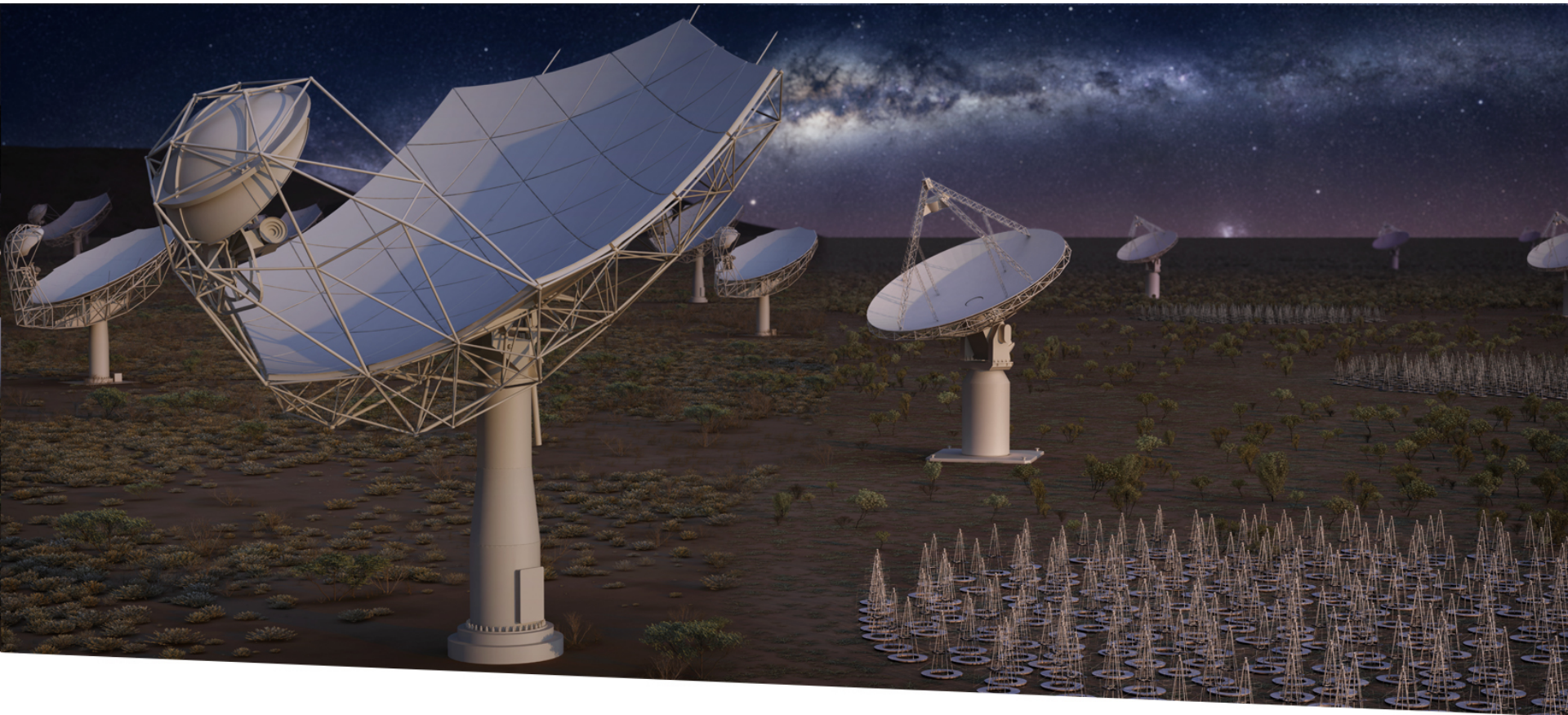


SKA Update



SQUARE KILOMETRE ARRAY Philip Diamond, Director-General

Exploring the Universe with the world's largest radio telescope

12th June 2017

Giovanni (Nanni) Bignami

1944 - 2017



Giovanni (Nanni) Bignami

- Physics, Milan, 1968
- Primarily X-ray astronomer; a PI in XMM-Newton 1988-1997
- Scientific Director, ASI (1997-2002)
- Director *Centre d'Étude Spatiale des Rayonnements* in Toulouse (2003-2006)
 - *Officier de la Légion d'Honneur*
- Chairman of ASI (2007-2008)
- President of INAF (2009-2015)
- Chairman SKA Board (2015-2017)

Distinguished astronomer, extremely high profile
ambassador for science and astronomy

ASKAP visit: September 2016



With Minister Pandor: 18 May



2017



Nanni's final boarding pass



Boarding Card / Tarjeta de embarque

BIGNAMI/GIOVANNIPROF

FROM / DE

Madrid (MAD)

DEPARTURE / SALIDA

25 May 19:50

TO / A

Milan-Linate (LIN)

