THEME [INFRA-2011-1.1.21.]
[Research Infrastructures for advanced radio astronomy]

Grant agreement for: Combination of CP & CSA*

Annex I - "Description of Work"

Project acronym: RadioNet3

Project full title: " Advanced Radio Astronomy in Europe "

Grant agreement no: 283393

Version date: 2011-10-28

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Part A

Workplan Tables

A1:
Project summary

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per project

General information			
Project title [3]	Advanced Radio Astronomy in Europe		
Starting date [4]	01/01/2012		
Duration in months [5]	48		
Call (part) identifier [6]	FP7-INFRASTRUCTURES-2011-1		
Activity code(s) most relevant to your topic [7]	INFRA-2011-1.1.21.: Research Infrastructures for advanced radio astronomy		
Free keywords [8]		Radio astronomy, Physics, Radio Physics, Astrophysics	

Abstract [9]

RadioNet is an I3 that coordinates all of Europe’s leading radio astronomy facilities in an integrated cooperation to achieve transformational improvement in the quality and quantity of the scientific research of European astronomers. RadioNet3 includes 27 partners operating world-class radio telescopes and/or performing cutting-edge R&D in a wide range of technology fields important for radio astronomy.
RadioNet3 proposes a work plan that is structured into 7 NAs, 9 TNAs and 4 JRAs with the aim to integrate and optimise the use and development of European radio astronomy infrastructures. The general goals of RadioNet3 are to:
- facilitate, for a growing community of European researchers, access to the complete range of Europe’s world-leading radio-astronomical facilities, including the ALMA telescope;
- secure a long-term perspective on scientific and technical developments in radio astronomy, pooling resources and expertise that exist among the partners;
- stimulate new R&D activities for the existing radio infrastructures in synergy with ALMA and the SKA;
- contribute to the implementation of the vision of the ASTRONET Strategic Plan for European Astronomy by building a sustainable and world leading radio astronomical research community.
RadioNet3 builds on the success of two preceeding I3s under FP6 and FP7, but it also takes a leap forward as it includes facilitation of research with ALMA via a dedicated NA, and 4 pathfinders for the SKA in its TNA Program. It has a transparent and efficient management structure designed to optimally support the implementation of the project.
RadioNet is now recognized by funding agencies and international project consortia as the European entity representing radio astronomy and facilitating the access to and exploitation of excellent facilities in this field. This is of paramount importance, as a dedicated, formal European radio astronomy organisation to coordinate and serve the needs of this community does not yet exist.

A2:
List of Beneficiaries

Project Number [1]	283393	Project Acronym [2]	RadioNet3

List of Beneficiaries

No	Name	Short name	Country	Project entry month[10]	Project exit month
1	MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	MPG	Germany	1	48
2	STICHTING ASTRONOMISCH ONDERZOEK IN NEDERLAND	ASTRON	Netherlands	1	48
3	Institut de Radioastronomie Millimetrique INSTITUT DE RADIOASTRONOMIE MILLIMETRIQUE INSTITUT DE RADIO ASTRONOMIE MILLIMETRIQUE SOCIETE CIVILE* I.R.A.M.	IRAM	France	1	48
4	ISTITUTO NAZIONALE DI ASTROFISICA	INAF	Italy	1	48
5	JOINT INSTITUTE FOR V.L.B.I. IN EUROPE (J.I.V.E.)	JIVE	Netherlands	1	48
6	THE UNIVERSITY OF MANCHESTER	UMAN	United Kingdom	1	48
7	CHALMERS TEKNISKA HOEGSKOLA AB	OSO	Sweden	1	48
8	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE	UCAM	United Kingdom	1	48
9	SCIENCE AND TECHNOLOGY FACILITIES COUNCIL	STFC	United Kingdom	1	48
10	STICHTING SRON NETHERLANDS INSTITUTE FOR SPACE RESEARCH	SRON	Netherlands	1	48
11	OBSERVATOIRE DE PARIS	OBSPARIS	France	1	48
12	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD	UOXF	United Kingdom	1	48
13	UNIVERSIDAD DE ALCALA	UAH	Spain	1	48
14	TECHNISCHE UNIVERSITEIT DELFT	TUD	Netherlands	1	48
15	EUROPEAN SOUTHERN OBSERVATORY - ESO EUROPEAN ORGANISATION FOR ASTRONOMICAL RESEARCH IN THE SOUTHERN HEMISPHERE	ESO	Germany	1	48
16	Korea Astronomy and Space Science Institute	KASI	Korea (Republic of)	1	48
17	UNIVERSITE DE BORDEAUX I	BORD	France	1	48
18	UNIVERSITE D'ORLEANS	UORL	France	1	48

No	Name	Short name	Country	Project entry month[10]	Project exit month
19	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Fraunhofer	Germany	1	48
20	TURUN YLIOPISTO	U. Turku	Finland	1	48
21	UNIWERSYTET MIKOLAJA KOPERNIKA W TORUNIU	UMK	Poland	1	48
22	UNIVERSITAET ZU KOELN	UCO	Germany	1	48
23	VENTSPILS AUGSTSKOLA	VENT	Latvia	1	48
24	AALTO-KORKEAKOULUSAATIO	AALTO	Finland	1	48
25	NATIONAL RESEARCH FOUNDATION	NRF	South Africa	1	48
26	COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION	CSIRO	Australia	1	48
27	STICHTING INTERNATIONAL LOFAR TELESCOPE	ILT	Netherlands	1	48

A3: Budget Breakdown

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One Form per Project

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EU contribution
				RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total A+B+C+D+E		
1	MPG	75.0	S	561,000.00	125,000.00	532,433.74	650,229.94	0.00	1,868,663.68	0.00	1,671,626.18
2	ASTRON	75.0	A	724,850.83	0.00	222,293.16	13,500.00	0.00	960,643.99	0.00	779,431.28
3	IRAM	75.0	T	298,000.00	0.00	365,340.32	7,500.00	0.00	670,840.32	0.00	596,340.32
4	INAF	75.0	T	373,666.67	68,400.00	158,418.55	2,500.00	0.00	602,985.22	0.00	486,911.05
5	JIVE	75.0	T	747,595.20	888,000.00	1,199,176.32	158,932.80	0.00	2,993,704.32	0.00	2,459,125.52
6	UMAN	75.0	T	71,566.67	0.00	542,388.45	2,000.00	0.00	615,955.12	0.00	598,063.45
7	OSO	75.0	T	460,613.33	0.00	304,738.15	4,500.00	0.00	769,851.48	0.00	654,698.15
8	UCAM	75.0	T	151,930.67	0.00	0.00	0.00	0.00	151,930.67	0.00	113,948.00
9	STFC	75.0	A	126,468.43	0.00	355,077.36	5,625.00	0.00	487,170.79	0.00	455,553.68
10	SRON	75.0	T	158,293.33	0.00	0.00	0.00	0.00	158,293.33	0.00	118,720.00
11	OBSPARIS	75.0	T	82,400.00	0.00	0.00	0.00	0.00	82,400.00	0.00	61,800.00
12	UOXF	75.0	T	332,533.33	0.00	0.00	0.00	0.00	332,533.33	0.00	249,400.00
13	UAH	75.0	T	183,640.00	0.00	76,000.00	0.00	0.00	259,640.00	0.00	213,730.00
14	TUD	75.0	A	158,333.33	0.00	0.00	0.00	0.00	158,333.33	0.00	118,750.00
15	ESO	75.0	F	151,200.00	0.00	0.00	0.00	0.00	151,200.00	0.00	113,400.00
16	KASI	75.0	F	0.00	264,000.00	0.00	0.00	0.00	264,000.00	0.00	0.00
17	BORD	75.0	T	78,280.00	0.00	0.00	0.00	0.00	78,280.00	0.00	58,710.00
18	UORL	75.0	T	65,233.33	0.00	0.00	0.00	0.00	65,233.33	0.00	48,925.00
19	Fraunhofer	75.0	A	215,108.42	0.00	0.00	0.00	0.00	215,108.42	0.00	161,331.32
20	U. Turku	75.0	T	0.00	25,915.94	0.00	0.00	0.00	25,915.94	0.00	0.00
21	UMK	75.0	T	0.00	0.00	38,000.00	0.00	0.00	38,000.00	0.00	38,000.00

A3:
Budget Breakdown

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EU contribution
				RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total A+B+C+D+		
22	UCO	75.0	T	82,640.00	0.00	0.00	0.00	0.00	82,640.00	0.00	61,980.00
23	VENT	75.0	F	0.00	0.00	38,000.00	0.00	0.00	38,000.00	0.00	38,000.00
24	AALTO	75.0	T	0.00	0.00	38,000.00	0.00	0.00	38,000.00	0.00	38,000.00
25	NRF	75.0	S	0.00	16,200.00	0.00	0.00	0.00	16,200.00	0.00	0.00
26	CSIRO	75.0	A	0.00	70,000.00	0.00	0.00	0.00	70,000.00	0.00	0.00
27	ILT	75.0	T	0.00	0.00	363,556.05	0.00	0.00	363,556.05	0.00	363,556.05
Total				5,023,353.54	1,457,515.94	4,233,422.10	844,787.74	0.00	11,559,079.32	0.00	9,500,000.00

Note that the budget mentioned in this table is the total budget requested by the Beneficiary and associated Third Parties.

*** The following funding schemes are distinguished**

Collaborative Project (if a distinction is made in the call please state which type of Collaborative project is referred to: (i) Small of medium-scale focused research project, (ii) Large-scale integrating project, (iii) Project targeted to special groups such as SMEs and other smaller actors), Network of Excellence, Coordination Action, Support Action.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project, and it cannot be changed. The project number **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

2. Project acronym

Use the project acronym as indicated in the submitted proposal. It cannot be changed, unless agreed during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry info force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a detailed justification on a separate note.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Activity code

Select the activity code from the drop-down menu.

8. Free keywords

Use the free keywords from your original proposal; changes and additions are possible.

9. Abstract

10. The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

11. The number allocated by the Consortium to the participant for this project.

12. Include the funding % for RTD/Innovation – either 50% or 75%

13. Indirect cost model
- **A: Actual Costs**
- **S: Actual Costs Simplified Method**
- **T: Transitional Flat rate**
- **F :Flat Rate**

Workplan Tables

Project number

283393

Project title

RadioNet3—Advanced Radio Astronomy in Europe

Call (part) identifier

FP7-INFRASTRUCTURES-2011-1

Funding scheme

Combination of CP & CSA

WT1
List of work packages

Project Number [1]	283393	Project Acronym [2]	RadioNet3

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	RadioNet3 Management	MGT	1	56.00	1	48
WP 2	Questions on Structuring European Radio Astronomy (QueSERA)	COORD	5	7.00	1	48
WP 3	Science Working Group (SWG)	COORD	4	3.50	1	48
WP 4	New skills for astronomers (New skills)	COORD	6	0.12	1	48
WP 5	Mobility for ALMA Regional Centre Users (MARCUs)	COORD	15	0.04	1	48
WP 6	European Radio Astronomy Technical Forum (ERATec)	COORD	1	4.00	1	48
WP 7	Radio Astronomical Spectrum Management	COORD	1	0.04	1	48
WP 8	UniBoard2	RTD	5	116.00	7	42
WP 9	Advanced European Terahertz HEterodyne Receivers (AETHER)	RTD	3	189.01	7	42
WP 10	High performance processing of Large Astronomical Datasets in an Open-source environment - Hilado	RTD	2	91.50	7	42
WP 11	Developments In VLBI Astronomy (DIVA)	RTD	1	74.00	7	42
WP 12	EVN	SUPP	5	0.03	1	48
WP 13	JCMT	SUPP	9	0.03	1	48
WP 14	e-MERLIN	SUPP	6	0.03	1	48
WP 15	100-m Radio Telescope Effelsberg	SUPP	1	0.03	1	48
WP 16	LOFAR	SUPP	27	0.03	1	48
WP 17	Westerbork Synthesis Radio Telescope (WSRT)	SUPP	2	0.03	1	48
WP 18	IRAM: Plateau de Bure Interferometer (PdBI) & 30-meter Telescope (PV)	SUPP	3	0.03	1	48
WP 19	APEX (Atacama Pathfinder Experiment)	SUPP	7	0.03	1	48
WP 20	Sardinia Radio Telescope (SRT)	SUPP	4	0.03	1	48
			Total	541.48		

WT2:
List of Deliverables

Project Number [1]	283393	Project Acronym [2]	RadioNet3

List of Deliverables - to be submitted for review to EC

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.1	Assembling the web/wiki pages	1	5	0.50	O	PU	2
D2.1	Plan for reaching astronomers across Europe	2	5	0.20	O	PU	10
D2.2	Terms of reference for the policy discussion	2	2	0.20	R	PU	10
D2.3	Production of outreach materials for astronomical community	2	1	0.50	O	PU	12
D2.4	Minutes of meeting outreach officers	2	4	0.20	R	PU	19
D2.5	Minutes from policy meetings	2	2	0.20	R	PU	19
D2.6	PR material aimed at general public	2	4	0.30	O	PU	30
D2.7	Minutes from policy meetings	2	2	0.20	R	PU	31
D2.8	Production of outreach materials for astronomical community	2	1	0.50	O	PU	36
D2.9	Report on effectiveness of task 2, advertising radio astronomy capabilities	2	5	0.30	R	PU	42
D2.10	White paper on European radio astronomy governance	2	2	0.40	R	PU	42
D3.1	Publication of presented papers & presentations	3	4	0.50	R	PU	9

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	online from 11th EVN Symposium						
D3.2	Publication of presented papers & presentations online from a Large ALMA Conference	3	4	0.20	R	PU	11
D3.3	Report & on-line presentations from Early Results from LOFAR	3	4	0.30	R	PU	16
D3.4	Publication of presented papers & presentations online from Large Conference	3	4	0.50	R	PU	22
D3.5	Publication of presented papers, presentations on-line from 12th EVN Symposium	3	4	0.50	R	PU	32
D3.6	Publication of presented papers & presentations online from Large Conference	3	4	0.50	R	PU	40
D4.1	YERAC	4	6	0.01	O	PU	6
D4.2	Focussed events: Preparing for SKA Pathfinders	4	6	0.01	O	PU	7
D4.3	Sub/mm-wave ERIS	4	3	0.01	O	PU	9
D4.4	YERAC	4	6	0.01	O	PU	18
D4.5	Cm-wave ERIS	4	6	0.01	O	PU	21
D4.6	Single dish mm-wave school	4	3	0.01	O	PU	22
D4.7	YERAC	4	3	0.01	O	PU	30

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D4.8	Solar Event	4	20	0.01	O	PU	33
D4.9	Sub/mm-wave ERIS	4	6	0.01	O	PU	34
D4.10	YERAC	4	6	0.01	O	PU	42
D4.11	Cm-wave ERIS	4	6	0.01	O	PU	45
D4.12	Single Dish mm-wave school	4	3	0.01	O	PU	46
D5.1	Updated versions of the 'User Guide to the European ARC'	5	15	0.01	R	PU	12
D5.2	This user guide is the standard introduction into the services provided by the European ARC structur	5	15	0.01	R	PU	24
D5.3	This user guide is the standard introduction into the services provided by the European ARC structur	5	15	0.01	R	PU	36
D5.4	This user guide is the standard introduction into the services provided by the European ARC structur	5	15	0.01	R	PU	48
D6.1	Report from the TWS Workshop 1	6	4	0.50	R	PU	7
D6.2	Report from the TOG Meeting 1	6	1	0.01	R	PU	11
D6.3	Report from the TWS Workshop 2	6	4	0.50	R	PU	19
D6.4	Report from the TOG Meeting 2	6	1	0.01	R	PU	27

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D6.5	Report from the TWS Workshop 3	6	4	0.50	R	PU	35
D6.6	Report from the TOG Meeting 3	6	1	0.01	R	PU	43
D6.7	Report from the TWS Workshop 4	6	4	0.50	R	PU	47
D7.1	Report from CRAF meeting 1	7	1	0.01	R	PU	10
D7.2	Report from CRAF meeting 2	7	1	0.01	R	PU	22
D7.3	Report from CRAF meeting 3	7	1	0.01	R	PU	34
D7.4	Report from CRAF meeting 4	7	1	0.01	R	PU	46
D8.1	Document on definition of coding interfaces and conventions	8	5	2.00	R	PU	9
D8.2	Hardware design document	8	2	8.00	R	PU	17
D8.3	Firmware design document: correlator	8	5	13.00	R	PU	17
D8.4	Firmware design document: digital receiver	8	4	13.40	R	PU	17
D8.5	Firmware design document beam former	8	1	4.50	R	PU	17
D8.6	Firmware design document: pulsar binning	8	6	9.50	R	PU	20
D8.7	Firmware design document: RFI mitigation	8	18	9.50	R	PU	20
D8.8	Prototype Hardware	8	2	5.00	P	RE	23
D8.9	Revised hardware design document	8	2	8.00	R	PU	29

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D8.10	Production hardware	8	2	2.70	P	RE	31
D8.11	Revised firmware design document: correlator	8	5	10.40	R	PU	33
D8.12	Revised firmware design document: digital receiver	8	4	11.00	R	PU	33
D8.13	Revised firmware design document: beam former	8	1	4.00	R	PU	33
D8.14	Report on effectiveness of green measures: correlator	8	5	6.00	R	PU	42
D8.15	Report on effectiveness of green measures: digital receiver	8	4	6.00	R	PU	42
D8.16	Report on effectiveness of green measures: beam former	8	1	3.00	R	PU	42
D9.1	Supra THz SIS and HEB receivers specification	9	12	4.00	R	RE	12
D9.2	Prototype components for 1-mm feed horn array (Task 2)	9	12	3.00	P	CO	18
D9.3	Report on supra THz SIS junctions, HEB devices and Schottky diodes development (Task 4)	9	12	18.00	R	RE	18
D9.4	Wideband OMT for W band (Task 1)	9	4	4.00	R	CO	24
D9.5	ALMA band 10 2SB or Balanced	9	10	8.30	P	RE	24

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	mixer design report (Task 3)						
D9.6	Prototype components for 1-mm IF hybrids (Task 2)	9	7	4.00	P	CO	30
D9.7	Reports on Supra-THz SIS and HEB mixers and LO chain tests (Task 4)	9	12	22.00	R	RE	33
D9.8	Prototype components for 4-12GHz MMIC tested on-wafer (Task 1)	9	19	4.00	P	CO	34
D9.9	Prototype IF amplifiers (Task 23)	9	13	18.00	P	RE	36
D9.10	Prototype LO for 1-mm array (Task 2)	9	9	3.00	P	RE	36
D9.11	Prototype 1-mm 2SB mixers (Task 2)	9	3	14.00	P	CO	36
D9.12	Prototype IF amplifiers (Tasks 3)	9	13	12.00	P	RE	37
D9.13	W-band MMICs (Task 1)	9	19	8.80	P	CO	40
D9.14	Report on supra THz mixer tests and on other mixer solutions considered (Task 4)	9	12	23.00	R	RE	41
D9.15	W band MMIC array module demonstrator (Task 1)	9	1	5.60	D	CO	42
D9.16	One-mm array receiver 7-pixel demonstrator (Task 2)	9	3	3.00	D	RE	42
D9.17	ALMA band 10 2SB or	9	10	8.30	D	RE	42

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	Balanced mixer single-pixel prototype and test report (Task 3)						
D10.1	Detailed activities plan, including top-level architecture of libraries and final selection of bench	10	2	5.00	R	PU	12
D10.2	Report on optimisation studies, indicating resulting improvement and guidelines for prototyping and	10	15	5.00	R	PU	18
D10.3	Report on the comparison of data formats, specifying the key characteristics of optimal formats for	10	8	8.00	R	PU	18
D10.4	Report specifying the requirements and architecture of the Fast Transient Imager, including identifi	10	2	5.00	R	PU	18
D10.5	Scientific publication on the application and adaptation of parallel solvers for large astronomical	10	12	8.00	R	PU	18
D10.6	Prototype code of improved ParselTongue library, to form a scripting	10	5	10.00	P	PU	24

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	interface to the prototype code						
D10.7	Optimised prototype software (in the repository), showing the actual performance gain from the optim	10	15	5.00	P	PU	30
D10.8	Prototype software for the demonstration of the solvers on a variety of hardware platforms.	10	12	8.00	P	PU	30
D10.9	Prototype FTI application (code in repository) for use on the target hardware platforms.	10	2	5.00	P	PU	30
D10.10	Scientific publication on the results of the demonstrator, and the overall performance gains obtaine	10	15	4.50	D	PU	38
D10.11	Scientific publication with the results from the FTI demonstrator application on the selected hardwa	10	2	5.00	D	PU	38
D10.12	Scientific publication of the results of demonstrator of large parallel solvers for huge astronomica	10	12	8.00	D	PU	38
D10.13	Demonstrator pipelines (code in repository)	10	5	10.00	D	PU	38

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	for the selected applications, including a standard imag						
D10.14	Final report integrating the three benchmark studies and the demonstrator pipelines	10	12	5.00	R	PU	42
D11.1	MIC LNA design report	11	7	4.00	R	PU	12
D11.2	Report on the design of the prototype of sampler and processing unit	11	4	8.00	R	RE	15
D11.3	Cryogenic test report of MIC LNAs using advanced low noise processes	11	7	6.00	R	PU	24
D11.4	Completing first sampler ADB3 prototype	11	1	8.00	P	RE	24
D11.5	Completing first FPGA Core3 board, prototype	11	4	6.00	P	RE	24
D11.6	Design study of the architecture of the 40 Gbit Ethernet output	11	7	7.00	R	RE	24
D11.7	MMIC LNAs design report	11	2	3.00	R	PU	27
D11.8	Evaluated packaging solution	11	1	7.00	R	PU	30
D11.9	MMIC LNA test report	11	2	3.00	R	PU	33
D11.10	Test of the integrated prototype of sampler and processing unit	11	4	4.00	R	RE	36
D11.11	Prototype system 40 Gbit	11	7	7.00	R	RE	36

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	Ethernet and test report						
D11.12	Test report of integrated feed system	11	2	4.00	R	PU	42
D11.13	Final report of task 2 with test of integrated system	11	4	5.00	R	PU	42
D12.1	Providing access of 228 hours to the infrastructure	12	5	0.01	O	PU	18
D12.2	Providing access of 152 hours to the infrastructure	12	5	0.01	O	PU	30
D12.3	Providing access of 228 hours to the infrastructure	12	5	0.01	O	PU	48
D13.1	Providing access of 147 hours to the infrastructure	13	9	0.01	O	PU	18
D13.2	Providing access of 102 hours to the infrastructure	13	9	0.01	O	PU	30
D13.3	Providing access of 147 hours to the infrastructure	13	9	0.01	O	PU	48
D14.1	Providing access of 236 hours to the infrastructure	14	6	0.01	O	PU	18
D14.2	Providing access of 163 hours to the infrastructure	14	6	0.01	O	PU	30
D14.3	Providing access of 236 hours to the infrastructure	14	6	0.01	O	PU	48
D15.1	Providing access of 339 hours to the infrastructure	15	1	0.01	O	PU	18
D15.2	Providing access of 228 hours to the infrastructure	15	1	0.01	O	PU	30
D15.3	Providing access of 339 hours to the infrastructure	15	1	0.01	O	PU	48

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D16.1	Providing access of 160 hours to the infrastructure	16	27	0.01	O	PU	18
D16.2	Providing access of 109 hours to the infrastructure	16	27	0.01	O	PU	30
D16.3	Providing access of 160 hours to the infrastructure	16	27	0.01	O	PU	48
D17.1	Providing access of 160 hours to the infrastructure	17	2	0.01	O	PU	18
D17.2	Providing access of 93 hours to the infrastructure	17	2	0.01	O	PU	30
D17.3	Providing access of 189 hours to the infrastructure	17	2	0.01	O	PU	48
D18.1	Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure	18	3	0.01	O	PU	18
D18.2	Providing access of 36 (PdBI) and 96 (PV) hours to the infrastructure	18	3	0.01	O	PU	30
D18.3	Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure	18	3	0.01	O	PU	48
D19.1	Providing access of 103 hours to the infrastructure	19	7	0.01	O	PU	18
D19.2	Providing access of 73 hours to the infrastructure	19	7	0.01	O	PU	30
D19.3	Providing access of 103 hours to the infrastructure	19	7	0.01	O	PU	48
D20.1	Providing access of 30 hours to the infrastructure	20	4	0.01	O	PU	18

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D20.2	Providing access of 90 hours to the infrastructure	20	4	0.01	O	PU	30
D20.3	Providing access of 135 hours to the infrastructure	20	4	0.01	O	PU	48
			Total	451.00			

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	MGT
Work package title	RadioNet3 Management		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

RadioNet3 project requires a well-defined and organized management to guarantee the smooth implementation of the financial, management and scientific activities and the success of the whole project. The overall central management will operate flexibly enough to build on the management experience of previous projects and the partner organizations, while on the other hand it will maintain a firm control of the overall progress and the provision of the work plan.

Description of work and role of partners

The management structure has been chosen to optimally handle the management tasks and challenges of this project. The detailed information on the management structure is described in Section 2.1.

The major focus of the RadioNet3 management will be on:

• Providing an effective and transparent management of the project
• Assuring the timely delivery of high quality deliverables and milestones
• Distributing the EC finances to partners based on the FP7 rules and Consortium Agreement.
• Defining an efficient method for the project implementation: monitoring of the project progress, communication across activities, notifying issues, etc.,
• Defining an internal communication system to assure the information update by all partners
• Maintaining the policy on Intellectual Property Rights
• Assure the RadioNet visibility in the world community by attending relevant meetings and distributing outreach materials
• Fostering cooperation with other associated projects e.g. SKA, ALMA, ASTRONET

The management of RadioNet3 will be done jointly between the MPG and JIVE. The MPG will be responsible for the scientific, financial and the overall management of the project and reporting to the EC. JIVE will be in charge of the management of the TNA and NA travel budgets and of support for information management. Both institutions have substantial experience in the management of other European and international projects. The coordination and effective administration structure will be supported and supervised by the Board.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	40.00
5	JIVE	16.00
	Total	56.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Assembling the web/wiki pages	5	0.50	O	PU	2
		Total	0.50			

Description of deliverables

D1.1) Assembling the web/wiki pages: The web page and the wiki pages for the project will be created. It will be used as the main communication platform for all activities (wiki), management tool (the restricted part) and as the information platform (web page). [month 2]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS1	Forming of the Board	1	3	CA signed
MS2	Appointment of the Management Team	1	4	Minutes of the Board Meeting
MS3	RadioNet3 Consortium Board Meeting	1	4	Minutes of the Board Meeting
MS4	RadioNet3 Consortium Board Meeting	1	16	Minutes of the Board Meeting
MS5	RadioNet3 Consortium Board Meeting	1	28	Minutes of the Board Meeting
MS6	RadioNet3 Consortium Board Meeting	1	42	Minutes of the Board Meeting

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	COORD
Work package title	Questions on Structuring European Radio Astronomy (QueSERA)		
Start month	1		
End month	48		
Lead beneficiary number [55]	5		

Objectives

The field of radio astronomy is set to blossom over the coming decade. Two major facilities are expected to become operational (ALMA & SKA1), which will have significant scientific and technological impacts in the field both scientifically and technically. Additionally, some traditional facilities are undergoing important upgrades. Clearly the technological advances are presenting a myriad of options to push science into uncharted discovery space. These science and technology aspects are addressed in other areas of the RadioNet3 programme. The need to better integrate, represent and advertise the radio astronomical facilities and ambitions is the aim of this Networking Activity.

As the body that encompasses the largest range in radio facilities in Europe, RadioNet3 has a natural role in advocating radio astronomy as a whole. Such outreach activities have different requirements when addressing different target audiences. Material aimed at the general public will have a clearly different signature from publications for peer astronomers, meant to enlarge the user community. When communicating with national and European policy makers, the focus will be entirely different again and address funding and governance issues. Accordingly, this activity is split into three tasks.

Description of work and role of partners

Task 1: Policy and Governance [ASTRON, RadioNet3 partners]

In its interaction with policy makers, the obvious issue for European radio astronomy is the future of its structure as a whole. RadioNet3 as a project and a consortium is rather loosely organized and has no coordinated long-term perspective on the European scale. Especially with the advent of the SKA, a natural question to ask is whether a new legal entity for radio astronomy is required within Europe. The potential role of existing vehicles (e.g. the current ESKAC collaboration, ESO, or a future JIVE-ERIC) is also relevant here.

The deliverables and milestones of this work package take the form of face-to-face meetings including invitations to relevant external parties as appropriate, plus a final position paper. This will produce a roadmap for existing RadioNet3 facilities that

• Recognises the impact ALMA and the SKA will have in the field, and builds and responds to the current ASTRONET review process,
• Defines the future role of existing facilities in the Northern hemisphere (incl. VLBI),
• Identifies an appropriate model for SKA scientific (user) support, that incorporates lessons learned from the ALMA experience,
• Establishes a clear vision on how the European radio astronomy community should formally organise itself in the coming decade,
• Addresses the need for future European scale integrating activities beyond RadioNet3 and consider how these should be funded.

This work package will be led by ASTRON and coordinated by the RadioNet3 office. It will take shape as a number of separate discussion meeting between the directors of the European facilities to which international partners and European players can be invited. This activity starts with defining the terms of reference of this group and results in a position paper.

Task 2: Advertising Radio Astronomy capabilities [JIVE, RadioNet3 partners]

This work-package aims at areas in Europe that do not have established communities in radio astronomy. Frequently, astronomers in these countries are not involved in defining the science priorities for the current programmes or the facilities of the future. Next to the very successful TNA programme, it is important to advocate the usage of these facilities in relation to science themes that can be important for ALMA and SKA in a more strategic context.

In this work package the RadioNet3 facilities will be advertised as a whole, particularly targeting fellow astronomers, who are in communities (geographically or topically) that are traditionally not engaged in radio astronomy. In particular QueSERA will:
• Visit national astronomy meetings in countries where there is no RadioNet3 membership or present colloquia at astronomy institutes in these countries.
• Advertise the existence of the European SKA Consortium as a platform to be involved in the definition of the SKA.
• Support radio astronomers to participate in conferences on science topics that traditionally have limited engagement in radio astronomy.
• Represent RadioNet alongside other research infrastructures and in European scale research infrastructure meetings.

This work package will be led by JIVE and coordinated by the RadioNet3 office on coordination with the various TNA programmes and notably the other NAs on training, science and engineering. In the start of the programme a plan will be drafted for approval by the board.

Task 3: Outreach for the general public [INAF, RadioNet3 partners]

Astronomy has a powerful appeal that can be used to reach the general public and to make it aware of the excitement of science and its importance for society. Radio astronomy in particular has the advantage that the public easily visits the icons of its trade, the large radio telescopes, as they stand in readily accessible parts of the country. Many of the facilities in the RadioNet3 consortium have visitor centres, open to the general public.

The RadioNet3 partners have a wide range of expertise in reaching the general public, although all of these generally aim at advertising the local accomplishments. This work-package will combine outreach effort of the European scale radio facilities. In addition, the activities can benefit already by simply using the expertise across the facilities and integrating these sometimes sub-critical individual efforts.

Explicitly, the objectives of this task are:
• Integrate the outreach activities of the major radio observatory programmes in Europe, in order to create high quality materials and to harness the full potential of national efforts that are often overlapping and closely related.
• Develop new high quality outreach and educational materials (including multi- media) and exhibits, that can be tested in the Visitor Centres (VCs), translated with relatively low effort (native speakers of almost every European language are involved in radio astronomical outreach activities) and then used by all RadioNet3 partners, but also by other institutions for astronomical research, colleges, local schools, etc.
• Pool human resources and exchange expertise in order to establish best practice (what works and what doesn’t) and make efficient use of limited resources.

This work package will be led by INAF and coordinated by the RadioNet3 office. In particular a list of national outreach organizations will be drafted (visitor centres, amateur astronomy organization, educational platforms) and an inventory will be made of the appropriate form of outreach material.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	7.00
2	ASTRON	0.00
3	IRAM	0.00
4	INAF	0.00
5	JIVE	0.00

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
6	UMAN	0.00
7	OSO	0.00
8	UCAM	0.00
9	STFC	0.00
10	SRON	0.00
11	OBSPARIS	0.00
12	UOXF	0.00
13	UAH	0.00
14	TUD	0.00
15	ESO	0.00
16	KASI	0.00
17	BORD	0.00
18	UORL	0.00
19	Fraunhofer	0.00
20	U. Turku	0.00
21	UMK	0.00
22	UCO	0.00
23	VENT	0.00
24	AALTO	0.00
25	NRF	0.00
26	CSIRO	0.00
27	ILT	0.00
	Total	7.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.1	Plan for reaching astronomers across Europe	5	0.20	O	PU	10
D2.2	Terms of reference for the policy discussion	2	0.20	R	PU	10
D2.3	Production of outreach materials for astronomical community	1	0.50	O	PU	12
D2.4	Minutes of meeting outreach officers	4	0.20	R	PU	19

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.5	Minutes from policy meetings	2	0.20	R	PU	19
D2.6	PR material aimed at general public	4	0.30	O	PU	30
D2.7	Minutes from policy meetings	2	0.20	R	PU	31
D2.8	Production of outreach materials for astronomical community	1	0.50	O	PU	36
D2.9	Report on effectiveness of task 2, advertising radio astronomy capabilities	5	0.30	R	PU	42
D2.10	White paper on European radio astronomy governance	2	0.40	R	PU	42
		Total	3.00			

Description of deliverables

D2.1) Plan for reaching astronomers across Europe: This work package will be led by JIVE and coordinated by the RadioNet3 office on coordination with the various TNA programmes and notably the other NAs on training, science and engineering. In the start of the programme a plan will be drafted for approval by the board. [month 10]

D2.2) Terms of reference for the policy discussion: The deliverables and milestones of this work package take the form of face-to-face meetings including invitations to relevant external parties as appropriate, plus final position paper. This will produce a roadmap for existing RadioNet3 facilities [month 10]

D2.3) Production of outreach materials for astronomical community: Production of outreach materials for astronomical community. [month 12]

D2.4) Minutes of meeting outreach officers: In particular a list of national outreach organizations will be drafted (visitor centres, amateur astronomy organization, educational platforms) and an inventory will be made of the appropriate form of outreach material. [month 19]

D2.5) Minutes from policy meetings: The deliverables and milestones of this work package take the form of face-to-face meetings including invitations to relevant external parties as appropriate, plus final position paper. This will produce a roadmap for existing RadioNet3 facilities [month 19]

D2.6) PR material aimed at general public: Production of PR material aimed at general public [month 30]

D2.7) Minutes from policy meetings: The deliverables and milestones of this work package take the form of face-to-face meetings including invitations to relevant external parties as appropriate, plus final position paper. This will produce a roadmap for existing RadioNet3 facilities [month 31]

D2.8) Production of outreach materials for astronomical community: Production of outreach materials for astronomical community [month 36]

D2.9) Report on effectiveness of task 2, advertising radio astronomy capabilities: Report on effectiveness of task 2, advertising radio astronomy capabilities. This work package will be led by JIVE and coordinated by the RadioNet3 office on coordination with the various TNA programmes and notably the other NAs on training, science and engineering. In the start of the programme a plan will be drafted for approval by the board. [month 42]

D2.10) White paper on European radio astronomy governance: The deliverables and milestones of this work package take the form of face-to-face meetings including invitations to relevant external parties as appropriate, plus final position paper. This will produce a roadmap for existing RadioNet3 facilities. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS7	Policy Meetings	2	16	Decision List
MS8	Meeting Outreach Officers	4	18	Decision List
MS9	1st Draft of the white paper	2	17	Drafting the document
MS10	Policy Meetings	2	28	Decision List
MS11	2nd Draft of the white paper	2	29	Drafting the document
MS12	Policy Meetings	2	40	Decision List

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	COORD
Work package title	Science Working Group (SWG)		
Start month	1		
End month	48		
Lead beneficiary number [55]	4		

Objectives

The main goal of this Networking Activity is to ensure a central coordination in the dissemination of knowledge and scientific results among the partners. This will be achieved through the organization and support to a wide range of meetings, such as large conferences, topic-oriented workshops and small meetings. Large conferences and topic oriented workshops will be followed by the publication of conference proceedings, either online or printed. For each event, presentation will be deposited on the web site of the conference.

Description of work and role of partners

In the very near future, major further steps are expected in radio astronomy. The Atacama Large Millimeter Array will deliver first science results in a few months from now, opening up our knowledge of astrophysics in the high frequency (hundreds of GHz) end of the radio spectrum; LOFAR is in the commissioning stage, and is soon expected to unveil astrophysical phenomena at the other extreme of the radio spectrum, i.e. the tens/few hundred MHz end. The upgrade to e-MERLIN is soon to be completed, allowing a sensitivity boost in the classic radio window (1.4 – 22 GHz) on the unique sub-arcsecond scale. Inclusion of new large telescopes in the European VLBI Network will further improve the sensitivity of VLBI in Europe and across the world. All this is remarkable in itself, and even more considering that such new generation instruments represent an intermediate step towards the advent of SKA, which is further prepared by the forthcoming interferometers such as ASKAP, MeerKAT and Apertif.

This golden age in radio astronomy that will dramatically increase the need to share expertise, knowledge and discoveries is bound to increase during the period of RadioNet3. The SWG will coordinate and organise the activity within the radio community, by means of three main tasks, as follows.

Task 1: Large conferences (60-120 participants) [INAF, RadioNet3 partners]

These events involve a large fraction of the community, and usually cover a variety of astronomical areas, in the spirit of sharing and cross dissemination of knowledge. An average of 4 –5 large conferences, lasting about a working week, will be organized during the whole period of the project. Conferences on early science results from ALMA and LOFAR, and the EVN Symposia will be included. The latter are traditional biannual large meetings of the VLBI community, where all users of the European VLBI Network and other VLBI arrays present the most recent scientific highlights in the field of milliarcsecond scale radio astronomical science.

The following conferences are already scheduled to be organized:
• The 11th EVN Symposium will be held in Bordeaux (F) in late Summer/early Fall 2012;
• A large Conference focussed on the ALMA Early Science will take place in Garching (DE) towards the end of 2012;
• The 12th EVN Symposium will take place in Summer 2013.

Task 2: Topic oriented workshops (40-70 participants) [INAF, RadioNet3 partners]

These small-intermediate workshops will bring together experts in a given science or technology field, who will share results, technology transfer and future perspectives. Workshop proceedings and/or online presentations will be provided. An average of 2 topic-oriented workshops each year, lasting 2-3 days, will be organized. The scientific topics will be chosen among the members of the WP Steering Committee, based on astrophysical issues and questions considered particularly important and urgent for the astronomical community. Task 2 will include interdisciplinary workshops, e.g. interplay between science and technology (to be coordinated with other NAs/JRAs in RadioNet3), and connections with other scientific communities strongly related to astronomy (i.e. astro-particle, physics, chemistry); multipurpose workshops, where data handling and science are dealt with (to be coordinated with the New Skills Working Group); science meetings to build up a roadmap for the future of radio astronomy in Europe (in coordination with the QueSERA).

Task 3: Small meetings (20-30 participants) [INAF, RadioNet3 partners]

Events where participants will get together to discuss specific scientific and/or technical developments. Meetings of the European Pulsar Timing Array Group will be part of these events. An average of 2 small meetings will be organized each year.
Flexibility will be a key feature of the SWG, which will encourage and support “last-minute” spontaneous initiatives, in a bottom-up process, as well as structured initiatives. It is expected to support an average of 1-2 spontaneous initiatives each year. These may be topic-oriented workshops, and/or smaller meetings such as for instance the ALMA Community Days.

A detailed and updated implementation plan will be delivered to the Board every three months. A total of 8-10 events is expected to be supported each year, ensuring wide scientific coverage as well as geographical distribution. This working group will provide support in the form of (1) travel and subsistence costs of participants, and (2) logistics in the organization of the events. To encourage the publication of conference proceedings, publishing costs are also (at least partly) covered.

The members of the steering committee are as follow:
T. Venturi, A. Possenti (INAF); A. Lobanov (MPG); M. Zwaan and L. Testi (ESO); S. Rawlings (UOXF); K. Grainge (UCAM); R. Beswick, B. Stappers (UMAN); M. Bietenholz (NRF- HartRAO); M. Haverkorn (ASTRON); Z. Paragi (JIVE); S. Aalto (OSO); B.W. Sohn (KASI), M. Kunert-Bajraszewska (UMK), R. Braun (CSIRO).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.00
2	ASTRON	0.00
4	INAF	3.50
5	JIVE	0.00
6	UMAN	0.00
7	OSO	0.00
8	UCAM	0.00
12	UOXF	0.00
15	ESO	0.00
16	KASI	0.00
21	UMK	0.00
25	NRF	0.00
26	CSIRO	0.00
	Total	3.50

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D3.1	Publication of presented papers & presentations online from 11th EVN Symposium	4	0.50	R	PU	9
D3.2	Publication of presented papers & presentations online from a Large ALMA Conference	4	0.20	R	PU	11
D3.3	Report & on-line presentations from Early Results from LOFAR	4	0.30	R	PU	16
D3.4	Publication of presented papers & presentations online from Large Conference	4	0.50	R	PU	22
D3.5	Publication of presented papers, presentations on-line from 12th EVN Symposium	4	0.50	R	PU	32
D3.6	Publication of presented papers & presentations online from Large Conference	4	0.50	R	PU	40
		Total	2.50			

Description of deliverables

D3.1) Publication of presented papers & presentations online from 11th EVN Symposium: Publication of presented papers & presentations online from the organised conference. [month 9]

D3.2) Publication of presented papers & presentations online from a Large ALMA Conference: Publication of presented papers & presentations online from the organised conference. [month 11]

D3.3) Report & on-line presentations from Early Results from LOFAR: Publication of presented papers & presentations online from the organised conference. [month 16]

D3.4) Publication of presented papers & presentations online from Large Conference: Publication of presented papers & presentations online from the organised conference. [month 22]

D3.5) Publication of presented papers, presentations on-line from 12th EVN Symposium: Publication of presented papers & presentations online from the organised conference. [month 32]

D3.6) Publication of presented papers & presentations online from Large Conference: Publication of presented papers & presentations online from the organised conference. [month 40]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS13	Organization of 11th EVN Symposium (Bordeaux, FR)	4	8	Conference organised

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS14	Organization of a large conference on ALMA Early Science (Garching, DE)	4	10	Conference organised
MS15	Organisation of the Workshop on Early Results from LOFAR	4	15	Conference organised
MS16	Organisation of a Large Conference (TBD)	4	21	Conference organised
MS17	Organization of 12th EVN Symposium	4	31	Conference organised
MS18	Organisation of a Large Conference (TBD)	4	39	Conference organised

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	COORD
Work package title	New skills for astronomers (New skills)		
Start month	1		
End month	48		
Lead beneficiary number [55]	6		

Objectives

This work package will equip astronomers to exploit current and future radio astronomy facilities, with the emphasis on observatories with RadioNet3 participation. These include enhanced existing arrays such as the EVN, e-MERLIN, WSRT/Apertif and IRAM/NOEMA, new telescopes like LOFAR and the major intercontinental projects, ALMA, SKA and its pathfinders. Single-dish facilities play a vital role, not least in providing increasingly rare opportunities for hands-on observing. Scientifically, studies of everything from the Sun to the CMB will benefit from enhanced synergy between hitherto largely separate techniques, e.g. using VLBI for Solar system observations or multi-wavelength matching-resolution studies with ALMA and e-MERLIN.

The new/upgraded instruments will attract an order of magnitude increase in the user community (commensurate with the investment). This growth brings in astronomers from institutes with no interferometry tradition. The new instruments are making great efforts to be 'user friendly' but the huge expansion in wavelength coverage, sensitivity and so on presents a grand challenge for the present generation of radio astronomers to update their techniques. It will be ensured that the innovative data reduction methods being developed by other RadioNet packages and elsewhere, are employed wherever appropriate. These scientists will, in turn, provide a core of experts to advise the much-expanded next generation of users. The majority of these will simply require a basic understanding of interferometry and associated software, in order to be able to concentrate on the real goal of interpreting the astrophysics, although the instrumental experts of the future have also to be nurtured.

Description of work and role of partners

The New Skills work package addresses these practical objectives. A major support to 3 events per year will be provided: (Task 1) a European Radio Interferometry School (ERIS), (Task 2) the Young European Radio Astronomers' Conference (YERAC) and (Task 3) a focussed event, in addition to smaller contributions to other workshops.

Hands-on work and problem solving is particularly effective, underpinned by lectures from the leading radio astronomy practitioners of the day. The host of each event establishes a Scientific Organising Committee - SOC (including one or more of the WP coordinators) and Local Organising Committee - LOC who are responsible for the scientific and practical planning and budgeting including additional fundraising. RadioNet3 contributes to the organisation of these events in terms of providing contact lists of expert lecturers or potential tutors, mailing lists for publicising events and above all continuity of experience.

The most concrete expression of this is web pages containing lecture and tutorial material. The pages set up for recent events are heavily used for reference by individuals and later interferometry schools and WP4 leader endeavours to keep the material up to date. The lectures from the Community of European Solar Radio Astronomers CESRA school in 2010 will be published as printed proceedings and a need has been identified for a manual of low frequency and wide-field radio interferometry. Basic feedback from each event is obtained, with two main goals. It will be monitored whether the attendance is wide and inclusive or the nature of obstacles, and what could be done to improve the materials presented to meet the needs of the participants. In RadioNet-FP7, the gender and geographical distribution of attendees is usually well balanced and high proportion of practical and problem-solving sessions was reached. Nonetheless SOCs must constantly be vigilant to ensure that sufficient material for beginners is included.

Task 1: European Radio Interferometry School (ERIS) [U. Turku, UMAN, IRAM]

Each ERIS concentrates (but not exclusively) on either cm- or mm-wave interferometry. Lasting about a week, the participants range from graduate students and pre-graduate students embarking on a specialised radio astronomy career, to astronomers who are already experts at another wavelength or in theoretical studies, drawn in to the rapidly expanding community exploiting radio facilities. Lectures introducing a technique are followed by related hands-on tutorials. These cover all aspects of data reduction from calibration to images or other products and their analysis in tackling astrophysical problems. Parallel sessions give more experienced 'students' the opportunity to explore advanced techniques, whilst ensuring that beginners can gain a thorough grounding in the basics. Project scientists or other leaders of the major radio instruments are guest speakers and participants practice planning observations by forming groups to prepare potential observing projects according to their scientific interests.

Attendance at past events has increased year on year, reaching nearly 100 in 2009. In recent years it has become the norm to assist participants in installing the required software and provide data for work on their own laptops. It will be investigated whether it is sometimes necessary to provide access to more powerful machines, to handle the high data volumes produced by the new instruments.

Task 2: Young European Radio Astronomers’ Conference (YERAC) [UMAN, IRAM, U. Turku]

YERAC has been held almost every year since 1968. Exclusively graduate students and early-career astronomers (including engineers) make presentations at YERAC. The history of YERAC and future plans has been collected at www.yerac.org. It can be seen that whilst there is an impressive geographical spread, some years were missed in the past. RadioNet3 support ensures continuity whilst maintaining the unique atmosphere in which young researchers are able to give talks and enter discussions without feeling intimidated. The educational content of YERAC is delivered by sessions led by experienced researchers such as demonstrations on presentation techniques or questions posed for discussion on the hot topics of the day. The opportunities for networking and technology transfer are particularly significant for participants at the start of their careers. A possibility of holding a future YERAC in South Africa is currently investigated, which would offer a unique training experience because of the involvement of the SKA pathfinder MeerKAT.

Task 3: Focussed training events [IRAM, UMAN, U. Turku]

Focussed training events include the biennial IRAM single-dish workshops. The lectures and tutorials concentrate on the techniques of single dish sub/mm-wave astronomy and their applications to different areas of astrophysics. Students conduct their own scientific projects, observing at the 30-m Pico Veleta telescope, reducing, analysing and interpreting their data under the supervision of the lecturers. This successful scheme provides a unique environment of hands-on experience with the current leading millimetre single dish telescope, also applicable to other single dish telescopes (such as the JCMT or APEX) and to the interpretation of Herschel data.

One of the most exciting aspects of the new generation of radio telescopes is their flexibility in applications to Solar system as well as other astronomical research. The first RadioNet-FP7-supported Solar Workshop, was the "CESRA (Community of European Solar Radio Astronomers) summer school on solar radio physics 2010", held at Nancay radio observatory. The next event will be a Solar Radio Interferometry School, geared towards exploiting VLBI, LOFAR and ALMA (in collaboration with the Czech ARC node in Ondrejov).

RadioNet is playing a vital role in preparing for the SKA and the training needs to allow the whole astronomical community to benefit will become clearer during the next five years. A workshop - Preparing for the SKA will be supported to train astronomers in reducing data from pathfinders and plan or participate in the ambitious observing projects foreseen for the early years of the SKA.

This work package will also make modest contributions to specialised events. In 2010 these included a LOFAR 'busy week', a workshop on cm-wave single-dish observing including a session on Effelsberg, and training in the new radio astronomy data reduction package CASA. Some of these are specific sessions within a larger event (e.g. the annual Multi-Wave Astronomy schools which teach radio, X- and gamma-ray astronomy techniques for black holes research). These (especially the CASA schools) have also benefited from the web-based material accumulated from ERIS and other major events. Future contributions will also be made to a workshop on the exploitation of large surveys such as those using LOFAR and SKA pathfinders and to the training content of Spectrum Management events and/or sponsoring educational sessions at larger meetings.

