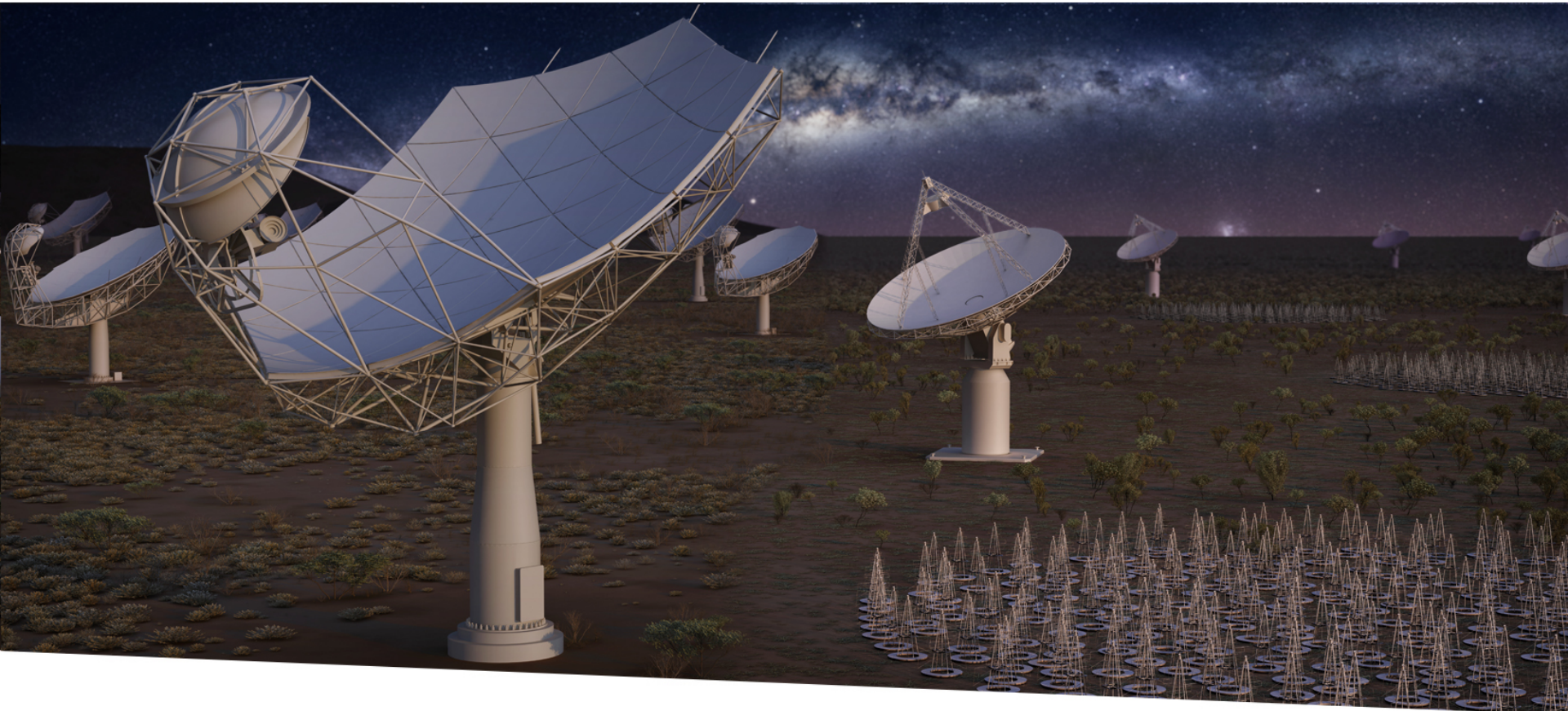


Square Kilometre Array:

Commission B: IAU GA



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

Philip Diamond, Director-General

Vienna 24th August 2018

SKA: A global Research Infrastructure



 **Members**
Host Countries: Australia, South Africa, United Kingdom

 **African partner countries**

SKA: A global Research Infrastructure



Potential Future Members



 **Members**
Host Countries: Australia, South Africa, United Kingdom



 **African partner countries**

SKA– Key Science Drivers: The history of the Universe

Testing General Relativity
(Strong Regime, Gravitational Waves)

Cosmic Dawn
(First Stars and Galaxies)

Cradle of Life
(Planets, Molecules, SETI)

