

Java in the Internet of Things: Small, Smart, Connected

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Program Agenda

- The 3rd IT Revolution: Tackling the Opportunity
- Java: The Platform for the Internet of Things
- Oracle Java ME Embedded 3.2
- Demo
- Outlook and Wrapping Up



The 3rd IT Revolution: Tackling the Opportunity







The 3rd IT Revolution is Happening Now

Explosion of Devices and Data







1990 Few Internetconnected devices 2010 12 billion Internetconnected devices 2025 1 trillion Internetconnected devices



Major Changes Driving the Embedded Space

Confluence of Multiple Factors

Technology Advancement	Hardware getting smaller, cheaper, more powerful
Connectivity	Everything is becoming connected: Wired or wireless, permanent or intermittent
Value Shift	From hardware-centric view to increasing value of software and connectivity
Industry Movement	Competition, time to market, flexibility, scalability, longevity, horizontal platforms – not point solutions



Internet of Things: Everything Connected



Looking Behind the Covers

Complex network of smart devices communicating with business applications



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IoT Development is Different

What keeps you awake at night?

- Multitude and variety of devices
- Security, privacy, reliablity
- Remoteness, no human control
- Long device lifecycle
- Connectivity, cost, infrastructure, bandwidth
- Device cost, power requirements

- Provisioning, management and monitoring
- Data flow and analytics
- Interoperability and standards
- Developer productivity
- Development cost, skill sets, re-use
- Time-to-market



Enabling the Ecosystem

Stop reinventing the plumbing!

Moving from proprietary point solutions to horizontal platforms and infrastructure:

- Application platform
- Security
- Connectivity
- Managability
- Interoperability
- Back-end integration
- . Tooling





Java: <u>The</u> Platform for the Internet of Things





The Full Picture: Device to Datacenter

End-to-End Data Flow, Security, Management, Integration





Java: The Platform for Device to Datacenter

A single development architecture across all domains



Java Technology Benefits

Portability	Developer Ecosystem	Single end-to-end development platform
Software Updatability	Security	Standards-based
Proven	Off-the-shelf components	Trusted vendor



Java Compared to Native Solutions

For Small Embedded Systems

	Oracle Java	Native
Cross-platform/multi-architecture	Yes	No
Sandbox security model	Yes	No
Robustness	Excellent	Varied
Multi-tasking/multi-threading	Built-in	Add-on, platform- specific
Customizable	Yes	Yes
Performance	Optimized	Varied
Updatability	Excellent	Varied
Efficient, scalable development model from small embedded to large systems	Yes	No
Developer Community	Large	Fragmented
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Small Embedded Devices

Java ME Embedded supports future-proof solutions

Java ME Embedded

Robust and secure
Long life remote operation
Feature-rich
n-field updatability
Local Intelligence
Low footprint / power aware
Up-stack value
Economies of scale
H/W-S/W independence

Controlled app execution

Monitor, manage, update



Wide API and protocol support Update function throughout lifetime Utilize local computing power Size-optimized features and APIs Build with commodity components Open, standardized, interoperable Platform independent applications



New Embedded Releases



Introduction into Oracle Java ME Embedded 3.2





Oracle Java ME Embedded Focus



Oracle Java ME Embedded

High-performance Java runtime for small embedded

Designed for Small Embedded

- Complete Java runtime optimized for lowfootprint ARM architecture devices
- Portable, extensible architecture to address diverse embedded requirements
- · Dedicated embedded features and APIs



Latest Java ME platform

- Best-in-class multitasking VM
- APIs to support connectivity, encryption, location, and web services
- Based on proven, widely-deployed technology



Flexible, long-life services

- Extend system life via remote software update preserving system integrity and certification
- Cross-platform, modular applications
- Distributed processing through Java end to end



Best-in-class tool chain

- Java ME SDK tools and emulation
- Netbeans and Eclipse IDE support
- Live, Java-level debugging on device





Oracle Java ME Embedded 3.2 Device Profile

Targeting wireless modules and horizontal M2M

Aspect	Description
System Architecture	ARM architecture SOCs incl. ARM9, ARM11, Cortex-M, -R, and –A
Device Type	Resource-constrained, headless, always-on
Operating System	Simple embedded kernel or more capable OS/RTOS
Connectivity	IP-based wired (Ethernet) or wireless (cellular or other) Including multiple access points
Peripheral I/O	Versatile access to peripheral I/O Serial, file, GPS, I2C, SPI, I2C, GPIO, memmap
Footprint	Minimum configuration (custom) approx. 130 KB RAM/350 KB ROM Full, standard configuration approx. 700 KB RAM/1500 KB ROM



Oracle Java ME Embedded

Unique and dedicated features for embedded

Highly Optimized Embedded Remote Low-footprint **Extensions** embedded targets VM Operation Multi-tasking VM Fully headless Remote • Supports operation application microcontroller- Robust, 24x7 deployment and class systems operation • Wireless and management Portable and wired connectivity Tuned for low Automatic start-up configurable footprint and Direct access to and recovery efficiency hardware from Verv low Remote requirements, Java In-field VM monitoring starting at • Extensibility by configurability options OEM or integrator • 350 KB ROM • 130 KB RAM



