分布式系统

Distributed Systems

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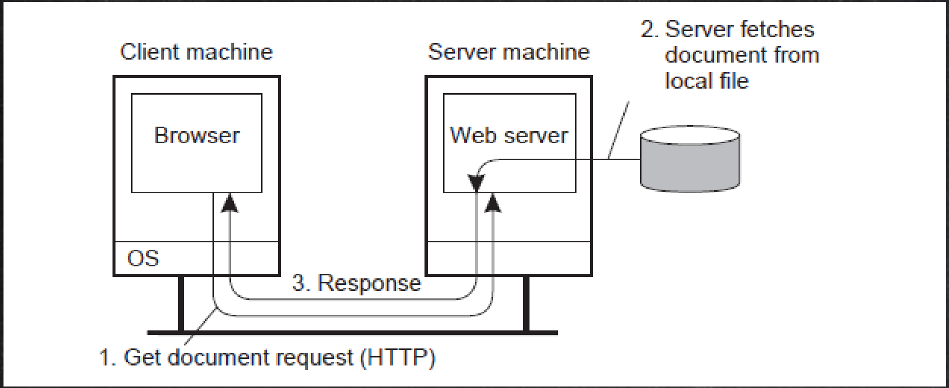
第十二讲 — 分布式Web系统

Distributed Web-Based Systems

➢ Essence

The WWW is a huge client-server system with millions of servers; each server hosting thousands of hyperlinked documents:

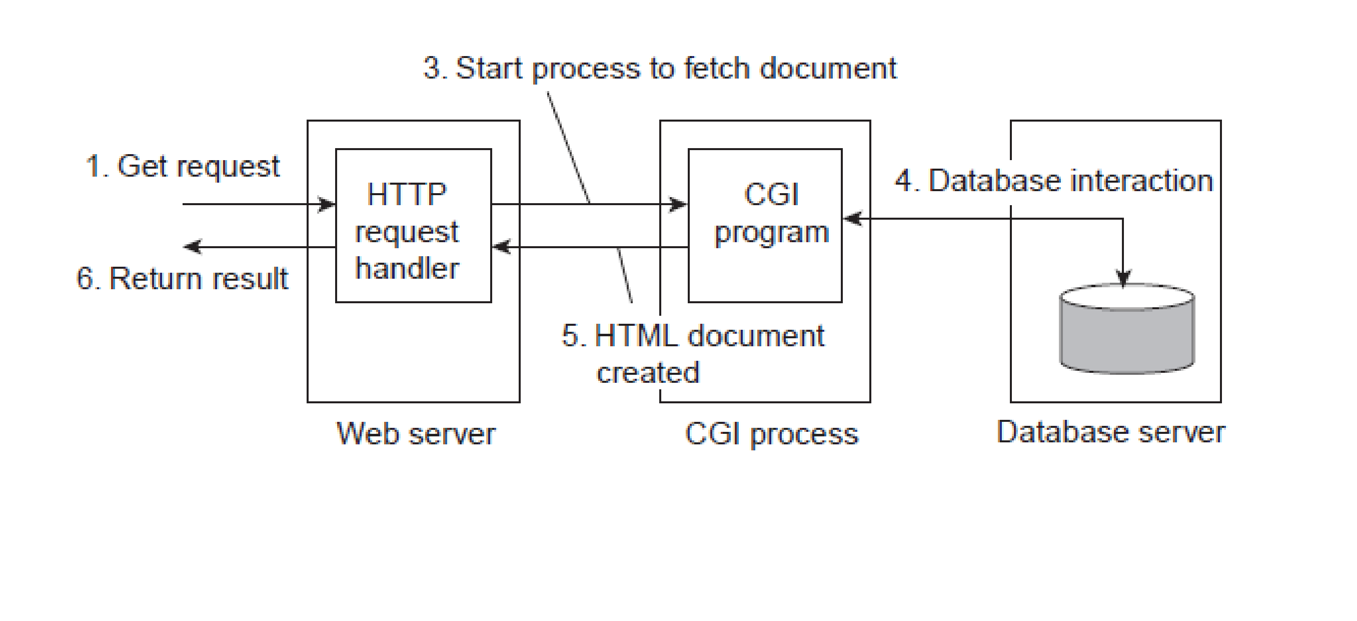

Client machine
Server machine
2. Server fetches document from local file
Browser
Web server
OS
3. Response
1. Get document request (HTTP)

- ➢ Documents are generally represented in text (plain text, HTML, XML)
- ➢ Alternative types: images, audio, video, but also applications (PDF, PS)
- ➢ Documents contain scripts that are executed by the client-side software

Multi-tiered Architectures

- Observation

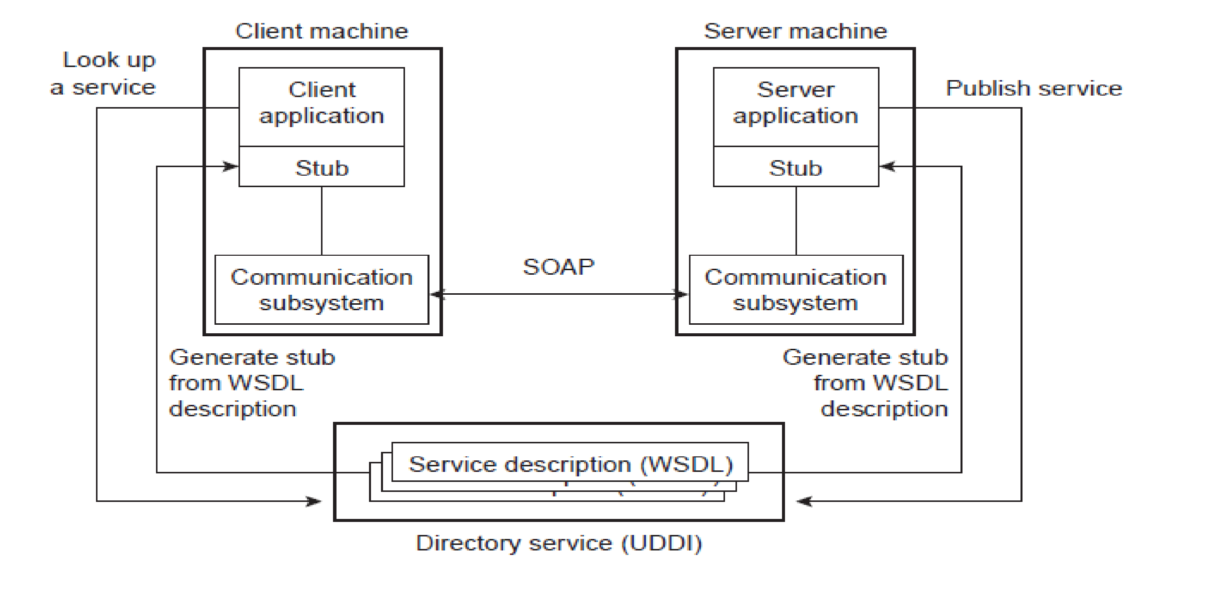
  Conventionally, web sites were organized into three tiers.



