MeerKAT update

(Overview & commissioning)

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SKA AFRICA
SQUARE KILOMETRE ARRAY

PHISCC Workshop

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SKA South Africa
Radio Astronomy Schedule

- **Phase 1**: construction of the pathfinder KAT-7 (7 antennae) completed in December **2010** & already in operation
- **Phase 2**: construction of the precursor MeerKat (64 antennae), fully funded (R3Bn ~AUD300Mn), should be completed ~**2016** & merged with SKA_1- mid
- **Phase 3**: construction of the SKA-mid (phases 1&2) (~3000 antennae) should be completed ~**2025**

Karoo Radio Astronomy Reserve

The MeerKAT Programme

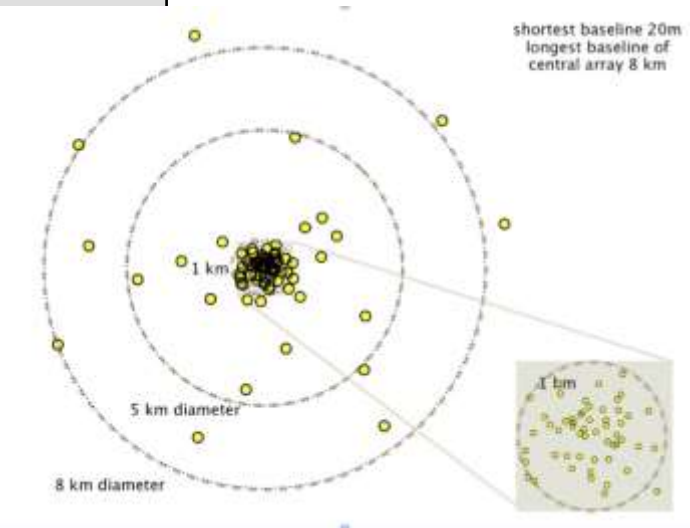
- Africa must have the legacy of a large radio telescope
  - Irrespective of the outcome of the SKA site competition
  - But not independent of the SKA
- MeerKAT is an SKA “precursor”
  - Engineering prototype
  - Early science (SKA “Phase 0”)
  - Until the SKA is completed, MeerKAT should be one of the most sensitive radio interferometer in the L-band
  - Phased development: KAT-7, MeerKAT, SKA_1, SKA_2
  - MeerKAT will be the first 25% of SKA_1 (mid-frequency dish array)

Pathfinder: KAT 7

More on KAT-7 Thursday: First HI Observations with KAT-7

Precursor array: MeerKat

- 64 antennae distributed in two components:
  - An inner dense core ~70% of the antennae (baselines: 29m to 1km), distributed in a 2D Gaussian uv-distribution with a σ ~300 m
  - An outer component ~30% of the antennae (baselines: up to 8km), distributed in a 2D Gaussian uv-distribution with a σ ~2 500 m
  - Commissioning: 2014 - 2016
  - Science operations: 2017



MeerKAT INITIAL PLANS

	2011	2016	2018
	Precursor (KAT-7)	MeerKAT Phase 1	MeerKAT Phase 2 & 3
Number of dishes	7	64	64
Receiver bands (GHz)	0.9 - 1.6	1.00 – 1.75	0.58 – 1.015 1.00 – 1.75 8 – 14.5
Max processed BW (GHz)	0.256	0.75	2 (goal 4)
Max baseline (km)	0.2	8	20
Min baseline (m)	20	29	29

Current MeerKAT Status
(12 June 2013)

Plans on track to complete the 64-dish MeerKAT by the end of 2016. The projected milestones are:

- January 2014: First dish installed (following acceptance testing)
- April 2014: Two dishes installed / First receptor integrated / ready for testing
- November 2014: 6 dishes
- June 2015: 16 dishes
- November 2015: 32 dishes working
- September 2016: All 64 dishes completed & tested

Current MeerKAT Status

- Commissioning of MeerKAT will start in 2014 and ramp up with the increasing number of antennas
- It is anticipated that some early science may be possible/feasible once a significant fraction of the array is constructed (32 ~ Dec 2015) / but commissioning activities will take priority
- The full array will be available for commissioning in 2017, hoping that most significant commissioning issues will have surfaced and be dealt with earlier so that there can be a rapid transition to MeerKAT science data collection by early 2018

