

# Controls Data Archiving at the ISIS Neutron and Muon Source for In-Depth Analysis and ML Applications

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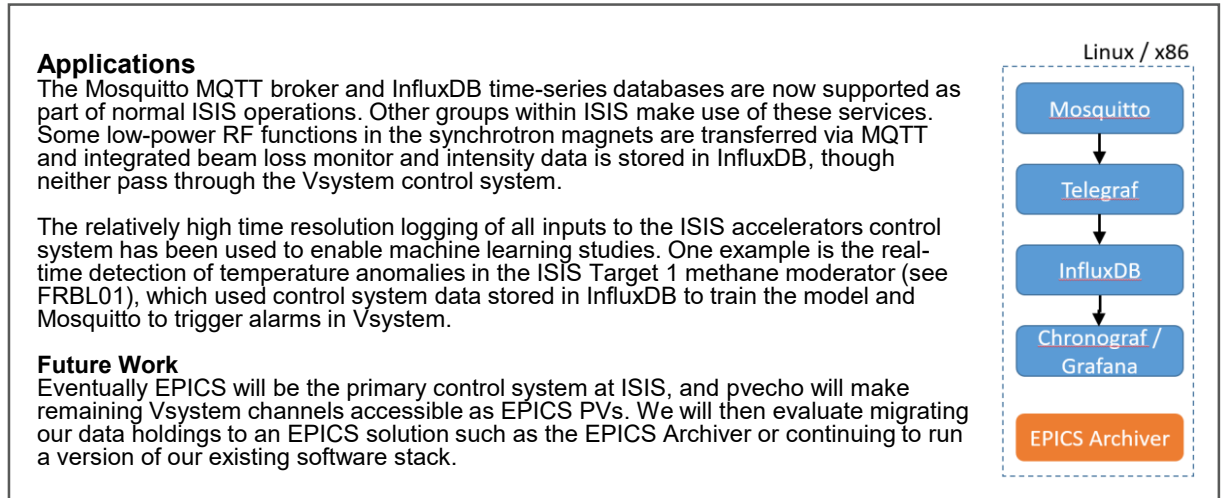
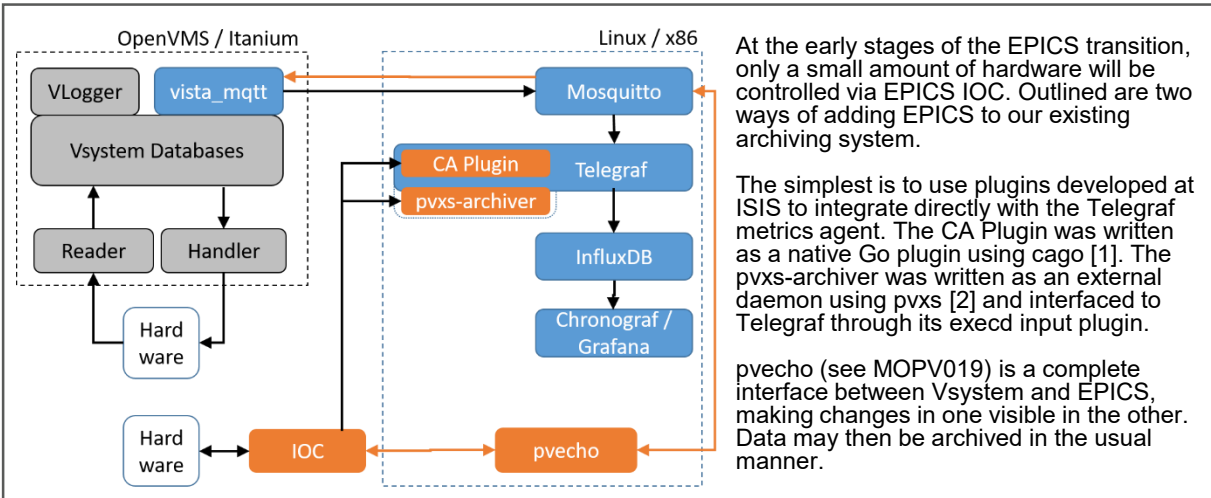
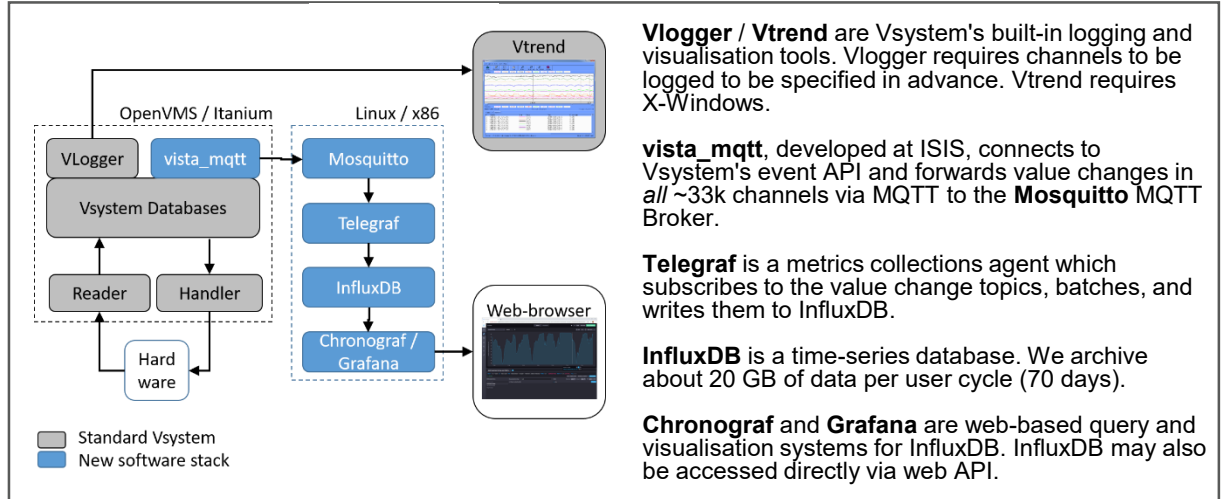
Since 2003 Vsystem's built-in tools have been used to permanently archive a subset of the available channels at 30 min time resolution. Since 2019 we have archived all control systems data using a new software stack capable of storing data at raw time resolution. During the initial stages of the EPICS transition, when EPICS data represents a small fraction of control system data, we plan to store EPICS data in our existing system.



