PROJECT PERIODIC REPORT

Grant Agreement number: 212243

Project acronym: PREPSKA

Project title: A Preparatory phase proposal for the Square Kilometre Array

Funding Scheme: SP4-Capacities, Combination of CP & CSA, Integrating Activities / e-Infrastructures / Preparatory phase

Date of latest version of Annex I against which the assessment will be made: 4 April 2008

Periodic report: **1st X** **2nd ☐** **3rd ☐** **4th ☐**

Period covered: **from 01/04/2008 to 30/09/2009**

Name, title and organisation of the scientific representative of the project's coordinator[1]: Prof.P.J.Diamond, Director, Jodrell Bank Centre for Astrophysics, University of Manchester

Tel: +44 (0)161 275 4214

Fax: +44 (0)161 275 4247

E-mail: Philip.diamond@manchester.ac.uk

Project website[2] address: http://www.jb.man.ac.uk/PrepSKA

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator[1]

I, as scientific representative of the coordinator[1] of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):

  ☐ has fully achieved its objectives and technical goals for the period;

  ✓ has achieved most of its objectives and technical goals for the period with relatively minor deviations[3];

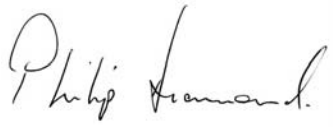
  ☐ has failed to achieve critical objectives and/or is not at all on schedule[4].

- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator[1]: .....Philip Diamond.....

Date: ..15./ Jan / 2010

Signature of scientific representative of the Coordinator[1]: .



[3] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

[4] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

1. Publishable summary

The Square Kilometre Array (SKA) will be one of the largest scientific projects ever undertaken. It is a machine designed to answer some of the big questions of our time: what is Dark Energy? Was Einstein right about gravity? What is the nature of dark matter? Can we detect gravitational waves? When and how did the first stars and galaxies form? What was the origin of cosmic magnetism? How do Earth-like planets form? Is there life, intelligent or otherwise, elsewhere in the Universe?

There are several issues that need to be addressed before construction of the SKA can begin:

1. What is the design for the SKA?
2. Where will the SKA be located?
3. What is the legal framework and governance structure under which SKA will operate?
4. What is the most cost-effective mechanism for the procurement of the various components of the SKA?
5. How will the SKA be funded?

This project, the preparatory study for the SKA (PrepSKA), is designed to address all of these points. PrepSKA will coordinate and integrate R&D work from around the globe in order to develop the fully-costed design for Phase 1 of the SKA, and a deployment plan for the full instrument. With active collaboration between funding agencies and scientists, all of the options for the policy-related questions will be investigated. The principal deliverable will be an implementation plan that will form the basis of a funding proposal to governments to start the construction of the SKA.

The SKA will have a collecting area of up to one million square metres spread over at least 3000 km, providing a sensitivity of up to 50 times higher than the Expanded VLA (which will soon be the world's currently most powerful radio telescope). In addition, the SKA will deliver an instantaneous field of view (FOV) of up to several tens of square degrees, many times that of existing instruments, and the new possibility of multiple simultaneous users of several large, independent fields-of-view. These capabilities are enabled by a much greater use of information and communications technology than in current designs, and the result will be an extremely powerful survey telescope with the capability to follow up individual objects with high angular and time resolution.

The baseline design for the SKA is an interferometer array capable of imaging the radio sky at frequencies from ~70 MHz to ~25 GHz, and providing an all-sky monitoring capability at frequencies below 1 GHz. The telescope is to be built in three phases, and will be able to carry out significant scientific observations as it is being built. The concept involves parabolic dishes with innovative feeds to maximize a combination of spatial and frequency coverage; at lower frequencies phased arrays can become cost-effective and offer new operational capabilities. Technological innovation, closely paralleling commercial IT developments, is the key to the design concepts under investigation and to the target cost of 1.5 billion Euro. Data transport rates are likely to be in the range of 100 Giga-bits/sec to Tera-bits/sec, with Petaflop capacity required for the central processor. Much of the required technology is currently being developed in the course of specific design studies (including the EC funded FP6 SKA Design Study, SKADS) and the construction of several SKA Pathfinder instruments around the world. The final step of integrating the accumulated R&D knowledge into a detailed system design for the SKA, is taking place under the aegis of PrepSKA.

Two locations for the telescope, Australia and Southern Africa, have been short-listed by the International SKA Steering Committee as acceptable sites for the SKA.

Objectives

The principal objectives of PrepSKA are:

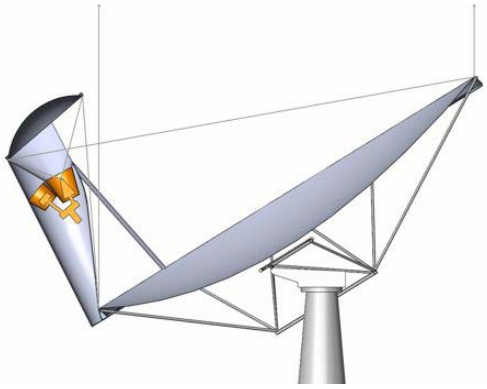
- to produce a deployment plan for the full SKA, and a detailed costed system design for Phase 1 of the SKA;
- to further characterise the two candidate SKA sites in Southern Africa and Australia and to analyse the various risks associated with locating the SKA at each of the sites;
- to develop options for viable models of governance and the legal framework for the SKA during its construction and operational phases;
- to develop options for how the SKA should approach procurement and how it should involve industry in such a global project;
- to investigate all aspects of the financial model required to ensure the construction, operation and, ultimately, the decommissioning of the SKA;
- to demonstrate the impact of the SKA on society, the economy and knowledge.
- to integrate all of the activities, reports and outputs of the various working groups to form an SKA implementation plan.

Status after 18 months of PrepSKA

PrepSKA began on 1st April 2008. The first few months focused primarily on the recruitment of staff within the work-packages setup to address the project objectives. In some cases this took longer than expected with the result that progress in some areas has been somewhat slower than expected. Below is a brief summary of progress in each work-package.

WP2: SKA Design:

- All funded engineering domain specialists are now in post and engaged in their planned coordination role in the R&D programme;
- The original project plan for WP2 was put together in mid-2007, the R&D programme has developed considerably since then and so the engineering team have restructured the programme to follow a systems engineering approach;
- The restructuring has resulted in the definition of a series of conceptual, preliminary and critical design reviews for all sub-systems and the SKA system as a whole;
- Led by the US-funded Technology Development Program a Dish Verification Program, involving groups from Canada and South Africa, has been established which has resulted in excellent progress on the optical and mechanical design of the dish component of the SKA. A potential design is shown here.



- In a parallel programme, and following on from the FP6-funded SKADS project**,** European institutes are continuing the design and development of an aperture array to provide the lower frequency, ultra-wide field of view capability of the SKA;
- A variety of options for novel, broadband single-pixel feeds are being investigated and some designs are already known to not satisfy the stringent SKA requirements;

- Groups in the Netherlands, Australia and Canada are developing new technology phased arrays for dishes and are achieving excellent results; systems are being deployed on the WSRT (Apertif) and ASKAP;
- Significant progress has also been achieved by several different groups in low-noise-amplifier development, digital signal processing hardware throughout the signal chain, beam-forming algorithms and hardware; data transport, time and phase transport over fibre and in the study of correlator concepts.

WP3: Site characterisation

- A team consisting of ASTRON, CSIRO and NRF, coordinated by the SPDO, are constructing the mobile infrastructure, the hardware for RFI tests and appropriate software. There have been some delays in the delivery of certain components but it is now expected that deep RFI measurements will take place simultaneously on both sites in early 2010.
- Extensive work has been on-going within both candidate sites and within the International Telecommunications Union to ensure that the regulatory aspects of the establishment of radio quiet zones around the sites are implemented.
- An external consultant was engaged to conduct a study into ionospheric scintillation above both core sites; both were shown to be among the best sites in the southern hemisphere. An additional study was commissioned to investigate the effects of the South Atlantic Anomaly on the ionosphere over the South African site; the report is yet to be delivered.
- Options are being explored to fund equipment to investigate the stability of the troposphere over both sites; this is a deviation from the original work plan.
- Significant effort is being provided by both candidate countries, by the University of Cambridge and the Configurations Task Force to investigate the optimum configuration for SKA stations.
- Finally, work is ongoing in both candidate countries to provide all required data to enable a thorough and detailed investigation of the influence of site characteristics on the telescope design, operations and cost.

WP4: SKA governance and legal framework

- The WP4 team at N.W.O in the Netherlands spent the first few months of the project in gathering information on the SKA, understanding its proposed operational structure and in conducting a detailed survey of possible legal frameworks in use in other international science facilities;
- A workshop on governance was conducted in Arlington, USA in November 2008; this was followed by a series of visits to major science facilities, e.g. ITER, CERN, ESO, ESRF etc
- Towards the end of the first 18 months of PrepSKA, WP4 produced a small number of strawman documents describing different legal frameworks which will serve as a basis for discussion with the WP4 core team and the funding agencies.

WP5: SKA procurement and industrial involvement

- The WP5 team at INAF in Italy are charged with developing the options for the procurement policy for SKA and in determining how best the project might engage with industry.
- The first activity was to understand the procurement process for similar large projects such as ALMA, E-ELT and CERN.

- This lead to the writing of a major document entitled 'Guidelines for Procurement'

WP6: SKA funding model

- STFC in the UK run WP6, the focus of which is the development of a funding model for the SKA. This is a complex activity requiring an understanding of the timescales for funding major infrastructure projects in different governments, their respective proposal and approval processes and also the more delicate question of how much each government might be willing to contribute to the SKA.
- Of necessity the work of WP6 is closely entwined with that of WP4 and 5, and also relies on the cost estimates that will ultimately emerge from WP2.
- The first major activity in WP6 was to conduct a policy survey of all appropriate funding agencies to understand the mechanics by which they funded projects; much information was gathered but this work is still ongoing to ensure that all agencies have a chance to provide information;
- Visits were made, and discussions held with several large projects and organisations to develop an understanding of best practice.
- All the information gathered has been incorporated into an Excel-based modelling system which is capable of examining a range of scenarios, partners and partner timescales to produce an optimum funding model for the SKA.

2. Project objectives for the period

The tables below list the deliverables and milestones that were planned for delivery in the first 18 months of PrepSKA. Detailed descriptions of the activities associated with each of these items is provided in the sections on Work-packages 2-6.

Del. no.	Deliverable Name	WP no.	Lead beneficiary number	Estimated indicative person-months	Nature	Dissemi-nation level	Delivery date (project month)
1.1	AR1	WP1	1/9	18	R	PU	19
2.1.1	SKA concept delineation	WP2	9	9	R	CO	9
2.1.2	SKA Phase 1 specifications and SKA performance goals	WP2	9	12	R	PU	12
2.1.3	SKA operations concept	WP2	9	6	R	PP	12
2.2.1	Sub-system hardware specifications	WP2	9	12	R	PU	15
2.10.1	Periodic WP2 progress reports	WP2	9	16	R	PP	12
2.10.2	Annual WP2 project plans	WP2	9	16	R	PP	1, 12
3.1	Report on Ionospheric scintillation and TIDs	WP3	9	12	R	CO	6
3.2	Deliver RFI hardware and software	WP3	9	12	O	-	12
3.3	Report on phase referencing and self-calibration	WP3	9	12	R	PU	12
3.4	Report on optimum configuration for the SKA	WP3	9	12	R	CO	18
3.11	Summary Report of WP3	WP3	9	14	R	CO	36
4.1	Deliver study on best practice governance and legal frameworks	WP4	2	28	R	PP	9
5.1	Working guidelines for procurement (WP2 design project)	WP5	4	12	R	PP	12
6.1	Summary of the survey of national funding opportunities, processes and	WP6	1	16	R	PP	9

	timescales						
6.2	Summary of initial investigations on options for alternative funding	WP6	1	16	R	PP	15

List and schedule of milestones

Milestone no.	Milestone name	WPs no's.	Lead beneficiary	Delivery date from Annex I	*Comments*
1.1	Periodic Report 1	WP1	1/9	19	
2.1	IEAC Review	WP2.1	9	11	
2.2	SKA specs set	WP2	9	12	
2.3	SKA Phase 1 prototyping: sub-system hardware spec set	WP2	9	15	
3.1	Ionospheric scintillation	WP3	9	7	
3.2	RFI Software and hardware delivery	WP3	9	12	
3.3	Array configuration, influence of site	WP3	9	18	
5.1	Working guidelines for Procurement (WP2 design project)	WP5	4	12	

3. Work progress and achievements during the period

The following sections describe, in detail, the progress of the work in each of the activity work packages. The management activities are described in Section 5 below.

Work Package 2 (SKA Design) progress report

WP Leader: Richard Schilizzi (UMAN(SPDO))

General

The objective of Work Package 2 is to produce a costed top-level design for the SKA and a detailed system design, including costing, for Phase 1 of the SKA. This work is being undertaken by the SKA Program Development Office based at the University of Manchester, together with the organisations and institutes participating in WP2. This report provides information on the work done in the period 2008-04-01 to 2009-09-30 (T + 18 Months) including spreadsheets displaying the status of the original Work Package 2 Tasks, Deliverables and Milestones, and their revised expected delivery dates .

Project Timescales

As expected in the planning stages of the Preparatory Study, and reinforced by the slower than hoped for ramp up of SPDO staff, it will be necessary to extend the period of the WP2 work. Funding has been allocated by the EC for 36 months; discussions with the EC scientific officer have confirmed that we may request a 9 month no-cost extension resulting in a total WP2 project extending to T+45. Therefore, much of the revised planning discussed below, for WP2 only, refers to this new timescale.

Staff

The full team of the SKA Program Development Office was finally assembled by May 2009 (see table below), more than one year after T0. This has led to a delay in planned deliverables. However, despite this delay, a considerable amount of work has been done since the original project inception date of 2008-04-01.

UMAN(SPDO) WP2 TEAM MEMBERS	
Designation	Name
Program Director (WP2 Coordinator)	Richard Schilizzi
Project Engineer	Peter Dewdney
Project Scientist	Joseph Lazio
Executive Officer	Colin Greenwood
Office Manager	Lisa Bell
Project Officer*	William Adams

System Engineer*	Kobus Cloete
Domain Specialist Signal Transport and Networks*	Roshene McCool
Domain Specialist Receptors*	Neil Roddis
Domain Specialist Software and Computing*	Duncan Hall
Domain Specialist Digital Signal Processing*	Wallace Turner
* funded by PrepSKA:WP2	

Coordination of the work

- One of the primary means of coordinating the global design effort for the SKA is a series of regular teleconferences held by the UMAN(SPDO) System Engineer and the Domain Specialists, details of which are posted on the UMAN(SPDO) WIKI (http://wiki.skatelescope.org/bin/view/Main/WebHome).
- Weekly technical meetings are held within the UMAN(SPDO) to receive and analyse inputs from the teleconferences, meetings, e-mail correspondence and the WIKI .
- Overall coordination of WP2 is carried out through annual WP2 meetings held in Manchester, and teleconferences of the Liaison Engineers appointed by the participating institutes and organisations. The Kick-off meeting was held from 14-18 November 2008 and was attended by over 40 participants. During the meeting parallel work-sessions of all WP2 sub-work packages were organised in order to discuss the detailed future work contribution of each partner. The second annual meeting will be held from 29-31 October and 80 participants are expected.
- UMAN(SPDO) staff has made a substantial number of visits to the WP2 participating organisations, in order to gather information and to participate in reviews of WP2-related technical work.
- Reports have been provided to the PrepSKA Board on two occasions. A Coordinating Committee including the PrepSKA management, and the Coordinators of WPs 2/3, 4, 5 and 6 has been initiated, and meets periodically.

Progress in Work Package 2 by Task Number

(Note: Task numbers and names refer to the original Description of Work)

WP 2.1: SKA Design

Objectives

WP2 is the main SKA design activity; it will produce a costed top-level design for the SKA and a detailed system design, incorporating costing, for Phase 1 of the SKA.

Progress

WP2.1 is the top-level system engineering task leading to the engineering design of the SKA. Its objectives are to set and review the specifications for SKA and Phase 1, undertake cost and performance optimization studies, examine trade-offs, and formulate conceptual SKA and detailed Phase 1 system designs. WP2.1 has been divided into the nine tasks reported on below. The project is coordinated by the UMAN(SPDO) with the work being done by all WP2 participants.

WP2.1.1: **SKA concept delineation**

- Significant progress has been made in the delineation of the SKA concept with the generation of a number of key documents: the Design Reference Mission* describing the science and technical requirements for a set of "envelope" components of the SKA Science Case, the System Engineering Management Plan (SEMP)*, the Document Standards Handling and Control Plan*, the Risk Management Plan* and the Risk Register.* The system engineering management approach to achieving PrepSKA WP2 milestones builds on experience in the Design Studies, Precursors and Pathfinders as well as a wealth of material available in the SKA memo series accessible on the SKA website (http://www.skatelescope.org/pages/page_memos.htm), and several other significant documents such as Guiding Principles, activities and targets for PrepSKA Work Package 2* (2008-11-02 Peter Dewdney), the International Engineering Advisory Committee report of 2009-06-01, amongst others.
- Further delineation of the SKA concept by the UMAN(SPDO) in collaboration with the SWG and the WP2 collaboration will be presented during the system Conceptual Design Review (CoDR) at T + 21. Work on the Design Reference Mission, which is a set of science cases from which the technical specifications are being derived, will continue into the next phase of the project and therefore the interaction between engineering and science will a*lso continue beyond this point. At the time of the CoDR at T+21 it will not yet be possible to present full details of technology solutions that will meet the majority of the science requirements. The work and tradeoffs in this regard will continue throughout PrepSKA.

This deviation from the original Description of Work will result in a comprehensive Project Plan in the project management sense that will allow for effective management of the time and resources committed to achieving WP2 Milestones by T + 45. It is anticipated that the Project Plan will be available by T + 20. This plan will become the platform from which monitoring and execution of the project will be managed.

WP2.1.2: **SKA specification**

- The first draft of the Design Reference Mission, created by the Science Working Group, was reviewed within the UMAN(SPDO) at T+18. The technical requirements for the instrument are being extracted from the DRM with a continual trade-off between science and engineering, constrained by the budget. It is anticipated that this process will be repeated several times throughout the project.
- An initial draft of the operations plan is now in circulation , with release to the SSEC planned in T + 20
- A detailed system specification was created by the UMAN(SPDO) for a possible Phase 1 scenario in order to derive first order costing and a high level schedule. It is foreseen that several iterations of these types of scenarios will take place in order to arrive at the final costed system design for Phase 1.
- UMAN(SPDO) has been analysing objective methods of technology selection in order to progressively work towards a feasible set of specifications.
- Cornell(TDP) has done extensive work on dish specification in preparation for the construction of a prototype, details of progress in these areas are dealt with in this

* Documents are available in on-line Appendices, see below.

report under tasks 2.3 – 2.6. The AAVP will benefit from the extensive work on Aperture Array prototypes carried out during SKADS.

- Although a limited first draft of the SKA specifications will be available at the end of the System Concept Phase at T+21, the majority of the work to develop the system requirement specification will be performed during the Definition Phase. The full SKA system requirement specification (SRS) will be presented and reviewed during the System Requirements Review at T+39 (SRR), which will be carried out by the IEAC and various other internal and external reviewers. To be able to test, accept and commission the Phase 1 instrument it will be necessary to develop a dedicated Phase 1 requirement specification as a subset of the full SKA SRS. It is proposed that this specification be developed after the SRR (during the Preliminary Design Phase) as a subset of the full SKA SRS. The development of test, acceptance and commissioning procedures will also form part of this work package. The milestone for this work package will therefore be a limited first draft SKA SRS to be available at system CoDR at T + 24, the final SKA SRS to be available at SRR at T + 39, updates (if applicable) to be available at the PDR during the post-PrepSKA detailed design phase, and the Phase 1 SRS to be available at the PDR.

WP2.1.3: SKA life cycle study.

- The aim of this task is to outline an end-to-end life cycle description of the SKA, and develop a first-order cost model applicable to major stages of the instrument's life. A clearer understanding of the phases through which the SKA will develop is emerging through discussions within the WP2 collaboration by way of teleconferences with the design groups, and attending meetings with the astrophysics community relevant to the SKA. In particular, the requirement to produce a high level schedule to formulate the system engineering approach has laid the foundation from which sub system tasks are being constructed by the UMAN(SPDO) and the sub-system design groups.
- First order costs per domain have been developed for the dish+single pixel feed option by UMAN(SPDO) and the aperture array + dish option by SKADS. The cost per domain for the dish+single pixel feed and phased array feed option is still under development by CSIRO(ASKAP) .These are rough estimates which require additional iterations before being used to further develop the life cycle model.
- The majority of the work will be performed as part of the system Definition phase. This will ensure that the life cycle requirements will form part of the SKA SRR and the subsequent Preliminary design at T+ 39.

