MeerKAT Control and Monitoring System Architecture (MOP067)

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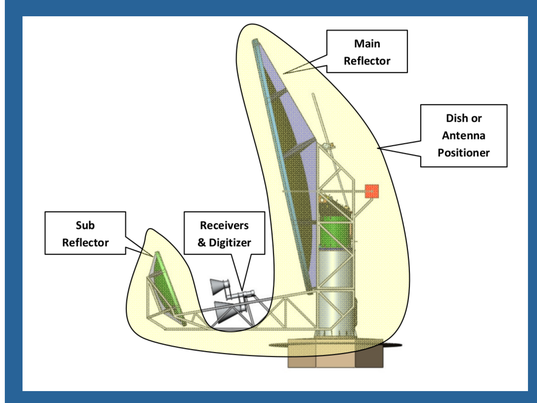
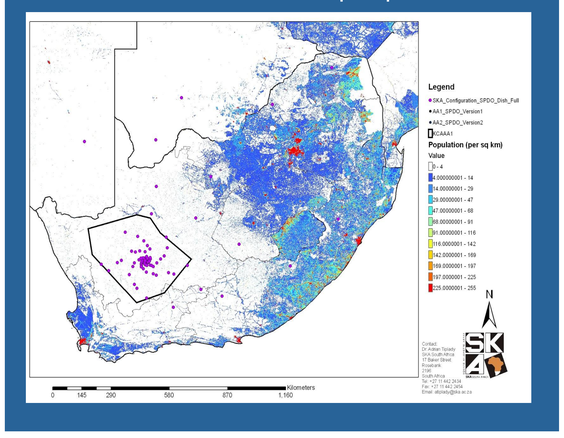
Artists impression of MeerKAT when complete

MeerKAT will be a 64-receptor aperture-synthesis inteferometric radio telescope array. MeerKAT will be the most sensitive L-band radio telescope in the world. It should be completed in 2017. MeerKAT is located in the sparesly populated semi-arid Karoo region of the Northern Cape Province, South Africa.

Receptor antennas are offset Gregorians with a 13.5m main reflector in a feed-low configuration providing an unblocked aperture with optimal optical performance. Multiple receiver systems can installed and are accessable without a cherry-picker.



Radio Frequency Interference (RFI) is a radio telescope's natural enemy, so MeerKAT avoids people.

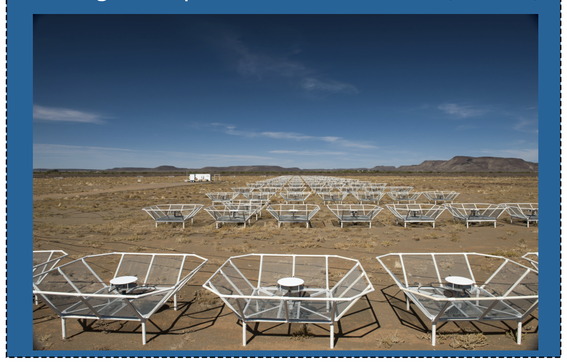


The MeerKAT site compound. Earthworks, power and other civil infrastructure completed in 2014, including fibre to all receptor pads and the underground RF-shielded data centre (KAPB)

MeerKAT receptor pads before the first antenna was installed.

First dish enroute from assembly shed at MeerKAT site compound to its pad.

Site colaboratively hosts other radio telescopes like the Precision Array for Probing the Epoch of Reionization (PAPER).



First light achieved in 2014, confirmed L-band MeerKAT reciever sensitivity exceeds specification. Locally developed UHF band feeds under construction, S-band receivers to be funded an produced by German Max-Planck-Institute for Radio Astronomy

