium Bleien in Gränichen was organised for interested participants. The CRAF meeting was opened by Professor Alexandre Refregier (Head of the Cosmology Research Group), who welcomed the participants.

In addition to thirteen CRAF members, the meeting was attended by the following participants: R. Millenaar (SKA Organisation), J. McCauley (Trinity College, Ireland), Damien Philippe Scherrer (Bakom), Mark Ebner (Bakom), Stella Lyubchenko (ECO) and Vincenza Tornatore (Politecnico di Milano). The following participants representing 'sister organisations' also participated in the meeting: Tasso Tzioumis (RAFCAP), Masatoshi Ohishi (IUCAF), Glen Langston (NSF), Tomas E. Gergely (NSF), Harvey Liszt (NRAO) and David Deboer (CORF).

For the first time, the meeting was chaired by Hans van der Marel, who had been appointed as the new CRAF Chairman for a three-year term from 1 February 2013. There was a special vote of thanks from the plenary to Axel Jessner for having served CRAF for the last four years as Chairman.

The plenary session was informed about the resignation of Harry Smith for personal reasons. Harry has done an excellent job as Frequency Manager during the last 2½ years. Currently there are no visible candidates for the post, and therefore CRAF would temporarily have to act without a Frequency Manager (FM). The selection process for a new FM would start as soon as possible. The plenary also discussed new operational models for more effective spectrum management activity.

During the RadioNet Board meeting held in Bologna in March, a proposal to establish a working group with people from the RadioNet Board was raised. The aim of the working group is to try to help CRAF solve some issues that are important for its future.

The ESF is expected to close down at the end of 2015, as a result of which a new legal umbrella for CRAF has to be identified. One option is for the ESF to establish a new legal structure for Expert Boards and Committees (EBCs). The ESF has commissioned a legal adviser to provide a comparative assessment of potential models for such a new legal structure for EBCs. Other options under evaluation by CRAF include a JIVE solution, since JIVE will probably become a European Research Infrastructure Consortium (an ERIC) before the end of 2014.

A document containing the position of CRAF on the WRC-15 Agenda Items in which CRAF has an interest was discussed with the 'sister organisations'.

Other topics discussed during the meeting were Iridium and UWB applications. A report from the meeting between BNetzA, IRIDIUM and CRAF at BNetzA held in Mainz on 11 March 2013 was given by Jessner. Additionally, a recent workshop organised by the Radio Spectrum Policy group of the EC on 'Spectrum for governmental services' in the framework of the study 'Analysis of technology trends, future needs and demand for spectrum in line with Art. 9 of the RSPP' held in Brussels was attended by van der Marel who reported to the plenary.

The next Annual General Meeting will be held in Dwingeloo (NL) in Spring 2014.

Pietro Bolli

"Watch the skies, everywhere!"

Article 29 of the Radio Regulations is a short but concentrated digest of the general provisions and measures to be taken to protect the Radio Astronomy Service (RAS) and ensure its unhindered operation in a world that is full of competing telecommunications applications. Much of CRAF's effort since its inception in the late 1980s has been focussed on trying to promote protection for European observatories during a period of significant growth of mobile (and satellite-mobile) telecommunications. However, recent proposals may also result in the use of similar devices not only on the ground, but also on all forms of aircraft, which is clearly of particular concern to the RAS. On this, the authors of RR Article 29 were there before us:

> "***29.12*** *In applying the measures outlined in this Section, administrations should bear in mind that the radio astronomy service is extremely susceptible to interference from space and airborne transmitters (for further information, see the most recent version of Recommendation ITU-R RA.769)*".

Here they remind us just how extraordinarily susceptible the RAS is to interference from air or space-borne platforms and that particular care is needed in order to protect the RAS from such use.