Web services

➢ Observation

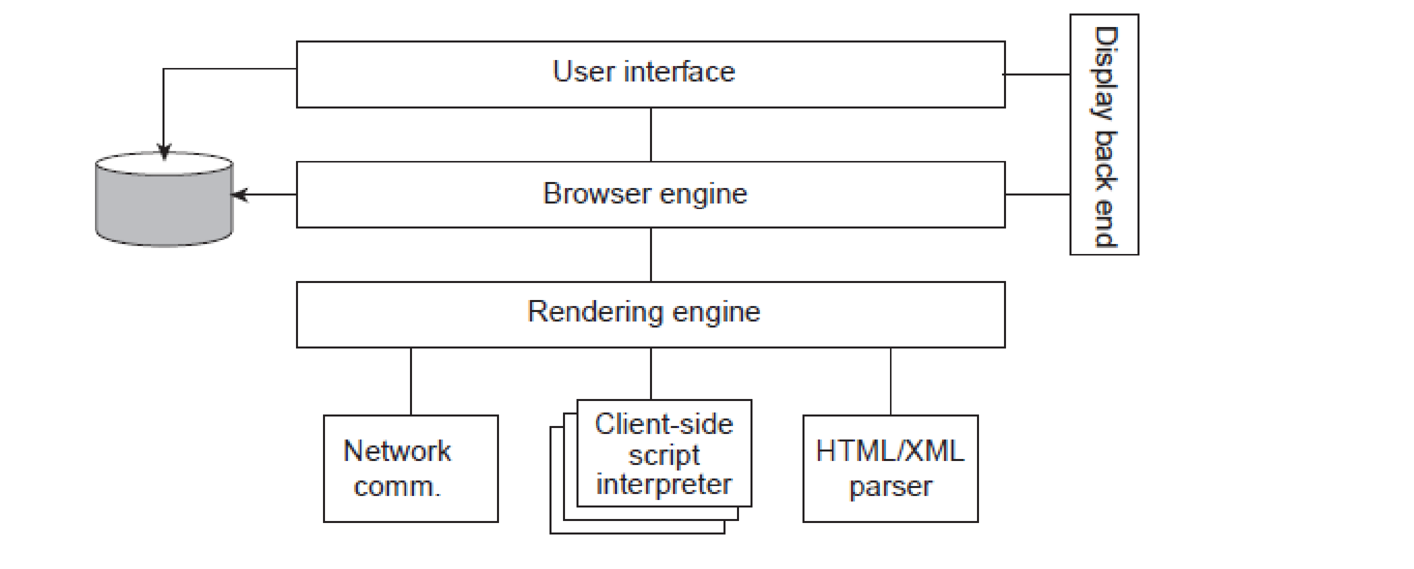
At a certain point, people started recognizing that it is was more than just user <-> site interaction: sites could offer services to other sites => standardization is then badly needed.



Clients: Web browsers

- Observation

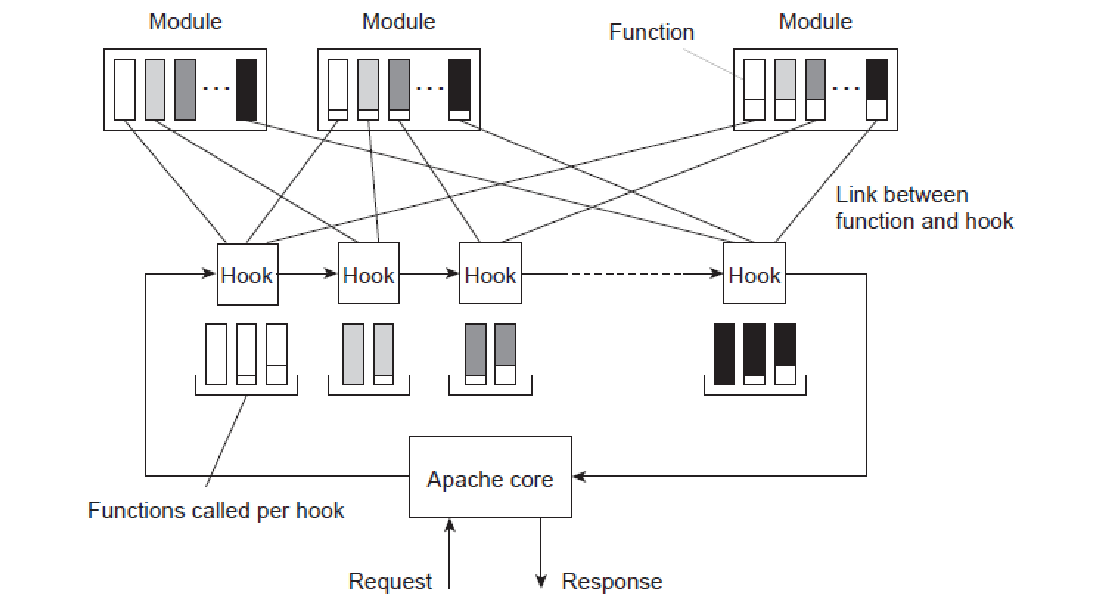
browsers form the Web's most important client-side software. They are used to be simple, but that is long ago.