WP2.1.4: SKA operations plan

- A draft Operations Plan produced by the Operations Working Group is under review, and will be presented to the SSEC by the UMAN(SPDO) at T+19. Further work on this will be performed during the concept phase, but the majority of work will be performed as part of the system definition phase. It is foreseen that a reviewed version of the Science Operations Plan will be available at the system CoDR at T + 21. This plan will be expanded, refined and finalised during the definition phase, and presented for review at the SRR at T + 39.
- CSIRO(ASKAP) is building one of the Precursor arrays on a candidate site, the Australia SKA Pathfinder, and is developing this site as the Murchison Radio-astronomy Observatory (MRO). Its operational design of ASKAP is being undertaken with regard to the future operation of the SKA. As these plans mature, these will be developed in conjunction with the UMAN(SPDO).

- Current thinking is that the SKA phase 2 deployments will continue during phase 1 operations. Science test and commissioning observations will be underway during the latter stages of phase 1 deployment. This overlap of construction and operations presents challenges for the operations plan. The operations plan is also a prerequisite to developing the high level architecture for software subsystems.

WP2.1.5: SKA support model

- This aspect of the project is still in the early stages of development. The approach is to first determine exactly what it is that needs to be built and then to develop an appropriate support model.
- The plan to be developed during this work package will address all the support aspects of both the full SKA and Phase 1. The plans will not be limited to maintenance aspects only, and will extend to all support functions required. This would include comprehensive logistics support. The majority of the work on this work package will be performed as part of the system definition phase as described in the revised work plan. Looking at the current high level planning it is evident that the definition phase will be completed before the site decision. This implies that two support models will be investigated and carried until the site decision is made.

WP2.1.6: SKA cost and performance optimization

- CSIRO(ASKAP), UCAM and UOXF have developed the SKA cost and performance (C&P) software tool. A Basis of Estimate process is under development within the UMAN(SPDO) which will feed in to the C&P tool. Data is being collected from the precursors and pathfinders, industry contributors and actual experiences to further refine the tool both with respect to the technical specifications and associated costs databases. As the design of the system emerges and the accuracy of the costs of their component parts becomes more accurate, the basis of estimate will grade the accuracy of those costs and narrow down the options, including the costs of risk and its mitigation.
- The basics of the C&P tool are in place. The route to progressively elaborate the technical and costing aspects of the SKA has been charted through the System Engineering Management Plan and the revised Schedule and Responsibility Matrix.
- Work on this package will be ongoing throughout PrepSKA and will culminate in the fully costed system design.

WP2.1.7: SKA manufacturing studies

- Experience gained in the precursor and pathfinder instruments is informing the approach to mass manufacturing of certain elements of the SKA. An SKA industry capability database being developed within WP5.
- Reports from NRC- HIA indicate that studies of the mass manufacturing of composite reflectors for the antennas have the potential of providing a cost efficient alternative to traditional metal reflectors. A schedule of studies into mass manufacturing of various sub systems of the SKA will be part of the revised work plan, and these studies will be performed once a degree of certainty of the technologies to be used has been arrived at, and the process of technology selection is well advanced.
- The majority of this work will be performed during the system definition phase after T+21. Significant contributions and work will also have to be performed within the elements and subsystems of the SKA.

WP2.1.8: SKA technical documentation

- A documentation handling procedure (PrepSKA WP2 & 3 Documentation Standards, Handling and Control) has been developed and adopted by the UMAN(SPDO) at T+15. These standards will be made available to all the partners, and control of documentation is handled centrally from the UMAN(SPDO).

WP2.1.9: SKA system design

- The formulation of the System Engineering Management Plan and its internal UMAN(SPDO) review at T+15 represents significant progress on this work package task. The document provides the cornerstone of the developing project plans, and is currently being externally reviewed by all participants in the System Engineering Design Group.
- Preparations are in place for the managed System Concept Design Review (T+21), which included the establishment of the system engineering design group and teleconferences, visits to and from participating organisations, and the administration of the large amounts of information flowing through the SKA community.
- The majority of the work in this task will be performed as part of the system Preliminary Design Phase. The identification, development and management of interfaces and relevant interface documentation will form part of the work and milestones within this work package. With regard to interfaces, the first identification and definition of system level interfaces will be presented at the system CoDR at T+21, along with the first draft of the interface register. These documents will be further developed and refined throughout PrepSKA and presented in sequence at the SRR(T+39) and the PDR in the post-PrepSKA phase

WP 2.2: SKA Phase 1 sub-system specification and evaluation

Objectives

To expand the sub-system requirements formulated within the WP2.1.9 system design into a form enabling the design and test of hardware prototypes for SKA Phase 1.

Progress

- Work by the UMAN(SPDO) domain specialists and the associated design groups within the WP2 collaboration lies at the centre of the SKA system design. It is a continuous process with the first CoDR planned at sub-system level at T+27 for dishes and single pixel feeds.
- In the revised work plan, this task has been moved to System Design.

WP 2.3: Initial Verification System

Objectives

To produce an Initial Verification System (IVS), a field prototype which rolls together the most advanced SKA Phase 1 technology components and demonstrates the functionality, cost effectiveness and manufacturability of the adopted SKA Phase 1 design.

Progress

- Tasks 2.3 to 2.6 have been re-structured into the Dish Verification Program (DVP) and the Antenna Array Verification Program (AAVP). The details of these programs are being developed, and the revised work plan, which forms part of this report, outlines the new tasks, deliverables and milestones associated with these programs.

- The decision to adopt a systems engineering approach for these tasks and to deviate from the approach in the original work plan for an IVS, was taken in order to streamline and coordinate the many tasks and activities necessary to arrive at the milestone of a costed system design. The systems engineering approach will be carried through to project completion. The knowledge and experience of the available resources will be incorporated in a structured manner to achieve the required results.
- It must be stressed that the revision of the IVS to the DVP and AAVP does not detract from the progress made in all aspects of receptor design and development, but rather that it is as a result of progressive elaboration within the domain that the programs have emerged. All aspects of receptor design and prototyping will be considered, with a view to taking a systems engineering approach, instead of isolating the sub systems of the receptors, and developing them separately.

WP 2.4: Dish Design and Optimisation

Objectives

To evaluate cost-efficient dish antenna prototypes funded and produced by SKA Pathfinders and Design Studies, each antenna being constructed using manufacturing technologies having potential application to the SKA. In the context of the SKA system design, to provide a detailed analysis of these antennas in terms of performance metrics, cost-performance trade-offs and flexibility attributes.

Progress

- With optical analysis as the starting point, studies of various dish options are being conducted with a view to concluding a design review in T + 26, at which one or two designs will be selected for prototyping and verification testing in 2012.
- An offset fed Gregorian antenna with wide band single pixel feed and space available for a phased array feed is currently being studied by Cornell (TDP). Here the aim is to produce a design that has low level, stable side lobes. A combination of optics and mount design will have to allow for an acceptable range of elevation angles, probably down to 10 degrees.

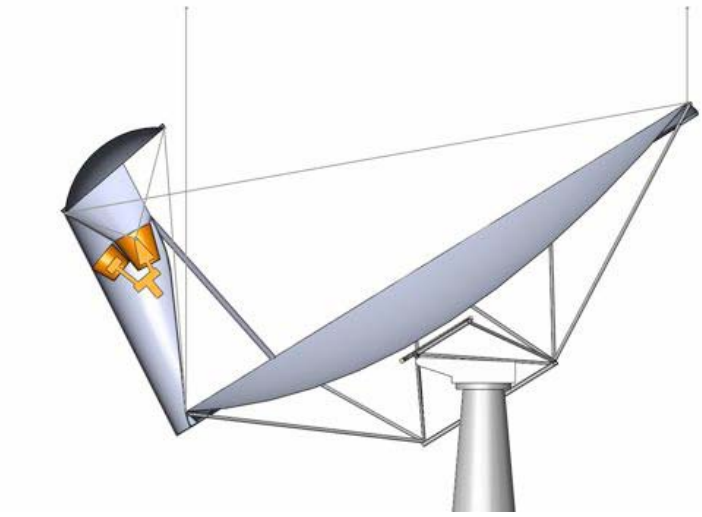


Figure 1. Offset Gregorian reflector model (Cornell-TDP)

- Initial studies by Cornell (TDP) have indicated a small cost ratio between symmetric and offset antenna configurations. There are several strong advantages of using an offset configuration: lower noise temperature, lower wide angle side lobes, and better main beam symmetry. There are mechanical advantages to an offset configuration, there is "real estate" available near the focus for multiple feeds, potentially a PAF and the mechanism to interchange them. Given all of these factors, the Cornell(TDP) Antenna Working Group has selected an offset, dual reflector concept for design and construction of the Cornell(TDP) prototype antenna. The prototype will be a major part of the Dish Verification Program, demonstrating the performance, cost and manufacturability of dish antennas for the SKA.
- Initial studies of optical designs for the Cornell(TDP) prototype, using conic sections, are complete and the results are being circulated by email and meetings and soon to be published as memos. Software to design dual offset shaped reflectors is available and has been described in two memos. Shaping allows a wider range of solutions of reflector antennas, simultaneously obtaining both high efficiency and low spill over.
- Cornell(TDP) initial mechanical design studies of reflectors, both symmetric and offset, are complete and have been circulated via email and presentations, memos are in process. The studies include:
    - A preliminary set of antenna specifications
    - Cost analysis of the Allen Telescope array
    - Production cost estimate of hydro-forming reflectors
    - Concept designs and initial analysis of mechanical supports for hydro-formed reflectors, both symmetric and offset.
    - Trade off study of mechanical implications for various optical designs.
- The Composite Applications for Radio Telescopes (CART) project at NRC-HIA began in January 2006. A costing analysis comparing designs in the 12m – 15m dish diameter range was undertaken. This included various manufacturing and assembly techniques applied to the reflectors only. Based on this study, composite reflectors appeared to offer advantages in cost, mass and frequency range over the other designs and manufacture methods. It was also determined that the Vacuum Infusion Process (VIP) offered the required strength, stiffness and dimensional control for astronomical instruments.
- Following a first phase consisting of the preliminary design and cost estimates, fundamental materials properties testing, and construction of a 1m reflector to verify RF and astronomical performance of composite reflectors, a second phase was initiated to construct a prototype 10m radio telescope to demonstrate concept feasibility and determine first order costs to a high degree of accuracy. This has been followed, as part of PrepSKA, by the construction of the Mk2 10m prototype, which incorporated lessons learned from the initial construction.
- Assessment of the Mk2 revealed that it has the same mass as the Mk1, but is much more production friendly, with a surface rms of 0.54 mm rather than 1.2 mm (*SKA Memo 106*). The deviations from the best-fit parabola are also much more evenly distributed than the Mk1 .The cost of this reflector design is \$1000US/m^2, with 60 % materials and 40% labour. Analysis of the Mk2 reflector under a variety of thermal load conditions characterized its thermal performance (*CART Memo 21*). In addition, a thermal finite element (FE) model of the Mk2 reflector was validated. The thermal modelling techniques can now be used to evaluate the thermal performance of future reflector designs.

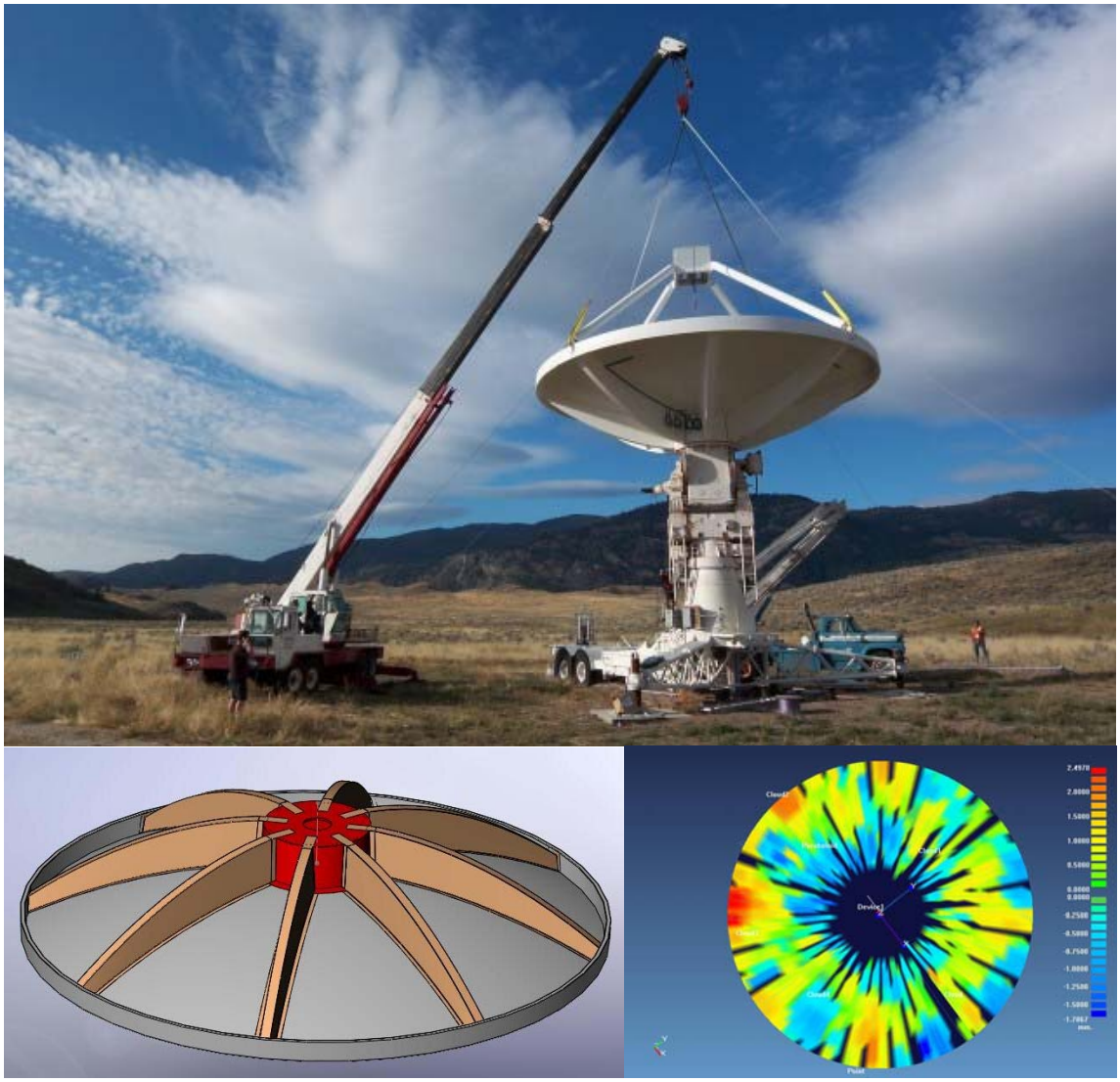


Figure 2. NRC-HIA CART MK2 Reflector
Top: Mk2 reflector being hoisted onto its pedestal.
Bottom left: structural design of the Mk2.
Bottom right: Laser metrology of the CART Mk2 reflector. The rms deviation from the best-fit parabola is 0.54mm.

- Work in NRC-HIA is now concentrating on the design of 12 and 15 m offset reflectors using optical designs developed as part of the US Cornell(TDP) program, and the further development of the associated mechanical and electrical interfaces to the overall system for inclusion into the DVP.
  To verify wind-loading estimates from model FE analysis, a contract has been let to the NRC Institute for Aerospace Research (IAR) for wind-tunnel testing of 1-m mock-ups of both a symmetric and offset reflector, with and without focus package and support. This testing is due in September 2009, with results in June 2010.
- NRC-HIA let a contract to Profile Composites, Sidney BC to establish production feasibility and costing at high volume manufacturing. The result was to recommend manufacture of all dish components near to the SKA site. The cost of complete composite reflector assembly (surface and backing structure) was determined to be \$400USD/m^2 for Phase 1 and \$371USD/m^2 for Phase 2, excluding profit margin. As a

check, the numbers and approach are compared with wind turbine blade manufacture, the only other similar volume and size production currently in composites. This report provides an excellent basis for accurate cost forecasting of large-scale production of future composite reflector designs.

- CSIRO(ASKAP) is building ASKAP as a specific demonstrator of the axi-symmetric wideband feed approach. It is working with the Chinese firm CETC54 on the design and construction of centre-fed panelled antennas. The system includes all aspects, from the antennas/feed to the computing and presentation of high-dynamic-range, wide-field-of-view images.
- NRF successfully constructed a 15m diameter one-piece moulded composite antenna at Hartbeesthoek during 2008/2009. Fourteen memos have been written documenting the construction, testing and performance metrics of the antenna. Following the design and construction of the 15m prototype antenna, the KAT-7 contract for 7 composite antennae in the Karoo has been awarded and construction in the Karoo is currently under way. Concerns surrounding materials used for composite reflectors (e.g. design issues related to mitigation of water ingress, UV life, long-term stability etc.) are being investigated
- Local funding in the Netherlands has been granted for the development of Polyplast dish elements, promising low cost and fast production.
- UOXF collaborated with Cornell (TDP) to verify the Cornell(TDP)'s new design code for shaped offset optics designs as part of the DVP. UOXF carried out full physical optics simulations of the Cornell(TDP)'s ray-optics based designs to verify that, including full scattering and diffraction effects, good cross-polarization and sidelobe performance can be achieved with an increase in aperture efficiency over non-shaped designs.

WP 2.5: Feed optimisation and prototyping

Objectives

To produce and evaluate prototype single-pixel, phased array and cluster feeds suitable for use with SKA dishes and to continue development of aperture phased arrays in order to optimize performance in accordance with WP2.1 SKA specifications.

Progress

- Cornell (TDP) is studying four broadband feeds for use in reflector antennas. There are prototypes of all these feeds and Cornell(TDP) has measured data for three of these, the Cornell(TDP) QSC, the Lindgren (Caltech) quadridge, the Kildal feed and simulated data on the updated ATA (log periodic) feed. This data has been placed in an online database for use in designing reflector optics. The characteristics of each feed are sufficiently different to require matching optical designs for each one. The performance of each feed will be analyzed while embedded in a matching optical design and graded on the composite performance of the entire system. The first iteration of this design process is complete and described in a progress memo. Improvements to each of the feeds and integration of the feeds with Low Noise Amplifiers continues.
- NRF is carrying out simulations of the MeerKAT feed and dish optics in order to optimize Ae/Tsys and sidelobe characteristics.
- CSIRO(ASKAP) is investigating the use of chequer-board phased array feed systems in other approaches, primarily offset Gregorian antennas, and a full report on this will

be available by T+24. They are working with the principal developers of similar technologies around the world to try and develop a collaborative and consensus approach.

