

Work package number ⁹	WP9	Lead beneficiary ¹⁰	12 - UMAN
Work package title	Capacity for VLBI in Africa		
Start month	1	End month	48

Objectives

The SKA is a transformational project with the aim to build up to 3000 dishes to extend current capabilities in radio astronomy by orders of magnitude. It is being constructed in a phased way with the 64 dish MeerKAT SKA-precursor following on from the KAT-7 prototype in the Karoo desert in the Northern Cape district. These will be integrated in the Phase 1 of the SKA mid-frequency array with the addition of 250 dishes in South Africa to be built over the 2018-2023 period with maximum 150km baselines. To provide the high angular resolution on the sky of the full SKA some of the remaining dishes will be spread over 1000s of kilometres, as well as work in tandem with existing VLBI arrays, in a ‘VLBI-mode’ (see WP10). So, although the core of the telescope will be in South Africa, the outlying stations will be located in 8 partner countries across Africa, namely: Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia. Given that the stations in these countries will not be built until Phase 2 of the SKA project during 2023-30, and that there is virtually no research astronomy activity in the partner countries at present, the South African SKA project (SKA-SA) initiated the African VLBI Network project or AVN.

The AVN aims to establish a 30 m class radio telescope in each of the partner countries and link these together in a Very Long Baseline Interferometry (VLBI) network. This will operate in tandem with the European VLBI Network (EVN). This will be achieved through a combination of converting ex-telecommunications dishes, a programme that is mainly funded and driven by SKA-SA, and newly built antennas. These dishes will provide a focus for the development of radio astronomy in each partner country so that a skilled local team is ready to install, maintain and operate the SKA outstations when they arrive. Moreover, the aim is to establish astrophysics education and research communities in these countries as a springboard for wider technical and economic development.

This is a very ambitious objective since in most partner countries astrophysics and associated technologies are starting from scratch and so a significant amount of training is required. To this end a number of initiatives investing in the development of the AVN and training of scientists and engineers in partner countries are underway. Notably these include investments, initially through the period 2015-2017, via the Newton fund from South Africa and the UK’s Royal Society to provide basic training and experience. These initiatives, along with the efforts of SKA-SA, have already established a network of contacts within a number of African countries. Available resources have limited these efforts to only a few countries (Kenya, Zambia, Namibia & Ghana) so far. This WP will provide an expansion of these existing initiatives to include other AVN partner countries (initially Botswana, Madagascar, Mauritius and Mozambique). Working in tandem and building upon these existing activities, this WP will bring the wealth of technical, operational and scientific expertise residing in Europe into this effort. It will provide a tangible platform for the future success of the AVN and provide an early link with the EVN, paving the path for early AVN and eventually SKA science delivery. This will be done in a sustainable manner by providing skills and training for communities in AVN countries to enable their future success.

Description of work and role of partners

WP9 - Capacity for VLBI in Africa [Months: 1-48]
 UMAN, JIV-ERIC, UNIVLEEDS

To succeed in this goal this WP will provide the resources to expand and support on-going scientific and technical training initiatives. This will be broken down into 4 key objectives each of which will increase the links between European based VLBI expertise by providing a network of bi-directional training visits, and setting up a sustainable framework for future developments. The WP will target a number of AVN countries which are not currently supported by other initiatives (such as Newton) as well as provide added value and expertise to on-going activities, thus providing cost effective training delivery outcomes.

This WP will enable:

- European radio astronomers to participate as expert trainers in existing funded training activities in Africa thus broadening the base of European involvement in EU-Africa collaboration. This will build upon the existing UK’s Newton project by mobilizing additional VLBI expertise from partner institutes to extend and enhance this effort. These VLBI partners will provide enhanced training opportunities, via technical and scientific expertise which will organise and contribute to annual network training meetings. Currently these Newton training initiatives are underway in Kenya,

Zambia, Namibia & Ghana and are capacity limited. This WP will aid and expand the capacity of these schemes, including extending them to a number of new participating countries, such as Botswana, Madagascar and Mozambique.

