Integrating EtherCAT Based I/O Into EPICS at Diamond

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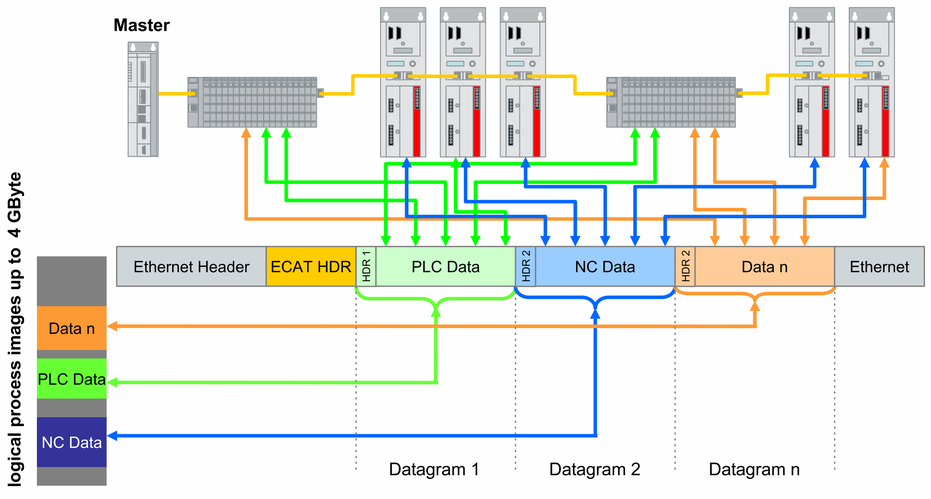
Abstract

Diamond Light Source is actively investigating the use EtherCAT based Remote I/O modules for the next phase of photon beamline construction. Ethernet based I/O in general is attractive, because of reduced equipment footprint, flexible configuration and reduced cabling. EtherCAT offers, in addition, the possibility of using inexpensive Ethernet hardware, off-the-shelf components with a throughput comparable to current VME based solutions. This paper presents the work to integrate EtherCAT based I/O to the EPICS control system, listing platform decisions, requirements considerations, software design and discussing the use of real time pre-emptive Linux extensions to support high-rate devices that require deterministic sampling.

EtherCAT

EtherCAT is a deterministic Ethernet fieldbus polled by the bus master. Each slave device is allocated part of the Ethernet frame and reads or writes as the frame passes through, allowing more efficient use of the available network throughput compared with systems where each slave forms a complete response packet.

New Diamond I/O controllers (IOCs) are Dell servers running real-time Linux, with a second network card for the EtherCAT bus.



