Developing web applications for PDAs and Cellphones

Mobile Station Execution Environment (MExE)

- MExE is a standard for defining various levels of wireless communication
- These levels are called *classmarks*
- Mobile devices can support more than one classmark
- Current Defined classmarks include:
  - Classmark 1: Wireless Application Protocol (WAP)
  - Classmark 2: PersonalJava & JavaPhone *(includes classmark 1)*
  - Classmark 3: J2ME, CLDC & MIDP

Classmark 1: WAP

WAP (Wireless Application Protocol)

- What is WAP?
  - It is a set of protocols for wireless data transmission
  - It strives to be an the equivalent of what the internet is for the wired world
  - Designed to address issues specific to mobile commerce

Issues WAP Addresses

- The limitations of wireless communication
  - Intermittent network connectivity
  - Large latency
- Providing an easy to uses interface for mobile devices
  - The screens are small
  - Limited input types
- Security concerns of transmitting wireless data
- Limited power and computational resources of mobile devices

WAP Gateway

- The WAP gateway provides a solution to the limitations of the wireless networks
- Mobile users connect to the gateway and any communications they request will be passed through the gateway
- It provides a access point to the rest of the web
- Takes over many cpu intensive operations for the mobile device
- Handles encryption and decryption as different (less strenuous) encryption protocols are used for mobile devices

Wireless Application Protocols

- WAP is based on:
  - WAE (Wireless Application Environment)
    - WML (Wireless Markup Language)
    - WMLScript (the javascript equivalent for WML)
    - WTAI/WTA (Wireless Telephony Application Interface)
  - WSP (Wireless Session Protocol)
  - WTP (Wireless Transaction Protocol)
  - WTLS (Wireless Transport Layer Security)
  - WDP (Wireless Datagram Protocol)

Wireless Markup Language

- WML is XML based
  - Follows strict xml formatting rules
- Replaces HTML in the WAP browser
- WML sites are called decks and are made up of cards
- The cards are the pages that the users views

