Welcome and SKA Overview

Michiel van Haarlem

Interim Director General – SKA Organisation

15 February 2012

SKA Concept

- A large radio telescope for transformational science:
  - up to 1 million m^2 antenna collecting area distributed over a distance of 3000^+ km;
  - operating at frequencies from 70 MHz (wavelength = 3+m) to 10GHz (~3 cm) with two or more detector technologies;
  - connected to a signal processor and high performance computing system by an optical fibre network.
- Providing
  - 50 x sensitivity of current world's best radio interferometers, and
  - up to 1 million x survey speed

Phased Construction

- Construction will proceed in two phases (SKA1 & SKA2).
  - Phase 1 will be a subset (~10%) of Phase 2.
- Major science observations already possible with Phase 1.
- Phased construction => parallel technology development for SKA2.

SKA2 Key Science Drivers

ORIGINS

- **Neutral hydrogen in the universe from the Epoch of Re-ionisation to now**

  When did the first stars and galaxies form?
  How did galaxies evolve?
  Dark Energy, Dark Matter

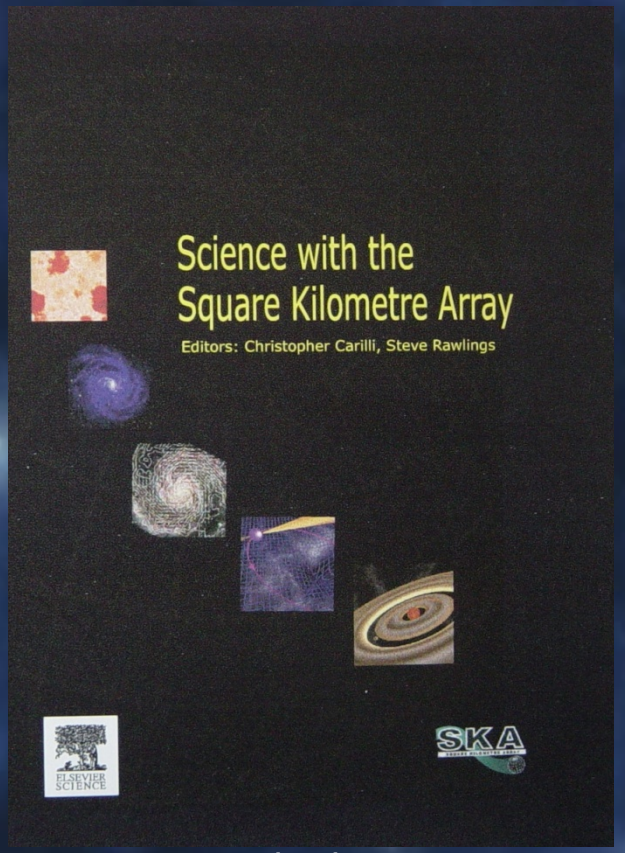
- **Astro-biology**

FUNDAMENTAL FORCES

- **Pulsars, General Relativity & gravitational waves**

- **Origin & evolution of cosmic magnetism**

TRANSIENTS (NEW PHENOMENA)



Science with the Square Kilometre Array

(2004, eds. C. Carilli & S. Rawlings, *New Astron. Rev.*, **48**)

SKA1 Key Science Drivers

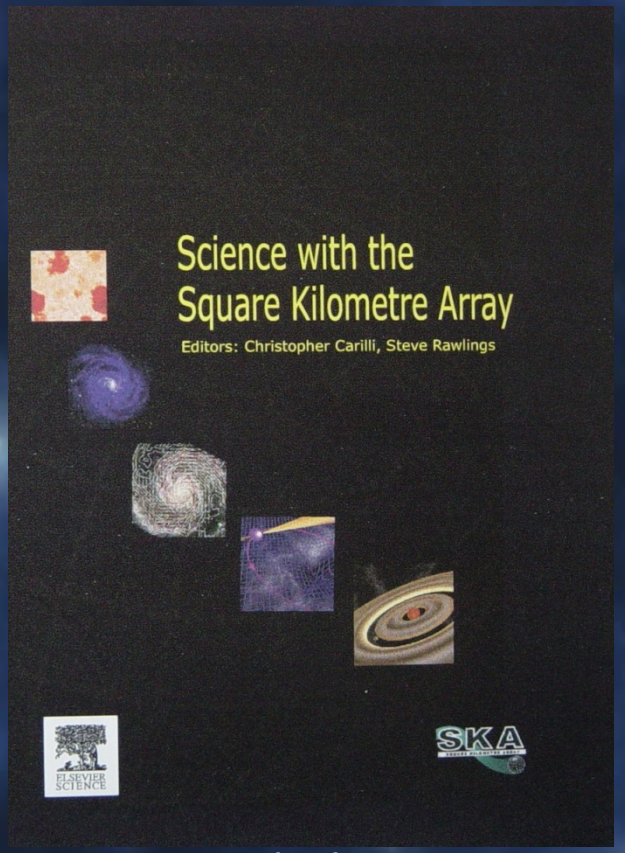
ORIGINS

- **Neutral hydrogen in the universe from the Epoch of Re-ionisation to now**

When did the first stars and galaxies form?
How did galaxies evolve?
Dark Energy, Dark Matter

