Module 5-Part 2

Vipin Das
Dept.of CSE
SAINTGITS

ASSIGNMENT 3 / Announcements

List out the features of major WiFi versions.

- 802.11 a ,802.11 n etc

Submit to linways on or before 01-March-2022

- First assignment submission was closed the night before audit.

-There are pending submissions for Assignment 2 also.

Retest for series 1 /series 2 is planned for this friday.[25-2-2022]

Get necessary sanctions from the concerned.

Domain Name System [DNS]

Every system on the internet needs an IP address to transfer data.

Same is the case with web servers also.

The port address of the weservers are standerdized.

But how will the client system know the IP address of the webservers.

DNS to the rescue !!!

Domain Name System [DNS]

In simple terms DNS will map the web address to an IP address.

DNS is a hierarchial arrangement of systems which helps to acheive the task.

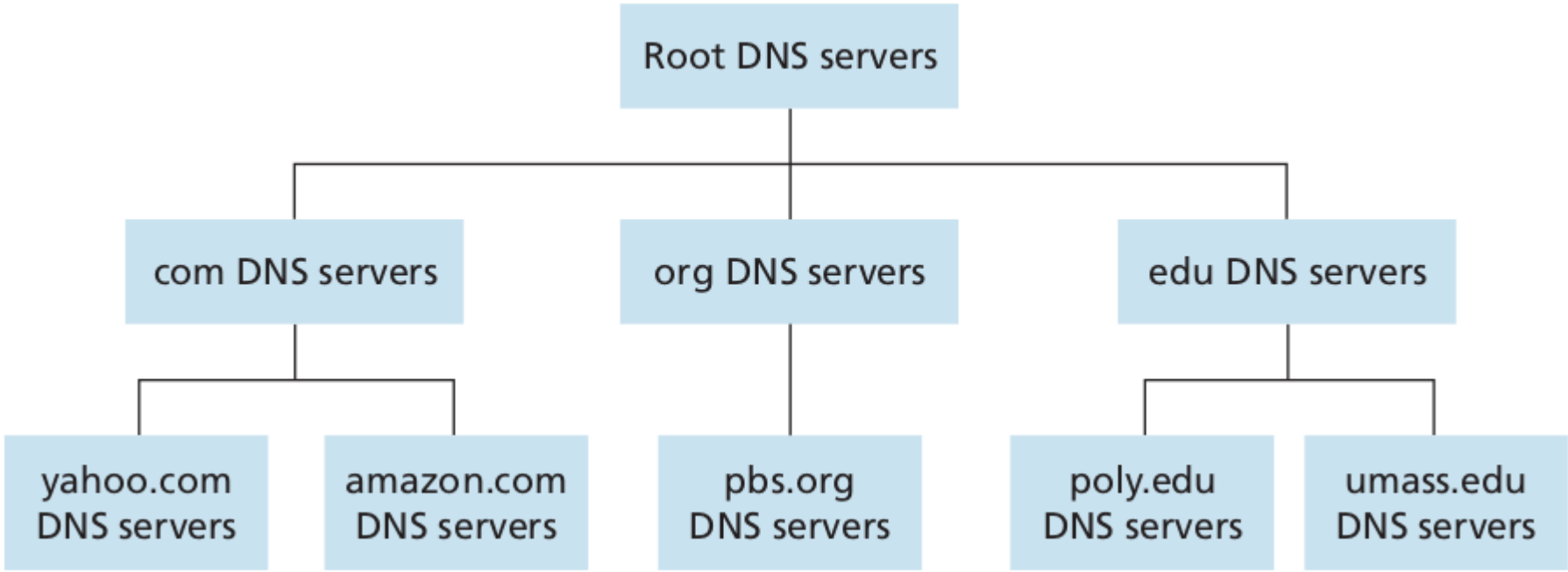
DNS follows a distriuted hierarchial structure.

DNS query follows a recursive order.

No single point of failure.

One single DNS server need not store all the records.

Hierarchial arrangement



Types of DNS servers.

Root DNS servers

A set of replicated servers which contains references to common domain servers such as .org,.com etc.

Top level domain name servers

These servers are responsile for top level domains such as .org,.com

Authoritative name servers

Every organization who owns a webserver needs to publish that IP.

They can set up their own DNS server or can pay a third party to provide the information.

