Web Engineering

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Web Engineering

Chapter 2: Foundation - Identifiers and Protocols (cont.)

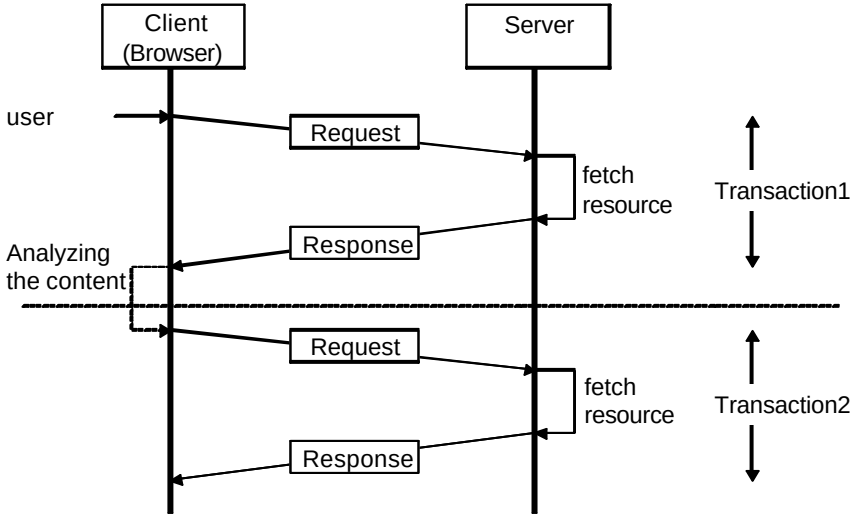
Communication with a Web Server

- HTTP is based on TCP –
  to experiment with the protocol telnet can be used.

```
> telnet 129.13.170.1 80[RETURN]
  GET /index.html HTTP/1.0[RETURN]
  [RETURN]
```

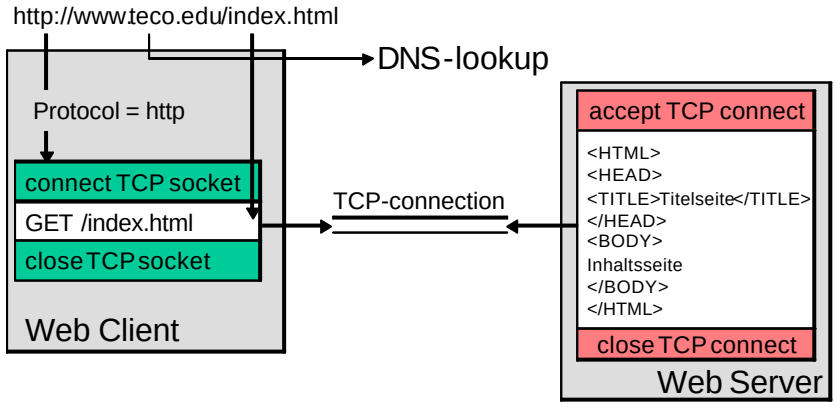
```
> telnet www.teco.edu 80[RETURN]
  HEAD /index.html HTTP/1.0[RETURN]
  [RETURN]
```


