



# From ASKAP-12 to ASKAP-36 and Beyond

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EPICS Collaboration Meeting – Spring 2016

21<sup>st</sup> September 2016

ASTRONOMY AND SPACE SCIENCE

[www.csiro.au](http://www.csiro.au)



# Talk Summary

- What is ASKAP
- Current status of project and its EPICS implementation
- EPICS implementation changes from BETA to ASKAP-12
- What's next for ASKAP



# What is ASKAP?

- Australian Square Kilometer Array Pathfinder
  - 36 dish radio telescope, north west region of Western Australia
  - Phased Array Feed (PAF) receiver technology
  - 30° wide field of view enabling fast survey of the sky
  - EPICS used for control, monitoring and data acquisition of mostly custom built hardware
- 
- BETA, the first generation 6 dish array decommissioned
  - Hardware & software revised for final ASKAP





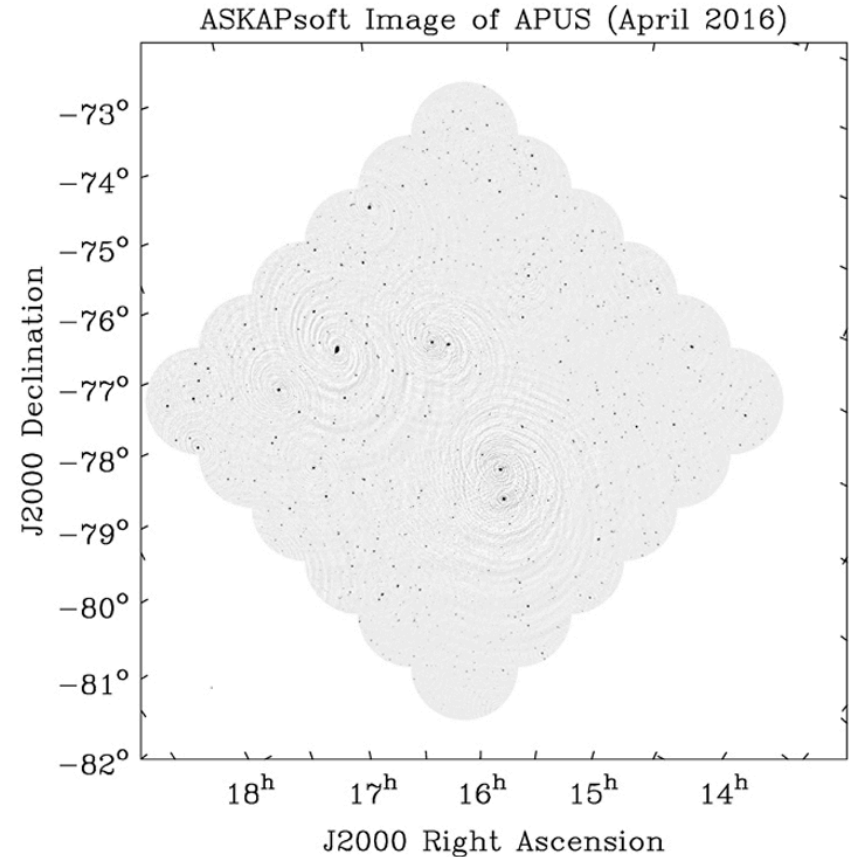
# Current Telescope Status - Hardware

- 12 antennas with MK-2 PAFs (RFoF) producing science
- ASKAP-12 transitioning to formal Early Science Program
- Remaining 24 PAFs in production for installation over next year
- Recently cut over to on-site dedicated power station
- 1.6MW of Solar, 2.5MWh of battery storage



# Science Results

- 36 Beam Image of APSUS field with over 1300 sources
- Supermassive black hole detected at center of 3 galaxies that have merged. Mass of 3 billion Suns



