Connected Limited Device Configuration HotSpot™ Implementation

Version 1.1.2 for the Java™ 2 Platform, Micro Edition

Key feature highlights

- Optimized implementation of a virtual machine supporting Connected Limited Device Configuration 1.0 and 1.1 specifications for the Java™ 2 Platform, Micro Edition (J2ME™ platform)
- Delivers significant performance enhancements in this latest 1.1.2 release
- Optimized for the ARM processor architecture
- Portable to a wide variety of target environments
- Provides extensive porting documentation to reduce time to market and lower deployment cost
- Offers a configurable architecture to optimize runtime performance, startup time, and footprint
- Integratable with the Sun Java™ Wireless Client 1.1.2
- Provides optional support for multitasking (multiple running MIDlets)

With the rapid adoption of mobile devices based on Java™ 2 Platform, Micro Edition (J2ME™) technology, wireless carriers and handset manufacturers are demanding higher levels of performance. To meet these demands, Sun offers Connected Limited Device Configuration (CLDC) HotSpot™ Implementation, Sun's high-performance Java virtual machine for wireless phones and communicator-type devices.

As the mobile data services market continues to mature, applications are becoming more sophisticated and end users are demanding better user experiences and more responsive applications. Because of this, wireless carriers, and in turn handset manufacturers, require greater performance and flexibility that will allow them to differentiate their offerings. And for handset manufacturers in particular, the rapid evolution and competitiveness of the mobile data services market has increased the pressure to improve product development efficiency and, at the same time, dramatically reduce cost and time to market.

Today, Sun is investing extensively in next-generation J2ME solutions that provide high-performance and feature-rich implementations while reducing porting and deployment costs. And CLDC HotSpot Implementation is an excellent example of just that.

The first generation of Java technology-enabled wireless devices was based on the K virtual machine (KVM) and delivered as part of Sun Microsystems' CLDC Reference Implementation. In contrast to the Reference Implementations, Sun's new solutions offer optimized software implementations targeted at specific device environments. CLDC HotSpot Implementation is such a solution, focusing on the emerging generation of wireless phones and communicator-type devices. Products based on CLDC HotSpot Implementation can achieve the maximum practical levels of performance in this segment.

CLDC HotSpot Implementation is compliant with J2ME Connected Limited Device Configuration (CLDC) 1.0 and 1.1 specifications. It is pretested and can be integrated with the Sun Java™ Wireless Client 1.1.2 for optimal full-stack performance. The Java Wireless Client 1.1.2 is an optimized implementation that focuses on performance, footprint, portability, and extensibility. Together, these optimized implementations offer unique, patented features that provide enhanced user experience as well as a software architecture designed to help reduce porting efforts.

Sun's optimized CLDC HotSpot Implementation allows you to choose the best options for your product by allowing extensive configuration and tuning.

Goals for Optimized Implementations

The goals of optimized implementations are to provide a high-performance, high-quality, and flexible implementation that reduces cost and time to market when porting J2ME wireless technologies to targeted handsets.

- *High Performance* — Essential for responsive, interactive user experiences in Java applications
- *High-Quality Code* — Emphasis on extensive internal testing and documentation; enhances quality in terms of code design and portability
- *Flexibility* — Necessary to cater to different devices with different processors, operating systems, and native hardware services

CLDC HotSpot Implementation Dynamic Compiler

To support higher levels of Java application performance, CLDC HotSpot Implementation has always delivered a large boost in performance as compared to conventional virtual machines. This is made possible by CLDC HotSpot Implementation's dynamic compiler, which compiles selected methods — recognized by the virtual machine as *hot spots* — to boost performance by nearly an order of magnitude. Other methods are executed by the very fast bytecode interpreter of CLDC HotSpot Implementation. In addition, CLDC HotSpot Implementation has always included superior garbage collection mechanisms.

Tuning for Optimization

Typically, performance and "footprint" in software are in conflict. This is due in large part to the fact that making software fit in a smaller memory size often makes it slower, while enhancing performance often makes the code size larger. Sun's optimized CLDC HotSpot Implementation reconciles these opposing goals by allowing extensive, customized configuration and tuning of optional features.

