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Linux/PCI: The new ESRF beamline control system

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The current instrumentation at the ESRF was developed, almost ten years ago, based on the VME standard and the OS/9 operating system. Even though it has fulfilled in the automated control of the beamline experiments, there is a need of higher performance technologies, among another things, to increase the speed of the acquisitions. The PCI and Compact PCI (cPCI) platforms offer very interesting possibilities in the instrumentation market, and in conjunction of modern industrial PCs, provide a low-cost, good performance solution to the modernization project at the ESRF. Linux has been chosen as the control operating system because it has proved to be a mature Unix-compatible kernel, freely distributed with a vast set of applications, and with a strong support of networking.

This work presents the modernization project of the instrument control at the ESRF. It supports the smooth hardware transition from VME to PCI/cPCI through the use of VME/PCI bus couplers and PCI/cPCI bus extenders. Such devices notably increase the amount of hardware that can be controlled by a single computer, reducing the overhead introduced by the network layer. It also improves the synchronization between different boards by software, making more flexible the configurations and less complex their external cabling. Because SPEC and TACO are still the main control layers, the system can be configured depending on the beamline complexity: from a single PC running SPEC and controlling directly all the hardware, to a completely distributed system for very intensive measurements. New features have been developed in this project, such as the Hook mechanism, a kernel-based buffer for soft real-time acquisition, which can synchronize the reading of boards in different VME, PCI and cPCI chassis. It has been also solved the problem of the enumeration of PCI/cPCI boards, which is made at boot time and hence change when similar boards added or removed. For this, a mechanism that keeps track of the position of the boards in terms of chassis and slot, ensures that the correct physical board is accessed when the user provides its logical identifier. The current instrumentation set up, which will be installed in the next months on the new beamline ID31, is also presented.