

Wireless Application Protocol & Wireless Markup Language



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Overview

- Motivation
- WAP
- WML
- Applications
- Conclusion

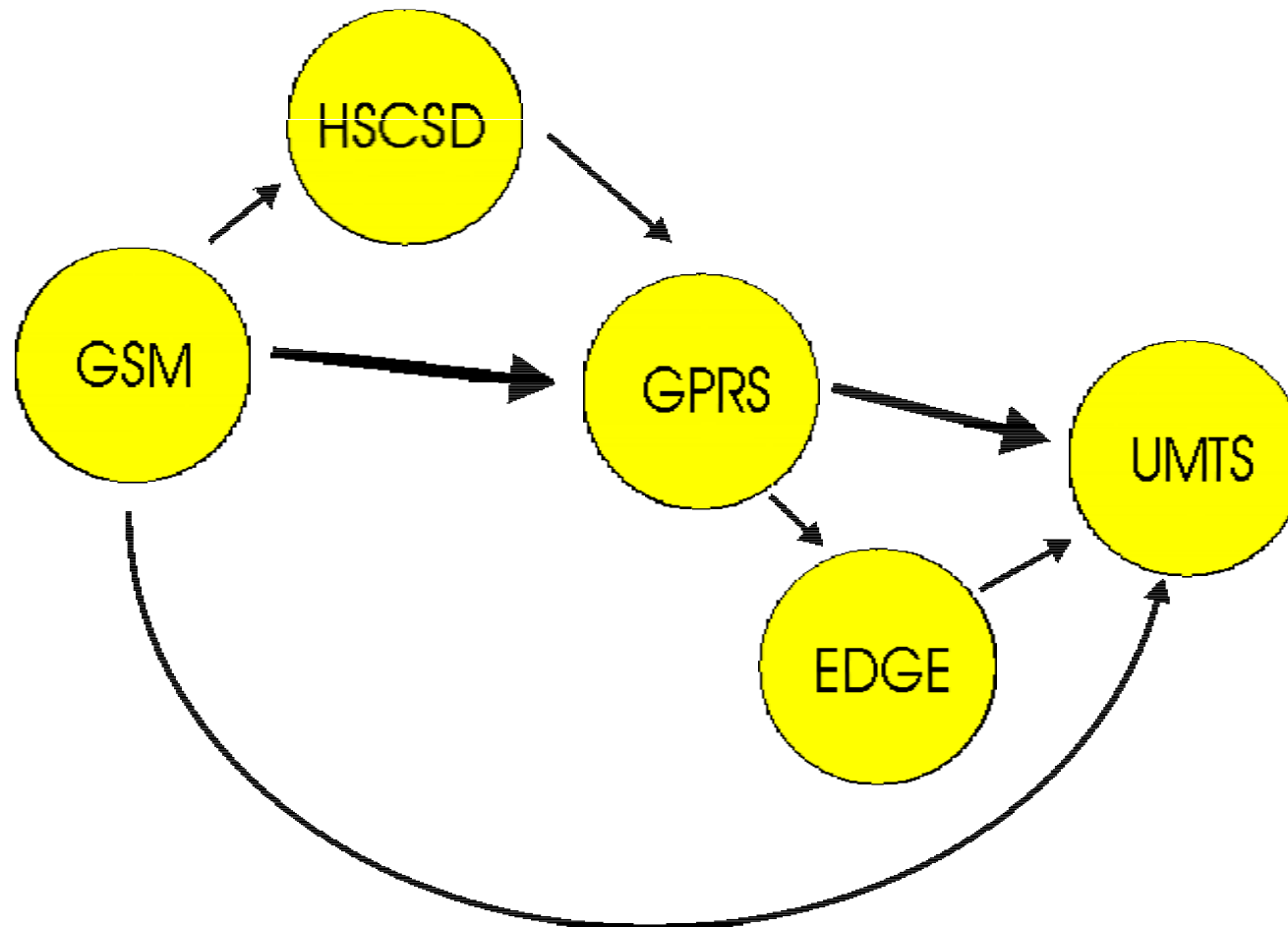




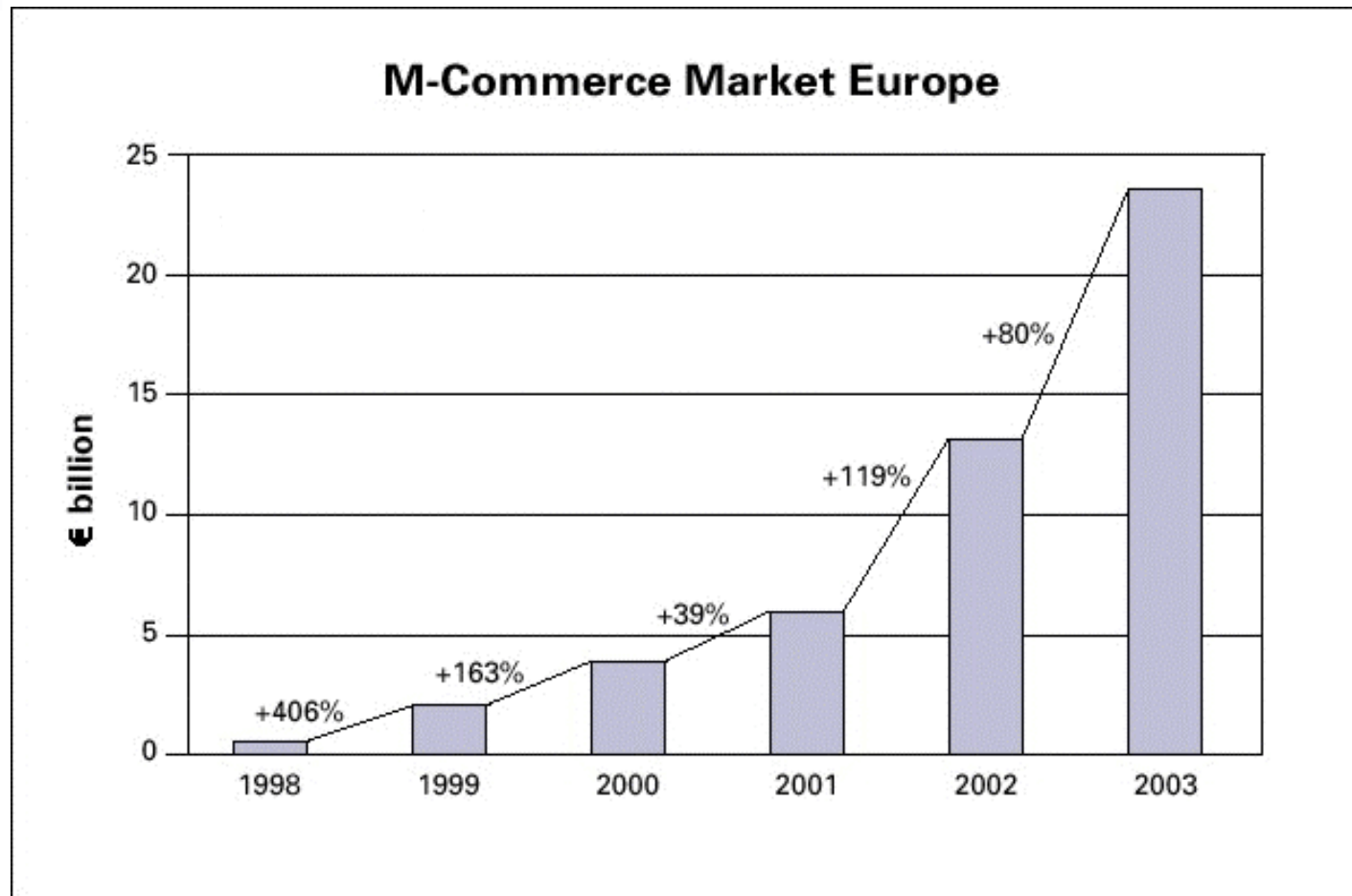
Motivation

- Advances of mobile communication systems, especially GSM
- Phenomenal growth of handy, PDA and other handheld devices
- New services required

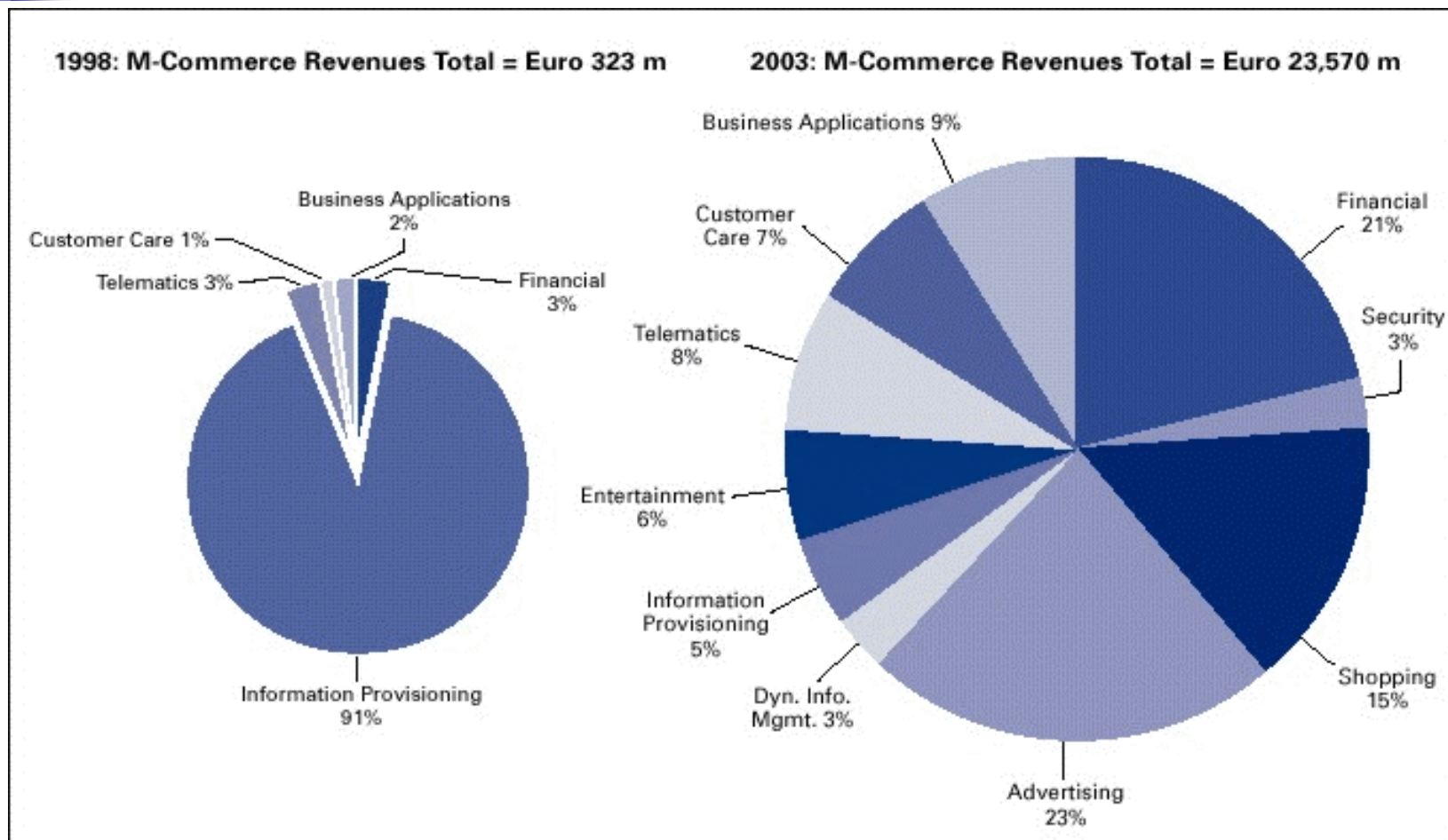
Wireless Communication

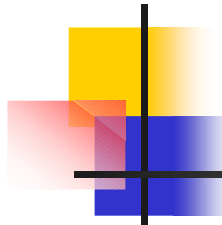


M-Commerce



Applications





PC + Internet

- High performance PC
- Wired Internet connection (V.90 modem, ISDN, xDSL, Ethernet, ...)
- Network protocols: TCP/IP + HTTP
- Document format: HTML



Problems with Wireless Networks

- Low bandwidth
- High latency and jitter
- High transmission error rate
- Low connection stability



Problems with Wireless Terminals (Handy, PDA,...)