FUNDAMENTAL FORCES

- **Pulsars, General Relativity & gravitational waves**

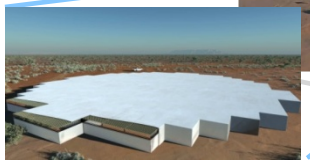


Science with the Square Kilometre Array

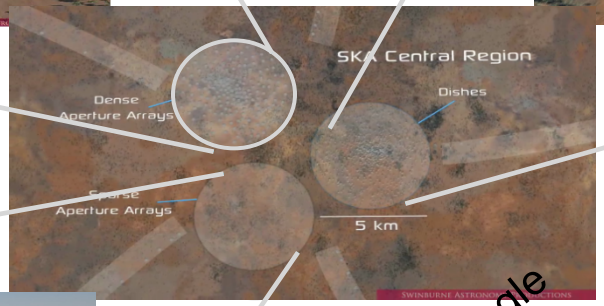
(2004, eds. C. Carilli & S. Rawlings, *New Astron. Rev.*, **48**)

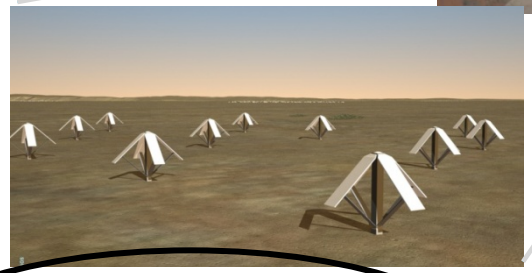
SKA2 Receptor Technologies

250 Mid Frequency Aperture Array Stations



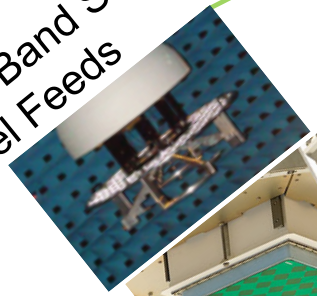
3000 Dishes

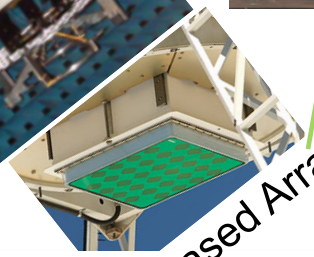




250 Low Frequency Aperture Array Stations

Wide Band Single Pixel Feeds





Phased Array Feeds

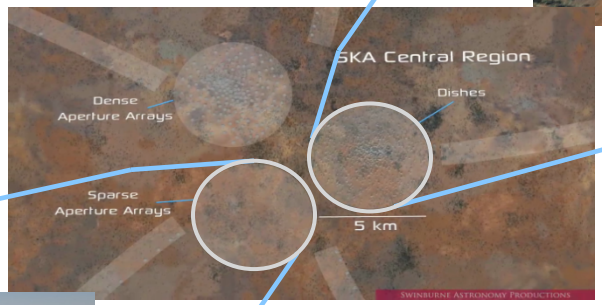
Artist renditions from Swinburne Astronomy Productions

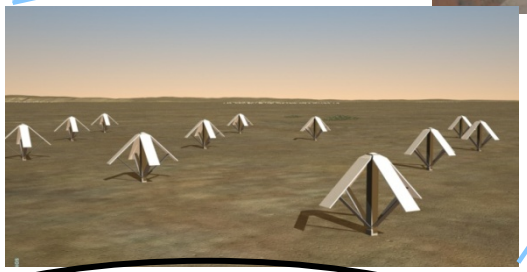
SKA1 Receptor Technologies

Baseline technologies are mature and demonstrated in the SKA Precursors and Pathfinders