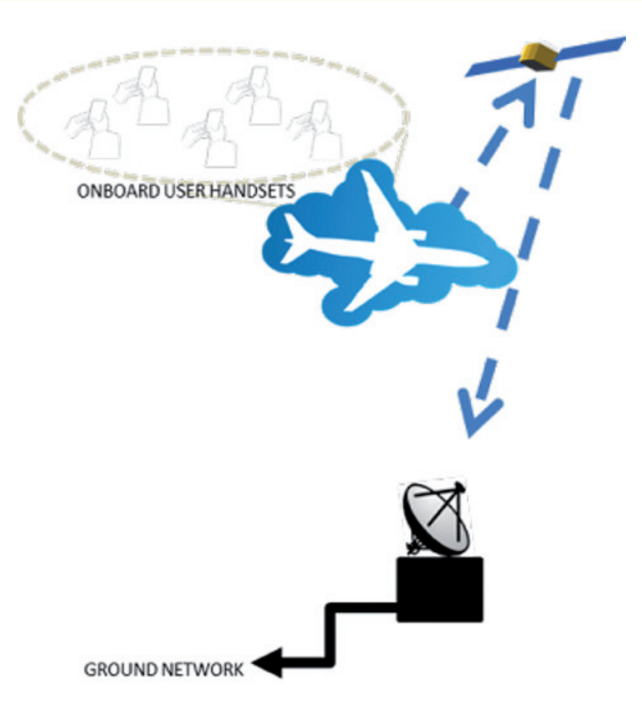

Figure 1. Connection via a satellite link

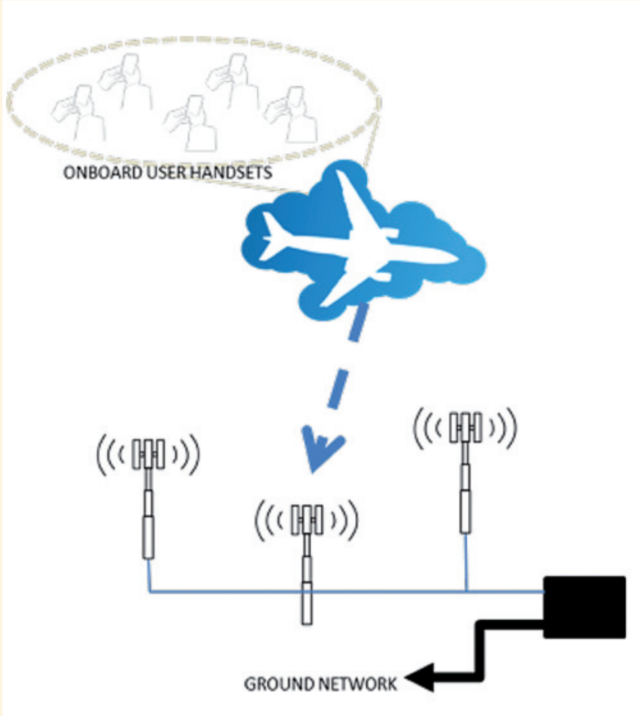

Figure 2. Direct air-to-ground communications

Potential airborne applications

Airborne UWB

UWB technology is equipment for short-range radio communication purposes involving the intentional generation and transmission of radio-frequency energy that spreads over a very large frequency range. This frequency range may overlap several frequency bands allocated to existing radio communication services. Applications such as enhanced wireless passenger communications and entertainment, non-safety wireless crew communications as well as non-safety wireless control and monitoring functions are candidates for the initial use of UWB technology. Devices using UWB technology are normally not allowed to create interference for other services and cannot claim interference protection from other services for themselves.

Wireless Avionics Intra-Communications ('WAIC')

A wider expression of the new airborne control and data technology has made its way into preparations for the next World Radio Conference (WRC-15). WAIC systems are proposed as an adjunct to enhancing efficiency and reliability whilst maintaining required levels of safety by reducing the need for complex and costly internal wiring harnesses in aircraft. However, WAIC system transmissions may not be limited to the interior of the aircraft structure. For example, sensors mounted on the wings or engines could communicate with systems located within the aeroplane. Therefore, they do not benefit from fuselage attenuation which is a significant issue in consideration of potential interference levels for the RAS. An additional concern is that unlike many other applications, WAIC subsystems will function continuously whilst aircraft are parked on airport aprons, taxiing, taking off and landing, and of course when fully airborne and cruising.

Mobile Communications in Aircraft (MCA) & Direct Air to Ground Communications (DA2GC)

This airborne mobile system will enable airline passengers to use their personal mobile handsets during approved stages of flight (usually only when cruising). Access on board the aircraft is provided by one or more base stations. However, on-board mobile terminals must be prevented from attempting to access networks on the ground. This is usually ensured by the inclusion of a Network Control Unit (NCU), which raises the noise floor inside the cabin for mobile receive-bands and consequently provides significant interference potential in itself. Connection to the cellular ground infrastructure is made either via a satellite link (MCA) or alternatively via a link to a terrestrial base station termed 'Direct Air to Ground Communications' (DA2GC) by CEPT.

Implications for the RAS spectrum

Table 1 summarises CRAF'S understanding of the potential frequency allocations to these new applications that might affect the RAS spectrum.

