Get the best out of embedded -
Oracle Optimized Java SE for Embedded Platforms

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1 Key Words: Java, Java SE, Embedded, Linux

2 Introduction

Embedded Java was for a long time dominated by down-sized versions of Java, rightly called micro editions (Java ME), forcing developers to acquire new expertise and live in a more complex world. However, this has changed in the last few years with the arrival of more powerful embedded hardware and operating systems. Sun, in recent years, had invested in extending the reach of Java into the Embedded World, but Oracle has now increased this investment, much of which is focused on the Java Standard Edition (Java SE) for embedded Linux projects. The objective is to create the best development experience for embedded projects.

The presentation will start with an overview of Oracle's technology for the embedded space, followed by an introduction to Oracle Java SE for Embedded solutions. We will be looking at different industries and markets. We will discuss technological features, optimizations for the embedded environment and underlying platform requirements. Best practices for deployments will be covered and existing deployments presented.

3 The Embedded Market

1997 was an important year for the embedded microprocessor industry, the year the number of embedded CPUs sold reached the number of CPUs sold for PCs and Servers combined. It was also an important year for the new "language kid on the block", Java; being only two years old and at version 1.1, Java got its own developer conference, JavaOne; with 8,000 visitors it was then the biggest in the world. Java also gained its first smaller sibling, JavaCard 2.0 which was to dominate the SIM Card market. The following year Java for Embedded was released, which would later become Java ME (Micro Edition), dominating the mobile developers' experience.

Since then the internet has become the main driving force of IT innovation. Today around 11 Billion Embedded CPUs/year[1] are being produced; this is more than five times the number for desktop and server combined. Processing power, RAM and ROM are now also at a level where pico or micro are no longer needed.

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[1] See VDC Research Group, website

4 Java SE for Embedded Systems

When Java ME was designed, memory, speed, footprint and OS conditions were very much different from today, forcing designers to use different paradigms for Java VMs and the APIs. Unfortunately, this also forced developers to become familiar with a different Java Environment and broke the “develop once run everywhere" promise.

A few years ago Java SE for Embedded was created. It allowed for the first time software architects to design an embedded system solution (almost) identical to the desktop. Java SE for Embedded available for embedded systems running ARM, PowerPC or x86 (see Picture 1) is the optimized variation of the well known Java SE hotspot with (most) of the improvements and features.

Processor	Operating System	Headless or Headful	FPU	Java SE Version
ARMv5	Linux	Headless	SFLT	1.6.0 U21
ARMv5/v6/v7	Linux	Headless & Headful (v7)	VFP	1.6.0 U21
PowerPC	Linux	Headless	Book-E	1.6.0 U21
PowerPC E500v2	Linux	Headless	SPE	1.6.0 U21
x86	Linux	Headless	X86	1.6.0 U21

Picture. 1: Java SE Embedded Target Platforms (Nov. 2010) Source: Oracle Inc, November 2010

5 The Technology of Java SE for Embedded Systems

Although Java SE embedded versions are almost identical to their desktop-siblings, some optimizations also address embedded needs.
Java SE embedded versions

- are optimized for a reduced RAM/ROM/Flash footprint,
- come in headless and headful configurations
- are optimized for embedded CPU architectures
- are “tuned” for embedded system requirements (startup time, GC etc.)

The size reduction, allowing Java SE embedded to run on systems with no more than 32 MB RAM (for Java VM) for headless configurations, has mainly been achieved by removing some depreciated code, some optional libraries (like RMI) and by compacting library files. For the developer there is no different experience as the embedded versions of Java SE are fully compliant to the Java SE TCK, i.e. they are identical to their well known desktop brothers.

Other optimizations are being pursued to improve the deployment, the experience and the operation of Java VM on the embedded system. Most of these optimizations are a joint effort with the vendors of the CPUs to guarantee an optimized solution. New features, such as multiprocessor support, dynamical recognition and support of special CPU features are continuously being added and optimized.

6 The Benefits of Java SE for Embedded Systems

Today, Java is the dominant development language and environment in the world, with over 9 million Java developers world-wide. Billions of lines of Java Code (many are open source-based) and thousands of libraries make this the most effective development environment existing. This, and the fact that you can have one code base for server, desktop and embedded systems, allows for much faster time to market, lower development costs and better maintainability.

Another big benefit of Java is that the HW (and to some degree OS) abstraction allow you furthermore to separate HW selection and development cycle from the SW development cycle. This gives you better return on investment, more flexibility and it is easier to adapt to new trends in the market.

7 How to get most out of Java SE for Embedded Systems

The Java SE for embedded VM has many features and optimizations. In the presentation different areas will be introduced, such as

- Processor optimizations
- Memory optimizations
- Garbage collection
- Multiprocessor support

The presentation will introduce these features in some detail and give some pointers on how to get the best optimizations.

8 Some word on Licensing

Java SE from Oracle, including the well known desktop binaries and the special embedded binaries, are commercial products governed by their respective licenses. The talk will give a short overview of these licenses, when/where they are applicable and what conditions they impose on the licensee, and introduce the commercial model.

9 The Market of Java SE for Embedded Systems

Since their advent in 2005 Oracle's Java SE solutions have been deployed in many projects and markets. From consumer-oriented Netbooks and Tablets to M2M oriented network equipment Java SE has been tested, integrated and deployed. With the increasing power of embedded systems, penetration is growing every minute. Especially hot markets are "smart grid", "M2M" and automation at the moment.

10 Conclusion and Outlook

Java SE for embedded systems is, simply put, the best development environment for embedded systems at this time. Oracle is investing considerable resources to drive this advantage and to broaden the footprint in the market. The talk will aim to address the general direction of this investment in the near future.

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