Abstract

EPICS is a widely used software framework for real-time controls in large facilities, accelerators and telescopes. Its multithreaded IOC (Input Output Controller) Core software has been developed on traditional single-core CPUs. The ITER project will use modern multi-core CPUs, running the RHEL Linux operating system in its MRG-R real-time variant. An analysis of the thread handling in IOC Core shows different options for improving the performance and real-time behavior, which are discussed and evaluated. The implementation is split between improvements inside EPICS Base, which have been merged back into the main distribution, and a support module that makes full use of these new features. This paper describes design and implementation aspects, and presents results as well as lessons learned.

Ralph Lange
Helmholtz-Zentrum Berlin für Materialien und Energie / BESSY II, 12489 Berlin, Germany
Franck Di Maio
ITER Organization, Route de Vinon, CS 90 046, 13067 Saint Paul-lez-Durance Cedex, France

Improvements

• Enhancement of EPICS thread show routines
  Easier correlation with Linux system level commands

• Parallelization of callback threads
  Less latency, lower queue usage, higher processing throughput

• Rule-based CPU affinity, scheduling policy, and priority settings
  Fine-tuning to run IOC on subset of CPUs, dedicate CPUs to EPICS or external real-time processing, optimize system’s performance

Example rules file:
Run all EPICS threads on CPUs 0-3, but run TestLoop at priority 99 on CPU 4.

Further Possibilities and Plans

• Callbacks for Scan-I/O mechanism
  Add callbacks to the scanIoRequest API, so that drivers know when records have finished processing

• Driver „private“ callback threads
  Add additional user-configurable priorities, so that drivers can use dedicated callback threads, with configurable number of parallel threads and queue depth (depth = 0 directly processes records from driver thread)

The authors would like to thank the ITER CODAC team and the EPICS Base Developers for their cooperation, help, and fruitful discussions.