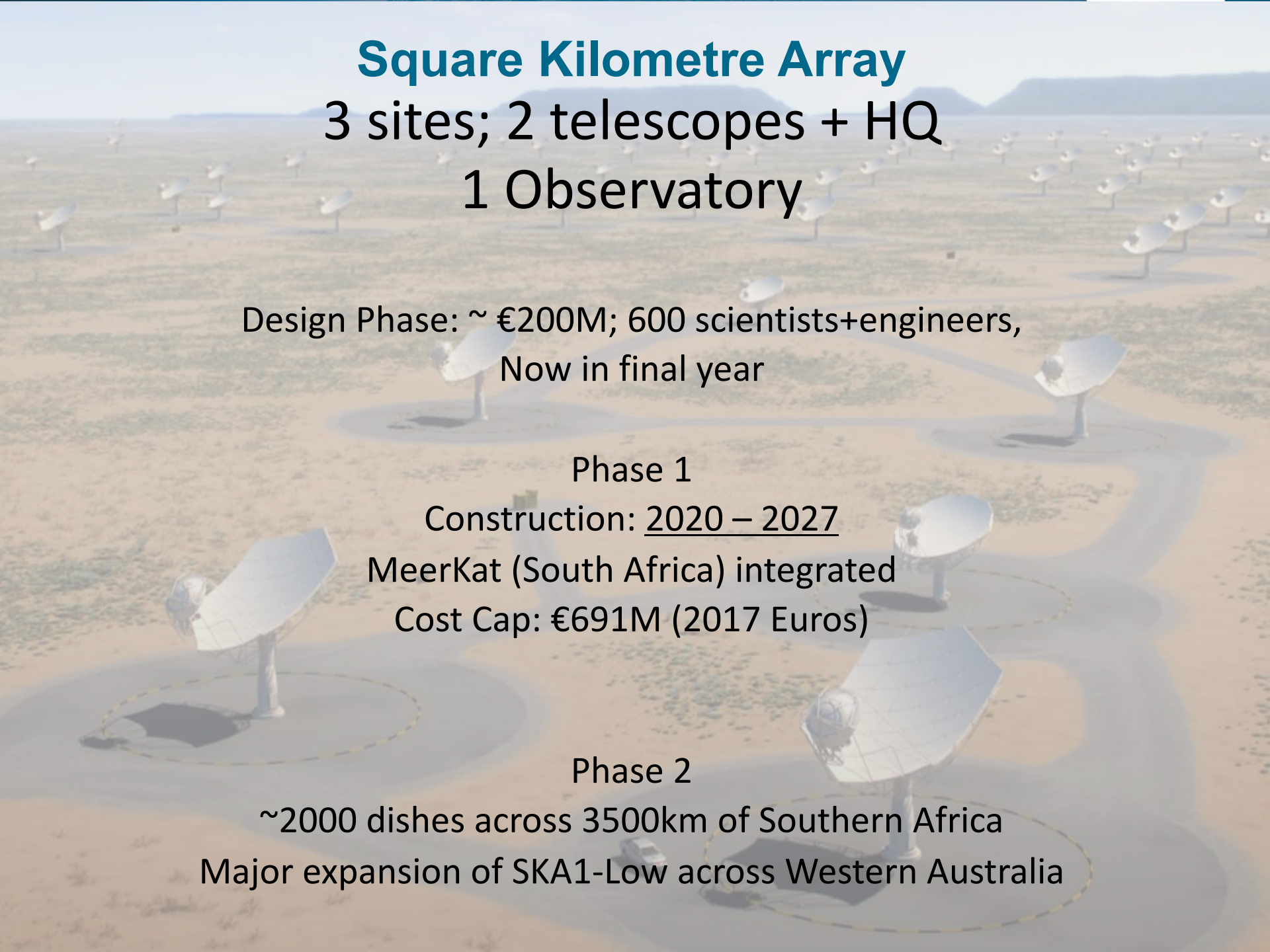
Galaxy Evolution
(Normal Galaxies $z \sim 2-3$)

Cosmic Magnetism
(Origin, Evolution)

Cosmology
(Dark Matter, Large Scale Structure)

Exploration of the Unknown

Broadest science range of any facility on or off the Earth.

An aerial photograph of the Square Kilometre Array (SKA) radio telescope facility. The image shows a vast, flat, arid landscape with numerous large, white, parabolic radio telescope dishes scattered across the terrain. The dishes are arranged in a grid-like pattern, with some closer to the foreground and others receding into the distance. The sky is clear and blue, and the ground is a mix of light brown and tan colors. The overall scene is a wide, open plain with low hills in the far background.

Square Kilometre Array

3 sites; 2 telescopes + HQ
1 Observatory

Design Phase: ~ €200M; 600 scientists+engineers,
Now in final year

Phase 1

Construction: 2020 – 2027

MeerKat (South Africa) integrated

Cost Cap: €691M (2017 Euros)

Phase 2

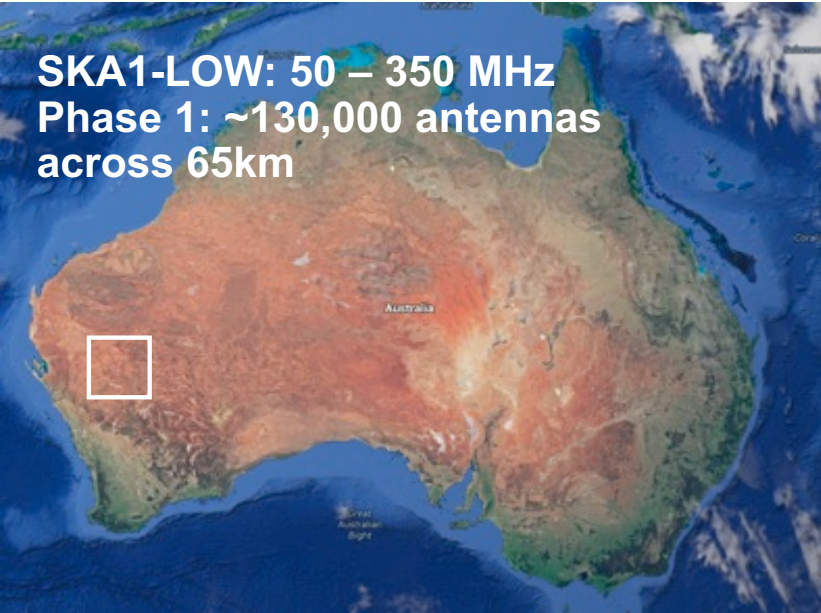
~2000 dishes across 3500km of Southern Africa