Example Use Cases

Enabling products and services across different market segments



Wireless Modules

Industrial Control



Smart Meters/Smart Sensors



Medical: eHealth & TeleHealth



General Machine-to-Machine (M2M) and IoT systems



Tools – Developing Efficiently

Java ME SDK and IDEs

- Java ME SDK
 - Tools and emulation for rapid development of embedded Java ME applications
- NetBeans & Eclipse Plug-ins
 - Integration with Java ME SDK
 - On-device deployment and debugging
 - Full-featured, integrated development environment for embedded
 - Same familiar toolchain for Java SE and Java EE development



NetBeans + device emulation



Platform Support

- Emulation runtime for Windows desktop systems
 - Complete product implementation, including I/O emulation
 - Integrated with Java ME SDK 3.2, NetBeans, and Eclipse
 - Available now through OTN under evaluation license
- Reference binary for ARM Cortex-M3/M4
 - Complete, ready-to-run executable for KEIL MCBSTM32F200 evaluation platform
 - Coming soon through OTN under evaluation license
- Other platforms
 - Cinterion modules, Qualcomm IoT dev platform
 - Other specialized platforms: Contact Oracle or an Oracle partner



ARM KEIL Microcontroller Eval. Platform

Easy evaluation and prototyping with Oracle Java ME Embedded

- Evaluation Board: Keil MCBSTM32F200
 - ARM Cortex-M3 STM32F20X SOC
 - 120 MHz, 2 MB RAM, 8 MB Flash
 - Available through distibutors worldwide
- Peripherals supported by Oracle Java ME Embedded 3.2
 - Headless (no graphics)
 - Network (Ethernet TCP/IP)
 - SD card (file)
 - Serial port communications
 - Devices attached via I2C bus, SPI bus, GPIO, memory-mapped I/O



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Cinterion Wireless Modules

Built on Oracle Java ME Embedded

- Smart & programmable
 - Complete and highly integrated
 - CPU, RAM/Flash, I/O, SIM
 - 2G/3G (voice + data), low power
 - Remote provisioning and management
- Add intelligence and connectivity to vertical solutions
 - Industrial automation
 - Healthcare
 - Security & monitoring







Qualcomm IoT Development Platform

Built on Oracle Java ME Embedded

- Modular & flexible
 - Complete development and prototyping platform
 - CPU, RAM/Flash, I/O, GPS, 3G, WiFi
 - Extensible through pluggable modules
- Universal IoT/M2M platform
 - Quickly and easily start building advanced IoT concepts with Java
 - Leverage Qualcomm and AT&T "Internet of Everything" developer programm



CDMA Technologies



Oracle Java ME Embedded: Functionality and APIs





Oracle Java ME Embedded 3.2 Stack



Dedicated New Embedded Features

Feature	Description
Application Managent System (AMS) API	Remote app management (install, start, update, etc.)
AMS lifecycle notifications	Application monitoring (e.g. errors, termination)
Application autostart/auto-restart	Autostart or restart applications
Device Access API	Access to peripherals via GPIO, SPI, I2C, and mem. map
Logging API	Flexible application-level logging framework
Access Point API	Support for multiple communication channels
Headless On-Device Debug (ODD)	Full source-level Java debugging
VM Configurator	Remote configuration of VM
OEM Extensibility	Product specialization through extension mechanism



Industrial Control Demo

Smart Solar Tracking System with Remote Integration



Quick Demo: Developing Applications





GPIO Example

```
/* Application extends MIDlet */
/* Error handling not shown */
import com.oracle.deviceaccess.*
. . .
led1 = GPIOManager.getPin(LED1 PIN ID);
button1 = GPIOManager.getPin(BUTTON1 PIN ID);
button1.setInputListener(new PinListener() {
  public void valueChanged(PinEvent event) {
    GPIOPin pin = event.getPin();
    System.out.println("listener1 "+ pin.getID());
    if(pin.getID() == BUTTON1 PIN ID) {
      led1.setValue(event.getValue());
```



Demo Developing Applications with NetBeans IDE and KEIL platform



Outlook & Wrapping Up





Coming Next: The Java ME 8 Platform

A Major Modernization: Feature-Rich, Flexible, Aligned with Java SE

Themes	 Platform modernization ME / SE Language Alignment Standardized Embedded APIs
Key Features	 Base: CLDC 8 (JSR 360) to align with SE8 App environment: Java ME Embedded Profile 8 (JSR 361) Peripheral I/O API (PIO) Additional, dedicated APIs for small embedded Improved developer experience and device tooling
Target Markets	 Small embedded, across a wide range of use cases and markets Edge devices, communication modules, healthcare monitoring devices, smart sensors, smart meters, general IoT and M2M

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Java ME 8 Platform Architecture





Public Roadmap

Embedded Java



Resources

Java Magazine Jan/Feb: "Embedded Everywhere"







More Resources

Where to Find More

Oracle OTN Embedded Java

http://www.oracle.com/technetwork/java/embedded

Oracle Java ME Embedded Product Page

-> overview/javame

Java Embedded Community

http://www.javaembeddedcommunity.com

Terrence Barr's blog

http://terrencebarr.wordpress.com





- Java is the technology for delivering robust, scalable, and integrated embedded solutions from device to datacenter
- Oracle's Java ME Embedded product is a feature-rich platform ideally suited to powering the Internet of Things
- Get started today
 - → Download the Java ME SDK 3.2 and start developing
 - → Get ready for development plartforms coming soon



Questions?





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