Mobile Software Systems
(part 1)

Overview

Topics:
1. Mobile Computing Market
2. Mobile Software Systems vs Mobile Applications
3. Mobile Thin and Fat Clients
4. Mobile Apps in Industry
5. Mobile Thin and Fat Clients. Web Page Hosting on Mobile Devices
6. SE Models to be Used for Mobile Software Systems Development
7. Mobile Application Development: emulators/simulators
8. Mobile Applications: Operating Systems
9. Mobile Devices: Challenges
10. Mobile SW and Web Security
Mobile Computing Market: Comparative Analysis

1. Mobile Computing Market:
   Comparative Analysis

Global Mobile Worker Population

- VDC Research: "...the mobile workforce is expected to reach 1.2 billion workers by 2014. Mobile knowledge worker population will grow by 19% through 2014... mobile line/task worker population will decline by 11.8% ...

- IDC Research: "...the worldwide mobile worker population will increase from just over 1 billion in 2010 to more than 1.3 billion by 2015. The Americas region, which includes the United States, Canada, and Latin America, will see the number of mobile workers grow from 182.5 million in 2010 to 212.1 million in 2015. North America has the largest number of mobile workers in this region, with 75% of the workforce mobile in 2010."
Mobile Device Statistics

Mobile Computing is the Largest Computing Shift Ever

Source: Yankee Group Research, 2011

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Mobile Device Statistics

Smartphone ownership by age

Source: The Pew Research Center’s Internet & American Life Project, April 20 – May 22, 2011 SpringTracking Survey, n=2,277 adult Internet users ages 18 and older, including 755 cell phoneinterviews. Interveners were conducted in English and Spanish. “Smartphone ownership” includes those who saytheir phone is a smartphone, or who describe their phone as running on the Android, BlackBerry,iPhone, Palm or Windows platforms.
Smart Phone Market Statistics

Platform differences in smartphone adoption

% within each column who say their phone is the following...

<table>
<thead>
<tr>
<th>Platform</th>
<th>Among cell owners</th>
<th>Among smartphone owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android</td>
<td>15%</td>
<td>35%</td>
</tr>
<tr>
<td>iPhone</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Blackberry</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Palm</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Windows</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: The Pew Research Center’s Internet & American Life Project, April 26 – May 22, 2011 Spring Tracking Survey. n=2,277 adult internet users ages 18 and older, including 755 cell phone interviews. Interviews were conducted in English and Spanish. “Smartphone owners” include those who say their phone is a smartphone, or who describe their phone as running on the Android, Blackberry, iPhone, Palm or Windows platforms.

Smart Phone Statistics

Multiple types of smartphones have become very popular...

Number of U.S. smartphone subscribers by platform

...making mobile Web sites that work on all phones more critical.

Proportion of colleges with mobile-specific Web sites:

<table>
<thead>
<tr>
<th>Month</th>
<th>9%</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: comScore, David Olsen, West Virginia University.
Most Popular OS for Mobile Apps. 
Most Popular Used Mobile Applications.

IDC Research: “…Apple’s iOS may be the dominant operating system in the tablet market, but among smart phones, Android is the reigning powerhouse. Android’s overall market share increased from 46.9 percent in Q2 2011 to 68.1 percent in Q2 2012.”

Markets&Markets Research: “More than 2 million [mobile] applications are currently available for communications, games, multimedia, productivity, travel, and utility purposes.”

Mobile Computing Market: Conclusion

“You will live and work in mobile computing environment”
2. 

*Mobile Software System.*  
*Mobile Application.*  
*Definitions*
Mobile Software System = Mobile Application: Definitions

# 1: Service-based
A wireless mobile application is defined as
a) a software application,
b) a wireless service or
c) a mobile service
that can be either pushed to users' handheld wireless devices or downloaded and installed, over the air, on these devices.

# 2: Access-based
An application which resides in the mobile phone or which is accessed/used by a mobile phone over any channel such as SMS (short message service), MMS (multimedia messaging service), GPRS (general packet radio service), Voice, DTMF (dual tone multi frequency).

