



Australian Government



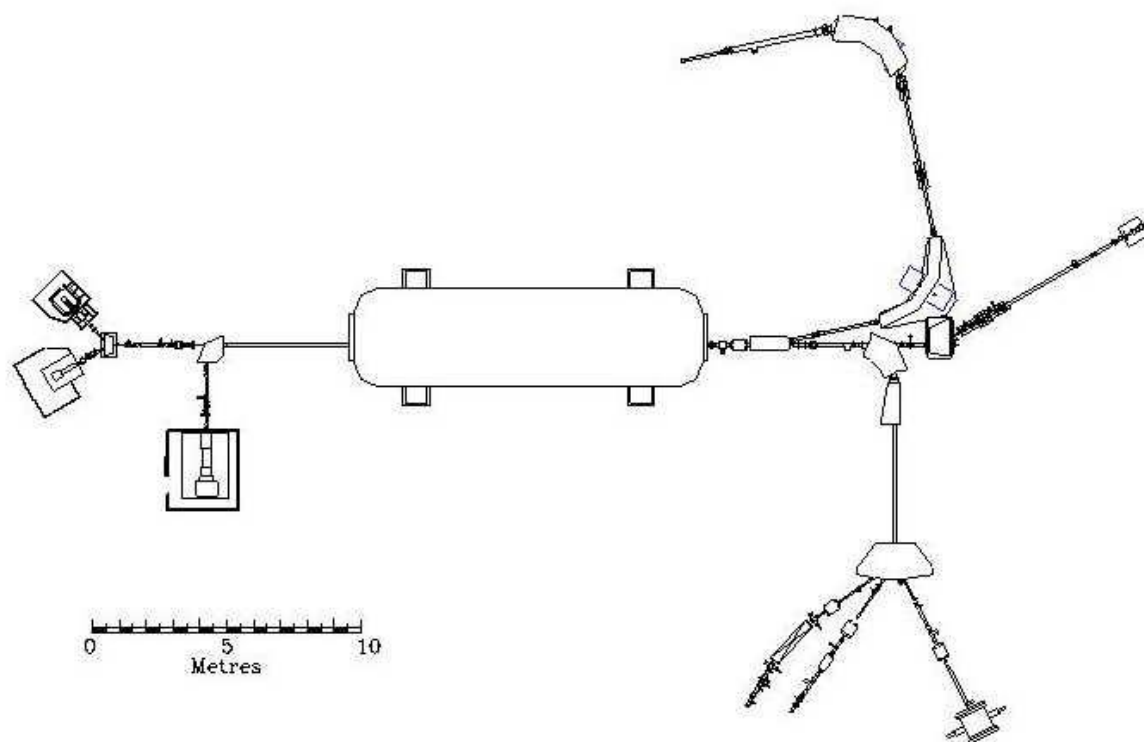
Moving from VME to EtherCAT on the ANTARES accelerator

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Presentation Outline

- Facility Overview
- Why replace current VME system and why use EtherCAT
- How EtherCAT works
- Tools we are using and our experiences

ANTARES Overview



First Solution

- First solution was rack-mounted PCs with PCI I/O cards running Linux and EPICS
- Did not want to use VME again for price reasons
- Abandoned this solution after feedback from electronics staff:
 - Preferred a remote I/O solution to reduce wiring
 - Analog inputs performing poorly?

Back to the drawing board

- Remote I/O
- Capable of the usual analog and digital I/O as well as being able to do 1 MHz counting and motion control
- Preferably already integrated into EPICS
- More cost effective than VME

