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

- Integration of caching on web browsers

  - ➢ Offline use

  - ➢ No automatic pre-fetching

  - ➢ Standard on today's browsers
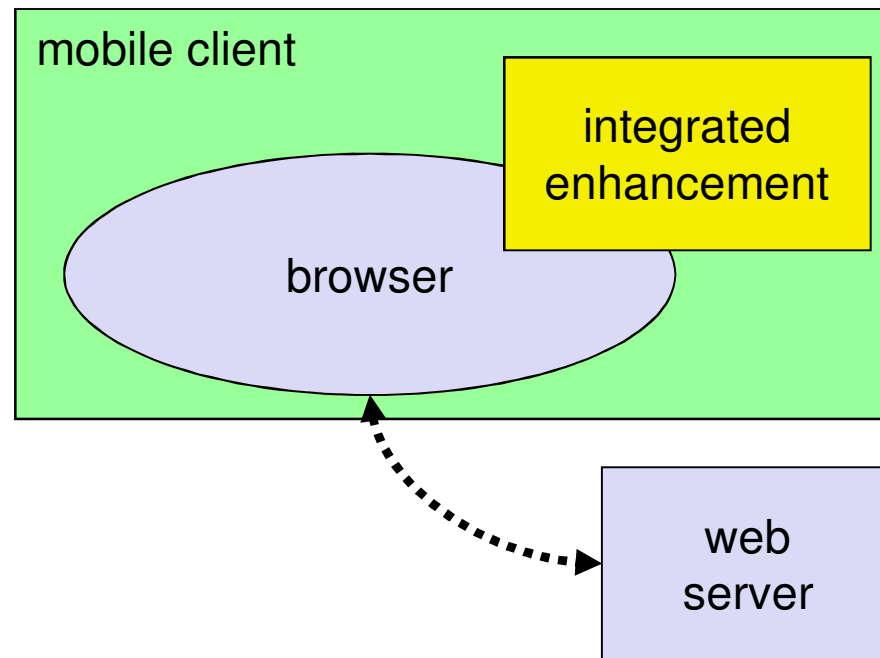
System Architecture for Web Access

