

# Status of ASKAP Monitoring and Control System

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ICALEPCS 2011, 10 – 14 October 2011, Grenoble, France



### What is ASKAP? Australian SKA Pathfinder ~ 1% SKA

#### Wide field of view radio telescope

- 36 antennas interferometer
- 12m diameter (3-axis)
- Max baseline 6 km
- 30" angular resolution
- Frequency 0.7 1.8 GHz
- 300 MHz bandwidth, 16k freq channels
- Phase Array Feeds (PAF) technologies yielding 30 sq degrees field of view
- Primarily a survey instrument
- Technical precursor of SKA
  - Demonstration of WA as SKA site
  - Phased Array Feeds technologies
  - Computing





### Where is ASKAP located?



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# Where is ASKAP located? Murchison Radio Observatory (MRO)





### Murchison Radio Observatory (MRO) Facts

- Located in Boolardy Station
  - 3,500 sq km, population <10







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- 315 km north east Geraldton
- Murchison Shire
  - "Shire with no town"
  - 50,000 sq km, population <160
  - 29 stations





### Murchison Radio Observatory (MRO) Facts

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  - 3,500 sq km, population <10
- 315 km north east Geraldton
- Murchison Shire
  - "Shire with no town"
  - 50,000 sq km, population <160
  - 29 stations
- Traditional lands of the Wajarri Yamatji

### Radio Quiet Zone





#### • January 2010

- First Antenna Installed (Antenna 29)
- May 2011
  - All Subsystems CDR completed





#### • January 2010

- First Antenna Installed (Antenna 29)
- May 2011
  - All Subsystems CDR completed
- June 2011
  - First VLBI fringes detected using Antenna 29 and other radio telescopes in Australia
  - Full PAF installed at Parkes





- Sep 2011
  - PAF interferometry Tests in Parkes





- Sep 2011
  - PAF interferometry Tests in Parkes
- Oct 2011
  - Installation of first PAF in Antenna 3
  - First Testing of Control Software at MRO (Antenna 1 and 3)





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### ASKAP Project Status Next Milestones

### • Feb 2012

- MRO Infrastructure Completed
- Installation of Boolardy Engineering Test Array (BETA) completed
  - 6 PAF, front-end and back-end electronics, Monitoring and Control Software
- Start BETA commissioning

### • May 2012

- Installation(assembly) of 36 antennas completed
- Site Acceptance Test of antennas continue

#### • Dec 2013

- ASKAP (36 antennas with PAF) construction complete
- ASKAP continues commissioning + early science operations



## **ASKAP Data Flow**

#### Virtual Thirty six Filterbanks MRO Beamformers antennas Pawsey Observatory Centre 1.9Tb/s Beamformed PAF filterbank ASKAP filterbank samples samples Science Data 18Tflop/s 27Tflop/s Archive Central Correlator Facility 1.9Tb/s processor 0.6Tb/s 2.5GB/s ASKAP Science 0.6Tb/s products via 100 Tflop/s VO protocols 18Tflop/s 27Tflop/s MRO-Perth link 340Tflop/s 10GB/s 0.6Tb/s 1.9Tb/s Operations 18Tflop/s 27Tflop/s data archive

#### ASKAP FPGA-based signal processing chain

T. Cornwell, Feb 22 2010



### ASKAP Software Architecture Past (ICALEPCS09)





### ASKAP Software Architecture Present







## Key Technologies EPICS

- Adopted in 2009
  - 6 months on Parkes Testbed System
  - BETA (6 Antennas): 30 Soft-IOCs, 300,000 Records, 40,000 Records to be archived
  - ASKAP (36 Antennas): 180 Soft-IOCs, 1M Records, 240,000 Records to be archived
- Solid communication protocol (Channel Access)
- Flexible, modular, multiple platform, lots of drivers available and tools
- Big, friendly and growing community
- EPICS Tools
  - "Off-the-shelf" drivers: SNMP, Modbus-TCP, TCP/ASCII(StreamDevice)
  - ASYN a C/C++ EPICS Driver framework
  - SNL a language to implement state models and sequences in IOC
  - PyEpics3, Python CA Client Library
  - EDM for Rapid GUI development



#### • Best OPI Yet (BOY)



![](_page_16_Picture_3.jpeg)

#### • Best OPI Yet (BOY)

![](_page_17_Figure_2.jpeg)

![](_page_17_Picture_3.jpeg)

#### Best OPI Yet (BOY)

![](_page_18_Figure_2.jpeg)

![](_page_18_Picture_3.jpeg)

#### • Best OPI Yet (BOY)

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◄	c3	01:44:49.003	Online		137.9	49.2		16245	48734	
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![](_page_19_Picture_3.jpeg)

# Key Technologies

### Adopted in 2009

### • Very good core functionality

- Interface Definition Language (SLICE)
- RPC communication paradigm
- Locator service
- Easy client/server code development
- Publish/Subscribe Issues (version 3.4.1)
  - Inability for subscriber to identify IceStorm server has died (no autoconnect)
  - No message queues or cache
- Looking into ways to improve

