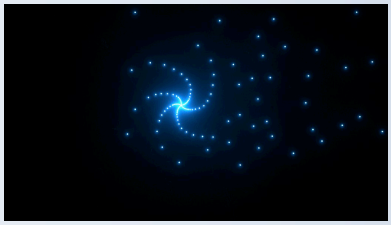
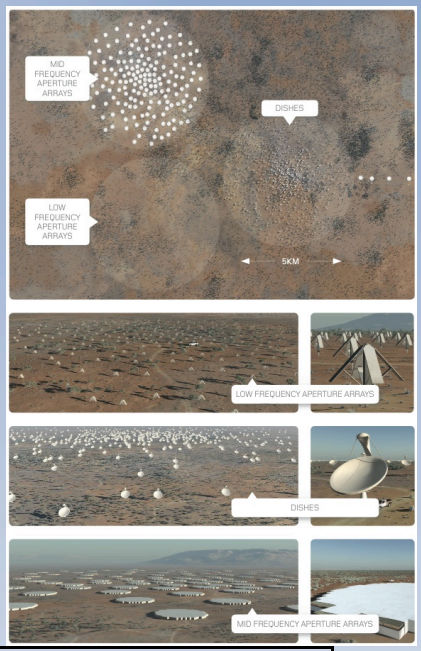
What is SKA?

The **Square Kilometre Array (SKA)** will be a multi-purpose interferometer of thousands of antennas linked together to provide a collecting area of one square kilometre and distributed in an area nearly the size of a continent. The SKA will be 50 times more sensitive than any other radio instrument and will survey the sky at least 10.000 times faster than the best current-day telescopes. Signals from separated antennas shall be combined via high-speed data links to a central processor, providing an angular resolution equivalent to that of a telescope with a diameter of more than 3000 km.



In order to achieve both high sensitivity and high-resolution images of the radio sky, the antennas of the SKA will be densely distributed in the central region of the array, and then logarithmically positioned in groups (more spaced at extremes) along several spiral arms extending up to 3000 km from the central core.



Three antenna types, high-frequency dishes and mid & low-frequency aperture arrays, will be used to provide continuous frequency coverage from 70 MHz to 10 GHz. In the lower (70-450 MHz) and middle (450-1400 MHz) part of the frequency band, two different types of antenna, aperture arrays, will act as a radio wide-angle lens and will be used to observe very large areas of the sky simultaneously. In the higher (1.2-10 GHz) part of the frequency band, the SKA will use 3000 dish antennas, each about 15 m wide, which will operate as a radio camera to provide high quality images.

The signal from the receiving elements will be transported back by optical fibres carrying up to 420 Gb/sec per dish and 16 Tb/sec per aperture array to a central processing engine where the data will be handled to form images and time series, and to combat the effect of radio frequency interference (RFI) signals.

Frequency Range	70 MHz To 10 GHz
Sensitivity Area / System Temp	5000 m²/K (400 μjy in 1 minute) between 70 And 300 MHz
Survey Figure-Of-Merit	4×10^{7} – 2×10^{10} m^4 K^{-2} deg^2 depending on sensor technology and frequency
Field-Of-View	200 square degrees between 70 And 300 MHz 1-200 square degrees between 0.3 And 1 GHz 1 square degree maximum between 1 And 10 GHz
Angular Resolution	<0.1 arcsecond
Instantaneous Bandwidth	Band Centre ± 50%
Spectral (Frequency) Channels	16384 per band per baseline
Calibrated Polarisation Purity	10000:1
Synthesised Image Dynamic Range	>1000000
Imaging Processor Computation	~10^{17} operations/second
Final Processed Data Output	10 Gb/second

Two locations are under consideration: Southern Africa and Australia–New Zealand. In Australia the SKA would stretch all the way to New Zealand, and in Southern Africa it would stretch to the Indian Ocean islands. The final site decision will be made in 2012 and will be based on several factors including the operating and infrastructure costs, as well as levels of radio interference.

