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Australian Nuclear Science & Technology Organisation

# Upgrade of the ANTARES Computer Control System and our experience of EPICS.

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## Why Upgrade?

- Remove reliance on old difficult to replace hardware
- Stop using an archaic operating system (OS-9)
- Handle issues with ANSTO developed software:
  - Inflexible Graphical User Interface (GUI)
  - Some parts were hard to understand and maintain



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Aimed to avoid these issues by using popular solutions as much as possible.

- Using x86 (standard desktop) PCs and the Linux operating system.
- EPICS (Experimental Physics and Industrial Control System) - the new control system - is used in many labs around the world and will be maintained for the foreseeable future (past 2010).



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# EPICS

- EPICS is a set of software components and tools that application developers use to create a control system.
- It's a collaboration. Different parts of EPICS were developed at different places.
- The base is released under the EPICS Open license.
- Runs on numerous hardware/operating-system combinations.



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- Written mainly in C, and to a lesser extent C++. There are scripts written in Perl.



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## The basic components of EPICS are:

- Operator Interface (GUI)
- IOC (Input/Output Controller). This is the guts of an EPICS system.
- LAN (Local Area Network), for communication between IOCs and OPIs.

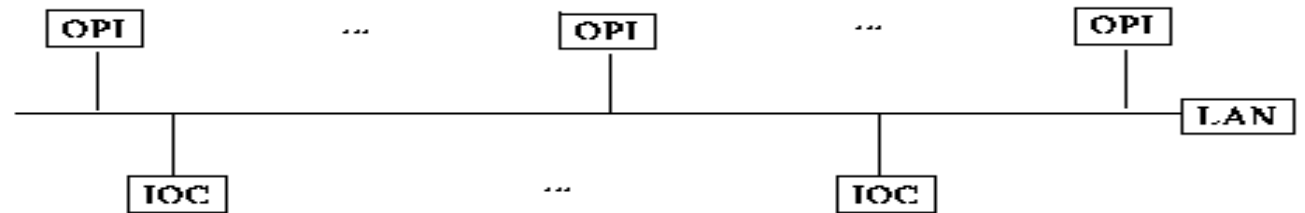


Figure 1 : EPICS based Control System



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- The heart of each IOC is a memory resident database
- The database is populated with records that define entities in the control system
- There are many different record types available to the developer.
- Developers may also create their own record types.



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- Records are used to define:
  - What hardware is present (Analog input, Analog output, Digital Input etc)
  - Chains of events by linking records together
  - Some functionality such as performing calculations and decision making





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- Records have to be processed (or run) for the control system to do any work
- Records are processed depending on the “scanning” scheme assigned to them
- Schemes include:
  - Periodic (eg every second)
  - I/O event driven
  - Passive (when it’s told)



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- Records that represent hardware (eg Analog Inputs) are generic - they know nothing about the specifics of the hardware
- When records are processed they call device support routines to handle the hardware
- You are able to write your own device support as required.



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# What parts of EPICS we use at ANTARES

- IOC
- Sequencer
- EDM (Extensible Display Manager)
- Channel Archiver
- Alarm Handler



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## IOCs

- Every EPICS installation would have to run at least one IOC.
- At ANTARES we run twelve different IOCs on one 1.8 GHz x86 PC with 512 MB of RAM.
- The total number of records is around 3100. The smallest IOC has 10 records, and the largest around 1120.



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# Sequencer

- While some logic and decision making can be implemented using particular types of records, the Sequencer provides a more powerful means of implementing logic.
- The Sequencer is used to run State Notation Language programs.
- The State Notation Language is based on the familiar concepts of state transition diagrams.
- If you can program in C then it isn't too hard to jump into programming SNL programs as they have a very similar syntax.



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## EDM

- Extensible Display Manager
- The GUI.
- It allows us to manipulate and observe records in the database using familiar items such as dials, sliders, text boxes etc.
- There are a few GUI options available to EPICS users, but EDM seems to be the most popular
- EDM provides the means to build your GUI as well as run it.



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## Graphics



Text

Text

Text

Text

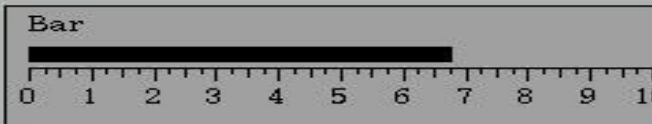
Text



## Monitors



Meter



Bar

6.8



3.2

Symbols



## Controls

Analog 1 0.1 6.8  
Analog 2 3.2

0 save rest 10

Ana 1 6.80

Ana 2 3.25

ON

ON

Send

Open New Display

Execute Shell Cmd

EXIT



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## Channel Archiver

- This tool is used to log the value/state of records over time to disk.
- We log around 250 records. At the moment that is producing around 90 MB of data per week.





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- We intend to use the Channel Archiver for two main purposes
  - Logging things like radiation levels that may be useful during audits for ARPANSA etc.
  - As a debugging tool. It may allow us to “look back in time” at events leading up to some event. We can see what actions operators have taken, sensor readings etc.



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## Our EPICS Experience

- EPICS is a stable system.
- It is large and complicated - but most of the time you can ignore the internals and just concentrate on developing your system.
- You do occasionally have to look at code in the base, which being so large can be a little confusing to navigate at first.
- It has a fairly complicated make system.



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- You can teach yourself EPICS from the documentation, but don't expect much material aimed at newbies. Plan for 2-3 months to get yourself up and running, and ready to have a go at anything that an application developer might want to do.
- Training courses are available. Generally four days in length.



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- There is a useful and friendly mailing list called “tech-talk” on which you have access to the people who write EPICS and the tools, as well as other EPICS users from around the world.
- There are also collaboration meetings every year to discuss the progress development of EPICS and future directions.