HTTP Transaction

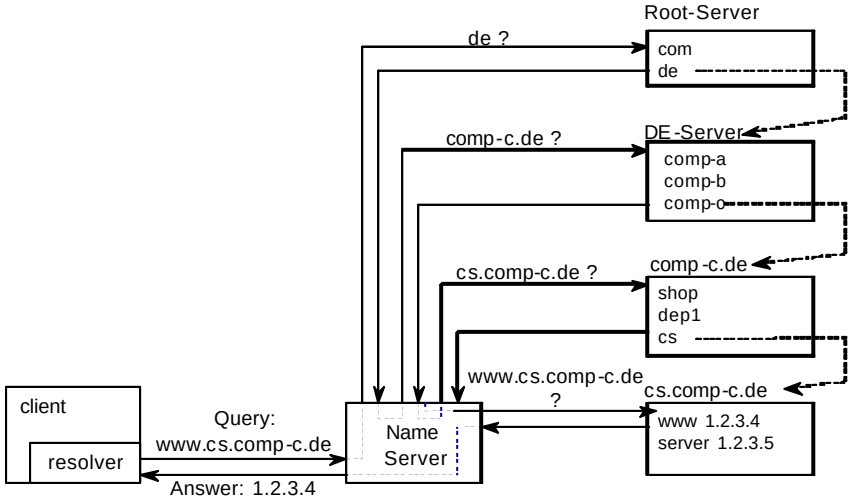


HTTP/0.9

- GET method
- simple, lightweight, fast, easy to implement
- Transfer of text documents (preferably HTML)
- Not specified in a RFC
  `[http://www.w3.org/Protocols/HTTP/HTTP2.html]`



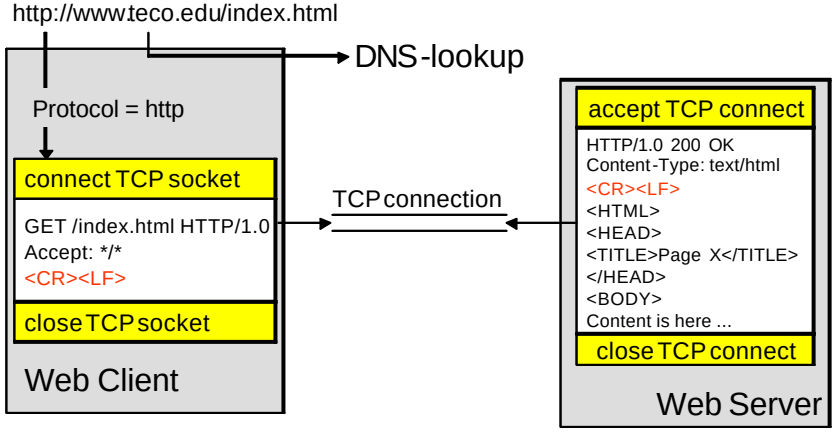
DNS host name resolution



HTTP/1.0

- only an informational RFC, 1992-1996 [RFC1945]
- message Types
  - request (GET, HEAD, POST)
  - response
- header fields
  - variable number of fields
  - Syntax: `<field_name> ":" <field_value>`
  - Transfer of meta information on the request, response, and content
- response codes
  - status and error information
- media types
  - transfer of arbitrary resources, especially
    - graphics, images, audio, video
  - based on MIME (multipurpose internet mail extensions)
- basic mechanism for access control and authentication

HTTP/1.0 - scenario



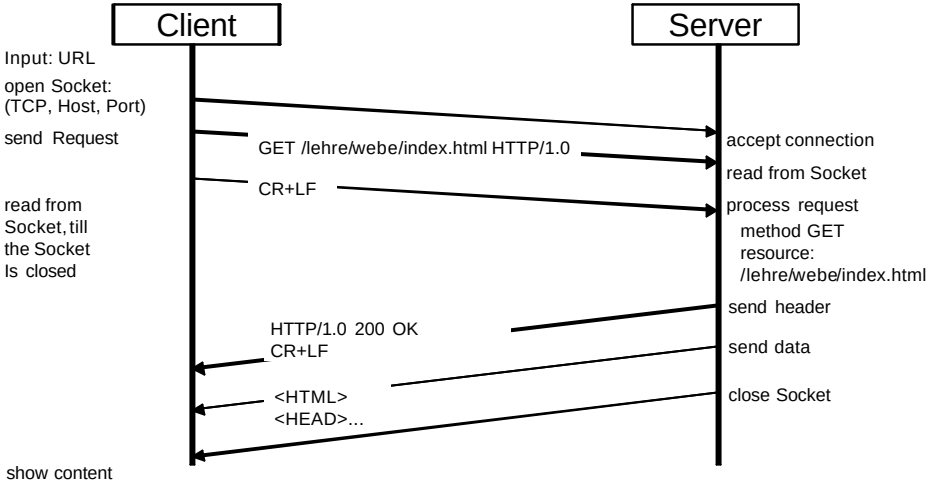
Document transfer (HTTP) I

- GET Method
- URL: **`http://www.teco.edu/lehre/webe/index.html`**
- procedure at the client side
  - Identify host name from the URL
    `www.teco.edu`
    resolve the IP-Address
    `129.13.170.1`
  - Identify port number
    `80` (default)
  - open Socket (TCP) to `129.13.170.1` Port `80`
  - sent method over the Socket
    `GET / lehre/webe/index.htmlHTTP/1.0`
  - Read from socket until the socket is closed by the server.
  - Result: header with status and the requested resource or an error message