250 Dishes

Central Region





50 Low Frequency Aperture Array Stations

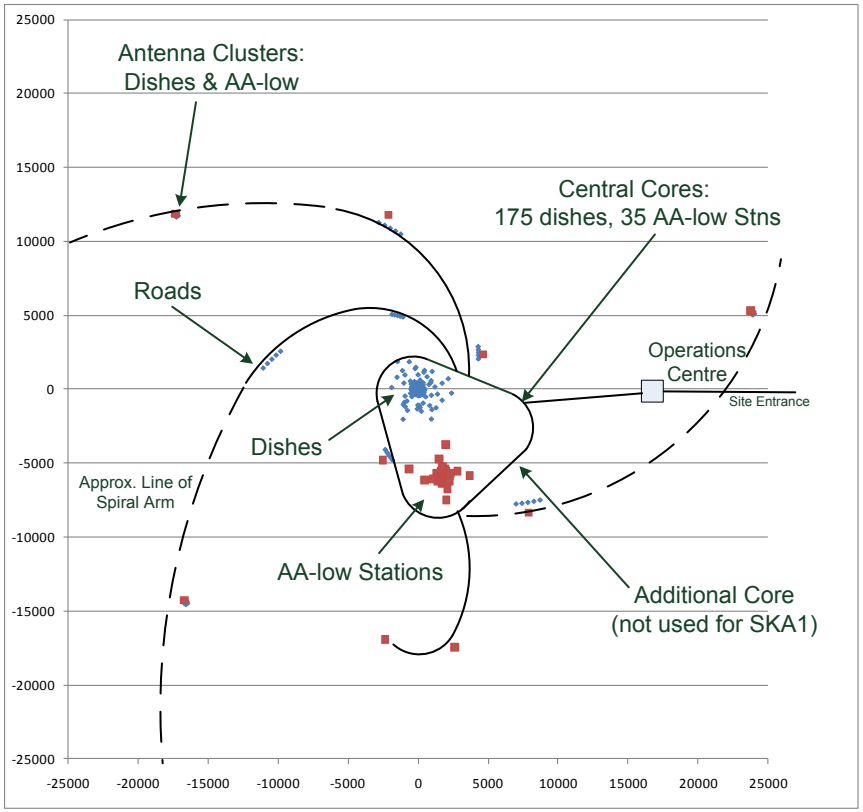
Single pixel feed

Exploring the Universe with the world's largest radio telescope

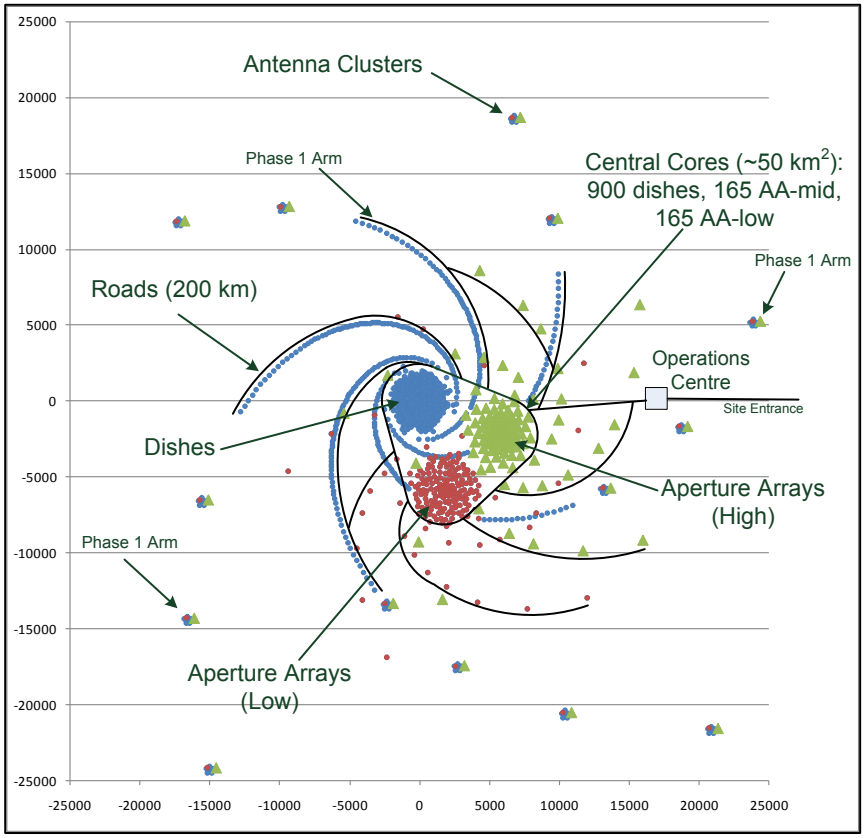
Artist renditions from Swinburne Astronomy Productions