Apache Web Server

➢ Observation

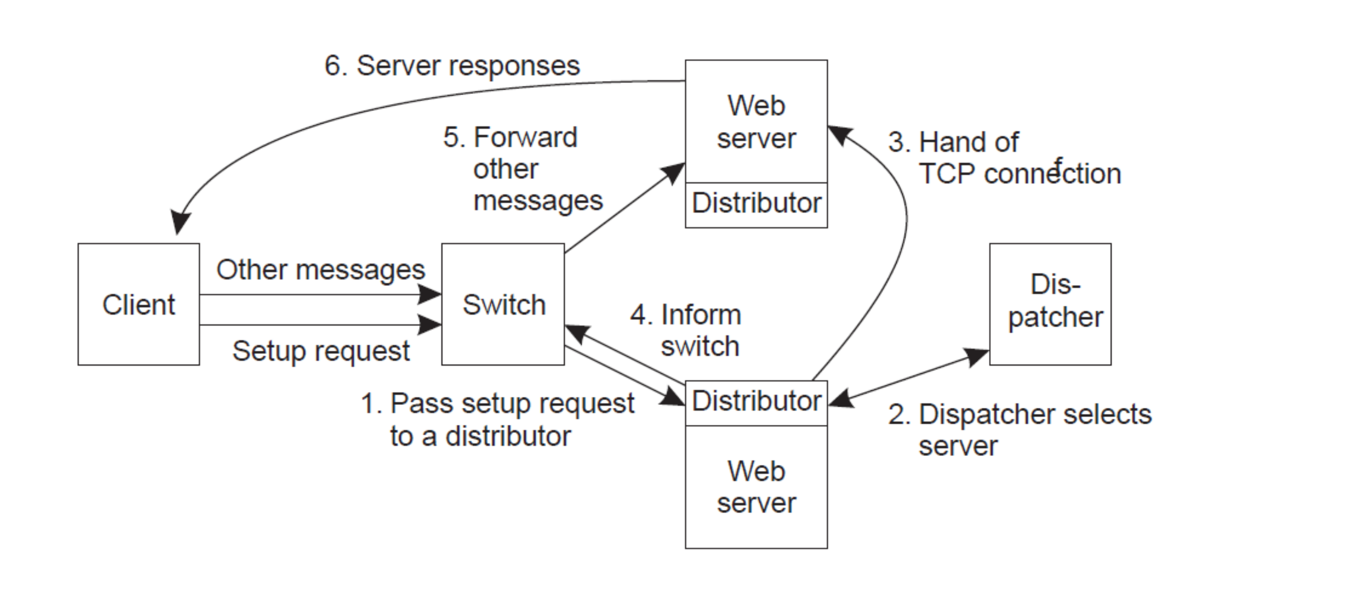
More than 70% of all Web sites are based on Apache. The server is internally organized more or less according to the steps needed to process an HTTP request:



Server Clusters (2/2)

- **Question**

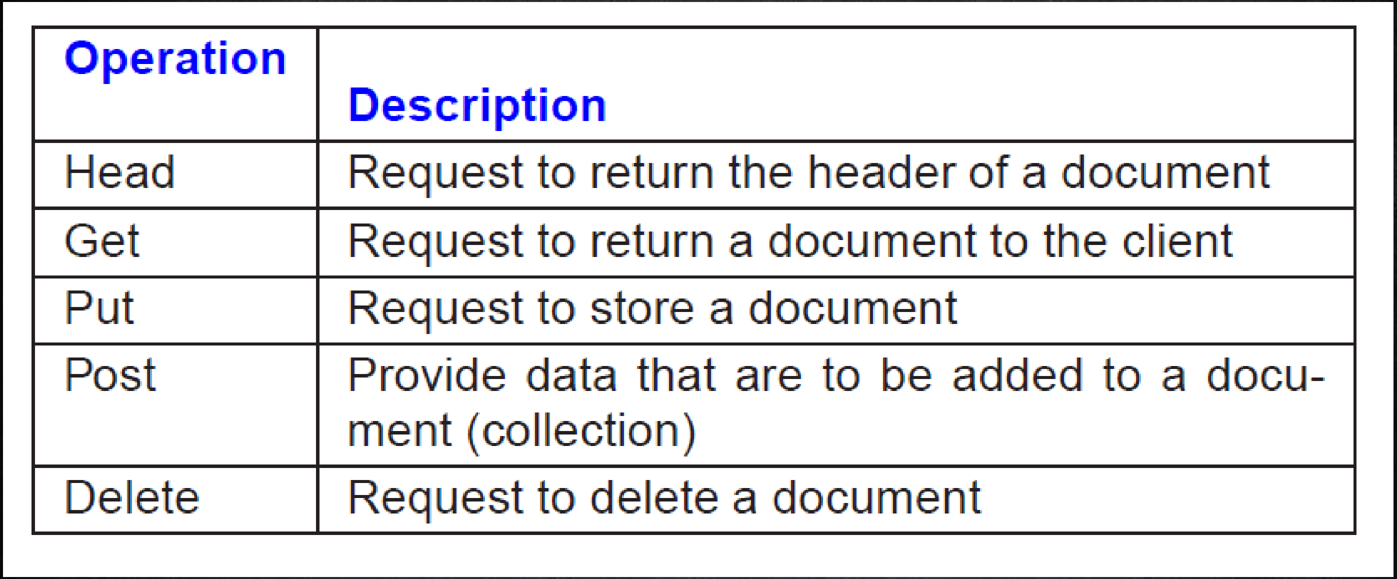
  Why can content-aware distribution be so much better?