Local DNS server

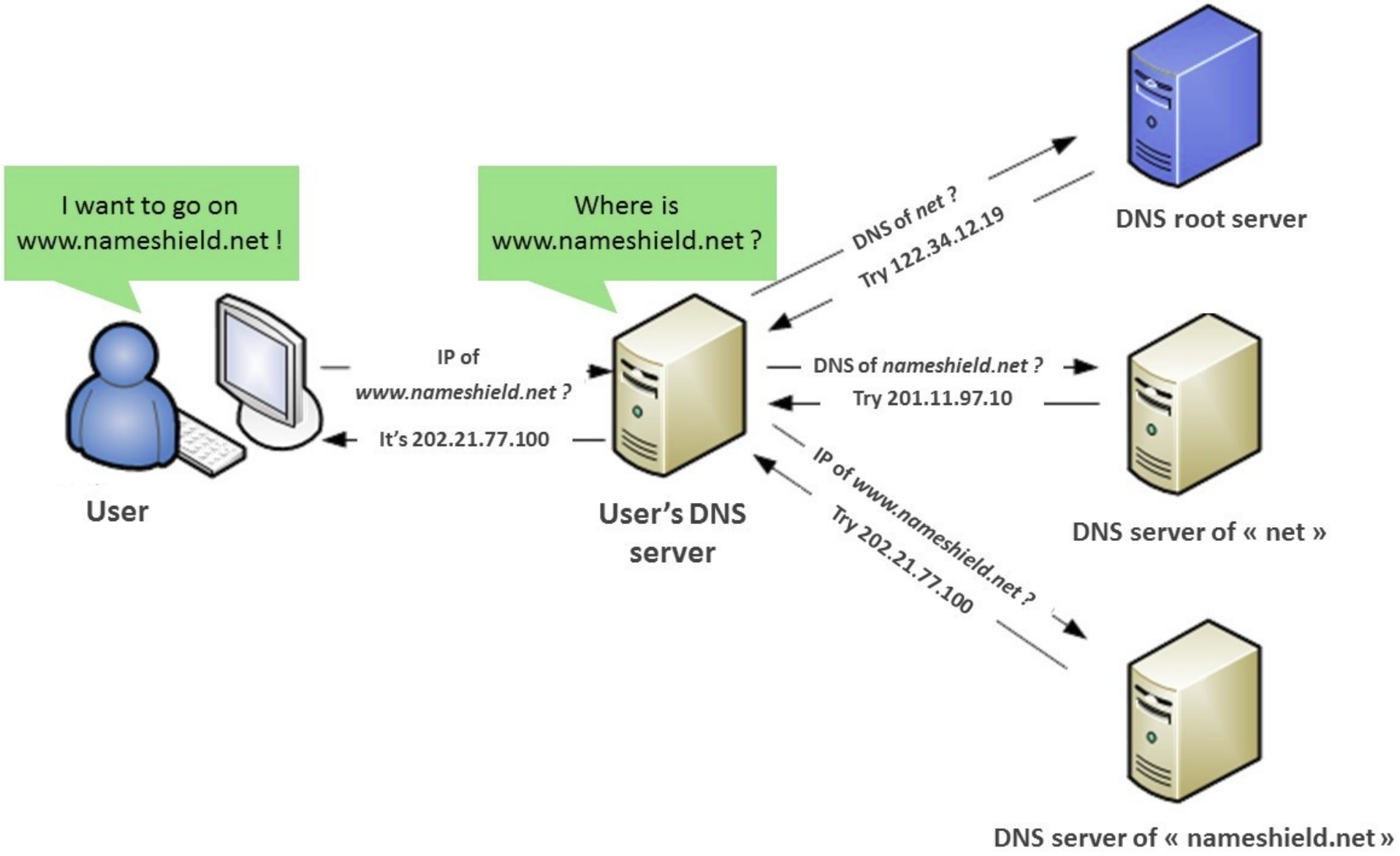
Local DNS server is not necesserily a part of the hierarchial DNS system.

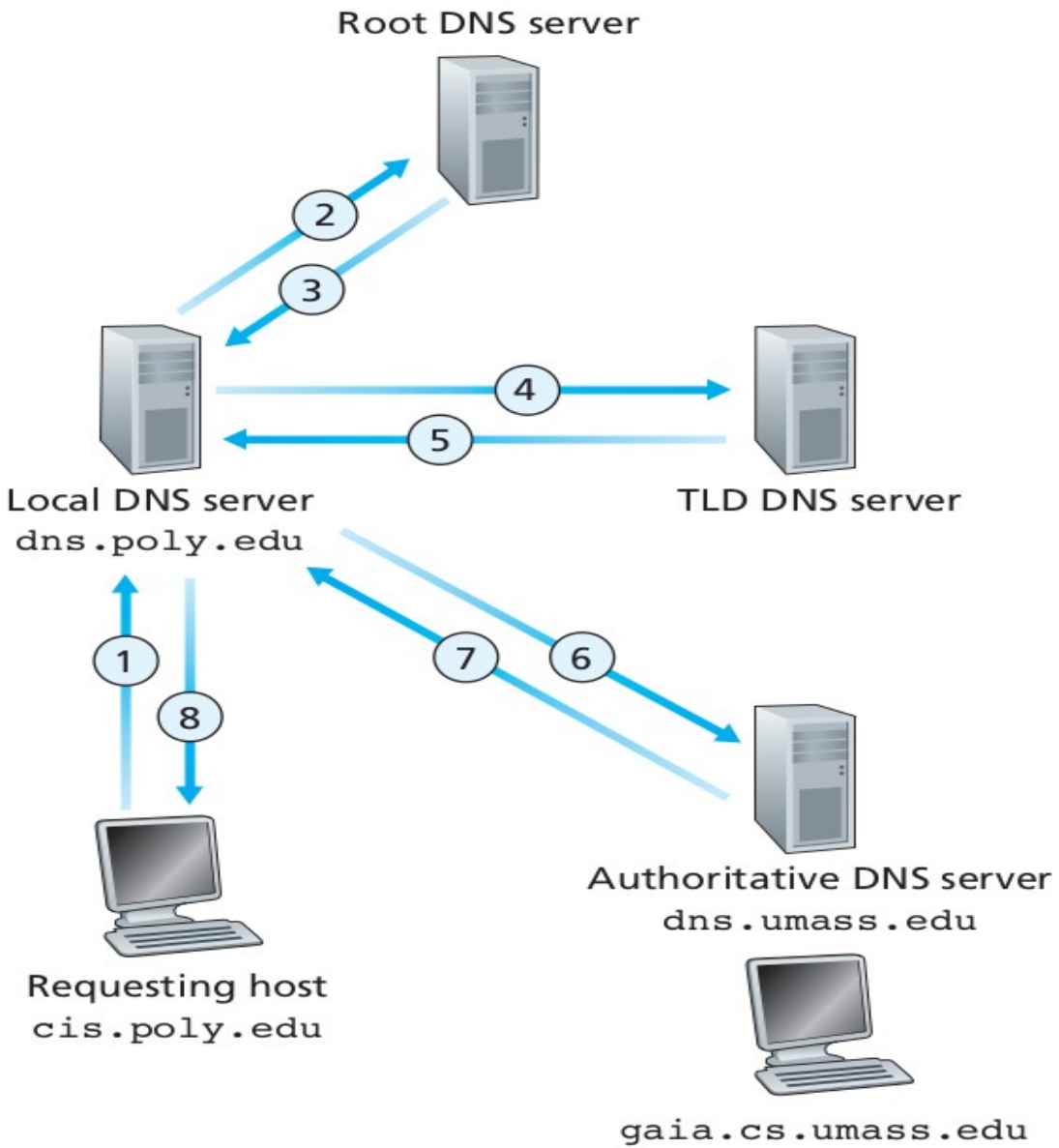
But becomes the first point to respond to a DNS query.

Local DNS servers are set up organizations and ISP.

