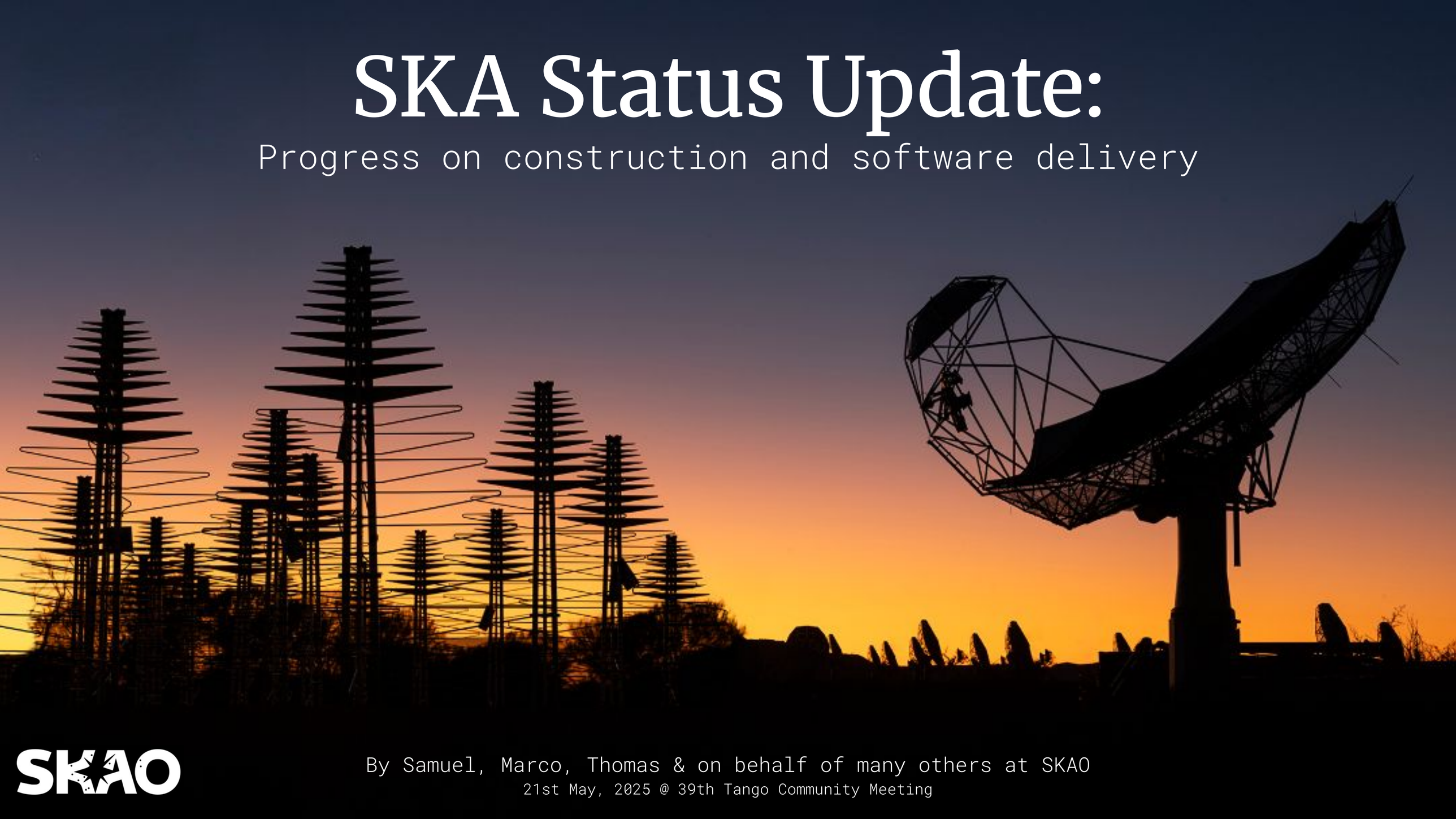
SKA Status Update:

Progress on construction and software delivery



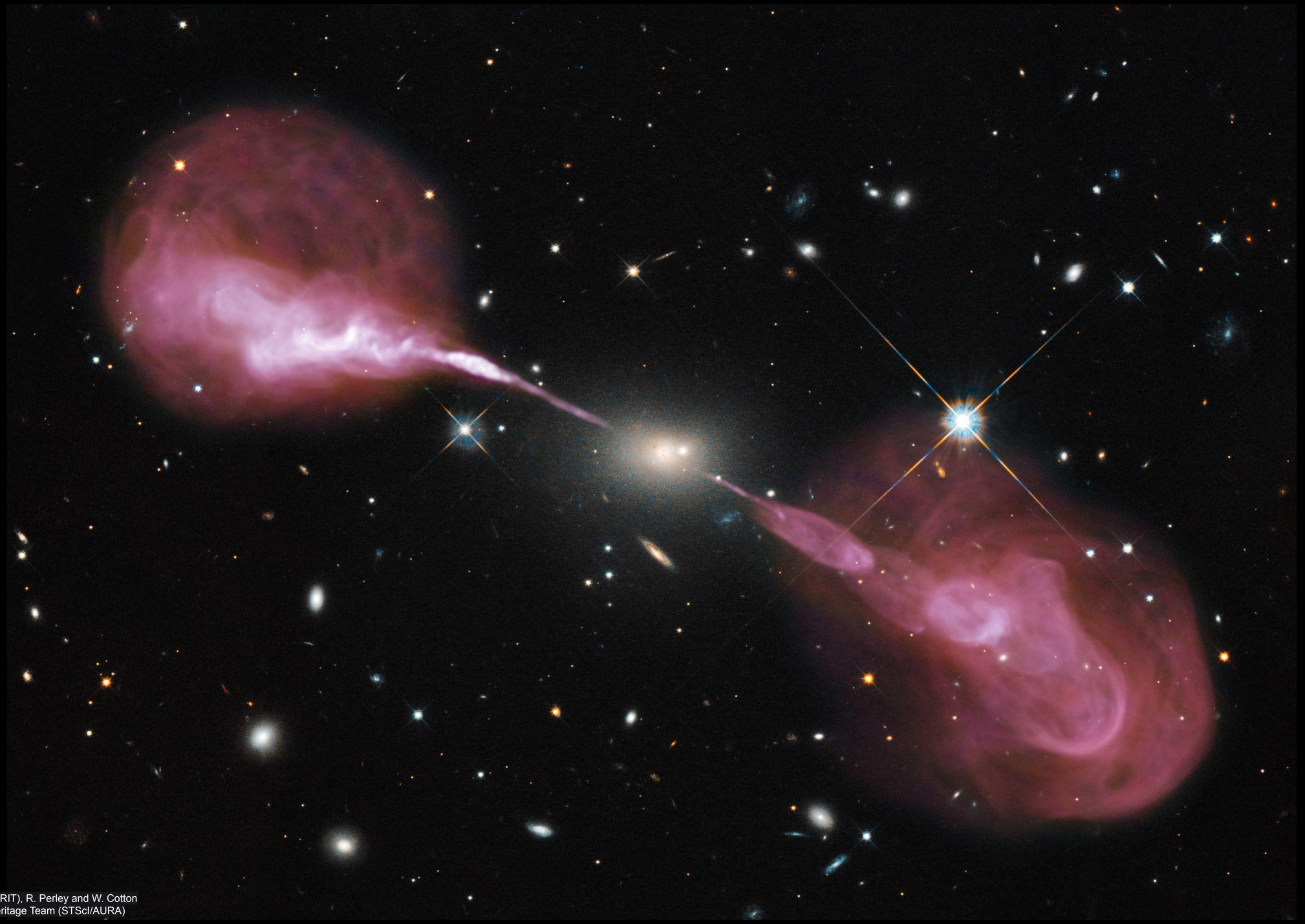
SKAO

By Samuel, Marco, Thomas & on behalf of many others at SKAO

21st May, 2025 @ 39th Tango Community Meeting

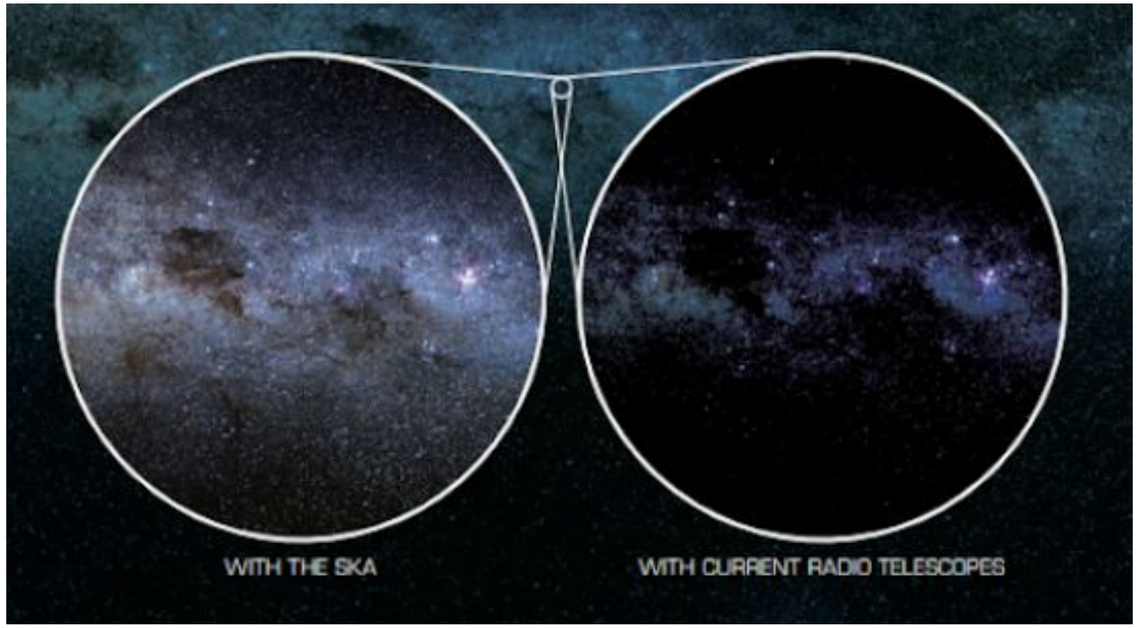
NASA, ESA, S. Baum and C. O'Dea (RIT), and the
Hubble Heritage Team (STScI/AURA)