Mobile Software System vs Mobile Application

We consider a mobile software system as greater entity than a mobile application in terms of a number of provided functions, a number of internal and distributed components, a number of technologies and Web services used, etc.

Particularly, usually a mobile software system has all features of a system such as
1) goal,
2) boundary,
3) main components (for example, a database, GUI, HELP, security system, communication system, etc.),
4) links between components,
5) inputs from environment and/or users,
6) outputs to environments and/or users,
7) interfaces (data exchange protocols) and/or communication protocols to interact with other mobile and/or Web systems,
8) constraints, and
9) environment.

As a result, mobile software engineer should consider not only functional requirements to mobile software system but also multiple non-functional requirements (operational, social, etc.).
What is a Mobile Application?

- Two types of mobile applications can be accessed by wireless devices:

  # 1: Browser-Based
  - A Browser-Based application is an application that is accessed through the use of the mobile device’s web browser
  - Browser-Based applications are coded with the use of a markup language
  - see Wireless Application Protocol

  # 2: Native Applications
  - Native applications are those applications that are found entirely on the mobile device
  - These applications have their own runtime environment for execution
  - Highly interactive applications are really only feasible when they are native applications
  - see Java ME Micro Edition (Java ME)

Mobile Applications: Examples
Sinclair's CC: Mobile Offerings

http://m.sinclair.edu

For Students:
- People Directory (4)
- College News & Events (5)
- General Campus Info (6)
- Sinclair FAQ’s
- Schedule Planner (2)
- Program Viewer (3)
- SCC Whiteboard
- Current Schedule*
- Current Booklist*
- My Advising Plan*
- Magic Helpdesk*

For Employees:
- Bookstore/Student Assistance App*

* Requires Authentication
(®) Student Indicated Importance on Survey
Mobile Software Systems: Examples

Options:

- **PYXIS platform**
  - financial services
  - education
  - business-to-business
  - business-to-consumer

- **Appcelerator**
  - cloud
  - mobile
  - streaming tech

- **BlackBoard Mobile**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Name</td>
<td>Device Supported</td>
<td>Platform</td>
<td>Project</td>
</tr>
<tr>
<td>Classmate</td>
<td>10 devices, Windows, Mac, Linux, Android, Apple, Blackberry, Symbian</td>
<td>BlackBoard Mobile</td>
<td>10 devices</td>
</tr>
</tbody>
</table>
# CASE STUDY: NBCUniversal

**NBC.com iPad app reaches #1 in the App Store and 2 million users within 9 months**

Rapid mobile innovation powered by Appador

## INTRODUCTION

NBC is one of the mainstream media companies in the United States, with a vast portfolio of TV stations, networks, and movies. The company’s mission is to provide high-quality entertainment and news to its audience. In recent years, NBC has been focusing on expanding its digital offerings, including mobile applications.

## THE CHALLENGE: SCALING NBC’S APPROACH TO MOBILE

Like many media companies, NBC had many challenges within the mobile space. Challenges included managing different platforms, creating same-day viewing experiences, and ensuring a seamless user experience across all platforms. NBC needed a solution that could scale quickly and efficiently to meet the demands of its audience.

## OBJECTIVE

NBC’s objective was to achieve rapid mobile innovation, ensuring that their applications were available and enjoyed by their audience.

## BENEFITS

- **Reduced development time:** NBC was able to develop applications faster, allowing them to reach the market quicker.
- **Improved user experience:** Applications were optimized for different devices, providing a better user experience.
- **Increased audience engagement:** NBC was able to engage with their audience through mobile applications, achieving higher user engagement.

