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

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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 benefi-ciary 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