- Small screen, limited display capability
- One-finger navigation
- Limited RAM/ROM
- Limited CPU performance
- Low battery life



Solutions

- Internet access via handheld devices was possible before WAP, but the technologies never took off commercially because they used proprietary technologies that didn't work across different platforms.



WAP-Forum

- <http://www.wapforum.org>
- A consortium of hardware, software, service and other wireless-industry vendors
- Founded in June 1997



WAP Overview (I)

- Designed to address small devices' technical limitations
- Work with a variety of wireless platforms
- Offer a scalable, extensible protocol stack
- Designed to solve some of the problems caused when small low-powered devices on different platforms try to use low-bandwidth wireless network technology to access services or data-intensive content via the Internet
- WAP uses proxy technology to connect wireless technology with the Web.



WAP Overview (II)

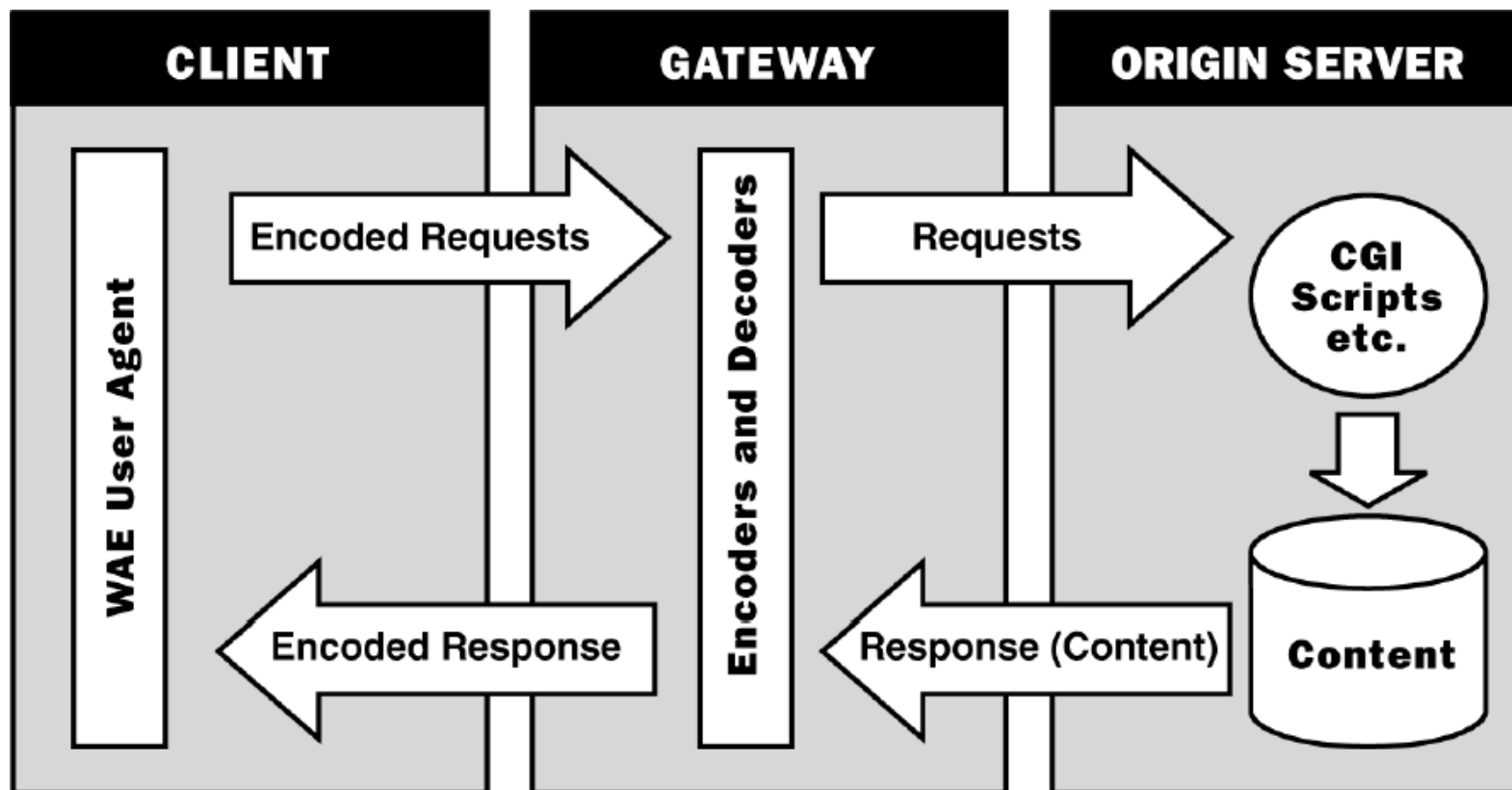
- The WAP system architecture is based on the WWW programming model, yet optimized to suit the characteristics of a mobile network.
- WAP is a global multi-layered protocol which is designed to bring Internet contents to “Thin-Client” devices
- Wireless Application Protocol (WAP) is a set of communications protocols that standardise the way that wireless devices can be used for internet-based access

