COMP327
Mobile Computing
Session: 2015-2016

Lecture Set 7 - The Mobile Internet

In this Lecture Set

- Challenges of Mobile access to the Internet
  - Early Wireless Internet Systems
  - Wireless Application Protocol
    - Architecture and Application Environment
- Multimedia Messaging Service
  - Short Messaging Service
  - OTA Programming

The challenges in moving from fixed line PCs to Mobile Devices

- To understand the challenges (and pitfalls) of moving to a Mobile Internet, first consider the fixed line Internet!
  - Initially, most usage was email and web
    - Mostly free, other than modem connection charges
  - Top down content distribution model
    - The web was "read-only" - Web 1.0
    - Early retailers (e.g. Amazon) exposed inventory, but offered few value-based services
  - Evolved slowly over several years ("incubation time"), driven by access and expectation
    - Technologies had the chance to settle and be tested before large-scale adoption

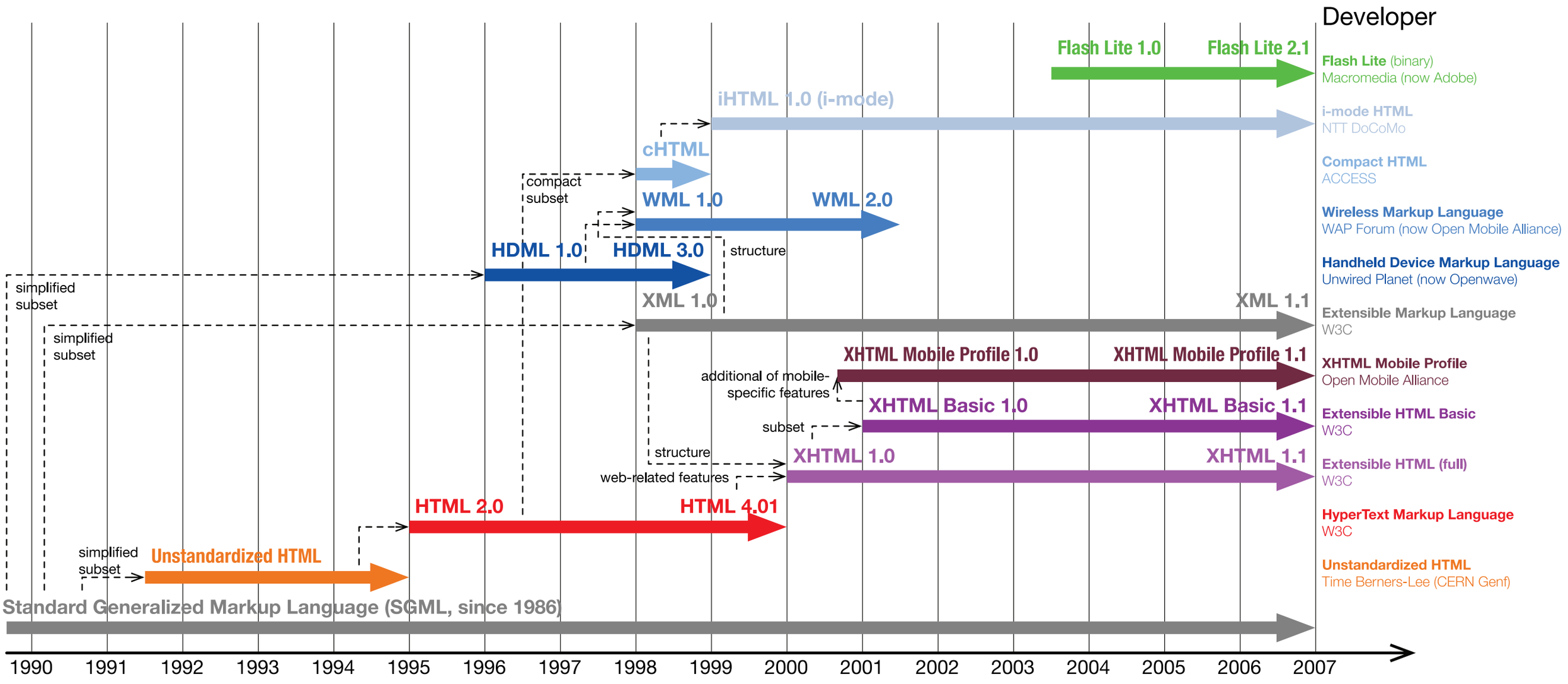
The challenges in moving from fixed line PCs to Mobile Devices