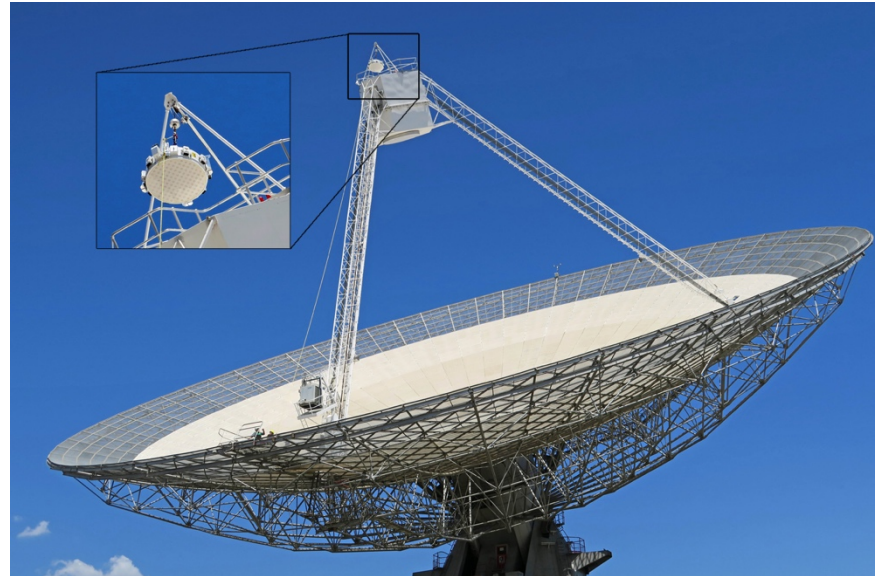
*The continuum image, produced with ASKAPsoft, has an rms of around 300  $\mu$ Jy/beam and a field of view of 30 square degrees. The image, produced using 36 beams and representing the full ASKAP FoV of 30 square degrees, contains over 1300 sources. Credit: ASKAP team.*

# Other Activities - PAF on Parkes

- PAF for Max Planck Institute for Radio Astronomy
- Currently installed on the Parkes 64m dish
- EPICSs IOC's used for control & data acquisition