•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)
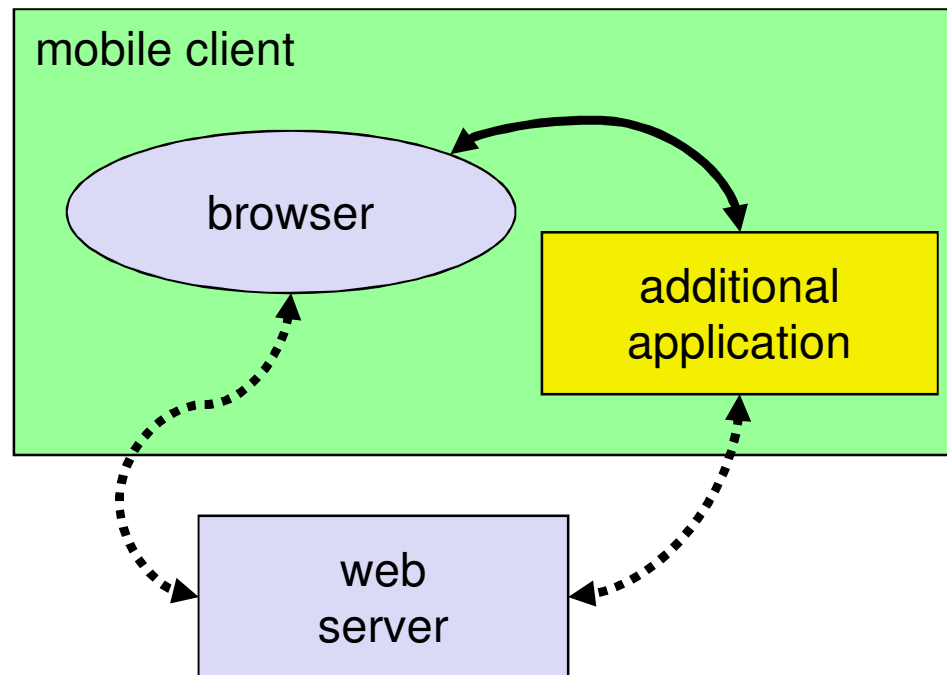
System Architecture for Web Access
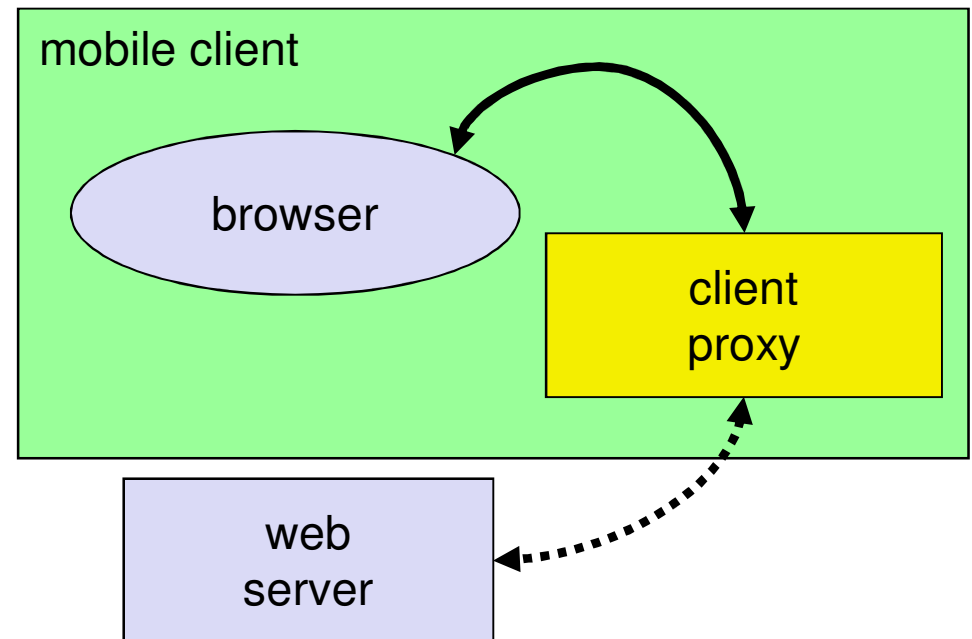
- Use a transparent client proxy

  ➢ 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

mobile client

browser

client proxy

web server

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System Architecture for Web Access