![](_page_20_Picture_11.jpeg)

## Software Development Process

- Iterative light-weight approach
- Integrate early, integrate often
  - Monthly software releases

#### • Milestone = Delivery of Software

- Not using Gantt Charts
- Highly adaptable to change of requirements

#### • "Document as you code"

- ...but focus on code not heavy (useless) documentation
- Automated tools to generate API documentation

#### • "Test as you code"

• Unit and functional testing as part of each module or component

![](_page_21_Picture_12.jpeg)

## Software Development Process Essential Tools

- Version Control System: Subversion
- Feature-rich build system
  - Recursive builds
  - Integrates many Third-party packages
  - One command: Update → Compile → Docs → Test → Release
  - Wraps constructions tools: scons, make, autoconf, setuptools and ant
  - Written in Python
- Redmine http://www.redmine.org
  - Project Management Tool
  - Issue (bug) Tracking with Milestone grouping
  - Sub-projects
  - Wiki
- Hudson http://hudson-ci.org
  - Continuous Integration Tool
  - Nightly builds, unit and functional testing

![](_page_22_Picture_16.jpeg)

### Software Development Process Essential Tools

#### • Hudson dashboard shows status of all build executors and jobs

#### Hudson

Hudson

G search 🕖 log in

ENABLE AUTO REFRESH

![](_page_23_Picture_5.jpeg)

#### ASKAP Software Build and Test Server

Build Queue	All Analys	sis Ceri	tral Processor Data Services Full_Builds	Synthesis Telescope Operating Syster	n	
No builds in the queue.	s	w	Job (	Last Success	Last Failure	Last Duration
Build Executor Status	•	☀	Acabaia	18 hr (#163)	N/A.	47 min
Master I ldle	•	3	askap otfobs	8 days 10 hr (#205)	11 hr (#213)	42 min
2 Idle 3 Idle	•	*	askapsoft build lenny 64 bit	6 hr 37 min (#143)	19 days (#118)	1 hr 19 min
automac 1 Idle	•	*	askapsoft build linux	14 hr (#554)	22 days (#531)	3 hr 32 min
2 Idle giltes	0	*	askapsoft build linux32	1 mo 9 days (#25)	1 mo 16 days (#28)	3 hr 10 min
1 Building askapsoft, build_lenny_64_bit #144	0	3	askapsoft build oss	1 mo 3 days (#465)	25 days ( <u>#473</u> )	4 hr 33 min
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minice 1 Idle	•	*	java-askag	12 hr (#145)	2 mo 3 days (#84)	53 min
2 Idle	•	*	ManiCA-ASKAP	17 hr (#98)	2 mo 3 days (#35)	33 min
	•	¥	open-monica	2 days 19 hr ( <u>#20)</u>	N/A	42 sec
	•	¥	gtf trunk, release	16 hr (#163)	13 days ( <u>#149</u> )	38 min
	•	*	Santhesis	16 hr (#218)	3 mo 22 days (#105)	5 hr 24 min
	•	*	Synthesis mpi	15 tr (#33)	17 days (#24)	1 hr 16 min
	•	*	system integration 1	11 hr (#161)	2 mo 3 days ( <u>#94</u> )	1 hr 21 min
	•	*	system integration_2	14 hr (#51)	27 days (#15)	1 hr 32 min

![](_page_23_Picture_8.jpeg)

# Challenges

Dealing with different "work culture"

 Firmware (FPGA/VHDL) developers do not follow same process as software developers

Hardware → Firmware → Verification Software → ICD

- Late delivery of ICD
- Late delivery of Software
- Operation of "half-baked" system
- Where is the hardware (with firmware) to test?
  - Software is at the end of the chain
  - Not enough time to perform full system testing and verification

#### • Pressure on getting results

• Squeeze software development and system verification

![](_page_24_Picture_12.jpeg)

### Challenges Measures to "ease the pain"

- Work closely with Hardware/Firmware developers
  - Iterative approach
- Built emulators
  - But we still need a draft ICD at least
- Iterative Development essential for adaptability
  - Monthly releases are easier to (re)scope
  - Move features depending on urgent needs

![](_page_25_Picture_8.jpeg)

### The Future

- Getting results with BETA (6 Antenna with PAF)
  - Integrate Correlator Hardware/Firmware
  - Installation/verification of the TOS @ MRO
- Support Parkes Test-Bed System
- Control System Studio
  - Integrate it into our build system
  - BEAST as a replacement of ALH
  - BOY as a replacement of EDM
- Facility Configuration Management
- Observation Management Portal
  - Evaluate different web technologies

![](_page_26_Picture_12.jpeg)

#### Australia Telescope National Facility CSIRO Astronomy and Space Science

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# Thank you

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![](_page_27_Picture_6.jpeg)