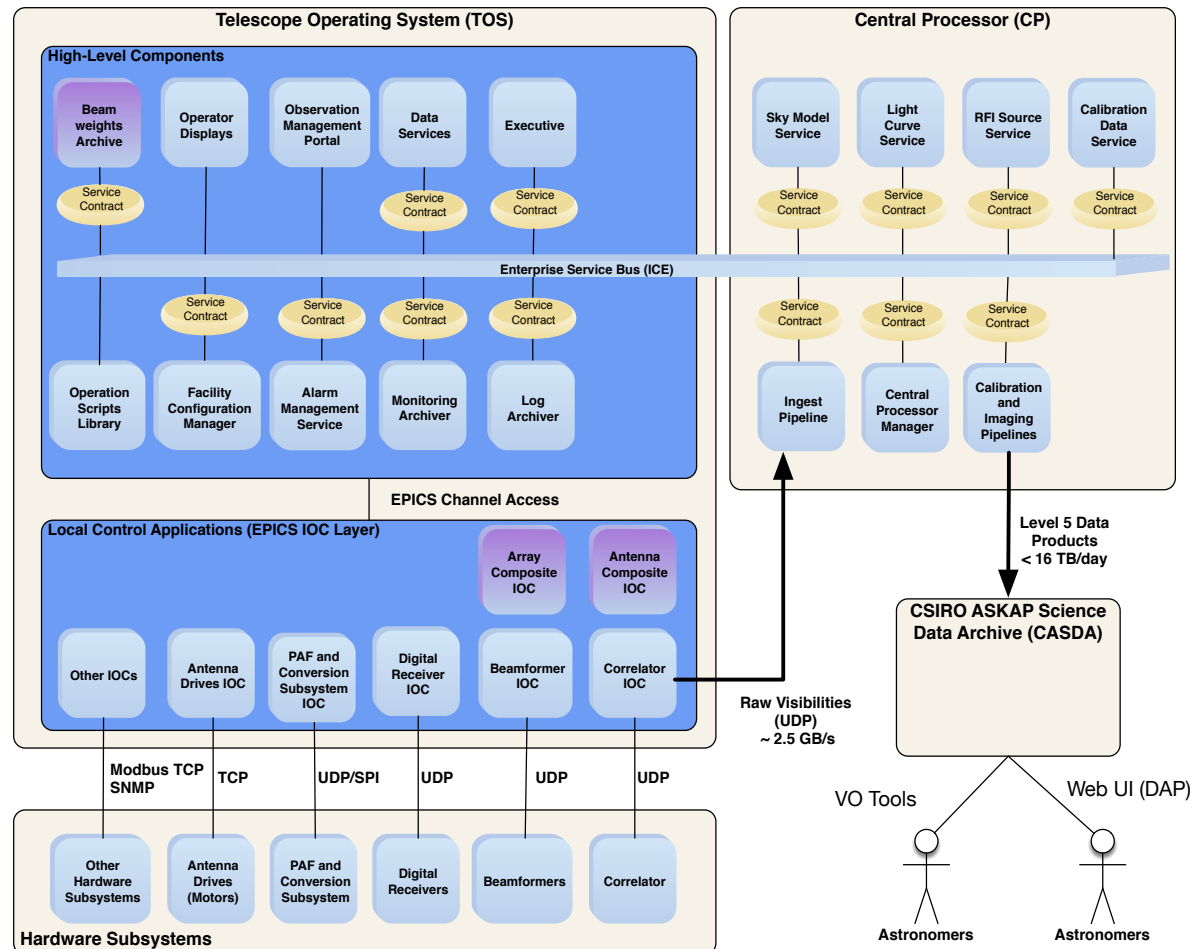


Caption: CSIRO's Parkes radio telescope. Credit: David McClenaghan, CSIRO



# Current Telescope Status - Software

- IOC development for early science complete
- Full control via EPICS IOCs of 12 dish array
- Demonstrated full control of 36 dish array with emulators
- Work now focusing on refining higher level software & services