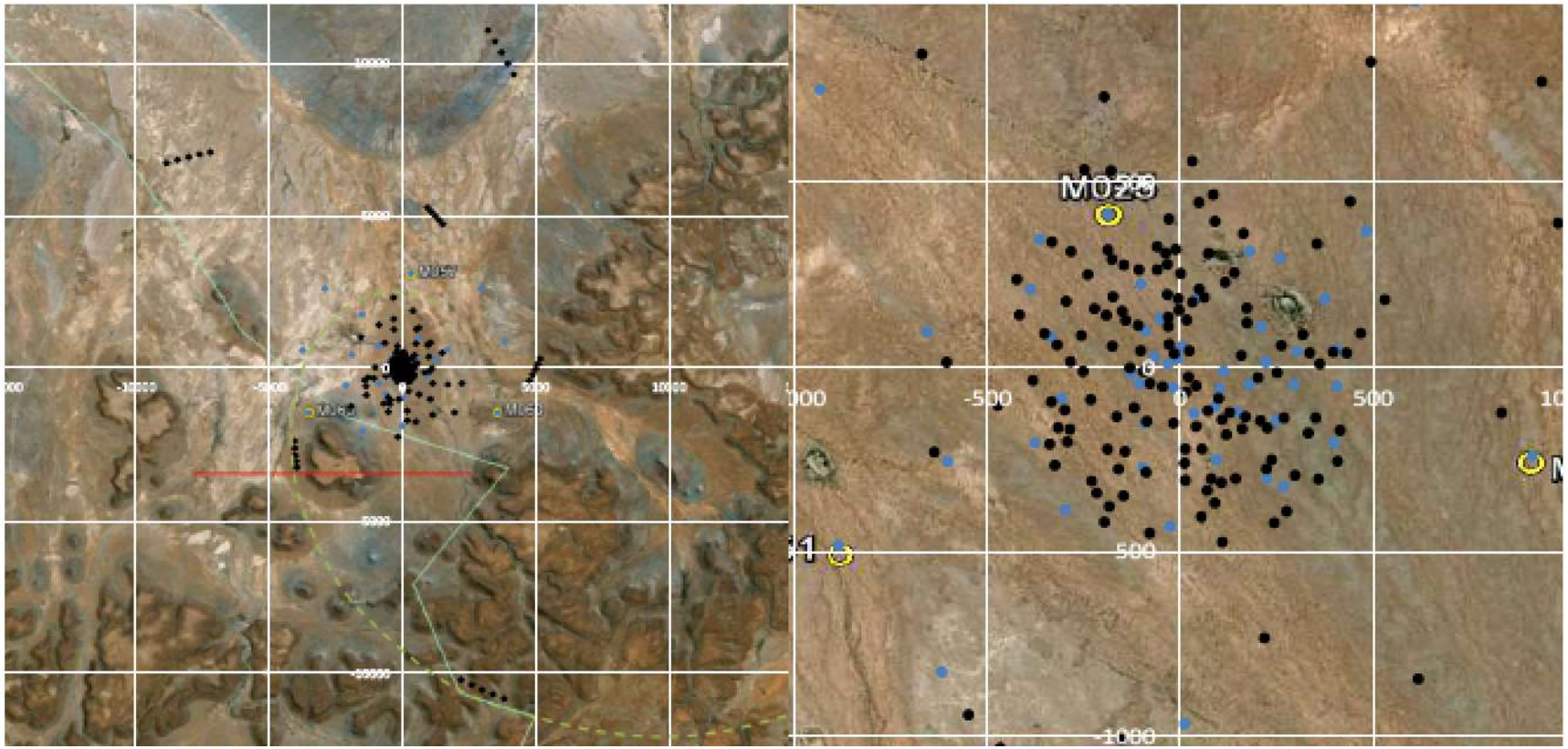
Current MeerKAT Status

- The current planning is that 2018-2020 will be devoted to the MeerKAT large science (L-band) programs with some transition to SKA_1
- The current SKA_1 (190 dishes) construction is expected 2018-2021 (full array 190 + 64 dishes)
- The planning is that the sensitivity of SKA_1 dishes should equal that of MeerKAT around end 2020
- At that point, it may make scientific sense to integrate MeerKAT into SKA_1 (and use the SKA correlator, etc).
- *However, the actual SKA timelines are less certain than those for MeerKAT, at this stage.*

