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.

Astronomical Measurements with First ASKAP PAF

Detailed system tests are currently underway using the first full-sized Phased Array Feed (PAF) chequerboard receiver on the ASKAP antenna testbed at CSIRO’s Parkes site in central NSW.

The ASKAP PAF is the first chequerboard receiver specifically built for radio astronomy; with 188 active elements it is a revolutionary ‘radio camera’ with the ability to simultaneously sample large areas of sky. The system comprises a chequerboard PAF, analogue and digital signal processing systems and all support systems required to fully test the novel receiver.

Since May 2011, ASKAP engineers have been testing this entirely new system to ensure the basic functionalities are robust, ahead of the systems being deployed onto the ASKAP antennas at the Murchison Radio-astronomy Observatory in Western Australia.

The first round of PAF testing took place at Parkes in June, using the receiver as an ‘aperture array’, with the PAF supported on the ground, and alternately pointed at the sky and a microwave absorbing foam block to supply ‘cold’ and ‘hot’ loads.

The tests confirmed the array was consistent with the model and the smaller 5x4 ‘proof-of-concept’ receiver used in earlier tests. System temperature exceeded expectations, particularly at the low end of the frequency band.

Results were presented at the 2011 International SKA Forum in July, and will be published in future technical papers.

With a validated signal path, the PAF was then installed on the Patriot 12-metre antenna known as the Parkes Testbed Facility (PTF), a three-axis testbed ASKAP antenna that was built specifically for testing the PAF.

The team achieved ‘first light’ with the PAF observing radio-galaxy PKS1934-638, by correlating all 188 PAF elements with the single beam of the 64-metre CSIRO Parkes antenna (‘The Dish’) and beamforming software.

Firmware to form PAF beams in real time before correlation is expected to be ready for testing in time for the next session at Parkes. This deceptively simple observation is the first complete test of the ASKAP front-end – from antenna through to the digital signal processing (DSP) hardware – and has never before been done for chequerboard PAFs.

Pleasingly, the PAF’s 188 low-noise amplifiers (LNAs) worked reliably well, with no evidence of the instabilities that are sometimes seen in early iterations of new RF signal chains.

“The new hardware continues to be very robust and is a credit to the designers and builders on the ASKAP team,” says John Reynolds, Systems Engineering, Integration and Commissioning (SEIC) team leader: “Development of monitoring and control software is proceeding rapidly in a healthy synergy with the testing schedule which augurs well for the upcoming deployment of the Alpha and Beta systems to the MRO.”

The exceptional performance of ~40K on-sky (at limited frequencies) was met and results will be discussed in a number of papers now being prepared for publication in major journals.

“Using the testbed antenna allows us to perform a full end-to-end test on the PAF with its tightly coupled signal and processing systems in a controlled Observatory environment,” says Ant Schinckel, ASKAP Project Director.

“It is a crucial step before installation of the first PAF on an ASKAP antenna at the MRO in the coming months.”
Alpha Ready for the MRO

As part of the next critical milestone in ASKAP PAF development, preparations are now underway for deployment of the first full receiver system to the MRO in the coming months.

Known as ‘Alpha’, the system comprises the first PAF receiver and components specifically designed for ASKAP.

The Alpha receiver system includes:

• 192 element chequerboard PAF receiver (188 active elements plus four for calibration).
• Analog conversion rack, digital receiver rack and beamformer rack.
• Timing reference and local oscillator systems.
• Power distribution, cooling and signal transport hardware.
• System control and management via the Telescope Operating System.

The COTS (Commercial Off The Shelf) computers in ASKAP run the Linux (Debian Lenny) operating system, with application software built around the EPICS (Experimental Physics and Industrial Control System) package.

This package was first developed by researchers in high-energy physics and now widely used in complex research instruments, including at the Australian Synchrotron in Victoria.

All components of Alpha are undergoing factory acceptance tests, and are scheduled for deployment to the MRO during September and October.

On site system integration and a full suite of functionality tests will be completed to ensure that the system is ready for operational (on-sky) testing.

Alpha will be followed by five more ASKAP PAF systems and dedicated correlator capable of correlating the 36 beams of 300 MHz each from the six antennas.

This six antenna system, known as the Boolardy Engineering Test Array (BETA), is an intermediate engineering and scientific commissioning instrument and a major milestone in the development of the full ASKAP telescope.

IPT Progress Update

ASKAP’s Integrated Project Teams (IPTs) have been progressing towards successful delivery of the project; a summary of a selection of milestones is included below.

ASKAP Antennas

On-site assembly of ASKAP antennas brought the total built at the MRO to nine, and parts for a further five new antennas (or parts of antennas) were delivered. Manufacture of the remaining antennas (numbers 15 – 36) continued to plan at the CETCS4 factory in China.

ASKAP Computing

Version 0.5 of the Telescope Operating System (TOS) was released and installed at Parkes to support PAF measurements and testing. Various enhancements were made to the central processor ingest and calibration pipelines, with a focus on meeting upcoming BETA milestones.

ASKAP Data Networks

The initial dual 1Gbit/s network was commissioned successfully between Geraldton and the MRO. A successful e-VLBI demonstration was performed in early July using temporary network bandwidth between Geraldton and Perth, with a permanent high-bandwidth connection to Perth awaiting finalisation of agreements between various parties.

ASKAP MRO Related Activities

Infrastructure construction on main access roads and on-site antenna access tracks is almost complete; fibre optic and power cabling at the MRO is underway. Construction of the control building foundations and the geo-cooling system began, with the modular building itself taking place at DRAO, Penticton, Canada.

CSIRO continued participation in the series of Concept Design Reviews (CoDRs) for the PrepSKA WP2 (SKA Technology Work Package). CSIRO led the SKA PAF sub-system concept at the WP2.2 Dish Array CoDR which took place at DRAO, Penticton, Canada.

ASKAP Related Activities

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