

Progress of the EPICS Transition at the ISIS Neutron and Muon Source

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ISIS Neutron and
Muon Source

Transition Decisions

Slide from EPICS Collaboration Meeting
Fall'22

Made

- Phoebus for user interaction
- favour PVAccess over Channel Access
- prefer IOCs (or equivalents) in containers on centrally managed servers

Deferred

- selection of technology for archiving of PVs
- selection of alarm handler software

Opportunistic

- Allow obsolescence to take care of old hardware

Fortunate

- Already a dedicated controls network



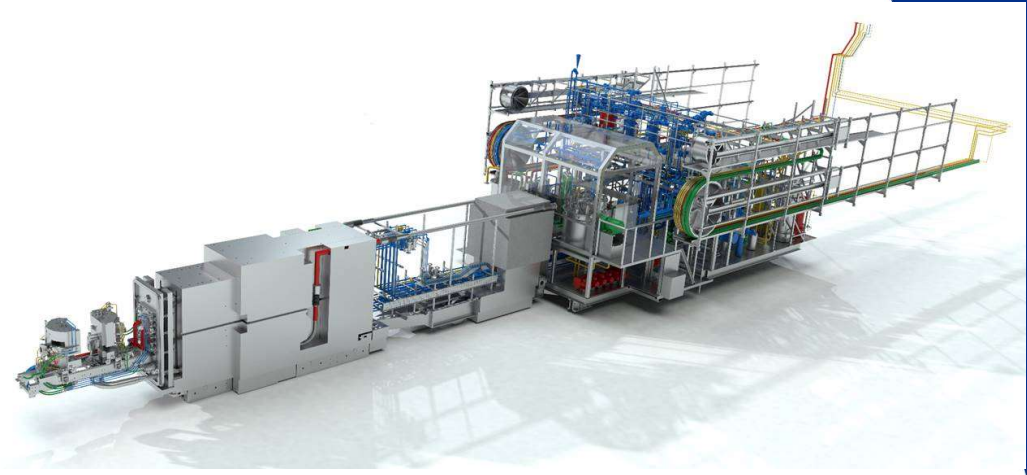
Target Station 1 Upgrade

Between Apr 2021 and Nov 2022 Target Station 1 (TS1) was closed for its first complete refurbishment since operations began in 1984.

This included changes to the design of the target and its cooling systems, the moderators, the reflector and all their associated services.

As part of the upgrade work most of the existing Omron CJ PLCs were replaced with three Omron NJ PLCs.

This was an opportunity for us to move these new systems to EPICS.