Document transfer (HTTP) II

- GET Method
- URL: **`http://www.teco.edu/lehre/webe/index.html`**
- procedure at the server side
  - A process on the machine `129.13.170.1` waits on port `80` for a connection request
  - If there is a request a connection is established, then:
    - read from socket to the first empty line
    - analyze the given request (extract method and resource name)
    - Write status on the socket
    - localize resource (e.g. File system), read the resource and write it to the socket
    - close the socket

Document transfer (HTTP) III



Tools I

- Program shows the request of the browser as web page:
  `http://www.teco.edu:8080/`
- Typical page:

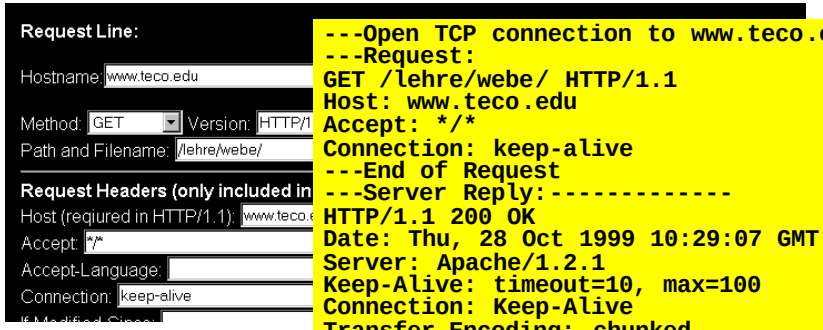
Sorry Not HTTP-Methods supported!

Your Request:

```
GET / HTTP/1.1
Accept: */*
Referer:
http://www.teco.edu/lehre/webe/beispiele.html
Accept-Language: en-us
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 5.0;
Windows NT; DigExt)
Host: www.teco.edu:8080
Connection: Keep-Alive
Cookie: SITESERVER=ID=fe340799f17c660e09e1f34c9dbf
```

Tools II

- Program to build and send HTTP-Requests:
  http://www.teco.edu/lehre/webe/beispiele/http.html




```
---Open TCP connection to www.teco.edu:80
---Request:
GET /lehre/webe/ HTTP/1.1
Host: www.teco.edu
Accept: */*
Connection: keep-alive
---End of Request
---Server Reply:-------------
HTTP/1.1 200 OK
Date: Thu, 28 Oct 1999 10:29:07 GMT
Server: Apache/1.2.1
Keep-Alive: timeout=10, max=100
Connection: Keep-Alive
Transfer-Encoding: chunked
Content-Type: text/html

b76
<html>
...
```


tools III

- programs to analyze the traffic in a network:
  `tcpdump` (Unix/Linux),
  `etherpeak` (Mac) [www.wildpackets.com],
  Systems Management Server (Windows NT)
- works only in superuser mode
- **abuse is illegal!**

HTTP/1.0 Example

- Request

```
GET /index.html HTTP/1.0
Accept: image/gif, image/x-xbitmap, image/jpeg, */*
Accept-Language: de
Accept-Encoding: gzip
User-Agent: Mozilla/4.0 (compatible; MSIE 5.0; Windows NT)

```

Request Method
Header
blank line (**CRLF**)

- Response

```
HTTP/1.0 200 OK
Server: ServerName
Content-Type: text/html
Content-Length: 80

<HTML>
<TITLE> ...
```

