

An African VLBI network of radio telescopes

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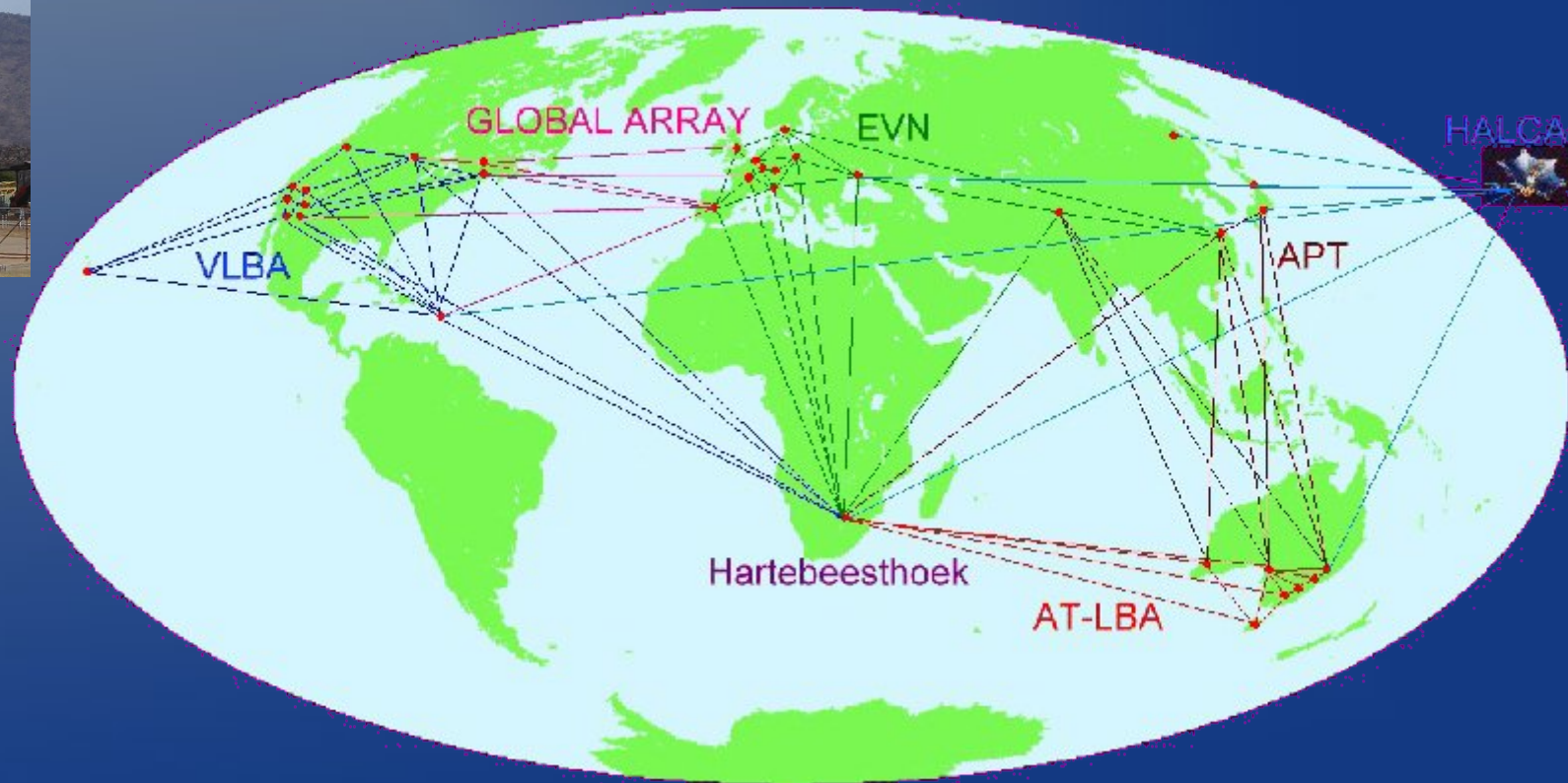
5 Department of Science and Technology, South Africa