Some Options Considered

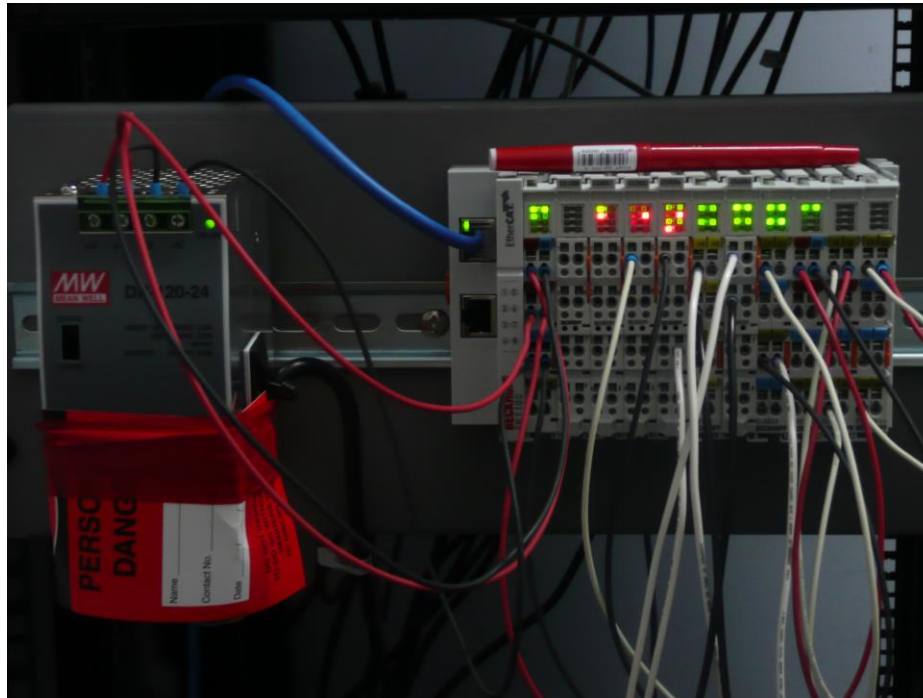
- Remote I/O modules from Moxa or Acromag
- Advantech PAC (APAX-5000 series)
- PLC based
- Cosylab MicroIOC
- Hytec 9010 Blade IOC

EtherCAT – Already integrated into EPICS

- In use at Diamond Light Source:
 - Diamond have written software to integrate it into EPICS
 - Digital and analog I/O
- A couple of other labs are using or trialing it as well (Daresbury, PSI)

EtherCAT – Remote I/O

- DIN rail mounted power supply, bus coupler, I/O units, and bus end cap plus I/O terminals.



EtherCAT – Cost Effective?

- Power supply, bus coupler, bus end cap, 4 channel analog input and 4 channel analog output: around \$1,200

EtherCAT – I/O Options

- Range of vendors to choose from: Beckhoff, National Instruments, Omron ...
- Analog and digital I/O, counters, motion control.

Other Advantages

- Determinism
- Embedded PCs (PLCs) available from Beckhoff that use the same EtherCAT I/O modules and can also be put on the EtherCAT bus.
Programmed using IEC 61131.3 languages or possibly C++