Major expansion of SKA1-Low across Western Australia

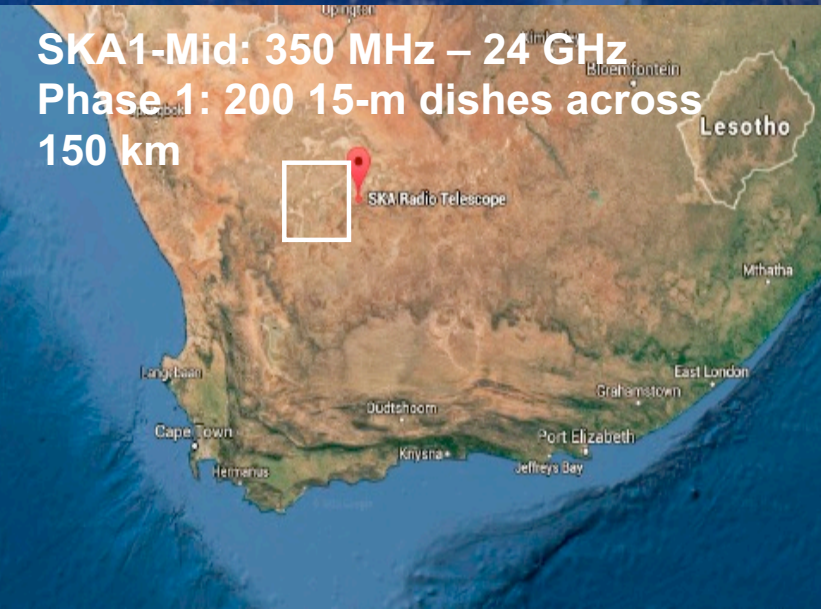
SKA: HQ in UK; telescopes in AUS & RSA



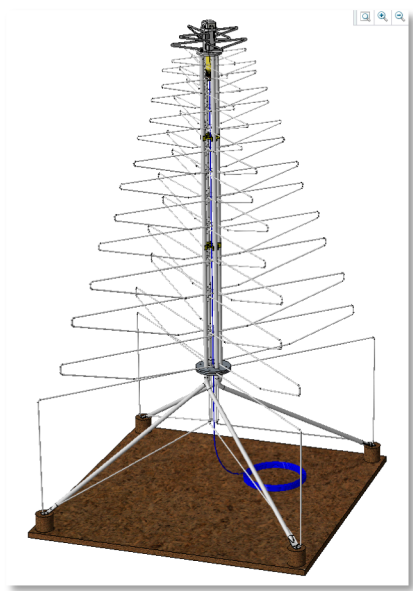
SKA1-LOW: 50 – 350 MHz
Phase 1: ~130,000 antennas
across 65km



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

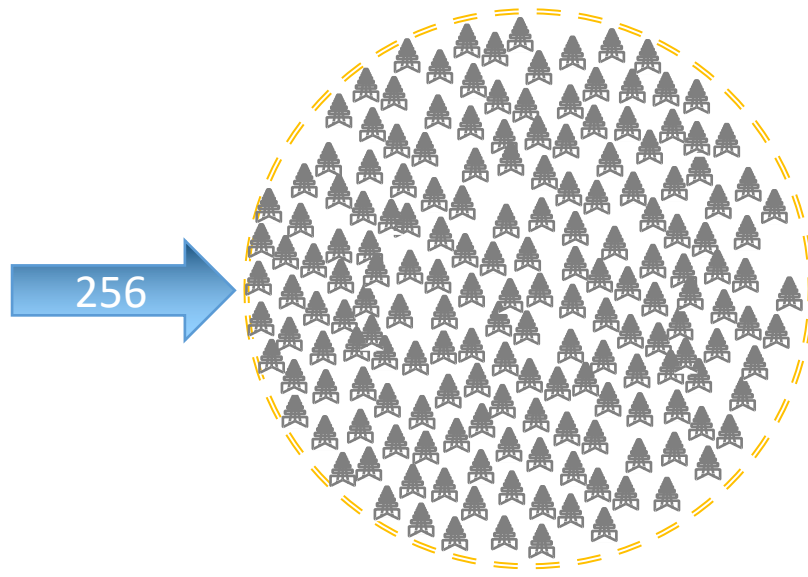


SKA1-Low: Array of Arrays



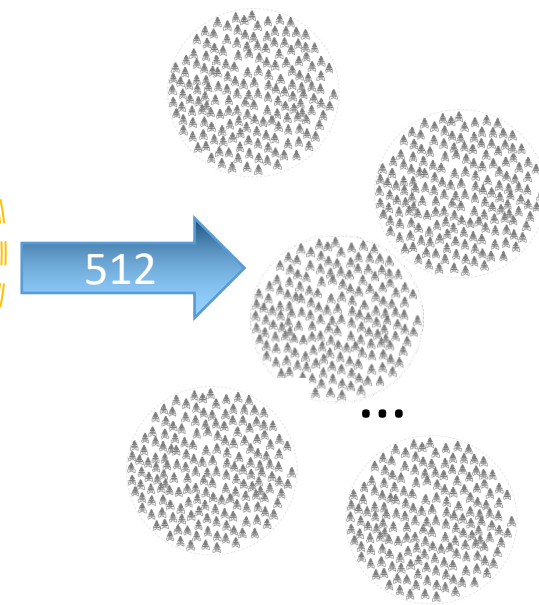
SKA1-Low
Antenna/Receptor

Antenna Beam



SKA1-Low
"Station"