Current VLBI-capable Radio Telescopes in Africa

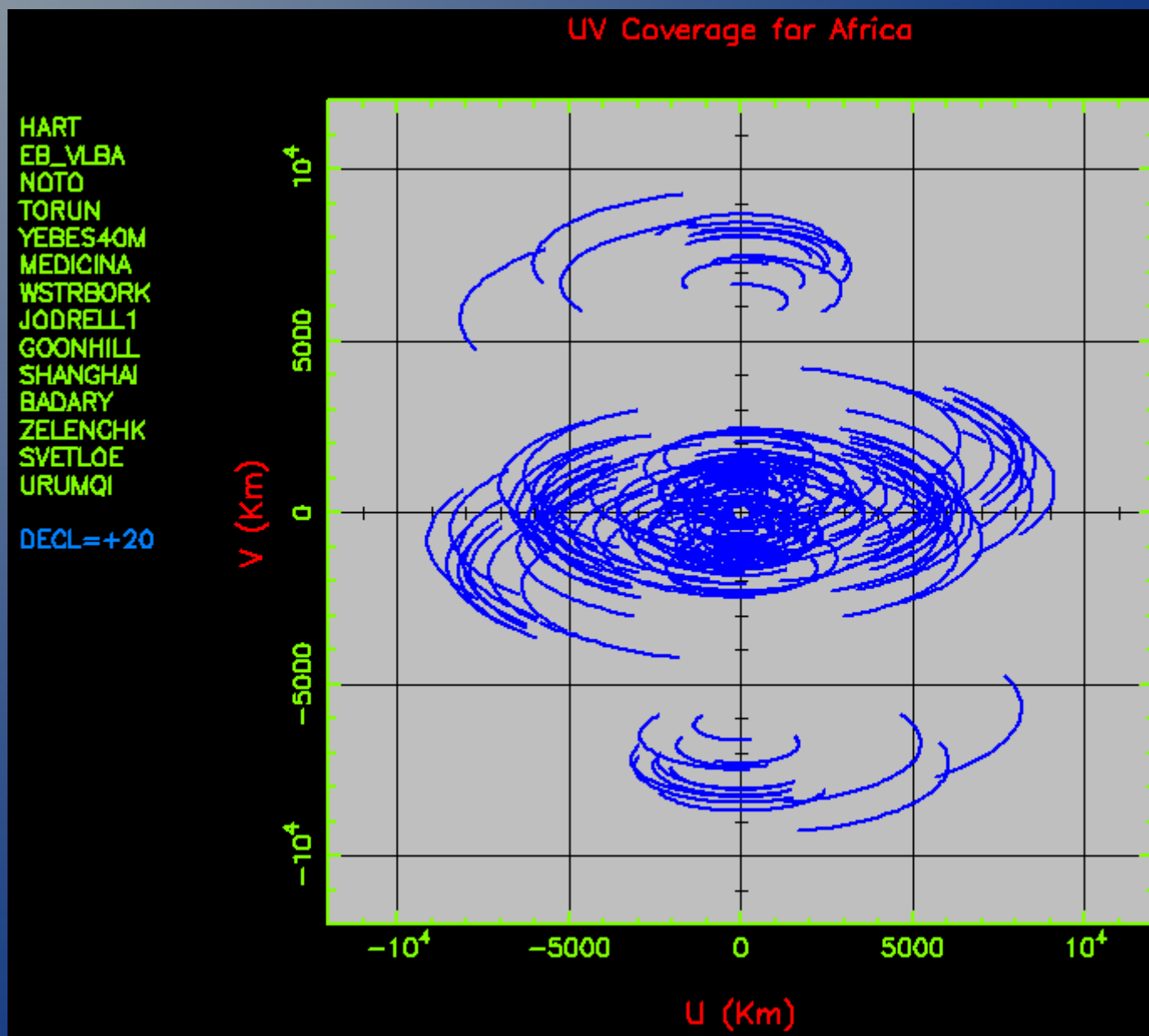


26m Radio Telescope,
HartRAO,
South Africa

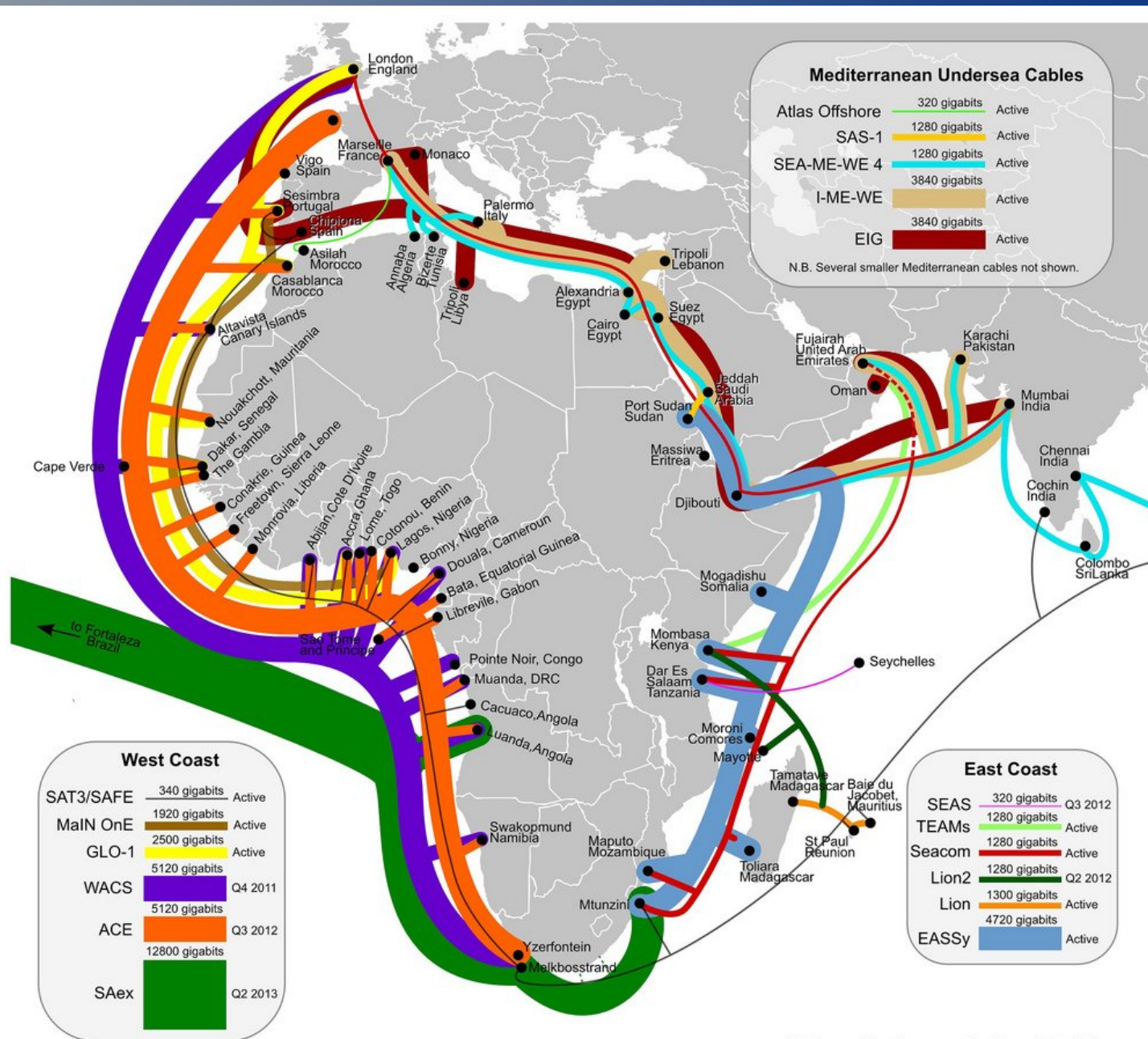
Radio Astronomy VLBI Arrays



European VLBI Network + HartRAO



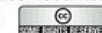
African Undersea Cables



African Undersea Cables (2013)