Status
Header
blank line (**CRLF**)
Data

Documents contain Resources I

- reply of the servers

```
HTTP/1.0 200 OK
Content-Type: text/html
Content-Length: 3213

<html>
<head>
<title>Oracle Corporation - Home</title>
...
</head>
<body bgcolor="#ffffff" link="#000000" vlink="#ff0000">
...
<INPUT NAME=q size=10 maxlength=800 VALUE=""><INPUT
TYPE="image" src="/templates/images/search_btn.gif"
width=36 height=18 value="go" border=0>
...
<a href="/html/dev_it.html">
<img src="/images/devit_off.gif" alt="Developers/IT"
   border=0></a>
...
<img src="/images/clear_dot.gif" width=50 height=1>
...
</body>
</html>
```

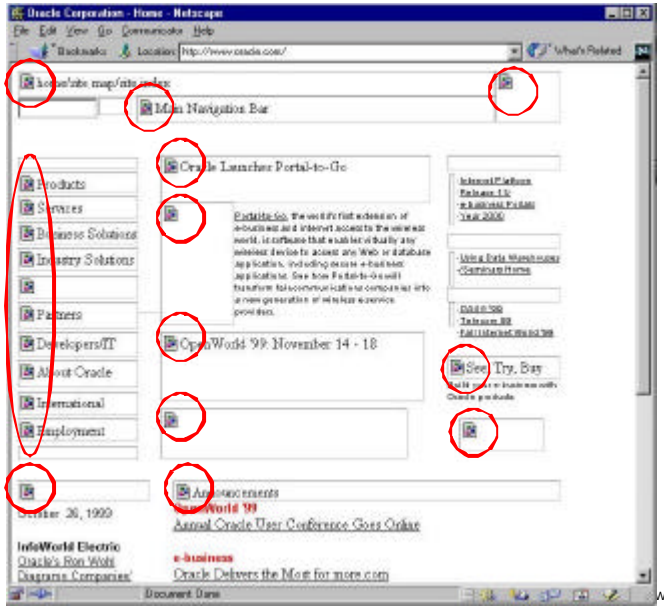
Documents contain Resources I

- reply of the servers

```
HTTP/1.0 200 OK
Content-Type: text/html
Content-Length: 3213

<html>
<head>
<title>Oracle Corporation - Home</title>
...
</head>
<body bgcolor="#ffffff" link="#000000" vlink="#ff0000">
...
<INPUT NAME=q size=10 maxlength=800 VALUE=""><INPUT
TYPE="image" src="/templates/images/search_btn.gif"
width=36 height=18 value="go" border=0>
...
<a href="/html/dev_it.html">
<img src="/images/devit_off.gif" alt="Developers/IT"
   border=0></a>
...
<img src="/images/clear_dot.gif" width=50 height=1>
...
</body>
</html>
```