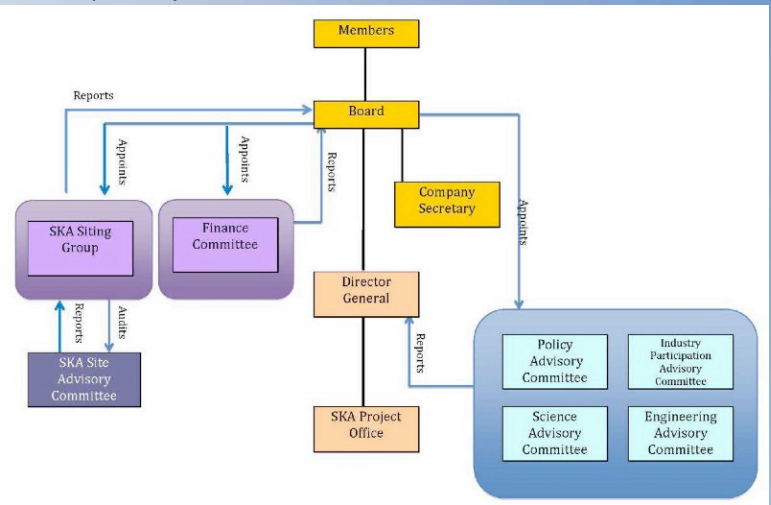
The SKA will be one of the key net generation instruments, with potential for fundamental breakthroughs in Radioastronomy, and, at the same time, will drive technological development in other areas of social impact, such as high-speed data distribution, massive data processing, or in the generation, storage and distribution of renewable energy, among others.

The total target cost for SKA is 1500 M€.

SKA Organizational Overview

Currently, the SKA Program Development Office (SPDO), based at the University of Manchester (UK), is the central organisation and is preparing a costed design that will be completed by 2012.

At November 2011, the SKA project was established as a stand-alone legal entity named The SKA Organisation (TSO). The governance structure of the SKA organization is shown in the figure. In late November the seven initial members of TSO (Australia, China, Italy, The Netherlands, New Zealand, South Africa and UK) signed the Members' Agreement and Articles of Association. It is anticipated that Germany and Canada will also become Members in 2012.