Wireless Markup Language

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">

<wml>
    <card id=card1> ….. </card>
    <card id=card2> ….. </card>
    …..
    <card id=card3> ….. </card>
</wml>
```

- WML pages have their own DTD
- A deck is the WML document
  - Enclosed in <wml> . . . </wml>
- A card is the WML document
  - Enclosed in <wml> . . . </wml>

Wireless Markup Language

- Variables defined in a one card are accessible from all cards
- Some other tags:
  - <!-->, <head>, <meta>, <template>,
, <p>, <table>, <td>, <tr>, <b>, <big>, , <a>, <anchor>, <img>, <do>, <onevent>, <postfield>, <go>, <timer>, <input>, <optgroup>, <option>, <select>, <setvar>
  - These are not all of the tags but as you can see many are the same as in HTML

WMLScript

- It is a lightweight version of JavaScript
- Runs client side
- Is compiled at a WAP gateway and sent to the device in byte code
- Not embedded in WML document
- Stored in a WMLS file (ie script.wmls)
- Includes Dialogs, Float, Lang, String, URL and WMLBrower function Libraries

Wireless Session Protocol

- Session level protocol
- It is the HTTP equivalent for WAP
- WSP is much more efficient than HTTP due to the bandwidth constraints of mobile devices
- Uses binary data vs text data

Wireless Transaction Protocol

- Provides both reliable and unreliable data transport
- Similar to TCP
- Built to minimize network traffic and be most effective over a wireless link

Wireless Transaction Layer Security

- Security layer protocol
- Similar to SSL (Secure Socket Layer)
- Provides authentication and encryption functionality
- Like SSL it is only used when needed

Wireless Datagram Protocol

- Similar to UDP (User Datagram Protocol)
- Lowest layer WAP protocol
- Lower layers are normally device dependent and some common interfaces are PPP (Point-to-Point Protocol), SMS (Short Messaging Service), and GPRS (General Packet Radio System)

WAP and the rest of the web

- Fewer that 1% of sites are written in WML
- Google has implemented a tool which converts regular HTML websites to WML for WAP browsers
- This allows WAP users access to the web content not specifically designed for mobile devices

Classmark 2: JavaPhone

Java Telephony API and its components

What is JavaPhone?

- It was created by the creators of Java, Sun Microsystems
- It is a Java like API for creating applications on cellular telephones
- Object Oriented

What is it used for?

- JavaPhone is used to develop applications for use on a variety of mobile devices
- It can also be used by telephone service providers to provide the connectivity to dynamic information services

How does it work?

- Much like regular Java, JavaPhone relies on an underlying virtual machine, or application environment which allows the telephone OS to seem transparent to the programmer.
- For JavaPhone this environment is either PersonalJava or EmbbededJava depending on the cellular hardware

Communications

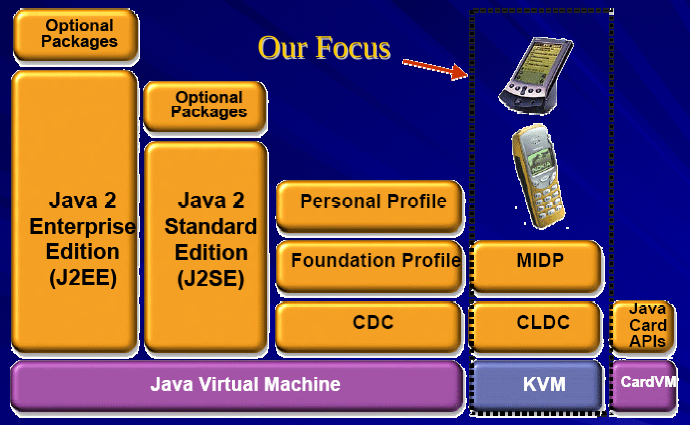
- Additional packages are available for communications
- The Communication API, which allows for communication with serial and parallel ports
- **The SSL package for use by applications to communicate securely communication over TCP/IP sockets**

Summary

- JavaPhone is an API that can be used to develop applications for mobile devices in the same way that applications are developed for a computer.
- It allows for the development of programs to access the web as well as other internet protocols (FTP, STMP, ect.)
- It also provides portability in an industry where many different hardware and OS implementations exist

Classmark 3: J2ME Environment

Java 2 Platform



MIDP – Mobile Information Device Profile

CLDC – Connected Limited Device Configuration

KVM – K Virtual Machine

Java 2 Micro Edition

-Java Virtual Machine ported onto a wide range of Operating Systems

-Growing processing power
- -More use of portable java
- -Less use of lower, more efficient languages

-J2EE JVM equivalent for the J2ME is the K Virtual Machine (KVM)

J2ME Continued

Targeted for
- Small, Standalone Devices
- Connectable Consumer Devices
- Cellular phones
- Personal Digital Assistants

Two Primary Components
- Configurations
- Profiles

Configuration

Defines Minimum Java Platform for
- A range of devices
- Requirements for memory and power
- Minimum Java Libraries
- Virtual Machine Capabilities

CLDC

(Connected Limited Device Configuration)

Specifies Java Environment For
- Mobile Phones
- Personal Digital Organizers

Devices
- Limited Memory, 128 kb - 512 kb
- Intermittent, low bandwidth network link
- Constrained UI's, small screens
- Most often wireless

K Virtual Machine (KVM)
- JVM designed for resource constrained devices
- CLDC runs on top of KVM

Profile

A collection of Java technology based APIs that add on to a Configuration to provide capabilities for a device type and extends its specific demands

MIDP

(Mobile Information Device Profile)

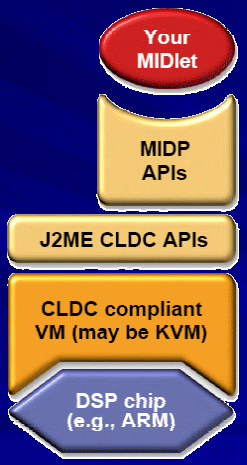
Specifies Java Environment For
- Mobile Phones
- Personal Digital Organizers

Addresses issues such as
- User Interface
- Store, Manage persistent local data
- Networking
- Application Model

Runs on top of the CLDC

Developed by a group of 20 companies representing the wireless industry

J2ME Wireless Device Stack



J2ME Devices

J2ME Software

Active Desktop
Access your home desktop from your mobile phone

Web Viewer
Supports HTML forms, image maps, GIFs, and JPEGs

UEMail
Mail client that communicates with any POP3/SMTP server

Street Fighter
The most famous arcade fighting game, with basic features

J2ME Software

M-Sports Soccer

Possibly the best soccer simulation available for mobile devices

All this software is available as shareware at
http://j2me-software.com/repository/index.jsp

J2ME Development Tools

- They are available now
- Most are free
- They are all you need to create mobile Java applications
- References
  - http://java.sun.com/j2me/
  - http://java.sun.com/products/cldc/
  - http://java.sun.com/products/midp/

J2ME Code

```
import javax.microedition.midlet.*;
import javax.microedition.io.*;
import javax.microedition.lcdui.*;
import java.io.*;

public class HttpMIDlet extends MIDlet implements
CommandListener {};
```

Testing Applications

- Available Virtual Mobile Device

SmartCards

Smart Cards

- tamper-resistant devices, usually containing an embedded 8-bit microprocessor
- utilize Application Protocol Data Units (APDU) to communicate with host devices through PIN codes and cryptographic keys
- Many different kinds including SIM, Java Card, UIM, WIM and S@T
- Used in cell phones, PDAs, satellite receivers, credit cards, etc.

SIM Cards

- Subscriber Identity Module
- Consist of microprocessor, ROM, EEPROM memory, volatile RAM, and serial I/O interface
- Software usually consists of an OS, file system, and application programs
- SIM cards rely on their GSM handset for battery and clock

The SIM Toolkit (STK)

- API used for securely loading applications onto SIM cards
- Allows mobile operator to create/provide services by loading them in the SIM without changing anything in the GSM handset. A convenient way of doing this is through Short Message Service (SMS).
- Once loaded, applications may be triggered through events such as incoming/outgoing calls, call duration, and/or location of the mobile device. Control software in the SIM monitors these events and reports them via SMS to a network based application server.

WIM Cards

- WAP Identity Module
- Used in conjunction with a SIM card
- Introduced with WAP spec 1.2 (Wireless Application Protocol)
- Provides end-to-end security for WAP applications, improving on the limitations of spec 1.1
- Allows the user to store certificates and digital signatures