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# Status of ASKAP Monitoring and Control System

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**ASKAP Control Software Group Lead**

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

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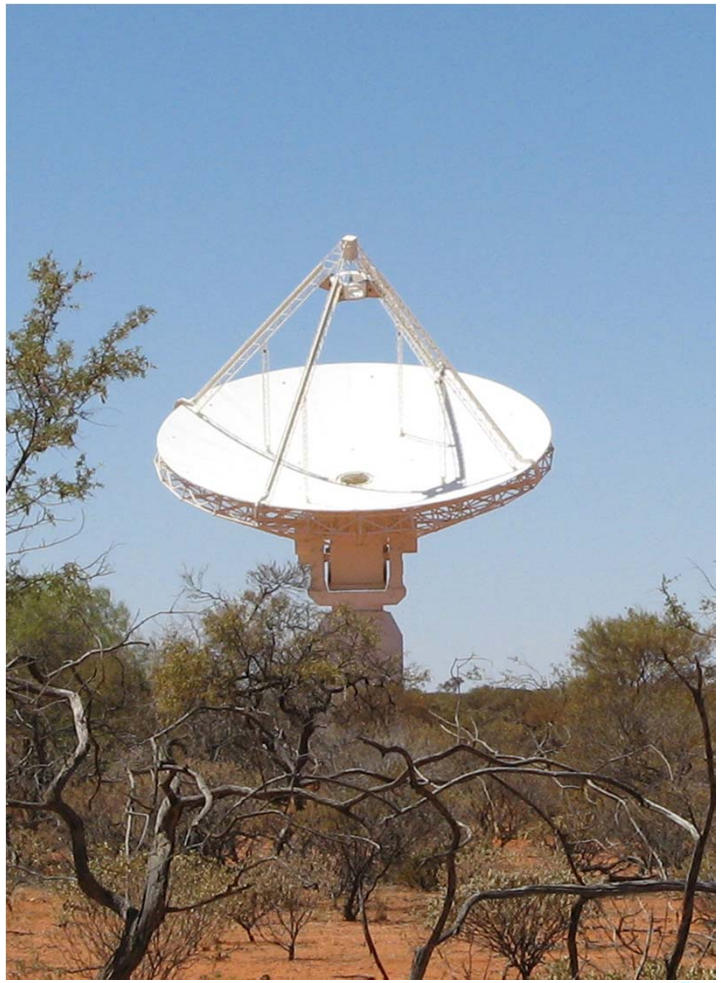
# What is ASKAP?
## Australian SKA Pathfinder ~ 1% SKA