## Table: NBC Mobile Apps Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Phone Mobile</th>
<th>Tablet Mobile</th>
<th>Appador</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate design for each device?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Integrate with native device features?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Security</td>
<td>Data Guard, Cache Cleaning</td>
<td>Safe-Froyo Only</td>
<td>Network-Only, AppLock, AppLock returns.</td>
</tr>
<tr>
<td>Multi-User Support?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hosting</td>
<td>Can host on campus or remote hosting; Talk with the back office about hosting services with APIs about remote hosting.</td>
<td>None needed</td>
<td>None needed</td>
</tr>
<tr>
<td>Support</td>
<td>Multiple levels of support for purchases (after initial implementation training)</td>
<td>Multiple levels of support for purchases (after initial implementation training)</td>
<td>Multiple levels of support for purchases (after initial implementation training)</td>
</tr>
<tr>
<td>Other features</td>
<td>XRP</td>
<td>XRP</td>
<td>Via system code</td>
</tr>
<tr>
<td>Web Presence</td>
<td>Basic</td>
<td>Basic</td>
<td>Via system code</td>
</tr>
<tr>
<td>Updater method</td>
<td>Updates are not visible in the app on a user’s phone</td>
<td>Updates are not visible in the app on a user’s phone</td>
<td>Updates are not visible in the app on a user’s phone</td>
</tr>
<tr>
<td>Integration</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Android Emulator</td>
<td>Built into designer</td>
<td>Customized device</td>
<td>Built into designer</td>
</tr>
<tr>
<td>iOS Emulator</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Beta Based Access</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Notes

- Not available in the app, but can be tested with simulator software.
- NBC also uses an internal testing environment.
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Integrations</td>
<td>Banner, Blackboard, Oracle, P2S, SharePoint, Data sources via API</td>
<td>Banner, Oracle (via data extract or license agreement)</td>
<td>Most likely path would be to connect via a Web Service to any customer data.</td>
</tr>
<tr>
<td>Data method</td>
<td>Map to Data Source</td>
<td>Data pushed via web service APIs</td>
<td>Data pushed in batch on a schedule to Central Service Cloud</td>
</tr>
<tr>
<td>Configurable screens to our reports</td>
<td>Can have multiple views based on role or a single view for all users</td>
<td>It might be possible to have different views based on a selection made every time the app is opened.</td>
<td>Yes, we can build the design, however we want. No complex optimization for the device.</td>
</tr>
<tr>
<td>GUI for workflow filtering</td>
<td>Good for compliance, Good for branding.</td>
<td>Good for compliance, Good for branding.</td>
<td>Good for compliance, Good for branding.</td>
</tr>
<tr>
<td>26</td>
<td>GUI for data filtering.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>27</td>
<td>Manipulation</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>28</td>
<td>D geared toward Higher Education</td>
<td>Just starting roll-out to higher Ed.</td>
<td>Identity Business</td>
</tr>
<tr>
<td>29</td>
<td>Pricing Info</td>
<td>Sealed pricing by CPU/bandwidth</td>
<td>365-day License Fee per application</td>
</tr>
<tr>
<td>Notes</td>
<td>This app can blend native &amp; Java Applications together in one shell. We mean that we can write the application, or link out to web based applications we design.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.

**Mobile Apps in Industry**

**Demand Drivers**

- **Consumer applications**
  - Communication
  - Entertainment

- **Enterprise applications**
  - Collaboration
  - Integration with Personal Information Management systems (PIM)

- **New application frontiers**
  - More capable devices open new possibilities
Consumer Applications

- **Messaging**
  - Text messaging is the top data service worldwide
  - Driven by convenience and simplicity
  - Users want more
    - Use of picture and video messaging significantly increases data traffic

- **Game downloads**
  - Driven by availability of better devices and increasing familiarity with mobile internet
  - On the phone games are fast, convenient, have nice user interface

- **Information Retrieval**
  - From service provider to users
    - Local news/weather/traffic alert subscriptions via text messaging
  - From users to service providers
    - Surveys, polls, discussions

Enterprise Applications

- **In the enterprise PIM is the king**
  - Dedicated devices such as PIM BlackBerry widely used since they provide seamless information sharing with the desktop
  - Always-on pushed-based communication eliminate the need for inconvenient synchronization