A DNS query made by a host inside the organization is resolved by the local DNS server.

They also cache the resolved IP address for fast access.


I want to go on www.nameshield.net !
Where is www.nameshield.net ?
DNS of net ?
Try 122.34.12.19
DNS root server
IP of www.nameshield.net ?
It's 202.21.77.100
User
User's DNS server
DNS of nameshield.net ?
Try 201.11.97.10
DNS server of « net »
IP of www.nameshield.net ?
Try 202.21.77.100
DNS server of « nameshield.net »


Root DNS server
2
3
4
5
Local DNS server
dns.poly.edu
TLD DNS server
1
8
7
6
Authoritative DNS server
dns.umass.edu
Requesting host
cis.poly.edu
gaia.cs.umass.edu

DNS Records and messages

The records that are maintained by the DNS servers are referred to as Resource Records.(RR)

One RR is a four tuple message who meaning changes based on the value associated.

<Name,Value,Type,TTL>

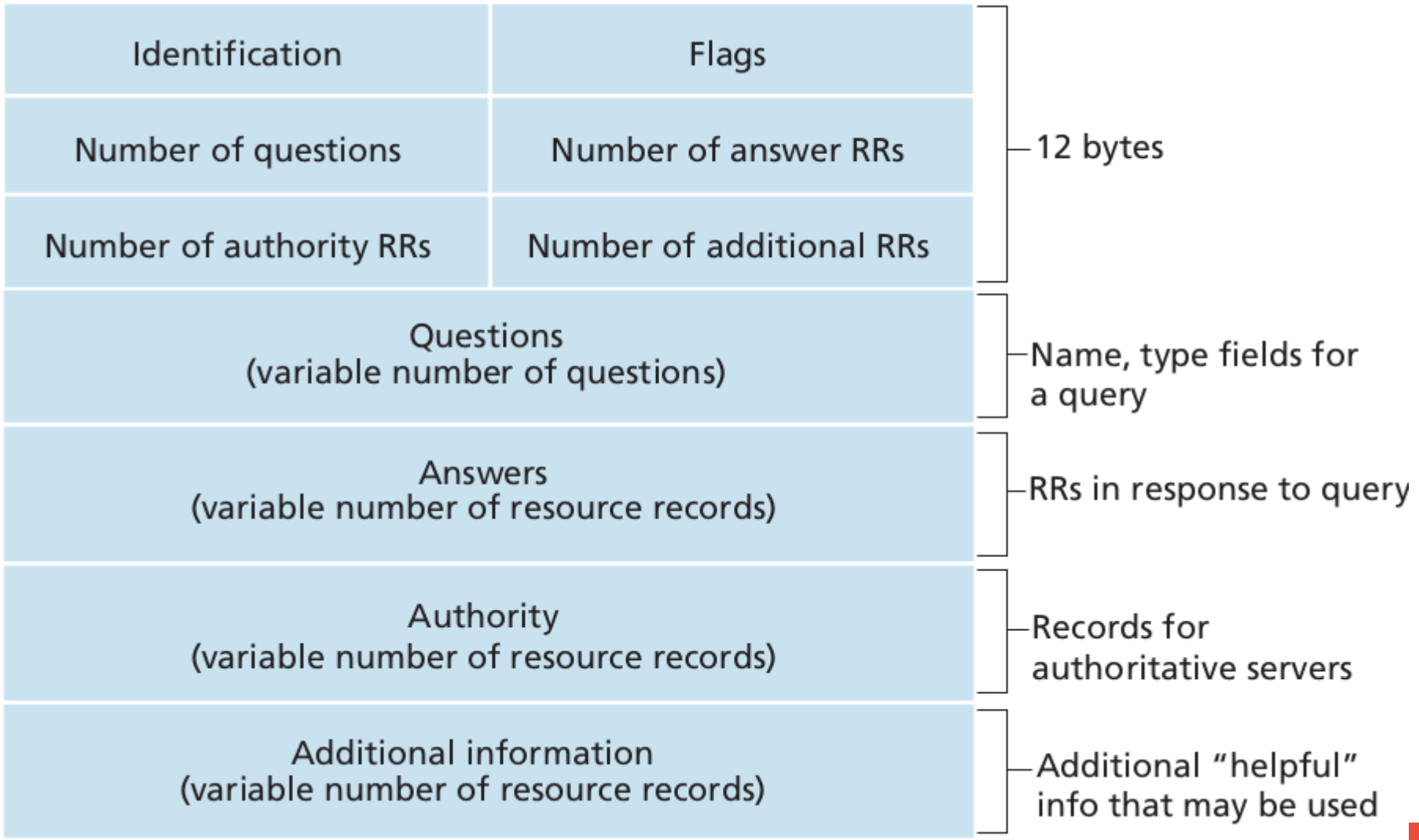
If type= A ,*Name* is a hostname and value is an IP address of the hostname.

If type =NS,*Name* is a domain name and value points to an authoritative DNS server.

If type=CNAME ,value is a canonical hostname for the value given in *Name*

If type= MX,value is the canonical hostname for the mailserver given in *Name.*

DNS message structure



The identification numer identifies a DNS query.

For the reply for a query the same identification number is used.

A set of flags is present in the header.

A bit to represent whether it is a query or a reply.

A bit to represent whether recursion is needed to resolve the address.

One it to represent whether the message is authoritiative or not.

A section to indicate the number of questions and answers present in the message.