- 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





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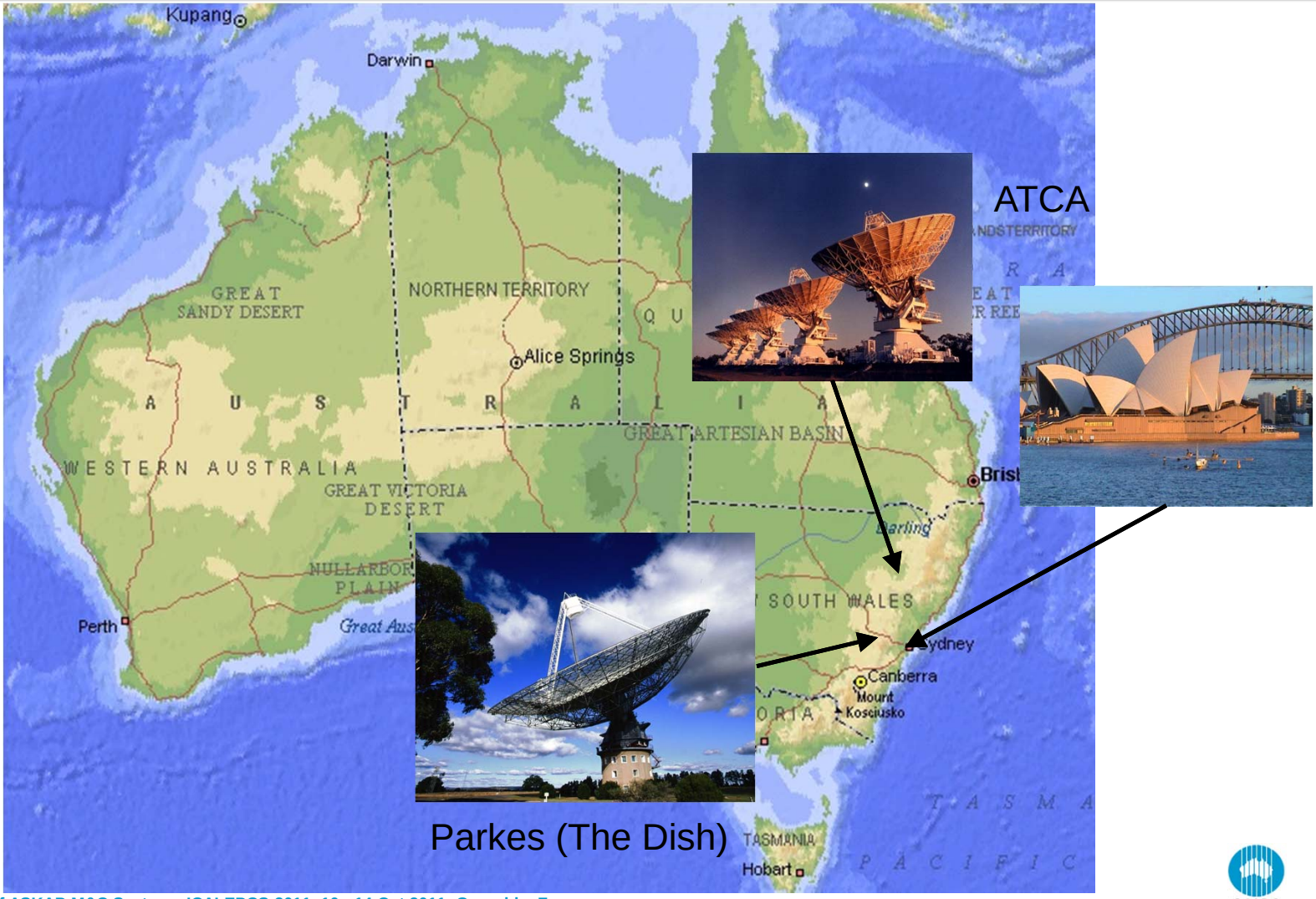
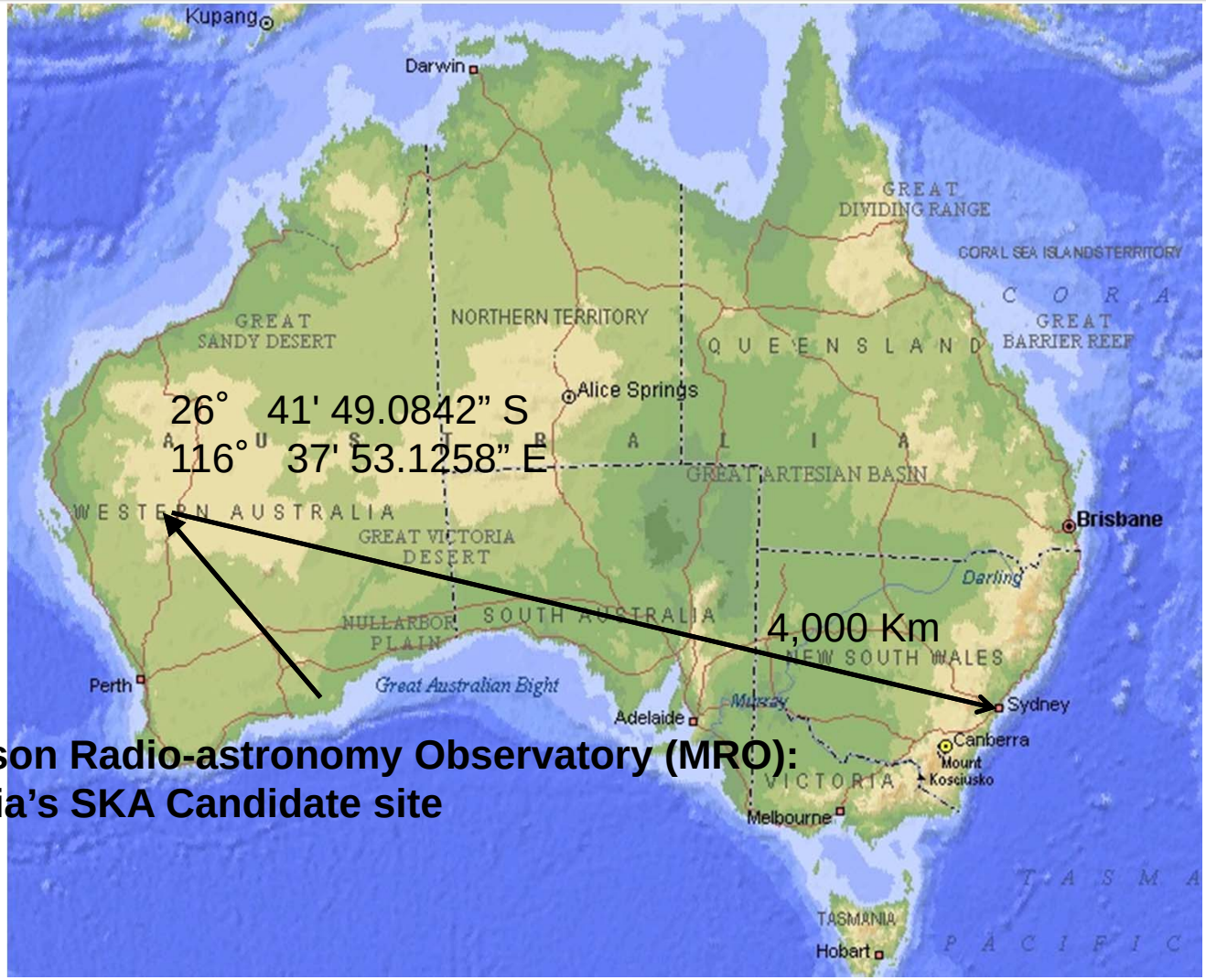
# Where is ASKAP located?