<http://manypossibilities.net/african-undersea-cables>

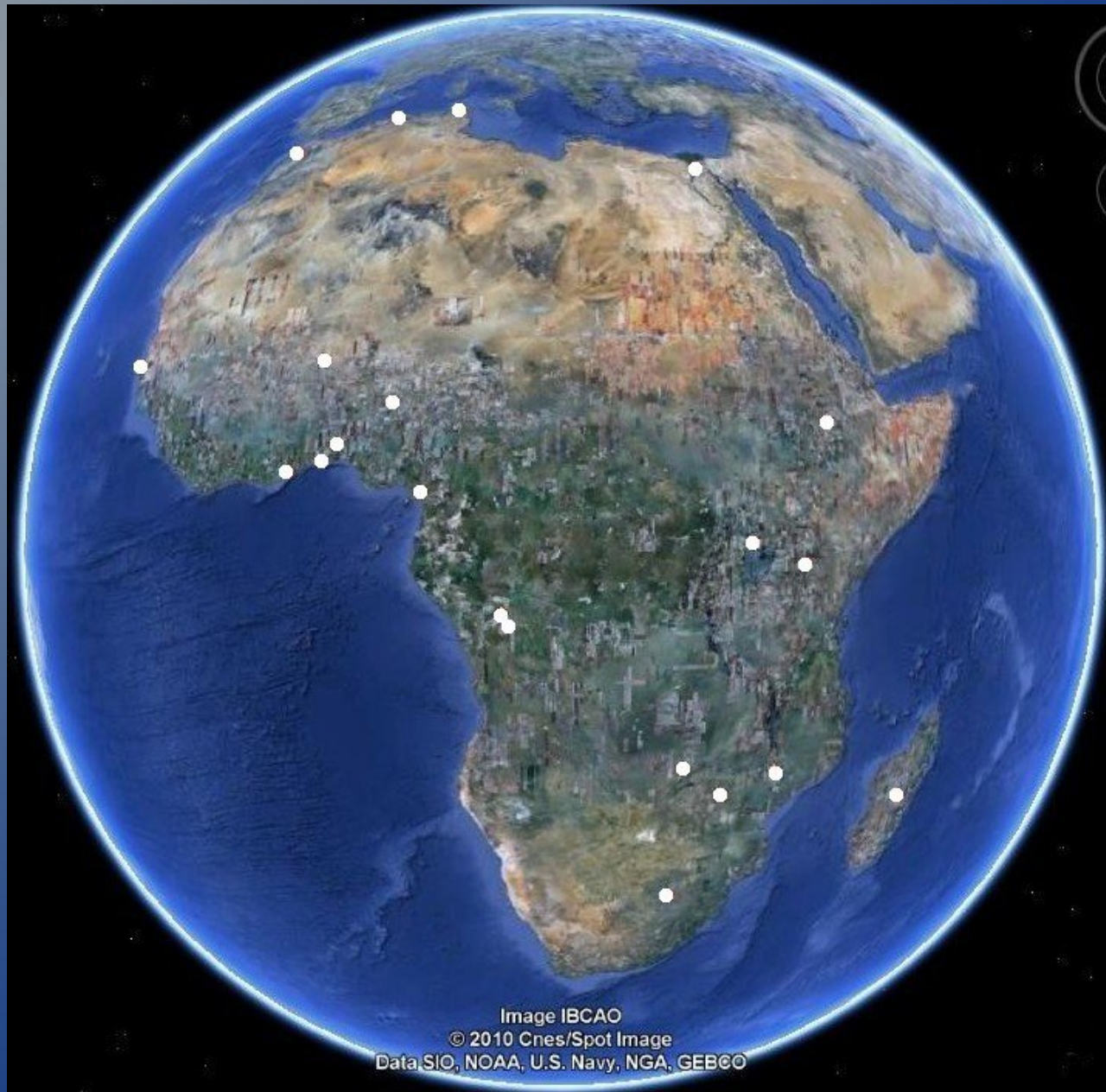
Version 31 - Oct 2011



African Countries with Large Satellite Earth Station Antennas

- SA SKA partners with large antennas:
 - South Africa, Ghana, Kenya, Madagascar, Zambia
- SA SKA partners without large antennas:
 - Botswana, Mauritius, Mozambique, Namibia
- Other African countries with large antennas:
 - Algeria, Benin, Cameroon, Congo Democratic Republic, Congo Democratic Republic, Congo People's Republic, Egypt, Ethiopia, Gabon, Malawi, Morocco, Niger, Nigeria, Senegal, Tunisia, Uganda, Zimbabwe