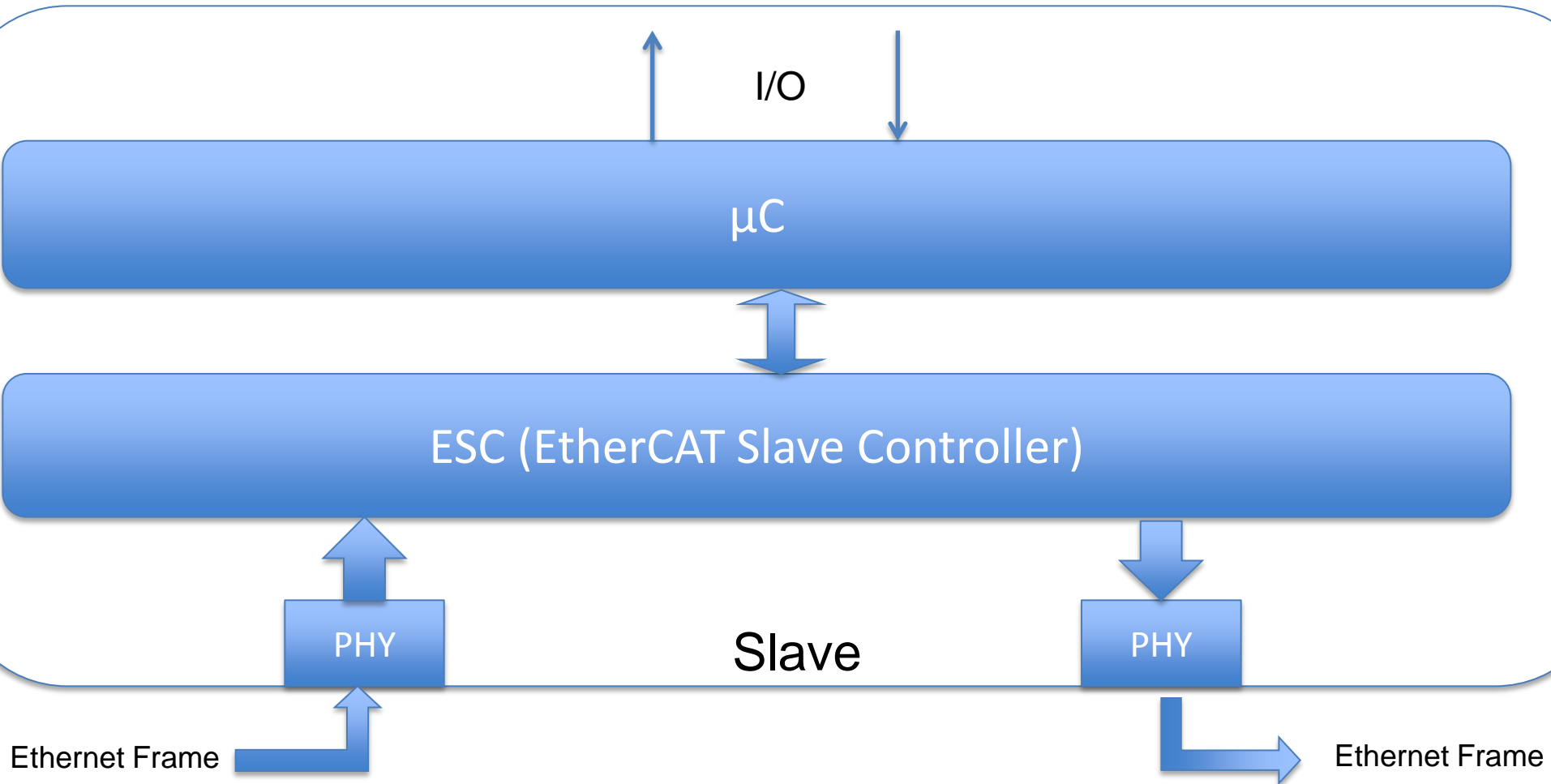
Other Advantages

- IP 67 modules available
- Safety terminals
- EtherCAT is an open technology

EtherCAT Operation

- Real-time Ethernet-based Fieldbus
- Master/slave
- Master requires no special hardware
- Operates cyclically. User defines cycle time. DLS EtherCAT scanner uses 1ms
- One Ethernet frame (probably) contains all process data.

