Section 1: The SKA
What, Where and When
SKA Organisation

Australia
Canada
China
Germany (MPIfR)
India
Italy
Netherlands
New Zealand
South Africa
Spain
Sweden
UK

Interested Countries:
• Switzerland
• Japan
• Korea
• ...

Members
Host Countries: Australia, South Africa, United Kingdom

African partner countries
## Timeline (SKA Phase 1)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>March 2019</td>
<td>Signing of convention that allows the IGO to be established</td>
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<tr>
<td>December 2019</td>
<td>System CDR: Conclusion of design phase</td>
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<tr>
<td>Q2 2020</td>
<td>SKA Observatory</td>
</tr>
<tr>
<td>June 2020</td>
<td>Submission of Construction Proposal and Operations Plan</td>
</tr>
<tr>
<td>December 2020</td>
<td>Approval and Commencement of Construction (T0)</td>
</tr>
<tr>
<td>December 2027/8</td>
<td>Completion of construction</td>
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**1 Observatory, 2 Telescopes, 3 Sites**
SKA1-LOW: Western Australia

- SKA1-LOW: 50 – 350MHz
- 131,000 dipoles:
  - 512 stations each with 256 antennas
- 65km baselines.
- Located at Boolardy Station in the Murchison Shire
SKA1-MID: Northern Cape, South Africa

- SKA1-MID: 350MHz – 14GHz
- 133 SKA dishes + 64 MeerKAT dishes
- 120km baselines.
- Located in the Karoo, Northern Cape
Section 2: Data
Transport, Processing, Archiving and Access
SKA Signal and Data Transport (SaDT)

- Three networks:
  - Synchronisation & Timing: UTC, 1pps and frequency reference.
  - Non-Science Data: M&C, general network access, UC etc.
  - Data: Digital Data Backhaul, CSP-SDP and SDP to SKA Regional Centres.
SKA Phase 1 Data Flows

SKA1-LOW

2 Pbit/s

~ 7 Tbit/s

SKA

CENTRAL SIGNAL PROCESSOR

9.3 Tbit/s

~130 Pfplos
300 PB/y

SCIENCE DATA PROCESSOR

100 Gbit/s

SKA Regional Centres

~ 20 Tbit/s

SKA1-MID

Uploads to Facebook
180PB

SKA1 Phase 1 Science Archive
600PB

~7.9 Tbit/s

100 Gbit/s
Historically the Science Data Processor (SDP) would not be considered part of the telescope. The data flow through the SKA is such that this model breaks early in this data delivery chain.

In planning the observing programme of the Observatory the SDP becomes part of the telescope that needs to be scheduled.
Observatory Data Products

- Catalogues:
  - Transient Source Catalogue
  - Science Data Product Catalogue
- Imaging:
  - Image Cubes
  - Gridded Visibilities
- Pulsars:
  - Pulsar and Transient Candidates
  - Pulsar Timing Solutions
  - Dynamic Spectrum
- Transient Buffer Data
- Calibrated Visibilities
SKA Regional Centres - 1

• There are three main factors that lead to a global collaborative model for SKA Regional Centres (SRCs):
  • the Observatory Data Products that emerge from the SKA Observatory are not in the final state required for science analysis and publication,
  • the data volumes are so large that direct delivery to end users is unfeasible,
  • the community of scientists working on SKA science data will be geographically distributed.

• NOT funded by the SKA construction budget!
SKA Regional Centres - 2

SKA Observatory

SKA1 Telescopes

Observatory Data Products

Project Status Database

Staging & Delivery

SKA Regional Centre 1...n

Project Support

Archive Support

Other Activities

SKA Obs Users

Archive Users
SKA Regional Centres - 3

Data Flow
Maintain the flow of data out of the Observatory and to the SKA community.
Allows the science programme to proceed according to schedule.

Data Processing
Provide compute resources to allow users to combine and analyse their Observatory & Advanced Data Products.

Science Archive
Provide data storage and tools to enable a SKA Science Archive and allow discovery science, perhaps from non-SKA users.

User Support
Provide support to users in these SRC activities.
International Network: Dedicated Links and Overlay

- OpEx link and transmission on the academic networks with 10 to 15 year IRUs priced in 2024 USD.
- Assume a dedicated Primary 100 Gbit/s link, a dedicated Backup 100 Gbit/s link and some use of shared NREN paths.
- I can’t emphasis strongly enough the importance of strong partnerships with NRENs (e.g. AARNet and CSIRO).
Further Thoughts

- Evolution of ethernet and transceivers (> 100Gbit/s)
- Location of equipment:
  - Trade-off between location (power, cooling, space) and long-haul transport.
- (Distributed) Regional Centres:
  - Deliberately testing single-stream TCP transport
  - Long-haul data transport (large RTT from Australia to Europe):
    - TCP window size of 1Gbyte
  - Data transfer nodes (e.g. ScienceDMZ is arguably best-in-class) / Security
  - Send multiple copies: “reliable” multicast?
  - Server and NIC performance (100Gbit/s not straightforward)
- FPGA versus GPU for specialized processing.
- Traditional HPC versus Cloud-based services.
- Access to data from elsewhere (surveys, observations at other frequencies)
We acknowledge the Wajarri Yamatji people as the traditional owners of the Murchison Radio-astronomy Observatory site.

Thank you

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