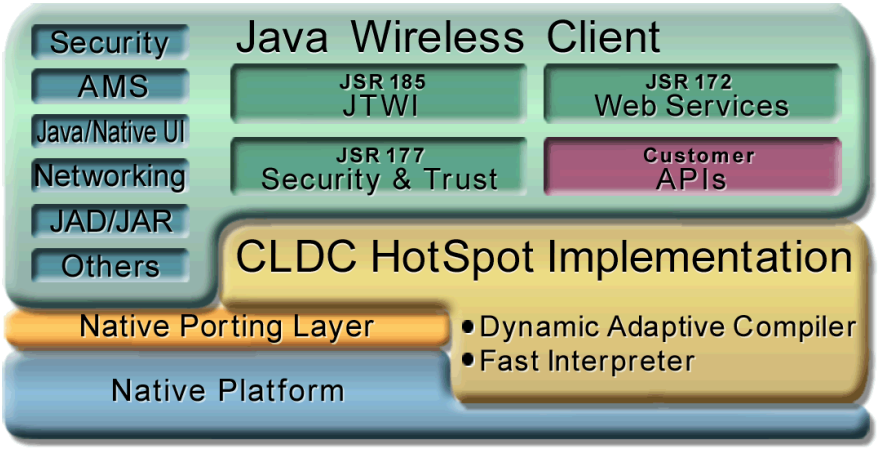

Figure 1: CLDC HotSpot Implementation and Full Stack

The architecture of CLDC HotSpot Implementation also enables the implementation to achieve its goal of flexibility. Device manufacturers can readily cater to their specific market and user needs by choosing the features that they need and tuning the corresponding options when building for their device.

For example, for slower processors (30 MHz and upwards), the virtual machine can be configured to invoke the dynamic compiler less frequently. There are an abundance of well-documented build and tuning options.

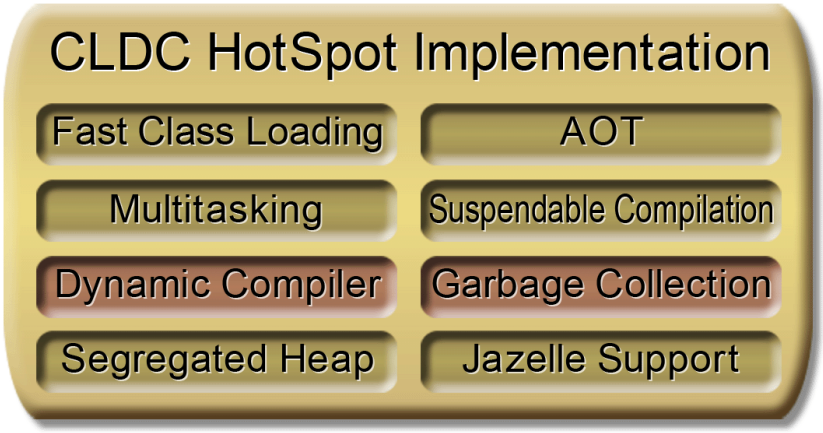

Figure 2: CLDC HotSpot Implementation Key Features

Upgraded Performance in this Release

Several new features are included in the 1.1.2 release of CLDC HotSpot Implementation to further enhance performance.

- Ahead-of-time (AOT) compilation of Java methods
- In-place execution (formerly known as Project Monet)
- Performance enhancements verified with industry-standard benchmarks such as the Embedded Microprocessor Benchmark Consortium (EEMBC)
- Minimal pauses due to improvements in compilation and garbage collection
- Thanks to the Sun/ARM collaboration, CLDC HotSpot Implementation now provides full integration with Jazelle hardware acceleration on enabled ARM processors. (Use of this feature requires a separate license from ARM Ltd.)

Features of CLDC HotSpot Implementation

AOT Option

Ahead-of-time (AOT) compilation can be used to significantly reduce startup times. In this release, only Java methods in system classes may be AOT-compiled. Such classes are compiled and ROMized during the build process on the development host.

In-Place Execution

This new feature allows handset manufacturers to transform selected Java application class files into a directly executable format known as an *application image*. An application image is loaded directly into the Java heap for execution, greatly reducing application startup time and dramatically increasing execution speed.

Shorter Execution Pauses

A number of new techniques have virtually eliminated noticeable pauses in execution. This is accomplished through:

- *Suspendable Compilation* — Execution continues with bytecode interpretation
- *Segregated Heap Architecture* — Separate heap areas for compiled methods
- *Improved Garbage Collection* — Each heap area is managed separately for garbage collection

Multitasking Option

To further increase opportunities for product differentiation, this release of CLDC HotSpot Implementation includes optional support for multitasking — running multiple MIDlets concurrently. This permits, for example, a running MIDlet to be suspended temporarily so that another MIDlet can alert the user about an incoming e-mail or instant message.

Connected Limited Device Configuration HotSpot™ Implementation

Out-of-the-Box Support on a Variety of Platforms

- Linux on ARM and x86 processors
- ADS on ARM, BigARM, and Thumb processors
- Microsoft Windows 2000 (for basic prototyping)

Source Code Release With Support for a Variety of Additional Platforms

- Intel XScale

Ease of Porting

To help ensure ease of portability, Sun continues to make improvements in the portability of CLDC HotSpot Implementation. In fact, even the porting documentation has been improved in this release as a part of this effort.

Serious Software Made Simple

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For More Information

To learn more about the J2ME platform and Connected Limited Device Configuration HotSpot Implementation, please visit java.sun.com/j2me.

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