- ASTRON's work on APERTIF has produced a first prototype of a phased array feed using Vivaldi elements which has been mounted on a dish at Westerbork and tested in interferometric mode with other dishes in the array. Results on the system temperature and efficiency of the system are very promising, and are being pursued further. System and front-end design, and back-end processing studies are being conducted, the results of which are relevant to the SKA.
- NRC-HIA is also investigating Vivaldi-based phased array feeds in a program called PHAD.This has demonstrated 1.) Calibration and beamforming of data using standard array signal processing techniques. 2.) High image rejection ratios (~40dB) can be obtained with direct conversion receivers using a self calibration technique 3.) Polarimetry measurements of a phase array feed on a reflector antenna for the first time and 4.) Instrumental polarization is a few percent and that ultimate performance will depend upon system stability. Planning is advanced for a 2nd generation phased-array feed, building on the lessons from PHAD to produce an astronomy-capable array. This system will target the 0.7 – 1.7 GHz range, and it could be incorporated with a future CART reflector antenna to for a PrepSKA antenna verification system.
- In parallel with the construction and testing of PHAD, NRC-HIA has carried out simulations of the performance of Phased-Array Feeds from the viewpoint of carrying out astronomical observations, particularly calibration and data correction issues that will have to be resolved to attain high-fidelity, wide-field, and full-polarization imaging capability.
- A great deal of work has been done on Aperture Array systems by the SKADS collaboration. This will form the backbone of work to be done in the AAVP in PrepSKA. Aperture arrays were originally included as a sub-task of WP2.5, but such is their importance that in the revised Work Plan, this has been expanded to be the AAVP, jointly led by ASTRON and the UK. The revised work plan reflects the AAVP inclusion into the WP2 program.
- The low frequency sparse aperture array design for the SKA will be heavily influenced by the LOFAR and other designs. Good progress has been made, with the LOFAR project reporting first fringes from the international LOFAR station in Effelsberg in Germany and the Dutch stations.
- INAF is involved in the AA-lo part of the AAVP. Based on the experience gained in the BEST – SKADS activity (400-416 MHz), INAF is in charge of the design of the 75 MHz-450 MHz (AA-lo) aperture array prototype.
- In the UK work has focused on the development of the 2-PAD system, an all-digital, dual polarisation aperture array. 2-PAD (Figure 3) was funded through the SKADS programme, but work will continue under UK PrepSKA funding; it is designed to work from 300MHz through to 1GHz and is in the process of being fully commissioned and tested. 2-PAD has been designed as a flexible platform upon which a variety of subsystems can be tested and validated. 2-PAD currently has three antenna arrays which are plug-and-play compatible with the system, the BECA, the ORA and the FLOTT (a derivative of the ASTRON FlowPAD design) all of which have been fully characterised at the anechoic chamber at Selex Gallileo. 2-PAD has also been trialling the use of CAT7 cable as the analogue transport medium for distances of 20m and under. The use of a screened room and novel CAT7 to bunker RFI interfaces to minimise leakage into the surrounding area have also been a

significant area of progress. The 2-PAD DAQ board (Data AcQuisition Board: Figure 3) provides the interface between the analogue and digital domains. The board comprises a 2 Channel high speed analogue to digital converter, a large high performance FPGA device (Xilinx Virtex 5) and a PHY extender device to allow inter rack data transmission of up to 20Gb/s over 15m using standard data transport mechanisms. It provides a large programmable resource at the channel level along with fine grain control of channel to channel synchronisation. The board also provides debug and system management interfaces.

- The interface between the antenna element and LNA has been identified as requiring special consideration. World-wide telecons have been established to discuss this and face-to-face meetings will be arranged.

Figure 3.
Left: 2-PAD: the 3 x 3m steerable aperture array at Jodrell Bank
Above: DAQ: the 2-PAD data Acquisition Board.

WP 2.6: Receiver optimization and prototyping

Objectives

To produce a suite of advanced receiver prototypes covering the frequency range 0.1 – 25 GHz, based on technologies being developed in SKA Pathfinders and Design Studies.

Progress

- Cornell (TDP) is developing low noise amplifiers to be integrated with the broadband feeds, primarily in SiGe and InP. Techniques and hardware to interconnect LNAs and feeds is also under development. UCAL are testing room temperature 90 nm CMOS and 65 nm CMOS LNAs. ASTRON and CSIRO(ASKAP) are developing discrete transistor LNAs with Avago pHEMTs and OMMIC mHEMTs, and UCAl are doing similar work with Avago GaS transistors. UMAN is working on GaAs MMIC LNAs, both at room temperature and cryo-cooled, as well as developing their own foundry process based on InP.
- CSIRO(ASKAP) is continuing research efforts to develop appropriate "receivers-on-a-chip" with industry to bring down the cost of deploying systems.
- UCAL (Engineering Division of the Institute for Space Imaging Science) spent 2009 rebuilding their noise measurement system in order to obtain better accuracy and lower levels of interference, to allow precise measurement sub 0.2dB Noise Figure

LNA behaviour. UCAL plan to package the 90 or 65 nm LNA into the Vivaldi phased array feed at NRC-HIA in 2010.

- UCAL is developing an ADC based on a combination of a voltage-to-time converter (VTC) and a time-to-digital converter (TDC). The first version has been designed and submitted for fabrication. In 2010, a very high-speed low-power flash ADC will be designed for comparison with the time-based design, and to see which architecture gives the best results.
- NRF has designed and tested novel feed horns, OMTs and LNA coupling, low cost, low maintenance and high reliability cryogenic systems based on Stirling cycle refrigerators, integrated RF chain systems, wide bandwidth ADCs, temperature stabilization, and RFI shielding. Various commercial LNA samples have also been tested.. In addition, samples of co-axial cables have been tested using a purpose-built bending jig simulating a typical cable wrap on the KAT-7 antenna in order to determine the durability of the co-axial cable and the degradation in performance after a specified number of bends in the cables wraps.
- OBSPAR(UORL) is conducting a study of a low noise amplifier driven by CMOS 65 nm technology in the 300 MHz – 1GHz band. The aim is to produce an all-integrated design, eliminating external biasing and using integrated input and output capacitors. Reported results have shown that 50 and 100 Ohm impedance matching produces too much power in the first instance and poor common mode rejection in the latter. 400 Ohms impedance matching has produced the best results thus far.

Figure 4. Phased array feeds
Left: APERTIF Phased array feed at Westerbork developed and built by ASTRON
Right: Chequerboard array feed at ASKAP developed and built by CSIRO(ASKAP)

WP 2.7: Signal transport specification and prototyping

Objectives

To produce advanced prototypes demonstrating SKA signal transport on distance scales ranging from less than 20 m to more than 200 km, to report on solutions for transport over still longer distances, and to demonstrate techniques for generation and distribution of local oscillator and timing information within the SKA. A design for the Array monitoring and control systems, in detailed form for Phase 1, will also be produced.

Progress

- The UMAN(SPDO), in collaboration with INAF, IT, NRF, ASTRON, MPG, and CSIRO(ASKAP) has established a work program for the study of suitable purpose-made and commercially available transmission systems that could be used to good effect on the SKA. Viewing the instrument from a systems engineering perspective has been instrumental in highlighting the interfaces of the Signal Transport and Networks domain with all of the other domains.
- Accurate tests and evaluations of the optical link used on the BEST system at INAF have been continued. At the same time new optical links, from a local company, are under evaluation to determine whether they can be suitable for AAVP activities with regard to both performance and costs.
- CSIRO(ASKAP) is working closely with the STaN domain specialist to define the best specific technical approaches. It is working on all aspects of signal transport for ASKAP, as well as technologies for SKA, e.g. inexpensive RF over fibre. CSIRO(ASKAP) is also investigating "low-overhead" digital data transport, important given the approximately 2 Tbps communications needed back from every ASKAP antenna. It is installing its own ~400km optical fibre cable from the MRO to its support facility in Geraldton and is investigating likely SKA data transport technologies. CSIRO(ASKAP) is also investigating cable transfer mechanics and its photonic implications.
- Based on extensive discussions with MPG and the STaN domain specialist at UMAN(SPDO), the focus of MPG involvement has shifted to this work package in close cooperation with INAF. A detailed schedule has been agreed upon and progress has been made on RF on fibre measurements on COTS broadband transmission lines at the Effelsberg telescope under operating conditions, an RF on fibre system up to 10 GHz bandwidth costing, and a 10 GbE direct link is being built from a FPGA based source to establish boundary conditions, production issues and costs for the digital transmission options. There has also been a first investigation on the projected availability of 100GbE devices in 2015, which has yielded a positive result with the assurance that appropriate components will be available at that time.
- UMAN has been using Merlin/eMerlin to test LO phase transfer over fibre. The system has been in use without problems to the MERLIN Pickmere telescope over a period of several months. In early October 2009 the trial has been extended to allow Darnhall to operate using LO over fibre with Pickmere reverting to the microwave links. The fibre LO at Darnhall has been routed out and back via Pickmere to extend the distance and to demonstrate a multi hop path. Observations are continuing in order to evaluate the performance of the system but initial indications are that it is operating without problems, including measurement of telescope offsets at 22GHz.
- The tasks within this domain have been rearranged and now involve 4 tasks in total. Details of the revised approach are available in the revised work plan which forms part of this report. The redistribution and precise specification of tasks and deliverables is being finalised.

WP 2.8: Signal processing optimization and prototyping

Objectives

To design and demonstrate the SKA signal processing chain from antenna through to the correlated or time-detected data.

Progress

WP2.8.1: Station digital signal processing

- The DSP domain specialist was the last UMAN(SPDO) member appointed, at T+14, and has been fast tracked into the program in order to align this domain with the progress made in others. Despite this late appointment, significant progress has been made.
- NRF is a key contributor to the CASPER collaboration that is working on large array processor design using an FPGA-based approach. The aim is to continuously track Moore's law in the design paying particular attention to the reduction in power utilization for fixed functionality, which should reduce the telescope running costs. The development of the ROACH II board is underway, which will double the processing capabilities of the first generation technology. The goal is to be ready for production in 18 months, hence demonstrating the key advantage of this approach tracking Moore's law.
- CSIRO(ASKAP) is developing architectures for energy-efficient signal processing and computing. It is implementing FPGA signal processing which is the most energy efficient and cost effective solution for a precursor instrument. In addition CSIRO(ASKAP) has identified signal transport both between modules and within modules as area where savings can be made. CSIRO(ASKAP) will work with the international project office on effective specific non-imaging signal processing.
- The Multi-dimensional Signal Processing Research Groups at the University of Calgary and the University of Victoria are using previous experience in synthesis, design and implementation of analog and digital multidimensional (MD) filters for real-time space-time applications such as array processing for terrestrial wireless applications to study ways in which these new filter methods might be useful in radio astronomy. Specifically they are developing 1) a Hardware-Accelerated Frequency-Domain Focal Field Synthesizer for Paraboloidal Reflectors, 2) 3D Space-Time Digital Pre-Filtering for Dense Phased Arrays, 3) Fractional Delay Multidimensional Space-time Filters, and 4) Infinite Impulse Response (IIR) Real-time 2D/3D Space-time Filtering Methods.
- ASTRON has been involved in the design of the next generation beam former chip, improving upon the current design used by SKADS/EMBRACE, which consumes too much power to be useful in a SKA application.
- OBSPAR(UORL) has been studying a one channel, dual beam RF beamforming chip. Results from this study have led to the design of a single channel RF beamformer chip, with the aim of reducing noise interference. An RF interface chip, developed by OBSPAR(UORL) in 2008 and tested in early 2009 has shown that isolation between transmission and reception needs to be improved; studies are continuing. Work is also being carried out on a fast Analog to Digital Converter chip. A first version was fabricated and tested early in 2009 which confirmed the theory. The next version will be sent to the Foundry in November 2009 and tested in 2010.
- The UOXF DSP group has been in discussions with a consortium of UK ASIC design houses plus a major Far Eastern silicon foundry to facilitate the design process for a DSP ASIC for aperture arrays, once PrepSKA UK funding becomes available. A UK company has applied to the UK Technology Strategy Board for a grant to support a design study on such a chip for SKA.
- UOXF has commissioned a design study from a leading UK technology company on integrating the analogue RF chain for mid frequency aperture arrays in to a small

analogue ASIC chip set, in preparation for aperture array verification work within PrepSKA.

WP2.8.2: Correlator

The Correlator is being considered as two distinct areas, viz:

1) Software Correlator for Phase 1. Korean and Indian colleagues have expressed interest in this area and have forwarded preliminary design parameters for initial benchmarking to the UMAN(SPDO) for review.

2) Initial discussions with CSIRO(ASKAP), NRAO, JIVE, UMAN, and UOXF have resulted in an agreement on the top level architecture concept for the Correlator for both Phases 1 and 2 of the SKA

WP2.8.3: Radio frequency interference mitigation

- It is intended to take a system level approach to RFI Mitigation with measures taken in all the areas of Signal Processing. OBSPAR and UORL are the joint lead institution for RFI mitigation, together with ASTRON, and have reported significant progress on this aspect as a result of their RFI mitigation studies for Pulsars and LOFAR. These are based on simulations with synthetic and real data, with the aim of designing real time filtering algorithms to deal with RFI corrupted radio astronomy observations. The MPG, CSIRO(ASKAP) and the UCAL will also be involved in this arena.
- INAF are investigating different adaptive beamforming algorithms that point zero (es) of the beam pattern in the direction of the interferer(s). Further studies in this field are going ahead for PrepSKA at IRA, especially for the more promising algorithm as the Minimum Variance Distortionless Response (MVDR). The future plan is to implement such an algorithm on the AA-lo as soon as a subsystem composed by a certain number of antennas will be available (the plan is within T+32).

WP2.8.4: Non-imaging processors

- OBSPAR and UORL have reported progress in the studies of RFI mitigation for pulsars, which improves the quality of astronomical observations that are mitigated by interference from spurious RF signals. The studies are based on the use of synthetic and real data. An implementation will be proposed on the pulsar instrumentation based on the Graphical Processing Units (GPU) designed at the Nancay Radio Astronomy station.
- The MPG digital group has developed a special version of their Pulsar Fast Fourier Transform Spectrometer (PFFTS) board enhanced with a dual□input 8□bit ADC and an additional Gigabit Ethernet interface. In addition, a novel Pulsar FPGA core has been developed which allows processing up to 750 MHz bandwidth in two polarisations, building the power spectrum, adding both polarisations, integrating the spectra over time and finally dumping the frequency channels out to a PC via Gigabit Ethernet. The latest core version allows decomposing the input signal into 512 spectral channels and transferring the data every 32 micro□seconds to a PC cluster for further signal analysis. The board has a more efficient pre-processing algorithm with significantly reduced frequency scallop loss, less noise bandwidth expansion, and faster sidelobe fall-off. Tests at Effelsberg have produced positive results in the 100MHz bandwidth and the infrastructure is being extended to cope with the amount of data being collected by the PFFTS backend.

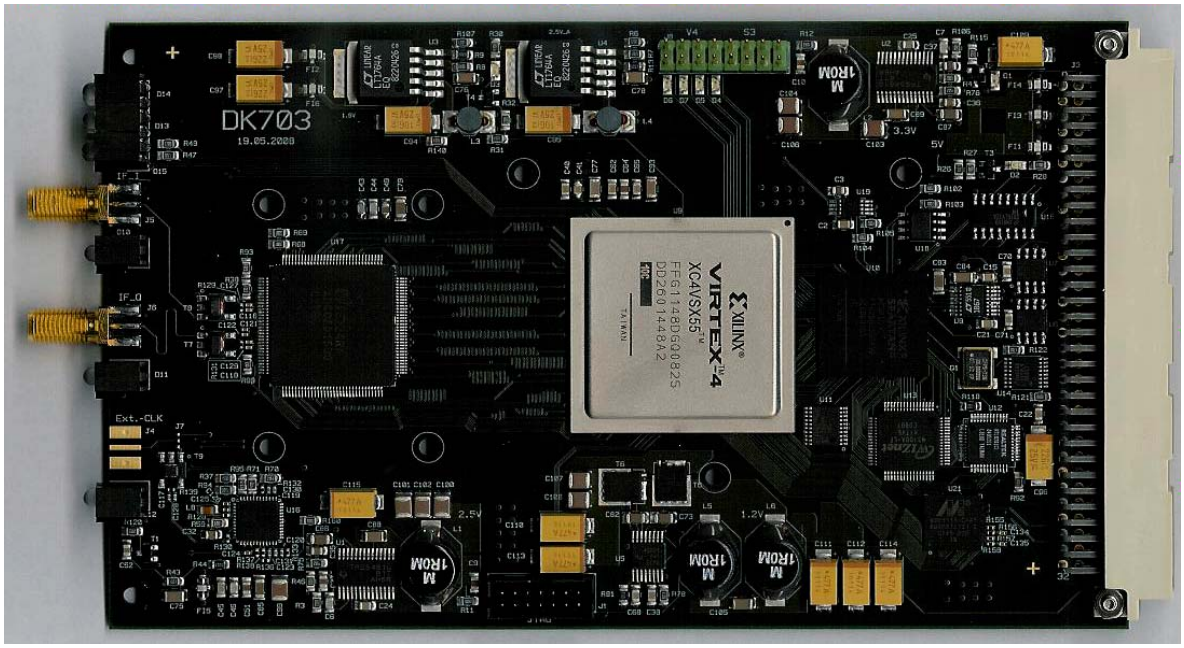


Figure 5: Dual input Pulsar Fast Fourier Transform Spectrometer (PFFTS) Board (MPG)

WP 2.9 Software/computing specification and prototyping

Objectives

To formulate and demonstrate strategies for the implementation of SKA computing hardware and software, data management solutions, calibration techniques and science application software.

WP2.9.1: computing and software specification

- This task focuses on the key requirements of the software and computing subsystems to be reflected in the SKA and Phase 1 system designs. Initial work on extracting non-functional performance requirements from the Design Reference Mission (DRM) has been carried out. Project documentation for several contemporary significant scale projects developing software and computing systems for radio astronomy has been reviewed and summarised to inform top down software and computing architecture development.

WP2.9.2: computing hardware

- This task investigates hardware options – with a focus on Commercially Off The Shelf (COTS) solutions – for SKA computing. The non-functional performance requirements identified from the DRM together with the reported performance of current best-in-class algorithms for calibration and imaging indicate a processing requirement of order 1 Exaflop. Current computational performance efficiencies of the world's largest and most efficient general purpose High Performance Computers (HPC) fall well short – by at least two orders of magnitude – of delivering this level of required throughput at reasonable (in the order of 10MW) power consumption. Commercially available High Performance Reconfigurable Computing (HPRC) architectures are being examined as potential candidates to meet the computation needs of SKA data processing for both imaging and non-imaging applications.

WP2.9.3: software engineering

- This task establishes software engineering methods and tools and develops the high level software architecture for the SKA, focusing on use of industry best practices and reuse of existing codes and COTS solutions. The scale of the required effort in software development has been exemplified by reference to the size of existing codes developed and refined over 30 years for calibration and imaging in radio astronomy: order of 1 million Source Lines of Code (SLOC). Using publically available benchmark data, this translates into order of 1,000 person years of effort for a fully integrated and documented solution set. This implies the need to coordinate the collaborative activities of several groups of development activity – most likely distributed across the globe in geographies, time zones and cultures. Further work is underway to disaggregate the problem space into a more detailed Work Breakdown Structure (WBS) amenable to global software development and industrial partnership.
- ASTRON is leading this sub-task and has accumulated a set of best practices for SKA software based on lessons learnt from LOFAR. They have also developed an outline of the software architecture for the SKA.

WP2.9.4: data products and virtual observatory

- This task establishes the strategies for the delivery of SKA and SKA Phase 1 data products to the astronomer, and for the management of the massive data sets produced and it is led by UCAM working with RUG, the International Centre for Radio Astronomy Research (ICRAR), and UCAL. Operations of similar scale activity at CERN have been investigated which are informing planning of this work.
- RUG has made progress on handling of large amounts of data – which potentially can be scaled to SKA requirements. The long term archive for LOFAR developed by RUG serves as a good model for the SKA and includes
    1. Distributed data storage on independent data storage nodes (basically one storage node per one group participating in the project)
    2. Distributed data processing on independent processing nodes managed by participants
    3. Distributed metadata storage which implements the common data model (the data model will be created by collaboration of all participants), the data model describes all data produced by the project from the raw data till the science ready data product and can be adjusted during the data processing
    4. Distributed development of the data processing software (pipelines) based on the common data model and common approach to the software development
    5. Centralized quality control
    6. Common data interfaces for an access to the data for participants of the project
    7. Common Virtual Observatory-based data interfaces for an access to the end product data for external users.
- UCAL has been granted funding to start in October 2009 to support the design and development of SKA cyber-infrastructure to address the need for a global and national cyber-infrastructure for SKA key science. There are three basic tasks to be accomplished 1) Development of a managed cyber-space for Canadian SKA key survey science, 2) Development of software and infrastructure for specialized data processing of SKA raw data streams within a distributed international development network, and 3) Interactive, Dynamic data mining.

WP2.9.5: calibration

- This task establishes the overall calibration strategy for creating images from SKA data, and it develops the architecture and algorithms for the SKA calibration system. Contemporary developments in algorithms to address the challenges of SKA-type data reduction have been reported and published in various forums including CALIM 2009 held at NRAO's facilities, Socorro March 30 – April 3 2009.
- CSIRO (ASKAP) staff led international calibration and imaging activities and is actively studying architectures and algorithms to yield sample astronomical fields. They are developing pipelines for automated processing of radio synthesis data on high performance computing systems, and are also working on the theory and practice of calibration and imaging for synthesis telescopes with phased array feeds. They are using SKADS-generated model skies for testing imaging performance in various ways, including structural and flux density accuracy.
- UCAL is working on calibration and imaging issues related to wide-field polarimetric imaging with focal-plane array systems, with emphasis on developing the techniques required for deep, high-dynamic-range imaging of polarized emission with the SKA. This includes 1) Imaging Exploration of the Deep polarized Sky, 2) Simulations of the deep sky to sub-microJy levels in full polarization, and 3) Algorithms and Software for wide-field imaging from the PAF-based u − v data. Good progress has been made in all these areas.