The work package leaders have many years of experience in low- and high-frequency radio astronomy teaching, observations and research. Dr. Anita M. S. Richards (UMAN), formerly MERLIN archivist and now working for the UK ALMA Regional Centre, will continue to serve as the work package coordinator. Dr. Arancha Castro-Carrizo is a staff astronomer at IRAM, deeply involved in the mm interferometer operations and support. Dr. Silja Pohjolainen (U. Turku) covers the area of Solar training. Each will take the lead for the relevant events as well as contributing to overall coordination. The effectiveness and inclusiveness of training delivery will be improved by enlisting a panel of domain experts to advise on the content of workshops and which other events to support and to propose ways to widen participation. The panel will include the Science Working Group (WP3) coordinator, experts in facilitating inclusivity, and representatives from major projects like CASA, LOFAR and SKA, formalising the practice of delegating resource allocation to project experts.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.12
3	IRAM	0.00
6	UMAN	0.00
20	U. Turku	0.00
	Total	0.12

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D4.1	YERAC	6	0.01	O	PU	6
D4.2	Focussed events: Preparing for SKA Pathfinders	6	0.01	O	PU	7
D4.3	Sub/mm-wave ERIS	3	0.01	O	PU	9
D4.4	YERAC	6	0.01	O	PU	18
D4.5	Cm-wave ERIS	6	0.01	O	PU	21
D4.6	Single dish mm-wave school	3	0.01	O	PU	22
D4.7	YERAC	3	0.01	O	PU	30
D4.8	Solar Event	20	0.01	O	PU	33
D4.9	Sub/mm-wave ERIS	6	0.01	O	PU	34
D4.10	YERAC	6	0.01	O	PU	42
D4.11	Cm-wave ERIS	6	0.01	O	PU	45
D4.12	Single Dish mm-wave school	3	0.01	O	PU	46
		Total	0.12			

Description of deliverables

D4.1) YERAC: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 6]

D4.2) Focussed events: Preparing for SKA Pathfinders: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 7]

D4.3) Sub/mm-wave ERIS: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 9]

D4.4) YERAC: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 18]

D4.5) Cm-wave ERIS: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 21]

D4.6) Single dish mm-wave school: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 22]

D4.7) YERAC: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 30]

D4.8) Solar Event: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 33]

D4.9) Sub/mm-wave ERIS: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 34]

D4.10) YERAC: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 42]

D4.11) Cm-wave ERIS: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 45]

D4.12) Single Dish mm-wave school: The organisation of the events is the deliverable of this work package, in particular: - practical and financial support for training events - web-based or printed publication of training resources (lectures, tutorials, etc.) [month 46]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS19	Invite proposals for events to receive modest support	6	2	Web-based material
MS20	SOC, date/venue and announcements for major events	3	4	Report
MS21	Feedback from major and other events and lessons for future organisation	3	9	Report from the event
MS22	Accumulation of resources for learning new skills	3	10	Web-based material

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS23	Invite proposals for events to receive modest support	6	14	Web-based material
MS24	SOC, date/venue and announcements for major events	6	16	Report
MS25	Feedback from events and lessons for future organisation	6	22	Report from the event
MS26	Invite proposals for events to receive modest support	6	26	Web-based material
MS27	SOC, date/venue and announcements for major events	20	28	Report
MS28	Feedback from events and lessons for future organisation	20	34	Report from the event
MS29	Feedback from major and other events and lessons for future organisation	6	35	Report from the major event
MS30	Invite proposals for events to receive modest support	6	38	Web-based material
MS31	SOC, date/venue and announcements for major events	6	40	Report
MS32	Feedback from events and lessons for future organisation	6	46	Report from the event

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	COORD
Work package title	Mobility for ALMA Regional Centre Users (MARCUs)		
Start month	1		
End month	48		
Lead beneficiary number [55]	15		

Objectives

The ALMA Regional Centre (ARC) in Europe is a unique network of (sub-) millimetre astronomy centres of excellence, being established to support the European user community for the global Atacama Large Millimeter/Submillimeter Array (ALMA) being commissioned in Chile. This Networking Activity will structure and strengthen the European user community, by means of supporting user visits to the seven nodes of the European ARC network for European ALMA users. This will directly strengthen the burgeoning ALMA community, as well as the RadioNet3 community as a whole. Moreover, it will broaden the European access to ALMA science. Encouraging mobility of the community across Europe will disseminate knowledge and enable innovative research partnerships. ALMA is a new and powerful instrument that is eagerly awaited by many in the RadioNet3 community and the ARC structure offers an unparalleled opportunity for European collaboration, if an effective means of exchanging expertise can be guaranteed.

The ALMA ARC nodes are structured around providing face-to-face user support at all stages where help might be required, i.e. ALMA proposal and observation preparation, data reduction and archival research. This Network Activity will mobilize users who require this help but do not have access to a local ARC node or who require expertise that is only available at an ARC node different from their local one. This mobility will remove gaps in ALMA support within Europe, allow European astronomers to make optimal use of the ARC Network and make them more effective in an internationally competitive environment. This Network Activity will strengthen the user community by exchanging good practices and by providing direct access to data from the world’s main millimetre telescope, which is very much in the spirit of the RadioNet3 infrastructure capacities program. Note that ALMA is built and operated by a global collaboration (ESO for Europe), but that all astronomers will have a chance to submit successful proposals.

Description of work and role of partners

Within the European radio astronomy community, the European ALMA Regional Centre (ARC) is a unique network of (sub)-millimetre astronomy activity. The ARC consists of a network of nodes spread across Europe plus a central coordinating node at the ESO headquarters in Garching. Each of these ARC nodes is either closely associated with one of the main European radio astronomy facilities linked together through RadioNet3, or is a leading research institute in radio astronomy research. The primary method of strengthening this new user community is to support travel of European astronomers to these nodes. This travel will emphasize the ties between the existing radio community and the nodes, spread expertise among the nodes and enable innovative new research collaborations.

Task 1: The European ALMA Regional Centre [ESO, INAF, IRAM, UMAN, OSO]

The European ARC's main task is to form the interface between the ALMA observatory and the European user community. As such, the ARC provides critical services to the European user community. The ARC is the point of contact for European ALMA users throughout the lifetime of a project, i.e. from proposal preparation to data analysis. One of the ARC's critical services, the face-to-face user support, is not implemented at the ESO headquarters, but at the ARC nodes. This service is coordinated by ESO.

There are currently seven ARC nodes in Europe:

1) Italian (Bologna; Representative: Jan Brand)

2) Bonn-Bochum-Cologne (Bonn; Representative: Frank Bertoldi)
3) IRAM (Grenoble; Representative: Frédéric Gueth)
4) Allegro (Leiden; Representative: Michiel Hogerheijde)
5) U.K. (Manchester; Representative: Tom Muxlow)
6) Nordic (Onsala; Representative: John Conway)
7) Czech (Ondřejov; Representative: Marian Karlicky)

Requests for face-to-face support will normally be received via the ALMA Helpdesk. Together with the user and the ARC nodes, details of the visits will be worked out. Each visitor to an ARC node is provided with appropriate computing facilities and is assigned a staff member for support purposes. After a visit, the user will be invited to submit feedback on the service received and whether the goals of the visit were met. In this way the nodes will accumulate the experiences of the users, especially in areas that require specialized knowledge or methods.

ARC nodes provide face-to-face support at the proposal preparation stage if the proposal and/or the observing program are particularly complicated. Furthermore, they provide archival research face-to-face support in order to ensure that the archive (and ALMA) is exploited to its full potential. However, it is expected that most requests for face-to-face user support be for expert help with data reduction.

Task 2: Implementation of this activity [ESO, INAF, IRAM, UMAN, OSO]

The way this activity is strengthening the user community is by supporting two types of visits to European ARC nodes for which there are currently no supported provisions:

• Most ARC node visits will be made to a user's local node. However, currently, users from Austria, Belgium, Portugal, and Switzerland, in addition to European users from non-ESO member states (e.g. Ireland, Poland to name a few) do not have direct access to a local ARC node. The first aim of this activity is to support users from all European countries to travel to an ARC node to use its services.

• Whereas all nodes will provide some level of face-to-face support, there are a number of areas in which individual nodes have particular expertise and so specialise in (e.g. solar observations, very high frequencies, polarization, mosaicking, high-dynamic-range imaging, etc.). If specialist support can only be (or better) provided at another node, it will be appropriate for users from a different region to travel in order to take advantage of this.

• Exchange of best practice. This NA will stimulate the ALMA expert centres to establish best practices and exchange the latest insights in data processing and observation preparation.

Task 3: Impact on the RadioNet3 community [ESO, INAF, IRAM, UMAN, OSO]

By structuring the mobility of the ALMA face-to-face support, direct benefits to the RadioNet3 community at large will be anticipated. As many ARC nodes are based close to other RadioNet3 facilities (for example, the UK ARC node at the Jodrell Bank Centre for Astrophysics in Manchester), visits to the nodes by ALMA users will therefore foster exchanges with other radio-astronomy scientists in the following ways:

• Through interaction with local staff during data analysis. Data processing methods are of common interest to all branches of radio astronomy, particularly with a view to the SKA.

Also, as all ALMA data reduction will be done in CASA, this will give these institutes greater experience with new software tools.

• During talks and seminars given by astronomers visiting the ARC nodes, there will be an opportunity to interact on science topics.

• Through the forming of collaborations, not only on science topics but also for the development of new observing opportunities through instrument development, for example the use of ALMA for VLBI (see the JRAs: AETHER & DIVA)

• Via the updating of the global ALMA Knowledge Base repository in the ALMA Helpdesk. All lessons learned from visits to ARC nodes will be included in this database, which will be widely accessible to registered astronomers.

Each user requiring support will apply to the central ARC at ESO to have the support approved and plan the trip, in coordination with the ARC node they wish to visit. An average of 10-12 trips per year to one of the ARC nodes in Bonn, Bologna, Grenoble, Leiden, Manchester, Ondřejov, and Onsala will be supported. Users that travel to the nodes will be requested to provide feedback (using standardized forms) to ESO, which will be used to monitor and improve the quality of the face-to-face support.

Another direct outcome of this activity will be the publications based on observations prepared and analysed during face-to-face support visits to the ARC nodes. A list of publications that benefited directly from support received through this activity will be maintained.

In addition to the direct outcome of the ARC node visits, there is the additional commitment to regularly update the ‘User Guide to the European ARC’ under this activity; this will be implemented through existing resources in the European ARC.

The overall administration and interface to the RadioNet3 management will be implemented at ESO in Garching (DE) by Martin Zwaan and Paola Andreani.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.04
15	ESO	0.00
	Total	0.04

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D5.1	Updated versions of the 'User Guide to the European ARC'	15	0.01	R	PU	12
D5.2	This user guide is the standard introduction into the services provided by the European ARC structur	15	0.01	R	PU	24
D5.3	This user guide is the standard introduction into the services provided by the European ARC structur	15	0.01	R	PU	36
D5.4	This user guide is the standard introduction into the services provided by the European ARC structur	15	0.01	R	PU	48
		Total	0.04			

Description of deliverables

D5.1) Updated versions of the 'User Guide to the European ARC': This user guide is the standard introduction into the services provided by the European ARC structure. It is available to all ALMA users through the ALMA Science Portal. Any changes in the characteristics of the ARC nodes will need to be reflected in the guide. [month 12]

D5.2) This user guide is the standard introduction into the services provided by the European ARC structur: This user guide is the standard introduction into the services provided by the European ARC structure. It is available to all ALMA users through the ALMA Science Portal. Any changes in the characteristics of the ARC nodes will need to be reflected in the guide. [month 24]

D5.3) This user guide is the standard introduction into the services provided by the European ARC structur: This user guide is the standard introduction into the services provided by the European ARC structure. It is available to all ALMA users through the ALMA Science Portal. Any changes in the characteristics of the ARC nodes will need to be reflected in the guide. [month 36]

D5.4) This user guide is the standard introduction into the services provided by the European ARC structur: This user guide is the standard introduction into the services provided by the European ARC structure. It is available to all ALMA users through the ALMA Science Portal. Any changes in the characteristics of the ARC nodes will need to be reflected in the guide. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS33	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	15	9	Minutes from the meeting
MS34	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	15	21	Minutes from the meeting
MS35	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	15	33	Minutes from the meeting
MS36	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	15	45	Minutes from the meeting

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	COORD
Work package title	European Radio Astronomy Technical Forum (ERATec)		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

The communication, training and scientific interaction between engineers and scientists involved in the development and operation of radio-astronomical instruments represents a key issue in keeping these facilities at a world-class technical level. While several opportunities for dissemination and training are possible for radio astronomers and are well established in the scientific community, technical and operational staff is de facto limited to minor interactions. ERATec will foster, strengthen and extend the collaboration between the groups working on the development and operation of radio astronomical instruments. It will also address scientists whose work is closely related to the telescopes and instrumentation to collect qualified input for developing instrumentation, which better matches the scientific demand. In practice, those scientists will be the “Friends of the Telescope”, support scientists and any other scientist involved in radio-astronomical instrumentation and their application to daily procedures at the observatories. Thus the suite of engineering workshops and TOG meetings will also include the astronomers in charge of local user support.

The direct contact between these groups will ensure a first-hand and immediate transfer of views and expertise, which will improve the information and feedback chains between the developer and user communities. Together with the more operation-oriented TOG and the non-VLBI “operators” the dissemination of knowledge in the community and the communication will be improved which will close the gap between scientific and technical staff at the partner institutes and will lead to enhance synergistic effects also between the partner institutes

Description of work and role of partners

The main activity of the RadioNet3 European Radio Astronomy Technical Forum will be to organise and support meetings and workshops of European radio astronomical staff, directly involved in the technical development of the observing facilities and their application.

These meetings will help to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. In short, this activity aims at preventing each observatory from 'reinventing the wheel' for all the problems encountered in the rapidly evolving context of modern radio astronomy, which now includes LOFAR, ALMA and the precursors and pathfinders of the SKA.
Furthermore, the training of young people will also form a crucial part of the work programme as well as the dissemination of expertise in special sessions at large international conferences.

The forum will maintain and update a series of web pages in the appropriate section of the RadioNet3 web/wiki sites. These pages will be the central reference location for calls for contributions, technical material and meeting registration and event announcements. This work package will be led by staff from the MPG (R. Keller & W. Alef) and INAF (K.-H. Mack).

Task 1: Topic-related Technical Workshops [MPG, INAF, RadioNet3 partners]

The major objective of this task is to further strengthen the collaboration between the groups active in the development and operation of radio astronomical instruments at the European level, providing a solid and formal ground for mutual growth, collaboration and support. With limited local manpower and a limited range of expertise at most observatories, close cooperation among engineers is essential. A general aim is to build collaborations and mutual support structures on a European scale that will help to avoid duplication of efforts, and will permit expertise to be shared freely across the RadioNet3 institutes. ERATec will provide a platform for this purpose and its activities are heavily focused on improving the data quality of current radio telescopes in Europe, in particular those of the Transnational Access facilities offered under this proposal.

More specifically, the objectives of this activity are to:
• Identify and collect the needs of the scientific community to find optimal specifications for instruments to be developed.
• Identify key technical issues and directions, in order to provide appropriate solutions or to propose collaborative projects in particular areas of technological development.
• Train the next generation of radio astronomical engineers or “operators” by means of short courses and lectures given by experts in the specific field.
• Foster collaborations, establish communication and synergies between system scientists, operational scientists and engineers across Europe and beyond.
• Strengthen international collaboration in bilateral and multilateral projects not only restricted to Europe.
• Strengthen and ease the interaction with industrial entities, with the two-fold objective of commercially capitalising the remarkable technical know-how and to have affordable and reliable partners for the development of future large-scale instrumentation.

Sub-task 1.1: Technical Workshops [INAF, RadioNet3 partners]

Forum participants will meet at least once per year for one or two days in the framework of a technical workshop (TWS) to which the TOG members will be also invited. Furthermore there will be up to three additional one-day TWS workshops distributed over the NA’s duration of 4 years. The technical meetings (workshops) will be topical ones, and the themes will be selected and planned on a yearly basis by a steering committee.

An appropriate call for contributions will be published on the forum pages and the prospective contributors will upload presentation material to be accessible in advance to every meeting participant. In any case, each meeting will be organized in a way to provide sufficient time both for formal presentation of high-level achievements and informal discussions on details of the work or future planning. The meetings will preferably be hosted by one of the participating institutions, which, in conjunction with the event, may describe its own technical facilities and achievements. The chairman of each meeting will be responsible for providing a report including:

• Meeting Agenda,
• Material from the formal presentations,
• List of participants,
• Summary of the meeting.

Subtask 1.2: European Radio Astronomy Engineering Special Sessions [MPG, RadioNet3 partners]

In order to bring the engineering results and expertise of the European radio astronomical engineers to the attention of the broader engineering community, special sessions will be organised within the framework of existing workshop suites or large international conferences (e.g. IEEE conferences, European Microwave Week etc.). The objective will be to exchange ideas and new directions, and to attract the interest of researchers in related fields to collaborate in the development of radio astronomical applications.

Task 2: EVN Technical Operation Group (TOG) [MPG, RadioNet3 partners]

The European VLBI Network (EVN), Technical & Operations Group (TOG) and its meetings represent the main basis on which other engineering collaborations have been built (e.g. SKADS), and they form the foundation for the successful operation of the EVN. Due to the nature of VLBI a high level of standardisation in observing and data handling is required at each station.

The TOG meetings will take place every 8 months (including meetings in the framework of the integrated workshops (sub-task 1.1). They will provide an element of training and development, targeting topical subjects of direct relevance to VLBI operations and thus the quality of the data the EVN delivers to the users. The main activities will include:
• Meeting Agenda; List of Participants,
• A programme of bi-annual lectures and practical demonstrations by the EVN TOG,
• Progress reports from EVN stations, correlators and other VLBI related institutions,
• Minutes of the meetings and material from the formal presentations,

• Action item list, to be pursued between meetings.

Members of the European Radio Astronomy Technical Forum will include operators, engineers and scientists from RadioNet3 partners, as well as experts from European and international academic institutions engaged in the development of radio-astronomical instrumentation, and representatives from selected industrial entities.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.00
4	INAF	4.00
	Total	4.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D6.1	Report from the TWS Workshop 1	4	0.50	R	PU	7
D6.2	Report from the TOG Meeting 1	1	0.01	R	PU	11
D6.3	Report from the TWS Workshop 2	4	0.50	R	PU	19
D6.4	Report from the TOG Meeting 2	1	0.01	R	PU	27
D6.5	Report from the TWS Workshop 3	4	0.50	R	PU	35
D6.6	Report from the TOG Meeting 3	1	0.01	R	PU	43
D6.7	Report from the TWS Workshop 4	4	0.50	R	PU	47
		Total	2.03			

Description of deliverables

D6.1) Report from the TWS Workshop 1: Report from the meeting in order to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. [month 7]

D6.2) Report from the TOG Meeting 1: Reports will include additionally the progress reports from EVN-stations, correlators and other VLBI related institutes, summary of the meeting and material from the formal presentations. [month 11]

D6.3) Report from the TWS Workshop 2: Report from the meeting in order to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. [month 19]

D6.4) Report from the TOG Meeting 2: Reports will include additionally the progress reports from EVN-stations, correlators and other VLBI related institutes, summary of the meeting and material from the formal presentations. [month 27]

D6.5) Report from the TWS Workshop 3: Report from the meeting in order to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. [month 35]

D6.6) Report from the TOG Meeting 3: Reports will include additionally the progress reports from EVN-stations, correlators and other VLBI related institutes, summary of the meeting and material from the formal presentations. [month 43]

D6.7) Report from the TWS Workshop 4: Report from the meeting in order to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. [month 47]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS37	TWS Workshop 1	4	5	Meeting web-page
MS38	TOG Meeting 1	1	9	Meeting web-page
MS39	TWS Workshop 2	4	17	Meeting web-page
MS40	TOG Meeting 2	1	25	Meeting web-page
MS41	TWS Workshop 3	4	33	Meeting web-page
MS42	TOG Meeting 3	1	41	Meeting web-page
MS43	TWS Workshop 4	4	45	Meeting web-page

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP7	Type of activity [54]	COORD
Work package title	Radio Astronomical Spectrum Management		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

The main objective of the Radio Astronomical Spectrum Management is to keep the radio astronomy frequency bands free of man-made interference in order to safe-guard this environment for fundamental astronomical research. The broad aims of the activity centre on coordinating activities designed to protect the electro-magnetic spectrum for passive radio astronomy observations. The radio astronomy community is at a significant disadvantage in pursuing this objective because it brings it into conflict with commercial and often government and EC interests, whose goals are largely motivated by profit, and that can call on legal, technical and PR resources that inevitably dwarf the efforts of our own community.

The specific objectives of this WP are:
• Ensure access and availability of the radio spectrum for scientific needs.
• Keep the available frequency bands of radio astronomical interest free from interference.
• Support the scientific community in their needs for passive use of interference free bands of interest.
• Represent all the EU and African (ITU Region 1) radio astronomy observatories, in decision-making consultations and/or meetings that deal with future access of the radio spectrum to fundamental research.

Description of work and role of partners

Task 1 Support of CRAF committee meetings [MPG, RadioNet3 partners]

Radio astronomers in Europe formed the Committee on Radio Astronomy Frequencies (CRAF) in 1988, to represent radio astronomical interests on national, European and global levels and to explain the very special and stringent requirements of scientific spectrum use to regulatory authorities. CRAF is an Expert Committee of the ESF and its members are delegated from radio observatories in 20 countries in Europe, but also from South Africa and the SKA as well as the European Space Agency (ESA), the International VLBI Service for Geodesy and Astrometry (IVS), the Institut de Radio Astronomie Millimétrique (IRAM) and the European Incoherent Scatter Scientific Association (EISCAT). CRAF holds up to two meetings per year where members inform each other about current interference problems, their interactions with national administrations and anticipated developments related to scientific spectrum use in their country. A coordinated strategy to address current and future problems is developed at the meeting and members give each other support in the solution of daily interference problems. Representatives from similar committees such as CORF (ITU Region 2: US and South America), RAFCAP (Asia-Pacific), EUMETNET (European meteorology and earth sensing) and the European Commission are frequently attending CRAF meetings as guests

Task 2 Support of the participation of CRAF members on international committees (ITU, ECC) [MPG, RadioNet3 partners]

On the global level the World Radio Conference in 2012 (WRC-12) in Geneva will take far reaching and legally binding decisions on the allocation and use of radio spectrum for all services, including radio astronomy.
The Study Group 7 of the ITU (SG7) prepares submissions to WRC and has four subsections dealing with: 1 Systems for space operation, space research, Earth exploration and meteorology; 2 Systems for remote sensing, including passive and active sensing systems, operating on both ground-based and space-based platforms; 3 Radio astronomy and radar astronomy; 4 Dissemination, reception and coordination of standard-frequency and time-signal services on a worldwide basis. CRAF members are needed there to give evidence on the requirements of radio astronomy and the impact of proposed decisions by administrations.

Usually there are four ITU-SG7 meetings per year where CRAF members ought to attend. The European Electronic Communications Committee (ECC) makes binding decision on European spectrum policy and use. There are at least seven committees, meeting two to three times a year, where matters relating to scientific use of radio spectrum are discussed and where radio astronomers from CRAF are requested to provide expert advice on the impact of a all kind of radio devices, ranging from high-powered radars and satellites to mass deployment of low powered ultra-wideband (UWB) devices or automotive short-range radars.

The visibility of CRAF at both the national and international level is crucial. The fundamental research can only then compete with steadily expanding demands on new frequencies from governments and the commercial firms. CRAF members actively lobby their own National Telecommunication Administration in order to raise enough votes to place issues and concerns of our community on the agenda of the appropriate international forums (such as meetings of the Conférence Européenne des Postes et des Télécommunications, CEPT, and the World Radio Conference of the International Telecommunication Union). If CRAF and the other international radio astronomy spectrum protection groups are not present at these meetings, the interests of the radio astronomy community will be ignored.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.04
2	ASTRON	0.00
3	IRAM	0.00
4	INAF	0.00
6	UMAN	0.00
7	OSO	0.00
8	UCAM	0.00
11	OBSPARIS	0.00
13	UAH	0.00
	Total	0.04

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D7.1	Report from CRAF meeting 1	1	0.01	R	PU	10
D7.2	Report from CRAF meeting 2	1	0.01	R	PU	22
D7.3	Report from CRAF meeting 3	1	0.01	R	PU	34
D7.4	Report from CRAF meeting 4	1	0.01	R	PU	46
		Total	0.04			

Description of deliverables

D7.1) Report from CRAF meeting 1: Reports (Minutes) from CRAF meetings and from the international meetings attended by CRAF members. [month 10]

D7.2) Report from CRAF meeting 2: Reports (Minutes) from CRAF meetings and from the international meetings attended by CRAF members. [month 22]

D7.3) Report from CRAF meeting 3: Reports (Minutes) from CRAF meetings and from the international meetings attended by CRAF members. [month 34]

D7.4) Report from CRAF meeting 4: Reports (Minutes) from CRAF meetings and from the international meetings attended by CRAF members. [month 46]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS44	CRAF Meeting No. 1	1	8	Meeting web-page
MS45	CRAF Meeting No. 2	1	20	Meeting web-page
MS46	CRAF Meeting No. 3	1	32	Meeting web-page
MS47	CRAF Meeting No. 4	1	44	Meeting web-page

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP8	Type of activity [54]	RTD
Work package title	UniBoard2		
Start month	7		
End month	42		
Lead beneficiary number [55]	5		

Objectives

UniBoard2 will create an FPGA-based, generic, scalable, high-performance computing platform for radio-astronomical applications. This WP consolidates and builds upon the experience obtained through the UniBoard project to create a completely re-designed platform with several innovative features, that will be ready for the next generation of astronomical instruments (notably the SKA), at the end of 2015.

Power efficiency is going to be a crucial issue for future instrumentation. For this platform the newest technology available on the timescale of the project will be used, which means replacing the current 40 nm with 28 nm or even 20 nm FPGAs. The use of a technique offered by FPGA manufacturers under names such as HardCopy or EasyPath will be investigate. This enables one to develop on standard FPGAs and then to freeze the design into ASICs with the same footprint. While a full-blown hard-copy production run is not feasible due to the high initial cost involved, UniBoard2 will design the applications with hard copy in mind, and run extensive simulations to determine its effect on power consumption. Further “green” measures will include the use of non-leaded components, the careful balancing of system parameters and performance and the optimisation of firmware designs and algorithms.

Currently, firmware is shared among partners through a common repository. Part of the effort in UniBoard2 will deal with formalizing the exchange mechanism through the definition of coding conventions and common interfaces, in order to optimize the re-use and the combination of available blocks of firmware among developers.

Description of work and role of partners

Task 1 Common functionality [ASTRON, JIVE]

Subtask 1.1 Hardware [ASTRON]
This part of the package will be the responsibility of ASTRON. The main activity will be the design and layout of the board. Although this project is in a sense a continuation of RadioNet2 UniBoard, the board will not be a simple re-spin with different FPGAs but a complete re-design, with a strong focus on environmental issues

Subtask 1.2 Testfirmware and standardisation [ASTRON, JIVE]
Testing the hardware requires the creation of a suite of specialized firmware. ASTRON and JIVE engineers will write firmware to test all interfaces and high-speed mesh, carry out the hardware tests and distribute the test programmes along with the hardware to the project partners.
Another part of this package concerns re-usability and standardisation, something often advertised but seldom achieved. In concert with the project partners a set of coding conventions and interface standards will be defined, to help optimise the re-use of blocks of code, and facilitate new developments.

Subtask 1.3 Control code [JIVE]
Low-level control code, needed to communicate with the board, will be developed by JIVE engineers on and off throughout the project, following the demands posed by the development of the various applications.

Task 2 Correlator [JIVE, UMAN]

This task will create a single-board all-station correlator. The main functionality of this application will be implemented by JIVE, while the pulsar binning/gating capability of the correlator, needed for pulsar astrometry, will be developed at the University of Manchester. Part of the effort at UMAN will focus on porting the pulsar timing and searching algorithms, developed in the current UniBoard project, to the new platform.

Task 3 Digital receiver [INAF, BORD, UORL]

INAF and the University of Bordeaux will develop the digital receiver application. In this mode, the board is used as a Digital Base Band Converter, which converts a wide input bandwidth into a variable number of data streams, which can then be further processed by a correlator, a spectrometer or pulsar processor. As a sub-package to the digital receiver, RFI mitigation algorithms will be developed and implemented by the University of Orleans.

Task 4 Beam former [MPG]

Scientific exploitation of the next generation of radio telescopes will be enabled by phased array feeds installed in the foci of telescope dishes. MPG will develop a system that will utilize the UniBoard2 hardware as a beam forming system. The aim is to derive a generic, modular design that is capable of providing a beam forming solution for a variety of front ends and telescope applications. In particular, the aim is to derive a prototype to be deployed at the 100-m telescope in Effelsberg to serve as test bed.

The overall project management will be done by JIVE; the day-to-day management of the individual packages will be the responsibility of ASTRON (hardware), JIVE (correlator), INAF (digital receiver) and MPG (beam former). The pulsar binning and RFI mitigation sub-packages, as well as the beam former work package will have fairly flexible timelines, enabling them to take full advantage of the developments in the other packages.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	11.50
2	ASTRON	24.70
4	INAF	19.00
5	JIVE	30.40
6	UMAN	9.50
17	BORD	11.40
18	UORL	9.50
	Total	116.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.1	Document on definition of coding interfaces and conventions	5	2.00	R	PU	9
D8.2	Hardware design document	2	8.00	R	PU	17
D8.3	Firmware design document: correlator	5	13.00	R	PU	17
D8.4	Firmware design document: digital receiver	4	13.40	R	PU	17

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.5	Firmware design document beam former	1	4.50	R	PU	17
D8.6	Firmware design document: pulsar binning	6	9.50	R	PU	20
D8.7	Firmware design document: RFI mitigation	18	9.50	R	PU	20
D8.8	Prototype Hardware	2	5.00	P	RE	23
D8.9	Revised hardware design document	2	8.00	R	PU	29
D8.10	Production hardware	2	2.70	P	RE	31
D8.11	Revised firmware design document: correlator	5	10.40	R	PU	33
D8.12	Revised firmware design document: digital receiver	4	11.00	R	PU	33
D8.13	Revised firmware design document: beam former	1	4.00	R	PU	33
D8.14	Report on effectiveness of green measures: correlator	5	6.00	R	PU	42
D8.15	Report on effectiveness of green measures: digital receiver	4	6.00	R	PU	42
D8.16	Report on effectiveness of green measures: beam former	1	3.00	R	PU	42
		Total	116.00			

Description of deliverables

D8.1) Document on definition of coding interfaces and conventions: Document on definition of coding interfaces and conventions. [month 9]

D8.2) Hardware design document: Hardware design document [month 17]

D8.3) Firmware design document: correlator: Firmware design document: correlator [month 17]

D8.4) Firmware design document: digital receiver: Firmware design document: digital receiver [month 17]

D8.5) Firmware design document beam former: Firmware design document beam former [month 17]

D8.6) Firmware design document: pulsar binning: Firmware design document: pulsar binning [month 20]

D8.7) Firmware design document: RFI mitigation: Firmware design document: RFI mitigation [month 20]

D8.8) Prototype Hardware: Prototype Hardware [month 23]

D8.9) Revised hardware design document: Revised hardware design document [month 29]

D8.10) Production hardware: Production hardware [month 31]

D8.11) Revised firmware design document: correlator: Revised firmware design document: correlator [month 33]

D8.12) Revised firmware design document: digital receiver: Revised firmware design document: digital receiver [month 33]

D8.13) Revised firmware design document: beam former: Revised firmware design document: beam former [month 33]

D8.14) Report on effectiveness of green measures: correlator: Report on effectiveness of green measures: correlator [month 42]

D8.15) Report on effectiveness of green measures: digital receiver: Report on effectiveness of green measures: digital receiver [month 42]

D8.16) Report on effectiveness of green measures: beam former: Report on effectiveness of green measures: beam former [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS48	Completed hardware design	2	11	Design document
MS49	Completed correlator firmware design	5	11	Design document
MS50	Completed digital receiver firmware design	4	11	Design document
MS51	Completed beam former firmware design	1	11	Design document
MS52	Completed pulsar binning firmware design	6	14	Design document
MS53	Completed RFI mitigation firmware design	18	14	Design document
MS54	Prototype hardware	2	27	Prototype

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP9	Type of activity [54]	RTD
Work package title	Advanced European Terahertz HEterodyne Receivers (AETHER)		
Start month	7		
End month	42		
Lead beneficiary number [55]	3		

Objectives

ALMA will produce a quantum leap forward with respect to existing ground based mm and sub-mm wave telescopes in terms of both spatial resolution and sensitivity. However, powerful as it is, the current ALMA project does not take full advantage of its vast size and excellent site location, due to time and budget constraints. The most critical technologies, those which concern front-end receivers, were frozen at a relatively early stage in the project development. Thus, there exists considerable opportunity for future enhancement of the array capability in terms of performance and, correspondingly, in science output. ALMA will also require the backup of existing large mm and sub-mm telescopes for complementary observations for which it is not optimized (e.g. for large scale mapping). The performance of those needs to be enhanced.

The AETHER consortium, containing Europe's foremost mm-wave instrumentation development laboratories, is ready to meet this challenge. Several consortium laboratories have played a leading role in the development and construction of the current ALMA receivers and consequently possess considerable relevant heritage and experience. All consortium members are pursuing, under the auspices of RadioNet, a broad mm and sub-mm wave (terahertz) detector development programme that has made a very significant contribution towards maintaining European mm/sub-mm wave research at the highest level in this critical area and that has contributed towards the improved performance of European mm/sub-mm telescopes, such as the IRAM 30-m telescope, PdBI and APEX.
The primary objective will be to develop a new generation of instrumentation to significantly extend the performance and scope of ALMA and of large existing European mm/sub-mm facilities in terms of operational frequency and sensitivity, thereby advancing ALMA science. Achievement of the objective will ensure that Europe is placed on an equal competitive footing with North America and East Asia with respect to securing future ALMA enhancement funding, and more generally will maintain the global position of the European mm and sub-mm wave community in terms of technical and scientific leadership.

AETHER will develop innovative heterodyne detectors and devices that yield a maximum gain sensitivity, bandwidth – including operation to beyond 1 THz – and mapping speed for ALMA. These developments will simultaneously enhance the performance of the large European mm/sub-mm observatory facilities, raising them to a position where they truly complement ALMA in terms of scientific return.

Description of work and role of partners

Four specific topics for development that cover the full span of frequencies observable from the ALMA site, Chajnantor have been identified. They are, by order of increasing frequency:

Task 1: 67-116 GHz extremely wide RF-band heterodyne module

Develop a single detector possessing a much larger IF bandwidth than the current ALMA Band 3 cartridge. At present, the 67-84 GHz part is not accessible by ALMA, but it contains the fundamental transition of key deuterated species (DCO+, DCN, DNC), as well as the strongest CO lines of quasars with redshift >5. The technology focus will be HEMT MMICs, with SIS mixer receiver as an alternative. Task 1 will continue the exploration of Fraunhofer IAF's metamorphic HEMT process on GaAs. Technology demonstrator will be an extremely large bandwidth heterodyne receiver module (67-116 GHz) competitive to the current InP-based HEMT technology. IAF's expertise in integration of solid-state circuits offers the capability within Europe to build large, highly integrated mm-wavelength focal plane array (FPA) receivers using MMIC's. In comparison to the

InP based technology, IAF's process could offer lower cost, especially for large area MMIC's integrating many building blocks on a single chip. The active participation of IAF researchers to the development of the cooled W-band HEMT LNA's is a key factor for achieving the best noise figures. Achieving the targeted bandwidth will be a major challenge. Verification of the hardware will include lab tests of a prototype pixel module suitable for assembly of arrays and a dedicated test effort at the IRAM 30-m telescope.

Subtask 1.1:Cryogenic characterization of single HEMT devices and design of cryogenic MMIC's [MPG, Fraunhofer, UAH, IRAM].
Measurement capabilities used for device characterization in AMSTAR+ will be extended to update the cryogenic MMIC model to the 67-116 GHz band. In parallel cryogenic characterization of the entire MMIC LNA will be carried out in prompt response to the production runs at all participating laboratories. This allows an evaluation of the entire design process (HEMT model plus circuit design) based on a large statistics of cryogenic data. MMIC design candidates for W-band include the current IAF cascode - and a single ended LNA design. Design of the 4-12GHz IF amplifier will build on a successful current design.

Subtask 1.2: Manufacturing runs of MMIC's in IAF's clean room [Fraunhofer].
There will be a minimum of 2 runs in 2011 and 2012 using space on IAF wafers dedicated for cryogenic device fabrication (min. 40% of reticle area per run). There will be shared wafer space available on IAF's current process for room temperature devices (min. of 2 runs min. 9% of reticle area per run). The latter wafer space is intended for realization of structures for noise testing of the devices.

Subtask 1.3: Design iteration of wideband OMT and heterodyne modules (pixels) [INAF, IRAM, MPG].
Heterodyne modules that constitute a single FPA pixel will be designed that contain 2 linearly polarized RF-channels per module and a compact waveguide OMT.

Subtask 1.4: Module tests [IRAM, MPG].
An IRAM array test cryostat will be constructed and used to evaluate a single pixel dual-polarization module with full band coverage. Final demonstration will be carried out at the IRAM 30m telescope.

Task 2: Highly integrated and miniaturized 2SB SIS receivers for λ~1 mm FPAs

Develop, build and test a 7-pixel prototype of a large sideband separating (2SB) SIS mixer FPA receiver. The prototype will operate near 1 mm wavelength, have a large tuning range, a very low noise and a high image rejection. The IF bandwidth will be 8 GHz. The 1 mm band is optimal for studying the emission from cold interstellar dust and molecules. The new detectors will at least double or quadruple the instantaneous bandwidth in comparison with the current IRAM Band 3&4 receivers or the ALMA Band 7 receivers. They will be small enough to be configured as dense pixel focal plane arrays (FPAs). Deployment of FPAs would greatly increase the mapping speed of the ALMA single-dish antennas, as well as the IRAM 30-m and APEX telescopes. In the long term, they could be used in interferometric mode on PdBI and ALMA.

Subtask 2.1: Feed horn array [UOXF].
Design and fabricate a broadband smooth-walled horn as well as a corrugated horn. Design, fabricate, and test a 7-pixel feed array using the most suitable of both designs.

Subtask 2.2: IF hybrid [OSO].
Design, build, and test an IF coupler chip for 4-12 GHz with low gain and phase imbalance for operation at cryogenic temperatures and to be integrated with the SIS mixers. Fabricate 7 coupler chips for the 7-pixel array.

Subtask 2.3: IF amplifier [UAH].
Evaluation of existent technology: comparison of MMICs and discrete devices. Based on this evaluation develop, build and test a prototype of a cryogenic IF amplifier with low input reflection and simplified biasing scheme. Fabricate IF amplifiers for the 7-pixel array.

Subtask 2.4: 2SB mixer array [IRAM].
Design, build, and test a 7-pixel sideband-separating mixer array operating near 1mm wavelength with low noise, ~10 dB image rejection, and 8 GHz IF bandwidth. The operational range will be ~30% of the central RF frequency.

Subtask 2.5: LO [STFC].
Evaluation of photonic LO developed within AMSTAR+. Based on this evaluation investigate the provision of a photonic LO source for the 7-pixel array.

Subtask 2.6: Integration and test [IRAM].
Integration of all components and test of the 7-pixel prototype.

Task 3: Sub-millimetre Wave 2SB SIS Mixers

Explore practical solutions for the construction of compact, low noise, wide IF bandwidth 2SB mixers operating at sub-mm wavelengths, in particular in the 800-950 GHz atmospheric window (ALMA Band 10). This should drastically improve the instantaneous bandwidth and sensitivity of APEX and ALMA, in the highest frequency atmospheric windows -- windows so far largely unexplored. Modular and compact 2SB or balanced mixer designs will be developed suitable for integration into focal plane arrays. Modular and compact IF system solutions will be developed within this task, as well as novel technological solutions to fabricate SIS junctions suitable for ALMA band 10. The grand challenge is to extend 2SB/balanced mixer technology into ALMA band 10. The work is orgznized in three subtasks:

Subtask 3.1: 2SB SIS Mixer for sub-mm wavelengths [SRON, TUD, OSO, UAH].
So far the only SIS mixers built for operation in the 800-950 GHz band were DSB mixers. More advanced mixer layouts (compact single-ended, sideband-separating, balanced) will be developed for this band. Different mixer micro-machining fabrication techniques of the different components will be investigated.

Subtask 3.2: Compact IF system [SRON, OSO, UAH].
Develop compact versions of IF amplifiers and matching schemes avoiding isolators suitable for large FPAs. Investigate compact superconducting hybrid technologies integrable into the mixer blocks.

Subtask 3.3: Mixer technology development [SRON, TUD].
For sub-mm frequencies, novel SIS junction technology and materials need to be investigated and developed. This includes NbTiN/SiO2/Al and normal metal tuning structures, epitaxial metal layers, and high critical temperature materials (e.g. NbN, NbTiN). New junction barriers will be explored for these high frequencies. Fabricated junctions and structures will be used in subtask 3.1.

Task 4: Supra-THz Heterodyne Receivers operating in the highest atmospheric windows

Explore and develop technical solutions that will support the construction of a heterodyne receiver operating in the highest atmospheric windows accessible from the best ground sites (1.36 THz and 1.5 THz). Such a receiver will be suitable for use on APEX and ALMA (Band 11); it will enhance the scientific capability of these telescopes in a largely unexplored spectral domain. Key receiver devices such as low noise, wide IF-bandwidth mixers, SIS tunnel junctions and HEB devices will be developed and fabricated. The frequency multiplier technology required for a suitable local oscillator (LO) source will also be developed. The construction of those devices will require careful design and simulation, and use of ultra-high precision micro-machining techniques. The AETHER consortium possesses the expertise and facilities requested for this challenging work, in particular the system design and simulation software, the device fabrication facilities, high-precision mechanical fabrication workshops, and THz test and measurement systems.

Subtask 4.1: Review of Band 11 system specifications and related technology [UOXF, UCAM, OBSPAR, STFC, ESO].
Review the receiver system and technology in terms of the anticipated science requirements for both ALMA and APEX. This will include, for example, system noise, polarization, stability etc. This review process will ensure that the Band 11 technical development strategy is aligned with both science and future operational needs.

Subtask 4.2: Development and fabrication of devices for mixers [UCAM, UCO, STFC, OBSPAR, TUD].
Develop devices that yield high performance above 1 THz. In the case of SIS mixers, this means high current density devices in conjunction with low loss transmission lines. For HEB devices, inovative routes will be developed to increase the IF bandwidth and reproducibility of fabrication. Schottky diode technology has recently demonstrated considerable improvement in sensitivity beyond 1 THz. The suitability of Schottky diode mixers for use on ALMA will therefore also be explored.

Subtask 4.3: Development of SIS mixers above 1 THZ [UOXF, UCAM, UCO, OSO].
Perform full electromagnetic and quantum simulations of the mixer chip. Explore designs that require low LO power by optimising coupling. Develop ultra-precision fabrication and assembly technology for mixer block and feed fabrication. Fabricate mixer and perform tests to optimise mixer performance, e.g., coupling with the IF.

Subtask 4.4: Development High performance Hot Electron Bolometer mixers [OSO, SRON, OBSPAR, TUD].

Investigate various HEB designs and configurations for best performance. This includes quasi-optical design, membrane substrate HEB and waveguide HEB mixer. The task shall investigate ways to unify SIS and HEB mixer components such as antenna coupling and mixer blocks.

Subtask 4.5: Development of Local Oscillator Sources for THz Mixers [STFC, OBSPAR].
Develop the conceptual design of, and broadbanding of key components (i.e. frequency multipliers) for a local oscillator system suitable for use with the Band 11 receiver. Waveguide-Schottky diode structures will be investigated and simulated and a broadband multiplier chain fabricated and tested.

A Task Leader will coordinate the work in each Task (Task 1: F. Schäfer, MPG; Task 2: D. Maier, IRAM; Task 3: A. Baryshev, SRON; Task 4: G. Yassin, UOXF). The JRA leader will ensure the coordination between the different Tasks and the control of budgetary matters (M. Guélin, IRAM). One face-to-face meeting per year will be organized in turn by participating institutes, during which progress reports on each Task are presented orally and discussed. These meetings give an opportunity to visit the laboratories involved in the JRA. Written progress reports are prepared prior to the meetings, that will be combined into an annual report. A detailed final report will be issued at the end of the JRA.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	5.60
3	IRAM	25.00
4	INAF	4.70
7	OSO	16.60
8	UCAM	10.00
9	STFC	8.00
10	SRON	16.60
11	OBSPARIS	9.90
12	UOXF	12.00
13	UAH	45.00
14	TUD	13.81
15	ESO	0.00
19	Fraunhofer	12.80
22	UCO	9.00
	Total	189.01

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D9.1	Supra THz SIS and HEB receivers specification	12	4.00	R	RE	12
D9.2	Prototype components for 1-mm feed horn array (Task 2)	12	3.00	P	CO	18

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.3	Report on supra THz SIS junctions, HEB devices and Schottky diodes development (Task 4)	12	18.00	R	RE	18
D9.4	Wideband OMT for W band (Task 1)	4	4.00	R	CO	24
D9.5	ALMA band 10 2SB or Balanced mixer design report (Task 3)	10	8.30	P	RE	24
D9.6	Prototype components for 1-mm IF hybrids (Task 2)	7	4.00	P	CO	30
D9.7	Reports on Supra-THz SIS and HEB mixers and LO chain tests (Task 4)	12	22.00	R	RE	33
D9.8	Prototype components for 4-12GHz MMIC tested on-wafer (Task 1)	19	4.00	P	CO	34
D9.9	Prototype IF amplifiers (Task 23)	13	18.00	P	RE	36
D9.10	Prototype LO for 1-mm array (Task 2)	9	3.00	P	RE	36
D9.11	Prototype 1-mm 2SB mixers (Task 2)	3	14.00	P	CO	36
D9.12	Prototype IF amplifiers (Tasks 3)	13	12.00	P	RE	37
D9.13	W-band MMICs (Task 1)	19	8.80	P	CO	40
D9.14	Report on supra THz mixer tests and on other mixer solutions considered (Task 4)	12	23.00	R	RE	41
D9.15	W band MMIC array module demonstrator (Task 1)	1	5.60	D	CO	42
D9.16	One-mm array receiver 7-pixel demonstrator (Task 2)	3	3.00	D	RE	42
D9.17	ALMA band 10 2SB or Balanced mixer single-pixel prototype and test report (Task 3)	10	8.30	D	RE	42
		Total	163.00			

Description of deliverables

D9.1) Supra THz SIS and HEB receivers specification: Supra THz SIS and HEB receivers specification [month 12]

D9.2) Prototype components for 1-mm feed horn array (Task 2): Prototype components for 1-mm feed horn array (Task 2) [month 18]

D9.3) Report on supra THz SIS junctions, HEB devices and Schottky diodes development (Task 4): Report on supra THz SIS junctions, HEB devices and Schottky diodes development (Task 4) [month 18]

D9.4) Wideband OMT for W band (Task 1): Wideband OMT for W band (Task 1) [month 24]

D9.5) ALMA band 10 2SB or Balanced mixer design report (Task 3): ALMA band 10 2SB or Balanced mixer design report (Task 3) [month 24]

D9.6) Prototype components for 1-mm IF hybrids (Task 2): Prototype components for 1-mm IF hybrids (Task 2) [month 30]

D9.7) Reports on Supra-THz SIS and HEB mixers and LO chain tests (Task 4): Reports on Supra-THz SIS and HEB mixers and LO chain tests (Task 4) [month 33]

D9.8) Prototype components for 4-12GHz MMIC tested on-wafer (Task 1): Prototype components for 4-12GHz MMIC tested on-wafer (Task 1) [month 34]

D9.9) Prototype IF amplifiers (Task 23): Prototype IF amplifiers (Task 2) [month 36]

D9.10) Prototype LO for 1-mm array (Task 2): Prototype LO for 1-mm array (Task 2) [month 36]

D9.11) Prototype 1-mm 2SB mixers (Task 2): Prototype 1-mm 2SB mixers (Task 2) [month 36]

D9.12) Prototype IF amplifiers (Tasks 3): Prototype IF amplifiers (Tasks 3) [month 37]

D9.13) W-band MMICs (Task 1): W-band MMICs (Task 1) [month 40]

D9.14) Report on supra THz mixer tests and on other mixer solutions considered (Task 4): Report on supra THz mixer tests and on other mixer solutions considered (Task 4) [month 41]

D9.15) W band MMIC array module demonstrator (Task 1): W band MMIC array module demonstrator (Task 1) [month 42]

D9.16) One-mm array receiver 7-pixel demonstrator (Task 2): One-mm array receiver 7-pixel demonstrator (Task 2) [month 42]

D9.17) ALMA band 10 2SB or Balanced mixer single-pixel prototype and test report (Task 3): ALMA band 10 2SB or Balanced mixer single-pixel prototype and test report (Task 3) [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS55	Device test reports from AMSTAR+ cryo-run delivered to IAF (Task 1)	1	8	Internal Report
MS56	Decision about horn design (Task 2)	12	11	Report
MS57	Cryo-run 1 finished and diced, devices delivered to testing labs (Task 1)	19	18	Internal Report, MMIC Devices
MS58	Delivery of 7-pixel feed array (Task 2)	12	18	Module and report
MS59	Decision about amplifier design (Task 2)	13	18	Report
MS60	Design of mixer array finished (Task 2)	3	18	Design Report
MS61	Technical specification of sub-systems (Task 4)	12	18	Design Report
MS62	Prototype of wideband OMT fabricated (Task 1)	4	24	Internal Report
MS63	Validation of IF coupler design (Task 2)	7	24	Report
MS64	Preliminary design of band 10 2SB/Balanced mixer (Task 3)	10	24	Report
MS65	Preliminary design of compact IF amplifier and hybrid (Task 3)	10	24	Design Report

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS66	SIS Technology development progress report (Task 3)	10	24	Progress Report
MS67	Mixer-and LO chain design completed (Task 4)	12	24	Test Report
MS68	Cryo-run 2 finished and diced, devices delivered to testing labs (Task 1)	19	30	Internal Report, MMIC devices
MS69	Delivery of 7 IF hybrid couplers (Task 2)	7	30	Couplers and Report
MS70	Evaluate feasible bandwidths for LNA and OMT designs; Decision on Noise BW trade-off (Task 1)	1	31	Internal Report
MS71	Delivery of Mixer and LO chain (Task 4)	12	33	Modules
MS72	Finished final MMIC testing (Task 1)	1	34	Internal Report
MS73	Wideband dual polarization W-band pixel module suitable for array integration fabricated (Task 1)	1	36	Report, Module
MS74	Delivery of final 4-12GHz MMIC LNAs for SIS/HEB IF amplifiers (Task 1)	19	36	MMIC devices tested on-wafer @300K
MS75	Delivery of IF amplifiers (Task 2)	13	36	Amplifiers and Report
MS76	Delivery of 2SB mixers (Task 2)	3	36	Mixers and Report
MS77	Delivery of LO source (Task 2)	9	36	LO and Report
MS78	Production and test of IF components (Task 3)	10	36	Prototype and Test Report
MS79	Test of W-band module presumably at 30m telescope (Task 1)	3	42	Prototype and Test Report
MS80	7-pixel receiver prototype fabricated and tested (Task 2)	3	42	Prototype and Report
MS81	Production and test 2SB mixer (Task 3)	10	42	Prototype and Test Report
MS82	Common test of 2SB mixer and IF components (Task 3)	10	42	Test Report
MS83	SIS Technology development final report (Task 3)	10	42	Final Report, Test Junctions
MS84	Full testing of Mixers with LO chain (Task 4)	12	42	Test Report

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP10	Type of activity [54]	RTD
Work package title	High performance processing of Large Astronomical Datasets in an Open-source environment - Hilado		
Start month	7		
End month	42		
Lead beneficiary number [55]	2		

Objectives

The scientific and technical goal for Hilado is to create optimized prototype software and demonstrator processing pipelines that improve the capabilities of currently planned software packages for existing and emerging radio telescopes. These developments are essential to increase the potential of the RadioNet user community in opening up those facilities for the more demanding scientific applications. Three examples may serve to illustrate this:

- Given the current limitations of processing platforms, the standard LOFAR imaging pipeline will not be able to process in a realistic timescale data for all 80 km baselines at full FoV, 30MHz bandwidth at the lowest frequencies. By applying the optimised software developed in Task 1 of this JRA, and deploying time critical functions (Solvers, Gridding) on specialised platforms as studied in Task 3, such extreme cases will become feasible.
- The most demanding ALMA imaging cases are multi-field mosaics of complex Galactic fields with multiple arrays, combined with single dish and with large numbers of spectral channels. Performing these on the computing hardware currently projected for ALMA will take an unrealistically long time. The development of prototype software in this JRA that can handle these data rates reliably (Task 1) and can run on relatively cheap specialised platforms (Task 3) is needed to enable these observations.
- Fast transient imaging is currently limited for LOFAR and other RadioNet facilities, the main reason being that the current processing pipelines are not capable of continuously handling the short integration times required for surveying Rotating Radio Transients (RRATS) or studying the nature of extragalactic millisecond phenomena like the “Lorimer-transient”. The developments of a demonstrator Fast Transient Imager (Task 2) will bring such options to the user.