R. Perley and W. Cotton (NRAO/AUI/NSF)



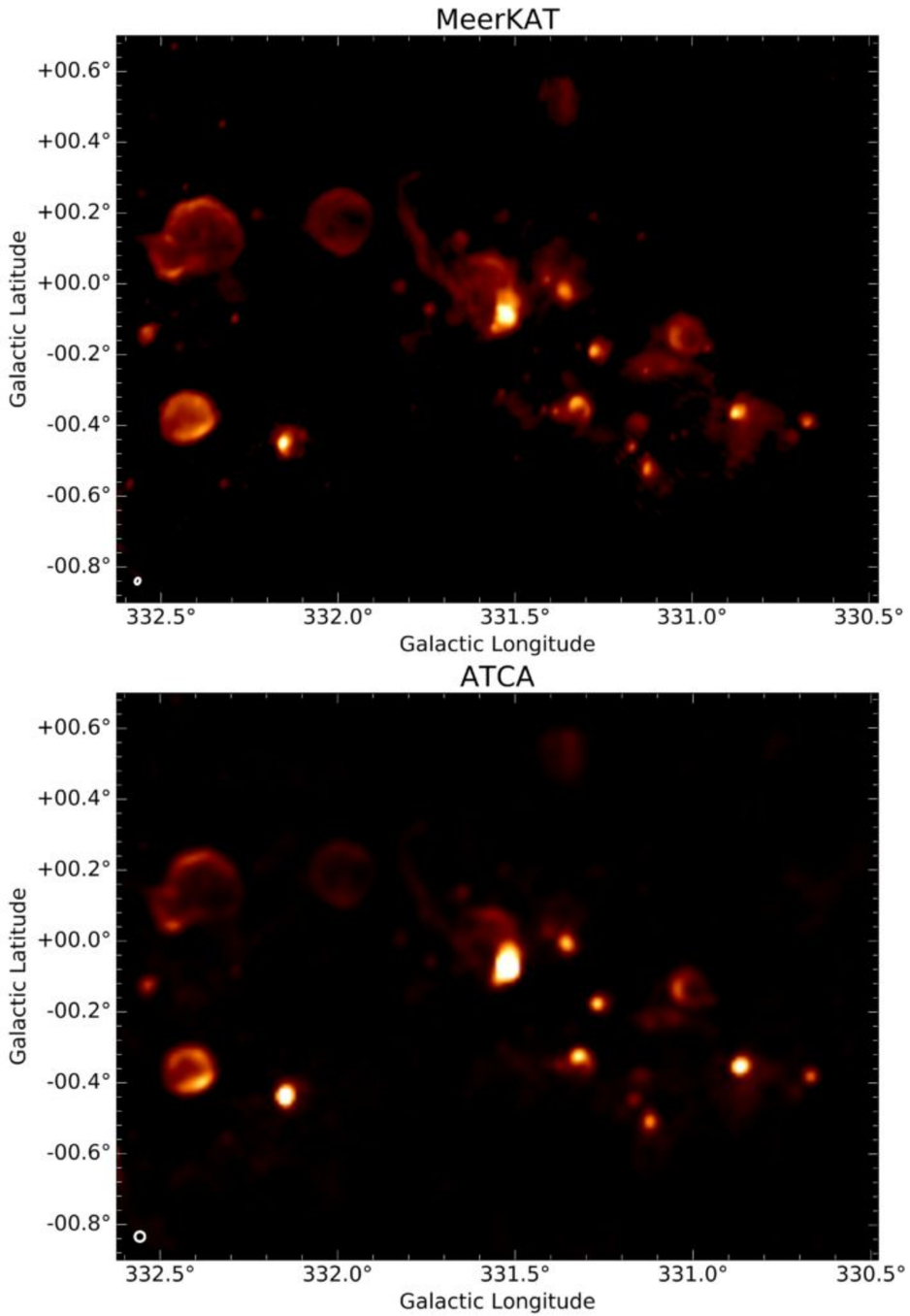
NASA, ESA, S. Baum and C. O'Dea (RIT), R. Perley and W. Cotton
(NRAO/AUI/NSF), and the Hubble Heritage Team (STScI/AURA)

Better resolution, sensitivity



A Star-forming Region in the Milky Way

The previous best image of this star-forming region was obtained with the Australia Telescope Compact Array (ATCA). The MeerKAT image is sharper and more sensitive; and shows fainter features with additional detail.

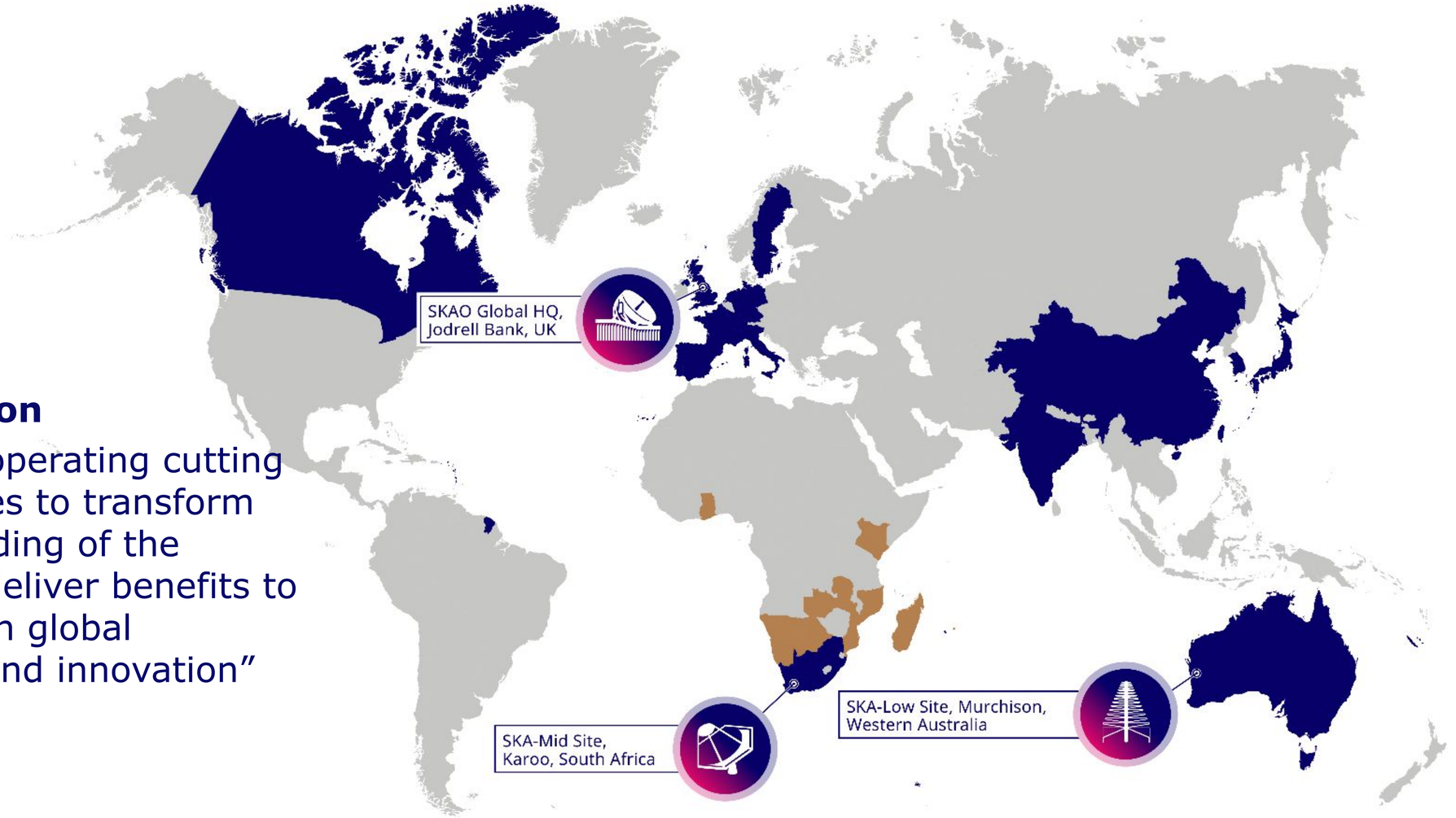


SKAO

One global observatory,
two telescopes, three sites

About ...

