



# Real-time EPICS data using DiaMoniCA

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ASTRONOMY & SPACE SCIENCE

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



# Australian Square Kilometre Array Pathfinder

- 36 antennas working as a single instrument – ASKAP
- The Murchison Radio-astronomy Observatory (MRO) is located in remote Western Australia in a radio quiet zone
- Other projects are also located at the MRO:
  - Murchison Widefield Array (MWA)
  - SKA1-low planned at the same site





# ASKAP Telescope Operator System (TOS)

The screenshot displays the ASKAP Monitoring & Control interface within a CS-Studio window. The main title is "ASKAP Monitoring & Control". The interface is divided into several sections:

- Top Bar:** Shows the current date and time: UT1 2018/06/06 08:44:36, LST 09h:30:00. It includes buttons for "Startup / Configure...", "Control...", "Maintenance...", "IOCs...", and "Hosts...".
- Array Status:** Displays "Array State: ONLINE", "Band: 1800MHz Filter", "Center Freq.: 1632", "Zoom: 18.5KHz", "Count: 198", "Corr. Upload Off", and "Count Metadata: 3431354 MD TIMEOUT".
- Subsystem State:** A grid showing the status of various subsystems (SEL, CMP, TRD, TRD, PAF, DRX, DRX, BMF, TRD, COR) across 36 channels. Legend includes: disconn, I/OC down, degraded, connected, busy, lowpower, idle, loaded, standby, online.
- Health:** A grid showing the health status of subsystems (CMP, TRD, TRD, PAF, DRX, DRX, BMF, TRD, COR) across 36 channels. Legend includes: OK, MINOR, MAJOR, INVALID, DISABLED.
- Drives:** A grid showing the status of drives (ak01) across 36 channels. Legend includes: disconn., local, stowing, slewing, stowed, tracking, drive error, idle, other.
- Alarm Area Panel:** A vertical list of alarm categories: Alarm Server, Environment, Disk Space, AK01, AK02, AK03, AK04, AK05, AK06, AK10, AK12, AK14, AK16, AK17, AK19, AK24, AK27, AK28, AK30, Correlator.
- Alarm Tree:** A hierarchical tree view of alarm areas, including "Area: Alarm Server (MAJOR/STATE\_ALARM)", "Area: Environment", "Area: Disk Space (MINOR/LOW\_ALARM)", and various AK areas.
- Quick Look:** A section with "Table", "Bars", "LEDs", and "Grafana" options.
- Navigation:** A grid of buttons for navigating between subsystems (01-06, 10-12, 14-17, 19-24, 27-30) and PDU.
- Weather:** Displays "Wind Direction" (North), "Wind Spd: 4 km/h", "Temp: 19 DegC", "RH: 58.3%", "Lightning: CLEAR", "Cloud: CLEAR".
- Array Alarm Summary:** A summary of alarm levels: Health (READ), Config (MAJOR), Timing Health (OK), PLL Lock (OK), BAT In (OK), REF In (OK), VCO Output (OK), BAT Status (OK), Host Clock Diff (OK), HW Events (A.HI), Hardware Health (Temperature: READ, Fan Speed: OK, Supply: OK, Voltage: READ, Current: A.LOW, DRX Synth: MAJOR), PAF Health (FEC EO: OK, TEC PSU: OK, TEC Controller: OK, PAF PSU: OK, PAF Controller: OK, Domino Temp: A.LOW, Domino Current: A.HI, RToF Power: READ, Cicada: A.LOW), Comms Health (Alignment: OK, TX Power: READ, RX Power: A.LOW, 10G Links: MAJOR, Bullant & FPGA: OK, Eth Errors: OK, PAF Errors: A.HI, TEC PSU Conn.: OK).

