Innovative operating system
for the Preon32 series

Features

- Applications can be written in Java™
- Arithmetic operations up to 64-Bit (long, double)
- Support of threads and synchronized statements
- Garbage collection with memory defragmentation
- Exception handling supported
- System properties for configuration of the application

Description

The PreonVM is the virtual machine (VM) by VIRTENIO for embedded systems with very limited resources, like the radio module of VIRTENIO - the **Preon32**. The virtual machine is highly optimized, requires no additional operating system and runs directly on the used microcontroller. The approach permits executing of translated Java™ applications on the radio module Preon32. In this context, VIRTENIO offers its customers corresponding software libraries for the different interfaces.

This approach makes it possible for developers to write applications easily that collect sensor data and control actuators. In addition, the radio interface for IEEE 802.15.4 and AES encryption in hardware are innovative components that are usable easily through the virtual machine.

Product benefits

Current embedded systems with constrained resources have been programmed with lots of effort in specific languages. Implementation of complex applications was time-consuming and had high potential for programming errors. The approach of VIRTENIO brings the convenience of the object-oriented programming language Java and all its benefits into the world of embedded systems. VIRTENIO provides the virtual machine as an innovative operating system for its wireless modules Preon32.

Using a virtual machine, applications for the radio module become independent of the employed architecture. Thus applications run unmodified and without manual modifications on different hardware platforms.
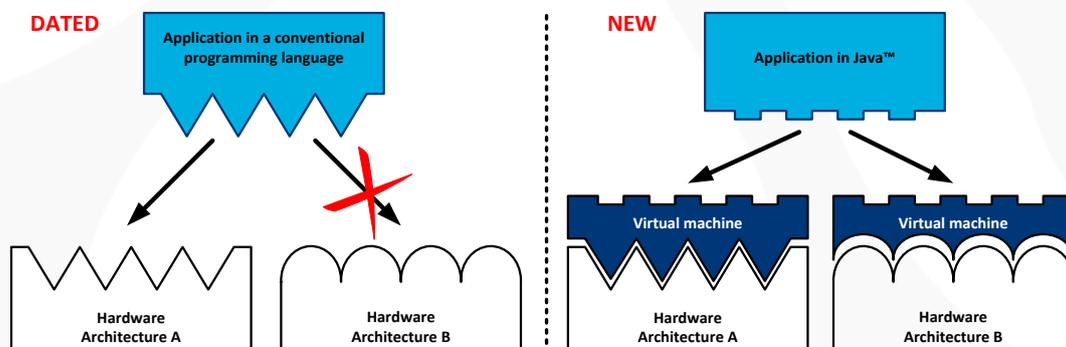

Figure 1: Advantage of a virtual machine on different platforms

Beside this the virtual machine helps to decouple the development process of the hardware and the application software. The application program is developed with abstract interfaces, which remain unchanged over time.

In addition, the virtual machine is optimized to run applications on small 8bit or 32bit microcontrollers with 8 Kbytes RAM and 128 Kbytes flash. The compiled virtual machine has a memory footprint of less than 64 Kbytes in the flash memory.

Preparation of applications for the virtual machine

On the radio module Preon32 the PreonVM is used as the operating software. Applications written in Java ™ can be used on the device after a compilation process as shown below.
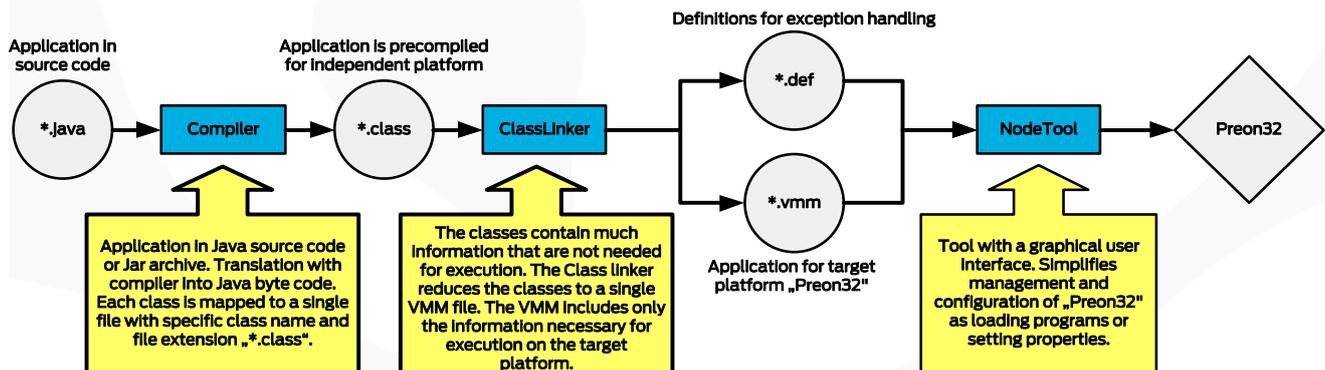

Figure 2: Transformation process for applications written in Java ™

Characteristics of the PreonVM

- Runs on small 8-bit or 32-bit microcontrollers
- Requires less than 64 KByte ROM / flash
- No additional operating system necessary (Bare metal approach)
- Support of all Java data types like `char`, `byte`, `int`, `long`, `float` or `double`
- Garbage Collector including defragmentation of memory
- Support of threads, including `synchronized`, `Object.wait`, `Object.notify`, `Object.notifyAll`, `Thread.sleep`, `Thread.interrupt`
- Support of exceptions, stack traces, multidimensional arrays, dynamic type checking
- Support of fast native methods
- Support of an event concept for synchronous and asynchronous events
- Compiles Java™ classes into system modules with small program size
- Easy portability to other platforms with minimal hardware dependency
- Support of different stack models depending on the used system

ClassLinker modules

- Classlinker of VIRTENIO compiles and links Java™ classes to modules (.vmm)
- Modules can import other modules
- Modules can be used as a library or an executable program
- Modules require only about 25% of the total size of all of its contained classes

Classes and driver library

- Runtime Library requires 20-30 Kbytes ROM / flash
- Highly compatible with many standard classes
- Driver Library for internal and external interfaces and peripherals such as sensors and actuators

Target systems

- Requires microcontrollers with more than 128 Kbytes ROM 8 Kbytes RAM and with 8 -, 16 - or 32-bit