Science and Technology Facilities Council

uk | SRC

SKAO Regional Centre United Kingdom

UK SKA Regional Centre: Enabling radio astronomy in the exabyte era

Louise Chisholm & Rob Beswick Joint Directors

Ian Collier - Technical Director; **Jack Radcliff** – Community Director; **Jeremy Coles** – Deputy Director

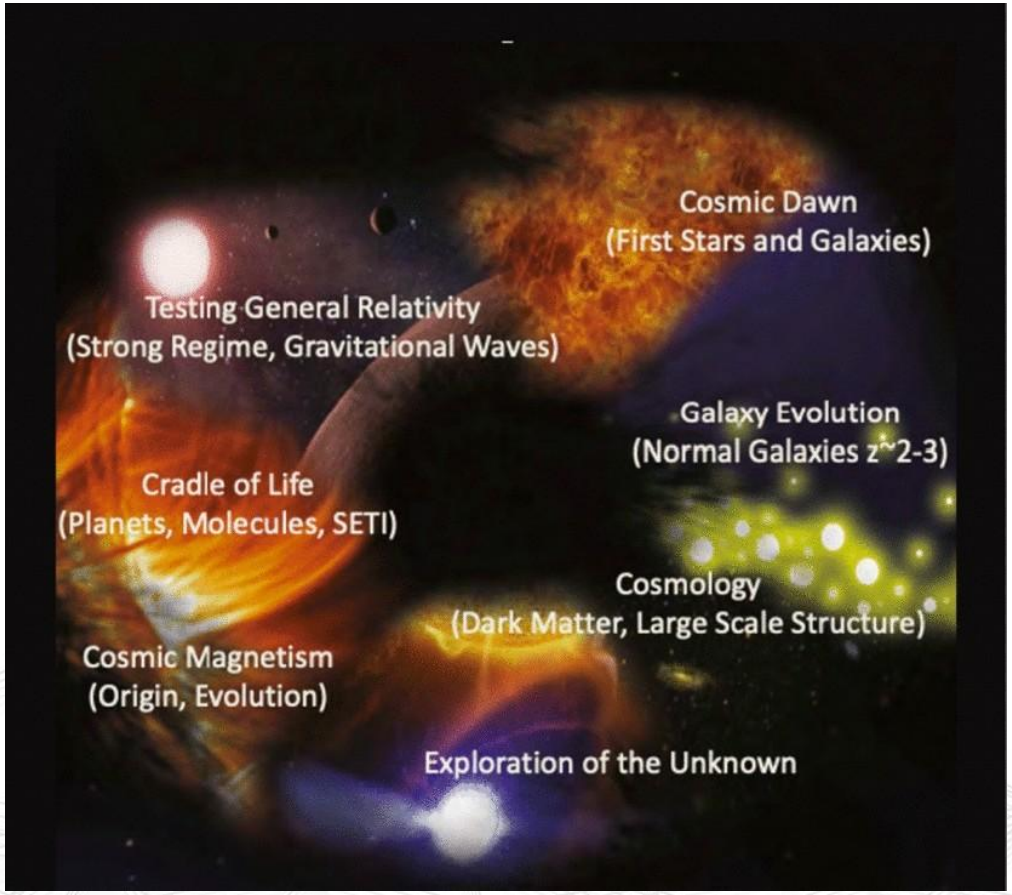
UKRI National Federated Compute Services NetworkPlus

Launch 5/3/2025

Square Kilometre Array Transforming Radioastronomy

- Square Kilometre Array (SKA) Observatory (SKAO) is a next-generation radio astronomy facility which will cover the frequency range from 50 MHz to 15 GHz.
- SKA Construction: ~2 billion Euro investment (2021)

Composite image of the SKA telescopes, blending real hardware already on site with artist's impressions. Credit: SKA Observatory



Credit: SKA Observatory

uk | SRC

UK SKA Regional Centre

UKSRC infrastructure and services: Supporting and facilitating UK science

uk | SRC

SKAO Regional Centre United Kingdom

Global SRC Network: Developing and delivering the global SRCNet.

Delivering STFC’s UK SKA Regional Centre Strategy

UKSRC’s mission is to maximise that the UK’s return on the UK’s SKAO investment.

UK SKA Regional Centre

Developing digital research infrastructure

Bespoke UK-based computational and data facilities, tools, and services will contribute to the analysis of 700PB of data generated per year by the SKA telescopes.

UK Science Community

Strengthening the UK astronomy community

UK astronomers will have opportunities to inform the UKSRC's development and to enhance their skills in preparation for the deployment of the SKA telescopes.

Global SRC Network

Collaborating internationally

The UKSRC team working with a global network of 14 nations and the SKA Observatory to develop interoperable functionalities to find, access, manipulate and visualise SKA Data products.

uk | SRC

UK teams

- Working towards both UK-national and SRCNet activities
- Cross-functional teams of SRCs working towards developing infrastructure and tools for SKA data handling.
- Part of the Scaled Agile Framework that coordinate work across SRCNet and other SKA areas (construction, software…)

UK based teams

Data Access & Compute
Cloud & Data metadata archive

Purple
AAI, data logistics, policy, PerfSONAR

Teal
Science Platform and workflow development

Sapphire
Science user support, training, and community engagement

International teams

Coral
Tests node deployment and support the tech development to build a performant SRCNet.

Tangerine
To deliver the SRCNet Science Gateway which provides users with access to SRCNet services

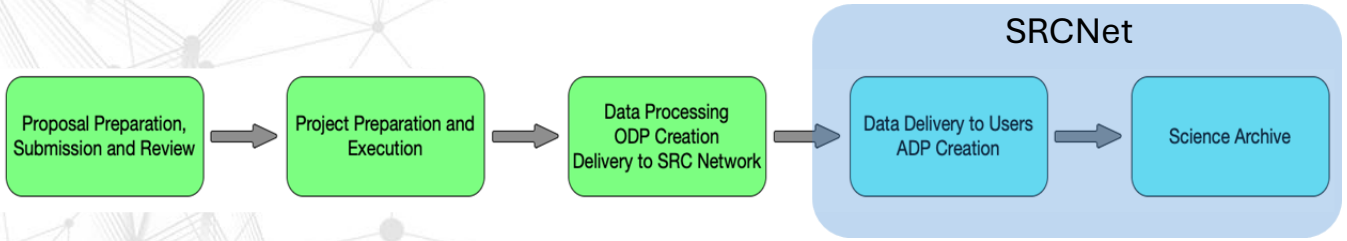
Magenta
SRCNet Rucio data management, data management APIs

SRC | Net
SKAO Regional Centre Network

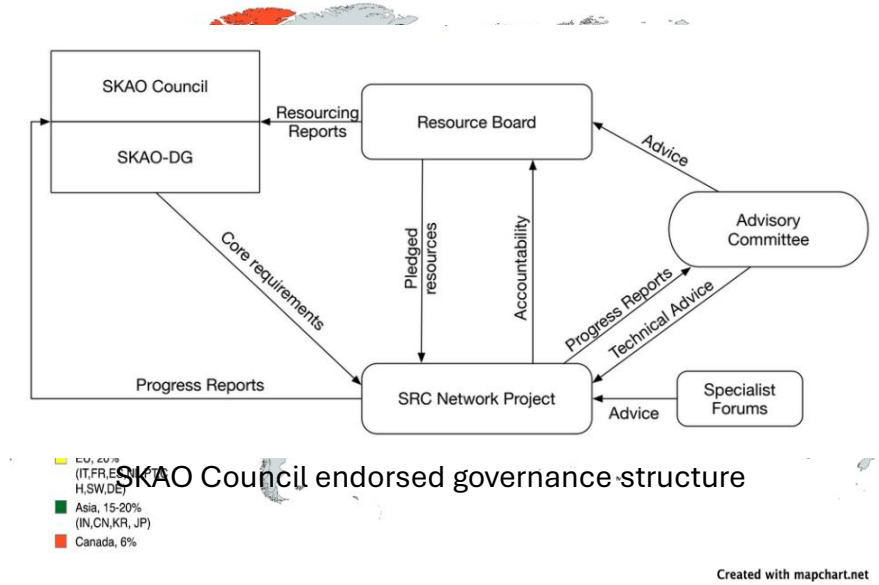
Program team
Responsible for the running of the ART

uk | SRC

Global SKA Regional Centre Network



- **Global SRC Network is essential to deliver science from the SKA**
  - SRCNet is the sole access point for Scientists to SKA data & science