EtherCAT Operation



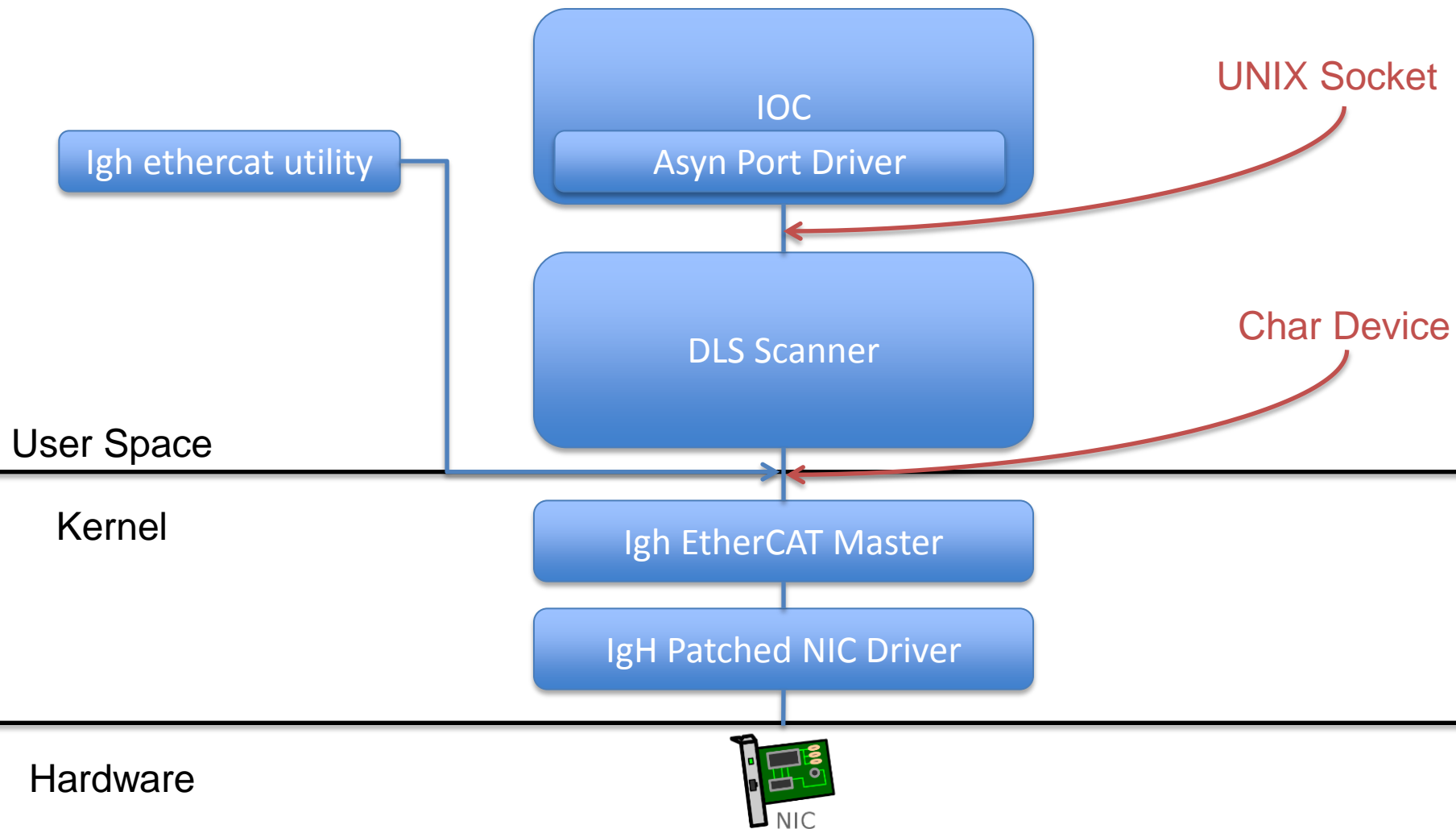
EtherCAT Operation

- Other protocols (e.g. TCP/IP) can be tunneled in the EtherCAT Ethernet frame
- Flexible topology (line, tree, star, ...)
- Find out more at ethercat.org. Downloads section is a good place to start.

Master PC

- Hardware
- Operating System
- Master Software
- Diamond Light Source software
- Application IOC

Software Architecture



Master PC Hardware

- Any PC would do but best to use NICs that the master has patched drivers for: 8139too, e1000, e100, r8169 and e1000e.

Master PC Operating System

- Linux with RT-Preempt patch. Ensure the kernel version you use has a RT-Preempt patch available and is supported by the master software.

Master Software

- Open source EtherCAT master from a German company IgH; part of the EtherLab product
- Master can run on different types of RT Linux
- Comes with a very useful utility to communicate with the master (e.g. to examine the bus)
- DLS uses a patched version of the EtherLab master
- Beckhoff TwinCAT is also useful

Diamond Light Source Software

- Scanner
- Socket connection
- Asyn port driver
- Configuration file utilities
- ESI files

Diamond Light Source Software

- Use chrt to set RT priorities of DLS scanner and any IOCs



Integrating Beckhoff Embedded PCs

- Beckhoff Embedded PCs (PLCs) are programmed using Beckhoff TwinCAT 2 or TwinCAT 3 software packages
- IEC 61131 part 3 languages plus C++ if using TwinCAT 3
- Embedded PC is a master that you can program to expose variables to the EtherCAT bus

Experiences

- If using Beckhoff EtherCAT terminals we prefer the EL series. They seem a little more robust than the ES series.
- Voltage step PS terminals might be required