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<sup>a</sup> Operating system

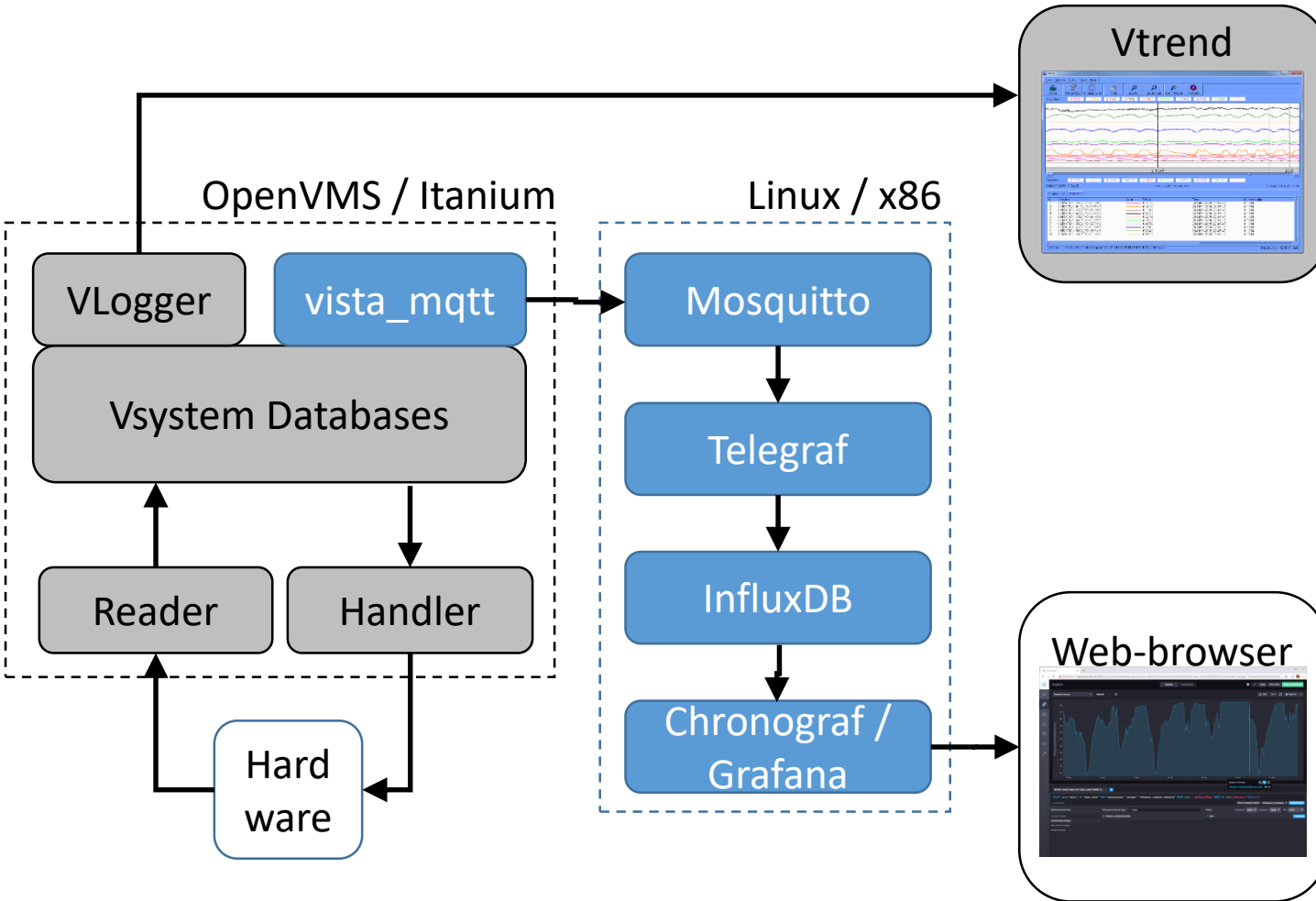
<sup>b</sup> Processor architecture



ISIS MCR in 1987, Graces/Babbage Control System



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Standard Vsystem  