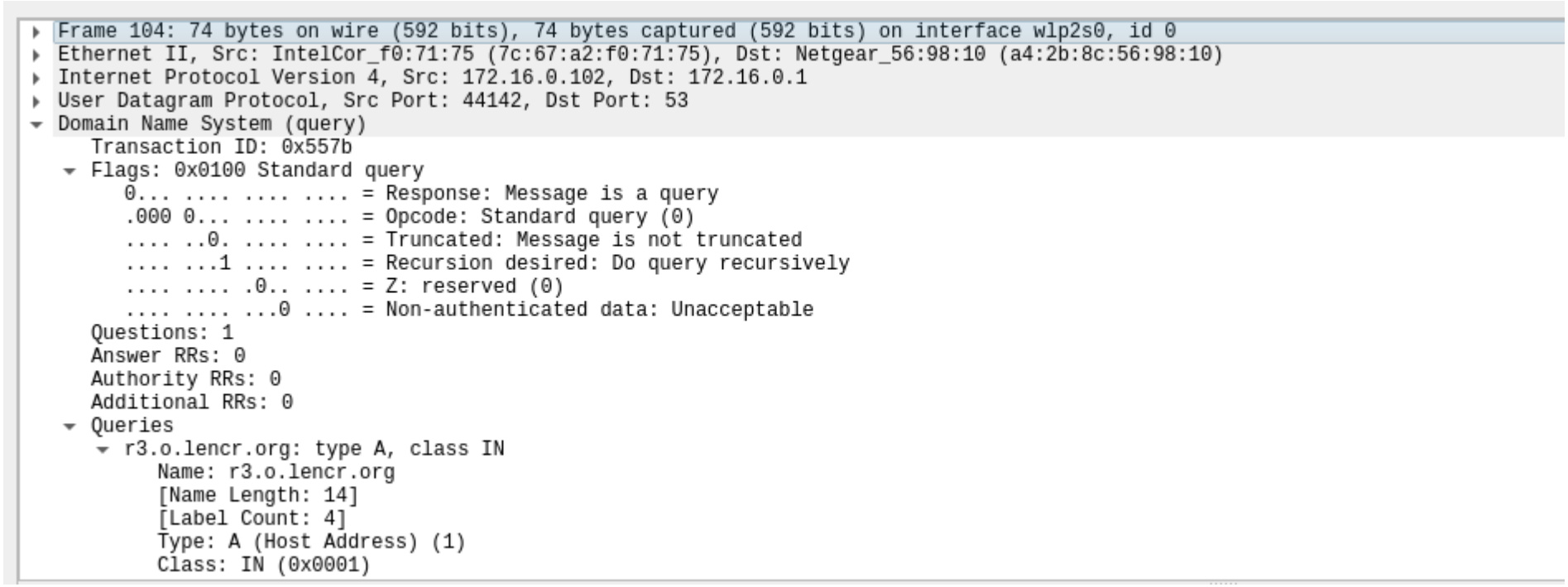
The question section contains more information on the query being made.

Also information is sent whether query seeks information about a host or a mail server.

The answer section can have more than one answer as domains typically have replicas.

Additional information field has information about the canonical hostnames.

From a packet capture



In real scenario

Our machine also maintains a cache of most commonly accessed DNS records.

Cache is maintained at different levels so as to avoid repetitive query.

FTP-File Transfer Protocol

Application level protocol designed to exchange files from a server.

FTP runs over TCP protocol.

Uses a seperate control and data connection.

The client establishes a control connection with the server.

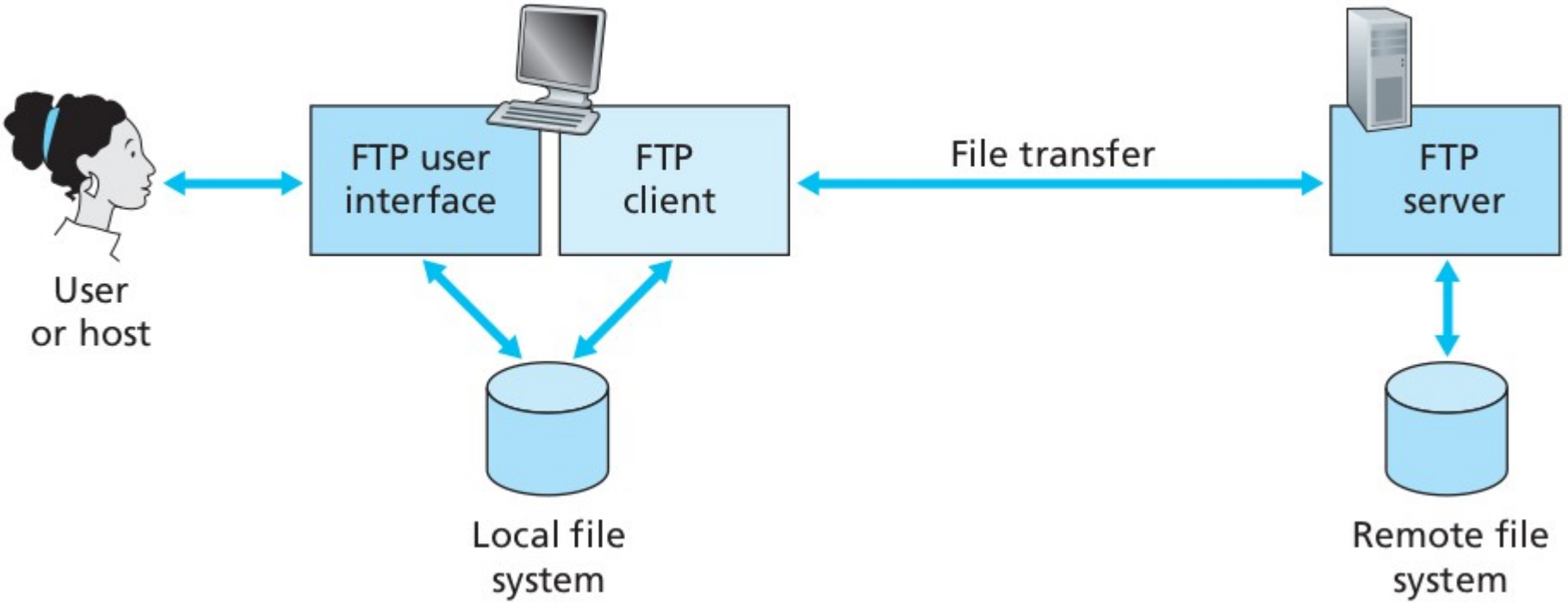
The commands to manipulate the files are sent through the control link.

Once the command to transfer a file is received,the server then initiates a data connection.

This connection is closed after the file is transfered but the control link is maintained.

The client can also upload data to server using a new connection.

There are FTP applications that have GUI and in most cases out browsers can support FTP conncection.