Target, Reflector and Modulator assembly with half the reflector removed



Fitting the ATEX area in the Target Service Area

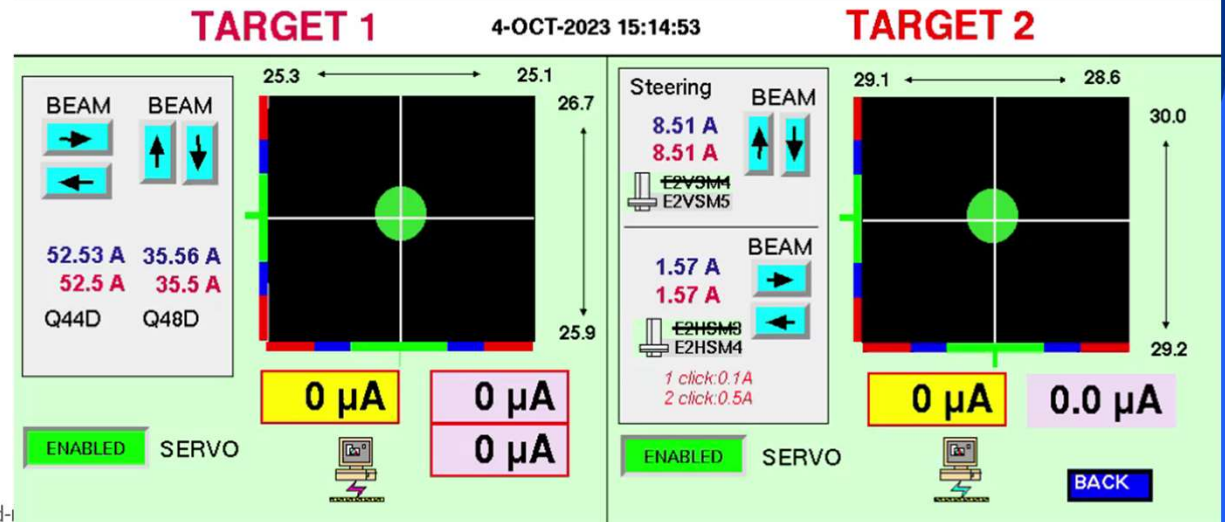
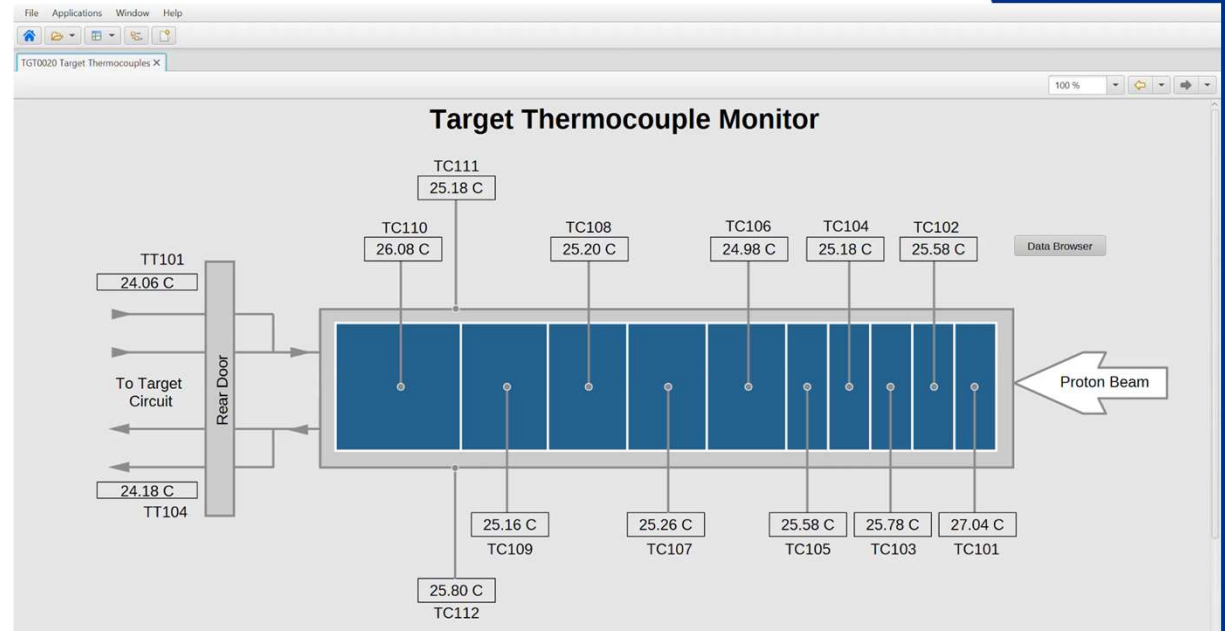
EPICS at ISIS Accelerators

Success!

We have our first end-to-end EPICS deployment – with caveats – and we are successfully running the EPICS and Vsystem control systems in parallel. PVEcho (WE2BC004) in successful operation for almost a year.

TS1 HMI in Phoebus (top)

Halo steering in Vsystem, showing control loop using data from EPICS (bottom)

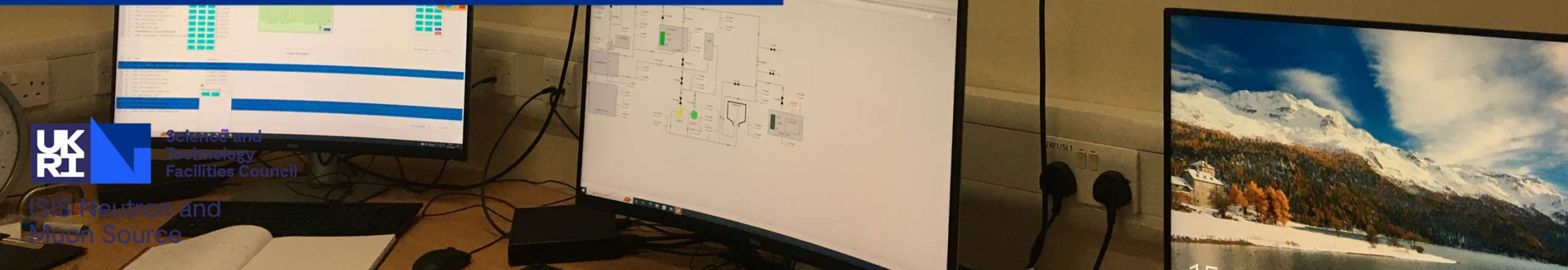


EPICS End-to-End

EPICS is now the primary system in use in the TS1 Control Room.

EPICS is in use in the Main Control Room, for TS1 screens.

As we are feeding all data to the EPICS Archiver Appliance the auto-converted screens have also been used by crew and accelerator physics for post-mortems, etc.

