Waratek® Cloud VM for Java

Technical Architecture Overview

White Paper

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TECHNICAL ARCHITECTURE OVERVIEW

INTRODUCTION

This document provides a brief high level overview of the architectural characteristics of the Waratek® Cloud Virtual Machine (VM) for Java innovation that makes possible the cloud solution that Waratek laboratories deliver.

Waratek, the Cloud VM for Java, is a Java-compatible Virtual Machine (JVM) based on Oracle HotSpot. Unlike conventional JVMs, the Waratek Cloud VM incorporates special design features that are responsible for 'cloud-ifying' the virtual machine for all normal Java applications, without requiring any code change to an existing application.

The rest of this short paper introduces the innovatiove design behind the Waratek Cloud VM which brings multitenancy, scalability, elasticity, and utility metering to the Java Platform without requiring any changes to your existing applications or future development efforts.

THE WARATEK CLOUD VM FOR JAVA

The Waratek Cloud VM for Java can be visualized as 3 distinct functional layers: virtual machine, platform extenders, and virtual containers. As Exhibit 1 shows, the virtual mahine layer hosts the platform extends and virtual container layers, supporting their innovative features through a specially designed Java virtualization engine. The virtual machine layer provides all of the standard capabilities and libraries expected from a 100% compatible TCK compliant JVM, ensuring compatibility with existing Java applications.

Any standard Java application can run on the Waratek VM with no alteration required. This is a huge departure from previous attempts to solve the issues of Java multitenancy, all of which rely on breaking Java compatibility or supporting only a limited sub-set of the standard Java libraries.

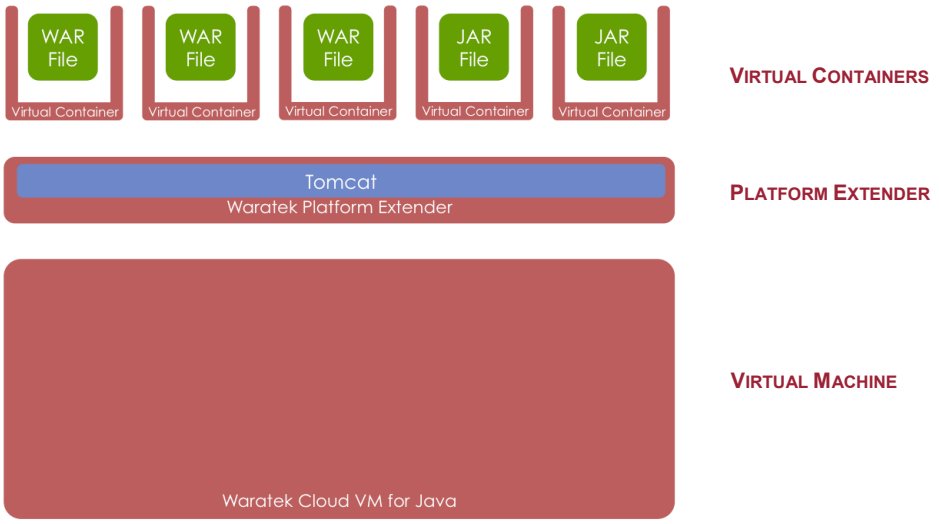

Exhibit 1: Three Part Structure of the Waratek Cloud Solution

WARATEK PLATFORM EXTENDER

The Platform Extender layer operates as an extension to the JVM to facilitate tailored multitenancy for different application frameworks. In Exhibit 1 the Platform Extender illustrated is the default Tomcat Platform Extender for the Apache Tomcat Servlet Container.

Multiple Platform Extenders are available for optimised multitenancy with leading application server suites such as JBoss, WebLogic, etc. The Platform Extenders complement existing application server suites, by decoupling a virtualized tentant application from the hosting application server suite on which it runs.