SKAO Council endorsed governance structure

- **UK is the largest single partner**
- UK's SRCNet contributions align with SKAO construction:

  ~20% effort and e-infrastructure facilities & services

SRC Network – collaboration of 16 partners

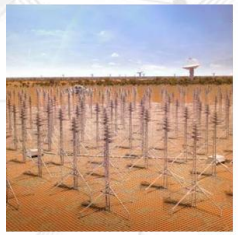
- All SRCs are outside of SKAO cost book
- Formal pledging of effort and e-infrastructure facilities & services
- Expecting 700PB/year from SKA-LOW and SKA-MID combined. Archive growth 1ExByte/year globally (UK 20%)
- There is too much data for one country

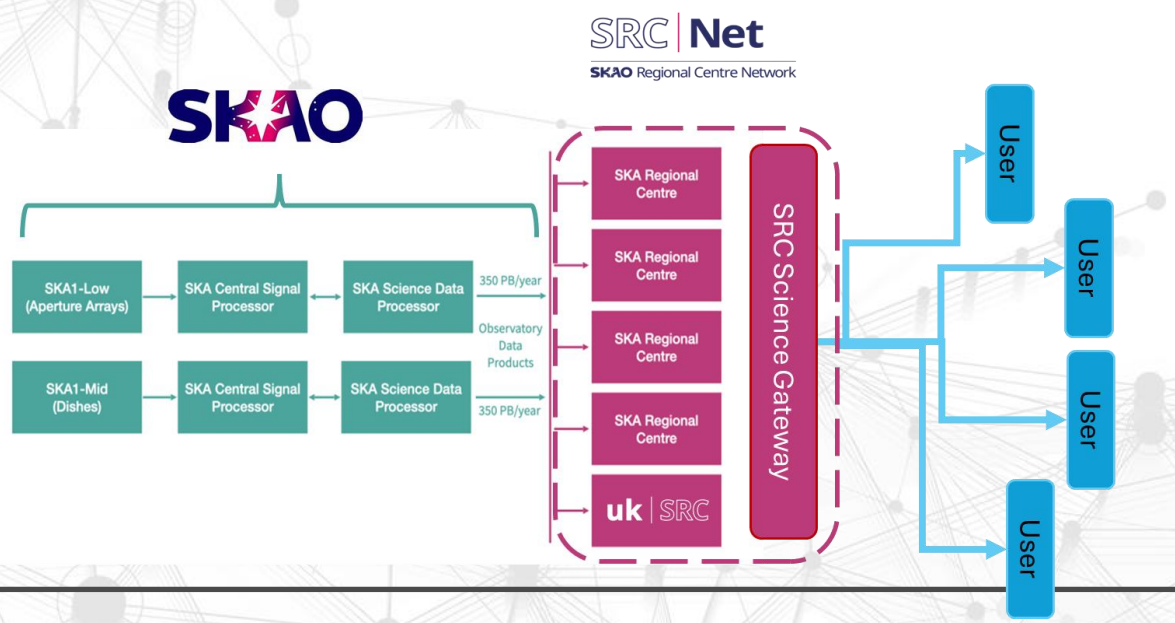
uk | SRC

SRCNet work is critical for SKAO delivery

SRCNet project is focused on the Federation of sites, data and services

- User accounts, single sign on (AAA)
- Provides the portal for scientists
- Delivers Data Products to Science Users
- Global archive of data and enable creation and storage of Advanced Data Products
- Provide the resources needed AKA – Preparing to deliver Science Platforms for science ‘beyond the laptop’