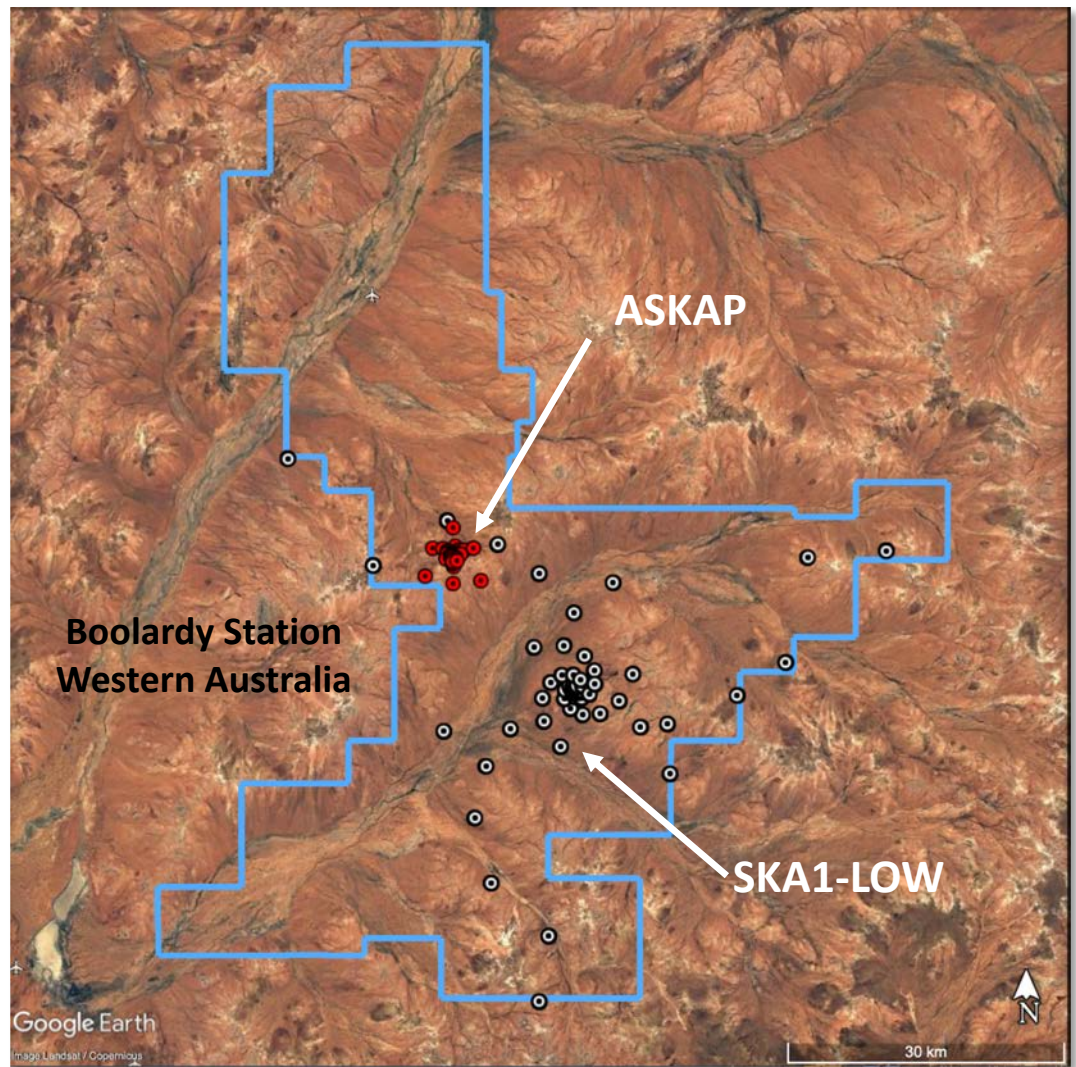
Station Beam



SKA1-Low
"Array"

