Hyper Text Transfer Protocol (HTTP)

Objective: Understand HTTP (the protocol that makes the Internet possible)

Accessing Resources over the Web

- <protocol>://<server>/<path>

Defines the address (Uniform Resource Locator)

Communication Protocol between the client and the server

Hypertext Transport Protocol (HTTP) characteristics

- Request-response mechanism:
  - Transaction is initiated by a client sending a *request* to server
  - Server generates a *response*
- Resource Identification
  - Each HTTP request includes a URI (Uniform Resource Identifier)
- Statelessness
  - The server does not maintain any information about the transaction
- Meta data support
  - Metadata about information can be exchanged in the messages

HTTP Request Format

Specifies request method

Request Line GET /index.html HTTP/1.0

Specifies resource via URI & meta data

Header Lines

Host: www.content-networking.com
Date: BBBBBBBBBBBB
User-Agent: Mozilla/5.0 (en) (WINNT; U)
Accept-Language: en-us

Carriage Return/Line Feed

Message Body

Content-length:
(Message Payload)

Request Methods

- GET
  - whatever information is identified by the Reuest-URI
  - Can Get static content <u>and</u> data produced by a program

- POST
  - Submit information to Web Server
  - Eg: posting to blog, submission of user form…
  - Information is included in message body
  - The actual function depends on request URI

Example

```
POST/phonebook.cgi.HTTP/1.0
Date:
User-Agent:
Accept Language: en-us
Content Length: 14
98490 55266
```

Looks up phone book for the number
Could have been also achieved by Get
But in that case number would have been in the Resource URL
Which would have been stored in the log

Request Methods…contd (ii)

- HEAD
  - Servers response does not include message body
  - Useful for getting resource metadata without transferring the resource
  - Also useful for debugging , checking for validity, accessibility and modification

- PUT
  - Requests a server store the enclosed data under the supplied Request URL.
  - Creates the resource if it does not create
  - Not useful for web publishing (FTP is preferred for security purposes)

- DELETE
  - Removes the Web object
  - Needs to be carefully used for security reasons

Request Methods…contd (iii)

- TRACE method
  - Invokes a remote appliction layer feedback of the request message
  - Useful for testing what is being received at the server
  - Also possible to forward to intermediaries for debugging purposes

- OPTIONS
  - Requests information about communication options available to server

HTTP Response Format

Status line with result code and phrase

Specifies server & resource meta data

Status line HTTP/1.0 200 OK

Header Lines

Date: BBBBBBBBBBBB
Server: Apache/1.3.12 (Unix)
Last-Modified: (date)
Content Type: text/html

Carriage Return/Line Feed

Message Body

Content-length:
(Message Payload)

Result Code and Phrase

- 1xx: Informational – Not Done Yet
- 2xx: Success – You win
- 3xx:Redirection-You lose but try again
- 4xx:Client Error – You lose, your fault
- 5xx:Server Error – You lose, my bad

