Networking Applications

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Mobile Web
Outline

Mobile Web

• 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 2/2

• 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 1/5

- Integration of caching on web browsers
  - Offline use
  - No automatic pre-fetching
  - Standard on today’s browsers

![Diagram of mobile client, browser, integrated enhancement, and web server]
System Architecture for Web Access 2/5

• 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)
System Architecture for Web Access 3/5

- 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
System Architecture for Web Access

• Use a network proxy
  ➢ content transformation
  ➢ pre-fetching
  ➢ caching
System Architecture for Web Access 5/5

• 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

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

Binary WML: binary file format for clients
WAP Protocols

- **WDP (Wireless Datagram Protocol)**
  - Common interface for higher WAP layers independent of network technology
- **WCMP (Wireless Control Message Protocol)**
  - Control/error reporting → 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

Origin Servers:
- Web server
- Other content server

Gateway:
- Encoders & decoders

Client:
- WTA user agent
- WML user agent
- Other WAE user agents

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 million 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 WAP1.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

Service discovery
- External services EFI
- Provisioning
- Navigation Discovery
- Service Lookup

Security services
- Crypto libraries
- Authentication
- Identification
- PKI
- Secure transport
- Secure bearer

Application framework
- Multimedia Messaging (Email)
- Content formats
- WAE/WTA User Agent (WML, XHTMLMP)
- Push

Protocol framework
- Push OTA
- Capability Negotiation
- Synchronisation
- Cookies

- Hypermedia transfer (WTP+WSP, HTTP)
- Streaming
- MMS

- Datagrams (WDP, UDP)
- Connections (TCP with wireless profile)

- IPv4
- CSD
- USSD
- GPRS
- IPv6
- SMS
- FLEX
- MPAK
- ...