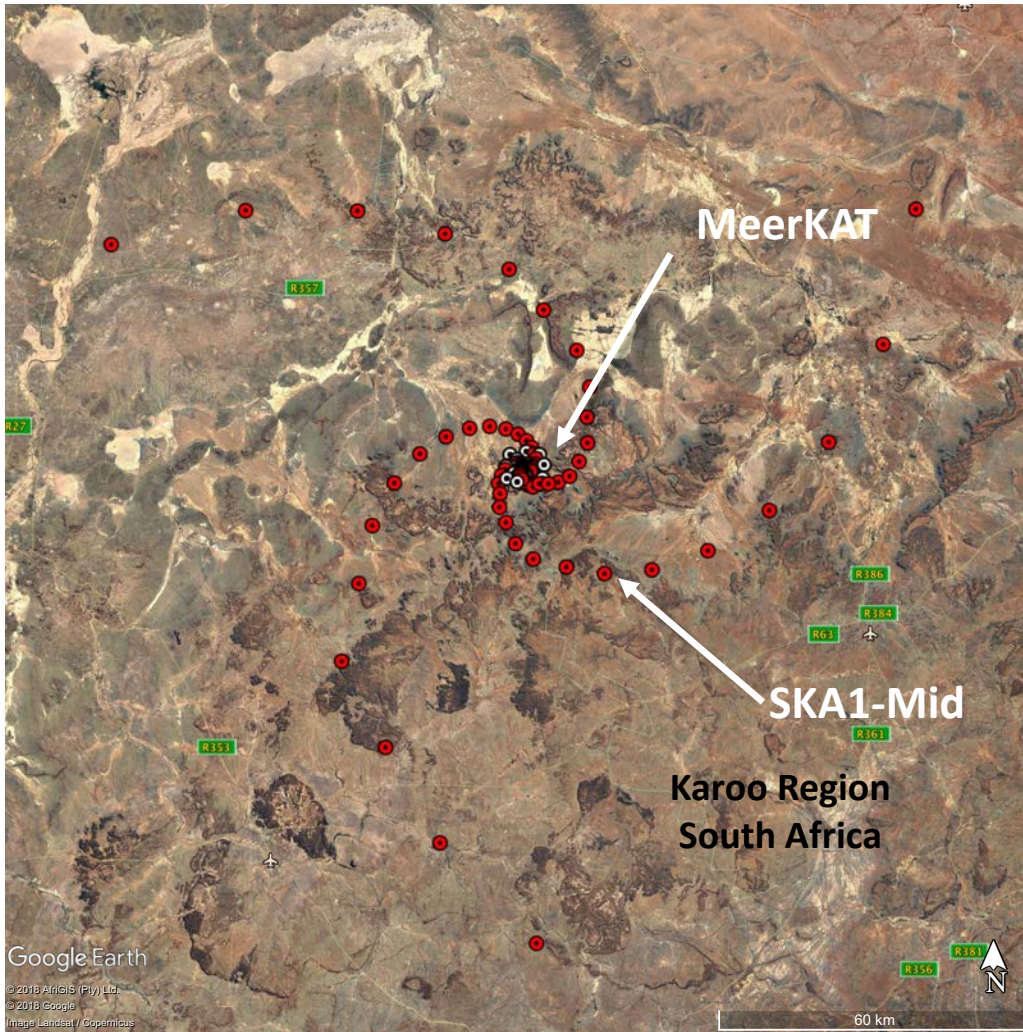
Correlation and
Tied-array Beams

SKA1 – Low: Layout



- 512 aperture array stations
- Maximum baseline 65 km
- 3 modified spiral arms

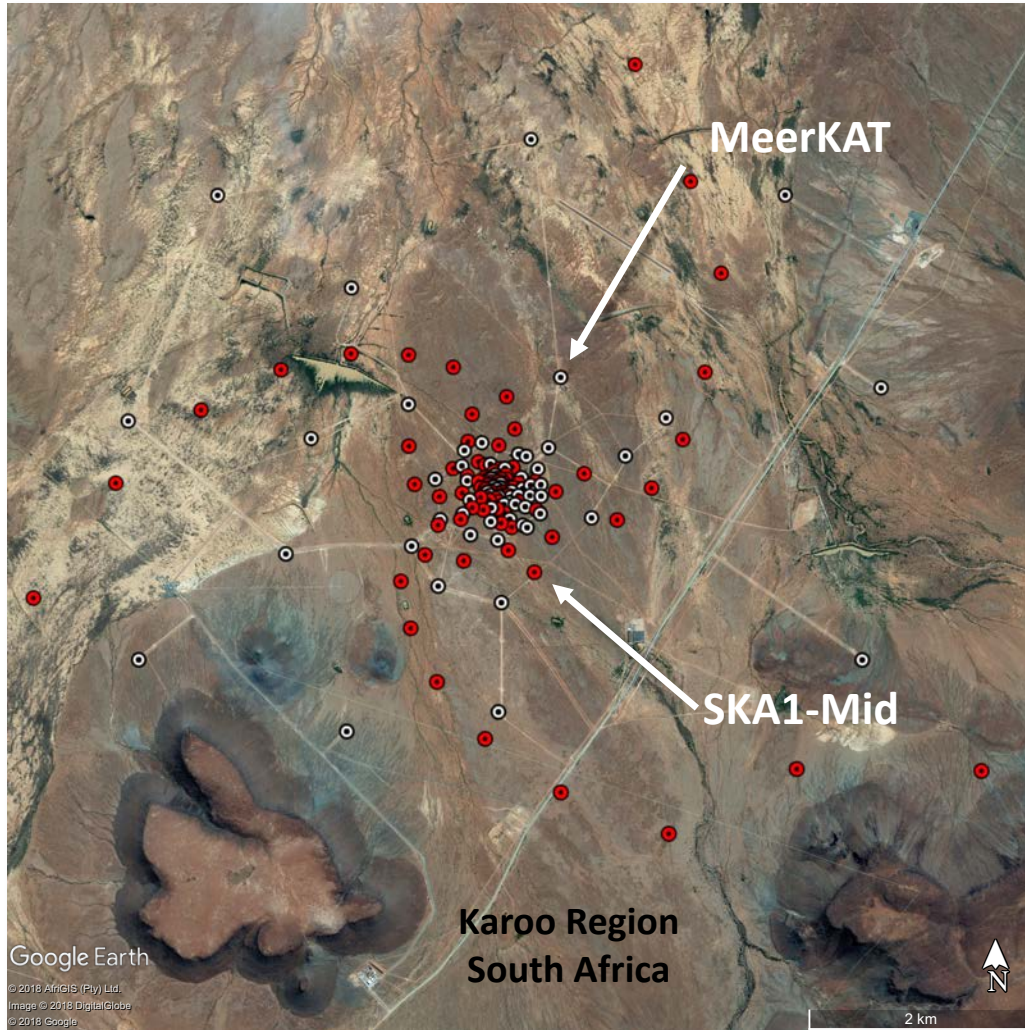
SKA1 –Mid: Layout



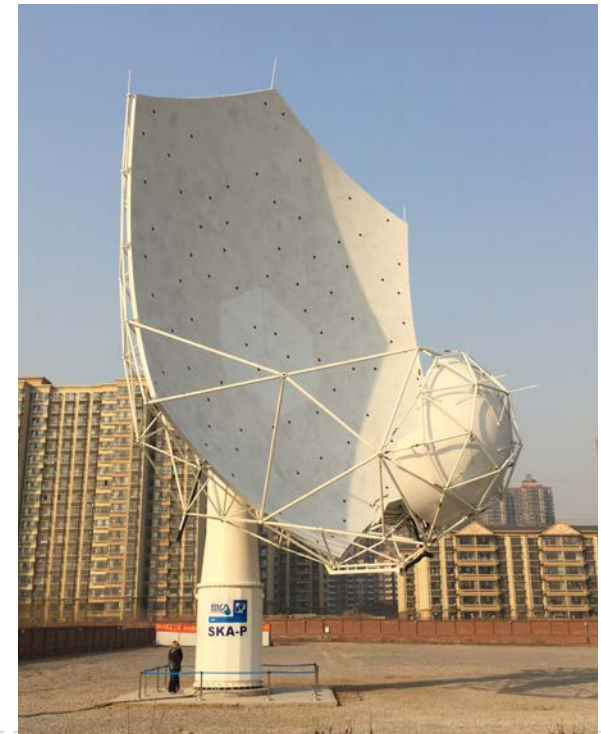
- 133 SKA 15m dishes
- 64 MeerKAT 13.5m dishes
- Maximum baseline 150 km
- 3 logarithmic spiral arms