ARRIVAL / LLEGADA

25 May 21:55



BN.1021

0751391165872

RESERVATION CODE / CÓDIGO DE RESERVA

LUQG4H

BOARDING TIME / HORA DE EMBARQUE

19:20 GRUPO 1

GATE CLOSES
CIERRE PUERTAS 19:35

GATE / PUERTA

-

FLIGHT / VUELO

IB3256

Operated by / Operado por
IBERIA LINEAS AEREAS

SEAT / ASIENTO

14F

Economy

--



2014 SKA Engineering Meeting
29 September - 2 October 2014
Fremantle, Western Australia



2013 SKA Engineering Information Leaflet

Manchester United Football Club
(Room: Salford Suite 1)
Manchester, UK

7-11 October 2013

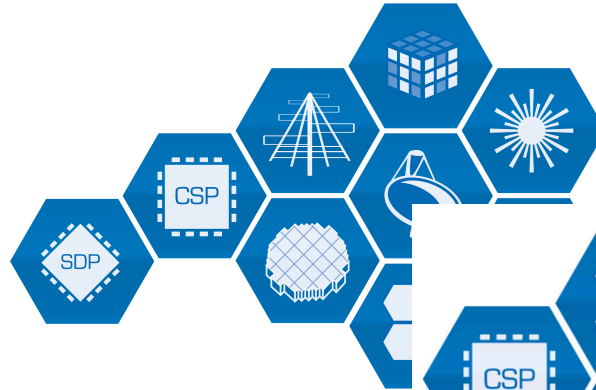
#SKAengcon14



Government of Western Australia
Department of the Premier and Cabinet
Office of Science



Australian Government
Department of Industry



Penticton
Nov 2015

Stellenbosch
Oct 2016





2017 SKA Engineering Meeting

12–16 June 2017

Rotterdam, the Netherlands

[#SKAengcon17](#)



Netherlands Organisation
for Scientific Research

ASTRON

Netherlands Institute for Radio Astronomy

Code of Conduct

- SKAO is committed to ensuring a meeting environment safe from bullying, intimidation, harassment, violence or discrimination.
- <https://indico.skatelescope.org/event/402/page/8>

Health, Safety and Environment Policy

We shall integrate good Health, Safety and Environmental performance in every planning, design and construction operations to achieve our aim of being safe and secure.



SKA PROJECT SAFETY MANAGEMENT PLAN

Document Number.....SKA-TEL-SKO-0000740
 Document Type PLAN
 Revision.....01
 Author.....John Kerr
 Date2017-03-21
 Document Classification.....UNRESTRICTED
 Status.....Released

Name	Designation	Affiliation	Signature
Authored by:			
John Kerr	Project Safety Manager	SKAO	Date:
Owned by:			
John Kerr	Project Safety Manager	SKAO	Date:
Approved by:			
Alistair McPherson	Head of Project	SKAO	Date:
Released by:			
Alistair McPherson	Head of Project	SKAO	Date:

“We want Health & Safety to be part of the way we think...

...we don't want it to be rooted in process...

...we want it to be part of our DNA...

...embedded in the way we approach work on a day to day level...”

Released in March

SKA— Key Science Drivers: The history of the Universe

Cosmic Dawn
(First Stars and Galaxies)

Testing General Relativity
(Strong Regime, Gravitational Waves)

Cradle of Life
(Planets, Molecules, SETI)

Galaxy Evolution
(Normal Galaxies $z \sim 2-3$)

Cosmology
(Dark Energy, Large Scale Structure)

Cosmic Magnetism
(Origin, Evolution)

Exploration of the Unknown

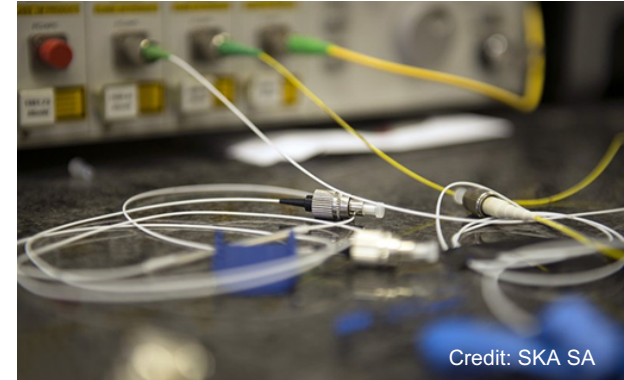
Broadest range of science of any facility, worldwide

SKA: driving innovation, creating impact



Infrastructure:

- Long-distance, high-capacity fibre networks
- High-performance computing and data storage
- Green computing



Credit: SKA SA



Software:

- Imaging techniques and data visualisation
- Machine learning and AI
- Data Mining

Past global impacts from Big Science, Research Infrastructures and astronomy:

- Internet, WWW, WiFi, global navigation systems, medicine
→ enormous contribution to global GDP and social wellbeing

Future huge potential impact from SKA and its innovation:

- eg Internet of Things

SKA Organisation: 10 countries, more to join



Australia (DoI&S)
Canada (NRC-HIA)
China (MOST)
India (DAE)
Italy (INAF)
Netherlands (NWO)
New Zealand (MED)
South Africa (DST)
Sweden (Chalmers)
UK (BEIS/STFC)



- Full members
- SKA Headquarters host country
- SKA Phase 1 and Phase 2 host countries

Interested Countries:

- Germany
- France
- Portugal
- Spain
- Switzerland
- Japan
- Korea

Contacts:

- USA
- Malta
- Mexico
- Brazil
- Ireland
- Russia



- African partner countries
(non-member SKA Phase 2 host countries)

This map is intended for reference only and is not meant to represent legal borders

Square Kilometre Array

3 sites; 2 telescopes + HQ

1 Observatory

Design Phase: ~ €200M; 600 scientists+engineers

Phase 1

Construction: 2019 – 2024

Construction cost cap: €674.1M (inflation-adjusted)

Operations cost: under development (see below)

MeerKat integrated

Observatory Development Programme (€20M/year planned)

SKA Regional centres out of scope of centrally-funded SKAO.