Communication (1/2)

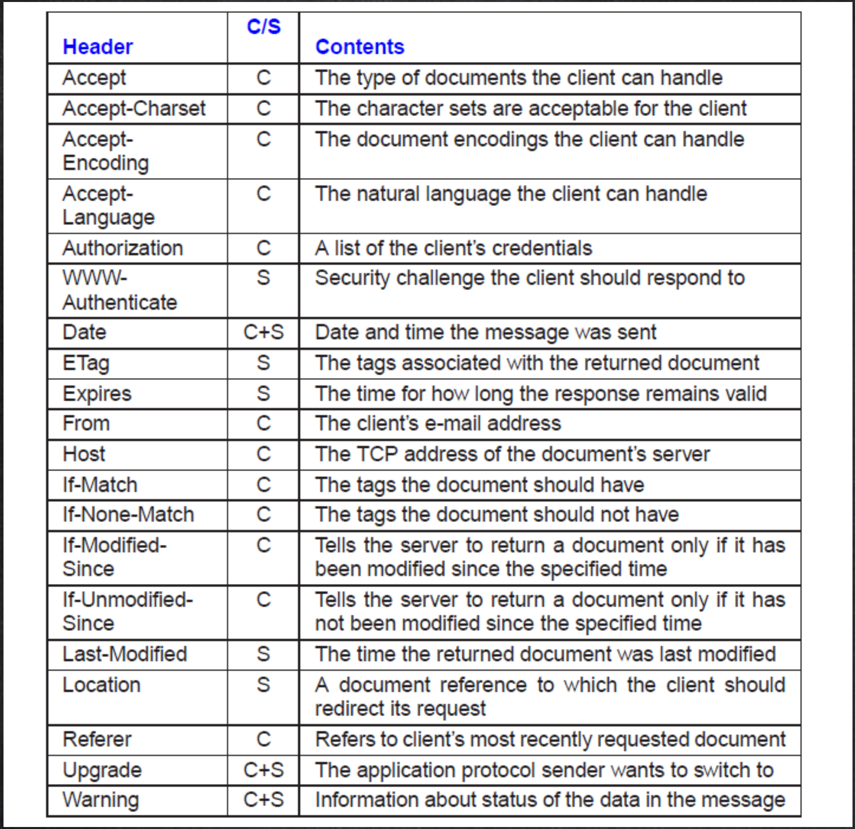
➢ Essence

Communication in the Web is generally based on HTTP; a relatively simple client-server transfer protocol having the following request messages:



Operation	Description
Head	Request to return the header of a document
Get	Request to return a document to the client
Put	Request to store a document
Post	Provide data that are to be added to a document (collection)
Delete	Request to delete a document

Communication (2/2)



Header	C/S	Contents
Accept	C	The type of documents the client can handle
Accept-Charset	C	The character sets are acceptable for the client
Accept-Encoding	C	The document encodings the client can handle
Accept-Language	C	The natural language the client can handle
Authorization	C	A list of the client's credentials
WWW-Authenticate	S	Security challenge the client should respond to
Date	C+S	Date and time the message was sent
ETag	S	The tags associated with the returned document
Expires	S	The time for how long the response remains valid
From	C	The client's e-mail address
Host	C	The TCP address of the document's server
If-Match	C	The tags the document should have
If-None-Match	C	The tags the document should not have
If-Modified-Since	C	Tells the server to return a document only if it has been modified since the specified time
If-Unmodified-Since	C	Tells the server to return a document only if it has not been modified since the specified time
Last-Modified	S	The time the returned document was last modified
Location	S	A document reference to which the client should redirect its request
Referer	C	Refers to client's most recently requested document
Upgrade	C+S	The application protocol sender wants to switch to
Warning	C+S	Information about status of the data in the message

SOAP

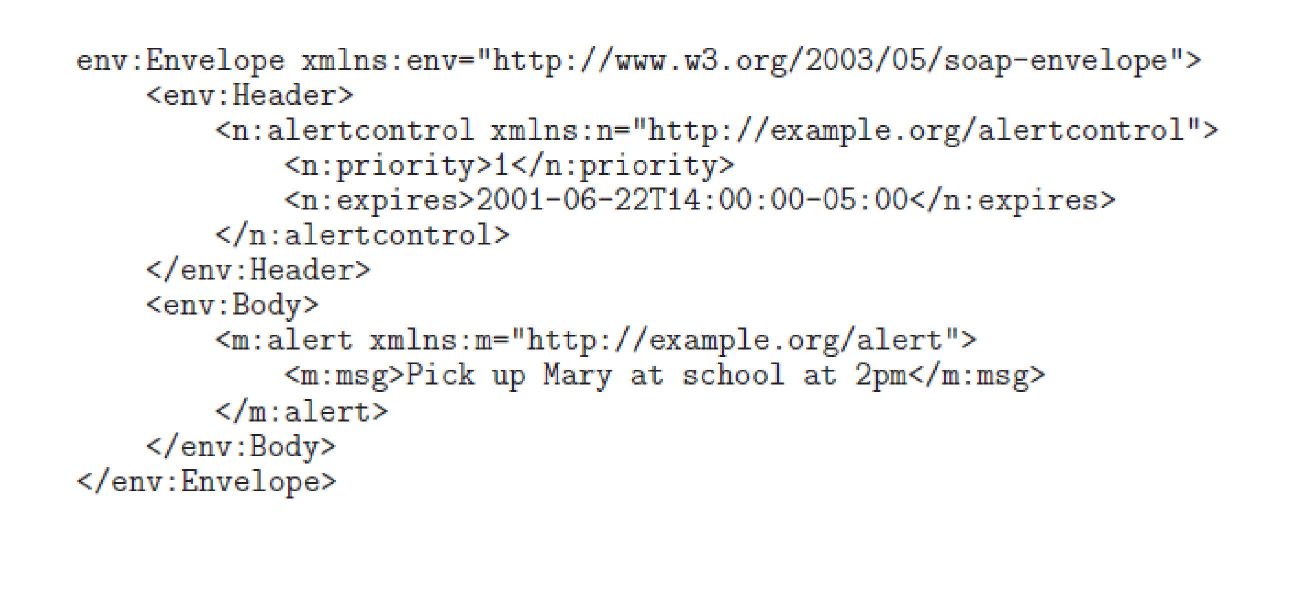
Simple Object Access Protocol: Based on XML, this is the standard protocol for communication between Web services.