Far from being limited to the two facilities mentioned, LOFAR and ALMA, these developments will readily apply to enable faster and thus deeper processing of data from other RadioNet facilities (e.g. e-Merlin, WSRT and EVN) as well as increasing the capabilities of the RadioNet community in engaging with other instruments, in particular EVLA, MeerKAT and ASKAP. The work in this JRA will also prepare for new facilities including the SKA.

It should be noted that none of the on-going SKA studies in software and computing is addressing the topics covered by this JRA, and thus will not help current RadioNet users in addressing the subjects illustrated above. Also the forthcoming Pre-Construction Phase for the SKA will not work on specific software developments, but rather on architectural studies, planning and costing of the software effort. However, the knowledge and prototype software developed in this JRA will form a knowledge base for the SKA Construction Phase (planned start 2016) when production software for the SKA will start to be developed.

Hilado is well aware that parallel computing initiatives for radio astronomy are taking place in various contexts (ALMA, LOFAR, EVLA, ASKAP, MeerKAT). Far from duplicating these activities, Hilado builds on these results to make a significant impact by targeted studies in a number of well-defined areas. Hilado can make a significant impact with a modest amount of resources exactly because of these links with existing project, where the basis infrastructure and development is done. Through specific and targeted optimisations, Hilado will enable specialised applications (like the Fast Transient Imager), open up new platforms (like fast solvers on GPU based clusters) and boost performance (through improved robustness and data formats). The common denominator in

Hilado is to address the issues related to the size of the datasets produced by the more extreme observations possible with telescopes like ALMA and LOFAR.

Hilado also explores a new development model for astronomical processing software. Expertise from a variety of disciplines needs to be tapped: from mathematics for the foundations of new algorithms, from computer science for optimizations for high-performance computer platforms and from industry to explore the space of novel architectures. Talented people around the world should be enabled and encouraged to contribute. This collaborative project will facilitate the adoption of the new developments, technologies and insights required by huge datasets, and will tap expertise beyond the boundaries of the radio astronomy community. The success of this project depends critically on placing existing as well as novel HPC technologies at the centre of the development of algorithms, software and procedures. The JRA aims at optimized prototype software that can be re-used in a variety of contexts, including both automated pipelines and user-adaptable scripts. This brings maximum value to a broad group of RadioNet users by allowing them to balance between highly optimized automated processing and highly flexible interactive application without sacrificing efficiency and performance.

Software will be developed in publicly available Open Source repositories like the CASACore library and Python scripting environment. This approach gives good opportunities for dissemination and training. It should be noted that there is currently no funded R&D effort on CASACore. The CASACore libraries are maintained by voluntary contributions from ASTRON, NRAO and CSIRO. Therefore no significant effort in improving the robustness and optimizing the performance of these libraries can be expected without additional effort. Especially on the reliable handling of huge astronomical datasets, significant gains can be obtained through a modest effort. Hilado will allow CASACore to be further optimized in those areas where most impact is expected. For ALMA and LOFAR this will be through performance optimizations, farming out of critical algorithms to optimized processing platforms and application of optimized data models for the various phases in the data processing.

Hilado builds on the earlier RadioNet joint research activities by reusing ParselTongue (ALBUS) and the insights from interoperability studies (ALBiUS). Collaborations are being formed with MeerKAT and ASKAP (on optimization of the CASACore library and benchmarking) and NRAO (extending their algorithm development and HPC for both ALMA and EVLA).

Description of work and role of partners

Hilado addresses aperture synthesis imaging problems over a very wide range of frequencies. The typical LF problems <1GHz (e.g. ionosphere, crowded fields) differ from the >10GHz issues (e.g. mosaicking) but share many underlying problems (e.g. differing primary beams, full polarization beams, large numbers of spectral channels, large gridding convolution and imaging problems, automated data editing). Activities are organized in four applications, each addressing the themes: Algorithms, Software and Platforms.
All tasks listed below will contribute to a detailed activities plan (D10.1) that will be subjected to a conceptual review early in the project, and to a finalk report integrating the three benchmark studies and the demonstrator pipelines (D10.14).

Task 1: Optimization of CASACore and CASA applications [ESO, ASTRON, UOXF, UCAM]

Research in the three themes will be as follows:
• Algorithms: profiling of algorithms and data formats, reordering them for optimal processing, studying potential routes for optimisation and porting them to HPC parallel architectures, including multi-level parallelism (e.g. clusters of multicores etc.), using hardware accelerators (e.g. GPUs, etc.) and novel architectures if available.
• Software: profiling of CASACore code and data formats to find and implement prototype software for optimised performance
• Platforms: demonstrate optimized algorithms, data formats and software on the ASTRON DAS-4 cluster, Oxford OSC's multi-core clusters, SMPs engines and GPU-based clusters.

This task will be carried out in three phases, each closed-out with Deliverables:
- Study phase, resulting in reports D10.2 (software) and D10.3 (dataformats).
- Prototyping phase, resulting in prototype software D10.7.
- Demonstration phase, resulting in scientific publications D10.10

Task 2: Fast Transient Imager [ASTRON, UOXF]

Research in the three themes will be as follows:

• Algorithms: studying of approaches to optimize real-time pipelines for continuous transient detection.
• Software: integrating imaging software in real-time frameworks, in particular the LOFAR On-line Application Pipeline (OLAP) and the Oxford Pelican suite.
• Platforms: demonstrator for real-time transient imager pipeline on the BG/P, DAS-4 cluster, the Oxford GPU-based transient platform.

It should be noted that the Fast Transient Imager is not part of the current LOFAR development. The current LOFAR implementations limit the scientific potential for transient detection because of the limited throughput that can be obtained with the standard pipelines. Therefore this task will significantly boost the performance of LOFAR both for the array and for single station mode. The latter will make this work highly relevant for all international partners. The application will also improve the potential of the RadioNet community to process e.g. large EVLA data-cubes produced by the WIDAR correlator at its full capability and to more efficiently handle MeerKAT surveys.

This task will be carried out in three phases, each closed-out with Deliverables:
- Study phase, resulting in report D10.4, specifying requirements and innovative architecture.
- Prototyping phase, resulting in a prototype FTI application D10.9.
- Demonstration phase, resulting in scientific publications D10.11 using real-time data from LOFAR.

Task 3: Large solvers for ALMA and the SKA [UOXF, ESO, ASTRON]

Research in the three themes will be as follows:
• Algorithms: (a) studying the mathematical foundations for large scalable solvers, seeking for new methods to apply multi-level parallelism, and (b) the use of accelerators such as GPUs will be considered for optimizing convolutional gridding schemes (A and W projection) and faceting.
• Software: developing optimized mathematical prototype software to boost the performance of existing applications.
• Platforms: demonstrator application farming out solvers to hardware accelerators, using the platforms mentioned above.

It should be noted that the current ASKAP and LOFAR developments do address the issues of Solvers. However: these do not include a rigorous study of the mathematical foundations, and are not directly targeted at farming out the most critical parts of the solvers to dedicated platforms. Hilado will give these critical aspects the targeted effort that is needed to move the field forward.

This task will be carried out in three phases, each closed-out with Deliverables:
- Study phase, resulting in publication D10.5 on the application and adaption of parallel solvers for large astronomical datasets.
- Prototyping phase, resulting in prototype software D10.8 of innovative solvers.
- Demonstration phase, resulting in scientific publications D10.12 of the results of large parallel solvers for huge astronomical datasets on selected hardware.

Task 4: Bringing it to the user [JIVE, ASTRON, UCAM]

Develop recipes locally, prototype application on common user platform, transparent porting to specific platform. The three research themes do not apply to this task. Instead two research lines will be pursued:
• Optimizing the scripting environment that makes the algorithms developed in the other tasks available to end-users (building on ParselTongue); studying ways to give users efficient access to the large datasets for which they are deployed.
• Optimizing the way in which insights from interactive processing can be brought into automatic HPC environments/pipelines.

This task will spend a modest effort in defining and providing interfaces to the pipelines and libraries developed in the other tasks. For instance, Task 2, the parameter interface to tune the Fast Transient Imager will be provided in ParselTongue, and the existing visualizers will be configured to give access to the output image stream. For Task 1, the interfaces to the optimized data formats will be uniformly configured to provide users transparent access to the data. Most of the effort in this task will be in configuring the existing applications for optimal use with the optimized libraries, rather than developing new code. Interaction with the end-user will be through the communication channels set up for the earlier ALBUS and ALBiUS JRAs.

The creation of prototype code and demonstrator processing pipelines will enable several of the more extreme observing schemes with existing RadioNet facilities, in particular LOFAR and ALMA.

This task will be carried out in two phases, each closed-out with Deliverables:
- Prototyping phase, resulting in prototype software in an improved ParselTongue library, D10.6.
- Demonstration phase, resulting in demonstrator pipelines for selected applications, D10.13

The project has aimed to concentrate development effort in a limited number of places to maintain critical mass. All partner institutes will provide additional manpower, and all have software/HPC groups with sufficient critical mass, which creates a proper working environment. The overall project management will be done by ASTRON. The day-to-day management of the individual tasks will be as follows. The CASA / CASACore work package will be led by ESO which is leading the European ALMA effort for which CASA will be the primary data processing package. The Fast Transient Imager work package will be led by ASTRON, which has experience with data processing for Transients from LOFAR. The Solver work package will be led by UOXF, which brings in the mathematical expertise from the UOXF e-Research Centre. Finally, the User work package will be led by JIVE, which has led the RadioNet ALBUS and ALBiUS projects. Within the work packages collaborations will be between two to three institutes, which will focus the effort. In practice, this will be implemented by telecon / videocon meetings, working visits, and managerial meetings.

The distributed nature of the project can be considered a risk, but the number of participating institutes is small and all institutes have a history of working with each other. Moreover, two of the institutes are at the same location (ASTRON, JIVE), whereas two other institutes are within the same country (UOXF, UCAM).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	ASTRON	22.00
5	JIVE	19.10
8	UCAM	10.00
12	UOXF	26.00
15	ESO	14.40
	Total	91.50

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D10.1	Detailed activities plan, including top-level architecture of libraries and final selection of bench	2	5.00	R	PU	12
D10.2	Report on optimisation studies, indicating resulting improvement and guidelines for prototyping and	15	5.00	R	PU	18
D10.3	Report on the comparison of data formats, specifying the key characteristics of optimal formats for	8	8.00	R	PU	18
D10.4	Report specifying the requirements and architecture of the Fast Transient Imager, including identifi	2	5.00	R	PU	18

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D10.5	Scientific publication on the application and adaptation of parallel solvers for large astronomical	12	8.00	R	PU	18
D10.6	Prototype code of improved ParselTongue library, to form a scripting interface to the prototype code	5	10.00	P	PU	24
D10.7	Optimised prototype software (in the repository), showing the actual performance gain from the optim	15	5.00	P	PU	30
D10.8	Prototype software for the demonstration of the solvers on a variety of hardware platforms.	12	8.00	P	PU	30
D10.9	Prototype FTI application (code in repository) for use on the target hardware platforms.	2	5.00	P	PU	30
D10.10	Scientific publication on the results of the demonstrator, and the overall performance gains obtaine	15	4.50	D	PU	38
D10.11	Scientific publication with the results from the FTI demonstrator application on the selected hardwa	2	5.00	D	PU	38
D10.12	Scientific publication of the results of demonstrator of large parallel solvers for huge astronomica	12	8.00	D	PU	38
D10.13	Demonstrator pipelines (code in repository) for the selected applications, including a standard imag	5	10.00	D	PU	38
D10.14	Final report integrating the three benchmark studies and the demonstrator pipelines	12	5.00	R	PU	42
		Total	91.50			

Description of deliverables

D10.1) Detailed activities plan, including top-level architecture of libraries and final selection of bench: Detailed activities plan, including top-level architecture of libraries and final selection of benchmark platforms, confirming their availability (including compilers etc.). [month 12]

D10.2) Report on optimisation studies, indicating resulting improvement and guidelines for prototyping and: Report on optimisation studies, indicating resulting improvement and guidelines for prototyping and benchmarking [month 18]

D10.3) Report on the comparison of data formats, specifying the key characteristics of optimal formats for: Report on the comparison of data formats, specifying the key characteristics of optimal formats for various phases in the imaging chain, indicating where and how readily available solutions can be applied [month 18]

D10.4) Report specifying the requirements and architecture of the Fast Transient Imager, including identifi: Report specifying the requirements and architecture of the Fast Transient Imager, including identification of target hardware platforms. [month 18]

D10.5) Scientific publication on the application and adaptation of parallel solvers for large astronomical: Scientific publication on the application and adaptation of parallel solvers for large astronomical datasets, in particular detailing the application on new hardware platforms [month 18]

D10.6) Prototype code of improved ParselTongue library, to form a scripting interface to the prototype code: Prototype code of improved ParselTongue library, to form a scripting interface to the prototype code developed in D02 and D09 in particular. [month 24]

D10.7) Optimised prototype software (in the repository), showing the actual performance gain from the optim: Optimised prototype software (in the repository), showing the actual performance gain from the optimization studies, and ready to be verified on the benchmark platforms [month 30]

D10.8) Prototype software for the demonstration of the solvers on a variety of hardware platforms.: Prototype software for the demonstration of the solvers on a variety of hardware platforms. [month 30]

D10.9) Prototype FTI application (code in repository) for use on the target hardware platforms.: Prototype FTI application (code in repository) for use on the target hardware platforms. [month 30]

D10.10) Scientific publication on the results of the demonstrator, and the overall performance gains obtaine: Scientific publication on the results of the demonstrator, and the overall performance gains obtained for large scale imaging applications [month 38]

D10.11) Scientific publication with the results from the FTI demonstrator application on the selected hardwa: Scientific publication with the results from the FTI demonstrator application on the selected hardware platforms using real-time data from LOFAR. [month 38]

D10.12) Scientific publication of the results of demonstrator of large parallel solvers for huge astronomica: Scientific publication of the results of demonstrator of large parallel solvers for huge astronomical datasets on the selected hardware platforms, detailing the improvements obtained. [month 38]

D10.13) Demonstrator pipelines (code in repository) for the selected applications, including a standard imag: Demonstrator pipelines (code in repository) for the selected applications, including a standard imaging pipeline, giving end-users access to parameters in the solvers and components through the improved ParselTongue libraries. [month 38]

D10.14) Final report integrating the three benchmark studies and the demonstrator pipelines: Final report integrating the three benchmark studies and the demonstrator pipelines [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS85	Conceptual Review	2	12	Review D10.1
MS86	Design Review of optimisation strategies	15	18	Review D10.2, D10.4
MS87	Design Review of Fast Transient Imager	2	18	Review D10.6
MS88	Design Review Parallel Solvers	12	18	Review D10.9
MS89	Completion of improved ParselTongue software	5	24	Code release D10.12 + test report
MS90	Completion of optimized imaging software	15	30	Code release D10.3 + test reports
MS91	Completion of FTI prototype software	2	30	Code release D10.7 + t

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS92	Completion of code library for parallel solvers	12	30	Code release D10.10 + test reports
MS93	Demonstrators completed	5	38	Code release + Review D10.5, D10.8, D10.11, D10.13
MS94	Final report completed	12	42	Review D10.14

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP11	Type of activity [54]	RTD
Work package title	Developments In VLBI Astronomy (DIVA)		
Start month	7		
End month	42		
Lead beneficiary number [55]	1		

Objectives

VLBI offers the highest angular resolution of all astronomical observing techniques and is therefore an essential tool for research in several highly important astrophysical areas, e.g., formation and propagation of powerful plasma jets, fundamental physics near the event horizon of supermassive black holes, environment and surface of nearby radio-stars, astrometry with highest precision possible which could e.g. lead to the detection of extrasolar planets. The technical developments, which are described in this JRA, would serve as a cornerstone for accomplishing key elements of EVN2015 and at the same time reach beyond the objectives formulated in the VLBI vision paper. In this vision document it was stated that: “Technology will be available to extend the IF bandwidth of the EVN stations to 1 GHz in the L-band, and to 2-4 GHz in the C-band and higher. Full digital sampling of these IFs will be possible soon (DBBC project).” This has been accepted by the VLBI community in Europe and was formulated as a recommendation for further developments to the EVN Board of Directors.

In DIVA key technology building blocks will be developed to consolidate the role of European VLBI and European radio astronomy in general as a leading competitor with respect to developments in the USA and Asia.

VLBI is facing new challenges in the coming years. Single pixel wideband feeds have become available and are for instance an essential part of the global geodetic VLBI efforts (VLBI2010 roadmap). New wide-band samplers, and bigger, as well as faster FPGAs have been announced. Astronomers on the other hand demand significantly more sensitive VLBI observations and better UV coverage to enlarge the parameter space that can be probed with VLBI observations. To address the demand for and options of wider bandwidths of feeds, receivers and IF systems at telescopes worldwide, including EVN and ALMA, VLBI has to adapt its observing bandwidths and strategies to the needs for increased sensitivity. This JRA will develop

(a) wide-band dm/cm-receivers with at least 4:1 frequency bandwidth and
(b) wide bandwidth / high-bitrate VLBI backends which will allow to utilise the full potential of the above mentioned wide-band dm/cm-receivers and of planned or existing receivers in the cm/mm/submm-range. Such a backend can also be adapted to the requirements of VLBI with ALMA, which was proposed as an ESO project.

(a) While the initial low noise performance achieved with off-the-shelf components is promising, progress has been relatively slow towards dedicated and optimal low power/low noise receiver IC’s (MMIC’s) essential for optimized integrated receivers in wide-band single pixel feeds such as the wide-band 11-feed developed in Europe through OSO/Chalmers. As a consequence, present low-noise receiving systems operate over at most a 2:1 frequency bandwidth as proven by the new e-VLA receivers. The 11-feed has, unlike the log-periodic antenna developed for the Allen Telescope Array (“ATA”), a fixed phase centre over a similar wide frequency range of order 10:1. This in combination with its wide frequency performance makes it an extremely interesting concept for VLBI provided that combined with suitable LNA’s, it could be proven to advance the state-of–the-art in combination with reflectors as primary sensors. One of our aims is to address these through a three-year dedicated R&D activity towards a prototype LNA-wideband feed in the attractive 1-4 GHz frequency range. Although more limited than the intrinsic bandwidth the 11-feed offers, the proposed reduced range makes our approach more realistic for the purpose of high bandwidth, low frequency VLBI with high potential also for other areas of radio astronomy.

The key elements here are new transistor technologies that promise excellent results for ambient or modest cryo-cooled low noise amplifiers. These processes, like 70nm mHEMTs from OMMIC, 50nm mHEMTs from IAF (Fraunhofer), have been tested in lab conditions with good results and are now advanced enough for use in astronomical receivers intended for VLBI. For this to happen, DIVA will research, design and evaluate wide bandwidth and very low noise temperatures with a focus on low power.

(b) In the last few years VLBI backends were developed both in Europe as an EVN project – the Digital Base-Band Converter Vers. 2; DBBC2) and later in the US by NRAO/Haystack/Casper (Roach Digital Backend; RDBE) with bandwidths of 2 times 512 MHz. Both systems will eventually offer similar performance at comparable cost. The DBBC2 development has a few months head start and it is the first time for 40 years that the dependency of European VLBI on US developed hardware could be broken.

In this JRA the next generation samplers and FPGAs, which will become available soon, will be used to develop the next generation digital backend: the DBBC3. At least 8 GHz samplers and a Virtex 7 FPGA will be used. This new dedicated, straightforward VLBI backend with the new state of the art hardware will defend the present independent status of VLBI backend developments in Europe and will be able to compete on the market against the US competitors. A particular strength of our approach is that the existing DBBC2 systems could easily be upgraded in a cost-effective way.

The DBBC3 is one component that (together with state of the art receivers as developed in this activity) could enable “first class” VLBI with “new” dishes from dm to mm and sub-mm wavelengths.

Description of work and role of partners

Task 1: Low-noise wide-band integrated amplifiers for VLBI reflectors [MPG, ASTRON, OSO]

A Microwave Integrated Circuit (MIC) approach will be used to demonstrate the capabilities of new discrete components coming up on the European market. This task will develop a high performance integrated LNA Monolithic MIC (MMIC) providing the wide bandwidth needed for highly sensitive VLBI astronomy in the dm/cm-range. Together with the prototype of task 2 it will become possible to extend wide-band VLBI down to the dm/cm range. In addition the approach chosen will also be suited for medium number mass production pointing towards SKA.

Sub-task 1.1: Low Noise Amplifier MIC Design [OSO, ASTRON, MPG].
In this sub-task devices for cryogenic application of semiconductor technologies already available or upcoming for gaining experience with those devices will be studied. There are very promising first results at room temperatures and cryogenic temperatures e.g. of the Fraunhofer 50nm process. This will be further explored and made available to the wider community.

Sub-task 1.2: MMIC Design [ASTRON, MPG, OSO].
Due to the requirement of higher repeatability of the performance of the final LNA, a simpler integration process, and because of the relatively large number of frontend units needed, a high integration level of functions is fundamental. Particular emphasis will be given to ultra low-noise cryogenic devices, which will be designed for existing and upcoming VLBI facilities as well as for the SKA. The desire to produce thousands of cryogenically cooled single pixel wide band feeds and even tens of millions of low-noise receivers for aperture arrays, each of which must have reliable high performance and long life expectancy, will place considerable demands on the device manufacturer. This is important to equip the numerous VLBI dishes in Europe and it is essential for both SKA and ALMA. A number of potential foundries and technologies will be investigated which can satisfy the requirements of low noise figures, but also the important efficiency and reproducibility issues. MMICs at cryogenic and room temperature will be designed for fabrication.

Sub-task 1.3: Packaging and Testing [MPG, OSO, ASTRON].
Radio astronomy instrumentation for SKA will need sophisticated packaging and testing technology. This sub-task will explore technologies suited for high quality and volume production and for reliably testing thousands of modules at cost effective prices. Innovative techniques for packaging and testing can significantly reduce the cost for the VLBI antennas and these are essential for the success of the SKA.

Sub-task 1.4: Feed integration and performance evaluation [ASTRON, OSO, MPG].
LNA performance cannot be translated directly into system noise temperature performance: the interaction with the antenna feed system is a crucial element. In particular the antenna impedance for a wide band system will play a determining role in the receiver noise temperature.

LNAs developed in subtask 1.2/1.3 will be integrated with wide band feeds, e.g. the 11-feed, in order to create a (dish) front-end prototype. Noise temperature evaluation will be performed in lab conditions and (if possible) in a full-scale reflector.

Task 2: 32 Gbit digital backend (DBBC3) [INAF, MPG, OSO]

The aim of this task is to develop a VLBI digital backend with 4 GHz bandwidth, single FPGA processor unit and 40/100 Gbps Ethernet output data highway (DBBC3). The DBBC3 (like the DBBC2) will be made available to European and other telescopes via small European industry.

A new generation of commercial samplers with at least 8 GHz sampling rate and more than 4 GHz input bandwidth will become available soon. New chips of the Virtex 7 family are on the market or have been announced. Due to the recent standardisation of 40 Gbit and 100 Gbit Ethernet consumer equipment at 40 Gbit will soon appear on the market and network providers are planning to upgrade their backbones to 100 Gbit in 2011. The new samplers, FPGAs and Ethernet hardware will be the key components of the new system.

Based on the experience gained in the DBBC project the components required for a VLBI backend will be reviewed and a system capable of the desired high data-rates will be designed, realised, integrated to a complete system, and tested in the labs and field. Final field tests will be carried out at Effelsberg, Onsala, or Noto where 2 – 4GHz bandwidths are planned for some high-frequency receivers. Alternatives are Pico Veleta or Plateau de Bure (single dish). The required sub-tasks are:

Sub-task 2.1: Sampling board for 4 GHz bandwidth [MPG, INAF].
This sub-task will develop a board (ADB3), which can sample an instantaneous band at least 4 GHz wide. It will be based on commercial sampler components with up to 8 GHz or higher sampling clock, which will become available in a short time. Interleaving methods have to be adopted to achieve the required performance for such a high sampling clock. The work will be based on the experience gained with 1 GHz sampling boards for the DBBC2. The data will be made available to the processing unit (sub-task 2.2) on a parallel or serial bus. In addition timing components and on-board test units will be designed and realised.

Sub-task 2.2: Single FPGA processing unit with VLBI firmware [INAF, MPG, OSO].
A new processing board (CORE3) with an FPGA of the latest FPGA families available on the market will be developed, preferably as a replacement or add-on element for the existing DBBC2. The board will receive the sampled data from the prototype of sub-task 2.1 and convert it to a form acceptable for VLBI correlators. The maximum output data-rate will be 32 Gbit/s. The processing options will include firmware for parallel fixed-band down-conversion, or formatting of the whole band without any sub-bands as needed e.g. for absorption line studies. This modest amount of processing can easily be realized in a modern FPGA.

Sub-task 2.3: 40 Gbit Ethernet output [OSO, INAF, MPG].
This sub-task will realise the massive data transfer at 32 Gbit/s from the prototype of the processing unit (sub-tasks 2.2) onto 40 Gbit Ethernet while maintaining all the information necessary to keep track of time and phase as required for VLBI. The system will make use of a mix between commercial and custom parts in order to simplify the project. The data format will be the VDIF standard. As 40 Gbit Ethernet has recently been standardised 40 Gbit consumer components will appear on the market in due time so that it is expected that a cost-effective approach can be chosen.

Sub-task 2.4: Integration and final testing of the system [INAF, MPG, OSO].
The sampling board, processing board and 40 Gbit Ethernet board will be integrated, tested in the labs and field tested at Effelsberg, Onsala, or Noto where 2 – 4GHz bandwidths are planned for some high-frequency receivers. Alternatives are Pico Veleta or Plateau de Bure (single dish).

In terms of management and implementation, the DIVA project will be very similar to JRAs carried out in the past RadioNet research. The overall project management will be done by MPG, developments will take place at the partner organizations. The different subtasks will have local coordinators as denoted in the work package description. This concentration of effort per package and institute will keep the project focused, minimize interdependencies and guarantee continuity throughout the duration.

The two tasks will be developed in parallel based on R&D work done so far. All contributing institutes have profound experience in the technological area of their subtask. The interfaces between the sub-tasks will be defined carefully. They also have little and well defined overlap which minimizes the risk of failure and time delays in the project.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	17.00
2	ASTRON	10.00
4	INAF	23.00
7	OSO	24.00
	Total	74.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D11.1	MIC LNA design report	7	4.00	R	PU	12
D11.2	Report on the design of the prototype of sampler and processing unit	4	8.00	R	RE	15
D11.3	Cryogenic test report of MIC LNAs using advanced low noise processes	7	6.00	R	PU	24
D11.4	Completing first sampler ADB3 prototype	1	8.00	P	RE	24
D11.5	Completing first FPGA Core3 board, prototype	4	6.00	P	RE	24
D11.6	Design study of the architecture of the 40 Gbit Ethernet output	7	7.00	R	RE	24
D11.7	MMIC LNAs design report	2	3.00	R	PU	27
D11.8	Evaluated packaging solution	1	7.00	R	PU	30
D11.9	MMIC LNA test report	2	3.00	R	PU	33
D11.10	Test of the integrated prototype of sampler and processing unit	4	4.00	R	RE	36
D11.11	Prototype system 40 Gbit Ethernet and test report	7	7.00	R	RE	36
D11.12	Test report of integrated feed system	2	4.00	R	PU	42
D11.13	Final report of task 2 with test of integrated system	4	5.00	R	PU	42
		Total	72.00			

Description of deliverables

D11.1) MIC LNA design report: A Microwave Integrated Circuits will be designed. [month 12]

D11.2) Report on the design of the prototype of sampler and processing unit: A board (ADB3), which can sample an instantaneous band at least 4 GHz wide, will be designed. A new processing board (CORE3) with an FPGA of the latest FPGA families available on the market will be designed with a maximum output data-rate of at least 32 Gbit/s [month 15]

D11.3) Cryogenic test report of MIC LNAs using advanced low noise processes: Microwave Integrated Circuits at room temperatures and cryogenic temperatures will be studied. [month 24]

D11.4) Completing first sampler ADB3 prototype: A prototype of the sampler board ADB3 will be delivered. [month 24]

D11.5) Completing first FPGA Core3 board, prototype: A prototype of the processing board Core3 will be delivered [month 24]

D11.6) Design study of the architecture of the 40 Gbit Ethernet output: A board for massive data transfer at 32 Gbit/s will be designed. [month 24]

D11.7) MMIC LNAs design report: MMICs at cryogenic and room temperature will be designed for fabrication. [month 27]

D11.8) Evaluated packaging solution: Efficient and cost effective packaging solutions for MMICs will be investigated. [month 30]

D11.9) MMIC LNA test report: The packaged MMIC LNAs will be tested in the lab. [month 33]

D11.10) Test of the integrated prototype of sampler and processing unit: The prototypes of the ADB3 and Core3 boards will be integrated into a processing unit. A test report will be delivered [month 36]

D11.11) Prototype system 40 Gbit Ethernet and test report: A prototype of a board which can ouptut 32 Gbit/s to Ethernet will be delivered and tested. [month 36]

D11.12) Test report of integrated feed system: LNAs developed in subtask 1.2/1.3 will be integrated with wide band feeds, e.g. the 11-feed, in order to create a (dish) front-end prototype. Noise temperature evaluation will be performed in lab conditions and (if possible) in a full-scale reflector [month 42]

D11.13) Final report of task 2 with test of integrated system: The sampling board, processing board and 40 Gbit Ethernet board will be integrated, tested in the labs and field. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS95	MIC LNA design	7	12	Design document
MS96	Report on field survey of commercial components	7	13	Report
MS97	MIC LNA completed	7	15	Prototype
MS98	Report on requirements for compatibility	7	15	Report
MS99	PCB prototype of ADB3 board	1	21	Prototype
MS100	PCB prototype of Core3	4	21	Prototype
MS101	Report on design of the custom part	7	22	Report
MS102	Prototype of ADB3 board	1	23	Prototype
MS103	Prototype of Core3	4	23	Prototype
MS104	MMIC LNA designs, two foundries	2	24	Design document
MS105	Prototype packaging	1	24	Prototype
MS106	MMIC LNA prototypes completed	2	27	Prototype
MS107	Prototype of custom part of 40 Gbps unit	7	29	Prototype
MS108	Design of front-end assembly	2	33	Design document

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS109	Realization of integrated feed prototype	2	39	Prototype

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP12	Type of activity [54]	SUPP
Work package title	EVN		
Start month	1		
End month	48		
Lead beneficiary number [55]	5		

Objectives

Name of the infrastructure: European VLBI Network (EVN)

Location (town, country): The EVN is a distributed network of radio telescopes located across the EU and beyond. EVN telescopes located within the EU include: Effelsberg (DE), Jodrell Bank and Cambridge (UK), Westerbork (NL), Onsala (SE), Medicina, Noto and SRT (IT), Yebes (ES), Torun (PL), Metsähovi (FI) and Irbene (LV). When conducting EVN observations, the participating telescopes operate as a single entity. Signals from each telescope are combined together at a central processing facility at the Joint Institute for VLBI in Europe (Dwingeloo, NL) for correlation. There are additional EVN telescopes in Russia (3), China (2), South Africa, and Puerto Rico. Joint observations with the UK MERLIN array and telescopes operated by NRAO (U.S.) are made on a regular basis.

Web site address: www.evlbi.org

Legal name of organisation operating the infrastructure: Joint Institute for VLBI in Europe

Location of organisation (town, country): Dwingeloo, the Netherlands

Annual operating costs (excl. investment costs) of the infrastructure (€):17.961.577

Description of the infrastructure:

The European VLBI Network (EVN) is a cooperative effort among institutes in eight EU countries, plus Russia, China, South Africa, and Puerto Rico. From its formation in 1980 as a consortium of 5 European observatories, the EVN has led the way in bringing about effective inter-operation among European radio astronomy institutes. The telescopes in Russia, China and South Africa create EVN baselines longer than 8000 km, providing milliarcsecond (mas) resolution at cm wavelengths. The EVN also often observes in conjunction with the U.S. Very Long Baseline Array and the Green Bank telescope (operated by NRAO), providing significantly more baselines in the range of 6000-11000 km. EVN observations conducted in conjunction with the UK MERLIN array introduce baselines down to 20 km, providing sensitivity to more extended emission on the order of arcseconds.

The correlation facility for the EVN is located at the Joint Institute for VLBI in Europe (JIVE). The ASIC-based MarkIV correlator has processed EVN and global observations since 1999. It can correlate up to 16 telescopes, each at 1024 Mbps, and can compute a quarter-million complex lags. The flexibility of the correlator allows a range of observational goals, from high-sensitivity, full-Stokes continuum mapping to high spectral-resolution kinematics of celestial masers with velocity resolutions better than 0,1 km/s. The combination of high spectral resolution and short integrations permits mapping over a wide field of view. A new software correlator developed at JIVE surpasses the capabilities of the MarkIV processor (e.g., more than 16 telescopes simultaneously, arbitrarily fine spectral and temporal resolution, more accurate phase tracking) and permits astronomical applications not available on the MarkIV, such as pulsar binning/gating and multiple phase-centres within a single wide-field correlation.

The real-time e-EVN, in which telescopes stream data directly into JIVE via high-speed optical fibre for correlation, rather than record onto disks for subsequent shipping, has continued to mature over the past few years. Data rates of 1024 Mbps are now routine and reliable. The principal advantages of the e-EVN lie in the far shorter turn-around time from observations to the receipt of the correlated data (the PI typically can access their data within hours of the end of the observations) and in more frequent observing opportunities (typically one 24hr period per month in addition to the main observing sessions). Target-of-opportunity (ToO) observations are also more flexible via e-EVN. These capabilities are unique to the e-EVN, and enable it to be used as a dynamic instrument in which transient and flaring sources may be meaningfully studied at a resolution of a few mas, and VLBI observations may be coordinated with other instruments at other wavelengths

Description of work and role of partners

Modality of access under this project:

The process by which external users gain access to the EVN begins with the Call for Proposals, issued three times per year via e-mail distribution lists and web-pages that reach the main body of radio astronomers in Europe and beyond. The availability of TNA support is explained in the call, with links to more information on the JIVE, EVN, and RadioNet web pages. The EVN provides a web-based proposal tool to facilitate submission. There are three EVN observing sessions per year, each about three weeks long, plus typically 10-15 days of real-time e-EVN observations. Following the review of proposals by the EVN Program Committee (PC), the EVN scheduler places observations into the EVN block schedule at the next available opportunity, based on the proposals' consensus grades from the PC and their technical requirements. Urgent target-of-opportunity experiments have their own expedited proposal procedures to request observing time outside the scheduled sessions. When granted observing time, the PI creates the detailed observing schedule. The observations and correlation proceed in absentia. Most PIs will use standard radio-astronomy software packages that many will have available at their home institutes to analyse their correlated data, but visits to JIVE and other EVN institutes are encouraged.

Support offered under this project:

All steps in the process of using the EVN, from proposing to data analysis, are described in the online EVN Users' Guide. Assistance in each step is available from the support scientists in JIVE's Science Operations and Support Group. New or inexperienced users are encouraged to request help from JIVE. When the EVN block schedule appears, JIVE sends an e-mail to the PI of each experiment, pointing out relevant scheduling issues and how to obtain assistance in scheduling and, where applicable, the benefits and responsibilities of TNA support. JIVE support scientists check each submitted schedule and may liaise with the PI to optimise the schedule.. To maximize efficiency, JIVE support scientists schedule e-EVN observations, possibly combining individual projects. Prior to correlation, JIVE confirms the technical requirements with the PIs. Following correlation, JIVE support scientists cary out quality control and place the resulting data on the EVN Archive from where the PI can download it via a web tool. Support scientists also run the EVN pipeline, which calibrates the data and produces preliminary images and other diagnostic plots. The entire correlated data and the pipeline results associated the sources selected by the PI remain proprietary for one year on the EVN Archive. The PI receives a one-month notification of the expiry of this proprietary period, and can request an extension from the PC chairman.

When JIVE distributes the correlated data to the PI, data analysis visits are offered, especially to new or inexperienced users, again indicating the availiability of TNA support. One person from each TNA-eligible project can have travel expenses reimbursed for such visits to JIVE or to another EVN institute.

Outreach of new users:

The distribution of the EVN Call for Proposals reaches the body of radio astronomers in Europe and beyond through the VLBI and EVN e-mail distribution lists and inclusion in the EVN and NRAO newsletters. The EVN sponsors biennial symposia and interferometry schools. The symposia bring together users to discuss their science, and allow them to learn about recent developments in the EVN. An associated EVN Users' Meeting focuses on more operational issues, and provides a forum for lively feedback. In the schools, new and inexperienced users can benefit from presentations by seasoned EVN astronomers and hands-on tutorials. The success of real-time e-EVN observations is the clearest case in which the EVN has become attractive to a new community of astronomers — those studying transient objects for which rapid milliarcsecond-scale images can be crucial, to inform and plan the on-going observations at other wavelengths.

Review procedure under this project:

The EVN Program Committee (PC) meets typically 4-6 weeks after each proposal deadline. The PC comprises twelve experienced European astronomers representing a broad spectrum of scientific and technical expertise. Four members are not affiliated with any of the EVN institutes. Each member serves a renewable 3-year term. The PC can also receive technical input from non-EVN institutes whose resources are also requested in a proposal. Proposals requesting additional non-EVN resources may be reviewed in parallel according to the policies of those other resources. The PC evaluates proposals based solely on their scientific merit and technical feasibility. Each member reviews all proposals prior to the meeting, and each proposal is discussed at length during the meeting until the PC reaches a consensus judgement. This review results in a numerical grade and a recommended time allocation. The PI receives as feedback the consensus grade and summary comments plus the all the comments from the individual PC members.

Unit of Access:

The Unit of Access is a “Network Hour” — one hour in which the EVN observes a PI’s experiment as shown on the block-schedule for a session, e-EVN day, or a ToO. Different experiments may use different network compositions. Included in this access is the subsequent correlation, which may take considerably longer than the observations depending on the correlation set-up desired by the PI.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.00
2	ASTRON	0.00
4	INAF	0.00
5	JIVE	0.03
6	UMAN	0.00
7	OSO	0.00
13	UAH	0.00
21	UMK	0.00
23	VENT	0.00
24	AALTO	0.00
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D12.1	Providing access of 228 hours to the infrastructure	5	0.01	O	PU	18
D12.2	Providing access of 152 hours to the infrastructure	5	0.01	O	PU	30
D12.3	Providing access of 228 hours to the infrastructure	5	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D12.1) Providing access of 228 hours to the infrastructure: The EVN infrastructure will provide access to 228 hours, for a total number of 49 projects and 99 users. [month 18] D12.2) Providing access of 152 hours to the infrastructure: The EVN infrastructure will provide access to 152 hours, for a total number of 35 projects and 68 users. [month 30] D12.3) Providing access of 228 hours to the infrastructure: The EVN infrastructure will provide access to 228 hours, for a total number of 49 projects and 99 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP13	Type of activity [54]	SUPP
Work package title	JCMT		
Start month	1		
End month	48		
Lead beneficiary number [55]	9		

Objectives

Name of the infrastructure: James Clerk Maxwell Telescope (JCMT)

Location (town, country): Mauna Kea, Hawaii, USA

Web site address: http://www.jach.hawaii.edu/JCMT

Legal name of organisation operating the infrastructure: UK Science and Technology Facilities Council (STFC)

Location of organisation (town, country): Swindon, UK

Annual operating costs (excl. investment costs) of the infrastructure (€):3.157.135

Description of the infrastructure:
The James Clerk Maxwell Telescope (JCMT) is the world's premier ground-based facility for astronomical observations at submillimetre wavelengths. Three essential ingredients afford this status: the size and quality of the telescope, its location, and its aggressive programme of instrumentation.

The JCMT is the largest single-dish telescope in the world designed specifically to operate in the submillimetre region of the spectrum (wavelength range 450µm–1mm). The primary reflector of the JCMT has a diameter of 15m and its figure is maintained at an accuracy of just 22µm rms through a programme of periodic holography and panel adjustment. The facility is situated at the summit of Mauna Kea, on the island of Hawaii, at an altitude of 4092m. This is one of the best sites in the world for submillimetre astronomy, and certainly the very best in the northern hemisphere.

Two categories of instrument are provided for users of the facility. (a) Heterodyne receivers are available in a number of atmospheric transmission windows to measure line emission from specific molecules, revealing physical information about the source being observed (composition, temperature and velocity). (b) A new continuum camera called SCUBA-2 is being commissioned during 2010/11 and will offer simultaneous high-fidelity imaging at 450µm and 850µm.

The JCMT is a joint project of the United Kingdom (55%), Canada (25%) and the Netherlands (20%). The managing agency is the UK Science and Technology Facilities Council (STFC). The Director JCMT is responsible for the operation and development of the telescope. The JCMT Board, a governing body that is defined by the tripartite agreement between the agencies, provides oversight. The administrative base for the facility is the Joint Astronomy Centre (JAC), an STFC establishment located at sea level in Hilo, Hawaii.
As a non-European country, Canada has declined to participate in the RadioNet project. Transnational access will be offered from UK and Netherlands telescope time only.
The mission of the JCMT is to enable astronomical observations and to provide the resultant data products to its users. Sophisticated data reduction pipelines are provided for each instrument.

The submillimetre region of the spectrum is relatively unexplored and offers a number of unique advantages: first, it is the region of thermal emission from cold objects such as the interstellar medium, molecular clouds and the earliest stages of star formation; second, the infrared emission from extragalactic sources at cosmological distances is redshifted to submillimetre wavelengths; and third, since the interstellar medium is optically thin it is possible to probe to the interior of dust-obscured regions. The major areas of research undertaken with the JCMT are, accordingly,

• Galaxy formation and evolution,
• Star formation in the Milky Way and nearby galaxies, and
• Planet formation around nearby stars.

Description of work and role of partners

Modality of access under this project:

The JCMT operates a novel flexible-scheduling system, which was designed to enhance the completion of the highest-ranked projects within the constraint posed by the variable observing conditions on Mauna Kea. All projects are placed into a queue, ordered by scientific priority as assigned by the ITAC (see below), and the observational details are entered remotely into a database by PIs. Any observer can then, in principle, carry out the observations. Approved projects are carried out in one of two modes:

• ‘Observer mode’: A member of the user group visits the telescope for an observing run. The duration of the run typically exceeds the time allocated to the user’s project. The observer is given limited privilege to override the queue priorities in order to observe his/her own project, providing that the weather conditions are appropriate for the project, that the source is at an observable local elevation, etc.; if these conditions are not met, then the observer carries out observations from the queue. Observers are usually invited from the highest-ranked projects.
• ‘Service mode’: The user group does not send an observer to the telescope, but the data are obtained by other observers over the course of the semester. Data are made available for download within 24 hours of the observations taking place.
Users who come to the telescope for an observing run are required to visit the Hilo office for briefings (see next section) prior to ascending the mountain. They typically also spend a day or two in the office analysing their data, in conjunction with the provided science support (see next section), before returning to their home institutions. Finally, visiting observers are also invited to give a brief seminar to the science staff describing their project or any other topic.

Support offered under this project:

One of the JCMT scientific staff will be assigned to each project as the ‘Friend of Project’, and will provide support and advice for all aspects of the observing process: designing the observations, confirming the accuracy of the programme entered into the database, checking data quality as observations proceed, and advising on the data reduction.

Projects carried out in observer mode will also be assigned a Support Astronomer. The role of the Support Astronomer, who may or may not be the Friend of Project, will be to support the actual observing process. This includes training in the JCMT’s observing system, safety briefing, review of the observing strategy, and resolution of any open issues. The Support Astronomer will spend the first night at the telescope to provide real-time support, and will be available by telephone throughout the remainder of the observing run. Other JCMT staff will provide logistical support for the observing process: local hotel and hire car reservations, bookings for transport to the summit and for lodging at the Mauna Kea common facility, registration of medical disclaimers for working at altitude, etc.

In addition, a Telescope Systems Specialist (TSS) will be assigned to each observing night. It is the TSSs who will actually carry out the telescope and instrument operations on behalf of the observer. Because the TSSs have considerable experience with the facility, they frequently advise and assist observers with on-the-spot alterations to their programmes which may be necessitated by sky conditions, instrument behaviour, etc. The TSSs will also be fully responsible for the safety of the facility and the personnel during the observing.
All of the above support is provided to all projects regardless of origin. No distinction is made, at the operational level, between internal and external projects and users.

Outreach of new users:

The availability of TNA support will be prominently noted in JCMT Calls for Proposals. The front page of the JCMT website also indicates the observatory’s membership in the RadioNet consortium. More generally, outreach to potential new users of the facility will be managed centrally by the RadioNet office.

Review procedure under this project:

The JCMT issues Calls for Proposals twice per year. Proposals are assessed by three national Time Allocation Groups (TAGs), which then make recommendations to the International Time Allocation Committee (ITAC). The ITAC resolves any conflicts between the three national TAGs (e.g., overlapping proposals), assesses any international proposals, and formally allocates the time. The members of the TAGs and the ITAC are selected by the three partner agencies from amongst the submillimetre user communities in the three countries; the ITAC itself is composed of the chairs of the three national TAGs and one additional member of the UK TAG (to reflect the UK's 55% share in the facility). The observatory provides the ITAC's technical secretary.

The observatory's role in the time allocation process is to manage the proposal submission system (NorthStar, developed by RadioNet during FP6), to carry out technical assessments of each proposal, and to provide technical and logistical support as required. Scientific assessment of the proposals is carried out entirely by the TAGs and ITAC, all of which use independent peer review as an essential component of the process. Feedback is provided to proposers by the TAGs/ITAC. At the conclusion of the process, the ITAC provides the observatory with a list of approved programmes and their observing constraints, ordered by scientific priority.

