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JavaOneSM
Sun's 1999 Worldwide Java Developer Conference*

JAVATM
TECHNOLOGY

EAT BREATHE

LIVE PLAY

Bill Joy

Founder and Chief Scientist
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JavaTM + JiniTM Technology: Driving the Business of Innovation

Four Key Technologies

- **Objects everywhere**
- **Spontaneous networks**
- **System on Chip**
- **Immersive Media**



Goal From Java Language Spec Preface

- [The] Java ... language [is] specifically designed to have as few implementation dependencies as possible. Java language allows application developers to write a program once and then be able to run it everywhere on the Internet.



Goal From Java Language Spec Preface

- We intend that ... all implementations of Java technology will accept the same programs. Except for timing dependencies or other non-determinisms and given sufficient time and sufficient memory space, a Java technology-based program should compute the same result on all machines and in all implementations.



Java Technology: Key Technical Ideas

- **A Better Language**
 - **Simplicity and C/C++ Compatibility Promote Fluency**
 - **GC and Threads Allow Software Components**
 - **Platform Independence Saves Time**
 - **Strong Typing Catches Errors Up Front**
 - **Declared Exceptions Forces Coverage in Code**



Java Technology: Key Technical Ideas

- **Scalable Applications**
 - **Threads for Parallel Speedup; Patterns “in the Large”**
 - **Dynamic Linking Allows Simple Apps to Grow**
 - **Range of Implementations from Java Card™ technology to Java HotSpot™ performance engine**



Java Technology: Some Futures

- **Soon: Volume Deployment in Non-PC Clients**
 - **Handhelds: Everybody's Personal Network Device**
 - **Screenphones: Net Access without Pain**
 - **Settops: Immersive Entertainment and Shopping**
 - **Can write @ 2x C++ w/ less bugs; Goal: 10x by 2005**



Java Technology: Some Futures

- **Enhancements for Specific Markets**
 - **Real-time Extensions for Embedded Systems**
 - **Parameterized Types in Language Catch Errors Early**



Java Technology: Some Futures

- **Numerical Programming Extensions Being Considered**
 - Fused multiply-add, directed rounding and interval arithmetic
 - Support for new user-defined numeric types
 - Numerical exception handling



Jini Technology Vision: Simply Connect

- **Moore's Law Driving To System-on-a-Chip**
 - **Embedded Devices: e.g. 100's in Cars**
 - **Personal Devices: e.g. Handsets**
- **Wired / Wireless Networks Will Be Ubiquitous**

Jini Technology Vision: Simply Connect

- **Allow Communities of Devices to Work Together**
- **Use Principles of Distributed Systems**
- **Design a Simple "BIOS" for Age of Devices**



Jini Technology: Key Technical Ideas

- **Each Device / Service Represented by an Agent**
 - **Defined as Java Type**
 - **Much Simpler than Specifying as a Network Protocol**

Jini Technology Futures

- **Continue Defining Standard Services**
- **Working on “Service Sets”**
- **Additional Layers / Class Libraries for**
 - **Agent Mobility**
 - **Rule-Based Context Triggers (Space / Time Aware)**
 - **Common Sense Reasoning about Context**



Pico Vision: Deep Embedded

- **Systems on a single chip**
- **Want Java/Jini technology for reliability/connectivity**
- **Want lowest area, cost, power**
- **Solution: Bytecode machine, Java technology support**



Pico: Key Technical Ideas

- For systems on a chip, fraction of die
- Great for limited media systems
 - Device without media rich input/output
 - Embedded devices with local control, network only

Pico Today

- Evaluation boards available
- IP on the web
 - Under community source
 - Anyone can download
 - Universities can use for research
 - Several companies developing sys-on-chip

Java to a TeraOp: Immersive Media

- Moore's Law continues about 1000x more
- Qualitative, not quantitative

'Any sufficiently advanced technology is indistinguishable from magic'

Arthur C. Clarke



Java to a TeraOp: Immersive Media

- Inexpensive media-intensive systems possible
- Conventional system architectures
 - Expensive (per chip compared to, say, DRAM)
 - Limited performance on immersive applications



Java to a TeraOp: Key Technical Ideas

- **Simple Architectural Step-Repeat**
 - Multiple identical functional units
 - Multiple processors on a chip
- **Inexpensive**
 - Keep CPUs small so can have many per chip

Java to a TeraOp: Key Technical Ideas

- Design for immersive applications / algorithms
- Support rich set of media datatypes and operations
- Very simple design for very high clock rate

Java to a TeraOp: Applications

- Graphics accelerators
- Media-rich thin clients
- Interactive entertainment
 - Game machine, settops, arcade, theme park
- Real-time stream media processing

Enablers: New Business Practices

- **Java Community Process**
 - Stakeholders Define Platform, Audited Formal Process
 - See [http://java.sun.com/about java/communityprocess/](http://java.sun.com/about/java/communityprocess/)



Enablers: New Business Practices

- **Sun Community Source License**
 - **Best of Proprietary and Open Source Models**
 - **Additional Right: Innovators can Profit, Responsibility: Compatibility**
 - **Source Code Easily Available, Fees for Commercial Use / Branding**
 - **See <http://java.sun.com/products/jini/licensing>**



Enablers: New Business Practices

- **Jini Community (Competition)**
 - Modeled after VISA (\$ Exchange): Object Exchange
 - See <http://www.jini.org>



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