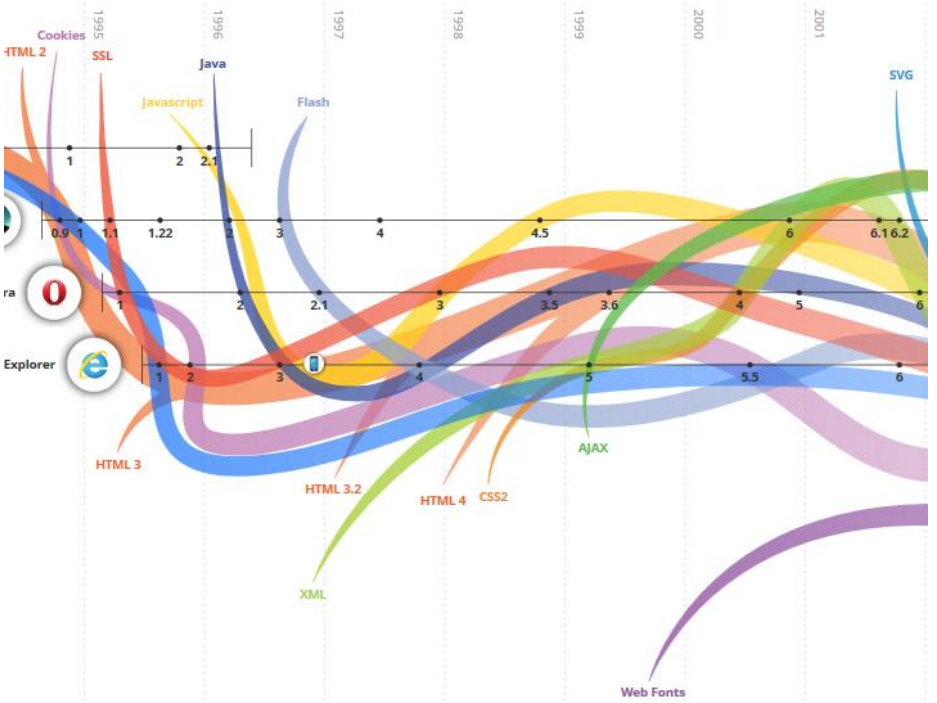


Web Architecture and Technologies

Ambient intelligence

Fulvio Corno

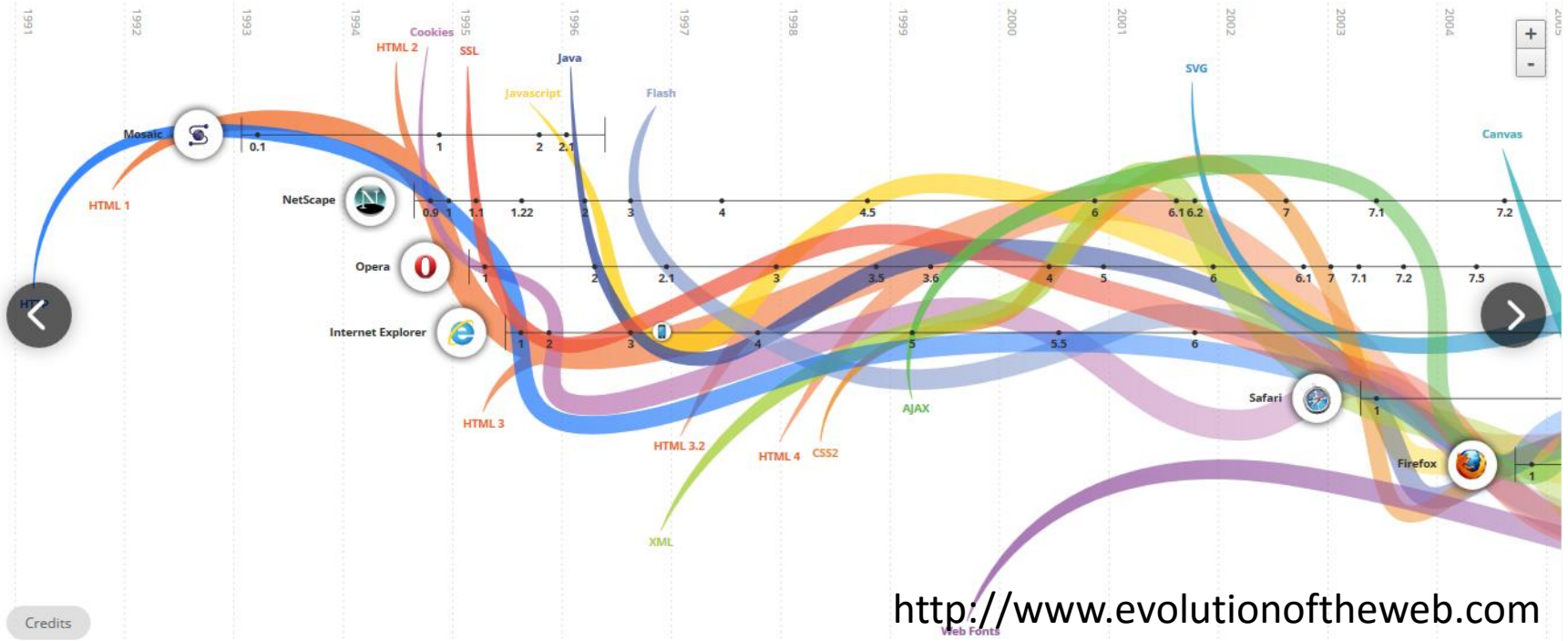
Politecnico di Torino, 2015/2016

POLITECNICO DI TORINO

e-Lite

Goal

- Understanding Web technologies
  - Adopted for User Interfaces
  - Adopted for Distributed Application Integration

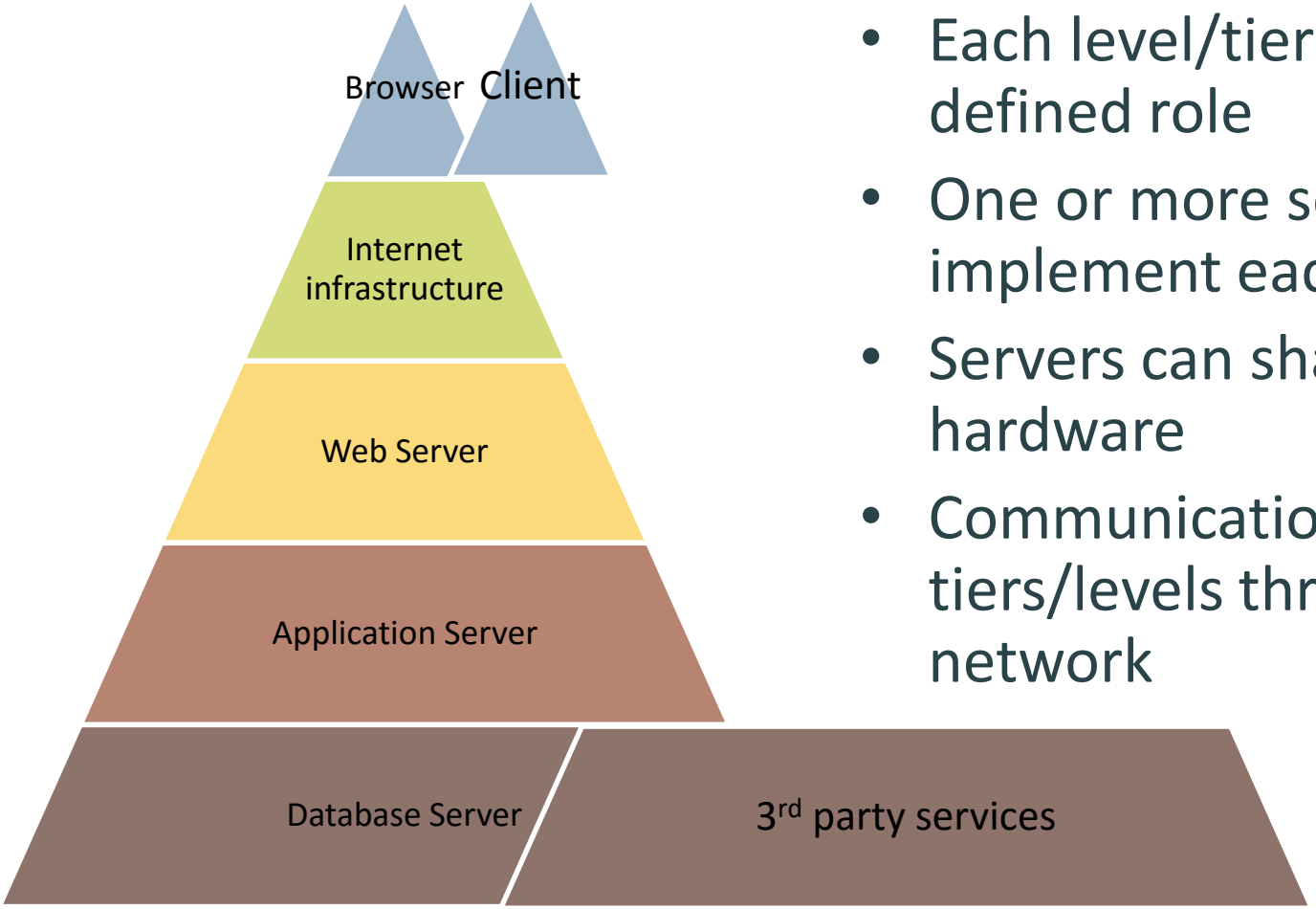


Web Architecture and Technologies

WEB ARCHITECTURE OVERVIEW

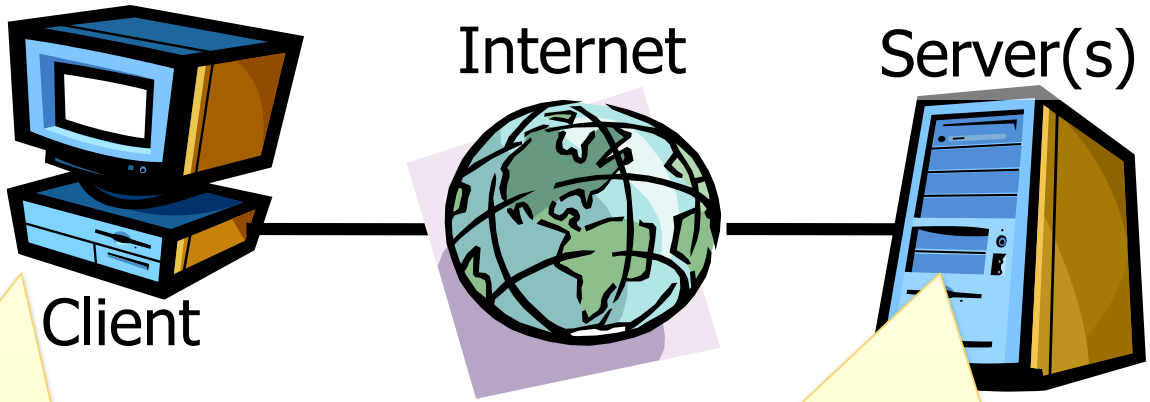
HISTORICAL EVOLUTION

N-tier (N-level) architecture



- Each level/tier has a well defined role
- One or more servers implement each tier/layer
- Servers can share hardware
- Communication between tiers/levels through the network