- **Increasingly consumer devices come with similar, low-end, built-in PIM software**
  - BUT inconvenient
    - Requires synchronization
    - Difficult to share information with the desktop
    - Closed platform, non-extendable
  - HOWEVER, they are programmable
    - J2ME, Symbian Platform, Microsoft Compact .NET
    - It has become possible to have enterprise PIM functionality on low consumer devices!
Emerging Applications

- **Location Based Services**
  - Users are already showing interest as illustrated by increasing use of text message alerts on local news/weather/traffic reports
  - Location information available on increasing number of devices
  - Mobile Payments
  - Mobile Ticketing

Mobile Applications

Mobile applications can be found in any industry, they have been developed for:
- Mobile Gaming (see gameloft)
- Mobile Banking (see RBC)
- Mobile Text, Presentation, and Spreadsheet (see Microsoft Office Mobile)
- Social Networking (see Facebook)
- Mobile News (see Yahoo! Mobile News)
- Location Aware Services (see Loopt)
5.

Mobile Thin and Fat Clients.
Web Page Hosting on Mobile Devices

Mobile application characteristics

• Programmability
  – Potential for creating more responsive applications – thin or fat
    (combats bad perception left by WAP)

• Critical personal data and security
  – Every application will access personal user profile in some form
    • Customizations, preferences, authentication information, personal
      information (contacts, tasks, appointments, etc.)
    • Mobile payments (credit cards, account information, e-tickets)

• Synchronous/Asynchronous Operation/Communication
  – Most applications are best described as event-based—core of the application
    logic is to react to some external events.

• Aesthetic, convenient user interface
  – Applications need pleasing, simple and responsive user interfaces

• Always-on network connectivity
  – Almost all applications heavily rely on network connectivity. Integration of data
    from the desktop (office, enterprise, school) to mobile device. Access anytime,
    anywhere is what increases utility of the mobile applications.
Thin Clients

- Thin clients have no custom application code and completely rely on the server for their functionality.
- They do not depend as heavily on the mobile device’s operating system or the mobile device type as fat clients.
- Thin clients typically use widely available web and Wireless Application Protocol (WAP) browsers to display the following types of application content pages:
  - Web (html, xml)
  - Wap (wml,...)

Fat clients

- Fat clients typically have one to three layers of application code on them and can operate independently from a server for some period of time.
- Typically, fat clients are most useful in situations where communication between a client and server cannot be guaranteed. For example, a fat client application may be able to accept user input and store data in a local database until connectivity with the server is re-established and the data can be moved to the server. This allows a user to continue working even if he/she is out of contact with the server.
- Fat clients depend heavily on the operating system and mobile device type and the code can be difficult to release and distribute. You may also have to support multiple code versions over multiple devices.
- Fat clients can be implemented using one, two, or three layers of application code. However, if you only use one layer it is extremely difficult to isolate the individual areas of functionality and reuse and distribute the code over multiple device types.
Fat Clients with Web Page Hosting

• It is possible to display and service web pages on the mobile device even when the mobile client is only periodically connected to the network and back-end systems.

• In order to do so, we need the equivalent of a “mini” web server on the mobile device.

6.

SE Models to be Used for Mobile Software Systems Development
Main Components of Mobile Software Systems Design

1) Technical Design (architectural design and component design) = Architectural or Structural Model (due to multiple available technical platforms)

2) Functional Design (overall behavior and functionality) = Functional Model

3) Interaction Design (interface design and aesthetic design = layout) = Interaction Model (GUI)

4) Information Design (content design and navigation design) = Information Model

Additional useful components:
*) Design Patterns or Templates  
**) Design and development Technologies and Tools