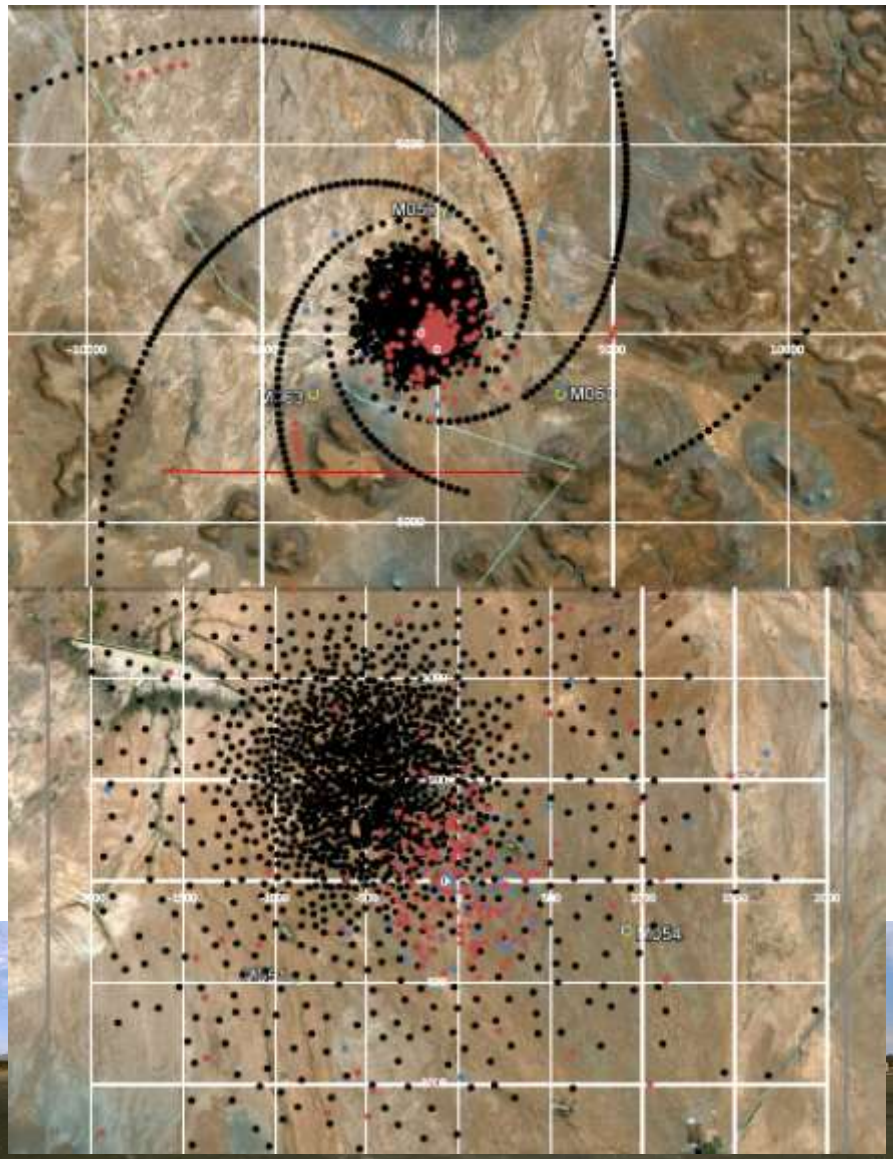
Current MeerKAT Status

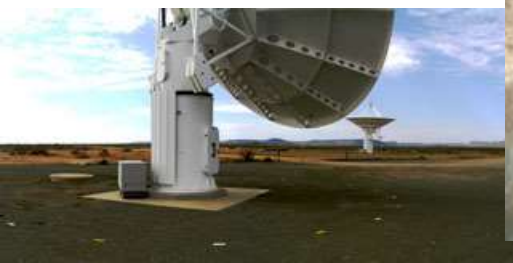
- As the longest MeerKAT baselines are 8 km and some MeerKAT surveys (continuum science) require longer baselines (20 km), the planning is to work with the SKAO to ensure that the first few SKA_1 dishes are built at those kind of distances and used for this science in the 2019-2020 timeframe.
- As the MeerKAT correlator would have 64 inputs, some of the MeerKAT core antennas would be disconnected to accommodate SKA_1 inputs for this science.