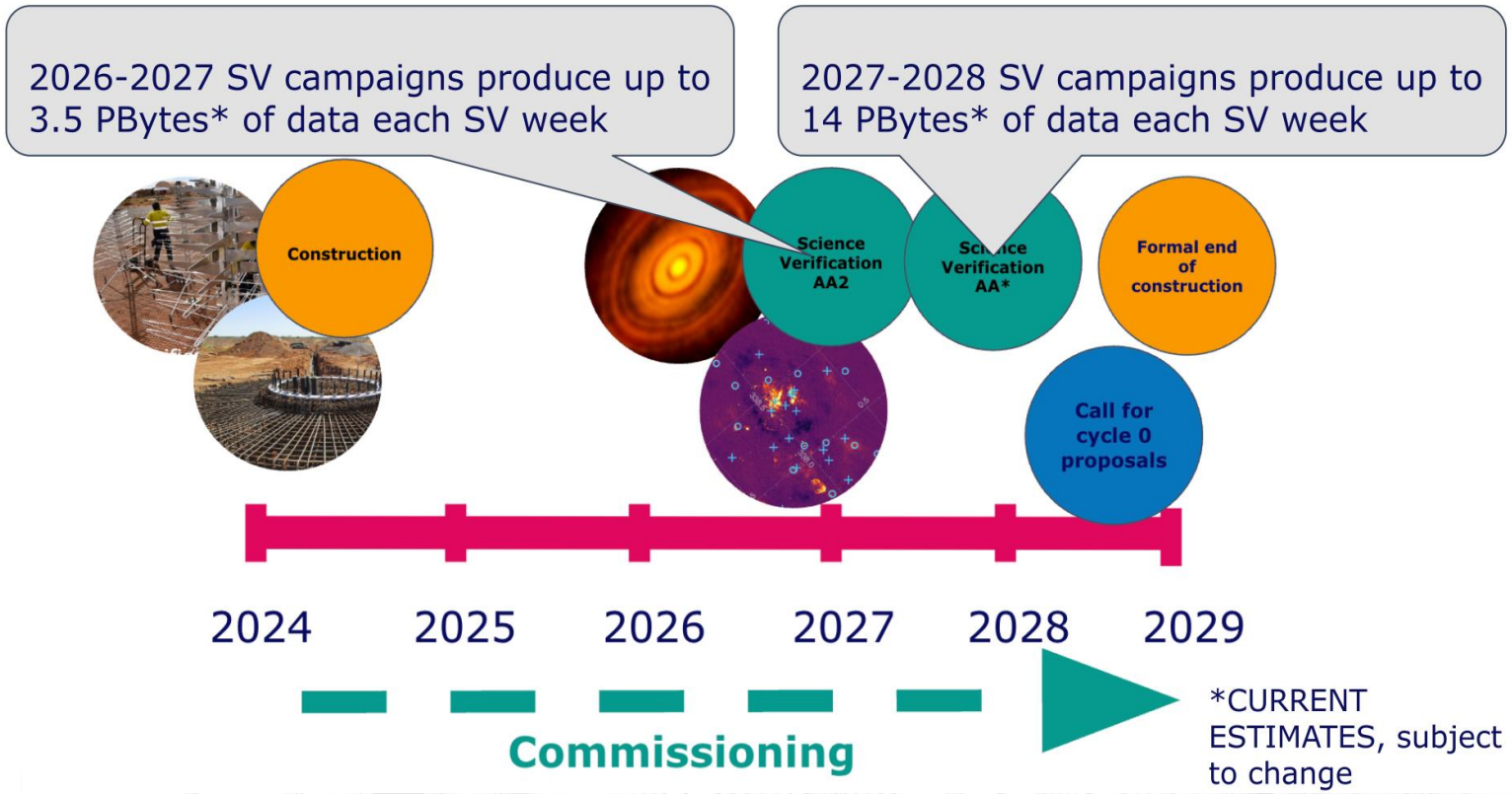


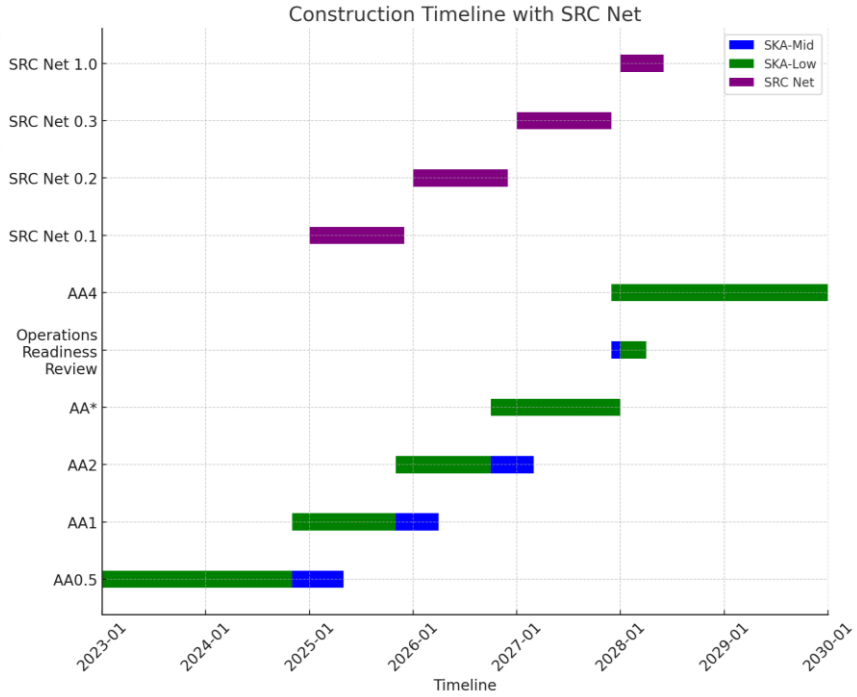
uk | SRC

SRCNet Timeline

- Build up capabilities within SRCNet before needing to scale out in capacity
- Delivery timelines are aligned with SKAO telescope array construction
- SRCNet is needed for Science Verification (SV) which provides an end-to-end test of the science performance of SKA with the astronomical community.


SKA-Mid-Australia

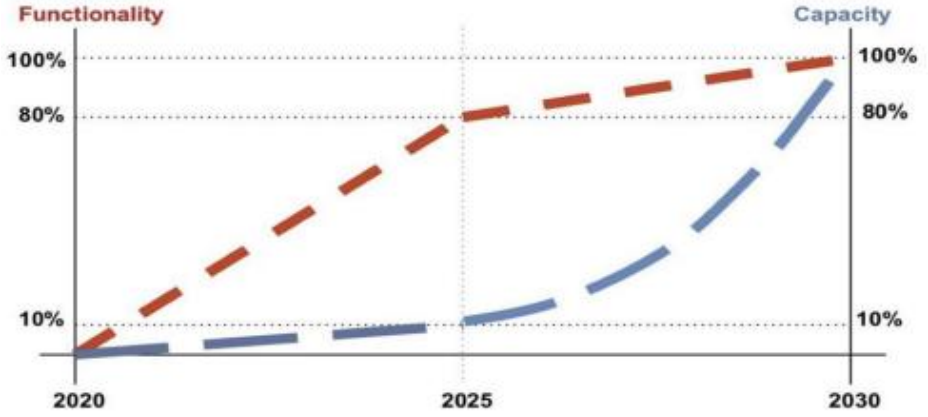




uk | SRC

SRCNet challenges

- **SKA anticipates lifetime of 30+ years**
  - Solutions developed now will evolve due to changing technology, science and external constraints
- **Interoperability** with
  - Other experiments for multi-wave astronomy
  - Global network and heterogeneous computational resources
- **Scale**: Data rates from telescopes
  - ~700 PB/year of data products
  - Proprietary data access periods
- **Users will not be downloading their SKA data**.
  - The SRCs will provide the resources and access for you to run your analysis and workflow
  - New way of approaching research for astronomers



Ramp-up of the SRC network

- The **total storage and compute requirement** for SKA science drives the need for a SRCNet
  - The total resources that are much more than any one country can provide alone.
- Compute/Storage resources pledged into the SRCNet will become part of a **global federated pool**

