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Linux RT Training: Embedded and Real-Time

3 days (21 hours)

Presentation

Linux RT (Real Time) is the best solution for adding real-time capabilities to your machines. With the emergence of Big Data, the need for real-time data is exploding. The Linux RT system is transparent, modular and extensible. This means that components can be modified and made visible, functionality can be omitted, and programmers can add additional modules as required. This RTLinux training course will introduce you to the program's architecture, the different types of real-time, hypervisors and the ADEOS and Xenomai domains. Our RT Linux training will teach you about the latest [Linux 4.4](#) version.

Objectives

- Real-time architectures under Linux
- Real-time under Linux and Linux RT
- ADEOS and Xenomai domains
- Real-time hypervisors and hardware virtualization

Target audience

- Developers
- Architects
- Linux system administrators

Prerequisites

Knowledge of a Unix system and C language

Linux RT training program

Introduction to real-time architectures under Linux

- History and evolution of the core
- Latency under Linux Vanilla, Patch RT, Timesys and Montavista
- Nano-kernels and interrupt virtualization
- History and principle of RTLinux and RTAI nano-kernels
- Interrupt virtualization with ADEOS and Xenomai
- History and principles of real-time hypervisors
- Open-source tools, L4Ka and pistachio. The OK-L4 and XtratuM projects

Real-time under Linux

- Introducing Linux Vanilla. Features, benefits and drawbacks
- Real-time application development API with Linux Vanilla
- RT patch application
- Application development with Linux RT
- Linux RT driver development
- Practical: RT patch installation. Developing a real-time application under Linux RT

Flexible real-time

- Fifo and Round-robin
- Timers
- Interruptions
- Classic real-time problems: Launching tasks in parallel, Priority inversion, Mutex resumption
- Creating real-time processes and threads
- Timer precision measurement
- Effect of kernel pre-emptibility on interrupt latency
- Priority inversion test. Priority inheritance. Mute recovery test

Enhanced real-time with Linux-rt

- Linux-rt patch: Principle. Patch by Ingo Molnar and Thomas Gleixner. Kernel compilation.
- Full pre-emption
- Threaded interrupts : Setting interrupt handler priority
- Instrumentation and measurement: RT-test and cyclictst tools
- Compile a kernel after applying the Linux-rt patch. Pre-emptibility check
- Use of cyclictst and comparison with the standard core
- Comparing the behavior of the examples in the previous chapter

ADEOS and Xenomai domains

- ADEOS: application of the ADEOS patch. Application development for ADEOS
- Xenomai: applying the Xenomai patch

- Application development with Xenomai
- Driver development for Xenomai
- Practical work
- Development of a trace tool with ADEOS. Development of a real-time application for Xenomai

Real-time hypervisors

- L4 and OKL4: implementation and configuration of OK-L4. L4Linux configuration
- Xtratum: domain management. Inter-domain communication
- Xtratum: application interface, schedulers, memory management and synchronization
- Installation of a hypervisor, Xtratum and Partikle or L4 and L4Linux. Real-time application development
- Real-time hypervisors and hardware virtualization
- Virtualization techniques for Intel and AMD hardware: using VT-x for virtualization
- Xen example, real-time limitations
- VLX: a commercial real-time hypervisor for Intel and ARM

Companies concerned

This training course is aimed at both individuals and companies, large or small, wishing to train their teams in a new advanced computer technology, or to acquire specific business knowledge or modern methods.

Teaching methods

Practical course: 60% Practical, 40% Theory. Training material distributed in digital format to all participants.

Organization

The course alternates theoretical input from the trainer, supported by examples, with brainstorming sessions and group work.

Validation

At the end of the session, a multiple-choice questionnaire verifies the correct acquisition of skills.

Sanction

A certificate will be issued to each trainee who completes the course.