MeerKAT & SKA$_1$

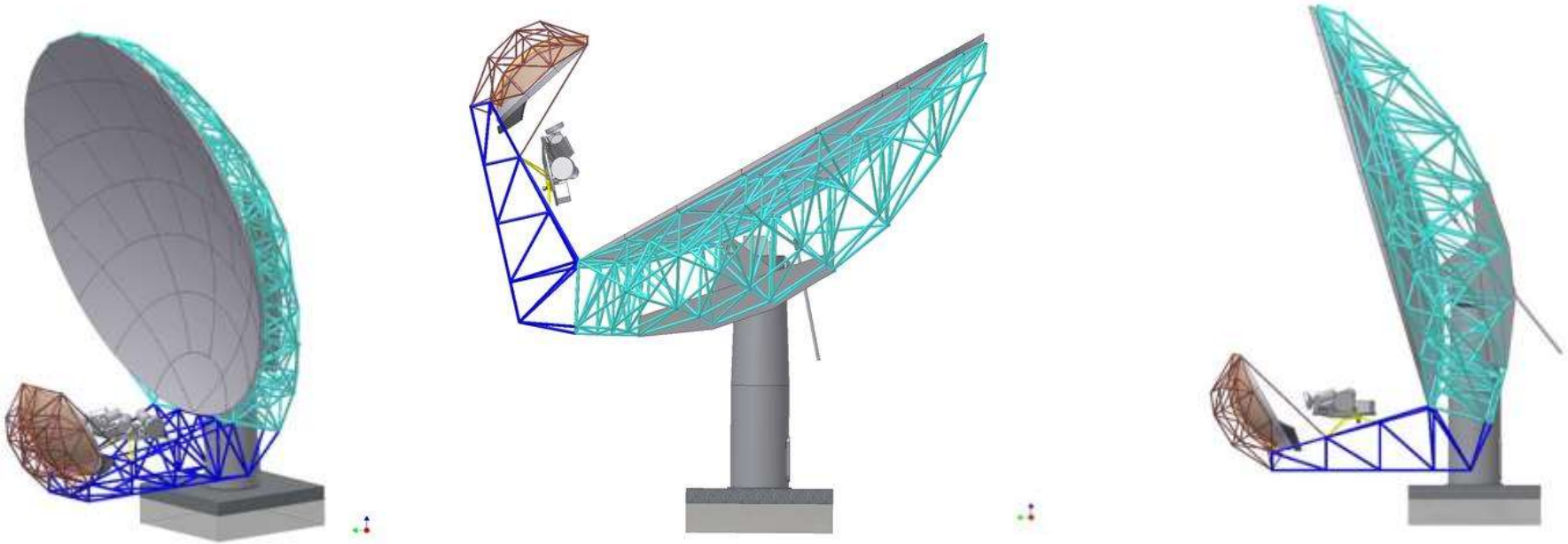


MeerKAT & SKA$_2$





MeerKat's antennae



Offset Gregorian design: metal instead of composite dishes

MeerKat's antennae

- Development of MeerKAT antennas on track by Stratosat Datacom / GDSatcom
- 1st antenna to be assembled on site and handed over to SKA SA for testing end of January 2014
- 2nd antenna to be handed over in April 2014
- Followed by extensive engineering testing by SKA SA for 6 months
- 62 other antennas delivered by the end of 2016

MeerKat's Feeds & Receivers

- The L-band feeds and cryo receivers (0.9-1.67 GHz) development is on track (by EMSS)
- Functional prototypes with measured performance were demonstrated June 2013
- The first two production systems will be deployed on the first two MeerKAT antennas beginning 2014

MeerKat's Feeds & Receivers

- Based on the modeling and the actual performance tests to date, MeerKAT is expected to achieve a sensitivity in excess of 300 m^2/K rather than the originally specified 220 m^2/K at L-band
- The UHF cryo receiver (0.58-1.015 GHz) development has started. A decision on whether these will be included in $MeerKAT_1$ end of 2016 will be made in the near future
- The X-band receiver (8-14.5 GHz) remains in the plans, but is not currently funded

MeerKat's Infrastructure

MeerKAT related infrastructure on site to be completed end 2013. Currently under construction:

- Roads
- Reticulation (power & fiber)
- Foundations for MeerKAT antennas
- On-site tarred landing strip
- Extension of the site complex assembly building
- Karoo Array Processor Building (KAPB)
- Pedestal Assembly building

