Wireless Web

Outline

- HTTP
- HTTP 1.0 problems
- Approaches to help wireless access
- HTTP 1.1 enhancements
- System Architecture for Web Access from Mobile Clients
- Internet Services for Mobile Wireless Devices
  - WAP 1.x and WAP 2.0
  - i-mode

Based on
- Jochen Schiller, *Mobile Communications*, 2nd Ed, Addison-Wesley, 2003, Chapter 10: “Support for Mobility”

HTTP

- HTTP (Hypertext Transfer Protocol) is a stateless, lightweight, application level protocol for data transfers between servers and clients
- First version HTTP 1.0 (1996), HTTP 1.1 (1999) is the current standard
- HTTP transaction consists of an HTTP request issued by a client followed by an HTTP response from a server
- HTTP is stateless → all HTTP transactions are independent
- HTTP assumes a reliable underlying protocol (TCP)
- HTTP 1.0 establishes a new connection for each request
- HTTP 1.1 keeps connection active for multiple requests

HTTP (especially 1.0) Problems 1/2

- Bandwidth and delay
  - Not designed for low bandwidth/high delay connections
  - HTTP protocol headers quite large and redundant (stateless)
  - Headers are readable for humans and transferred in plain ASCII
  - Content is transferred uncompressed
  - A single TCP connection for every item in a web page (TCP does not leave slow start phase)
  - Need for DNS look-up (potential delay increase)
HTTP (especially 1.0) Problems

- Caching
  - Important in supporting (partially) disconnected web browsers
  - Caches can be maintained locally (client-based) or for a whole company or a university
  - Caching can be disabled by content-providers
    - Need for realistic feedback
    - Pages contain dynamic objects
  - Customization stored in cookies
  - Mechanism of accessing web servers might change due to change of access points
  - Security mechanisms might inhibit caching

Approaches to Help Wireless Access

- Image scaling
- Content transformation
- Content extraction (headlines and keywords)
  - Give the user the option to download the full page based on some keywords or headlines
  - Could generate an automatic abstract for some page (semantic compression)
- Special languages and protocols
  - Replace HTML and HTTP with other languages and protocols better adapted to wireless environment
  - Ideas integrated into Wireless Application Protocol (WAP)
  - Enhancements integrated into the server or into a gateway between fixed and mobile network (application gateways)

HTTP 1.1 Enhancements

- Connection re-use
  - Persistent connections
- Caching enhancements
  - To fetch most up-to-date version of an item, that item can be revalidated with origin server
  - Can determine if two different URLs map to same content
  - Content can flagged to be cacheable in private caches only or anywhere
- Bandwidth optimization
  - Negotiation of compression parameters and compression style (hop-by-hop or end-to-end)
  - Partial transmission of objects

System Architecture for Web Access

- Integration of caching on web browsers
  - Offline use
  - No automatic pre-fetching
  - Standard on today’s browsers
Can use a companion application for the browser that supports pre-fetching of content, caching, and disconnected service (not transparent to browser and 2 ways exist for accessing content)

- Use a transparent client proxy
  - acts as server for browser and client for web server
  - Can apply pre-fetching strategies
    - All pages, the current pages point to
    - All pages including those the pre-fetched pages point to (up to a certain limit)
    - Pages but no pictures

Use a network proxy
- content transformation
- pre-fetching
- caching

Integrate the use of a client proxy and network proxy
- Better cooperation between client and network proxies in pre-fetching and caching
Wireless Application Protocol (WAP)

- Goals
  - deliver Internet content and enhanced services to mobile devices and users (mobile phones, PDAs)
  - independence from wireless network standards
  - open for everyone to participate, protocol specifications will be proposed to standardization bodies
  - applications should scale well beyond current transport media and device types and should also be applicable to future developments

- Forum
  - was: WAP Forum (www.wapforum.org)
  - now: Open Mobile Alliance (www.openmobilealliance.org)

WAP Scope of Standardization

- Browser
  - “micro browser”, similar to existing, well-known browsers in the Internet
- Script language
  - similar to Java script, adapted to the mobile environment
- WTA/WTAI
  - Wireless Telephony Application (Interface): access to all telephone functions
- Content formats
  - e.g., business cards (vCard), calendar events (vCalendar)
- Protocol layers
  - transport layer, security layer, session layer etc.