One Observatory Two Telescopes Three Continents



SKAO's Mission

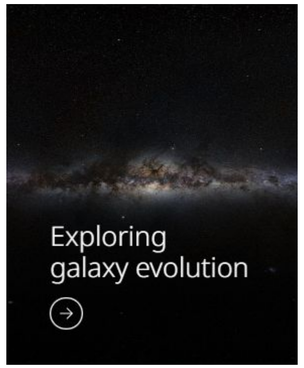
"To build and operating cutting edge telescopes to transform our understanding of the universe and deliver benefits to society through global collaboration and innovation"

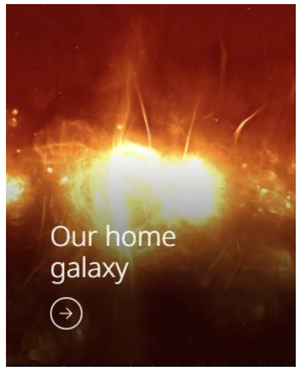
Australia
Canada
China
Germany
India
Italy
The Netherlands
Portugal
South Africa
Spain
Switzerland
United Kingdom

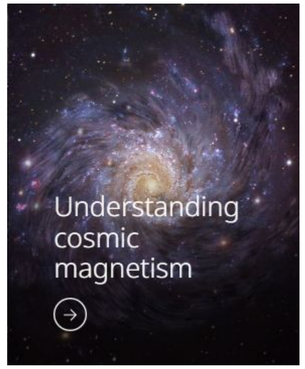
SKAO Partnership - includes SKAO Member States* and SKAO Observers (as of Nov 2024)

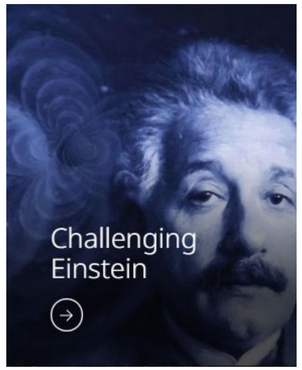
African Partner Countries

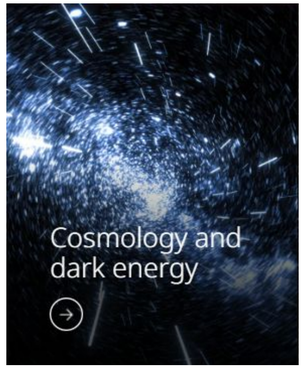
Science Goals

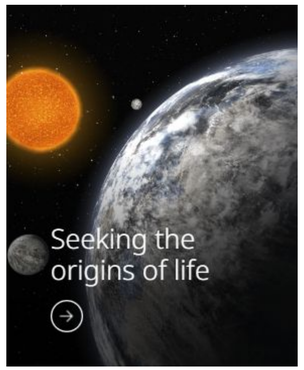


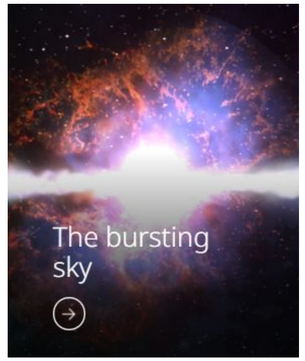












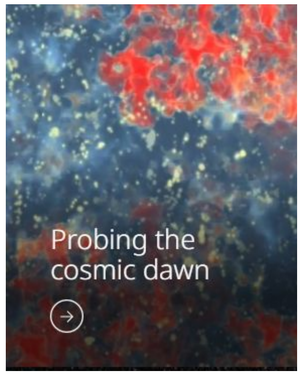
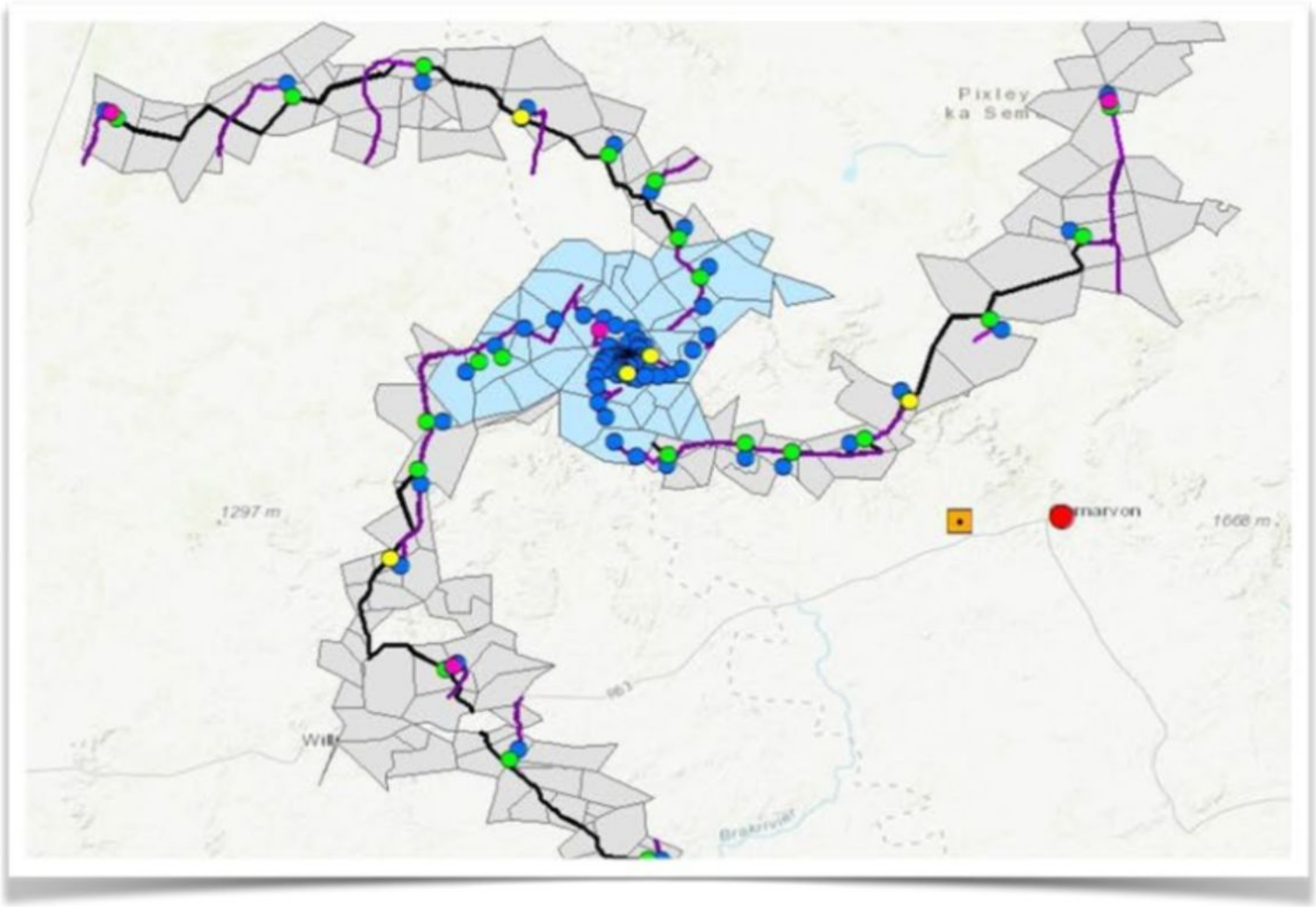