General Architecture



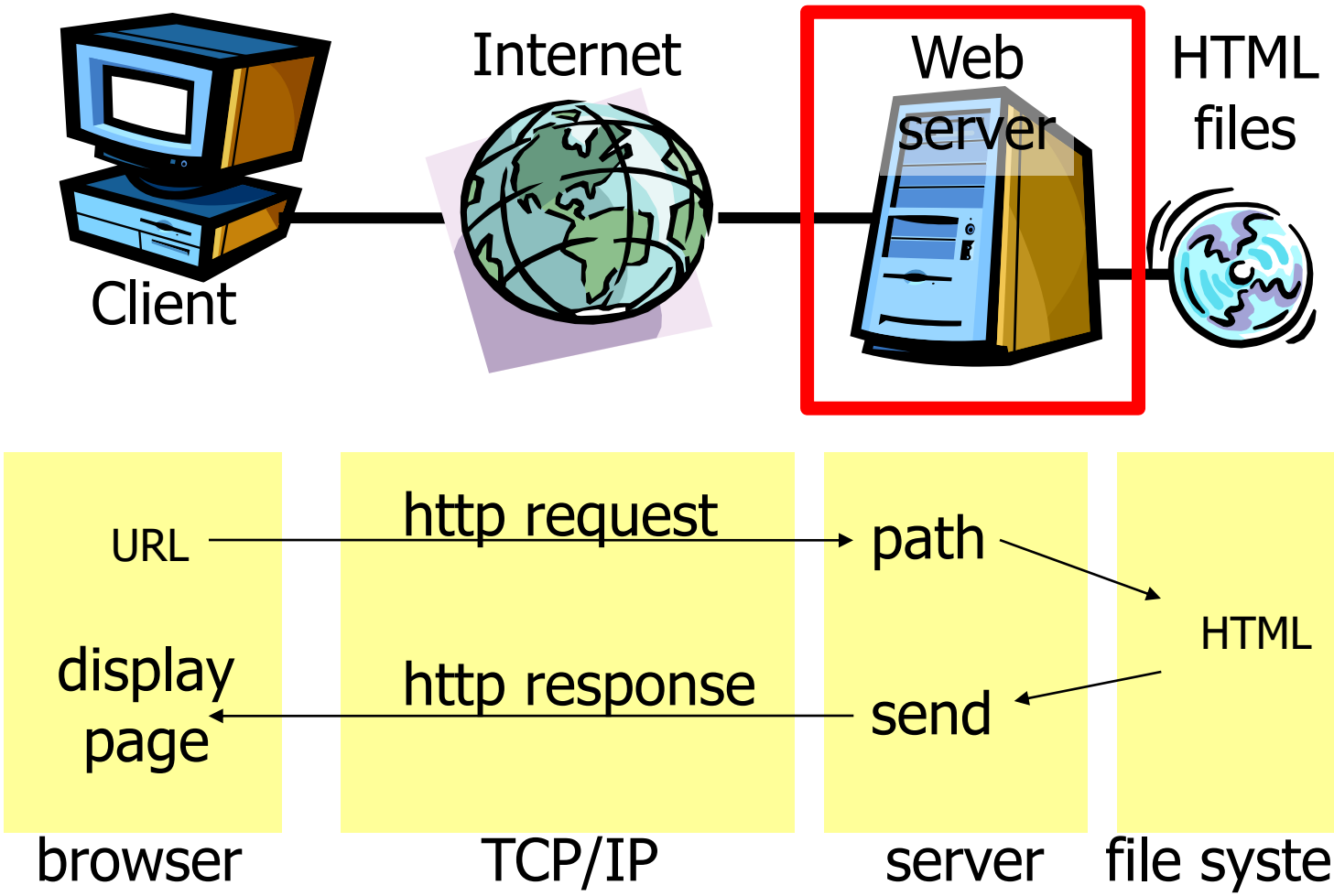
- Historically, a web browser
- But also:
  - Mobile application
  - Desktop application
  - Other server application

- Logical server:
  A process that runs on a host that relays information to a client upon the client sending it a request.
- Physical server :
  A host computer on a network that holds information (eg, Web sites) and responds to requests for information

Web server (logical)

- Manages the HTTP protocol (handles requests and provides responses)
  - Receives client requests
  - Reads static pages/contents from the filesystem
  - Activates the application server for dynamic pages/content generation (server-side)
  - Provides an file (HTML, or other) back to the client
- One HTTP connection for each request
- Multi-process, Multi-threaded or Process pool

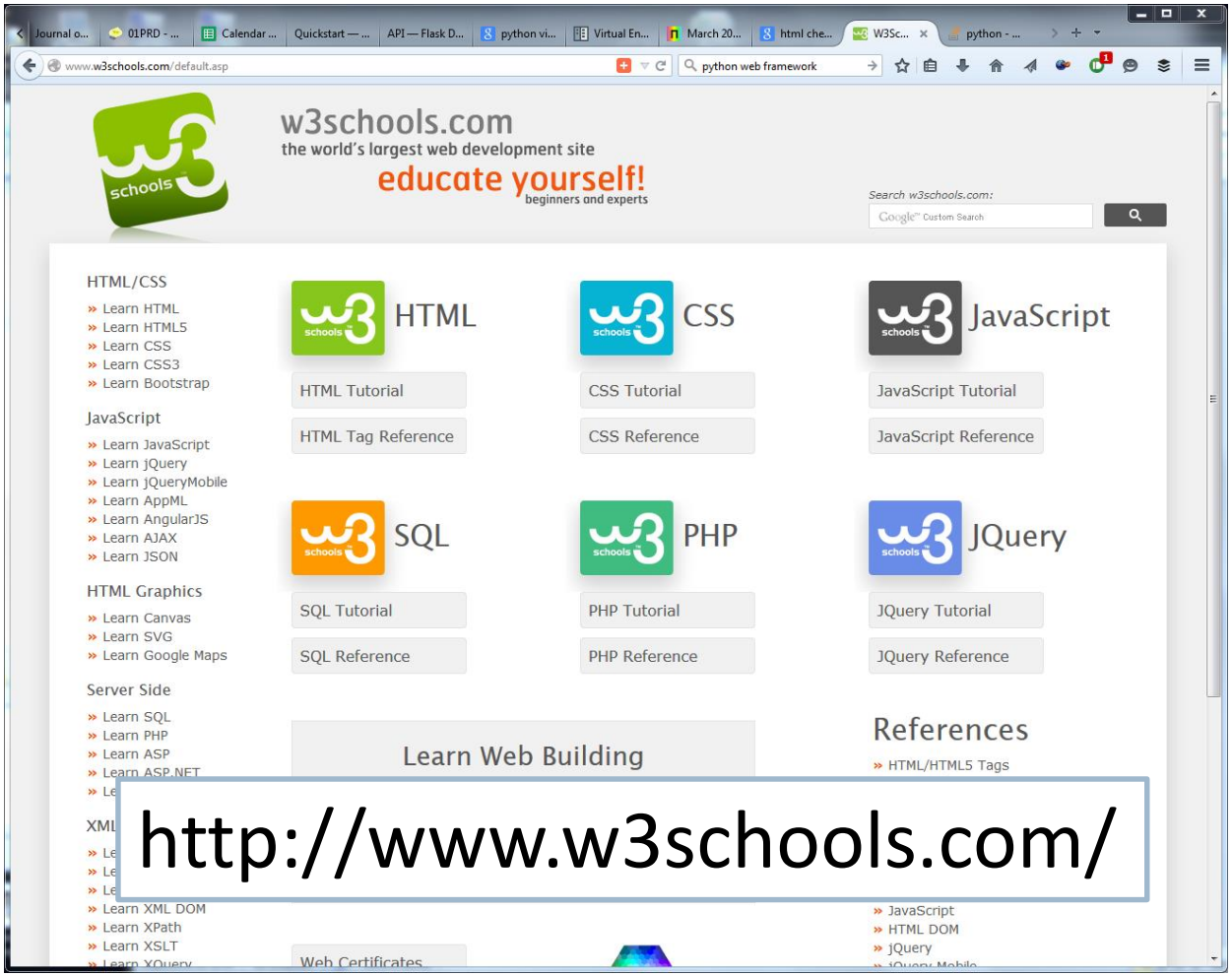
Example


Internet
Web server
HTML files
Client
URL
http request
path
HTML
display page
http response
send
browser
TCP/IP
server
file system

Adopted standards

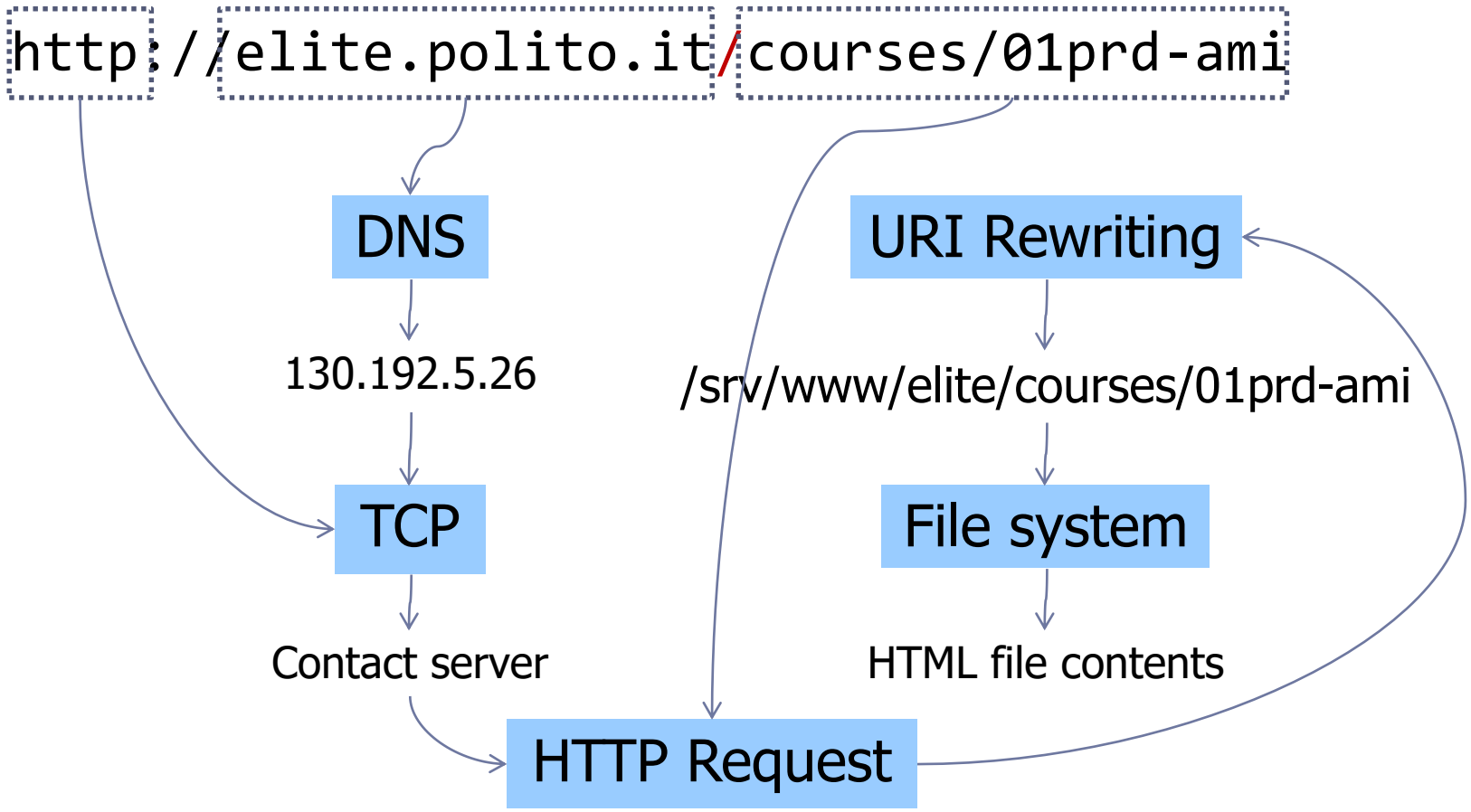
- URL (uniform resource locator) for finding web pages
- HTML (hyper text markup language) for writing web pages
- GIF (graphics interchange format), PNG (portable network graphics), JPEG, … for images
- HTTP (hyper text transfer protocol) for client-server interaction
- TCP/IP (transmission control protocol over internet protocol) for data transfer