Understanding effects on the RAS

The most important aspect to the protection of the radio astronomy service relates to acceptable levels of interference in a real-life scenario, where there are many aircraft operating these services, which are distributed in the sky and which are in a direct line of sight to a radio telescope. The reality of the physical situation is hard to model; a number of parameters of unknown and/or dynamically variable values must be taken into account. Radio astronomy receivers may be of the order of 70-80 dB more sensitive than a mobile base station receiver, and aircraft flying at heights of up to 13 000 m with even very weak emissions can easily be 'seen' by a radio telescope at a distances of hundreds of kilometres.

RAS observatories use very high gain antennas. As the very narrow antenna beam covers only a very small solid angle, interference to the radio astronomy station will be received mostly through the antenna side lobes. Hence it has become the practice to model the RAS observatory antenna as having a gain of 0 dBi in all directions for most interference calculation scenarios. Indeed, the widely used tables of interference threshold criteria in the Recommendation ITU-R RA.769: "*Protection criteria used for radio astronomical measurements*" were calculated for this case.

RAS protection requirements for a single 'composite' interferer

Signals from internal aircraft equipment usually propagate to the outside of an aircraft via the fuselage. Hence the aircraft fuselage attenuation is a very important factor when considering how aircraft equipment emission limits should be set. Fuselage attenuation in itself is highly dependent on the individual aircraft features such as its size, construction and material, number of windows, physical orientation in flight, etc. It is also envisaged that for some of the applications each aircraft might be fitted with not just one, but several individual devices both inside and out (such as in the case of WAIC).

The difficulties in defining the values (or range of values) for parameters needed in the modelling of some of the physical effects mentioned above, leads CRAF to conclude that the most appropriate form of specifying the emissions would be to consider an equivalent level for emissions (wanted or unwanted) into the RAS bands outside of the aircraft that must be met, regardless of its physical orientation or how many devices are on board (either internal or external); i.e. effectively treating the aircraft emission as a point source. This leads to a straightforward determination of protection levels for the single entry case. The worst case scenario for interference at an RAS observatory will be from an aircraft flying directly over the observatory at the minimum height at which the system is allowed to operate. For example, from ECC Report 93 this is 3 000 m (~10,000 ft) above ground level for the MCA application. This has been proposed for other situations. Since the aircraft is in a line of sight to the observatory, at these frequencies the path loss may be calculated to a reasonable approximation based upon the free space path loss equation (FSPL). The threshold

RAS Frequency Band		Status	FN	Potential Airborne Allocation	Application	RAS Utilisation
2655-2690	MHz	Sec	5.149	Shared	MCA	Continuum observations, VLBI
2690-2700	**MHz**	**PRI**	**5.340**	Adjacent	MCA (WAIC?)	Continuum observations, VLBI (Also, RAS techniques used by SRS)
3100-3400	MHz	†	5.149	Shared & Adjacent	Airborne UWB (DA2GC?)	Spectral line observations (Methine lines)
4990-5000	MHz	PRI	5.149	Nearby	(WAIC?)	Continuum observations, VLBI
6.65-6.6752	GHz	Sec	5.149	Shared & Adjacent	Airborne UWB	Spectral line observations (Methanol line)
15.35-15.4	**GHz**	**PRI**	**5.340**	Adjacent	WAIC	Continuum observations, VLBI

† Use supported by RR FN 5.149

Table 1. RAS and potential airborne allocations

Frequency Band	RAS BW used (MHz)	Limit on interference power from ITU-R RA.769-2 (dBm)	FSPL at 3000 m a.g.l. (dB)	Implied limit exterior to aircraft in RAS BW (dBm)
2690-2700 MHz	10	-177‡	111	-66
3100-3400 MHz	1	-181*	112	-69
4990-5000 MHz	10	-177‡	116	-61
6.650-6.6752 GHz	1	-181*	119	-62
15.35-15.4 GHz	50	-172‡	126	-46

* Value for **spectral line** observation of 1 MHz BW, T_A = 12 K, T_R = 10 K, t = 2000 s
‡ Value for **continuum** observation over full BW, T_A = 12 K, T_R = 10 K, t = 2000 s

Table 2. Permissible interference power levels external to an aircraft to ensure protection of the RAS from a worst case single entry composite interferer

level of interference, detrimental to RAS operation, is provided in Recommendation ITU-R RA.769-2 for any given frequency, bandwidth and type of observation. It can be used in a simple calculation to determine the maximum permitted power outside the aircraft. Some examples of derived exterior limits for the RAS bands under consideration are shown in Table 2.