Unit of Access at JCMT:

Time is allocated on the telescope in units of hours and this is the adopted unit of access. As in FP6 and FP7, it is proposed to calculate the quantity of delivered access differently for the two modes of operation:
• For projects undertaken in service mode: the delivered access is the number of hours spent observing the project.
• For projects undertaken in observer mode: the delivered access is the number of hours allocated to the project. This scheme recognises that the observatory staff will provide the full range of support to visiting observers regardless of which projects are actually observed during the observer's run. All of the support functions described above (logistical support, observing training, scientific support before and after the observations) are included in the unit cost.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
9	STFC	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D13.1	Providing access of 147 hours to the infrastructure	9	0.01	O	PU	18
D13.2	Providing access of 102 hours to the infrastructure	9	0.01	O	PU	30
D13.3	Providing access of 147 hours to the infrastructure	9	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D13.1) Providing access of 147 hours to the infrastructure: JCMT infrastructure will provide an access of 147 to the infrastructure for a total number of to 6 projects and 25 users. [month 18]

D13.2) Providing access of 102 hours to the infrastructure: JCMT infrastructure will provide an access of 102 to the infrastructure for a total number of to 3 projects and 16 users. [month 30]

D13.3) Providing access of 147 hours to the infrastructure: JCMT infrastructure will provide an access of 147 to the infrastructure for a total number of to 6 projects and 25 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP14	Type of activity [54]	SUPP
Work package title	e-MERLIN		
Start month	1		
End month	48		
Lead beneficiary number [55]	6		

Objectives

Name of the infrastructure: e-MERLIN

Location (town, country): Macclesfield, UK (Operations Centre) and Manchester, UK (VisitorSupport, Administration and Research)

Web site address: www.e-MERLIN.ac.uk

Legal name of organisation operating the infrastructure: University of Manchester on behalf of the Science and Technology Facilities Council

Location of organisation (town, country): Oxford Road, Manchester, M13 9PL, United Kingdom

Annual operating costs (excl. investment costs) of the infrastructure (€):2.326.786

Description of the infrastructure:

e-MERLIN is a unique astronomical facility, which provides radio imaging, spectroscopy and polarimetry with 10-150 milliarcsecond resolution and microJansky sensitivity at centimetre wavelengths. It supplies the short-baseline high-sensitivity complement to the European VLBI Network and provides a natural matched-resolution centimetre-wave complement to ALMA at millimetre wavelengths.

e-MERLIN is recognized by the SKA project as one of the pathfinders to SKA: scientifically, it provides a stepping stone towards the characterization of the sub-microJansky source population with high angular resolution and it involves important technological developments relevant to SKA, in particular high-bandwidth long-distance data transport (210 Gb/s total, with a maximum link of over 400km) and synchronization at the picosecond level over optical fibre links. e-MERLIN together with the other ‘new-generation’ instruments, such as e-VLBI and LOFAR, will attract, develop and equip a new generation of astronomers with the background and specialized skills to use the SKA.

STFC and the University of Manchester now operate e-MERLIN under a contractual framework, which runs until at least April 2014. It is hoped that this arrangement will continue in some form beyond that date, and at least until the SKA is operational in 2020.
The e-MERLIN upgrade includes new receivers (with improved sensitivity, wide frequency coverage, and greater flexibility) and a 210 Gb/s optical fibre network has been installed to connect each telescope to a powerful new correlator at Jodrell Bank Observatory. ‘First fringes’ with e-MERLIN were obtained in 2009 and the system is now in the final stages of commissioning: the first images with the full network were made in September 2010.

e-MERLIN will have a maximum instantaneous bandwidth of 4 GHz, giving a sensitivity of a few micro Jy/beam at its prime frequencies of 1,5 & 6 GHz. Together with the high resolution provided by the long baselines and the wide-field, spectroscopic and polarisation capabilities enabled by the new correlator, this will enable a wide range of new science programmes to be undertaken.

The key scientific topics for e-MERLIN cover a broad range from studies of pebble-sized grains in the process of aggregation into planets in disks around nearby stars to the growth and evolution of distant galaxies. Some of these key topics will be investigated through the e-MERLIN Legacy Programme which comprises 5,000hrs of allocated time during the first 2,5 years of operations of the telescope. The proposals received requested a total of over 10,000 hours and involved 325 astronomers from over 100 institutes in more than 20 countries. This gives an indication of the demand for e-MERLIN and the size and spread of the user-community.

The majority of the remaining observing time, about 50% of the total, is available to the entire astronomical community through the normal peer-reviewed proposal process. It is primarily this time, which forms the basis of this Transnational Access Programme.

The expected science highlights of the legacy and open-time projects may include:
• the first detections of pebble-sized building blocks of planets orbiting nearby young stars,
• tests of how outflows of material determine the formation of young stars
• an examination of where and how stars are born in nearby galaxies, including effects on the IMF
• the physics of radio jets from super-massive black holes and their influence on their host galaxies
• surveys of distant galaxies to measure the history of star-formation and the role of black holes in galaxy evolution
• precise measurements of gravitationally lensed objects to determine the mass profiles of the centres of galaxies and investigate their dark matter haloes

Description of work and role of partners

Modality of access under this project:

Application for observing time with MERLIN/e-MERLIN is made via Northstar, a Web-based application tool developed under the RadioNet FP6 Synergy Networking Activity. Observing applications are received for two proposal deadlines in each calendar year (15 March and 15 September). E-MERLIN is operated under a policy of open access to all research users and user groups both within the United Kingdom and internationally. Technical and engineering support for MERLIN is based at Jodrell Bank Observatory (JBO), whilst National Facility (NF) personnel located in the Jodrell Bank Centre for Astrophysics (JBCA) on the campus of the University of Manchester provide science support. Most observations are in service mode, although users may be in attendance for the observations if they wish. The users indicate scheduling constraints and detailed observing modes electronically. The final scheduling is dynamic and is carried out by facility staff based on the information provided by the users. The fundamental deliverables of the instrument are raw interferometric data on the approved targets and associated calibration scans. Within a dedicated MERLIN User Support Unit located at JBCA, specialist computing facilities, analysis software, and imaging expertise are provided for visiting users to process their data to radio images. Visiting users are allocated individual analysis computers and are assigned a support scientist who leads them through their data analysis. JBCA and NF personnel are available to users if they wish to discuss the interpretation of their radio images. Most user groups will usually send one or two representatives to JBCA for this purpose following the conclusion of their observations

Support offered under this project:

Users and user groups wishing to use MERLIN/e-MERLIN are provided with substantial assistance at every stage from proposal preparation through scheduling, calibration, and final imaging. JBO and JBCA are centres of excellence in astronomical imaging and have been involved in external MERLIN user support for over 15 years. JBCA also hosts an ALMA Regional Centre node providing valuable opportunities for interactions between the e-MERLIN and ALMA users and the co-development of support techniques and interferometry skills by centimetre and millimetre experts. On-line help is available for proposal preparation and data processing, and the web-based proposal tool is linked to this site. Additional individual help is available by email contact with user- support personnel. Visitors are invited to present talks outlining their areas of research; providing ideal opportunities to work with collaborators and develop new projects.

Outreach of new users:

Calls for proposals are normally issued twice per year before each proposal deadline. Calls will be available on the MERLIN web page and the e- MERLIN Newsletter (previously published in March and September), and specifically distributed to identified user groups and institutes worldwide. The calls indicate that travel and subsistence funding is available to EU user groups for such visits through RadioNet.
Latest scientific results are presented in conferences and workshops where access to MERLIN is advertised. As e-MERLIN becomes fully available during FP7, a major publicity campaign is planned and potential new user groups will be specifically target.

Review procedure under this project:

Following the proposal deadline, applications are circulated to external referees for peer review, where typically around 50% are from outside the UK, drawn mostly from Europe. Formal reports are returned and a Time Allocation Group (TAG) appointed by STFC under the auspices of the Panel for the Allocation of Telescope Time (PATT) reviews all applications. The TAG consists of four external members and one University of Manchester representative. The external members are drawn primarily from UK user groups and contain one European representative from outside the UK. Membership is rotated on a staggered timescale of two to three years. TAG members for both successful and unsuccessful proposals prepare detailed feedback. The detailed time allocation is included and for rejected applicants, a description of why the proposal was unsuccessful together with advice on re-submission. This feedback is then circulated to proposal PIs by STFC.

Unit of Access:

Telescope (Array) hours (this time can include also pointing and calibration checks made for particular projects additionally to the observing time).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
6	UMAN	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D14.1	Providing access of 236 hours to the infrastructure	6	0.01	O	PU	18
D14.2	Providing access of 163 hours to the infrastructure	6	0.01	O	PU	30
D14.3	Providing access of 236 hours to the infrastructure	6	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D14.1) Providing access of 236 hours to the infrastructure: The infrastructure will provide an access of 236 to the infrastructure for a total number of to 15 projects and 45 users. [month 18]

D14.2) Providing access of 163 hours to the infrastructure: The infrastructure will provide an access of 163 to the infrastructure for a total number of to 10 projects and 30 users. [month 30]

D14.3) Providing access of 236 hours to the infrastructure: The infrastructure will provide an access of 236 to the infrastructure for a total number of to 15 projects and 45 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP15	Type of activity [54]	SUPP
Work package title	100-m Radio Telescope Effelsberg		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

Name of the infrastructure: Radio Observatory Effelsberg

Location (town, country): Max-Planck-Straße 28, 53902 Bad Münstereifel, Germany

Web site address: http://www.mpifr-bonn.mpg.de/english/radiotelescope/informationAstronomers/index.html

Legal name of organisation operating the infrastructure: Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.

Location of organisation (town, country): Hofgartenstraße 8, 80539 München, Germany

Annual operating costs (excl. investment costs) of the infrastructure (€): 2.518.928

Description of the infrastructure:

The 100-m radio telescope of the Max-Planck-Institut für Radioastronomie (MPIfR) is a unique European astronomical facility that combines superb sensitivity and wide frequency coverage with distinct versatility, making the telescope not only a world-class instrument for astronomical research (rivalled only by the Green Bank Telescope in the US) but also a test bed for emerging and future innovative technology.

The telescope, located in a protected valley near Bad Münstereifel-Effelsberg, can be used to observe radio emission from celestial objects in a wavelength range from 73 cm (408 MHz) down to 3.5 mm (86 GHz). Its sensitivity at high frequencies is achieved through the accuracy of the surface profile (better than 0.5 mm rms), which is maintained over a wide range of elevation via a homologous design. In order to optimize its use, many of the telescope sub-systems are being continuously upgraded, as detailed below. The most recent upgrade includes a GUI-driven telescope control system allowing the observer an easy but powerful approach for advanced observing planning.

Description of work and role of partners

Modality of access under this project:

Observer’s access to the Effelsberg 100-m telescope is awarded on the basis of successful observing proposal, subject to a peer review procedure by a TAC (see below). MPIfR has adopted the web-based proposal tool “North Star” which was developed by the FP6 NA2 (Synergy) program. Proposals selected for observation are scheduled as soon as possible (normally within 3-6 months). ToO proposals can be submitted at any time. The Principal Investigator is responsible for the preparation, execution and analysis of the proposed observations. Therefore, it is expected that at least one of the investigators is present at the observatory for the scheduled observing time to maximize feedback and flexibility. Absentee and remote observations are possible and become more common for certain programs. The total observing time available per year is ~5000 hours (excl. test observations and reserved time for international obligations like VLBI). On average, about 5 user groups per year are hosted and supported under this proposal, with an average observing time per proposal of about three nights (~45 hours). Normally, one or two observers are present at the telescope. Hence, the estimated number of users over four years is 30; about 90 person-days are expected to be spent at the observatory.

Support offered under this project:

External users are offered support by specialised and experienced local staff at all project stages: scientific and technical support for the preparation of the proposal, during the observations as well as during the data reduction process. In addition, technical staff at the radio observatory (receiver engineers, telescope operators, etc.) is available at any time to ensure successful data taking. Users who gain access to the telescope can also count on the help of scientists ("friends of observers") from the institute's headquarters in Bonn who are experienced in the corresponding observing modes (spectroscopy, continuum, pulsars, and VLBI). Furthermore, the MPIfR provides external users with transportation from Bonn to the telescope site (~40 km distance), en-suite accommodation at the observatory (for one or two observers per project), a well-equipped library, office space, kitchen and computer access. A collection of all information necessary for observers can be found on the web pages of the observatory:
http://www.mpifr-bonn.mpg.de/english/radiotelescope/informationAstronomers/index.html.

In the past, a significant fraction of the support gained from the FP6 TNA program was used to enhance the existing infrastructure for visitors at the radio observatory as well as for the improvement of the information transfer (e.g., by the design of new web pages which are constantly updated).

Outreach of new users:

In order to provide easy access to information about the telescope capabilities and available support, a newsletter (http://www.mpifr-bonn.mpg.de/div/effelsberg/ newsletter/) is now issued with every call for proposals. This newsletter is sent out three times a year, about one month prior to the proposal deadlines. It is posted to the research institutes in the fields of radio astronomy and astrophysics, and distributed by electronic mail to a wide group of astronomers and astronomical institutes in Europe.

In 2002, the "International Max Planck Research School for Radio and Infrared Astronomy" (IMPRS) was established at the MPIfR offering interested students scholarships and dissertation projects in radio astronomy. Many of the students attending the IMPRS in the past years used the 100-m telescope on a regular basis. Experience shows that these students often act as "multipliers" in later stages of their career: they promote the instrument and initiate observing projects with their own students. In order to facilitate easy access to the telescope also for external students, in September 2010, a "Single Dish Summer School" took place at the MPIfR in Bonn and Effelsberg. In this school about 60 participants learned how to plan, carry out, and analyse single-dish observations.

Review procedure under this project:

The Programme Committee Effelsberg (known as PKE), currently consists of three members elected from the scientific staff of the institute, and five experts (2 Germans + 3 Europeans) from outside the MPIfR. The PKE meets face-to-face three times per year to assign grades and allocate observing time to successful proposals. After the meeting, the proposers receive a notification about the assessment including the grade, amount of time granted, the comments of the referees, and – if necessary – scheduling information.

Every two years an external Scientific Advisory Committee of the MPIfR visits the institute. During these visits, aspects of the allocation process and of the usage of the telescope are reviewed and discussed. Results of these discussions are reported to the MPG president and the institute directors and discussed by the scientific council of the MPIfR.

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	MPG	0.03
	Total	0.03

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D15.1	Providing access of 339 hours to the infrastructure	1	0.01	O	PU	18
D15.2	Providing access of 228 hours to the infrastructure	1	0.01	O	PU	30
D15.3	Providing access of 339 hours to the infrastructure	1	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D15.1) Providing access of 339 hours to the infrastructure: The infrastructure will provide an access of 339 to the infrastructure for a total number of to 7 projects and 11 users. [month 18]

D15.2) Providing access of 228 hours to the infrastructure: The infrastructure will provide an access of 228 to the infrastructure for a total number of to 6 projects and 8 users. [month 30]

D15.3) Providing access of 339 hours to the infrastructure: The infrastructure will provide an access of 339 to the infrastructure for a total number of to 7 projects and 11 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP16	Type of activity [54]	SUPP
Work package title	LOFAR		
Start month	1		
End month	48		
Lead beneficiary number [55]	27		

Objectives

Name of the infrastructure: LOFAR

Location (town, country):
Fibre-connected antenna stations concentrated near Exloo, The Netherlands, and extending into Germany, France, Sweden, and the United Kingdom
Data processor in Groningen, The Netherlands
Control and User Support Center at ASTRON, Dwingeloo, The Netherlands

Web site address: http://www.astron.nl/radio-observatory/astronomers/lofar-astronomers

Legal name of organisation operating the infrastructure: Stichting International LOFAR Telescope (ILT)

Location of organisation (town, country): Dwingeloo, The Netherlands

Annual operating costs (excl. investment costs) of the infrastructure (€):4.457.570

Description of the infrastructure:

The Low Frequency Array (LOFAR) is a brand-new and uniquely powerful telescope operating at low frequencies, 10—240 MHz, for studies ranging from the Sun to the early universe, with a sensitivity orders of magnitude better than previous telescopes. LOFAR is an array of 40 antenna stations in the Netherlands and 8 stations in France, Germany, Sweden, and the United Kingdom; stations in other countries are in the planning stage. All stations are connected by fibre to the high-performance central data processing and archive facilities in Groningen, The Netherlands and further distributed systems. Dedicated LOFAR software has been developed to process and analyse the data for specific astronomical applications.

The ILT was founded under Netherlands law in November 2010, following an MoU cementing the collaboration between national LOFAR astronomy consortia in France, Germany, The Netherlands, Sweden, and the United Kingdom signed on the day of the array’s dedication (June 12, 2010). The ILT Board, which sets the overall science policy for the exploitation of all LOFAR facilities, has representatives from ASTRON and all participating national LOFAR astronomy consortia. Individual institutional partners, such as station owners, commit resources (LOFAR hardware and other facilities, money, and effort) that together cover the annual operations budget approved by the ILT Board. Individual antenna station owners make these available for ILT operations without transfer of ownership, and the ILT does not employ personnel. ASTRON, seated in Dwingeloo, the Netherlands, is the coordinating operational entity within the ILT; it employs the ILT Director, and commits the bulk of the annual operational resources. The ILT formally started its full functions on 1 January 2011.

Since 2009 ASTRON’s Radio Observatory has been conducting initial operations with LOFAR, in an intensive observing programme consisting of commissioning and early science projects, with increasing hardware and software availability. As of 2012, the ILT will have stable common-user operations for the first fully-fledged sciece programmes using an initial set of telescope modes. In parallel there will be continued development of software for more complex and processing-intensive applications.

Description of work and role of partners

Modality of access under this project:

Documentation and specification tools for designing observing projects are available online and users are welcome to draw on the advice of specialists on detailed instrumental setups and visit the observatory in Dwingeloo at any stage of their work.
The large initial volume of the raw data necessitates initial reduction within a week and hence users may be required to be present or in close interaction with the observatory immediately following the observation. Averaged visibilities and images are stored in the ILT's Long Term Archive facilities, which also has powerful computational facilities, enabling investigators to further process the data should they wish so. Observatory staff maintains the archive and facilitate open access to it. Archive use may in its own right require substantial use of LOFAR processing resources, and thus require allocation through a proposal and intervention by observatory staff.

Timely processing of the data through the correlator and ancillary powerful cluster computers is actually a major pacing item for observing projects, requiring careful resource management. The running of LOFAR resources for the ILT is therefore in the hands of expert operators at ASTRON, who control the flow of observations and monitor the state of the entire system. Observatory experts inspect the data quality soon after observation and provide feedback for the user as well as for the engineering staff involved in maintenance. Automated data reduction pipelines produce first-look results that are available to the users and the observatory staff alike. Engineers maintain the equipment, and they are continuously refining the data processing software at the heart of LOFAR.

Support offered under this project:

Support astronomers with expertise in a wide range of fields and techniques are available to advise all users at all stages of their projects, from proposal preparation, through observing specification, to data analysis. The Science Support Group is expanding in order to communicate and coordinate with the users, and to assist them in all aspects of their research projects. A substantial part of these interactions happens via the internet.

In addition, the observatory supports visiting scientists with office, computing facilities and accommodation. These facilities will be used by experienced users, working with observatory experts on creative projects that push LOFAR to its limits as well as new users. It is important that users who do not have easy access to the large, well-established key-science groups, are well supported to help them deal with a new instrument and large data volumes.

Outreach to new users:

The LOFAR partner institutes in the Netherlands and other countries participate in national consortia along with, typically, dozens of other institutes and individuals interested to participate in the scientific exploration of LOFAR. In addition, members of ASTRON and other LOFAR partner institutions through colloquia and presentations at other institutes as well as personal research contacts will continue to foster the use of LOFAR by the wider international community.

User meetings and workshops are planned at least twice yearly in the first few years, to be a forum for interaction and feedback, where users can learn about the latest scientific results and the latest technical capabilities of LOFAR. It is planned to offer further "LOFAR Data Analysis" schools, to introduce astronomers to the insights of LOFAR data and analysis software.

Review procedure under this project:

An international Programme Committee (PC), with scientists selected solely for their astronomical and technical expertise, is directly mandated by the ILT board, to carry out the uniform scientific and technical assessment of all LOFAR projects and proposals. It has already operated, in late 2009, for the commissioning and initial science proposals. Of the current 15 members, three are from Dutch institutes and the others are affiliated with institutes across Europe and in the USA.
The "Announcement of Opportunity for Observations with LOFAR" will be issued twice-yearly and will be e-mailed to a wide distribution list of more than 700 addresses, drawn from existing LOFAR contacts, the astrophysical literature, and lists of international astronomical institutes.

Proposals are submitted via a dedicated version of the web-based tool NorthStar. Support scientists and software engineers are at hand in the time leading to the submission deadline to provide expert information to proposers.

The PC members will then pre-grade each proposal on its scientific merit, and its technical feasibility and in a face-to-face meeting of the PC each proposal will be discussed and rated individually. Technical experts from ASTRON will be available to advise the committee at their request on technical as well as scheduling issues. Using the uniform PC assessments, the national consortia, may, in relation to the investments and operational contributions of their constituents, distribute shares of the observing time. Additional shares of time (so far set to total 10% in the first year of operations, and 20% in the second year) are available to proposers regardless of whether they or their environment have been contributing to the development of LOFAR.

In any case, multi-national teams, assembled on the basis of scientific expertise, will carry out the majority of the projects; an important task of the ILT is to organise operations that offer optimal support to these diverse user groups.

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time)

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
27	ILT	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D16.1	Providing access of 160 hours to the infrastructure	27	0.01	O	PU	18
D16.2	Providing access of 109 hours to the infrastructure	27	0.01	O	PU	30
D16.3	Providing access of 160 hours to the infrastructure	27	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D16.1) Providing access of 160 hours to the infrastructure: The infrastructure will provide an access of 160 to the infrastructure for a total number of to 6 projects and 26 users. [month 18]

D16.2) Providing access of 109 hours to the infrastructure: The infrastructure will provide an access of 109 to the infrastructure for a total number of to 4 projects and 18 users. [month 30]

D16.3) Providing access of 160 hours to the infrastructure: The infrastructure will provide an access of 160 to the infrastructure for a total number of to 6 projects and 26 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP17	Type of activity [54]	SUPP
Work package title	Westerbork Synthesis Radio Telescope (WSRT)		
Start month	1		
End month	48		
Lead beneficiary number [55]	2		

Objectives

Name of the infrastructure: Westerbork Synthesis Radio Telescope

Location (town, country): Westerbork/Dwingeloo, The Netherlands

Web site address: www.astron.nl

Legal name of organisation operating the infrastructure: ASTRON

Location of organisation (town, country): Dwingeloo, The Netherlands

Annual operating costs (excl. investment costs) of the infrastructure (€):1.323.932

Description of the infrastructure:

The Westerbork Synthesis Radio Telescope (WSRT), owned and operated by ASTRON in The Netherlands, has 14 fully-steerable parabolic reflectors, distributed in an East-West configuration of 2700m length. It is equipped with a sensitive receiver package providing almost continuous coverage at decimeter and centimeter wavelenghts as well as frequency agility. Coupled to its flexible half-million channel correlator, and its modern pulsar and VLBI backends, the WSRT continues to be a uniquely capable facility in the world that is consistently oversubscribed and draws a wide international user base.

The WSRT will see its next major upgrade in 2012-13. An ambitious 21cm receiver system, “Apertif”, consisting of phased-array feeds and digital beamformer, developed at ASTRON, will be installed at the focal plane of 12 (out of 14) of the WSRT dishes, replacing the current Multi-Frequency Frontends (MFFEs). The project is fully funded, has passed its critical design review, and has consistently been on schedule. With Apertif, many beams can be formed simultaneously at each dish (nominally 37), enlarging the instantaneous Field-of-View for the 12 WSRT dishes to 8 square degrees (an increase of a factor of 30 compared to the current WSRT) and 16384 spectral channels can be formed over a 300 MHz contiguous bandpass that can be tuned anywhere between 1000 and 1750 MHz. These new capabilities enable unique wide-field continuum, spectral line, and pulsar surveys in a wide 21cm band; the survey speed of the WSRT will increase by a factor 20.

For the first few years, the Apertif-equipped WSRT will be operated as a survey instrument for a large part of the available observing time. A significant part of the observing time will be available to smaller “open-time” projects available to all users. All proposals in the Apertif-era will be internationally peer-reviewed, as is the case for the current WSRT facilities.

Description of work and role of partners

Modality of access under this project:

Most WSRT observations are 12-hour synthesis runs, carried out by expert operators, who calibrate and tune the instrument beforehand, and monitor the state of the system from the integrated Control Room in Dwingeloo. Direct intervention of users, and/or their presence at the WSRT, is possible upon request, for example for certain complex pulsar observations, but most users specify their instrument settings and prepare their observing schedules online beforehand. Immediately upon completion of an observation the data may be retrieved over the internet (the WSRT archive is connected at 10 Gbit/s). The data can also be analysed during a visit to Dwingeloo (see below). The data are stored in the archive but remain available for the private use of the investigators for twelve months after completion of the observations, after which they become publicly available.

Observatory experts inspect the data quality soon after observation, and provide feedback for the user as well as for the engineering staff involved in maintenance. An automated data reduction pipeline produces first-look results that are available to the users and the observatory staff alike. Users are always assured of adequate data quality, because in those rare instances where an observation is affected by technical problems to the extent that it is not usable for the scientific goals of the proposal, WSRT staff will automatically reschedule that observation.

When APERTIF is operational, it is expected that manpower from the survey collaborations will contribute to the inspection and processing of the data. ASTRON will offer further expert advice in scheduling and will continue the development of software, and will manage the data archive. All Apertif survey data will become part of the Open Access Archive and thus available to the global astronomical community.

Support offered under this project:

ASTRON astronomers with expertise in a wide range of fields and techniques are available to advise all users at all stages of their projects, from proposal preparation, through observing specification, to data analysis. A substantial part of these interactions happens via the internet. Up-to-date extensive technical information on WSRT systems is available at ASTRON’s website.

In addition, the observatory supports visiting scientists with office and computing facilities. They can stay on-site at the guesthouse of ASTRON. Inexperienced users often spend a week or so at ASTRON to analyse their data, guided by a local staff member. On the other hand, some of the most experienced users are also regular visitors, working with observatory experts on creative projects that require software or even hardware extensions to the existing instrumental capabilities.

Proposal preparation and submission, and project design, are facilitated by the web-based tools NorthStar and MoM. The transition from the current WSRT system to Apertif is planned as a relatively brief period of reduced operations while the receivers are changed (approximately 6 months in 2012-13, although some observing will be offered with the partial array). This has been taken into account in the profile of the TNA support request. It is followed by an intensive commissioning year, in which support from the observatory and interaction with the survey teams will be crucial. When Apertif becomes operational, in the second half of the period covered by this proposal, the smaller “open time” projects will be supported in the same way as described above.

Outreach of new users:

As one of the most powerful radio observatories in the world and one of the most sensitive elements of the European VLBI Network (EVN) of radio telescopes, the WSRT has excellent name recognition in the international community, and the general capabilities of the WSRT are widely known amongst the international astronomical community. In addition, ASTRON staff members often give presentations on recent highlights of WSRT-related research when visiting other astronomical institutes.

The six-monthly call for proposals is e-mailed to a wide distribution list of, at last count, approximately 600 addresses, drawn from recent proposals, the astrophysical literature, and lists of international astronomical institutes. The call summarizes the most recent advances in the capabilities of the WSRT, points out the opportunities of the RadioNet TNA programme, and refers to the WSRT web site (which was thoroughly revised in 2009) for much more elaborate information.

The call for “Expressions of Interest for Apertif Surveys” (EoIs) (deadline Sept 22, 2010), to the world-wide astronomical community, was sent to a large list of astronomers including those in the list of WSRT proposals. Eighteen EoI's were submitted and evaluated by a small committee. Authors of the selected EoI's were invited to attend a joint Apertif surveys workshop in Nov 22-23, 2010, to facilitate voluntary collaborations and to discuss in depth the various trade-offs that allow for maximum commensurability and scientific return of the surveys. Following these discussions a Call for Proposals is expected in the autumn of 2011.

Review procedure under this project:

The assessment and selection procedure is aimed simply at obtaining the best possible science results with the WSRT, and is open to scientists based in any country. WSRT proposals can be submitted and processed via the web-based tool NorthStar, the RadioNet web-based proposal tool. NorthStar also supports the proposal review activities.

The WSRT Programme Committee (PC) is composed of 10 members, selected from the international astronomical community on a personal basis for their knowledge of relevant research fields. They are appointed for a 3-year term. The astronomers of the Science Support Group (SSG) of ASTRON's Radio Observatory Division, advise the PC on technical issues.

The PC meets face-to-face twice per year, following research proposal deadlines around 15 March and 15 September, to discuss and rate observing requests for the subsequent semesters. SSG astronomers are present as technical and scheduling advisors, keeping track of the overall oversubscription and the efficient filling of the observing queue for the semester. Afterwards, a written (e-mail) is given to the proposers on the science case as well as other technical issues.

Proposals submitted in response to the “Call for Proposals for Apertif” (expected in the autumn of 2011), will also be assessed by the Programme Committee, in a similar fashion, and will be allocated time based on their scientific merit.

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time)

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	ASTRON	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D17.1	Providing access of 160 hours to the infrastructure	2	0.01	O	PU	18
D17.2	Providing access of 93 hours to the infrastructure	2	0.01	O	PU	30
D17.3	Providing access of 189 hours to the infrastructure	2	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D17.1) Providing access of 160 hours to the infrastructure: The infrastructure will provide an access of 160 to the infrastructure for a total number of to 4 projects and 18 users. [month 18]

D17.2) Providing access of 93 hours to the infrastructure: The infrastructure will provide an access of 93 to the infrastructure for a total number of to 3 projects and 10 users. [month 30]

D17.3) Providing access of 189 hours to the infrastructure: The infrastructure will provide an access of 189 to the infrastructure for a total number of to 5 projects and 22 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP18	Type of activity [54]	SUPP
Work package title	IRAM: Plateau de Bure Interferometer (PdBI) & 30-meter Telescope (PV)		
Start month	1		
End month	48		
Lead beneficiary number [55]	3		

Objectives

Name of the infrastructure: Plateau de Bure Interferometer (PdBI) & 30-meter Telescope (PV)

Location (town, country):

- Plateau de Bure Interferometer: Hautes-Alpes, France
- 30-metre Telescope: Pico Veleta, Granada, Spain

Web site address: http://www.iram-institute.org/

Legal name of organisation operating the infrastructure: : Institut de Radioastronomie Millimétrique (IRAM)

Location of organisation (town, country): Saint-Martin d'Hères, France

Annual operating costs (excl. investment costs) of the infrastructure (€):

30-m Telescope (PV): 2.865.268
Plateau de Bure Interferometer (PdBI): 4.337.962

Description of the infrastructure:

The 30-m telescope located at an altitude of nearly 3000m on the Pico Veleta in the Spanish Sierra Nevada has been designed with a surface accuracy and a pointing capability for observations in the atmospheric windows at 3, 2 and 1 mm. Occasionally the telescope is even used at 0.8 mm during particularly favourable atmospheric conditions.

While other telescopes exist in Europe that can observe in the 3mm atmospheric window, e.g. the 100m telescope in Germany, the Onsala telescope in Sweden, and the Metsahovi telescope in Finland, and while European groups operate (sub-)mm-telescopes like APEX in Chile and the JCMT in Hawaii, the IRAM 30-m telescope is by far the most sensitive in its wavelength range. It offers unique observing capabilities through the simultaneous availability of several low-noise heterodyne receivers (EMIR), an 18-channel heterodyne array (HERA) and a 119 channel bolometer array (MAMBO). The heterodyne receivers can be connected to a variety of analogue and digital backends that allow spectroscopic studies at resolutions between 3.3 KHz and 4 MHz. One of the backends is capable of making cross correlations, a feature which is used for polarization observations.

The telescope is also equipped with a Mark IV VLBI terminal, and VLBI experiments at 3, 2 and 1.3mm wavelengths have successfully been carried out in recent years. By combining the 30m-telescope with the 15-m diameter antennas on the Plateau de Bure Observatory, it has indeed been possible to detect for the first time fringes with high signal/noise ratio in a VLBI experiment at 1.3mm. The 30-m telescope is also very well suited and often used for complementing interferometer maps with short spacing information.

The Plateau de Bure Interferometer started in 1990 as a 3-element array. It is located at 2550m altitude in the French Alps, near Gap. Since then, 3 more 15-m diameter antennas have been added, and today all 6 telescopes are equipped with low-noise heterodyne receivers for the 3mm, 2mm, 1mm and 0.8mm atmospheric windows. The SSB receivers provide a contiguous bandwidth of 4 GHz in each polarization. There is at present no other interferometer on the Earth that offers the same sensitivity at these wavelengths. With baselines up to

768 meters (in east-west direction) it allows sensitive imaging at sub-arcsecond resolution (0.2-0.3 arcsec at 1.2mm wavelength).

The signals from the 6 antennas are processed by two IRAM-developed digital correlators, which allow a large variety of observing modes and the possibility to phase up all 6 antennas for VLBI experiments. Global VLBI experiments at 3mm wavelength together with the American VLBA and a number of European telescopes are performed twice a year. VLBI observations at 1.3mm were performed with the 30m telescope, and in the longer term experiments are planned that also use the ALMA antennas in Chile.

A major upgrade is currently proposed that will transform the Plateau de Bure Interferometer into a new qualitatively different and much more powerful instrument, the NOEMA Interferometer. The project consists in doubling the number of 15m antennas (from 6 to 12), increasing the total IF of the receivers from 8 to 32 GHz, and extending the East-West baseline from 0.8 to 1.6km. Together with the IRAM 30-meter telescope, the proposed enhancement will provide the scientific community full access to all of the millimetre windows, from about 70 to 375 GHz, in the northern hemisphere, with a unique combination of two complementary facilities.

Description of work and role of partners

Modality of access under this project:

Access to both IRAM facilities is through a proposal submission followed by a peer review process. IRAM issues twice per year (mid-March and mid-September) a Call for Proposals for both instruments corresponding to the summer and winter semesters. The observing periods last from June 1st to November 30th, and from December 1st to May 31st.
The observed data are validated by IRAM staff and made available to principal investigators. All astronomical data are archived in the IRAM archives. Data headers are also archived at the Centre des Données astronomiques de Strasbourg (CDS) for public searching and listing.

Support offered under this project:

IRAM provides all the necessary logistics and the best possible environment for users to ensure that their research projects are successful, at the time of the proposal submission deadline, during the data acquisition phase, and later on throughout the data analysis stage. Be it at the 30m telescope or during visits at the IRAM headquarters (Grenoble), users of the facilities benefit from a high-quality administrative and scientific support service (a local contact astronomer in Grenoble for users of the Plateau de Bure interferometer, and astronomers and operators at the observatory and in Granada for users of the 30m telescope), and dedicated training from astronomers and specialists in millimetre radioastronomy. Scientists from EU countries receive the same support during the observations and during the data reduction phase.

Outreach of new users:

Under the TNA scheme, every “Call for Observing Proposals” explicitly advertises the possibility of access based on the scientific merit to both the Plateau de Bure interferometer and the 30-metre telescope. IRAM will encourage astrophysicists who are not familiar with millimetre astronomy to apply for observing time on the facilities and publicizes the TNA scheme through seminars, lectures, users meetings and conferences. IRAM also makes publicity for TNA on its website, in printed form via the IRAM Newsletter, and informs users about the possibility of funding in the Calls for Proposal and eligible users when reporting IRAM Director’s approved recommendations resulting from the IRAM Program Committee meetings.

Review procedure under this project:

The fundamental principle for allocating time at the IRAM Observatories is the scientific merit of the proposals received. A Program Committee comprising 12 members reviews the proposals, issues recommendations based on scientific merit and technical feasibility, and advises the IRAM Director. The successful proposals may be A-rated (leading to a direct allocation of time at both observatories, and with a guaranteed successful completion for the Plateau de Bure interferometer) or B-rated (scheduled at the telescope with a lower priority, i.e. no guarantee of observing time, which allows for scheduling flexibility and overall balance). Typically, 30% of the observing time goes to observers that are not from one of the IRAM partner countries. For proposals received under the TNA scheme, the same procedure is applied, with the same peer review process in place. All A-rated projects are scheduled, no matter how much time is needed to achieve their scientific aims. IRAM has implemented a scheme to include requests for large amounts of observing time (>100 hours) for key science projects and legacy programmes.

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time)

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
3	IRAM	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D18.1	Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure	3	0.01	O	PU	18
D18.2	Providing access of 36 (PdBI) and 96 (PV) hours to the infrastructure	3	0.01	O	PU	30
D18.3	Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure	3	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D18.1) Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure: The infrastructure will provide an access of 43 (PdBI) and 142 (PV) hours to the infrastructure for a total number of to 18 (PdBI) and 37 (PV) projects and 70 (PdBI) and 112 (PV) users. [month 18]

D18.2) Providing access of 36 (PdBI) and 96 (PV) hours to the infrastructure: The infrastructure will provide an access of 36 (PdBI) and 96 (PV) hours to the infrastructure for a total number of to 14 (PdBI) and 26 (PV) projects and 60 (PdBI) and 76 (PV) users. [month 30]

D18.3) Providing access of 43 (PdBI) and 142 (PV) hours to the infrastructure: The infrastructure will provide an access of 43 (PdBI) and 142 (PV) hours to the infrastructure for a total number of to 18 (PdBI) and 37 (PV) projects and 70 (PdBI) and 112 (PV) users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP19	Type of activity [54]	SUPP
Work package title	APEX (Atacama Pathfinder Experiment)		
Start month	1		
End month	48		
Lead beneficiary number [55]	7		

Objectives

Name of the infrastructure: APEX (Atacama Pathfinder Experiment)

Location (town, country): Llano Chajnantor, Chile (at 5100 m altitude in the Atacama Desert; the base camp is located in Sequitor, close to the town San Pedro de Atacama).

Web site address: www.chalmers.se/oso/observations/apex

Legal name of organisation operating the infrastructure: Chalmers tekniska högskola AB

Location of organisation (town, country): Göteborg, Sweden

Annual operating costs (excl. investment costs) of the infrastructure (€):623.086 (OSO share)

Description of the infrastructure:

Onsala Space Observatory at Chalmers University of Technology (OSO) is the Swedish National Facility for Radio Astronomy. It operates two telescopes at Onsala, a 25 m cm-wave telescope and a 20 m mm-wave telescope, and it is one of three partners in the Atacama Pathfinder Experiment (APEX) project, a 12 m sub-mm telescope in Chile. OSO also provides the channel through which Sweden is involved in large international radio astronomy projects, such as the EVN, JIVE, LOFAR, ALMA, and SKA, and it is a partner in RadioNet.

In RadioNet3, a total of 279 hours (about 70 hours/year) of observing time on APEX is offered to the TNA programme.
APEX is a 12-m sub-mm radio telescope located at 5100 m altitude on Llano Chajnantor, Chile (see http://www.apex-telescope.org/). The telescope is of excellent quality (15 µm rms surface accuracy; Güsten et al. A&A 454, L13) and the site is also excellent as proven by the successful operation at 1.5 THz (Wiedner et al. A&A 454, L33). Observations are carried out from early April to late December (excluding the Bolivian winter). In 2011, it started its fifth year of regular, scheduled observations.

OSO is one of three partners that operate APEX, and its share of the total costs is 23%. This is also the Swedish share of the observing time, but, as the host country, Chile gets 10% of the Swedish time. Consequently, OSO distributes 21% of the observing time to the community. The partners have signed a contract to operate APEX until the end of 2015, with a possible extension to 2017.

APEX is equipped with a suite of bolometer cameras and single-pixel heterodyne receivers as common-user instruments, covering the range 1.3 mm to 0.2 mm. Currently, the LABOCA 295- channel 870 µm bolometer array, the SABOCA 37-channel 350 µm bolometer array, and the 4- channel heterodyne receiver (230, 350, and 500 GHz, an 1.3 THz) are installed as common-user instruments. Additional instruments, so called PI-instruments, are available through collaborations with the groups responsible for them. Among the PI instruments, CHAMP+ (two 7-channel heterodyne arrays at 690 and 810 GHz) can be mentioned. The spectrometer is of the FFT-type and covers 2 GHz with a total of about 32000 channels.

The telescope and its instruments provide a unique opportunity for European astronomers to observe southern sky objects in continuum and spectroscopic mode at sub-mm wavelengths. Astrophysical questions such as the origin of large-scale structure in the universe and the origin of stars and planetary systems are addressed.

The APEX common-user receivers are:

1) 870 µm (Temperature: 60 – 100 mJy Hz0.5 (NEFD); Type: 295 channel bolometer array);
2) 350 µm (Temperature: 200 mJy Hz0.5 (NEFD); Type: 37 channel bolometer array);
3) 210 – 270 GHz (Temperature: ~125 K @ 211–240 GHz,~190 K @ 240 –270 GHz (SSB); Type: SIS mixer);
4) 270 – 380 GHz (Temperature: ~135 K over 60% of the band, higher at the highest frequencies (SSB); Type: SIS mixer);
5) 380 – 500 GHz (Temperature: 100 K (DSB); Type: SIS mixer);
6) 1.25 – 1.39 THz (Temperature: <1200 K (DSB; 80% of the band); Type: HEB mix)

Description of work and role of partners

Modality of access under this project:

Access to APEX is through a proposal and peer review process (see below). The observations at APEX are complicated by the high altitude of the telescope, 5100 m, which prevents the use of a regular visiting-astronomers scheme. APEX observations are therefore made in semi-service mode through a scheme where the APEX staff and (selected) visiting astronomers carry out the observations. The observations are scheduled in roughly five 11-day blocks spread over the year. For each block, OSO coordinates the selection of about two visiting astronomers that will help to execute all observations scheduled in the block. These observers must pass a high-altitude physical test. The help of visiting astronomers increases the amount of usable observing time by about 50%, and thus is absolutely essential for an effective use of the investment. Users must fill in a web-based "Project submission form". The observed data is validated by the APEX staff, distributed to PIs on CDs, and archived in the ESO archive.

Support offered under this project:

The observations are carried out in semi-service mode as described above. TNA-eligible users may act as visiting astronomers (subject to a physical test) at the expense of OSO. OSO offers help, both during the proposal phase and the data reduction phase, to those unfamiliar with radio astronomy methods and techniques.

Outreach of new users:

Calls for proposals are issued twice per year, and they are available at the OSO web site (http://www.chalmers.se/rss/oso-en/observations/proposals). Information about the Calls is also sent by email to more than one hundred previous users of OSO telescopes and other potentially interested astronomers. By providing clear guidelines and on-line tools for estimating observing time, the proposal process is made as simple as possible for new users.

Community funding of Transnational access to Swedish time on APEX will make it possible to extend the daily number of operating hours, thereby providing European astronomers new opportunities to use the facility. The demand on APEX from Swedish astronomers is high; the TNA programme will allow user groups with no Swedish members to use APEX. The possibility for European astronomers to use APEX under the TNA programme will be clearly advertised in the Calls for proposals. Based on the result for the RadioNet FP7 TNA programme, a higher demand for access from TNA-eligible user groups than the amount of observing time offered in the TNA programme is expected.

Review procedure under this project:

Observing proposals for Swedish time on APEX are accepted twice per year, April 15 and October 15, and are evaluated in terms of scientific merit by a Time Allocation Committee (TAC) with five members. The actual observing time scheduled on the telescope is determined by the APEX staff based on the recommendations by the TAC (the scheduled time can differ slightly from the recommended time, due to, e.g., weather conditions and the availability of the requested local sidereal time interval). Up to a maximum of 30% of the observing time distributed by the committee can be allocated to Large Programmes. The definition of a Large Programme is similar to that used by ESO (e.g., a minimum of 100 hours telescope time, a potential to lead to a major advance in the field of study, and a strong scientific justification).

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time)

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
7	OSO	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D19.1	Providing access of 103 hours to the infrastructure	7	0.01	O	PU	18
D19.2	Providing access of 73 hours to the infrastructure	7	0.01	O	PU	30
D19.3	Providing access of 103 hours to the infrastructure	7	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D19.1) Providing access of 103 hours to the infrastructure: The infrastructure will provide an access of 103 to the infrastructure for a total number of to 5 projects and 21 users. [month 18]

D19.2) Providing access of 73 hours to the infrastructure: The infrastructure will provide an access of 73 to the infrastructure for a total number of to 4 projects and 14 users. [month 30]

D19.3) Providing access of 103 hours to the infrastructure: The infrastructure will provide an access of 103 to the infrastructure for a total number of to 5 projects and 21 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	283393	Project Acronym [2]	RadioNet3

One form per Work Package

Work package number [53]	WP20	Type of activity [54]	SUPP
Work package title	Sardinia Radio Telescope (SRT)		
Start month	1		
End month	48		
Lead beneficiary number [55]	4		

Objectives

Name of the infrastructure: Sardinia Radio Telescope

Location (town, country): San Basilio, Italy

Web site address: www.ira.inaf.it

Legal name of organisation operating the infrastructure: Istituto Nazionale di Astrofisica

Location of organisation (town, country): Rome, Italy

Annual operating costs (excl. investment costs) of the infrastructure (€): 2.223.696

Description of the infrastructure:

The Italian radioastronomical facilities of the Istituto Nazionale di Astrofisica (INAF) are operated by the Istituto di Radioastronomia (IRA) at two different sites, one in Medicina near Bologna (Emilia-Romagna), the other in Noto near Siracusa (Sicily), both hosting 32-m single-dish telescopes.

In collaboration with the observatories of Cagliari and Florence, the IRA is currently constructing the Sardinia Radio Telescope (SRT) in the location of San Basilio (about 35 km north of Cagliari, Sardinia). Operations are due to start in 2012 with the first-light receivers.

The SRT is a parabolic dish of 64 m diameter with the following characteristics at its final stage of completion:

• Shaped surfaces (primary and secondary): These mitigate multiple reflections between the secondary and the feed and optimize field-of-view and antenna efficiency.

• Active control of the primary mirror to compensate for gravitational deformations as well as thermal and steady wind distortions.

• Frequency coverage between 300 MHz and 100 GHz with (single- and multi-beam) state-of-the art receivers: This will allow observations at hitherto rarely explored frequencies, e.g. for the search of new molecular lines or full-polarisation studies of the high-frequency continuum emission.

• Multiple focus positions, frequency agility and multiple backends: The combination of these characteristics will rank the SRT among the most versatile and efficient single-dishes in Europe.

The SRT site is reasonably dry during the winter season (600 m altitude) and located in an orographic depression which acts as a natural wind-screen and reduces radio frequency interference, The expertise for design and construction of the SRT is largely based on the institute’s long-standing experience with its two 32-m dishes. The simultaneous operation of three observatories is facilitated by the intrinsic redundancy related with two almost equal, albeit smaller, radio telescopes (antennas, receivers, backends, and driving software). The SRT builds on developments prototyped at the Medicina and Noto antennas and will in many aspects represent the most advanced radio single-dish telescope in Europe. It will be able to offer opportunities to the astronomical community by 2012. The SRT will be among the largest five fully steerable single-dish radio telescopes in Europe and the largest one with an active primary surface (world-wide second only to the 100-m GBT). Because of its excellent metrology it will be particularly competitive above 20 GHz. Consequently, one of the first-light receivers will be a new 7-feed array for observations between 18 and 26 GHz, unique at this frequency in Europe.

In addition, digital backends will enormously increase the possibilities for signal analysis and greatly improve the observing efficiency for continuum, spectroscopy and pulsar applications. These hardware innovations are supported by enhanced control software which is currently being developed for usage at all three observatories.

Description of work and role of partners

Modality of access under this project:

As part of the Italian radio astronomical infrastructure the SRT will have a similar access policy to the Noto and Medicina telescopes. In principle, the IRA telescopes are used for single-dish observations for about 200 days per year. For the SRT a typical duration of few 10 hours per project can be assumed. All proposals are subject to peer-reviewing (see below). Users will have access to the entire suite of hardware operated by the observatory to perform observations in continuum, spectroscopy or pulsar observations. A plan for the implementation of the Italian telescope network foresees the central steering of all three antennas from a joint operation centre which will be set up at the three sites. The observations at each telescope will be supervised by specially trained operators who can work at any of the observatory sites. As for many standard observing programmes the presence of a visiting observer will not be required (e.g. in case of repetitive long-term programmes or simultaneous observations involving more than one instrument), the operators will ensure the execution of the observations according to the guidelines defined by the principal investigators of the project.

Support offered under this project:

The IRA observatories are staffed with small teams of engineers and astronomers. In general, observers are encouraged to come to the telescopes to carry out their observations themselves. They are lodged on the sites, and assisted by staff members over the duration of their project. A typical observing run commences with an introduction to the telescope and its observing system by one of the telescope staff members. This includes instruction on operating the antenna under computer control as well as the setup of frontends and backends. He/she is also introduced to the on-line data collection and quick-look analysis. In general, observers have a high degree of independence and are able to acquire a sufficient command of all necessary system procedures to reach the desired project goals. Handbooks of the system and some ‘electronic helpers’ (e.g. Exposure Time Calculator) are available via internet to facilitate the preparation phase. In case of emergency staff members can be called at any time to keep the loss of observing time to a minimum. After the end of an observing run the user is provided with the data in a widely used format (MBFits) for further analysis which can also be performed under the guidance of a local specialist either at the observatory or the institute’s headquarters at Bologna. Observers are invited to give seminars at the observatory or the institute in Bologna and collaborations with the observatory staff may be developed. The institutes in Cagliari and Bologna provide a stimulating astronomical environment due to the presence of several institutes (INAF and Universities) which together cover all branches of astronomy.

At the 32-m telescopes several observing campaigns are already being successfully performed via the Internet by experienced users. This mode of remote observing is expected to increase in the future with beginning-to-end monitoring of the project. An important contribution is the installation of the optical fibre link between the observatories and the institute at Bologna to the European Géant network. While this link is already in place and was successfully tested at Medicina, preparations are ongoing for the other sites.

Outreach of new users:

Calls for observing proposals are issued twice a year and published on the institute’s web site (http://www.ira.inaf.it/proposal) and the INAF Newsticker. They are also advertised via various email exploders currently reaching basically the entire Italian astronomical community and the Principal Investigators of previous projects. The Call for Proposals points to various sources of useful information that may be required to prepare and generate the proposal. In particular, research teams are requested to complete a form that contains all (personal, scientific and technical) information required for evaluation and scheduling of the project. Observing proposals for the periods from May 1 to October 31 and from November 1 to April 30 can be submitted electronically before the deadlines at the beginning of April and October using the web-based proposal submission engine. Target of Opportunity proposals can be submitted at any time.