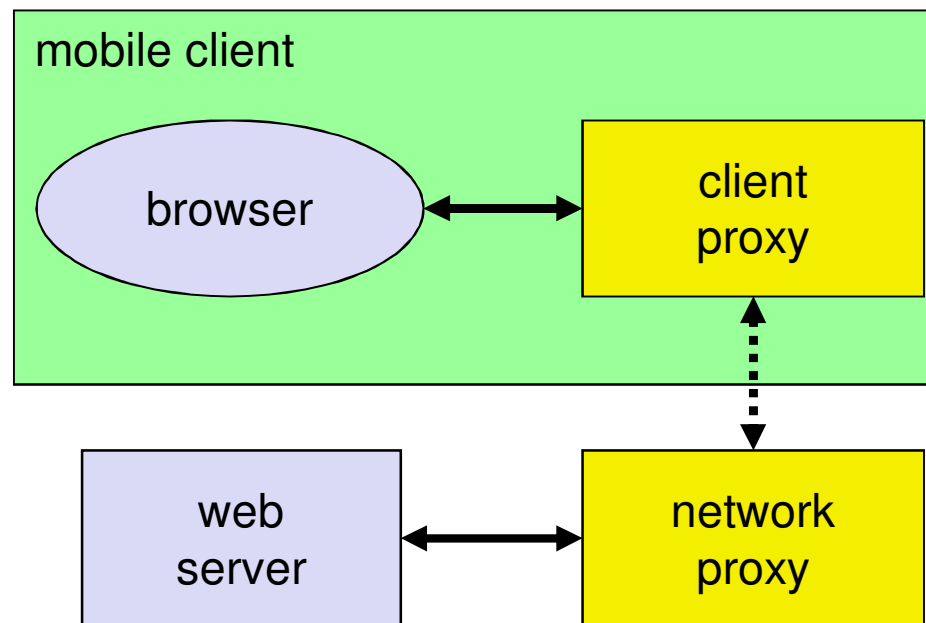•Use a network proxy

➢content transformation

➢pre-fetching

➢caching
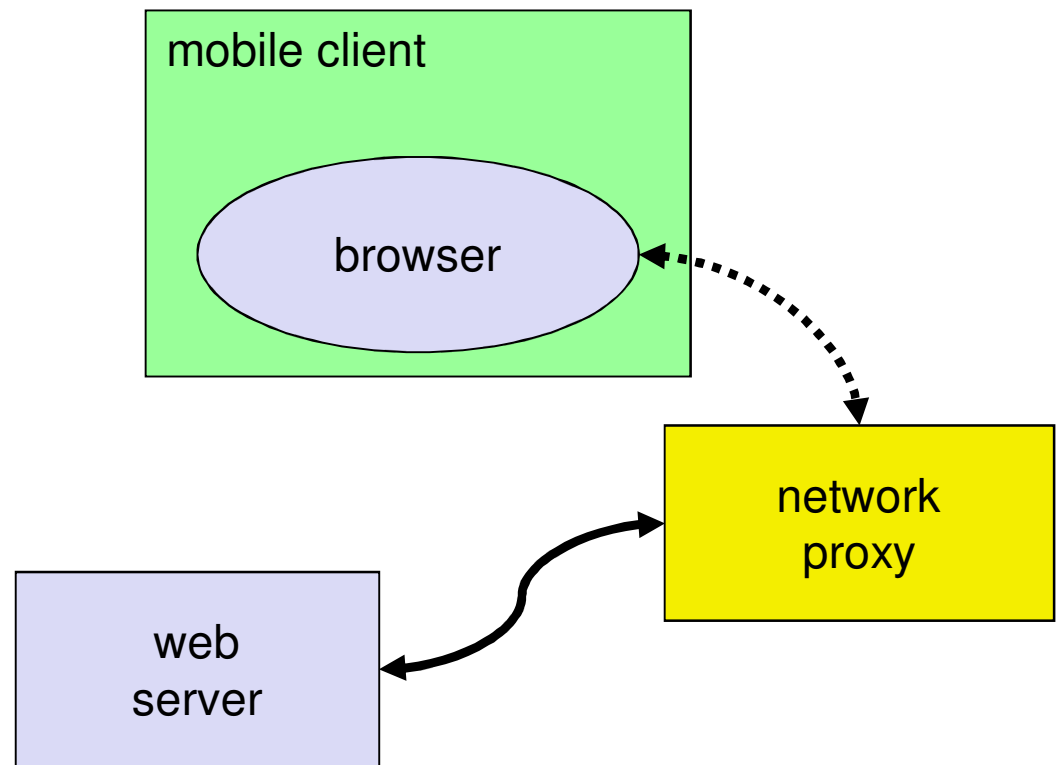
System Architecture for Web Access 5/5