Phase 2: start mid-2020s (AIP now)

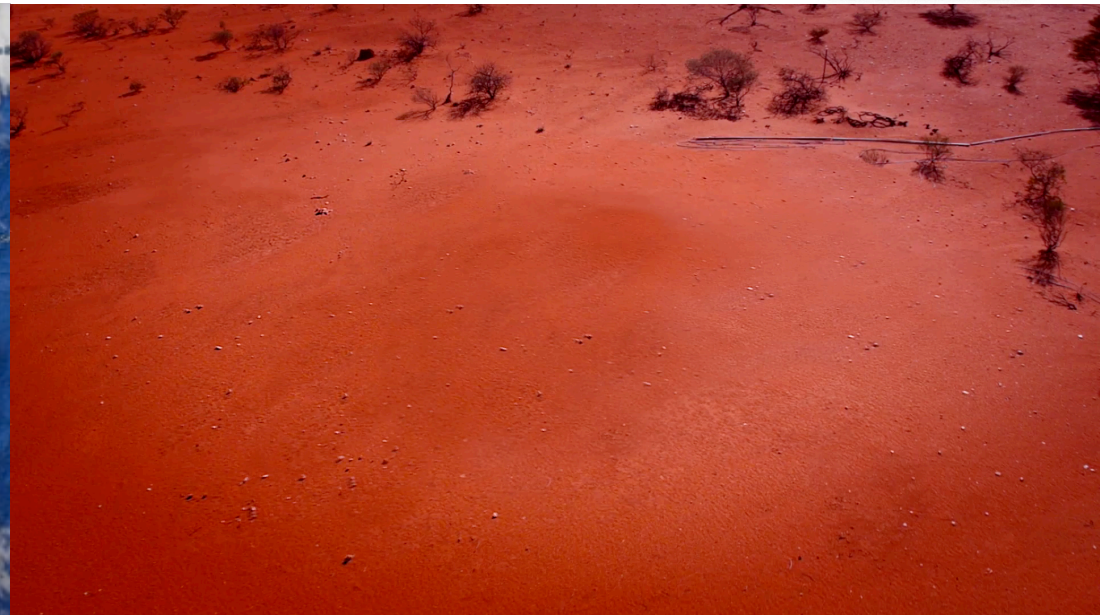
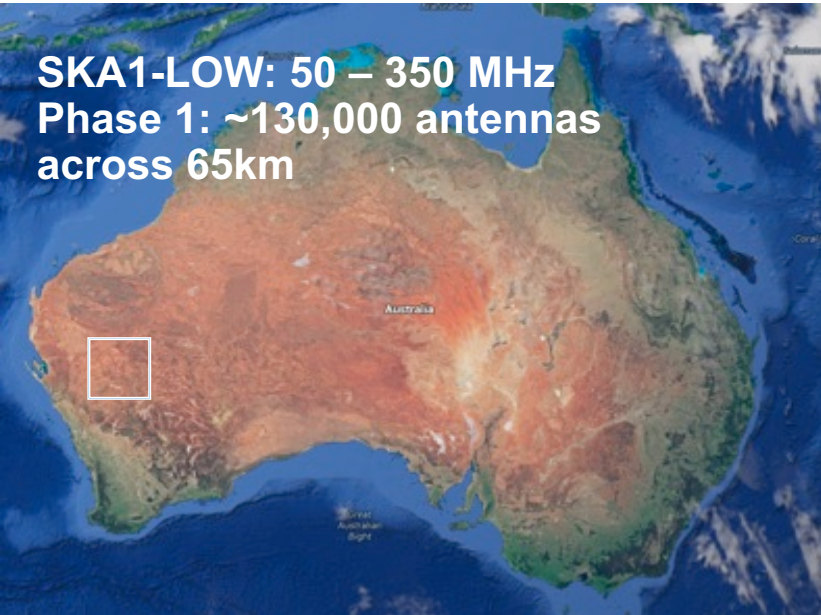
~2000 dishes across 3500km of Southern Africa