Africa VLBI Network - Potential



Large satellite antenna locations

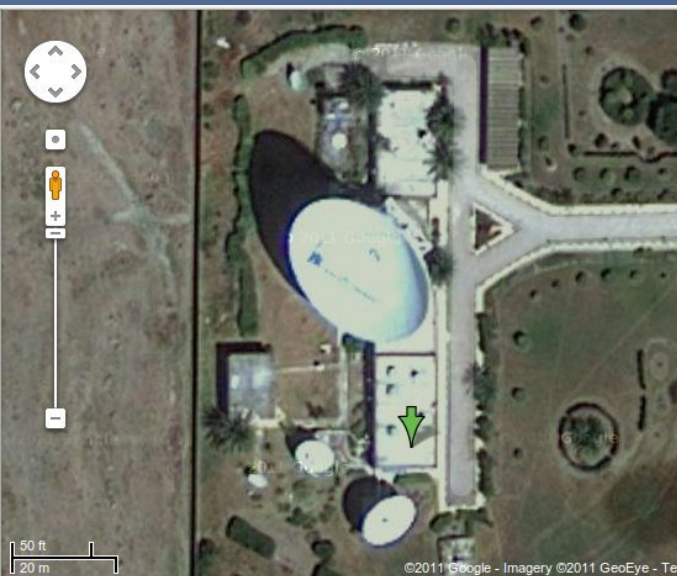
North African Satellite Stations



Morocco
Souk el Arba
2011



Algeria
Lakhdaria
2011



Tunisia
Dikhla
2011



Egypt
Mahdi
2011

West African Satellite Stations



Senegal
Gandoul
2011



Niger
Karma



Ghana
Kuntunse
2011

Nigeria
Kujama
2009

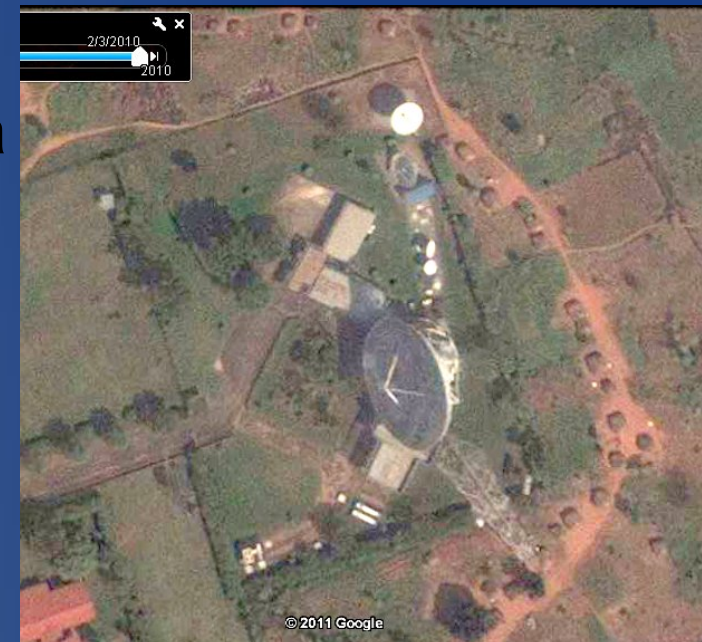


Nigeria
Lanlate
2003

East African Satellite Stations



Ethiopia
Sululta
2009



Uganda
Mpoma
2010



Kenya
Longonot
2010

