

*“Developing large-scale astronomy facilities, such as the MeerKAT and the SKA, can become a powerful driver of scientific, socio-economic and human capital development throughout the continent of Africa, for the benefit of the world. We are proud that this African bid is being led by South Africa.”*

— Naledi Pandor,  
Minister of Science  
and Technology



# SKA FOR AFRICA AND AFRICA FOR SKA

## THE AFRICAN SKA SCIENCE PARTNERSHIP ON THE CONTINENT OF OPPORTUNITY

WHEN THEY ENDORSED the African SKA bid at the 15<sup>th</sup> Assembly of Heads of State of the African Union in July 2010, the African leaders emphasised that the development of science, technology, and innovation throughout the region would allow Africa to play an increasingly important role in the global knowledge economy. They have called on Africa’s development partners and the global scientific community to support Africa’s aspirations to host the SKA.



The configuration of the SKA core and remote stations throughout Africa.

Africa has much to offer the international SKA project in terms of its physical, infrastructure and intellectual requirements, and hosting the SKA will add to the already growing inventory of scientific infrastructure in Africa. In particular, Africa is becoming a destination for ground-based astronomy, space science and geodesy instruments.

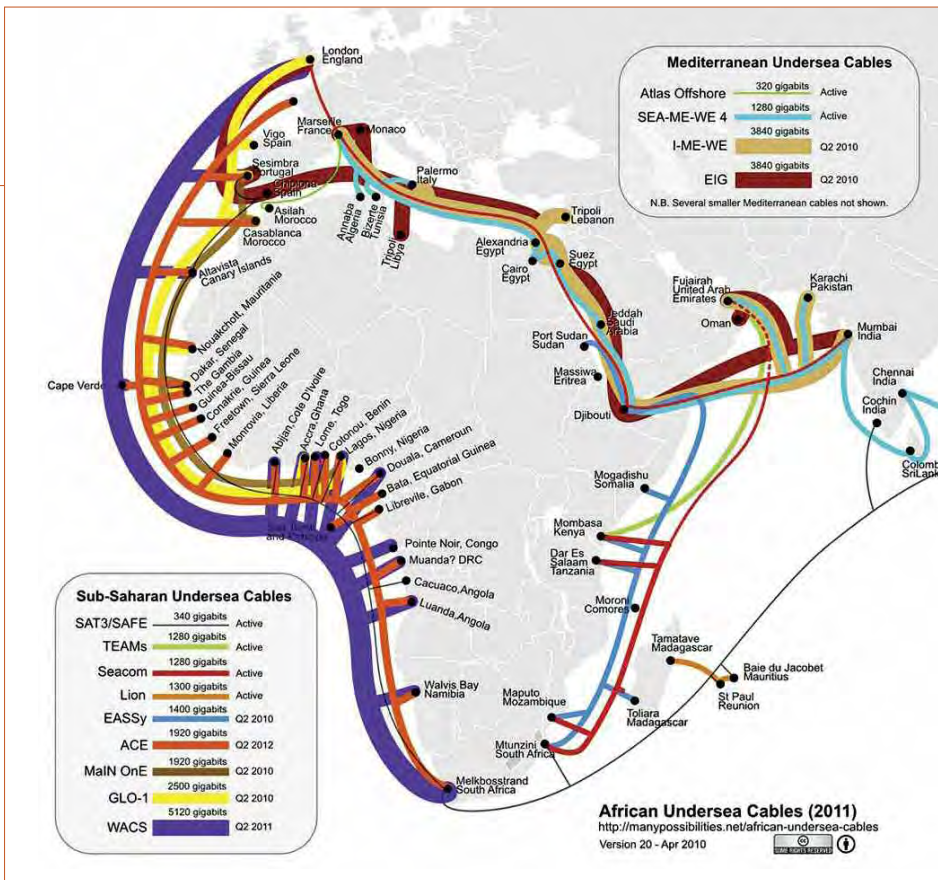
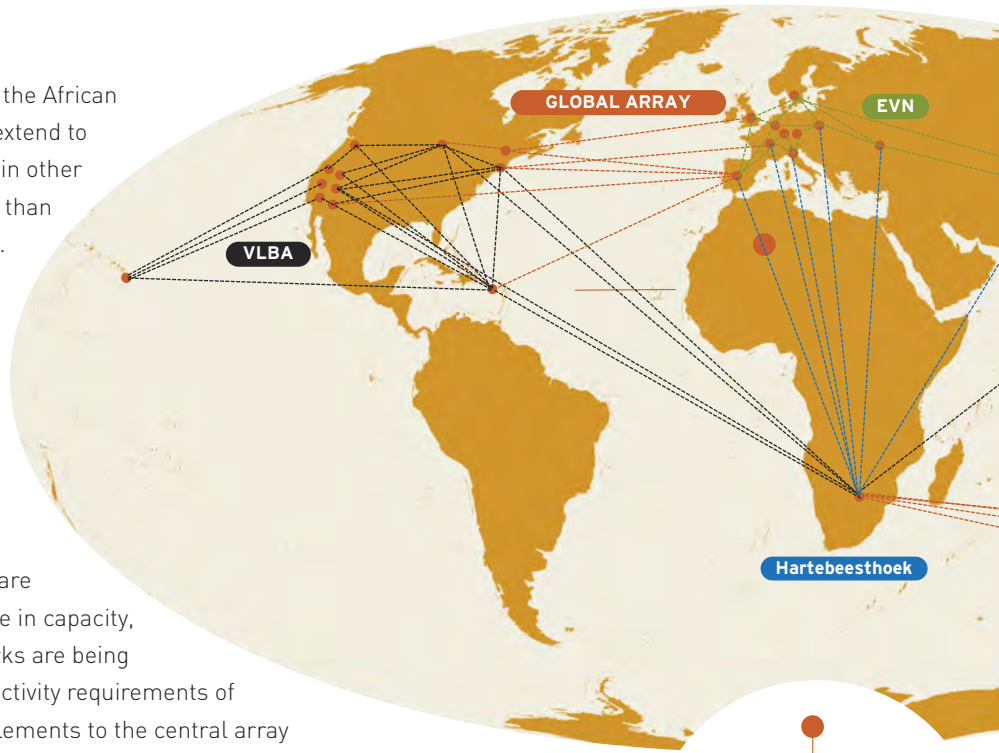
The African bid to host the SKA is led by South Africa and includes eight fully committed partner countries, namely, Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia, and Zambia. This science driven partnership is cohesive, dynamic and representative of Africa’s commitment to establishing the continent as a significant player in the world of scientific discovery and innovation.