Major expansion of SKA1-Low across Western Australia

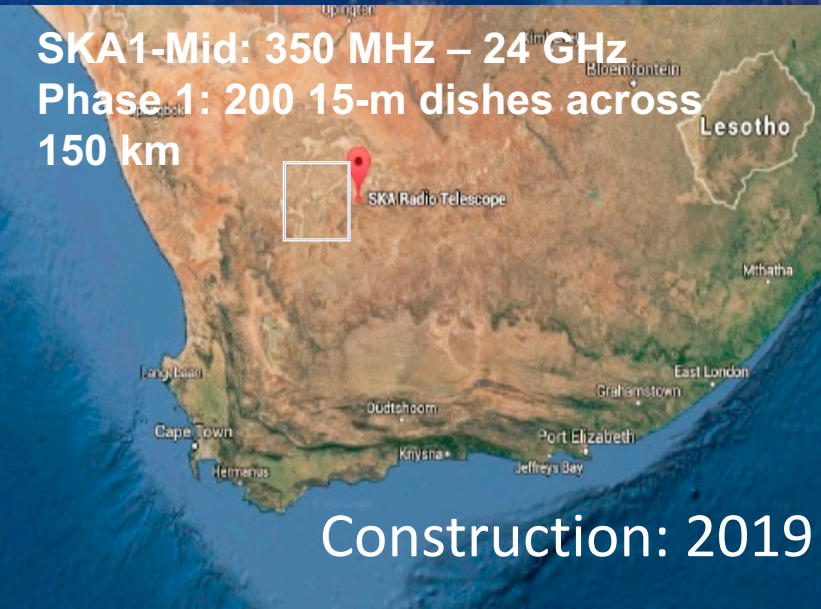
SKA: HQ in UK; telescopes in AUS & RSA



SKA1-LOW: 50 – 350 MHz
Phase 1: ~130,000 antennas
across 65km



SKA1-Mid: 350 MHz – 24 GHz
Phase 1: 200 15-m dishes across
150 km

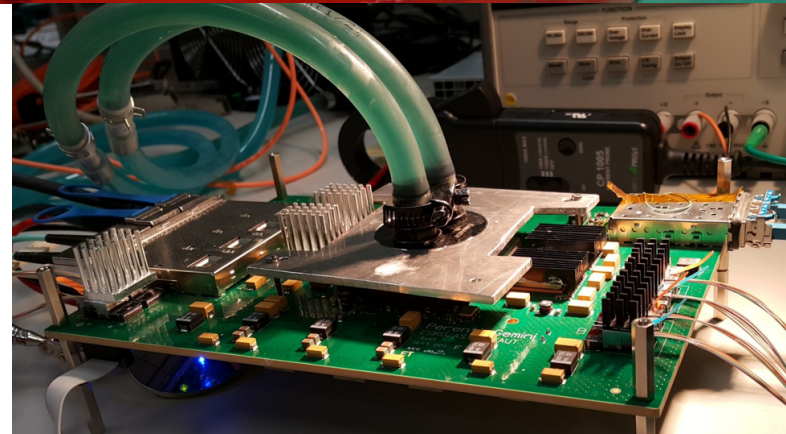
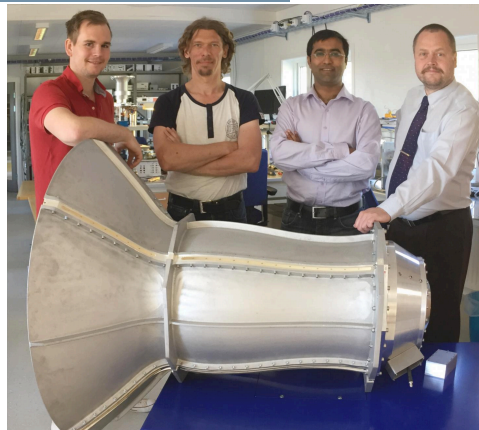
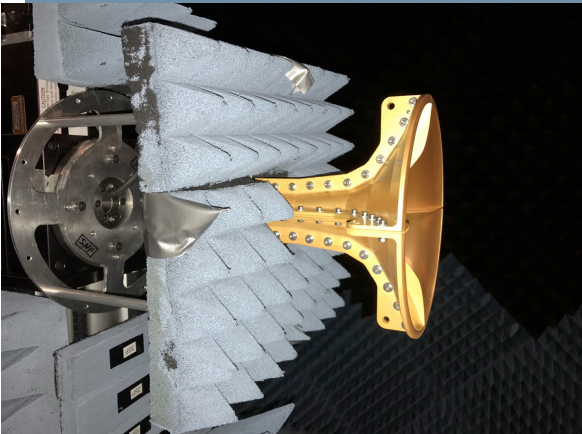
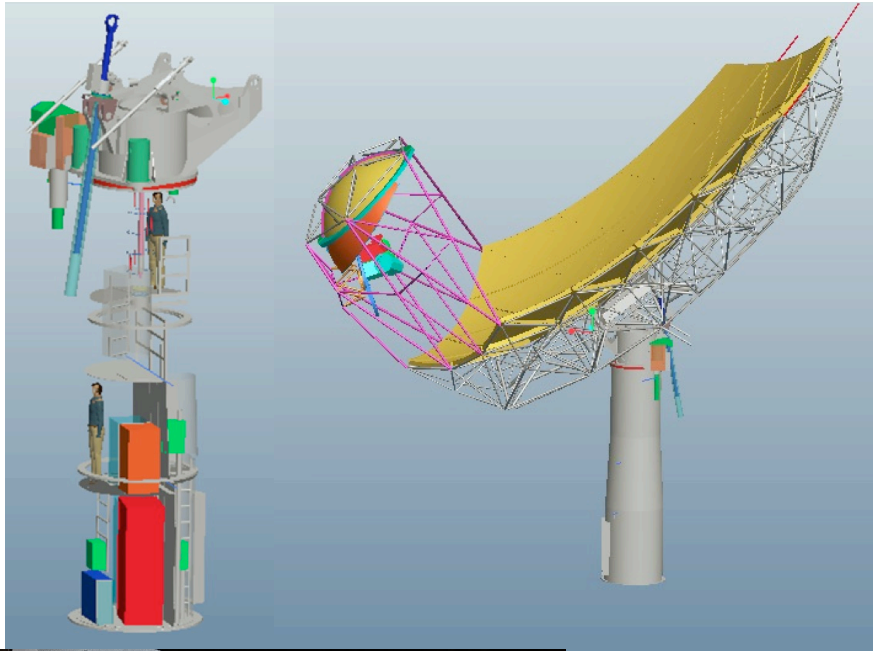