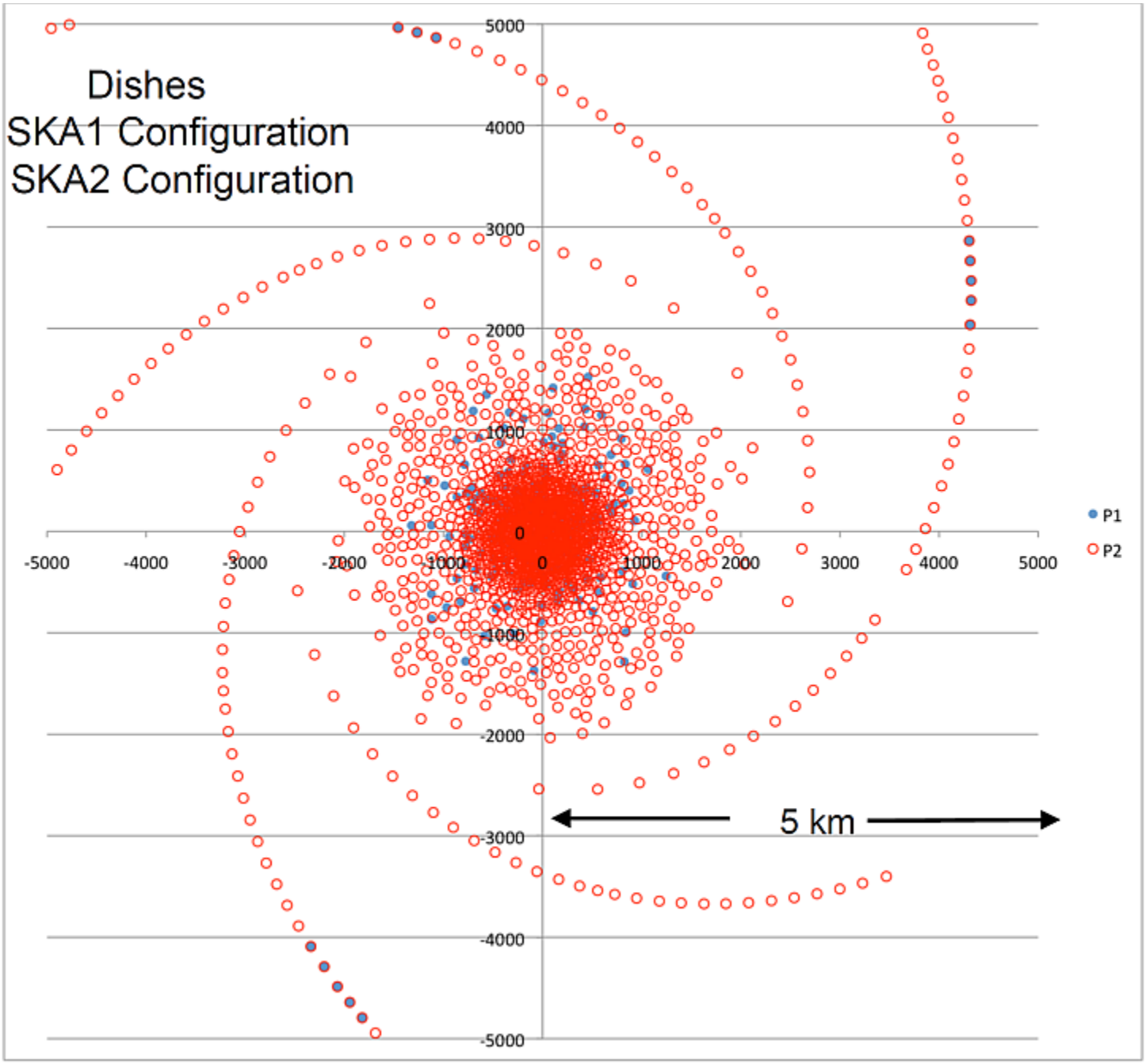
SKA Site Layout

Central SKA1 Site



Central SKA2 Site

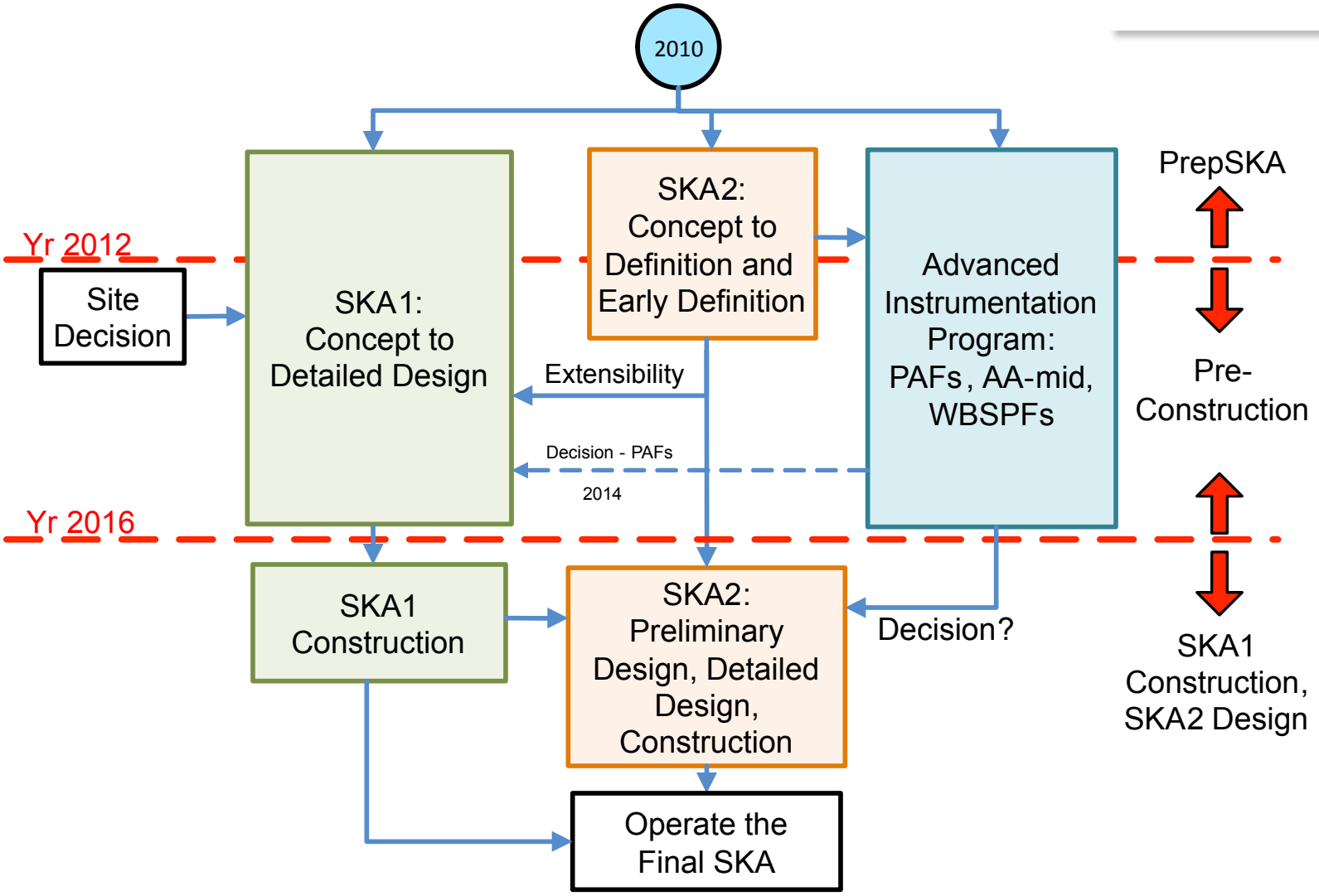



Dishes
Blue: SKA1 Configuration
Red : SKA2 Configuration
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
4000
5000
P1
P2
5 km

SKA1 => SKA2

- SKA1 has been broadly defined (science & technology).
  - "Step" along the way to constructing SKA2.
- However, the full technology complement for SKA2 is not yet well defined
  - a flexible plan for SKA1 => SKA2 is needed
  - introduce a program to mature the technologies that will enhance the science output of SKA2.
  - **Advanced Instrumentation Program (AIP)**
- The AIP will continue to develop innovative technology for
  - Phased array feeds on the dishes (PAFs),
  - Mid-frequency Aperture Arrays (AA-mid),
  - Ultra-wideband single pixel feeds on the dishes (WBSPFs).
- Development of AIP technologies
  - parallel with design and roll-out of SKA1 until early 2016