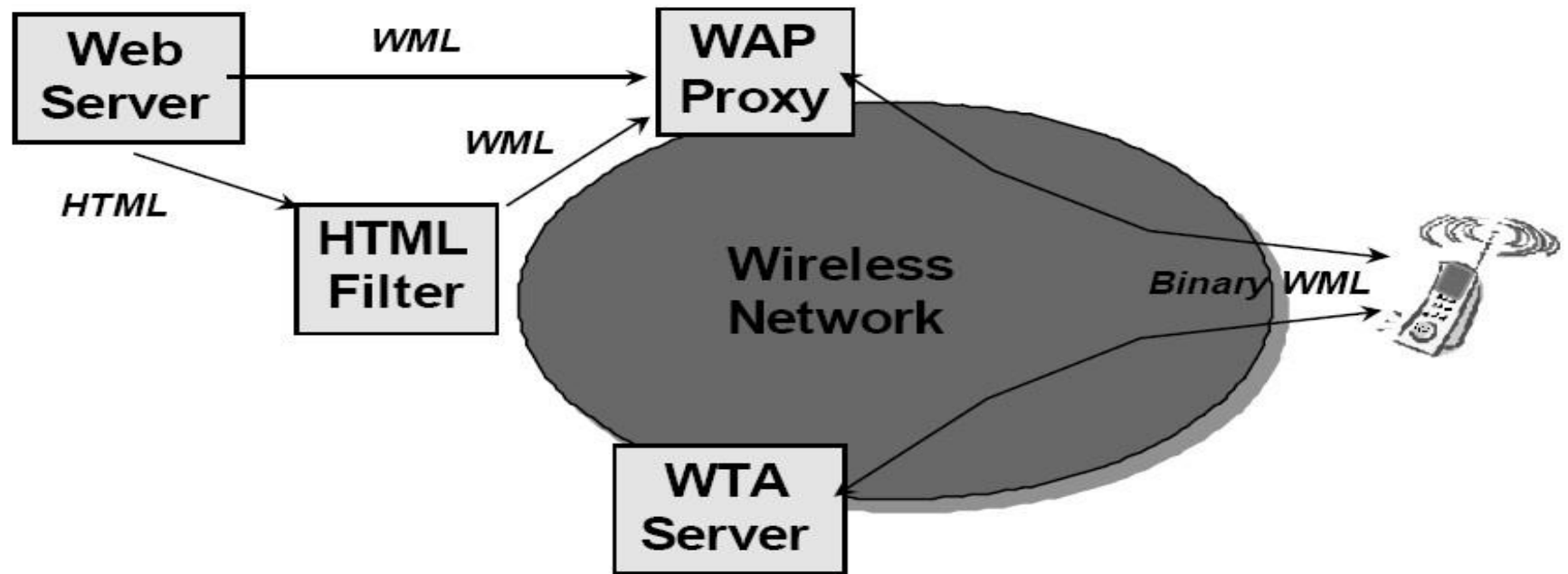


WAP Overview (III)

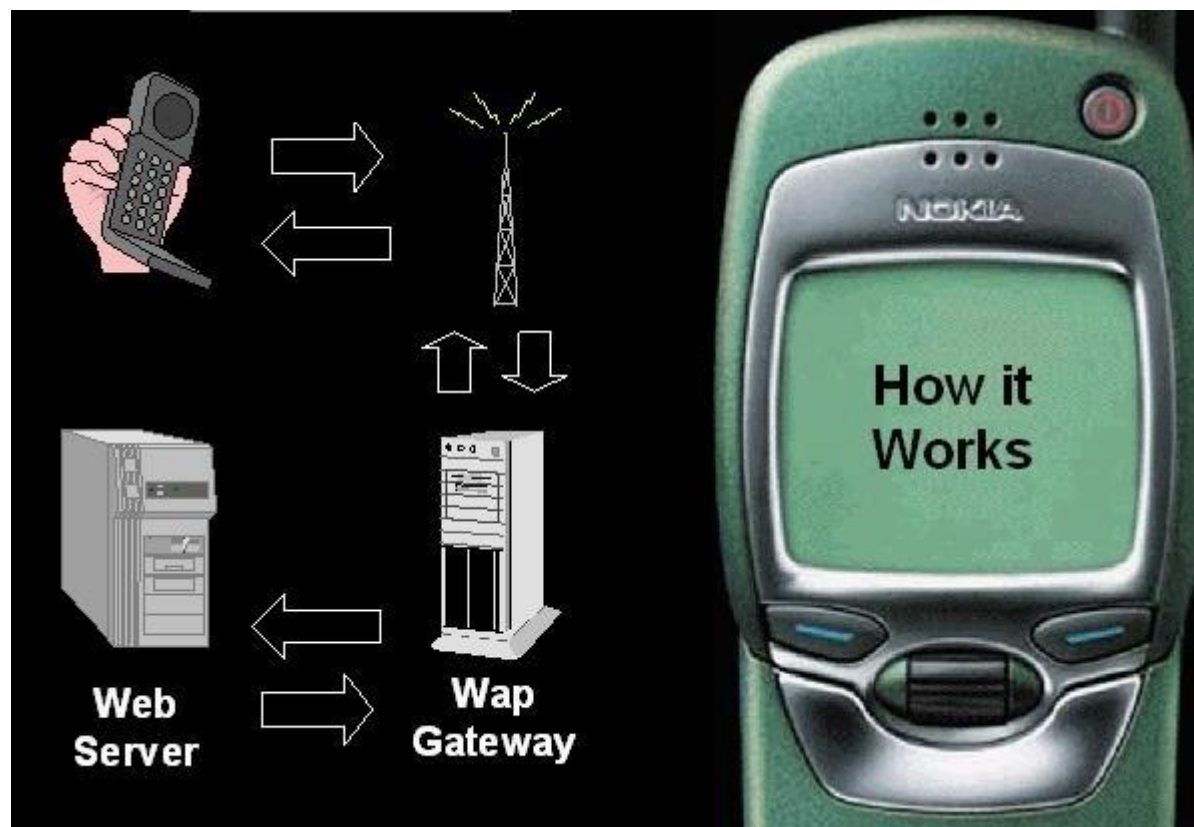
- Client/Server approach
- Microbrowser in the mobile phone, requiring only limited resources
- WAP puts the intelligence in the WAP Gateways