Construction: 2019 – 2024; Cost cap: €675M

Status



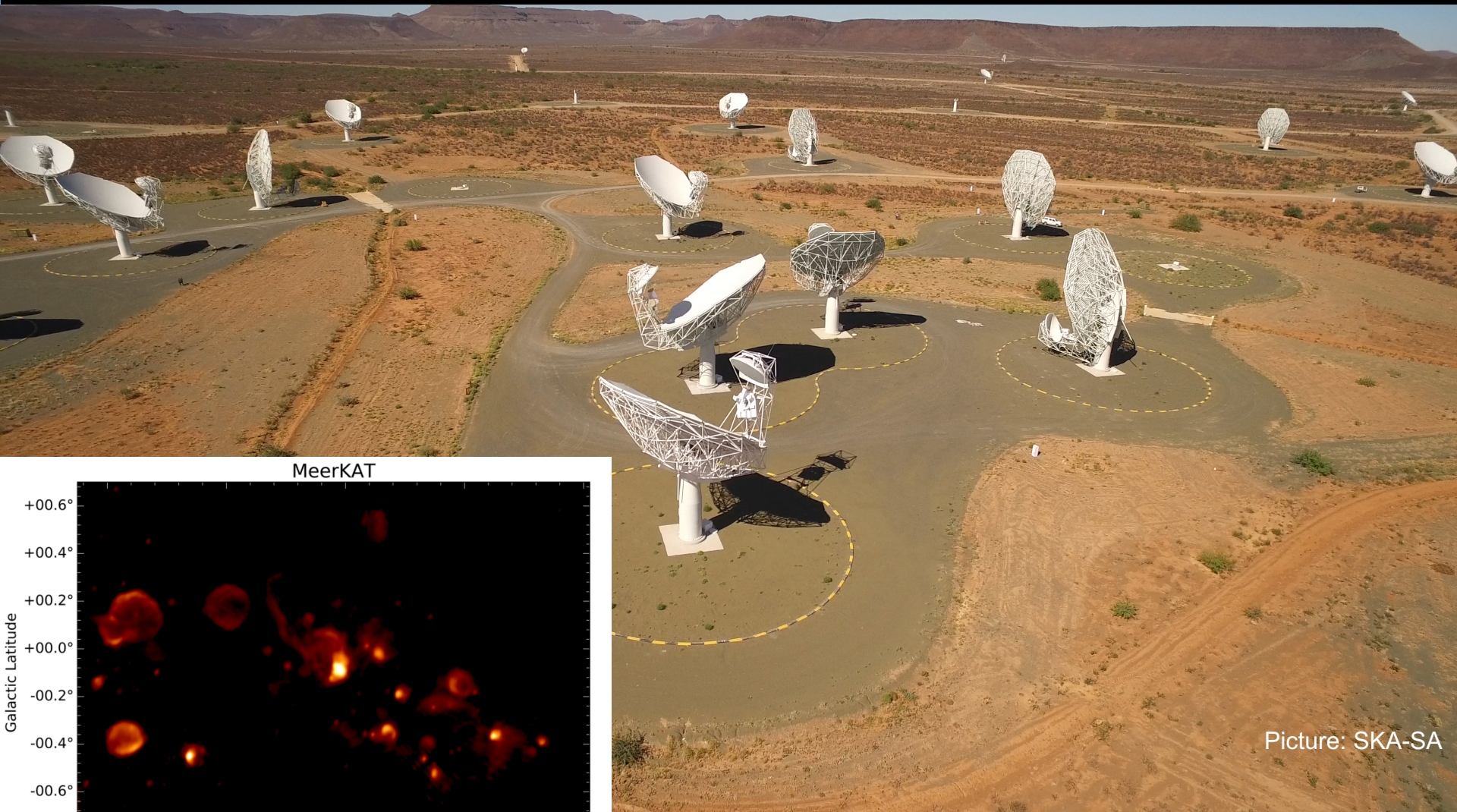
Technical Progress



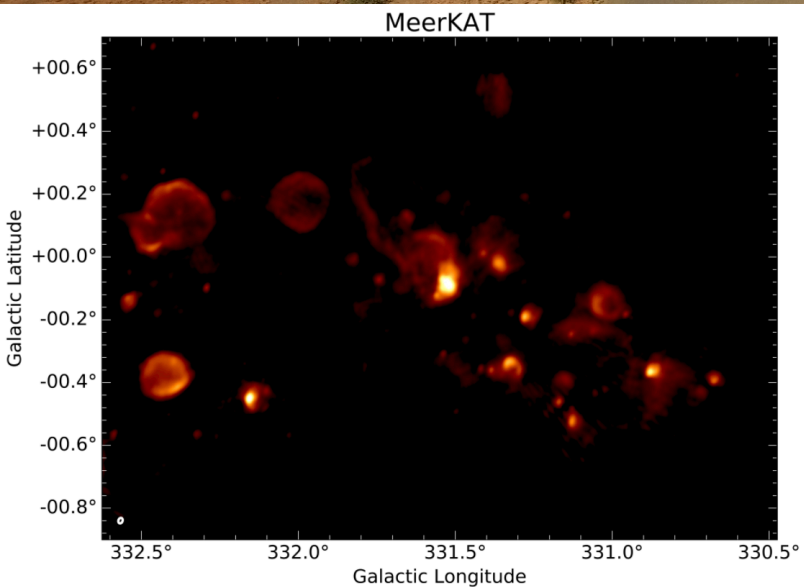
SKA-LOW prototype antenna station deployed