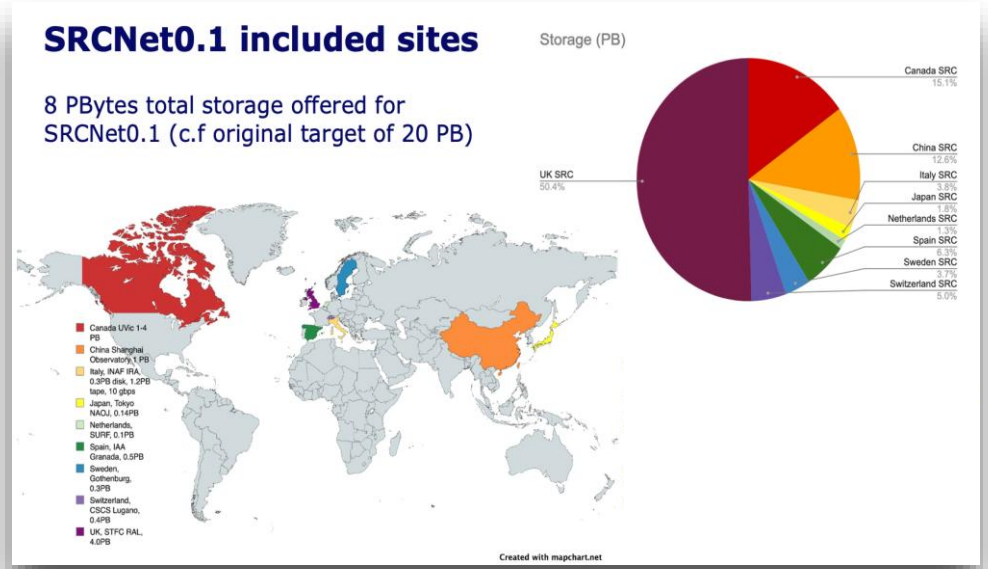
uk | SRC

SRCNet v0.1: initial prototype

SRCNet v0.1 represents the **initial functional prototype release.**

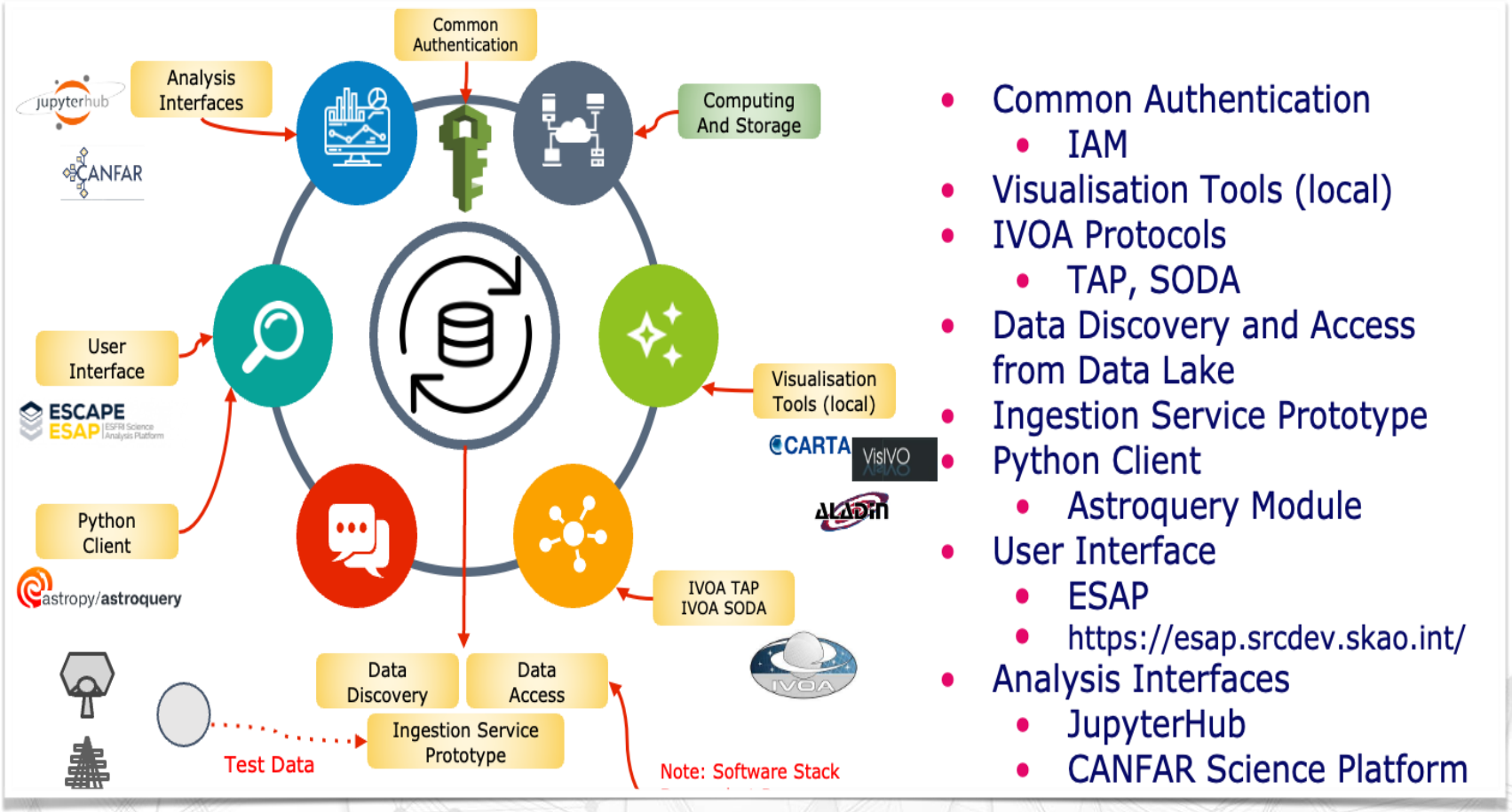
- 8 countries expected to participate in v0.1.

- Minimum goal of 4 deployed Nodes:
  - other Nodes integrated when ready.
- ‘Engineering Prototype’: Internal users only; providing:
  - Common authentication and authorisation
  - Use of Test (i.e random / simulated) – or open – data
  - Data ingestion
  - Data discovery
  - Data distribution and replication
  - Data access
  - Basic data analysis (e.g. visualisation / notebooks)
- Also to continue to develop pipelines, workflows, benchmarking and profiling



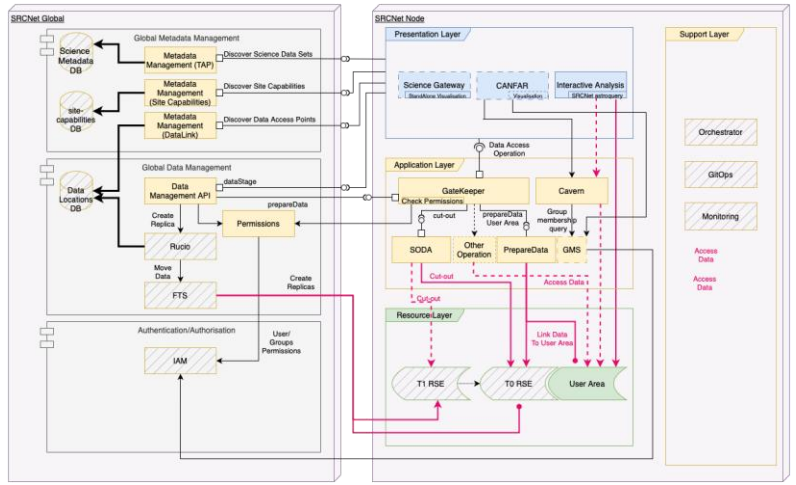
Milestone	Description	SRC Net Functionality	Scope (users)
SRCNet v0.1 First quarter of 2025	First version of SRCNet sites deploying common services and connecting via SRCNet APIs. **Enable technical tests of the architectural implementation**. [Added c.f. document] (Potentialy Opportunity to engage SRCNet with AA0.5 data transfer and access.)	• Test data (and some precursors data) disseminated into a prototype SRC Net • Data can be discovered through queries to the SRC Net • Data dissemination to SRC nodes • Data can be accessed through a prototype data lake • Data replication. Data can be moved to a local SRC area where non-connected local interactive analysis portals (notebooks) could allow basic analysis • Unified Authentication System for all the SRCs • Visualisation of imaging data	**SRC ART members** Members of SKA Commissioning team **(potentially, but not required)**

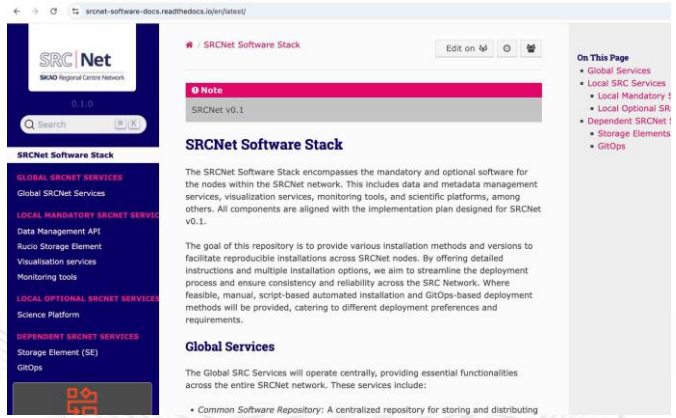
SRCNet Software stack



- Common Authentication
  - IAM
- Visualisation Tools (local)
- IVOA Protocols
  - TAP, SODA
- Data Discovery and Access from Data Lake
- Ingestion Service Prototype
- Python Client
  - Astroquery Module
- User Interface
  - ESAP
  - https://esap.srcdev.skao.int/
- Analysis Interfaces
  - JupyterHub
  - CANFAR Science Platform