- Things were different when the Mobile Internet launched
  - Access was initially targeted at general public
    - Previous technologies were tried and tested by students and universities, which ironed out problems
  - Access was charged from day one!
    - Reduced adoption, and raised false expectation
  - Content and Services were adapted from the Web, rather than redesigned to exploit mobility
    - Very few sites or services had any appeal or use for users
    - WAP stack required new tools and additional effort, yet served a small user base!
  - Early networks unsuited for packet-switched data
    - Initial usage was expensive, thus limiting uptake

The Mobile Internet: Early Precursors

- Early approaches to providing content had to contend with new technical challenges:
  - Limited Screen Size and limited input capability
    - Not suited for most web pages
  - Limited memory, processor and power
    - May struggle to handle any client-side processing
  - Intermittent connectivity
    - HTTP is stateless
- Web 2.0 was emerging on the fixed-line Internet
  - Placed greater demands on both the device and the interface
  - Greater potential for mobile devices, though this was not realised for years
- Various content markup solutions have emerged

Evolution of Mobile Web–Related Markup Languages



Taken from Wikipedia, at http://en.wikipedia.org/wiki/File:Mobile_Web_Standards_Evolution_Vector.svg

WAP: Wireless Application Protocol

- An open international standard to support access to the Mobile Web
  - Established in June 1997
    - Joint Forum including Ericsson, Nokia, Motorola and Openwave
      - The previous approaches discussed were all proprietry
      - WAP was developed as an open standard
- Released WAP Specification 1.1 in Summer 1999
  - First services and devices available by the end of that year
  - Based on GSM, it was heavily hyped, but failed to live up to expectation in Europe (although successful in Asia)
    - "*Worthless Application Protocol*", "*Wait And Pay*"

Wireless Markup Language (WML)

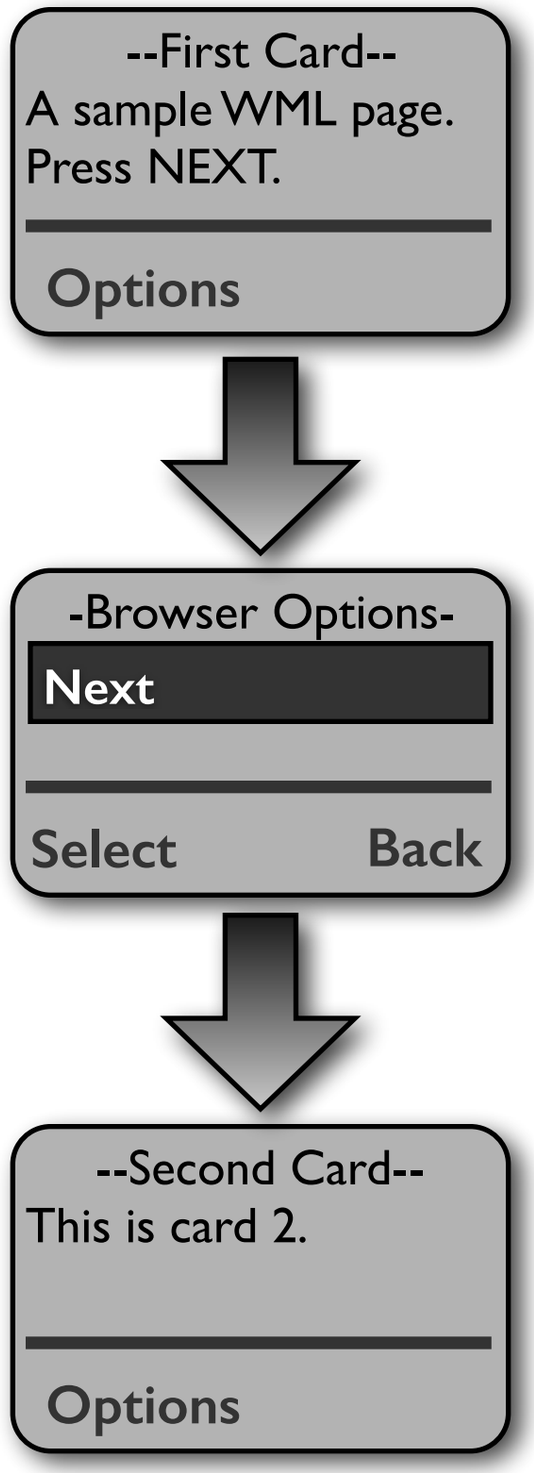
- Based on the *Deck of Cards* Metaphor
  - All cards sent simultaneously
  - User then navigates content without bursty comms
    - Overcomes GSM/GPRS latency problems with "bursty" browsing behaviour
    - Uses soft keys, where the semantics change as the context changes
- Includes client-side logic through WMLScript
  - Simplified variant of JavaScript
  - Avoids unnecessary round-trip comms
    - e.g. validating user-entered data
  - Supports functions for digital signing
- WAP 2.0 supports XHTML Basic
  - Separates the data (XML) from the presentation (CSS)

Inspiration for the "*Deck of Cards*" Metaphor

- Mobile Phones have tiny screens
  - Can only display a limited amount of content
- Many applications assume a dialog-based interaction (i.e. *cards*)
  - Each interaction involves a number of options, leading to further options based on the earlier choice
- By bundling all the cards together (a *deck*) and sending in one transaction, transmission time and delays could be reduced.