WARATEK VIRTUAL CONTAINERS

The central feature for supporting robust multitenancy within the Waratek Cloud VM are the Java virtual containers (VC) provided by the virtual containers layer. The Java VC layer virtualizes the Java Platform similar to how a hypervisor virtualizes a physical server.

A Java VC is a light-weight form of metacircular virtual machine which behaves and operates like its own logical JVM, or can be configured in novel virtualized arrangements for new and exciting multitenancy models. Each Java VC presents a virtualized abstraction to the hosted application of the underlying JVM and application server platform (if any), and appears invisible to the hosted application software within. Java VCs are extremely lightweight at less than 1 megabyte overhead per virtual container, meaning a single Waratek Cloud VM can host tens of simultaneous VCs.

In the example below (Exhibit 2), three special-purpose "servlet VCs" and two general-purpose Java VCs are deployed. Which types of Java VCs are supported within a given configuration is controlled by the particular platform extender loaded at that time.

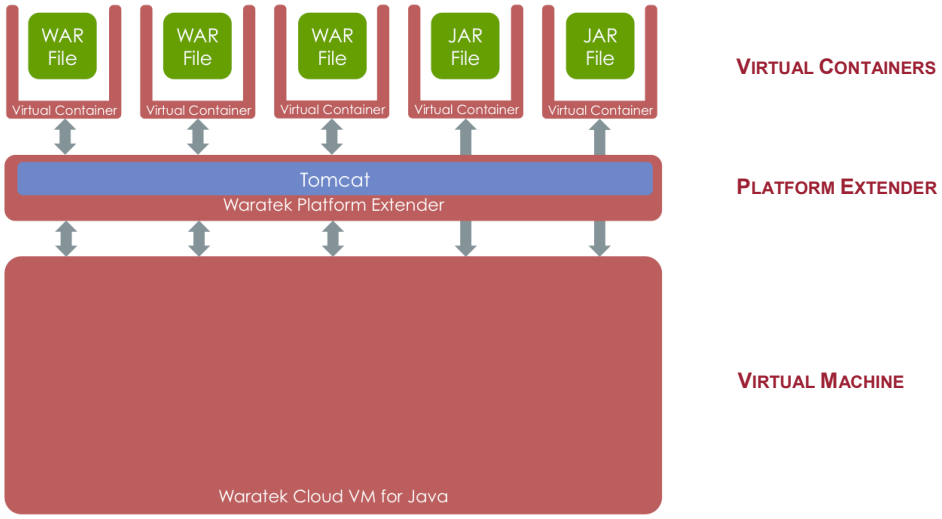

Exhibit 2: Internal Communications and Application Isolation

INTERNAL COMMUNICATIONS

The arrangement in Exhibit 2 above allows the Waratek Cloud VM for Java to bring true cloud capabilities to the Java Platform.

Java virtual containers virtualize the entire software stack (application server suite, JVM, and operating system) on which a Java application operates. Java applications deployed to a virtual container enjoy a secure virtual Java environment isolated from neighbouring application

tenants, and from the complexities of the platform and infrastructure services on which they are hosted.

With Java virtual containers, multiple mutually-distrusting Java applications can be hosted within a single JVM without sacrificing security, stability, or efficiency between neighbouring virtual containers.

By isolating tenant applications from one another and the hosting application server platform and JVM, this allows individual tenant applications to be unaware of one another and to appear to be the only tenant application operating on that server. The application server platform and JVM can then be safely shared across multiple tenant applications without increasing operational risk.