WP2.9.6: science post-processing

- This task addresses the final processing required for imaging and non-imaging observations. Imaging algorithms are closely associated with algorithms being developed for calibration, and activities for this task are reported for WP2.9.5 above.
- Algorithms for non-imaging applications such as search for and analysis of pulsar and transient signals are being developed by various groups including ASTRON and UCAM.
- UCAL is focussing work in this area on polarimetric imaging science and has contributed a chapter on this subject to the Design Reference Mission. Algorithms and techniques are being developed through a combination of simulations and SKA path finding observing programs. Two specific programs are polarisation stacking and the processing of large area spectro-polarimetric surveys. Developments achieved to this point include: 1) Infrastructure for computation and storage of massive survey data set has been set up; a multi-core compute cluster with fast optical fibre link to a storage area network of several hundred Terabytes. 2) A software processing pipeline for calibration and imaging from focal-plane feed array observations.

WP 2.10 Design study management:

Objectives

This project will provide support for the WP2 engineering study in terms of project planning, reporting, and financial and related interactions between UMAN(SPDO) and regional SKA programs.

Progress

- Monthly general and technical meetings have been established from which minutes and action item lists are derived and managed. Based on the Documentation Handling and Management Guidelines adopted by the UMAN(SPDO), a shared repository has been set up for document storage and control. Monthly reports are submitted to the PrepSKA coordinating group. All scheduled reports, such as the report to the IEAC in April 2009, are submitted after managed reviews within the UMAN(SPDO). An event calendar has been set up and is managed. Finances and interaction with the host organisation, UMAN, are administered by the Executive Officer. Extensive work on the revision of the work plan has been undertaken and a revised plan will form part of this report. This plan will continue to be managed according to internationally accepted Project Management practices. Scheduled teleconferences are held within every domain, and transcripts are kept in the document repository.
- Regular coordination meetings are held with the SSEC and UMAN(SPDO) management.
- Interaction between WP2 and WP3 is enhanced with monthly week long visits to UMAN(SPDO) by the Site Engineer. Interaction between the Science Working Group and UMAN(SPDO) is facilitated through scheduled teleconferences and planned visits to UMAN(SPDO) by the Project Scientist.
- The adoption of the system engineering management approach, with the System Engineering Management Plan providing the basis upon which plans have been developed, has led to a revision of the WP2 tasks. The revised work plan forms part of this report. This has resulted in a new project management plan being implemented and managed.(Revised Gantt chart appended) The revised plan is sufficiently detailed in every domain within WP2 to allow for each to run as an individual project contributing in a managed format to the program as a whole.
- Global engineering communications, through the establishment of design work groups, and scheduled teleconferences has proven to be a cost effective and efficient means of getting required input from the geographically dispersed contributors within all domains. Additional means of communications and information dissemination are the SKA WIKI and SKA website, which are updated on a regular basis. All major conferences and meetings are attended by relevant members of the UMAN(SPDO) to ensure communication between all stakeholders remains current.
- Recommendations from the IEAC report, which include the endorsement of the Revised Work Plan, have been taken note of and are being introduced to the UMAN(SPDO) WP2 operations. A response to the IEAC report is being drafted and reviewed and is planned for submission to the SSEC

APPENDICES.

NOTE: All Appendices to this report are available by following this link:
http://webmail.jb.man.ac.uk/PrepSKAwiki/EcReportAppendicesDocuments
Or these URLs
http://www.skatelescope.org/~adams/Design_Reference_Mission.pdf
http://www.skatelescope.org/~adams/Guiding_Principles.pdf
http://www.skatelescope.org/~adams/SKASEMP.pdf
http://www.skatelescope.org/~adams/RiskManPlan.pdf
http://www.skatelescope.org/~adams/RiskRegister.pdf
http://www.skatelescope.org/~adams/SPDODocManStructure.pdf
http://www.skatelescope.org/~adams/DocMgtPlan.pdf

Work Package 3 (Further site characterisation) progress report

WP Leader: Rob Millenaar (SPDO Site Engineer, chair SCWG)

Introduction

Work Package 3 of PrepSKA deals with studies for characterising various elements of the environment at the two shortlisted candidate sites for hosting the SKA: Southern Africa and Australia. Leading the effort is the SPDO Site Engineer, who took on the work starting on September 1, 2008.

A summary of the WP3 sub-workpackages:

- WP3.1 Investigate the RFI environment by carrying out deep integrations at the central site and selected remote sites.
  Measure the radio frequency spectrum from 70 MHz up to 2 GHz, down to as close to the ITU-specified levels as possible, using measurement specifications as laid down in the:
  - Protocol document,

  with hardware constructed according to the:
  - Instrumentation Plan document,

  and to carry out measurements at both sites simultaneously in the way as specified in the:
  - Measurement Plan document.

  The work package identifies 3 phases:
  - Design and construction of:
    - Digital spectrometer (CSIRO)
    - RF electronics and system integration (NRF)
    - Software development for data processing and reporting (ASTRON)
  - Measurement campaign at the central sites and selected remote sites
  - Reporting of the measured results.

- WP3.2 Make preparations for the establishment of a Radio Quiet Zone (RQZ) for the central region of the array.
  The two sites are pursuing the establishment of RQZs individually. They will keep the SPDO informed of the expected end result and progress in its achievement. The SCWG[5] Regulatory Affairs Task Force will provide comments on the individual RQZ processes when requested. The SCWG Task Force will participate in international efforts to have the RQZ issue brought to the attention of the International Telecommunications Union with the aim of obtaining an ITU Recommendation on the longer term. Protection for remote array-stations will also be considered and assessed.

- WP3.3 Carry out detailed studies of ionospheric fluctuations pertaining to the two sites.
  Obtain models of the scintillation index, S4, as a function of elevation, azimuth, time of day, and solar cycle at the central and selected remote sites to better characterise the ionosphere. Acquire detailed statistics on the size, velocity and occurrence of Travelling Ionospheric Disturbances (TIDs) for solar maximum and minimum.

- WP3.4 Carry out studies of the effects of tropospheric turbulence on high frequency observations.

[5] The Site Characterisation Working Group (SCWG) replaced the SEWG (Site Evaluation Working Group) mentioned in the original PrepSKA Work Plan.

Study the high-frequency limits of phase-referencing and self-calibration, and determine the implications for the SKA design.

- WP3.5 Optimize the array configuration.
  Study the ideal configurations for the SKA for the different Key Science Projects and determine the single configuration that optimises the total return from the Key Science Projects. Match the "ideal" configuration to the geographical realities of the two short-listed sites in order to determine the optimum configuration for each site. This task will draw on the work done in SKADS DS2T2 to provide the primary information on the ideal configuration.

- WP3.6 Determine the influence of the site physical characteristics on the telescope design, operations, and costs.
  The characteristics of the sites (e.g. ambient temperature, wind levels, level of RFI) are likely to have an influence on the telescope design. Information from the Precursor telescopes and from the European SKADS DS3T1 and US TDP studies will be gathered to address this issue and its potential influence on the costs.

- WP3.7 Investigate infrastructure deployment costs and timescales, operational models.
  1) Deployment costs based on uniform designs and standards: develop uniform designs and standards for estimating the costs of the infrastructure and its decommissioning.
  2. Timescales for the deployment of the telescope infrastructure: refine current estimates of the timescale for infrastructure deployment for each of the sites specifically, in consultation with the sites.
  3. Operational models: develop the "ideal" operational model for the SKA which can then be applied to the two sites individually and adapted to the local realities, liaising with WP2.1.3, WP 2.1.4 and WP2.1.5. Provide draft operations agreements for remote stations in other countries, where appropriate.

- WP3.8 Sustainability of the science environment in the face of potential RFI threats.
  Acquire additional demographic studies of the regions surrounding the central array and the remote stations to refine estimates of the future RFI threat. Analyse the potential consequences of any mining or other development interests near the central sites.

This report gives an overview of the activities within WP3 that have started up after 1 April 2008 and the state of affairs 18 months later, 1 October 2009.

Activities

Besides the dedicated activities for the eight sub work packages, activities of a more general nature were undertaken. These are summarised in the following sections.

The Site Characterisation Working Group

To assist the SPDO Site Engineer a Site Characterisation Working Group was assembled, with representatives from site proponents and other Working Groups that have an interest in site related matters or that could provide required information to WP3. Within the SCWG a number of dedicated Task Forces have been set up to address specific matters. The SCWG has held a number of teleconferences and a face-to-face meeting.

The Task Forces

The following Task Forces were set up:

- Radio Frequency Interference measurements, dealing with WP3.1.
- Radio Quiet Zones and Spectrum Management, dealing with WP3.2.
- Tropospheric Stability measurements, dealing with WP3.4.
- Configurations Design, dealing with WP3.5.

Working visits, meetings and conferences

The Site Engineer has paid visits to both host organisations for the candidate sites to discuss all aspects of site characterisation. Meetings were organised to kick off and coordinate the work on RFI measurements and Configurations Design. The Calibration and Imaging workshop in Socorro was attended and a presentation on configurations design given.

Wiki

On the SPDO Wiki, pages have been set up for WP3. Per sub-package, sections contain information, documents and tools on that particular Work Package. The aim of the Wiki is to disseminate information and promote cooperation as much as is possible.

Site information collection

The SPDO requests and collects information regarding the candidate sites for the SKA, both from South African and Australian hosts. The site engineer has visited both countries and has established the necessary contacts for that purpose.

Australia, CSIRO:
Site access is being finalised, with the conclusion of the Indigenous Land Use Agreement, which is within the Notification period with the National Native Title Tribunal. First site works are expected in November to accommodate the delivery of the first ASKAP antenna in December. Early science activity continuing apace, with MWA finalizing the 32-tile installation.

South Africa, NRF:
Site establishment is nearing completion, with 85km access road to site upgraded, 14,000 hectares of land purchased by SKA South Africa, and the design completed of a 33kV RF-quiet power line, to be constructed to site by end 2009. Optic fibre will be installed at the same time, with connection to the main POP site in Carnarvon. An on-site facility has been constructed, including accommodation, office space, and dish construction shed. Civil works for KAT-7 is nearing completion, with trenching and reticulation to still be completed by end 2009. The first two dishes have been installed at KAT-7 site, with the remaining 5 to be installed by the end of 2009. The off-site support base, 10km outside of Carnarvon, was refurbished to include 3 houses, workshop, office and laboratory space.

For the establishment of the Radio Quiet Zone at the site, the promulgation of the Astronomy Geographic Advantage Act (Act No. 21 of 2007) into law. Design of an optimised low powered broadcasting network for the Northern Cape Province, to be published as part of the new Terrestrial Broadcasting Frequency Plan of South Africa. Development of regulations with all operators of radio communication infrastructure in the area of the Northern Cape Province has taken place and

been finalised. Development of optimised network solutions for critical telecommunication service delivery that is not to the detriment of operating radio astronomy facilities.

The sub-work packages

WP3.1 Investigate the RFI environment by carrying out deep integrations at the central site and selected remote sites

The work started with writing the sections on a measurement protocol, a measurement and instrumentation plan, which were part of an agreement amongst partners to cooperate, design and build instrumentation and software, and subsequently to operate two systems in order to collect RFI data at the two proposed core sites, plus a selection of remote sites. The design was done, both for the RF part and for the digital spectrometer part. The RF part is now nearly ready and the digital part needs some extra months to be completed. It is expected that the integration and testing of the systems can take place by the end of 2009. The measurements will then commence at both sites in the beginning of 2010. By the end of 2010 the data should be in and reporting of the results undertaken.

Originally it was intended that much of the measurements would be done in 2009, but because of quite severe delays in the delivery of critical parts of the digital system, this had to be postponed. The current schedule still allows us to reach our goals in time.

The partners and their responsibilities so far:
ASTRON, The Netherlands – measurement protocol, data processing software, reporting software
CSIRO, Australia – digital spectrometers, anti aliasing filters
NRF, South Africa – RF system, trailers, system integration and testing
SPDO, UK – project management, reporting

Australia, CSIRO:
Construct hardware for the RFI monitoring equipment, and carry out the deployment and execution of the measurements at the core and remote sites, consistent with the 2008 MoA on RFI and any subsequent agreed modifications.

A digitizer has been designed and manufactured, and a ROACH board has been acquired. The hardware for the prototype is currently being tested. The firmware is also being developed and tested.

South Africa, NRF:
Refurbishment and complete overhaul of 2 self-contained trailers, including supporting infrastructure (generators, air-conditioners, trailers etc.). Design, construction and testing of 2 new RF frontends to cover the band 70 MHz to 2 GHz. Reconstruction of two cabinets with control and computer equipment, including shielding. Redesign of software control was done.

WP3.2 Make preparations for the establishment of a Radio Quiet Zone (RQZ) for the central region of the array

France, OPAR:
In support of the development of national legislation regarding the regulatory protection of radio astronomical observations from the two candidate SKA sites, in Australia and in South Africa, astronomers involved in representing the requirements of the worldwide radio astronomical community in matters of spectrum management at the International Telecommunication Union

(ITU) in Geneva, have been working towards an ITU-R Report on "Characteristics of Radio Quiet Zones", and ultimately an ITU-R Recommendation on regulatory aspects of Radio Quiet Zones. These activities are coordinated by IUCAF, the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Sciences, with the active participation of the national spectrum management Administrations of, e.g., Australia and South Africa. IUCAF is inter-disciplinary committee of ICSU, and sponsored by COSPAR, the IAU and URSI. IUCAF is a Sector Member of the ITU. The past IUCAF chair, Wim van Driel, is also chair of the Task Force on Regulatory Matters of the SCWG.

First, Question ITU-R 242/7 on Radio Quiet Zones was introduced at and adopted by the ITU, which opened the way towards drafting ITU-R Reports or Recommendations. At present, a dozen input documents on existing Radio Quiet Zones and the requirements for future Radio Quiet Zones have been submitted to Working Party 7D (radio astronomy) of the ITU, the leading ITU forum in this matter. An ITU Correspondence Group has been established which can continue work towards the ITU-R Report between meetings of Working Party 7D, which are held once every 9 months on average. The correspondence group is led by the past IUCAF chair. The regulatory requirements of the SKA Radio Quiet Zone form the benchmark for the activities within the ITU.

WP3.3 Carry out detailed studies of ionospheric fluctuations pertaining to the two sites

A report on ionospheric scintillation was commissioned from an external consultant. This expert has much experience in investigating this phenomenon and had done a report for the first round of short listing candidate sites for the SKA. The consultant completed the Ionospheric Scintillation Investigation Reports (ISIR) for the core areas of the two site proponents. From the reports it becomes clear that the two sites are the best sites on the southern hemisphere we can wish for, as far as the ionosphere is concerned.

An additional report was requested from South Africa, to assess the influence, if any, of the South Atlantic Anomaly of the ionosphere. This phenomenon was flagged as an unknown factor in the site bid report of South Africa (2005). The requested report is intended as a follow-up to that concern. The investigation was commissioned from the South African Hermanus Observatory, who are well equipped to perform such an investigation. At the time of this mid-term PrepSKA report the investigations have been carried out, and the report is being written. After receipt of the report by the SPDO, it will be sent to an independent consultant for review. A final report on the aspect of ionospheric scintillation will be written by the Site Engineer.

WP3.4 Carry out studies of the effects of tropospheric turbulence on high frequency observations

Besides the study of the climate conditions at the core and remote station locations in the two host candidates – information that can be retrieved from the 2005 site bids and through additional local information – the possibilities for performing atmospheric stability measurements by means of a phase stability interferometer are being investigated. Discussions with prospective partners are underway, but no decisions have been taken at this point in time.

WP3.5 Optimize the array configuration

A major design effort is underway towards what can be seen as the optimum configuration to facilitate the science that the SKA aims to serve. The Key Science Projects are taken as the basis for this, and the Science Working Group is working on a Design Reference Mission (DRM) that address the system requirements for several science components. Together with the provisional specifications in SKA Memo 100, these documents form the basis for establishing what the configuration should look like.

A special meeting was held in March 2009 to kick off the work of the Configurations Task Force, with members from South Africa (providing the software tool), the University of Cambridge (doing the majority of the design and analysis work) and the SPDO (the Site Engineer organising and coordinating the work). A subsequent meeting was held where agreement was sought and found amongst the two site proponents and the SPDO on the methods, participation and timescales of the design work and deliverables.

In the Summer of 2009 a first report was produced detailing the results of analysis testing the sensitivity of a set of configuration figures-of-merit to changes in array layouts. The purpose of this initial study is to find empirically the degrees of freedom that exist in placing antennas and stations, such that good scientific properties are obtained, while keeping the cost of the infrastructure within bounds. In the second half of 2009 the configurations will be designed with the practical realism per host included. This is done via geographic and RFI masks that are specified by the SPDO in cooperation with the site proponents and delivered by the latter. The last phase in the design process is agreed to be done by the CTF at the host institute of each candidate site at the end of 2009.

UK, University of Cambridge:
Work was done on improving and running the TrenchCOAT optimisation tool. This concerns speed optimisations and migrating the code to main servers for batch processing. The output was analysed for all different trial layouts.

Work was done on developing and running code to assess the uv-gap and psfrms figures of merit for various configurations, including extending the algorithms to cope with full length synthesis scans on arrays of order 2000 collectors.

Work was done on generating the layouts, analysing and presenting the results.

Australia, CSIRO:
Provide appropriate input to the configuration development process including information on RFI, transmitters, geotechnical, geological, infrastructure cost, etc. CSIRO has provided robust and rigorous reports on EMI buffer zones, is working on transmitter/receiver saturation issue, and has worked with SPDO and RSA to put together workplan for site characterisation activity.

South Africa, NRF:
South Africa is responding and providing input on a range of issues to do with the site optimisation process, including response on EMI issues and various geophysical mask constraints. South Africa is busy updating its GIS database with all relevant information that could be required for the generation of masks, including relevant information from its African partner countries.

WP3.6 Determine the influence of the site physical characteristics on the telescope design, operations, and costs
During WP3, the collection and reporting of physical characteristics will be an ongoing activity. Up to this point in time a report on climate conditions at the two sites has been written. Additional information is being collected and will be included in upcoming versions of the document.

Australia, CSIRO:
Provision of data on site properties for the core area and for the remote stations, to be used in the WP2 work on system design.

A CSIRO team is updating earlier GIS maps and providing new data where appropriate. Along with the international project office, the team is working on defining criteria for the site masks. Aurecon has been contracted to work with the team to produce GIS site masks based on all criteria.

South Africa, NRF:
South Africa has responded to all requests from the SPDO, and is busy working on updated infrastructure costing through its various consultants, including Aurecon. South Africa is busy updating its GIS database with relevant information that will inform design, construction and operational costs.

South Africa is researching renewable energy power solutions through its various consultants and research groups to complement grid power.

WP3.7 Investigate infrastructure deployment costs and timescales, operational models
When the final configurations for both sites have been designed and endorsed by the SSEC, the cost to deploy and operate the infrastructure will be investigated by an external consultant. This is planned to take place in 2010. Preparations for engaging an independent consultant are being made.

WP3.8 Sustainability of the science environment in the face of potential RFI threats
An external consultant will be engaged to examine the future sustainability of the radio quietness in both candidate sites. Preparations for engaging the consultant are being made.

Status of deliverables

The WP3 deliverables are summarized in the table below, in order of delivery date. The delivery date was originally based on the starting date of 1 April 2008. The table shows that some of these deliverables have not been completed according to the original schedule. The reasons are that workforce resources were not made available on the originally planned schedule, including the site engineer who began work at T+5 months. This affected deliverables WP3.1 and 3.4. Delays in delivery of critical sub-units for the RFI equipment delayed deliverable WP3.2. The scope of deliverable WP3.3 has changed and that is still in progress. The dates given in the last two columns reflect the original and the revised due dates.

Work Package 4 (Governance & Legal Framework) progress report

WP Leader: Patricia Vogel (NWO)

WP4 – REPORT

This Activity Report 2008/2009 is an update of the previous reports which have been discussed and approved by the PrepSKA Board in its meetings.

