

ASKAP Technical Update

CSIRO Astronomy and Space Science

June 2011



The ASKAP Technical Update contains a brief summary of recent science and technical developments and milestones related to the Australian SKA Pathfinder (ASKAP) project. Each issue also looks at an aspect of key ASKAP activity. Previous issues can be read online at www.atnf.csiro.au/projects/askap.

Next Stage of ASKAP Systems Integration Underway

As ASKAP moves into the 'delivery' phase, full systems integration is now underway at the CSIRO Astronomy and Space Science headquarters at Marsfield in Sydney.

The Marsfield ASKAP Test Engineering System (MATES) will be used to rigorously test all ASKAP systems prior to installation on ASKAP antennas at the Murchison Radio-astronomy Observatory (MRO) in Western Australia.

MATES duplicates a complete ASKAP antenna system; from the Phased Array Feed (PAF), through analogue signal conditioning, digital conversion, channelisation and beamforming, with full system control and monitoring managed through the Telescope Operating System.

Additionally, the MATES timing reference systems, network equipment, power distribution and data transport hardware

allow the ASKAP antenna functions and interfaces to be tested to a high degree.

MATES integration testing is led by a dedicated ASKAP Systems Engineering, Integration and Commissioning (SEIC) team, and supported by the ASKAP team, in particular the Analog Systems, Digital Systems and Computing Integrated Project Teams (IPTs).

The SEIC IPT not only sets-up and conducts the tests, but also observes quality gates around subsystem integration readiness, configuration management, reporting results and logging issues.

According to SEIC IPT leader John Reynolds, "the ASKAP team is making terrific progress with the integration of the MATES platform."

"Only minor issues have been found so far, which is a credit in itself to the engineering teams that supplied subsystems for integration."

ASKAP Project Highlights:

- First full-size PAF systems delivered to the Parkes Testbed Facility (PTF) for on-sky testing.
- First PAF (destined for installation on an ASKAP antenna at the MRO) successfully undergoing full integration testing at Marsfield.
- 'First light' achieved on the new, dedicated SKA-ready, optical fibre connection between the MRO and Geraldton.

First Full Size PAF Delivered to PTF for In-Sky Testing

The MATES integration system has already been used to successfully validate one full-size PAF prototype which was moved to the Parkes Testbed Facility (PTF) in late May 2011.

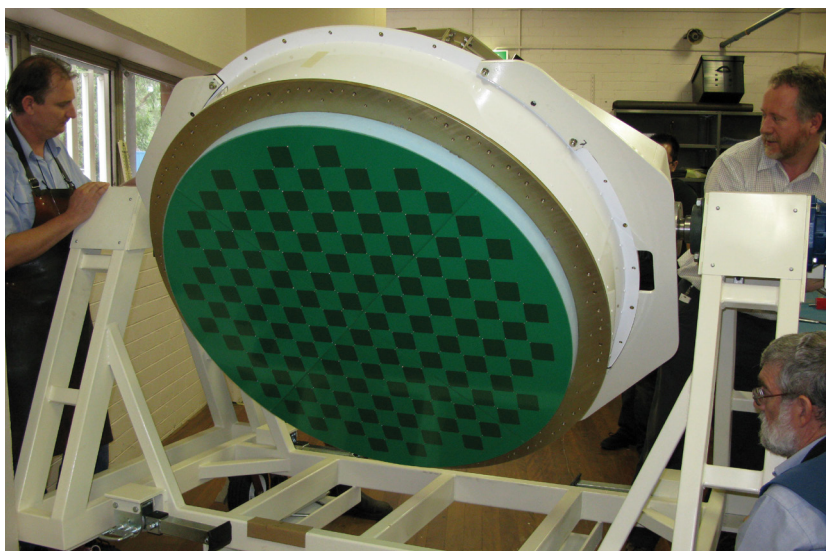
This PAF system will be tested in conjunction with CSIRO's 64-m Parkes Radio Telescope, taking advantage of the lower RFI environment of Parkes. As part of the on-sky testing, the PAF will observe real astronomical sources.

IPT Progress Update

ASKAP's Integrated Project Teams (IPTs) have been reaching key milestones and progressing towards successful delivery of the project.