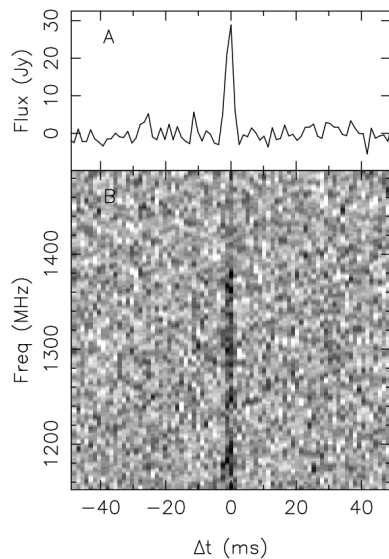
MeerKAT (AR 1.5)



Picture: SKA-SA



Precursors



Exploring the Universe with the world's largest radio telescope

New SKA HQ building: work underway

£16.5M investment
Completion in June 2018



Cost of SKA1



SKA Cost Control Project

- Initiated following recommendation of the SKA Board in Nov 2016, cost estimate at that time of €917M.
- Require solutions to **meet the Cost Cap** of €674M
- Two scenarios brought forward:
 1. Sequential **minimisation of science impact**
 - A sequence of **reinstatable** (via extra funding) measures to achieve the cost cap
 - Ordered **by** increasing **science impact**
 2. Re-use of **precursor technologies**
- **Science assessment teams**: low freq. range, pulsar timing req., low maximum baseline
- **Detailed Technical studies**: Low: beamforming, antenna; Mid: correlator, timing, MeerKat-based, SDP staged deployment
- SKA Science “**Town Hall meeting**” to review with science community

SKA1 construction *provisional* totals



Element	Estimate (M Euro incl. contingency) - Feb 2017	Estimate (M Euro incl. contingency) - Jun 2017	Change	% Change	Reason
AIV	32.8	34.3	1.6	5	Product Assurance and Admin functions increased per Cost Review
CSP	125.9	110.1	-15.8	-13	Frequency slice architecture for Mid.CBF adopted (ECP-170017 in transit)
DSH	173.7	173.2	-0.5	0	
INAU	96.0	€917M → €806M			
INSA	67.9				
LFAA	107.9	111.7	3.8	4	Shipping costs included per Cost Review
SaDT	66.7	57.1	-9.6	-14	Updated vendor quotes; some re-use of MeerKAT timescale; reduced component costs; refined software labour costs
SDP	114.5	114.5	0.0	0	
TM	43.7	43.0	-0.6	-1	
Totals	829.0	806.4	-22.6	-3	