•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
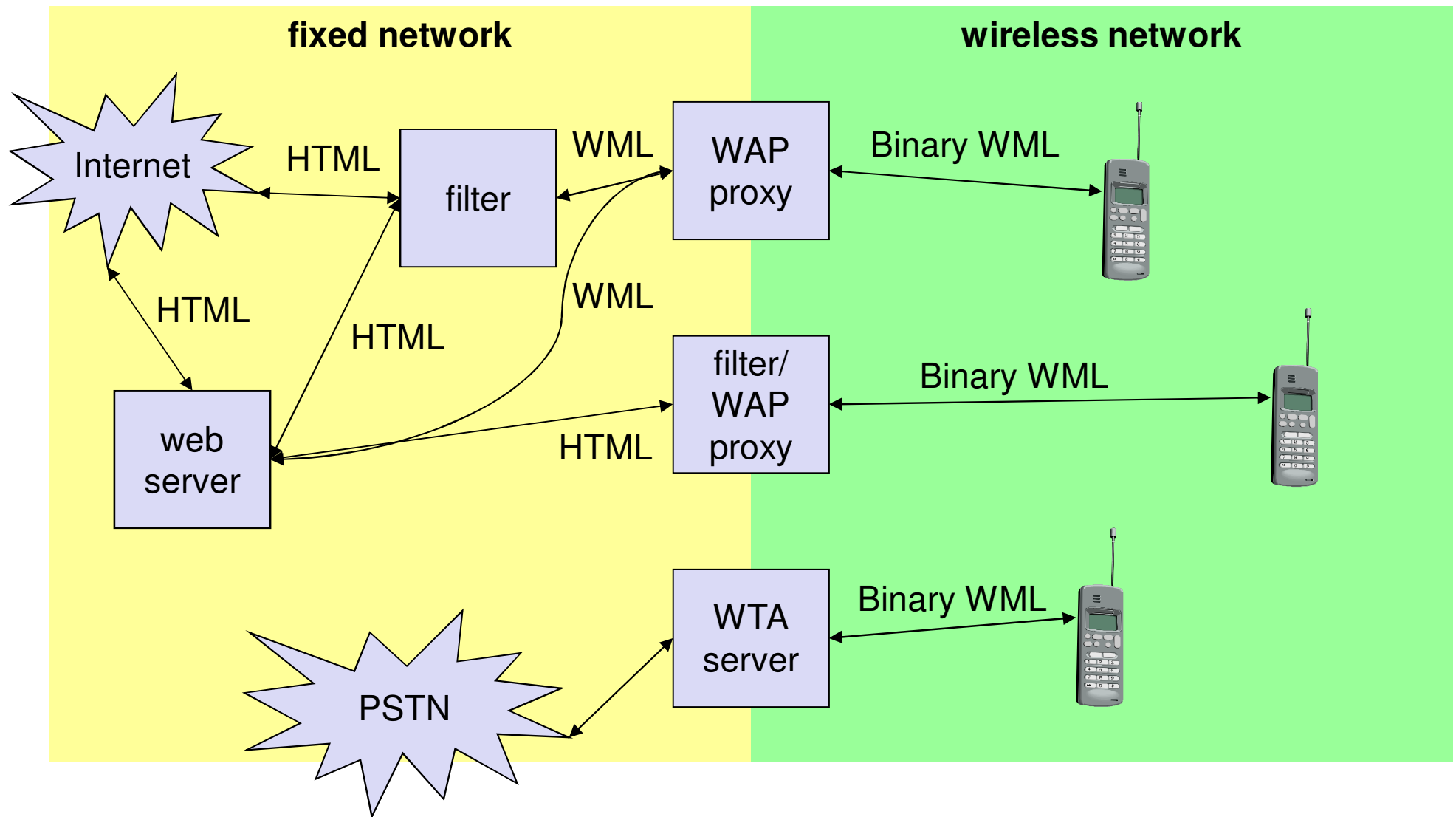 - ➢ similar to Java script, adapted to the mobile environment
- WTA/WTAI
  - ➢ *Wireless Telephony Application* (Interface): access to all telephone functions
- Content formats
  - ➢ e.g., business cards (vCard), calendar events (vCalender)
- Protocol layers
  - ➢ transport layer, security layer, session layer etc.