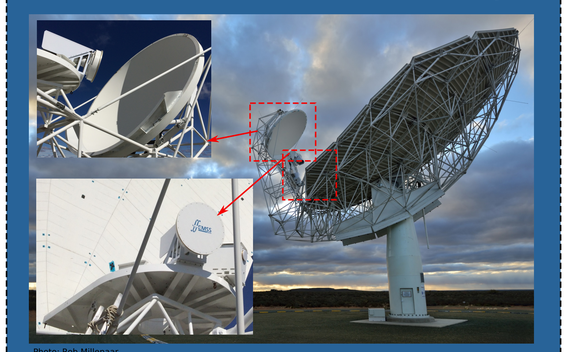
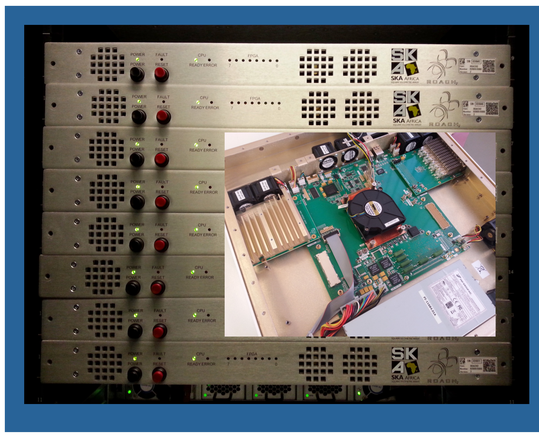


Photo: Rob Millenaar

8 receptors on site by end October, rolling deployment continues till early 2017.

Receptor sends ***digital*** voltage data to central KAPB, a first for radio telescopes; received by Correlator Beam Former (CBF).

KAPB partially populated, more MeerKAT coming, ready for SKA phase 1. Double-door RF-"airlock" in inset.

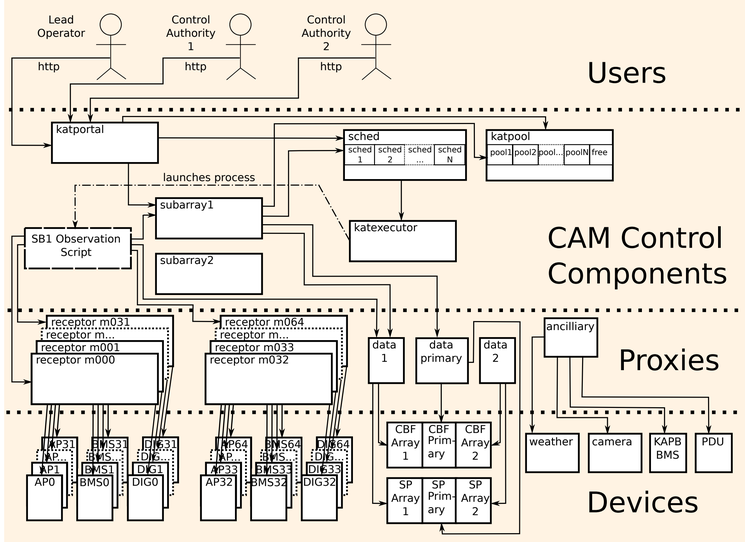


Receiver Test System (RTS) CBF using ROACH2 (Virtex-6 FPGA) boards. MeerKAT will upgrade to SKARAB (Virtex-7 FGPA) boards. SKARAB board shown in inset.

CBF performs first level of computation and data reduction (averaging), output sent to Science Processing (SP) subsystem for archival and imaging

MeerKAT Control and Monitoring (CAM) Architecture

CAM Observation Control Architecture



Connections along directed lines from Karro Array Telescope Contrrol Protocol (KATCP) clients to servers. Clients observe and/or control servers.

Lead Operator sets up subarrays by allocating resources. Control Authorities manage observations on subarrays

katpool manages resource allocations (to subarrays) and assigments (to SBs). When an SB (script) completes its assigned resources become available to other SBs again.

sched manages observation scheduling through Schedule Blocks (SBs). It instructs **katexecutor** to run an observation script with the correct parameters.

SB1 observation script connects to **subarray1** and identifies itself. **subarray1** replies with a datastructure describing the telescope resources assigned to SB1. The script only connects to its assigned KATCP resources.

katsyscontroller controls any KATCP server needed to to ensure safe and reliable telescope operation.

katmonitors subscribe to all KATCP sensors (monitoring points). They buffer sensor samples for CAM Sensor Store and calculate aggregate sensor rules.

kataware subscribes to **katmonitor** aggregates and applies rules for raising alarms. **katsyscontroller** applies alarm actions, **katportal** informs users of alarms.

When SB1 completes, **katexector** ensures the that the script exits. **sched** selects the next SB from array1's schedule and repeats the process.

At the end of the observations, the CA or LO can request **subarray1** to be freed. The CBF is instructed to deprogram "array1", freeing up its FPGA resources, and **katpool** frees resources allocated to by moving them from "pool1'" to the free pool.

CAM Monitoring and Intervention Architecture