  - decision made on usage in SKA2.

Phased Approach to Technical Development



Top Level Schedule

Technical

- 2008 - 12 Telescope system design and cost (preparatory)
- 2013 - 15 Detailed design in the pre-construction phase
- 2016 - 19 SKA1 construction
- 2016 Advanced Instrumentation Program decision
- 2018 - 23 SKA2 construction
- 2020 → Full science operations with Phase 1
- 2024 → Full science operations with Phase 2

Programmatic

- 2011
  - Approve funding for pre-construction phase
  - Establish SKA Organisation as a legal entity
  - Select location for the office of the SKA Organisation
- 2012 Site selection
- 2014 Approve construction funding for SKA1
- 2018 Approve construction funding for SKA2

Site Selection

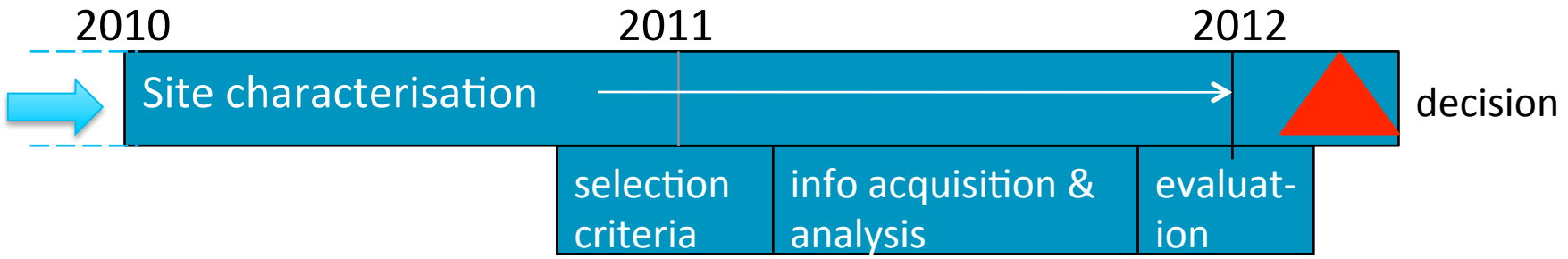
Physical requirements

1. Extremely radio quiet environment
2. At least 3000 km in extent
3. Low ionospheric turbulence
4. Low tropospheric turbulence