In practice the 'single entry' interferer worst case is mitigated by the likelihood that an aircraft is directly above an observatory at 3000 m for a significant period of time is low. However, balancing this, the aggregation effect from the likely density of aircraft around the observatory is also a very important consideration, as this could produce a substantially increased background noise level.

Mathematical modelling of true aggregation scenarios, including temporal effects, aircraft densities, RAS and aircraft antenna pointing considerations, etc. are challenging as a significant number of parameters have to be estimated and/or dynamically varying values have to be taken into account. In practice, only broadly representative modelling situations can be evolved as aircraft densities vary significantly over 24 hour periods and are far from uniform over Europe. CRAF is actively pursuing studies to provide realistic estimates of aggregate interference from airborne sources.

Regulation

Airborne UWB

As an application, Airborne UWB is probably the most mature in regulatory terms. The ECC conducted a coexistence study considering UWB applications on board aircraft and existing radio services in the frequency bands from 3.1 GHz to 4.8 GHz and from 6.0 GHz to 8.5 GHz (ECC Report 175). In this report and subsequent regulation (ECC/DEC(12)03), it was acknowledged that the Methanol line at 6.7 GHz is important to the RAS and this has resulted in tighter emission limits being imposed at this frequency. Unfortunately requirements for lines around 3.3 GHz were not highlighted. ECC/DEC(12)03 was formally adopted by the ECC at its full plenary meeting in November 2012.

MCA

Of the three frequency bands currently being considered for the proposed MCA application, the RAS is only sensitive to the 2.6 GHz proposal. An initial technical contribution from CRAF on protection requirements for the RAS pointed out that an allocation to MCA in the 2620-2690 MHz band may potentially affect RAS existing operations in the shared part of this band and from unwanted emissions into the adjacent 2690-2700 MHz passive band. An ECC Report on MCA (Report 187) has recently been approved. This shows that in the 2600 MHz connectivity band, based on the basic analysis carried out in the report, compatibility with adjacent band radar services could not be ensured and that without further analysis, the band could not be made available for connectivity at this present time. In parallel, ECC-PT1 considered amendments to the associated regulatory instrument ECC DEC(06)07 and discussed whether further studies were required on 2.6 GHz connectivity to complete its work. For the moment it concluded that there was no need for these within the timescales of the EC Mandate. It was noted that CEPT Report 48 allows connectivity at 1800 MHz for LTE and 2100 MHz for UMTS and these connectivity bands were considered sufficient for the present time without the addition of the 2.6 GHz band. The amended ECC DEC(06)07 is yet to be discussed within ECC-PT1.

DA2GC

Work in CEPT on spectrum issues concerning Broadband DA2GC is also now in progress. Originally the band 3400-3600 MHz was chosen as a candidate for potential allocations. Although there are no formal RAS allocations in or immediately adjacent to this band, there are RAS allocations covered by RR footnote 5.149 at 3260.0-3267.0 MHz, 3332.0-3339.0 MHz and 3345.8-3352.5 MHz for the specific study of three weak molecular lines of the CH molecule. CRAF had begun to raise concerns relating to possible interference from the unwanted emissions of these systems to CH molecular line observations. However, WGFM had its own reasons for deciding that this band was not a suitable candidate for studies for this service, effectively removing the issue for the time being.

WAIC

As a specific agenda item for the next World Radio Conference, the CEPT is likely to support a total spectrum requirement of 239 MHz for the proposed application. The effect on the RAS of allocations will clearly depend very much on which frequencies are finally chosen for deployment. Bands 4200-4400 MHz and 15.4-15.7 GHz are amongst those favoured for future study, but potential allocations near RAS bands at 2700 MHz and 5 000 MHz have not yet been formally ruled out. CRAF will continue to contribute to the development of the work on the agenda item as it progresses in both CEPT and the ITU-R.