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




**Murchison Radio-astronomy Observatory (MRO): Australia's SKA Candidate site**

# Murchison Radio Observatory (MRO)
## Facts

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

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- Murchison Shire
  - “Shire with no town”
  - 50,000 sq km, population <160
  - 29 stations

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- 315 km north east Geraldton
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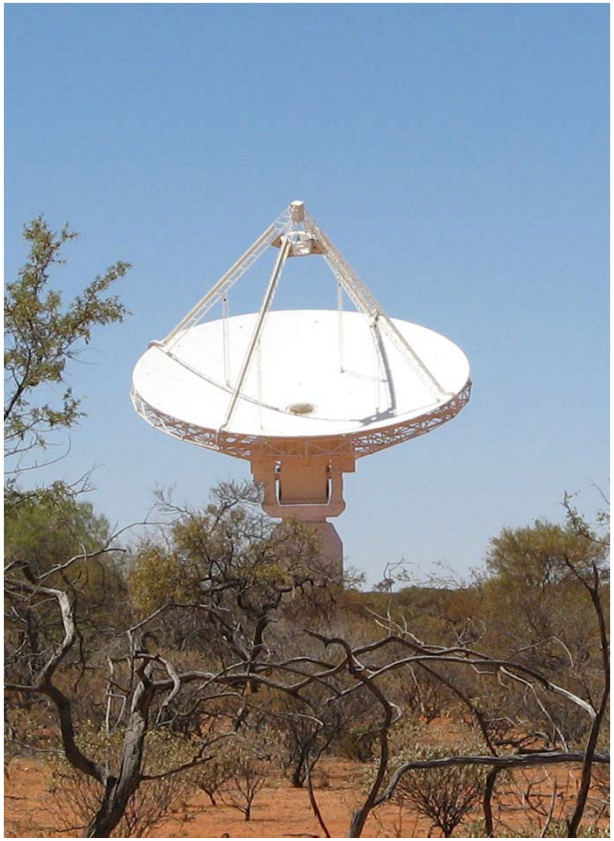
- Traditional lands of the Wajarri Yamatji
- Radio Quiet Zone

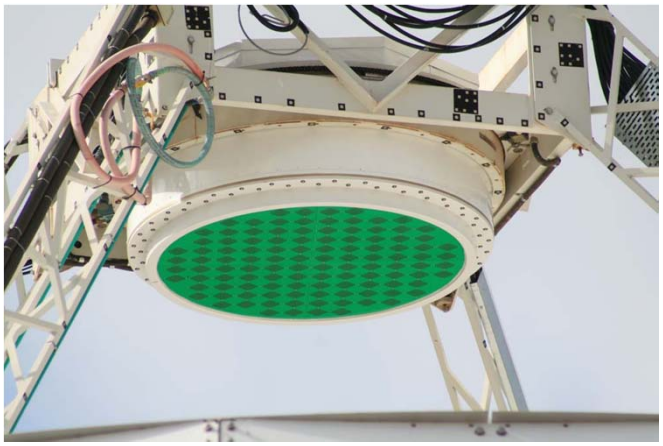
# ASKAP Project Status
## Highlights

- January 2010
  - First Antenna Installed (Antenna 29)
- May 2011
  - All Subsystems CDR completed



# ASKAP Project Status
## Highlights

- 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



# ASKAP Project Status
## Highlights

- Sep 2011
  - PAF interferometry Tests in Parkes

# ASKAP Project Status
## Highlights

- 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)