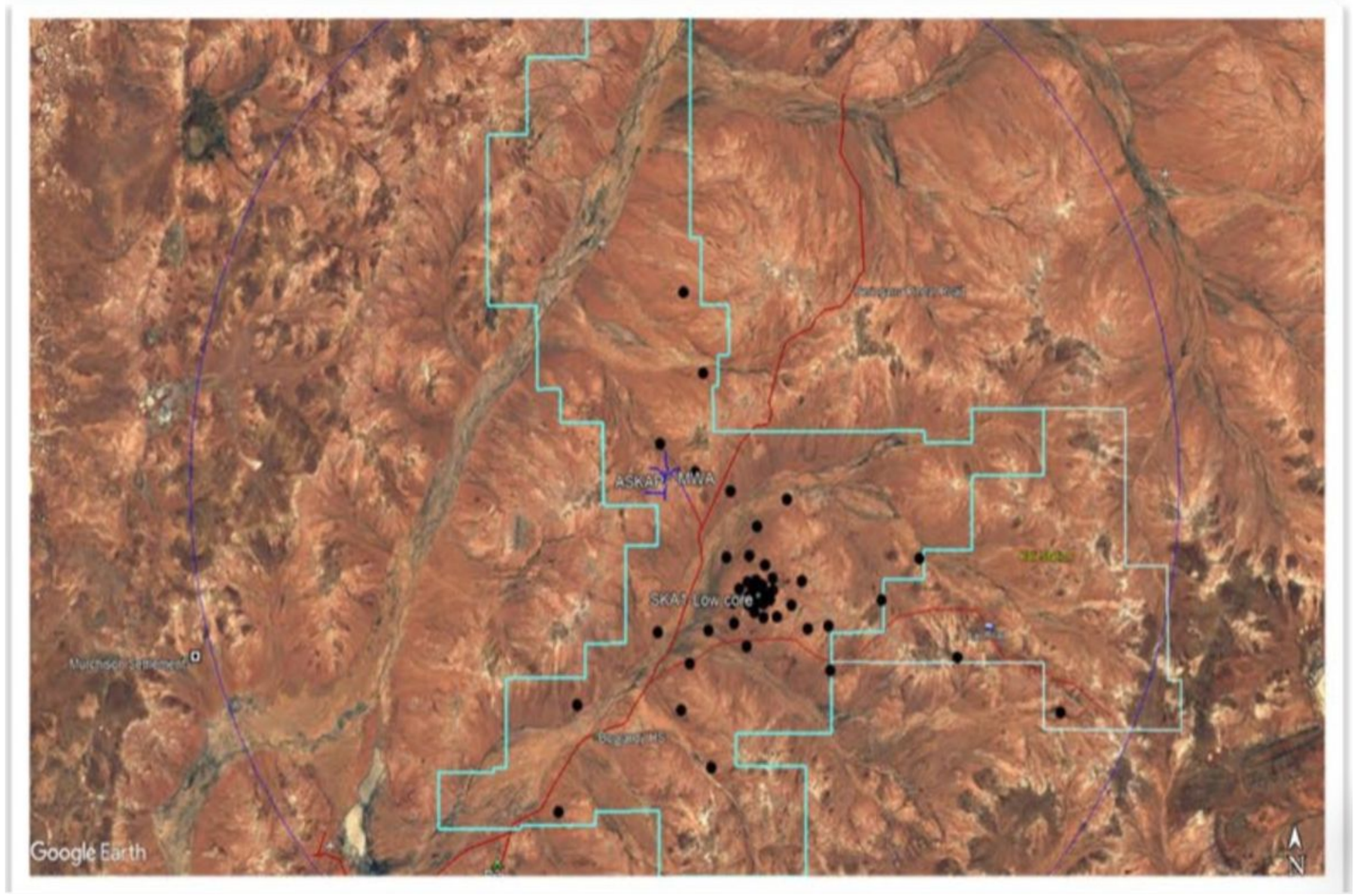
Image credits: SKAO website

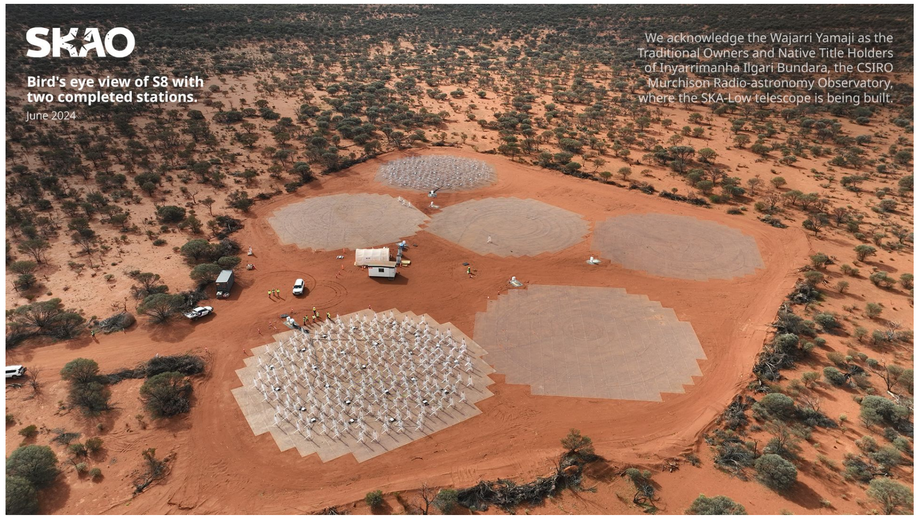
SKA-Mid Telescope



- 197 fully steerable dishes
- Maximum baseline 150 km
- Frequency range 350 MHz - 15.4 GHz

SKA-Low Telescope





- 512 stations
- Maximum baseline 70 km
- Frequency range 50 MHz - 350 MHz

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One global observatory,
two telescopes, three sites

Roadmap

Delivery Overview

Milestone Event (earliest)		SKA-Mid	SKA-Low
Construction Approval		**2021 Jul**	**2021 Jul**
AA0.5 AIV start	4 dishes 4 stations	**2025 Nov**	**2024 Jul**
AA0.5 end	4 dishes 4 stations	2026 May	2025 Jul
AA1 end	8 dishes 16 stations	2027 Jan	2026 Jan
AA2 end	64 dishes 64 stations	2027 Dec	2026 Nov
AA* end	144 dishes 307 stations	2028 Sep	2028 May
Operations Readiness Review		2029 Jan	2028 Jul
End of Staged Delivery programme		Formal end of construction (including contingency): 2029 Mar	
AA4	197 dishes 512 stations	TBD	TBD

- Completed 43 months of activity from a projected 93-month construction phase
- 97 contracts have been awarded for approximately €776M, which is 78% of the Capital Cost of Construction
- As of February 2025, progress measures indicate 43% of project work complete, compared with 46% planned and 46% spent

SKA-Low’s early success (March 2025)

S8 Cluster / AA05

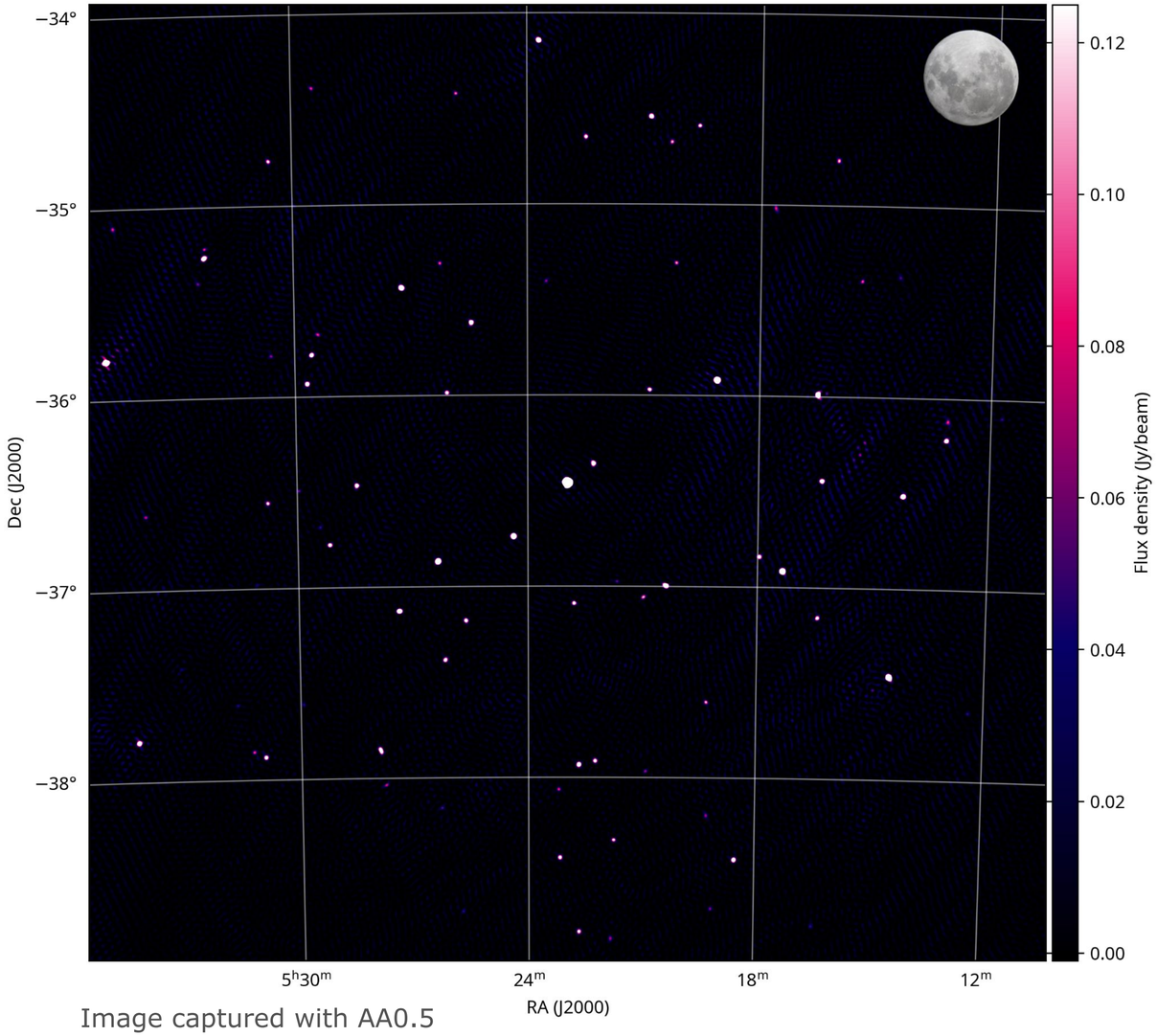
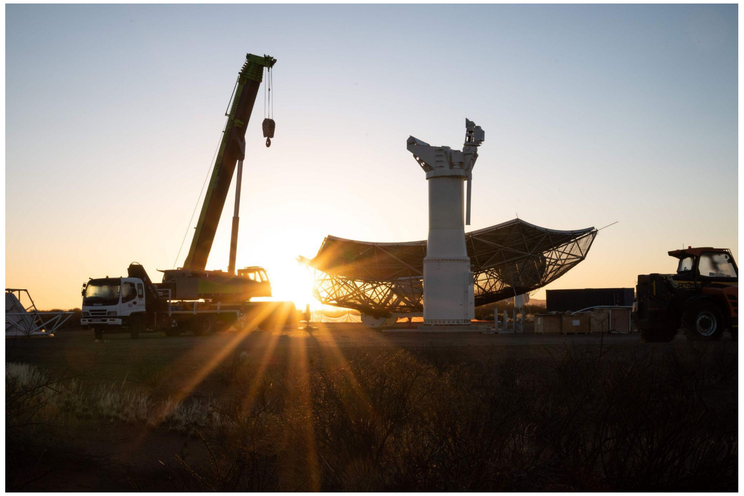