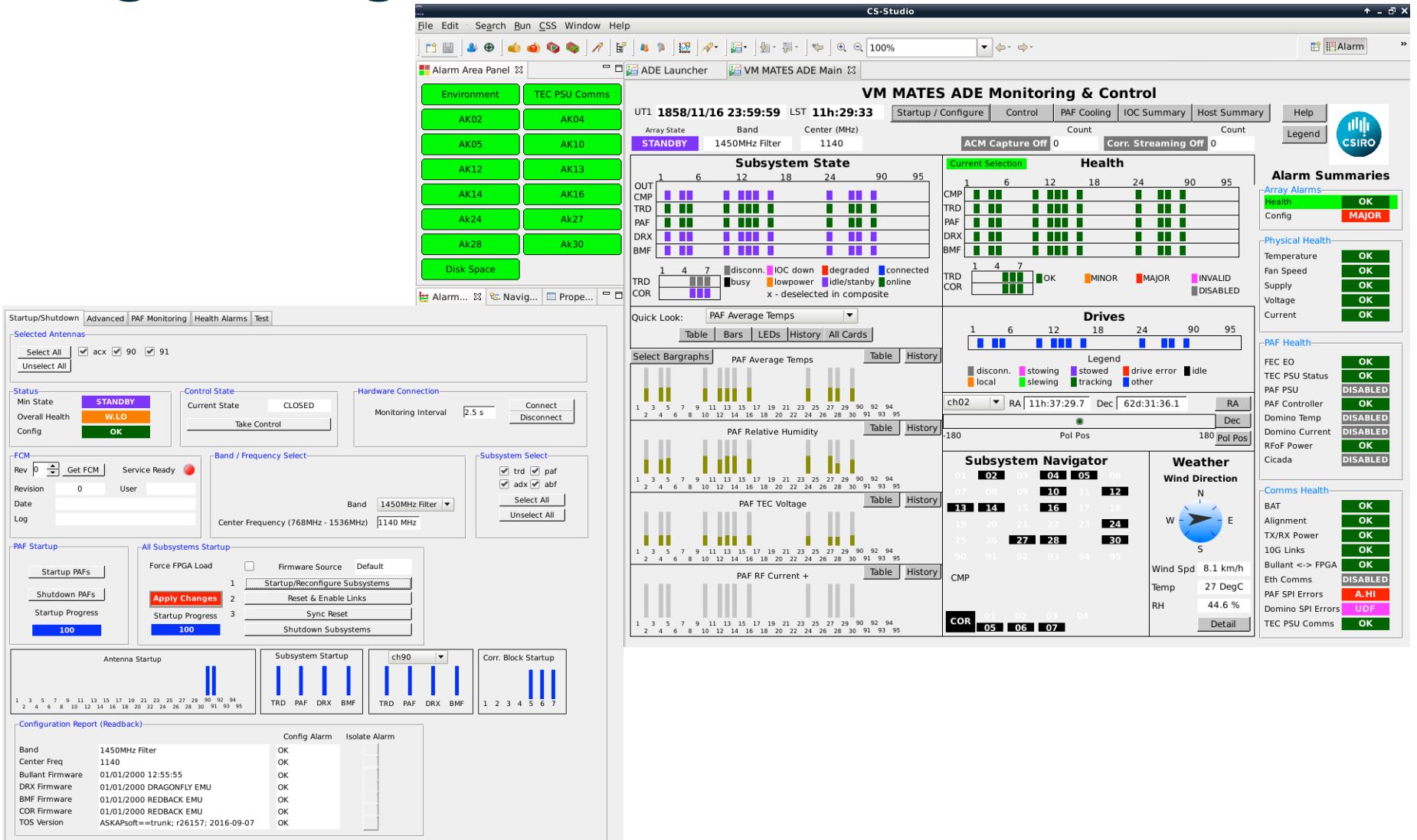


# GUIs in ASKAP


- CSS/BOY for Engineering GUIs, alarm server (BEAST)
- Full 36 antenna engineering GUI with BOY
- Web based (jQuery, Angular.js & d3.js) end user Observation Management Portal (OMP)
- OMP displays EPICS PVs via MoniCA (EPICS channel archiver for ASKAP)




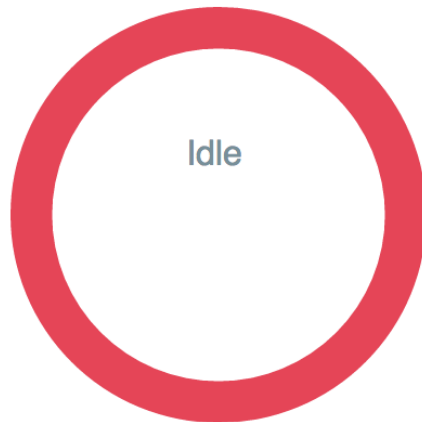
# Engineering GUIs



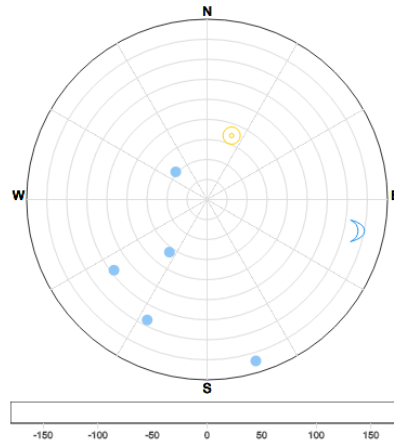
# Observation Management Portal

 Home Schedule Scheduler Scheduling Blocks Submit Observation Manage Observation has09e ▾

