
RadioNet 2000-2020: a cohering force in European Radio Astronomy

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RadioNet Pre-History

European Commission and Radio Astronomy

1983	Giancarlo Setti et al proposal for expansion of MPIfR Mk3 correlator - unsuccessful Setti + Paolo Fasella (D-G Science, Research and Development) discuss large EVN data processor	
1986	Further discussion with Fasella by van Lieshout, van der Laan, RTS	
1988	20-station EVN data processor proposal (18 MECU) - unsuccessful	
FP2 1987-1991	Science Stimulation grant (1989) (incl. Penny & Giles playback unit for MPIfR MkIII processor)	0.44 M ECU
FP3 1990-1994	Access to Large Scale Facilities x 2 Fellowships Grouped by Laboratories	1.75 0.3
FP4 1994-1998	Access to Large Scale Facilities (x 2) Research & technical Development (post-correlation integrator RFI-robust receiver,) Cooperation with Hungary (SGO) and Poland (torun)	1.875 1.0 0.766
FP5 1998-2002	Access to Large Scale Facilities x 2 Infrastructure Cooperation Network (RadioNET) began in 2000	2.1 0.8 M€

Why was European radio astronomy a natural candidate for an ICN in 2000, from the EC point of view?

- long history of cooperation forged in the EVN since 1980
- also a long history of cooperation at λ mm (IRAM)
- 17 years of interaction with the EC, and 9 contracts spanning the 1990s, primarily for EVN access and RTD
- EC blessing for the establishment of JIVE as the European VLBI Data Processing Centre in 1992
- two global radio astronomy projects on the horizon with leading roles for Europe – ALMA and SKA
- No umbrella organisation for radio astronomy in Europe like ESO or CERN

Advanced Radio Astronomy in Europe, RadioNet contracts, 2000-2020

- 1) FP5 Infrastructure Coordination Network (ICN), 2000-2004, €800k
- 2) FP6 Integrated Infrastructure Initiative (I3), 2004-2008, €12.4M

From FP6 onwards, the earlier separate programs for Access and RTD were added to the ICN but under new names: Trans-National Access (TNA), Joint Research Activities (JRA), and Networking Activities (NA)
- 3) FP7 Combination of collaborative projects and coordination and support actions for Integrating Activities, 2008-2012, €10M
- 4) FP7 Combination for Integrating activities, 2012-2015, €9.5M
- 5) Horizon 2020 Integrating activities for advanced communities, 2017-2020, €9.5M

Total RadioNet funding (2000-2020): €42.2M

Spin-off programs in radio astronomy

- FARADAY (2001, FP5 €1.5M) focal plane arrays
- *EuroPlaNet (2005, FP5) multi-disciplinary; Cassini-Huygens VLBI support
- SKADS (2005, FP6, €10.4M)
 - Marie Curie Conferences & Training (2007, €0.6M)
- EXPReS (2006, FP6 €3.9M)
- ESTRELA (2006, FP6) Marie Curie Early Stage Training in long λ RA
- ANGLES (2006, FP6), Marie Curie EST in gravitational lens research
- PrepSKA (2008, FP7 €5.5M)
- nEXPReS (2010, FP7 €3.5M)
- ASTERICS (2015, H2020) multi-disciplinary; total grant €15M
- Jumping JIVE (2016, H2020 €3M)
- AENEAS (2017, H2020 €3M)
- *ESCAPE (2019, H2020) multi-disciplinary; total grant €16M)

Note: * = not RA-led

TOTAL (Spin-off) = €31.4M + GRAND TOTAL = €81M +

Structuring the European Research Area

I3s – RadioNet, OPTICON, EuroPlaNet, and ILIAS became elements of the European Research Area

- main purpose was to coordinate and integrate national research infrastructures to increase the power of pan-European research

RadioNet Networking Activities, Trans-national Access and Joint Research Activities in FP6, FP7, and H2020

NAs → enhance *coordination and co-operation* of partners and community

- *promote the science* performed with the facilities, *train next generation of astronomers and engineers*, provide *forums for engineering and technical aspects*
- *maintain and upgrade facility operations*
- map out the *future development of the discipline*

TNA → access to European radio astronomy facilities via a transparent process and an integrated, professional and consistent level of *support* to individual users

JRAs → research and development in support of existing facilities, and in preparation for SKA and ALMA

RadioNet people

One requirement for success was good management of this enormous coordination effort and substantial associated EC and national funding

- Coordinator, Project Manager, Project Scientist, other support staff
 - RadioNet Board
 - WP leaders
 - EC officers
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- Another was buy-in from the community

RadioNet people

FP5 RadioNet, 2000-2004, 11 partners/9 countries in Europe (+ Australia & Canada for SKA), 2 international organisations – JIVE, IRAM
Coordinator: RTS (2000-2002), Mike Garrett (2003-2004), *Program Manager:* Leonid Gurvits

FP6 RadioNet, 2004-2008, 24 partners/10 countries – Europe, Australia, South Africa, 4 international organisations – JIVE, IRAM, ESO, ESF
Coordinator: Phil Diamond, *Project Manager:* Althea Wilkinson, *Project Scientist:* Leonid Gurvits

FP7 RadioNet, 2009-2012, 26 partners/13 countries – Europe, South Korea, South Africa, USA/ 3 international organisations – JIVE, IRAM, ESO
Coordinator: Mike Garrett, *Project Manager:* Andre van Es, *Project Scientist:* Corina Vogt