The control connection is setup on port 21 and data transfer can happen through port 20.

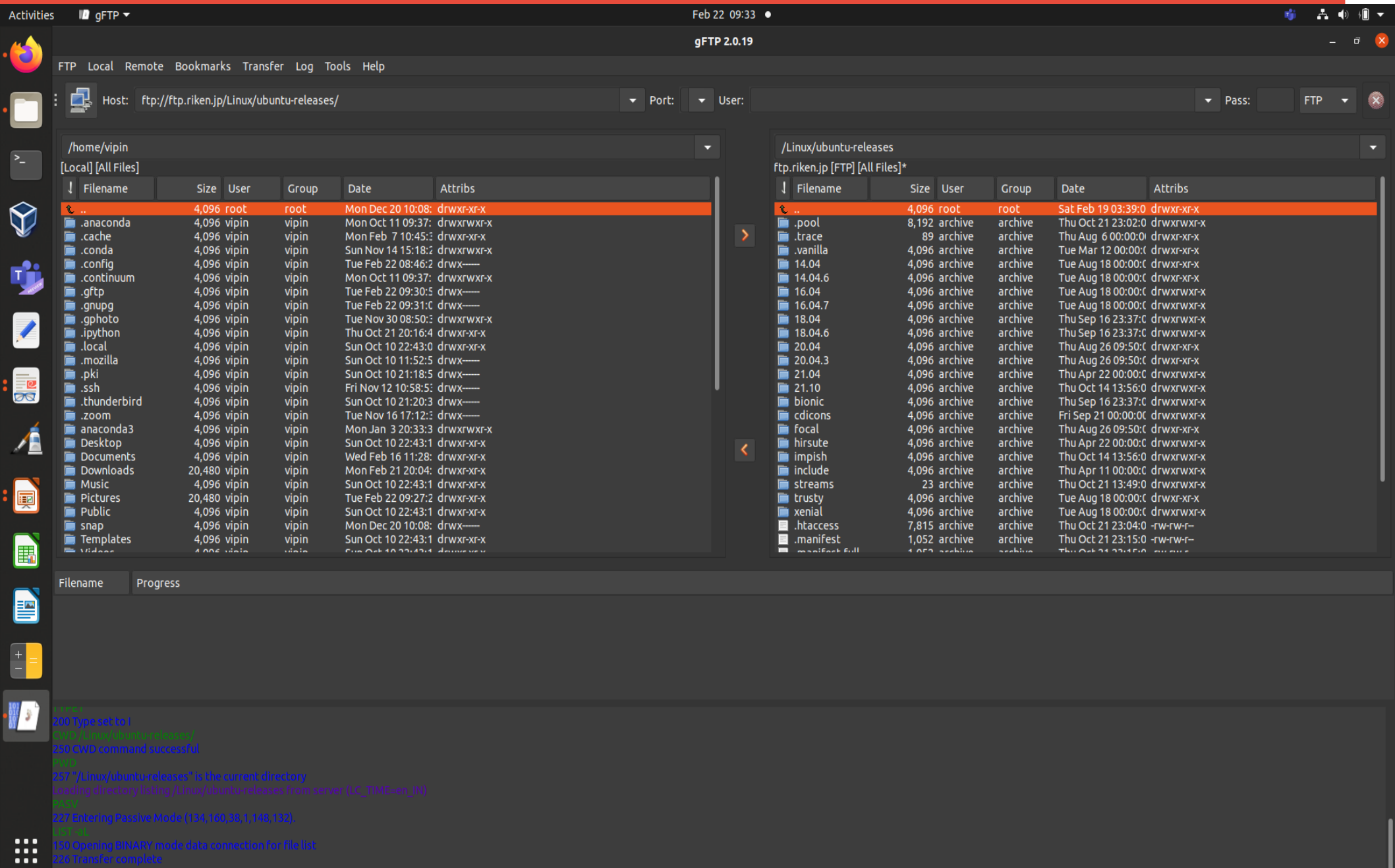
FTP Messages

The commands are sent across in 7 bit ASCII representations.

Commands are in human readable format.

- `USER username:` Used to send the user identification to the server.
- `PASS password:` Used to send the user password to the server.
- `LIST:` Used to ask the server to send back a list of all the files in the current remote directory. The list of files is sent over a (new and non-persistent) data connection rather than the control TCP connection.
- `RETR filename:` Used to retrieve (that is, get) a file from the current directory of the remote host. This command causes the remote host to initiate a data connection and to send the requested file over the data connection.
- `STOR filename:` Used to store (that is, put) a file into the current directory of the remote host.