HTML in 5 minutes



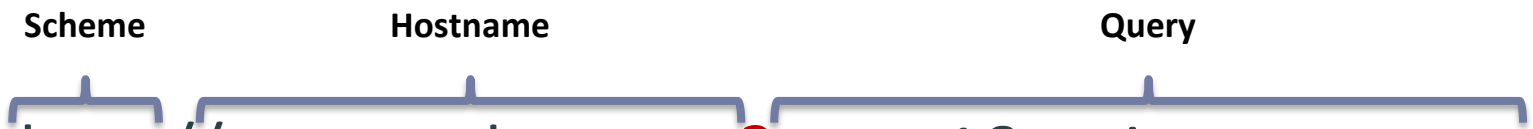
URL

RFC 2396
http://www.w3.org/Addressing/



URI Basics

- http://www.sadev.co.za/users/1/contact



- http://www.sadev.co.za?user=1&action=contact

- http://rob:pass@bbd.co.za:8044

- https://bbd.co.za/index.html#about

HTTP protocol

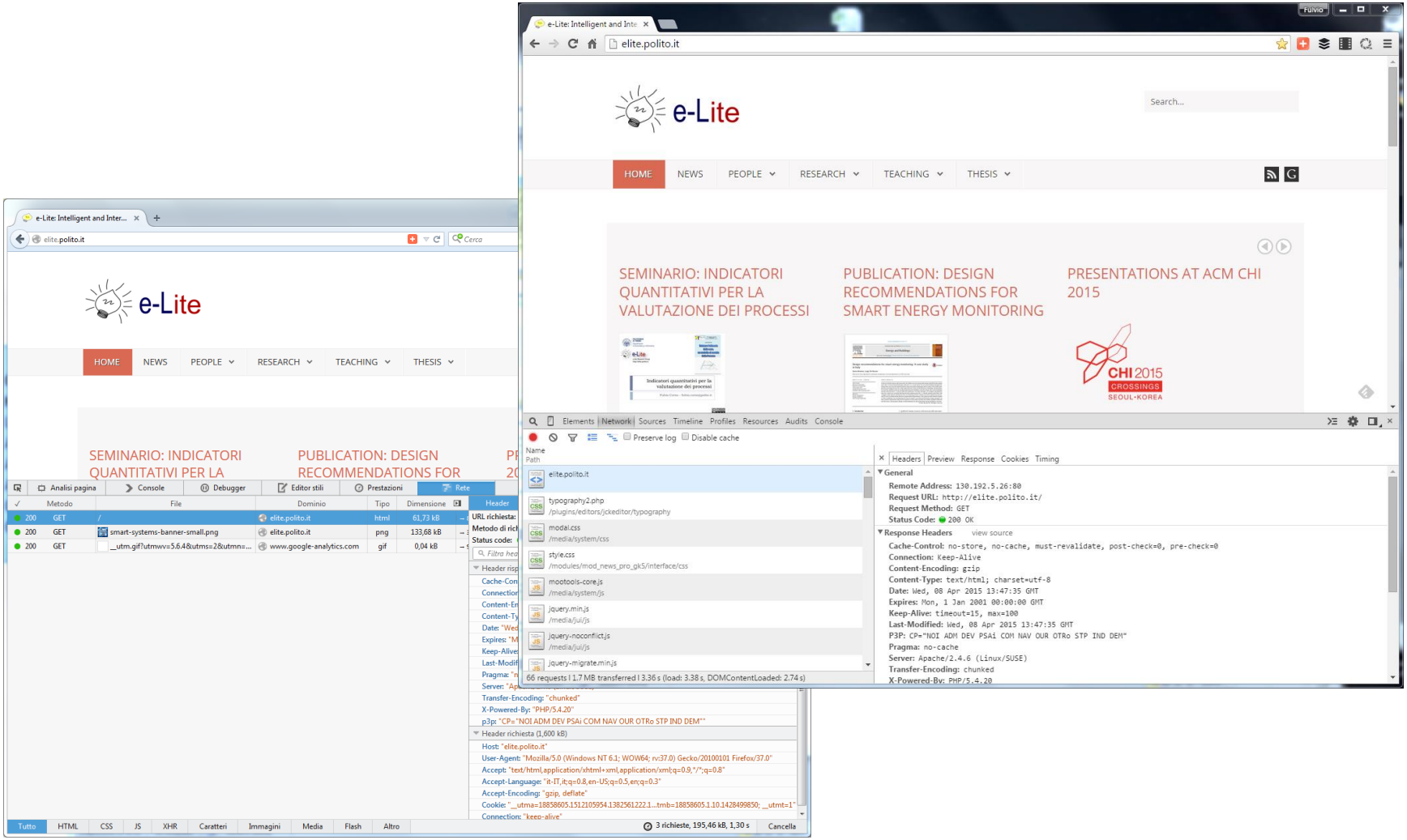
RFC 2616, RFC 2617
http://www.w3.org/Protocols

```
GET / HTTP/1.1
Host: elite.polito.it
User-Agent: Mozilla/5.0
Accept: text/html,appl
Accept-Language: it-I
Accept-Encoding: gzi
Cookie: __utma=1885
Connection: keep-a
```

```
HTTP/1.0 200 OK
Cache-Control: no-store, no-cache, must-revalidate,
Connection: Keep-Alive
Content-Encoding: gzip
Content-Type: text/html; charset=utf-8
Date: Wed, 08 Apr 2015 13:36:24 GMT
Expires: Mon, 1 Jan 2001 00:00:00 GMT
Keep-Alive: timeout=15, max=100
Last-Modified: Wed, 08 Apr 2015 13:36:24 GMT
Pragma: no-cache
Server: Apache/2.4.6 (Linux/SUSE)
Transfer-Encoding: chunked
X-Powered-By: PHP/5.4.20
p3p: CP="NOI ADM DEV PSAi COM NAV OUR OTRo STP IND DEM«

<!DOCTYPE HTML>
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en-GB">
<head>
. . . . . .
```

Browser developer tools



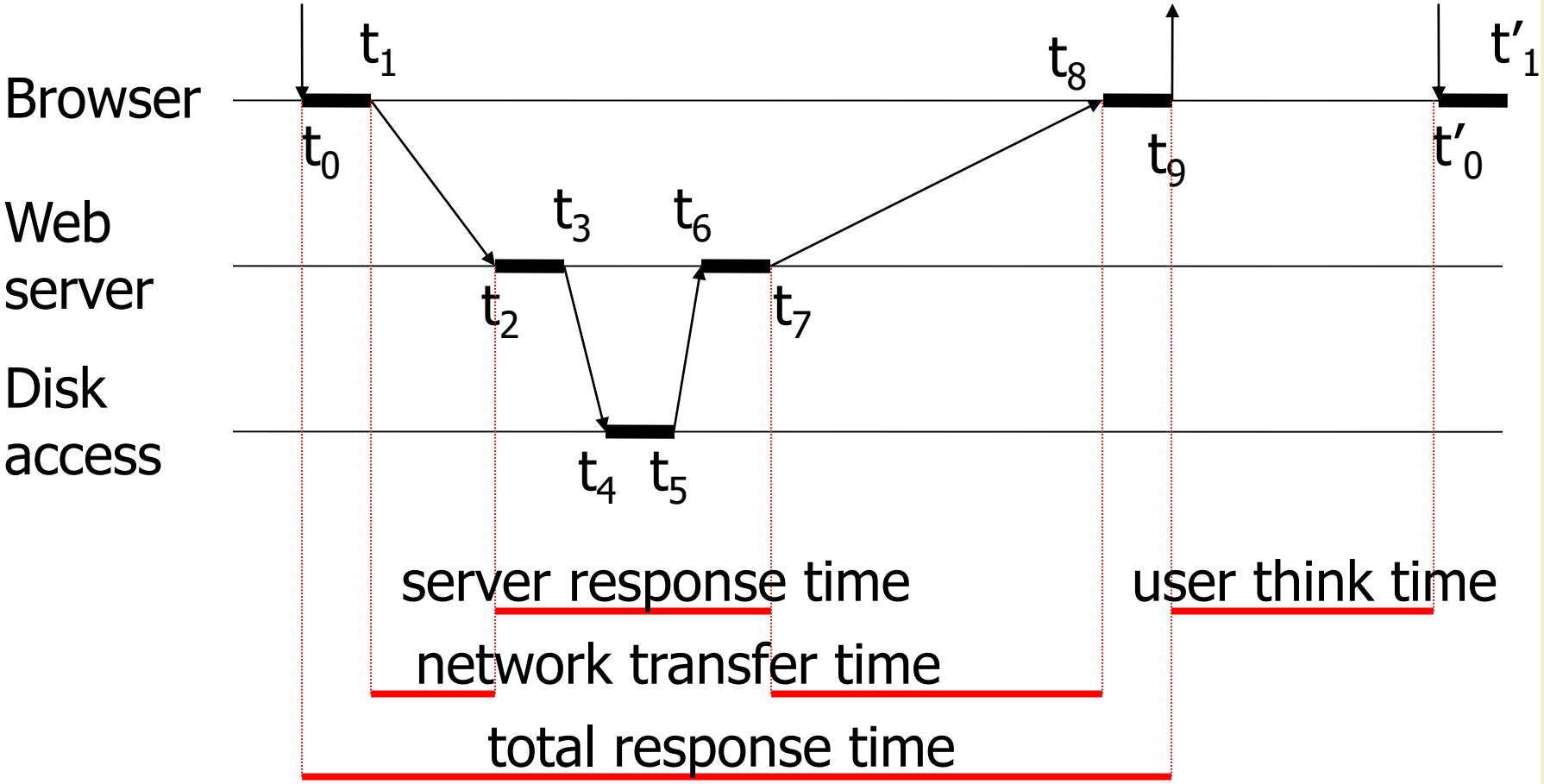
Performance measures

- **Latency**: time required for providing a 0 byte http page. Includes the server activation time, the request decoding time, the file access time, the transmission time and the time for closing the connection.
  - Unit of measure: http/s or s/http
- **Throughput**: maximum speed at which infinite-sized pages can be sent.
  - Unit of measure: Bytes (Mbytes)/s
- **#Requests / s**

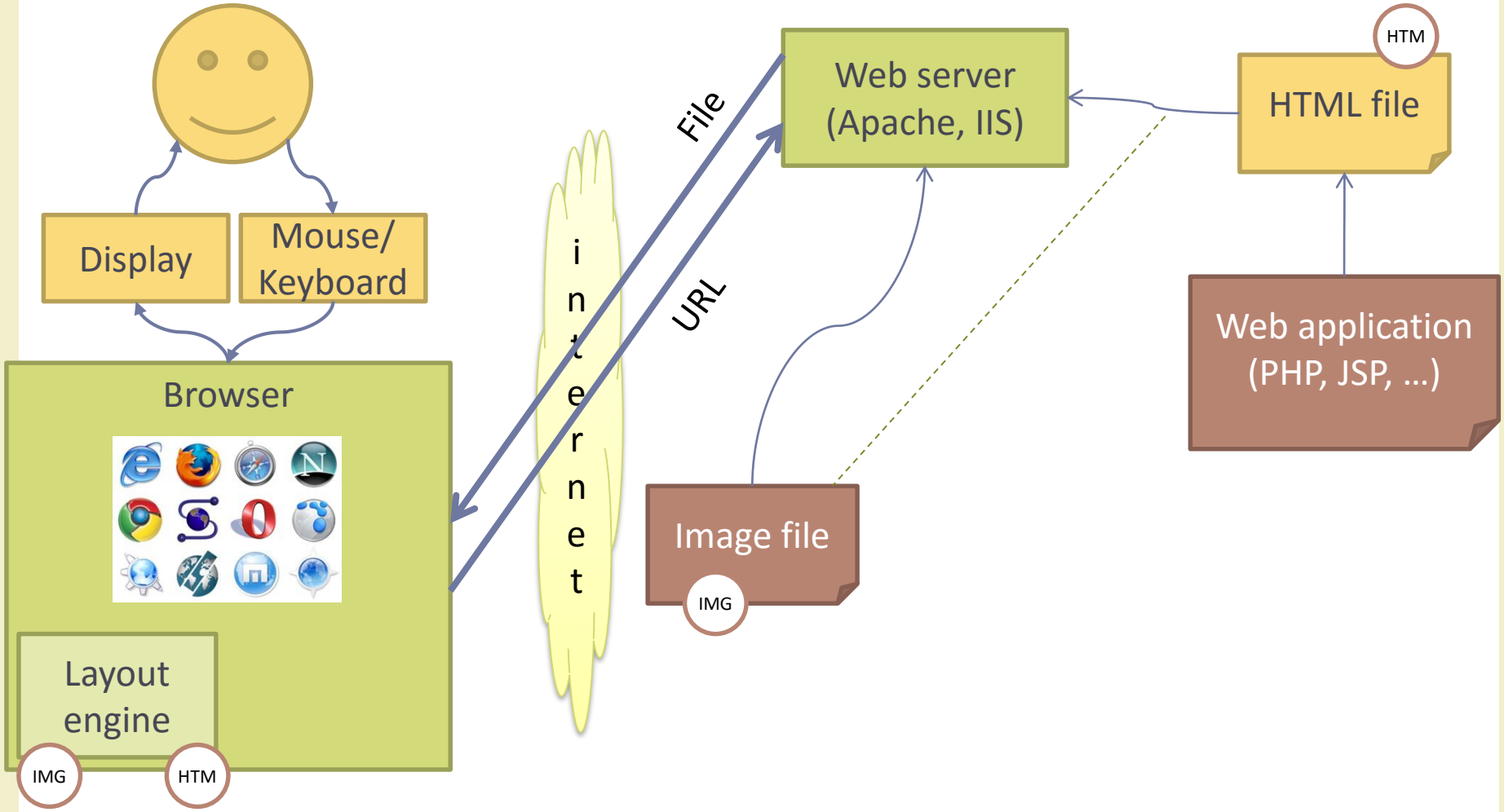
Delay time

- T = Latency + ResponseBytes / Throughput
- This equation is valid if:
  - The other architecture elements (I/O subsystem, network, ...) are not overloaded
  - The web server has not yet reached its maximum workload
- Example:
  - Latency: 0,1s
  - ResponseBytes : 100kBytes
  - Throughput: 800kBytes/s
  - T= 0,1s+ 100KBytes / 800KBytes/s =0,225s