WML Example

```
<?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" title="First Card">
    <do type="accept" label="NEXT">
      <go href="#Card2"/>
    </do>
    <p mode="wrap">A sample WML page.
     Press NEXT.</p>
  </card>
  <card id="Card2" title="Second Card">
    <p>This is card 2.</p>
  </card>
</wml>
```



WAP Criticisms

- **Idiosyncratic WML language**
  - Providers have to either provide WML specific content, or rely on Web-to-WAP transcoders.
    - *"Conceptual Distance"* between PC screens and mobile display too great
- **Underspecification of terminal requirements**
  - Early WAP standards left many features optional
    - Devices often failed to operate properly; functionality was often inconsistent
- **Constrained User Interface Capabilities**
  - Early WAP devices had small monochrome screens with limited buttons
  - Even later colour devices lacked conventional PC based interactions
- **Lack of Good Authoring Tools**
  - Demands of authoring for WML greater than HTML, but poor tool support

The WAP User Experience

- Although WAP introduced a number of features designed to improve the mobile internet experience, many complained of:
  - Slow connections, hence steep bills (pre GPRS)
  - Dead-ends or sites being down
  - Sites with poor sign-posting making search difficult
  - Uneven quality and stale content
  - Small screens
- Studies in late 2000 found that mundane tasks took longer than users could tolerate

The WAP User Experience

- Problems with WAP usage included:
  - Technical limitations due to bearer (GSM) rather than WAP itself
  - Poor site design with little consideration of the user experience.
    - Little in the way of intuitive navigation support
    - Design typically reflected the wired Internet practices with little attempt to understand Mobile Computing constraints
  - Poor content and poorly managed sites
    - Unlike i-Mode, European operators failed to set up business models to encourage the generation of quality content
  - Device limitations
- However, several of these limitations have faded with time, although some issues remain...!

Messaging
MMS and SMS

- Messaging services that allow short messages to be sent from a mobile device...
  - ...often to other mobile devices, but also to services and servers.

- SMS - Short Messaging Service
  - A "conversational" communication mechanism where users exchange short messages
  - Generated revenues of US$114.6 billion globally in 2010 (up from US$89B in 2008)
    - In 2010, 6.1 trillion messages were sent!
  - Initial uptake was low (0.4 messages per month per user in 1995, 35 in 2000)

- MMS - MultiMedia Messaging Service
  - An extension of SMS which can handle multimedia (video, images, sound, rich text etc)
    - 336 million messages sent in the UK in 2006, 553m in 2008
    - More "event" driven - often activity spikes at christmas, celebrations etc
    - 4.4 million picture messages were sent on Christmas Day 2008 (3x daily average)

Short Messaging Service SMS

- The most widely used data application on the planet
  - Uses include *Messaging*, *OTA programming*, *Value-added Services*, and *Televoting*

- Originally defined as part of the GSM series of standards to send up to 160 7-bit character messages
  - Sent over the signalling paths during quiet (non-call) periods
  - Required the inclusion of a Short Message Service Centre node (SMSC).
  - First commercial deployments in 1993

- Subsequent uptake in other technologies
  - cmda networks, Digital AMPS, 3G, and both satellite and landline networks

Short Messaging Service SMS

- Messages sent to a Short Message Service Centre (SMSC)
  - Provides a store and forward mechanism:
    - Attempts to send messages to recipients
    - If recipient is unavailable, the message is queued for a later retry
    - No guarantees that message will be sent, but delivery reports can be requested

SMS Message Size

- Messages are 140 octets long (8*140=1120 bits) plus routing data and metadata

- Messages can be encoded using different alphabets:

1. Default GSM 7-bit alphabet
   - Each character encoded as 7 bits from a basic character set
   - Possible to send up to 160 characters (160 * 7 = 1120 bits = 40 octets)
   - Extended character set provides an additional table of escaped characters
     - Represented using 2 characters - an escape, followed by a second character
     - For example: the character '[' is actually encoded using an 'Esc' character and '<'