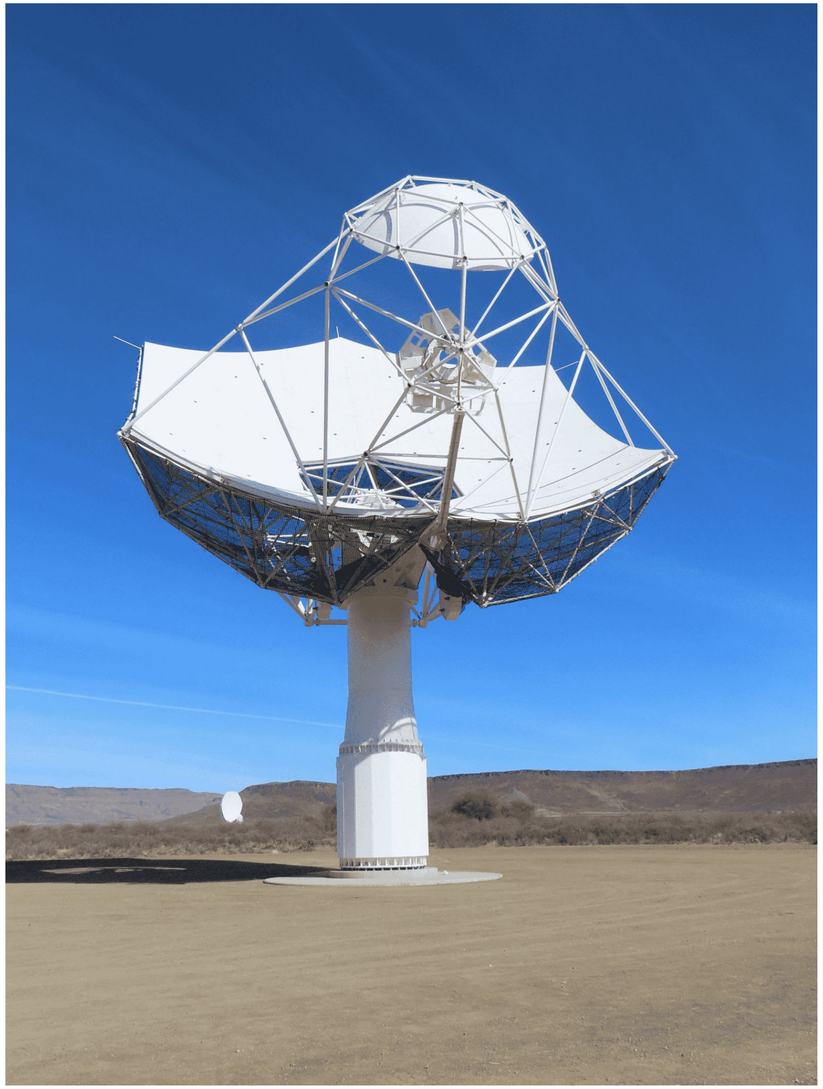
Image captured with AA0.5

press release

SKA-Mid Current Status

- 3 dishes structures built (3 big lifts)
  - 4 more awaiting assembly against planned 12
- Risks identified and mitigated
  - AA0.5 nearing completion
- Fringes targeted for end of 2025





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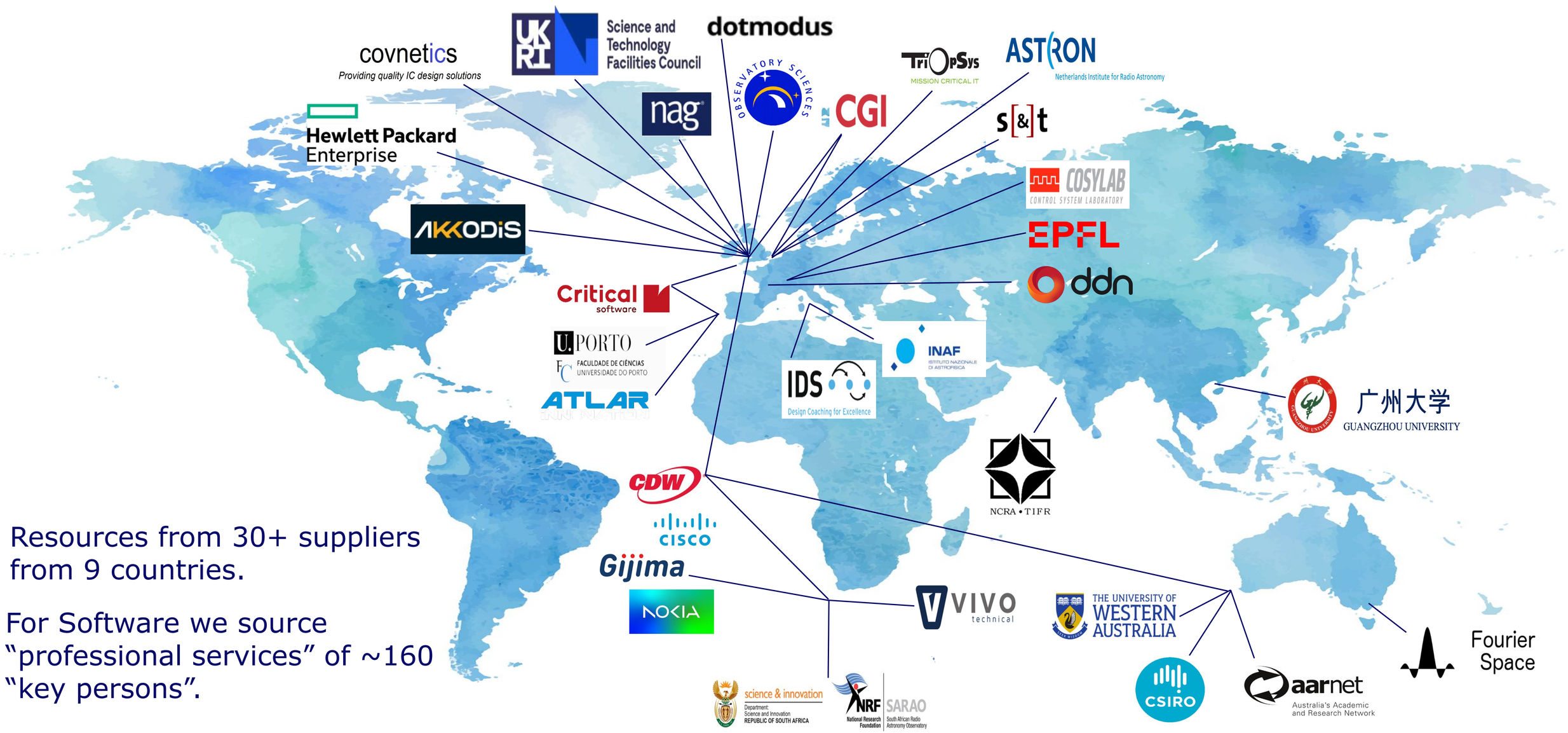
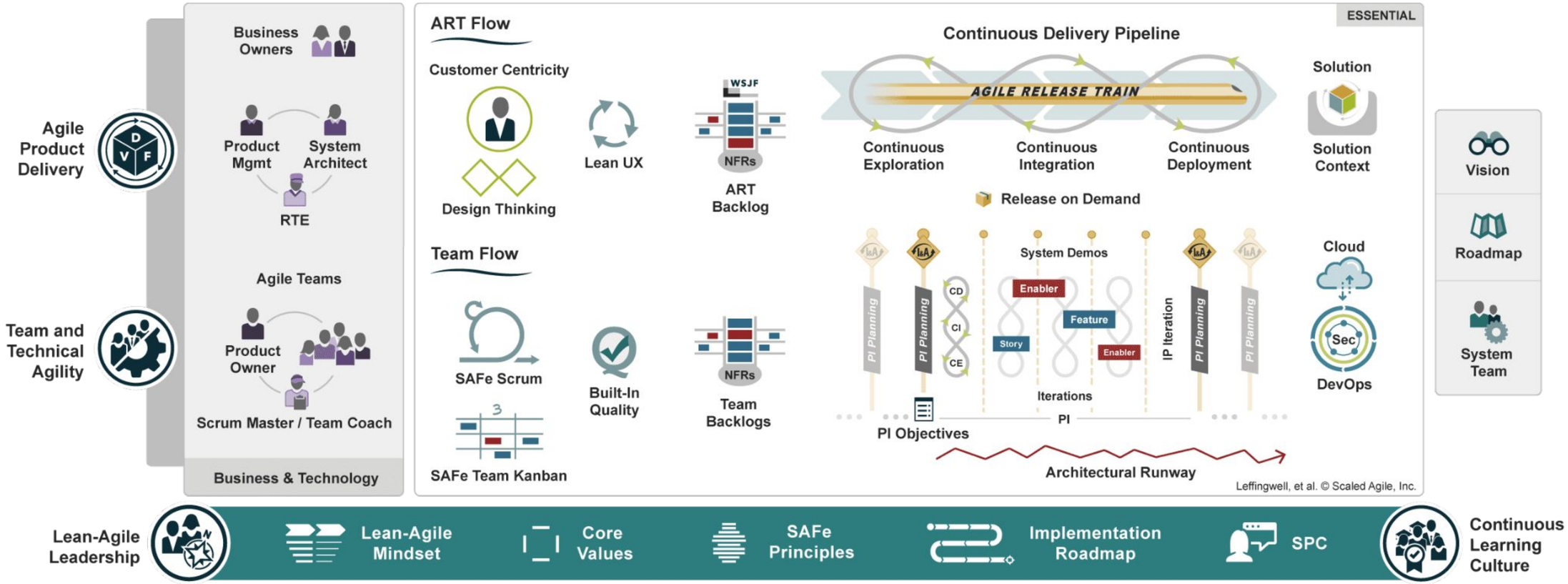
Software

