AN EMBEDDED EPICS CONTROLLER BASED ON ETHERNET/SERIAL BOX

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Abstract:

The SSRF (Shanghai Synchrotron Radiation Facility) control system takes the Ethernet as backbone. All kinds of serial devices such as vacuum pumps are connected to Linux IOCs via a kind of Ethernet/serial box made by Moxa company. In the pre-research stage of SSRF, the old model of this Ethernet/serial box was only a simple Ethernet/serial protocol converter which was functioned by firmware. Aim to this, we have developed several kinds of EPICS device drivers based on NetDev for our serial devices.

Recently, Moxa company has upgraded the converter by replacing old arm9 CPU with a more powerful Intel Xscale CPU. It supports MontaVista Linux as its embedded OS, also cross-compiler is provided to make further development available. Since we have decided to use the new model of converter in our facility finally, we manage to port EPICS IOC core on MontaVista Linux and implement the same function on the new converter as old one's to avoid modifying existent EPICS device driver. By these, the dedicated Linux IOC can be omitted and the whole system can be more efficient and expandable.

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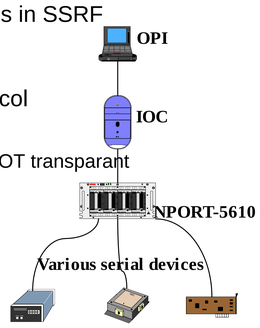
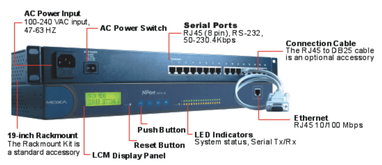
- OLD status of controlling serial devices in SSRF
  - Hardware: Linux IOC +NPort5610+Serial devices
  - Software: NetDev+proprietary protocol
  - Difficult to debug
    - Program in firmware of Nport5610 is NOT transparant





*NetDev is an EPICS device driver skeleton for serial equipments, developed by KEKB SSRF adopted it and added more supports for various serial devices

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NetDev's applications in SSRF

NetDev

- A common asynchronous device driver framework developed originally by KEK
- We do some add/modification for our usage
- Not only for serial devices but also for PLCs

Device	Maker	Protocol
Ion pump power supply controller	Custom	TCP/UDP
Vacuum gauge	Varian	TCP/UDP
Dabo power supply controller	Custom	TCP/UDP
Hwhr step motor controler	Custom	TCP/UDP
Monitor module of VME cabinent	ELMA	TCP

Device driver supports of serial devices in SSRF

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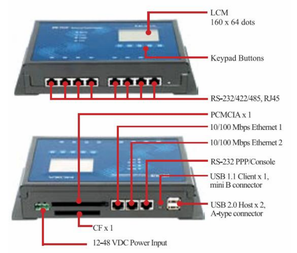
New Ethernet box UC7400



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- The world always changes…
  - NPORT5610 is used as only protocol converter
  - Hard to do further development on NPORT5610's firmware
  - New embedded system coming from MOXA Corp.
    - With Monta Vista Linux embedded
    - Cross-compiler environment
    - Intel Xscale IXP-422M 266Hz CPU,12M RAM,32M Flash ROM (extendable)
    - Wireless network supported

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What aroused our mind???

- Embedded EPICS Controllers are more and more popular
  - We definitely want to try new technology
- Software advantages
  - UC kernel is 2.4.18_mvl30-ixdp425
  - Cross-compile toolset includes GNU gcc/g++ version is 3.3.2
  - NFS/Telnet protocols/abundant Linux function library are supplied
- Hardware capabilities
- Others
  - Producer MontaVista is the undisputed leading provider of commercial-grade Linux development platforms for intelligent devices and communications infrastructure
  - Moxa is register user of MontaVista Linux that means they can acquire complete, end-to-end support from source code level

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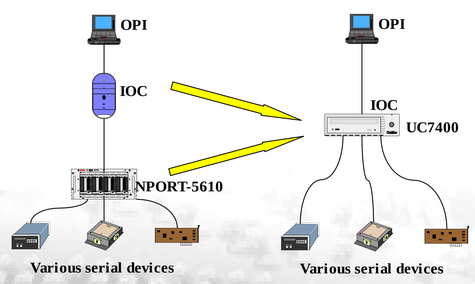
Current architecture of serial devices controlling in SSRF



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What we have done

- Create new make files
  - make EPICS base support "linux-xscale" target
- Create new driver API on Monta vista linux
  - Protocol converter between BSD socket protocol and proprietary protocol
  - Using non-block mode to solve timeout connections
  - Read for local configure file and write logs to file system
- Trivial modifications of several EPICS base source codes
- Don't need to modify netDev, just use it directly
- Download EPICS applications through Ethernet

Console display of UC7400 via telnet

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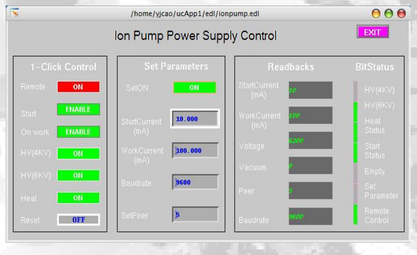
Just a sample: Controlling ion pump power supply with new UC7400 embedded EPCIS controller

Domestic ion pump power supply controller



GUI by edm

STATUS

The idea of embedded EPICS controller based on UC7400 was first proposed in the end of 2006. In March, 2007, all the work about porting and migration has been accomplished. In this summer, some tests were carried out concerning the serial devices of vacuum in linac controls. Furthermore, the SSRF booster commissioning is scheduled in the coming October, we are going to replace more Nport5610 with UC7400. Our target is to use only UC7400 in storage ring. Ps, besides serial devices, PLCs used in SSRF can also benefit from the work in this paper as they can be controlled by this embedded EPICS controller too.