 New software stack

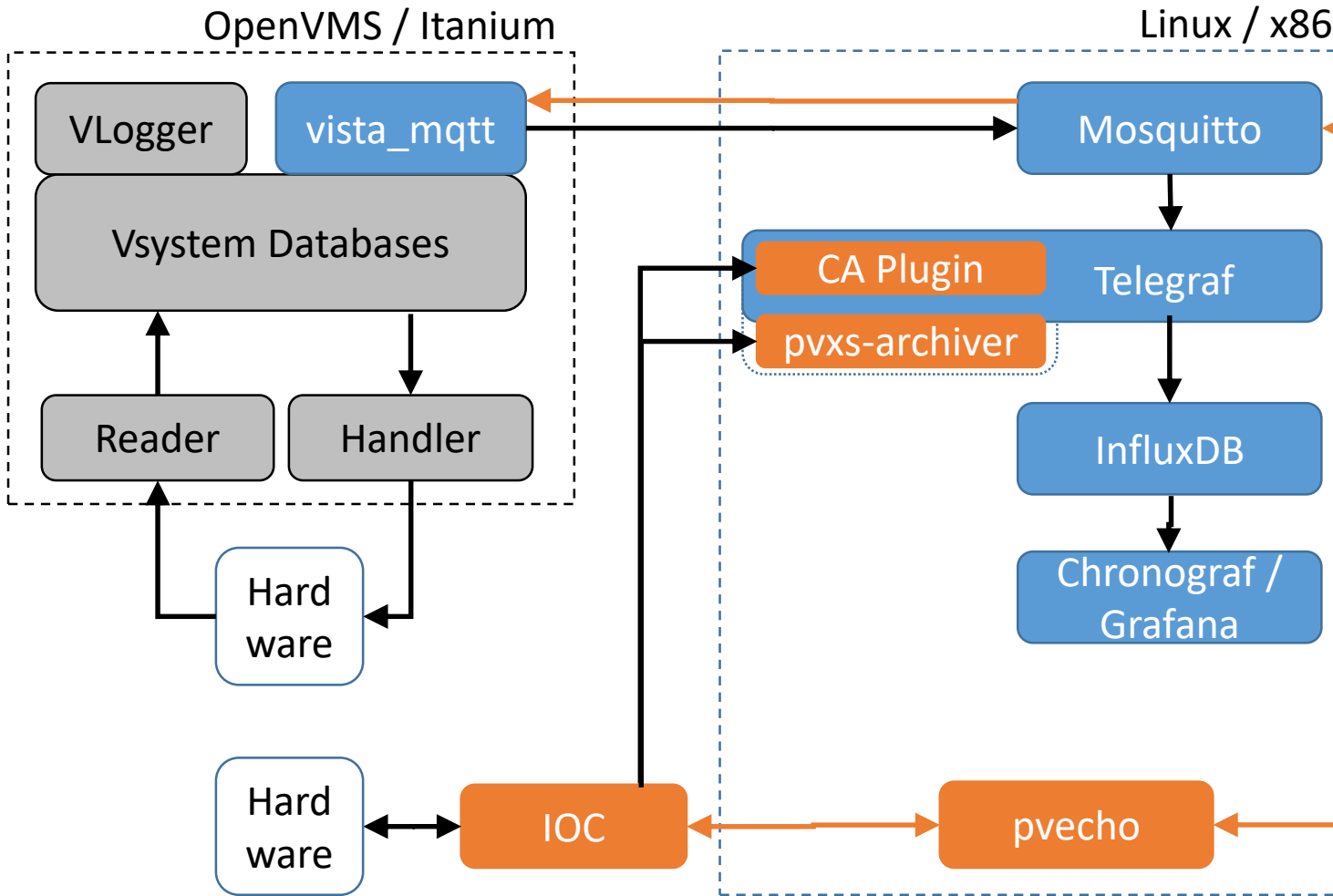
**Vlogger / Vtrend** are Vsystem's built-in logging and visualisation tools. Vlogger requires channels to be logged to be specified in advance. Vtrend requires X-Windows.