WAP 1.x Architecture

Internet

WAP

Internet	WAP
HTML, Java	**A-SAP** — Application Layer (WAE)
HTTP	**S-SAP** — Session Layer (WSP)
	TR-SAP — Transaction Layer (WTP)
SSL/TLS	**SEC-SAP** — Security Layer (WTLS)
TCP/IP, UDP/IP, media	**T-SAP** — Transport Layer (WDP) — WCMP

additional services and applications

Bearers (GSM, CDPD, ...)
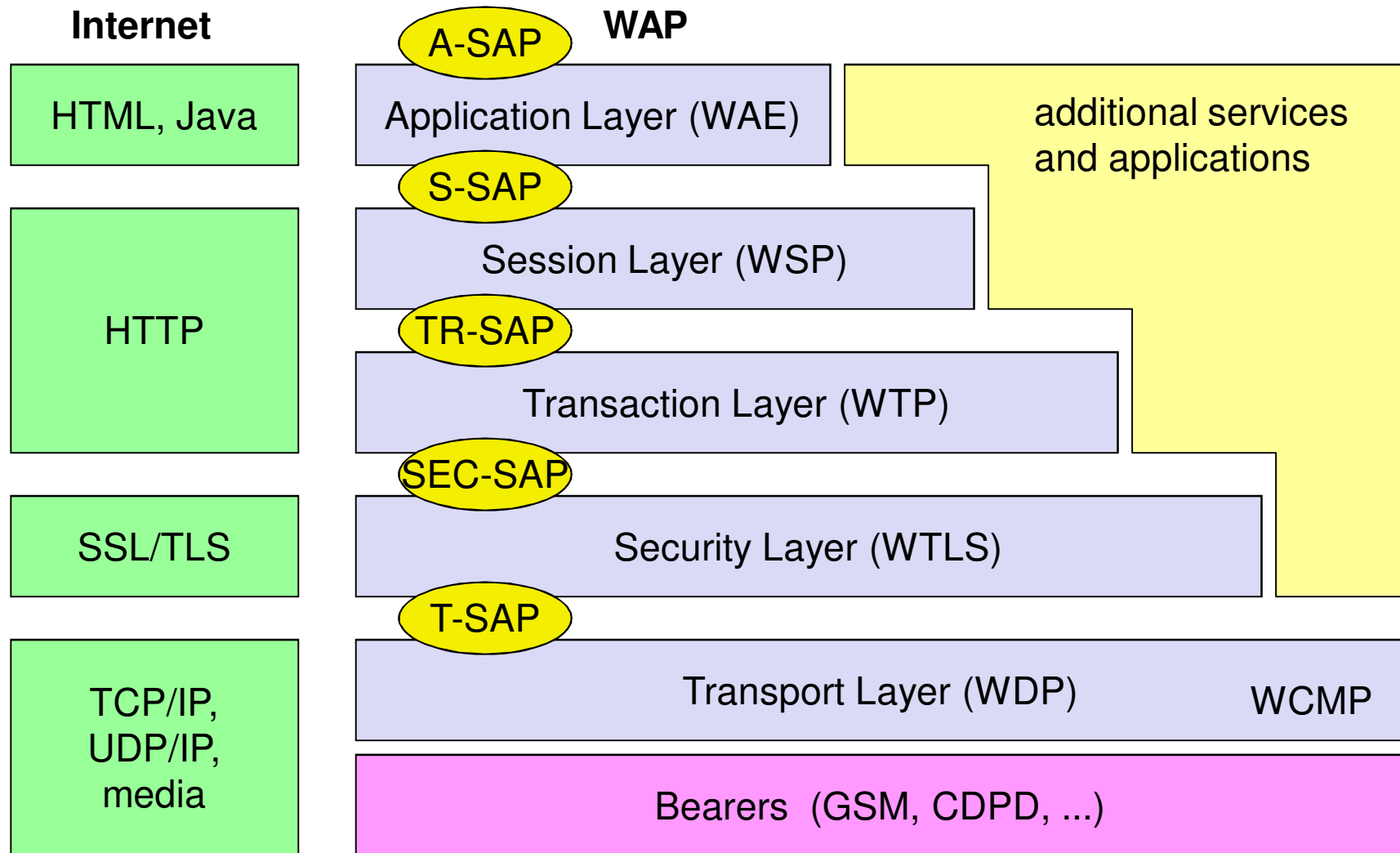
WAE comprises WML (Wireless Markup Language), WML Script, WTAI etc.