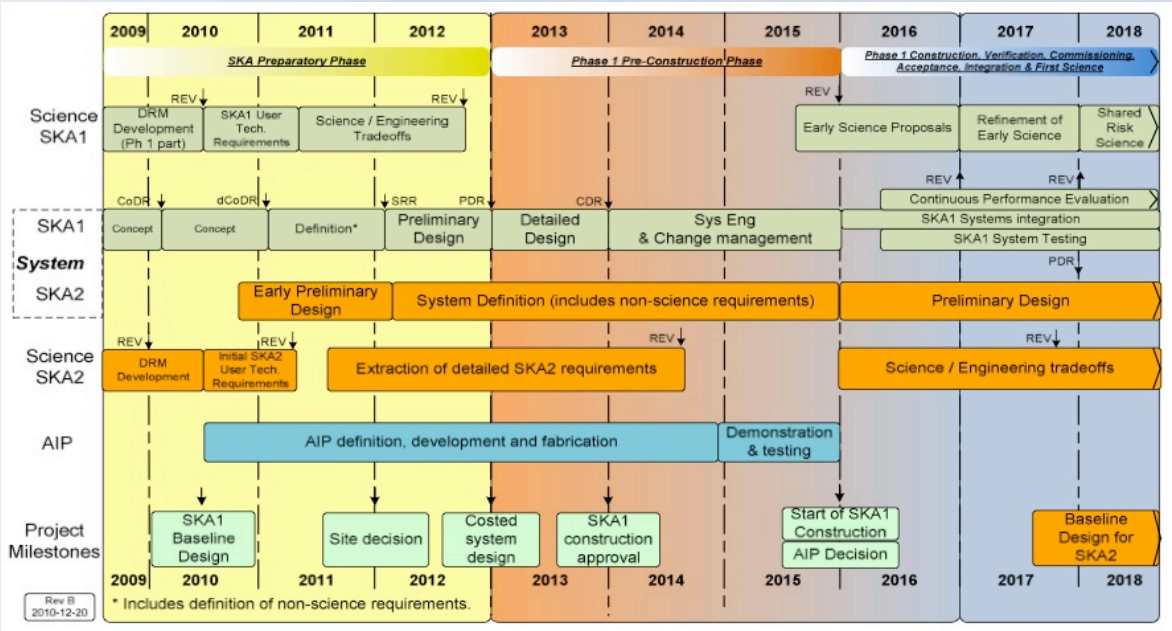


Top level (indicative) schedule for the SKA	
Technical	
2008-12	Telescope concept design and cost
2013-15	Detail design & pre-construction cost
2016-18	Phase 1 construction
2016	Advanced instrumentation program decision
2018 ->	Full science operations with phase 1
2024 ->	Full science operations with phase 2
Programmatic	
Nov 2011	Approve pre-construction funding
Dec 2011	Establish SKA organisation as a legal entity
Early 2012	Site selection
2014	Phase 1 construction funding approved (350 M€)
2017	Phase 2 construction funding approved (1.2 B€)

The project is now entering a transition period. Many functions of the SPDO will be transferred to the new organisation (SKA Project Office, SPO) by March 2012. Meanwhile the SPDO will manage central funding and work allocation for the pre-construction phase of the SKA instrument at the selected site.

By the end of 2012 the organisation will be relocated to the newly built headquarters within the Jodrell Bank radio astronomy complex outside Manchester, UK.

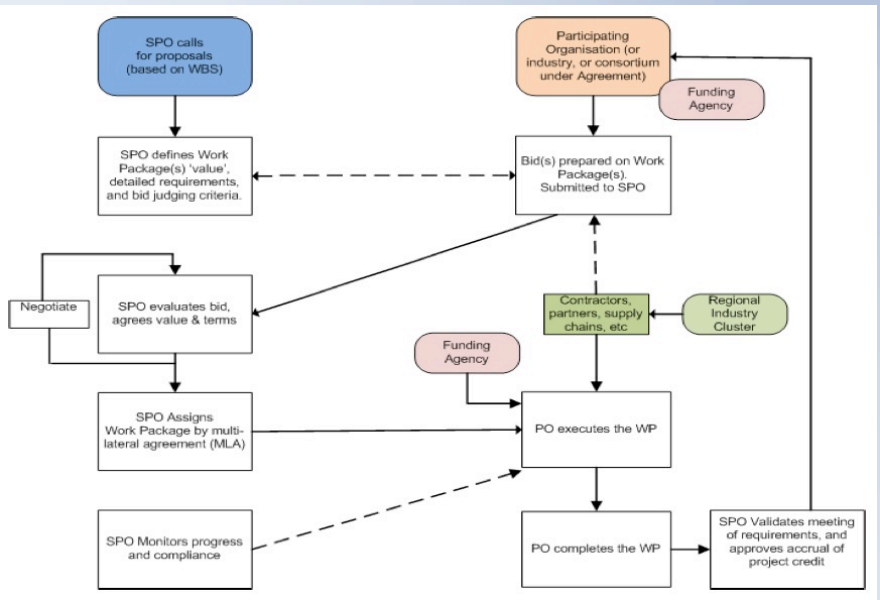
A more detailed (indicative) time chart for the SKA Project (as of November 2011) is shown in the figure below.



SKA Work Breadown Structure (WBS)		
	Facilities	
	Project Management	
	Science	
	SKA System Design and System Level System Eng.	
	Telescope	
		Dish Array
		Low Frequency Aperture Array
		Signal and Data Transport
		Central Signal Processor
		Science Data Processor
		Telescope Manager
		Sync and Timing
		Power
		Site and Infrastructure
		Advanced Instrumentation

The scope of the project to be developed in the Pre-construction Phase, Stage 1, will include all work, at all levels, necessary to develop the SKA project from the end of the preparation phase to the completion of the definition phase. The SKA high-level breakdown structure is shown in the table (left).