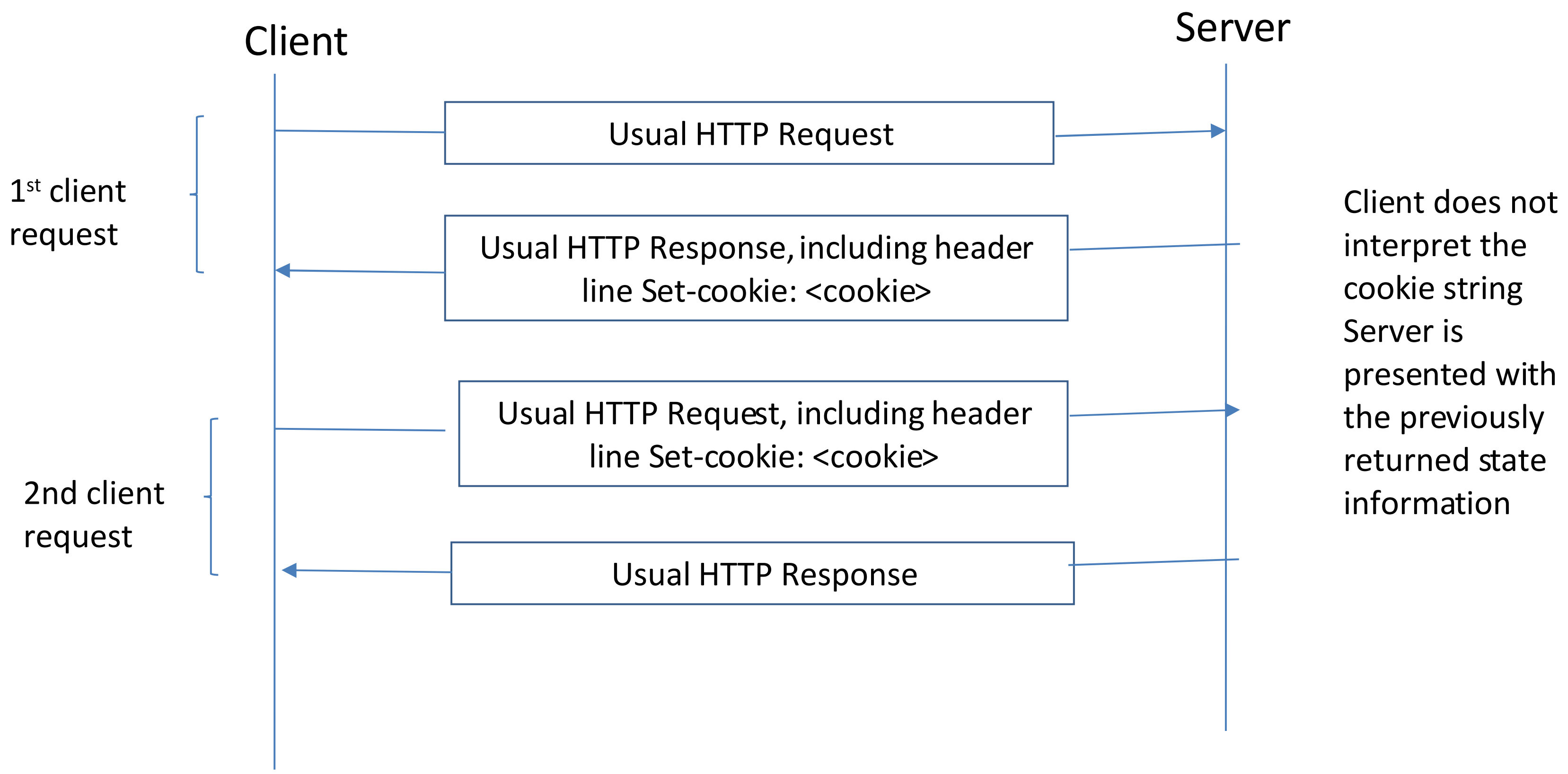
200 OK
204 No Content
300 Mutiple Choices
301 Moved Permanently
302 Moved Temporarily
304 Not Modified
400 Bad Request
401 Unauthorized
404 Not Found
500 Internal Server Error

Improvements in HTTP/1.1

- Persistent connections
  - Keeps the connection open after the server response
  - Connection can be closed by either client or server
- Request Pipelining
  - Allows a client to send several requests without waiting for a response
  - Server responds in the same order
- Chunked Encoding
  - Allows sender to break a message into arbitrary sized chunks
  - Useful for dynamically created response messages