Two candidates short-listed in 2006:

Australia + NZ Southern Africa

(China and Argentina-Brazil not selected)

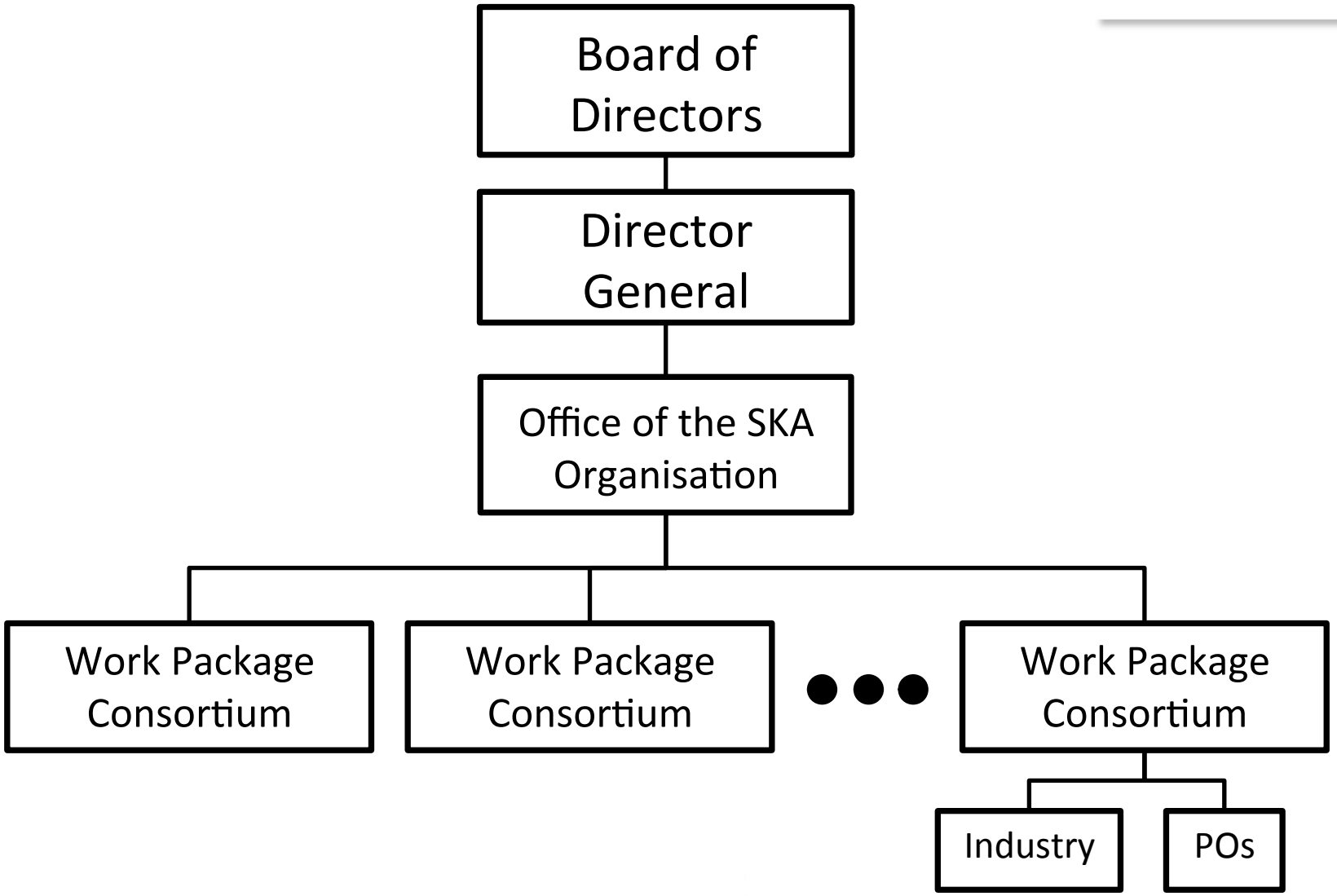


Site selection process

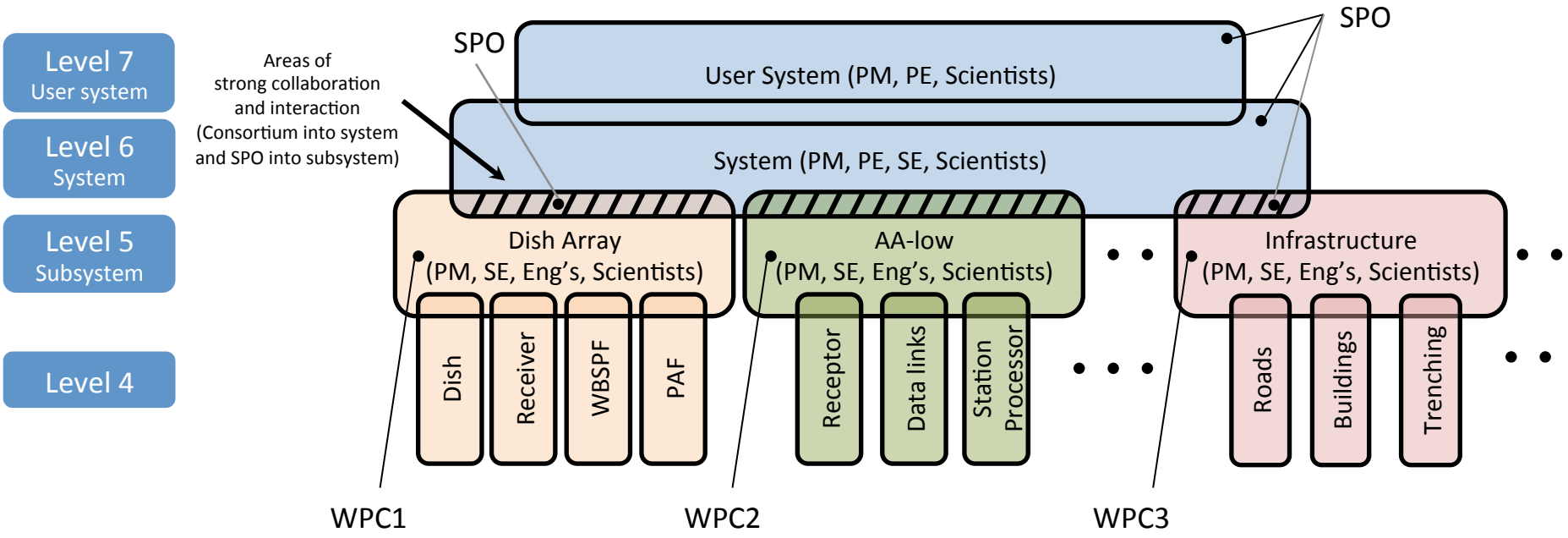

Image © 2007 TerraMetrics
Image NASA
Google


0
1000
2000
3000 km

SKA Organisation Chart



SKA Project Structure



Office of the SKA Organisation

- Will be responsible for:
  - the overall management and engineering of the project
  - establishment and roll out of project management practices and tools across the project
  - the overall SKA project management and system design
  - the execution of the full spectrum of system engineering activities such as requirements development and analysis, architectural design, trade-off studies, logistics engineering, etc.
  - oversee and manage the engineering effort covering aspects such as change control, technical control boards, implementation and testing of changes, etc.
- Project Management and Engineering strategies and philosophies within the project will be based on internationally accepted project management and system engineering principles, standards and practices

Work Package Consortia

- SKA Office will “contract” the work on major subsystems to a small number of work package consortia (WPC).
- The work package consortia have the responsibility to deliver production-ready subsystems (design and analysis documents, verified prototypes, etc) according to well defined requirements

Goals of Pre-construction Phase

- Progress the SKA design to Production Readiness Review stage and let contracts for construction of major sub-systems
- Progress infrastructure roll-out on selected site to allow sub-systems to be deployed (costs part of construction phase)
- Mature the SKA legal entity into an organisation capable of carrying out the construction, verification, and operation of the telescope

Delivering the Plan – Stage 1

Pre-construction phase Stage 1:

January 2012 – March 2013

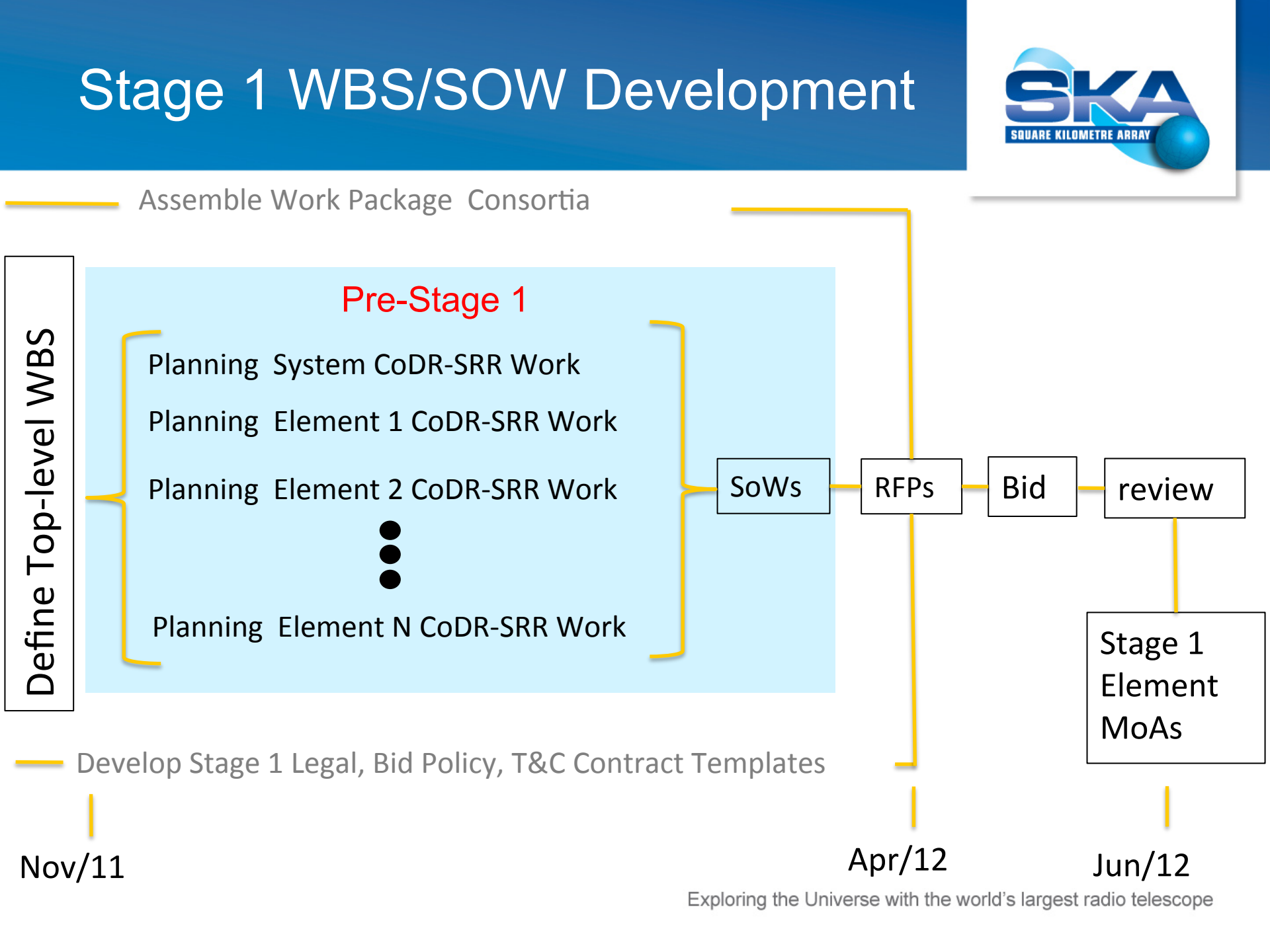
- Essentially completing the final steps of the preparatory phase programme
- Sign agreements by mid-2012 to complete work required to bring each sub-system through to (sub)systems requirements reviews (SRRs)
- Develop detailed work breakdown structures (WBSs) for the pre-construction phase (stage 2).

Delivering the Plan – Stage 2

Pre-construction phase Stage 2:
March 2013 – December 2015

- Work packages to be defined through to the beginning of telescope construction based on detailed Work Breakdown Structures (WBSs) developed in Stage 1.
- Conduct Preliminary Design Reviews (PDR), Critical Design Reviews (CDR) in preparation for Production Readiness Reviews.
- Final deliverables will be a series of “data packs”, which are self-contained document sets containing sufficient detail to let construction contracts.

Stage 1 WBS/SOW Development



Objectives of WBS/SOW

- The objectives of the WBS/SOW are:
  - To provide a clear overview of the scope of work to be performed during Stage 1 of the SKA pre-construction phase, and
  - To provide a clear overview of the deliverables to be developed during this phase.
- Used in the request for proposal process to be conducted by the SKA Organisation

Towards WP Assignments for Stage 1

- First draft Consortium Agreement ready by end February
- Close to final Stage 1 WBS/SOW ready by end February
- First draft indication of Work Packages extracted from WBS/SOW ready by end of February
- Issue call for **Expression of Interest** early March
- Receive Expressions three weeks later
- Consolidate and have results of EoI ready by end March
- Have final WBS/SOW ready by end March
- Have final Consortium Agreement template ready by end March
- Issue RFP's during April as well as guide the consortia forming during this period
- The visits to/meetings with potential consortia in May
- Receive RFP's at end of May
- Evaluate during early June
- Proposal to Board end of June


SKA
SQUARE KILOMETRE ARRAY