Computing & Software Supplier Ecosystem



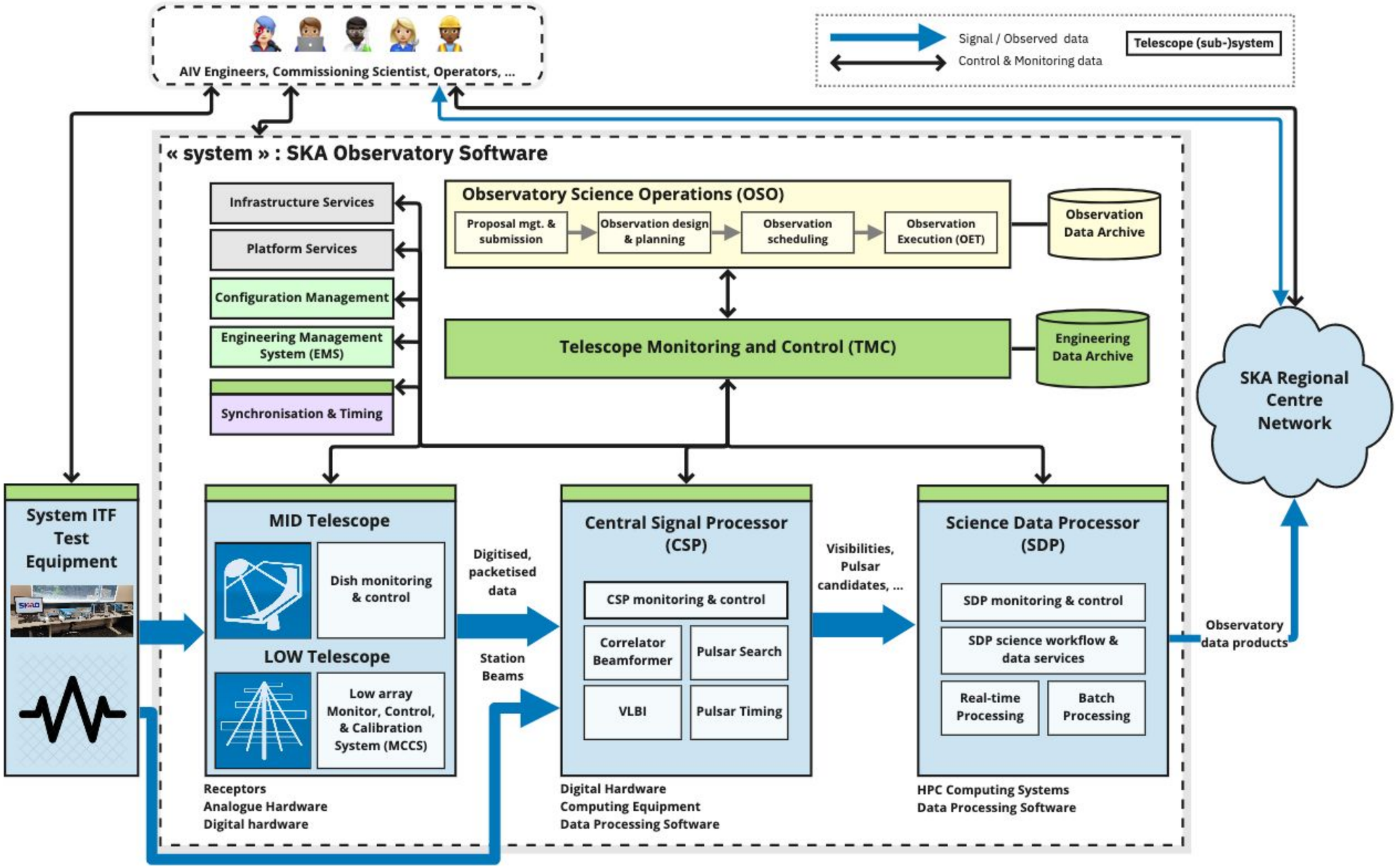
- Resources from 30+ suppliers from 9 countries.
- For Software we source “professional services” of ~160 “key persons”.

