UK SKA Regional Centre Strategy

1. Summary

This UK Square Kilometre Array (SKA) Regional Centre Strategy sets out the Vision, Pillars and Strategic Objectives for the UK's involvement in the SKA Regional Centre (SRC) work. This Strategy covers the timescale of the construction phase and early operations phase (2022 to 2030). This Strategy is owned by the UK SKA Programme Board and activities are led by the UKSRC Forum, to become a UKSRC Project, and supported by the UK SKA PMO.

2. Context and Scope

The SKA will be the world's largest, most sensitive radio telescope, allowing astronomers to perform transformational science and advancing our understanding of the Universe. By 2028, the two instruments of the SKA will see 197 mid-frequency dishes (including the 64 dishes of the MeerKAT telescope) in South Africa and 131,072 low-frequency antennas in Australia.

The operation of the SKA Observatory (SKAO) assumes the existence of a network of SRCs (SRCNet). The SRCNet is required to provide the portal for scientists to access the SKA including provision of computing resources and support to enable the user community to analyse SKA data products.

By 2028, the two telescopes will be moving 2PB per day to the SRCNet with a further estimated 4-6PB of Advanced Data products being produced by users. It is this huge data movement, processing and curation requirement that requires the SRCNet to be a distributed compute and data facility connected by high-speed networks (100Gbps) and operated by cloud technologies. The status of the telescopes, construction and deployment sets the SRCNet timeline. This Strategy is timely as the SRCNet has begun a three-year programme of prototyping, implementation, and early commissioning to deliver an operating SRCNet by 2025. By 2025, the SRCNet aims to achieve 10% capacity and 80% functionality of what is needed for full operations.

The SRCNet offers the UK an opportunity to help realise the sustained impact and translation of cutting-edge data-science technologies required by the SKA. The data requirements of the project will drive next generation data-intensive supercomputing developments, and the work required to develop the SRCNet will help to maintain and build collaborations with UK industry.

In order to enable the greatest possible return to the UK from its investment in the SKA, both scientific and within the data science technical work, it is essential for the UK to lead and fully participate in the SRCNet. This document provides the strategy for UK involvement in the SRCNet.

3. Vision and Mission

The ultimate Vision of the UK's participation in the SRC work is for the SRCNet to meet the needs of the UK Science Community, providing seamless access to SKA data and support, and enabling UK scientists to lead exploitation. Its mission is to maximise the return to the UK through a contribution to the SRCNet at a level commensurate with the UK's leading role in the project, and to deliver a UKSRC Node, enabling the UK to maximise scientific return and drive innovation in data science.

4. Strategic Pillars

The UK SKA Regional Centre Strategy is founded around three Strategic Pillars which are expanded on in the following sections:

SRC Network: To lead, participate and influence global SKA Regional Centre activities for the benefit of the UK.

UK SKA Regional Centre: To design, deliver and support an SRC within the UK, which will form a component of the global SRC Network.

UK Science Community: To communicate and engage with the UK Science Community, ensuring the SRC Network and UKSRC meet the needs of the community.

5. SRC Network

The SRCNet will provide infrastructure, services and expert support that will enable a global capability to distribute, process, analyse and curate the data from the telescopes. The UK is engaged, and must continue to engage, in the design and definition of the SRCNet which includes the basic governance and operational model needed to meet baseline functionality.

Currently the UKSRC Forum is participating in the SRCNet programme and will continue to do so for the UK to play a leading and influential role in the development of the SRCNet, and thus benefit from the science and innovation opportunities. A UKSRC Project will be formed formally through an Open Call to lead the UK's involvement in the SRCNet, and form and operate a UK SKA Regional Centre. To adequately support the SRCNet and to capitalise on opportunities, the UK must support SRCNet activities at a level commensurate with the UK's leading role in the project to date. This support (resource) will be managed by the UKSRC Project and is necessary to achieve the UK's scientific aspirations and to maximise the exploitation of SKA science for the UK Science Community.

The UK has an opportunity to leverage its international, leading position within radio astronomy and the SKAO to its benefit and the benefit of the wider community. Member countries are in the process of securing funding for national SRC efforts. Therefore, the rapid deployment and development of UK SRC resources will enable the UK to maintain its leadership role, shaping, driving and supporting SRC solutions. This will have wide ranging benefits for the UK's Science Community by enabling it to be fully prepared for the earliest phases of SKA operations. It will also provide multiple benefits in advance of the SKA's operational phases, such as supporting the growth of the radio astronomy community and immediate science exploitation benefits via supporting UK users of SKA pathfinder facilities such as MeerKAT, ASKAP, LOFAR and e-MERLIN. Participation in the SRCNet now offers an opportunity to help realise the sustained impact and translation of data-science technologies required. This will result in commercial spin-out opportunities to provide wider UK economic benefits. For example, the UK is already working with StackHPC to develop Openstack services and tools for the SKA.

5.1 SRC Network Objectives

- To lead, participate and influence SRC working groups and steering committees to benefit the needs and priorities of the UK Science Community and to capitalise on opportunities for growth.
- To play a leading role in priority areas and encourage collaborative working to deliver an SRCNet that realises the transformational science opportunities of the SKA.
- Build long-term international partnerships in technical R&D and co-design with SKA members, partners and technology providers, through collaboration on the SRCNet.
- Contribute to, and capitalise on, wider technical benefits for UK science and the UK IT industry.

6. UK SKA Regional Centre

To enable the greatest possible return to the UK from its investment in the SKA, both scientific and within the data intensive supercomputing and data science technical work, it is essential for the UK to develop a UKSRC, a node that will form a key component of the SRCNet, contributing to the global SRC model.