Global/Local architecture



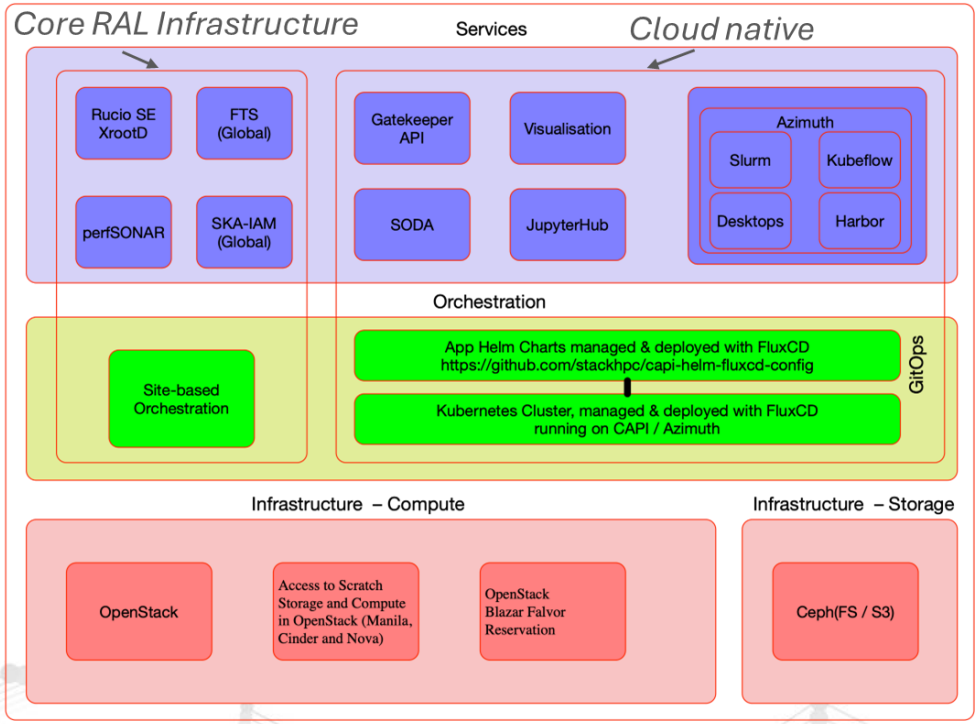


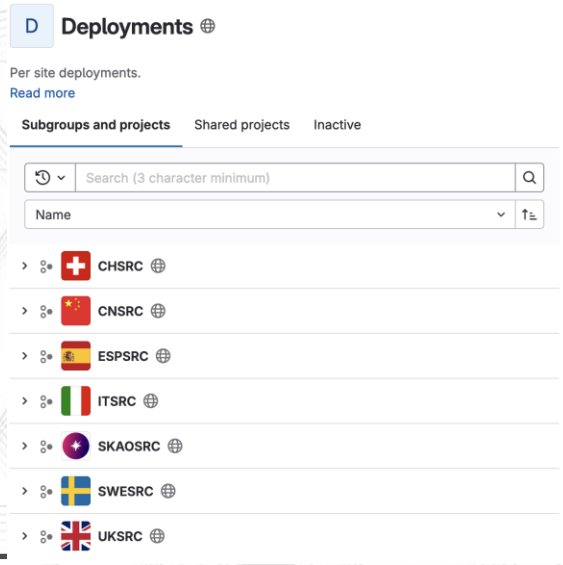
https://srcnet-software-docs.readthedocs.io/en/latest/index.html

UK deployment of SRCNet v0.1

- For v0.1 concentrate initial deployment at Rutherford Appleton Laboratory (RAL) STFC, near Oxford, UK (i.e., same location as the WLCG UK Tier-1).
- Deployment teams from RAL, Cambridge, Manchester, StackHPC contributing.
- GitOps style approach recommended (e.g. ArgoCD/FluxCD, k8s);

uk | SRC
SKAO Regional Centre United Kingdom



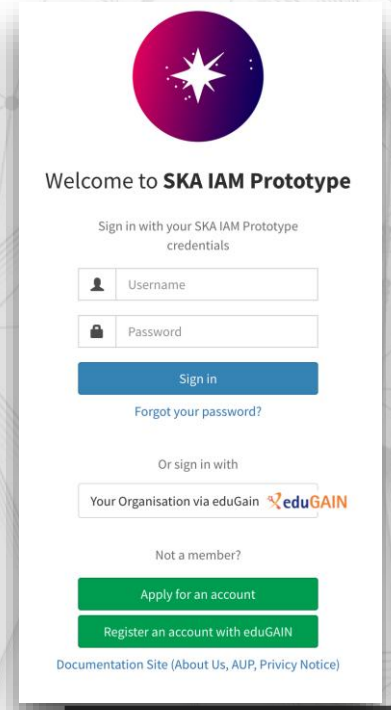


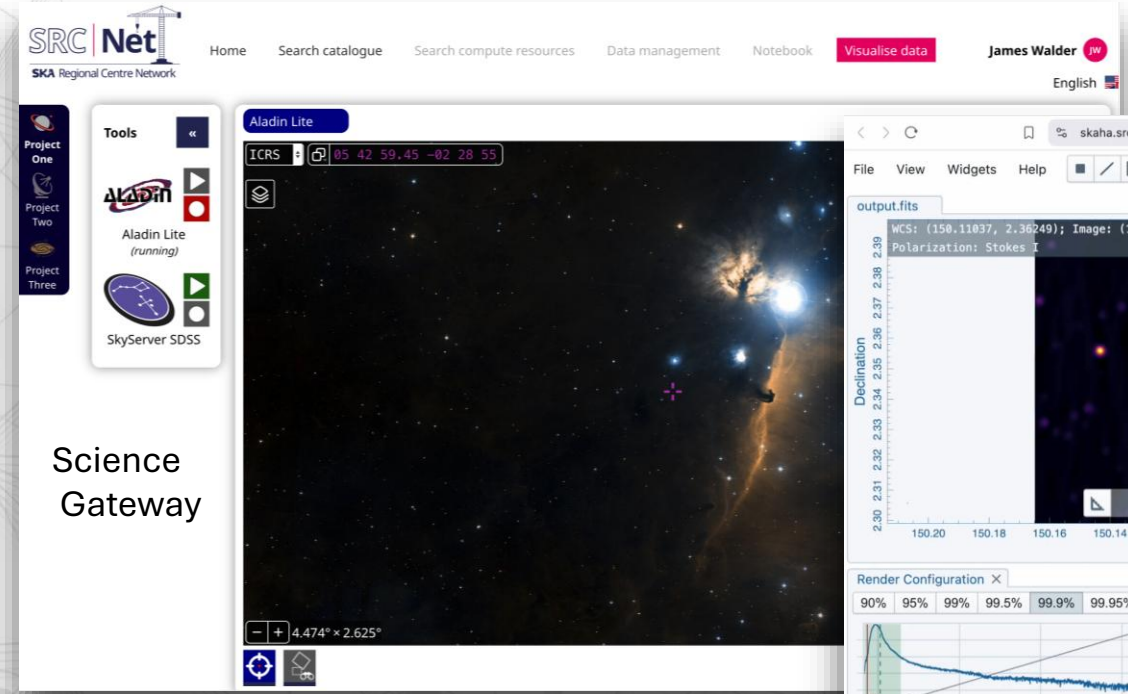
SRC | Net
SKAO Regional Centre Network

uk | SRC

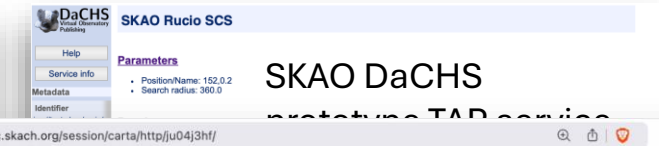
SRCNet v0.1 Software Stack Demo

- Authentication via SKA-IAM (INDIGO IAM) instance Running at RAL
- Login possible via your IdP
- Science Gateway to query catalogue, search for compute resources and perform Data management.
- Use of SODA Cutout service, and further analysis in CARTA. (*snippets taken from the CHSRC demo portion*)