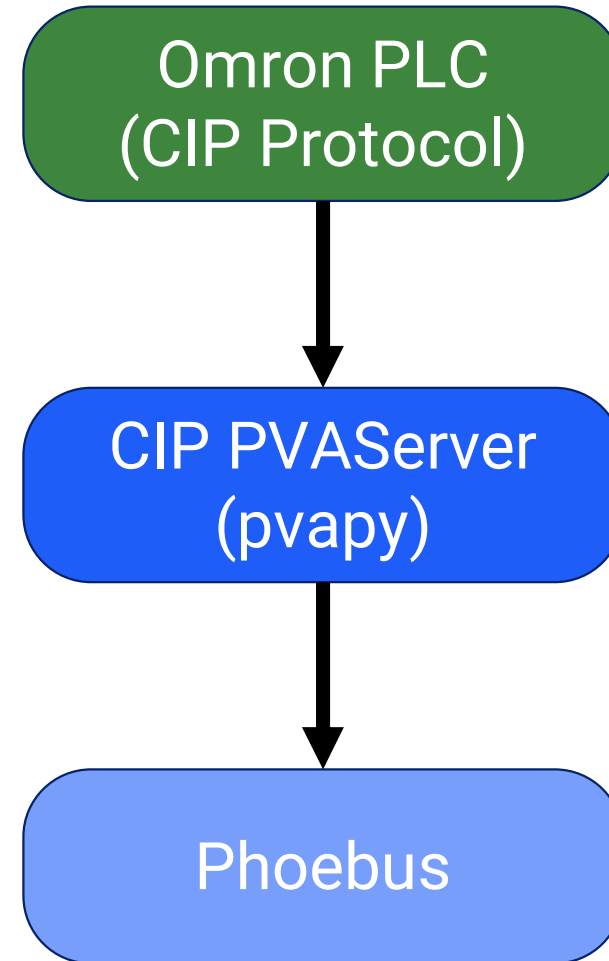


EPICS at ISIS Accelerators

Talked about our CIP PVAServer at the previous EPICS Collaboration Meeting.

Our system is unusual – we have implemented our “IOC” in Python, which we run in a Docker Container. We read the configuration of the PVs (e.g. alarm settings) from the PLC.

It interfaces conventionally with Phoebus and the EPICS Archiver Appliance.