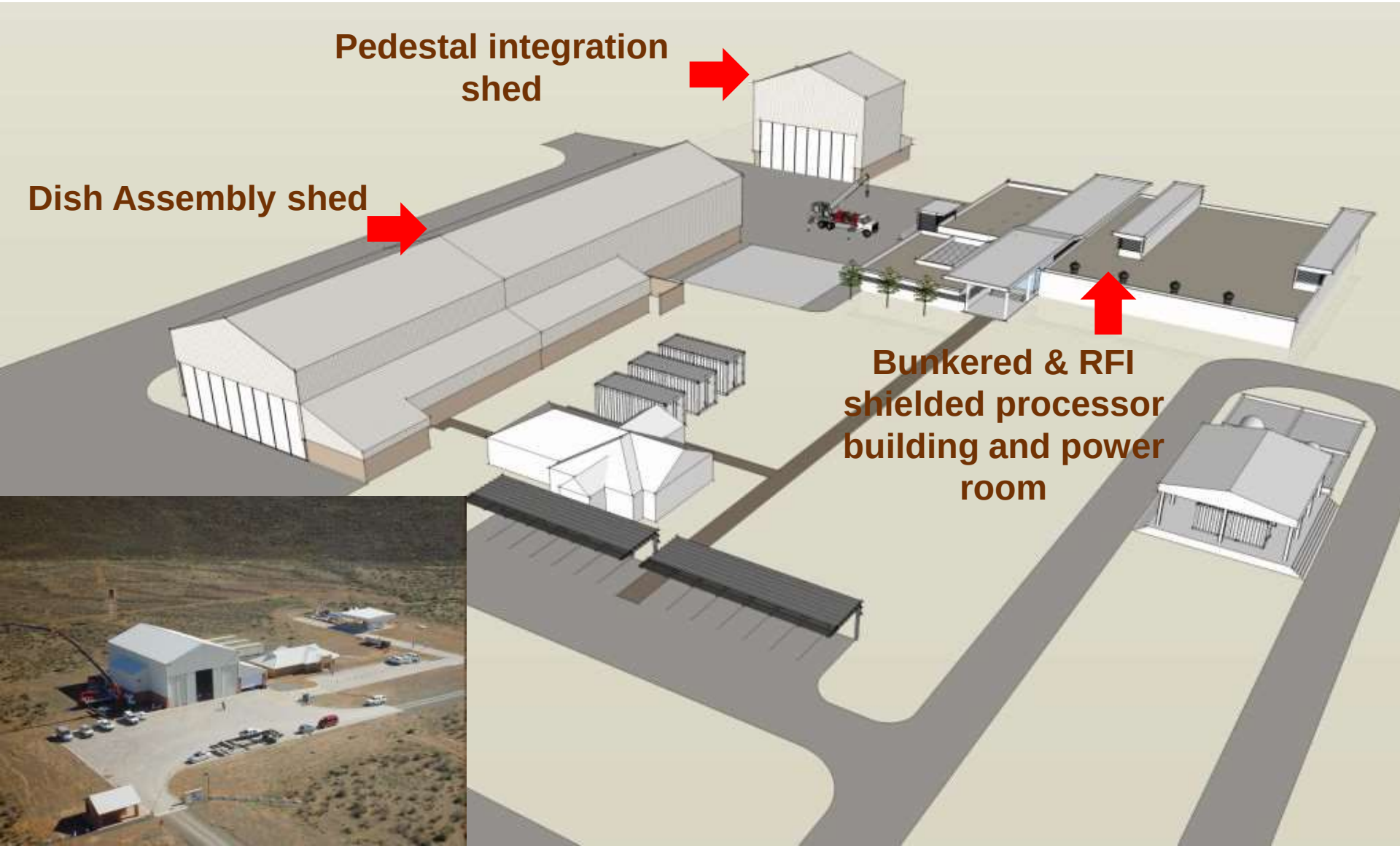
+ additional workshops at the Klerefontein support base

MeerKat: start of construction

July 25 2012

Road network near the core

Site Complex extension for MeerKAT



Power and Infrastructure

Power and Infrastructure

18 May 2013

CONCLUSIONS

- Important milestones for MeerKAT:
  1. First antenna: January 2014
  2. First receptor test system: April 2014
  3. Antennas construction completed: June 2016
  4. MeerKAT large science programmes (L-band + baselines up to 8 km): 2018 - 2019
  5. MeerKAT large science programmes (continuum + baselines up to 20 km) 2019 - 2020

Thank's to Jasper Horrell

Science processing sub-system manager
on the MeerKAT project
for the current MeerKAT status
as of 12 June 2013