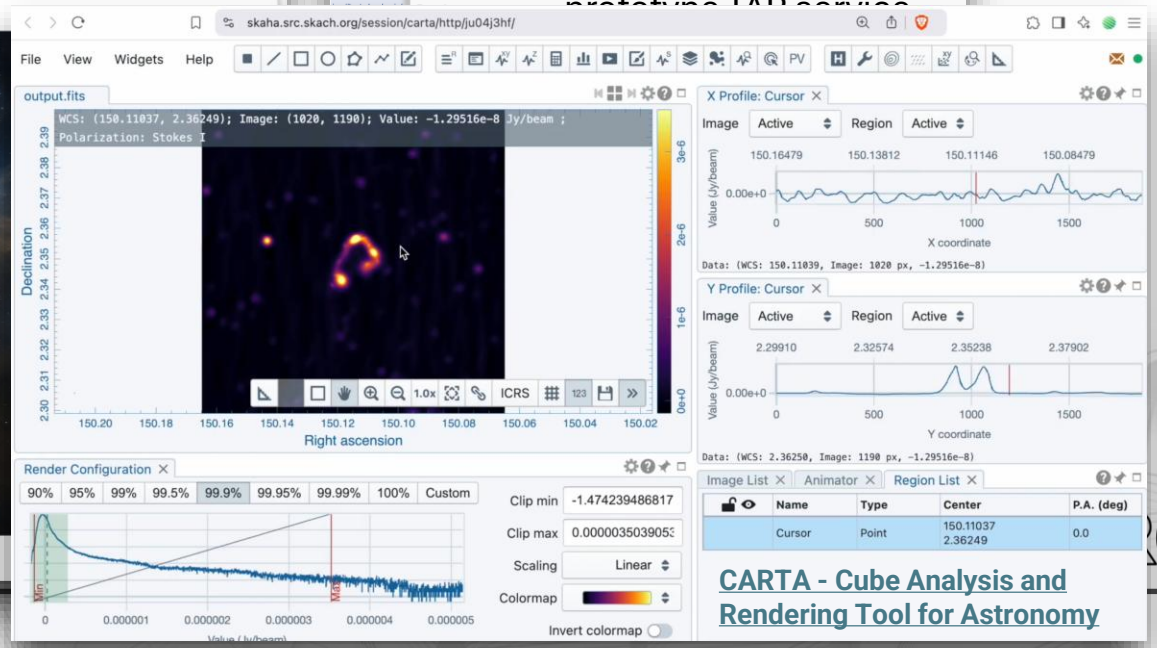




Science Gateway



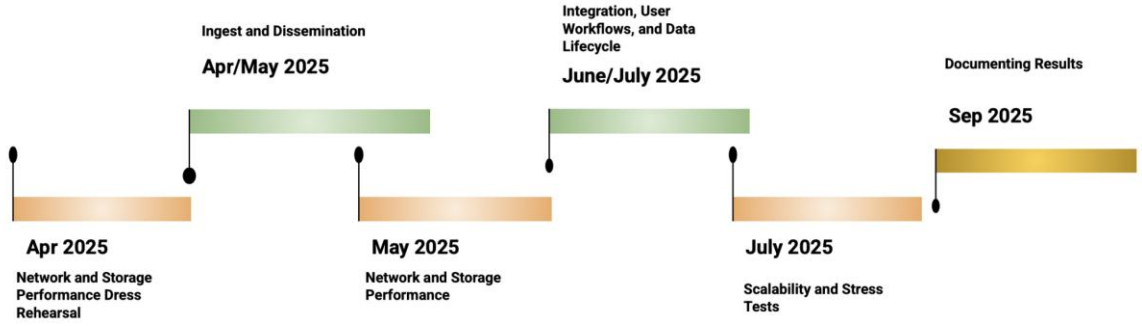
SKAO DaCHS prototype TAP service



[CARTA - Cube Analysis and Rendering Tool for Astronomy]

Next steps

- SRCNet v0.1 Data movement campaigns
  - capture and inform current and future architectural decisions
- SRCNet v0.2
  - Adds in Federated job execution
  - User Storage
  - Preparations for Science Verification:
    - Workloads
    - Data dissemination
  - Selected scientists have access
- SRCNet v0.3
  - Increased sets of functionalities
  - Increased usage by Science communities
  - More Science verifications and additional workloads



Milestone	Description	SRC Net Functionality	Scope (users)
SRCNet v0.2 First quarter 2026	AA1 and Commissioning	• **Data dissemination using telescopes sites interface** • First version of federated execution. Access to remote operations on data using services and the possibility to invoke execution into a relevant SRC • Subset of SDP workflows runnable in the SRCs • First Accounting model implementation. • User storage areas • Visualisation of imaging and time series data through remote operations • Preparation of SRCNet User Support	Selected scientists from community Members of Science Operations SRC ART members

Milestone	Description	SRC Net Functionality	Scope (users)
4th quarter 2026	Cycle 0 proposals, AA2 and Science Verification	• Improved data dissemination. Use of available storage • **SKA preliminary data (and some precursors data) disseminated into a prototype SRCNet** • Upgraded federated computing. Basic execution planner implementation and move execution to a selected SRC • Upgrade of subset SDP workflows runnable in the SRCs • Provide access to the first set of workflow templates for science analysis (light ADPs) • ADPs ingestion system • Spectral data visualisation and manipulation • Implementation of SRCNet User Support	Science verification community (**public access**) Members of Science Operations SRC ART members

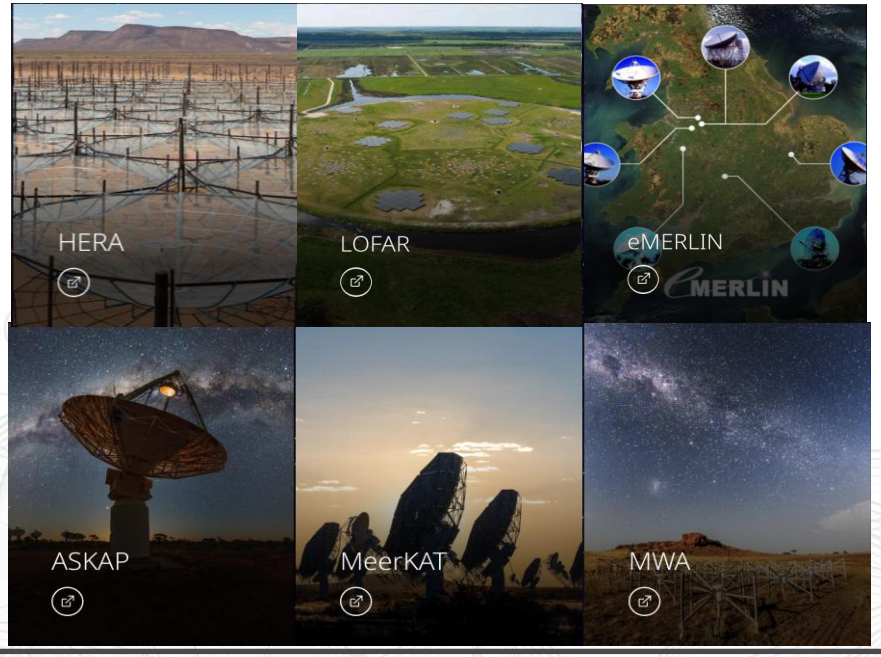
uk | SRC

UKSRC supporting the UK community

- SKAO is under construction, and SRCNet has no data yet
- The UKSRC wants to help support and prepare the **UK astronomy community** to develop a facility informed by our future-users and **maximise the science return from SKA**.
- **Supporting** UK researchers using data from SKAO precursors and pathfinder telescopes

