



# Developing Java Applications for Mobile Devices

## A glimpse of the future

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## Introduction

- The „Connected PDA“ & Java™
- CLDC & Java™ Virtual Machine
- An Example: Trading Application
- Graphical User Interface Issues
- Trading Application Demo
- Source code examples
- Security and Performance
- Java versus WAP/WML

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## The Connected PDA & Java

- Connected & Secure Applications
- The Mobile Handset is going to be a PDA
- Everybody will have a Mobile Handset
- Why Java fits perfectly:
  - Portability
  - Secure Execution Environment
  - Downloadable Code

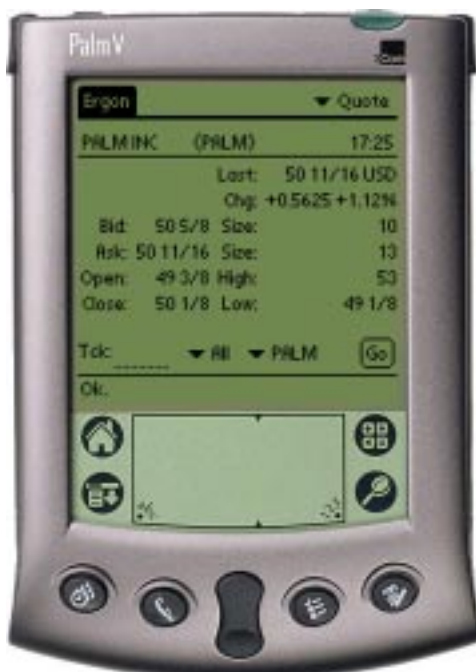


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# CLDC & Java™ VM

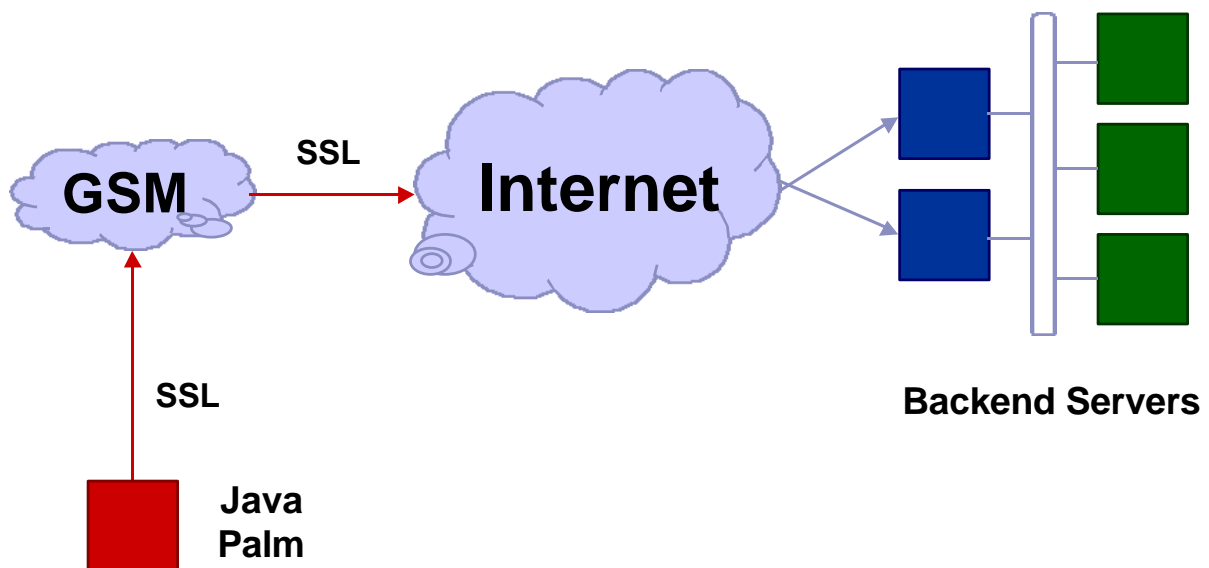
- Java™ technology on Consumer Devices
- A small and portable virtual machine (KVM 270KB versus J2SE™ ++1,000 KB)
- Complete Java runtime environment (GC, Threads, Interfaces)
- KVM Sun, Jbed Esmertec, Waba, J9 IBM

## An Example: Mobile Trading Application



- Palm Organizer
  - 75%–80% Market Share
  - Device Capabilities
  - Multiple VMs
- Trading Anywhere at Anytime
- Integration into Palm Environment
- Transparent Network Computing

# System Architecture



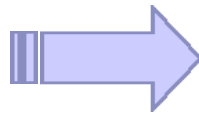
# Issues in Mobile Computing

- Very Small Heap Memory  
Palm Dynamic Heap < 64KB!
- Restricted Static Memory
- Communication Bandwidth currently(!)  
only 9,600 bps
- Connection Setup, Latency
- Special Display and Keyboard

# User Interface Design

- Application versus Browser Paradigma
- GUI Toolkits: KAWT, Dynaworks
- Toolkit problem: Memory Footprint
- MIDP specifications

Is a Trading Application on a standard phone possible and sensible?