# Data view in MoniCA

- MoniCA is a real time monitoring and control system developed for the Compact Array by CSIRO – used across many CSIRO observatories.
- For ASKAP – EPICS data is archived to the MoniCA database

Point	ak02	ak04	ak05	ak12	ak13	ak14	Units
Servo state	ONLINE	ONLINE	ONLINE	ONLINE		ONLINE	
Servo sub-state	Stowed	Stowed	Stowed	Stowed		Stowed	
Master remote/local status	REMOTE	REMOTE	REMOTE	REMOTE		REMOTE	
Pointing corrections enabled/disa...	ENABLED	ENABLED	ENABLED	ENABLED		ENABLED	
Azimuth Position	145.046	144.779	144.86	145.142		144.994	Deg
Elevation Position	90.007	90.009	89.98	89.856		89.924	Deg
Polarisation Position	103.643	103.648	103.637	103.637		103.64	Deg
Azimuth Error	0.0	0.0	0.0	0.0		0.0	Deg
Elevation Error	0.0	0.0	0.0	0.0		0.0	Deg
Polarisation Error	0.0	0.0	0.0	0.0		0.0	Deg
Right Ascension (J2000)	149.499	149.498	149.51	149.598		149.551	Deg
Declination (J2000)	-26.6	-26.598	-26.622	-26.722		-26.672	Deg
Point							Units
Wind Speed	stn1						km/h
Wind Direction	2.0						degrees
Air Temperature	247.0						C
Relative Humidity	18.6						%
	58.7						

# DiaMoniCA

- DiaMoniCA is a collection of software components for data exploration from a MoniCA database
- Originally developed to bring analysis and machine learning to MoniCA archive data

- InfluxDB
- Grafana
- MoniCA Server
- PBDAVA+Diagonica
- MoniCA InfluxDB Archiver Plugin
- pv2influx lookup service
- Grafana dynamic dashboard
- Jupyter Notebooks



# EPICS to MoniCA

- EPICS data archived to MoniCA database and viewable in real time via MoniCA Java client
- EPICS data archived in 2 hourly batches from MoniCA to InfluxDB
- Limitations:
  - Reliant on CS Studio or the MoniCA Java client for viewing **live** data
  - Batch archiving - views in Grafana generally showed stale data
- **Latest update** - Improved archiving from MoniCA to Influx DB to give us **real time EPICS data viewable in Grafana**







UTC  
09:01:35 UTC

LST  
09:47:02

Browser  
17:01:35

MRO  
17:01:35 AWST

Scheduling Block ID <b>N/A</b>	Scan Number <b>0</b>	Scan Progress <b>N/A</b>	Air Temp <b>18.9 °C</b>	Rel. Humidity <b>59.3%</b>	Wind Direction <b>241°</b>	Wind Speed <b>5.5 km/h</b>	Rain (Max) <b>13 mm</b>	Array State <b>ONLINE</b>
Scan Duration <b>N/A</b>								Correlator State <b>STANDBY</b>

Current Scheduling Block				Current Target							
site	ID	Alias	Template	site	Name	Direction	Frame	Phase Direction	Roll Mode	Roll Angle	Frequency (MHz)
askap	5595	Masers	Standard	askap	G285.263-0.050	10:31:29.87 -58:02:18.0	J2000	10:31:29.87 -58:02:18.0	pa_fixed	0	1632.5