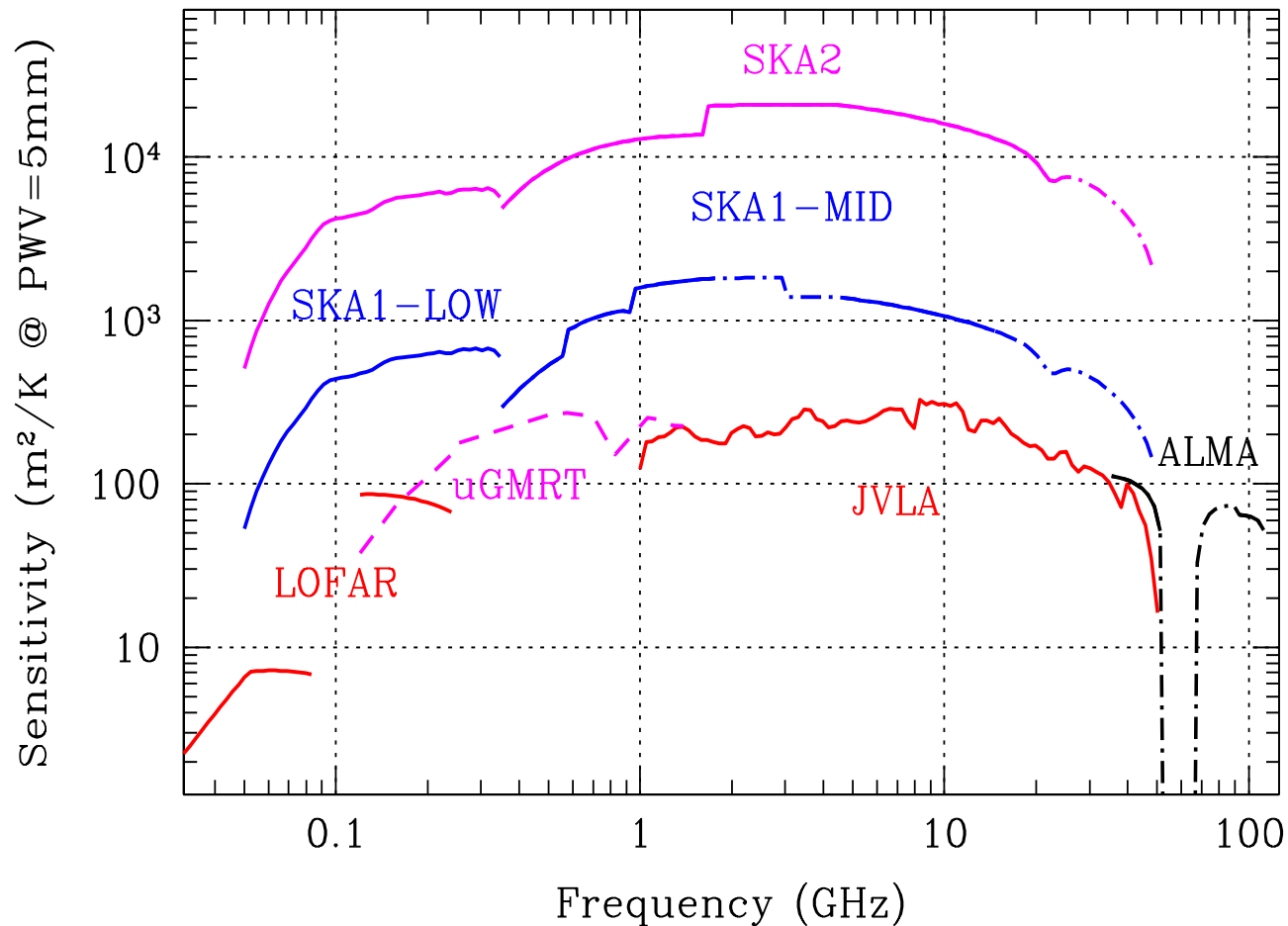
SKA1 –Mid: Layout



- 133 SKA 15m dishes
- 64 MeerKAT 13.5m dishes
- Maximum baseline 150 km
- 3 logarithmic spiral arms
- ~ 50% within ~2 km randomly distributed



SKA1 Anticipated Sensitivity



- Improved performance predictions now available at all frequencies
- Opportunity for seamless interface of SKA to ALMA capabilities

SKA HQ: Jodrell Bank, UK



€20M project; UK contribution

Building complete

Occupancy
September

A 'nexus for radio astronomy'