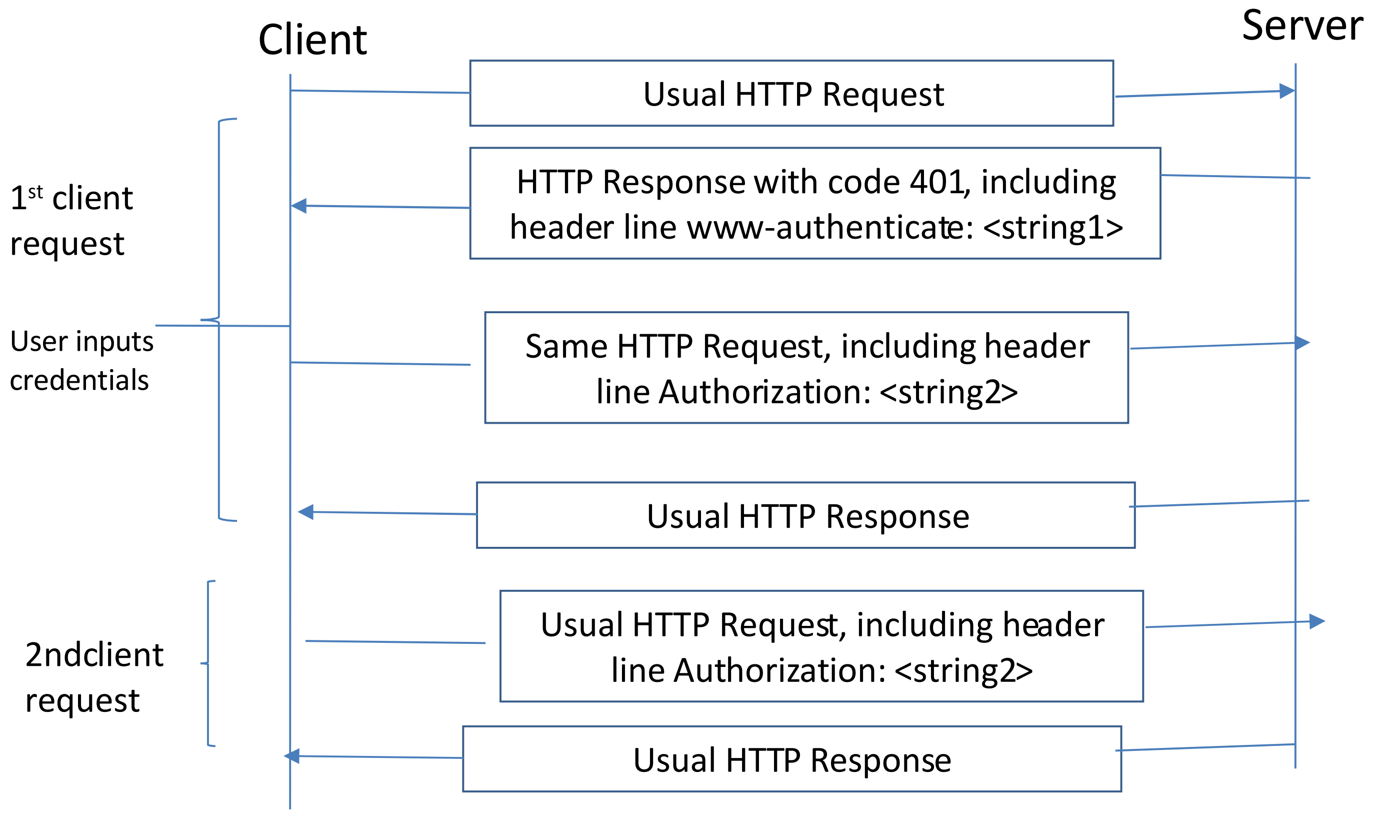
Cookies

- HTTP is stateless protocol
- Cookies manage state maintenance by shifting the burden to client
- Cookies are transmitted in clear text (security issue)


Client
Server
1st client request
2nd client request
Usual HTTP Request
Usual HTTP Response, including header line Set-cookie: <cookie>
Usual HTTP Request, including header line Set-cookie: <cookie>
Usual HTTP Response
Client does not interpret the cookie string
Server is presented with the previously returned state information

User Authentication

- Users browser information remembers credentials and includes them in headers for subsequent requests
- Browser typically deletes stored authentication credentials once browser is closed
- HTTP allows various authentication mechanisms