# 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



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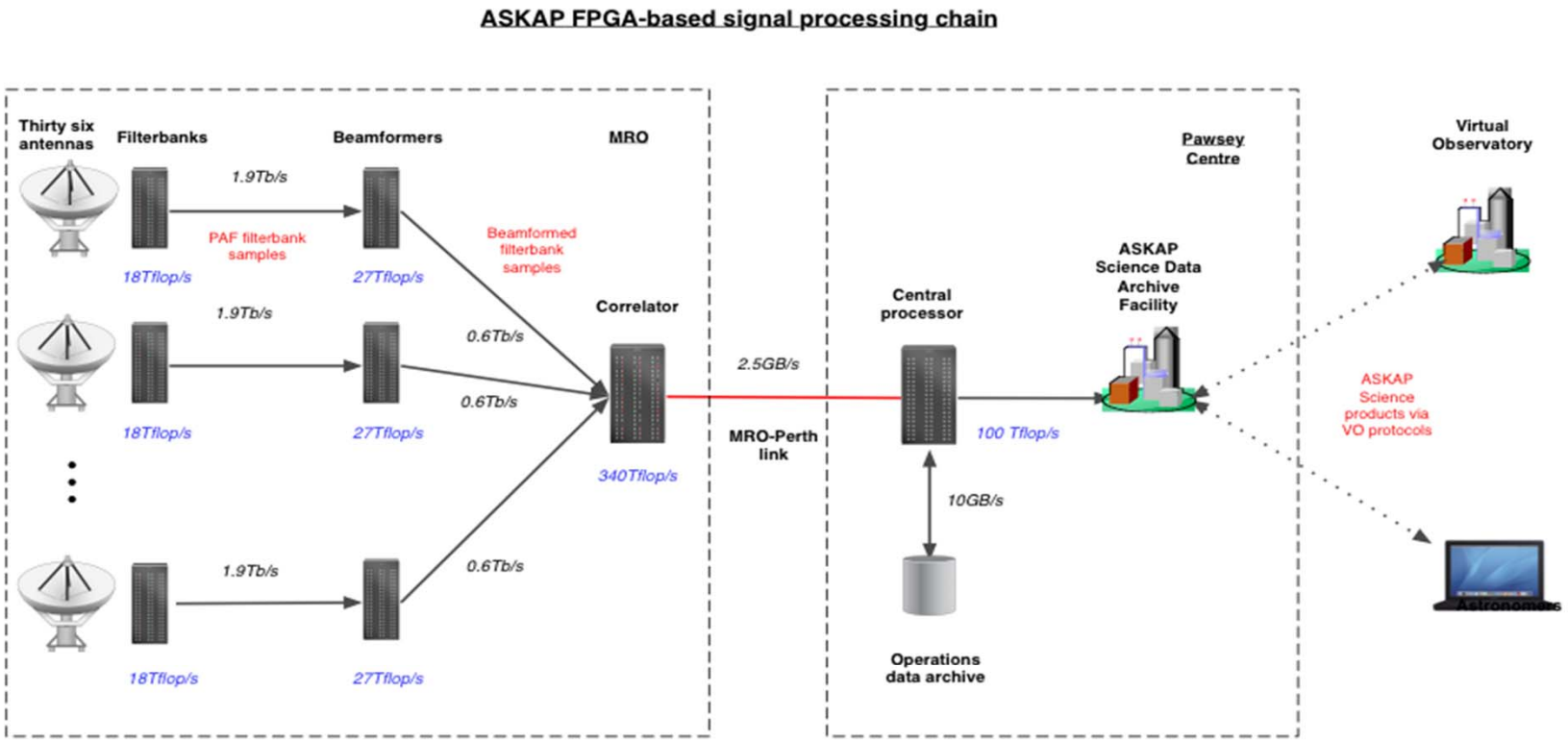
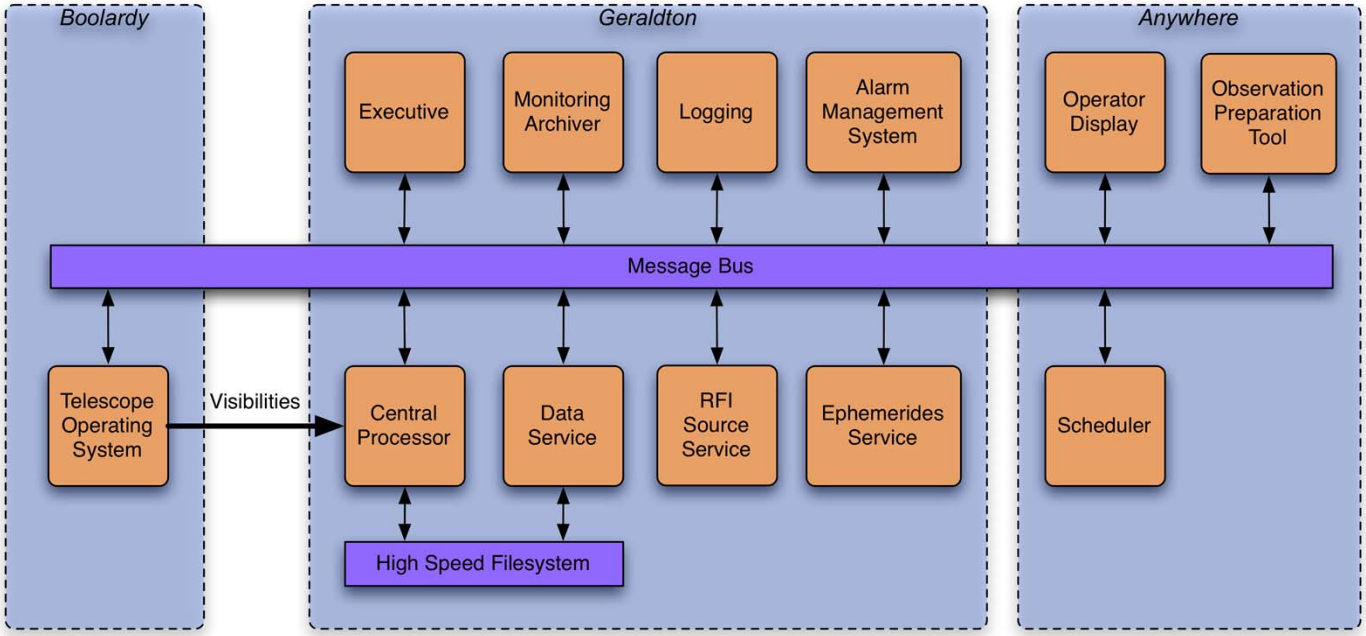
# ASKAP Data Flow