Documents contain Resources II

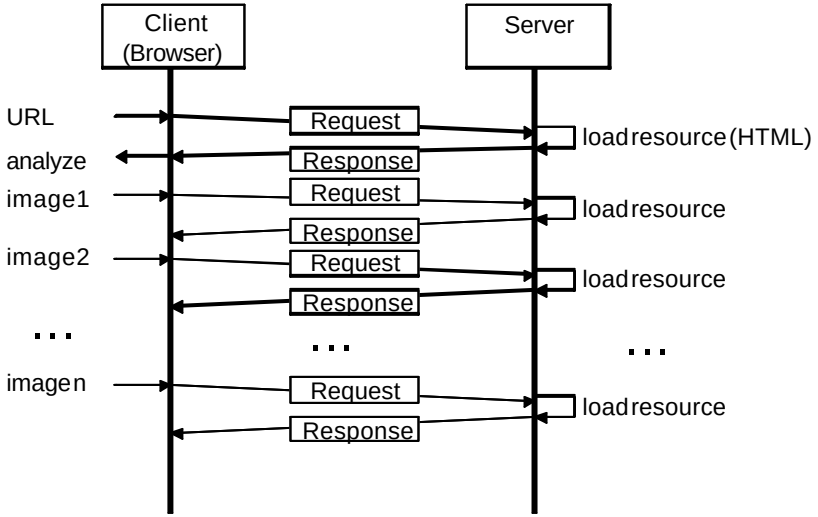


- images
- background
- buttons
- music
- audio

Documents contain Resources III

- images
- background
- buttons
- music
- audio

Documents contain Resources IV



HTTP/1.0, Performance Problems

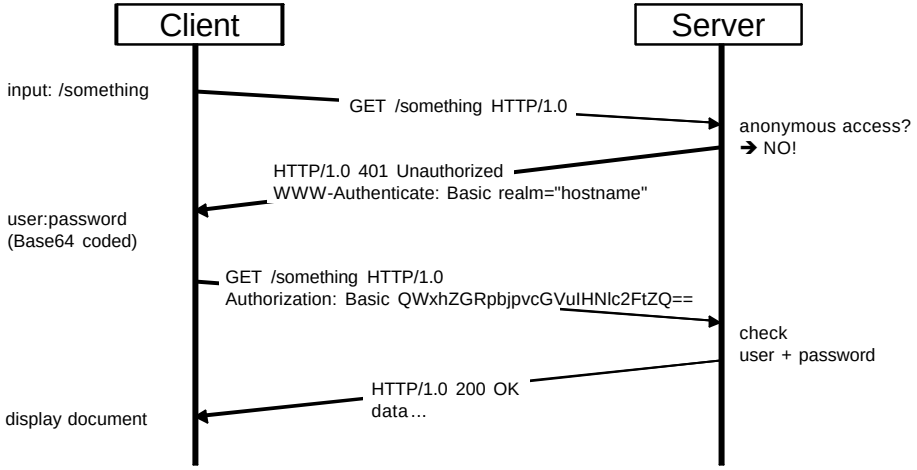
- see further reading:
  Simon E Spero, July 1994,
  Analysis of HTTP Performance problems
  http://www.w3.org/Protocols/HTTP/1.0/HTTPPerformance.html

- In HTTP most time is spend waiting and not transferring data due to the slow start mechanism in TCP

HTTP/1.0, Basic Authentication I

- restrict access to selective resources
- Include information about the user (names) in access log file
- basic authentication
  - simple username - password scheme
  - **<user>:<passwd>** Base64 coded
    Base64: groups of 24 Bits are encoded in 4 6 -Bit characters (highly compatible subset of US-ASCII), in RFC1521
  - No encryption!
- procedure:
  - client requests a resource
  - server answers with status code: `401 Unauthorized` und header `WWW-Authenticate`
  - client requests a resource with additional header `Authorization: <user>:<passwd>` (Base64 coded)
  - server checks `<user>:<passwd>` with access restrictions
  - If `<user>:<passwd>` is valid user will return the resource

HTTP/1.0, Basic Authentication II



HTTP/1.0 Example User und Password I

- request

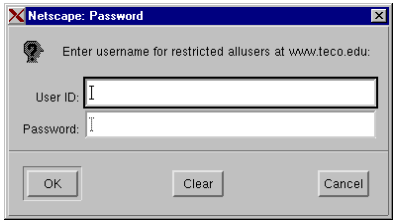
```
GET /index.html HTTP/1.0                          ← request method
Accept: image/gif, image/x-xbitmap, image/jpeg, */*   ┐
Accept-Language: de                                   ├ header
User-Agent: Mozilla/4.0 (compatible; MSIE 5.0; Windows NT) ┘
                                                  ← blank line (CRLF)
```

- response

```
HTTP/1.0 401 Access Denied                        ← status
Server: Apache/1.2.1                                  ┐
WWW-Authenticate: Basic realm="teco150pc.teco.edu“    ├ header
Content-Length: 24                                    │
Content-Type: text/html                               ┘
                                                  ← blank line (CRLF)
Error: Access is Denied                           ← data
```

HTTP/1.0 Example
User und Password II

- browser will prompt user to input user name and password



- if there is a password stored from a previous access the browser will use this (transparently for the user)

HTTP/1.0 Beispiele
User und Passwort III

- request

```
GET /index.html HTTP/1.0
Accept: image/gif, image/x-xbitmap, image/jpeg, */*
Accept-Language: de
User-Agent: Mozilla/4.0 (compatible; MSIE 5.0; Windows NT)
Authorization: Basic YWxicmVjaHQ6dGVzdA==
```

request method; header; blank line (**CRLF**)