In order to attract more users, especially from outside Italy, the Calls for Proposals will be distributed more widely to the international astronomical community. The Northstar proposal tool, developed in the framework of FP6 NA 2 (Synergy), will replace the existing proposal submission engine. This will further facilitate the access to the SRT, especially for astronomers not familiar with radio observations.

A lower limit for the future interest of the international radio community in the SRT can be extrapolated from the current observing requests for the smaller 32-antennas at Medicina and Noto. More than two thirds of the observing proposals are typically submitted from research groups outside the IRA. Judging from the informal requests from non-Italian institutions one can be confident that the SRT will meet a wide interest of the European astronomical community.

Review procedure under this project:

All users regardless of their origin follow the same procedure in requesting access to the IRA telescopes. Observing proposals are evaluated by the Time Allocation Committee (IRA-TAC). The five members of the IRA-TAC are appointed by the INAF president. Currently, the members are affiliated with five Italian research institutes. In future, the composition of the TAC is expected to include non-Italian representatives. Observing proposals are ranked according to their scientific merit and technical feasibility, taking into account technical advice provided by the telescope schedulers. The results (including the overall rating of the proposal as well as individual comments) are communicated to the proposers by email. If the proposal has been accepted for observations, it will be scheduled for observations within the following semester, taking into account a series of constraints (observers' preference, technical feasibility, general scheduling). After the observations, observers are encouraged to complete a user's feedback form to report any comment or complaint to the observatory staff.

Unit of Access:

Telescope hours (this time can include also pointing and calibration checks made for the particular project additionally to the observing time)

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
4	INAF	0.03
	Total	0.03

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D20.1	Providing access of 30 hours to the infrastructure	4	0.01	O	PU	18
D20.2	Providing access of 90 hours to the infrastructure	4	0.01	O	PU	30
D20.3	Providing access of 135 hours to the infrastructure	4	0.01	O	PU	48
		Total	0.03			

Description of deliverables

D20.1) Providing access of 30 hours to the infrastructure: The infrastructure will provide an access of 30 to the infrastructure for a total number of to 1 project and 1 user. [month 18]

D20.2) Providing access of 90 hours to the infrastructure: The infrastructure will provide an access of 90 to the infrastructure for a total number of to 4 projects and 4 users. [month 30]

D20.3) Providing access of 135 hours to the infrastructure: The infrastructure will provide an access of 135 to the infrastructure for a total number of to 6 projects and 6 users. [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT4:
List of Milestones

Project Number [1]	283393	Project Acronym [2]	RadioNet3

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Forming of the Board	WP1	1	3	CA signed
MS2	Appointment of the Management Team	WP1	1	4	Minutes of the Board Meeting
MS3	RadioNet3 Consortium Board Meeting	WP1	1	4	Minutes of the Board Meeting
MS4	RadioNet3 Consortium Board Meeting	WP1	1	16	Minutes of the Board Meeting
MS5	RadioNet3 Consortium Board Meeting	WP1	1	28	Minutes of the Board Meeting
MS6	RadioNet3 Consortium Board Meeting	WP1	1	42	Minutes of the Board Meeting
MS7	Policy Meetings	WP2	2	16	Decision List
MS8	Meeting Outreach Officers	WP2	4	18	Decision List
MS9	1st Draft of the white paper	WP2	2	17	Drafting the document
MS10	Policy Meetings	WP2	2	28	Decision List
MS11	2nd Draft of the white paper	WP2	2	29	Drafting the document
MS12	Policy Meetings	WP2	2	40	Decision List
MS13	Organization of 11th EVN Symposium (Bordeaux, FR)	WP3	4	8	Conference organised
MS14	Organization of a large conference on ALMA Early Science (Garching, DE)	WP3	4	10	Conference organised
MS15	Organisation of the Workshop on Early Results from LOFAR	WP3	4	15	Conference organised
MS16	Organisation of a Large Conference (TBD)	WP3	4	21	Conference organised
MS17	Organization of 12th EVN Symposium	WP3	4	31	Conference organised

WT4:
List of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS18	Organisation of a Large Conference (TBD)	WP3	4	39	Conference organised
MS19	Invite proposals for events to receive modest support	WP4	6	2	Web-based material
MS20	SOC, date/venue and announcements for major events	WP4	3	4	Report
MS21	Feedback from major and other events and lessons for future organisation	WP4	3	9	Report from the event
MS22	Accumulation of resources for learning new skills	WP4	3	10	Web-based material
MS23	Invite proposals for events to receive modest support	WP4	6	14	Web-based material
MS24	SOC, date/venue and announcements for major events	WP4	6	16	Report
MS25	Feedback from events and lessons for future organisation	WP4	6	22	Report from the event
MS26	Invite proposals for events to receive modest support	WP4	6	26	Web-based material
MS27	SOC, date/venue and announcements for major events	WP4	20	28	Report
MS28	Feedback from events and lessons for future organisation	WP4	20	34	Report from the event
MS29	Feedback from major and other events and lessons for future organisation	WP4	6	35	Report from the major event
MS30	Invite proposals for events to receive modest support	WP4	6	38	Web-based material
MS31	SOC, date/venue and announcements for major events	WP4	6	40	Report

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS32	Feedback from events and lessons for future organisation	WP4	6	46	Report from the event
MS33	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	WP5	15	9	Minutes from the meeting
MS34	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	WP5	15	21	Minutes from the meeting
MS35	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	WP5	15	33	Minutes from the meeting
MS36	Discussion of the ARC node team to prepare updates of the 'User Guide to the European ARC'	WP5	15	45	Minutes from the meeting
MS37	TWS Workshop 1	WP6	4	5	Meeting web-page
MS38	TOG Meeting 1	WP6	1	9	Meeting web-page
MS39	TWS Workshop 2	WP6	4	17	Meeting web-page
MS40	TOG Meeting 2	WP6	1	25	Meeting web-page
MS41	TWS Workshop 3	WP6	4	33	Meeting web-page
MS42	TOG Meeting 3	WP6	1	41	Meeting web-page
MS43	TWS Workshop 4	WP6	4	45	Meeting web-page
MS44	CRAF Meeting No. 1	WP7	1	8	Meeting web-page
MS45	CRAF Meeting No. 2	WP7	1	20	Meeting web-page
MS46	CRAF Meeting No. 3	WP7	1	32	Meeting web-page
MS47	CRAF Meeting No. 4	WP7	1	44	Meeting web-page
MS48	Completed hardware design	WP8	2	11	Design document
MS49	Completed correlator firmware design	WP8	5	11	Design document
MS50	Completed digital receiver firmware design	WP8	4	11	Design document

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS51	Completed beam former firmware design	WP8	1	11	Design document
MS52	Completed pulsar binning firmware design	WP8	6	14	Design document
MS53	Completed RFI mitigation firmware design	WP8	18	14	Design document
MS54	Prototype hardware	WP8	2	27	Prototype
MS55	Device test reports from AMSTAR+ cryo-run delivered to IAF (Task 1)	WP9	1	8	Internal Report
MS56	Decision about horn design (Task 2)	WP9	12	11	Report
MS57	Cryo-run 1 finished and diced, devices delivered to testing labs (Task 1)	WP9	19	18	Internal Report, MMIC Devices
MS58	Delivery of 7-pixel feed array (Task 2)	WP9	12	18	Module and report
MS59	Decision about amplifier design (Task 2)	WP9	13	18	Report
MS60	Design of mixer array finished (Task 2)	WP9	3	18	Design Report
MS61	Technical specification of sub-systems (Task 4)	WP9	12	18	Design Report
MS62	Prototype of wideband OMT fabricated (Task 1)	WP9	4	24	Internal Report
MS63	Validation of IF coupler design (Task 2)	WP9	7	24	Report
MS64	Preliminary design of band 10 2SB/Balanced mixer (Task 3)	WP9	10	24	Report
MS65	Preliminary design of compact IF amplifier and hybrid (Task 3)	WP9	10	24	Design Report

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS66	SIS Technology development progress report (Task 3)	WP9	10	24	Progress Report
MS67	Mixer-and LO chain design completed (Task 4)	WP9	12	24	Test Report
MS68	Cryo-run 2 finished and diced, devices delivered to testing labs (Task 1)	WP9	19	30	Internal Report, MMIC devices
MS69	Delivery of 7 IF hybrid couplers (Task 2)	WP9	7	30	Couplers and Report
MS70	Evaluate feasible bandwidths for LNA and OMT designs; Decision on Noise BW trade-off (Task 1)	WP9	1	31	Internal Report
MS71	Delivery of Mixer and LO chain (Task 4)	WP9	12	33	Modules
MS72	Finished final MMIC testing (Task 1)	WP9	1	34	Internal Report
MS73	Wideband dual polarization W-band pixel module suitable for array integration fabricated (Task 1)	WP9	1	36	Report, Module
MS74	Delivery of final 4-12GHz MMIC LNAs for SIS/HEB IF amplifiers (Task 1)	WP9	19	36	MMIC devices tested on-wafer @300K
MS75	Delivery of IF amplifiers (Task 2)	WP9	13	36	Amplifiers and Report
MS76	Delivery of 2SB mixers (Task 2)	WP9	3	36	Mixers and Report
MS77	Delivery of LO source (Task 2)	WP9	9	36	LO and Report
MS78	Production and test of IF components (Task 3)	WP9	10	36	Prototype and Test Report
MS79	Test of W-band module presumably at 30m telescope (Task 1)	WP9	3	42	Prototype and Test Report

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS80	7-pixel receiver prototype fabricated and tested (Task 2)	WP9	3	42	Prototype and Report
MS81	Production and test 2SB mixer (Task 3)	WP9	10	42	Prototype and Test Report
MS82	Common test of 2SB mixer and IF components (Task 3)	WP9	10	42	Test Report
MS83	SIS Technology development final report (Task 3)	WP9	10	42	Final Report, Test Junctions
MS84	Full testing of Mixers with LO chain (Task 4)	WP9	12	42	Test Report
MS85	Conceptual Review	WP10	2	12	Review D10.1
MS86	Design Review of optimisation strategies	WP10	15	18	Review D10.2, D10.4
MS87	Design Review of Fast Transient Imager	WP10	2	18	Review D10.6
MS88	Design Review Parallel Solvers	WP10	12	18	Review D10.9
MS89	Completion of improved ParselTongue software	WP10	5	24	Code release D10.12 + test report
MS90	Completion of optimized imaging software	WP10	15	30	Code release D10.3 + test reports
MS91	Completion of FTI prototype software	WP10	2	30	Code release D10.7 + t
MS92	Completion of code library for parallel solvers	WP10	12	30	Code release D10.10 + test reports
MS93	Demonstrators completed	WP10	5	38	Code release + Review D10.5, D10.8, D10.11, D10.13
MS94	Final report completed	WP10	12	42	Review D10.14
MS95	MIC LNA design	WP11	7	12	Design document
MS96	Report on field survey of commercial components	WP11	7	13	Report
MS97	MIC LNA completed	WP11	7	15	Prototype

WT4:
List of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS98	Report on requirements for compatibility	WP11	7	15	Report
MS99	PCB prototype of ADB3 board	WP11	1	21	Prototype
MS100	PCB prototype of Core3	WP11	4	21	Prototype
MS101	Report on design of the custom part	WP11	7	22	Report
MS102	Prototype of ADB3 board	WP11	1	23	Prototype
MS103	Prototype of Core3	WP11	4	23	Prototype
MS104	MMIC LNA designs, two foundries	WP11	2	24	Design document
MS105	Prototype packaging	WP11	1	24	Prototype
MS106	MMIC LNA prototypes completed	WP11	2	27	Prototype
MS107	Prototype of custom part of 40 Gbps unit	WP11	7	29	Prototype
MS108	Design of front-end assembly	WP11	2	33	Design document
MS109	Realization of integrated feed prototype	WP11	2	39	Prototype

WT5:
Tentative schedule of Project Reviews

Project Number [1]	283393	Project Acronym [2]	RadioNet3

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	18	NN	This will be the review of the project development, achievements and future plans. It will be organised after the submission of the 2nd Periodic Report.

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	283393	Project Acronym [2]	RadioNet3

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17	WP 18	WP 19
1 - MPG	40.00	7.00	0.00	0.12	0.04	0.00	0.04	11.50	5.60	0.00	17.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
2 - ASTRON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.70	0.00	22.00	10.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
3 - IRAM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
4 - INAF	0.00	0.00	3.50	0.00	0.00	4.00	0.00	19.00	4.70	0.00	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 - JIVE	16.00	0.00	0.00	0.00	0.00	0.00	0.00	30.40	0.00	19.10	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 - UMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.50	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
7 - OSO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.60	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
8 - UCAM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 - STFC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
10 - SRON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11 - OBSPARIS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 - UOXF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13 - UAH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 - TUD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 - ESO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - KASI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 - BORD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18 - UORL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19 - Fraunhofer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 - U. Turku	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17	WP 18	WP 19
21 - UMK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22 - UCO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 - VENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 - AALTO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 - NRF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 - CSIRO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27 - ILT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Total	56.00	7.00	3.50	0.12	0.04	4.00	0.04	116.00	189.01	91.50	74.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 20	Total per Beneficiary
1 - MPG	0.00	81.33
2 - ASTRON	0.00	56.73
3 - IRAM	0.00	25.03
4 - INAF	0.03	54.23
5 - JIVE	0.00	65.53
6 - UMAN	0.00	9.53
7 - OSO	0.00	40.63
8 - UCAM	0.00	20.00
9 - STFC	0.00	8.03
10 - SRON	0.00	16.60
11 - OBSPARIS	0.00	9.90
12 - UOXF	0.00	38.00
13 - UAH	0.00	45.00
14 - TUD	0.00	13.81
15 - ESO	0.00	14.40
16 - KASI	0.00	0.00
17 - BORD	0.00	11.40
18 - UORL	0.00	9.50
19 - Fraunhofer	0.00	12.80
20 - U. Turku	0.00	0.00
21 - UMK	0.00	0.00
22 - UCO	0.00	9.00
23 - VENT	0.00	0.00
24 - AALTO	0.00	0.00
25 - NRF	0.00	0.00
26 - CSIRO	0.00	0.00

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 20	Total per Beneficiary
27 - ILT	0.00	0.03
Total	0.03	541.48

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	283393	Project Acronym [2]	RadioNet3

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 MPG	Part. 2 ASTRON	Part. 3 IRAM	Part. 4 INAF	Part. 5 JIVE	Part. 6 UMAN	Part. 7 OSO	Part. 8 UCAM	Part. 9 STFC	Part. 10 SRON	Part. 11 OBSPARI	Part. 12 UOXF	Part. 13 UAH	Part. 14 TUD
1. RTD/Innovation activities														
WP 8	11.50	24.70	0.00	19.00	30.40	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 9	5.60	0.00	25.00	4.70	0.00	0.00	16.60	10.00	8.00	16.60	9.90	12.00	45.00	13.81
WP 10	0.00	22.00	0.00	0.00	19.10	0.00	0.00	10.00	0.00	0.00	0.00	26.00	0.00	0.00
WP 11	17.00	10.00	0.00	23.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Research	34.10	56.70	25.00	46.70	49.50	9.50	40.60	20.00	8.00	16.60	9.90	38.00	45.00	13.81
2. Demonstration activities														
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Consortium Management activities														
WP 1	40.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Management	40.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Work Packages for Coordination activities														
WP 2	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 3	0.00	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 4	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 5	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 6	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 7	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Coordination	7.20	0.00	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WT7:
Project Effort by Activity type per Beneficiary

4. Other activities														
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Work Packages for Support activities														
WP 12	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
WP 14	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 15	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 17	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 18	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 19	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 20	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Support	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00

Total	81.33	56.73	25.03	54.23	65.53	9.53	40.63	20.00	8.03	16.60	9.90	38.00	45.00	13.81

WT7:
Project Effort by Activity type per Beneficiary

Activity type	Part. 15 ESO	Part. 16 KASI	Part. 17 BORD	Part. 18 UORL	Part. 19 Fraunho	Part. 20 U. Turk	Part. 21 UMK	Part. 22 UCO	Part. 23 VENT	Part. 24 AALTO	Part. 25 NRF	Part. 26 CSIRO	Part. 27 ILT	Total
1. RTD/Innovation activities														
WP 8	0.00	0.00	11.40	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	116.00
WP 9	0.00	0.00	0.00	0.00	12.80	0.00	0.00	9.00	0.00	0.00	0.00	0.00	0.00	189.01
WP 10	14.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	91.50
WP 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.00
Total Research	14.40	0.00	11.40	9.50	12.80	0.00	0.00	9.00	0.00	0.00	0.00	0.00	0.00	470.51
2. Demonstration activities														
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Consortium Management activities														
WP 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.00
Total Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.00
Work Packages for Coordination activities														
WP 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
WP 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50
WP 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
WP 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
WP 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
WP 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Total Coordination	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.70
4. Other activities														
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WT7:
Project Effort by Activity type per Beneficiary

Work Packages for Support activities														
WP 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
WP 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
WP 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Total Support	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.27

Total	14.40	0.00	11.40	9.50	12.80	0.00	0.00	9.00	0.00	0.00	0.00	0.00	0.03	541.48

WT8:
Project Effort and costs

Project Number [1]	283393	Project Acronym [2]	RadioNet3

Project efforts and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)							Total receipts (€)	Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Access costs (€)	Total costs		
1	MPG	81.33	502,208.33	0.00	130,929.94	703,091.67	532,433.74	1,868,663.68	0.00	1,671,626.18
2	ASTRON	56.73	421,983.33	13,500.00	25,037.50	277,830.00	222,293.16	960,643.99	0.00	779,431.28
3	IRAM	25.03	156,250.00	7,500.00	30,000.00	111,750.00	365,340.32	670,840.32	0.00	596,340.32
4	INAF	54.23	266,166.67	2,500.00	10,125.00	165,775.00	158,418.55	602,985.22	0.00	486,911.05
5	JIVE	65.53	369,833.00	82,500.00	801,184.50	702,610.50	1,037,576.32	2,993,704.32	0.00	2,459,125.52
6	UMAN	9.53	43,541.67	2,000.00	1,187.50	26,837.50	542,388.45	615,955.12	0.00	598,063.45
7	OSO	40.63	264,833.33	4,500.00	23,050.00	172,730.00	304,738.15	769,851.48	0.00	654,698.15
8	UCAM	20.00	79,006.67	0.00	15,950.00	56,974.00	0.00	151,930.67	0.00	113,948.00
9	STFC	8.03	49,155.33	5,625.00	25,700.00	51,613.10	355,077.36	487,170.79	0.00	455,553.68
10	SRON	16.60	96,833.33	0.00	2,100.00	59,360.00	0.00	158,293.33	0.00	118,720.00
11	OBSPARIS	9.90	49,500.00	0.00	2,000.00	30,900.00	0.00	82,400.00	0.00	61,800.00
12	UOXF	38.00	182,333.33	0.00	25,500.00	124,700.00	0.00	332,533.33	0.00	249,400.00
13	UAH	45.00	106,875.00	0.00	7,900.00	68,865.00	76,000.00	259,640.00	0.00	213,730.00
14	TUD	13.81	72,980.77	0.00	9,684.95	75,667.61	0.00	158,333.33	0.00	118,750.00
15	ESO	14.40	120,000.00	0.00	6,000.00	25,200.00	0.00	151,200.00	0.00	113,400.00
16	KASI	0.00	80,000.00	0.00	140,000.00	44,000.00	0.00	264,000.00	0.00	0.00
17	BORD	11.40	47,500.00	0.00	1,425.00	29,355.00	0.00	78,280.00	0.00	58,710.00
18	UORL	9.50	39,583.33	0.00	1,187.50	24,462.50	0.00	65,233.33	0.00	48,925.00
19	Fraunhofer	12.80	71,925.33	0.00	69,100.00	74,083.09	0.00	215,108.42	0.00	161,331.32
20	U. Turku	0.00	16,197.46	0.00	0.00	9,718.48	0.00	25,915.94	0.00	0.00

WT8:
Project Effort and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)							Total receipts (€)	Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Access costs (€)	Total costs		
21	UMK	0.00	0.00	0.00	0.00	0.00	38,000.00	38,000.00	0.00	38,000.00
22	UCO	9.00	48,750.00	0.00	2,900.00	30,990.00	0.00	82,640.00	0.00	61,980.00
23	VENT	0.00	0.00	0.00	0.00	0.00	38,000.00	38,000.00	0.00	38,000.00
24	AALTO	0.00	0.00	0.00	0.00	0.00	38,000.00	38,000.00	0.00	38,000.00
25	NRF	0.00	10,000.00	0.00	5,000.00	1,200.00	0.00	16,200.00	0.00	0.00
26	CSIRO	0.00	50,000.00	0.00	0.00	20,000.00	0.00	70,000.00	0.00	0.00
27	ILT	0.03	0.00	0.00	0.00	0.00	363,556.05	363,556.05	0.00	363,556.05
	Total	541.48	3,145,456.88	118,125.00	1,335,961.89	2,887,713.45	4,071,822.10	11,559,079.32	0.00	9,500,000.00

WT9:
Summary of transnational access / service provision per installation

Project Number [1]	283393	Project Acronym [2]	RadioNet3

Summary of transnational access / service provision per installation

Part. num.	Org. short name	Short name of infrastructure	Installation									
			Num.	Name	Operator country code	Unit of access	Total Estimated costs	Estimated unit cost	Min. quantity of access to be provided	Access costs charged to the GA	Est. num. of users	Est. num. of proj.
1	MPG	Effelsberg	1	Effelsber	Germany	hour	10,075,713.20	503.79	906.00	456,433.74	30	20
1	MPG	EVN	2	EVN-Effel	Germany	hour	10,447,631.94	125.00	608.00	76,000.00	266	133
2	ASTRON	WSRT	1	WSRT	Netherlands	hour	5,295,727.66	330.98	442.00	146,293.16	50	12
2	ASTRON	EVN	4	EVN-WSRT	Netherlands	hour	5,295,728.50	125.00	608.00	76,000.00	266	133
3	IRAM	IRAM	1	PdBI	France	hour	17,351,849.11	1,701.16	122.00	207,541.52	200	50
			2	PV	France	hour	11,461,070.26	415.26	380.00	157,798.80	300	100
4	INAF	SRT	1	SRT	Italy	hour	8,894,781.60	323.21	255.00	82,418.55	11	11
4	INAF	EVN	5	EVN-Mc	Italy	hour	9,199,432.00	43.75	608.00	26,600.00	266	133
4	INAF	EVN	6	EVN-Nt	Italy	hour	4,734,193.60	37.50	608.00	22,800.00	266	133
4	INAF	EVN	7	EVN-SRT	Italy	hour	8,797,732.60	43.75	608.00	26,600.00	266	133
5	JIVE	EVN	1	EVN-JIVE	Netherlands	hour	6,519,950.40	1,706.54	608.00	1,037,576.32	266	133
6	UMAN	e-MERLIN	1	e-MERLIN	United Kingdom	hour	9,307,141.75	734.47	635.00	466,388.45	120	40
6	UMAN	EVN	3	EVN-JBO	United Kingdom	hour	2,563,937.40	125.00	608.00	76,000.00	266	133
7	OSO	APEX	1	APEX	Sweden	hour	2,492,341.09	819.85	279.00	228,738.15	56	14
7	OSO	EVN	8	EVN-OSO	Sweden	hour	7,338,353.00	125.00	608.00	76,000.00	266	133
9	STFC	JCMT	1	JCMT	United Kingdom	hour	12,628,540.49	896.66	396.00	355,077.36	66	15
13	UAH	EVN	13	EVN-Yebes	Spain	hour	6,092,836.00	125.00	608.00	76,000.00	266	133
21	UMK	EVN	9	EVN-Torun	Poland	hour	3,256,566.00	62.50	608.00	38,000.00	266	133
23	VENT	EVN	10	EVN-Irben	Latvia	hour	2,046,717.00	62.50	608.00	38,000.00	266	133

WT9:
Summary of transnational access / service provision per installation

Part. num.	Org. short name	Short name of infrastructure	Installation									
			Num.	Name	Operator country code	Unit of access	Total Estimated costs	Estimated unit cost	Min. quantity of access to be provided	Access costs charged to the GA	Est. num. of users	Est. num. of proj.
24	AALTO	EVN	11	EVN-Metsa	Finland	hour	5,553,205.80	62.50	608.00	38,000.00	266	133
27	ILT	LOFAR	1	LOFAR	Netherlands	hour	17,830,281.22	847.45	429.00	363,556.05	70	16
						Grand Total	167,183,730.62			4,071,822.10		

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It cannot be changed unless agreed so during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

53. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

54. Type of activity

For all FP7 projects each work package must relate to one (and only one) of the following possible types of activity (only if applicable for the chosen funding scheme – must correspond to the GPF Form Ax.v):

• **RTD/INNO =** Research and technological development including scientific coordination - applicable for Collaborative Projects and Networks of Excellence

• **DEM =** Demonstration - applicable for collaborative projects and Research for the Benefit of Specific Groups

• **MGT =** Management of the consortium - applicable for all funding schemes

• **OTHER =** Other specific activities, applicable for all funding schemes

• **COORD =** Coordination activities – applicable only for CAs

• **SUPP =** Support activities – applicable only for SAs

55. Lead beneficiary number

Number of the beneficiary leading the work in this work package.

56. Person-months per work package

The total number of person-months allocated to each work package.

57. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

58. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

59. Milestone number

Milestone number:MS1, MS2, …, MSn

60. Delivery date for Milestone

Month in which the milestone will be achieved. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

61. Deliverable number

Deliverable numbers in order of delivery dates: D1 – Dn

62. Nature

Please indicate the nature of the deliverable using one of the following codes

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

63. Dissemination level

Please indicate the dissemination level using one of the following codes:

• **PU =** Public

• **PP =** Restricted to other programme participants (including the Commission Services)

• **RE =** Restricted to a group specified by the consortium (including the Commission Services)

• **CO =** Confidential, only for members of the consortium (including the Commission Services)

• **Restreint UE =** Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments

• **Confidentiel UE =** Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments

• **Secret UE =** Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments

64. Delivery date for Deliverable

Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date

65. Review number

Review number: RV1, RV2, ..., RVn

66. Tentative timing of reviews

Month after which the review will take place. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

67. Person-months per Deliverable

The total number of person-month allocated to each deliverable.

SEVENTH FRAMEWORK PROGRAMME

Capacities Specific Programme

Research Infrastructures

Grant agreement for: Integrating Activity – Combination of Collaborative Project and Coordination and Support Action

Annex I. - "Description of Work"

Project acronym: *RadioNet3*

Project full title: Advanced Radio Astronomy in Europe

Grant agreement no.: *283393*

Date of preparation of Annex I (latest version): Draft 13/09/2011

Date of approval of Annex I by Commission: *(to be completed by Commission)*

PART B

TABLE OF CONTENTS

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B 1.1 Concept and project objective(s)

Radio astronomical research in Europe is based on a suite of specialised radio telescopes that cover a range of wavelengths from decametres to sub-millimetres. Some radio telescopes are sensitive to low brightness emission from cold interstellar clouds, others have the unique capability to study the extremely bright emission from highly relativistic plasma in great detail. The variety of available angular resolutions, combined with state-of-the-art sensitivities have resulted in extremely versatile radio facilities.

European radio astronomers have access to a wide range of radio telescopes through a number of national facilities and through European collaborations where infrastructure providers have joined their efforts to establish and maintain world-class research facilities. Together the European nations provide the users with sensitive telescopes like the Effelsberg and Sardinia dishes, the millimetre telescopes of IRAM, JCMT and APEX, interferometers probing high resolution like WSRT, e-MERLIN and the EVN, and the IRAM interferometer at high frequencies.

While all these instruments are themselves undergoing spectacular upgrades, in the coming years the *RadioNet3* consortium will offer new, unique capabilities with the International LOFAR telescope becoming fully operational and the ALMA (sub-) millimetre-array being commissioned. Moreover, the healthy ambitions of the radio community are reflected in the leading role Europe has established in defining the SKA.

Building on the FP6 and FP7 Integrated Infrastructure Initiatives this programme will continue the organization of European radio astronomy under the flag of *RadioNet3*. The ambition of this program is to foster European radio astronomy, and to shape the radio astronomical scene in Europe into a complete, innovative and accessible set of research facilities. Specifically, *RadioNet3* provides a sustainable and broad-based platform for the continued organisation of the European radio astronomy community, which is essential for securing a lasting European leadership in all aspects of radio astronomy.

The transnational access (TNA) programme of *RadioNet3* is designed to stimulate the full exploitation of the open skies policy that has been at the core of the operations philosophy of most radio astronomical facilities for decades. Now, the advent of LOFAR and ALMA offer even better opportunities to involve many more European astronomers in *RadioNet3*, because of the new scientific fields (e.g. planet formation, astro-particles) these telescopes will open up. The networking activities (NAs) of *RadioNet3* transform the way science is conducted in Europe; they provide a natural forum for developing European collaborations, for the sharing of ideas and results and for mobilizing the researchers themselves. This is important with the emergence of new research opportunities through SKA and its pathfinder telescopes. The *RadioNet3* Joint Research Activities will support targeted R&D to the facilities upgraded under construction in the areas of new digital techniques that allow radio astronomers to make more efficient use of telescope hardware by increasing the observing bandwidth or the field of view of the telescopes. Some of the developments are specifically relevant towards reaching the ambitious goals that are set for the SKA.

This programme strikes a balance between the needs for user access and technological development. The innovative telescope facilities included in the programme are of paramount interest to the astronomical community in terms of transnational access. They are also those that will benefit most directly from the results of the research activities.

As an Integrating Activity, the mission of *RadioNet3* is to optimise the use and development of European radio astronomy infrastructures. The general goals of *RadioNet3* are:

- To provide and facilitate, for a growing community of European researchers, access to the complete range of Europe's outstanding radio-astronomical facilities, including the ALMA telescope, in order to address a wide range of topics in astronomy;
- To secure a long term perspective on scientific and technical developments in radio astronomy, pooling the skills, resources and expertise that exist within the *RadioNet3* partnership;
- To stimulate new R&D activities for the already existing radio infrastructures in synergy with ALMA and with the SKA, as the radio telescope of the future, ensuring that a healthy scientific and technical community will be ready and prepared for the SKA;
- To contribute to the implementation of the vision developed in the *ASTRONET Strategic Plan for European Astronomy* by building a sustainable radio astronomical research community with world leading qualifications.

B 1.2 Progress beyond the state of the art

The state-of-the-art in radio astronomy has advanced tremendously over recent years. Some of these advances have been the direct results of the *RadioNet* I3 activities under FP6 and their continuation in FP7. This holds for the development of multi-pixel cameras and focal-plane arrays for single dishes, dramatically expanding the imaging and surveying capabilities of telescopes operating at centimetre through sub-millimetre wavelengths. New advanced techniques for data handling and the implementation of new algorithms for interferometry have considerably enhanced the toolbox for radio astronomical processing, effectively creating a new community of expert users throughout Europe. The development of a generic digital board is about to bring a spectacular increase in computing power and I/O capacity of radio astronomical hardware. This will provide a unified framework for building the next generation of the "back-end" systems, such as receivers, formatters, samplers, and correlators.

RadioNet3 will play a role in stimulating European users to take advantage of the so-called SKA precursors ASKAP and MeerKAT (under construction in Australia and South Africa, respectively). Specifically, the e-MERLIN, LOFAR and e-EVN facilities are all SKA pathfinders and have been outfitted to do measurements in parts of parameter space, unmatched anywhere in the world. In addition, the WSRT is planning a multi-pixel receiver upgrade (Apertif), which will enhance its survey capabilities by an order of magnitude. All these instruments comprise a unique and multifaceted set of tools that enables addressing the most challenging problems of modern astrophysics and fundamental physics.

1.2.1 Networking activities – weaving the fabric of science

The networking activities of *RadioNet3* are specifically aimed at promoting timely and effective communication of results and uninterrupted interchange of ideas in European radio astronomy. They are linked to each other and to the TNA facilities and JRAs, to ensure that the Integrating Activity is indeed integrated and coherent. The NAs will comprise the following key WPs:

- *WP1* (*RadioNet3* Management) will lead and control the overall progress and the provision of the work plan, provide an effective and transparent management of the project, and assure the timely delivery of high quality deliverables and milestones. Together with WP2, WP1 will foster cooperation with other associated projects, e.g., SKA and ALMA development, and will assure RadioNet visibility in the world community.

- *WP2* (Questions on Structuring European Radio Astronomy) will provide the platform for discussions on preparing a long-term strategy for structuring radio astronomy in Europe. *RadioNet* provides the necessary coordination of the community in this context. Through WP2 the partners will represent and advertise the radio astronomy facilities and ambitions within the three major stakeholder communities: the European policy makers, the broader, European and worldwide astronomical community, and the general public.

- *WP3* (Science Working Group) will organize and support a range of radio science related conferences, topical workshops, and smaller collaboration meetings. These events will focus on the science goals of the facilities, ensure a central coordination in the dissemination of knowledge and scientific results among the partners, and address the broader astrophysical context of radio astronomical research.

- *WP4* (New Skills for Radio Astronomers) will train astronomers to exploit current and future radio astronomy facilities, focussing especially on *RadioNet3* facilities. This work will aim at broadening the radio astronomy user base and providing both the solid theoretical background and the hands-on, problem-solving skills necessary to maximize the scientific return from radio astronomical instruments.

- *WP5* (Mobility for ALMA Regional Centre Users) will enhance the ALMA Regional Centre nodes in Europe and strengthen the user community, by giving it access to the full, distributed ALMA expertise. At the same time, it will stimulate the ALMA expert nodes to establish best practices and exchange the latest insights in data processing and observation preparation.

- *WP6* (European Radio Astronomy Technical Forum) will foster, strengthen and extend the collaboration between the groups working on the development and operations of radio astronomy instruments in Europe. WP6 will promote enhanced communications, training and scientific interactions among engineers and scientists involved in the development and operation of radio astronomy instruments. This will provide a solid and formal ground for mutual growth of technical experience at and synergies between the various partner institutes.

- *WP7* (Radio Astronomical Spectrum Management) will provide a European voice within regulatory bodies to protect the radio astronomy bands, to ensure availability of the radio spectrum for scientific needs. It will bundle all the EU and African (ITU Region 1) radio astronomy observatories in decision-making consultations and/or meetings that deal with future access of the radio spectrum to fundamental research.

1.2.2. Transnational Access activities – ensuring scientific excellence

The *RadioNet3* facilities offer unique capabilities over an unprecedented range of wavelengths – from the largely uncharted territory of decametric astronomy, to be explored in detail by LOFAR, to the sub-millimetre emission measured by the JCMT, IRAM and APEX. Research organisations, universities or national observatories with well-established peer review processes that ensure the highest quality of their research host all these facilities. Many of the facilities now use the Northstar proposal tool developed in FP6 RadioNet, making it easier for new users to develop projects for telescopes they have not previously used. All the facilities take active steps in publicising their availability to the European astronomical community, often through meetings supported by the proposed networking activities. TNA-supported astronomers receive support at each stage of the observing process, have the opportunity to interact with scientists and engineers at these institutes, and very often develop long-term collaborations with staff at working at the facilities. This is the way to produce top-class science and to prepare the European community for the SKA at the same time.

Continued technical development and substantial investments over the past few years have maintained the global competitiveness of all these facilities and often gone beyond that by establishing truly unique European capabilities. At the same time, there is the opportunity for the community to access ALMA, giving sub-arcsecond capabilities for thermal emission at unprecedented sensitivity. It should be noted that the European community support for ALMA is served in a *RadioNet3* Networking Activity. But clearly this activity also continues the long-standing, bottom-up tradition of collaboration in radio astronomy that started with the EVN and owes much to EC Framework Programme funding. The TNA programme fosters this collaborative spirit amongst a much wider range of radio and sub-mm facilities than before, and thereby offers a unique chance for a wider range of new European users. The *RadioNet3 TNA programme will open an access to 20 state-of-the-art radio telescope facilities.*

1.2.3. JRA programme – technical development for future discoveries

The four *RadioNet3* Joint Research Activities share the objective to stimulate new R&D activities for the existing radio infrastructures, in synergy with ALMA and the development of the SKA. They form a coherent and integrated programme aimed at providing innovative developments, supporting the scientific programmes at the *RadioNet3* telescopes and keeping the facilities state-of-the-art. Ultimately they will provide leadership towards future developments and help determine the global developments towards the SKA.

- *WP8* (UniBoard[2]) will focus on the development of a generic high-performance computing platform for radio astronomy, along with the implementation of several different applications (correlator, digital receiver, aperture antenna beam former). This JRA will consolidate and build upon the experience obtained in the RadioNet-FP7 JRA UniBoard, and will create a completely re-designed platform with several innovative features, that will be ready for the next generation of astronomical instruments (especially the SKA), at the end of 2015.

- *WP9* (AETHER) will respond to the critical demand for novel broad-band millimetre and sub-millimetre (terahertz) detectors, which is essential for improving the performance and fully exploiting the capabilities of the leading facilities in these wavelengths, most notably the European (sub) millimetre telescopes, such as the IRAM 30-m telescope, PdBI, APEX and ALMA.

- *WP10* (HILADO) includes software developments to address the dramatic increase of the quality and volume of astronomical data expected to come with the advent of new facilities and advanced observational techniques. To this end new software for calibration, reduction and processing of these data is critically needed. HILADO will create optimized libraries and software components that enable high performance processing of the data from existing and new facilities (LOFAR, ALMA, e-MERLIN, EVLA, EVN), moving their scientific performance beyond the capabilities that will be delivered in their current development phases.

- *WP11* (DIVA) will develop key technology building blocks to consolidate the role of European VLBI and European radio astronomy in general as a leading competitor with respect to developments in the USA and Asia. New breakthroughs in global VLBI science are expected, with the advent of ultra-broad-band recording systems, greatly increasing the instantaneous sensitivity. DIVA addresses the need to prototype an extension of the present recording system with high-speed samplers, thus consolidating the leading European position in the global broadband interferometry developments.

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy and general description

RadioNet3 involves 27 partners who contribute to a total of 20 different work packages (7 Networking Activities, 4 Joint Research Activities and 9 Trans-National Access Activities). The management team will centrally control the Integrating Activity. The centralization is limited to the degree appropriate for this large consortium and encourages and supports efficient self-management within the individual work packages, linking them together by a transparent and efficient reporting structure and decision processes.

The *RadioNet3* work packages are independent from each other, avoiding the danger of risk accumulation for the Activity as a whole, should a specific work package encounter problems or delays. The management structure of *RadioNet3* is ready to track and monitor the progress of the work packages in such a way that any problems that do require coordinated action, such as budget adjustments, are identified in a timely manner. The coordinator and his team can address these together with work package leaders, seeking approval of the consortium board when needed.

The coordinator will be assisted by a local project manager to monitor the progress with the programme and the budget, specifically on the JRA and TNA aspects. For all of these work packages qualified and experienced project leaders have been identified within the *RadioNet* family. The *RadioNet3* project scientist will work closely with the leaders of the Networking Activities, ensuring that the implementation and monitoring of all the activities is done efficiently. Together with the *RadioNet3* support at JIVE procedures for claims and travel will be maintained, as well as the web interfaces for internal and external communication.

Risk associated with NAs

The major risk associated with **WP2 – WP7** lies in the organisation of meetings and workshops, in particular: (i) poor attendance of events, (ii) events poorly received or (iii) difficulty supplying tutors or lecturers. These are minor risks and can be easily overcome by announcing events well in advance and advertising more thoroughly if initial registrations are slow. Feedback at each event will be collected for the improvement of organisation and content. The invitation of the key speakers will be done well in advance to allow for seeking extra funding for their travel if required.

The main risk of **WP2 (QueSERA)** is that it may be hard to reach consensus on the development of policies and governance for a common European radio community, even though the urgency to develop these is clear to most *RadioNet3* executives. The fact that this is now a formally recognized *RadioNet3* activity will help expedite the process.

There is a risk identified in **WP5 (MARCUs)** related to funding shortages at the ARC nodes. If this funding were to fail, the remaining nodes must provide all the support. Some risk is connected to staff changes at the ARC nodes, since staff on fixed-term contracts, i.e. post-docs, delivers some of the support tasks of the ARC nodes. Making sure there is considerable overlap with new appointments will mitigate the risk associated with this.

Risk associated with JRAs

The **WP8 (UniBoard^2)** is aiming towards building a new hardware board with completely new components and this will pose new challenges: the need to harness more computing power, higher interface speeds and higher clock rates will result in a considerable increase in complexity. Although this can be considered a risk, it is here that the extensive experience gained by the team through the on-going UniBoard project will prove its worth. Designing this board to be 'green' enough for future large-scale facilities will be a challenge too, but not so much a risk. Even if the results turn out to be less than optimal in terms of power efficiency, valuable lessons will be learned for following projects. Using lead-free components will complicate fabrication, but has to be dealt with anyway, as the use of leaded components is being phased out. Finally, the distributed nature of this project could lead to an inefficient use of resources, but this team has already proven to be quite capable of operating effectively within such collaboration.

The risk of Task 1 of **WP9 (AETHER)** - 4-12GHz LNA MMIC is considered to be low. The risk level of W-band components is medium to high due to the extremely large bandwidth. However the risk can be reduced by re-assessment of noise-bandwidth trade-off if necessary. The risk of the successful construction of a 7-pixel prototype in Task 2 is considered to be medium. The development of some of the components like mixers and amplifiers has already started within AMSTAR+ with quite promising results. For other components like IF hybrids, smooth-walled horns, or LO source, where bandwidth or efficiency have to be improved, there are fall-back solutions based on proven technologies like corrugated horns, stand-alone IF hybrids, or classical LO sources, but presenting disadvantages for a multibeam receiver in terms of cost and degree of integration. Task 3 has a medium risk due to the fact that a 2SB mixer has never been made in the 800-950GHz frequency range. Not only are the dimensions of waveguide components much smaller but also the SIS junction technology is much more complex than for lower frequency. The risk mitigation will be to base current technology on already proven ALMA band 9 2SB technology, and demonstrated heritage in making AlOx barrier based SIS junctions in ALMA band 10 range. The risk of Task 4 can arise mainly as a result of delay in developing devices to work well at the required frequencies and specifications. This could cause a delay in the start of fabrication.

Given the research nature of the problems studied in particular in Task 1 of **WP10 (Hilado)** there is a risk of insufficient focus on the final demonstrations, leading to delays in the start of prototype code development. As the responsibility for each task lies with an institute that has direct interest in the results, potential delays will be noticed at an early stage of the project. This will make it possible to adjust the scope or make additional resources available. The Hilado partners will moreover deploy existing staff, allowing for a quick ramp-up of activities, regardless of any delays in hiring new staff.

Developing equipment with very broad bandwidth as proposed in **WP11 (DIVA)** poses new challenges in the design of the different components and their integration into subsystems. Here the extensive experience of the partner institutes will help to control the risk of failure or of not meeting the design specifications. The fact that this project will be performed at different institutions poses a risk, but this is considered low, given the experience of all partners in international collaborations. Recent MMIC LNA work of the partners gives high confidence in the achievability of competitive low noise amplifiers for the specified bands (Task1). The packaging and integration of the feed will pose a challenge where careful multidisciplinary design will be required. The associated risk is medium to high with limited availability of alternatives. The experience gained in developing similar hardware and firmware in DBBC2 will reduce the risk of Task 2. The work on 40 Gbit Ethernet output will mostly depend on commercial parts becoming available on the market. A risk could be that 40 Gbps hardware will be given up soon or not become available as expected because industry will favour the higher data-rate technology (100 Gbps). This low risk is mitigated by considering in the project both technologies in parallel (40 and 100 Gbps) and choosing the most appropriate one in terms of cost and availability of components.

Risk associated with TNAs

The on-going development of *RadioNet3* infrastructures poses some risks for the TNAs, as the most advanced observing facilities for radio astronomy are only just being developed. When working at the cutting edge of new technology some risks simply cannot be avoided.

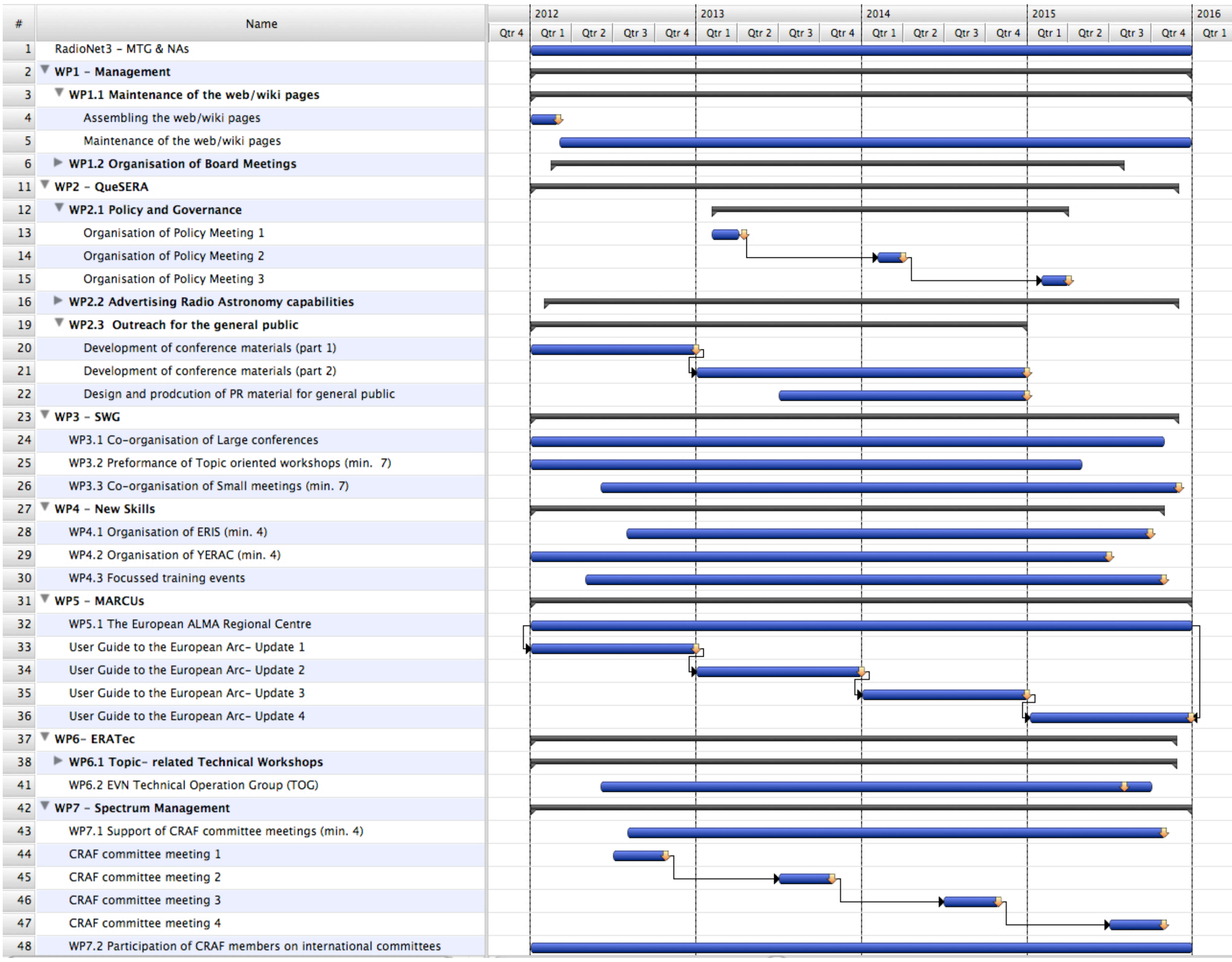
A risk was identified for **TNA LOFAR (WP16)** that commissioning could be slower than necessary to allow the proposed access for users, and that there might be a problem identifying eligible users given the international nature of the LOFAR collaboration. The formal structure is now clear: the ILT is established as a collaboration between consortia and with station owners in 5 countries, but is seated in the Netherlands, and uses the Radio Observatory of ASTRON as the central operational entity, including the handling of TNA support to users. All proposals are uniformly reviewed for scientific merit; a purely open skies policy will apply to 10% and 20% of the time in the first and second year of operations, respectively. User involvement has started on the basis of commissioning and early science proposals, the results of which are the subject matter of the LOFAR First Science workshop (14-15 September 2011). The next step is the formal beta-test demonstration of the initial suite of LOFAR operational capabilities, which includes interferometric imaging, tied array pulsar and spectral modes, and transient buffer board readout capabilities. An important part of this is the first all-sky survey (MSSS). Large-scale user projects will be assigned to use this initial suite in 2012 based on scientific proposals. To be sure, the ILT will coordinate further development and commissioning of more complex modes for several more years in parallel with science operations, as behoves a broad and world-leading facility such as LOFAR. However, providing 2.5% of the annual total number of LOFAR observing hours as access under the TNA-LOFAR in *RadioNet3* is a rather modest requirement. Pre-proposals for the operational phase showed broad international interest and a potential oversubscription rate of up to 10.

The observing time offered through the **TNA WSRT (WP17)** programme will originally make use of the current WSRT multi-frequency facilities. A 6-month gap is then foreseen in this time, while Apertif is installed in late 2012-13. Such an upgrade always carries the risk of delays until the instrument is operational again. Only starting the full rollout once the production is sufficiently far advanced mitigates this risk. It will be preceded by a test-phase on a few dishes while routine observing continues on the majority of the array. To mitigate the risk a smaller access to the infrastructure will be offered during the upgrade time.

WP 20 (TNA-SRT): As the SRT is still under construction there is a small risk that it might not be completed in time. It is foreseen that the commissioning will be completed by the end of 2011. The start of the operation with first light receivers for shared risk observations is scheduled for Spring 2012. Therefore the availability of the SRT for the TNA programme by the beginning of 2012 can be assumed. In order to mitigate the risk a non-linear access to the TNA was schedule, in which only few projects will be scheduled at the beginning of the *RadioNet3* project. The total time offered under the TNA-SRT access seems to be reasonable to achieve within the total project duration.