SKA-MID

SKA-LOW



SKA pathfinder & precursor telescopes

Credit: SKA Observatory

SKA will change how astronomers undertake research

SKA will change how research is undertaken

→ larger volumes of data and data processing capabilities

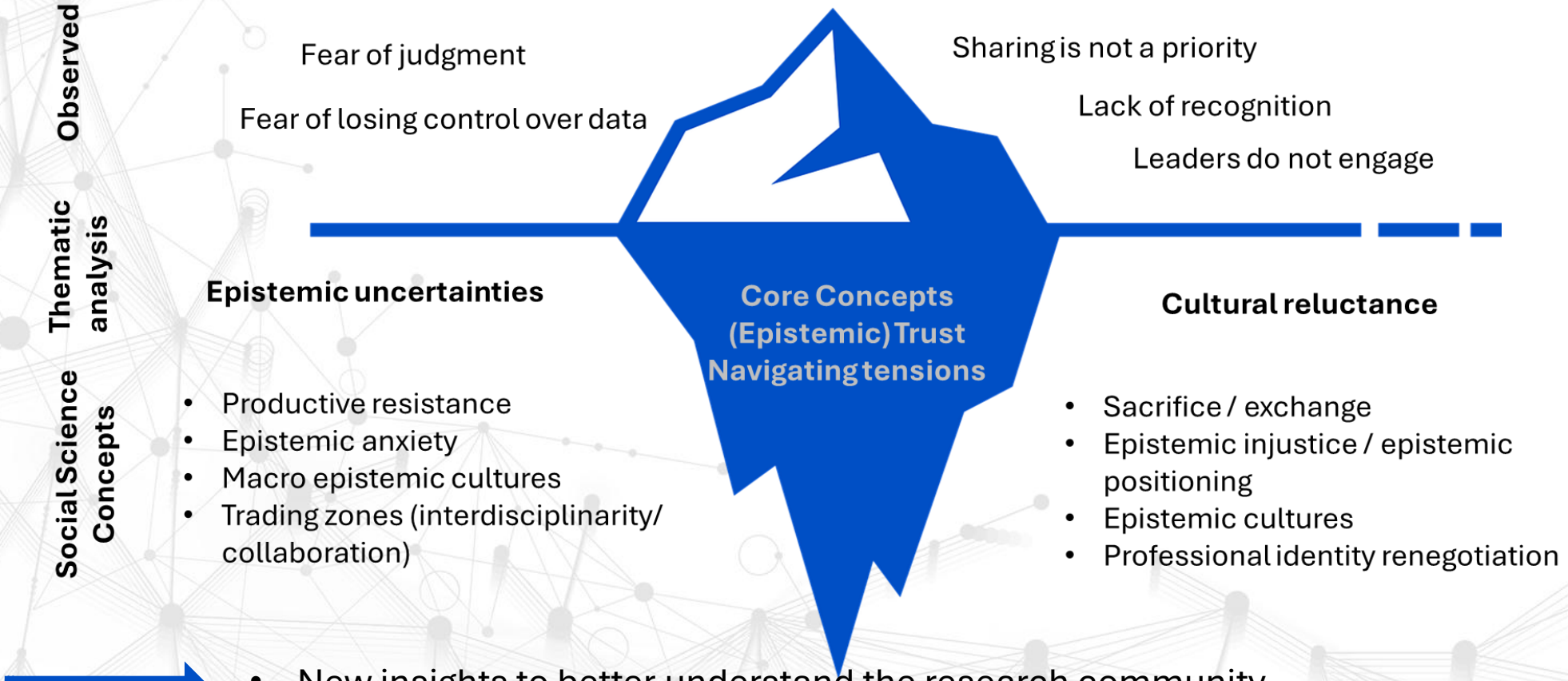
→ transform how data is gathered, analysed and shared e.g. via the “science gateway”

→ Challenges are not just technical and include cultural and social aspects

Social science approaches to make hidden social and cultural challenges and barriers visible and develop approaches to address them

- human/social aspects of professional practice,
- professional identity and agency
- actions humans take in response to changes in their situation and context

Conceptual framework that reexamines social and cultural barriers to data sharing

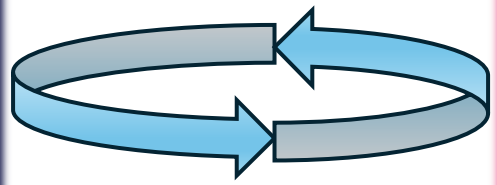


- New insights to better understand the research community
- New starting points to codesign approaches to support the community as research practices evolve

Demonstrator cases / early adopter projects

Users benefits

- Access to compute resources
- Workflows within UKSRC architecture
- Science/development/tech support from UKSRC
- Participate in the future direction and features in UKSRC/SRCNet
- New science using UKSRC resources



Community Cocreation

UKSRC Benefits

- Inform development of UKSRC architecture & development
- Incorporate new workflows
- Ability to stress-test system with new workflows and users
- Develop science support models

- Informing science user support services & community engagement
- High memory servers deployed and are in use in UCL, Durham, Manchester and Cambridge
- Opportunity to “stress test’ the UKSRC facility as it develops
- Develops various reusable workflows and tools for now and future (SKAO)
- Call for new projects coming soon

Current demonstrator cases

- ★ Processing and delivery of LOFAR2.0 international station data. (LOFAR)
- ★ Late-time 21cm intensity mapping in autocorrelation mode. (MeerKAT)
- ★ Multi-wavelength datasets for radio continuum and HI surveys. (MeerKAT, LOFAR, Rubin Obs., VISTA, WISE, DESI Legacy Survey)
- ★ Galactic plane and cluster surveys. (MeerKAT, ASKAP, e-MERLIN, JVLA, Gaia, Rubin Obs., WISE)
- ★ Discovering Pulsars and Fast Transients through Candidate Identification, Classification and Machine Learning. (MeerKAT, LOFAR, other transient facilities)
- ★ Incoherent Radio Transients. (e-MERLIN, MeerKAT, JVLA, LOFAR, ASKAP)
- ★ SKA-EoR analysis demonstrator. (LOFAR, HERA)