2. National Language Shift Table
   - Also uses 7-bit encoding, but requires a 4 octet UDH (User Data Header) to identify the language
     - Uses an extended escaped character set to represent a "shift" table
   - Possible to send up to 155 characters (155 * 7 = aprox 136 octets, + 4 UDH octets)
   - Supports languages such as Urdu, Hindi, etc,

SMS Message Size

- Messages are 140 octets long (8*140=1120 bits) plus routing data and metadata

- Messages can be encoded using different alphabets:

3. 8-bit data alphabet
    - Treated as raw data - up to 1120 bits (or 140 octets of data)

4. 16 bit UCS-2 alphabet
    - Supports most commonly used Latin and eastern character sets
        - Arabic, Chinese, Korean, Cyrillic
    - Possible to send up to 70 16-bit characters
    - Default mode is GSM7-bit, but if an extended character is used (e.g. lower case c with cedilla - ‘ç’), then all characters are converted into 16-bit UCS-2 characters.

Longer SMS messages

- Concatenated SMS can be used to overcome the message length limitation (140 octets)
  - Message is split into a number of *segment messages*, each of which include User Data Header (UDH)
    - Receiving device then re-assembles message
    - Each smaller message is charged at the same price as a single message.
- UDH lengths can vary, depending on the alphabet
  - **GSM 7-bit alphabet:** 153 7-bit characters per segment
  - **8-bit data alphabet:** 134 8-bit characters per segment
  - **16-bit UCS-2 alphabet:** 67 16-bit characters per segment

- *Example*
  - *A message containing 160 7-bit characters can be sent in a single SMS message*
  - *A message containing 161 7-bit characters will be sent as two SMS messages*
    - *The first containing 153 7-bit characters and a 49-bit UDH*
    - *The second containing 8 7-bit characters and a 49-bit UDH.*

MultiMedia Messaging Service - MMS

- Often considered a spinoff of SMS and WAP
  - Extends SMS to support transmission of media
    - Driven primarily due to the uptake of camera capabilities within mobile phones
    - Also used to deliver ring tones, etc
  - Developed by the Open Mobile Alliance (OMA)
    - However, was also part of 3GPP and WAP groups
    - Launched in March 2002 across GSM/GPRS and 3G
    - However, deployment and uptake delayed in the US until 2009 (AT&T)
- Messages typically sent to other mobile devices
  - But due to backward compatibility, messages are sometimes viewed over the web from a 3rd party device

MultiMedia Messaging Service - MMS

- Completely different delivery mechanism to SMS
  - Multimedia content is first encoded using MIME format
    - Then sent to the recipient carrier's MMS store and forward server (MMSC)

- The MMSC determines if the recipient's device is MMS capable:
  - Content is extracted and sent to a temporary HTTP enabled store
  - An SMS control message containing the content's URL is sent
  - The recipient's WAP browser opens and receives content from the URL

- If the device is not MMS capable (legacy experience):
  - Content is delivered to a web based service
  - URL is forwarded to the recipient as a standard SMS message

- Differences in device capability may require transcoding of content

Over-the-air programming (OTA)

- One of the main challenges of MMS is the number of handset parameters that need configuring.
  - Bad configuration is often responsible for poor user experience
- Over-the-air programming (OTA) increasingly being used to set configuration parameters
  - New software updates or configurations can be sent directly to the device from network operators
- Several Methods in use
  - A call or SMS alerting the user to a new update. User then dials in (when convenient) triggering an automatic software update.
  - SMS may be sent automatically due to a trigger; e.g. using a service for the first time, or after having signed up for a service

Typically relies on the device possessing a provisioning client to set parameters.

Exercises...

- Describe the Deck-of-Cards metaphor, and explain its origins and motivation. How does it improve the user experience over GSM networks?
- Why did WAP appear to fail, and why is the future of Mobile Computing more promising? What challenges learned from the WAP experience still need to be overcome?
- Compare and contrast the delivery mechanisms used by SMS and MMS. Describe each, and give details about how MMS messages are sent to legacy (non MMS capable) devices.

To Recap...

- In this lecture set, we covered:
  - Differences between Internet access from a PC over a fixed line vs a Mobile wireless device
    - And how this affected early provision of mobile services
  - Early approaches, which led to WAP
    - The WAP stack, WML and Deck-of-Cards
  - Other content delivery systems
    - SMS, MMS and OTA

Further Reading

- ***M-Commerce***
  Norman Sadeh (Wiley, 2009)
  - Chapter 4

- ***Pervasive Computing: The Mobile World***
  Uwe Hansmann, Lothar Merk, Martin S. Nicklous, Thomas Stober (Springer Professional Computing, 2003)
  - Chapter 11

- ***Beyond 3G: Bringing Networks, Terminals, and the Web Together***
  Martin Sauter (Wiley, 2009)
  - Chapter 6