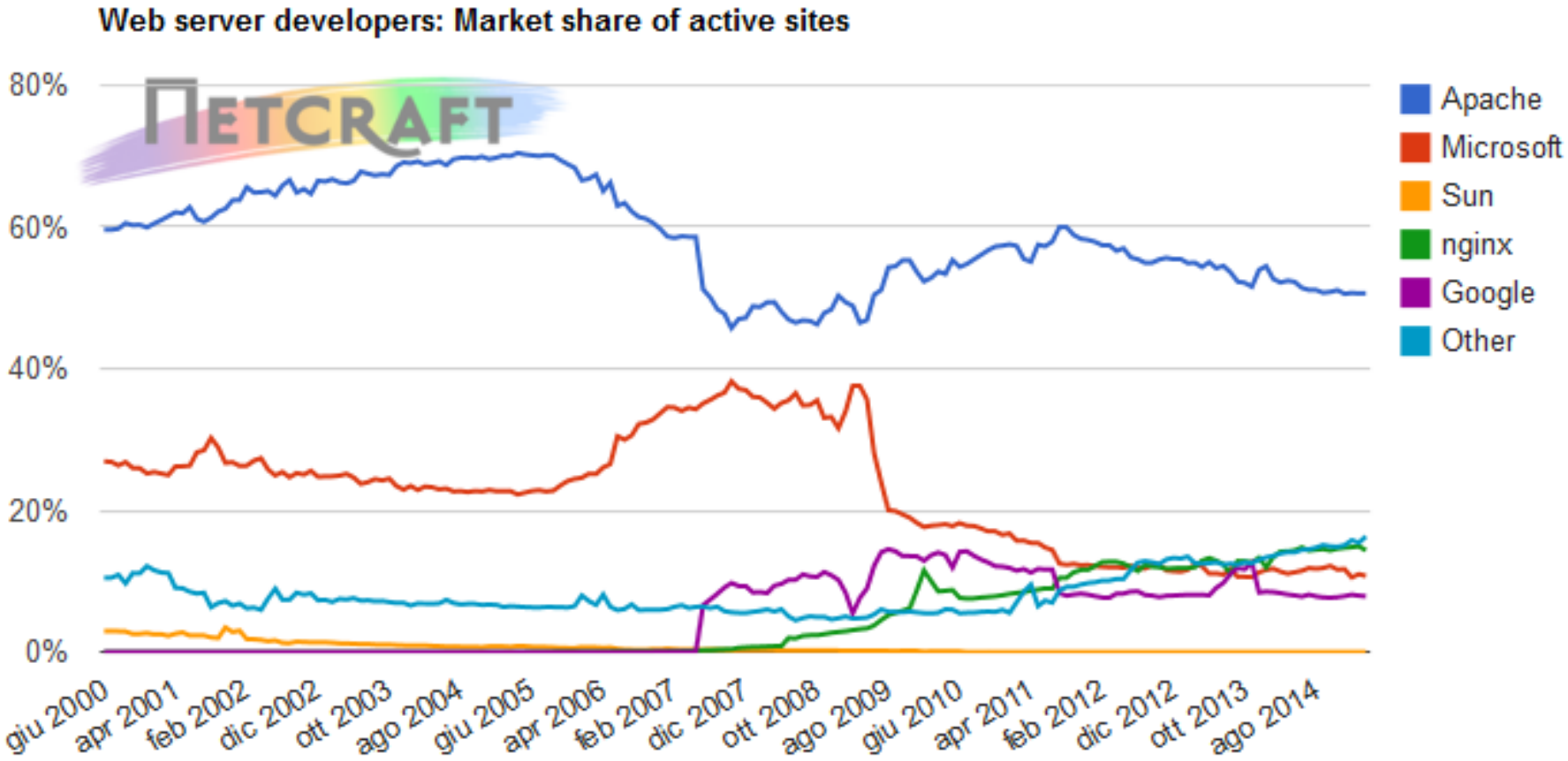
Static web transaction



General Architecture



The most adopted web servers



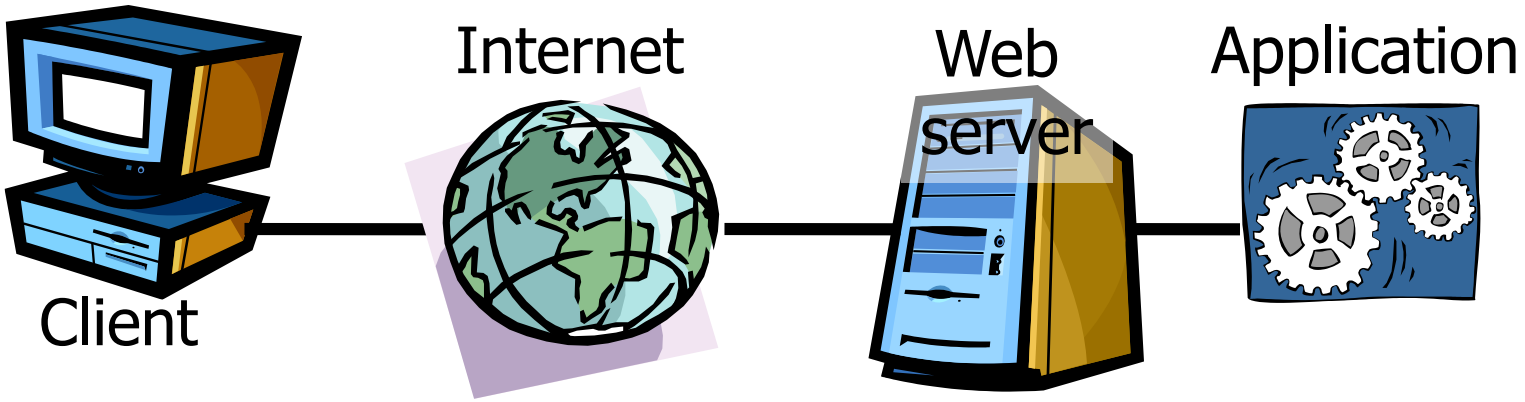
Source: http://news.netcraft.com/

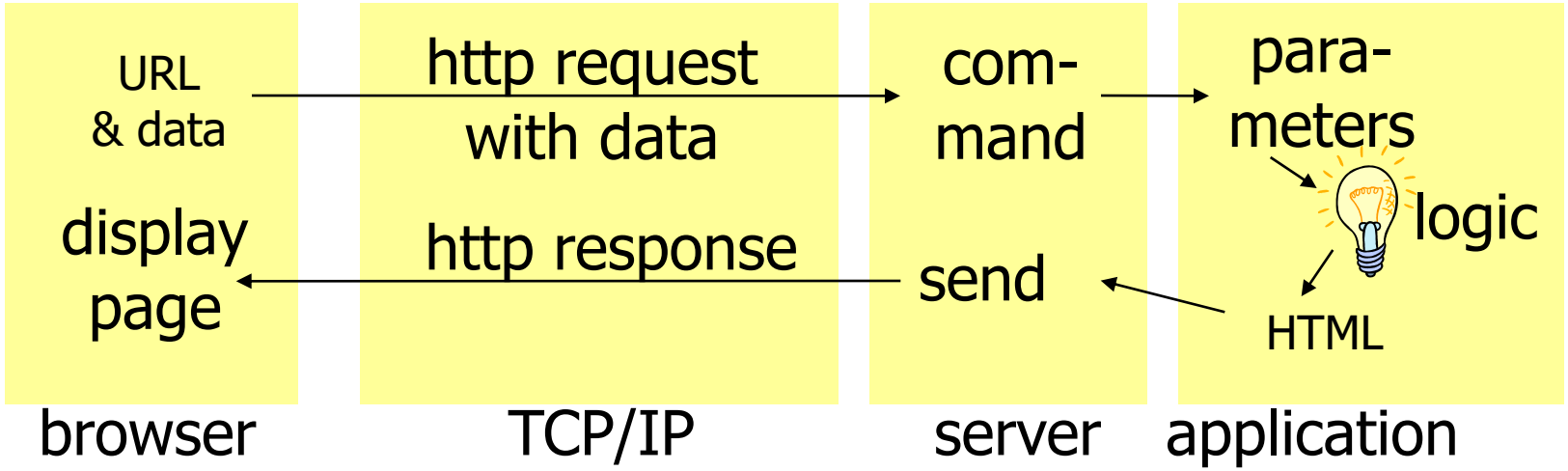
http://news.netcraft.com/archives/2015/03/19/march-2015-web-server-survey.html

Application server

- Dynamic page generation and content generation
- Manages the site business logic
- It’s the middle tier between the client browser and the data residing on a database
- Implements the session mechanisms
- Different technologies and architectures are available