WAP Network Elements

wireless network

Internet

HTML

filter

WML

WAP proxy

Binary WML

HTML

HTML

WML

web server

HTML

filter/ WAP proxy

Binary WML

WTA server

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 →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

- **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
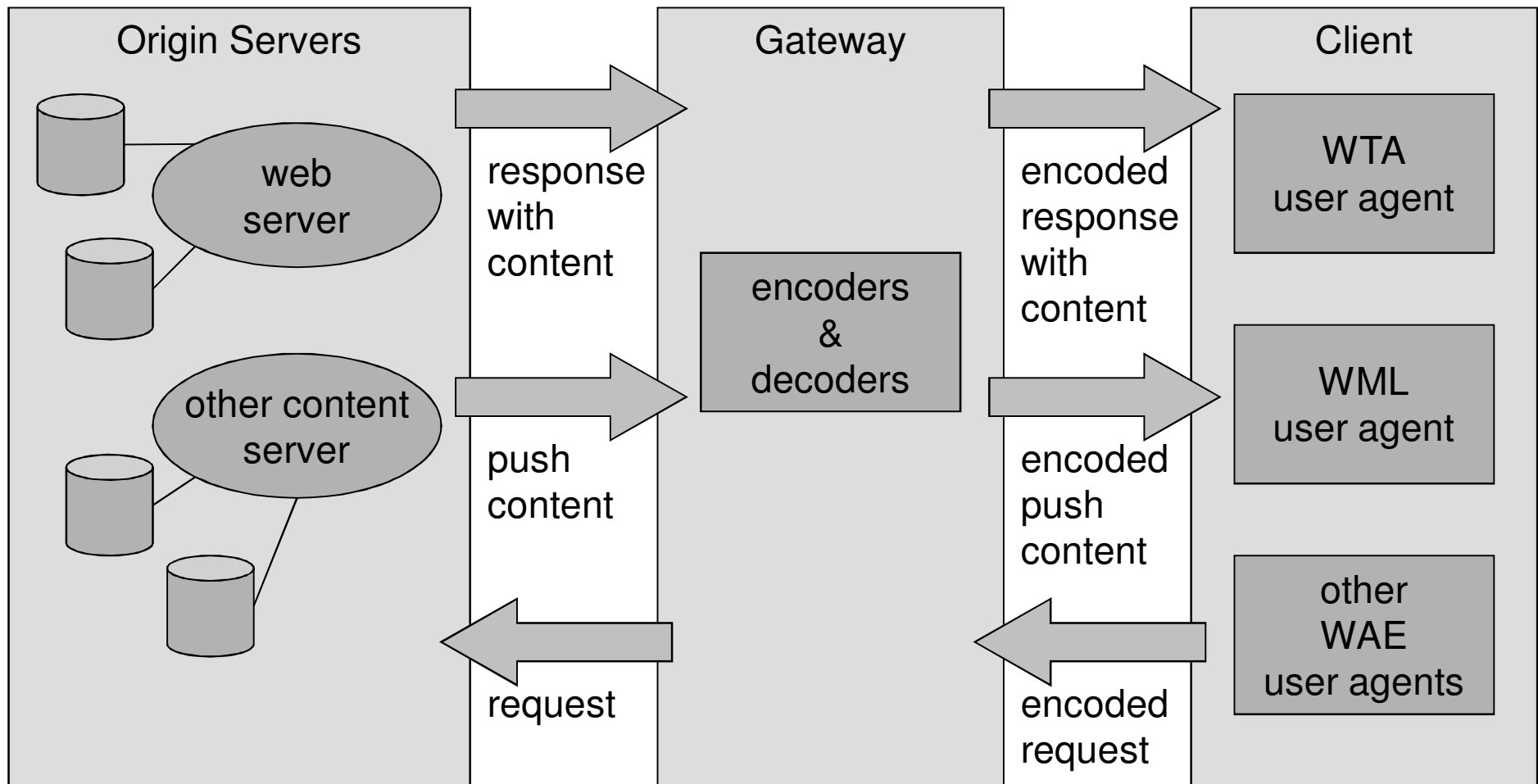 - ➤ Asynchronous transactions
  - ➤ Transaction abort, error handling