WAP 1.x Architecture

<table>
<thead>
<tr>
<th>Internet</th>
<th>HTML, Java</th>
</tr>
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<tbody>
<tr>
<td>HTTP</td>
<td></td>
</tr>
<tr>
<td>SSL/TLS</td>
<td></td>
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<tr>
<td>TCP/IP, UDP/IP, media</td>
<td></td>
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</tbody>
</table>

WAP comprises WML (Wireless Markup Language), WML Script, WTAI etc.

WAP Network Elements

- Fixed network
- Wireless network

Internet HTML

Fixed network

WAP

wireless network

Binary WML

web server

WAP proxy

Binary WML

PSTN

Binary WML: binary file format for clients
WAP Protocols 1/6

- **WDP (Wireless Datagram Protocol)**
  - Common interface for higher WAP layers independent of network technology
- **WCMP (Wireless Control Message Protocol)**
  - Control/error reporting \(\rightarrow\) similar to ICMP in TCP/IP
- **WTLS (Wireless Transport Layer Security)**
  - Based on TLS (Transport Layer Security), formerly SSL (Secure Sockets Layer)
  - Optimized for low-bandwidth communication channels
  - Provides authentication, privacy, data integrity, and protection against DOS attacks

WAP Protocols 2/6

- **WTP (Wireless Transaction Protocol)**
  - Different transaction services, offloads applications
  - Application can select reliability, efficiency
  - Support of different communication scenarios
    - **class 0**: unreliable message transfer (push service)
    - **class 1**: reliable message transfer without result message (reliable push service)
    - **class 2**: reliable message transfer with exactly one reliable result message (typical web browsing)
  - Low memory requirements, suited to simple devices (< 10 Kbytes)

WAP Protocols 3/6

- **WTP (Wireless Transaction Protocol)**
  - No explicit connection setup or tear-down is required
  - Reliability
    - Unique transaction identifiers (TID)
    - Acknowledgements
    - Selective retransmission
    - Duplicate removal
  - Optional: concatenation & separation of messages
  - Optional: segmentation & reassembly of messages
  - Asynchronous transactions
  - Transaction abort, error handling

WAP Protocols 4/6

- **WSP (Wireless Session Protocol)**
  - Operates on top of WDP or WTP
  - Provides session management, capability negotiation, and content encoding
  - WSP/B (WSP/Browsing) better suited for browsing-type applications
    - HTTP1.1 functionality
    - Exchange of session headers
    - Push and Pull data transfer
    - Asynchronous requests are optional
  - Can use WSP/B over WTP (classes 0, 1, and 2)
  - Can use WSP/B over WDP or over WTLS if security is required
WAP Protocols 5/6

- WAE (Wireless Application Environment)
  - Create a general-purpose application environment based on technologies of WWW
  - Components
    - architecture: application model, browser, gateway, server
    - WML: XML-Syntax, based on card stacks, variables, ...
    - WMLScript: procedural, loops, conditions, ... (similar to JavaScript)
    - WTA: telephone services, such as call control, text messages, phone book, ... (from WML/WMLScript)
    - content formats: vCard, vCalendar, Wireless Bitmap, WML, ...

WAP Protocols 6/6

Origin Servers:
- web server
- other content server

Gateway:
- push content
- other content

Encoded request
- encoded response with content
- push content

WAE logical Model

i-mode 1/2

- Introduced in Japan by NTT DoCoMo in 1999
- Offers email, web access, and picture exchange
- More than 45 million users in Japan and 5 millions worldwide (June 2005)
- Technology
  - Packet oriented (PDC-P)
  - Compact HTML plus proprietary tags, special transport layer (Stop/go, ARQ, push, connection oriented)

i-mode 2/2

- Uses a packet-oriented bearer
- WAP started with connection-oriented bearers
  - Poor user experience
  - Connection permanently open to support real interactive web browsing
  - New connection had to be established each time content was loaded
- Misconception: complete WAP concept is a failure
WAP 2.0 1/2

- Published in July 2001
- Roughly sum of WAP 1.x, i-mode, Internet protocols, and ….
- Support WAP 1.x, but additionally integrates IP, TCP (with a wireless profile), TLS, and HTTP (wireless profiled)
- WAP 2.0 browsers support WML as well as XHTML with a mobile profiler
- Consists of a protocol framework and an application framework
- Protocol framework consists of
  - Bearer services
  - Transport services (WDP or UDP, TCP with a wireless profile)
  - Transfer services (HTTP wireless profiled, MMS)
  - Session services

WAP 2.0 2/2