FTP client gFTP



HTTP – Hyper Text Transfer Protocol

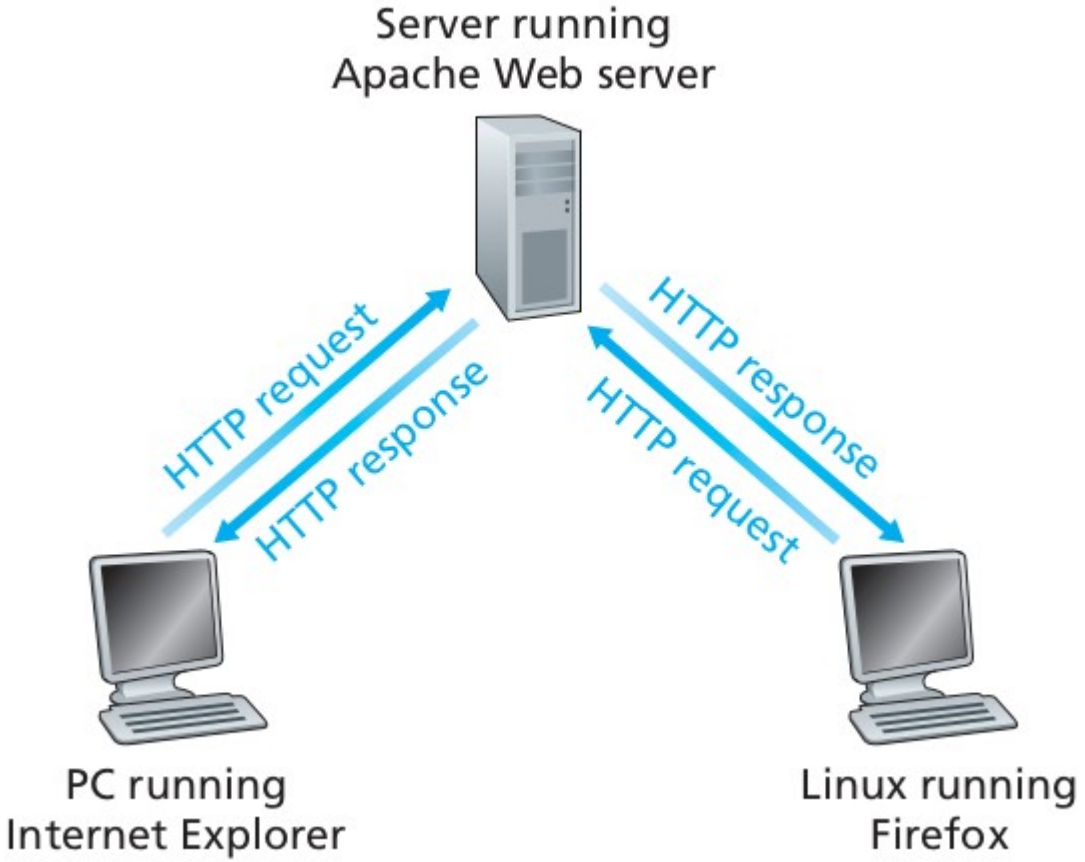
Not specifically mentioned in syllabus .

HTTP is one of the most widely used application level protocol.

Used to download web based objects and the common client application is web browser.

HTTP messages are categorized into HTTP request and HTTP response.

HTTP does not maintain any state of transmission.So the client can request for the same resources again and again.


Server running
Apache Web server
HTTP request
HTTP response
HTTP response
HTTP request
PC running
Internet Explorer
Linux running
Firefox

HTTP methods

HTTP defines methods/functions to transfer data

GET method – Used to retrieve information from the user.

POST – Upload /update a resource to the server

PUT – upload /create a new resource to the server

DELETE – Remove a content from the server

Persistent and Non persistent HTTP

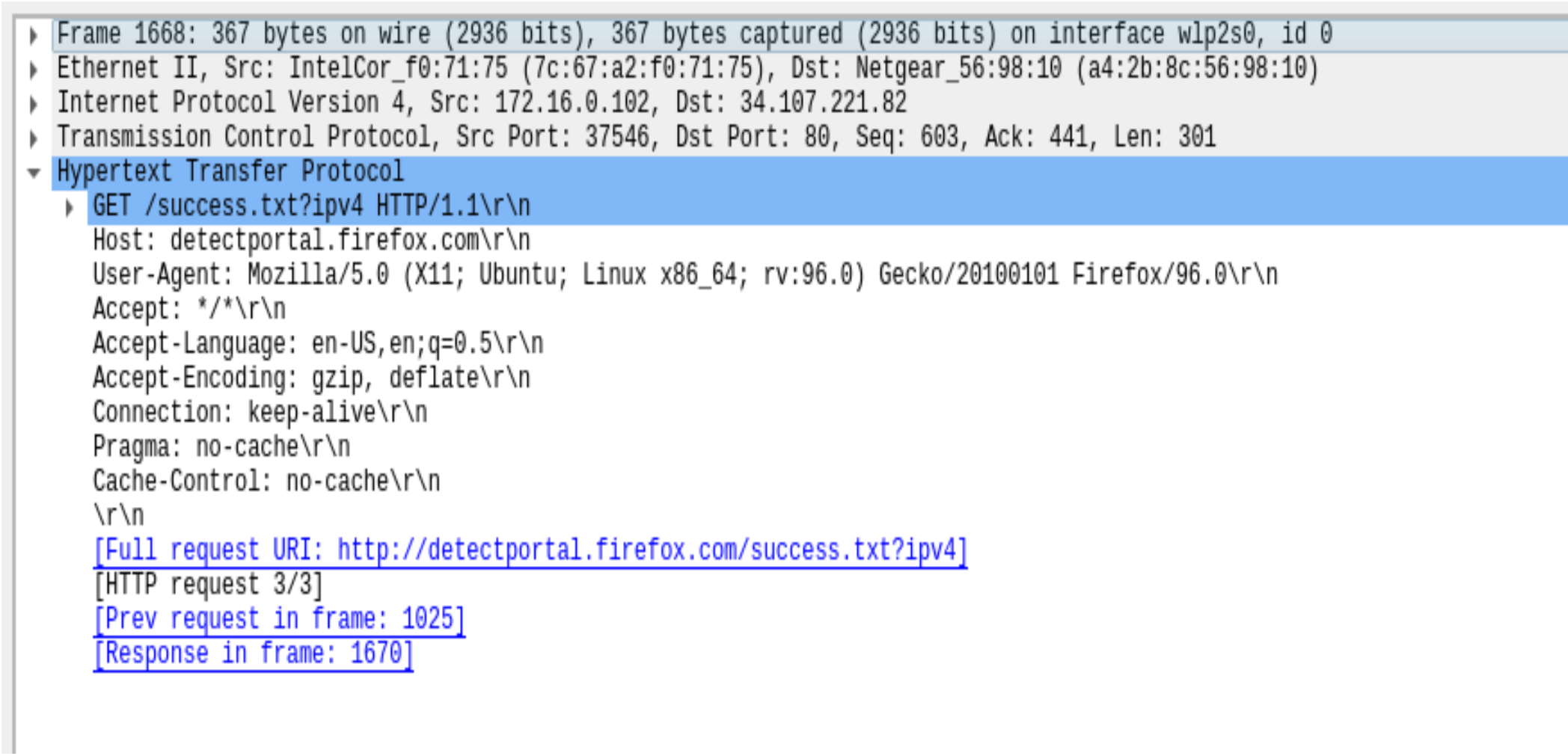
A webpage typically contains many objects.

Since HTTP runs on top of TCP a connection setup (3 way handhake).