Dynamic web transaction

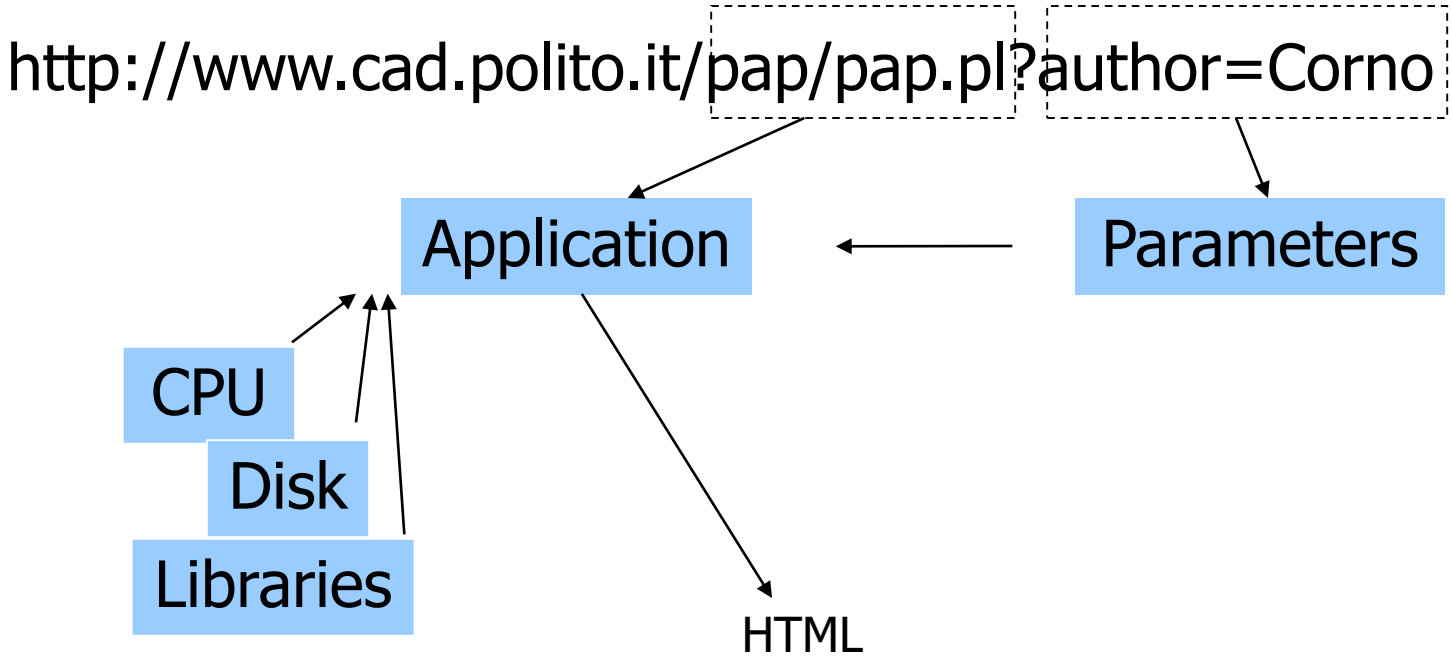




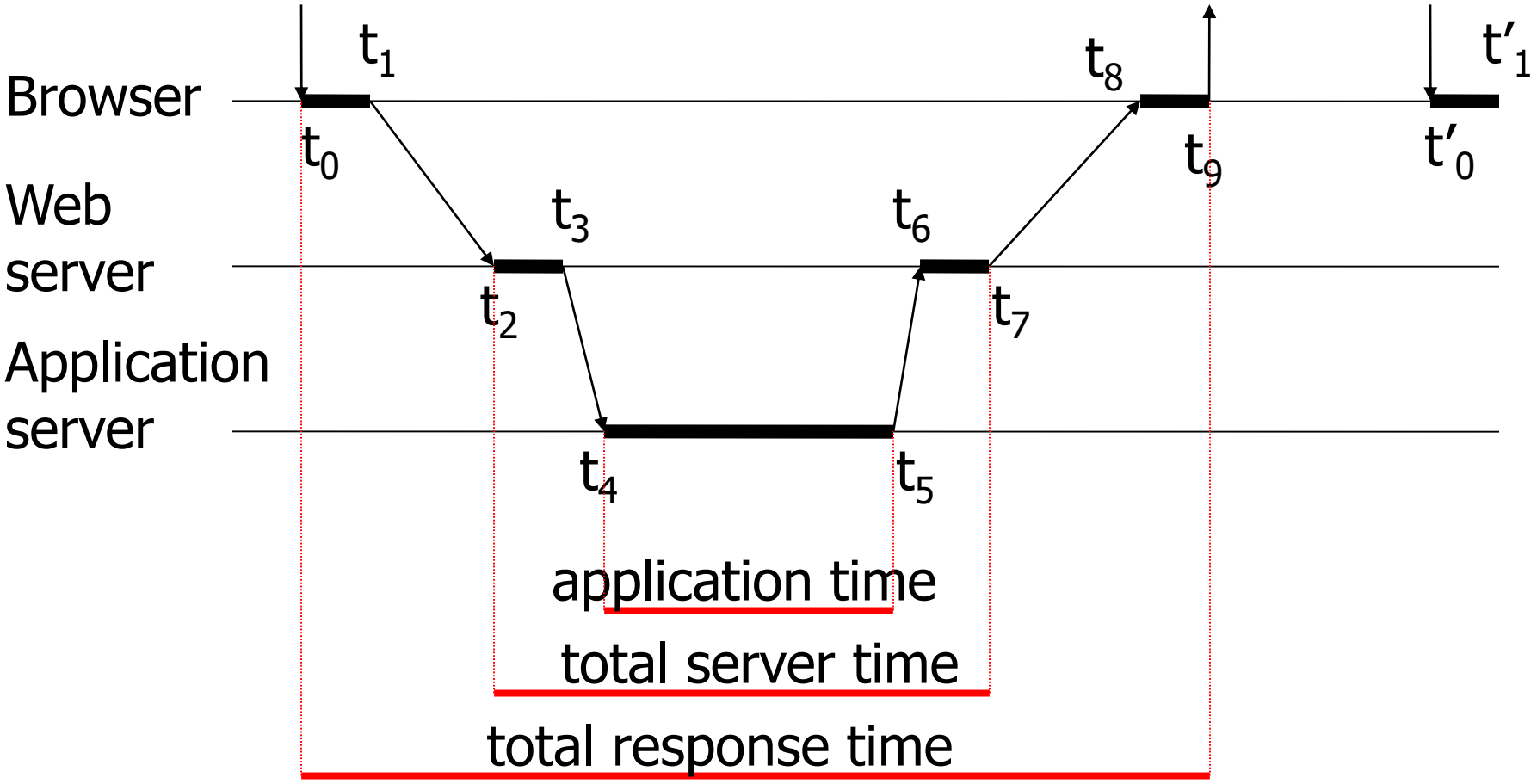
Adopted standards

- HTTP-POST for sending user-specified data
  - In addition to URL-encoding in GET requests
- Technologies for integrating application logic into web servers
  - Obsolete: CGI (common gateway interface), ISAPI (internet information server application programming interface), server-side script
  - java servlets
  - ASP (active server pages), JSP, PHP, PERL, Python as new languages for application development

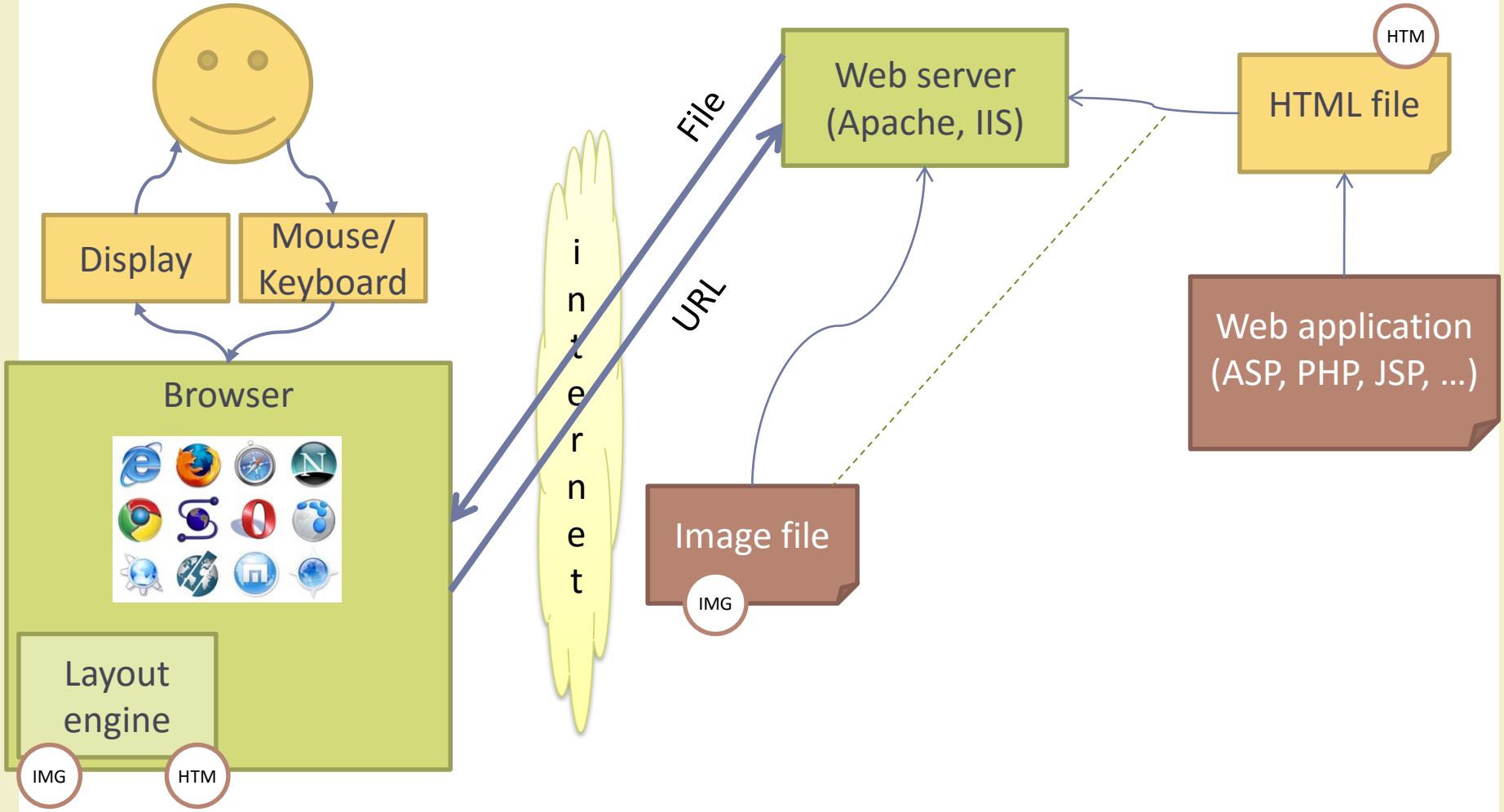
URL (HTTP GET)


http://www.cad.polito.it/pap/pap.pl?author=Corno
Application
Parameters
CPU
Disk
Libraries
HTML

Dynamic web transaction



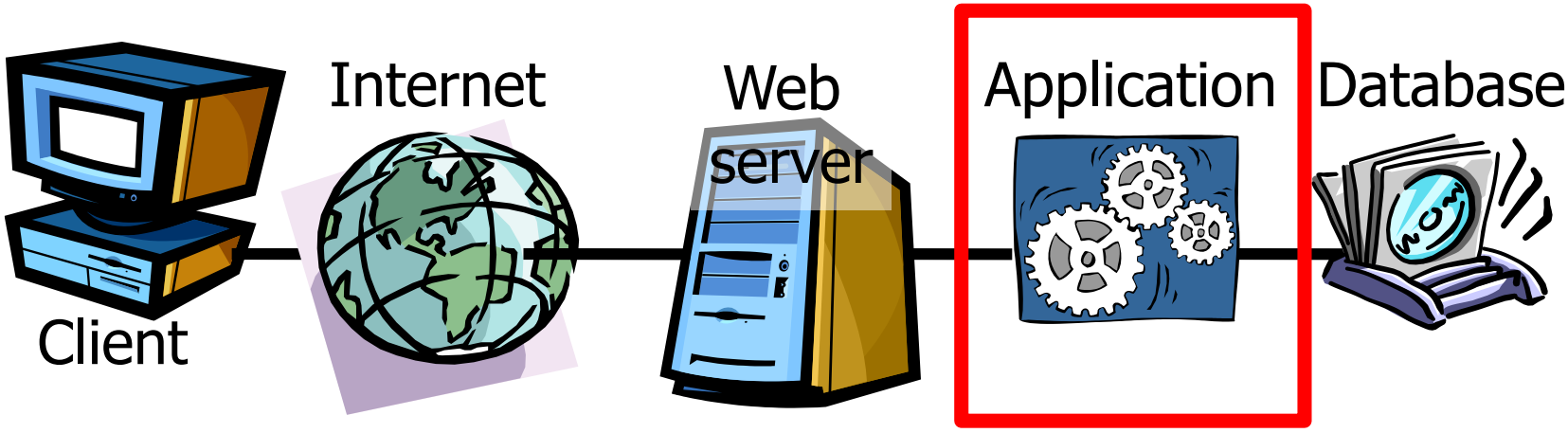
General Architecture

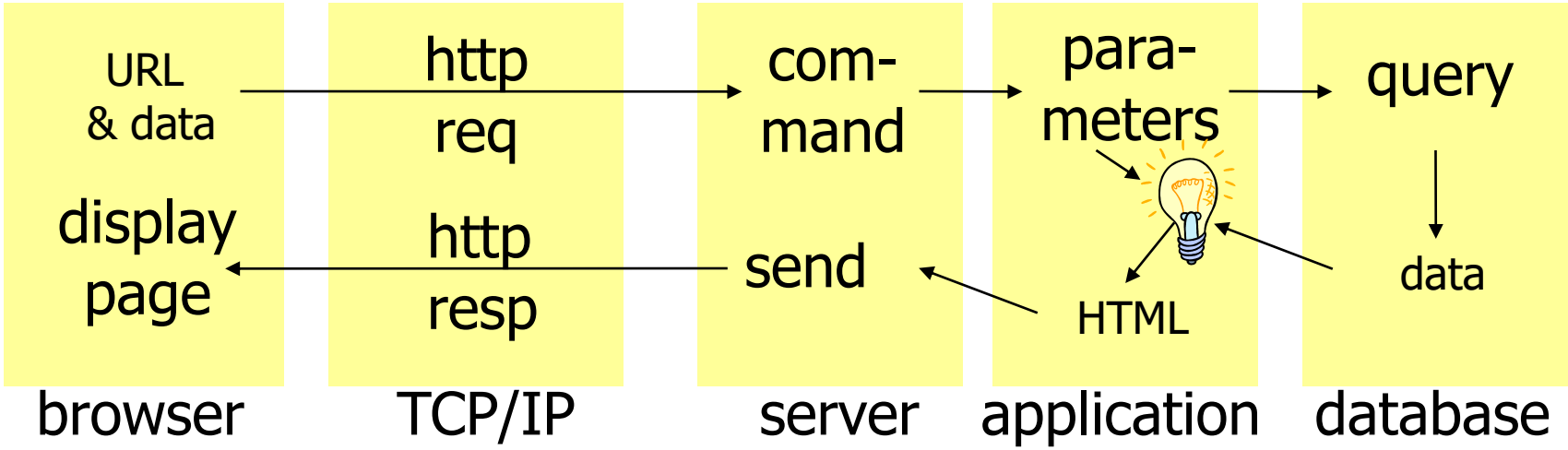


Database server

- Stores the data on which the application server works.
- Executes the queries issued by the application server:
  - Updates the stored data
  - Inserts new data
  - Provides back query results
- The most frequent/complex queries can be implemented internally as stored procedures (pre-compiled queries with parameters)

Example


Internet
Web server
Application
Database
Client


URL & data
http req
com-mand
para-meters
query
display page
http resp
send
data
HTML
browser
TCP/IP
server
application
database