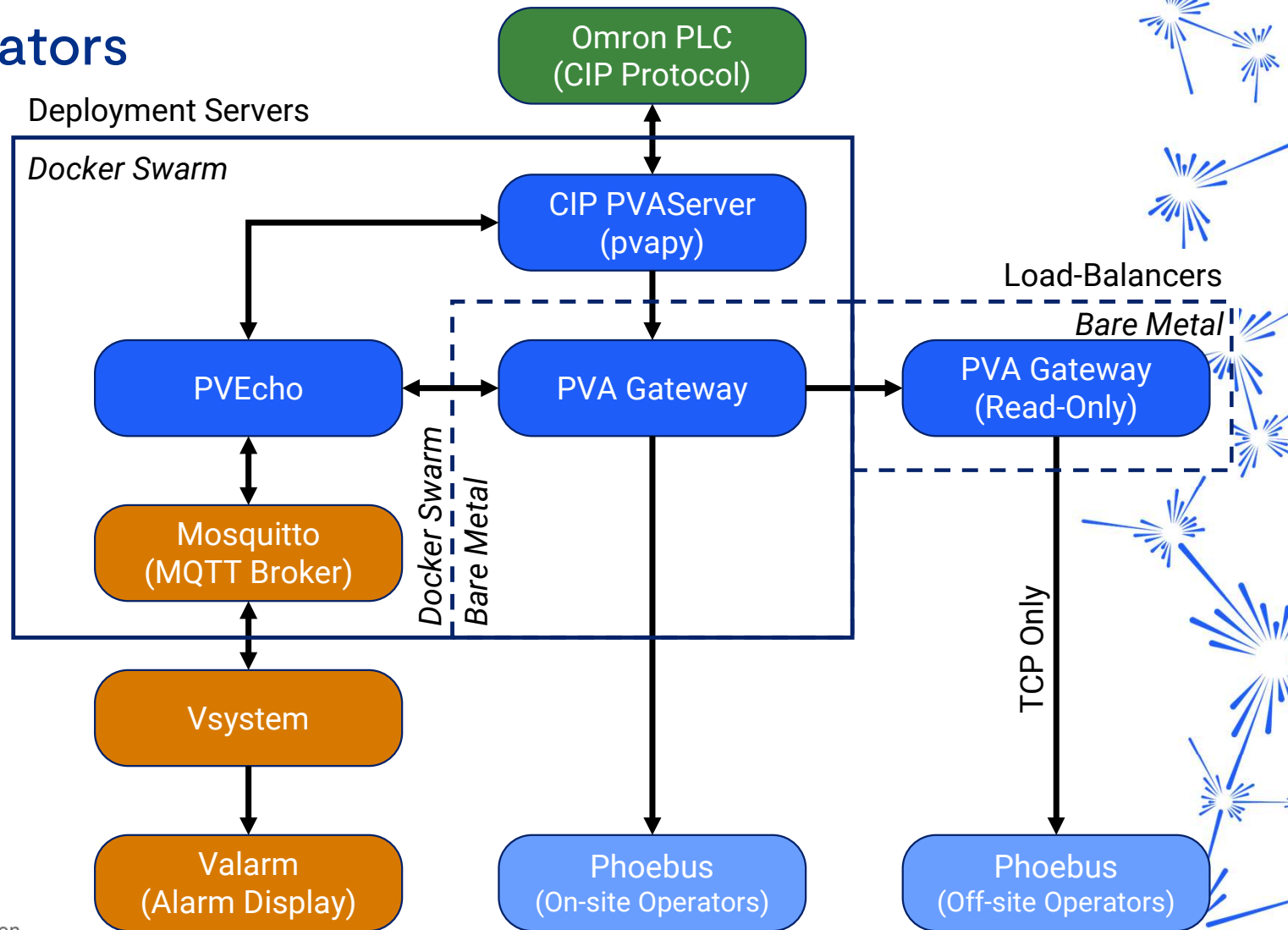
EPICS at ISIS Accelerators

The implementation proved more complex in practice!

We still use Vsystem in two different ways:

- A small number of values originating in Vsystem are written to the PLCs
- We chose to have only one alarm interface in our Main Control Room (MCR). This is currently Valarm.

All values logged to EPICS Archiver Appliance and, through PVEcho & Vsystem, to InfluxDB.



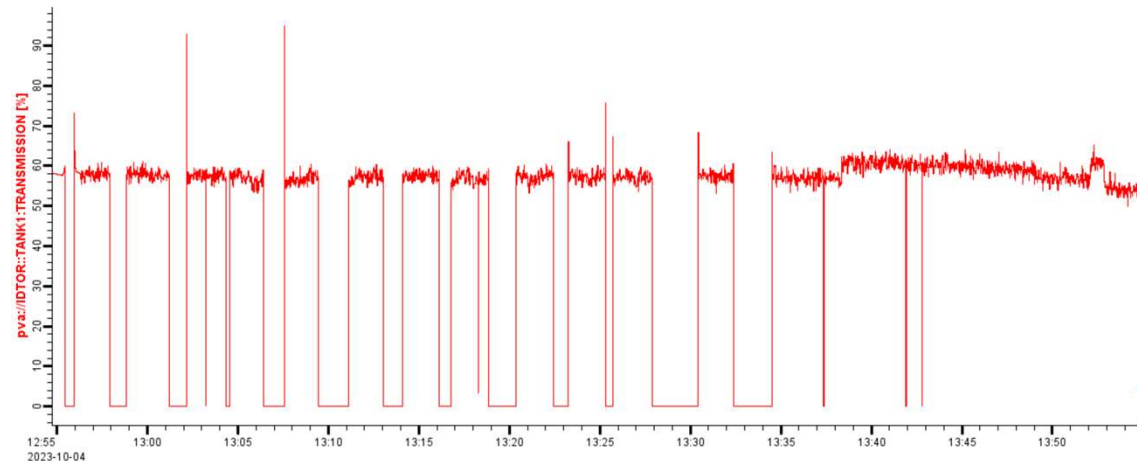
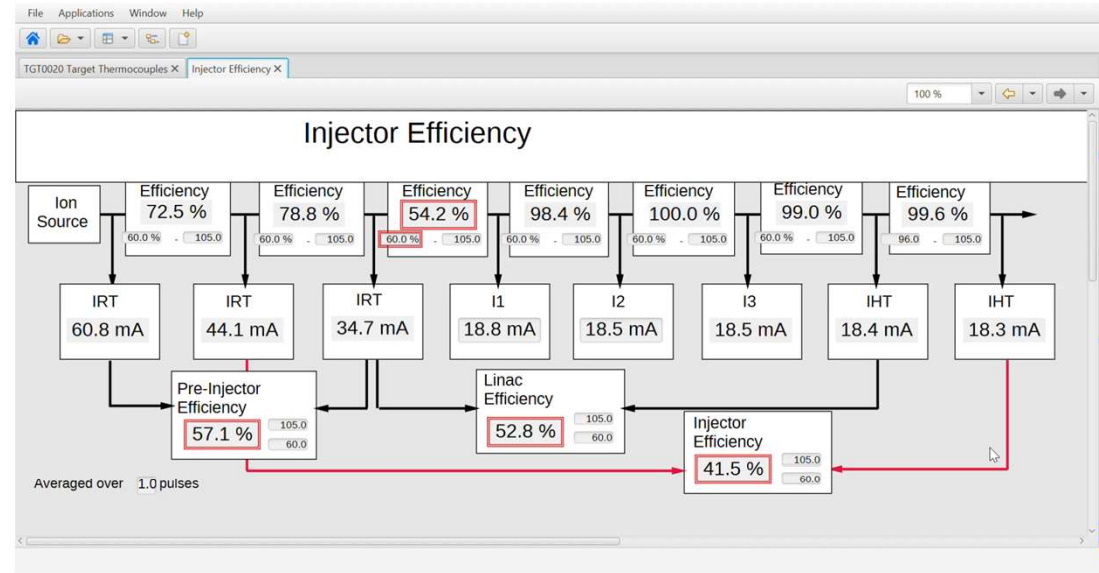
Note: archiving and logging infrastructure not shown.