B 1.3.2 Timing of work packages and their components

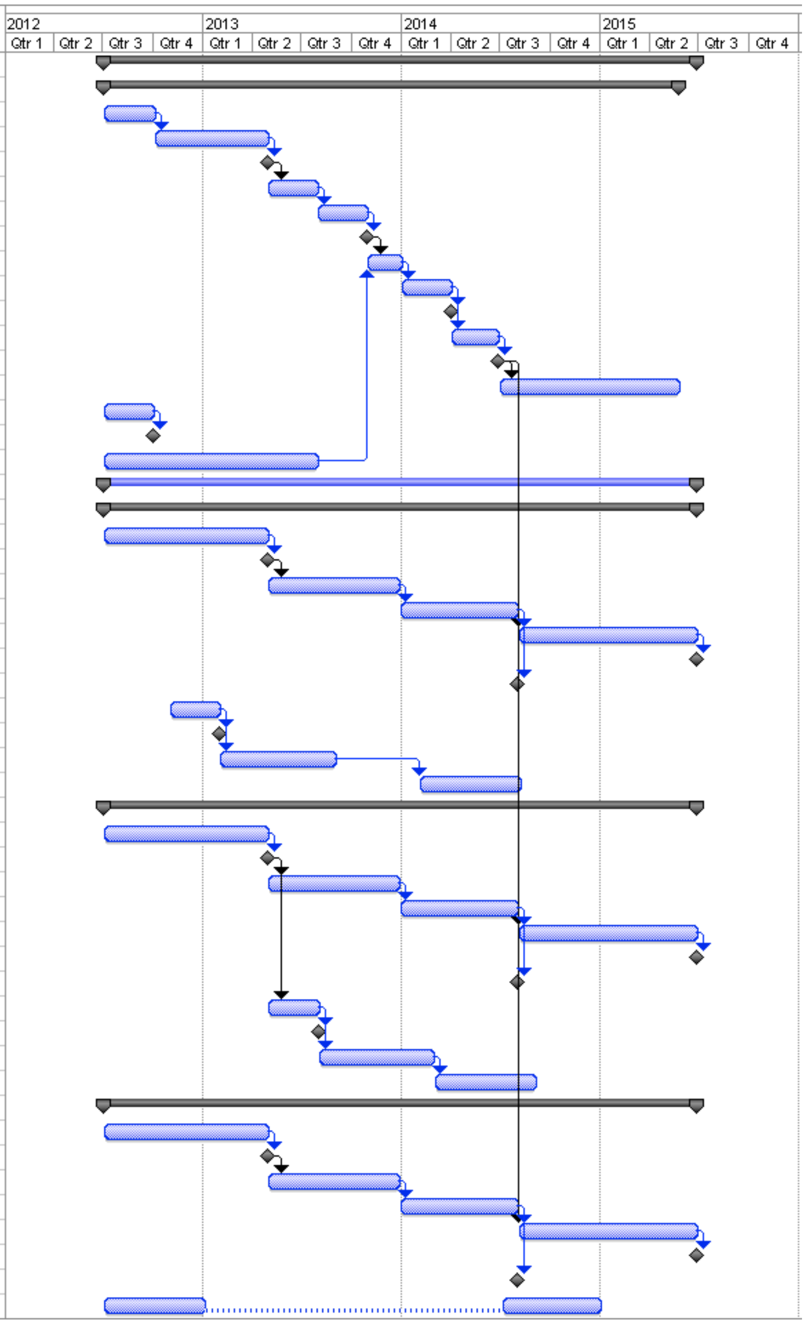
MANAGEMENT AND NETWORKING ACTIVITIES



JOINT RESEARCH ACTIVITIES

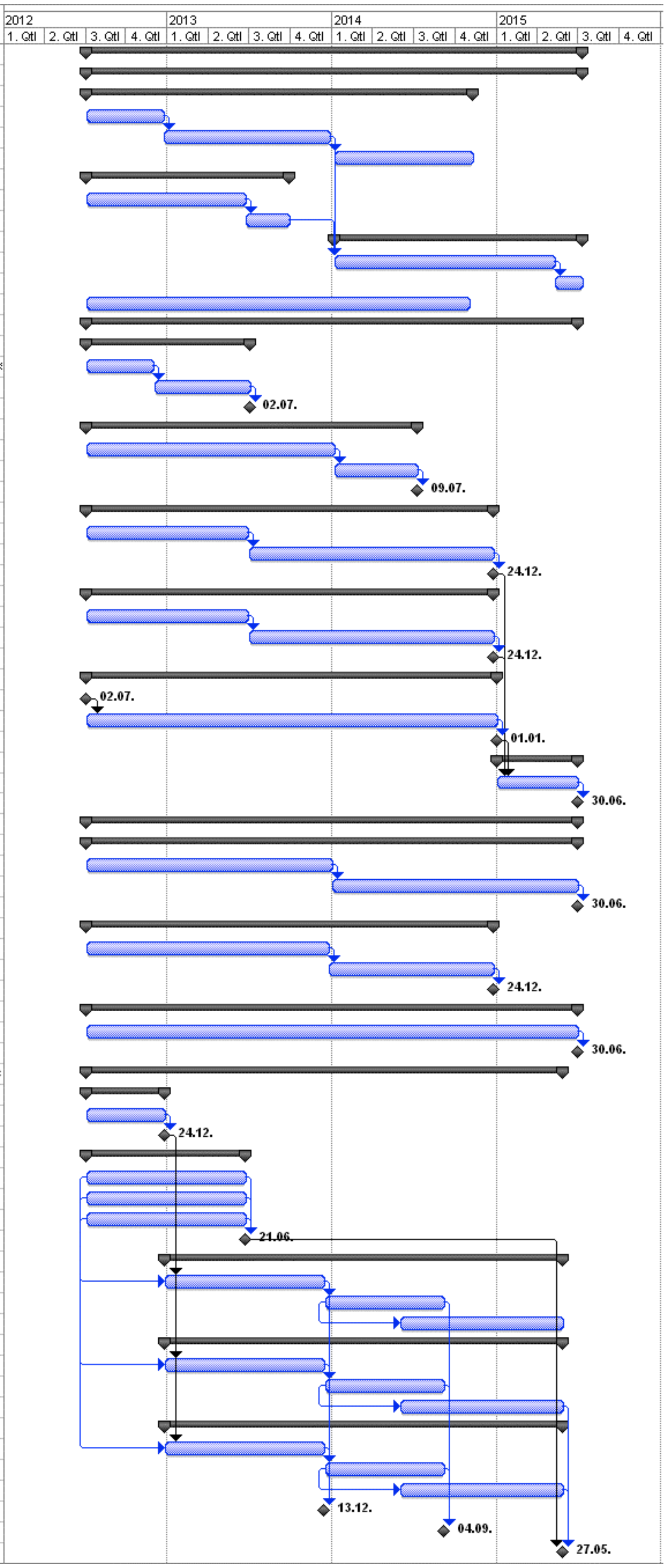
WP8 UniBoard²

ID	Task Name
1	**WP 8 UniBoard^2**
2	**WP8.1 Hardware**
3	System design
4	Board design
5	Completed hardware design
6	Board implementation
7	Prototype run
8	Prototype hardware
9	Basic hardware test
10	Test & Integration
11	Revised board design document
12	Production run
13	Hardware delivery
14	Preparation for 2nd phase
15	Definition of interfaces and coding conventions
16	Interfaces and coding conventions document
17	Test firmware
18	**Firmware**
19	**WP8.2 Correlator**
20	Firmware design
21	Completed correlator firmware design
22	Firmware implementation
23	Test & Integration
24	Firmware implementation 2nd phase
25	Document on effect of green measures
26	Revised firmware design document
27	Pulsar binning design
28	Completed pulsar binning design
29	Pulsar binning implementation
30	Pulsar binning test & integration
31	**WP8.3 Digital Receiver**
32	Firmware design
33	Completed digital receiver firmware design
34	Firmware implementation
35	Test & Integration
36	Firmware implementation 2nd phase
37	Document on effect of green measures
38	Revised firmware design document
39	RFI mitigation firmware design
40	Completed RFI mitigation design
41	RFI mitigation implementation
42	RFI mitigation test & integration
43	**WP8.8 Beam Former**
44	Firmware design
45	Completed beam former firmware design
46	Firmware implementation
47	Test & Integration
48	Firmware implementation 2nd phase
49	Document on effect of green measures
50	Revised firmware design document
51	Generic control software



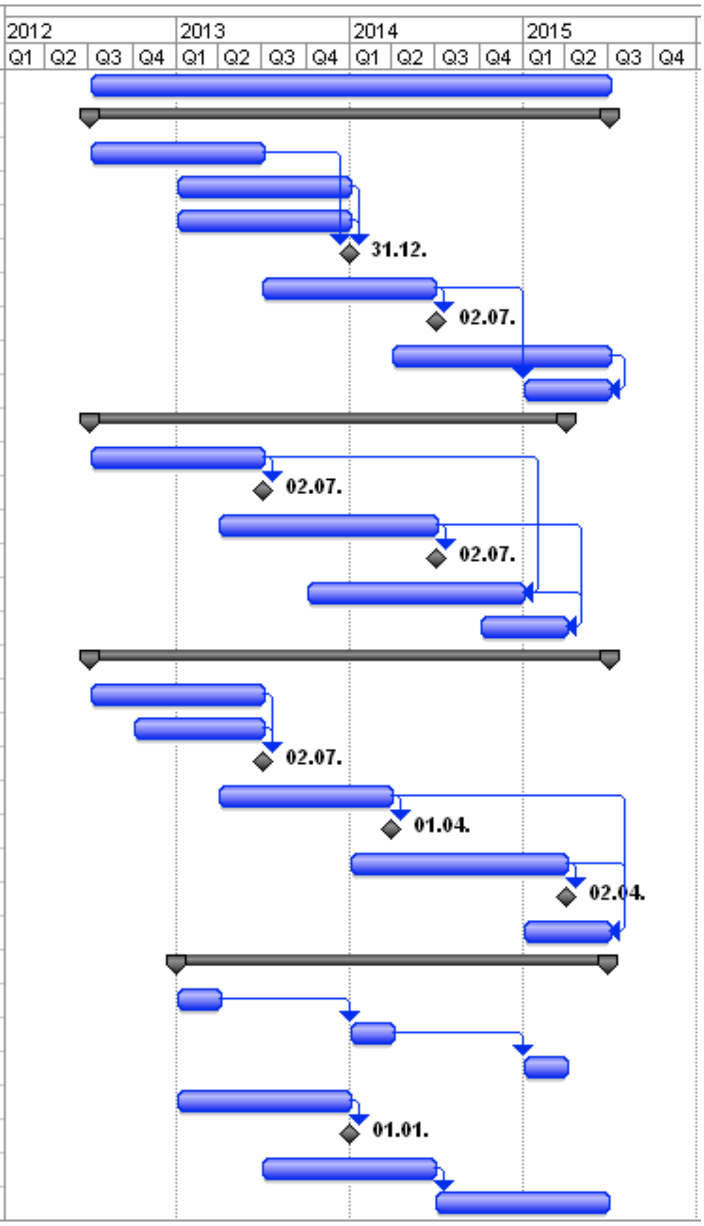
WP9 AETHER

Nr.	Task Name
1	**WP9 - AETHER**
2	**WP9.1 67-116 GHz exremely wide RF-band receivers**
3	**9.1.1 Active devices**
4	AMSTAR+ cryo chip re-design
5	Cryo run 1 1st iteration
6	Cryo run 2nd iteration
7	**9.1.2 OMT & BW assessment**
8	Wideband OMT design & manufacturing
9	Evaluate feasible BW for LNA & OMT
10	**9.1.3 Prototype**
11	Design of wideband dual pol W_band pixel
12	Test of W-band module at 30m telescope
13	Design & manufacture of 4-12 GHz IF-MMICs
14	**WP9.2 : Highly integrated and miniaturized 2SB SIS receivers**
15	**9.2.1 Feedhorn array**
16	Design, build, and test smooth-walled and corrugated horns
17	Design and fabricate a 7-pixel feed array
18	Delivery of 7-pixel feed array
19	**9.2.2 IF hybrid coupler**
20	Design, fabrication, and test
21	Fabrication for 7-pixel array
22	Delivery of 7 IF hybrid couplers
23	**9.2.3 IF amplifiers**
24	Evaluation of existing technology
25	Design and fabrication of amplifiers for 7-pixel array
26	Delivery of IF amplifiers
27	**9.2.4 2SB mixer array**
28	Design of 7-pixel mixer array
29	Fabrication and test of 2SB mixers
30	Delivery of 2SB mixers
31	**9.2.5 LO system**
32	Decision about LO source
33	Fabrication
34	Delivery of LO source
35	**9.2.6 Integration and test**
36	Testing of 7-pixel prototype
37	Prototype and test report
38	**WP9.3 Sub-millimeter Wave 2SB SIS Mixers**
39	**9.3.1 2SB/Balanced mixer**
40	Preliminary design of band 10 2SB/Balanced mixer
41	Production and test 2SB mixer
42	2SB mixer prototype and test report
43	**9.3.2 IF amplifier**
44	Preliminary design of compact IF amplifier and hybrid
45	Production and test of IF
46	IF amplifier prototype and test report
47	**9.3.3 SIS Technology**
48	Development
49	Final report
50	**WP9.4 Supra-THz broadband, high sensitivity SIS and HEB rec**
51	**9.4.1 Band 11 System Specification Review**
52	System specification review
53	system specification report
54	**9.4.2 Development of devices**
55	Develop SIS junctions for > 1 THz
56	Develop HEB devices for wide IF bandwidth
57	Develop waveguide Schottky devices
58	Device development report
59	**9.4.3 Development of SIS mixers above 1 THz**
60	Design of SIS mixer chip and block
61	Fabrication of SIS mixer hardware
62	Mixer testing and evaluation
63	**9.4.4 Development of HEB mixers**
64	Design of HEB mixer
65	Fabrication of HEB mixer hardware
66	Mixer testing and evaluation
67	**9.4.5 Development of LO sources for THz mixers**
68	Design of LO chain
69	LO chain fabrication
70	LO chain testing and evaluation
71	Mixer/LO chain designs complete
72	Full mixers and LO chain delivered
73	Mixer and LO testing and evaluation complete



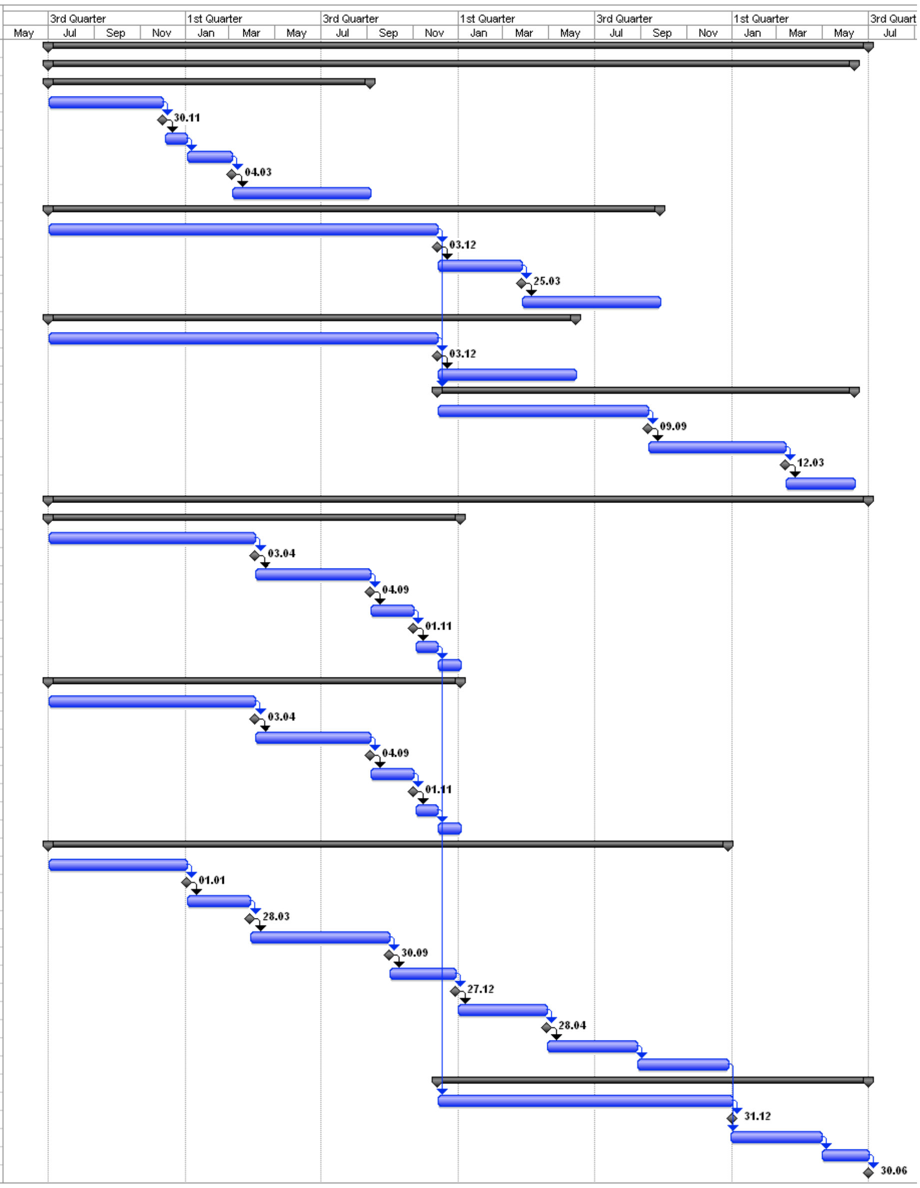
WP10 Hilado

Nr.	Vorgangsname
1	**WP 10 Hilado**
2	**WP 10.1 Optimisation CASACore and Apps**
3	Profiling of algorithms
4	Analysis of data formats
5	Profiling of software code
6	Design Review of optimisation strategies
7	Prototyping optimised software
8	Completion of optimized imaging code libraries
9	Demonstration on benchmark platforms
10	Publication of results
11	**WP 10.2 Fast Transient Imager**
12	Analysis of algorithms and dataflow
13	Design Review of Fast Transient Imager
14	Development of prototype software
15	Completion of FTI prototype code
16	Development of demonstrator
17	Final reports
18	**WP 10.3 Large solvers**
19	Research in mathematical foundations
20	Analysis of platform requirements
21	Design Review Parallel Solvers
22	Development of prototype software
23	Completion of code library for parallel solvers
24	Demonstration on benchmark platforms
25	Benchmarks completed
26	Publication of results
27	**WP 10.4 Bringing it to the user**
28	Workshops with community (1)
29	Workshops with community (2)
30	Workshops with community (3)
31	Definition of interfaces
32	Completion of improved ParselTongue library
33	Configuration of applications
34	Demonstrator for selected applications



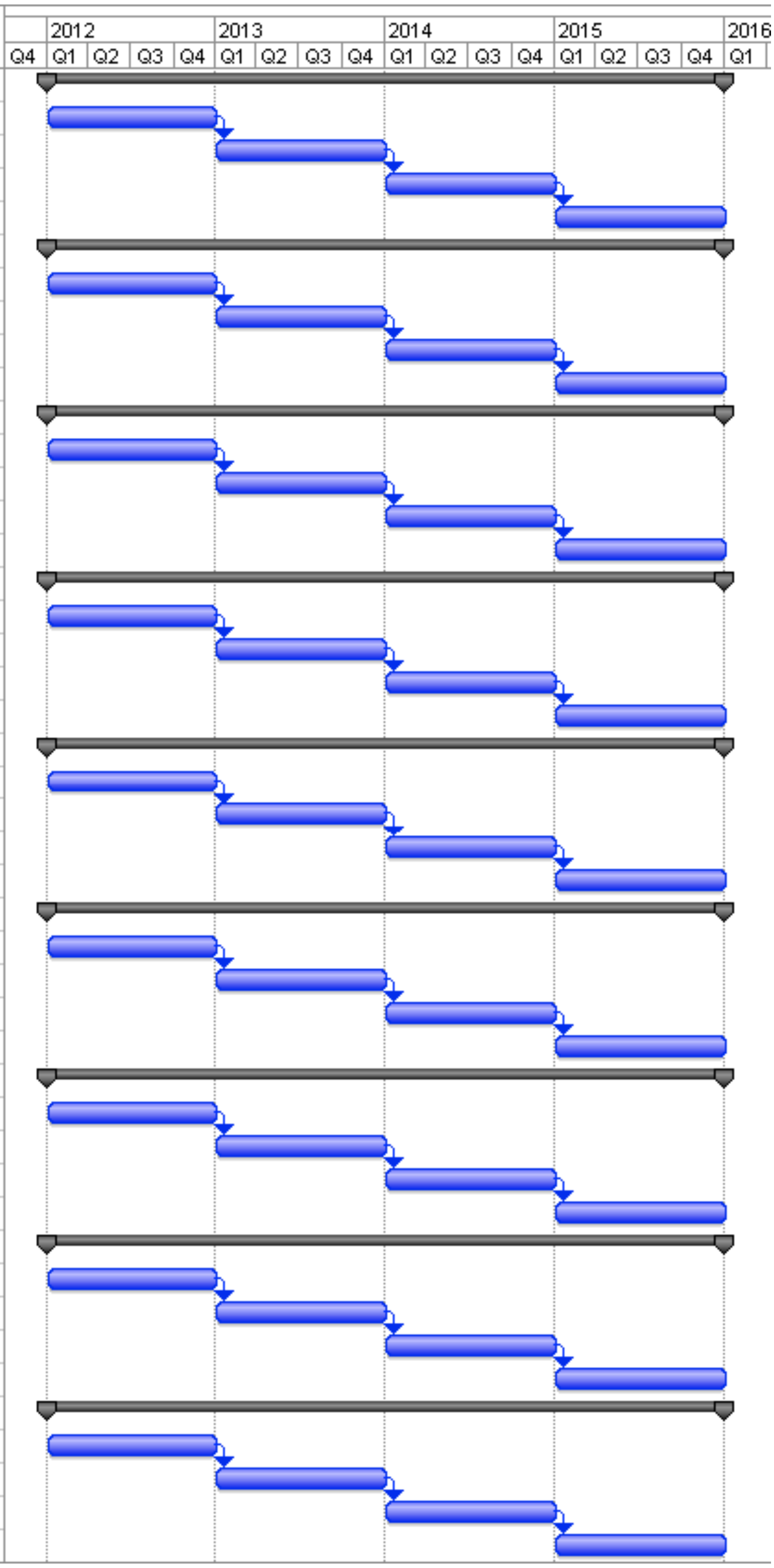
WP11 DIVA

ID	Vorgangsname
1	**WP11 - DIVA**
2	**WP11.1 Low noise wide-band integrated amplifiers for VLBI Reflektors**
3	**WP11.1.1 Low Noise Amplifier MIC Design**
4	MIC LNA Design
5	MIC LNA Design ready
6	MIC LNA Design Report
7	MIC LNA production
8	MIC LNA completed
9	MIC LNA test and characterisation
10	**WP11.1.2 MMIC Design**
11	MMIC LNA design
12	MMIC design ready
13	MMIC LNA design report
14	MMIC LNA prototype ready
15	MMIC LNA test and characterisation
16	**WP11.1.3 Packaging and Testing**
17	Prototype packaging
18	Prototype packaging completed
19	Packaging evaluation
20	**WP11.1.4 Feed integration and performance evaluation**
21	Desing of front-end assembly
22	Front-end assembly design ready
23	Realization of integrated feed prototype
24	Integrated feed prototype
25	Front-end assembly test report
26	**WP11.2 32 Gbit digital backend (DBBC3)**
27	**WP11.2.1 Sampling board for 4 GHz bandwidth**
28	Design of sampler unit ADB3
29	Sampler ADB3 design report
30	PCB realization
31	PCB prototype
32	Populating ADB3 board
33	Prototype of ADB3 board
34	Test of ADB3 board
35	ADB3 prototype ready
36	**WP11.2.2 Single FPGA processing unit with VLBI firmware**
37	Design of FPGA board Core3
38	FPGA board Core3 design report
39	PCB realization
40	PCB prototype
41	Populating FPGA board
42	Prototype of Core3 FPGA board
43	Test of FPGA board
44	Core3 FPGA prototype ready
45	**WP11.2.3 40 Gbit Ethernet output**
46	Field survey of commercial componentes
47	Report of market research
48	Compatibility with ADB3 and Core3
49	Report on requirements for compatibility
50	Design of the custom part of the 40 Gbps unit
51	Report on design of the custom part
52	Design of the complete 40 Gbps unit
53	Report on design of 40 Gbps unit
54	PCB custom part realization
55	Prototype of custom part of 40 Gbps unit
56	Integration commercial and custom parts
57	40 Gbps prototype unit
58	**WP11.2.4 Integration and final testing of the system**
59	Integrating prototype ADB3 and Core3
60	Testreport on integrated ADB3 and Core3 units
61	Integrating 40 Gbps board
62	Final test report
63	Integrated DBBC prototype



TRANSNATIONAL ACCESS (WP12 – WP20)

Nr.	Vorgangsname
1	**WP12 TNA EVN**
2	TNA EVN Year 1
3	TNA EVN Year 2
4	TNA EVN Year 3
5	TNA EVN Year 4
6	**WP13 TNA JCMT**
7	TNA JCMT Year 1
8	TNA JCMT Year 2
9	TNA JCMT Year 3
10	TNA JCMT Year 4
11	**WP14 TNA e-MERLIN**
12	TNA e-MERLIN Year 1
13	TNA e-MERLIN Year 2
14	TNA e-MERLIN Year 3
15	TNA e-MERLIN Year 4
16	**WP15 TNA Effelsberg**
17	TNA Effelsberg Year 1
18	TNA Effelsberg Year 2
19	TNA Effelsberg Year 3
20	TNA Effelsberg Year 4
21	**WP16 TNA LOFAR**
22	TNA LOFAR Year 1
23	TNA LOFAR Year 2
24	TNA LOFAR Year 3
25	TNA LOFAR Year 4
26	**WP17 TNA WSRT**
27	TNA WSRT Year 1
28	TNA WSRT Year 2
29	TNA WSRT Year 3
30	TNA WSRT Year 4
31	**WP18 TNA IRAM**
32	TNA IRAM Year 1
33	TNA IRAM Year 2
34	TNA IRAM Year 3
35	TNA IRAM Year 4
36	**WP19 TNA APEX**
37	TNA APEX Year 1
38	TNA APEX Year 2
39	TNA APEX Year 3
40	TNA APEX Year 4
41	**WP20 TNA SRT**
42	TNA SRT Year 1
43	TNA SRT Year 2
44	TNA SRT Year 3
45	TNA SRT Year 4



B2. Implementation

B 2.1 Management structure and procedures

RadioNet3 will adopt basically the same successful consortium organization and procedures that have been employed in the management of its two predecessors in FP6 and FP7. Small modifications will be applied to further increase the organisational efficiency and transparency to the partners.

A small but substantial improvement will be introduced by expanding the role of the Project Scientist, who will be in charge of the scientific management as well as the Information & TNA-NA Travel Budget Assistant, whose responsibilities are described in details below.

The *RadioNet3* consortium will be structured according to the following bodies: the Governing Board, the Coordinator, the Executive Committee and the Management Team (see Figure 2.1.1).

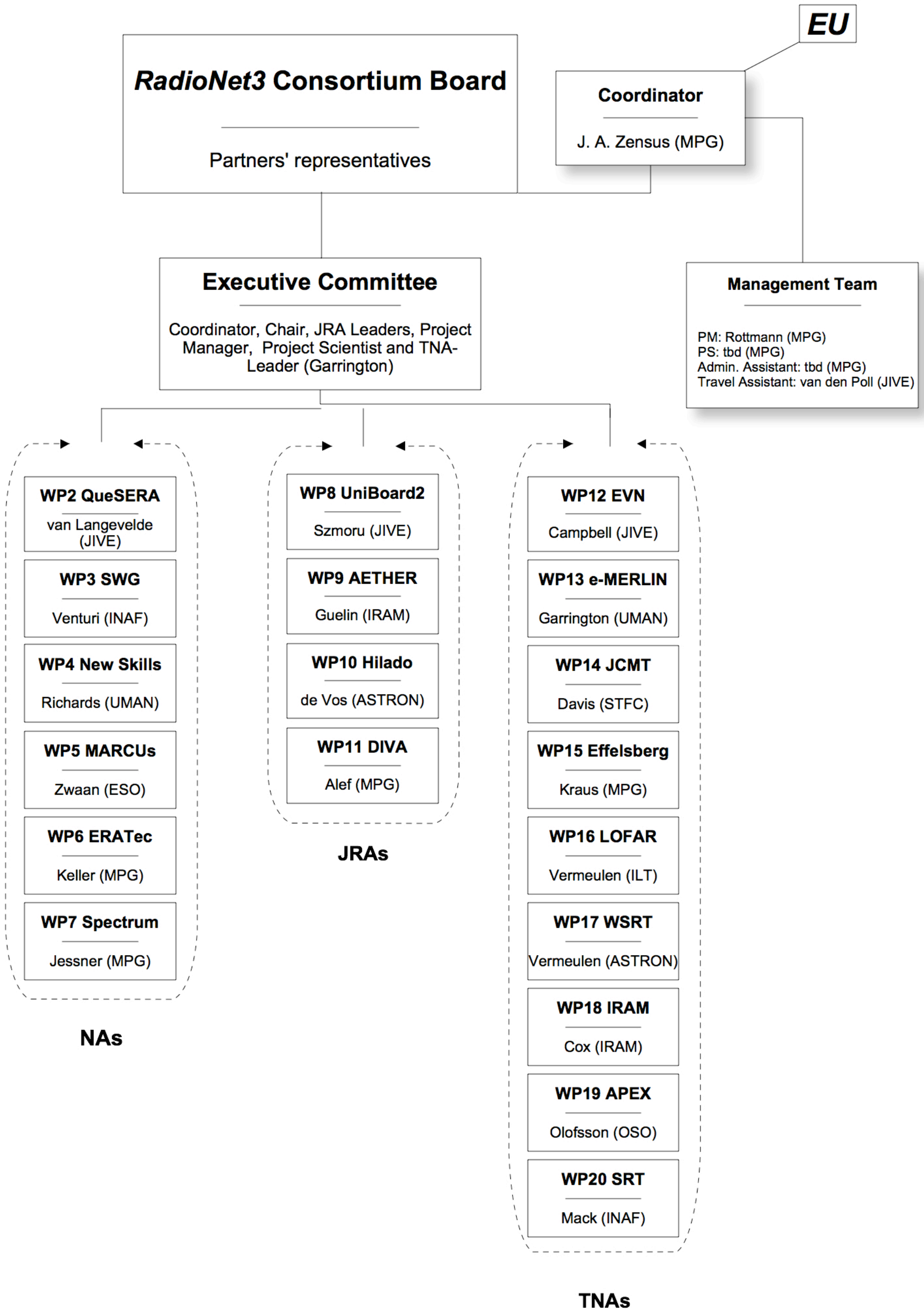


FIGURE 2.1.1: RADIONET3 CONSORTIUM

RadioNet3 Consortium Board

The governing and deciding body of *RadioNet3* will be the *Consortium Board,* hereafter 'the Board'. Each participating institution will nominate one representative to the Board (in most cases this will be the institute director). The Board will define terms-of-reference and will elect from its membership a chairman who will serve for a renewable term of two years. The Board will meet in person at least once per year and will hold additional teleconference meetings when required. Board members can nominate a representative to attend the meeting or assign their vote to a proxy from the Board membership. The chairman (supported by the Coordinator & Management Team, see below) will ensure that written invitations and agendas for meetings are distributed in a timely fashion, and that written minutes of each meeting are provided in accordance with the Consortium Agreement (CA). In keeping with the spirit of collaboration, a policy of decision-making by consensus of a quorum will be aimed for. If consensus cannot be reached, decisions will be made by a simple majority vote of a quorum. A quorum is reached if 2/3 of the Board votes are present. Work package leaders will be invited at the discretion of the chairman of the Board to attend the Board meetings to report on Work Package activities, without having voting rights. Other guests to the Board meetings can also be invited at the discretion of the Chair. The general scope of the Board include all issues of consortium policy and decision making including, but not limited to:

- Content, finances and intellectual property rights of the Consortium, such as proposals for changes to the Work Plan to be agreed by the EC; changes to the Consortium Plan including budget and changes to the Background and Intellectual Property Rights,
- Evolution of the Consortium, in particular aspects of entry and withdrawal of a partner.
- Appointments on the basis of the Work Plan such as Work package leaders and Members of the Executive Board.

RadioNet3 Coordinator

The Coordinator of *RadioNet3* will be Prof. J. Anton Zensus. The Coordinator will be a member of the Board but not its Chairman. The Coordinator will be the intermediary between the Consortium partners and the European Commission and will perform all tasks assigned to the Consortium as described in the Grant Agreement and in the Consortium Agreement.

The Coordinator will dedicate up to 20% of his working time to the project. This effort will be fully financed by the MPG.

The Coordinator will distribute the Community financial contribution according to the Grant Agreement, the Consortium Plan and the approval of reports by the EC. Each partner will be required to manage their own funds, provide timely financial reports (e.g. cost statements) to the Coordinator for compilation. In particular, the Coordinator will be responsible for:

- Monitoring compliance by the partners with their obligations;
- Keeping the address list of partners and other contact persons updated and available;
- Collecting, reviewing to verify consistency and submitting reports and other deliverables (including financial statements and related certifications) to the EC;
- Transmitting documents and information connected with *RadioNet3* to and between Work Package Leaders, as appropriate, and any other partners concerned;
- Administering the Community financial contribution and fulfilling the financial tasks described in the Grant Agreement and the Consortium Agreement;
- Providing, upon request, the partners with official copies or originals of documents, which are in the sole possession of the Coordinator when such copies or originals are necessary for the partners to present claims.

RadioNet3 Management Team

The *Management Team* (MT) will be proposed by the Coordinator to and appointed by the Executive Committee. The MT will assist and facilitate the work of the Coordinator and the Executive Committee, especially in the execution of the decisions of the Board as well as in the overall management of *RadioNet3* activities. It will collect and provide all necessary information from and to the partners (i.e. minutes of meetings, scientific and financial reports). However, the responsibility for providing these scientific and financial reports in time lies with the project partners. The Management Team will be composed as follows:

- Project Manager
- Project Scientist
- Administrative Assistant
- Information & TNA-NA Travel Budget Assistant

The Management Team and the Coordinator will meet at least once per month. The minutes of the meetings will be recorded and stored in the protected area of the *RadioNet3* wiki.

Project Manager (6 person-months/yr): will be responsible for the day-to-day management of *RadioNet3*, i.e. the preparation of reports to the EC and to the *RadioNet3* Board, controlling of the implementation plan, organisation and execution of all management-level meetings and teleconferences. The Project Manager will be the contact person for the execution of all contractual and financial affairs. The Project Manager will be entirely financed by the MPIfR. For this position, the Coordinator has proposed Dr. Izabela Rottmann.

Project Scientist (4 person-month/yr): s/he will assure the visibility of *RadioNet3* by attending scientific conferences and events related to the project. S/He will be in charge of monitoring the progress of the TNA and NA activities and report to the Executive Committee and the Board. The Project Scientist will be strongly involved in the outreach activities of *RadioNet3*.

Administrative Assistant (6 person-month/yr): s/he will be the responsible controller of all financial and administrative issues of RadioNet3. S/he will check the financial statements and budgetary reports to verify consistency with the project tasks before consolidating and sending them to the EC.

Information & TNA-NA Travel Budget Assistant (4 person-month/yr): Aukelien van den Poll will be in charge of the distribution of the travel budget (including local organisation costs) of all TNA and NA activities and will be responsible for supporting the Project Manager with the information management (such as maintenance of the Wiki). The same way of managing the NA & TNA travel budgets has proven very successful in previous *RadioNet* projects.

RadioNet3 Work Package Leaders

A Work Package Leader will manage a Work Package (WP). The Board based on their scientific experience and management skills will appoint the Leaders. Each WP Leader will be responsible for the implementation of the work plan and in particular for:

- Communicating any plans, deliverables, documents and information connected with the WP to the WP members;
- Reporting to the Executive Committee on the work progress and any future plans;
- Coordinating on a day-to-day basis the progress of the technical work;
- Implementing decisions made by the Governing Board relevant to the WP;
- Advising the Coordinator and the Management Team of any discrepancy with the Work Plan, including any delay in delivery.

RadioNet3 Executive Committee

The *Executive Committee* is appointed by the Board and will be responsible for the coordination of the project implementation and will report and be accountable to the Board. The Executive Committee will consist of the *RadioNet3* Coordinator and Chair of the Board, Project Manager, Project Scientist and the Leaders of the 4 JRAs and the TNA Leader. The Project Scientist will report the progress of the NAs to the Executive Board. The TNA Leader will report in the Executive Board on development of the TNA activities as a whole and advise on any TNA budget reallocations. The Coordinator has proposed for this function Dr. Simon Garrington. The Executive Board will meet at least 4 times per year and will be chaired by the Coordinator. These meetings may be in person or by teleconference. Accepted minutes of Executive Board meetings will be made available to the Board. The Executive Board will be responsible for the implementation of the decisions of the Board. This will involve

- Supporting the Coordinator in preparing meetings, related documents and deliverables;
- Proposing decisions and preparing the agenda of the Board;
- Developing a plan for the strategic direction of the *RadioNet3* programme and the distribution of resources therein;
- Seeking a consensus between the partners;
- Receiving and reviewing the progress reports of the various Work Packages;
- Maintaining control of the project contingency funding and allocating such funds in support of new *RadioNet3* activities, as and when appropriate

C**onsortium Agreement**

A clear set of rules for managing the project and for regulating issues relating to its operation amongst the project partners will be provided by a Consortium Agreement. It will establish a management and regulatory framework for the project team members, and also provide guidance with respect to the rules, rights and responsibilities within the project to newcomers to the project team (in the event of staff turnover during the project lifetime). The Consortium Agreement will play a key role in the project by providing a coherent operational framework for the project team. It will regulate issues related to intellectual property brought by the project partners (Background) and intellectual property created during and after the project (Foreground). Additionally the Consortium Agreement will regulate the distribution of the Community financial contribution and liability and confidentiality arrangements between partners.

The Consortium Agreement will help to ensure that the process of producing project deliverables and the achievement of project outcomes are made as efficient as possible. All project partners and project team members will be aware of their Consortium Agreement's content and its implications for their work. The Consortium Agreement of *RadioNet3* will be based on the DESCA template.

Funds

The Coordinator will distribute the Community financial contribution to the Project:

- To the partners without unjustified delays,
- As defined in the Description of Work and the Consortium Agreement
- Applying the payment modality defined in the Grant Agreement.

The payment distribution will be recorded and centrally stored by the Coordinator to allow the traceability for each partner and EC. It is envisaged that with Board approval 5% of the allocated TNA budget will be kept initially in a common fund (contingency budget) to allow reaction to unforeseen developments (subject to Board decision) by limited budget reallocation. Thereof a discretionary fund of 1.5 % will be held by the Coordinator to allow flexible reallocation across the whole project. Each partner will be responsible for financial management according to its own accounting and management rules and practices as well as for conducting periodical audits of costs.

Outreach

As the body that encompasses the largest range in radio facilities in Europe, *RadioNet3* has a natural role in advocating radio astronomy as a whole. Such outreach activities have different requirements when addressing different target audiences. Material for reaching the general public will have a clearly different signature from publications meant for peer astronomers, aiming to enlarge the user community of radio facilities. When communicating with national and European policy makers, the focus will be entirely different again and address funding and governance issues. The outreach will be mostly done via the Network Activities. All possible audiences will be addressed: from pupils (WP2 QueSERA), via students (WP4 New Skills), researchers (WP2 SWG, WP5 MARCUs) and engineers (WP6 ERATec) up to policy makers (WP2 QueSERA, WP7 Spectrum Management). The project has allocated a specific budget for outreach materials, which will be distributed at the visitor centres in all radio observatories among the *RadioNet3* partners and additionally at the various astronomical meetings organised by, within and outside the project. The Project Scientist together with the Information Assistant will be in charge of the implementation of the *RadioNet3* outreach policy, such as materials design, press releases and the web portal. Furthermore *RadioNet3* will promote radio astronomy via the active participation of the Coordinator and/or Porject Scientist in essential astronomical and politically important non-astronomical conferences. The involvement in the structuring of the future of European astronomy will be guaranteed via *RadioNet3* participation in the important astronomical panels such as ASTRONET, European SKA consortium etc.

B 2.2 Beneficiaries

Participant No. 1: MPG (DE)

The Max-Planck-Institut für Radioastronomie (MPIfR) is one of 80 independent research institutes of the Max Planck Society (MPG) that perform basic research in the natural sciences, life sciences, social sciences, and the humanities – in our case in the areas of radio- and farinfrared astronomy. The MPIfR is the leading radio astronomical institute in Germany and operates the 100-m radio telescope in Effelsberg at centimetre and millimetre wavelengths, one of the world's most important facilities in radio astronomy. With a long expertise in technological developments, the MPIfR led the construction of the 12-m HHT on Mt.Graham, USA, the 12-m submillimetre telescope APEX at Llano de Chajnantor, Chile (2005), and the 30-m radio telescope on Pico Veleta, Spain. The institute completed in 2007 the first international LOFAR station DE-1 in Effelsberg. MPIfR staff has been involved in very-long-baseline interferometry (VLBI) since the mid-1970s and has been operating five generations of VLBI correlators. Currently, MPIfR operates a new-generation correlator – a software correlator based on an international cooperation with the USA, Australia and Finland. MPIfR operates several technical labs that develop technical equipment for mm-cm, mm-submm, infrared, and optical telescopes. MPIfR is engaged in national, European and international scientific cooperation. The institute is involved in a number of emerging facilities: SOFIA, ALMA, SKA, optical interferometry facilities (VLTI and LBT), and mm-VLBI. The MPIfR is coordinating the COST Action *MP0905* and the ERC-Advanced Grant *GLOSTAR*, has been and is participating actively in a number of EU-funded collaborations, e.g. *RadioNet*, SKADS and EXPReS (all FP6); *RadioNet-FP7*, NEXPReS, PrepSKA, E-SQUID (all FP7).

Role in RadioNet3: MPIfR will provide the overall coordination and management of *RadioNet3*. It provides access to the 100-m Effelsberg telescope and contributes as participants to the JRAs AETHER & DIVA. Beside its engagement in several NAs, the MPIfR is coordinating the NA ERATec. Key staff involved in *RadioNet3* includes: *Prof. Dr. J. Anton Zensus,* Director, has been Chairman and active member of the *RadioNet*. He has vast experience in project management and is the Co-ordinator of *RadioNet3*. *Dr. Izabela Rottmann* will be responsible for the *RadioNet3* Project Management. She is currently project manager for the COST Action MP0905 and managing all activities of the MPIfR within *RadioNet-FP7*. *Dr. Alex Kraus* (head of the Effelsberg Observatory) is leading the Effelsberg TNA programme in *RadioNet3*; *Dr. Reinhard Keller* (head of the electronic division) is the chairperson of the NA ERATec (WP6) and the PI of the Task1 in the JRA DIVA; *Dr. Walter Alef* (head of the VLBI department) is a chairman of the EVN TOG, he will lead additionally the JRA DIVA (WP11).

Participant No. 2: ASTRON (NL)

ASTRON is the Netherlands Institute for Radio Astronomy, and is part of the Netherlands Organisation for Scientific Research (NWO). It provides front-line observing capabilities for Dutch and international astronomers across a broad range of frequencies and techniques. It operates the WSRT and is the central operational organisation for LOFAR within the ILT. It has a strong technology development programme, encompassing both innovative instrumentation for existing telescopes and the new technologies needed for future facilities. ASTRON also conducts a vigorous programme of fundamental astronomical research. ASTRON is involved in large-scale software and system development. It coordinated the EC FP6 SKADS programme and coordinates the 2009-2011 *RadioNet-FP7* programme. It participates and participated in various other EC projects: *RadioNet* FP6, EXPReS FP6, NEXPReS FP7 and PrepSKA FP7. ASTRON plays a major role in many aspects of preparation for the Square Kilometer Array and its general director, Prof. Mike Garrett, is the current chairman of the international SKA Science and Engineering Committee (SSEC). ASTRON enjoys extensive collaborative contacts with Dutch Universities and Radio Astronomy institutes all over the world.

Role in RadioNet3: ASTRON will provide access to the WSRT (WP17), will lead the JRA Hilado (WP8), contribute to the JRAs UniBoard^2 (WP7), and participate in the NAs ERAtec, Science Working Group, New Skills for Radio Astronomers, and QueSERA. Key staff involved in *RadioNet3* include: *Dr. René C. Vermeulen*, the director of the ASTRON Radio Observatory that operates the WSRT telescope and is also the central operating organisation for the ILT, is an expert in radio interferometry, applying it to studies of active galactic nuclei and their surroundings. He has extensive experience in managing telescope operations, and has led a multi-party European collaboration on setting up the International LOFAR Telescope (ILT), of which he is now the first director. *Dr. Ronald Nijboer* is an expert in applied mathematics, and has extensive experience as leader of the LOFAR software development and developer of the initial calibration schemes. Having led the local Albius project components, he will now lead the JRA Hilado. *André Gunst*, LOFAR system engineering manager, expert in the field of digital signal processing and specialized in A/D conversion, will bring his extensive experience from UniBoard^2 into the JRA UniBoard^2.

Participant No. 3: IRAM (FR)

IRAM is an international institute funded by the CNRS (France), the MPG (Germany) and the IGN (Spain), operating two observatories both of which offer unique scientific capabilities to their wide user communities. The first facility is the 30-metre telescope located on Pico Veleta (Spain) at an altitude of 2900 metre and is equipped with a suite of heterodyne receivers (operating at 3, 2, 1 and 0.8 mm), an heterodyne array and a bolometer cameras operating at 1 mm. The second facility is an interferometer consisting of 6 x 15-m antennas located at 2550 metre in the French Alps operating at 3, 2, 1 mm and starting winter 2010-2011 at 0.8 mm. Both facilities are the leading instruments of their type. The technological research, development and construction of equipment (including software), is done at the IRAM headquarters in Grenoble. The technical expertise of IRAM mainly concerns the development and making of mm and sub-mm mixers with waveguide technology, the manufacturing of SiS junctions and the development of analogue and digital backends. In particular, IRAM has designed and built the SIS receivers and an heterodyne receiver array for the IRAM telescopes and all the related back-end systems. IRAM has fabricated the SIS junctions for the HIFI Band I mixers and has designed the ALMA front-end common optics and Band 7 cartridge; it is in charge of the production of the latter. IRAM has a large expertise in software development, both for real-time instrumental monitoring systems and offline data analysis. It has developed with the help of Grenoble Observatory its own instrument calibration and data analysis software package, GILDAS that is used on the IRAM Pico Veleta 30-m telescope, on the IRAM Plateau de Bure interferometer, as well as on several other European and American telescopes. IRAM has been organising for the past 12 years, regular schools on millimetre wave astronomy and interferometry.

Role in RadioNet3: IRAM is involved in several NA, in particular in the NA New Skills (WP4). It will make available the 30-metre telescope located on Pico Veleta and the IRAM Plateau de Bure interferometer via the *RadioNet* Transnational Access programme (WP18). It leads the AMSTAR+ Joint Research Activity in *RadioNet-FP7*, building on the success of AMSTAR in *RadioNet* FP6 (also led by IRAM), and it will lead the new AETHER JRA mm/submm receiver front-ends (WP9). Key staff involved in *RadioNet3* include: *Dr. Pierre Cox,* IRAM Director, whose scientific interests are mostly in the fields of interstellar dust and molecules, circumstellar environments and high redshift galaxies; *Dr. Karl Schuster,* IRAM Deputy Director, whose scientific interests are mostly in the fields of circumstellar disks, interstellar medium and receiver front ends. *Dr. Michel Guélin,* PI of the AMSTAR+ JRA and of the proposed AETHER JRA and former Deputy Director of IRAM; his scientific interests are mostly in the fields of molecular spectroscopy, astrochemistry and interstellar medium in galaxies*; Dr A. Navarrini,* Head of IRAM receiver group; *Dr. Doris Maier,* Research Engineer, Head of the IRAM mixer development group*; Dr. Frederic Gueth,* Responsible of the IRAM interferometry schools (IMISS).

Participant No. 4: INAF (IT)

The Italian National Institute for Astrophysics is participating in *RadioNet3* via The Istituto di Radioastronomia (IRA). IRA operates major national infrastructures (the Medicina and Noto 32m radio telescopes) and is responsible for design, construction and operation of the Sardinia Radio Telescope, a parabolic 64-metre antenna. IRA is member of the European VLBI Network and the International VLBI Service for Astrometry and Geodesy (IVS). It is involved in major international ground-based projects such as ALMA, LOFAR and SKA. IRA hosts the Italian ALMA Regional Centre on behalf of the Istituto Nazionale di Astrofisica. IRA has gained expertise in the development of state-of-art components for mm/sub-mm receivers including MMIC and has extensive experience in working with cryogenically cooled low-noise amplifier systems. In the framework of the EC funded project FARADAY, IRA prototyped a multi-feed array cryogenically cooled receiver at 22GHz, and is developing a new generation of multi-purpose digital back-ends for radio astronomy (e.g. EVN). IRA supports various high-level educational programs (Courses, Master Thesis and PhDs) in collaboration with several University Departments in Bologna, Cagliari and Catania.