First meetings
scheduled for
October



Current status



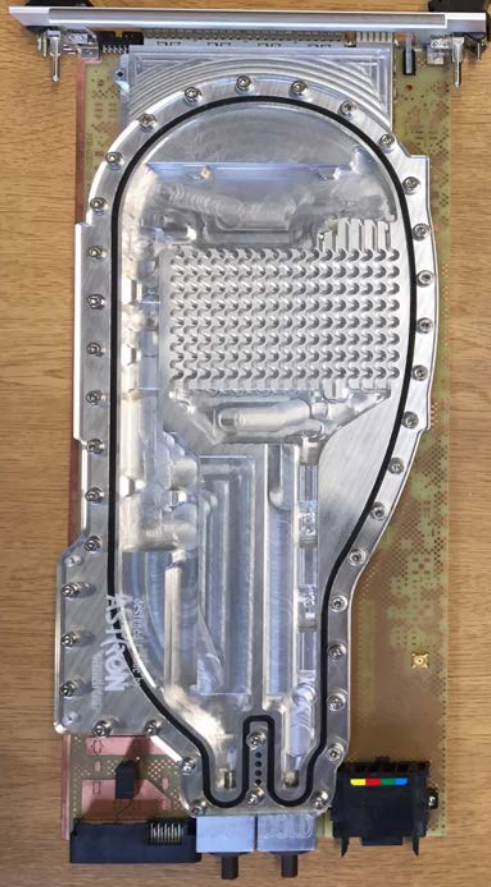
SKA-P2: Karoo MPG funded



Building SKA: AAVS1; SKA1-Low prototype



NL/Aus/NZ



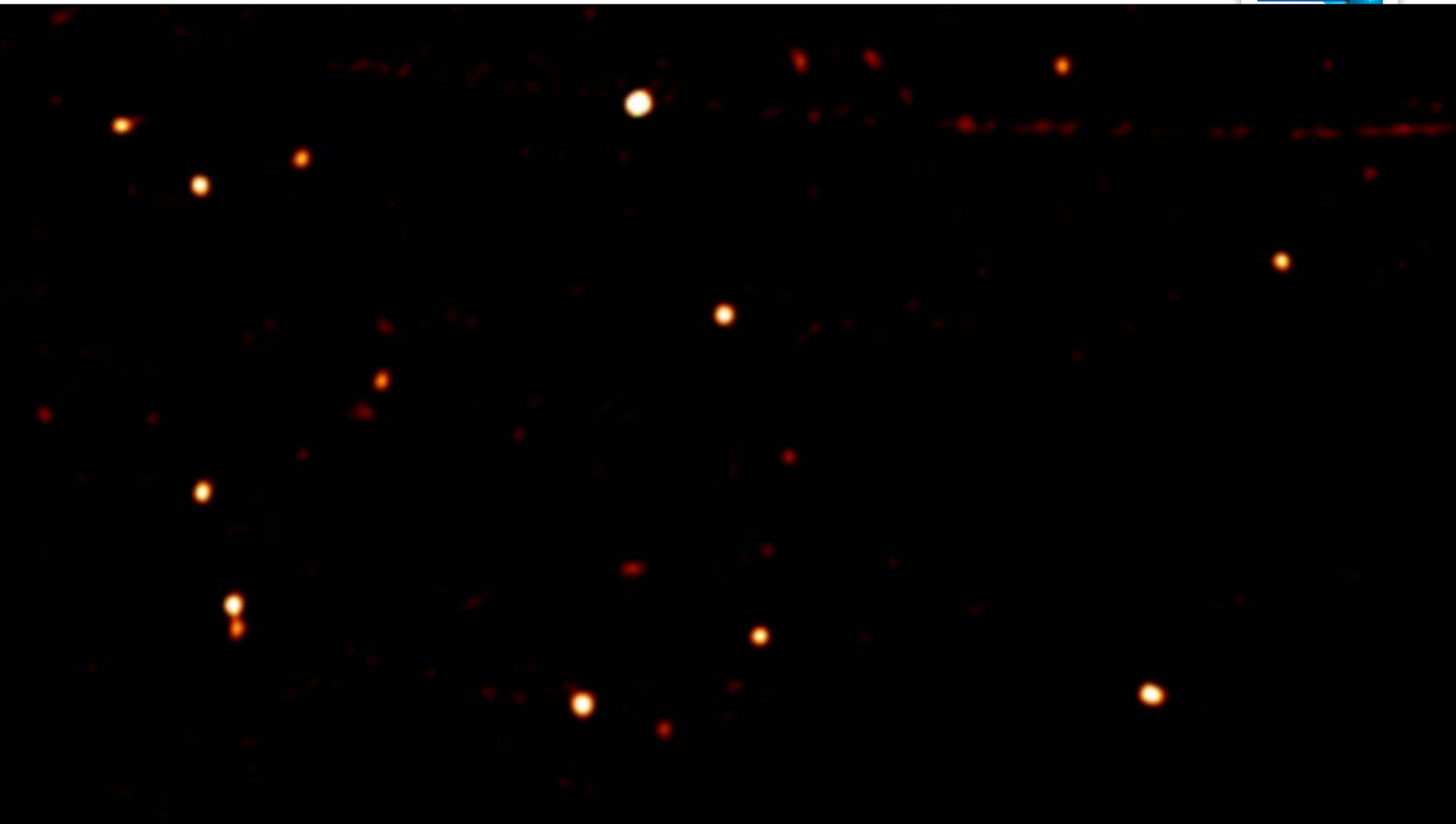
UK/IT/NL



Launch of MeerKAT: July 13 To be integrated into SKA

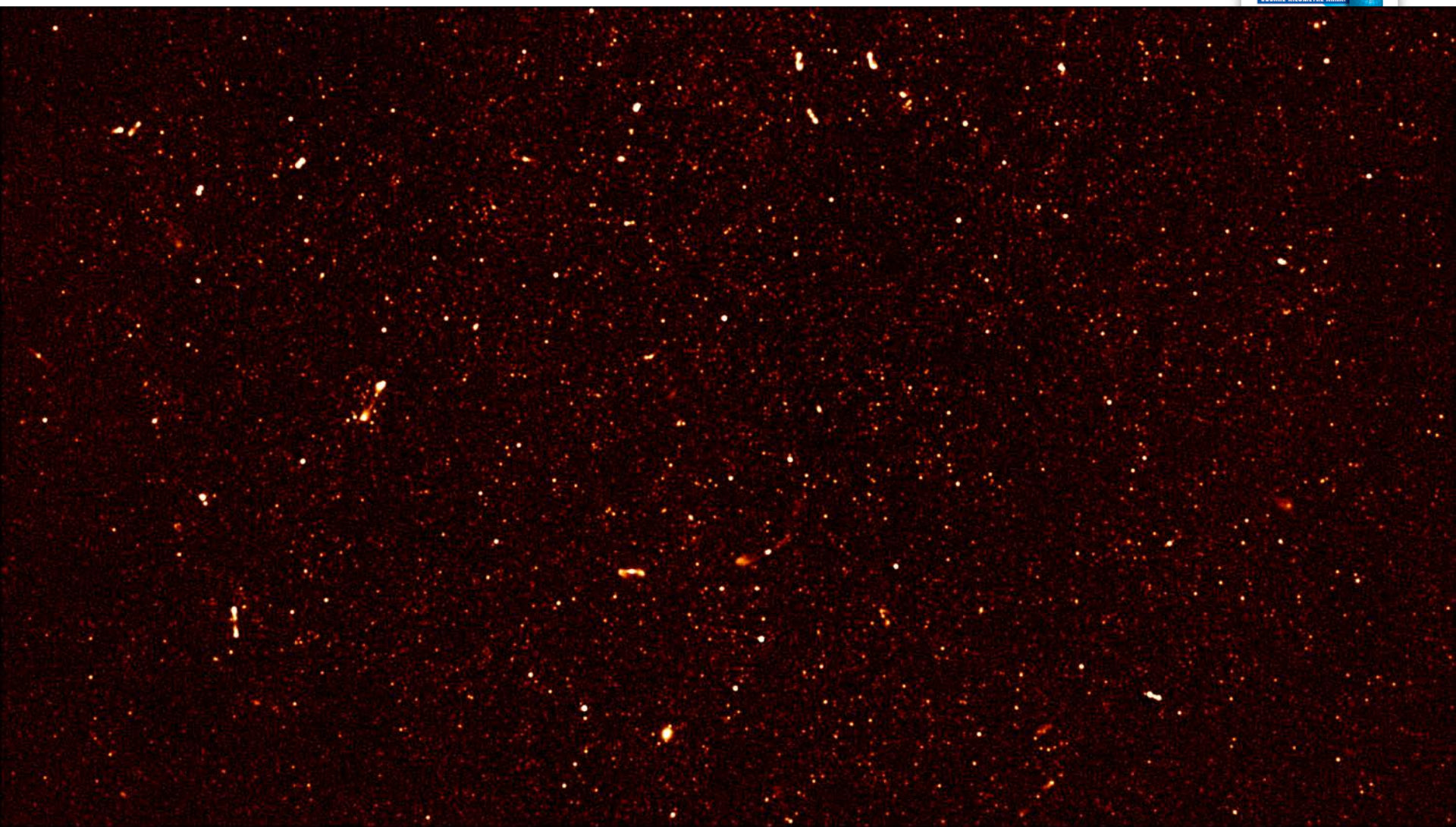


MOST 843MHz image



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MeerKAT 1.4GHz image



Development of Governance



Establishing treaty organization similar to ESO, CERN

Text of treaty and key protocols now finalized and agreed.

Formal signing ceremony expected in Rome in Nov/Dec 2018.

Expect treaty ratification ~12 months later.