Delivering Computing and Software

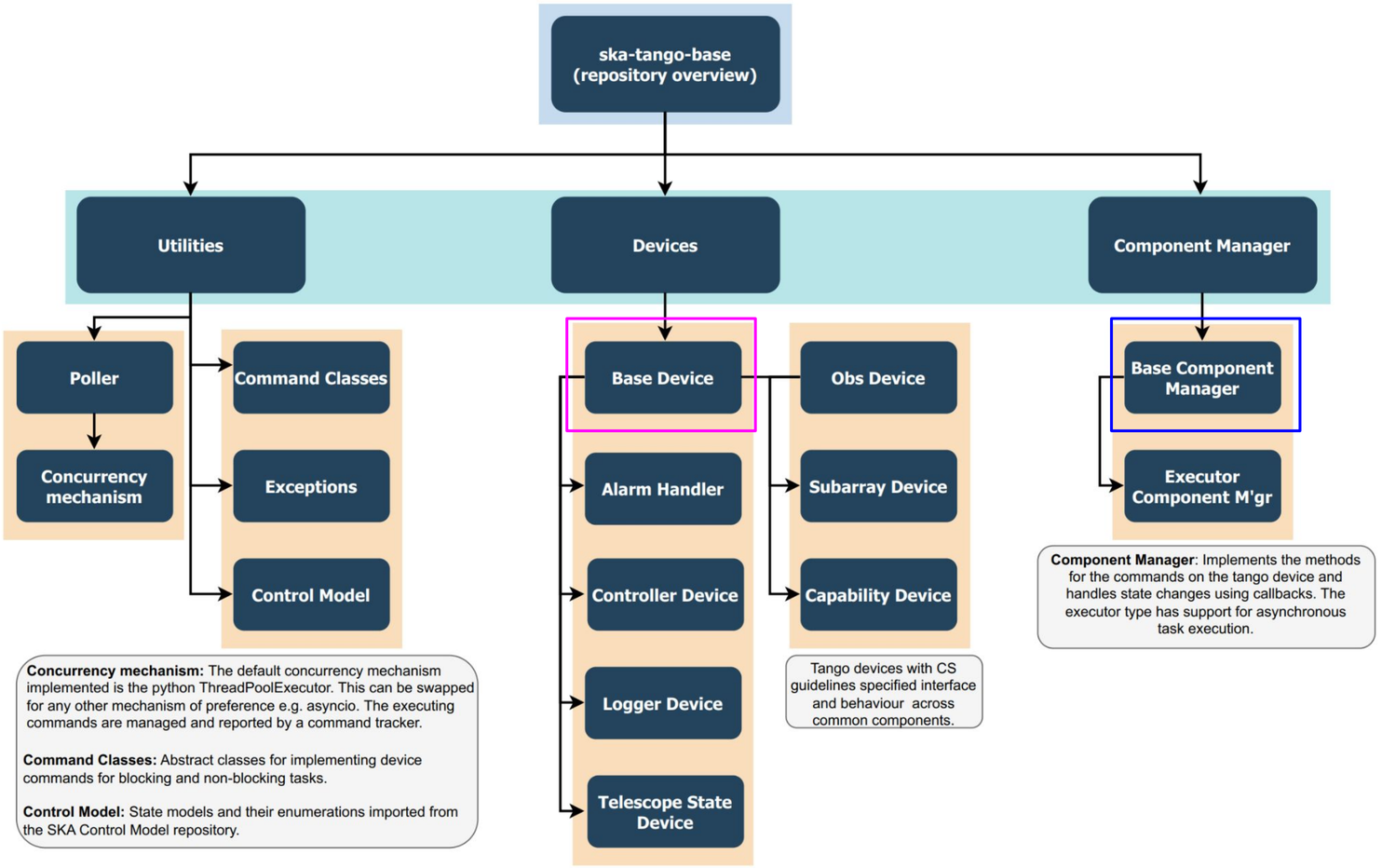


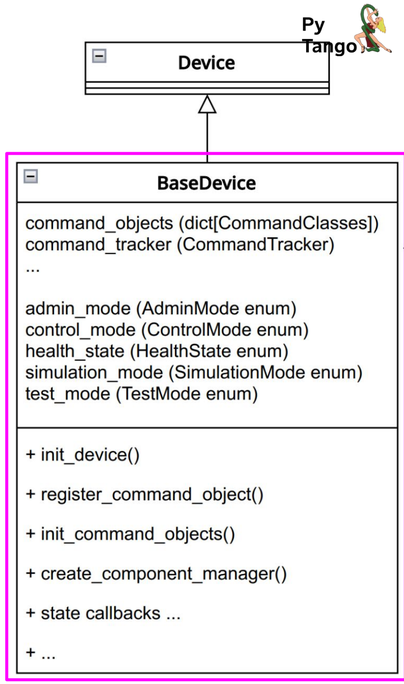
- Coordinated effort of 30 globally distributed teams in 6 Agile Release Trains (ARTs)
- Content, technical and process alignment between the ARTs is managed by the Solution Team & ART Program Teams.
- All ARTs follow the same 3-month planning, prioritisation and delivery cadence .
- Work is shared with stakeholders through frequent system demos.

Key Software Components



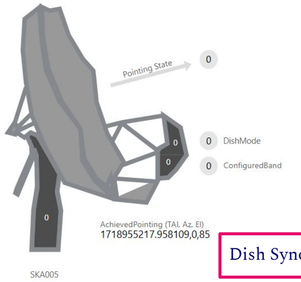
Control System Guidelines + Base Classes





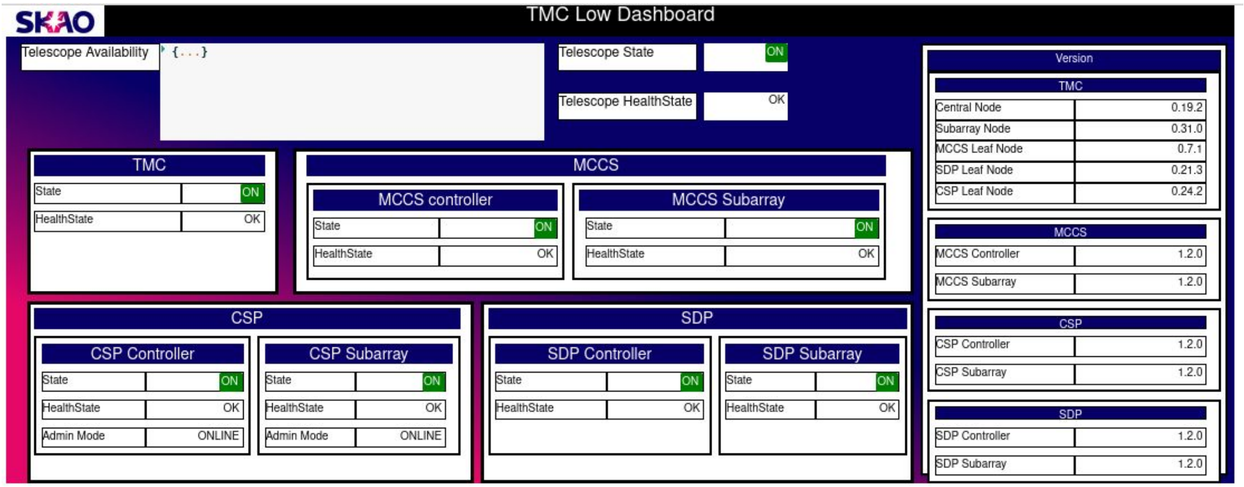
Tango Community @ SKA

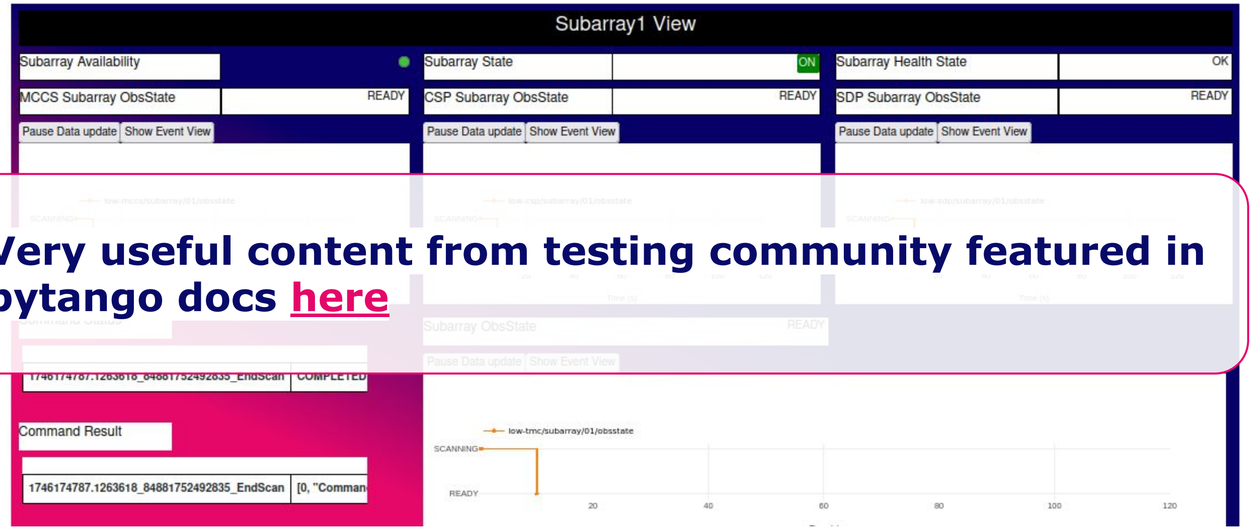
- **Tango Community of Practice**
- CI/CD & Testing Community of Practice



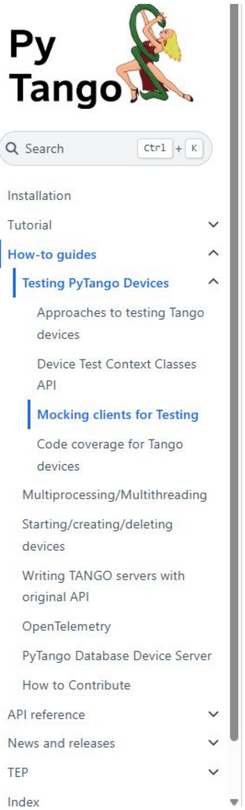
Dish Synoptic View

Taranta dashboard





Very useful content from testing community featured in pytango docs here



Mocking clients for Testing

Test Doubles: The idea behind mocking Tango entities

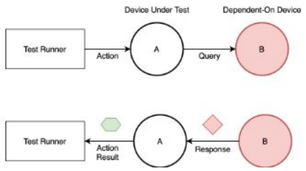
Suppose we want to test a Tango Device, **Device A**. In particular, we want to assert that when a certain *action* is invoked on **Device A**, it should produce an expected result. This will prove to us that **Device A** 's implementation sufficiently manifests the behaviour we would like it to have.

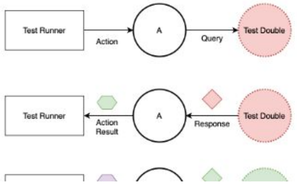
Now suppose **Device A** depends on **Device B** to complete its action. In other words, the *result* will depend, in part, on the state of **Device B**. This means that to test this scenario, both devices need to be in a base state that we control.

This might be difficult to achieve when using real devices since it might require a lot of orchestration and manipulation of details irrelevant to the test scenario, i.e. to get **Device B** into the required state.