Mobile SW System Analysis Models: Goals and Outputs/Diagrams

<table>
<thead>
<tr>
<th>Analysis Models</th>
<th>Goal</th>
<th>Diagrams to be used to reflect analysis models</th>
<th>Tools to be used</th>
</tr>
</thead>
</table>
| 1) Configuration Model + Technical Design | Describes the environment and infrastructure in which the Mobile SW resides. | Components:  
- Hardware, operating systems  
- Software  
- Internet, browsers  
- Data Protocols  
- Security considerations etc. | UMLet or SmartDraw  
- MS Visio  
- IBM Rational Software  
- SmartDraw |
| 2) Functional Model | Defines the operations that will be applied to Mobile SW content and describes other processing functions that are independent of content but necessary to the end user. | Components:  
- Activity Diagrams (ADs)  
- Sequence Diagrams (SDs)  
- State Transition Diagrams (STDs)  
- SwimLane Diagrams (SLDs) | UMLet  
- SmartDraw  
- UMLet or SmartDraw  
- SmartDraw |
| 3) Interaction Model | Describes the manner in which users interact with the Mobile SW | Components:  
- Use Cases (UCs)  
- User interface prototypes | UMLet  
- MS Expression Studio  
- Visual Paradigm |
| 4) Information model (or, Content Model) | Identifies the full spectrum of content to be provided by the Mobile SW. Content includes text, graphics and images, and video and audio data. | Components:  
- Content Objects (including, Data Objects)  
- Data Flow Diagrams (DFDs)  
- Content Model Trees (CMTs) | Microsoft Visio  
- IBM Rational Software  
- SmartDraw |
Mobile SW Systems Design: integrative use of prototyping (for GUI) and incremental (for functionality) models

Mobile SW System Engineering Process: Framework (main) Activities & Actions (development cycle based on incremental models)

- Why incremental?
  - Requirements evolve over project time (duration) ☑
  - Changes will occur frequently (and always at inconvenient times for engineers and developers ☑
  - Time lines are short … and very short … ☑

- The answer: Incremental delivery allows you to manage those changes!
Incremental Delivery

Repeat the ENTIRE system development life cycle (SDLC) for each quick increment (however, with most of required framework activities)

- Increment 1: small amount of time, just a few functions, GUI
- Increment # 2: small amount of time, just a few functions, GUI
- Increment # 3: Time is doubled + new functions
- Increment # 4: Time is doubled again + almost all other functions.

- The system grows by adding new and enhanced functionality with each increment created
- Each increment tackles a relatively small set of requirements and proceeds until the entire scope of the project is completed
- Repeating a process phase until ultimately meeting the project requirements (iterating the phases) and developing and delivering a system in stages (increments)

Mobile SW Systems: Framework Activities and Design Process (increment-based)
Mobile Applications:
examples of incremental delivery of functionality

Valencia's CC Mobile Applications
Valencia's Mobile Applications

Valencia's Mobile Applications

Valencia's Mobile Applications

Valencia's Mobile Applications
Valencia's Mobile Applications

Valencia College on Your Android™
Connect to Valencia College resources on-the-go with Valencia Mobile for Android. The application is available to download for free from the Google Android Market.

Campus Maps
View a map of each campus area and all of their buildings. This map includes a GPS location of where you are in respect to the campus buildings.

News
Keep up-to-date with all of the Valencia College news updates with a simple RSS reader to the Valencia News Web site.

Grades
View your grades anytime and from anywhere.

Schedule
View your schedule and details in a readable format.

Account Balance
View your account balance and make payments to Valencia College online.

Directory Search
Search for faculty and staff contact information with our directory search.

Coming Soon
This area shows the latest upcoming features that Valencia College is putting online today. All new app experience.
Valencia's Mobile Applications

- Campus Maps
  View a map that shows all of the building locations. You can zoom in on a building and view its information.
- News
  Stay up-to-date with the latest news and events using Valencia's app. Share the news with your friends.
- Grades
  View your grades on your mobile device from anywhere.
- Schedule
  View your class schedule on your mobile device without the need for a computer.
- Account Balance
  View your account balance online and get alerts for financial issues.
- Directory Search
  Search for student and staff information on your mobile device.
- Coming Soon
  Stay up-to-date with the upcoming features of the Valencia mobile app.
Prototyping Models

- **Throwaway prototyping** – (also called Close-Ended Prototyping, or Rapid Prototyping) refers to the creation of a model that will eventually be discarded rather than becoming part of the final delivered software.