- response

```
HTTP/1.1 200 OK
Server: Apache/1.2.1
Content-Length: 2989
Content-Type: text/html

<HTML>
<TITLE> ...
```

status; header; blank line (**CRLF**); data

HTTP/1.0 Beispiele
User und Passwort III

- request

```
GET /index.html HTTP/1.0
Accept: image/gif, image/x-xbitmap, image/jpeg, */*
Accept-Language: de
User-Agent: Mozilla/4.0 (compatible; MSIE 5.0; Windows NT)
Authorization: Basic YWxicmVjaHQ6dGVzdA==
```

request method; header; blank line (**CRLF**)

- response

```
HTTP/1.1 200 OK
Server: Apache/1.2.1
Content-Length: 2989
Content-Type: text/html

<HTML>
<TITLE> ...
```

status; header; blank line (**CRLF**); data

Critical Points/Problems with HTTP/1.0

- no support for non-IP-based virtual hosts
  - It is not possible run more than one web server on a machine with only one IP-address
- only one request per connection
  - low performance with TCP (e.g. slow start, RFC2001)
- very basic caching model
  - no protocol level support for proxies and gateways
- no partial transfer of resources
  - high data value due to complete retransmission
  - disconnection results in complete retransmission
- insecure and simple authentication
  - password not encrypted

HTTP/1.1 – Abstract RFC 2616

The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. It is a generic, stateless, protocol which can be used for many tasks beyond its use for hypertext, such as name servers and distributed object management systems, through extension of its request methods, error codes and headers (z.B. RFC2324). A feature of HTTP is the typing and negotiation of data representation, allowing systems to be built independently of the data being transferred.

HTTP has been in use by the World-Wide Web global information initiative since 1990. This specification defines the protocol referred to as "HTTP/1.1", and is an update to RFC 2068.

HTTP/1.1 at a Glance I

- application protocol (ISO layer 7)
- For cooperatively used distributed hypermedia systems.
- properties:
  - generic
  - state-less
  - object-oriented
  - open
  - support for typing
  - support for negotiation of data formats and representation
  - independent of data transmitted
- HTTP is used in the World-Wide Web since 1990
- current specification is "HTTP/1.1" (RFC2616)

HTTP-URLs - Examples

```
<http_URL> = "http://" <host> [ ":" <port> ] [<abs_path>]
```

```
http://www.teco.edu/
http://www.teco.edu:80/index.html
http://129.13.170.1/index.html

http://www.teco.edu/lehre/webe/unterlagen.html#abschnitt3

http://www.teco.edu/lehre/webe/folien/webev221099.pdf
http://teco16a.teco.uni-karlsruhe.de/projects/hp/screen.gif

http://teco16a.teco.uni-karlsruhe.de/~albrecht/urlaub/photo1.jpg
http://teco16a.teco.uni-karlsruhe.de/%7Ealbrecht/urlaub/photo1.jpg

http://teco16a.teco.edu:8080/cgi-bin/printenv
http://teco16a.teco.edu/cgi-bin/addr.pl?name=Maier&alter=26
http://www.altavista.com/cgi-bin/query?pg=q&q=+algorithm*++base64

http://www.teco.edu/~albrecht/cgi/../index.html
```


HTTP-URLs - Details

```
<http_URL> = "<http>://" <host> [ ":" <port> ] [<abs_path>]
```

```
<http> ::= (H|h)(T|t)(T|t)(P|p)
```
- Caution!, Implementation is browser dependent

```
<host> ::= <DNS-Name> | <IP-Adresse>
```

```
www.teco.edu
teco16a.teco.uni-karlsruhe.de
web.de
129.13.170.1
```

```
<port> ::= <digits>
```

```
80 (Standard), 1080, 8080, 3128
```

```
<abs_path> ::= "/"[<path ["?"<query>]["#"<fragment>]
```

```
/, /index.html, /cgi/../index.html,
/urlaub/photo.jpg, /lehre/webe/unterlagen.html#v1,
/cgi-bin/print.pl?name=Maier&alter=26,
/~albrecht/, /%7Ealbrecht/, /%7e%61lbrecht/
```