ASKAP Antennas

Commissioning and some fine finishing and fit-out work at the six antennas at site continued. Two new L-band feed systems installed at two antennas will be used alongside the PAF on a third antenna for the first phase of detailed BETA testing. Six new antennas have arrived in Fremantle and onsite



> The PAF package, showing the chequerboard array minus its weathershield, being prepared for transport to Parkes to begin in-sky testing. Credit: Russ Bolton, CSIRO.

assembly will commence in late June; construction of the remaining antennas (numbers 15-36) are on track at the CETC54 factory in China.

ASKAP Computing

As 'early adopters' of the Pawsey Phase 1A computing system, the ASKAP team pushed the scaling curve forward with the spectral line imager demonstrated at 1024 cores. The 'Selavy' source-finding service was released to test specific ASKAPsoft implementation of the source-finder. Various efficiency enhancements were made to the ASKAP calibration pipeline, along with the development of the calibration parameter and sky model databases. Version 0.3 of the Telescope Operating System (TOS) monitoring and control software was released mid-April and this software is now in use within MATES verification at Marsfield.

ASKAP Data Networks

Installation of the fibre cable between Geraldton and the MRO was completed. Equipment necessary to provide the high bandwidth data transfer from the MRO to the Pawsey Centre (Perth) is based on a joint design between CSIRO and AARNet to realise a homogeneous network with scalability to support future bandwidth requirements. Various other small infrastructure works continue, in order to make this network ready to carry traffic by mid-year.

ASKAP Digital Systems

Data communications of 2Tbps from the MATES antenna digital receiver to the central site beamformer is now operational; antenna data is arriving at the correct FPGA at the correct time. Processing of the first Array Covariance Matrix (ACM) in real-time was achieved. On the production side two complete ASKAP antenna systems were delivered (Parkes and the first one for MRO), and the remaining five for BETA are due to be completed over the coming months.

ASKAP MRO Related Activities

MRO infrastructure construction is well underway, including access roads, antenna foundations and a refurbished

airstrip; the work will continue over the coming months. The fibre optic cable link to Geraldton reached the MRO and testing was successfully completed. Radio frequency interference (RFI) testing and site selection for the MRO power station were conducted. RFT documentation for the Murchison Support Facility (MSF) is due to be released in June.

ASKAP RFI Monitoring

First-off production of ASKAP BETA circuit cards and sub-assemblies passed MIL461F RE102 validation in the 30MHz–2GHz range. Additional modifications were required to meet acceptable emission limits of the antenna-related assemblies. Pre-compliance emissions tests of the 500kW power generation plant were conducted at the MRO using Open Area Test Site (OATS) principles. Transient mode SKA RFI measurements at the MRO and South African sites have neared completion after a number of software modifications were implemented.

ASKAP Signals

Two sets of antenna pedestal racks were fitted out with wiring harnesses in MATES; a cable form template and master set was produced to enable these to be duplicated in all of the next sets of systems. Antenna monitor and control radio-quiet SPI hardware was successfully operated in MATES and on the first PAF. Critical measurements of the RFoF prototype optical links have shown exceptional stability can be achieved and development continued on a 6-channel proof-of-concept RFoF gain card for a next generation PAF. Additionally, a prototype roundtrip phase meter design, required for absolute phase referencing at antennas, was successfully tested.

ASKAP System Engineering, Integration and Commissioning

As highlighted on the front page, MATES integration platform testing began in April, with a platform that comprises a complete set of electronics hardware for one antenna, including the first full-size PAF receiver. The system was deployed to Parkes for the Parkes Testbed Facility (PTF) in late May.

ASKAP Science and User Policy

In May and June, ASKAP Project Scientists used CSIRO's Australian Telescope Compact Array (ATCA) to lead the characterisation observations of two fields which will form the first scientific observations with ASKAP BETA. The fields, located near the radio galaxy Fornax A and the gas emitting galaxy Circinus, were observed in two separate week-long sessions, producing data template images and cubes with which to compare with the first BETA observations.

SKA Related Activities

A series of Concept Design Reviews for the PrepSKA WP2 (SKA Technology Work Package) are taking place through 2011. CSIRO is participating in all of these and leads the development of the SKA PAF concepts. CSIRO engineers have been preparing material for these reviews (digital systems, dish array, signal transport and computing), working closely with international colleagues to outline options, and provide cost estimates, for SKA-ready systems.

For further information:

Flornes Conway-Derley
Communication Officer
CSIRO Astronomy and Space Science
Email: flornes.conway-derley@csiro.au
Web: www.atnf.csiro.au/projects/askap

Contact Us

Phone: 1300 363 400
+61 3 9545 2176

Email: enquiries@csiro.au

Web: www.csiro.au

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