Role in RadioNet3: IRA will provide access to the EVN and SRT (WP12 and WP20) via the transnational access programme under the responsibility of *Dr. Karl-Heinz Mack*. IRA will lead the NA Science Working Group (WP3), and it will play important roles in the NAs QueSERA (WP2), MARCUs (WP5) and ERATec (WP6). IRA is heavily involved in the JRAs UniBoard2 (WP8) and DIVA (WP11). Key staff members involved in *RadioNet3* include: *Dr. Franco Mantovani*, Senior Scientist, *RadioNet-FP7* Board Chairman, will be the IRA contact person in *RadioNet3*; *Dr. Tiziana Venturi*, respected scientist, chairperson of the EVN Program Committee, who will chair the Science Working Group; Dr. *Stefania Varano,* outreach officer of the Istituto di Radioastronomia, in charge of the Visitor Centre "Marcello Ceccarelli" at the Medicina radio observatory, who will lead Task3 'Outreach for general public' in the NA QueSERA. Personnel involved in DIVA; *Dr. Gino Tuccari,* senior physicist, who has an excellent reputation in digital backends (DBBCs) for VLBI data acquisition. *Dr. Gianni Comoretto*, senior physicist, excellent digital backends expertise, for single dish in particular (specrometers).

Participant No. 5: JIVE (EU/NL)

The Joint Institute for VLBI in Europe (JIVE) is funded by several major Research Councils and Radio Astronomy national facilities in Europe. It operates the MkIV VLBI Data Processor of the European VLBI Network (EVN). In its capacity as the central institute of the EVN, JIVE provides both end-user support as well as support to the telescopes in the array. JIVE scientists conduct forefront astronomical research, using VLBI in a wide range of applications including astrometry. JIVE staff are developing state-of-the-art VLBI (Very Long Baseline Interferometry) techniques and technology, including real-time VLBI, so called e-VLBI. JIVE is the coordinator of the NEXPReS FP7 project. JIVE also hosts the central data archive of the EVN and facilitates the access of users to the data by providing several software interfaces and web services. There is extensive expertise in software development with an emphasis on correlation algorithms, data processing and space mission applications. JIVE participates in many SKA projects with a focus on simulations and correlator architectures. JIVE is the legal entity representing the European SKA Consortium. It has the ambition to transform from a Dutch foundation into a European Research Infrastructure Consortium.

Role in RadioNet3: As the central institute of the EVN, JIVE will provide the user services and access to outside users of the EVN through its TNA program (WP12). Building on the experience in previous framework programs, JIVE will carry out some of the central management of *RadioNet3* (WP1), in particular the administration of the TNA & NA travel budget. JIVE will house the PI of the UniBoard[2] JRA (WP8). Key staff involved in *RadioNet3* includes: *Dr. Huib Jan van Langevelde*, the current JIVE director, expert in radio and mm interferometry and the study of astrophysical masers. Van Langevelde has an appointment at Leiden University where he supervises several PhD students. He will take a leading role in the NA QueSERA (WP2); *Dr. Bob Campbell*: Head of operations at JIVE and responsible for the implementation of the EVN TNA, world expert on interferometer techniques and astrometry. *Dr. Arpad Szomoru*: Head of JIVE's R&D division and a leading figure in the development of e-VLBI. PI of the JRA UniBoard[2] and in particular the correlator application that will be deployed for e-VLBI; *Drs. Aukelien van den Poll*: project assistant responsible for carrying out the central services for TNA travel that have been implemented at JIVE.

Participant No. 6: UMAN (UK)

UMAN is the largest single-campus university in the UK, with 27,000 undergraduate and 10,000 postgraduate students. It spends ~ £300M annually on research. The Jodrell Bank Centre for Astrophysics (JBCA), which is an integral part of UMAN's School of Physics and Astronomy, is, with 180 staff and students, the second largest astronomy and astrophysics group in the UK. JBCA runs Jodrell Bank Observatory, home of the 76-m Lovell Telescope, and the e-MERLIN/VLBI National Facility. It has a broad ranging research programme, from studies of solar plasmas to the origins of the Universe, and most astrophysical phenomena that lie therein. JBCA also has a strong technology programme, with groups working on instrumentation R&D for multi-pixel cameras for studies of the Cosmic Microwave Background; for a wide range of technologies for the SKA, for broadband data transmission, for improved receiver systems and for algorithmic development. JBCA is also the host organisation for the SKA Programme Development Office.

Role in RadioNet3: UMAN has a role in the JRA UniBoard[2] (WP8). The e-MERLIN facility will be available via the TNA programme (WP14), and UMAN is an EVN Partner (WP12). The NA New Skills (WP4) will be lead by UMAN. Key staff involved in *RadioNet3* will include: *Prof. Simon Garrington*, Director of the e-MERLIN/VLBI National Facility and the Head of Operations at JBO, who is currently the PI of *RadioNet-FP7* in Manchester. His research interests are wide, and he has published papers in fields as diverse as VLBI studies of stars in Orion to deep-field observations of the most distant parts of the Universe. He is the leader of the e-MERLIN upgrade project, which has recently achieved the first maps made with e-MERLIN. *Dr Ben Stappers*, Head of the pulsar group at JBCA, is PI of pulsar search and transient projects with both LOFAR and meerKAT, and is also involved in projects with ASKAP. He has been involved in the development and commissioning of two pulsar backends and is currently leading the pulsar application part of UniBoard in *RadioNet-FP7*. His research interests range from using neutron stars to try and detect gravitational waves to using radio telescopes in unique ways, such as trying to detect cosmic ray impacts on the Moon. *Dr. Anita M. S.Richards* (JBCA, UMAN), formerly MERLIN archivist and now working for the UK ALMA Regional Centre, continues as the leader of the NA New Skills.

Participant No. 7: OSO (SE)

Onsala Space Observatory (OSO) is the Swedish National Facility for Radio Astronomy. The Swedish Research Council evaluates and provides funding for its operation, and it is operated by Chalmers University of Technology, Gothenburg, Sweden. OSO operates three telescopes at Onsala, a 25-m cm-wave telescope, a 20-m mm-wave telescope, and a LOFAR station. It is one of three partners in the APEX (Atacama Pathfinder Experiment) project, a 12-m sub-mm telescope at 5100 m altitude in Chile. Through this, Sweden has 21% of the APEX observing time (Chilean time subtracted). OSO also has a strong receiver development programme for mm and sub-mm wavelengths, as well as pursues developments of other radio astronomical instruments (radiometers, feeds, etc.). OSO's main purpose is to provide Swedish and international astronomers with the possibility to perform astronomical research in frequency bands in the wavelength range from about 0.8 GHz up to 1.5 THz. In addition, OSO provides the channel through which Sweden is involved in large international radio astronomy projects, such as the EVN, JIVE, LOFAR, SKA, and ALMA, and it is a partner in *RadioNet-FP7*, NEXPReS, and Prep-SKA.

Role in RadioNet3: OSO will provide Trans-National Access through all its four telescopes (WP12 and WP19), it will participate in the JRAs AETHER (WP9) and DIVA (WP11), and in some of the NAs. Key staff involved in *RadioNet3* includes: *Prof. Hans Olofsson*, director, is managing the OSO involvement in *RadioNet3*. *Dr. Magnus Thomasson* is leading the OSO TNA programme. *Prof. Victor Belitsky*, head of the Group for Advanced Receiver Development, leads the activities of OSO within AETHER. *Dr. Miroslav Pantaleev* (head of Electronics Development Laboratory) and *Dr. Michael Lindqvist* (vice-chair of EVN TOG) lead the OSO activities within DIVA, the latter being also the OSO representative in CRAF.

Participant No. 8: UCAM (UK)

The University of Cambridge hosts one of the most important centres of physics in Europe, especially in the astronomy field. Astronomy research is carried out in the Cavendish Laboratory (Department of Physics), the Institute of Astronomy and theoretical work the Department of Applied Mathematics and Theoretical Physics. A new venture, the Kavli Institute for Cosmology in Cambridge in which all three groups participate provides an environment for close collaboration between the three groups in areas of common interest. The Astrophysics Group in the Cavendish has about 40 research staff, 25 students and 10 support staff and has a long-established excellence in radio astronomy currently operating the 18-element AMI telescope at the Mullard Radio Astronomy Observatory. Cambridge has a wide-ranging technical and astrophysical research programme. Cambridge, together with Oxford and Manchester in the UK, are playing a major role in the development of the SKA and was a major participant in the highly successful SKADS programme. The group has a strong involvement in sub-mm astronomy: the group built the HARP receiver for JCMT and hosts a world-leading detector development activity and is developing the software to make on-line calibration corrections based on water vapour radiometer measurements for ALMA. There is also a strong research programme in the development of Bayesian data analysis techniques applied to astronomy and cosmology and the development of software pipeline for automated data reduction.

Role in RadioNet3: UCAM will contribute as a participant in JRAs AETHER (WP9) and Hilado (WP10) and in the coordination and networking activities QueSERA, the Science Working Group and Spectrum Management. Key staff involved in *RadioNet3* includes: *Prof. Paul Alexander*, is head of the Astrophysics group and leads the Cambridge SKA activity. His research interests include galaxy evolution, various technical aspects of interferometry – he will be the overall Cambridge PI and lead the Hilado contribution. *Prof. Stafford Withington* is the head of the Detector Physics group and is a world expert in the development of technologies for high-frequency detectors in radio astronomy. He will lead the Cambridge involvement in AETHER. *Dr. John Richer* is the UK ALMA project scientist and leads the calibration work for ALMA. *Dr. Michael*

Hobson leads the theoretical data processing group and is a world expert on the application of Bayesian techniques to quantitative data analysis problems in astronomy and other fields.

Participant No. 9: STFC (UK)

The Science and Technology Facilities Council (STFC) is one of Europe's largest multidisciplinary research organisations, supporting scientists and engineers world-wide. It is a non-departmental government public body, and was formed in 2007 through a merger of the Particle Physics and Astronomy Research Council (PPARC) and the Council for the Central Laboratory of the Research Councils (CCLRC). STFC has a wide remit which includes: administering research grants in astronomy, particle physics, space science and nuclear physics; operating world-class UK research facilities; and providing UK access to a range of research facilities overseas. STFC owns and operates both the James Clerk Maxwell Telescope (JCMT), the world's premier facility for submillimetre astronomy, and the Rutherford Appleton Laboratory (RAL), the UK's leading physics-based research institute.

Role in RadioNet-3: STFC proposes to make the JCMT available for transnational access (WP13), and will also participate in the JRA AETHER (WP9). Key staff involved in *RadioNet3* will include: *Prof. Gary Davis*, Director of the JCMT and a member of the RadioNet Board under FP6 and FP7; *Prof. Brian Ellison*, Senior Principal Scientist at RAL, UK Project Manager for the Atacama Large Millimetre Array (ALMA), with many years experience in millimetre/sub-millimetre wave (terahertz) technology, and also a member of the *RadioNet3* Board under FP6; and *Dr. Peter Huggard*, a Principal Scientist at RAL, a specialist in photomixer sources of THz radiation and high-performance filtering for heterodyne radiometry. The STFC participation in AETHER will be carried out wholly within the Millimetre Technology Group in the Earth Observation & Atmospheric Science Division of RAL Space.

Participant No. 10: SRON (NL)

SRON is the Netherlands Institute for Space Research and is funded by NWO, the Netherlands science foundation. Its main mission is the development and use of innovative instrumentation for cutting-edge space research. SRON has laboratories in Groningen and Utrecht. SRON-Utrecht concentrates on research for x-ray astronomy and Earth oriented science, while SRON-Groningen is the expertise centre for (far-) infrared and submillimeter technology and instruments. SRON-Groningen has many years of experience in the development of advanced optical, infrared and submillimeter instrumentation for astronomical applications. It has built instruments for the infrared satellites IRAS (operational in 1983) and ISO (operational 1995 – 1998). Since 1998 SRON – as PI institute – has been developing and building the *Heterodyne Instrument for the Far-Infrared* (HIFI) for ESA's Herschel Space Observatory with contributions from more than 20 partners in 12 countries. HIFI has been launched successfully launched by ESA in 2009 and now in operation. SRON, in collaboration with TU Delft and NOVA, is also building the ALMA Band 9 (600 - 720 GHz) receivers some of which are already in operation. Currently SRON is a PI institute for SPICA SFARI project.

Role in RadioNet3: SRON is heavily involved in JRA AETHER (WP9). Key staff involved in *RadioNet3* includes: *Dr. A. Baryshev*, instrumentation expert, member of the *RadioNet3* Board, group leader, management and oversight, leader of Task 3 of AETHER; *Dr. A. Khudchenko,* instrument scientist, mixer and receiver research, *R. v.d der Schuur,* fine mechanic, machining and prototype fabrication.

Participant No. 11: OBSPARIS (FR)

Paris Observatory (www.obspm.fr) is the largest astronomy centre in France, and one of the most important in the world. It has the status of an independent University. It represents itself one third of astronomy in France. It covers almost all the fields of Astronomy/Astrophysics. Among its 7 different laboratories, the whole Nançay Radio Astronomy Station personnel, and part of GEPI, LESIA and LERMA researchers and engineers, work in the field of radio astronomy. OBSPARIS participated in various networking activities within FP6, and LERMA participated in the JRA AMSTAR (*RadioNet* FP6) and AMSTAR+ (*RadioNet-FP7*). OBSPARIS is also a significant contributor to both FP6 SKADS and FP7 PrepSKA.

Role in *RadioNet3*: OBSPARIS is a partner in the JRA AETHER (WP9) and contributes to the NAs QueSERA (WP2) and Spectrum Management (WP7). Key staff involved in *RadioNet3* includes: *Jean-Michel Krieg*, LERMA, technical manager for the OBSPARIS participation in JRA AETHER, responsible for various R&D projects for CNES and space missions in the mm/sub-mm domain; *G. Theureau*, astronomer in Nançay, working with NRT data (galaxies and pulsars), member of EPTA European Pulsar timing Array, specialist of public outreach, will be involved in the NA QueSERA; *Wim van Driel*, astronomer at GEPI, expertise in particular on spectrum management, member and former chairman of IUCAF and CRAF, chairman of SKA-France, member of IAU commission 50, participates in the NA Spectrum Management (WP7).

Participant No. 12: UOXF (UK)

The University of Oxford and its Astrophysics sub-Department has the fastest-growing radio astronomy group in Europe. It has expertise in all aspects of radio astronomy from telescope and instrument design (CBI2, CBASS, QUIET, ARTEMIS) to detector physics (SIS and bolometer devices), data analysis and the astrophysics of radio-emitting objects. The research and development of radio astronomy hardware benefits from a strong collaboration with the Department of Engineering. It also works closely with the Oxford e-Research Centre that plays a major role in advanced ICT and high-performance computing (HPC).

Role in RadioNet3: Oxford will have a major involvement in the JRAs AETHER (WP9) and Hilado (WP10), and will also take an active part in QueSERA (WP2) and SWG (WP3). Oxford works on the JRA AETHER (WP9) will be led by Prof Ghassan Yassin who has expertise in all the main tasks to be undertaken. In AETHER Task 2 -highly integrated double-sideband (2SB) SIS receivers - his group will develop and deliver a new-high performance feed developed at Oxford that does not employ corrugation and can be fabricated cheaply and quickly. He will lead AETHER Task 4 - Supra-THz Heterodyne receivers - to develop an SIS mixer operating above 1.3 THz, an HEB operating around 1.5 THz and LO sources to feed these detectors. Oxford will lead the design and preliminary testing of the SIS mixer in collaboration with Cambridge, Cologne and RAL, requiring novel technology development in the areas of superconducting device physics and technology, mixer physics and superconducting electromagnetic design and testing.Oxford work on the JRA Hilado (WP10) will be led by *Prof Steve Rawlings and Dr Stef Salvini*. They will lead a software development team working jointly in Oxford Astrophysics and the Oxford e-Research Centre (OeRC). OeRC expertise in high-performance computing (HPC) will be exploited to develop HPC methods for current and future radio astronomy in the areas of algorithms and solvers. An existing collaboration between Oxford and ASTRON that has already delivered a new fast-transient instrument for LOFAR stations will be developed into an imager through *RadioNet3*.

Participant No. 13: UAH (ES)

The University of Alcalá (UAH) offers degrees in five branches of knowledge: Arts and Humanities, Law and Social Sciences, Sciences, Health Sciences, and Engineering and Architecture, to its approximately 20,000 undergraduate students, and performs research projects in all these fields. The IGN (Instituto Geográfico Nacional) operates national facilities at Yebes including two millimetre-wave radio telescopes and it owns world-class laboratories for the RF-technology development including quasi-optics. IGN will act as a third party to UAH.

Role in *RadioNet3*: UAH is a major participant in the JRA AETHER (WP9). The IGN with its 40-m telescope is an important partner of the TNA EVN (WP12). Key staff involved in *RadioNet3* include: Manuel Rosa Zuera (Professor of signal processing), Mrs. Pilar Jarabo, and engineers involved in tasks 1 and 3 of the JRA AETHER which will be employed by the UAH, they will be working mainly in the laboratories of IGN at Yebes and at Alcalá de Henares. Moreover Rafael Bachiller (Director of OAN-IGN) and Francisco Colomer (IGN) will serve as contact persons for the access of the IGN telescope in EVN TNA. Additionally, the IGN staff Juan Daniel Gallego and Alberto Barcia will be the contact persons for the access of the UAH staff to the IGN laboratories.

Participant No. 14: TUD (NL)

Delft University of Technology (TUD) is the oldest and largest engineering school in The Netherlands. It was founded in 1842 and received the right to grant PhD degrees in 1905. Education at TUD covers the major fields of engineering and it has a particular strong research profile in the nanosciences. The Department of Nanoscience has become the Kavli Institute of Nanoscience to acknowledge its leading position in many areas of nanoscience such a molecular biophysics, quantum information processing, nanoelectronics for space research, physics of nano-electronics and theoretical physics. It has a commonly run nanofacility equipped for various general processes and for specific research groups. The facility is used by industries like MAPPER, a multi-electronbeam lithography development company. Research is funded through a variety of national, European and US research organisations.

Role in RadioNet3: TUD will participate in the JRA AETHER (WP9) and in the NA QueSERA (WP2). Key staff involved in *RadioNet3* includes: *Prof. Teun M. Klapwijk*, director, is managing the TUD involvement in *RadioNet3* and leads Task 3 of TUD within AETHER. *Dr. Jianrong Gao*, senior scientist at SRON and at Delft University, leads Task 4 of TUD within AETHER. *Tony Zijlstra*, senior technician in nanotechnology, and *David Thoen*: junior technician in nanotechnology will be involved in Tasks 3 and 4 of AETHER.

Participant No. 15: ESO (EU)

ESO, the European Southern Observatory, is the foremost intergovernmental astronomy organisation in Europe and the world's most productive astronomical observatory. ESO provides state-of-the-art research facilities to astronomers and is supported by Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Several other countries have expressed an interest in membership. ESO's main mission, laid down in the 1962 Convention, is to provide state-of-the-art research facilities to astronomers and astrophysicists, allowing them to conduct front-line science in the best conditions. The annual member state contributions to ESO are approximately 135 million Euros and ESO employs around 700 staff members. By building and operating a suite of the world's most powerful ground-based astronomical telescopes enabling important scientific discoveries, ESO offers numerous possibilities for technology spin-off and transfer, together with high technology contract opportunities and is a dramatic showcase for European industry. Whilst the Headquarters (comprising the scientific, technical and administrative centre of the organisation) are located in Garching near Munich, Germany, ESO operates, in addition to the Santiago Centre, three unique observing sites in Chile: La Silla, Paranal and Chajnantor.

ESO is leading the European contribution to ALMA construction and operations on behalf of its member states. The interface between the European user community and the ALMA observatory will be the European ALMA Regional Center (ARC). The ARC consists of the central office and seven partners or ARC nodes that will help ALMA users obtain the best science from this instrument.

Role in RadioNet3: ESO will be leading the NA MARCUs (WP5), participating in the JRAs AETHER (WP9) and Hilado (WP10), as well as in the NAs QueSERA (WP2) and Science Working Group (WP3). Key staff involved in *RadioNet3* include: *Dr. Leonardo Testi* (European Project Scientist for ALMA at ESO); *Dr. Robert Laing* (Instrument Scientist for ALMA at ESO); *Dr. Paola Andreani* (ARC Manager at ESO); *Dr. Martin Zwaan* (ARC Astronomer at ESO); *Dr. Dirk Petry* (ARC Scientist at ESO).

Participant No. 16: KASI (KR)

The Korea Astronomy and Space Science Institute (KASI) is the national astronomy research institute of Korea established in 1974. KASI has played a major role in establishing a modern programme of astronomical research in S. Korea. KASI established the Sobaeksan OpticalObservatory & Bohyunsan Optical Observatory, expanded the observational wavelength range to the radio via the establishment of the Taeduk Radio Observatory, and is operating the

Korean VLBI Network (KVN). The KVN is a dedicated mm-VLBI array that employs a unique simultaneous multi-frequency observation system. KASI hosts the Korean-Japanese Joint VLBI correlator (KJJVC) center. The KJJVC is responsible for VLBI data processing of the KVN and will correlate the data of the East-Asian-VLBI & VSOP-2. In 2009 KASI joined in the international project to build one of the largest ground-based optical-infrared telescopes in the world, which is the Giant Magellan Telescope (GMT). KASI is involved in two SKA related international projects. KASI is involved in two FP7 projects: in PrepSKA, KASI participates in the software correlator development. In *RadioNet-FP7*, KASI takes part in the JRA UniBoard development.

Role in RadioNet3: KASI will contribute as a participant in the NA Science Working Group (WP3). Key staff involved in *RadioNet3* includes*: Dr. Bong Won Sohn*, senior researcher and associate professor, overall responsible for KASI's participation in *RadioNet3*. *Dr. Sang Sung Lee* is senior researcher and responsible for the NA Science Working Group.

Participant No. 17: BORD (FR)

The "Laboratoire d'Astrophysique de Bordeaux" (LAB) is a research laboratory funded by the University Bordeaux 1 and the CNRS. It is involved in extragalactic, galactic, stellar and planetary science. The major research topics include: reference systems and astrometry, active galactic nuclei, kinematics of stars in the Milky Way, interstellar medium, high-mass star formation, circumstellar discs and migration process, self-gravitating structures, Solar System dynamics, planetary atmospheres and surfaces, exoplanets as well as studies about the origin of life on Earth and in the Universe. In addition, the LAB has strong experience in building electronical equipment for both space and ground-based instrumentation. It has played and plays a prominent role in two major international projects, ALMA and Herschel. This includes innovative developments in digital filtering, fast digitizers, and IF/RF analog signal conditioning for ALMA and the organisation of the corresponding industrial production along with delivery of the analog part of the High Resolution Spectrometer for Herschel. More recently, the LAB has been involved in developments for the Martian rover programs MSL11 and Exomars. The LAB cooperates with ESO, ESA and various European institutes or local industry on these technological projects. It is engaged in a number of national, European and international scientific collaborations among which preparation of the Gaia space astrometric mission and the International VLBI Service for geodesy and astrometry (IVS). The LAB hosts the ERC-Starting grant E^3ARTHS and participates in several EU-funded FP6 or FP7 projects such as *RadioNet*, CATS, VAMDC and Europlanet. In *RadioNet-FP7*, the LAB contributes to the JRA UniBoard and ALBiUS, while in *RadioNet3*, it will contribute to the JRA UniBoard[2].

Staff involved in RadioNet3: Patrick Charlot, LAB Director, will be responsible for the overall work within *RadioNet3*. He has vast experience in astrometric and astrophysical VLBI and was the chairperson for the EVN Program Committee from 2003 to 2008; he is currently involved in the JRA ALBiUS within *RadioNet-FP7*. *Philippe Cais,* head of the LAB Electronics laboratory, was involved in the construction of the digital filtering sub-system for the ALMA correlator and co-lead the Herschel-HIFI correlator team. *Benjamin Quertier* has expertise in the mathematical tools required for digital signal processing and in digital electronics at large; he was involved in VHDL programming for the ALMA digital filters and in the filter qualification tests. Both of them participate in the JRA UniBoard within *RadioNet-FP7* and will contribute to new JRA UniBoard[2].

Participant No. 18: UORL (FR)

The University of Orleans (UORL) founded in the 14th Century has over ~ 15000 students and employs 882 lecturers in 5 Faculties, 1 School of Engineering and Technology and 4 Institutes of Technology. 34 research laboratories are coordinated by the Research Department and are divided into 6 centres of excellence including “Mathematics, informatics and electronics”. UORL is also a participant in several EC FP6 and FP7programmes (for example SKADS, *RadioNet-FP7*, PREPSKA for the radio astronomy part). UORL has been the co-supervisor of the RFI mitigation workpackage in the SKADS European project and is involved in similar studies for the PrepSKA European project. UORL is engaged in European and international scientific cooperation and involved in some emerging facilities such as LOFAR and SKA. UORL has defined the RFI algorithms for the pulsar binning machine in the previous UniBoard project

Role in RadioNet3: UORL participates in the JRA UniBoard² (WP8) and in the NA QueSERA (WP2). UORL activity will include the design of RFI mitigation algorithms for the board firmware.. Key staff involved in *RadioNet3* includes: *Dr. Rodolphe Weber*, scientific coordinator of the Radio Frequency Interferences mitigation group at the Nançay radio Observatory. His interests are in digital backends and signal processing algorithms for radio astronomy. *Dr. Cédric Dumez-Viou*, digital engineer at the Nançay radio Observatory, has supervised the implementation of various RFI mitigation algorithms for the Nançay facilities and for the previous UniBoard² project.

Participant No. 19: Fraunhofer (DE)

The Fraunhofer Institute for Applied Solid-State Physics, IAF, is a leading research and technology centre for compound semiconductors and their application in microelectronics and optoelectronics. Fraunhofer IAF is a gateway between state-of-the-art research and industrial implementation of novel micro- and nanoelectronic circuits, as well as optoelectronic devices. The IAF focuses on III/V-compound semiconductors and their heterostructures for advanced transistors and optoelectronic devices. Epitaxial growth in atomic dimensions and device structures of less than 50 nm are the daily essentials of IAF technology. For military and commercial applications, the IAF develops a broad variety of microwave and millimetre-wave monolithic integrated circuits (MMICs) based on III-V compound semiconductors using advanced HEMT technology. Operating between 1 GHz and 0.5 THz, these integrated circuits combine high functionality with small chip size and cost-effective production. The IAF offers epitaxial and technology services, design, prototyping and small volume production for packaging and module fabrication and covers the complete MMIC technology chain. In previous projects the metamorphic HEMT technology was successfully extended to cryogenic temperatures and related ultra-low noise applications. In ongoing projects, the current high performance room-temperature mHEMT technology is re-investigated and modified to a dedicated cryo-process to yield optimum noise performance at very low temperatures.

Role in RadioNet3: The IAF is an essential partner in the JRA AETHER (WP 9) and participating in the NA QueSERA (WP2). Key staff involved in *RadioNet3* includes: *Dr. Matthias Seelmann-Eggebert*, Senior Scientist, Technical Officer and local Project Coordinator for *RadioNet3* activities. He has expertise in modeling of semiconductor devices, ca. 20 authored and co-authored publications on MMICS in the last 3 years. *Daniel Bruch*, designer of front end MMICs, i.e. LNAs for mm-wave and IF applications.

Participant No. 20: U. Turku (FI)

The University of Turku, Finland´s second largest university, is an internationally competitive research-led university whose operation is based on high-level multidisciplinary research. The University of Turku offers study and research opportunities in seven faculties: Humanities, Mathematics and Natural Sciences, Medicine, Law, Social Science, Education and Turku School of Economics. In addition to the faculties, the university has 11 special units dedicated to research or services. The university has about 3000 employees (58% female) and 20773 students. In 2009 there were 2309 postgraduate students, and 144 doctorates were awarded. The university has participated in the framework programmes since the second programme. Physics and Astronomy are among the oldest disciplines at the University of Turku. The teaching of Physics started in the autumn semester of 1922, and the teaching of Astronomy a year later when Yrjö Väisälä became professor of Physics and later also professor of Astronomy. Today the Department of Physics and Astronomy offers a rich curriculum supported by a broad research profile. The teaching covers experimental and theoretical physics as well as astrophysics and astronomy. The high-quality basic research is accompanied by original and successful development of physical applications for industrial purposes. The Department of Physics and Astronomy offers an extensive programme in Astronomy and Space Physics leading to MSc and PhD degrees, with all teaching done in English. Tuorla Observatory at the University of Turku is the leading astronomical institute in Finland in many areas of astronomical research. Major research areas include solar physics, stars and stellar systems, cosmic ray physics, space instrumentation, large-scale structure in the Universe, cosmology, active galaxies and instrumentation for both ground- and space-based observations. A special field of expertise is Radio Astronomy. Tuorla Observatory has long-running collaboration with Metsähovi Radio Observatory at Aalto University in Finland. FINCA, the Finnish Centre for Astronomy with ESO, operates at Tuorla Observatory.

Role in RadioNet3: *Dr. Silja Pohjolainen* (university teacher at Tuorla Observatory, Department of Physics and Astronomy) has long experience in solar radio physics. She is the President of European solar radio astronomers organization CESRA since June 2010, and will be in charge of organizing research training in solar radio astronomy within NA New Skills (WP4).

Participant No. 21: UMK (PL)

The Torun Centre for Astronomy (TCfA) at the Nicolaus Copernicus University (UMK) consists of two Departments (Astronomy and Astrophysics and Radio Astronomy). It is an institute of the Faculty of Physics, Astronomy and Computer Sciences. The Faculty is one of 16 at the Copernicus University. The University has about 31 000 students and 4 400 staff. Currently TCfA teaches about 100 students (undergraduates, graduates and Ph.D.). In 2010, a ranking list of the Polish Ministry of Science and Higher Education in the group of physics and astronomy science located the Faculty as number one among the polish universities. TCfA has the status of "excellence" awarded by the National Commission for Education, an independent body operating at ministerial level.

Role in RadioNet3: UMK will make available the 32-m radio telescope in Torun to the TNA EVN programme (WP12). UMK is also invoved in the NAs QueSERA (WP2), SWG (WP3) and Spectrum Management (WP7). Key staff involved in *RadioNet3* includes: *Andrzej Kus*, Professor of Radio Astronomy, Director of TCfA and chairperson of the EVN Consortium Board of Directors. His expertise is in instrumentation, receivers and back-ends, interferometry, interest in cosmic masers and extragalactic radio astronomy; *Prof. Marian Szymczak,* Chair of the Radio Astronomy Department, with scientific interest in physics of stellar masers, *Dr. Magdalena Kunert-Bajraszewska*, friend of e-VLBI, local coordination of e-EVN sessions; *Dr. Jerzy Usowicz,* RFI monitoring and mitigation, CRAF memeber representing TCfA; *Kazimierz Borkowski* - friend of VLBI, local scheduler and coordinator of EVN sessions at Torun; *Eugeniusz Pazderski* - head of R&D group, maintenance of receivers and control systems; *Roman Feiler* - software engineer, maintenance of field system and other control packages.

Participant No. 22: UCO (DE)

The Kölner Observatorium für SubMillimeter Astronomie (KOSMA) is part of the I. Physikalisches Institut of the University of Cologne (UCO). Its astronomical research focuses on the submm- and THz-frequency range. It has a strong instrument development group that has provided (multipixel) receivers for KOSMA's own telescope at Gornergrat (CH), and receivers or parts of receivers for various other observatories throughout the world. It has recently provided the mixers for Band 2 of HIFI on the Herschel Satellite and for GREAT 1.4/1.9 THz on SOFIA. Currently KOSMA is involved in building state of the art receivers for the SOFIA airplane observatory (2.5 THz HEB mixer), for the NANTEN2 observatory (2x8 pixel dual colour 500GHz/800 GHz SIS mixer array receiver) and for the APEX observatory (7 pixel 1.1THz SIS mixer array) in the Atacama in Chile and for the STO Balloon observatory for Antarctica (4 x1.9 THz HEB mixers and array receiver optics). All receiver development and fabrication is done in house. KOSMA has its own nanostructure facility, state of the art high frequency design/measurement tools, and an excellent mechanical workshop.

Role in RadioNet3: UCO participate in JRA AETHER (WP9, Task4) for the development of SIS THz mixers and mixer devices. Key staff involved in *RadioNet3* include: *Dr. K. Jacobs*: head of the nanostructure facility, 20 years of experience in submm/THz detector development; *Dr. C. Honingh*: mixer development, 15 years of experience in submm/THz detector development; *Mr. S. Selig*: Diploma student on the subject of SIS device fabrication processing development and candidate for PhD position on this project, *Dipl. Phys. M.P. Westig*: PhD student on the subject of THz SIS detectors; *Dipl. Ing. S. Wulff*: engineer and head of clean room; *Mr. S. Schultz*: mechanical design & mixer assembly.

Participant No. 23: VENT (LV)

Ventspils University College (VUC) is one of the leading higher education establishments in Latvia. VUC offers both academic and professional studies in various specialties, particularly Electronics and Information Technologies. During the academic year 2010/2011 there are about 882 students studying at VUC. Two research institutes have been founded at VUC and one of them, the Ventspils Engineering Research Institute „Ventspils International Radio Astronomy Centre" of Ventspils University College (VIRAC), will be involved in *RadioNet3*. VIRAC operates the 32-m radio telescope in Irbene at centimetre wavelengths and currently is preparing a 16-m radio telescope for observations. VIRAC is developing software for the correlator for VLBI data processing based on own computer cluster. VIRAC has been and is participating in EU-funded collaborations in FP6 and FP7, such as *RadioNet-FP7* and NEXPReS. Furthermore, VIRAC is executing the project "Signals related to Artificial Earth Satellites: Technologies of Receiving, Transmitting and Processing" funded by the European social fund, which is related to space debris radio observations. The 32-m radio telescope is now being equipped with the necessary equipment to take part in VLBI observations with the aim to become a full member of the EVN consortium.

Key staff involved in RadioNet3 includes: *Dr. Ivars Smelds,* leader of the VLBI group of VIRAC, is responsible for developing VLBI technologies and the implementation in the Irbene observatory. His scientific interests also include the fields of astrochemistry, interstellar medium and space debris. *Dr. Normunds Jekabsons* is responsible for mathematical modelling, developing software for VLBI data processing and high performance computing. He is also the manager of the project "Signals related to Artificial Earth Satellites: Technologies of Receiving, Transmitting and Processing", and is involved in the FP7 project NEXPReS. *Asoc. Prof. Juris Zagars* is leader of the Satellite navigation group and is the Latvian delegate in FP7 "Space" and "Security" program committees. His scientific interests lie in the fields of space navigation, reference frames, SLR and geodetic VLBI theory and applications.

Participant No. 24: AALTO (FI)

Aalto University (formerly known by the short name TKK) is the parent organisation of the Metsähovi Radio Observatory (MRO). Metsähovi Radio Observatory operates a 14-m mm-wave radio telescope and is a specialist in mm-VLBI and geodetic e-VLBI. Metsähovi is a long time partner in the EVN and has been participating in VLBI observations since 1991. Since the early 1990's Metsähovi has been one of the few institutes in the world where high-speed VLBI data acquisition systems have been actively constructed and developed further. Recent and future developments have concentrated on maximising the applicability of Commercially Available Off-the-Shelf (COTS) technology for multi-gigabit radio astronomy data acquisition and storage applications. As a partner in industry space technology projects as well as ESA Planck and NASA AMS-02, Metsähovi is an active expert in several networking, computing, VLBI hardware, and data processing projects.

Role in RadioNet3: Metsähovi makes available the facilities of its mm-VLBI radio telescope as part of the TNA EVN programme (WP12). Key staff involved in *RadioNet3* includes: *Dr. Ari Mujunen*, software engineer at Metsähovi Radio Observatory. At MRO, he has written software and created electronic designs for the in-house telescope control and single-dish data acquisition system. *Jouko Ritakari* is a hardware engineer at Metsähovi Radio Observatory. At MRO, he has developed hardware and firmware for high-speed data acquisition systems and led the project where MRO manufactured its own VLBI "VLBA DAS" rack in 1991. He has also experience in designing data communication networks, as he has designed several of the largest private networks in Finland. *Guifré Molera Calvés*, researcher and active collaborator in international projects as the AMS-02, EXPReS and the upcoming ESA/JIVE ExoMars and PRIDE projects. Currently he is writing his PhD thesis, focused on planetary spectroscopy with VLBI equipment and high-accuracy spacecraft tracking with single dish observations.

Participant No. 25: NRF (ZA)

The Hartebeesthoek Radio Astronomy Observatory (HartRAO) is the only major radio astronomy observatory in Africa, which is operated by the National Research Foundation (NRF). The tasks that are relevant to RadioNet are those performed by: 1) HartRAO, which carries out observations with the 26m radio telescope. Especially relevant is the use of the 26m antenna as part of the European VLBI Network (EVN). It provides access to the longest baselines to Europe, thereby giving the highest resolution at frequencies up to 22 GHz, and 2) the MeerKAT project which is a project to build a 64 x 13.5m antenna array as a precursor to the Square Kilometre Array. Within the MeerKAT project is a smaller array of 7 x 12m antennas (KAT-7) which will be operational and available for PI proposals in late 2011. Innovative developments in the MeerKAT project include a 13.5 gregorian offset antenna of the type proposed by the SKA project, with a reflector formed on site using a composite material for light weight high surface precision, and a new correlator design based on a collaboration with the USA. Proposals for observing time with MeerKAT show a huge European interest and many excellent ideas for transformational astronomical science and cosmology. Scientific links to ALMA are facilitated by the upper (8 - 15 GHz) band of MeerKAT enabling observations of high rd-shift carbon monoxide in the ground state transition of the molecule.

Role in RadioNet3: HartRAO is strongly involved in NA QueSERA (WP2) and the steering committee of the NA SWG (WP3). Key staff involved in *RadioNet3* includes: *Professor Bernie Fanaroff*, director of the SKA South Africa project, will play a leading role in the South African part of *RadioNet3*. *Professor Roy Booth*, earlier director of Onsala Space Observatory was the first *RadioNet* Board chairman and is a member of the Board of *RadioNet-FP7*. *Dr. Jonathan Quick* of HartRAO will lead the South African VLBI technical developments and the continuation of eVLBI with the 26m antenna. Several MeerKAT digital and software engineers will participate in relevant working groups.

Participant No. 26: CSIRO (AU)

CSIRO Astronomy and Space Science (CASS) is staffed by around 300 people, and is the largest single astronomical institution in Australia. The Division is responsible for managing the Australia Telescope National Facility (ATNF), which provides a uniquely powerful view of the southern hemisphere radio spectrum. The ATNF comprises three observatories in New South Wales, and construction is underway to add a fourth (the Australian SKA Pathfinder (ASKAP) at the Murchison Radio Observatory in Western Australia by 2013. Technical research and development, and support of the ATNF and the new ASKAP instrument, are conducted at CASS' headquarters in Marsfield, Sydney. In addition, the Canberra Deep Space Communication Complex (CDSCC) at Tidbinbilla was recently incorporated into CASS operations. As part of the Host Country agreement with NASA, a fraction of the time on the CDSCC antennas is available to the astronomical community.

CASS' research capabilities are:

- Astronomy & Astrophysics, comprising of expertise in observational astronomy and its interpretation in terms of the physical processes and systems that comprise the universe beyond our solar system. CASS has substantial expertise in pulsar studies, Galactic and extragalactic HI studies, polarimetry, star-formation regions, and studies of Active Galactic Nuclei.
- Radio Telescope Operations capability, made up of technical management and specialist understanding of very complex facilities including skills in radiofrequency engineering, digital electronics and signal processing, cryogenic systems and numerical and real-time control software.
- Data analysis software, a strong team has developed and maintains software for the reduction of pulsar, single-dish and interferometry data. It is writing ASKAPsoft, which will process the PB of data produced by ASKAP and is also conducting research into new data processing algorithms.
- Radio Science & Engineering, including expertise in RF receiver engineering, mm- and cm-wavelength receiver technology and multi-fielding expertise, radio-frequency electromagnetic/mechanical design and fabrication, the design of Microwave Monolithic Integrated Circuits and cryogenic receiver systems. Capability includes expertise in data handling, data transport, fibre-optic communications, signal processing, digital correlator design and construction, multi-beam and focal-plane array receiver technologies, and associated software. Supporting expertise includes the measurement, characterisation and mitigation of Radio Frequency Interference.

Role in RadioNet3: CSIRO is strongly involved in NA QueSERA (WP2) and the steering committee of the NA SWG (WP3). *Key staff involved in RadioNet3* includes: *Prof. Phil Diamond*, Chief of CSIRO Astronomy and Space Science. Prof Diamond's research is focused primarily on astrophysical masers and starburst galaxies. He also has a keen interest in the techniques of interferometry and the algorithms that are used to calibrate and image radio data. Prof. Diamond will be the primary contact for the RadioNet3 collaboration. *Dr. Robert Braun*, Assistant Director Astrophysics, CASS. Dr. Braun is an Honorary Professor of the University of Sydney. Dr. Braun's research is focused on the interstellar and intergalactic medium of the Milky Way, and nearby and distant galaxies. Another recent research focus has been the detection and documentation of the large-scale magnetic field topology of nearby galaxy disks. Dr. Braun will be the focal for scientific matters. *Phil Crosby*, Head of Strategic Planning, CASS. Mr. Crosby manages CASS' long range strategic planning, new science theme and business development, overall risk management and industry liaison. He is also responsible for Industry Participation Strategy for the SKA Program Development Office (SPDO), where he established several key science support collaborative agreements with industry. Mr Crosby's technical background is in electronics and communications engineering, and international application of Technical Standards. Mr. Crosby will be the administrative contact for *RadioNet3*.

Participant No. 27: ILT (NL)

The International LOFAR Telescope (ILT) is the foundation, established under Netherlands law in November 2010 and seated in Dwingeloo, The Netherlands, in which ASTRON and national LOFAR astronomy consortia in France, Germany, The Netherlands, Sweden, and the United Kingdom collaborate on the exploitation of all LOFAR facilities for astronomy in their countries. The ILT offers these facilities in a common-user environment to all interested parties. The ILT employs no personnel. ASTRON, seated in Dwingeloo, the Netherlands, is the coordinating operational entity within the ILT; it employs the ILT Director, and commits the bulk of the annual operational resources. The ILT formally started its full functions on 1 January 2011.

Role in RadioNet3: The ILT is involved in NA QueSERA (WP2) and it will provide access to the LOFAR telescopes (WP16). The overall science policies and functioning of the independent proposals review committee (PC) are the direct responsibility of the ILT Board. The operational handling of access is coordinated through ASTRON.

B 2.3 Consortium as a whole

The participants of *RadioNet3* bring together a wide range of relevant expertise in the field of radio astronomy. The consortium includes 27 organisations, including all of the major radio observatories in Europe. In addition, institutes with state-of-the-art knowledge in advanced electronics are also valued partners in the programme. Strong collaborations exist with large international organisations and associations such as ESO and the SKA project. The competence of the participants spans the areas of (i) fundamental astrophysical research, (ii) operations of large-scale radio telescope facilities, (iii) scientific support, (iv) innovative technology development for astronomical instrumentation and (v) public outreach, teaching and higher education. This distributed knowledge base reflects the diverse set of activities proposed within this proposal.

The consortium collectively has significant experience in managing large projects, including large EC projects. The consortium is based on the previous *RadioNet* FP6 and FP7 partnerships; the long-standing collaboration and trust that exist between the participants guarantees good communication and an easy exchange of information. Unnecessary duplication between *RadioNet3* and its immediate predecessor *RadioNet* FP7 is avoided through the natural progression of the projects themselves and the continuity of the *RadioNet* partnership.

Each work package is led by a particular institute and individual, chosen by the consortium on the basis of their expertise and knowledge. Some of the activities build on previous initiatives funded under FP6 and FP7, in particular the Transnational Access programme. In this area, the experience of the consortium in producing high quality data products and making them available to the international astronomical community is considerable. The consortium operates the largest and the best radio telescopes worldwide — collaboration between telescopes is especially close in the area of European and Global VLBI. The consortium also boasts significant expertise in the area of fundamental research and education. Partners include some of the largest Universities and research institutes in Europe. They address problems in fundamental astrophysics and enjoy an international reputation in the development of advanced and innovative technology. The members of this consortium are responsible for a large fraction of all publications (both scientific and technical) associated with the field of radio astronomy.

In summary, the *RadioNet3* consortium consists of internationally leading institutes with complementary and overlapping expertise, spread both within and across the partners. The consortium is mature and stable, but also flexible in terms of embracing new partners and ideas. The result is that this consortium has all the skills and competencies needed to handle the wide range of different activities and associated deliverables, as described in the proposal. The Table 2.3.1 below shows the partner involvement in the various WPs of *RadioNet3.*

Partner No/ Name		MGT	NA						JRA				TNA									
		WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17	WP 18	WP 19	WP20
1	MPG	X	X	X		X	X	X	X	X		X	X			X					
2	ASTRON		X	X				X	X		X	X	X					X			
3	IRAM		X	X	X	X		X		X									X		
4	INAF		X	X		X	X	X	X	X		X	X								X
5	JIVE	X	X	X					X		X		X								
6	UMAN		X	X	X	X		X	X				X		X						
7	OSO		X	X		X		X		X		X	X							X	
8	UCAM		X	X				X		X	X										
9	STFC		X							X				X							
10	SRON		X							X											
11	OBSPARIS		X					X		X											
12	UOXF		X	X						X	X										
13	UAH		X					X		X			X								
14	TUD		X							X											
15	ESO		X	X		X				X	X										
16	KASI		X	X																	
17	BORD		X						X												
18	UORL		X						X												
19	Fraunhofer		X							X											
20	U. Turku		X		X																
21	UMK		X	X									X								
22	UCO		X							X											
23	VENT		X										X								
24	AALTO		X										X								
25	NRF		X	X																	
26	CSIRO		X	X																	
27	ILT		X														X				

<u>TABLE 2.3.1</u> OVERVIEW OF THE RADIONET3 PARTNERS EXPLICITELY INVOLVED IN THE IMPLEMENTION OF THE WPS

Industrial involvement

The main objectives of the Joint Research Activities (JRA) are to produce prototypes of highly specialised equipment and software for forefront astronomical research. Although there is no direct role for industrial partners within *RadioNet3*, many of the participants are closely connected to industrial parties (e.g. the Technical University in Delft) or have commercial business units (e.g.

The Fraunhofer Institute for Applied Solid-State Physics). It is also expected that the JRA partners will make use of local SMEs for the manufacture of specialised passive components.

Interest from industry is likely to focus on the R&D activities within the JRAs. The UniBoard[2] project in particular presents the possibility of a collaboration with and technology transfer to commercial parties — the board's generic set-up makes it at an attractive system for non-science applications. ASTRON already has experience in this area, making the LOFAR processor boards available to local commercial entities. Provided the JRAs lead to successful prototypes, with sufficiently generic connectors and interfaces, the potential for industrial involvement via production manufacturing is fairly high. ALMA is a good example of the potential success of such an approach (e.g. the production of water radiometers).

The next generation of telescopes such as the SKA has already attracted much attention from industrial parties, in part because of the large number of receptors in the array, the enormous computational challenges, and the associated commercial opportunities. The JRAs in *RadioNet3* are all aimed at the development of new radio astronomical instrumentation. As such they have the potential to facilitate the active and much needed involvement of industrial partners in the development of the large-scale instruments of the future.

2.3.i) Sub-contracting

The Joint Institute for VLBI in Europe (JIVE) wishes to subcontract part of the work of the JRA UniBoard[2] (WP8). Due to the complexity of the board and the very high density of its components, the actual PCB production and assembly require highly specialised equipment, only available to commercial producers. As a consequence, this part of the work cannot be done in-house and will be instead subcontracted to one or more specialised firms in a value of approx. 66.500€ (see the Table 2.3i. 1)

According to the FP7 Rules several partners (ASTRON, IRAM, INAF, JIVE, UMAN, OSO and STFC) must deliver Certificates of financial statements. As those partners do not posses their own audit departments and therefore this work has to be subcontracted (see WP1 in Table 2.3i. 1).

RadioNet3 partners that subcontract part of their work remain responsible for all its rights and obligations under the Work Plan, including the tasks carried out by the subcontractor. The *RadioNet3* partners will ensure that any intellectual property generated by a subcontractor will revert to the *RadioNet3* partners. Care will be taken that the selection procedure of the subcontractor is carried out in such a way as to guarantee transparency and equal treatment, based on the rules that apply for the selection of procurement contracts at *RadioNet3* partner institutes.

WP Number	Beneficiary name	Beneficiary Number	Subcontracting
WP1	ASTRON	2	13.500,00
WP1	IRAM	3	7.500,00
WP1	INAF	4	2.500,00
WP1	JIVE	5	16.000,00
WP1	UMAN	6	2.000,00
WP1	OSO	7	4.500,00
WP1	STFC	9	5.625,00
Total subcontracting in WP1			51.625,00
WP8	JIVE	5	66.500,00
Total subcontracting in WP8			66.500,00
TOTAL SUBCONTRACTING for *RadioNet3*			118.125,00

***TABLE 2.3.I. 1* RADIONET3 SUBCONTRACTING**

Third parties (other than subcontractors)

The University of Alcalá (UAH) does not have the technological capacity to carry out the work, since very sophisticated instrumentation is needed.

The National Astronomical Observatory, a department of the National Geographical Institute (IGN), with its laboratories at Yebes (Guadalajara, Spain), is specialised in the development of state-of-the-art instrumentation for radio astronomy. IGN operates national facilities at Yebes including the 40m radio telescope involved in the EVN.

The University of Alcalá, not having access to such specialised equipment, wishes to use the resources of the IGN to carry out the work in the RadioNet3 project. Additionally the IGN will offer an access to its 40m telescope under the TNA-EVN programme. The IGN will act as a third party to the UAH making available some of its resources to a beneficiary. The UAH could charge the travel costs of IGN staff attending project meetings. The expected cost of the third Party is presented in the Table 2.3.i2.

Agreements already exist between the UAH and IGN to facilitate this process.