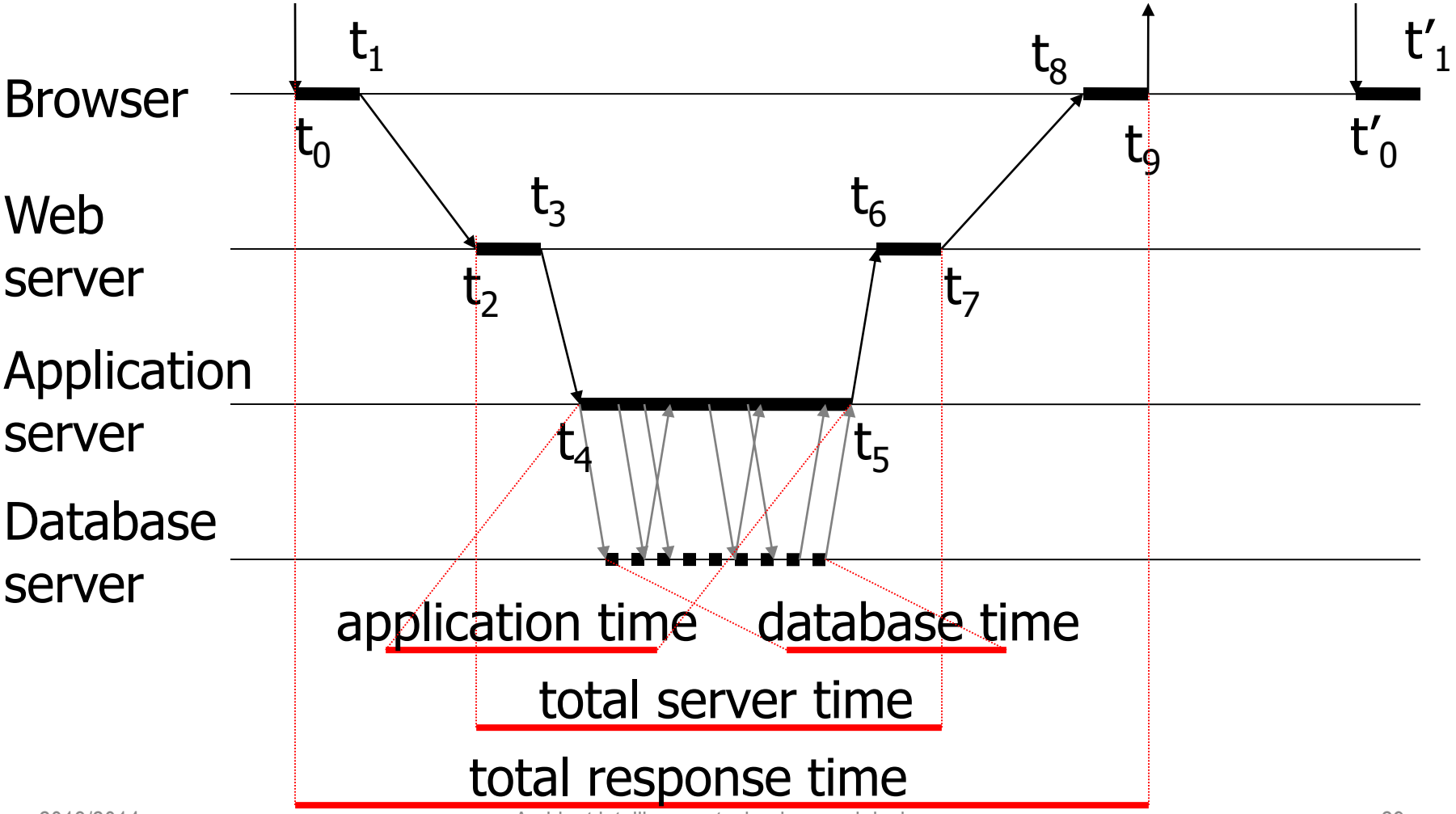
Adopted standards

- Cookies for storing the state of a session
- Java, JavaScript, ActiveX, Flash to program the user interface on the browser
- SQL (structured query language), ODBC (open database connectivity) to access data bases

Database server

- Queries are almost always in SQL
  - SELECT * FROM table;
  - ….
- Often adopts the relational database model
  - Other models can be used
    - Object model
    - Triple model
- The most advanced/complete solutions are called Transaction servers

Database-driven transaction



Example (PHP)

The application composes the query

```
<?php
$query = “SELECT doc_id FROM key_doc_index, keywords WHERE
key_doc_index.key_id = keywords.id AND keywords.key =
$_REQUEST[“query”];”;
```

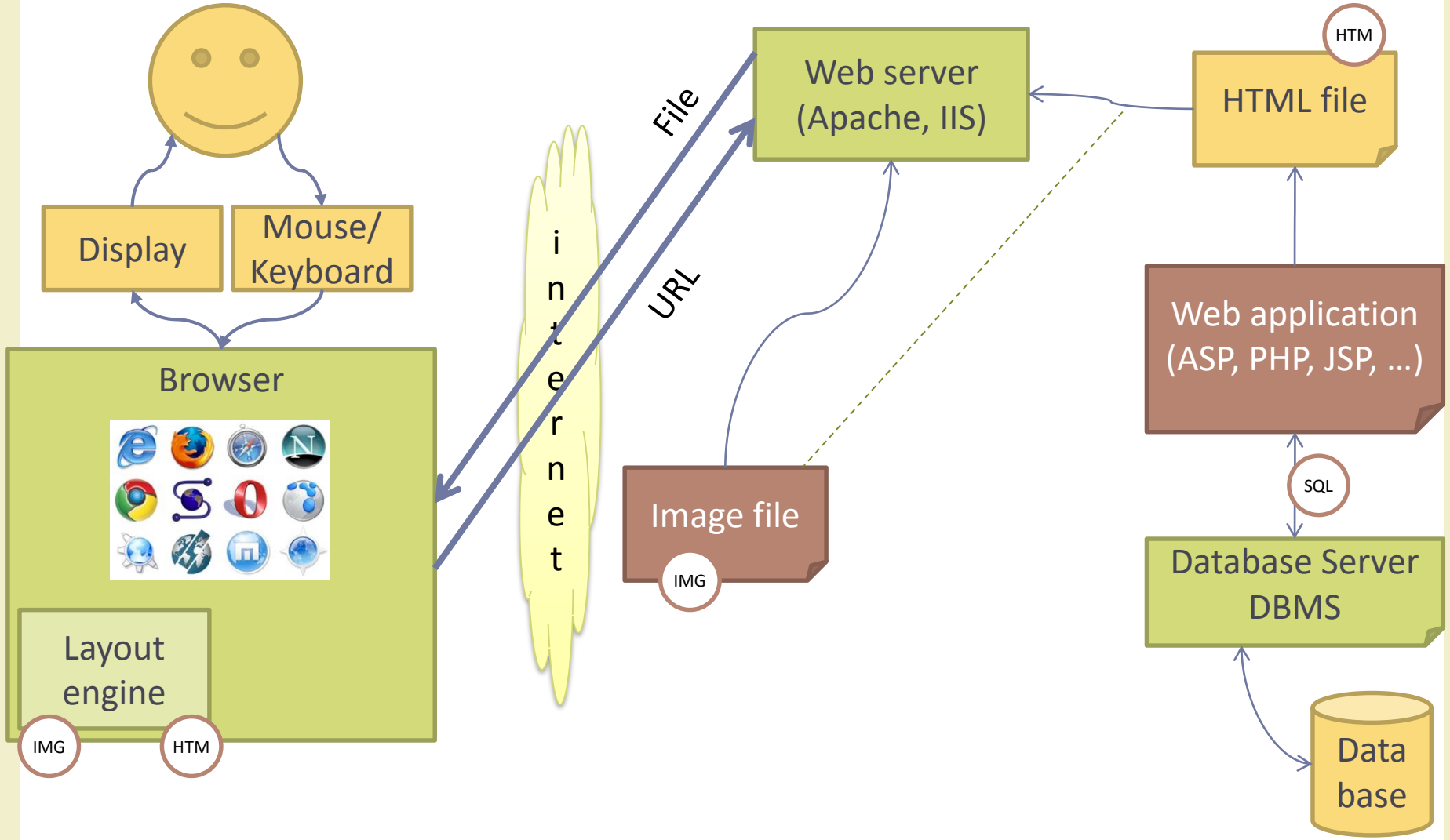
The query is sent to the db-server and a rowset containing the results is returned

```
$rowset = mysql_query($query);
```

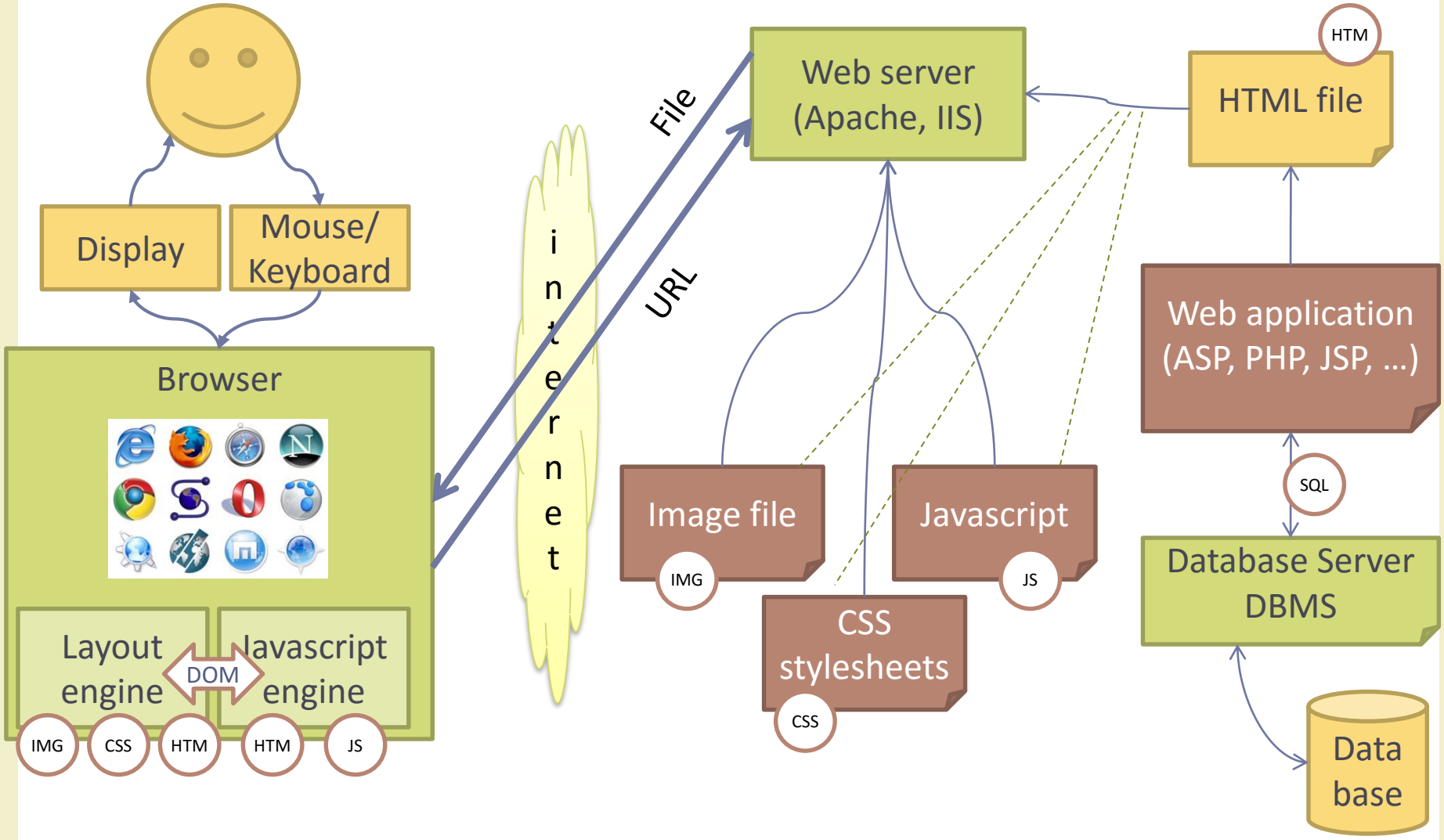
```
while($row = mysql_fetch_row($rowset))
{
//elaborate data
}
?>
```