WAP Service Model

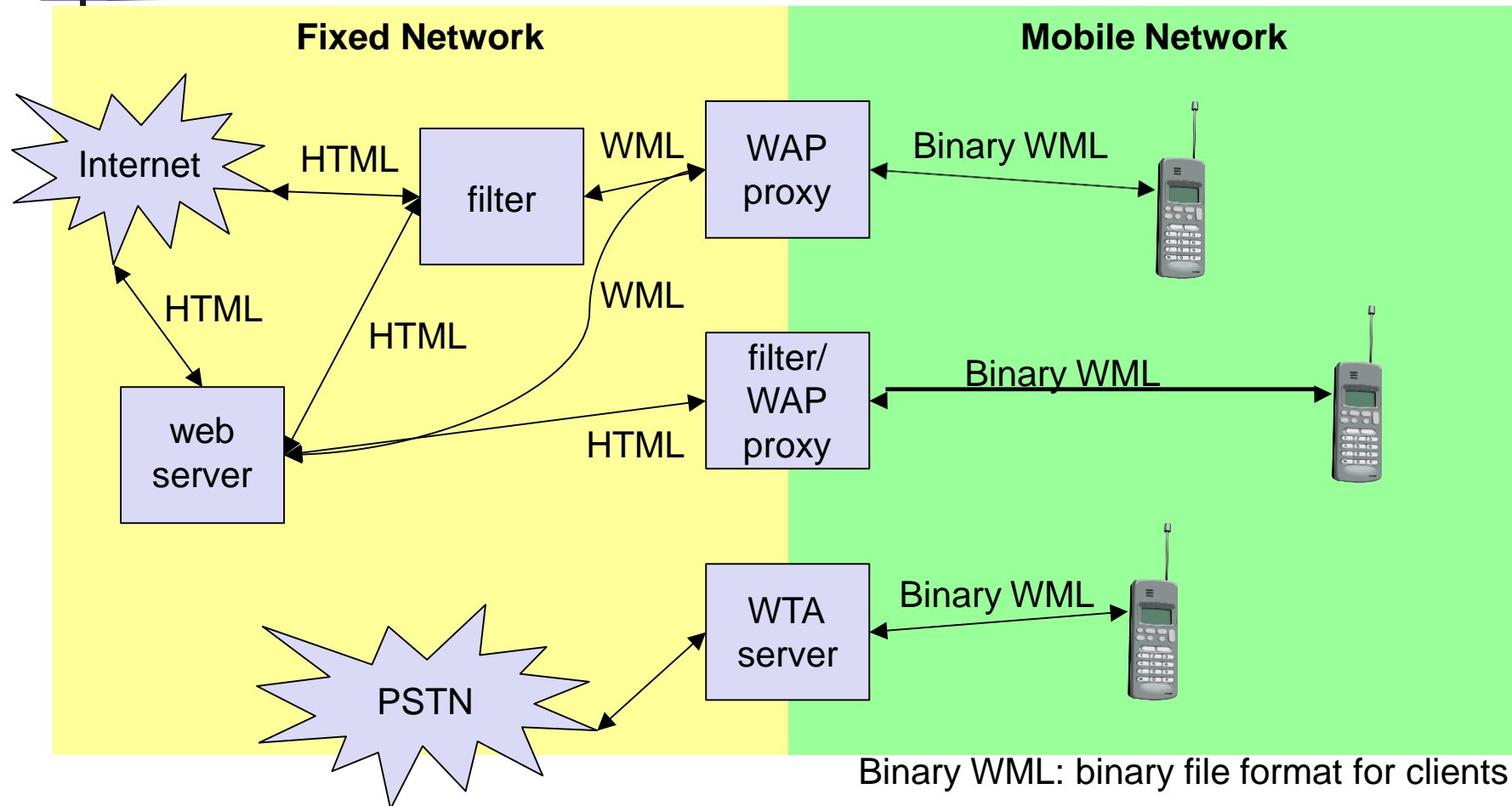




How It Works

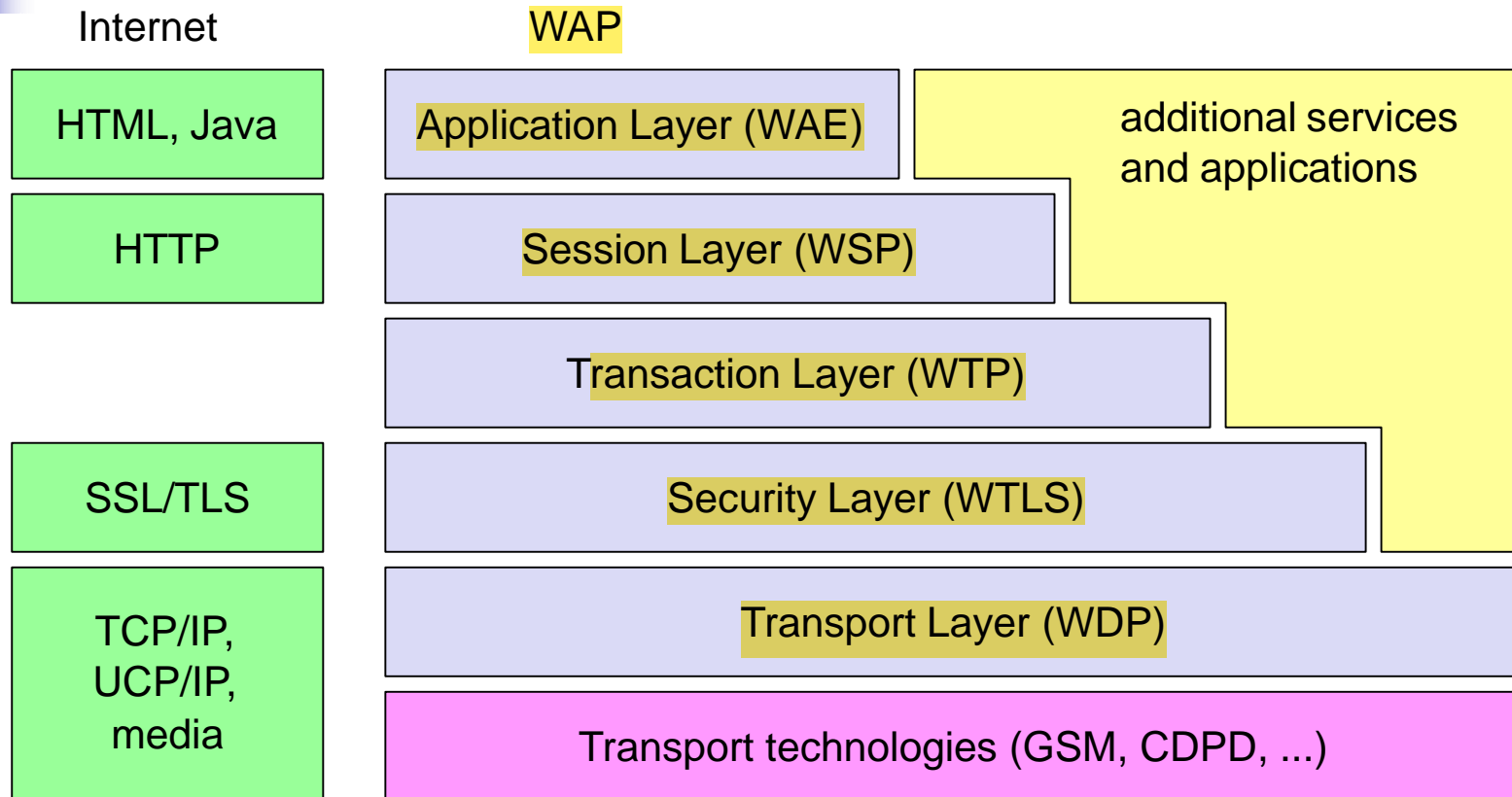


WAP Network Elements



PROTOCOL STACK

WAP Reference Model



WAE comprises WML (Wireless Markup Language), WMLScript, WTAI etc.