Lessons Learned – Easy Access to Archiving

Our operators were using the EPICS Archiver Appliance before we even deployed the new screens.

Operators and equipment owners have made it clear to us just how important for diagnosis (especially of new systems) they regard easy access to trend data.

Interface to our existing InfluxDB data, see **TUMBCM008**

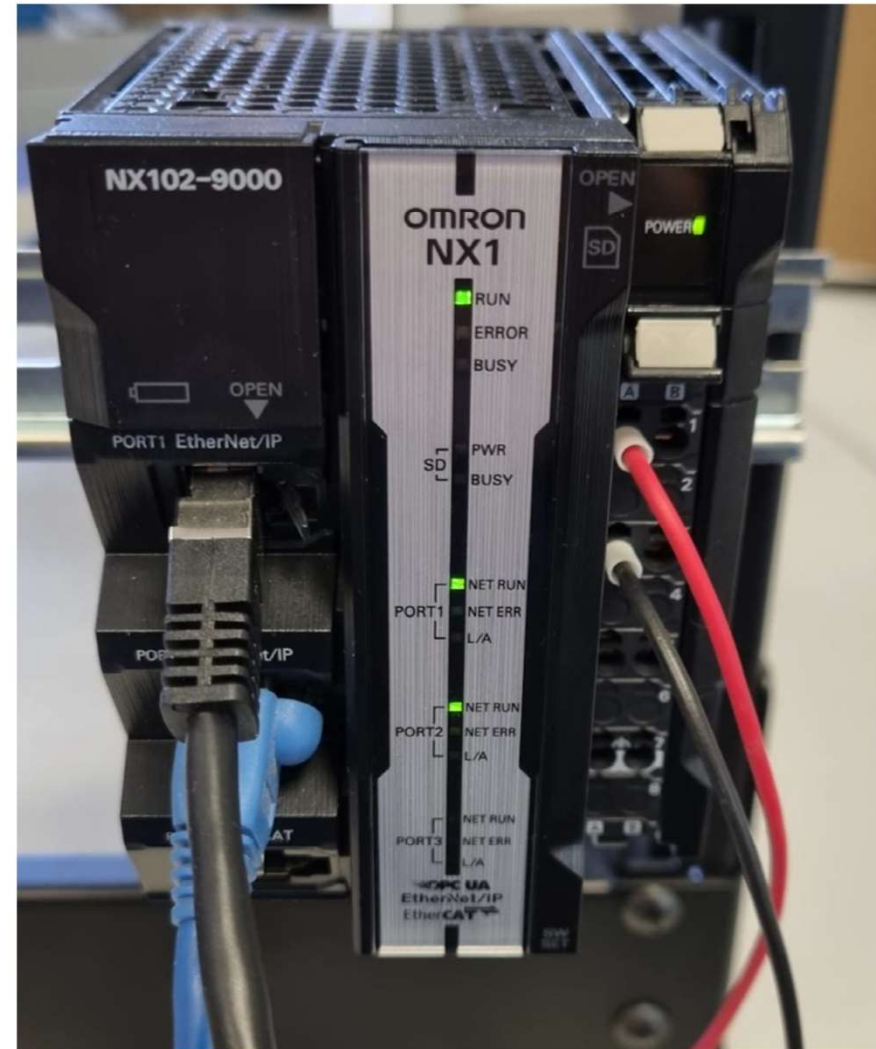


Lessons Learned – CIP PVAserver

Our unusual design, reading structured configuration data from the PLCs worked.

But it was not performant. The problem was the PLCs' own CIP implementation.

Moving to an MQTT implementation for faster operation and p4p for future-proofing, see **TUMBCM026**.