Description of work

The activities of WP4 have had some delay with starting up because the WP4 staff was not (fully) available from the very beginning of the project. It took some time to hire the qualified staff needed to support the activities of WP4. The WP4-team managed to organize the activities and supporting activities listed in this report, stick to the schedule as described in the WP4 workplan* that was approved by the PrepSKA Board in April 2008 (Perth).

WP4 started in April 2008. The first part-time policy officer started at the end of May and the team was complete by November 2008. The team collected many background documents relevant for developing SKA governance, established contacts with and collected input from the SKA project via the SPDO-director, national and international organizations and the EC-office (DG Research). Most of the background documents are available on the PrepSKA Wiki. This activity contributes to the objective of making available a knowledge base on Governance for the SKA.

Soon after the beginning of the project the first activities of the WP4-team were started: the organization and preparation of the meetings and telecons with the Core Group WP4. and also the organization of the 1st PrepSKA WP4-Workshop on Governance Models that took place on 19 November 2008 in Washington DC. Almost all the Core Group WP4 members and invited experts also from the broader Working Group WP4 participated in the Workshop. NSF accomodated the workshop. We succeeded in inviting 4 interesting external speakers, presenting the governance models of international RIs and their experiences with these projects and organizations.*

This successful workshop provided important input for the WP4 work. During the period December 2008 – February 2009 the team carried on with the results and lessons learned and prepared further discussion and meetings with the Core Group. Based on the conclusions of the Workshop and presented lessons learned, WP4 was able to prepare a short list of the legal models and existing RIs that seems to be most relevant to explore more in depth when developing the options for SKA Governance.*

In addition to the PrepSKA assignment WP4 took up an active role providing input for the Agencies SKA Group (ASG) on governance issues.

The WP4 team prepared input for the Agencies SKA Group (ASG) governance discussion about the process towards a SKA Implementation Agreement. We foresee that this will be more intense in the coming period, as it was agreed in the ASG meeting in July 2009 in The Hague that the WP4 team will lead a “tiger team” that will advise on a skeleton for a joint SKA implementation agreement to be discussed in the October 2009 meeting of the ASG.

Another activity of WP4 is to exchange experience with other PPs (Preparatory Phase Projects supported by the EC). WP4 participates in the ESFRI- workshops for PPs and the working group of distributed Infrastructures. WP4 has established contacts with existing RIs on governance and legal matters, for example ITER, ESRF, CERN, ESO and with the OECD Global Science Forum that is

starting up an action on best practice governance of international science projects. We provided input in the start up phase of this action, SKA is planned to be one of the cases to look at in this GSF-activity. Through this active approach we are establishing a knowledge base and a network of experienced specialists that are useful in the process of defining the options for a SKA governance that could also be useful for other (global) projects.

Approach

In the first part of 2009 the WP4 work focused on narrowing down the options for legal frameworks and organizations from the gathered information compiled in the previous period and the discussions within the Core Group WP4 and the other PrepSKA and Agencies meetings. We have delivered a comparison of best practices in governance and legal framework *(Deliverable 1.)* of multinational research facilities. The findings were discussed in February and July in the WP4 Core Group meetings. The written report of this deliverable will be finalised and discussed with the WP4 Core Group in autumn 2009.

The WP4 approach consisted of a SWOT-analysis of legal frameworks for international projects and the comparison of the characteristics of SKA with existing facilities: similarities and differences. The next step will be to focus on the potential risks and constraints of the legal frameworks that seem of interest for the SKA.

In order to implement our approach we had a number of meetings and visits to international Research Infrastructure projects/organizations, with the purpose of gathering first-hand information on how things work in practice at different facilities and to gather information from experts on legal issues and possible solutions for constructing and running large facilities in order to further define the requirements for a sound SKA governance.

In the WP4 Core Group meeting of 26 February 2009 in Cape Town the preliminary conclusions of the Washington Workshop on Governance were presented and discussed. The main conclusion from this meeting in Cape Town was that WP4 should focus on the first deliverable, especially on the legal framework. In the WP4 Core Group meeting of 8 July 2009 in The Hague the results of the governance survey (legal models) and the first results and a proposal for a shortlist of existing facilities to be used as model for SKA were presented.

It was advised to provide a 'straw man' governance document – based on the insights up till now. We will distribute a first draft straw man model in November 2009 and schedule a telecon with the Core Group to discuss this. We do expect that launching a straw man document will fuel the discussion and will clarify the risks for a treaty-based and a non-treaty-based SKA-organisation.

As said above, in order to implement our approach we had a number of meetings with experts and visits to existing international facilities. It was useful to learn from experiences from other projects and facilities, but at the same time it makes us realise that SKA is a unique project, that there are no existing facilities whose structure we can adopt. SKA is still developing as a project, the results of the other Work Packages WP2 and WP3 as well as the work in the other policy WPs will have an impact on the governance issues. Therefore also the cooperation and meetings with the other WPs in PrepSKA and the integration of our findings were and will be important for the WP4 work in the rest of the project period.

Overview of Meetings and activities WP4

In chronological order, WP4 initiated or participated in the following activities and meetings. For most of the meetings and visits the agendas, notes and papers or reports are available on the PrepSKA Wiki page.

- PrepSKA kick off meetings in Perth, 10-11 April 2008:
  - WP4 Working Group; presentation of the draft WP4 Work Plan and initial plan for the first 19 months. [URL..]
  - PrepSKA Board; approval of the WP4 Work Plan by the PrepSKA Board.[URL..]

- Coordination Group meeting (Telecon), end of April 2008.[URL..]

- Coordination Group meeting, May 2008, Manchester.[URL..]

- Core Group, telecon, 25 June 2008.[URL..] In this meeting the WP4 Core Group discussed the more detailed Work Plan objectives for the first 19 months and agreed on a schedule for WP4 meetings in 2008/2009.
  The WP4 team provided a Status Report on WP4 objective 1 (Inventory of the specific characteristics and identification of constraints on SKA) and WP4 objective 2 (Inventory of available governance models). The Core Group advised to proceed in parallel with both objectives and agreed on the WP4 proposal to organize a Workshop with presentations on Governance Models of existing international research facilities. This Workshop took place on 19 November 2008 in Washington DC.

- Visit of PrepSKA coordinator to DG-Research, Brussels, August 2008.

- Coordination Group, telecon, September 2008.[URL..]

- WP4 coordinator attended the Information Day for preparatory ESFRI-projects, organized by the EC, September 2008.

- Policy Survey WP4-WP6, September/October 2008. WP4 team provided input to the WP6 team for drafting the Policy Survey to collect information from Funding Agencies involved in PrepSKA, also covering Governance related issues.

- Core Group, telecon, 10 October 2008. [URL..]

- Informal visit NSF, legal department, 18 November 2008, Washington DC, USA.

- WP4 1st Workshop on Governance models, 19 November 2009, Washington DC, USA.[URL..]
  The overall aim of this Workshop was to see what the pro's and con's of existing governance models of large international research facilities are and to further define the requirements for developing feasible governance models for SKA. For this Workshop all members of the Working Group and Core Group WP4 were invited. The Workshop consisted of presentations by invited speakers for ESRF, the ALMA-project, ESO and the Gemini Observatory, followed by a panel and a final discussion. In the WP4-team reported on the progress of the work for developing SKA governance and give an introduction to the legal frameworks available for Research facilities.

- In January/February 2009 the WP4-team provided input to STFC and NWO for the discussion of the funding agencies with respect to the decision making process in PrepSKA and the ASG by providing an analysis of the current governance. [URL..]

- WP4-team participated in the Legal Workshop – Exchange of Experiences between Preparatory Phase Projects, organized by EC, DG-Research, (6 February 2009, Brussels).

- Coordination Group, meeting (11 February 2009 Heathrow airport, U.K.).

- SKA Forum and PrepSKA meetings, 20 – 27 February 2009, Cape Town, South Africa;
    - Visit to Meerkat site (20-22 February 2009).
    - Informal discussion about SALT (23 February 2009).
    - Attending the SKA forum (25 February 2009).
    - Meetings of the WP4 Core Group (26 February 2009). [URL..]
    - Presentation to the PrepSKA board (27 February 2009). [URL..]

- Visit to ITER-organization (24 March 2009, Cadarache, France). [URL..]

- Participation Legal Workshop – Exchange of Experiences between Preparatory Phase Projects organized by EC, DG-Research (14 May 2009, Brussels).

- Meeting with Stefan Michalowski, OECD Global Science Forum (GSF) (25 May 2009, Brussels). [URL..]

- Coordination group Telecon (17 June 2009).

- Telecon with WP6 (Sherri-Lee Samuels) to exchange information (18 June 2009).

- Meeting with the PrepSKA coordinator Phil Diamond (18 June 2009, The Hague).

- Informal visit to ESO HQ, combined with WP6 (7 July 2009, Garching, Germany). [URL..]

- Informal meeting with K. Kellerman, R. Vermeulen, R. Schilizzi, and P. Diamond, and WP6 team (8 July 2009, The Hague) to learn and discuss about SKA in the operational phase. [URL..]

- Informal discussion about AAT (8 July 2009, The Hague).

- Meeting of the WP4 Core Group (8 July 2009, The Hague). [URL..]

- Informal meeting to learn from CERN (16 July 2009)

- Visit to ESRF (3 September 2009, Grenoble, France). [URL..]

- Informal meeting WP4-5 (10 September 2009, Rome, Italy).

- Coordination Group meeting (11 September 2009, Rome, Italy). [URL..]

Staffing and management of the project

NWO is leading the PrepSKA Work Package 4, Coordinator of WP4 is Patricia Vogel, senior policy manager and coordinator of Institutes of NWO. The WP4 activities are carried out at NWO, with in-kind support from NWO, ASTRON and with external funding from the Dutch Ministry of Education, Culture and Science to support NWO in this project. The staff-time (~ 0,2 fte) for the coordination of PrepSKA WP 4 is part of the in-kind contribution of NWO to PrepSKA. Because of the understaffing in 2008, the in-kind contribution in staff-time by NWO was more than foreseen. The WP4-team is supported by a junior staff assistant, Ms Kirsten Soekhoe since 1 May 2008 (~0,1 fte). This is also an in-kind contribution by NWO to the PrepSKA project.

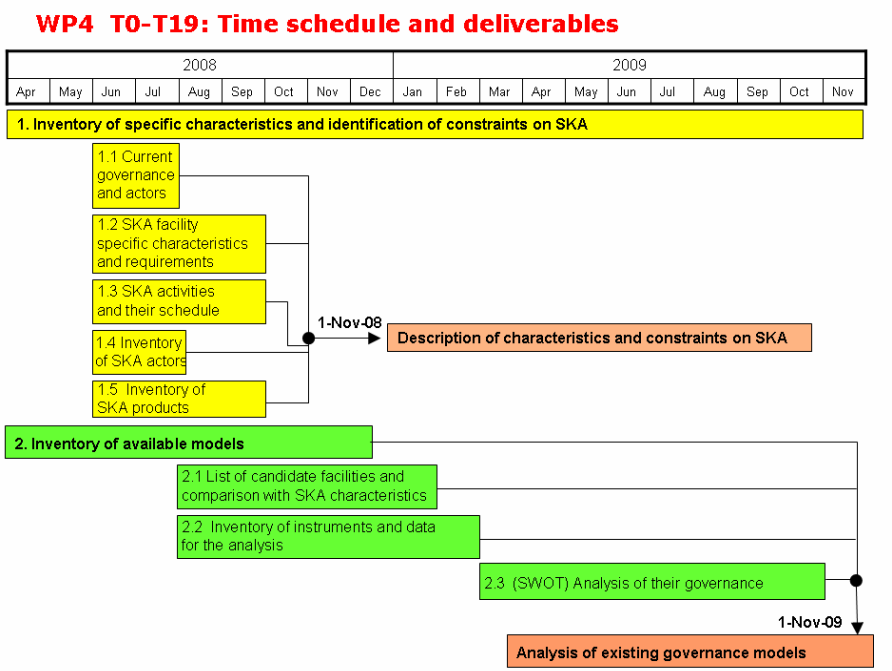
In April 2008 the Coordination Group discussed the PrepSKA Working Group structure and the PrepSKA coordinator did generate a modified proposal for the structure of the project. This included the establishment of the Core Groups for the Policy WP's as a subset of the broader Working Group. The lists with the members of WP4 Core Group [URL..] and WP4 Working Group [URL..] are available on the PrepSKA Wiki.

For the support of the WP4 the EC provides funding for 1 full time staff member at policy level, material costs and a budget for subcontracting. A financial report of WP4-expenses in 2008 was provided to the PrepSKA Board in February 2009 and a Midterm Financial report for the period April 2008 to the end of September 2009 was provided in October 2009 as part of this current report.

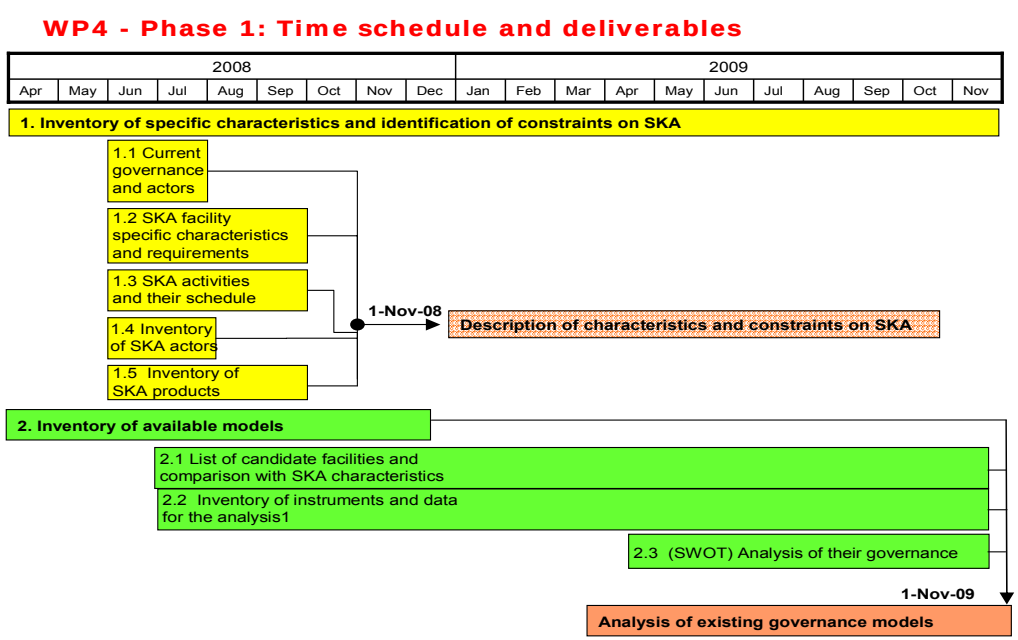
By the end of April 2008 the formal agreement procedure for the funding of the PrepSKA-project allowed NWO to start the procedure for hiring the supporting staff for the WP4-team: Dr. Stefania Usai (internal candidate NWO from the Physics Department) was appointed part-time **(**0,4 fte) as a policy officer, starting in this job at the end of May.

In May 2008 NWO started also the procedure for hiring the senior policy officer with a legal background. We advertised for this vacancy internally and externally and hired Miriam Roelofs LL.M, Dip.EL (NWO-lawyer) in a part-time position (0,7 fte). She started at the 1st November as senior policy officer in the PrepSKA WP4-team.

Time Schedule and Deliverables 25 June 2008



Time Schedule and Deliverables 16 February 2009



The original plan for delivery of deliverable WP4.1 is shown above left, however WP4 experienced that the process of exchanging of information and further insights required extensive interaction with other Work Packages, and so the revised plan is shown on the right. During this process the requirements and constraints of SKA become more clear.

Work Package 5 (Procurement and Industrial Involvement) progress report

WP Leader: Corrado Perna (INAF)

Summary

PrepSKA WP5 is in charge of delivering a set of procurement model options for the construction of the SKA and to define a strategy to involve industry in the whole project development process, starting from the current concept phase up to construction. The work is undertaken under the leadership of INAF, using internal experts as well external consultants. The first deliverable has been submitted to the ASG to obtain the views of the funding agencies, it will then be submitted to the Board for formal approval.

Personnel

The WP5 leader is Corrado Perna, supported by:

- Giulia Antinucci, administrative staff;
- Francesco Corbellini, technical staff with expertise in data storage managment;

and by external consultants, that at the present stage, are:

- Phil Crosby, 2 years consultancy part-time shared with the WP2.
- Riccardo Colangelo, *ad hoc* consultancy for deliverable 5.1.

Progress

Task	Action	Status
5.1	Defining a communication flow with WP2 to gather information such as: list of parts, technical requirements, services and related costs	In progress. Executed by Phil Crosby who acts as WP2 – WP5 liaision officer
	Raw analysis of the procurement during the design phase in other large projects as E-ELT, ALMA etc..;	Done
	General Rules for involving industry in the PrepSKA phase	Done
	First draft report	Done
	Final guidelines	Draft under review by agencies.
5.2	Defining criteria to identify the industrial capabilities related to the SKA Design requirements.;	In progress
	Detailed rules for involving industry in the PrepSKA phase of the project	In progress
	Performing surveys (national/regional based) using the well defined selection criteria;	Delayed
	Creating an on-line database	In progress
5.3 5.4 5.5	Acquisition of documentation about procurement models, mainly from WTO, ESO, CERN, NASA, ESA, ITER, etc… and national/regional tender rules.	In progress
	Comparative SWOT and risk analysis	
5.6	Deliver report	

Communication and reporting

WP5 has communications difficulties due to the high specialization of the WP topics. We experienced that both the use of the PrepSKA wiki (http://webmail.jb.man.ac.uk/PrepSKAwiki), that has been implemented only recently for WP5, the exchange of emails and the teleconferences (experienced once on 2 September 2008) can't fit the communication needs of the WP5. Then it seems that only periodic face 2 face meetings can encourage the participation of the WP members.

Schedule

The deliverable 5.1, expected to be issued by 31 March 2009, was submitted to the Board in draft form in February for its Cape Town meeting. The document has since been revised with the input of Phil Crosby and then submitted to the ASG for feedback. Once comments have been received it will be submitted to the Board for formal approval.

Meanwhile, progress in gathering information for the others deliverables has been made starting from the WP5 Workshop held in Cape Town last February, whose special guest was the Head of the Procurement Office of the CERN, Mr. Ander Unnervik; he provided extremely useful information about the procurement policies used in building a large scale science facility, namely the LHC. The presentations from that workshop can be found on the PrepSKA wiki: [URL..]

Resources

The staff expenditure is in line with the budget originally envisaged and no concerns seem foreseen towards the end of the project. In contrast, travel spending has been greater than originally predicted, so WP5 will review the DoW in order to reasonable increase the travel budget. Note that the budget for external consultancies has been strongly modified due to the appointment of Mr. Crosby, so a review of the possible subcontract expenses is in progress.

Work Package 6 (SKA Funding Model) progress report

WP Leader: Simon Berry (STFC)

Summary

PrepSKA WP6 aims to develop options for the international community on how the SKA might be funded. It will address the construction, operating and ultimate decommissioning of the facility. Work is undertaken under the leadership of STFC, using an expert core group of funding agency and government officials. It is one of three policy workpackages within PrepSKA, and works closely with WP4 (governance) and WP5 (procurement). Progress has been reasonable since kickoff, although initially slow as a result of delayed staff recruitment. The initial phase of information gathering has been largely completed, and the next phase will focus on incorporating these inputs to a developing funding model.

Personnel

WP6 is led by the Science and Technology Facilities Council. Simon Berry (SB) is workpackage leader, supported by policy officer Sherrie-Lee Samuel (SLS) and administrator Simon Haynes (SH). Other STFC contributing to WP6 during the project lifetime have been Tony Medland and Michelle Cooper.

Progress and issues

The programme of work in WP6 has been in several phases:

1 – Work with Core Group and SPDO to understand the scope of the SKA project and schedule issues: This initial work, developed in two initial core group teleconference meetings resulted in the development of a policy document outlining an initial set of assumptions on the SKA cost and phasing for use by WP6. Several other questions have been identified and considered, which are now being addressed in both the PrepSKA project, and in specialist working groups initiated by the Agencies SKA Group.