- European radio astronomers to travel to AVN and prospective AVN institutions to give seminars or short lecture series to major physics departments in countries with an interest in developing radio astronomy. This will provide a flexible resource to broaden the base of African radio astronomy. Initial self-funded activities by this group have provided seminars (>2000 attendees, Jan 2016) in major Universities in Nigeria highlighting the scope of potential expansion and the significant interest in prospective AVN countries.
- The funding of a limited number of short term placements of African personnel with an interest in developing their radio astronomy expertise, in both scientific and technical/operational areas, with European institutes. The scientific, technical and operational experience of the partners in this proposal will provide an invaluable training opportunity for the burgeoning AVN community. Trips will provide critical operational training in how a VLBI station is run, hands-on training at European telescopes, exposure to radio astronomy research and attendance at meetings and training schools within Europe. This will also help to initiate and facilitate communication between AVN technical staff and the pool of expertise in Europe, opening up future collaborative opportunities.
- The setting up of an AVN technical & support personnel forum network to remotely connect technical and operational staff within AVN countries allowing the dissemination of knowledge throughout the continent and channel communication of technical issues with EU partners. This forum would provide an AVN equivalent to the highly successful EVN Technical and Operations Group and a self-coordinating technical body for future AVN activities, helping to provide longterm technical sustainability of the AVN.

Implementation and Deliverables:

Staff effort from UMAN, UNIVLEEDS and JIVE will be utilised, along with significant in-kind contributions from all partners, to deliver these training opportunities, host exchanges and manage this WP (UMAN). Relevant partners are assigned against individual objectives above. All partners will provide in-kind contributions to training trips in Africa and host exchanges within Europe. EVN institute (JIVE, UMAN, INAF, CHALMERS-OSO) partners will provide exposure to hands-on VLBI observing during EVN sessions. In conjunction with UMAN and SKA-SA, UNIVLEEDS who lead the existing Newton programme will dedicate 5 months of effort over the project duration to manage the interface between

these initiatives. This will be vital to maximise the impact and return of both programmes. The budget request for this WP is 120 kEuro for travel and subsistence expenditure to cover objectives 1-3. This will comprise of 10-15 trips per year over the 4yr duration of the WP at an average cost of ~2-3 kEuro per trip (note that cost of exchange trips, which will be of longer duration and based in Europe, will have a higher average cost). Travel will comprise of a mixture of EU experts travelling to Africa to deliver training and lectures, and AVN trainees undertaking short (~1-3 week) placements in Europe, or within Africa, for example to SKA-SA to utilize their expertise.

WP Lead UMAN (Rob Beswick) liaising with the existing NEWTON project at University of Leeds (Melvin Hoare) and DST South Africa (Antia Loots).

Participation per Partner

Partner number and short name	WP9 effort
1 - JIV-ERIC	9.60
11 - UNIVLEEDS	4.00
12 - UMAN	9.00
Total	22.60

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D9.1	Minutes of telecom 1	12 - UMAN	Report	Public	2

List of deliverables

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
D9.2	Mid-term report on training visits to African countries	12 - UMAN	Report	Public	23
D9.3	Final report on exchange visits to be hosted in Europe	12 - UMAN	Report	Public	47

Description of deliverables

D9.1 : Minutes of telecom 1 [2]
 Minutes of Telecom 1, kick-off meeting amongst WP partners

D9.2 : Mid-term report on training visits to African countries [23]
 Mid-term report on training visits to African countries

D9.3 : Final report on exchange visits to be hosted in Europe [47]
 Final report on exchange visits to be hosted in Europe

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS30	Minutes of telecom 1	12 - UMAN	2	Minutes of telecom 1, noted by exec
MS31	Mid-term report on training visits to African countries	12 - UMAN	23	Mid-term report on training visits to African countries, noted by exec.
MS32	Final report on exchange visits hosted in Europe	12 - UMAN	47	Final report on exchange visits hosted in Europe, approved by board