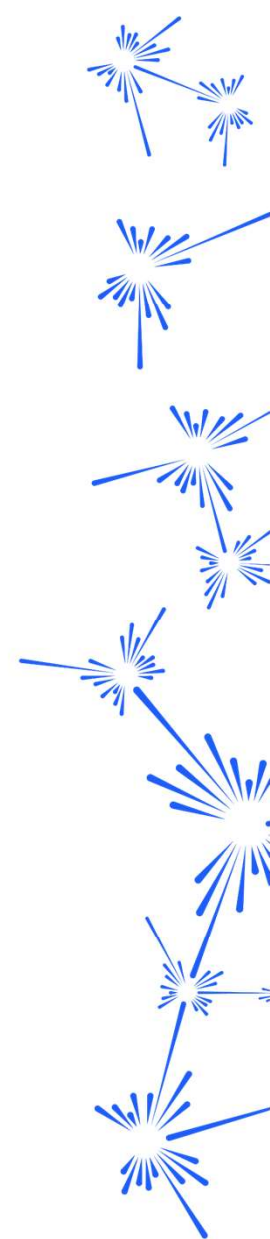
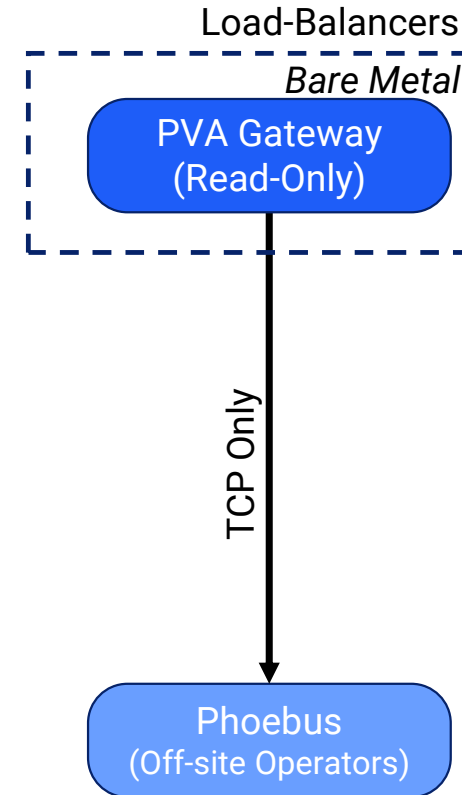


Lessons Learned – Remote Access

The most urgent request we received from operators was for remote access (via VPN) to the new TS1 control screens.

We implemented this using a read-only PVA Gateway using EPICS_PVA_NAME_SERVERS (TCP only).

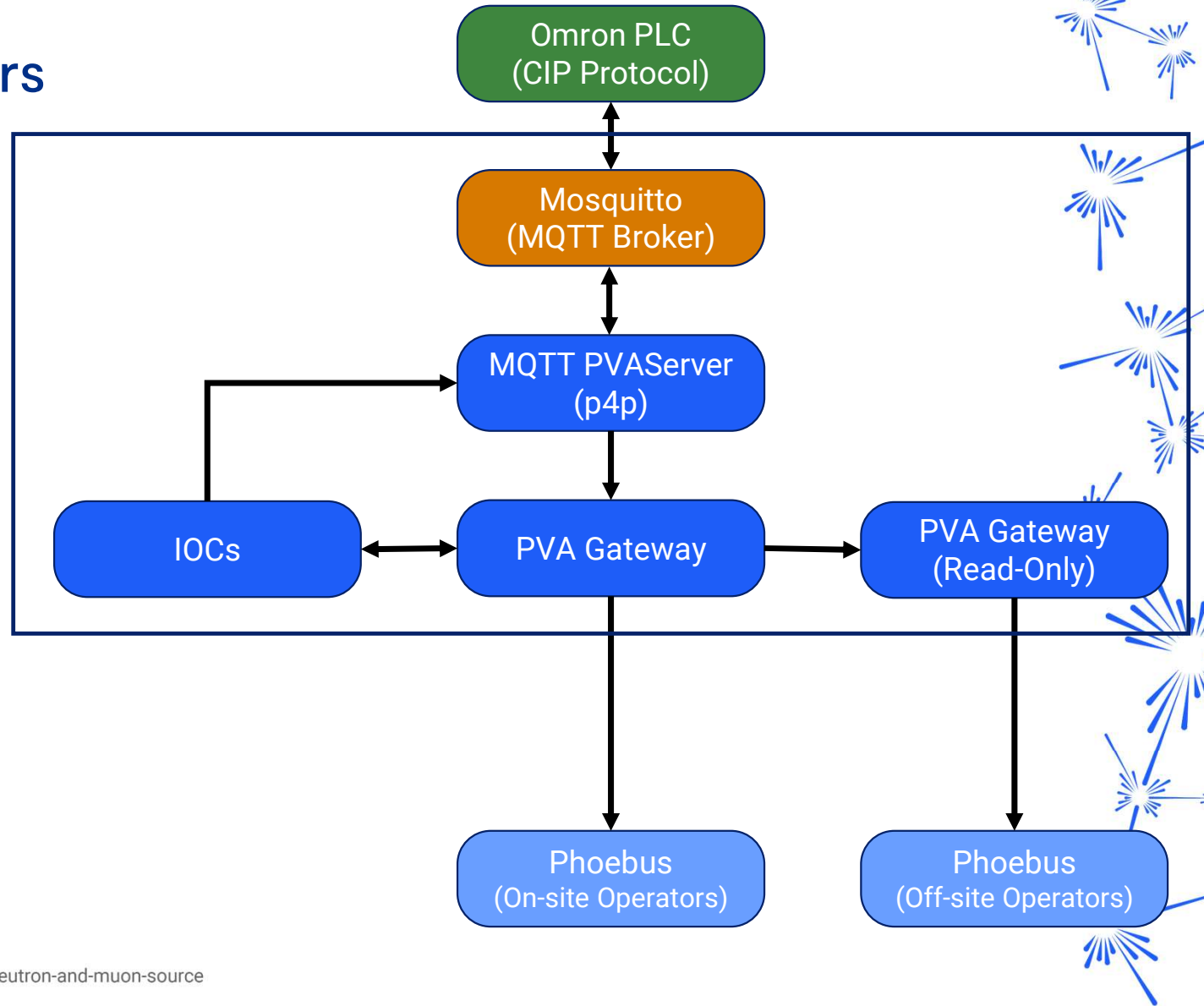
This is also how we support access to EPICS PVs in our Docker on Windows development systems.