2 – Development of a policy survey to funding agencies: This was completed, jointly with WP4 and WP5. Responses were received from 17 funders/governments during late 2008. These ranged in quality/usefulness, and although an initial assessment of the inputs was made, detailing funding issues/timescales/processes (see deliverable 6.1) we are focusing more effort on this in the coming months. In particular, as a result of ongoing study, it is clear that a further round of interviews will be required. The inputs so far have contributed to development of initial funding scenarios for presentation to the WP6 Core Group and in due course to the Agencies SKA Group (successor to the International SKA Forum group). Delivery of the report was delayed, as a result of limited available effort in the early stages, and slow responses from funding bodies.

3 – Gathering information from large Research Infrastructures on best practise: Identifying best practise is key to developing viable and realistic funding model options. ALMA presents the nearest astronomy mega-science example, and in September 2009, SLS visited NSF and the North American ALMA project base to discuss progress and policy issues. In addition, discussions have been held with ITER, ESO and with UK policy managers engaged with ESRF, XFEL and CERN – all of which provide relevant analogues to SKA. A report is in preparation from these visits.

4 – Developing a flexible modelling tool:. An Excel-based approach, capable of modelling a range of scenarios, funding breakdowns, timelines and schedules, has been developed and is in use as the basis for WP6 activities going forward. Results from initial modelling scenarios are available on the PrepSKA wiki. We anticipate refinement of this tool (the results from which we note has been

in use in several external for a), using the schedule and technical inputs now available from the SPDO, meshed with the factual data on possible funding availability from funders, being the focus of WP6 effort in the coming months if we are to hold to the schedule of deliverable 6.3. One particular focus in recent weeks has been a more analytical approach to the base assumptions on regional funding shares and the link between construction kickoff and the realism of funding ambitions within the likely partners (summarised as: is there sufficient resource to envisage construction start on the planned timescale?).

5 – Alternative funding approaches: At a schedule reassessment in early 2009, work on this element was de-prioritised by WP6, and the deliverable was not met. Our rationale for this, endorsed by the WP6 Core Group, was that non-governmental funding was unlikely to play a major role in the realisation of SKA (although we are commissioning a study from fund-raising experts to assess this further). One exception to this statement is the possibility of a loan from the European Investment Bank (EIB). An initial meeting and followup discussions have taken place on the concept, requirements and mutual risks present in obtaining EIB financing. This aspect will be taken forward as a higher priority, and a report will be made available by T+19.

Communication and reporting

WP6 has made extensive use of the PrepSKA wiki (http://webmail.jb.man.ac.uk/PrepSKAwiki) as a communication tool. Two core group teleconferences have taken place, and following a kickoff meeting in Perth (April 2008) full face-to-face meetings/workshops have taken place in November 2008 (Washington) and February 2009 (Cape Town). Reports have been provided to the PrepSKA Board on two occasions. SH has taken on the task of coordinating most of the wiki development activity for all of PrepSKA. A 'Coordination Group' featuring the PrepSKA management, WPs 2, 4, 5 and 6 has been initiated, and meets periodically.

Schedule

Progress towards the first deliverable was slower than anticipated, resulting from lack of available effort until January 2009. Work towards deliverable 6.2 has been deliberately slowed in favour of more effort being available towards developing the draft final funding model, which we see as an ongoing task, rather than the sequential 'concluding' workpackage element originally planned.

Resources

With a delayed recruitment, staff expenditure has been less than originally envisaged and no concerns are foreseen towards the end of the project. We plan that additional effort will be deployed as the project continues in order to maintain the planned schedule of work. In contrast, travel spending has been greater than originally predicted, as a result of major meetings in Washington (WP6 workshop in November 2008) and Cape Town (workshop and Board in February 2009), various adhoc meetings and a week spent by the WP6 policy officer visiting NSF in Washington in September 2009. Virement to cover ongoing travel requirements will be requested in the updated DoW.

Work Package 7 (SKA Implementation Plan) progress report

WP Leader: Philip Diamond (UMAN)

There has been no activity in this work package as yet.

4. Deliverables and milestones tables

Deliverables (excluding the periodic and final reports)

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.1.1	SKA concept delineation	WP2	UMAN	R	CO	9	36	See report under WP2.1.1
2.1.2	SKA Phase 1 specifications and SKA performance goals	WP2	UMAN	R	PU	12	36	See report under WP2.1.2 and DRM
2.1.3	SKA operations concept	WP2	UMAN	R	PP	12	36	See report under WP2.1.4
2.1.4	Composite volume, SKA life cycle study, operations plan and support model – Y3 report	WP2	ASTRON	R	PP	36	36	Part of Revised description of work

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.1.5	Composite volume, SKA cost and performance optimization, manufacturing studies and technical documentation – Y3 report	WP2	UMAN	R	PP	36	45	Part of Revised description of work
2.1.6	SKA system design – interim report	WP2	UMAN	R	PP	36	36	Part of Revised description of work
2.2.1	Sub-system hardware specifications	WP2	UMAN	R	PU	15	36	See text WP2-030.010.R.001 – 4
2.2.2	Report on sub-system integration and evaluation	WP2	UMAN	R	PP	27	45	Part of Revised description of work
2.3.1	Y3 Report on IVS specification	WP2	UMAN	R	PP	36	45	IVS has been replaced by DVP and AAVP
2.3.2	Y3 prototype IVS hardware	WP2	UMAN	P	PP	36	48	IVS has been replaced by DVP and AAVP
2.3.3	Y3 Report on IVS integration and test	WP2	UMAN	R	PP	36	45	IVS has been replaced by DVP and AAVP
2.4.1	Y3 report detailing performance and cost data for high dynamic range ASKAP antenna	WP2	CSIRO	R	CO	36	45	Dish & Aperture Array work has been restructured into DVP and AAVP programs

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.4.2	Y3 report detailing performance and cost data for composite MeerKat antenna	WP2	NRF	R	CO	36	45	Part of Revised description of work
2.4.3	Y3 report detailing performance and cost data for carbon fibre antenna	WP2	NRC-HIA	R	CO	36	45	Part of Revised description of work
2.4.4	Y3 report detailing performance and cost data for TDP antenna	WP2	Cornell	R	CO	36	25	Dish & Aperture Array work has been restructured into DVP and AAVP programs
2.5.1	Delivery of Y3 prototypes and report evaluating four single pixel 0.3-25GHz feeds	WP2	Cornell	R,P	PP	36	45	Upper frequency for Mid SKA is 10 GHz
2.5.2	Delivery of Y3 prototypes and report evaluating an AA tile to SKA spec	WP2	UMAN / ASTRON	R,P	PP	36	45	Original WP is now part of the AAVP
2.5.3	Delivery of Y3 prototypes and report evaluating a PAF to SKA spec	WP2	CSIRO	R,P	PP	24	36	Part of Revised description of work

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.5.4	Delivery of Y3 prototypes and report evaluating an MFC to SKA spec	WP2	NRF	R,P	PP	24	NA	No longer required
2.6.1	Initial delivery: at least one functional low-noise amplifier per SKA band	WP2	ASTRON	P	PP	24	36	LNA is now part of the DVP & AAVP
2.6.2	Initial delivery prototype integrated receivers suitable for operation in all SKA bands	WP2	CSIRO	P	PP	24	36	Part of Revised description of work
2.6.3	Y3 Status report on the applicability of new-generation cryo-coolers to the SKA and, if applicable, prototype cooling systems	WP2	Cornell	R,P	PP	36	45	Part of Revised description of work
2.7.1	Initial demonstration of complete low-cost antenna-to-central processing link, with Y3 performance report	WP2	CSIRO / INAF	P,R	PP	24	42	Part of Revised description of work

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.7.2	Y3 report on options for SKA phase 1 station to core links	WP2	UMAN	R	PP	36	42	Part of Revised description of work
2.7.3	Y3 report on strategy for LO and timing distribution	WP2	UMAN	R	PP	36	42	Part of Revised description of work
2.7.4	Y3 report on approach to array monitoring and control	WP2	UCAM	R	PP	36	42	Part of Revised description of work
2.8.1	Deliver Y3 report on costed DSP and correlator design proposals	WP2	UOXF.DL / NRC-HIA	R	PP	36	42	Part of Revised description of work
2.8.2	Deliver Y3 report on SKA RFI mitigation strategy	WP2	ASTRON / OBSPARIS	R	PP	36	42	Part of Revised description of work
2.8.3	Deliver Y3 report on implementation and algoritms for non-imaging processing	WP2	UMAN	R	PP	36	42	Part of Revised description of work

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.9.1	Composite volume, (draft) SKA computing and software specification, computing hardware strategy, calibration strategy	WP2	UMAN	R	PU	24	36	Part of Revised description of work
2.9.2	Composite volume, (draft) software systems architecture, SKA data products strategy and science post-processing strategy	WP2	ASTRON / UCAM / CSIRO	R	PU	24	36	Suggest changing lead beneficiary to UMAN
2.9.3	Prototype IVS demonstration hardware	WP2	UMAN	P	PP	36	42	Subject to available funds
2.9.4	Prototype IVS demonstration software	WP2	UMAN	P	PP	36	NA	ASKAP, MEERKAT development results
2.9.5	Y3 report on computing and software specs and strategies for science post-processing	WP2	CSIRO	R	PP	36	42	Suggest changing lead beneficiary to UMAN

Del. no.	Deliverable Name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex 1 (project month)	Actual / Forecast Delivery Date (project month)	Comments
2.10.1	Periodic WP2 progress reports on WP 2 Tasks	WP2	UMAN	R	PP	12, 24, 36	18	Monthly meetings , Minutes and Action Items lists created and Monthly reports saved on shared area. In addition, IEAC & similar reports generated as required.
2.10.2	Annual WP2 task project plans	WP2	UMAN	R	PP	1, 12, 24	21,33	Schedule draft for WP 2 created T+9. Continuous modification taking place. Stable schedule expected T+20, thereafter subject to change control.

WP3 Deliverables

Del. no.	Deliverable name	WP no.	Lead Beneficiary	Nature	Diss. level	Delivery Date (orig.)	Delivery Date (updated)	Comments
3.1	Report on ionospheric scintillation and TIDs for Australia and Southern Africa	3.3	UMAN	Report	CO	T+6	T+18	Work completed, report being written
3.2	Deliver RFI hardware and software	3.1	UMAN	Other	-	T+12	T+21	Hardware constructed and under test; software also under test.
3.3	Report on phase referencing and self calibration for SKA measurements at high	3.4	UMAN	Report	PU	T+12	T+45	Decided to pursue measurements via small

	frequencies							interferometer; talking to groups to implement.
3.4	Report on the optimum configuration for the SKA	3.5	UMAN	Report	CO	T+18	T+21	Much work done; GIS databases being updated.
3.6	Report on the infrastructure deployment timescales, costs and operational models	3.7	UMAN	Report	CO	T+30	T+30	
3.7	Report on the risk analysis of the science environment	3.8	UMAN	Report	CO	T+30	T+30	
3.8	Report on RFI measurements in Australia	3.1	UMAN	Report	CO	T+33	T+33	
3.9	Report on RFI measurements in Southern Africa	3.1	UMAN	Report	CO	T+33	T+33	
3.5	Report on the physical characteristics of the sites on telescope design, operations, and costs	3.6	UMAN	Report	CO	T+36	T+36	
3.10	Report on progress and prospects for Radio Quiet Zones for the short-listed SKA sites	3.2	UMAN	Report	CO	T+36	T+36	
3.11	WP3 Final site report	3	UMAN	Report	CO	T+36	T+36	

CO= confidential, PU= public

WP4 Deliverables

Del. no.	Deliverable name	WP no.	Lead Beneficiary	Nature	Diss. level	Delivery Date (orig.)	Delivery Date (updated)	Comments
4.1	Deliver study on best practice governance and legal frameworks	4	N.W.O	Report	PU	T+9	T+19	Delayed due to hiring staff; deadline extended with Board approval. Much work completed, strawman models generated and under discussion
4.2	Options paper for governance and legal framework	4	N.W.O	Report	CO	T+27		
4.3	White paper on governance model and legal framework	4	N.W.O	Report	CO	T+35		

CO= confidential, PU= public

WP5 Deliverables.

Del. no.	Deliverable name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I (proj month)	Delivered Yes/No	Actual / Forecast delivery date	Comments
5.1	Guidelines for Procurement for WP2	5	INAF	Report	PP	T+12	Yes	T+18	Delayed waiting for feedback from ASG
5.2	Industry Inventory	5	INAF	Report	PP	T+24	No	T+33	Analysis in Progress. Report to delay as a final deliverable due to it being closely linked to WP2 technical issues
5.3	Analysis of Procurement Models	5	INAF	Report	PP	T+33	No	T+33	-
5.4	Risk analysis of the procurement models	5	INAF	Report	PP	T+33	No	T+33	-
5.5	Deliver report on procurement models to the SKA Forum	5	INAF	Report	PP	T+33	No	T+33	-
5.6	Deliver options paper for FA	5	INAF	Report	PP	T+33	No	T+33	-
5.7	Incorparate white paper on final procurement model in Prepska report	5	INAF	Report	PP	T+33	No	T+33	-

WP6 Deliverables

Del. no.	Deliverable name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I (proj month)	Delivered Yes/No	Actual / Forecast delivery date	Comments
6.1	Summary of the survey of national funding opportunities, processes and timescales presented to the International SKA Forum	6	STFC	Report	PP	T+9	Yes	T+12	Initial work with Core Group has been to define and understand project scope, schedule and main issues. Then, joint survey defined with WP4 and WP5 and distributed to agency representatives. Range of inputs received on funding issues forming basis of report. Report has been made available via the PrepSKA wiki to partners, rather than to (superceded) SKA Forum. Further work being undertaken to further understand detailed funding timing issues in each potential partner.
6.2	Summary of initial investigations on options for alternative (eg private and/or corporate) funding of the SKA.	6	STFC	Report	PP	T+15	No		Not complete. Reassessment of work programme, endorsed by PrepSKA Board resulted in this being de-prioritised. Work has been underway, focusing on discussions with EIB, and commissioning a study of private and/or corporate funding options.
6.3	Draft options paper on the SKA funding model provided to the International SKA	6	STFC	Report	PP	T+19	No		Work underway. Highlights include: Development of an Excel-based tool to study various unding concepts

	Forum								Work with SPDO to understand possible expenditure profiles for the project under different scenarios Analysis of funding approaches, timing and issues from deliverable 6.1 to different funding scenarios

WP2 Milestones

Milestone no.	Milestone name	WPs no's.	Lead beneficiary	Delivery Date from Annex 1	Achieved Yes/No	Actual forecast achievement Date	Comments
2.1	IEAC Review	WP2.1	UMAN	11	Yes	14	Delivered 2009-06-01. SPDO Action Item list created 2009-06-05. Action Items being followed up within SPDO.
2.2	SKA specs set	WP2	UMAN	12	No	45	Technical specifications to be derived from the Design Reference Mission (DRM) under development by the Science Working Group (SWG). DRM has been reveiwed by SPDO
2.3	SKA Phase 1 prototyping: sub-system hardware spec set	WP2	UMAN	15	No	45	DVP and AAVPreplacing original IVS plan. Please see Revised description of work and Report text for further details
2.4	SKA design MTR	WP 2.1	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2.5	SKA dish options MTR	WP2.4	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details

Milestone no.	Milestone name	WPs no's.	Lead beneficiary	Delivery Date from Annex 1	Achieved Yes/No	Actual forecast achievement Date	Comments
2.6	SKA Feed options MTR	WP2.5	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2.7	LNA,receiver and cryogenics MTR	WP2.6	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2,8	Signal transport MTR	WP2.7	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2.9	Signal processing MTR	WP2.8	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2.10	Software/computing MTR	WP2.9	UMAN	24	No	45	System Engineering approach has been adopted. Please refer to Revised description of Work for full details
2.11	SKA Phase 1 first design review (1DR)	WP2	UMAN	27	No	45	Revised high level schedule produced 2009-08-01

WP5 Milestones

Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
5.1	Deliver guidelines for procurement in WP2	5	INAF	T+12	Yes	T+18	Delayed due the feedback from ASG
5.2	Deliver report on inventory of relevant industries	5	INAF	T+24	No	T+33	Will delay as a final deliverable due to close linkage with WP2 technical issues
5.3	Deliver report on procurement models	5	INAF	T+33	No	T+33	Information gathering In progress

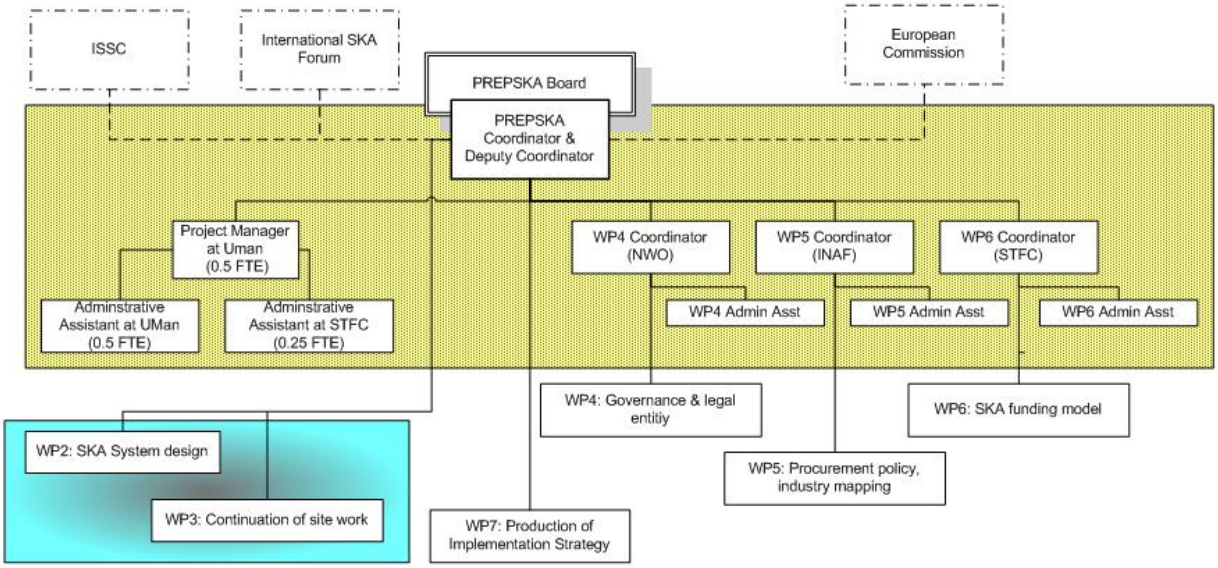
WP6 Milestones

Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
6.1	Complete survey of national funding agencies	6	STFC	T+9 months	Yes	T+12	Initial survey activity complete at T+12. More detailed followup work, obtaining further inputs from possible funders now underway.
6.2	Full funding model	6	STFC	T+33 months	No	T+33	Work relevant to this milestone underway.

5. Project management

Management Structure

The management structure of PrepSKA is shown below:



Since this diagram was drawn there have been two significant changes in bodies related to but external to PrepSKA. First, the International SKA Steering Committee (ISSC) has been dissolved and re-formed as the SKA Science and Engineering Committee (SSEC); there is no practical change in the oversight role that this body has with regard to the WP2 and WP3 activities. Secondly, and with considerably greater impact, the International SKA Forum, which at the time was the name given to the informal funding agencies group, has metamorphosed into the Agencies SKA Group (ASG). The ASG has expanded its remit and taken onto itself significant roles in developing interim SKA management structures, overseeing the SKA timeline and considering how to resolve funding issues following the end of PrepSKA and prior to the approval of Phase 1 construction.

The SKA Forum is now the name adopted for a major annual event (Perth: April 2008; Cape Town: February 2009; the Netherlands: June 2010) in which the SKA project seeks to inform governments, industry and other influential bodies of its goals and status.

Management Tasks and Achievments

Status of the contract

The PrepSKA contract was signed in August 08; however due to communication issues between the STFC legal office (not the STFC astronomy office) and the scientific coordinator a copy was not received until February 2009. Copies were sent to all partners in March 2009.

Status of the finances

The delivery of the finances is a somewhat happier story. Although there were delays caused by internal EC issues the first tranche of EC funding was received in October 2008 and was distributed to the 4 organisations receiving EC funding. At the time PrepSKA received less than expected but the remainder of the first tranche was received in June 2009 and distributed. No organisation has reported any cash flow problems resulting from these delays.

A full financial report covering the period 1 April 2008 to 30 Sept 2009 is given below.

Formation of the Co-ordination Group

As was discussed and agreed at the first Board meeting in Perth in April 2008 a group has been formed to ensure close co-ordination between the various work-packages. This was a prescient move since, as the work-package teams have developed their programmes, it has become clear that there are strong and multi-dimensional links between all major work-packages; clear and efficient communication is essential.