uk | SRC

https://zenodo.org/communities/uk_skarc

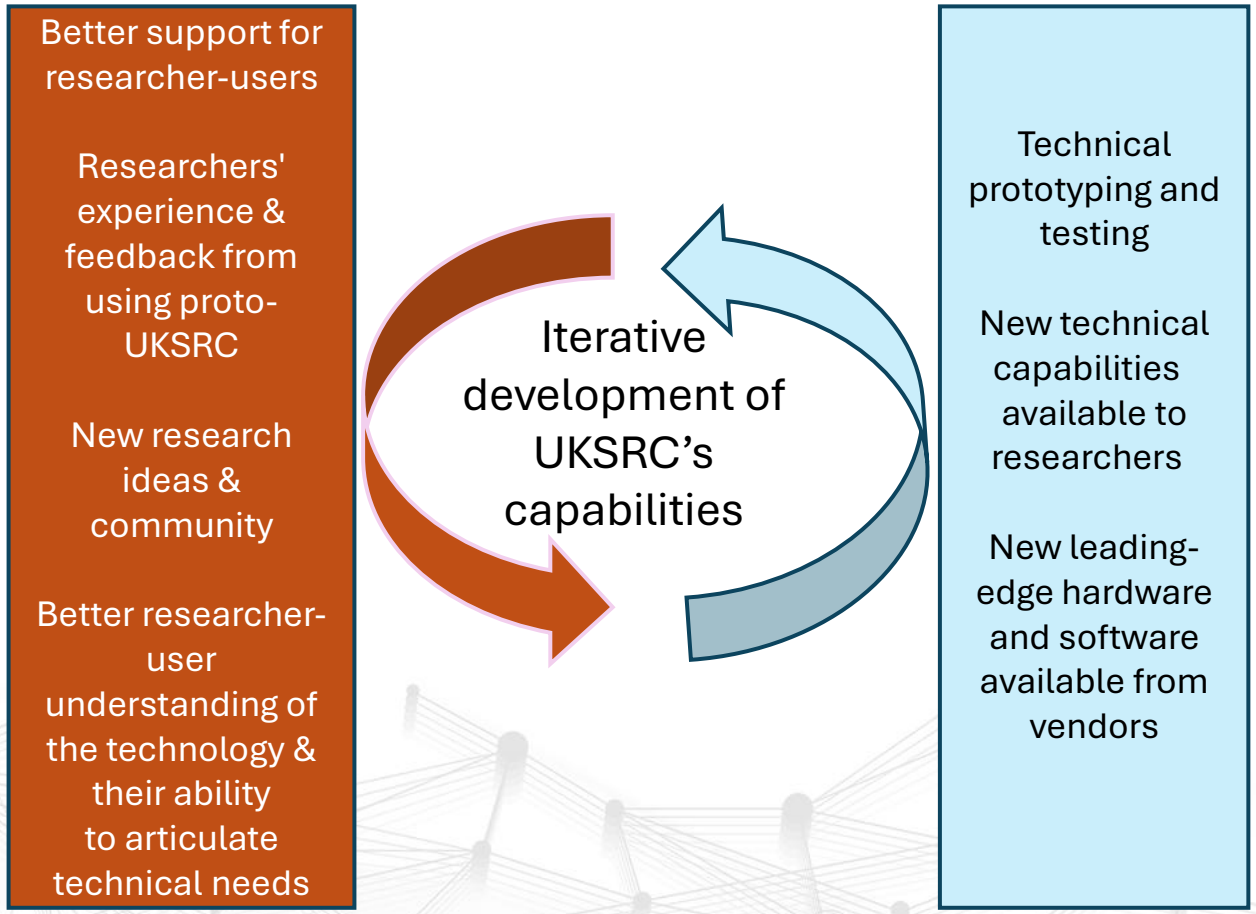
Summary

UKSRC will provide infrastructure and services for UK radio astronomy in the exabyte era.

The UKSRC will increase the capacity of the UK research community by providing:

- Better data access and curation
- Better software and tools for analysis
- Better support, training and careers pathways

This will maximise UK's return on investment in SKAO construction



uk | SRC

Science and Technology Facilities Council

UNIVERSITY OF CAMBRIDGE

THE UNIVERSITY of EDINBURGH

Durham University

University of Hertfordshire UH

MANCHESTER 1824 The University of Manchester

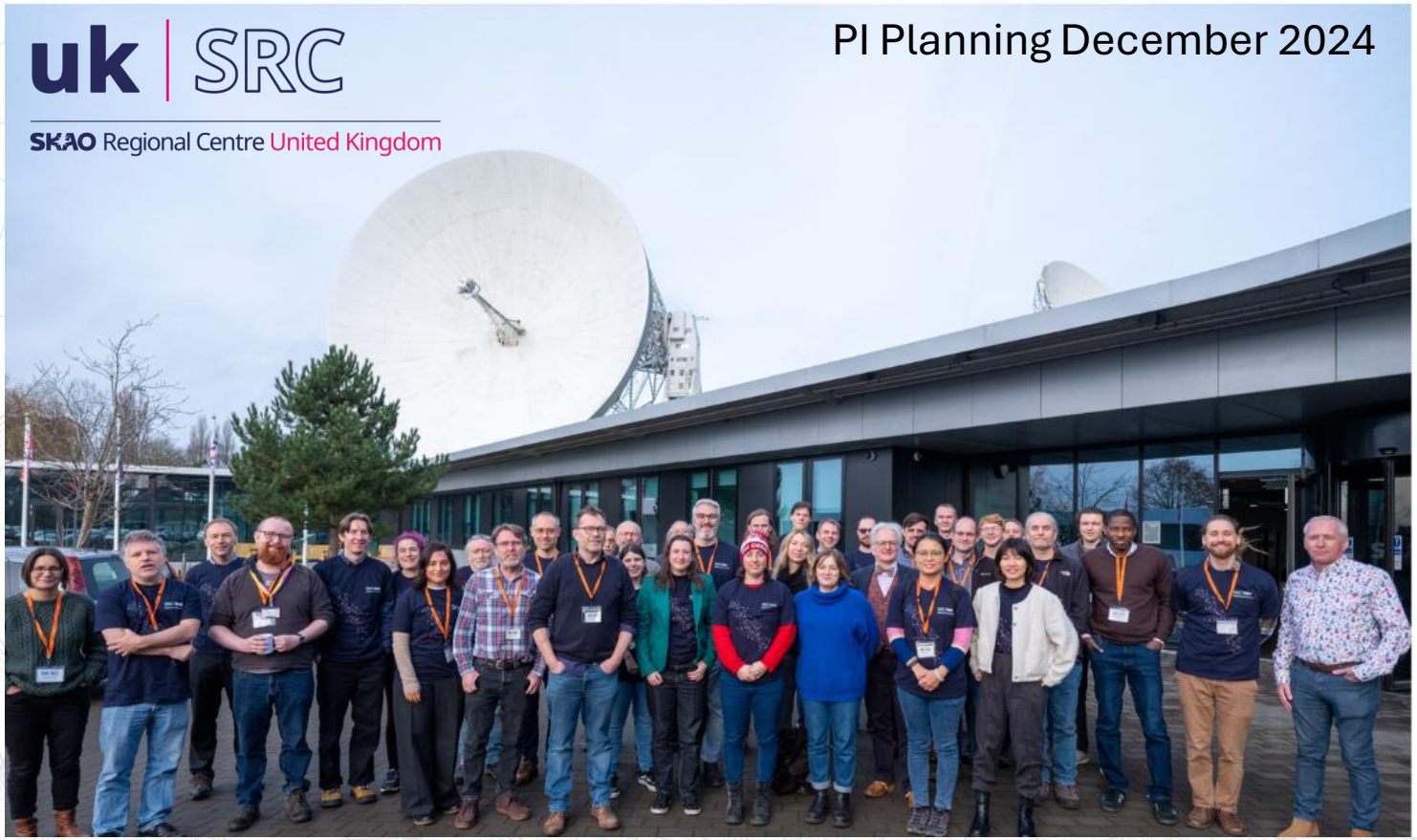
UCL

Science and Technology Facilities Council | Scientific Computing

uk | SRC

SKAO Regional Centre United Kingdom

PI Planning December 2024



SRC | Net

SKAO Regional Centre Network

FAIR Data Accelerator:
Cultivating cultures of data sharing

Francisco Duran del Fierro, Allison Littlejohn, Eileen Kennedy, Louise Chisholm

UCL Centre for Advanced Research Computing

Knowledge Lab UCL

Department for Science, Innovation & Technology

UK Research and Innovation

uk | SRC

l.chisholm@ucl.ac.uk

https://www.uksrc.org/

uk-ska-regional-centre-uksrc