WAP Protocols

- 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

response with content

push content

request

Gateway

encoders & decoders

Client

encoded response with content

encoded push content

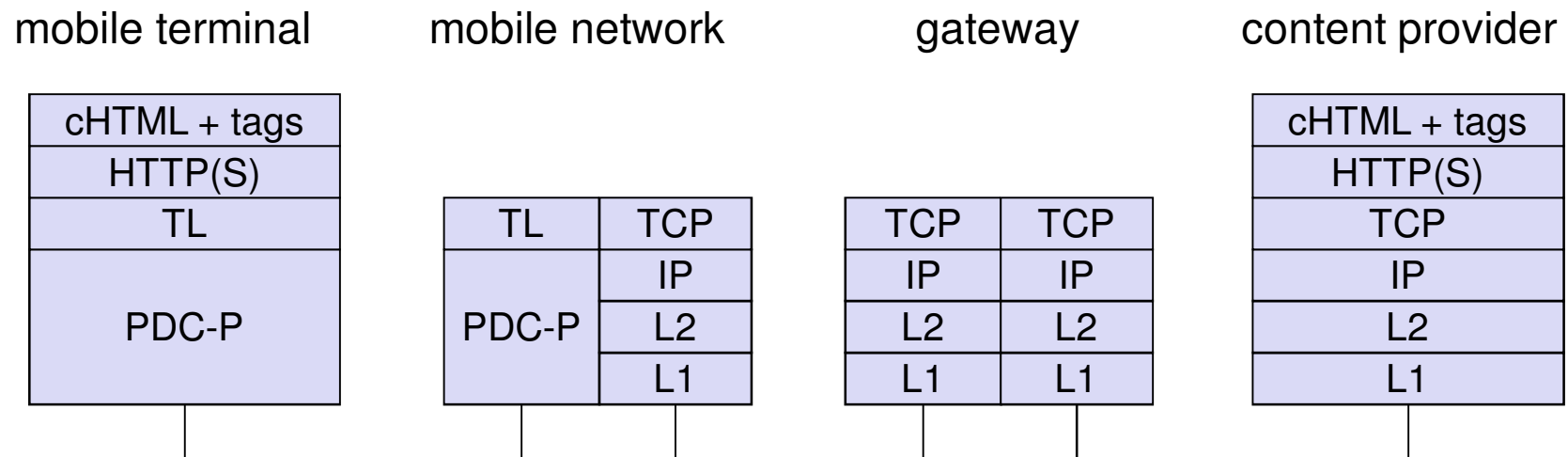encoded request

- 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 millions worldwide (June 2005)
- Technology
  - ➢ Packet oriented (PDC-P)
  - ➢ Compact HTML plus proprietary tags, special transport layer (Stop/go, ARQ, push, connection oriented)

mobile terminal	mobile network	gateway	content provider

mobile terminal		mobile network		gateway		content provider
cHTML + tags						cHTML + tags
HTTP(S)						HTTP(S)
TL		TL	TCP	TCP	TCP	TCP
			IP	IP	IP	IP
PDC-P		PDC-P	L2	L2	L2	L2
			L1	L1	L1	L1

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

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WAP 2.0 2/2