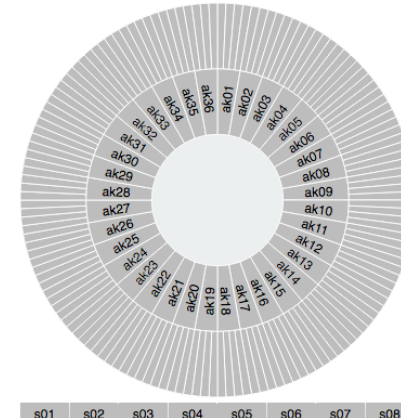
|   |                 |                      |                          |                  |
|---|-----------------|----------------------|--------------------------|------------------|
| Person Currently in Charge<br>Robin Wark (4609)  | UTC<br>03:24:21 | MRO/AWST<br>11:24:21 | Client Local<br>11:24:21 | LMST<br>10:21:23 |
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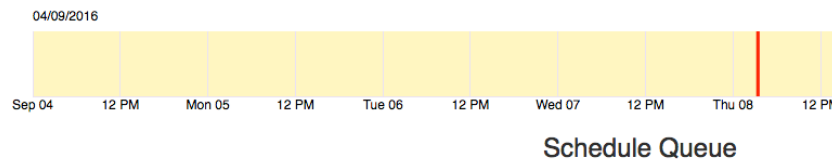
Executive




Telescope Pointing



Telescope Health



Schedule Queue

Chat 

CH Craig Haskins

AH Aidan Hotan

Type your message here...

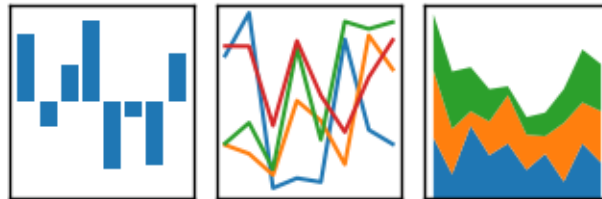
# DiaMoniCA – EPICS + MoniCA + influxdb

- Pilot project to import EPICS archived data (via our EPICS archiver MoniCA) to a time series database
- Selected influxdb for initial evaluation
- Python Pandas for data analysis
- Grafana for data visualization