Key drivers over coming months

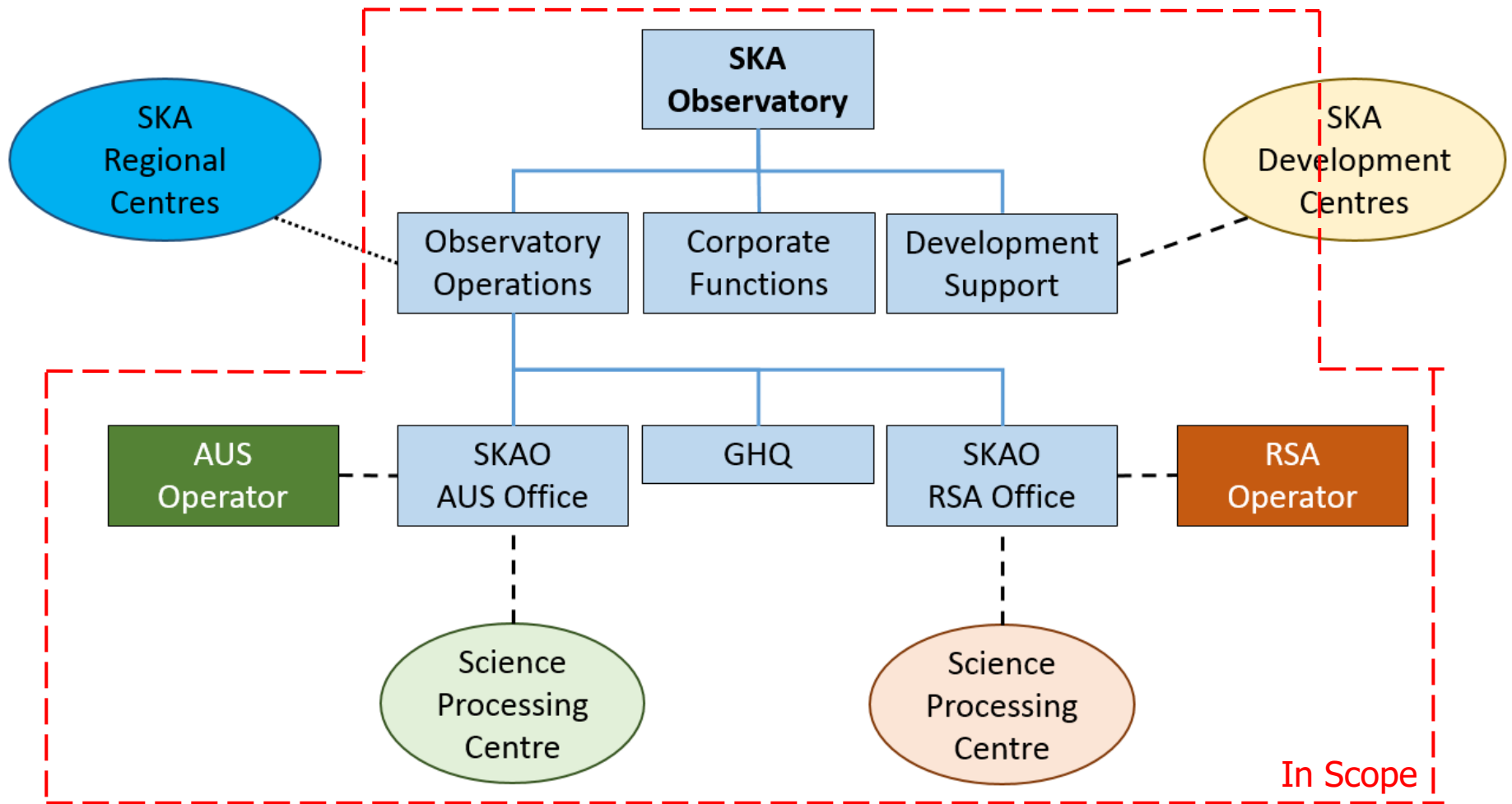
- Cost
- Performance
- Schedule
- Must manage conflicting pressures of scientists ('wait, need more information') vs governments ('push, financial & political drivers')
- We, SKAO, will drive ever harder on the three key points

Consortia	Monthly Burn Rate €M
AIV	0.06
CSP	0.43
DSH	0.91
INAU	0.09
INSA	0.09
LFAA	0.50
SADT	0.21
SDP	0.49
TM	0.38
TOTAL	3.16

Future Governance

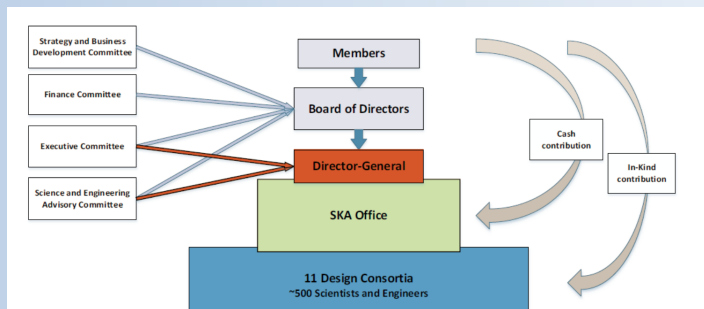


Eventual scope under SKA Observatory Operations



----- Service Level Agreements

..... Memorandum of Understanding 28

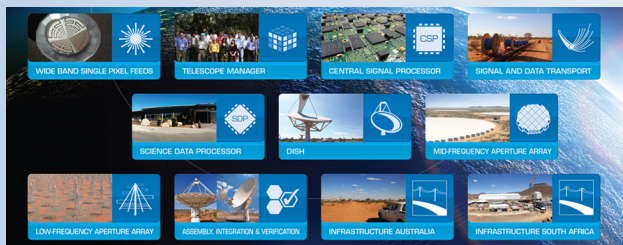


Design Phase

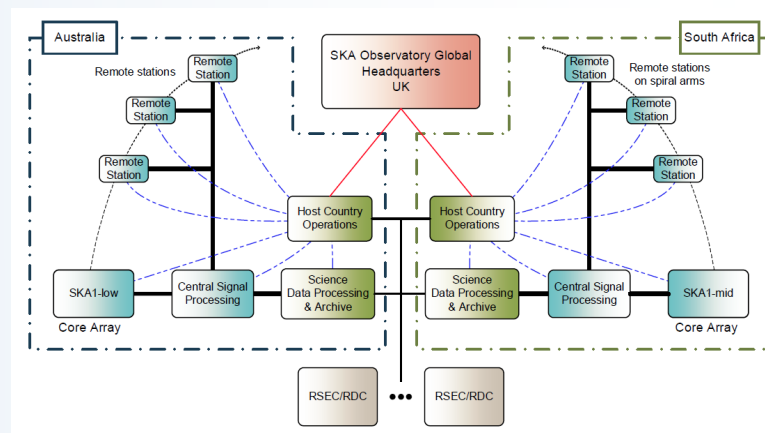


Construction/Ops Phase

2016



SKA Organisation Ltd UK company structure



SKA Observatory IGO

IGO Negotiation process

- 4 plenary meetings:
 - 14-16 October 2015
 - Jan 2016, April 2016, then September 2016
- Participation from all current SKAO members:
 - Majority as 'negotiating parties' – triggered by mandate being provided by a Member's government (RSA, AUS, UK, IT, NL, CN, IN, NZ, SE)
 - 'Observer' status for those without that mandate (Canada, Germany)
- Aim:
 - Negotiation of core texts of agreements
 - Negotiation on supporting concepts that input to agreements or supporting policies
- Working Groups dealing with financial models, procurement approach, telescope access, IP etc: now focused on 'Task Force' to finalise issues