URI Comparison

- When comparing two URIs to decide if they match or not, a client SHOULD use a case-sensitive octet-by-octet comparison of the entire URIs, with these exceptions:
  - A port that is empty or not given is equivalent to the default port for that URI-reference;
  - Comparisons of host names MUST be case-insensitive;
  - Comparisons of scheme names MUST be case-insensitive;
  - An empty abs_path is equivalent to an abs_path of "/".
- Characters other than those in the "reserved" and "unsafe" sets (see RFC 2396) are equivalent to their ""%" HEX HEX" encoding.
- URL comparison is necessary for caching

<host> Comparison

- **<host>** is an IP-address
  - same IP → host is equivalent
- **<host>** is a DNS name
  - same DNS name (case insensitive) → same host
  - DNS resolution to the same IP-address does not imply that hosts are equal! (non-IP based virtual hosts)
- example
  - **www.TecO.EDU** = **WWW.TECO.EDU** = **www.teco.edu**
  - **www.teco.edu** (IP=129.13.170.1) is not the same as **wearable.teco.edu** (IP=129.13.170.1)

<port> Comparison

- same port number
- In case there is no port number then **<port>** is equal to 80
- examples
  - **http://www.teco.edu/** is equal **http://www.teco.edu:80/**
  - **http://www.teco.edu:8080/** is not equal **http://www.teco.edu:80/**

<abs_path> Comparison I

- **<path>** must be handled case sensitive.
  Caution! Some implementations are not case sensitive (e.g. DOS/Windows)
- empty **<path>** is equal **/**
- when **/** is requested the server will reply with a directory listing, a designated file (e.g. index.html, index.htm, default.htm, etc.), or and error message (e.g. "Directory browsing not allowed"). Therefore there is not garanty that **/** is equal to a certain file name.
- the parts **<query>** and **<fragment>** are case sensitive

<abs_path> Comparison II

- Escaped encoding (RFC2396)

- ```
  escaped = "%" hex hex
  hex     = digit|"A"|"B"|"C"|"D"|"E"|"F"
            |"a"|"b"|"c"|"d"|"e"|"f"
  ```

- examples
  - **http://www.teco.edu** is equal **http://www.teco.edu/**
  - **http://www.teco.edu** ist not nessarily equal to **http://www.teco.edu/index.html**
  - **http://www.teco.edu/~albrecht/** is equal **http://www.teco.edu/%7ealbrecht/** is equal **http://www.teco.edu/%7Ealbrecht/** is equal **http://www.teco.edu/%7E%61lbrecht/**

?	%3F
=	%3D
%	%25
;	%3B
<SP>	%20
<CR>	%0D
<LF>	%0A
Ä	%C4
Ö	%D6
Ü	%DC
ä	%E4
ö	%F6
ü	%FC
ß	%DF

Structure of HTTP Messages

```
HTTP-message = Request | Response

generic-message = start-line
   *message-header
   CRLF [ message-body ]

start-line = Request-Line | Status-Line

message-header = field-name ":" [ field-value ] CRLF
```


General Header Fields

```
general-header = Cache-Control
 | Connection
 | Date
 | Pragma
 | Transfer-Encoding
 | Upgrade
 | Via
```


Request

```
Request = Request-Line
   *(general-header | request-header | entity-header ) CRLF
  [ message-body ]

Request-Line   = Method SP Request-URI SP HTTP-Version CRLF

Method = "OPTIONS"
| "GET"
| "HEAD"
| "POST"
| "PUT"
| "DELETE"
| "TRACE"
| extension-method
```
```

Request Header Fields

```
request-header = Accept
 | Accept-Charset | Accept-Encoding  | Accept-Language
 | Authorization
 | From
 | Host
 | If-Modified-Since  | If-Match  | If-None-Match
 | If-Range  | If-Unmodified-Since
 | Max-Forwards
 | Proxy-Authorization
 | Range
 | Referer
 | User-Agent
```