As Scientific Coordinator I chair the Co-ordination group, a list of the teleconferences and face-2-face meetings of this group and other management activities is provided below. Simon Haynes of STFC will, from October 2009, be responsible for the organisation and minuting of co-ordination group meetings.

The membership of the co-ordination group is:

P. Diamond (UMAN:Chairman), A.Wilkinson (UMAN, Proj Mgr);
R.Schillizi (SPDO) – WP2;
P. Vogel (NWO), S Usai (NWO), M. Roelfs (NWO) – WP4
C. Perna (INAF) – WP5
S. Berry (STFC), S-L Samuels (STFC), S. Haynes (STFC) – WP6

Project-wide or management meetings

Each work package has numerous meetings which focus on specific activities related to their work; these are detailed in the individual reports above and shall not be repeated here.

The table below lists the meetings which are either project-wide or focused on management and coordination activities.

Meeting	Date	Venue	# participants	URL of notes. Comments
1st PrepSKA Board, SKA Forum, SKA meetings	9-13 April 08	Curtin Univ, Perth	~200	
Coordination group telecon	29 April 08	-	6	
Coordination group meeting	4 June 08	Manchester	6	
Co-ord to INAF	3-4 Sept 08	Rome	3	
Co-ord to TDP mtg	9-11 Sept 08	Washington, DC	12	TDP Advisory Board
Coordination group Telecon	18 Sept 08	-	8	
PrepSKA Workshop	18-22 Nov 08	Washington, DC	35	
IFAG meeting	21 Nov 08	Washington, DC	20	
2nd PrepSKA Board	26 Nov 08	- (telecon)	25	
European Conf on Research Infrastructures	8-10 Dec 08	Versailles	~200	
Coordination group meeting	11 Feb 09	Heathrow	8	
3rd PrepSKA Board, SKA Forum, SKA meetings, ASG	20-27 Feb 09	Cape Town	~200	
Co-ord meeting with Chairman of ASG	19 Mar 09	RAL, UK	~5	
Co-ord at US SKA Consortium meeting	13-16 May 09	Washington, DC	~40	
Co-ord at AAS meeting for US Astro2010 Panel	7-10 June 09	Pasadena	~100	
Co-ord meeting with WP6	16 June 09	Manchester	5	

team				
Coordination group Telecon	17 June 09	- (telecon)	8	
Co-ord meeting with WP4 team	18 June 09	Den Haag	5	
WP4/6 core group f2f, ASG meeting	8-9 July 09	Den Haag	~30	
Co-ord meeting with WP5 team	24 Aug 09	Bologna	3	
Co-ord meeting with EC Project Officer and Robert-Jan Smits	1 Sept 09	Brussels	3	
Coordination group meeting	11 Sept 09	Rome	9	
Co-ord attending ASG Schedule Tiger Team mtg	24 Sept 09	London	12	
Co-ord attending COST workshop planning mtg	25 Sept 09	London	25	

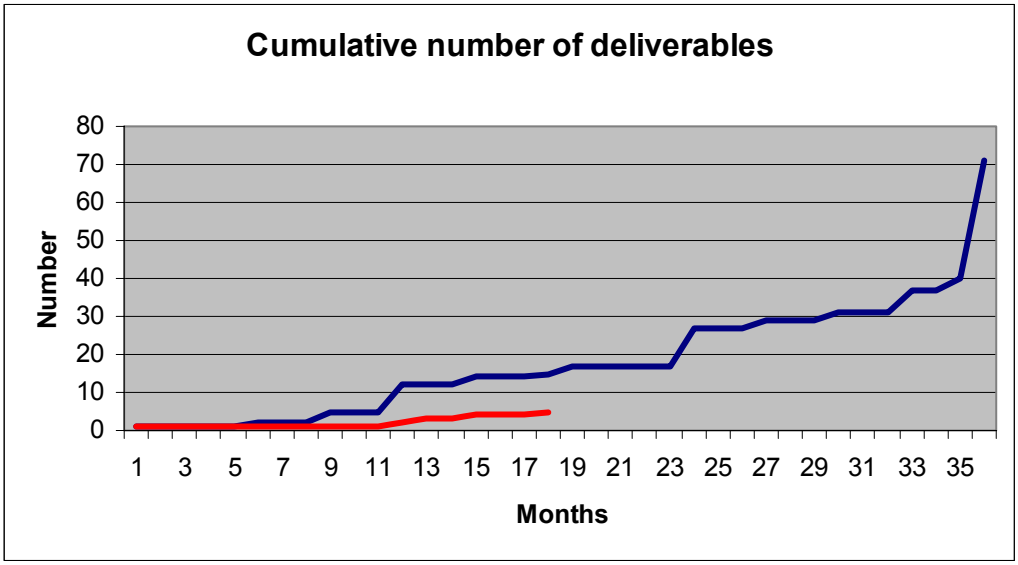
Project website

A dedicated PrepSKA wiki tool has been developed under WP1. Interactive in nature, but developed, overseen and managed from STFC, this forms the baseline communication mechanism for the project, with workpackages assigned a dedicated workspace for presentation of material for discussion, reference materials for the project and archiving material. In addition to its core role, the PrepSKA wiki also houses material related to SKA agency workstreams on schedule and governance. The wiki is also maintained as the home for material related to the PrepSKA Board, and overall management of the PrepSKA project, including schedules and workpackage plans.

There are plans to produce a formal public website to introduce PrepSKA to the external world.

Project Status

Each work-package has provided an individual report on their activities and current status, this section will therefore focus on the overall status and will provide a summary of progress as compared to the initial plan.



PrepSKA formally has 71 deliverables; the figure provides an indication of the time profile on which the deliverables will be provided. There is a dramatic jump at the end of the project, which is expected. The red line shows what has been achieved to date.

There are several reasons for this slow start:

- The problems associated with the appointment of personnel; this plagued all work-packages and produced, on average, a 6 month delay.
- Several major PrepSKA partners have still not received their matching national funding and so have problems in providing appropriate personnel to participate in direct PrepSKA activities.
- WP2 has, as described elsewhere in this report, been engaged in a major modification of the original plan, focusing on a system engineering approach. This has resulted in a redefinition of some deliverables and their delay until later in the study.
- WP3 has encountered problems in the on-time delivery of hardware and software, but these are now overcome and progress is expected to be rapid with the work being completed on the original timescale.

However, it is expected that with full staffing and matching funding beginning to flow, that progress will improve from this point.

Problems and solutions

In a project of the magnitude and complexity of PrepSKA there will always be problems, the challenge is to develop solutions that enable rapid resolution. Below is a list of the major problems encountered in the first 18 months of the study and the solutions either implemented or proposed.

- Problem: the WP2 work was always expected to take longer than the 3 years of EC funding allowed, when combined with the unavoidable slow hiring of the Domain Specialists there are inevitable delays in the project leading to concerns that planned work cannot be finished within the existing funded period.
    - Solution: an examination of the budget shows that the WP2 programme can be extended with a 9-month no-cost extension. Discussions with the EC Scientific officer have indicated that she will approve such an extension, a formal request will be made following the submission of the periodic report.
- Problem: it was realised that the WP2 domain specialists were employed under 'RTD' rather than 'Support'; this may cause problems at audit since the work they are doing is support rather than direct R&D and it also resulted in the budget for salaries being much less than planned due to the significantly greater indirect costs resulting from the former category.
    - Solution: the co-ordinator proposed to the Board and the EC that the budget should be re-allocated within the original fixed financial envelope for WP2. This was approved and the University of Manchester recognised that it would not receive as much in indirect costs as was previously expected.
- Problem: there were difficulties in hiring an expert in procurement policy at INAF, this was limiting the ability of the WP5 team to address its workplan.
    - Solution: re-direct €145k of consultancy funds from WP5 to fund the appointment of an Industry Participation Manager within the SPDO. Phil Crosby of CSIRO was seconded to this role and works in close co-operation with Corrado Perna, WP5 leader at INAF.
- Problem: there was initially a lack of coordination between the work-packages resulting in duplication of work and communication problems.
    - Solution: the PrepSKA Co-ordination group (described above) was formed and seems to be working effectively.

- Problem: there were and are difficulties in engaging PrepSKA Board members and others with on-going work within the policy work packages. Documents are placed on the wiki but feedback is only received by the same, small number of people.
    - Solution: a partial solution has been adopted in the Simon Haynes (STFC) has been appointed as wiki/web manager and is now sending out monthly status reports to the Board to inform them of new documents etc being placed on the wiki. However, this problem has not yet been fully resolved.
- Problem: there are several issues related to the participation of PrepSKA partners in the WP2 activities: a) several major partners have not yet received their national matching funding; b) there are various communication difficulties between the SPDO and the partners, possibly a natural consequence of a distributed R&D project; c) there is difficulty in tracking adequately the matching effort provided by the PrepSKA partners, this is especially important for those European partners who are providing auditable matching effort.
    - Solutions: a) encourage partners to push their funding agencies to provide funds, use PrepSKA Board as a mechanism to encourage the flow of money;
    - Solutions: b) there are several approaches being implemented in parallel to solve the communication problems: (i) liaison engineers have been appointed at each institute and meet regularly by telecon and annually face-2-face; (ii) a Resource Committee consisting of the Directors or senior managers at each partner institute has been formed; (iii) the SPDO System Engineer is assisting the International Project Engineer in improving the communications with groups around the world; (iv) an advertisement for a high-level Project Manager is being prepared;
    - Solutions: c) as yet, no solution has been reached. We need a mechanism whereby the WP2 team leader can approve matching effort as being relevant to the project.

6. Explanation of the use of the resources

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 1 (STFC) FOR THE PERIOD

Work Package	Item description	Amount	Explanations
	Personnel costs	*€68,533.73*	*Salaries of 2 STFC staff deployed on PrepSKA, plus effort from another STFC staff member*
	Subcontracting		
	Major cost item 'X'	*€7,719.84*	*Cost of meetings, travel etc.*
	Major cost item 'Y' ……..		
	Remaining direct costs		
TOTAL DIRECT COSTS[6]		*€76,253.57*	

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 2 (NWO) FOR THE PERIOD

Work Package	Item description	Amount	Explanations
	Personnel costs	€78,450.96	Senior policy officer, Policy officer, see JOR
	Subcontracting		
	Major cost item 'X'	€23,947.10	Travel and subsistence
	Major cost item 'Y' ……..		
	Remaining direct costs		
TOTAL DIRECT COSTS		€102,398.06	

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 3 (INAF) FOR THE PERIOD

Work Package	Item description	Amount	Explanations
	Personnel costs	101438.39	Admin, technical staff, Board member & WP coordinator
	Subcontracting	18564	Contract to draft technical document
	Major cost item 'X'	7090.87	Speakers reimbursement, SA and Rome + conference meal
	Major cost item 'Y' ……..	16065.46	Travel and Subsistence
	Remaining direct costs		
TOTAL DIRECT COSTS		143158.72	

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 4 (UMAN) FOR THE PERIOD

Work Package	Item description	Amount	Explanations
WP1	Personnel costs	€33,880.07	Proj, Manager 25%, Proj Officer 25%, Senior Res Admin 10%, Res Accounts officer 10%
WP1	Subcontracting		Audit costs

[6] Total direct costs have to be coherent with the directs costs claimed in Form C

WP1	Major cost item 'X'	€12,678.57	Travel and Subsistence
	Major cost item 'Y' ……..		
	Remaining direct costs		
TOTAL DIRECT COSTS		€46,558.64	

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 4 (SPDO) FOR THE PERIOD

Work Package	Item description	Amount	Explanations
WP2 & WP5	Personnel costs	€439,496.94	Domain specialists, see Just of Resources form
WP	Subcontracting		
WP2	Major cost item 'X'	€51,192.86	Travel and Subsistence
	Major cost item 'Y' ……..		
WP2	Remaining direct costs	€11,534.20	Consumables
TOTAL DIRECT COSTS		€502,224.00	

Contract N°	212243	Project acronym	PrepSKA
Participant N°	1	Participant short name	STFC

		WP6 - Support	
		Total effort in person-months [1]	21.75
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost	59376.60	Monthly salaries	
Subcontracting	0		
Other Direct costs	7719.84	Travel costs to meetings train, car hire, accommodation. Meeting Room hire	
Indirect costs	0	7% permitted maximum indirect costs	

		Management	
		Total effort in person-months [1]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost	9157.13		
Subcontracting	0		
Other Direct costs			
Indirect costs	0	60% permitted maximum indirect costs	

Total direct eligible costs	76253.57		
Total indirect costs	0.00		
Total costs [3]	76253.57	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.

[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	**212243**	**Project acronym**	**PrepSKA**
Participant N°	**2**	**Participant short name**	**NWO**

		WP4 - Support	
Reporting Period 01-04-2008-31-07-2009		**Total effort in person-months** [(1)]	12.37
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost	€ 78,450.96	Senior Policy officer 0,7 FTE 6,9 person month, Policy officer 0,4 FTE 5,4 person month	
Subcontracting			
Other Direct costs	€ 23,947.10	Travel, meetings, workshops and visits.	
Cost item 1			
Cost item 2			
…			
Indirect costs	€ 7,167.86	7% maximum permitted indirect	

		WP4 - Management	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost			
Subcontracting			
Other Direct costs			
Cost item 1			
…			
Indirect costs		7% maximum permitted indirect	

Total direct eligible costs	€ 102,398.06		
Total indirect costs	€ 7,167.86		
Total costs [3]	€ 109,565.92	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	
Justify any deviations with respect to the planned budget			

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
For an access activity do not include the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	212243	Project acronym	PrepSKA
Participant N°	4	Participant short name	INAF

		WP5 - Support	
		Total effort in person-months [(1)]	13.87

Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost	79,224.47	Administrative staff, technical staff, Board member and WP coordinator
Subcontracting	18,564.00	Contract to draft technical document (PrepSKA deliverable WP5.1)
Other Direct costs	7090.87	Travel reimbursement invited speakers (PrepSKA WP5 Workshop,Cape Town, February, 2009), meals for Rome meeting 11-9-2009
Cost item 1	16065.46	Travel & Subsistence
…		
Indirect costs	74756.83	7% maximum permitted indirect costs

		WP5 - Management	
		Total effort in person-months [(1)]	1.88

Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)
Personnel cost [(2)]		
Subcontracting		
Other Direct costs		
Cost item 1		
…		
Indirect costs		60% maximum permitted indirect costs, excluding subcontracting

Total direct eligible costs	142,916.98		
Total indirect costs	27,367.91		
Total costs [3]	170,284.89	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

No subcontracting in management due to the reallocated budget from INAF to UMAN-SPDO

Personnel and travel & subsistence in management are strictly related to the participation of the WP coordinator and the Board member in the Board meeting

[1] Contractors must include the total estimated human effort in the categories funded auditable, unfunded auditable and matching not auditable
Human effort should match time sheet entries
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	212243	Project acronym	PrepSKA
Participant N°	9	Participant short name	UMAN

Euro conversion rate as of 01/10/09	**0.91085**

WP7 - Support

Total effort in person-months [1]	

Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost		
Subcontracting		
Other Direct costs		
Cost item 1		
…		
Indirect costs	0.00	60% maximum permitted indirect costs, of which 7% payable by EC

Management

Total effort in person-months [1]	14(14)

Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)
Personnel cost [2]	33,880.07	Project Manager 3.46 man months, Project Officer 2.19 man months, Senior Research Administrator 1.77 man months, Research Accounts Officer 0.6 man months
Subcontracting		
Other Direct costs	12,678.57	Travel and Subsistence
Cost item 1		
…		
Indirect costs	27,935.19	60% maximum permitted indirect costs, excluding subcontracting

Total direct eligible costs	46,558.65		
Total indirect costs	27,935.19		
Total costs [3]	74,493.84	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	
Justify any deviations with respect to the planned budget			

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
Human effort should match time sheet entries
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	212243	Project acronym	PrepSKA
Participant N°	9	Participant short name	UMAN-SPDO

Euro conversion rate as of 01/10/09	**0.91085**

WP2A - RTD

Total effort in person-months [(1)]	

Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost		
Subcontracting		
Other Direct costs		
Cost item 1	2,424.90	Travel and subsistence
…		
Indirect costs	1,454.94	60% permitted maximum indirect costs

WP2B - Support

Total effort in person-months [(1)]	62(62)

Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost	391,347.74	Domain Specialist in Receptors 1FTE x 15 months, Domain Specialist in Signal TR 1FTE x 13 months, Domain specialist in signal process, SPDO Domain Specialist 1FTE x 9 months, SPDO-CDIT Systems Engineer 1FTE x 11 months, SPDO Project Management Officer 1F
Subcontracting		
Other Direct costs		
Cost item 1	35,379.07	Travel and subsistence
Cost item 2	10,517.00	Consumables
Indirect costs	262,346.29	60% maximum permitted indirect costs, of which 7% payable by EC

		WP3 - Support	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost			
Subcontracting			
Other Direct costs			
Cost item 1	10,295.62	Travel and subsistence	
Cost Item 2			
Indirect costs	6,177.37	60% maximum permitted indirect costs, of which 7% payable by EC	

		WP3 - Management	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Cost item 1	999.78	Consumables	
Subcontracting			
Indirect costs	599.87	60% Indirect	

		WP5 - Support	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost	48,149.20	Industry Participation Strategist 1FTE x 6 months	
Other Direct costs			
Cost item 1	3,093.25	Travel and subsistence	
Cost item 1	17.42	Consumables	

Indirect costs	30,755.93	60% maximum permitted indirect costs, of which 7% payable by EC

Total direct eligible costs	502,224.00		
Total indirect costs	301,334.40		
Total costs [3]	803,558.40	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

[1] Contractors must include the total estimated human effort in the categories funded auditable, unfunded auditable and matching not auditable
Human effort should match time sheet entries
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

7. Financial statements – Form C and Summary financial report

FP7 - Grant Agreement - Annex VI - Combination of CP & CSA

Form C - Financial Statement (to be filled in by each beneficiary)

Project nr.	212243	Funding scheme	Combination of CP & CSA
Project Acronym	PrepSKA		
Period from	01/04/2008	Is this an adjustment to a previous statement?	No
To	30/09/2009		
Legal Name	SCIENCE AND TECHNOLOGY FACILITIES COUNCIL	Participant Identity Code	999980179
Organisation short Name	STFC	Beneficiary nr.	1
Funding % for RTD activities (A)	75.00	If flat rate for indirect costs, specify %	N/A

1. Declaration of eligible costs/lump sum/flate-rate/scale of unit (in €)

	Type of Activity					
	RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total (A+B+C+D+E)
Personnel costs	0.00	0.00	59,376.60	9,157.13	0.00	68,533.73
Subcontracting	0.00	0.00	0.00	0.00	0.00	0.00
Other direct costs	0.00	0.00	7,719.84	0.00	0.00	7,719.84
Indirect costs *	0.00	0.00	0.00	0.00	0.00	0.00
Access costs			0.00			0.00
Lump sums/flat rate/scale of unit declared	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	67,096.44	9,157.13	0.00	76,253.57
Maximum EC contribution	0.00	0.00	67,096.44	9,157.13	0.00	76,253.57
Requested EC contribution						76,253.57

* Indirect costs relating to:
- "Coordination" and "Support" activities are reimbursed up to a maximum of 7% of the direct eligible costs relating to these activities excluding the direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiary.
- "RTD", "Management" and "other" activities are reimbursed in accordance with the various options foreseen in Article II.15.2 a), b) and c) of the grant agreement.