West Central African Satellite Stations



Congo
Kinshasa
Nsele
2005



Congo PR
Mougouni
2009



Benin
Abomey
Calavi
2002



Cameroon
Bepande
2009

Southern African Satellite Stations



Malawi
Kanjedza
2010

Zimbabwe
Mazowe
2010



Madagascar
Tsirinana
2009



Zambia
Mwembeshi
2001
30m not in
use 2009
Rehab quote
2011

South Africa
Hartebeesthoek
2010



VLBI networks benefiting

European VLBI Network

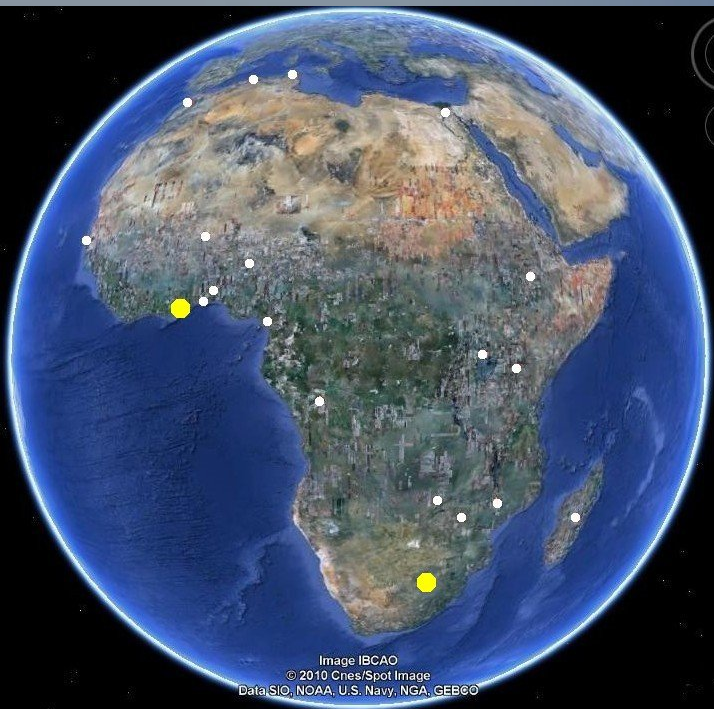
Australia Telescope Long Baseline Array

MeerKAT

SKA?

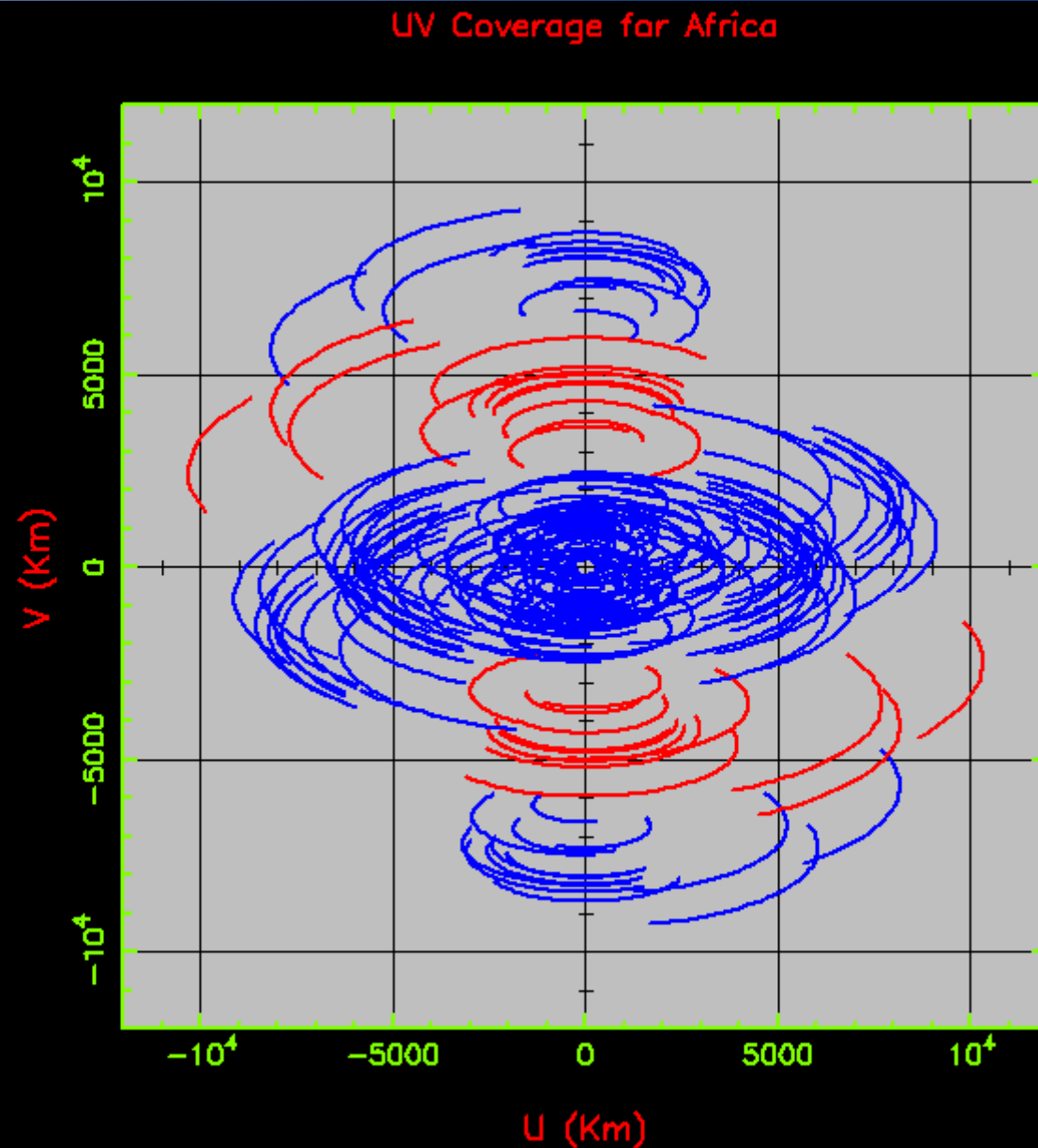
Astrometry (IVS)?