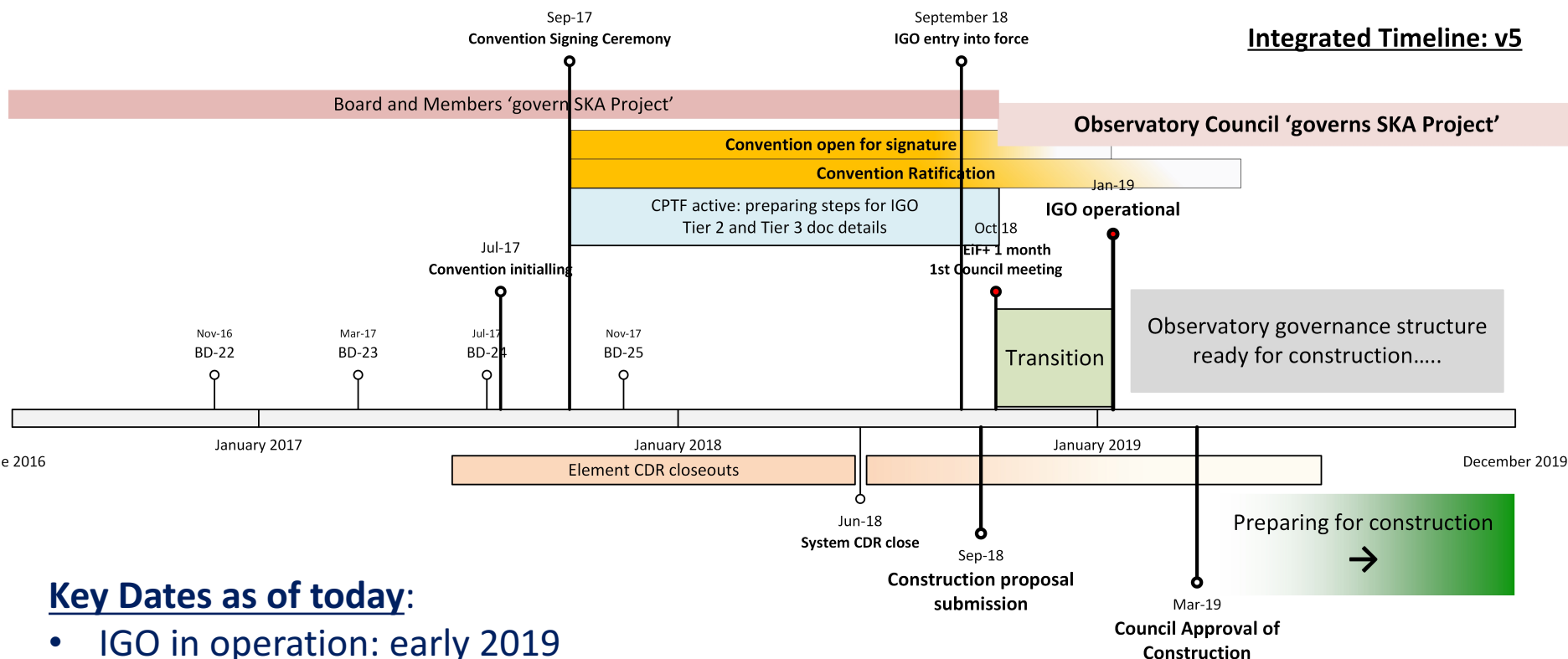
High-level IGO timeline

- **Now to July:**
 - Finalising the Convention text and other ‘treaty-level’ documents
 - High-level discussions on procurement principles, access etc
 - Governments preparing to ‘initial’ the documents
 - Discussions about initial phases of funding the IGO (not SKA1 construction...)
- **~July:**
 - Documents ‘initialled’ to mark end of negotiation process; governments prepare to sign the Convention
- **Best guess – September:**
 - Signing event for negotiating governments – most sign in one go, others when ready
 - Ratification of Convention by governments begins
 - ‘Proto IGO Council’ starts work preparing for IGO – policies, the transition from the company etc

The full picture...



Integrated Timeline: v5



Key Dates as of today:

- IGO in operation: early 2019
- Design process 'complete' ~mid/late 2018
- IGO Council approves construction: early/mid 2019
- SKA1 construction procurement begins: ~late 2019



Summary



- Overall progress is very positive:
 - Technical progress moving well, dealing with challenges
 - Clear that a transformational SKA1 can be built within the cost-cap; additional partner nations will bring additional science capability.
 - Must continue to drive costs down. Schedule is a major concern.
 - Precursors/pathfinders being delivered; delivering science
 - Route to an IGO now appears firm thanks to continuous support from governments
 - HQ construction started
 - Real money being spent now by governments, real commitment being made at political level
- SKA only possible through the drive, enthusiasm and support of the science and engineering community and governments of partner nations.



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

