



# Advanced Programming

## Java ME

# Embedded Systems

- **Embedded systems** are computer systems embedded into complete devices, whose dedicated functions reside within a larger mechanical or electrical system.
- Low power consumption, small size, rugged operating ranges, and low per-unit cost.
- **Micro-controllers, sensors, gateways, mobile phones, PDAs, TV set-top boxes, digital media devices, M2M modules, printers and more.**
- Difficult to program and to interact with.

# Internet of Things

- **Internet of Things (IoT)** represents the network of physical objects - devices, vehicles, buildings and other items - embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.
- IoT uses **sensors** to collect data and **wireless connectivity** to orchestrate a response.
- IoT is built on a confluence of technologies, new and old hardware platforms, big data, cloud computing, and machine-to-machine (M2M) computing.
- **Interoperability** → coordination of multiple devices
- **Ubiquitous** computing, **pervasive** computing.

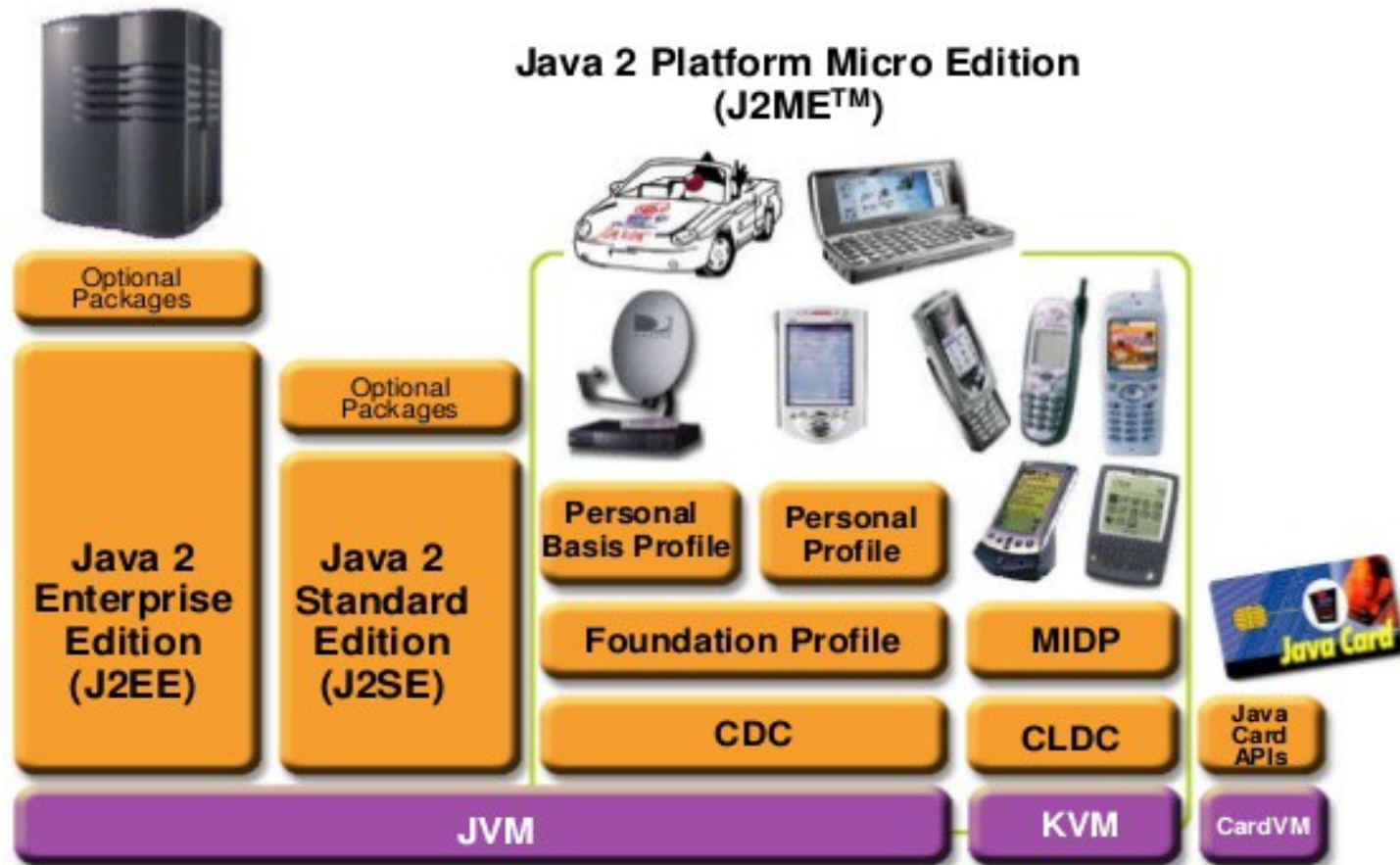
# Java Platform, Micro Edition

- Java ME provides a robust, flexible environment for applications running on **embedded and mobile** devices in the Internet of Things.
- Java ME technology was originally created in order to deal with the constraints associated with building applications for small devices: applications running on small devices with **limited** memory, display and power capacity.
- Applications based on Java ME are **portable** across many devices, yet leverage each device's native capabilities.

