NEW DEVELOPPMENT ON TORE SUPRA DATA ACQUISITION UNITS

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13th International Conference on Accelerator and Large Experimental Physics Control Systems

energie atomique • energies alternatives

Association EURATOM-CEA

CEA / DSM / Institut de Recherche sur la Fusion par confinement Magnétique
CEA-Cadarache, 13108 ST-PAUL-LEZ-DURANCE (France)

The Tore Supra data acquisition system (DAS) was designed in the early 1980s and has considerably evolved since then. Three generations of data acquisition units still coexist. Cost and maintenance of different operating systems become expensive. As a result, it was decided to explore an alternative solution based on an open source operating system (OS) with a diskless system for the fourth generation. In 2010, Linux distributions for VME bus and PCI bus systems have been evaluated and compared to Lynx OS™ real time OS. The results obtained allowed to choose a version of Linux for VME and PC platform for DAS on Tore Supra. In 2011, the Tore Supra DAS dedicated software was ported on a Linux diskless PCI platform.
The new generation was successfully tested during real plasma experiment on one diagnostic, called DCEDRE.

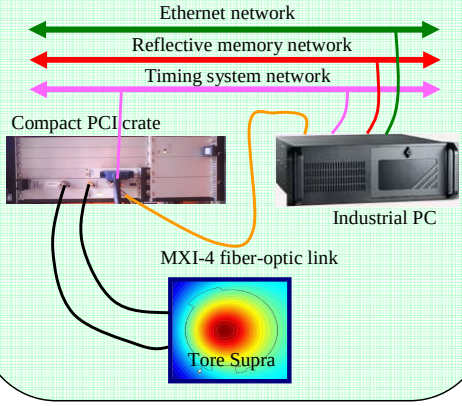
Needs for DAS on Tore Supra

- ✓ RTOS, hard real time behavior
- ✓ Guarantee 2 ms cycle time
- ✓ Support diskless system
- ✓ Large choice of data acquisition board
- ✓ Support x86 and PowerPC architecture
- ✓ MOM RTworks support
- ✓ SCRAMNet® Reflective memory network

Linux for PCI bus system

- ➢ custom solution has been developed
- ➢ PXE boot
- ➢ 2.6.28.10 preemption kernel (low latency desktop)
- ➢ Intel dual core 3GHz industrial PC
- ➢ Compact PCI crate
- ➢ MXI-4 bridge

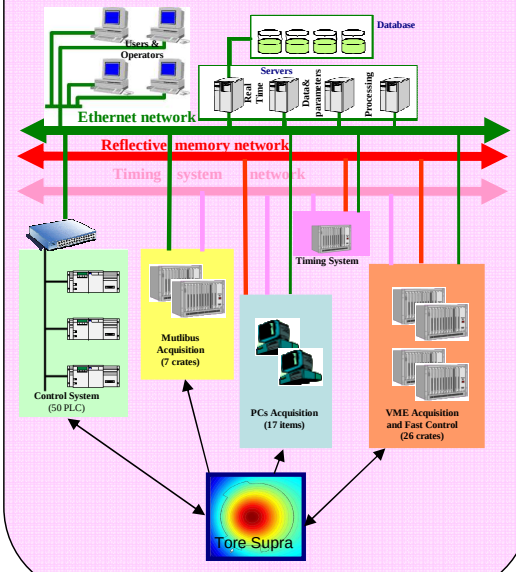
New DAS for Tore Supra



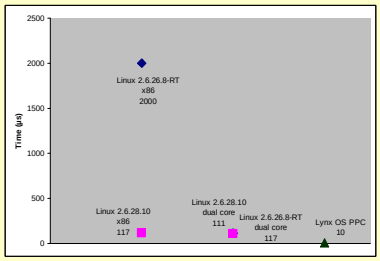
Diskless system on Tore Supra

- ✓- a common kernel
- ✓- a common file system
- ✓- easy updating and backup
- ✓ reliability (no hard disk)

Tore Supra data acquisition system

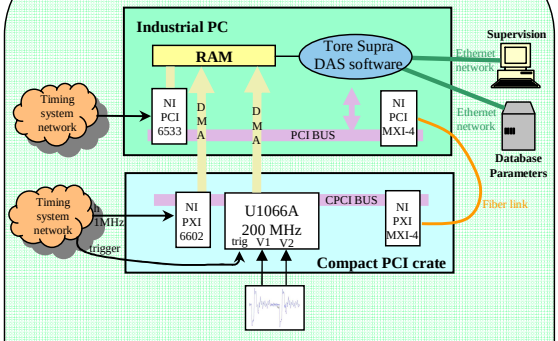


Polling frequency limit



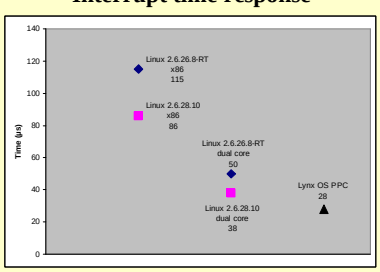
➢ Some VME I/O devices do not generate interrupt → polling device.
➢ To consider more quickly an event than interrupt

New DCEDRE diagnostic



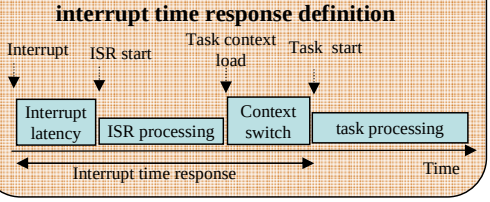
Measuring the full frequency spectrum of electrostatic probes signal during high frequency power injection into the plasma

Interrupt time response



A home made board and driver is used to Generate an interrupt on a periodic event every 500µs

Interrupt latency and interrupt time response definition



Next steps

- ➢ Performance tests with Xenomai in 2012.
- ➢ New diagnostic for plasma control with Linux 2.6 diskless system in 2012.
- ➢ Upgrade data acquisition unit of hybrid heating on Linux diskless system with real time arc detection algorithm 100µs cycle in 2012.
- ➢ For x86 dual core system, to dedicate a core to Linux and the other to Xenomai.

Conclusion

Linux on PCI bus systems fulfils Tore Supra needs for soft real time application. Linux 2.6.28.10 preemptible kernel (low latency desktop) on x86 dual core is the best solution and obtain equivalent performance to Lynx OS on interrupt time response. PCI platforms will reduce the cost of hardware, development time and operating costs. Linux has been used successfully on a new diagnostic for the dust detection in 2010. It can count and quantify the dust sucked into a vacuum duct continuous 24/7. In 2011, the new diagnostic DCEDRE has validated the new diskless PCI architecture with Linux OS on experiences.