EVN + HartRAO + Ghana



HART
GHANA
EB_VLBA
NOTO
TORUN
YEBES4QM
MEDICINA
WSTRBORK
JODRELL1
GOONHILL
SHANGHAI
BADARY
ZELENCHK
SVETLOE
URUMQI

DECL=+20



Benefits of antenna conversion for the country

- Continued use of very expensive installation that is now or is becoming redundant, at relatively low cost
- In country training in practical radio astronomy:
 - Single-dish research
 - Very Long Baseline Interferometry (VLBI) for high angular resolution imaging
- Create a pool of astronomers able to use current and future radio telescope arrays
- Stimulate fibre optic network development with spinoff for country
 - Links to global radio astronomy networks through VLBI
- Opportunities for training, research and development in engineering and technology:
 - low-noise microwave feeds and receivers
 - analogue and digital electronics
 - digital signal processing
 - control and monitoring systems
 - software engineering
 - wide bandwidth networks
- Stimulate interest in science, engineering and technology through outreach programme
- Promote the establishment / development of a national Space Agency

Science Objectives - VLBI

Imaging with high angular resolution of compact, bright radio sources:

- Quasars – changes in jet structure, calibrators, astrometry
- Microquasars – behaviour and parallaxes - distances
- Masers – star-forming (e.g. methanol) – understand variability and measure the distances to star-forming regions in the Milky by parallax, to map spiral arms
- Pulsars – proper motions and parallax, interstellar scattering, emission region size
- Transient sources
- Supernovae – behaviour of exploding star remnants
- Interacting binary star behaviour
- E-VLBI and TOO VLBI through internet – rapid response to new events

Science Objectives – single dish

- West African and Central African stations:
 - Near equator so see more of the sky than any other radio telescope
 - Can see the entire Milky Way
- Single dish opportunities:
 - Spectroscopy with narrowband multi-channel receiver
 - Monitor masers in star-forming regions eg for periodic variations (methanol at 6668MHz, 12178MHz)
 - Survey formaldehyde absorption in Milky Way dark clouds (4829 MHz, 14488MHz)
 - Pulsar observing with wideband multi-channel receiver
 - Monitor pulsars for glitches, long term behaviour, proper motion
 - Search / monitor for intermittent pulsars and transients (RRATs)
 - Radio continuum flux measurement with wideband multi-channel receiver
 - Monitoring of Gamma-ray flare sources