Harry Smith & Axel Jessner

Twin Telescope Wettzell – A new class of radio telescopes for VLBI

The official inauguration of the Twin Telescope Wettzell (TTW) project, which had been undertaken by the German Federal Agency for Cartography and Geodesy (Bundesamt für Kartographie und Geodäsie (BKG)), took place on 26 April 2013. The Geodetic Observatory Wettzell is one of only a few fundamental stations for geodesy. It operates a set of complementary geodetic space measurement systems – Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR) and permanently installed receivers for Global Navigation Satellite Systems (GNSS), such as GPS, Glonass and Galileo on the one site. The realisation of the most accurate global reference systems – the primary task of geodetic observatories – also requires a time-keeping laboratory and gravity meters, which are also in operation at Wettzell. The International Association of Geodesy (IAG) defines the realisation of the Global Geodetic Observing System (GGOS) as the geodetic contribution to the Global Earth Observing System of Systems (GEOSS). The GGOS proposes to establish global reference frames to an accuracy of 1mm for a 3D position and the monitoring of reference point velocities to an accuracy of 0.1mm/yr. This goal shall be reached by the year 2020. With regard to the global change discussion, an important contribution to the magnitude of the rise in sea levels is related to accurate global reference systems, which is the task for geodesists.

The most important geodetic space technique is Very Long Baseline Interferometry, which links the primary celestial reference frame, ICRF, (fixed in the universe) with the most accurate terrestrial reference frame, ITRF, by observing the Earth's rotational behaviour. Only using VLBI can one measure the Earth's precession, nutation, polar motion and rotational velocity at the same time. As a by-product of this, the direct distance between the radio telescope reference points (invariant points in their construction) and the positions of the quasars used as references for the ICRF are measured precisely. The geodetic VLBI operations are globally organised by the International VLBI Service for Geodesy and Astrometry (IVS). This role is recognised by the IAG and the International Astronomical Union (IAU). Continuous monitoring of the Earth's rotation using VLBI is essential for any kind of space navigation as well as for the accuracy of GNSS based navigation systems on Earth.

During the past decade the IVS has developed a modernisation plan for geodetic VLBI ('VLBI2010') in order to meet future user requirements. In the meantime, many improvements to VLBI measurements by the IVS member institutions have been made so that they meet the specifications of the GGOS proposal. The VLBI2010 vision proposes a new class of radio telescopes to enable continuous observations (24h/7d) with a pointing to a different quasar every 30s and data acquisition for a sufficient signal-to-noise ratio (SNR) within 10s. The remaining 20s are available for slewing; thus a velocity of up to 12 deg/s must be supported by the new VLBI instrument.

For more than 30 years geodetic VLBI observations have been made at S-band (2.2-2.35 GHz) and X-band (8.1-8.9 GHz). However, the increasing commercial exploitation of the electromagnetic spectrum has meant that radio frequency interference is a significant factor in data-loss. VLBI2010 proposes an expansion of the spectrum to be observed by the use of new wideband feeds and receiv-

Figure 3. The new Twin Telescope Wettzell at the Geodetic Observatory of the Federal Agency of Cartography and Geodesy (BKG) and the Technical University of Munich (TUM). Two 13.2m radio telescopes with a ring focus design will observe in the 2-14 GHz range. Future IVS observation plans mean that there will be continuous observations in 30s slew-track cycles (24h/7d).

ers to cover the range from 2 to 14 GHz. Thus, instead of just two hopefully interference free bands, additional bands, which might be interference free at the time, could be observed. Wideband feeds with one focal plane have a wider opening angle than classical corrugated horn feeds, and so a new reflector design has been necessary to support the new optics. Since many IVS radio telescopes are now old and it is not possible to improve their 'system' optics, new radio telescopes need to be built. Therefore, the concept of the TTW was developed following the ideas of the VLBI2010 vision.

The TTW consists of two identical 13.2m radio telescopes and a new operations building with laboratories. Each telescope has an azimuth/elevation (az/el) mount with a primary ring focus (thus avoiding shadowing by a sub-reflector) and a secondary point focus. Almost the whole of the surface of the main reflector is therefore used for the signal collection, enabling an antenna efficiency of up to 80%. Both telescopes can be moved to any position above the horizon within less than 20s thanks to their kinematic parameters: v_{az} = 12 deg/s, v_{el} = 6 deg/s, a_{azel} = 3 deg/s/s. The two telescopes can be pointed in different directions at the same time (for better sampling of the atmosphere, sub-netting in VLBI observations) or in the same direction (array mode, higher sensitivity for astrometry). The redundancy of the two telescopes also permits maintenance procedures to be carried out without interruption to the proposed continuous observing programs.

The proposed data recording rates will increase to 32 Gbps requiring new recording and data transmission capabilities. Additionally, the software correlators must be adjusted to the larger volume of data to be processed.