WDP - Wireless Datagram Protocol

- Protocol of the transport layer within the WAP architecture
 - Uses directly transport mechanisms of different network technologies
 - Offers a common interface for higher layer protocols
 - Allows for transparent communication using different transport technologies
- Goals of WDP
 - Create a worldwide interoperable transport system with the help of WDP adapted to the different underlying technologies
 - Transmission services such as SMS in GSM might change, new services can replace the old ones



WTLS - Wireless Transport Layer Security

- Goals
 - Data integrity
 - prevention of changes in data
 - Privacy
 - prevention of tapping
 - Authentication
 - creation of authenticated relations between a mobile device and a server
 - Protection against denial-of-service attacks
 - protection against repetition of data and unverified data
- WTLS
 - Based on the TLS (Transport Layer Security) protocol (former SSL, Secure Sockets Layer)
 - Optimized for low-bandwidth communication channels



WTP - Wireless Transaction Protocol

- Common interface to transport mechanisms, port-based abstract interface to applications
 - Application is independent of transport mechanisms
- Support of different communication scenarios
 - Connection oriented (WTP/C): reliable, full-duplex, QoS negotiation, flow control, message oriented
 - Transaction oriented (WTP/T): reliable, data already in the first packet, flow control
 - Connectionless (WTP/D): unreliable, can be UDP if IP used for layer 3
- Supports peer-to-peer, client/server and multicast applications
- Low memory requirements, suited to simple devices (< 10kbyte)
- Efficient for wireless transmission
 - Segmentation/reassembly
 - Selective retransmission
 - Header compression
 - Optimized connection setup (setup with data transfer)



WSP - Wireless Session Protocol

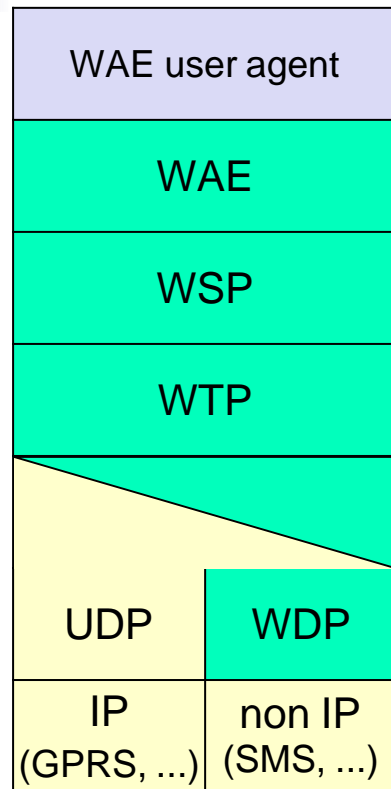
- HTTP 1.1 functionality
 - Request/reply, content type negotiation, ...
- support of client/server, transactions, push technology
- key management, authentication, Internet security services
- session management (interruption, resume,...)



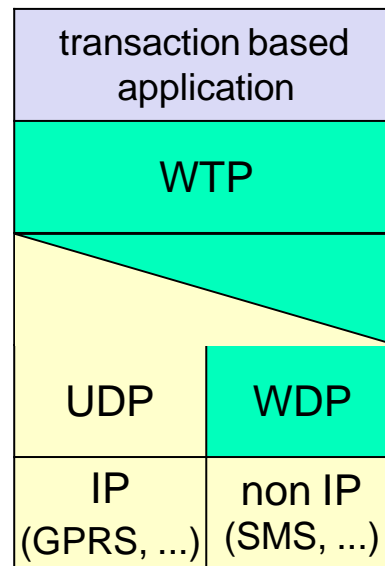
WAE - Wireless Application Environment

- Goals
 - Network independent application environment for low-bandwidth, wireless devices
 - Integrated Internet/WWW programming model with high interoperability
- Requirements
 - Device and network independent, international support
 - Manufacturers can determine look-and-feel, user interface
 - Considerations of slow links, limited memory, low computing power, small display, simple user interface (compared to desktop computers)
- 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, ... (accessible from WML/WMLScript)
 - Content formats: vCard, vCalendar, Wireless Bitmap, WML, ...

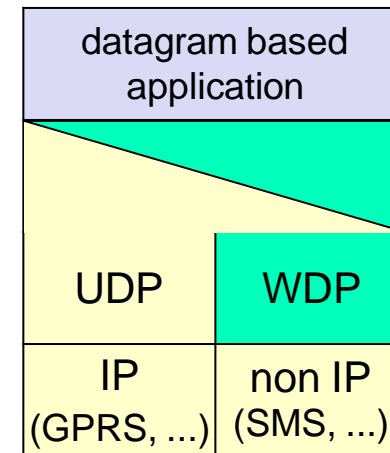
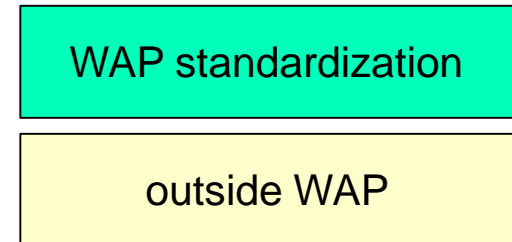
Examples for WAP protocol stacks