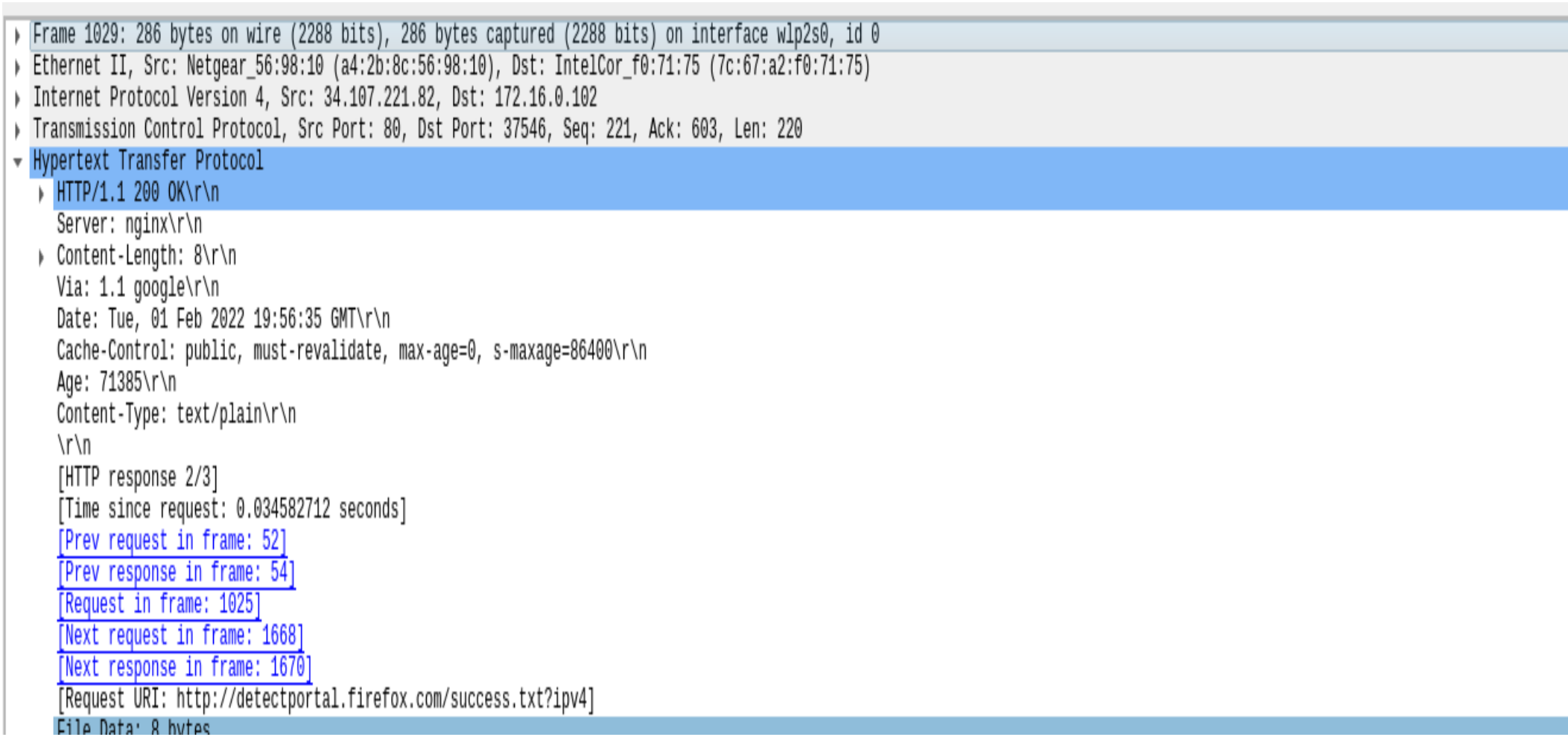
The connection can be closed after transferring individual items. -Non persistent.

The same connection is used to transfer multiple items – Persistent.

HTTP Request



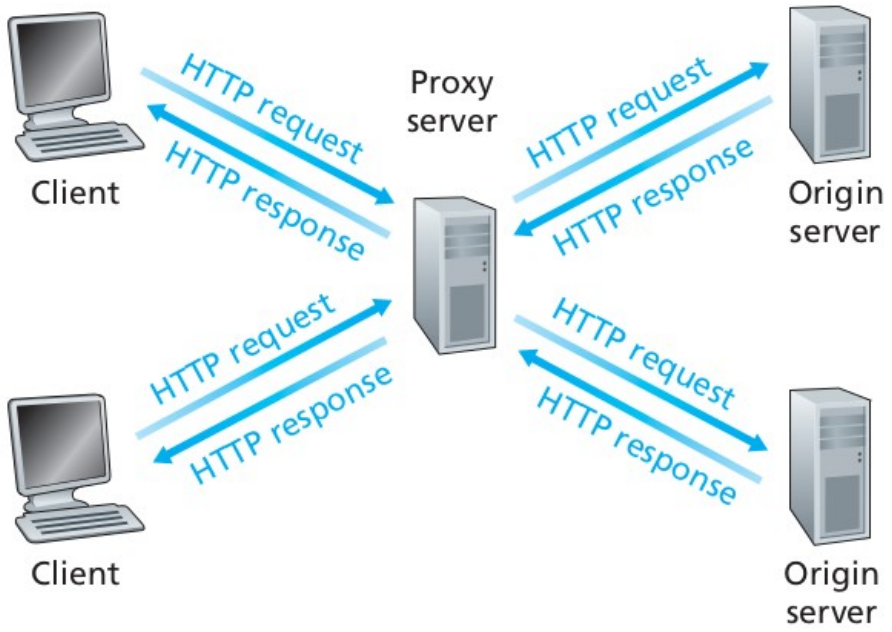
HTTP Response



Web Proxy

Web proxy or web cache establishes HTTP transfer on behalf of the clients.

A copy of the transfered data is kept so as to speed up transfer in the next time.



Electronic mail

Let’s go back in time.!!!

Only organizations had email services.

They had to setup special resources to send and receive emails.

From the systems developed to address many of the issues modern email systems evolved.