Type of Costs	Third party Name	Beneficiary Name	Beneficiary Number	Amount
Access cost to the infrastructure of IGN	IGN	UAH	13	76.000,00
Travel cost of the IGN staff	IGN	UAH	13	2.000,00
Estimated Total cost of the third party				78.000,00

TABLE 2.3.I. 2 ***RADIONET3 THIRD PARTY COSTS***

2.3.ii) Other countries

Radio astronomy has a long tradition of international cooperation, illustrated for example by the European VLBI Network (EVN) closely working with the US Very Long Baseline Array (VLBA) from the very beginning of VLBI operations in the early 1990s. The EVN itself extends well beyond Europe and routinely collaborates with non-EVN stations located all over the world. Just recently three new members, stations of the Russian KVAZAR VLBI network, formally joined the EVN. This goes to show that it is essential to involve non-European partners in a project as ambitious in its scientific and technological goals as *RadioNet3*.

The Korean Astronomy and Space Science Institute (KASI) is the national astronomy research institute of Korea. KASI first established the Sobaeksan Optical Observatory & Bohyunsan Optical Observatory. It then expanded its operations to the radio via the establishment of the Taeduk Radio Observatory. It also is responsible for the construction of the Korean VLBI Network (KVN). KASI will join the *RadioNet3* project as a self-funding partner. KASI will apply for funding to the Korean National Research Foundation to support KASI researchers and students to attend the scientific meetings organised by *RadioNet3*. KASI will actively participate in the NAs QueSERA (WP2) and Science Working Group (WP3) and make a significant contribution to the selection of the meeting topics organised under the umbrella of the *RadioNet3* project.

The Hartebeesthoek Radio Astronomy Observatory (HartRAO), operated by the National Research Foundation (NRF) of South Africa, also joins the *RadioNet3* project as a self-funding partner. HartRAO is an associate member of the EVN, but also collaborates with the Australian Telescope Long Baseline Array, the Asia Pacific Telescope, the US VLBA and the Global Array. The observatory provides students and lecturers from South African universities with the facilities and opportunities to perform research. HartRAO is closely involved in the Square Kilometre Array (SKA) project competing with Australia for the final site selection of the SKA. HartRAO is participating in the building of the MeerKAT telescope, a SKA pathfinder, and as such will function as an important connection between *RadioNet3* and the SKA. In particular HartRAO will assure the *RadioNet3* involvement in SKA-oriented meetings and schools via their active participation in the steering committee of the NAs QueSERA, Science Working Group and New Skills (WP2, WP3 & WP4, respectively).

CSIRO Astronomy and Space Science (CASS) also will join the *RadioNet3* project as a self-funding partner. CASS is responsible for managing the Australia Telescope National Facility (ATNF), which provides a uniquely powerful view of the southern hemisphere radio spectrum. The ATNF comprises three observatories in New South Wales, and construction is underway to add a fourth (the Australian SKA Pathfinder (ASKAP) at the Murchison Radio Observatory in Western Australia by 2013. Technical research and development, and support of the ATNF and the new ASKAP instrument, are conducted at CASS' headquarters in Marsfield, Sydney. In addition, the Canberra Deep Space Communication Complex (CDSCC) at Tidbinbilla was recently incorporated into CASS operations. As part of the Host Country agreement with NASA, a fraction of the time on the CDSCC antennas is available to the astronomical community. CSIRO will actively participate in the NAs QueSERA (WP2) and Science Working Group (WP3).

2.3.iii) Additional partners

At present no additional partners to the *RadioNet3* project are foreseen.

B 2.4 Resources to be committed

This section provides a management level description of resources and budget identifying personnel and any other major costs and a description of the resources, which are needed to carry out the project (personnel, other and indirect costs etc. for each beneficiary). In addition to the requested EC funds, the RadioNet3 partners as needed will expend substantial contributed effort.

2.4.1 Budget distribution of the Management and the NAs of RadioNet3

The management of *RadioNet3* will be concentrated at MPG and JIVE, hosting the members of the management team (see section 2.1). The breakdown of the budget for the Management Activity (WP1) shows that a significant part of the budget is dedicated to personnel costs (see table 2.4.1). It has been decided to finance the Project Scientist, the Administrative Assistant and partially the Information & TNA-NA Travel Budget Assistant out of the project. Furthermore, the travel budget of WP1 will be used to organise the Board meetings and additionally to support the Board members to attend Board meetings. The costs related to preparation of audit certificates have been allocated to the WP1 Management (subcontracting). To emphasise the importance of the project and the level of commitment of the Coordinator to this project, the MPIfR has decided to entirely finance the work of the Coordinator in this project. Furthermore the Project Manager will be provided to the *RadioNet3* project as in-kind contribution of the MPIfR.

In turn, the WP Leaders will largely do the actual work in the Networking Activities with limited support from the EC funded project budget. To unburden the NA leaders it was decided to take the administrative work connected to the budget management away from the leaders' institutes. Instead, a centralised travel budget will be administered at JIVE. This method of handling the NA travel budget was tried and proven in the previous *RadioNet* projects. Each NA leader will be responsible for the assignment and determination of the level of travel support and the validation of the claims for reimbursement. The Travel Budget Assistant at JIVE will make payments based on travel claim forms accepted by the NA leaders.

The NA budget will be mostly used to support participants of the meetings organised by the Networking Activities (see Table 2.4.1). In addition it will be dedicated to support financially the organisation of meetings. The budget of the NA QueSERA (WP2) will be used to support the development of outreach material aimed at the general public, as well as material of a more general nature, such as a conference booth and educational material for Visitor Centres at the radio astronomical observatories.

Beneficiary	Personnel cost	Subcontracting	Other Direct costs	Indirect cost	Total cost	EC contribution
WP1 (Management)						
MPG	250.000,00	0,00	50.229,94	350.000,00	650.229,94	650.229,94
JIVE	89.333,00	16.000,00	0,00	53.599,80	158.932,80	158.932,80
ASTRON	0,00	13.500,00	0,00	0,00	13.500,00	13.500,00
IRAM	0,00	7.500,00	0,00	0,00	7.500,00	7.500,00
INAF	0,00	2.500,00	0,00	0,00	2.500,00	2.500,00
UMAN	0,00	2.000,00	0,00	0,00	2.000,00	2.000,00
OSO	0,00	4.500,00	0,00	0,00	4.500,00	4.500,00
STFC	0,00	5.625,00	0,00	0,00	5.625,00	5.625,00
WP2 (QueSERA)						
JIVE	0,00	0,00	70.000,00	42.000,00	112.000,00	74.900,00
MPG	43.750,00		20.000,00	61.250,00	125.000,00	68.212,50
KASI	40.000,00		70.000,00	22.000,00	132.000,00	0,00
U.Turku	2.699,58			1.619,75	4.319,33	0,00
NRF	5.000,00		2.500,00	600,00	8.100,00	0,00
CSIRO	25.000,00			10.000,00	35.000,00	0,00
WP3 (SWG)						
INAF	22.750,00	0,00	0,00	13.650,00	36.400,00	24.342,50
JIVE	0,00	0,00	182.000,00	109.200,00	291.200,00	194.740,00
KASI	40.000,00		70.000,00	22.000,00	132.000,00	0,00
NRF	5.000,00		2.500,00	600,00	8.100,00	0,00
CISRO	25.000,00			10.000,00	35.000,00	0,00
WP4 (New Skills)						
JIVE	0,00	0,00	151.000,00	90.600,00	241.600,00	161.570,00
U.Turku	13.497,88			8.098,73	21.596,61	0,00
WP5 (MARCUs)						
JIVE	0,00	0,00	31.500,00	18.900,00	50.400,00	33.705,00
WP6 (ERATec)						
INAF	20.000,00	0,00	0,00	12.000,00	32.000,00	21.400,00
JIVE	0,00	0,00	73.500,00	44.100,00	117.600,00	78.645,00
WP7 (Spectrum Management)						
JIVE	0,00	0,00	47.000,00	28.200,00	75.200,00	50.290,00
TOTALS	582.030,46	51.625,00	770.229,94	898.418,28	2.302.303,68	1.552.592,74

***TABLE 2.4.1.* RADIONET3 MANAGEMENT & NAS (WP1 – WP7) BUDGET DISTRIBUTION**

2.4.2 Budget distribution of the Joint Research Activities of RadioNet3

The resources to be committed in the Joint Research Activities (WP8 – WP11) of *RadioNet3* are presented in Table 2.4.2. As it can be seen in the breakdown of the total JRA costs in table 2.4.2, the predominant fraction of the total budget requested for the JRAs is related to personnel costs. Some of the activities have allocated budget for equipment and material. Additionally, as the actual PCB production and assembly done in the JRA UniBoard[2] (WP8) requires highly specialised equipment, only available to commercial producers, this part of the work will be subcontracted to one or more specialised firms (see section 2.3.i).

Beneficiary	Personnel cost	Subcontracting	Other Direct costs	Indirect cost	Total cost	EC contribution
WP8 (UniBoard2)						
JIVE	172.266,67	66.500,00	139.080,00	186.808,00	564.654,67	423.491,00
MPG	71.875,00	0,00	0,00	100.625,00	172.500,00	129.375,00
ASTRON	201.716,67	0,00	3.087,50	121.030,00	325.834,17	244.375,63
INAF	69.666,67	0,00	2.375,00	43.225,00	115.266,67	86.450,00
UMAN	43.541,67	0,00	1.187,50	26.837,50	71.566,67	53.675,00
BORD	47.500,00	0,00	1.425,00	29.355,00	78.280,00	58.710,00
UORL	39.583,33	0,00	1.187,50	24.462,50	65.233,33	48.925,00
WP9 (AETHER)						
IRAM	156.250,00	0,00	30.000,00	111.750,00	298.000,00	223.500,00
MPG	30.333,33	0,00	22.100,00	42.466,67	94.900,00	71.175,00
INAF	19.583,33	0,00	4.200,00	14.270,00	38.053,33	28.540,00
OSO	96.833,33	0,00	2.000,00	2.000,00	158.133,33	118.600,00
UCAM	33.333,33	0,00	10.200,00	26.120,00	69.653,33	52.240,00
STFC	49.155,33	0,00	25.700,00	51.613,10	126.468,43	94.851,33
SRON	96.833,33	0,00	2.100,00	59.360,00	158.293,33	118.720,00
OBSPAR	49.500,00	0,00	2.000,00	30.900,00	82.400,00	61.800,00
UOXF	48.000,00	0,00	19.500,00	40.500,00	108.000,00	81.000,00
UAH	106.875,00	0,00	7.900,00	68.865,00	183.640,00	137.730,00
TUD	72.980,77	0,00	9.684,95	75.667,61	158.333,33	118.750,00
Fraunhofer	71.925,33	0,00	69.100,00	74.083,09	215.108,43	161.331,32
UCO	48.750,00	0,00	2.900,00	30.990,00	82.640,00	61.980,00
WP10 (Hilado)						
ASTRON	151.433,33	0,00	6.000,00	107.800,00	265.233,33	198.925,00
JIVE	108.233,33	0,00	6.104,50	68.602,70	182.940,53	137.205,40
UCAM	45.673,33	0,00	5.750,00	30.854,00	82.277,33	61.708,00
UOXF	134.333,33	0,00	6.000,00	84.200,00	224.533,33	168.400,00
ESO	120.000,00	0,00	6.000,00	25.200,00	151.200,00	113.400,00
WP11 (DIVA)						
MPG	106.250,00	0,00	38600	148.750,00	293.600,00	220.200,00
ASTRON	68.833,33	0,00	15.950,00	49.000,00	133.783,33	100.337,50
INAF	134.166,67	0	3550	82.630,00	220.346,67	165.260,00
OSO	168.000,00	0	21050	113.430,00	302.480,00	226.860,00
TOTALS	2.563.426,43	66.500,00	464.731,95	1.871.395,17	5.023.353,55	3.767.515,16

<u>TABLE 2.4.2.</u> RADIONET3 JRAS (WP8 – WP11) BUDGET DISTRIBUTION

The R&D activities undertaken in all JRAs of *RadioNet3* require the purchase of components and other consumables. These costs of materials sum up to a total amount of 348.114,95 € and have been summarised in the category Other Direct costs. In WP9 AETHER the use of clean-room facilities are foreseen. As JRAs internal meetings are foreseen on a regular basis, a fraction of the JRA budget has been allocated for travel, which is at the level of 92.367,00 €. Additionally the JRA Hilado (WP10) plans expenses for equipment at the level of 9.500,00 €.

The JRAs have an ambitious, but feasible scope. To enable the timely realisation of the work plan, the partners - if required - will commit additional resources. This contribution will be offered by manifold means: some partners will contribute with additional manpower, others will provide access to their facilities.

2.4.3 Additional resources to be committed by the partners of RadioNet3

For the *RadioNet3* partners the realisation of the envisaged goals of the project is of maximum priority. As it is clear that the EC contribution can only be seen as a – although substantial – support to the I3 activities, all partners offer in-kind contribution to the realisation of the *RadioNet3* goals as needed.

2.4.4 Transnational Access costs

The travel budget for TNAs in *RadioNet3* is 101.000€, which will be centrally administered by the Information & TNA/NA Assistant at JIVE. The TNA leaders will be responsible for identifying eligible persons and setting the level of reimbursements. The proposed TNA travel budget was set based on the experiences made with TNA travel reimbursement in the current RadioNet-FP7.

Beneficiary	Personnel cost	Subcon-tracting	Access Cost	Other Direct Cost (Travel)	Indirect cost	Total cost	EC contribution
WP12 (TNA-EVN)							
JIVE			1.037.576,32	101.000,00	60.600,00	1.199.176,32	1.145.646,32
MPG			76.000,00			76.000,00	76.000,00
UMAN			76.000,00			76.000,00	76.000,00
ASTRON			76.000,00			76.000,00	76.000,00
INAF			76.000,00			76.000,00	76.000,00
OSO			76.000,00			76.000,00	76.000,00
UMK			38.000,00			38.000,00	38.000,00
VENT			38.000,00			38.000,00	38.000,00
AALTO			38.000,00			38.000,00	38.000,00
UAH (IGN)			76.000,00			76.000,00	76.000,00
WP13 (JCMT)							
STFC			355.077,36			355.077,36	355.077,36
WP14 (e-MERLIN)							
UMAN			466.388,45			466.388,45	466.388,45
WP15 (Effelsberg)							
MPG			456.433,74			456.433,74	456.433,74
WP16 (LOFAR)							
ILT			363.556,05			363.556,05	363.556,05
WP17 (WSRT)							
ASTRON			146.293,16			146.293,16	146.293,16
WP18 (IRAM)							
IRAM			365.340,32			365.340,32	365.340,32
WP19 (APEX)							
OSO			228.738,15			228.738,15	228.738,15
WP20 (SRT)							
INAF			82.418,55			82.418,55	82.418,55
TOTALS	0,00	0,00	4.071.822,10	101.000,00	60.600,00	4.233.422,10	4.179.892,10

***TABLE 2.4.4.* RADIONET3 TNAS (WP12 – WP20) BUDGET DISTRIBUTION**

The Unit Cost for the Transnational Access (TNA) programmes (WP12 - WP20) are presented in the following tables:

Calculation of Unit Costs for Transnational Access to EVN-JIVE (WP12)

Participant number	**5**	**Organisation short name**		**JIVE**	
Short name of Infrastructure	**EVN**	**Installation number**	**1**	**Short name of Installation**	**EVN-JIVE**
Name of Installation	**EVN-JIVE**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Computers / Networking		324.445,00
	Consumables		173.017,00
	Maintenance		103.987,00
	Energy		196.908,00
	Total A		**798.357,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	491,4	2.614.821,00
	Technical	511,9	2.680.233,60
	Total B		**5.295.054,60**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 426538,812**	426.538,80
D. Total estimated access eligible costs = A+B+C			6.519.950,40
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			3.400
F. Fraction of the Unit cost to be charged to the project [2]			89,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**1706,54**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**1.037.576,32**

Calculation of Unit Costs for Transnational Access to EVN-Effelsberg (WP12)

Participant number	**1**	**Organisation short name**		**MPG**	
Short name of Infrastructure	**EVN**	**Installation number**	**2**	**Short name of Installation**	**EVN-Effelsberg**
Name of Installation	**EVN-Effelsberg**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		1.312.000,00
	Consumable costs		656.000,00
	Utilities		1.968.000,00
	Total A		**3.936.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific staff	191,72	1.154.010,00
	Technical staff (engineers)	143,79	708.320,16
	Technical staff (technicians, telescope operators,…)	862,73	3.965.811,84
	Total B		**5.828.142,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 683489,94**	683.489,94
D. Total estimated access eligible costs = A+B+C			10.447.631,94
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			20.000
F. Fraction of the Unit cost to be charged to the project [2]			23,9%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**125**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**76.000,00**

Calculation of Unit Costs for Transnational Access to EVN-JBO (WP12)

Participant number	**6**	**Organisation short name**		**UMAN**		
Short name of Infrastructure	**EVN**	**Installation number**	**3**	**Short name of Installation**	**EVN-JBO**	
Name of Installation	**EVN-JBO**			**Unit of access**	**Hour**	

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Telescope costs		246.500,00
	VLBI operating costs		58.000,00
	VLBI equipmnent maintenance		58.000,00
	Fibre link share		58.000,00
	Total A		**420.500,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Telescope operation	47	354.948,00
	Telescope maintenance	94	406.692,00
	Receiver systems	47	218.526,00
	Fibre and digital systems	94	754.512,00
	Operations and user support	33	241.025,40
	Total B		**1.975.703,40**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max**	**167734,238**	167.734,00
D. Total estimated access eligible costs = A+B+C			2.563.937,40
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			3.600
F. Fraction of the Unit cost to be charged to the project [2]			17,6%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**125**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project** [3][4] **= G x H**			**76.000,00**

Calculation of Unit Costs for Transnational Access to EVN-WSRT (WP12)

Participant number	2	Organisation short name		ASTRON	
Short name of Infrastructure	EVN	Installation number	4	Short name of Installation	EVN-WSRT
Name of Installation	EVN-WSRT			Unit of access	Hour

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		Eligible Costs (€)
	Maintenance		442.979,00
	Running costs & utilities		893.209,00
	Energy		719.626,00
	Total A		2.055.814,00
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	151,2	1.237.929,00
	Senior technical	264,96	1.512.817,00
	Junior technical	28,8	142.719,00
	Total B		**2.893.465,00**
C. Indirect eligible costs < = 7% x ([A-A']+B)[1]		max 346449,53	346.449,50
D. Total estimated access eligible costs = A+B+C			5.295.728,50
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			16.000
F. Fraction of the Unit cost to be charged to the project [2]			37,8%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**125**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**76.000,00**

Calculation of Unit Costs for Transnational Access to EVN-Mc (WP12)

Participant number	**4**	**Organisation short name**		**INAF**	
Short name of Infrastructure	**EVN**	**Installation number**	**5**	**Short name of Installation**	**EVN-Mc**
Name of Installation	**EVN-Medicina**			**Unit of access**	**Hour**

	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Maintenance		444.000,00
	Power Supply		505.600,00
	Consumables		44.000,00
	Utilities		800.000,00
		Total A	**1.793.600,00**
		of which subcontracting (A')	
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific and Engineering staff	581,5	4.082.400,00
	Technical staff	581,5	2.721.600,00
		Total B	**6.804.000,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max** **601832**	601.832,00
D. Total estimated access eligible costs = A+B+C			9.199.432,00
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			33.024
F. Fraction of the Unit cost to be charged to the project [2]			15,7%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**43,75**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**26.600,00**

Calculation of Unit Costs for Transnational Access to EVN-Nt (WP12)

Participant number	**4**	**Organisation short name**		**INAF**	
Short name of Infrastructure	**EVN**	**Installation number**	**6**	**Short name of Installation**	**EVN-Nt**
Name of Installation	**EVN-Noto**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		444.000,00
	Power Supply		505.600,00
	Consumables		44.000,00
	Utilities		800.000,00
	Total A		**1.793.600,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific and Engineering staff	116,3	816.480,00
	Technical staff	387,7	1.814.400,00
	Total B		**2.630.880,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 309713,6**	309.713,60
D. Total estimated access eligible costs = A+B+C			4.734.193,60
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			33.024
F. Fraction of the Unit cost to be charged to the project [2]			26,2%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**37,5**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**22.800,00**

Calculation of Unit Costs for Transnational Access to EVN-SRT (WP12)

Participant number	**4**	**Organisation short name**		**INAF**	
Short name of Infrastructure	**EVN**	**Installation number**	**7**	**Short name of Installation**	**EVN-SRT**
Name of Installation	**EVN-SRT**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		600.000,00
	Power Supply		1.460.000,00
	Consumables		140.000,00
	Utilities		1.126.000,00
	Total A		**3.326.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific and engineering staff	232,6	1.630.260,00
	Technical staff	697,8	3.265.920,00
	Total B		**4.896.180,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max**	**575552,6**	575.552,60
D. Total estimated access eligible costs = A+B+C			8.797.732,60
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			27.520
F. Fraction of the Unit cost to be charged to the project [2]			13,7%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**43,75**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**26.600,00**

Calculation of Unit Costs for Transnational Access to EVN-OSO (WP12)

Participant number	7	**Organisation short name**		OSO	
Short name of Infrastructure	EVN	**Installation number**	8	**Short name of Installation**	EVN-OSO
Name of Installation	EVN-OSO			**Unit of access**	Hour

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Running costs		1.174.000,00
	IT costs		222.000,00
	Utilities		1.452.000,00
	Total A		**2.848.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientists	168	1.238.798,00
	Technical support (operators, technicians, engineers)	288	1.519.660,80
	Computer support	86,4	470.171,52
	Mechanical service	172,8	781.643,52
	Total B		**4.010.273,84**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 480079,1688**	480.079,16
D. Total estimated access eligible costs = A+B+C			7.338.353,00
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			18.800
F. Fraction of the Unit cost to be charged to the project [2]			32,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**125**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project** [3][4] **= G x H**			**76.000,00**

Calculation of Unit Costs for Transnational Access to EVN-Torun (WP12)

Participant number	**21**	**Organisation short name**		**UMK**	
Short name of Infrastructure	**EVN**	**Installation number**	**9**	**Short name of Installation**	**EVN-Torun**
Name of Installation	**EVN-Torun**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Consumables		284.000,00
	Maintenance, utilities, running costs		1.290.000,00
	Total A		**1.574.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	138	524.880,00
	Technical	414	944.640,00
	Total B		**1.469.520,00**
C. Indirect eligible costs < = 7% x ([A-A']+B)[1]	**max**	**213046,4**	213.046,00
D. Total estimated access eligible costs = A+B+C			3.256.566,00
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			30.000
F. Fraction of the Unit cost to be charged to the project [2]			57,6%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**62,5**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**38.000,00**

Calculation of Unit Costs for Transnational Access to EVN-Irbene (WP12)

Participant number	**23**	**Organisation short name**		**VENT**	
Short name of Infrastructure	**EVN**	**Installation number**	**10**	**Short name of Installation**	**EVN-Irbene**
Name of Installation	**EVN-Irbene**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Consumables		110.560,00
	Maintenance		190.600,00
	IT costs (internet, program products)		45.300,00
	Total A		**346.460,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	134.4	581.400,00
	Technical	179.2	437.760,00
	Engineers	179.2	547.200,00
	Total B		**1.566.360,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 133897,4**	133.897,00
D. Total estimated access eligible costs = A+B+C			2.046.717,00
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			24.000
F. Fraction of the Unit cost to be charged to the project [2]			73,3%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**62,5**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**38.000,00**

Calculation of Unit Costs for Transnational Access to EVN-Metsahovi (WP12)

Participant number	**24**	**Organisation short name**		**AALTO**	
Short name of Infrastructure	**EVN**	**Installation number**	**11**	**Short name of Installation**	**EVN-Metsahovi**
Name of Installation	**EVN-Metsahovi**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Property maintenance		763.864,00
	Utilities, consumables		553.040,00
	Total A		**1.316.904,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific and technical staff	908,2	3.873.008,00
	Total B		**3.873.008,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max**	**363293,84**	363.293,80
D. Total estimated access eligible costs = A+B+C			5.553.205,80
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			28.000
F. Fraction of the Unit cost to be charged to the project [2]			31,5%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**62,5**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**38.000,00**

Calculation of Unit Costs for Transnational Access to EVN-Yebes (WP12)

Participant number	**13**	**Organisation short name**		**UAH**	
Short name of Infrastructure	**EVN**	**Installation number**	**12**	**Short name of Installation**	**EVN-Yebes**
Name of Installation	**EVN-Yebes**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		2.624.000,00
	Utilities		875.000,00
	IT costs		437.000,00
	Total A		**3.936.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	68.2	393.600,00
	Technical	136.4	577.440,00
	Engineers	136.4	787.200,00
	Total B		**1.758.240,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 398596,8**	398.596,80
D. Total estimated access eligible costs = A+B+C			6.092.836,80
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			12.000
F. Fraction of the Unit cost to be charged to the project [2]			24,6%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**125**
H. Quantity of access offered under the project (over the whole duration of the project)			608
I. **Access Cost charged to the project [3][4] = G x H**			**76.000,00**

Calculation of Unit Costs for Transnational Access to JCMT (WP13)

Participant number	**9**	**Organisation short name**		**STFC**	
Short name of Infrastructure	**JCMT**	**Installation number**	**1**	**Short name of Installation**	**JCMT**
Name of Installation	**James Clerk Maxwell Telescope**			**Unit of access**	**hours**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		510.294
	Computing		334.591
	Running Costs		1.086.695
	Summit infrastructure		1.391.712
	Total A		**3.323.292,28**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Computing	336	2.263.404,00
	Engineering	177,6	1.369.253,38
	Science	614,4	3.953.885,18
	Technical	206,4	892.539,65
	Total B		**8.479.082,21**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max**	**826166,2142**	826.166,00
D. Total estimated access eligible costs = A+B+C			12.628.540,49
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			14.084
F. Fraction of the Unit cost to be charged to the project [2]			100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**896,66**
H. Quantity of access offered under the project (over the whole duration of the project)			396
I. **Access Cost charged to the project [3][4] = G x H**			**355.077,36**

Calculation of Unit Costs for Transnational Access to e-MERLIN (WP14)

Participant number	**6**	**Organisation short name**		**UMAN**	
Short name of Infrastructure	**MERLIN**	**Installation number**	**1**	**Short name of Installation**	**e-MERLIN**
Name of Installation	**e-MERLIN**			**Unit of access**	**Hours**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .	**Eligible Costs (€)**
	Euro Rate used (16/11/10) 0.851 GBP/Euro	
	Facility costs	2.881.586,00
	Telescope engineering and maintenance	403.055,00
	Receivers and digitial systems	283.377,20
	Operations and user support	88.131,61
	Total A	**3.656.149,81**
	of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Management	66,44	593.574,96
	Telescope operation	154,00	929.236,00
	Receiver systems	121,73	407.490,17
	Operations team	181,50	1.081.449,60
	Fibre and digital	162,64	811.750,50
	Telescope maintenance	271,33	1.218.612,28
	Total B		**5.042.113,51**

C. Indirect eligible costs < = 7% x ([A-A']+B) [1] **max 608878,4324**	608.878,43
D. Total estimated access eligible costs = A+B+C	9.307.141,75
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time	12.672
F. Fraction of the Unit cost to be charged to the project [2]	100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)	**734,47**
H. Quantity of access offered under the project (over the whole duration of the project)	635
I. **Access Cost charged to the project [3][4] = G x H**	**466.388,45**

Calculation of Unit Costs for Transnational Access to Effelsberg (WP15)

Participant number	**1**	**Organisation short name**		**MPG**	
Short name of Infrastructure	**MPIfR**	**Installation number**		**Short name of Installation**	**Effelsberg**
Name of Installation	**100-m Radio Telescope Effelsberg**			**Unit of access**	**Hours**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	maintenance		1.200.000,00
	utilities		840.000,00
	energy costs		960.000,00
	Total A		**3.000.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	scientific staff	238	1.312.766,40
	technical staff (engineers)	300	1.354.601,60
	technical staff (technicians, telescope operators)	890	3.749.187,20
	Total B		**6.416.555,20**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 659158,864**	659.158,00
D. Total estimated access eligible costs = A+B+C			10.075.713,20
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			20.000
F. Fraction of the Unit cost to be charged to the project [2]			100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**503,79**
H. Quantity of access offered under the project (over the whole duration of the project)			906
I. **Access Cost charged to the project** [3][4] **= G x H**			**456.433,74**

Calculation of Unit Costs for Transnational Access to LOFAR (WP16)

Participant number	**27**	**Organisation short name**		**ILT**	
Short name of Infrastructure	**LOFAR**	**Installation number**	**1**	**Short name of Installation**	**LOFAR**
Name of Installation	**LOFAR**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		215.456,79
	Running Costs & Utilities		4.678.840,14
	Energy		5.018.101,20
	Total A		**9.912.398,13**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	352,8	2.888.499,92
	Sr. Technical	618,24	3.529.906,16
	Jr. Technical	67,2	333.010,02
	Total B		**6.751.416,09**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 1166466,996**	1.166.467,00
D. Total estimated access eligible costs = A+B+C			17.830.281,22
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			21.040
F. Fraction of the Unit cost to be charged to the project [2]			100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**847,45**
H. Quantity of access offered under the project (over the whole duration of the project)			429
I. **Access Cost charged to the project [3][4] = G x H**			**363.556,05**

Calculation of Unit Costs for Transnational Access to WSRT (WP17)

Participant number	**2**	**Organisation short name**		**ASTRON**	
Short name of Infrastructure	**WSRT**	**Installation number**	**1**	**Short name of Installation**	**WSRT**
Name of Installation	**Westerbork Synthesis Radio Telescope**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		442.979,16
	Running Costs & Utilities		893.209,31
	Energy		719.625,68
		Total A	**2.055.814,15**
		of which subcontracting (A')	
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific	151,2	1.237.928,54
	Sr. Technical	264,96	1.512.816,93
	Jr. Technical	28,8	142.718,58
		Total B	**2.893.464,04**

C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max 346449,4731**	346.449,47
D. Total estimated access eligible costs = A+B+C		5.295.727,66
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time		16.000
F. Fraction of the Unit cost to be charged to the project [2]		100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)		**330,98**
H. Quantity of access offered under the project (over the whole duration of the project)		442
I. **Access Cost charged to the project [3][4] = G x H**		**146.293,16**

Calculation of Unit Costs for Transnational Access to IRAM-PdBI (WP18)

Participant number	**3**	**Organisation short name**		**IRAM**	
Short name of Infrastructure	**IRAM**	**Installation number**	**1**	**Short name of Installation**	**PdBI**
Name of Installation	**Plateau de Bure Interferometer**			**Unit of access**	**hours**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .	**Eligible Costs (€)**
	Direct operational costs	3.514.685,00
	access costs	1.689.859,00
	maintenance costs	788.863,00
	insurance costs	1.193.431,00
	Total A	**7.186.838,00**
	of which subcontracting (A')	***1.115.346,87***

B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Observatory staff	808,3527205	5.037.584,00
	Technical support staff	264	1.503.565,04
	Astronomical suppport staff	389,2707692	2.561.661,07
	Total B		**9.102.810,11**

C. Indirect eligible costs < = 7% x ([A-A']+B)[1] **max 1062201,087**	1.062.201,00
D. Total estimated access eligible costs = A+B+C	17.351.849,11
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time	10.200
F. Fraction of the Unit cost to be charged to the project [2]	100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)	**1701,16**
H. Quantity of access offered under the project (over the whole duration of the project)	122
I. **Access Cost charged to the project [3][4] = G x H**	**207.541,52**

Calculation of Unit Costs for Transnational Access to IRAM-PV (WP18)

Participant number	3	Organisation short name	IRAM		
Short name of Infrastructure	IRAM	Installation number	2	Short name of Installation	PV
Name of Installation	30-meter telescope			Unit of access	Hour

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .	**Eligible Costs (€)**
	Direct operational costs	1.487.915,00
	access costs	343.677,00
	maintenance costs	87.717,00
	insurance costs	383.146,00
	Total A	**2.302.455,00**
	of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Observatory staff	1544,878049	4.967.281,00
	Technical support staff	120	650.793,00
	Astronomical suppport staff	488,5403377	2.790.751,26
	Total B		**8.408.825,26**

C. Indirect eligible costs < = 7% x ([A-A']+B) [1]	**max 749789,6182**	749.790,00
D. Total estimated access eligible costs = A+B+C		11.461.070,26
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time		27.600
F. Fraction of the Unit cost to be charged to the project [2]		100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)		**415,26**
H. Quantity of access offered under the project (over the whole duration of the project)		380
I. **Access Cost charged to the project [3][4] = G x H**		**157.798,80**

Calculation of Unit Costs for Transnational Access to APEX (WP19)

Participant number	**7**	**Organisation short name**	**OSO**

Short name of Infrastructure	**APEX**	**Installation number**	**1**	**Short name of Installation**	**APEX**
Name of Installation	**APEX**			**Unit of access**	**Telescope hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .	**Eligible Costs (€)**
	APEX Chajnantor (diesel fuel, generator maintenance, consumables, …)	174.800
	APEX Sequitor (food, power, water, IT, vehicle maintenance and fuel, …)	327.520
	APEX contractor services (cleaning etc.)	114.080
	APEX insurances	31.280
	APEX liquid helium and nitrogen	46.000
	OSO travel costs for support astronomer etc.	140.000
	(For APEX: 23% of costs used, corresponding to the Swedish part of the project)	
	Total A	**833.680,00**
	of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	APEX station manager etc. (international staff members)	22,1	202.415,00
	APEX astronomers (paid associates)	55,2	368.014,72
	APEX operators and engineers (local staff)	121,4	556.581,69
	OSO director	9,6	113.823,36
	OSO astronomers (support, proposal handling, etc.)	39,1	254.776,32
	(For APEX: 23% of costs used, i.e., the Swedish part of the project)		
	Total B		**1.495.611,09**

C. Indirect eligible costs < = 7% x ([A-A']+B)[1]	**max 163050,3763**	163.050,00
D. Total estimated access eligible costs = A+B+C		2.492.341,09
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time		3.040
F. Fraction of the Unit cost to be charged to the project [2]		100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)		**819,85**
H. Quantity of access offered under the project (over the whole duration of the project)		279
I. **Access Cost charged to the project [3][4] = G x H**		**228.738,15**

Calculation of Unit Costs for Transnational Access to SRT (WP20)

Participant number	**4**	**Organisation short name**		**INAF**	
Short name of Infrastructure	**INAF**	**Installation number**	**1**	**Short name of Installation**	**SRT**
Name of Installation	**Sardinia Radio Telescope**			**Unit of access**	**Hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .		**Eligible Costs (€)**
	Maintenance		600.000,00
	Power Supply		1.460.000,00
	Consumables		140.000,00
	Utilities		1.126.000,00
	Travel		88.000,00
	Total A		**3.414.000,00**
	of which subcontracting (A')		
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff**	**Person-Months**	**Personnel Costs (€)**
	Scientific and Engineering staff	232,6	1.632.960,00
	Technical staff	697,8	3.265.920,00
	Total B		**4.898.880,00**
C. Indirect eligible costs < = 7% x ([A-A']+B) [1]		**max 581901,6**	581.901,60
D. Total estimated access eligible costs = A+B+C			8.894.781,60
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			27.520
F. Fraction of the Unit cost to be charged to the project [2]			100,0%
G. **Estimated Unit cost charged to the project** = F x (D/E)			**323,21**
H. Quantity of access offered under the project (over the whole duration of the project)			255
I. **Access Cost charged to the project [3][4] = G x H**			**82.418,55**

B3. Impact

B 3.1 Strategic impact

3.1.1 Expected impacts listed in the work programme

The primary aim of *RadioNet3* is to integrate the key European research facilities in radio astronomy and their resources with a long-term perspective. The *RadioNet3* project is accordingly structured to maximise the integrating effect.

Being recognized as *the* European entity representing the community interests in radio astronomy is one of the major, long-term impacts of *RadioNet3*. This is established by facilitating the access to and exploitation of world-class instruments for astronomical use. Moreover, the *RadioNet3* consortium is the starting point for most strategic discussions on the prioritization and development of new large-scale user facilities, both in Europe and on a global scale. This is of paramount importance, as there does not exist a dedicated European radio astronomy organisation to coordinate and serve the needs of the field. In *RadioNet3* this discussion has a dedicated place in the Networking Activity QueSERA (WP2).

The *RadioNet3* work program and collaboration structure will also be of vital importance for maintaining a balance in European radio astronomy between long-term ambitions and readily accessible research facilities. On the one hand the *RadioNet3* consortium is embracing the new opportunities for observing with LOFAR and ALMA, and it is enthusiastic to contribute to the optimization and technical readiness of the SKA, and to optimally preparing the user community for these advanced research opportunities. On the other hand it recognizes the responsibility to offer unique and top-class facilities that complement the instrumentation for the researchers and students that are doing radio astronomy today. Thus, the NA and JRA programmes have been tailored to optimize the cross-fertilization between these two, both vital, aspects of current European radio astronomy. They provide platforms where policy makers, engineers and – foremost – researchers can meet to discuss the impact of experiences with current instruments and extrapolate these to the future infrastructures. Moreover, all the JRAs have been designed to innovate the usage of existing European instruments, but at the same time will feed into the technical development of the next generation, global radio telescopes.

3.1.2 Expected impact of the NA programme

Timely and effective communication of results and uninterrupted interchange of ideas are important for advancing cutting edge research programmes and constantly progressing science and technology. At the same it is recognized that it is important for our community to have a set of network events that continues to foster the coherence of European radio astronomy with respect to strategic developments. The networking activities of *RadioNet3* are specifically aimed at promoting these vital aspects. They also provide the lubrication necessary to enable an Integrating Activity such as *RadioNet3* to achieve its desired impact.

The principal expected impacts from the *RadioNet3* NA programme are therefore to

- Prepare a long-term strategy for structuring radio astronomy in Europe,
- Enable the discussion of future research directions,
- Represent and advertise the radio astronomy facilities and ambitions within the three major stakeholder communities: the European policy makers, the broader, European and worldwide astronomical community, and the general public,
- Ensure that the results which are generated are made available to the outside world in a comprehensible and coherent form,
- Provide opportunities for interaction on scientific and engineering fronts,
- Ensure that the next generation of scientists and engineers are exposed to, and become familiar with, the capabilities of the RadioNet facilities,
- Foster of the exchange of best practice between operations at different RadioNet facilities,

- Strengthening the ALMA user community in Europe by offering access to the distributed expertise in the European ALMA Regional Centre nodes and boost the effectiveness of these by establishing an efficient exchange mechanism for best practices,
- Train students and new users in the techniques of radio astronomy,
- Protect the European and global radio frequency environment in which the RadioNet facilities and future telescopes operate.

3.1.3 Expected impacts of the JRA programme

The four *RadioNet3* Joint Research Activities share the objective to stimulate new R&D activities for the already existing radio infrastructures in synergy with ALMA and with the SKA, as the radio telescope of the future. This ensures that Europe has the scientists and engineers that are ready for the next period, when the possibilities for radio astronomy research will be revolutionized by the advent of the SKA.

In general terms the JRA programme will be a key ingredient for keeping the existing facilities state-of-the-art, including new ones like ALMA, LOFAR and the Sardinia telescope. As always, the JRA programmes are directly aimed at providing new options for making astronomical discoveries with the RadioNet facilities. This is an essential step in making sure that the European facilities offer competitive opportunities in comparison with other world-class facilities, notably the new telescopes in the Southern hemisphere. Moreover, all of the proposed JRA programmes are directly relevant for the future instrumentation of either ALMA or the SKA.

WP8 (UniBoard^2) will focus on development of a generic high-performance computing platform for radio astronomy, along with the implementation of several different applications (correlator, digital receiver, beam former). By deploying the latest techniques, this prototype will be more powerful and more economic in terms of energy consumption. It will be an important asset for upgrading the existing facilities with new correlator power, potentially allowing more VLBI or LOFAR baselines or more WSRT or MERLIN spectral resolution. It could also be important for phasing up of large bandwidth millimetre interferometers for use in VLBI arrays (ALMA, PdB). UniBoard^2 can also be used for large array receivers that give single dish telescopes large fields of view. The project is also able to attract users from outside the consortium and the experience with it is feeding into the design considerations of the SKA.

WP9 (AETHER) will respond to the critical demand on novel broad-band millimetre and sub-millimetre (terahertz) detector development, which is essential for improving the performance and fully exploiting the capabilities of the leading facilities in this range of wavelength, most notably the European mm/sub-mm telescopes, such as the IRAM 30-m telescope, PdBI, APEX and ALMA. The programme is addressing specific prototype needs for the next generation ALMA instrumentation, but there is also a complementary ambition to bring these new instruments to the other European facilities.

WP10 (Hilado) will develop computing approaches to address the dramatic increase of the quality and volume of astronomical data with the advent of new facilities and advanced observational techniques. On one hand it will push the capabilities of the RadioNet interferometer telescopes by enabling observing modes that otherwise cannot be supported. On the other hand it is the only existing effort, even on a global scale, to harmonize the distributed efforts in radio astronomy processing software. As such this is a vital component in calibrating the software effort needed for the SKA and it is an essential program to foster the emerging European community in this area.

WP11 (DIVA) will develop key technology building blocks for centimetre radio astronomy that will increase the bandwidth and therefore sensitivity of European facilities including the European VLBI network. It is therefore an essential ingredient in keeping these facilities at the forefront of radio astronomical research, but it also offers essential ingredients for future innovation, for example by supporting the development of MMICs for radio astronomy. This is potentially also important for the development of millimetre VLBI including ALMA. Moreover, the programme aims to feed into the development of wide-band receivers for the SKA.

3.1.4 Expected impacts of the TNA programme

The TNA programme of *RadioNet3* offers access to world-class research infrastructures in Europe, spanning the complete range in radio astronomy characteristics and wavelengths. Although these facilities operate (at least partly) on the principle of "open skies" access, the TNA programme is absolutely essential in assuring that this principle can be maintained and that a level of support that really allows non-expert users from all over Europe to access these facilities can complement the policy.

Principal expected impacts from the *RadioNet3* TNA programme are to

- Remove technical, financial and logistical barriers which prevent European astronomers from taking full advantage of these world leading facilities,
- Encourage external European use of the full range of nationally funded radio astronomy facilities,
- Contribute towards the provision of a high level of professional support given to European users of nationally funded facilities covering all aspects of their use, from proposal preparation, through scheduling and execution of observations, to data analysis and interpretation,
- Provide external European users with the opportunity to visit world-leading radio astronomy facilities, to participate in the observing process, and to interact with other expert engineers and scientists at these institutes.
- Maintain the global competitiveness of the TNA facilities In Europe by continued technical development and substantial investments.

The anticipated outcome from this broader European use of radio astronomy facilities is an increase in the scientific output of European research groups, by providing them with access to a wide range of observational capabilities. At the same time it will stimulate novel observational programmes of the European radio astronomy facilities by having new users access them. Since these facilities are unique and spread across Europe, this can only be achieved on a European rather than national level. The *RadioNet3* TNA programme, together with the open skies policy, puts the world's best radio astronomy facilities at the use of Europe's most talented astronomers.

B 3.2 Plan for the use and dissemination of foreground

The dissemination activities of *RadioNet3* are designed to gather and present the project’s achievements and successes throughout Europe. It can be foreseen that the project mainly will generate new knowledge. In order to spread this knowledge, the outreach approach of the consortium is foreseeing a twofold dissemination strategy, i.e. (a) for the scientific community and (b) for the general public, including media and school children. On a horizontal axis, the website of the *RadioNet3* project will play a pivotal role in the dissemination strategy, allowing for a direct interaction between the different players, such as a science blog, forum, list of *RadioNet3* related publications. The Project Scientist together with the Information Assistant will be in charge of the implementation of the *RadioNet3* outreach and dissemination strategy, such as materials design and distribution, press releases and the web portal. Furthermore *RadioNet3* will promote radio astronomy via the active participation of the Coordinator and/or Project Scientist in key astronomical and politically important non-astronomical conferences.

a) Dissemination within the scientific community

All *RadioNet3* partners will be encouraged to attend and to participate actively in conferences and workshops by giving talks and presenting posters. Beyond the dissemination of scientific results at international meetings, the meetings organised via the *RadioNet3* NAs Science Working Group (WP3), New Skills (WP4), MARCUs (WP5) and ERATec (WP6) will have a tremendous impact on disseminating the results of the *RadioNet3* project. The results attained by *RadioNet3* and the associated opportunities of the work programme, will be presented at large national and international astronomy meetings that engage the whole community e.g. general meetings of the International Astronomical Union (IAU), and JENAM (the Joint European and National Astronomy Meeting).

Astronomers benefiting from Transnational Access will be expected and actively encouraged by WP leaders to publish their results in refereed journals. Technical results arising from JRAs will also be published in appropriate engineering and/or scientific journals. It will be a regular requirement that RadioNet3 and the associated EC-funding be clearly acknowledged in all publications.

b) Outreach to the general public

The Outreach and Dissemination Strategy of *RadioNet3* designed and conducted in the NA QueSERA (WP2) will be responsible for and oversee the dissemination activities for the different target groups of the general public. The dissemination material will be adapted to the needs of these specific groups. The following target groups have been identified:

- School children
- Female school children, students and young scientists
- Media: scientific and non-scientific press, digital media and TV
- Industry (telecommunications sector, chips manufacturers, software producers)
- General public

The *RadioNet3* dissemination plan will specify in detail how the different target communities mentioned above will be approached. Appropriate information to these groups will be developed and disseminated proactively, taking into account their specific needs. Contacts to broadcast media will be sought to address the general public.

c) Website

RadioNet3 will set up a Website with three different areas:

1. Public Area: It will contain information such as partner institutes, general introduction into the science performed and the TNA facilities within the *RadioNet3* consortium, research activities, information on and the electronic proceedings of workshops/ conferences/ symposia, and forthcoming events, contact persons for scientific and project related questions, entry point for Media, information for the different target groups defined above, science blog, link to the EC. Activity reports, lists of, and links to, preprints and publications arising from *RadioNet3* activities and news will be published on this non-protected part of the web page.
2. Internal Area: This area will serve as the *RadioNet3*-internal information archive and therefore will be password-protected. Here, all information related to the implementation of the work description will be made available, such as: MC minutes, reports, agenda, data archive, etc. There will be a web-based mailing list for *RadioNet3* partners only, for discussions and rapid information exchange.
3. A discussion forum for engineers and scientists will be installed for discussion on key technologies being developed/required for new instrumentation, their management and operation.

Intellectual Property Rights

Given the academic nature of all partners most of the information exchange will happen in an open atmosphere, but there may be areas in which management of knowledge capital will be important. For this a flexible implementation of Intellectual Property Rights (IPR) will be necessary. This formal process of ownership and for use and sharing of intellectual property will be defined in the *RadioNet3* Consortium Agreement. In general, developments within the project will be viewed as shared products, equally available to all project partners. In particular, the agreement provides adequate and effective protection of knowledge that is capable of industrial or commercial application. This is clearly required for the developments of technological processes but also for special design and characterization procedures developed in the partners' laboratories. IPR will be a standing agenda item at the team meetings and followed by the Management Team throughout the projects duration.

B4. Ethical issues

There are no ethical issues in the *RadioNet3* project.

B5. Gender aspects

Common to all European Member State countries is that women continue to be under-represented in the highest academic ranks and in decision-making positions in scientific organisations, even if this under-representation varies somewhat from country to country, as has been demonstrated by the EU Women and Science reports during the past decade (EC, 2000; EC, 2003; EC, 2006; EC, 2008a and b). Females are particularly under-represented in the physical sciences and engineering, therefore also in astronomy. The result is that women are poorly represented in decision-making bodies concerned with institute management, and strategic decisions.

The RadioNet community is aware of these problems, and is actively taking steps to encourage female recruitment and participation. All institutes involved in *RadioNet3* have a policy of promoting and developing their staff equally, regardless of gender or race. Therefore the RadioNet3 board has adopted already in 2009 a policy of equality in the treatment of associated personnel, regardless of sex, ethnic origin, physical handicap, sexual orientation or religion. The board and participating institutes will endeavour to provide a working environment that is free of discrimination or harassment, that addresses the day-to-day needs of all genders, religions and race, and that enables all personnel to work in an atmosphere of safety, dignity and mutual respect. Where appropriate, flexible working hours (including possible part-time appointments) and the ability to work at home will be encouraged.

The process of recruitment and promotion within *RadioNet3* will be fair and transparent, all appointments will be made on the basis of merit alone and the selection panel will (whenever possible) include a female staff member. She will not only participate in the interview process, but will also be involved in drawing-up the associated selection criteria. All staff involved in any *RadioNet3* recruitment process, will be made aware of their obligation to enforce equal opportunity regulations.

What is noticeable over recent years is that there are an increasing number of young female astronomers and engineers entering the profession. It is therefore our aim to develop a more equitable distribution of the genders in the future. In order to sustain and support this development, the *RadioNet3* partners are resolved to encourage all staff (both men and women) to engage and participate in local actions that tackle gender (and other related) issues.

Actions already underway at RadioNet institutes or planned within the *RadioNet3* context include:

- Setting-up mentoring programmes that support women in all aspects of their career development, including encouragement to apply for promotion,
- Encouraging the inclusion of women as leading members of Scientific & Technical Organising Committees,
- The emergence of institute diversity committees charged with addressing local gender, and minority issues with a direct reporting line to senior management,
- The organisation of “girls days” – in which local school girls are invited to visit and tour RadioNet Research Facilities,
- The implementation of a family friendly working environment in order to allow both parents to advance in their careers (such as day care at the institutes; parents and child rooms),
- The development of educational and outreach materials to promote gender equality supporting female astronomer’s and engineers mobility (e.g. COST Action MP0905 with participation of many *RadioNet3* partners; ASTRON’s Helena Kluyver visitor programme).

With these policies and actions in place, the *RadioNet3* project can positively promote gender equality issues, and at the same time, raise public awareness of the opportunities that are now available to women (and other minorities) within the domain of research infrastructures and the realm of the physical sciences more generally.