The SKA project will have a strong central Project Office (SPO) with management and system design authority. Once approved, the SPO will allocate the Work Packages covering major subsystems to a small number of successful bidders, who may be Participating Organizations (POs). WP Consortia (formed by institutes and/or industry) will be funded by local sources and will operate under Consortium Agreements. By forming consortia, the capacity required to carry out large WPs can be assembled from several organisations so as to make maximum use of expertise. Close links between different levels will provide close collaboration and involvement between the SPDO/TSO and consortia, as well as inside each consortium.



The currently **proposed process for allocation of the Pre-construction phase Work Packages** is shown in the left figure. The legal instrument covering the award of the WP will be a form of multilateral agreement, while the bidding consortia will be required to set in place a formal contract between the parties.

The preparation of the WBS/SOW for the Pre-construction Phase Work Packages shall take place during the first quarter of 2012 as listed in the table below.

The Request for Proposals (RFP) is scheduled for April 2012. Bids must be presented, evaluated and the agreements signed by June 2012.

Major milestones for the WBS/SOW preparation	
14 Nov 2011	First draft and wider review of WBS
12 Dec 2011	First inputs from working groups
30 Jan – 3 Feb 2012	Work session in Manchester
12 Mar 2012	Final draft to Interim General Director
26 Mar 2012	Final publication of WBS/SOW

Industrial Overview

As the SKA project moves through the design, development, construction and operational stages, industry will play a crucial role in the delivery and through-life support of the technologies and infrastructures. The scale of the SKA, as well as the need to mass-produce components, requires industry engagement on a scale unprecedented in radio astronomy.

The SKA expects to collaborate with a variety of industry partners, including niche R&D companies, followed by increasing engagement through commercial contracts with high-volume manufacturers, technology systems vendors, site services and installation firms, as well as power and data transmission specialists.

SKA domains with potential for industry engagement are the following:

- Site studies and infrastructure engineering.
- Scheduling, operations and maintenance models.
- Low-cost, mass manufacturing of small to medium diameter dishes.
- Wide bandwidth feed antennas for dishes.
- Broadband, active, phased arrays for aperture and focal plane applications.
- Low-noise, highly integrated, receivers for both cryogenic and uncooled applications.
- High-speed (terabits/s) digital fibre optic links for distance regimes extending from 100 m to >3 000 km.
- Low-cost, high-speed (GS/s) analogue to digital converters.
- High-speed digital signal processing engines (petabyte/s) and ultra-fast super computing (at exaflop rates).
- Power supply.

The SKA will drive technology development, particularly in information and communication technology. Spin-off innovations in this area will benefit other systems that process large volumes of data from geographically dispersed sources. The energy requirements of the SKA also provide an opportunity to accelerate technology development in scalable renewable energy generation, distribution, storage and demand reduction.

Pivotal SKA technology is being demonstrated with a suite of precursor and pathfinder telescopes as well as with design studies by SKA groups around the world. Key SKA technologies will be determined from these and many solutions will be selected and integrated into the final instrument.

SKA Pre-cursors	
ASKAP (Australia)	Phased Array Feed (PAF) to trial wide-field-of-view high-dynamic technologies
MeerKAT (South Africa)	Array of 60 13.5 m offset-fed dishes with single pixel wideband feeds
MWA (USA, Australia)	Low-frequency (80-300 MHz) single band sparse array telescope based on tile of bow-tie dipole elements
SKA Pathfinders	
LOFAR (Netherlands)	Low-frequency aperture array telescope based on antenna tiles
ATA (USA)	42-element array to test coupling effects between shrouded offset Gregorian antennas
APERITIF (Netherland)	Phased Array Feed system (PAF) of dual polarized antenna arrays
e-MERLIN (UK)	cm-wavelength array spanning 217 km (first full-time array to be connected at 10 Gb/sec)
e-EVN (Europe)	Interferometry network of radio telescope from Europe to China to Puerto Rico and South Africa
EVLA (USA)	27-element array of 25 m diameter dishes located in New Mexico
LWA (USA)	~53 stations of ~256 dipole pairs spread over ~100 m diameter area
SKA Molonglo Prototype (Australia)	To provide low frequency spectroscopy and polarisation capability
Arecibo (USA)	Development of phased array feeds and testing of data management and cyber infrastructure

