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RTEL4I (Real Time Embedded Linux for Industries)

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Introduction

RTEL4I project deals about creating a free IDE (Integrated Development Environment) in order to achieve migration from proprietary hard real-time embedded systems (RTOS) to Linux environment easily. Of course same IDE could be used for creating native real-time applications for Linux.

IDE runs on Linux but is “distribution agnostics” as it just needs standard tools (such as GCC, JRE, ...) which are available in most recent (and decent) Linux distributions.

RTEL4I is not targeted in new RTOS definition. In the opposite, we have integrated several free and validated software components such as Linux kernel, GNU toolchain, Eclipse, Xenomai, RTAI, PREEMPT-RT or Busybox in a unified, adaptable and robust environment.

RTEL4I started in November 2008 and ended in June 2011. It was sponsored by DGCIS (Direction Générale de la Compétitivité, de l'Industrie et des Serives), Région Ile-de-France and Ville de Paris through Systematic Cluster (http://www.systematic-paris-region.org). Project was a collaboration between two SME (Open Wide, Mandriva), one large company (SAGEMCOM) and one engineer school (ENSEIRB-MATMECA). Open Wide was initiator and project leader.

Rationale

We started RTEL4I because we noticed our customers – mostly working in embedded systems - had to deal with several heterogeneous SDK (Software Development Kit) as they could get one specific SDK for one supported architecture. As an example some board makers use Buildroot as a build system, some others use OpenEmbedded or the old-fashioned LTIB. Managing such heterogeneous environments is a great problem regarding cost, training and quality insurance.

Most of time, budget for a single project was not large enough to integrate advanced features such as version management or IDE integration. Thus we used to provide CLI (Command Line Interface) based tools and SDK (sometimes) most of time integrated in a well-known build system such as Buildroot.

Of course, there are very good (commercial) products by Wind River or Montavista but they are quite expensive and dedicated to editor's supported architectures.

Description, work packages

RTEL4I project had several work packages :

1. Enhancing SDK and IDE for embedded real-time development
2. Porting Linux real-time extensions to targeted CPU
3. Providing binary packages and a “ready-to-run” Linux distribution (Mandriva Linux)
4. Providing test tools and procedures for industrial validation on real reference boards
5. Disseminating work and technologies

RTEL4I allows to integrate supplier tools (SDK i.e. adapted Linux kernel and toolchain) in a common homogeneous environment. One developer can start a project using Command Line Interface (CLI), some others could use Eclipse and a project manager could get accurate information about project status (i.e. version management, branches) using a simple web browser. The following picture describes RTEL4I layers.

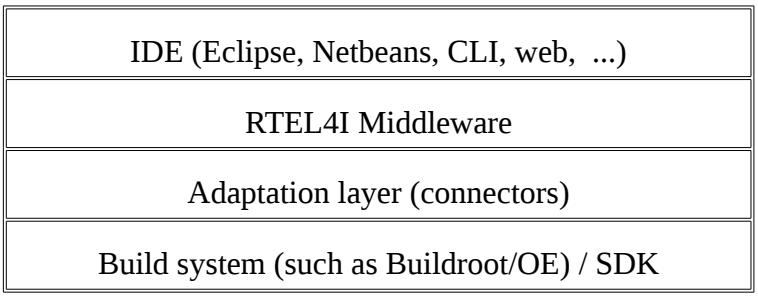

Figure 1. RTEL4I layers

We propose a free and open solution based on a common “middleware” providing an open source API for IDE (Command Line Interface, Eclipse, Netbeans, Kdevelop, ...) and embedded Linux system builders (Buildroot, OpenEmbedded, ...).

RTEL4I provides several components, mainly :

- Real time extensions for several target architectures such as x86/Atom, ARM, SH4 (ST40), Altera NIOS II and Xilinx Microblaze. Main targeted extension is Xenomai (http://www.xenomai.org) but PREEMPT-RT was ported to soft-core CPU such as NIOS II and Microblaze. Working on soft-core CPUs was a great part of the project as nothing was done already though Altera and Xilink are very famous in recent industrial projects.
- Adapted SDK for supporting kernel real-time extensions
- Open-source “middleware” written in Python language.
- Dedicated “plugin” for Eclipse IDE. Eclipse already provides CDT (http://www.eclipse.org/cdt) for C/C++ development but we've added several functionnalities such as advanced version control and branch management. Current version of RTEL4I is based on the powerful and fast Git version control system.
- Web based tool for project remote management (based on middleware too).
- Adapted build system providing general purpose engine for embedded Linux image production. Current supported build system is Buildroot (http://buildroot.uclibc.org) but OpenEmbedded (http://www.openembedded.org) will be supported soon as we “only” need to connect it to the middleware.
- Adapted or original testing/measuring tools for real-time performances measurement. That's a very important part of the project as RTEL4I is dedicated to industrial use. Our industrial partner (SAGEMCOM) did a great job in defining test/validation tools and procedure.

Results & conclusion

RTEL4I ended in june 2011. It's still a research and development tool and we have to work on IDE interface (Eclipse plugin) in order to fix some bugs and performance problems.

Nevertheless we produce great results regarding middleware or low-level porting such as ST40 and NIOS II support for Xenomai or PREEMPT-RT support for Microblaze.

Related links

http://www.rtel4i.org

http://uuu.enseirb-matmeca.fr/~kadionik/microblaze-preempt-rt

http://uuu.enseirb.fr/~kadionik/nios2-preempt-rt

http://uuu.enseirb.fr/~kadionik/nios2-xenomai