FACULTY OF SCIENCE

THE UNIVERSITY OF SYDNEY

SKAMP Newsletter

ISSUE 04
FEBRUARY 2011

SKAMP WORKSHOP

In January 2011 the SKAMP team held a one day workshop, designed to introduce new members to the project, review the work that has been done and set project deliverables for 2011. It also provided the opportunity to discuss the contribution that SKAMP will be making to a number of science projects linked to SKA (Square Kilometre Array) key goals.

Following presentations on Science with Radio Astronomy and The History of the Molonglo Observatory, the discussions focused more specifically on SKAMP progress, our links with CAASTRO (Centre for All-Sky Astrophysics) and the transient science that is currently driving the project.

Also discussed were further science projects related to SKA goals, in which SKAMP will play a role. These included: Blind survey of HI absorption in high redshift galaxies (z~0.7); Search for OH megamasers in disks around super-massive black holes (z~1); Cosmic magnetism studies – "diffuse Galactic polarisation and Rotation Measure"; and Radio Recombination Lines (H199α is 841 MHz).

The meeting concluded with in-depth discussions on the software needs of SKAMP and transient research. Immediate priorities were set for the software development team with a follow-up meeting held on-site at the Molonglo Observatory to finalise the development strategy.

The SKAMP digital system hardware is now complete and the front end receivers are nearing production, so efforts are really beginning to focus on the design and development of the front end and back end software.

Contributions from all workshop attendees ensured the meeting was a success. In attendance: Keith Bannister, Jay Banyer, Duncan Campbell-Wilson, Sean Farrell, Bryan Gaensler, Deb Gooley, Anne Green, Paul Hancock, Dick Hunstead, Mike Kesteven (CSIRO), Kitty Lo, Greg Madsen, Tara Murphy and Darshan Thakkar.

SKAMP workshop. L to R: Tom Landecker, Dick Hunstead, Jay Banyer & Duncan Campbell-Wilson Courtesy Tom Landecker.

STAFF ANNOUNCEMENTS

Greg Madsen

Greg joined SKAMP in January 2011 as Project Team Leader working with Jay Banyer and Molonglo staff on a range of issues pertaining to the astrophysics of radio transients, including the commissioning of SKAMP as a radio transient detection telescope. He will serve this role in his capacity as a Senior Research Fellow on the Dynamic Universe within the new CAASTRO Centre of Excellence. Greg was awarded a PhD from the University of Wisconsin in 2004 and was most recently a Sydney University Research Fellow working with Bryan Gaensler. Greg's science background is on the study of physical processes in Galactic interstellar medium, and he was involved in the development, commissioning and operations of the WHAM (Wisconsin H-Alpha Mapper) survey telescope, a high resolution optical spectrograph.

Jay Banyer

Jay commenced as a CAASTRO Senior Software Engineer in January 2011. Jay has first class honours in computer science from UTS, and has spent the last 9 years working at Optiver Australia as a senior IT architect. Jay will be developing software for image processing and transient detection for radio surveys with SKAMP and ASKAP.

SKAMP SOFTWARE

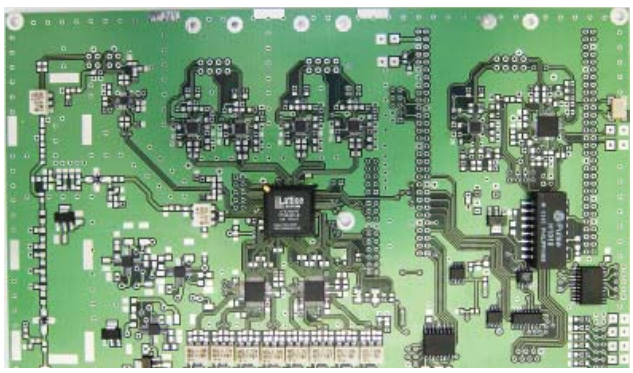
As part of the concentrated focus on SKAMP's software needs, the project welcomed two new members to the team. Jay Banyer and Greg Madsen will be working closely with Duncan Campbell-Wilson, Darshan Thakkar and various science advisors, focusing their efforts on the software components of SKAMP. In particular, Jay will initially be working on the data pipeline and acquisition, and Greg will focus on science-related aspects such as calibration, visualisation, imaging, and MIRIAD integration. Future work includes the development of the transient detection pipeline.

There has been much activity since January, and significant progress has been made in a number of areas. Jay and Greg spent some time on-site working with Duncan, Darshan and Tom Landecker discussing SKAMP's scientific drivers and the unique software needs of the project. New tools have been introduced: source control with Subversion; Eclipse programming IDE; and the software platform of Ubuntu 10.04 has now been confirmed.

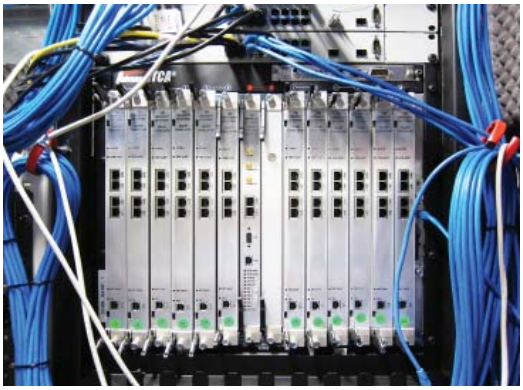
The team has tested disk throughput and, using existing equipment has demonstrated the feasibility of using RAID arrays. They have also demonstrated the existing network equipment with the full data load. Specifications have been determined for correlator output packet format and some basic tools and libraries have been created for working with the raw data. In order to plot the correlator output, two packages, PLplot and PGPLOT, are being evaluated. Jay and Greg have demonstrated visualisation ideas for showing the large number of baselines, enabling a visual inspection of the telescope date to ensure it is accurate and as expected from antenna to correlator output.