- **Evolutionary Prototyping** (also known as Breadboard Prototyping) is quite different from Throwaway Prototyping. The main goal when using Evolutionary Prototyping is to build a very robust prototype in a structured manner and constantly refine it.

- **Incremental prototyping** – In this case, the final product is built as separate prototypes. At the end, the separate prototypes are merged in an overall design.

- **Extreme prototyping** – Extreme Prototyping as a development process is used for developing especially web applications. Basically, it breaks down web development into three phases, each one based on the preceding one.
  1. **STATIC**. The first phase is a static prototype that consists mainly of HTML pages.
  2. **FUNCTIONALITY ADDED TO EACH PAGE/SCREEN**. In the second phase, the screens are programmed and fully functional using a simulated services layer.
  3. **SERVICES ADDED**. In the third phase, the services are implemented.

The process is called Extreme Prototyping to draw attention to the second phase of the process, where a fully-functional UI is developed with very little regard to the actual services to be used.

WebApp and Handheld (Mobile) Devices

Choose content carefully:

- Choose only that which is most essential (regularly accessed info or urgent info)
- Customize content for the target user
- Target only the information important to that user

Perceived speed is important:

- Minimize page length (studies show users that hate to scroll)
- Use quick hyperlinks instead
- Allow for forward + backward navigation
Mobile App GUI Design Patterns

Delta.com GUI
6. **Mobile Applications: Technical Design**

(configuration model – OS, technical platforms, development technologies or emulators, specific mobile devices, etc.)
7.

Mobile Application Development: emulators/simulators

Ad-hoc Development of Mobile SW Systems and Apps

- Step 1: A common development process is to create the mobile application within the preferred IDE
- Step 2: The application is then tested in the IDE’s emulation environment
- Many of the IDE’s contain different devices which can be emulated for the developer to test their application
- Step 3: The final step is to test the application on a physical device and if applicable, network
- There is no substitute for testing the application on a real device as it will provide the developer with real insight as to the characteristics of the mobile phone
Handheld Emulators/Simulators

- Generally come with handheld OS SDKs
  - Android (Google & Open Handset Alliance)
    - http://developer.android.com/
  - iPhone (Apple)
  - webOS (Palm)
    - http://developer.palm.com/

- Web-based simulators (sort of)
  - Opera Mini Simulator – good
  - TestiPhone.com – absolutely worthless
Android Emulator

The Android SDK includes a mobile device emulator—a virtual mobile device that runs on your computer. The emulator lets you prototype, develop, and test Android applications without using a physical device.

The Android emulator mimics all of the typical hardware and software features of a typical mobile device, except that it can not receive or place actual phone calls. It provides a variety of navigation and control keys, which you can "press" using your mouse or keyboard to generate events for your application. It also provides a screen in which your application is displayed, together with any other Android applications running.

Download the Android SDK

The Android SDK has changed! If you've worked with the Android SDK before, you will notice several important differences.

If you are new to the Android SDK, please read the Quick Start, below, for an overview of how to install and set up the SDK.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Package</th>
<th>Size</th>
<th>MDS Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>android-sdk_04-windows.exe</td>
<td>23265119 bytes</td>
<td>a83d4e3b683f7c9e017f377557e40260be</td>
</tr>
<tr>
<td>Mac OS X (x86)</td>
<td>android-sdk_04-mac_x86.dmg</td>
<td>23685727 bytes</td>
<td>60abeb07b53a0f53b8f6688e0c0af07f369c47</td>
</tr>
<tr>
<td>Linux (x86)</td>
<td>android-sdk_04-linux_x86.tar.gz</td>
<td>199654 bytes</td>
<td>a83d4e3b683f7c9e017f377557e40260be</td>
</tr>
</tbody>
</table>
Browser compatibility – don’t skip this
XHTML/HTML/CSS validation
(extensible hypertext markup language/ hypertext markup language/cascading style sheets)

- XHTML/HTML
- CSS
- Accessibility

Get right with these before you move on to platform compatibility.