typical WAP
application with
complete protocol
stack



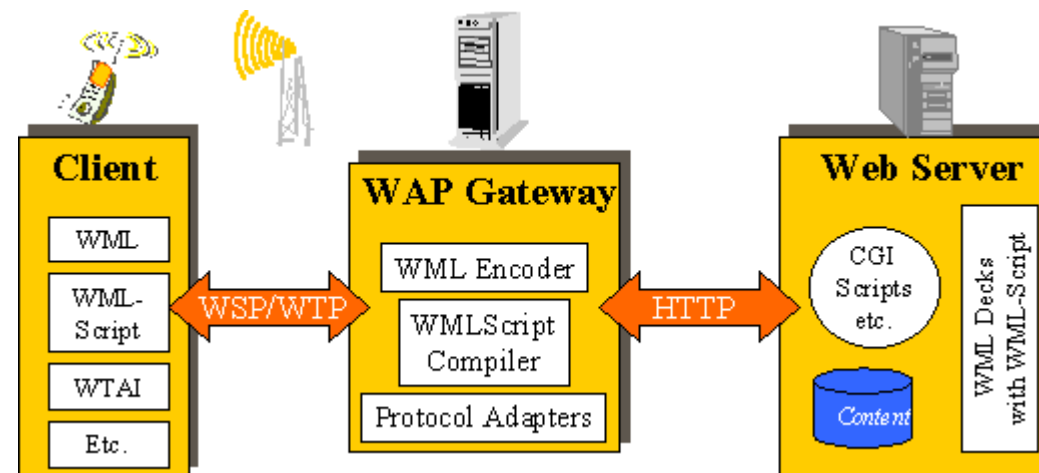
WAP&WML



pure data application
with/without
additional security

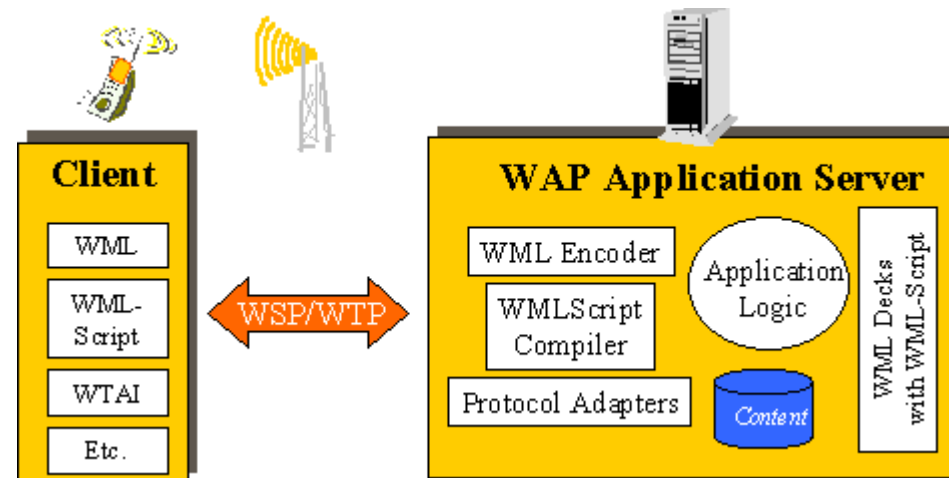
Network Example #1

WAP Gateway



Network Example #2

WAP Application Server





Payload vs. Overhead

HTTP/TCP/IP

1. → TCP SYN
2. ← TCP SYN, ACK of SYN
3. → ACK of SYN, **Data Request**
4. ← ACK of Data
5. → **Reply**
6. ← ACK of Reply
7. → **Data Request**
8. ← ACK of Data
9. → **Reply**
10. ← ACK of Reply
11. → **Data Request**
12. ← ACK of Data
13. → **Reply**
14. ← ACK of Reply
15. → TCP FIN
16. ← TCP FIN, ACK of FIN
17. → ACK of FIN

WSP/WTP/UDP

1. → **Data Request**
2. ← ACK, Reply
3. → ACK, **Data Request**
4. ← ACK, Reply
5. → ACK, **Data Request**
6. ← ACK, Reply
7. → ACK

Bold packets contain payload

Non-bold items are overhead

Typical Handset Session — 3 Requests, 3 Responses

HTTP/TCP/IP

17 packets

65% Overhead*

WSP/WTP/UDP

7 packets

14% Overhead*

**does not account for DNS, SSL, Authentication or Cookies*



HTML and mobile devices

- HTML
 - designed for computers with “high” performance, color high-resolution display, mouse, hard disk
 - typically, web pages optimized for design, not for communication
- Mobile devices
 - often only small, low-resolution displays, very limited input interfaces (small touch-pads, soft-keyboards)
- Additional “features”
 - animated GIF, Java AWT, Frames, ActiveX Controls, Shockwave, movie clips, audio, ...
 - many web pages assume true color, multimedia support, high-resolution and many plug-ins
- Web pages ignore the heterogeneity of end-systems!
 - e.g., without additional mechanisms, large high-resolution pictures would be transferred to a mobile phone with a low-resolution display causing high costs



WML/WMLScript

- Wireless Markup Language
- Based on XML
- WML enables small and flexible information display on mobile phones or PDAs
- WML permits scale of display
- WMLScript is based on ECMAScript



WML (I)

- Tag-based browsing language
 - Screen management (text, images)
 - Data input (text, selection lists, etc.)
 - Hyperlinks and navigation support
- W3C XML-based language
- Inherits technology from HDML and HTML



WML (II)

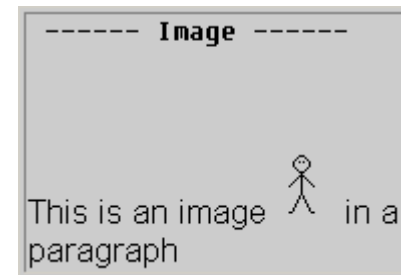
- Card metaphor
 - User interactions are split into cards
 - Navigation occurs between cards
- Explicit inter-card navigation model
 - Hyperlinks
 - UI event handling
 - History
- State management and variables
 - Reduce network traffic
 - Results in better caching

WML Example (I)

```
<?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="no1" title="Image">
<p>
This is an image

in a paragraph
</p>
</card>
</wml>
```



WML Example (II)

```
<?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="School">
<do type="accept" label="Answer">
  <go href="#card2"/>
</do>
<p>
<select name="name">
  <option value="HTML">HTML School</option>
  <option value="XML">XML School</option>
  <option value="WAP">WAP School</option>
</select>
</p>
</card>
<card id="card2" title="Answer">
<p>
You selected: $(name)
</p>
</card>
</wml>
```

----- School -----

HTML School	<input checked="" type="radio"/>
XML School	<input type="radio"/>
WAP School	<input type="radio"/>