Antenna conversion examples



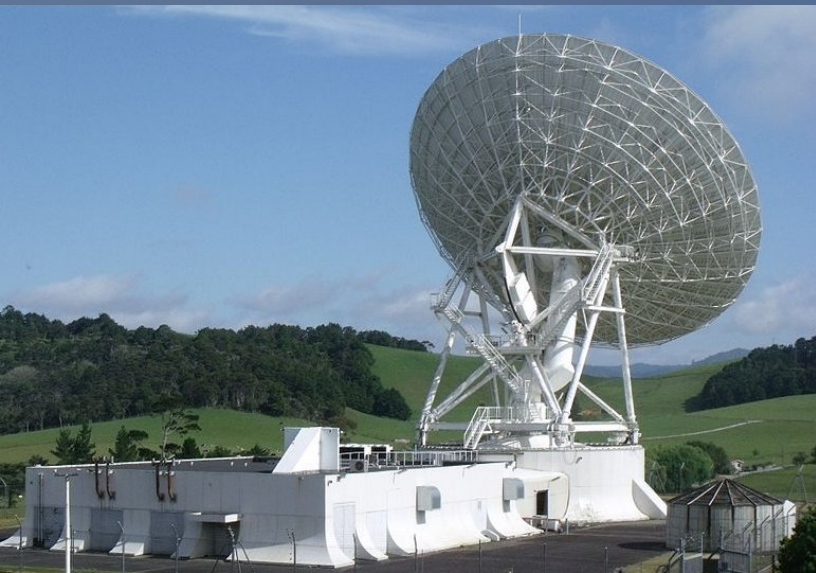
Australia Ceduna - operating



Japan Yamaguchi - operating



Peru Sicaya – First light 2011/03



New Zealand Warkworth -
handed over 2010/11



Ireland Elfordstown –
handed over 2011 May



England Goonhilly –
shut down 2008,
seeking funding

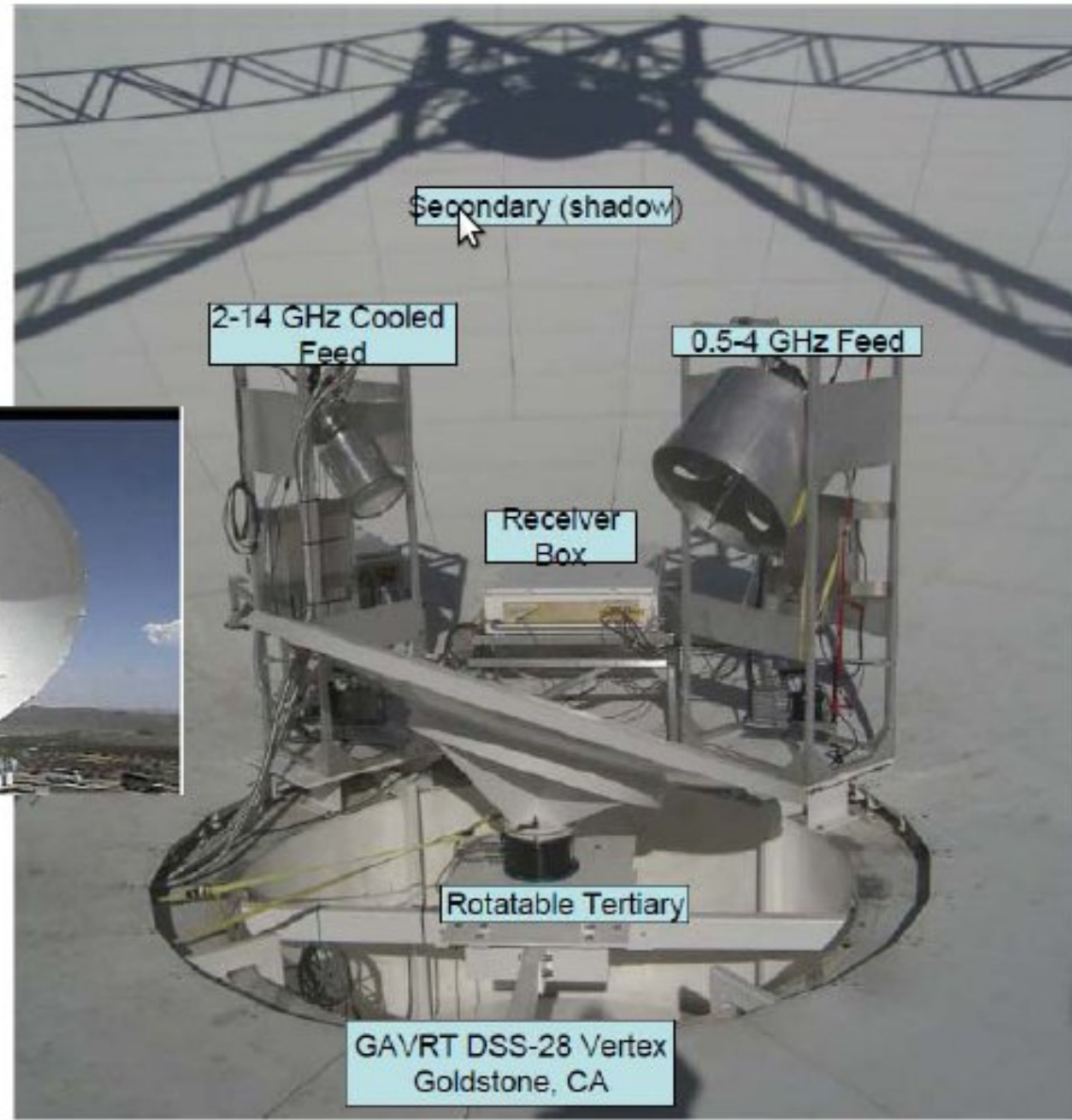
A Recipe for the Conversions?



Two Feeds with switchable optics

Jet Propulsion Laboratory
California Institute of Technology

DSS28 34m
Telescope



Imbriale, Weinreb,
Jones, Mani