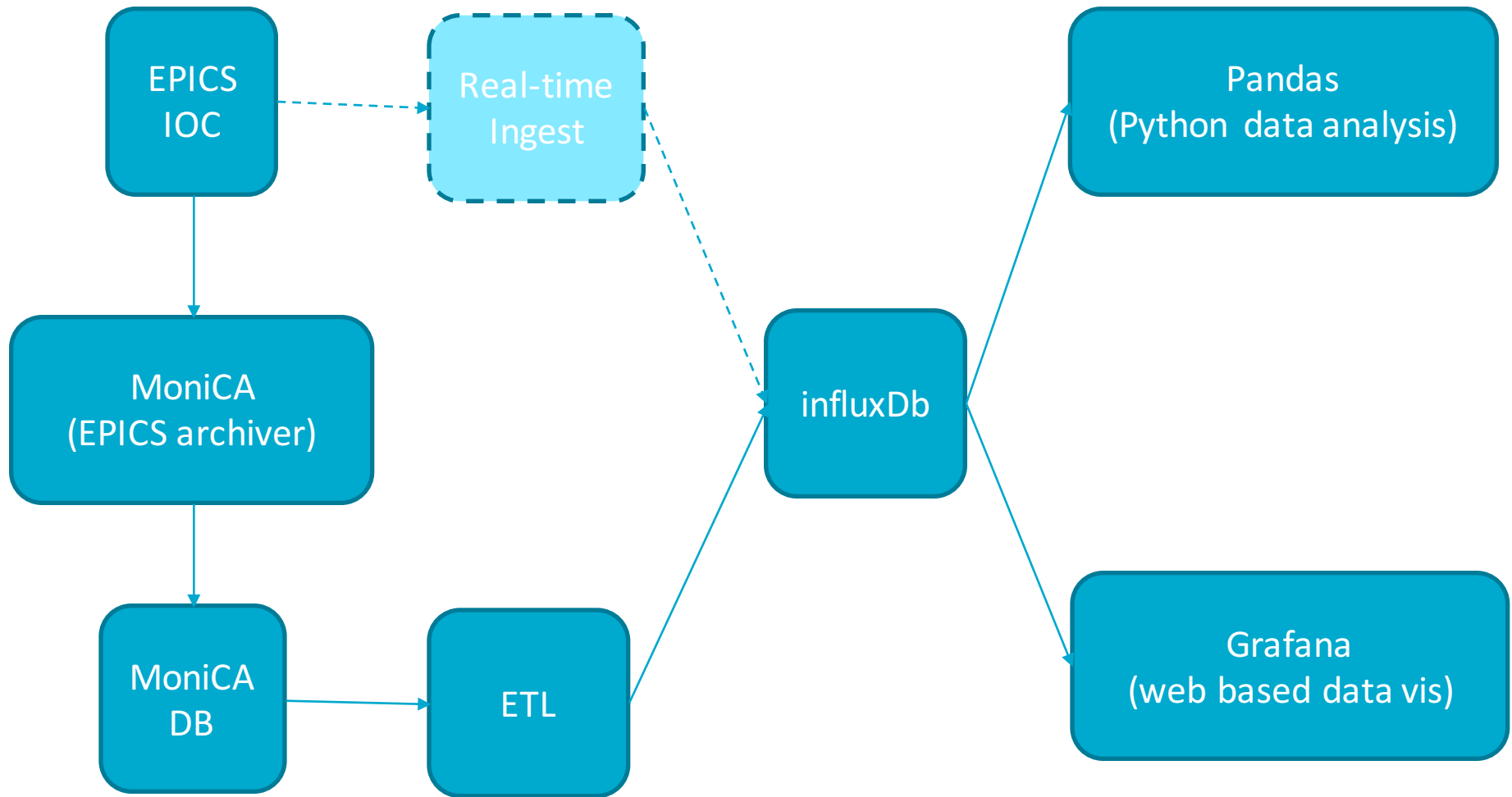


pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



# DiaMoniCA – EPICS + MoniCA + influxdb





# Pandas – Python Data Analysis Toolkit

- Find days in last year where wind speed exceeded safe limits

```
➤ # query the influxdb server
➤ result = client.query("SELECT max(WindSpeed) as maxWindSpeed from environment.weather
    WHERE time >= '{0}' AND time < '{1}' GROUP BY time(1d)".format(timeStart,timeStop))
➤ # get the pandas DataFrame
➤ df = result['environment.weather']
➤ # find days where winds peed exceeded 40km/h
➤ df[df.maxWindSpeed > 40]
```

|                           | maxWindSpeed |
|---------------------------|--------------|
| 2016-04-05 00:00:00+00:00 | 43.5         |
| 2016-04-06 00:00:00+00:00 | 44.0         |
| 2016-04-08 00:00:00+00:00 | 69.5         |
| 2016-05-08 00:00:00+00:00 | 41.0         |

# Grafana



# EPICS Changes from BETA to ASKAP-12

| BETA   | ASKAP-12  |
|--|---|
| Flat database, control all IOCs directly from py-epics | Hierarchical IOCs, control through top level IOC and record linking                   |
| EPICS Sequencer  | Now use a master asynPortDriver class to manage slave asynPortDrivers                 |
| All user interfaces in CSS                             | Combination of web based tools & CSS can better target different classes of end users |
| Too much scripting in BOY                              | Living with it for now, need to re-evaluate for DisplayBuilder or web                 |
| CSS Databrowser  | Still have it but user base more comfortable with standalone MoniCA GUI               |
| BOY Custom widgets                                     | Unsuccessful, made do with linking containers & rules.                                |
| Graphical EPICSs database editing                      | Programmatic database generation with heavy use of templates                          |

# What's Next for ASKAP

- As operational procedures solidify, adding more automation
- Introduce EPICS v4 into production
- Custom Alarm Server – Notifications via Slack
- Investigate moving Engineering GUIs to web
- Deploy web based data visualization tools into production
- Fault detection/fault prediction with DiaMoniCA



# Thank you

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