SMTP-Simple Mail Transfer Protocol

Two Major Components of any email architecture.

User Agents and Mail servers.

A user interacts with the user agent.

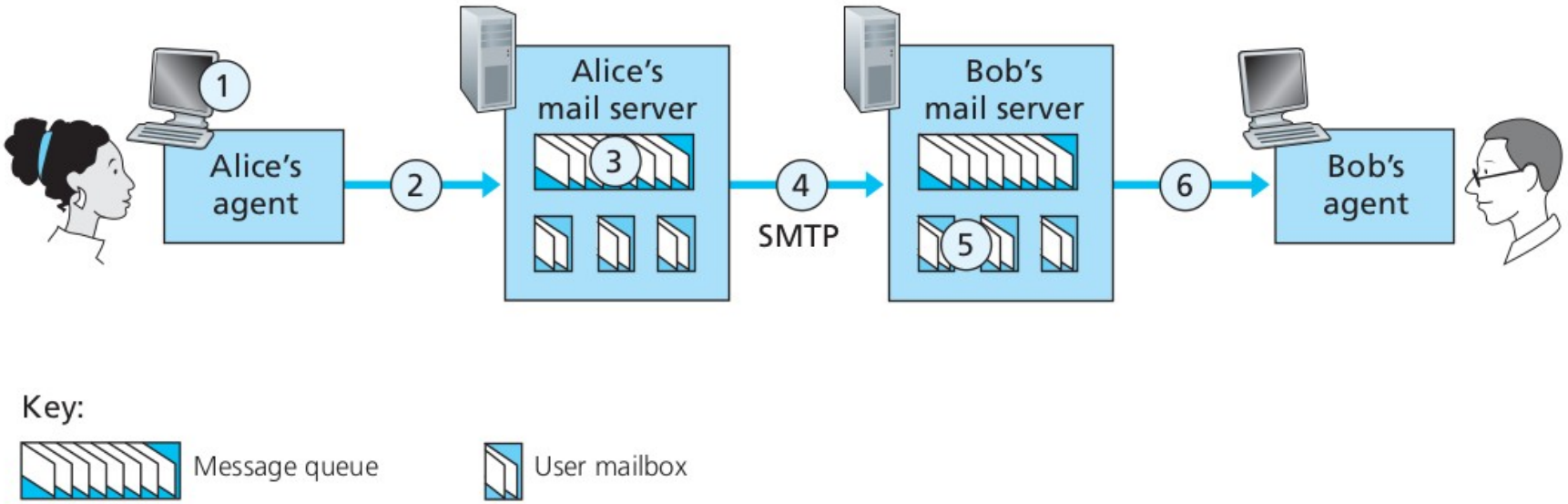
Composing of emails,manipulation of emails are all done by the user agent.

Gmail ,outlook etc are all web based user agents.

Mail servers store the emails.

User agents interact with mail servers to send and receive mail.

SMTP protcol helps to transmit email over Internet from one server to the other.


1
Alice's agent
2
Alice's mail server
3
4
SMTP
Bob's mail server
5
6
Bob's agent
Key:
Message queue
User mailbox

The steps

1. Alice invokes her user agent for e-mail, provides Bob's e-mail address (for example, bob@someschool.edu), composes a message, and instructs the user agent to send the message.

2. Alice's user agent sends the message to her mail server, where it is placed in a message queue.

3. The client side of SMTP, running on Alice's mail server, sees the message in the message queue. It opens a TCP connection to an SMTP server, running on Bob's mail server.

4. After some initial SMTP handshaking, the SMTP client sends Alice's message into the TCP connection.

5. At Bob's mail server, the server side of SMTP receives the message. Bob's mail server then places the message in Bob's mailbox.

6. Bob invokes his user agent to read the message at his convenience.

Contd.

SMTP transmitted only email with text.

No other data including images or video were supported.

Similiar to HTTP and FTP ,SMTP uses specific commands and response code to indicate staus of the transaction.

```
S: 220 hamburger.edu
C: HELO crepes.fr
S: 250 Hello crepes.fr, pleased to meet you
C: MAIL FROM: <alice@crepes.fr>
S: 250 alice@crepes.fr ... Sender ok
C: RCPT TO: <bob@hamburger.edu>
S: 250 bob@hamburger.edu ... Recipient ok
C: DATA
S: 354 Enter mail, end with "." on a line by itself
C: Do you like ketchup?
C: How about pickles?
C: .
S: 250 Message accepted for delivery
C: QUIT
S: 221 hamburger.edu closing connection
```

SMTP Codes

Status Code	Description
211	System status, or system help reply
214	Help message
220	Service ready
221	Service closing transmission channel
250	Requested mail action okay, completed
251	User not local; will forward to
354	Start mail input; end with "."
421	Service not available, closing transmission channel
450	Requested mail action not taken: mailbox unavailable
451	Requested action aborted: local error in processing
452	Requested action not taken: insufficient system storage
500	Syntax error, command unrecognized
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command parameter not implemented
550	Requested action not taken: mailbox unavailable
551	User not local; please try <....>
552	Requested mail action aborted: exceeded storage allocation
553	Requested action not taken: mailbox name not allowed
554	Transaction failed

MIME-Multipurpose Internet Mail Extension

SMTP supported only ASCII character exchange.

So simple issues like composing email in languages other than english was not supported.

Same is the case with transfer of non ascii data include image,video etc.

MIME supported transfer of a wide variety of data as email.

Contd..

MIME defines new headers to include additions.

MIME supports different encoding schemes so as to accomodate various types of data.

Encoding schemes decide how the data is represented.

Type	Example subtypes	Description
text	plain, html, xml, css	Text in various formats
image	gif, jpeg, tiff	Pictures
audio	basic, mpeg, mp4	Sounds
video	mpeg, mp4, quicktime	Movies
model	vrml	3D model
application	octet-stream, pdf, javascript, zip	Data produced by applications
message	http, rfc822	Encapsulated message
multipart	mixed, alternative, parallel, digest	Combination of multiple types

The final delivery from the mail server to the end user happens with the use of various other protocols.

IMAP and POP3 are the common end delivery protocols.