The Twin Telescope Wettzell, manufactured by German Vertex Antennentechnik GmbH, is the first rigorous realisation of the VLBI2010 specifications and forms part of the VLBI2010 Global Observing System (VGOS), which was formally introduced during the last IVS-General Meeting in Madrid, 2012. Partner institutions in Spain, Norway, Sweden, Finland, Russia, China, Japan, USA, Australia and New Zealand have similar radio telescope projects. The IVS maintains contact with partners in South-Africa and Brazil in order to extend the

Figure 4. 26 April 2013: Official opening of the TTW by State Secretary, Frau Cornelia Rogall-Grothe, together with Prof. Dr. Hansjörg Kutterer (President of the BKG - right) and Dipl. Inf. Hans Pongratz (Vice-president of TUM – left). The TTW will be operated by the BKG and the TUM.

VGOS infrastructure to the Southern hemisphere and to improve the global network coverage.

Today, man's quality of life depends on many commodities. The IVS is contributing to it with its observation programmes, although often without receiving public acknowledgement. The passive use of the expanded observing spectrum in the range 2-14 GHz according to VLBI2010 is a signal that the RAS should strive more and more for local protection zones for the VLBI sites against interfering radiation, firstly to protect the investments made in the new VLBI infrastructure and secondly to protect and maintain our standard of life.

Hayo Hase

Radio astronomy activity in Ireland

Radio astronomy in Ireland is well established with many researchers working with data from sources as diverse as LOFAR, the Arecibo telescope and the VLA. Until recently little has been done with data measured in Ireland. Some hopes were raised in recent times with the granting to the radio astronomy community the use of a 32m dish in Midleton, Co. Cork in the south of the country. The dish is currently stowed, and has not been moved for some time. An engineering survey of the dish was carried out in 2012, as a result of which it was estimated that the cost of bringing the dish into operation for radio astronomy in a way that was fully suitable for joint observations with e-MERLIN and the European VLBI Network would be approximately 600k€, not including the cost of an e-MERLIN suite of receivers and an H-maser. The proposal to convert the 32-m telescope is currently shelved.

Work at the Rosse Observatory in Birr in the centre of the country (www.rosseobservatory.ie) has been proceeding at a more modest level, although the instrumentation has been steadily built up over the last three years on a very modest budget with a view to developing the site into a LOFAR station. Currently the focus of the observatory is on solar observations. The radio instrumentation comprises three low cost Callisto receiver systems (www.e-callisto.org) as follows.

Receiver No.	Antenna	Frequency range observed
1	Tracking Tennadyne T-28 Log-periodic	100-200 MHz
2	Tracking Tennadyne T-28 Log-periodic	200-400 MHz
3	Schwarzbeck bicone type 9136 with 9122 balun	10-100 MHz

Recently (April 2013) two additional receivers were installed to receive LHCP and RHCP signals from an array of four LOFAR LBA antennas, kindly donated by our colleagues at the Chilbolton LOFAR station. The frequency range of this system is 10-80 MHz. These have already received first light and have detected a solar type III radio burst on 22 April 2013 only three days after installation.

An RFI survey covering the range 100-300 MHz was carried out in May of this year using a LOFAR high band element on loan from ASTRON. Two groups of spectra were acquired over a 90 minute period for each. The