Antenna State			Servo State					Servo Coords								
antenna	State	Health	antenna	Substate	State	Remote Local	Pointing	antenna	Az	EI	Pol	Az Err	EI Err	Pol Err	RA	Dec
ak01	ONLINE	MAJOR	ak01	Stowed	ONLINE	REMOTE	ENABLED	ak01	-	-	-	-	-	-	9.766	-26.580
ak02	ONLINE	MAJOR	ak02	Stowed	ONLINE	REMOTE	ENABLED	ak02	145.047	89.008	103.643	-	-	-	9.768	-26.602
ak03	ONLINE	MAJOR	ak03	Stowed	ONLINE	REMOTE	ENABLED	ak03	144.487	89.952	103.644	-	-	-	9.770	-26.648
ak04	ONLINE	MAJOR	ak04	Stowed	ONLINE	REMOTE	ENABLED	ak04	144.779	90.011	103.648	-	-	-	9.768	-26.599
ak05	ONLINE	MAJOR	ak05	Stowed	ONLINE	REMOTE	ENABLED	ak05	144.860	89.980	103.637	-	-	-	9.769	-26.625
ak06	ONLINE	MAJOR	ak06	Stowed	ONLINE	REMOTE	ENABLED	ak06	145.558	90.015	103.634	-	-	-	9.768	-26.595
ak10	ONLINE	MAJOR	ak10	Stowed	ONLINE	REMOTE	ENABLED	ak10	145.025	89.934	103.640	-	-	-	9.771	-26.661
ak12	ONLINE	MAJOR	ak12	Stowed	ONLINE	REMOTE	ENABLED	ak12	145.142	89.856	103.637	-	-	-	9.774	-26.725
ak14	ONLINE	MAJOR	ak14	Stowed	ONLINE	REMOTE	ENABLED	ak14	144.994	89.925	103.640	-	-	-	9.772	-26.675
ak16	ONLINE	MAJOR	ak16	Stowed	ONLINE	REMOTE	ENABLED	ak16	144.883	89.990	103.641	-	-	-	9.768	-26.614
ak17	ONLINE	MAJOR	ak17	Stowed	ONLINE	REMOTE	ENABLED	ak17	145.568	89.943	103.641	-	-	-	9.771	-26.651
ak19	ONLINE	MAJOR	ak19	Stowed	ONLINE	REMOTE	ENABLED	ak19	145.162	89.923	103.636	-	-	-	9.772	-26.667
ak24	STANDBY	MAJOR	ak24	Stowed	ONLINE	REMOTE	ENABLED	ak24	144.848	89.942	103.644	-	-	-	9.771	-26.665
ak27	ONLINE	MAJOR	ak27	Stowed	ONLINE	REMOTE	ENABLED	ak27	145.518	89.995	103.642	-	-	-	9.767	-26.605
ak28	ONLINE	MAJOR	ak28	Stowed	ONLINE	REMOTE	ENABLED	ak28	144.978	90.211	103.631	-	-	-	9.759	-26.425
ak30	ONLINE	MAJOR	ak30	Stowed	ONLINE	REMOTE	ENABLED	ak30	144.884	90.011	103.625	-	-	-	9.769	-26.592



# Real time alerting via Grafana and Kapacitor

- Grafana alerts directed to Slack and Mattermost
- More complex alerting rules possible with Kapacitor

The image displays two chat windows. The left window is a Slack channel named '#alarm' with a header 'Slack - ASKAP'. It shows a 'grafana' bot alert at 6:25 AM: 'CRITICAL akscor01/disk\_used/var:92%'. Below it is a 'Grafana Alert' at 10:02 AM: '[Alerting] PAF Average Temp Alert ak05 40.7'. A second 'Grafana Alert' at 2:13 PM: '[OK] PAF Average Temp Alert'. The right window is a Mattermost chat titled 'Alerts - CASS-S&C CASS - Team Chat'. It shows a 'webhook' bot notification at 1:55 PM: '[Alerting] Test notification' with a line graph titled 'Memory / CPU' and the text 'Someone is testing the alert notification within grafana.' Below the graph are labels 'High value 100' and 'Higher Value 200'. Further down, a 'kapacitor' bot alert at 1:59 PM: 'CRITICAL rotwang/cpu\_used:88%' and another at 2:03 PM: 'INFO rotwang/cpu\_used:47%'. Both chat windows have search bars and user avatars.




<b>T</b>	<b>Telegraf</b> Collects time-series data from a variety of sources.
<b>I</b>	<b>InfluxDB</b> Delivers high performance writes and efficiently stores time-series data.
<b>C</b>	<b>Chronograf</b> Visualizes and graphs the time-series data stored in InfluxDB.
<b>K</b>	<b>Kapacitor</b> Provides alerting, ETL and detects anomalies in time-series data.