**NO!**

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# Live Demo

- Setup of demo
- Login
- Portfolio view
- Quote, store a quote
- Lets trade PALM on NASDAQ
- Examine orders, cash and portfolio
- Configuration by memo

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# User Interface Challenges

- How to paint() efficiently and flicker free on the KVM
- Allocate as few GUI objects as possible
- The current GUI classes are a very useable Hack ;-)
- Table, ComboBox & Patched Classes

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# How to Use Palm Databases

- Full DB Access Interface
- All Internal Databases can be used!  
MemoDB, CalendarDB, ...

```
int dbCreatMemo = 0x6d656d6f,  
int dbTypeMemo = 0x44415441;
```

```
Database memoDB;
```

```
memoDB = new Database(dbTypeMemo,  
                     dbCreatMemo,  
                     Database.READWRITE);
```

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# Code Example

## Palm Database Read

- Find Memo “Ergon” and read it

```
int noOfRecs = memoDB.getNumberOfRecords();

for (int i=0; i < noOfRecs; i++) {
    byte[] rec = memoDB.getRecord(i);
    if (rec != null) {
        String data = new String(rec);
        if (data.regionMatches(true,0,"Ergon",0,5)) {
            Vector conf = Util.tokenize(data,'\n');
            /* Do something with conf */
            break;
        }
    }
}
memoDB.close();
```



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# Code Example

## Palm Database Write

- Insert Quote Data into a Memo

```
StringBuffer buf = new StringBuffer(64);
Vector v = quoteDisplay.getValues();

for (int i=0; i<v.size(); i++) {
    buf.append(label[i]);
    buf.append(v.elementAt(i)); buf.append('\n');
}
buf.append((char)0);

byte[] rec = buf.toString().getBytes();
memoDB.addRecord(rec);
memoDB.close();
```



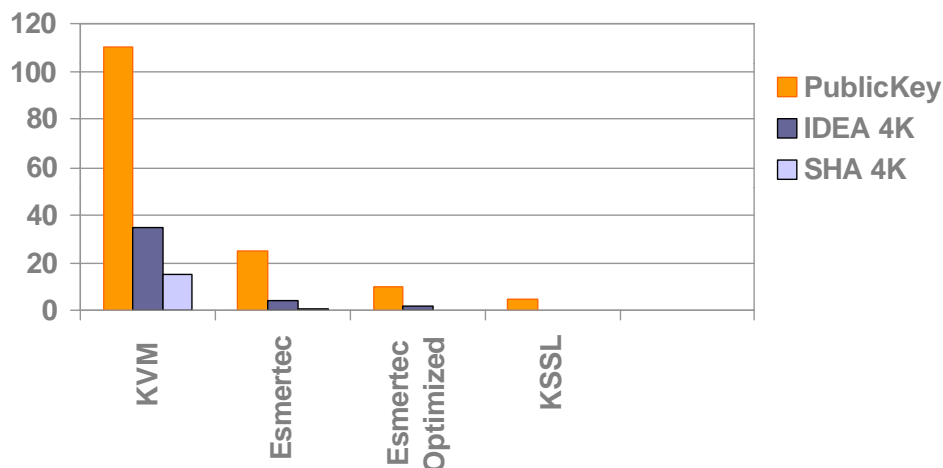
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# Authentication & Encryption

- SSL Implementation in Java
- SSL Code Size ~100KB
- KSSL
- Open Problems ( $2^{14}=16\text{KB}$  Buffer)
- Random Generator
- SSL versus WTLS
- Authentication

# Runtime Performance

- A Bottleneck: SSL Performance





# Memory Footprint

- Limited Dynamic Heap Resource
- Generation of many short lived Objects
- Too many GUI Objects
- Startup Time  
(lazy class loading, romizing, compiling)

# Java Application versus WAP

	JAVA	WAP
Local Computing	YES	NO
Flexibility	+++	-
Encryption	SSL	WTLS
	MATURE	NEW
Security Review	YES	NO
GUI Features	+++	+
Transm. Information	DATA	DATA++

# Development Environment

- Standard JDK™ software
- KVM on the Solaris and Windows platforms
- Pose Emulator
- Mocha PPP for Windows
- Wish: Memory Dumper
- Wish: IR between KVM and other Applications

# Java VMs for Small Devices

- KVM
- JBed Esmertec
- WABA (Palm, Windows CE)
- IBM Visual Age Micro Edition (J9 VM)
- PersonalJava™ and EmbeddedJava™ technologies
- J2SE™ platform (Psion Snowdrop 5MX implementation)

# J2ME Resources

- KVM Arch [archives.java.sun.com/archives](http://archives.java.sun.com/archives)
- Bill Day [www.billday.com/KVMArchive](http://www.billday.com/KVMArchive)
- KVMWorld [www.kvmworld.com](http://www.kvmworld.com)
  
- KAWT [www.trantor.de/kawt](http://www.trantor.de/kawt)
- Dynaworks [www.brainon.ch/area51/brf/DynaWorks](http://www.brainon.ch/area51/brf/DynaWorks)
- KSSL [nobel.eng.sun.com/~vgupta/Presentations](http://nobel.eng.sun.com/~vgupta/Presentations)
  
- POSE [www.palmos.com/dev](http://www.palmos.com/dev)
- Mocha PPP [www.mochasoft.dk/palm.html](http://www.mochasoft.dk/palm.html)
  
- IDEN Motorola [idendev.com](http://idendev.com)
- QCOM PdQ [www.kyocera-wireless.com/pdq](http://www.kyocera-wireless.com/pdq)

# Summary

- J2ME is a mature and stable environment
- “Real World Applications” are possible
- Major promise to execute untrusted code in a distributed network
- Boost as soon as High Speed Mobile Networks are available



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