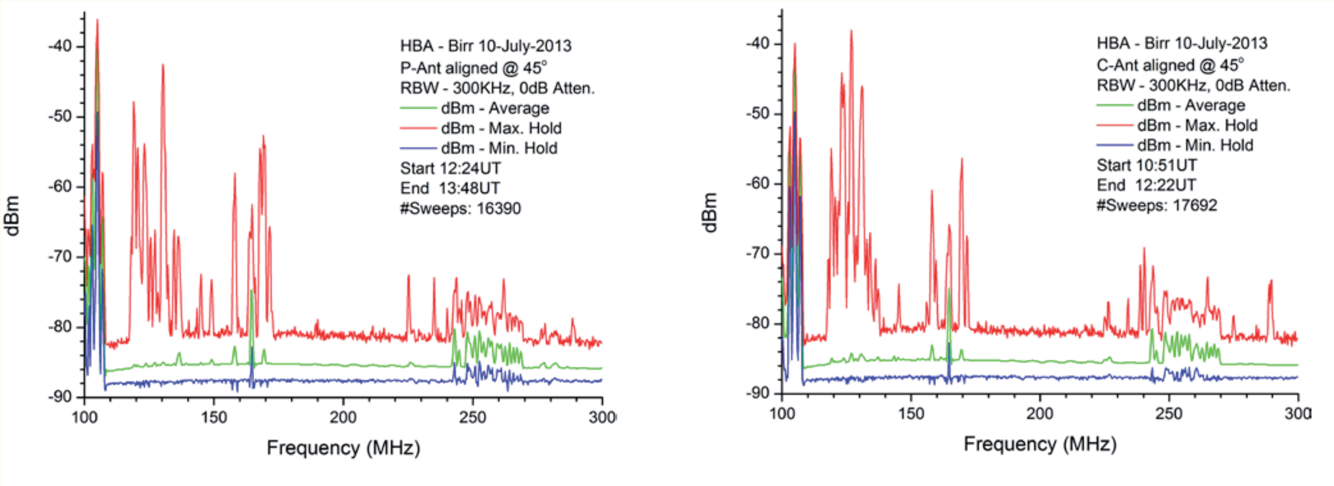

Figure 5. Preliminary results of the RFI survey covering the band 100-300 MHz

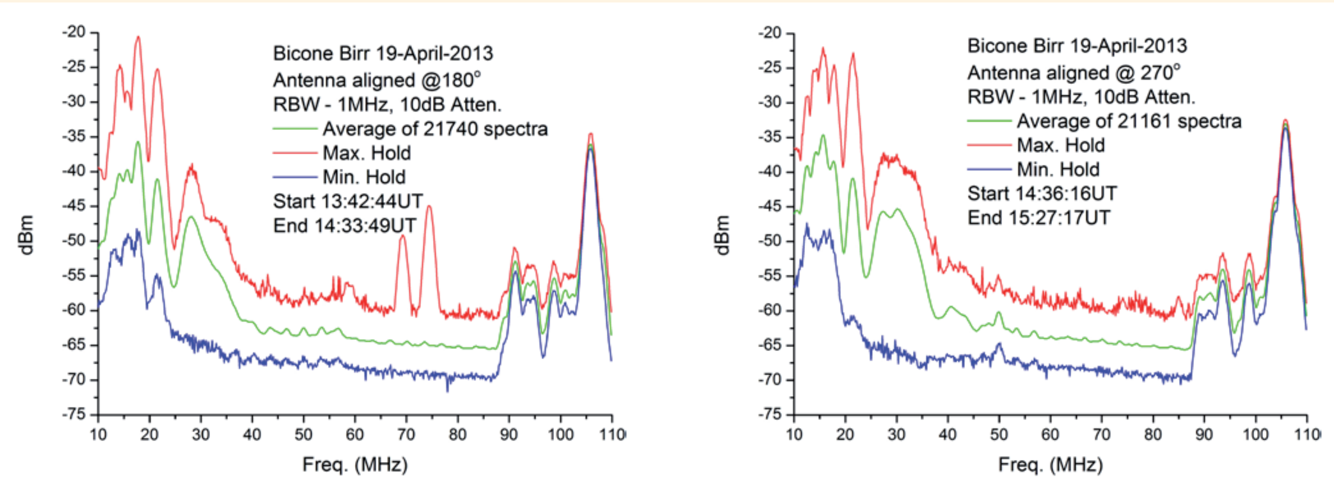

Figure 6. Results of the RFI survey covering the band 10-80 MHz

antenna orientation was changed by 90 degrees between the two. Preliminary results (Figure 5) indicate a relatively clean spectrum in this range.

A survey covering the LOFAR LBA range of 10-80 MHz, undertaken in April using our Schwarzbeck bicone antenna, yielded the plots shown in Figure 6.

Also shown (Figure 7) are spectra taken in June 2009 at the Rosse Observatory (blue) compared with those from Bleien Radio Observatory in Switzerland (red; offset by 10 dB) and from Potsdam Bornim (green; offset by 20 dB). The Rosse Observatory spectrum is essentially quiet at all frequencies, except for the FM band covering 88-108 MHz. It appears that the RFI situation has changed little at the Rosse Observatory since this survey was undertaken by Christian Monstein for the Callisto network, which placed the observatory among the most RFI free sites surveyed worldwide for that network in the frequency range of 45-870 MHz.

However, as with elsewhere in Europe, wind power is being heavily developed in Ireland and this situation needs to be monitored as the situation in this regard will surely change with potential impact on the spectrum.