Answer

----- Answer -----

You Selected: HTML



WMLScript

- WMLScript is the scripting language used in WML pages
- WMLScript is a light version of the JavaScript language
- WML scripts are not embedded in the WML pages. WML pages only contains references to script URLs
- WMLScript is compiled into byte code on the server before it is sent to the WAP browser
- WMLScript is a part of the WAP specification



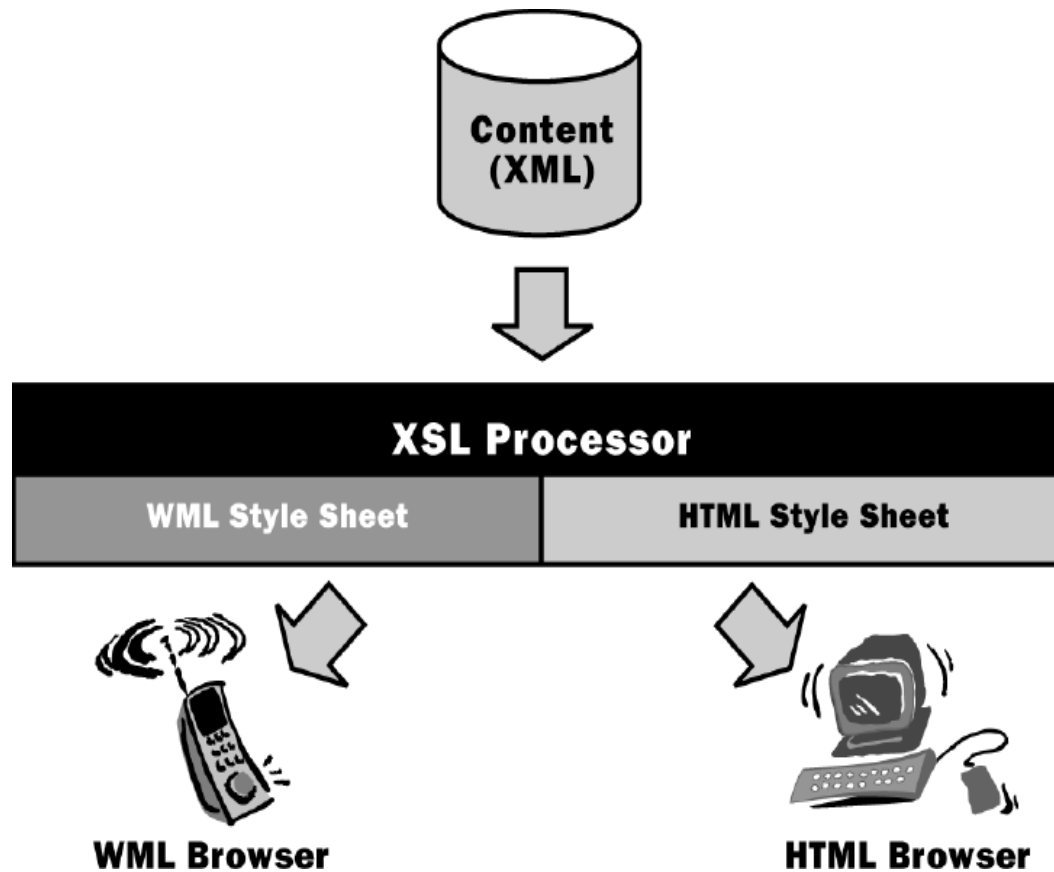
WMLScript Example

```
<?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="no1" title="Go to URL">
<do type="options" label="Go">
<go href="check.wmls#go_url('my_url')"/>
</do>
<p>
Enter a URL:
<input type="text" name="my_url"/>
</p>
</card>
</wml>
```

```
extern function go_url(the_url)
{
if (String.find(the_url,"http://") < 0)
{
the_url="http://" + the_url;
}
WMLBrowser.go(the_url);
}
```

check.wmls

Contents Provision





Implementation

- Nokia Activ Software Suite
- Phone.com UP.Link Server
- Kannel
 - <http://www.kannel.org>
 - Open Source Project

Test WAP on PC

- Virtual WAPJAG
 - <http://virtual.wapjag.com>
 - <http://virtual.wapjag.com/?url=wap.n-tv.de>





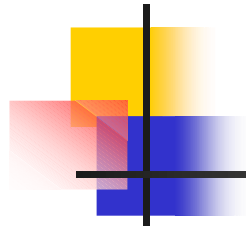
Useful WAP sites:

- WAP sites catalog
 - <http://www.wap.de/Katalog/index.html>
- News
 - wap.n-tv.de
 - wap.tagesschau.de
- Information
 - wap.lufthansa.de
 - wap.bahn.de
- Search engine
 - wap.fireball.de



Possible Applications

- M-commerce - shopping, tickets, micro-payments
- Finance - statements, funds transfer, shares trading
- M-billing - notification, presentation and payment of bills
- Enterprise access - inventory, shipment/sales updates, email
- M-care - customer service, payment status, account updates
- Entertainment - games, gambling, interactive multi-player events
- Messaging - communication and collaboration
- Travel - scheduling, advisories, reservations
- Location services - traffic reports, parking information, store discounts, event recommendations



Consumer Applications

- Simple Person to Person Messaging
- Voice and Fax Mail Notifications
- Unified Messaging
- Internet Email
- Prepayment
- Ringtones
- Mobile Commerce
- Affinity Programs
- Mobile Banking
- Chat
- Information Services



Corporate Applications

- Job Dispatch
- Remote Point Of Sale
- Customer Service
- Remote Monitoring
Such As Meter Reading
- Vehicle Positioning
- Corporate Email
- Remote LAN Access
- File Transfer
- Web Browsing
- Document Sharing
- Collaborative Working
- Audio
- Still Images
- Moving Images
- Home Automation



WAP 2.0 - the Next Generation

- XHTML (with backwards compatibility to WML)
- TCP
- Color graphics
- Animation
- Large file downloading
- Location-smart services
- Streaming media
- Data synchronization with desktop PIM



But, What is Actually WAP

- Where are the phones
- Wasn't actually possible
- Challenges
 - Will it offer appealing content
 - Will it be obsolete by other technologies
 - What happens if „Thin-Client“ becomes more powerful
 - What happens if more bandwidths are available