Hosting an SRC within the UK will give the UK community the greatest opportunity to exploit SKA science and to conduct excellent multidisciplinary research. A UKSRC will enhance the UK as an international destination of choice for Astronomy, attracting top scientists and producing highly cited papers. The UKSRC will help to deliver SRCNet functionalities identified within the SRC White Paper[1]. It will be compliant with the required architecture and standards, whilst providing local operational infrastructure to the scientific needs of the UK Community.

Once established, the UKSRC will continue close collaboration with commercial and industrial partners primarily through open-source collaboration, building on STFC's encouraged bleeding edge exploitation of open-source software and novel technologies seen through other e-infrastructures, DiRAC and GridPP. European SKA-partner countries are pursuing development of their own SRC nodes which may form a Collaborative Network. Close working with European partners to ensure a coordinated European approach to the SRCNet will be required. If and when appropriate, the UKSRC may federate with other European SRCs.

The UKSRC Forum has established links with multiple programmes and partner projects both within the UK and internationally. This includes strong involvement within the development process alongside SRCNet partners and the SKAO. In addition, the UKSRC Forum has developed links with infrastructure projects, development programmes, existing facilities and a wide range of international and national projects. These links will enable the UKSRC to develop and deliver the required data and science services, with regard to the SKAO and wider astronomical facilities, if appropriate. It will provide the UK Community with important advantages in securing UK leadership in SKA key science programmes, and seed important technical research that can improve the hardware, software, services and workflows that SKA researchers use in the future. Such research generates new ideas and skills that can be used by the UKSRC and SRCNet.

6.1 UK SKA Regional Centre Objectives

- To design, deliver and support a UKSRC that will be compliant with the global SRC architecture and standards, whilst providing local operational infrastructure commensurate with the scientific needs and priorities of the UK Science Community.
- To establish a UKSRC Facility Project Office, led by a Director, to enable the UK to develop and create its own SRC and to contribute to the development of the SRCNet.
- To collaborate with SKAO and Members to ensure components of the SRCNet provide a collection of services and infrastructure that will comprise a global capability to distribute, process and curate the data from the SKA telescopes.
- To engage, utilise and build on the UK expertise and leadership that exists across SKA pathfinders and related data intensive supercomputing, big data and associated areas.

7. UK Science Community

Community engagement, through information gathering, consultation and participation, will ensure the community is kept abreast of activities and will allow needs and priorities to be heard. Good community engagement will positively impact on the breadth of science delivered by the UKSRC as existing and new communities will be able to utilise and contribute to the new services.

To enhance skills within the UK, the SRCNet will support and deliver training in computing not only for those scientists looking to exploit the SKA, but for work experience students, student interns, apprentices and early career graduates. Components of the SRCNet will be required to provide professional development for SRC funded staff, enhancing skills during the project

[1] https://aussrc.org/wp-content/uploads/2021/05/SRC-White-Paper-v1.0-Final.pdf

that enhance their future value to UK enterprises. The UKSRC will enhance training opportunities, enabling a skilled workforce within the UK and enhancing the skills pipeline.

It is strategically important that the UK's activities are coordinated and aligned with SKA pathfinder facilities, as well as other multi-wavelength and multi-messenger facilities. Connections have been established between pathfinders and user groups such as e-MERLIN/VLBI, LOFAR, Meerkat and ASKAP, and regular dialogue with key multi-wavelength facilities such as LSST/Rubin exist. Access to SKA pathfinder data streams will provide the real-world data required to test and develop SRC capabilities. This will allow early community adoption of SRC services, as well as help to test and develop applications that are used by the community. This will expand and prepare the UK Science Community ahead of operations.

Participation in the SRCNet will also provide an opportunity for coordination and sharing of computing infrastructure within STFC. This will build on the initiative of IRIS, a coordination body to organise the sharing of resources and expertise across STFC, and to prepare STFC for integration into a UKRI-wide infrastructure. The SKA is already a full Member of IRIS, which includes Hartree, GridPP and DiRAC, and will be leveraged as appropriate. Close collaboration will allow the sharing of expertise, resources and infrastructure, and will dramatically reduce risk to the project. This approach is particularly appropriate given the now strong link between CERN and SKA, and their collaboration within AENEAS and ESCAPE on re-usable technical components. The big data challenges of the SKA will drive computing transformation in the UK, enabled by the UKSRC, by bringing together efforts across Turing, Excalibur, IRIS, JISC with a common focus on producing distributed computing and data services that operate at a data-stream level of multi-PB per day.

The SKA is not only a revolutionary science project transforming our understanding of the Universe and the fundamental laws of physics, but is one of the most exciting engineering and big data challenges of the century. It has the potential to drive innovation in areas such as energy efficient High Performance Computing and provides a unique opportunity to engage and inspire the next generation of scientists and engineers.

7.1 UK Science Community Objectives

- To maintain strong community engagement through the UK SKA Science Committee and a Community Director, communicating the latest news, critical project time points and developing the UK science priorities for the SKA.
- Maintain a close collaborative alliance and coordinate activities with SKA pathfinder and precursor facilities, as well as other multi-wavelength and multi-messenger facilities. Using lessons learnt and real data to develop the UKSRC.
- To enable the UK Community to lead and exploit opportunities afforded by the SKA through professional outreach, including training and skills opportunities and capabilities, attracting and retaining talent.
- Engage the public in line with the UK SKA PMO's Outreach Strategy with support from the UK SKA Outreach Officer. Promoting the STFC philosophy that 'STEM is enjoyable and accessible for all'.