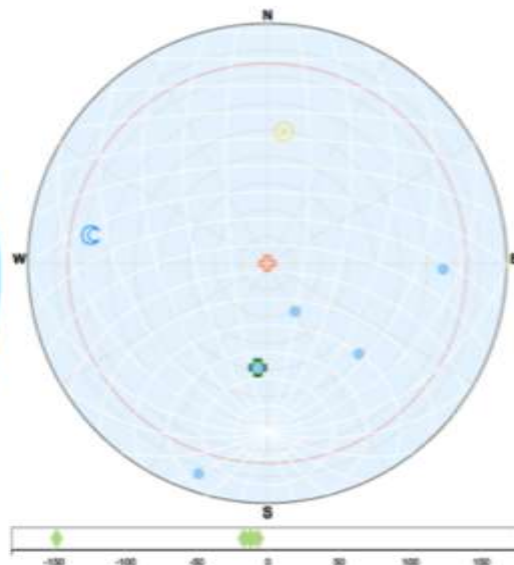
# Web based Operator Management Portal (OMP)


[Home](#)
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[Scheduling Blocks](#)
[Submit Observation](#)
[Manage Observation](#)
tay34q - ⚙

Person Currently in Charge Robin Wark (4609) 	UTC 03:48:59	MRO/AWST 11:48:59	Client Local 11:48:59	LMST 04:41:37
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Executive



Telescope Pointing



Telescope Health



Schedule Queue

# More web-based technologies for control & monitoring

- Relatively large number of users who would like access to the control and monitoring views of the system at the same time
- Currently use CS Studio – only a few instances used via VNC sessions
  - Onerous for some users to set up locally – different operating systems
  - Limited VNC sessions – limited access/difficult to coordinate between teams
- Would be much easier to access the the control and monitoring views from a website
  - Can access anywhere
  - No need for local installation – works on any OS with no setup

# Prototype for Web OPI

## ♥ ma05 Beamformer Temperature Summary C

Show PV Names  Show Disabled

Description	Item	Unit	c01	c02	c03	c04
Bullant Local 1:Temperature	1	C	31.00	30.00	29.00	30.00
Bullant Local 2:Temperature	2	C	32.00	33.00	30.00	31.00
Bullant FPGA:Temperature		C	41.00	42.00	38.00	38.00
Power Supplies:Temperature		C	41.00	42.00	39.00	40.00
Ethernet PHY:Temperature		C	42.00	42.00	39.00	41.00
Fan 1:Fan Control Temperature	1	C	31.00	31.00	29.00	30.00
Fan 2:Fan Control Temperature	2	C	29.00	28.00	27.00	28.00
ATX 1:ATX Power Supply temperature	1	C	0.00	0.00	0.00	0.00
ATX 2:ATX Power Supply temperature	2	C	0.00	0.00	0.00	0.00
Bullant FPGA:FPGA self monitored temperature		C	43.80	44.30	41.34	42.33
Redback FPGA Fans 1:Ref Temp Sensor	1	C	51.13	50.00	49.88	50.25
Redback FPGA Fans 2:Ref Temp Sensor	2	C	50.50	52.38	50.63	51.63
Redback FPGA Fans 3:Ref Temp Sensor	3	C	49.00	50.13	48.75	49.88
Redback FPGA Fans 4:Ref Temp Sensor	4	C	52.50	54.50	52.75	53.38
Redback FPGA Fans 5:Ref Temp Sensor	5	C	47.75	47.50	46.88	47.13
Redback FPGA Fans 6:Ref Temp Sensor	6	C	49.75	51.38	50.13	50.13
Redback PCB upper left temperature		C	41.00	44.00	41.00	41.00
Redback PCB upper right temperature		C	37.00	39.00	37.00	37.00





# Thank you

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