EPICS at ISIS Accelerators

How we hope to simplify our architecture in the next few months:

- Bring the PVA Gateways into the Docker Swarm (fail-over)
- Remove Vsystem by transferring more systems to EPICS (FINS and CPS are next)
- Remove Valarm by migrating to Phoebus alarm management



Save and Restore

A long-standing request from our machine physicists. The old system involves text files of values generated from Vsystem and manually restored.

We are currently trialling:

- Phoebus save-and-restore, with automated snapshots
- A web-based solution which integrates with the EPICS Archiver Appliance.

#	PV Name	Timestamp	Status	Severity	Stored Setpoint	Δ Live Setpoint	Live Setpoint
1	RTIME:TIMER...	2023-10-04 12:42:16	NONE	NONE	0	-1	1
2	IPHASE_SCOPE...	2023-10-04 14:59:59	NONE	NONE	16.7657184600...	-0.8556289...	17.621347
3	IRFQ:ARC_OFF...	2023-09-05 09:29:59	NONE	NONE	960	0	960
4	RMMPSUPSPXI...	2023-10-04 14:59:58	NONE	NONE	1054.5400390625	-0.0200195...	1054.56
5	IRFQ:ARC_DCR...	2023-10-04 14:59:56	NONE	NONE	58.3159980773...	+6.0999984...	52.216
6	IPHASE:TANK3...	2023-09-14 14:17:04	NONE	NONE	0	0	0
7	IRFQ:GAS_ON...	2023-09-05 09:29:59	NONE	NONE	688	0	688
8	IRFQ:SCOPE_T...	2023-09-05 09:29:59	NONE	NONE	5	0	5
9	IRFQ:MAG_REA...	2023-10-04 14:59:51	NONE	NONE	9.58432006835...	-0.0048799...	9.5892
10	ISEPTUM:COM...	2023-10-04 14:59:58	NONE	NONE	4456.44580078...	+2.5346679...	4453.911
11	IPHASE:TANK1...	2023-10-02 08:48:09	NONE	NONE	113.437805175...	0.0	113.437805
12	RMMPSUPSPXI...	2023-10-02 21:56:34	NONE	NONE	395.0	0.0	395.0
13	IT4HMAG:HHS...	2023-10-04 13:01:52	NONE	NONE	-7.0430002212...	0.0	-7.043
14	IT4HMAG:HVS...	2023-09-04 02:43:17	NONE	NONE	1	0	1
15	IRFQ:ANODE...	2023-10-04 14:59:48	NONE	NONE	416.507995605...	-1.9519958...	418.46
16	IRFQ:ARC_OFF...	2023-09-05 09:29:59	NONE	NONE	5	0	5
17	IRFQ:RF_READ...	2023-10-04 14:59:53	DEVICE	MAJOR	0.00854596495...	+0.0018312...	0.0067146868
18	IPHASE:RFQ_P...	2023-09-30 14:33:52	NONE	NONE	-42.998043060...	0.0	-42.998043
19	IRFQ:IS_SAMP...	2023-09-05 09:29:59	NONE	NONE	5	0	5