A **Test Double** is a component that can act as a real device but is easier to manipulate and configure into the states that we want during testing. This means that we can replace **Device B** with its **Test Double** as long as it conforms to the interface that **Device A** expects.

What's more, we can manipulate the **Test Double** to respond in the way we expect **Device B** to respond under the various conditions we want to test. A **Mock** is simply a type of **Test Double** that might have some conditional logic or behaviour to help in testing.



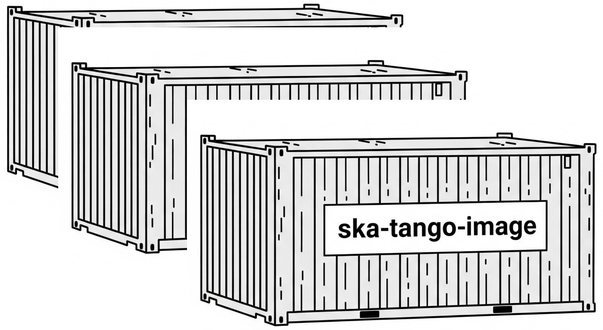


Test Doubles: The idea behir mocking Tango entities
Tango's DeviceProxys
Mocking the DeviceProxy
Solution
Moving on
Using pytest and fixtures
Acknowledgement

Tango Community @ SKA: ska-tango-images

Defines a set of Docker images and Charts files that are useful for TANGO control system development

```
ARG CAR_OCI_REGISTRY_HOST
ARG SKABUILDPYTHON_VERSION
ARG BUILD_IMAGE="artefact.skao.int/ska-build-python:${SKABUILDPYTHON_VERSION}"
ARG BASE_IMAGE="${CAR_OCI_REGISTRY_HOST}/ska-tango-images-tango-python:local"
FROM $BUILD_IMAGE AS build
ARG PYTANGO_VERSION
ARG DSCONFIG_VERSION

ENV VIRTUAL_ENV=/app
RUN set -xe; \
    apt-get update; \
    apt-get install -y --no-install-recommends \
        python3-venv; \
    python3 -m venv $VIRTUAL_ENV
ENV PATH="$VIRTUAL_ENV/bin:$PATH"

RUN pip install --no-cache-dir pytango==${PYTANGO_VERSION} dsconfig==${DSCONFIG_VERSION}

RUN pip uninstall -y pip

FROM $BASE_IMAGE AS final

ENV VIRTUAL_ENV=/app
ENV PATH="$VIRTUAL_ENV/bin:$PATH"

COPY --from=build $VIRTUAL_ENV $VIRTUAL_ENV

LABEL int.skao.image.team="Team Wombat" \
      int.skao.image.authors="oci-support@skao.int" \
      int.skao.image.url="https://gitlab.com/ska-telescope/ska-tango-images" \
      int.skao.image.source="images/ska-tango-images-tango-dsconfig/Dockerfile" \
      int.skao.application="MaxIV Tango Dsconfig" \
      description="Contains the dsconfig application from the Tango controls collaboration" \
      license="BSD-3-Clause"

# Existing Helm charts assume tango-dsconfig starts in the root directory
WORKDIR /
```

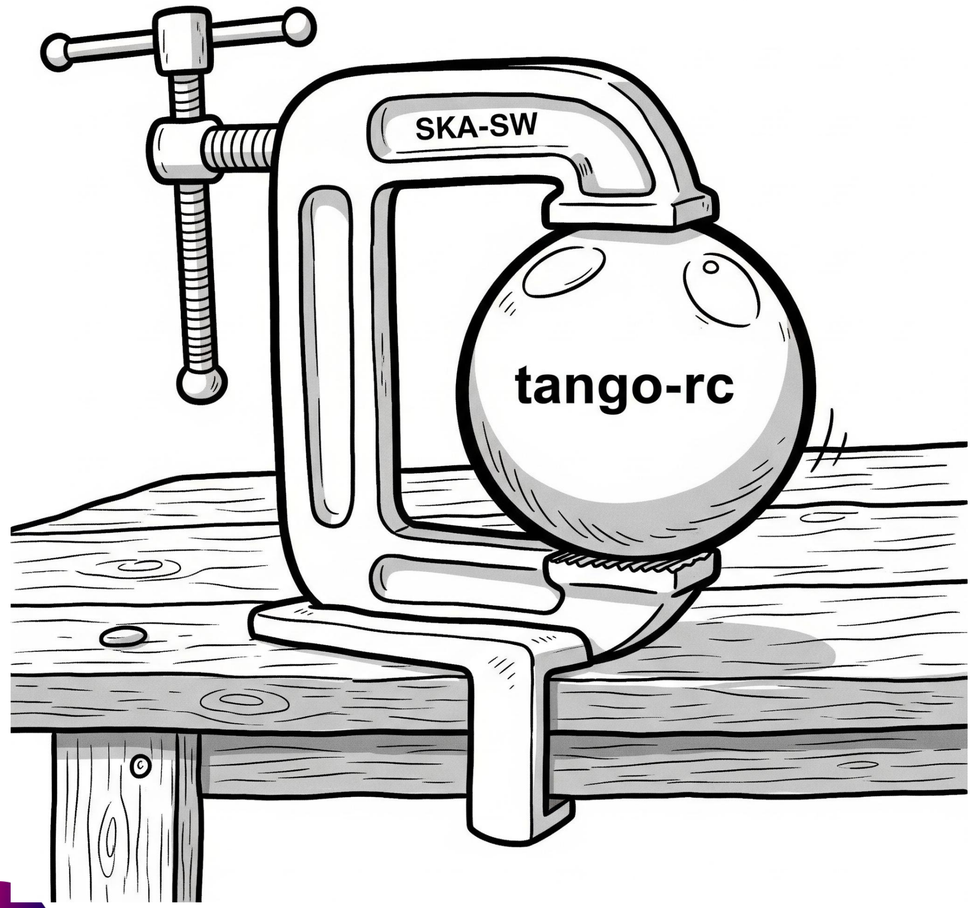


- hdbpp x 4
- rest-server
- tango-admin
- tango-base
- tango-boogie
- tango-cpp
- tango-python
- tango-dsconfig
- tango-jive
- tango-pogo
- tango-rest
- tango-test

see docs

Tango Community @ SKA: ska-tango-...

ska-tango-test-bench: Test bench for testing Tango release candidates against SKA software



ska-tango-event-monitor: Provides facilities to monitor the Tango event system performance for your Tango devices

```
New subscriptions:
        mid-dish/simulator-spfrx/ska001/b3capabilitystate.idl5_change: 0 (1 callback(s) registered)
        mid-dish/simulator-spfrx/ska001/attenuationpolh.idl5_change: 0 (1 callback(s) registered)
        mid-dish/ds-manager/ska001/band1pointingmodelparams.idl5_change: 1 (1 callback(s) registered)
        ...
New publishers:
        mid-dish/dish-manager/ska001/longrunningcommandresult.change: 9
        mid-dish/dish-manager/ska001/longrunningcommandsinqueue.change: 9
        mid-dish/dish-manager/ska001/dishmode.change: 3

Publishing performance:
                        Event Gaps (µs):   50530.85±30847.31   (min=5, 10%=7, 90%=100408 max=997019)
                   Event push time (µs):      19.03±3.30       (min=1, 10%=1, 90%=53 max=80)
Received events or callbacks changed:
        mid-dish/simulator-spfrx/ska001/b3capabilitystate.idl5_change: +1 (+0 callbacks)
        mid-dish/simulator-spfc/ska001/b5acapabilitystate.idl5_change: +2 (+0 callbacks)
        mid-dish/simulator-spfrx/ska001/b1capabilitystate.idl5_change: +1 (+0 callbacks)
        ...
Subscription performance:
                        Event Gaps (µs):   22872.29±17275.67   (min=3, 10%=4, 90%=39767 max=582494)
                     Sleeping time (µs):  308647.49±282357.37  (min=1, 10%=1, 90%=147990 max=10031724)
                   Processing time (µs):     194.31±70.49      (min=1, 10%=2, 90%=359 max=2396)
              First callback latency (µs):     887.19±135.66     (min=196, 10%=244, 90%=1678 max=3904)
                     Callback Count (µs):       0.89±0.05       (min=0, 10%=0, 90%=1 max=1)
```

Event monitoring in action, see Thomas Ives' talk

Tango Community @ SKA: ...

- ska-tango-testing: provides test harness elements for testing Tango devices
- On demand Tango workshops for teams led by Thomas Juerges
- Contributing runners for tango CI jobs (along with DESY, MAX IV & ALBA)
- Active collaboration on Taranta
- Driving development of device servers in a kubernetes context (workshop by Matteo Di Carlo)

SKAO TANGO

We've made a key technical choice and forged a valuable partnership that perfectly aligns with SKAO's belief in open source.

This product's excellence is built on the strength of our community – **GRAZIE** to everyone who has contributed!

Questions?

We recognise and acknowledge the Indigenous peoples and cultures that have traditionally lived on the lands on which our facilities are located.

SKAO

www.skao.int