The application elaborates the data

General Architecture



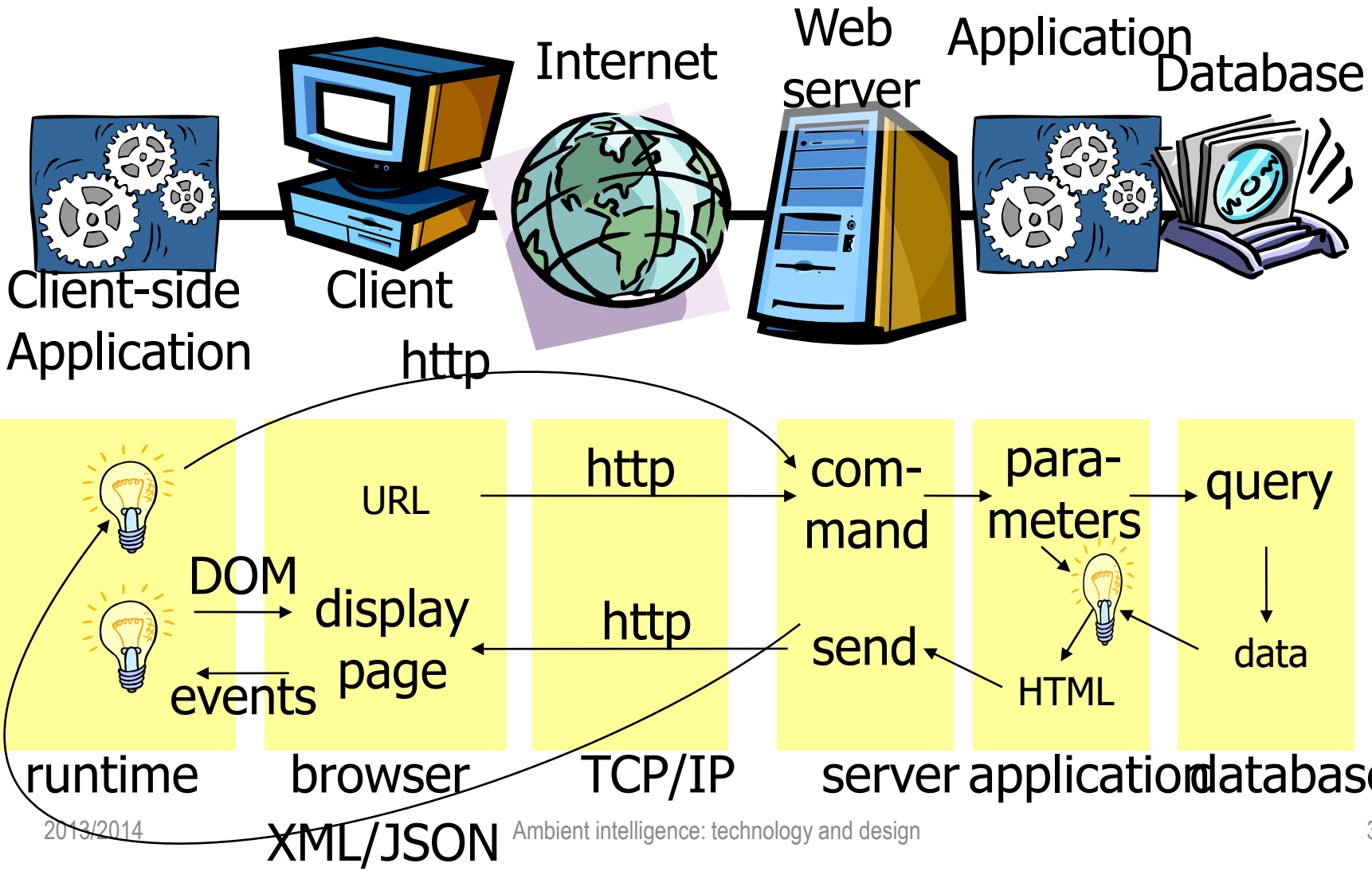
General Architecture



Web 2.0

- Web applications support social interaction models
- Peer exchange and user-contributed content instead of rigid publisher/reader pattern
  - Online communities
- Rich, dynamic, interactive user interfaces
- Integration of contents across web sites (mashups)

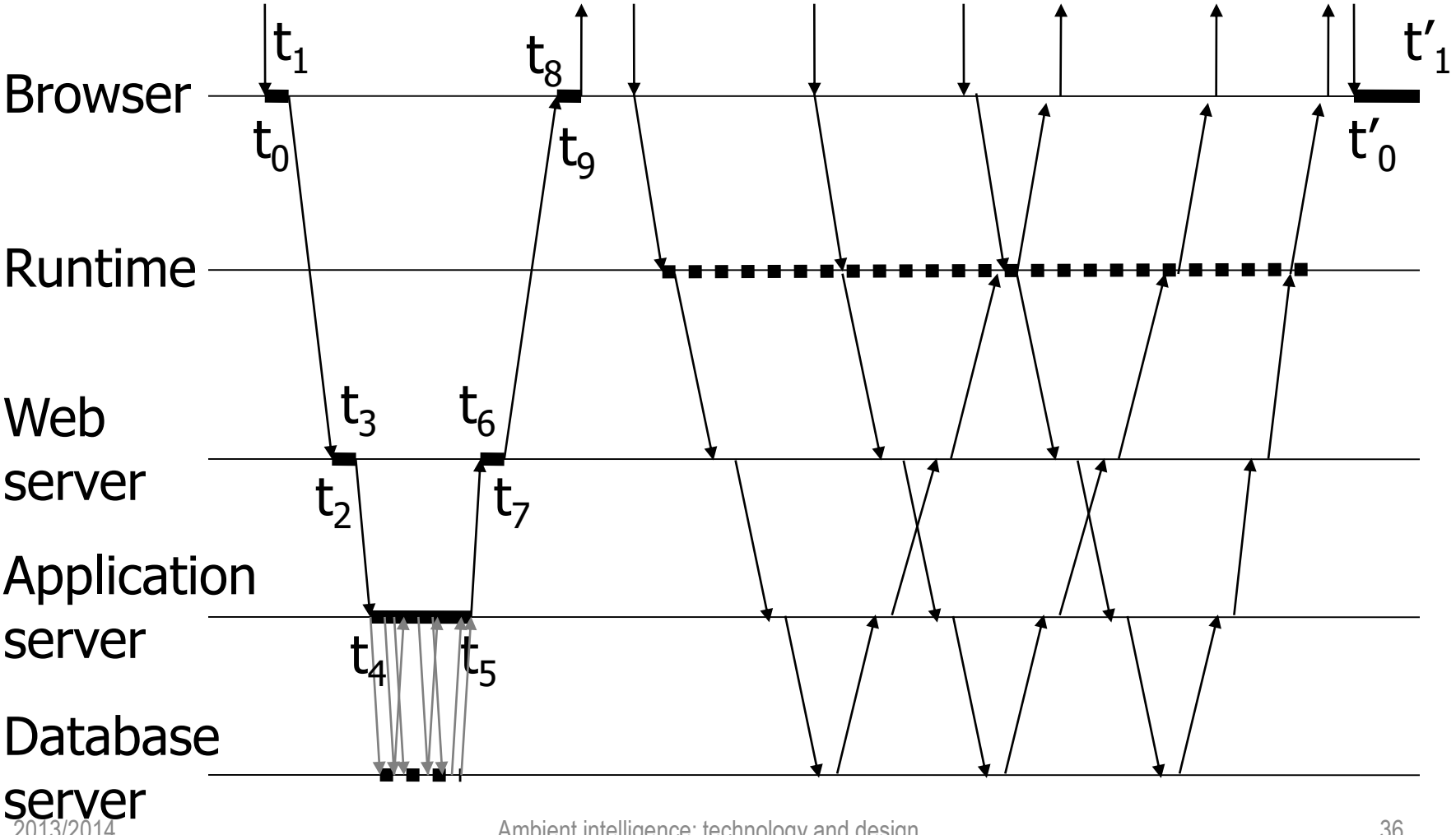
Rich-Client Asynchronous Transactions



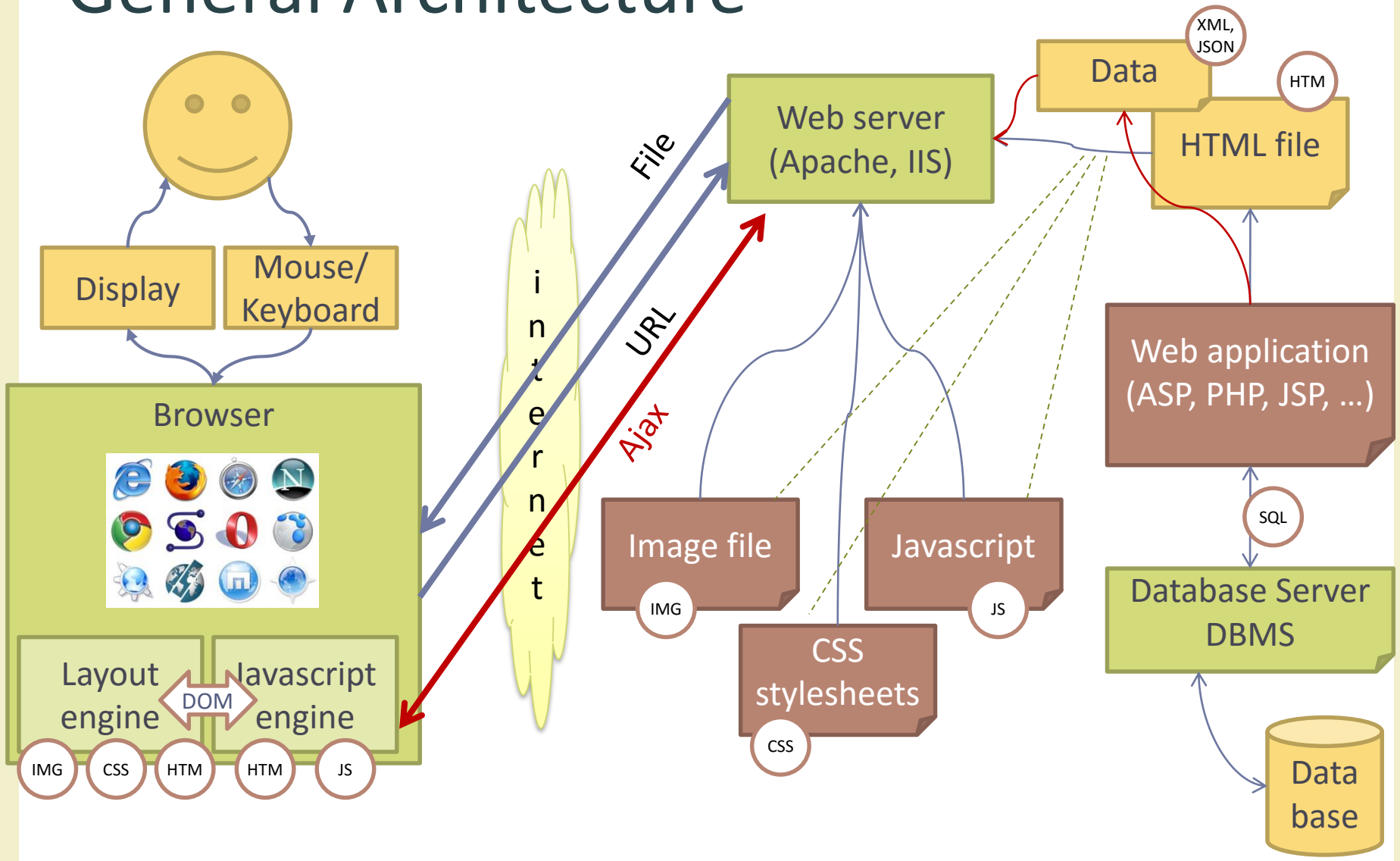
Adopted standards

- Dynamic HTML: DOM, Javascript, CSS
  - JavaScript, Flash to handle a runtime environment on the browser
  - DOM (XHTML Document Object Model) to allow on-the fly modification of the web page
  - CSS 2.1 to modify attribute and handle objects
- AJAX: Asynchronous Javascript and XML
  - XMLHttpRequest for asynchronous communication to the server
  - Data transfer formats: JSON, XML, RDF, RSS, Atom, FOAF, ...
- Mash-up technology