key	PV	description	current_set	set_last_changed	archived_set	current_read	read_last_changed	archived_read
0	IDTOR:HEDS.TRANS...	HEDS Transmission				100.000	2023-10-04 16:51:23	100.000
1	IDTOR:IHT5.CURRENT	IHT5 Current				20.667	2023-10-04 16:51:27	20.859
2	IDTOR:IRT2.CURRENT	IRT2 Current				39.967	2023-10-04 16:51:27	39.227
3	IDTOR:LEBT.TRANS...	LEBT Transmission				73.330	2023-10-04 16:51:28	70.772
4	IDTOR:RFQE.TRANS...	RFQ Transmission				89.201	2023-10-04 16:51:28	88.502
5	IDTOR:TANK1.TRAN...	Tank1 Transmission				59.181	2023-10-04 16:51:28	61.345
6	IDTOR:TANK2.TRAN...	Tank2 Transmission				97.666	2023-10-04 16:51:28	98.214
7	IDTOR:TANK3.TRAN...	Tank3 Transmission				100.000		100.000
8	IDTOR:TANK4.TRAN...	Tank4 Transmission				98.858	2023-10-04 16:51:28	98.823
9	IRFQ:DIPOLE_1_X.R...	LEBT Dipole 1 X - Rea...	1.500	2023-09-25 08:42:20	1.500	1.501		1.501
10	IRFQ:DIPOLE_1_Y.R...	LEBT Dipole 1 Y - Rea...	1.500	2023-09-27 09:04:15	1.500	1.502		1.502
11	IRFQ:DIPOLE_2_X.R...	LEBT Dipole 2 X - Rea...	1.000	2023-09-25 08:37:32	1.000	1.001		1.001
12	IRFQ:DIPOLE_2_Y.R...	LEBT Dipole 2 Y - Rea...	0.400	2023-09-27 09:04:27	0.400	0.401		0.401
13	IRFQ:DIPOLE_3_X.R...	LEBT Dipole 3 X - Rea...	0.000		0.000	0.000		0.000
14	IRFQ:DIPOLE_3_Y.R...	LEBT Dipole 3 Y - Rea...	1.200		1.200	1.201		1.201
15	IRFQ:EXT_READ_VO...	I/S EXTRACT read volts				17.002	2023-10-04 16:51:28	16.991
16	IRFQ:SOLENOID_1.R...	Danfysik 800 PSU Con...	356.000		356.000	355.999		355.999
17	IRFQ:SOLENOID_2.R...	Danfysik 800 PSU Con...	35.000		35.000	34.999		34.999
18	IRFQ:SOLENOID_3.R...	Danfysik 800 PSU Con...	457.000		457.000	456.999		456.999

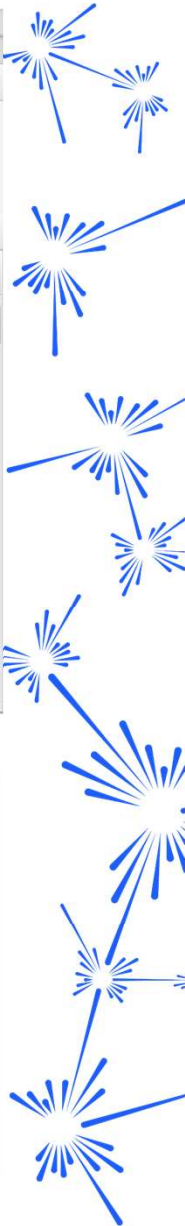


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Challenges

Loss of effort – particularly in infrastructure and liaison with users and operators

- Delays in modification and acceptance testing of auto-converted screens
- Naming convention – a success for new PVs from TS1, but delayed for application to those bridged from PVEcho.
- Implementation of other EPICS IOCs – expect CPS/PXI and FINS soon (>50% of existing Vsystem channels). A mix of Python-based interfaces and conventional IOCs.
- Technical issue with pvgets – unsure of cause (possible interaction between pvapy and PVA Gateway)



CyberSecurity

Our network is:

- isolated from the public internet
- not isolated from the site network
- mixes all types of equipment (servers, desktops, PLCs, etc.)
- not segmented by purpose (e.g. injector, targets)

No security beyond that provided by PVA Gateways.
No pvAccess authentication and authorisation.

We have a Technical Advisory Panel on Cybersecurity in November. Please ask if you are interested in supplying expertise and advice!





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Questions?



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