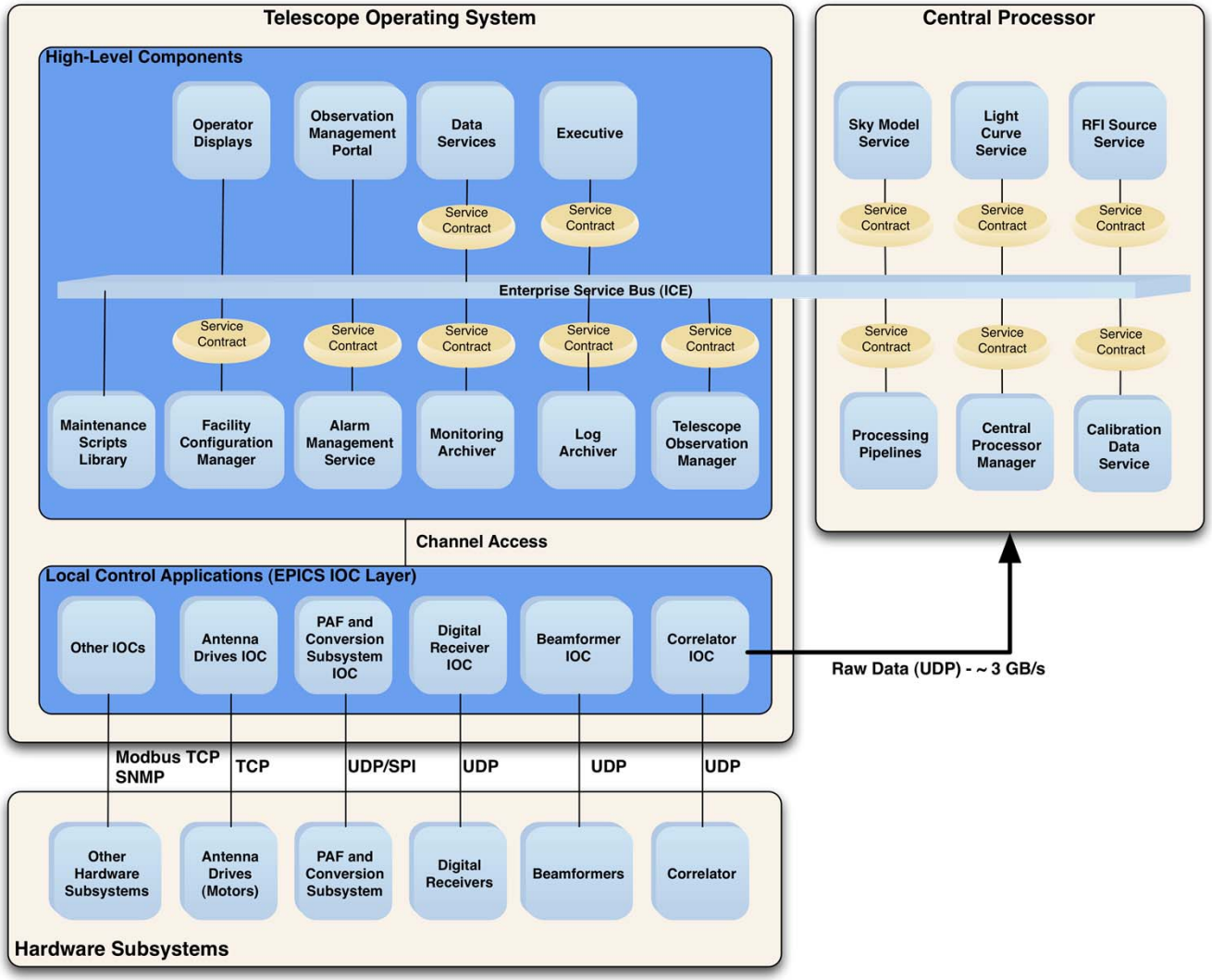



T. Cornwell, Feb 22 2010

# 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



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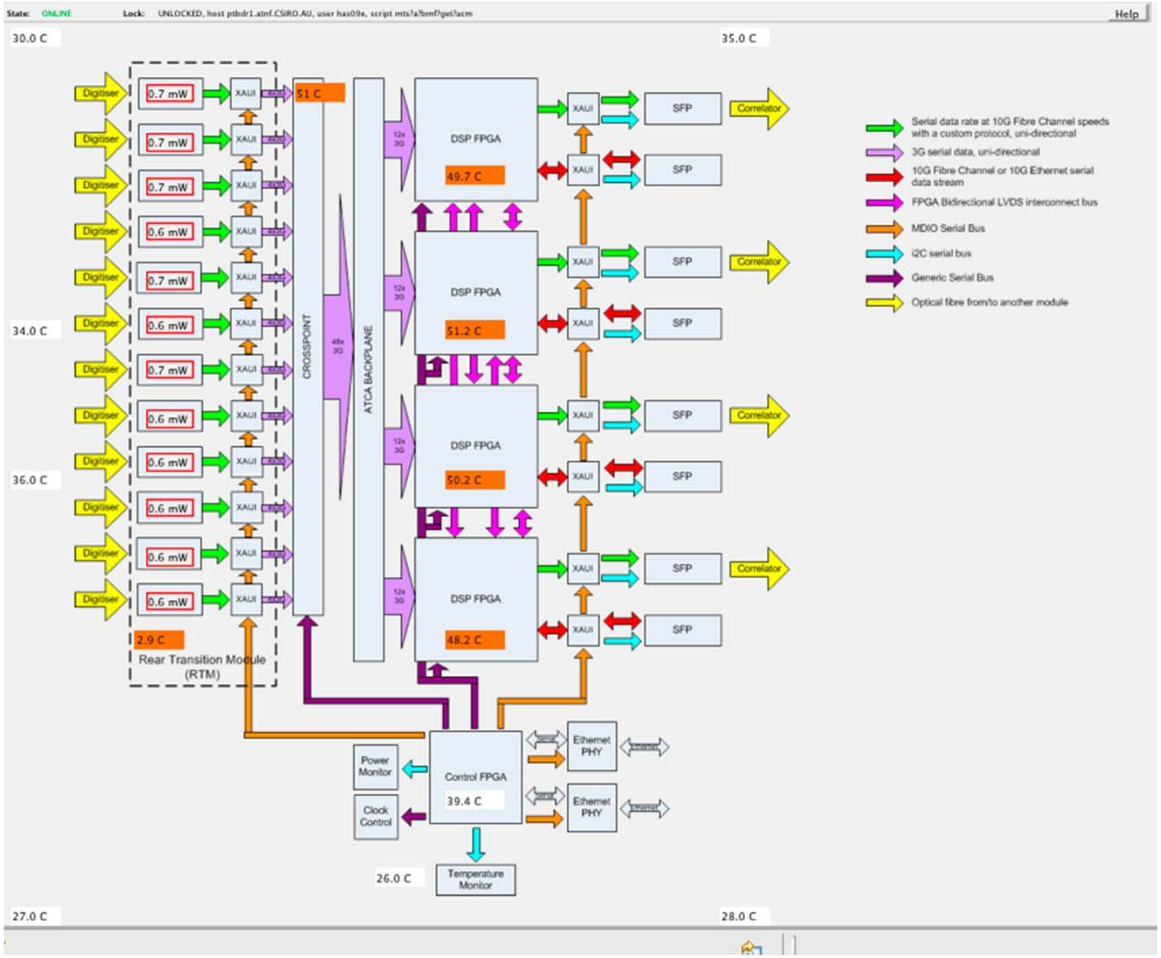