• Data flow challenges

SKA1-LOW



~ 2 Pb/s



~ 7 Tb/s



300 PB/yr
~ 130 PFlops

~ 9 Tb/s



~ 5 Tb/s



~ 130 PFlops
300 PB/yr



SKA Regional Centres



SKA1-MID

LOFAR
23PB

Uploads to Google
100PB

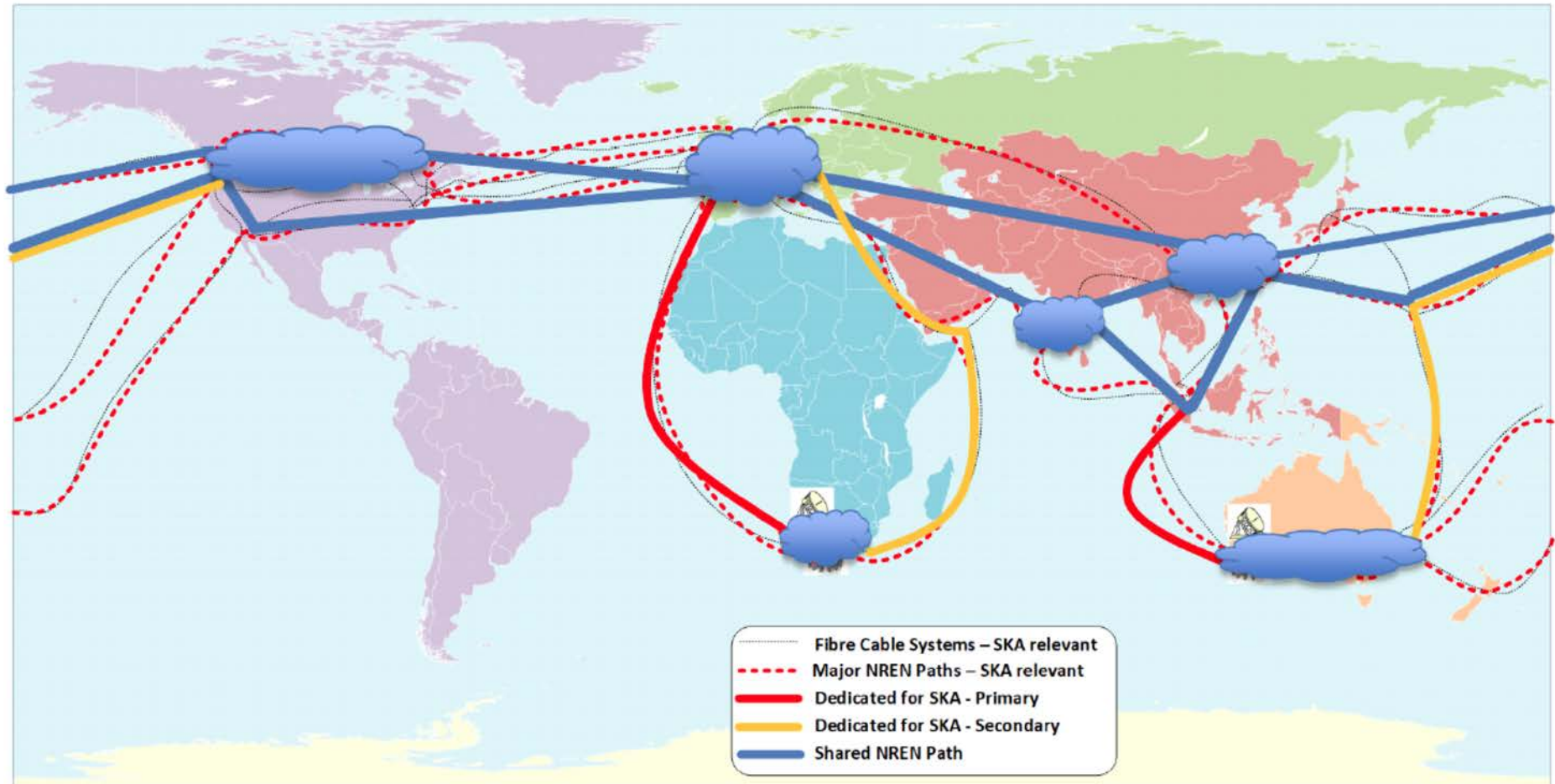
Uploads to Facebook
180PB

SKA
Phase1 Science Archive
600PB



• Data flow challenges

- Pipelines deliver science-quality data products to SKA Regional Centres
- Distributed data archive, centralized engineering data
- Metadata will follow VO standards



Observatory Data Products flow from the Science Data Processors in Perth and Cape Town to SRCs around the globe



CDR Activity – Updates

Element	RRN Submission	CDR Submission	CDR Meeting	CDR Close
TM	29 January 2018	28 Feb 2018	17-20 Apr	27 Jul 2018
SaDT & SAT	17 January 2018	28 Feb 2018	15-18 May 2018	Sep 2018
INAU	19 March 2018	30 April 2018	27-29 June 2018	Sep 2018
INSA	19 March 2018	30 April 2018	2-4 July 2018	Sep 2018
CSP	18 May 2018 - PSS Element CDR - PST Element CDR - CBF Low - CBF Mid	30 Jun 2018 (includes LMC sub-element)	25-28 Sep 2018	31 Oct 2018
MeerKAT Integration			22 Oct 2018	31 Dec 2018 (t)
SDP Pre-CDR	09 Mar 2018	25 Apr 2018	20-22 Jun 2018	
SDP CDR	17 Sep 2018	31 Oct 2018	17-19 Dec 2018(t)	28 Feb 2019(t)
LFAA	24 Sep 2018(t)	29 Oct 2018	03-05 Dec 2018	15 Jan 2019 (t)
AIV	01 Oct 2018	12 Nov 2018 (t)	08 Jan 2019 (t)	30 Mar 2019 (t)
DSH Pre-CDR	07 Sep 2018	28 Sep 2018	08 Nov 2018	
DSH CDR	01 Apr 2019	22 Apr 2019	05 Jun 2019 (t) - Dish Structure: Mar 2019 - incl. B2;05 Jun 2019 - B1,5: 24 Oct 2019 (t)	
System CDR			Jun 2019 (t)	Sep 2019 (t)

Timeline

Key dates:

- **Nov/Dec 2018: Convention signing**
- **June 2019: System design final**
- **Dec 2019: SKA Observatory exists**
- **Dec 2019: Construction proposal submitted to SKAO Council**
- **Q1 2020: Construction begins**
- **2026/7: SKA1 construction complete**

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Thank you

www.skatelescope.org