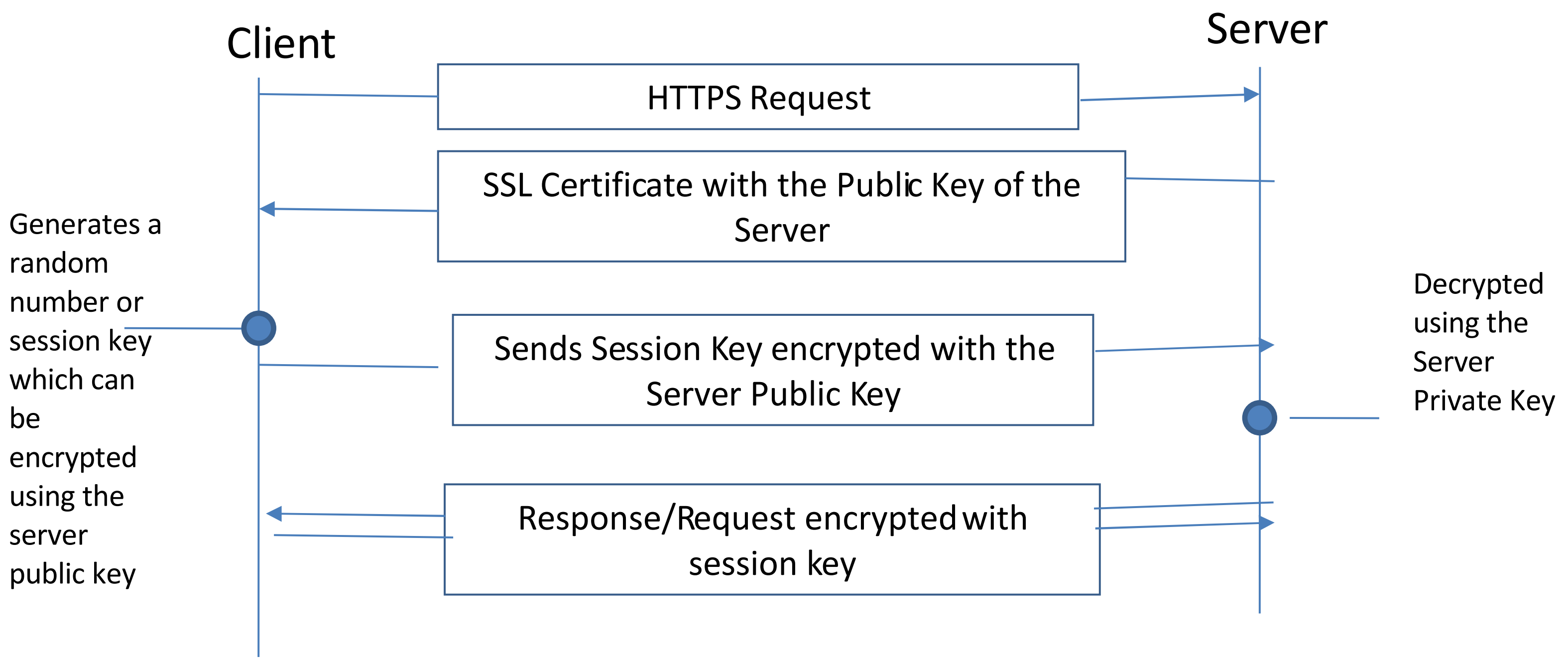

Client
Server
Usual HTTP Request
HTTP Response with code 401, including header line www-authenticate: <string1>
1st client request
User inputs credentials
Same HTTP Request, including header line Authorization: <string2>
Usual HTTP Response
2ndclient request
Usual HTTP Request, including header line Authorization: <string2>
Usual HTTP Response

SSL: Secure Web Communications

- SSL protocol is application independent
- Operates between application layer and transport layer
- Application protocols such as HTTP sit on top of it and TCP/IP beneath it
- SSL provides:

How SSL Works

- The Public Key is a random number generated in pair (the other part of the pair is the private key known only to the server)
- Data encrypted by the public key can be decrypted only by using the private key


Client
Server
HTTPS Request
SSL Certificate with the Public Key of the Server
Generates a random number or session key which can be encrypted using the server public key
Sends Session Key encrypted with the Server Public Key
Decrypted using the Server Private Key
Response/Request encrypted with session key

Ensuring SSL version compatibility

- There are different versions of SSL depending on the encryption algorithm used.
- The browser sends the versions it supports
- The server sends the certificate. The certificate includes:
  - The identity of the organization to which the web server belongs
  - The certificate's expiration date
  - The public key
  - The identity of the organization that issued the certificate, known as a certification authority (CA)
- Browsers store and recognize certificates issued by a number of well-known CAs.

What it does and what it does not

What It Does	What it Does Not
Data encryption Server authentication Message integrity Optional client authentication	SSL does not protect the data stored on the disk. Information getting stolen through pages cached on the browser Stealing confidential information from the browser memory. Since in SSL data is encrypted only during transmission on the network, it is in clear text in the browser memory