# Key Technologies
## EPICS – Control System Studio

- Best OPI Yet (BOY)



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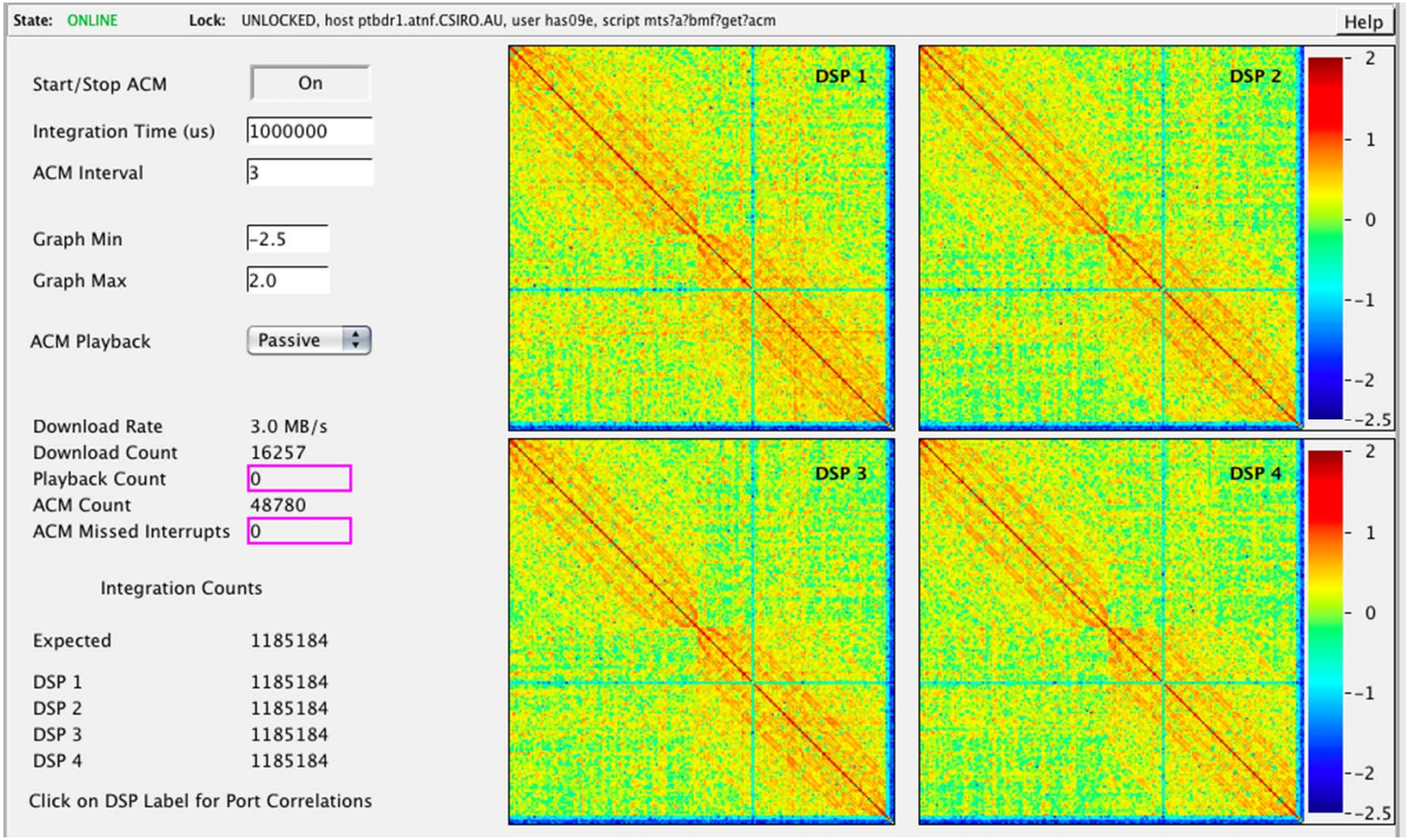

