

ATNF ATUC Memorandum

To: ATUC
From: Warwick Wilson
Date: 24 November 2005
Subject: Technology Development Report

ATCA 7mm systems

The contract with NASA to develop a 7mm (Ka-band) capability on the ATCA has been finalised. It calls for the installation of the 7mm systems to be completed by May 2007.

MNRF1997 – 3/12mm systems

The new Mopra MMIC-based 3/12mm receiver was installed in September. It performed very well in a short observing session in October, with very good Tsys from 77GHz to 115GHz. A spare ATCA 3/12mm frontend has been completed. It is currently being used at Marsfield to do heat load tests in preparation for the eventual installation of 7mm components in the ATCA 3/12mm receivers. When these tests are complete it will be sent to Narrabri. The fabrication of a set of spare components for the ATCA and Mopra 3/12mm receivers has been delayed but is expected to be completed by March next year.

MNRF2001 – ATCA Broadband Upgrade (CABB)

Graham Carrad has taken over as project manager.

A major milestone was reached in October with the successful use of the CABB prototype digital filter bank circuit board in a 2GHz-bandwidth spectrometer (MOPS) at Mopra. This was a first demonstration of the complex signal processing hardware and firmware that will be required for CABB.

Based on experience gained from the development of the signal processing system, and on the status of design work in other areas of CABB, a re-evaluation of the overall project is being carried out. The result thus far is a new implementation plan, which includes a more detailed model of the installation and commissioning phase of the project and how this would interact with other major activities at the time, such as the NASA 7mm acceptance testing and spacecraft tracking. The new plan indicates a significant overrun compared to the original June 2007 completion date for CABB.

The new plan sees a "Stage 1" CABB becoming available for testing in July 07. Stage 1 will be a single frequency system with the antenna equipment installed in such a way as to allow parallel operation of the existing backend and the new CABB backend. The existing backend will be required to provide Ka-band tracking for NASA, due to begin in July 07. The period from July 07 until early 2008 will be used to thoroughly test the CABB system. Testing will also be necessary to ensure that the CABB backend can provide the required spacecraft tracking facility. Initial operational use, with one frequency only, will also be possible during this time. At the completion of this period an extended shutdown will be required to remove the existing backend systems from the antennas and install the full CABB antenna equipment in its final position.

A major issue recently has been uncertainty in the supply of the Xilinx FPGAs which are a fundamental component of the overall CABB system design. The immediate problem is a, at present indefinite, delay in the delivery of FPGAs for the sampler prototype, originally due in October. There is significant doubt whether Xilinx will ever achieve the performance required for the current CABB design with this family

of FPGAs. This has forced a major re-think of the design of the sampler/data transmission systems. Initial indications are that there are other practical options available. There appear to be ways around the Xilinx problem in the DFB/Correlator area.

Mopra 8GHz Spectrometer (MOPS)

After the successful installation and operation of one 2GHz quadrant of MOPS, the major remaining tasks are the production fabrication of the DFB PCBs and the design of firmware to provide the required performance in terms of available bands and frequency resolutions. A detailed user requirements document, taking into account limitations imposed by the now well understood available processing power, is being prepared. Final installation of the full 8GHz spectrometer is planned for May 06.

MNRF2001 – MMIC Development

Russell Gough has taken over as project manager.

InP MMICs

There will be a delay of around 6 months in the delivery of wafers from the final InP fabrication run in the EU Faraday project collaboration, due to an oversight by the manufacturer in obtaining export licenses. We are attempting to have one wafer delivered in December. The most important circuits required from this run are production quantities of the 7mm LNAs and mixers.

Integrated Receivers

Devices from the initial fabrication run for the RF-CMOS integrated receiver MMIC, containing RF test structures, were delivered in August. All circuits, with the exception of the LNA, performed to design specification. The problem with the LNA has since been identified. The next run, containing more test structures and an initial full receiver circuit will be submitted for fabrication in April 06.

6GHz Multibeam Receiver for Parkes

Installation of the receiver at Parkes has been delayed from November to January 06 following a late change in the configuration of components within the dewar. Jodrell Bank engineers decided to include isolators at the inputs of their LNAs but did not inform ATNF. As a result, the LNA mounting hardware, which had already been fabricated, needed to be redesigned.

The receiver, without dewar internals, was taken to Parkes in November for a test installation. This went very well and served its purpose in revealing a number of minor issues that require attention before the final installation.

Pulsar Digital Filterbank

The prototype 256MHz bandwidth pulsar digital filterbank was installed at Parkes in June and has been operating very successfully since. The production unit is largely complete, with the exception of the Xilinx FPGAs, where the same problems with availability as mentioned above for CABB are causing delays. In a worldwide search of suppliers, two chips have been located and purchased for the signal processing system. The chips are engineering prototypes, with reduced performance, allowing a maximum bandwidth of 500MHz. Similar chips for the digitisers have not yet been located. The project will be stalled until a source for these chips can be found.

NTD

The test bed platform for the focal plane array technology is coming together. The two ex-Fleurs dishes have been assembled, except for raising the dishes onto the mounts. The dishes were assembled, surveyed, adjusted and resurveyed. A new snake and mouse mesh surface has been installed. The control systems have been built and tested. Fibre optic, coax and shielded cat 5e cable have been bought and are ready for installation in the next couple of weeks.

A modified THEA tile, which will be used as the first focal plane array prototype, is being purchased from ASTRON. Douglas Hayman will travel to Dwingeloo in the first week of December to witness the acceptance tests.

After several delays Mr Anatoliy Boryssenko has arrived from the University of Massachusetts to assist the NTD antenna staff with the use of his software to optimise the designs of phased array antenna feeds.

The development of the prototype digital beamformer and the 24 receivers has progressed well. Both these systems have been packaged and tested together. We have also been providing copies of these for the South Africans. There has been communication with the South African KAT development engineers and they are keen to collaborate to assist in our further development.

The main activity for the next quarter is to commission and develop the test bed and start experimental work assessing the performance of creating beams using the THEA tile as a phased focal plane array. The development of other feed designs suitable for use in dense focal plane arrays is also continuing. This work will be focussed on producing results for the NTD critical design review (CDR) which is scheduled for the end of March 2006.

SKA Site Testing

The SKA International Radio Measurement team (ASTRON) finally made it on-site at Mileura from September 23rd to October 19th. Their measurement program went without a hitch and was successful. We understand that their measurements agreed with ours and showed that Mileura is a world class radio quiet site.

Measurements and data collection at Mileura continue as planned. The site testing data collected thus far has been sampled and a first pass analysis of the measured RFI has been completed. This was used in the preparation of the site submission document. The SKA RFI Radio Trailer will be taken to two "typical" remote array stations for a quick look survey as required by the RFP.

Following detailed data processing, analysis and preparation of reports in accordance with the requirements specified by the SKA Site Spectrum Monitoring (SSSM) working group, a submission to the International SKA Project Office is due on the 17th March 2006.