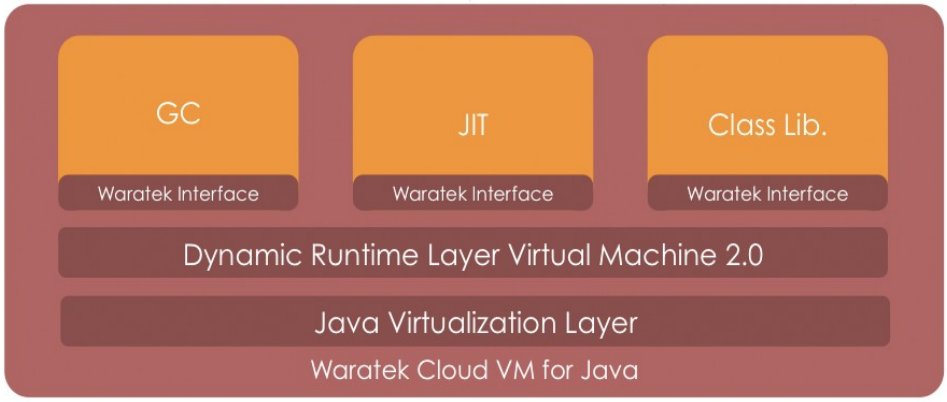

Exhibit 3: Composition of the Waratek Virtual Machine

VM COMPOSITION

The underlying Waratek VM is the engine that powers all of the capabilities that Waratek brings to Java. It contains all of the standard elements that any modern JVM provides.

- Automatic garbage collection services
- Static and dynamic Just-In-Time compilation support
- Standards-compliant Java class libraries

The Waratek VM is specially designed to support interoperability with existing leading JVM components of leading conventional JVMs, allowing 80% of the VM layer to use existing industry available components already tested and in production use today. The Waratek Interfaces integrate these components into the core of the Waratek Cloud VM.

The Dynamic Runtime Layer Virtual Machine (DRLVM) serves as the architectural core of the Waratek VM, interconnecting each of the three categories of JVM components together in a specially-designed virtual machine framework. DRLVM is an extremely flexible software framework

capable of changing and switching individual JVM components statically and at runtime.

JAVA VIRTUALIZATION LAYER

The Java Virtualization Layer is the centerpiece of the Waratek Cloud VM for Java, managing and operating all of the hosted VCs and providing console access to manipulate the virtual containers. A specially-designed "Java virtualization interactive terminal" – jirsh – is built into the virtualization layer software and provides the administrator of the system the ability to control and monitor the behaviour of the entire system in realtime.

As every aspect of the VC execution is isolated, it allows administrators to have fine-grained control over core execution and consumption parameters for each virtual container, just as they do today for virtual machines.

Using the Waratek console, administrators can define CPU priority, memory limits, and bandwidth quotas etc, as well as measure every aspect of individual VC execution, such as CPU consumption measured in gigahertz-hours (GHz-h) like electricity consumption is measured in kilowatt-hours (kW-h).

The Waratek Cloud VM for Java is designed to provide an open framework for extensible and customizable Java virtualization and multitenancy through specially-designed Java virtual containers. Enhanced and special-purpose Java VCs can be created using Waratek APIs, such as "servlet VCs" for hosting ".war" web-applications. A range of Platform Extensions adding new application server and language support capabilities such as Scala, Python, Ruby, and Groovy will begin to be released this summer.

CONCLUSION

In summary, this high-level overview provides a brief introduction to this new breed of Java virtual machine designed specifically for cloud computing environments. As it can be seen, the innovative design of the Waratek Cloud VM for Java not only offers Java application users full unabridged benefits and efficiencies that cloud computing stands for, but also continues the Java promise – 'write-once-run-anywhere' – for those enterprise level Java investments wishing to migrate to the cloud.

For further technical material on Waratek, our Cloud VM product, please contact us on enquiries@waratek.com. Also take the time to register for our Newsletter and be regularly updated on the launch schedule of forthcoming releases.

ABOUT WARATEK

A dynamic start-up, Waratek is a 30-strong team of seasoned IT professionals, drawn from around the world to a Dublin headquarters where extensive and revolutionary research has led to more than 50 international patents culminating in game-changing cloud technology. The company is focused on providing enterprise customers, data centres and cloud providers with disruptive technologies to advance the performance and reliability of application infrastructure while significantly reducing costs.