During March 2011, the software group will focus their work on the following:

- Evaluation of container file formats (HDF5, FITS);
- Specification of the SKAMP observation file format
- Development of tools for working with observation files
- Development of a tool for correlator control
- Complete documentation of correlator control interface



Populated FPGA SKAMP receiver board. Courtesy Dick Hunstead.



Manufactured correlator boards installed within ATCA cages. Courtesy Dick Hunstead.

SKAMP HARDWARE

In order to determine the integrated system performance, intensive final testing of the receiver hardware, firmware and software is continuing. The testing process has uncovered some interesting issues:

1. Problem with RF isolation between the receiver input amplifier and a DC supply circuit for the Low Noise Amplifiers. This issue has been resolved and leakage level is now at device off-state isolation level.
2. Unwanted harmonics in the local oscillator chain have been significantly reduced. It is still unclear where the residual signals are being generated, and the optical transmitter and receiver are the current suspects for non-linear distortion. A single analogue carrier gives a clean spectrum. Two carriers give mixing products, which is not unexpected but the mixing product power level is unexpectedly high. This problem does not prevent receiver operation but the source of harmonics is still being investigated and will be resolved soon. Laser shot noise in the Local Oscillator (LO) chain is also being examined with reference to improving the LO system phase noise. Several techniques are being examined to improve the LO phase noise performance.
3. Down-converter outputs are specified to be balanced to 0.3dB, but circuit measurements have shown this is not the case when implemented. Investigations revealed that the external component tolerances caused this imbalance, rather than the Down Converter device. The issue has been resolved by including a set-on test resistor in the output stage, and prototype results indicate a possible 1% scatter in production.

Four final prototypes of the receiver FPGA boards have returned from parts placement. The site team is bringing them to life and are currently making some control software changes to accommodate the new hardware.

SKAMP FIRMWARE

Darshan Thakkar continues to make significant progress on the correlator firmware. All FPGAs on the correlator board have now been exercised.

The datagen modules in the Route-Sum (R/S) chips are sending antenna data to all CMACs (Complex Multiply Accumulate) through the Long-Term Accumulators (LTAs) and the output of the cells (1104) is fed back to the R/S via the LTAs. All cell outputs have been verified to be correct in the LTA. All buses between the chips operate at the full rate of 600 Mbps.

The following diagram shows the development status of correlator firmware components.

WHAT IS A SKUMP?

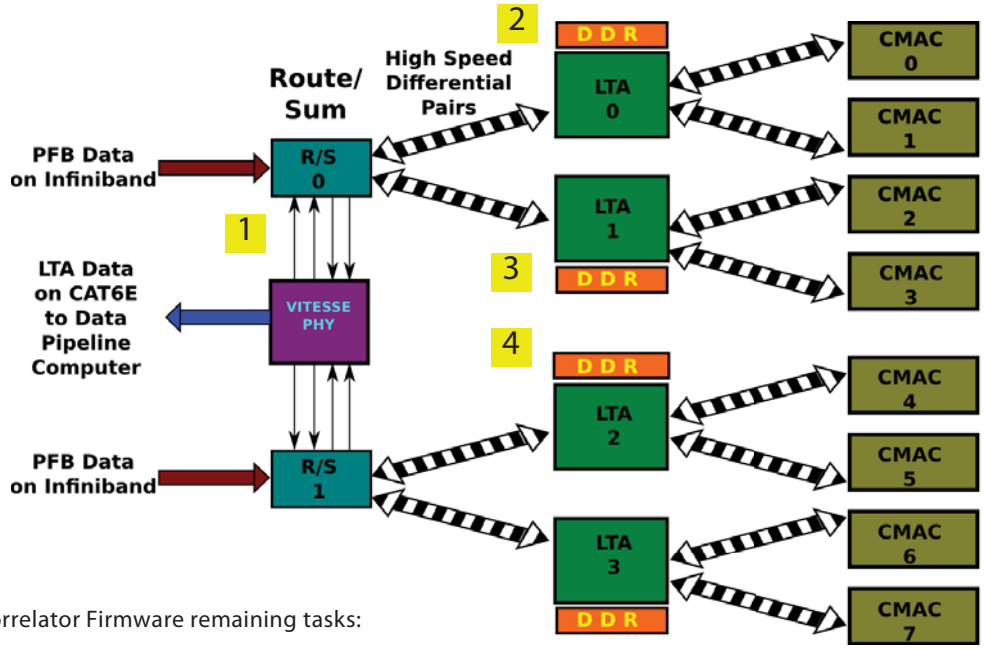
The SKAMP software team communicate every day and have recently been battling with a frequently used term that is time-consuming in conversation and phrased slightly differently each time it is used. This frustration has triggered the invention of the term "SKUMP".

Skump (skŭmp)

noun

1. A set of visibilities from all antennas at a particular frequency for one unit of time

2. SKAMP data dump from the correlator board (approx. 70,000 complex numbers)



SKAMP Correlator Blocks. Courtesy Darshan Thakkar, USYD.

SKAMP Correlator Firmware remaining tasks:

1. MAC Controller written - yet to be integrated - 75% complete
2. DDR Controller written - yet to be integrated - 75% complete
3. Long-term Accumulator Adders currently missing
4. PFB packet decoder - 50% complete

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