# Java Platforms Overview



## The Java™ Platform



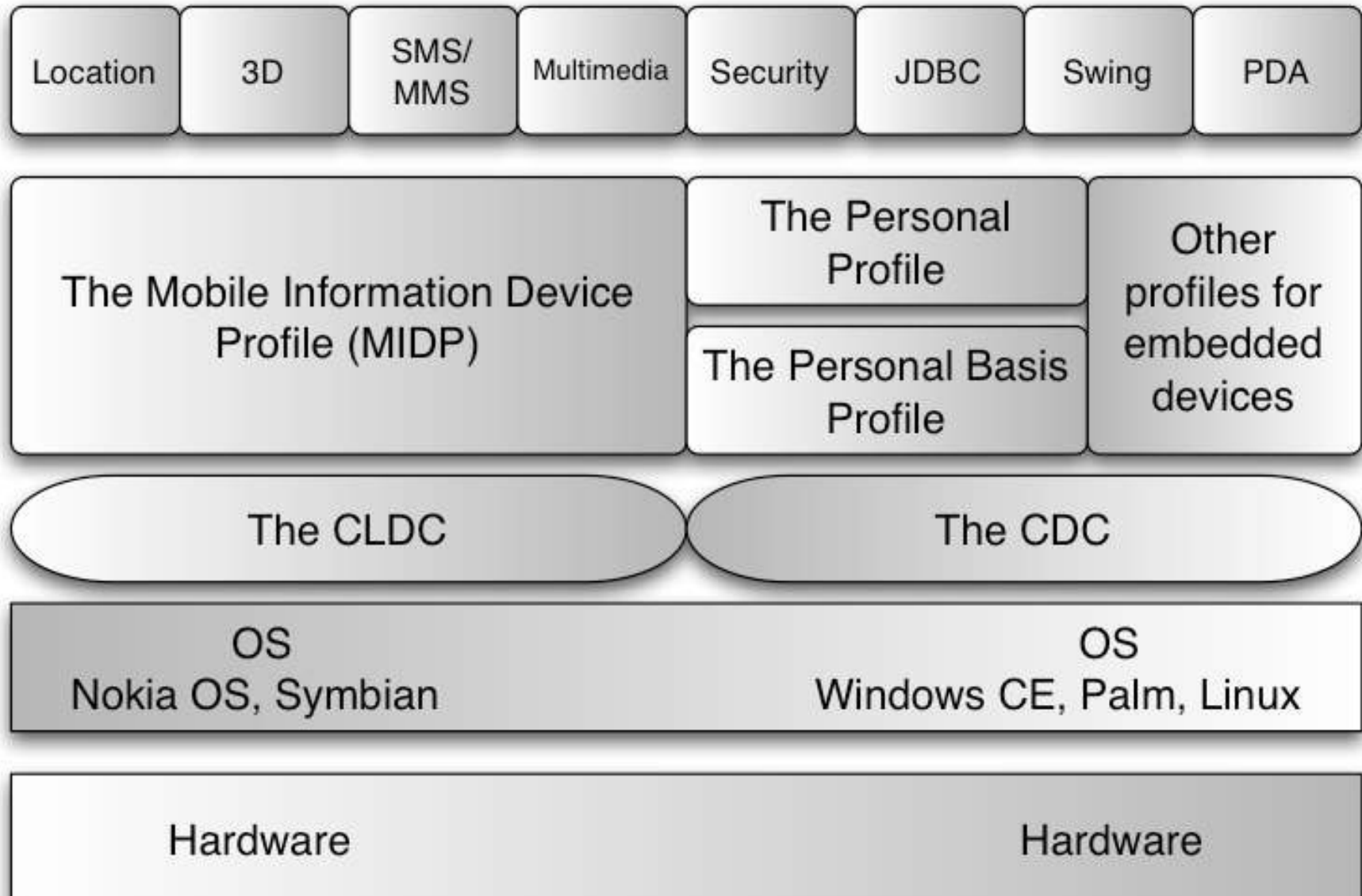
# Oracle Java ME

- **Oracle Java ME Embedded** is a **Java runtime** that leverages the core Java ME technologies deployed in billions of devices around the world in the IoT.
  - implementation of the Java ME standards
  - alignment with Java SE 8 features and APIs
  - support to customize and "right-size" the platform to address a wider range of use cases with target devices starting as low as 128 KB RAM and 1 MB of Flash/ROM
- **Oracle Java ME SDK** provides device emulation, a standalone development environment and a set of utilities for rapid development of Java ME applications.

# Configurations and Profiles

- A **configuration** provides the basic set of libraries and VM capabilities for a broad range of devices.
  - **Connected Limited Device Configuration (CLDC)** is the configuration for small devices, and
  - **Connected Device Configuration (CDC)** is the configuration for more capable mobile devices such as smartphones and set-top boxes.
- A **profile** is a set of APIs that support a narrower range of devices.
  - **CLDC Mobile Information Device Profile (MIDP)**, provides GUI, networking, and persistent storage → **MIDlets**.
  - **CDC Foundation/Personal Basis/Personal Profiles**, may provide AWT → **Xlets**.

# Optional Packages





# MIDlet Example

```
import javax.microedition.lcdui.*;
import javax.microedition.midlet.MIDlet;
public class Hello extends MIDlet implements CommandListener {
    public void startApp() {
        Display display = Display.getDisplay(this);
        Form mainForm = new Form("Hello");
        mainForm.append("Hello world!");
        Command exitCommand = new Command("Exit", Command.EXIT, 0);
        mainForm.addCommand(exitCommand);
        mainForm.setCommandListener(this);
        display.setCurrent(mainForm);
    }
    public void pauseApp () {}
    public void destroyApp(boolean unconditional) {}
    public void commandAction(Command c, Displayable s) {
        if (c.getCommandType() == Command.EXIT)
            notifyDestroyed();
    }
}
```