FP7 RadioNet, 2012-2015, 27 partners/13 countries - Europe, Australia, South Korea, South Africa, 3 international organisations – JIVE, IRAM, ESO
Coordinator: Anton Zensus, *Project Manager:* Izabela Rottmann, *Project Scientist:* Franco Mantovani/Hans-Rainer Klöckner

H2020 RadioNet, 2017-2020, 28 participants/14 countries - Europe, South Korea, South Africa/ 4 international organisations – JIV-ERIC, IRAM, ILT, ESO
Coordinator: Anton Zensus, *Project Manager:* Izabela Rottmann, *Policy/ Outreach Assistant:* Rainer Mauersberger

Overall goals

coordinate new initiatives in radio astronomy including next generation instruments such as ALMA and the SKA

Specific activities

- enhance the quality of operations and make more effective use of the existing European VLBI Network
 - operations training workshops - exchange best practices of VLBI operations, calibration; tapes → disks; EVN Reliability Index used as measure of EVN performance
 - EVN Symposia (2000 and 2002), EVN VLBI School (2001), YERAC re-established in 2003
- build up the necessary scientific, technical and organizational consensus for the two major future radio astronomy facilities, ALMA and SKA
 - European SKA Consortium (ESKAC) established in 2000 under the aegis of RadioNet
 - SKA – supported in part SKA Science meetings → SKA Science Book (Eds Carilli and Rawlings)
 - ALMA - supported in part a number of meetings on ALMA science, operations and management
- RadioNet-Opticon Round-Tables at EAS Meetings in Munich (2001), Porto (2002), ALMA-SKA-OWL workshop (2003)

TNA Program 2004-2020

What it did:

- removed technical, financial and logistical barriers which prevented European astronomers from taking full advantage of the facilities
- provided a high level of professional support for individual European users:
 - proposal preparation, scheduling & execution of observations, data analysis and interpretation

Contracted time always exceeded

FP6 TNA: EVN, e-MERLIN, EFF, WSRT, IRAM (PdB, PV), JCMT, OSO; **333 projects**

FP7 (2009-12) TNA: EVN, e-MERLIN, EFF, WSRT, IRAM (PdB, PV), JCMT, OSO, SRT, LOFAR; **386 projects**

FP7 (2012-15) TNA: EVN, e-MERLIN, EFF, WSRT, LOFAR, IRAM (PdB, PV), APEX; **759 projects**

H2020 TNA: EVN, e-MERLIN, EFF, LOFAR, IRAM (NOEMA, PV), APEX; APERTIF Long Term Archive (ALTA) - **143 projects** (3yr) MARCUs support for ALMA users to visit Regional Centre Nodes - **130 research programs (year 2)**

Networking activities 2004-2020

Networking Activity	FP6 2004-08	FP7 2009-2012	FP7 2012-15	H2020 2017-20
Science	<i>Science Workshops Conferences, Workshops</i>	<i>Science WG Conferences, Workshops</i>	<i>Science WG Conferences Workshops</i>	<i>Science Dissemination</i>
Engineering	<i>Engineering Forum, Synergy Workshops; EVN-TOG; software</i>	<i>Engineering Forum EVN-TOG</i>	<i>ERAtec EVN-TOG, tech workshops</i>	<i>EVN-TOG, GMVA tech workshops technical dissemination</i>
Radio freq management	<i>Spectrum management</i>	<i>Spectrum management</i>	<i>Spectrum management</i>	<i>Spectrum management</i>
training	<i>training YERAC, Interferometry/ single dish schools</i>	<i>training YERAC, Schools</i>	<i>new skills ERIS, CESRA, YERAC</i>	<i>training events Data processing , ERIS, Schools</i>
Future development of Radio Astronomy	<i>Astronomy across Europe ALMA Forum; AstroNet; SKA subs</i>		<i>Que-Sera RadioNet White Paper</i>	<i>Sustainability SPOOR</i>
Outreach	→			

Joint Research Activities (2004-2020)

JRA		FP6 2004-08	FP7 2008-12	FP7 2012-15	H2020 2017-20
ALBUS	Advanced Long Baseline User Software	X			
ALBiUS	Advanced Long Baseline inter-op User Software		X		
AMSTAR	mm/sub-mm instrumentation	X			
AMSTAR+	mm/sub-mm multi pixel array		X		
PHAROS	cryogenic focal plane arrays	X			
APRICOT	cm/mm multi-pixel array		X		
UniBoard	Generic FPGA-based computing platform		X		
UniBoard ²	Computing board for large data streams			X	
AETHER	Broadband mm/sub-mm detectors			X	
AETHRA	Advanced heterodyne mm/sub-mm receivers				X
DIVA	1.5-5.5 GHz wideband Rx+ DBBC3			X	
BRAND EVN	1.5-15.5 GHz wideband Rx for EVN				X
HILADO	improvements to CASA-core library			X	
RINGS	Radio Interferometry Next Generation S'ware				X

RadioNet as a cohering force in European radio astronomy

- Radio astronomy has always been “open” and collaborative → VLBI → European VLBI → RadioNet
- For the last 20 years, RadioNet has been a significant part of the framework supporting European radio astronomy and enabling TNA, NAs and JRAs
- The fabric of our community has changed. The primary institutional/national structure is now complemented by a strong European component enhancing the way we do, and think about, astronomy
- RadioNet rightfully has a prominent place in the European Research Area
- The astronomy community and the European Commission can be proud of all that RadioNet has achieved these last 20 years. It was worth the money and the effort!

Acknowledgements

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FP5

FP6

**FP7-2
H2020**

**FP5
FP7-1**