- ➢ SOAP is bound to an underlying protocol (i.e., it is not independent from its carrier, HTTP、SMTP)
- ➢ Conversational exchange style: Send a document one way, get a filled-in response back.
- ➢ RPC-style exchange: Used to invoke a Web service.

A Note on XML

- Observation

  XML has the advantage of allowing self describing documents.

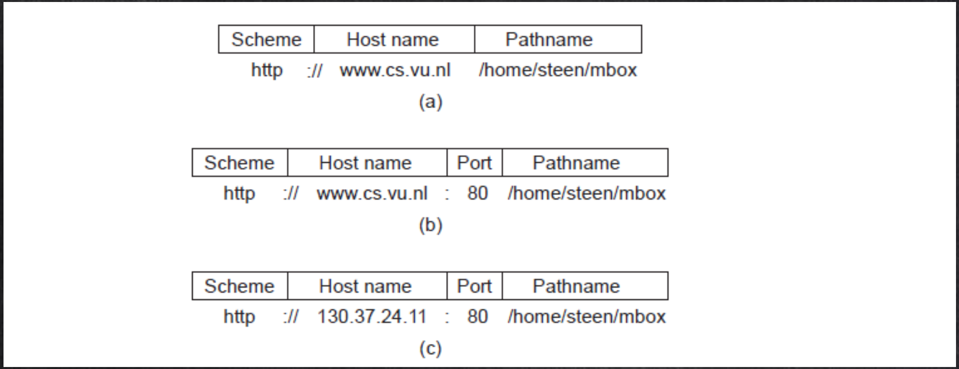


```
env:Envelope xmlns:env="http://www.w3.org/2003/05/soap-envelope">
    <env:Header>
        <n:alertcontrol xmlns:n="http://example.org/alertcontrol">
            <n:priority>1</n:priority>
            <n:expires>2001-06-22T14:00:00-05:00</n:expires>
        </n:alertcontrol>
    </env:Header>
    <env:Body>
        <m:alert xmlns:m="http://example.org/alert">
            <m:msg>Pick up Mary at school at 2pm</m:msg>
        </m:alert>
    </env:Body>
</env:Envelope>
```

Naming: URL

- URL

  Uniform Resource Locator tells how and where to access a resource.



Scheme		Host name	Pathname
http	://	www.cs.vu.nl	/home/steen/mbox

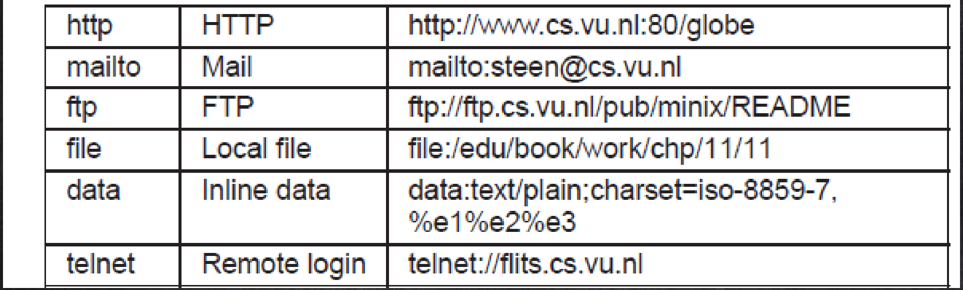
(a)

Scheme		Host name		Port	Pathname
http	://	www.cs.vu.nl	:	80	/home/steen/mbox

(b)

Scheme		Host name		Port	Pathname
http	://	130.37.24.11	:	80	/home/steen/mbox

(c)

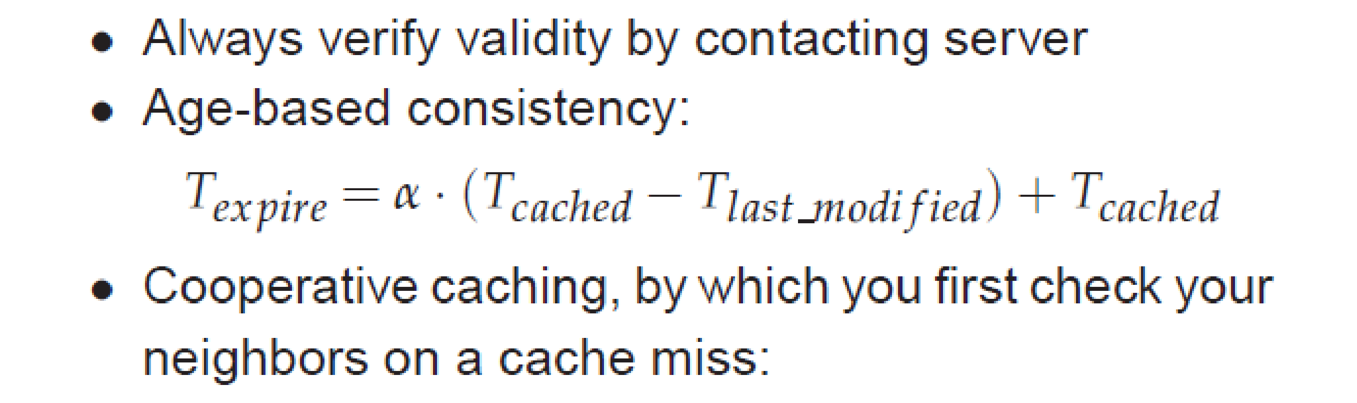


http	HTTP	http://www.cs.vu.nl:80/globe
mailto	Mail	mailto:steen@cs.vu.nl
ftp	FTP	ftp://ftp.cs.vu.nl/pub/minix/README
file	Local file	file:/edu/book/work/chp/11/11
data	Inline data	data:text/plain;charset=iso-8859-7, %e1%e2%e3
telnet	Remote login	telnet://flits.cs.vu.nl