# MIDlet Emulators



# Game Support

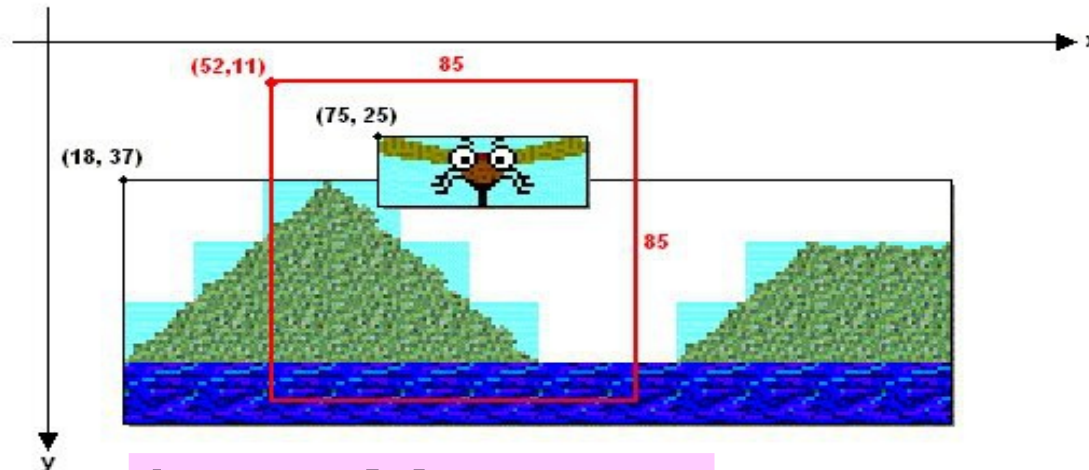
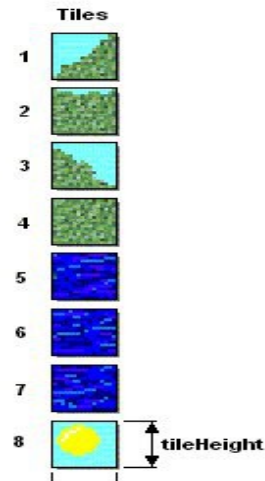
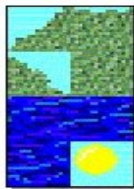
## TiledLayer



OR



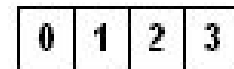
OR



## LayerManager

## Sprite

### Default Frame Sequence



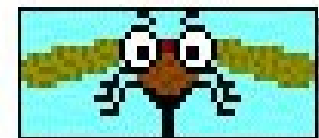
0



1



2



3



# CLDC 8 and MEEP 8

- CLDC 8 aligns the core Java ME virtual machine, language support, libraries, and other features with Java SE 8. A consolidated and enhanced Generic Connection Framework for multi-protocol I/O is supported.
- MEEP 8 (ME Embedded Profile) provides a powerful and flexible application environment for **small** embedded Java platforms.
  - A new, lightweight component and services model
  - Shareable Components (Shared Libraries → LIBlets)
  - Multi-application concurrency, inter-application communication, and event system
  - Application management
  - API optionality to address low-footprint use cases

# Raspberry PI

- Credit card-sized single-board computers developed with the intent to promote the teaching of basic computer science in schools.
- Linux-kernel-based operating systems.
- Python, C, C++, Java, Perl, Ruby, etc.



# Java ME + Raspberry Pi

- **Java ME 8 + Raspberry Pi + Sensors = IoT World**

<http://www.oracle.com/technetwork/articles/java/cruz-gpio-2295970.html>

- Java ME 8 includes a powerful API for controlling devices such as *LEDs, relays, LCDs, sensors, motors, and switches*.
- This article is the first in a three-part series about how to connect electronic sensors to the Raspberry Pi Model B using general-purpose input/output (GPIO), inter-integrated circuit bus (I2C), serial peripheral interface bus (SPI), or universal asynchronous receiver/transmitter (UART) interfaces.
- By using Java ME 8 to control devices with different types of interfaces and connecting the devices to a Raspberry Pi, we can create an Internet of Things (IoT) world.
- Develop classes in Java ME 8 that can
  - Detect a flame using a DFRobot flame sensor (model DFR0076)
  - Detect movement using an HC-SR501 passive infrared (PIR) motion detector
  - Measure distance using an HC-SR04 ultrasonic ranging module

# Lego Mindstorm



LEGO® Mindstorms® EV3  
can run the ARMv5 port of  
**Java SE Embedded**



# References

- *Java Platform, Micro Edition*

<http://www.oracle.com/technetwork/java/embedded/javame/index.html>

- *Java ME 8 and the Internet of Things*

<http://www.javaworld.com/article/2848210/java-me/java-me-8-and-the-internet-of-things.html>