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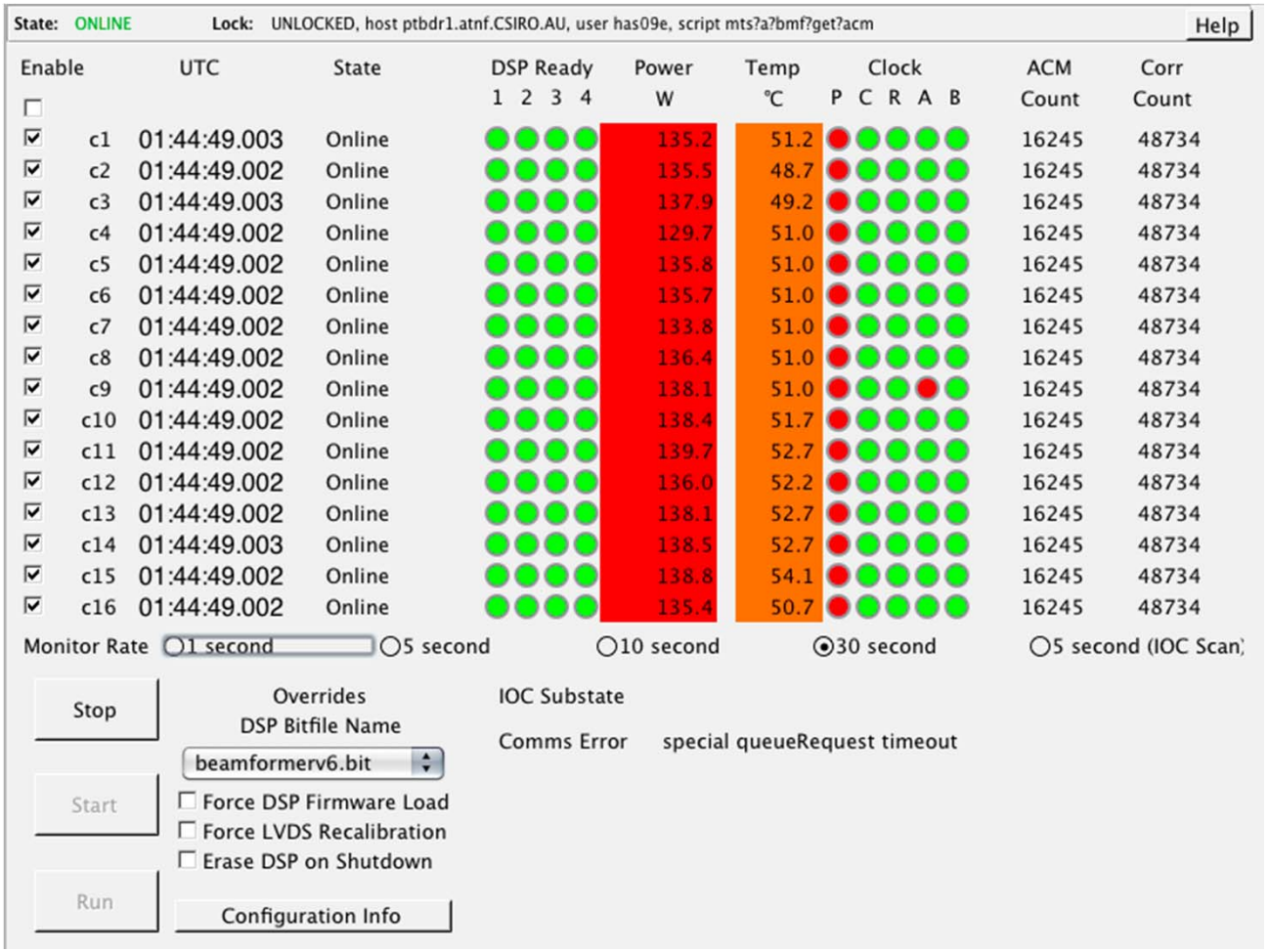