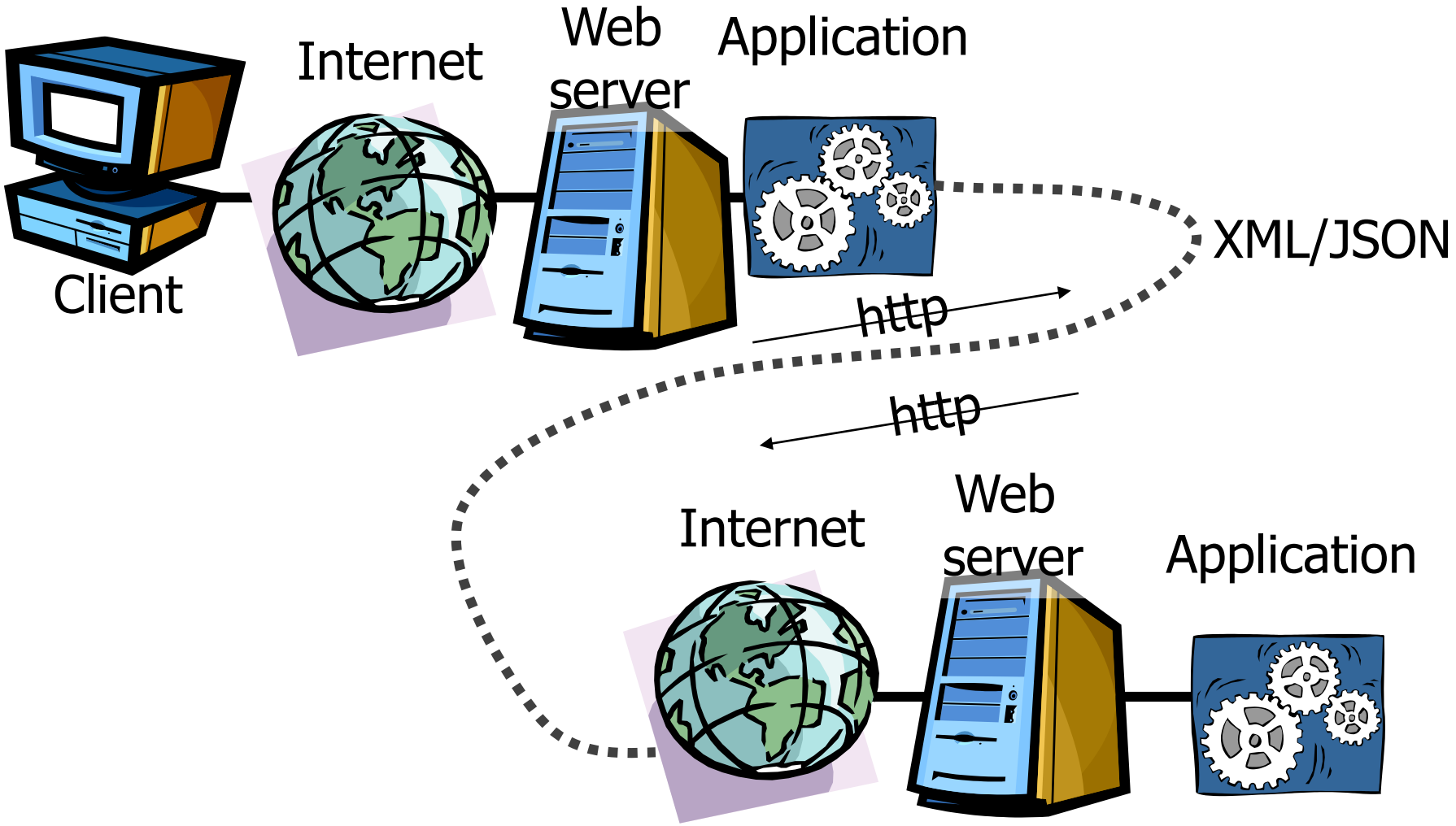
Rich-client transaction



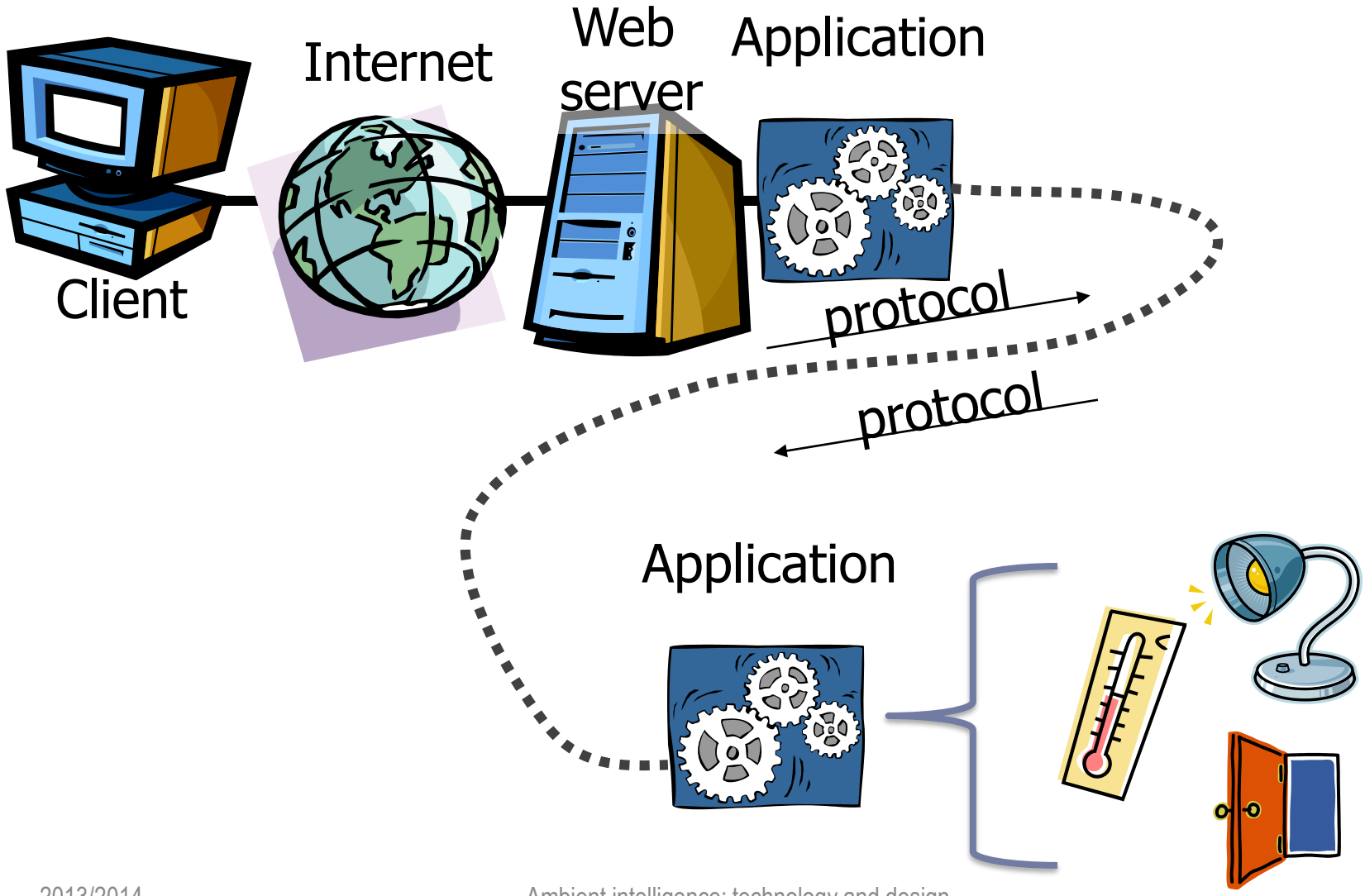
General Architecture



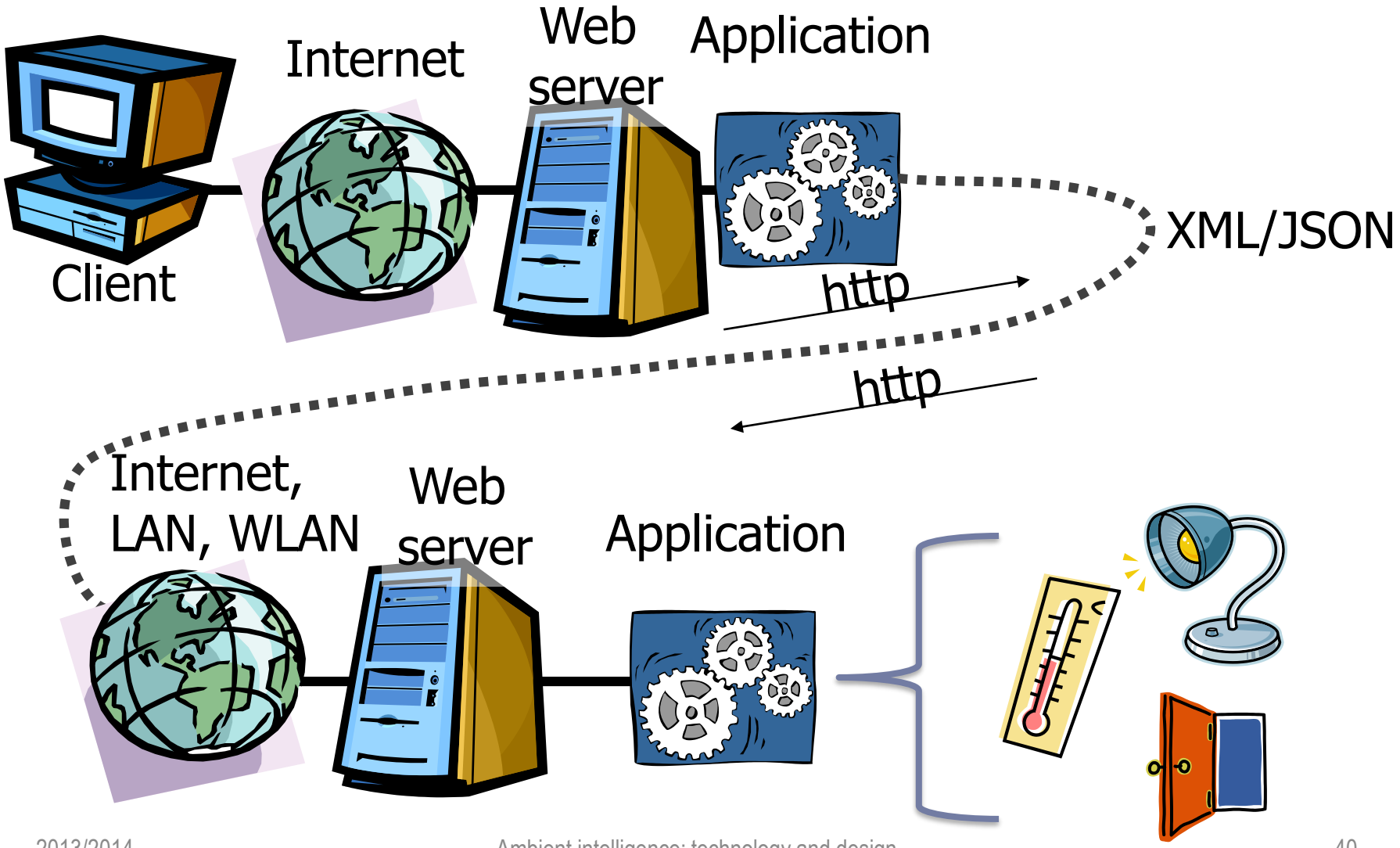
Distributed transactions



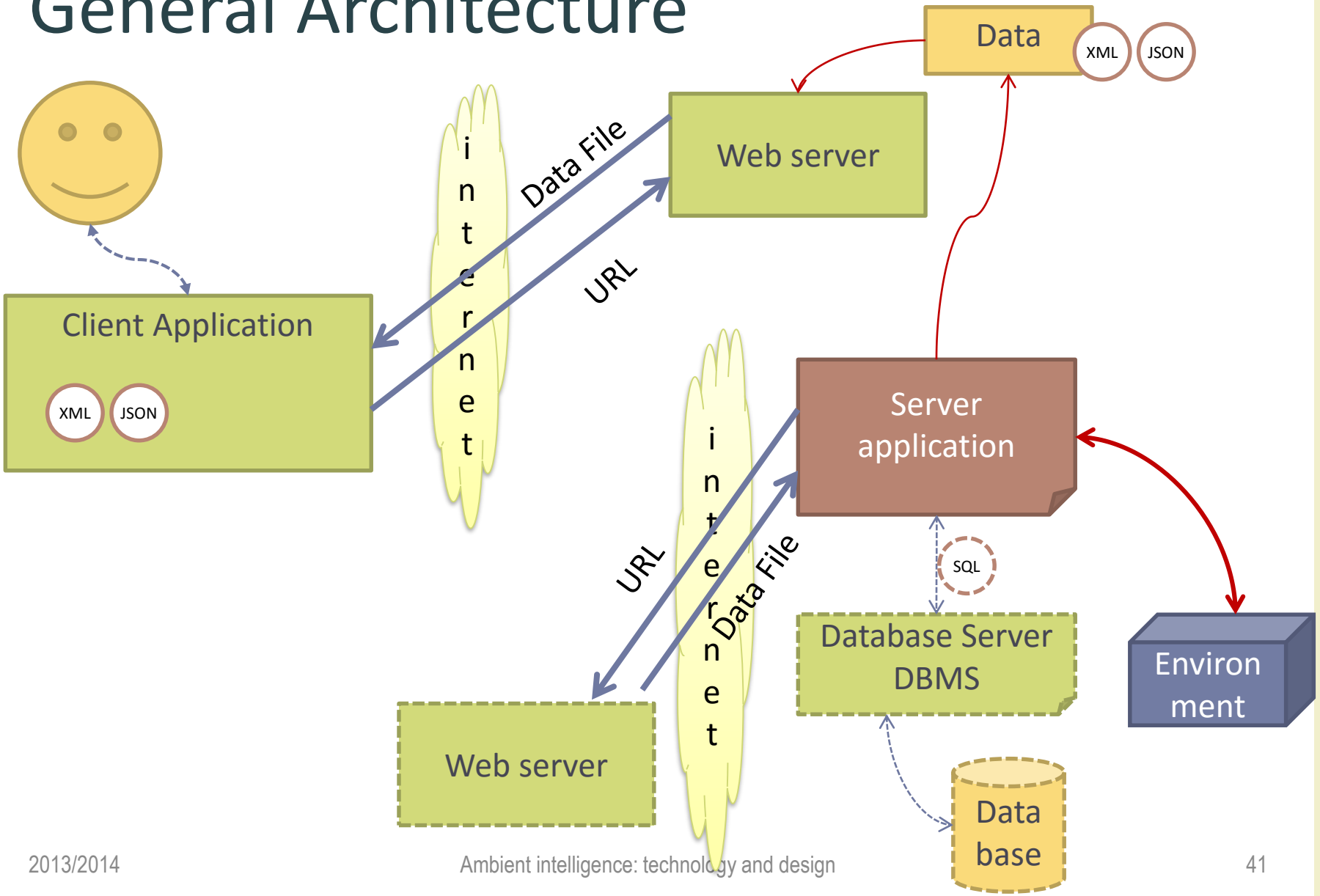
AmI control


Client
Internet
Web server
Application
protocol
protocol
Application

AmI control via http



General Architecture



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