2. Declaration of receipts

Did you receive any financial transfers or contributions in kind, free of charge from third parties or did the project generate any income which could be considered a receipt according to Art.II.17 of the grant agreement? No

If yes, please mention the amount (in €)

3. Declaration of interest yielded by the pre-financing *(to be completed only by the coordinator)*

Did the pre-financing you received generate any interest according to Art.II.19? Yes

If yes, please mention the amount (in €) 7,808.00

4. Certificate on the methodology

Do you declare average personnel costs according to Art.II.14.1? No

Is there a certificate on the methodology provided by an independant auditor and accepted by the Commission according to Art.II.4.4? No

Name of the auditor		Cost of the certificate (in €), if charged under this project	

5. Certificate on the financial statements

Is there a certificate on the financial statements provided by an independant auditor attached to this financial statement according to Art.II.4.4? No

Name of the auditor		Cost of the certificate (in €)	

6. Beneficiary's declaration on their honour

We declare on our honour that:

- the costs declared above are directly related to the resources used to attain the objectives of the project and fall within the definition of eligible costs specified in Articles II.14 and II.15 of the grant agreement, and, if relevant, Annex III and article 7 (special clauses) of the grant agreement;
- the receipts declared above are the only financial transfers or contributions in kind, free of charge, from third parties and the only income generated by the project which coule be considered as receipts according to Art.II.17 of the grant agreement;
- the interest declared above is the only interest yielded by the pre-financing which falls within the definition of Art.II.19 of the grant agreement;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Beneficiary's Stamp	Name of the Person(s) Authorised to sign this Financial Statement
	Jane Tirard
	Date & signature
	14/10/2009

FP7 - Grant Agreement - Annex VI - Combination of CP & CSA

Form C - Financial Statement (to be filled in by each beneficiary)

Project nr.	212243	Funding scheme	Combination of CP & CSA
Project Acronym	PrepSKA		
Period from	01/04/2008	Is this an adjustment to a previous statement?	No
To	30/09/2009		
Legal Name	ISTITUTO NAZIONALE DI ASTROFISICA	Participant Identity Code	999868920
Organisation short Name	INAF	Beneficiary nr.	4
Funding % for RTD activities (A)	75.00	If flat rate for indirect costs, specify %	60.00

1. Declaration of eligible costs/lump sum/flate-rate/scale of unit (in €)

	Type of Activity					
	RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total (A+B+C+D+E)
Personnel costs	0.00	0.00	101,438.39	0.00	0.00	101,438.39
Subcontracting	0.00	0.00	18,564.00	0.00	0.00	18,564.00
Other direct costs	0.00	0.00	23,156.33	0.00	0.00	23,156.33
Indirect costs *	0.00	0.00	74,756.83	0.00	0.00	74,756.83
Access costs			0.00			0.00
Lump sums/flat rate/scale of unit declared	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	217,915.55	0.00	0.00	217,915.55
Maximum EC contribution	0.00	0.00	151,880.35	0.00	0.00	151,880.35
Requested EC contribution						151,880.35

* Indirect costs relating to:
- "Coordination" and "Support" activities are reimbursed up to a maximum of 7% of the direct eligible costs relating to these activities excluding the direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiary.
- "RTD", "Management" and "other" activities are reimbursed in accordance with the various options foreseen in Article II.15.2 a), b) and c) of the grant agreement.

2. Declaration of receipts

Did you receive any financial transfers or contributions in kind, free of charge from third parties or did the project generate any income which could be considered a receipt according to Art.II.17 of the grant agreement?	No
If yes, please mention the amount (in €)	

3. Declaration of interest yielded by the pre-financing *(to be completed only by the coordinator)*

Did the pre-financing you received generate any interest according to Art.II.19?	No
If yes, please mention the amount (in €)	

4. Certificate on the methodology

Do you declare average personnel costs according to Art.II.14.1?	No
Is there a certificate on the methodology provided by an independant auditor and accepted by the Commission according to Art.II.4.4?	No

Name of the auditor		Cost of the certificate (in €), if charged under this project	

5. Certificate on the financial statements

Is there a certificate on the financial statements provided by an independant auditor attached to this financial statement according to Art.II.4.4?	No

Name of the auditor		Cost of the certificate (in €)	

6. Beneficiary's declaration on their honour

We declare on our honour that:

- the costs declared above are directly related to the resources used to attain the objectives of the project and fall within the definition of eligible costs specified in Articles II.14 and II.15 of the grant agreement, and, if relevant, Annex III and article 7 (special clauses) of the grant agreement;
- the receipts declared above are the only financial transfers or contributions in kind, free of charge, from third parties and the only income generated by the project which coule be considered as receipts according to Art.II.17 of the grant agreement;
- the interest declared above is the only interest yielded by the pre-financing which falls within the definition of Art.II.19 of the grant agreement;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Beneficiary's Stamp	Name of the Person(s) Authorised to sign this Financial Statement
	Giampaolo Vettolani
	Date & signature
	04/11/2009

FP7 - Grant Agreement - Annex VI - Combination of CP & CSA

Form C - Financial Statement (to be filled in by each beneficiary)

Project nr.	212243	Funding scheme	Combination of CP & CSA
Project Acronym	PrepSKA		
Period from	01/04/2008	Is this an adjustment to a previous statement?	No
To	30/09/2009		
Legal Name	THE UNIVERSITY OF MANCHESTER	Participant Identity Code	999903840
Organisation short Name	UMAN	Beneficiary nr.	9
Funding % for RTD activities (A)	75.00	If flat rate for indirect costs, specify %	60.00

1. Declaration of eligible costs/lump sum/flate-rate/scale of unit (in €)

	Type of Activity					
	RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total (A+B+C+D+E)
Personnel costs	0.00	0.00	439,496.94	33,880.07	0.00	473,377.01
Subcontracting	0.00	0.00	0.00	0.00	0.00	0.00
Other direct costs	2,424.90	0.00	59,302.38	13,678.36	0.00	75,405.64
Indirect costs *	1,454.94	0.00	299,279.59	28,535.06	0.00	329,269.59
Access costs			0.00			0.00
Lump sums/flat rate/scale of unit declared	0.00	0.00	0.00	0.00	0.00	0.00
Total	3,879.84	0.00	798,078.91	76,093.49	0.00	878,052.24
Maximum EC contribution	2,909.88	0.00	533,715.27	76,093.49	0.00	612,718.64
Requested EC contribution						612,718.64

* Indirect costs relating to:
- "Coordination" and "Support" activities are reimbursed up to a maximum of 7% of the direct eligible costs relating to these activities excluding the direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiary.
- "RTD", "Management" and "other" activities are reimbursed in accordance with the various options foreseen in Article II.15.2 a), b) and c) of the grant agreement.

2. Declaration of receipts

Did you receive any financial transfers or contributions in kind, free of charge from third parties or did the project generate any income which could be considered a receipt according to Art.II.17 of the grant agreement?	No
If yes, please mention the amount (in €)	

3. Declaration of interest yielded by the pre-financing *(to be completed only by the coordinator)*

Did the pre-financing you received generate any interest according to Art.II.19?	No
If yes, please mention the amount (in €)	

4. Certificate on the methodology

Do you declare average personnel costs according to Art.II.14.1?			No
Is there a certificate on the methodology provided by an independant auditor and accepted by the Commission according to Art.II.4.4?			No
Name of the auditor		Cost of the certificate (in €), if charged under this project	

5. Certificate on the financial statements

Is there a certificate on the financial statements provided by an independant auditor attached to this financial statement according to Art.II.4.4?			Yes
Name of the auditor	UNIAC	Cost of the certificate (in €)	3,800.00

6. Beneficiary's declaration on their honour

We declare on our honour that:

- the costs declared above are directly related to the resources used to attain the objectives of the project and fall within the definition of eligible costs specified in Articles II.14 and II.15 of the grant agreement, and, if relevant, Annex III and article 7 (special clauses) of the grant agreement;
- the receipts declared above are the only financial transfers or contributions in kind, free of charge, from third parties and the only income generated by the project which coule be considered as receipts according to Art.II.17 of the grant agreement;
- the interest declared above is the only interest yielded by the pre-financing which falls within the definition of Art.II.19 of the grant agreement;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Beneficiary's Stamp	Name of the Person(s) Authorised to sign this Financial Statement
	Prof. P.J.Diamond
	Date & signature
	30/11/2009

.

FP7 - Grant Agreement - Annex VI - Combination of CP & CSA

Form C - Financial Statement (to be filled in by each beneficiary)

Project nr.	212243	**Funding scheme**	Combination of CP & CSA
Project Acronym	PrepSKA		
Period from	01/04/2008	Is this an adjustment to a previous statement?	No
To	30/09/2009		
Legal Name	NEDERLANDSE ORGANISATIE VOOR WETENSCHAPPELIJK ONDERZOEK	**Participant identity Code**	999663862
Organisation short Name	NWO	**Beneficiary nr.**	2
Funding % for RTD activities (A)	75.00	**If flat rate for indirect costs, specify %**	20.00

1. Declaration of eligible costs/lump sum/flat rate/scale of unit (in €)

	Type of Activity					
	RTD (A)	**Coordination (B)**	**Support (C)**	**Management (D)**	**Other (E)**	**Total (A+B+C+D+E)**
Personnel costs	0.00	0.00	78,450.96	0.00	0.00	78,450.96
Subcontracting	0.00	0.00	0.00	0.00	0.00	0.00
Other direct costs	0.00	0.00	23,947.10	0.00	0.00	23,947.10
Indirect costs *	0.00	0.00	20,479.61	0.00	0.00	20,479.61
Access costs			0.00			0.00
Lump sums/flat rate/scale of unit declared	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	122,877.67	0.00	0.00	122,877.67
Maximum EC contribution	0.00	0.00	109,565.92	0.00	0.00	109,565.92
Requested EC contribution						109,565.92

[illegible] "Coordination" and "Support" activities are reimbursed up to a maximum of 7% of the direct eligible costs relating to these activities excluding the direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiary. [illegible] "Management" and "Other" activities are reimbursed in accordance with the various options foreseen in Article [illegible] of the grant agreement.

2. Declaration of receipts

Did you receive any financial transfers or contributions in kind, free of charge from third parties or did the project generate any income which could be considered a receipt according to Art.II.17 of the grant agreement? — No

If yes, please mention the amount (in €)

3. Declaration of interest yielded by the pre-financing *(to be completed only by the coordinator)*

Did the pre-financing you received generate any interest according to Art.II.19? — No

If yes, please mention the amount (in €)

4. Certificate on the methodology

Do you declare average personnel costs according to Art.II.14.1? — No

Is there a certificate on the methodology provided by an independent auditor and accepted by the Commission according to Art.II.4.4? — No

Name of the auditor		**Cost of the certificate (in €), if charged under this project**	

5. Certificate on the financial statements

Is there a certificate on the financial statements provided by an independent auditor attached to this financial statement according to Art.II.4.4? — No

Name of the auditor		**Cost of the certificate (in €)**	

6. Beneficiary's declaration on their honour

We declare on our honour that:

- the costs declared above are directly related to the resources used to attain the objectives of the project and fall within the definition of eligible costs specified in Articles II.14 and II.15 of the grant agreement, and, if relevant, Annex III and article 7 (special clauses) of the grant agreement;
- the receipts declared above are the only financial transfers or contributions in kind, free of charge, from third parties and the only income generated by the project which could be considered as receipts according to Art.II.17 of the grant agreement;
- the interest declared above is the only interest yielded by the pre-financing which falls within the definition of Art.II.19 of the grant agreement;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Beneficiary's Stamp	**Name of the Person(s) Authorised to sign this Financial Statement**
	N.Collignon
	Date & signature
	22/12/2009

Organisation	Task	Activity	Start Date	End Date	PI/Manager	Budget (€)	RTD 75% only	Support	Management	Total costs to date	Commitment	Actual + Commitment	Balance remaining	% spent	Problem?	Comments
STFC	Mgmt	Staff	01/04/2008	31/03/2011	Berry	33,457.22			9,157.13	9,157.13	0.00	9,157.13	24,300.09	27.37		Personnel appointed in Jan 09
		Other direct														
		Audits				4,000.00			0.00	0.00	0.00	0.00	4,000.00	0.00		Exchange rate £/€ = 1.097876
		Indirect				22,474.33			0.00	0.00	0.00	0.00	22,474.33	0.00		(01/10/09)
		Total				59,931.54			9,157.13	9,157.13	0.00	9,157.13	50,774.41	15.28		
	WP6	Staff	01/04/2008	31/03/2011	Berry	231,685.29		59,376.60		59,376.60	0.00	59,376.60	172,308.69	25.63		Exchange rate £/€ = 1.097876
		Sub-contracts				40,000.00				0.00	0.00	0.00	40,000.00	0.00		(01/10/09)
		T&S, consumables				25,000.00		7,719.84		7,719.84	0.00	7,719.84	17,280.16	30.88		
		Indirect				17,967.97		0.00		0.00	0.00	0.00	17,967.97	0.00		
		Total				314,653.26		67,096.44		67,096.44	0.00	67,096.44	247,556.82	21.32		
N.W.O	WP4	Staff	01/04/2008	31/03/2011	Vogel	248,988.00		78,450.96		78,450.96	0.00	78,450.96	170,537.04	31.51		
		Sub-contracts				80,000.00				0.00	0.00	0.00	80,000.00	0.00		
		T&S, consumables				29,000.00		23,947.10		23,947.10	0.00	23,947.10	5,052.90	82.58		
		Indirect				19,979.16		7,167.86		7,167.86	0.00	7,167.86	12,811.30	35.88		
		Total				377,967.16		109,565.92		109,565.92	0.00	109,565.92	268,401.24	28.99		
INAF	WP5	Staff	01/04/2008	31/03/2011	Perna	218,232.59		101,438.39		101,438.39	0.00	101,438.39	116,794.20	46.48		
		Sub-contracts				140,000.00		18,564.00		18,564.00	0.00	18,564.00	121,436.00	13.26		
		T&S, consumables				29,000.00		23,156.33		23,156.33	0.00	23,156.33	5,843.67	79.85		
		Indirect				19,426.28		8,721.63		8,721.63	0.00	8,721.63	10,704.65	44.90		
		Total				406,658.87		151,880.35		151,880.35	0.00	151,880.35	254,778.52	37.35		
UMAN	Mgmt	Staff	01/04/2008	31/03/2011	Diamond	231,009.88			33,880.07	33,880.07	0.00	33,880.07	197,129.81	14.67		Exchange rate £/€ = 1.097876

	Subcontracting				2,000.00			0.00	0.00					(01/10/09)
	T&S, consumables				56,815.00			12,678.57	12,678.57	0.00	12,678.57	44,136.43	22.32	
	Indirect				173,894.93			27,935.19	27,935.19	0.00	27,935.19	145,959.74	16.06	
	Total				463,719.81			74,493.83	74,493.83	0.00	74,493.83	387,225.98	16.06	
WP7	T&S, consumables	01/04/2008	31/03/2011	Diamond	50,000.00		0.00		0.00	0.00	0.00	50,000.00	0.00	No activity planned to date
	Indirect				3,500.00		0.00		0.00	0.00	0.00	3,500.00	0.00	
	Total				53,500.00		0.00		0.00	0.00	0.00	53,500.00	0.00	
WP2	Staff	01/04/2008	31/03/2011	Schilizzi	2,384,469.42		391,347.74		391,347.74	0.00	391,347.74	1,993,121.68	16.41	
	T&S, consumables				190,000.00	2,424.90	45,896.07		48,320.97	0.00	48,320.97	141,679.03	25.43	
	Equipment				168,773.27				0.00	0.00	0.00	168,773.27	0.00	
	Indirect				476,265.60	1,454.94	30,607.07		32,062.01	0.00	32,062.01	444,203.59	6.73	Charged at 7% support rate
	Total				3,219,508.29	2,909.88	467,850.88		470,760.76	0.00	471,730.72	2,747,777.57	14.65	
WP3	Sub-contracts	01/04/2008	31/03/2011	Schilizzi	290,000.00				0.00	0.00	0.00	290,000.00	0.00	
	T&S, consumables				50,000.00		10,295.62	999.78	11,295.40	0.00	11,295.40	38,704.60	22.59	
	Equipment				108,000.00				0.00	0.00	0.00	108,000.00	0.00	
	Indirect				11,060.00		720.69	599.87	1,320.56	0.00	1,320.56	9,739.44	11.94	
	Total				459,060.00		11,016.31	1,599.65	12,615.96	0.00	12,615.96	446,444.04	2.75	
WP5	Staff	01/04/2008	31/03/2011	Schilizzi	145,000.00		48,149.20		48,149.20	0.00	48,149.20	96,850.80	33.21	
	T&S, consumables				0.00		3,110.68		3,110.68	0.00	3,110.68	-3,110.68		
	Indirect				0.00		3,588.19		3,588.19	0.00	3,588.19	-3,588.19		
	Total				145,000.00		54,848.07		54,848.07	0.00	54,848.07	90,151.93	37.83	
PrepSKA	Grand Total	01/04/2008	31/03/2011		5,499,998.94	2,909.88	862,257.97	85,250.61	950,418.48	0.00	951,388.42	4,546,610.52	17.30	

Summary Financial Report - Combination of Collaborative Project and Coordination and Support Action

Project Acronym	PrepSKA	Project number	212243	Reporting period from	01/04/2008	to:	30/09/2009	Page	01-Jan

Funding Scheme	CP+CSA

Beneficiary number	If 3rd party, linked to beneficiary	Adjustment (yes/no)	Organisation short name	Type of activity: RTD (A)		Coordination (B)		Support (C)		Management (D)		Other (E)		Total (A)+(B)+(C)+(D)+(E)		Receipts	Interest
				Total	Max EC Contribution	Total	Max EC Contribution	Total	Max EC Contribution	Total	Max EC Contribution	Total	Max EC Contribution	Total	Max EC Contribution		
1		No	STFC					67,096.44	67,096.44	9,157.13	9,157.13			76,253.57	76,253.57		
2		No	NOW					163,836.90	109,565.92					163,836.90	109,565.92		
3		No	INAF					217915.55	151,880.35		0.00			217,915.55	151,880.35		
4		No	UMAN	3,879.84	2,909.88			798,078.91	533,715.27	76,093.49	76,093.49			878,052.24	612,718.64		
Total				3,879.84	2,909.88	0.00	0.00	1,246,927.80	862,257.98	85,250.62	85,250.62	0.00	0.00	1,336,058.26	950,418.48		
Requested EC contribution for the reporting period (in €)															950,418.48		

8. Certificates

List of Certificates which are due for this period, in accordance with Article II.4.4 of the Grant Agreement.

Beneficiary	Organisation short name	Certificate on the financial statements provided? yes / no	Any useful comment, in particular if a certificate is not provided
1	STFC	No	Expenditure threshold not reached
2	NWO	No	Expenditure threshold not reached
	INAF	No	Expenditure threshold not reached
Etc.	UMAN	Yes	

A copy of each duly signed certificate on the financial statements (Form C) or on the methodology should be included in this section, according to the table above (signed originals to be sent in parallel by post).

LIST OF ABREVIATIONS

AA.....Aperture Array
AAVP.....Aperture Array Verification Program
ASKAP.....Australian SKA Pathfinder
CART.....Composite Applications for Radio Telescopes
CDR..... Critical Design Review
C&P..... Cost and Performance tool
CoDR..... Concept Design Review
DR ..... Design Review
DRM.....Design Reference Mission
DVP ..... Dish Verification Program
IVS.....Initial Verification System
MRO..... Murchison Radio Observatory
NRC-HIA.....National Research Council-Hertzberg Institute of Astrophysics
PAF.....Phase Array Feed
PDR ..... Preliminary Design Review
SEDG ..... System Engineering Design Group
SEMP ..... System Engineering Management Plan
SKA ..... Square Kilometre Array
SKADS.....SKA Design Studies
SPDO.....SKA Program Development Office
SRR .....System Requirements Review
SRS.....System Requirements Specification
SSEC.....SKA Science and Engineering Committee
SWG.....Science Working Group
WBSPF.....Wide Band Single Pixel Feed

LIST OF CONTRIBUTING INSTITUTIONS

ASTRON.....Netherlands Foundation for Research in Astronomy (NL)
CNRS.....Centre National de la Recherche Scientifique (FR)
Cornell.....Cornell University (USA)
CSIRO.....Commonwealth Scientific and Industrial Research Organisation (AU)
DIISR.....Department of Innovation, Industry, Science and Research (AU)
ICRAR.....International centre for Radio Astronomy Research (AU)
INAF.....Istituto Nazionale di Astrofisica (IT)
IT.....Instituto de Telecomunicacoes (PT)
JIVE.....Joint Institute for VLBI in Europe (EU (NL))
MPG….....Max Planck Institut fur Radioastronomie (DE)
NRC-HIA.....National Research Council – Herzberg Institute of Astrophysics (CA)
NRF.....National Research Foundation (ZA)
NWO.....Netherlands Organisation for Scientific Research (NL)
OBSPAR.....Observatoire de Paris (FR)
RUG.....University of Gronigen (NL)
SPDO.....SKA Program Development Office (UK)
STFC.....Science and Technology Facilities Council (UK)
UCAL.....University of Calgary (CA)
UCAM.....University of Cambridge (UK)
UMAN.....University of Manchester (UK)
UORL.....University d' Orleans (FR)
UOXF.DL.....University of Oxford (DL)