**vista\_mqtt**, developed at ISIS, connects to Vsystem's event API and forwards value changes in *all* ~33k channels via MQTT to the **Mosquitto** MQTT Broker.

**Telegraf** is a metrics collections agent which subscribes to the value change topics, batches, and writes them to InfluxDB.

**InfluxDB** is a time-series database. We archive about 20 GB of data per user cycle (70 days).

**Chronograf** and **Grafana** are web-based query and visualisation systems for InfluxDB. InfluxDB may also be accessed directly via web API.



At the early stages of the EPICS transition, only a small amount of hardware will be controlled via EPICS IOC. Outlined are two ways of adding EPICS to our existing archiving system.

The simplest is to use plugins developed at ISIS to integrate directly with the Telegraf metrics agent. The CA Plugin was written as a native Go plugin using cago [1]. The pvxs-archiver was written as an external daemon using pvxs [2] and interfaced to Telegraf through its execd input plugin.

pvecho (see MOPV019) is a complete interface between Vsystem and EPICS, making changes in one visible in the other. Data may then be archived in the usual manner.

[1] goca: A Go interface to EPICS Channel Access, M. Gibbs, <https://github.com/mattgibbs/goca>

[2] pvxs, M. Davidsaver, <https://mdavidsaver.github.io/pvxs/>

## Applications

The Mosquitto MQTT broker and InfluxDB time-series databases are now supported as part of normal ISIS operations. Other groups within ISIS make use of these services. Some low-power RF functions in the synchrotron magnets are transferred via MQTT and integrated beam loss monitor and intensity data is stored in InfluxDB, though neither pass through the Vsystem control system.

The relatively high time resolution logging of all inputs to the ISIS accelerators control system has been used to enable machine learning studies. One example is the real-time detection of temperature anomalies in the ISIS Target 1 methane moderator (see FRBL01), which used control system data stored in InfluxDB to train the model and Mosquitto to trigger alarms in Vsystem.

## Future Work

Eventually EPICS will be the primary control system at ISIS, and pvecho will make remaining Vsystem channels accessible as EPICS PVs. We will then evaluate migrating our data holdings to an EPICS solution such as the EPICS Archiver or continuing to run a version of our existing software stack.