Web Proxy Caching

➢ Basic Idea

Sites install a separate proxy server that handles all outgoing requests. Proxies subsequently cache incoming documents. Cache-consistency protocols:

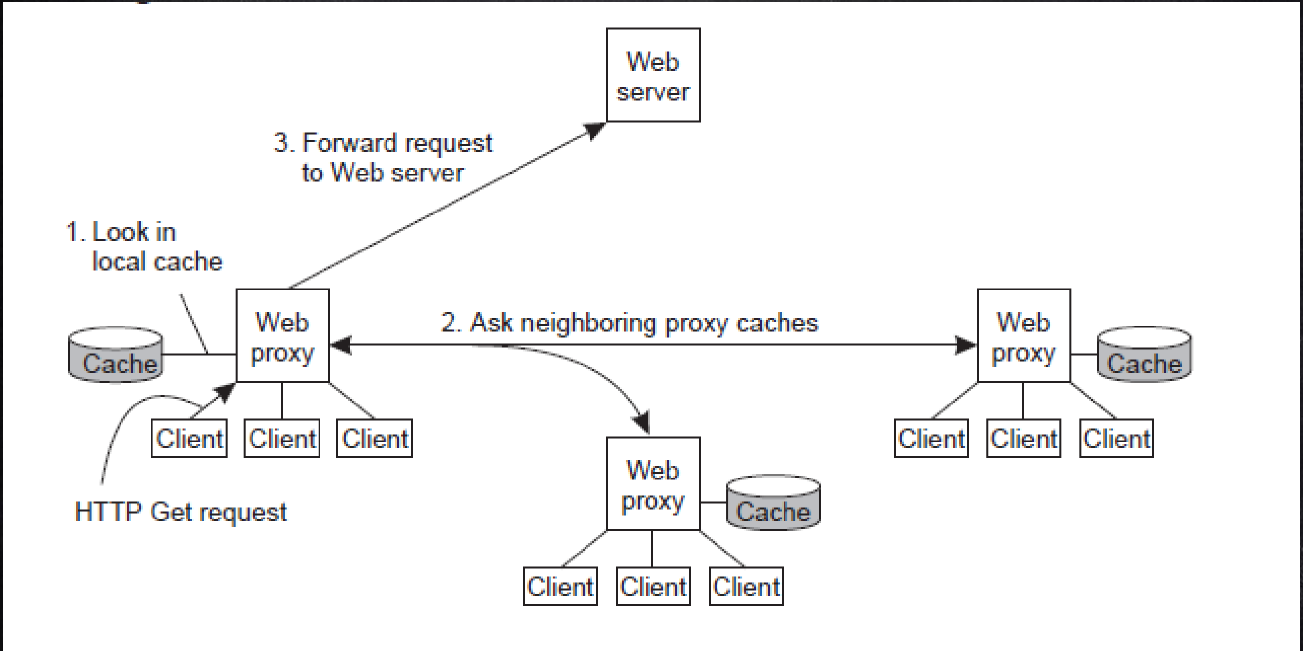


- Always verify validity by contacting server
- Age-based consistency:

$$T_{expire} = \alpha \cdot (T_{cached} - T_{last\_modified}) + T_{cached}$$

- Cooperative caching, by which you first check your neighbors on a cache miss:

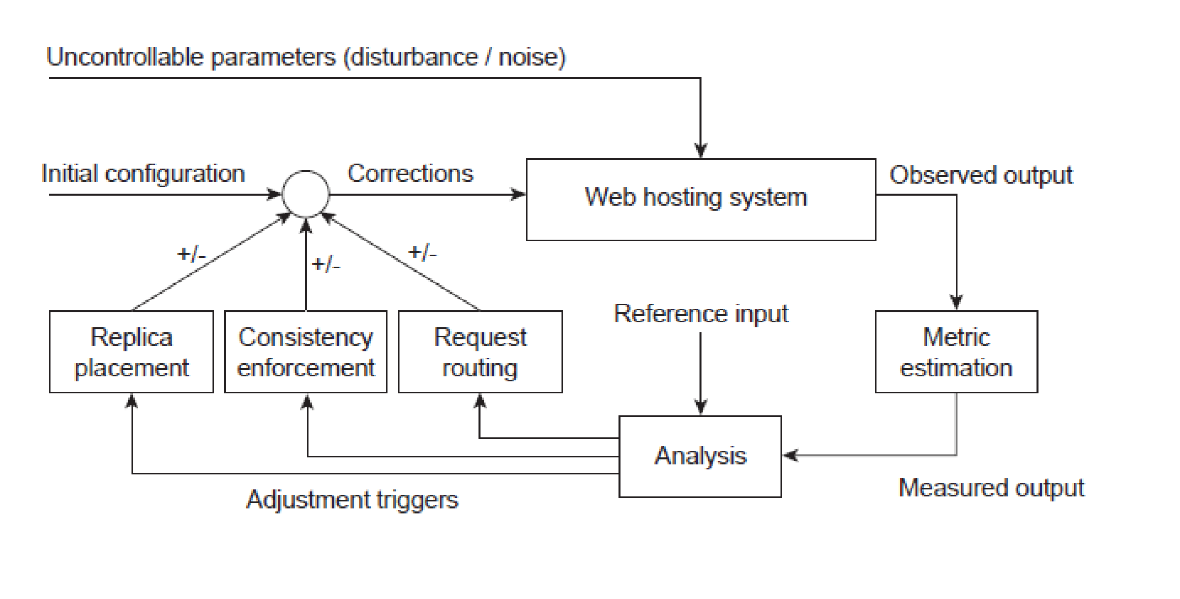
Web Proxy Caching



Replication in Web Hosting Systems

➢ Observation

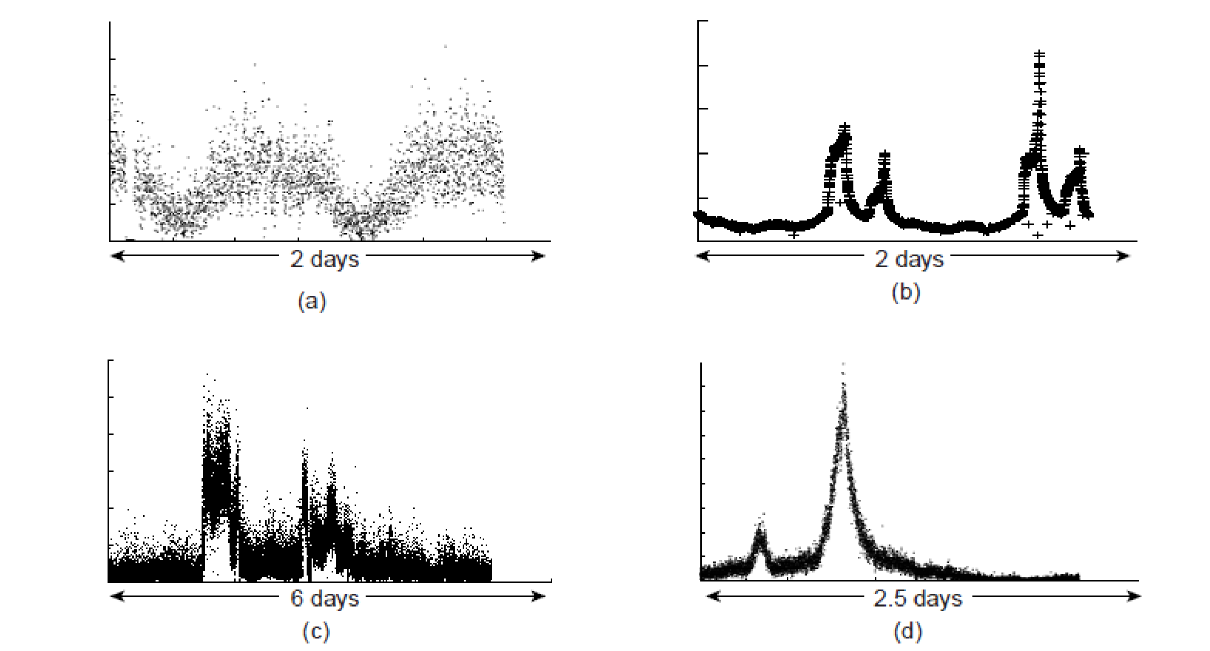
Sites install a separate proxy server that handles all outgoing requests. Proxies subsequently cache incoming documents. Cache-consistency protocols:



Handling Flash Crowds

- Observation

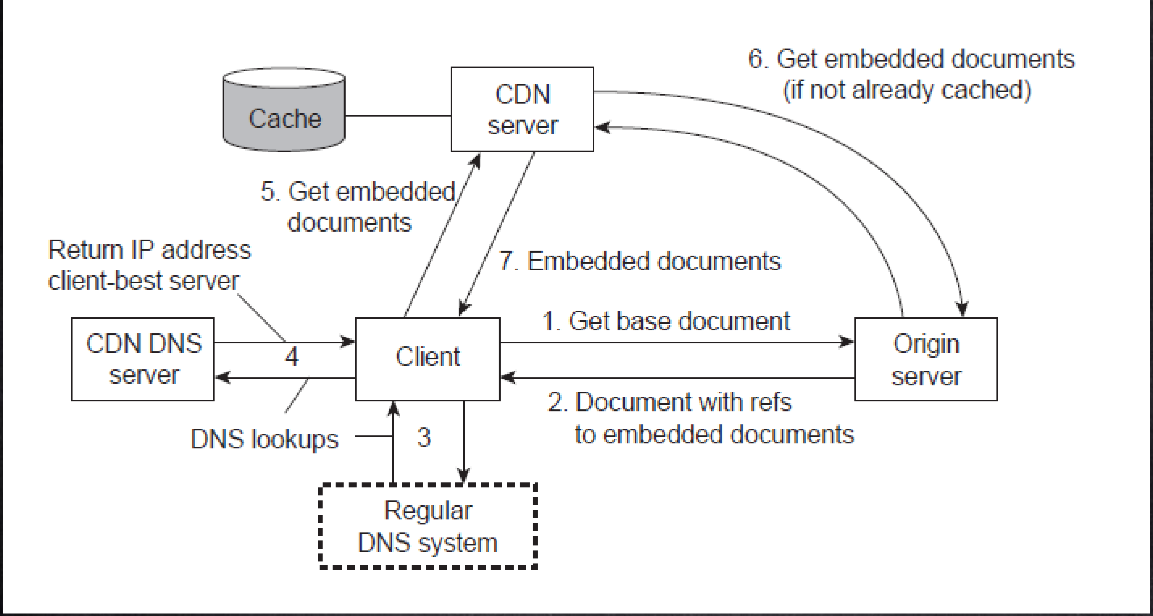
We need dynamic adjustment to balance resource usage. Flash crowds introduce a serious problem:



Server Replication

➢ Content Delivery Network

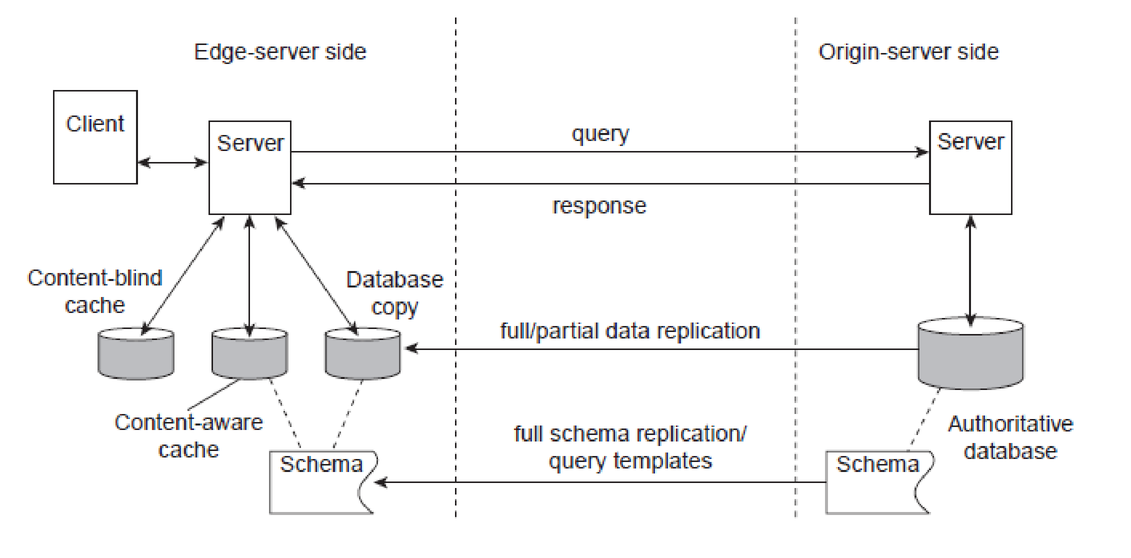
CDNs act as Web hosting services to replicate documents across the I nternet providing their customers guarantees on high availability and performance (example: Akamai).



Replication of Web Apps. (1/3)

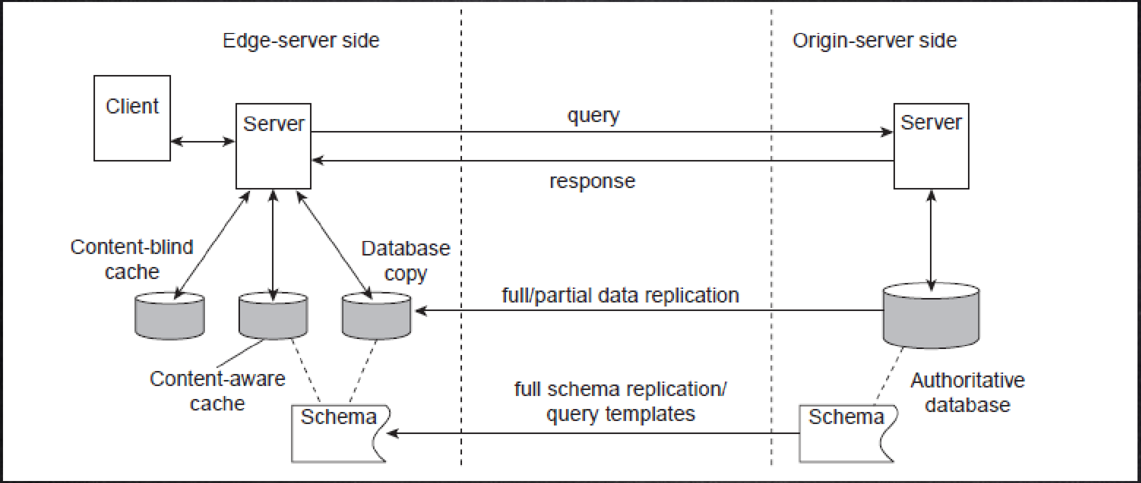
➢ Observation

Replication becomes more difficult when dealing with databses and such. No single best solution.



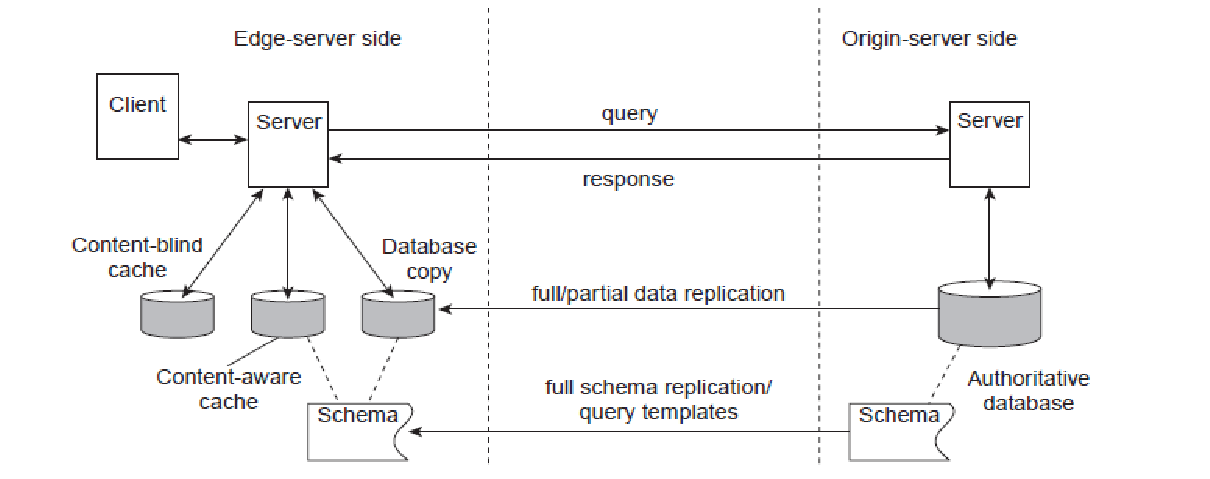
Assumption: Updates are carried out at origin server, and propagated to edge servers.

Replication of Web Apps. (2/3)



- **Full replication:** high read/write ratio, often in combination with complex queries. **Note:** replication may possibly speed-down performance when R/W ratio goes down.
- **Partial replication:** high read/write ratio, but in combination with simple queries

Replication of Web Apps. (3/3)



- ➢ **Content-aware caching:** Check for queries at local database, and subscribe for invalidations at the server. Works good with range qu eries and complex queries.
- ➢ **Content-blind caching:** Simply cache the result of previous querie s. Works great with simple queries that address unique results (e.g., no range queries).

谢谢！