## IDEAL ENVIRONMENT AND UNIQUE LOCATION

The SKA antenna configuration requires the placement of antennas over a wide range of spatial scales, spanning tens of metres to thousands of kilometres. The shape of the African mainland and its Indian Ocean islands provides a platform for the nominal SKA configuration with “baselines” extending out to 3 000 km. This configuration provides excellent image quality at all angular scales.

The geographical shape and location of the African continent also allow for baselines that extend to observatories and remote SKA stations in other continents, which are very much longer than the nominal 3 000 km SKA requirement. In particular, Africa's location relative to the other continents allows existing observatories in Europe, the USA, South America and Australasia to be used in conjunction with the SKA to achieve extreme spatial resolutions and astrometric positions.

The communications systems in Africa are currently undergoing a massive increase in capacity, and high bandwidth optical fibre networks are being installed that will satisfy the data connectivity requirements of the SKA, both for connecting antenna elements to the central array processor and distributing data products to the rest of the world.



This map of existing radio astronomy VLBI networks clearly illustrate the unique location of Africa in relation to VLBI stations on all continents. Antennas in the African VLBI Network would link up with these existing stations to form a truly global telescope.

An extensive and expanding network of undersea cables provide ample data connectivity within Africa and connects the continent to the rest of the world.

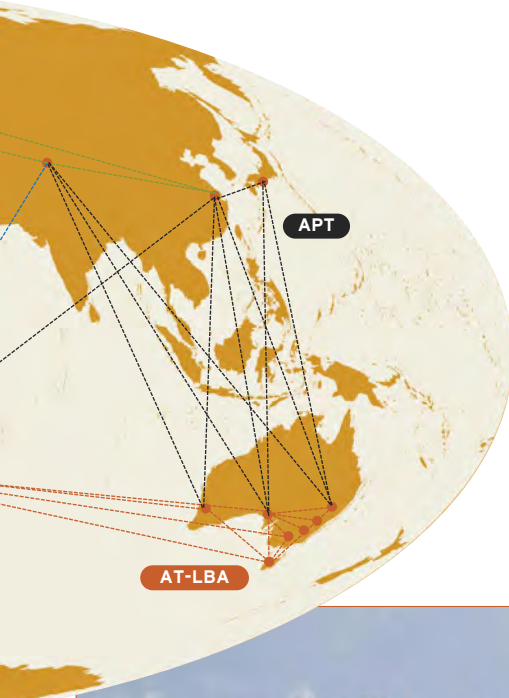
TL Venkatasubramani (in front, second from left) manager of the African VLBI Network Project, with a group of colleagues and students at the karoo telescope site.



# THE AFRICAN VLBI NETWORK

Through the activities of the African SKA initiative, Africans have taken heed of the scientific opportunities that radio astronomy provides. Because of growing optical fibre connectivity throughout Africa, in excess of twenty large telecommunications antennas are becoming obsolete, and this has provided the opportunity for developing an African VLBI Network (AVN). The obsolete antennas are being identified and evaluated for refurbishment and conversion to VLBI stations. Maximum use will be made of existing infrastructure and on-site staff in the conversion process and continued operations. Currently two antennas are being actively considered for conversion, one in South Africa and one in Ghana.

