ASKAIC update - November 2008

Dr Carole Jackson
CSIRO Australia Telescope National Facility
*** A new Radio Telescope & New Observatory ***

- Site management & infrastructure – roads, power, optical fibre
- Project management – Build, maintenance, operations & scheduling
- Low-cost antennas
- Focal plane phased array (FPA) receivers (0.3 – 3 GHz)
- Low noise uncooled receiver components (‘receiver-on-chip’)
- High speed, low cost DSP
- Intelligent, self-monitoring control systems
- RFI mitigation techniques
• Phased Array Feed testing on-going at Parkes Testbed Facility
• ASKAP Antenna contract signed
• Science Survey Teams Expressions of Interest
• In midst of Preliminary Design Reviews
• System architecture complete
• Native title negotiations on-schedule (mid ’09)
• Fibre contract(s) starting this year (late ’09)
• Environmental & heritage study done
YOU ARE NOW LEAVING THE MURCHISON RADIO-ASTRONOMY OBSERVATORY

THANK YOU FOR BEING RADIO QUIET
Australian SKA Industry Opportunities

ASKAP as an SKA Pathfinder (PrepSKA)

• Has to demonstrate **SKA sub**systems & key technologies to TRL ≥ 7

Engage in early-phase R&D (co-investment or service)

• Demonstrate capability to international SKA community
• Develop skills in-house
• Foster strategic international relationships
  • Multi-national company engagement
  • Foster relationships in wider radio astronomy community – esp Canada, USA, South Africa & EU.

Engage with Aus SKA Industry cluster activities –

On line Capability Directory
Networking, positioning IP & skills towards SKA
Industry Engagement IPT - What’s what now!

- **Industry Opportunities Register**
  - Published: Updates by Feb 2009: web only

- **Australian Industry Participation Plan**
  - Launched on 11th November.
  - Describes how CSIRO will ensure Aus industry will be given every opportunity to become involved in ASKAP & MRO.

- **Industry Collaboration & support**
  - ASKAP/SKA multi-stakeholder workshop for sustainable energy options.
  - Visits/advice from many ASKAIC cos

- **Briefing industry (ongoing): Briefs, news & Other events**
  - Industry chiefs meeting with Minister Carr.
  - Industry visit to Parkes testbed: 17 Nov 08
  - News - ongoing - here we are!
MRO Project

**Status:**
- defined basic requirements for the two sites, including power, building space, roads, antenna power, etc
- worked with SKM on the submission to obtain PWC approval.

**Next steps:**
- Non-invasive geotechnical study (December 2008)
- Refining requirements specs for facilities (Nov - Dec 2008)
- Develop brief to design groups (Dec 2008)
- Engage (EOI, RFT, direct contracts) design and construction groups

**Stakeholders:**
- ASKAP IPTs
- SKA
- Other site users - MWA, PAPER etc
MRO project: Power

Power requirements:

ASKAP: 613 kW
MWA: 120 kW
Total: 733 kW

= 2 million litres of diesel - a tanker a week!
= $4m per year

Generation:
- as much “green” as possible.
- demand side management: 1 kW per year is $4,000 of diesel
  - capital cost versus operating costs
- working with a range of companies to investigate options:
  - PV solar, thermal solar
  - (wind, geothermal)
  - issues: energy storage
ASKAP Computing strategy

- **Choose areas of innovation**
  - Synthesis processing
  - Parallel processing
- **Partner!**
  - ASTRON & other SKA-institutions
  - Industry
- **Be conservative in most areas**
  - e.g. use mature, stable EPICS as basis for monitor and control
- **Close collaboration with Science Teams**
  - Vital to get strategies, algorithms correct
- **Develop iteratively**
  - Sequence of increasingly complete solutions
- **Package science capabilities**
  - Science/Software Instruments
- **Release incrementally**
CPTEST2: first parallel processed mosaic image

- Run on 8 node Sun v20z cluster
- Data simulated and imaged using CONRAD
- Linear mosaic using

![Image of mosaic with coordinates and channels]

- Long integration continuum image
- Snapshot every 150s over 12 hours
- 28 channels over 112 MHz
ASKAP data flow, processing, and storage

Thirty six antennas

One beamformer per antenna

Correlator

1.3Tb/s

27Tflop/s

0.4Tb/s

340Tflop/s

1GB/s

100Tflop/s

<1GB/s

Central archive

Central processor

ASKAP control facility

Astronomers

Boolardy

Geraldton

Anywhere

1.3Tb/s

27Tflop/s

0.4Tb/s
ASKAP & Imaging Innovation

• Telescope = imaging from measurements of E-field
• Standard approach to ASKAP
  • Antenna+PAF->Beamformers->Correlator->Inverse FFT Box->Image

• Another approach
  • Antenna+PAF->Massive solver of linear equations->Image
• Or
  • Antenna+PAF->2 Petaflop Black Box->Image
• …. better still
  • Antenna+PAF->2 Petaflop Black Box->Science result
• …. and so finally…. 
  • SKA->few Exaflop Black Box->Science result
Single Digital Backend

ASKAP control facility

<1GB/s

Science archive

1.5PFlops

Single Digital Backend

Thirty six antennas

1.3Tb/s

1.3Tb/s

1.3Tb/s

Astronomers

Boolardy

Geraldton

Anywhere

CSIRO
Single Digital Backend

• **Unique concept**
  - Beamforming, correlation, imaging, science analysis in one computer

• **Breakdown of processing for ASKAP**
  - Summing to form multiple beams on the sky: 1.0 PFlop/s
  - Correlation to form cross-correlation of beams: 0.3 PFlop/s
  - Imaging and science analysis: 0.1 PFlop/s
  - Low computational complexity

• **Beamforming, correlation currently performed in specialized FPGAware**
  - 50 racks for ASKAP, ~ 5,000 for SKA?
  - For SKA, integration, scale, complexity will be killers

• **Advantages of computer-based processing**
  - We buy the hardware readily integrated and assembled by someone else,
  - Linux operating system, complete with compilers, debuggers, profilers, etc.
  - We can contract outside for hardware and software support.
  - There is an easy (although not free) upgrade path.
  - We program it using a high level language and tools.
• Strong interest from industry in SKA (and ASKAP) computing
• In computing issued request for help on key processing element
  • Convolutional resampling
• Many replies
  • IBM - Collaborative agreement: Cell, Blue Gene, System S
  • CRAY - Collaborative/research agreement embed FPGA
  • Intel provided equipment, analytical help
  • Other interactions - SGI, Sun, etc
• Net result
  • Rapid advances in our understanding
• Many ongoing interactions
  • Number of meetings with vendors at Supercomputer 08 in Austin
• Will issue Call for Expressions of Interest for SDB
ASKAP developments (Antennas - FPA support)

Cable wraps and cable assemblies;

- Lightweight - compact
- High cable packing density
- Mechanical life testing
ASKAP Antennas

ATNF team involved in design consultation & ensuring technical specification is delivered (RTM)
• On track for CDR Dec 08, PPR Mar 09: 1st antenna Nov 09

ASKAP IPT supporting work
• Detailed model/analysis of the cable management systems
• Detailed design/modelling of the cable wraps - esp polarisation axis
• Detailed definition of the antenna control system

Other:
• Implementation of pedestal systems & services (including air cooling)
• Implementation of FPA cooling system