Joe McCauley

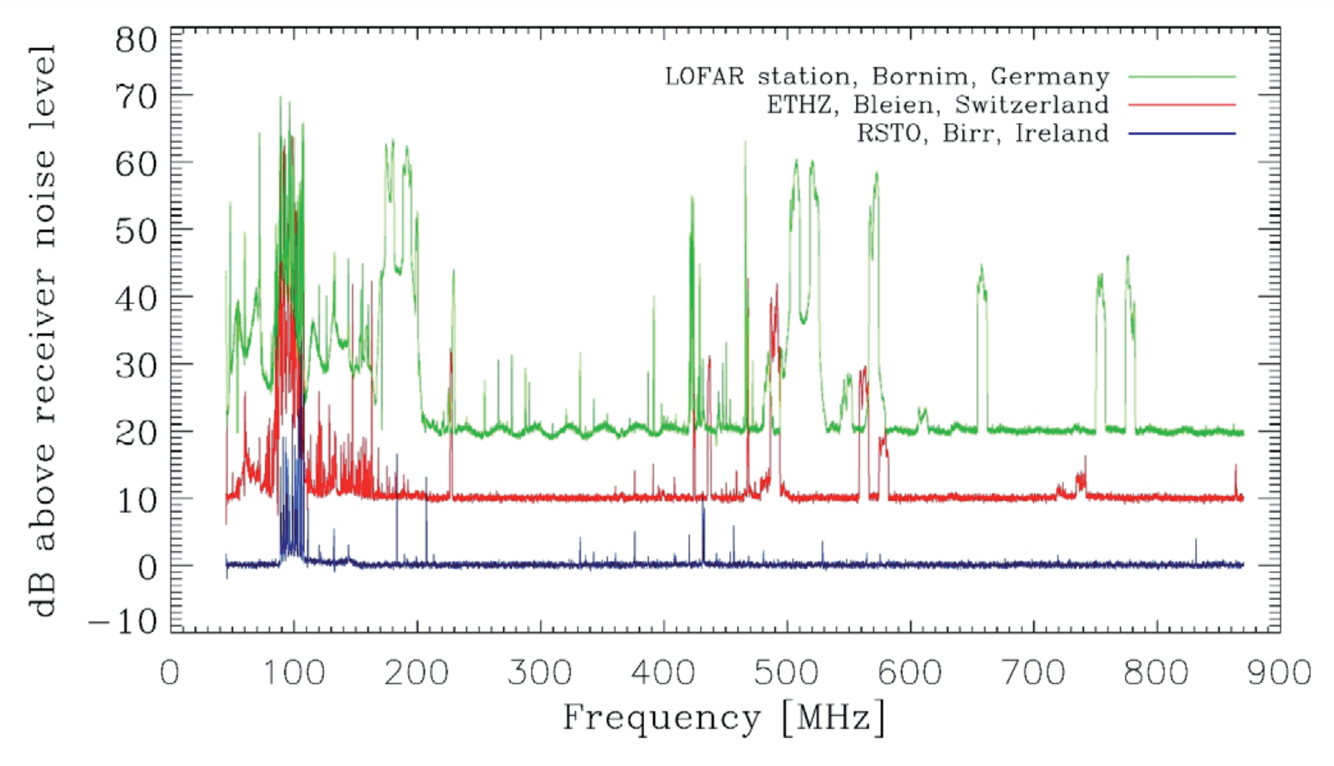

Figure 7. Comparison of spectral surveys taken at Birr (Ireland), Bleien (Switzerland) and Potsdam Bornim (Germany)

The European Science Foundation hosts six Expert Boards and Committees:

- The European Space Sciences Committee (ESSC)
- The Nuclear Physics European Collaboration Committee (NuPECC)
- The European Marine Board
- The European Polar Board (EPB)
- The Committee on Radio Astronomy Frequencies (CRAF)
- The Materials Science and Engineering Expert Committee (MatSEEC)

In the statutory review of the Expert Boards and Committees conducted in 2011, the Review Panel concluded unanimously that all Boards and Committees provide multidisciplinary scientific services in the European and in some cases global framework that are indispensable for Europe's scientific landscape, and therefore confirmed the need for their continuation.

The largely autonomous Expert Boards and Committees are vitally important to provide in-depth and focused scientific expertise, targeted scientific and policy advice, and to initiate strategic developments in areas of research, infrastructure, environment and society in Europe.

Front cover:
The 7-m telescope of the Bleien observatory in Switzerland, operated by the ETH, Zürich, is shown in the background.

Committee on Radio Astronomy Frequencies (CRAF)

CRAF is an Expert Committee of the European Science Foundation. Established in 1988, it represents all the major radio astronomical observatories in Europe. Its mission is to coordinate activities to keep the frequency bands used by radio astronomers in Europe free from interference.

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