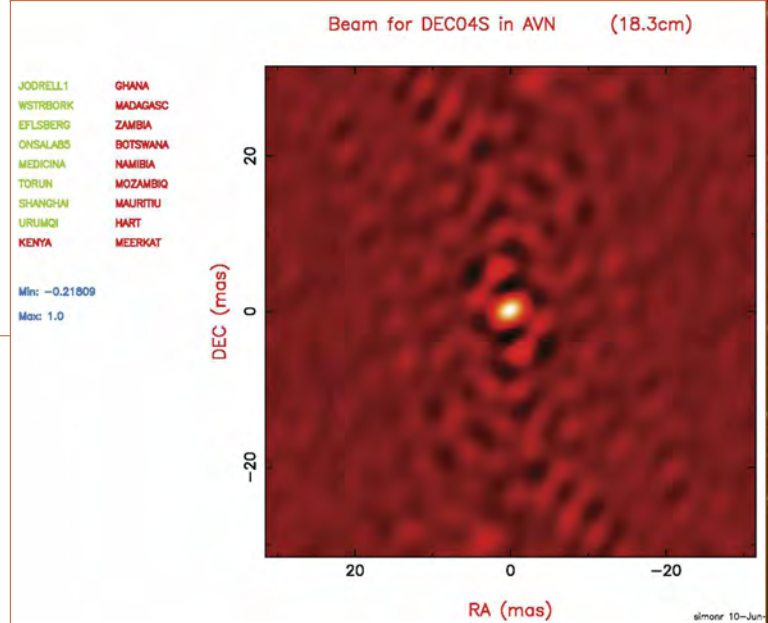
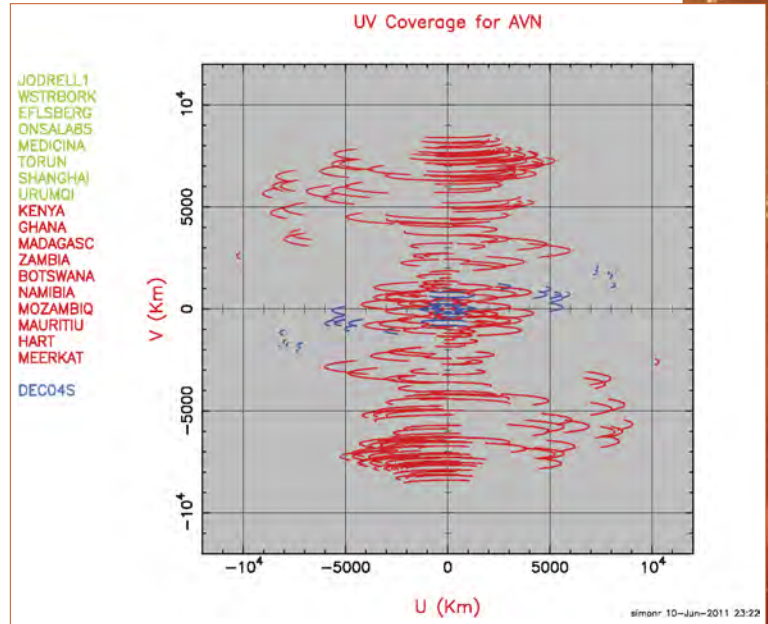
When used in conjunction with other VLBI networks, such as the European VLBI Network (EVN), the extra baselines provided by the AVN will provide very much improved image quality and resolution. The AVN stations would also play an important role in an African-based SKA.



The conversion of Ghana's 32-m satellite communications antenna as part of an African VLBI network will provide a model for similar dish conversions across the continent.



The African VLBI Network (AVN) coupled with the existing European VLBI Network (EVN) would be an outstanding high-resolution array. "U-V coverage" is a measure of imaging quality, and the graph above shows the limited coverage of the EVN network alone (shown in blue) compared to the extended coverage (shown in red) that the African stations would provide. The bottom panel shows the quality of the high-resolution-beam that the AVN will achieve.



## CRITICAL MASS IN AFRICA

A unique opportunity presented by the participation of the partner countries in the SKA South Africa project is the access to the substantial academic resources in those countries. Academics and students in the partner countries are actively participating in the SKA South Africa Human Capital Development programme, and a depth of expertise in the scientific and engineering aspects of radio astronomy is being developed in the academic institutions of these countries. Mauritius has an existing base of radio astronomy expertise and infrastructure that provides an excellent base for local expansion and the transfer of expertise to other countries.

At a May 2011 workshop held in Carnarvon, near the MeerKAT and potential SKA site, academics from the African partner countries and collaborating institutions beyond Africa worked out a coordinated plan for the further development of centres of expertise in relevant science and engineering disciplines throughout Africa. This will provide an extensive pool of scientists and engineers who will participate in African and global radio astronomy projects, including the African VLBI Network, MeerKAT and the SKA.



Academics from Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia were joined by their South African counterparts and participants from the UK and US at a May 2011 workshop in the Karoo, South Africa to plan collaboration in the training of astronomers on the African continent.

[www.ska.ac.za](http://www.ska.ac.za)

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