| Enable | | UTC | State | DSP Ready 1 | 2 | 3 | 4 | Power W | Temp °C | Clock P | C | R | A | B | ACM Count | Corr Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☑ | c1 | 01:44:49.003 | Online | | | | | 135.2 | 51.2 | | | | | | 16245 | 48734 |
| ☑ | c2 | 01:44:49.002 | Online | | | | | 135.5 | 48.7 | | | | | | 16245 | 48734 |
| ☑ | c3 | 01:44:49.003 | Online | | | | | 137.9 | 49.2 | | | | | | 16245 | 48734 |
| ☑ | c4 | 01:44:49.002 | Online | | | | | 129.7 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c5 | 01:44:49.002 | Online | | | | | 135.8 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c6 | 01:44:49.002 | Online | | | | | 135.7 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c7 | 01:44:49.002 | Online | | | | | 133.8 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c8 | 01:44:49.002 | Online | | | | | 136.4 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c9 | 01:44:49.002 | Online | | | | | 138.1 | 51.0 | | | | | | 16245 | 48734 |
| ☑ | c10 | 01:44:49.002 | Online | | | | | 138.4 | 51.7 | | | | | | 16245 | 48734 |
| ☑ | c11 | 01:44:49.002 | Online | | | | | 139.7 | 52.7 | | | | | | 16245 | 48734 |
| ☑ | c12 | 01:44:49.002 | Online | | | | | 136.0 | 52.2 | | | | | | 16245 | 48734 |
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| ☑ | c14 | 01:44:49.003 | Online | | | | | 138.5 | 52.7 | | | | | | 16245 | 48734 |
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| ☑ | c16 | 01:44:49.002 | Online | | | | | 135.4 | 50.7 | | | | | | 16245 | 48734 |

# Key Technologies
## ICE

- 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 auto-connect)
  - No message queues or cache
- Looking into ways to improve



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# 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



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# 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



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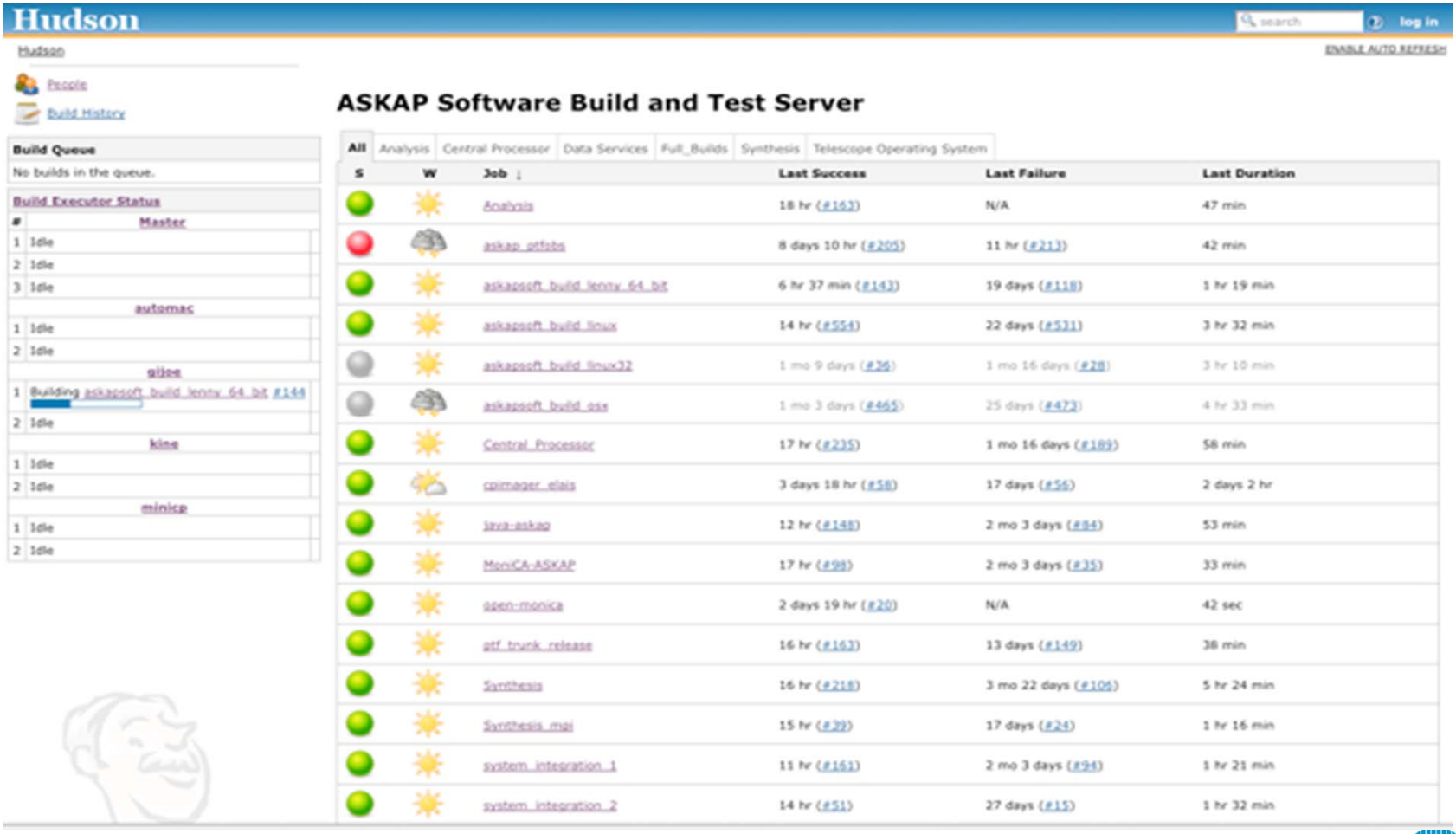
# Software Development Process
## Essential Tools

- Hudson dashboard shows status of all build executors and jobs



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# 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



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# 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



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# 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



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# Thank you

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