SKA Industrial participation in Spain: VIA-SKA

VIA-SKA is the name of the project led by the Instituto de Astrofísica de Andalucía (CSIC) for studying the feasibility of the Spanish Industrial Participation in the Square Kilometre Array (SKA). This project has been funded by the Ministerio de Ciencia e Innovación (MICINN) and includes researchers and engineers from the Instituto Geográfico Nacional, Universidad de Granada, Universidad de Barcelona, Universidad Carlos III, Instituto de Física de Cantabria / Universidad de Cantabria, Universidad de Valencia, Centro de Astrobiología and Instituto Astrofísico de Canarias.

Currently, Spain has requested to be an Observer entity in the SKA Founding Board. The aim of the VIA-SKA project is to analyze the feasibility and interest of the Spanish industrial participation in SKA that could lead to the eventual formation of a Consortium of Public Research Centres and Industry. This could provide to the relevant Spanish funding agencies with solid reasons for joining the SKA Organization, with enough guarantees to ensure the industrial return.

VIA-SKA main actions are:

- Identifying the technological niches in which both Spanish Industry and Research Centres may contribute to the SKA work packages, and those areas in which the Spanish science-technology system could benefit from such participation.
- Establishing contacts with previously identified Spanish Industry and Research Centres to inform them about the SKA opportunities and the details about their possible participation.
- Providing a Knowledge Base for members (Research Centres and Industry participating in VIA-SKA), which will be kept updated to the status and requirements of the SKA programme.
- Interacting with Industry groups in other countries to establish strategic alliances for participating in the definition of the SKA work packages.
- Promoting the formation of a Consortium and proposing its participation in the SKA work packages.

As part of the actions of the VIA-SKA project, a survey of Spanish industry is being performed in order to identify the actors that could have technological profiles relevant to the SKA project. The intention is to introduce the SKA project to Spanish Industry and identify companies interested in a prospective participation in SKA.

In case of interest, companies are requested to participate in VIA-SKA. Company contact details will be included in the VIA-SKA mailing lists and company information registered in the VIA-SKA web portal, where the company technological skills and SKA work packages best matching those skills will be identified.

The identification of Spanish Industry's interest and capabilities is a previous step to attempt the eventual formation of a Consortium, and to promote official Spanish participation in the SKA project.

The need for a quick response by Spanish industry at this point is driven by the SKA schedule. The preparation of the SKA WBS/SOW for the Pre-construction Phase Work Packages shall take place during the first quarter of 2012. The Request for Proposals (RFP) is scheduled for April 2012. The potential consortium must be ready before that time to enter in competition.

Sources

Documents used as sources to build these introductory pages are:

SKA WBS/SOW Guidelines

SSKA Project Execution Plan, R. T. Schilizzi et. al. (http://www.skatelescope.org/publications/)

SKA Official web page: http://www.skatelescope.org

Update on the SKA, R. T. Schilizzi, AA Workshop (http://www.astron.nl/aavp2011/documents.php)

Acronyms

AIP	Advanced Instrumentation Program
APERITIF	Aperture Tile In Focus
ASKAP	Australian SKA Pathfinder
ATA	Allen Telescope Array
e-MERLIN	electronic Multi-Element Radio Linked Interferometer Network
e-EVN	electronic European VLBI Network
EVLA	Expanded Very Large Array
LOFAR	Low Frequency Array
LWA	Low Wavelength Array
MWA	Murchison Widefield Array
PAF	Phased Array Feed
PO	Participating Organization
RFI	Radio Frequency Interference
RFP	Request For Proposals
SKA	Square Kilometer Array
SOW	Statement Of Work
SPDO	SKA Program Development Office
SPO	SKA Project Office
TSO	The SKA Organization
WBS	Work Breakdown Structure
WP	Work Package

Contact:

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