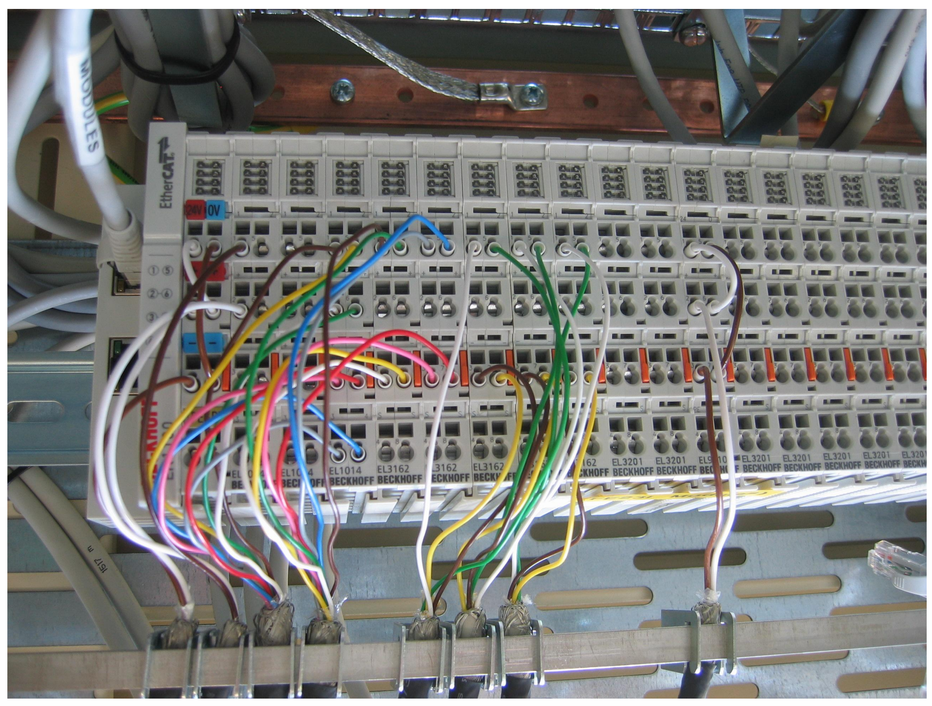
Real-Time Linux

The PREEMPT_RT Linux Kernel from RedHat is used to ensure regular bus cycles. This kernel offers a POSIX user-space real-time programming model.

Kernel	Mean Latency	Max Latency
2.6.18	1630 us	2745 us
2.6.33	52 us	243 us
2.6.33-rt3	5 us	54 us

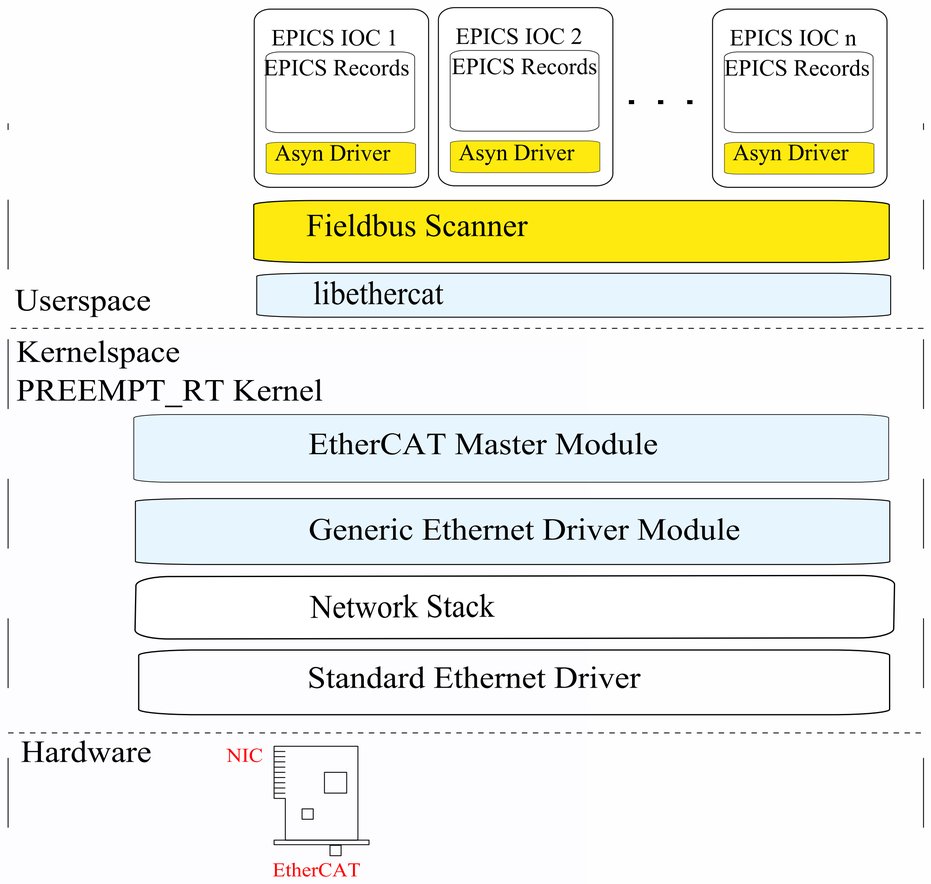
Beckhoff DIN Rail Mounted Terminals

This installation is from a new Diamond photon beam front end. The network cable connects to the second Ethernet adapter on the server. Sealed box I/O modules with M12 signal connectors are also available and will be used on beamlines.



System Architecture

The Scanner real-time task polls the bus at 1KHz and sends updates to the IOCs over a UNIX domain socket. The EPICS driver uses the ASYN framework and generates a named port for each device on the bus.



For more information please visit www.diamond.ac.uk or contact ronaldo.mercado@diamond.ac.uk