Contents

1. Get Started

1.1. Information

Online | EPUB | MOBI | PDF | Github

`server for dummies` is an educational project to understand how typical web services work. It's focused in the application layout services, like:

Services	Transport	Port
DNS (Primary and secundary)	TCP/UDP	53/UDP 53/TCP
SMTP	TCP	25/TCP 587/TCP (alternative) 465/TCP (SMTPS)
POP3	TCP	110/TCP 995/TCP (encrypted)
IMAP	TCP	143/TCP 220/TCP (IMAP3) 993/TCP (IMAPS)
LDAP	TCP/UDP	389 (TCP/UDP)
HTTP/HTTPS	TCP	80
SSH	TCP	21
FTP	TCP	20/TCP DATA Port 21/TCP Control Port
IPSEC		
TELNET	TCP	23
DHCP	UDP	67 (server) 68 (client)

For installing all services and get ready your machine for the action, this project has a repository with the original source coude and it is available for everyone.

Have fun!

NOTE: This is only a educational example. Don't use in production.

1.2. How to use

1) Clone the repo:

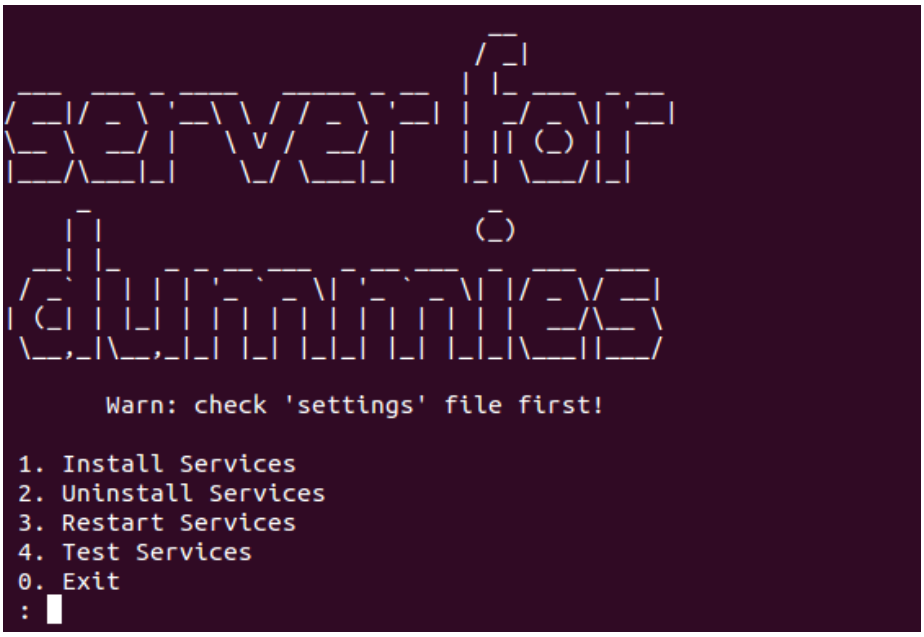
```
git clone https://github.com/Kikobeats/server-for-dummies.git
```

2) go to folder `server-for-dummies` and edit `settings.sh` with your options:

```
## DNS Settings
DNS_NAME="st.um"
PRIMARY_DNS="172.16.22.135"
SECONDARY_DNS="172.16.22.137"
FORWARDERS="155.54.1.10;"

## SMTP Settings
LOCAL_NETWORK="172.16.22.0/24"
RELAY_DOMAINS="$DNS_NAME; um.es"

## OPENSSL Settings
USERNAME="josefranciscoverdugambin"
```

3) Run it with admin account!

```
sudo sh init.sh
```



1.3. Test services

All services have been tested in VM VMWare under Ubuntu Server 12.04:

- VM 1 – Main client
- VM 2 – Primary DNS

- VM 3 – Secondary DNS

For test services connectivity run 'Test services'

1.4. Examples

Include:

- 3 example of domains
  - www1.st.um – Basic domain
  - www2.st.um – Domain with HTTP authentication (authorized users here)
  - www3.st.um – Domain with HTTPS (check you are visiting https in the browser!)
- 2 mails accounts examples
  - run `./Services/Mail/account.sh` to create it at first time
- LDAP
  - Sample data for check read and modify operations (check here)

Example SSL

Example Mails

Example SSH

2. Understand

2.1. How Internet works

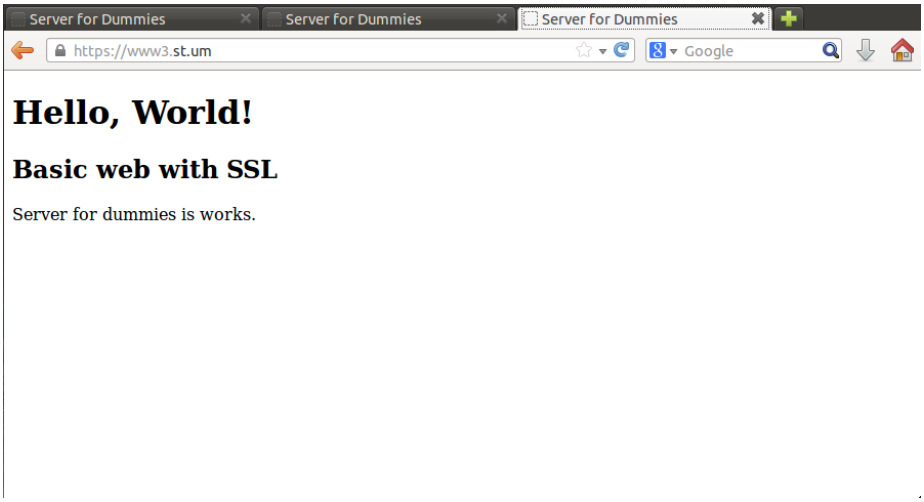
Internet is the best invent in the last 50 years, and maybe someone can say that is the best invention in the world.

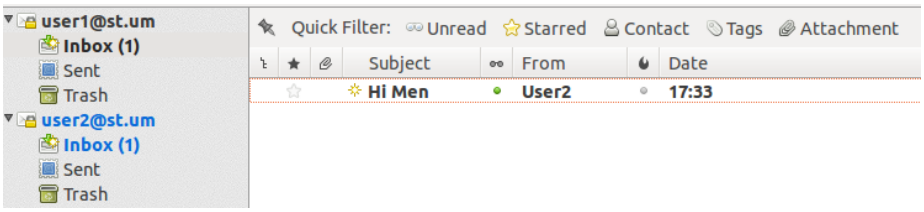
First, relax. Internet is not perfect and needs much human value to make it a secure service for daily things, for example, reading your mail, visiting a cats' website, downloading creative commons music and films…

Internet is nested in layers called OSI model. Seven layers compound the OSI model and each layer offers services for differents things.

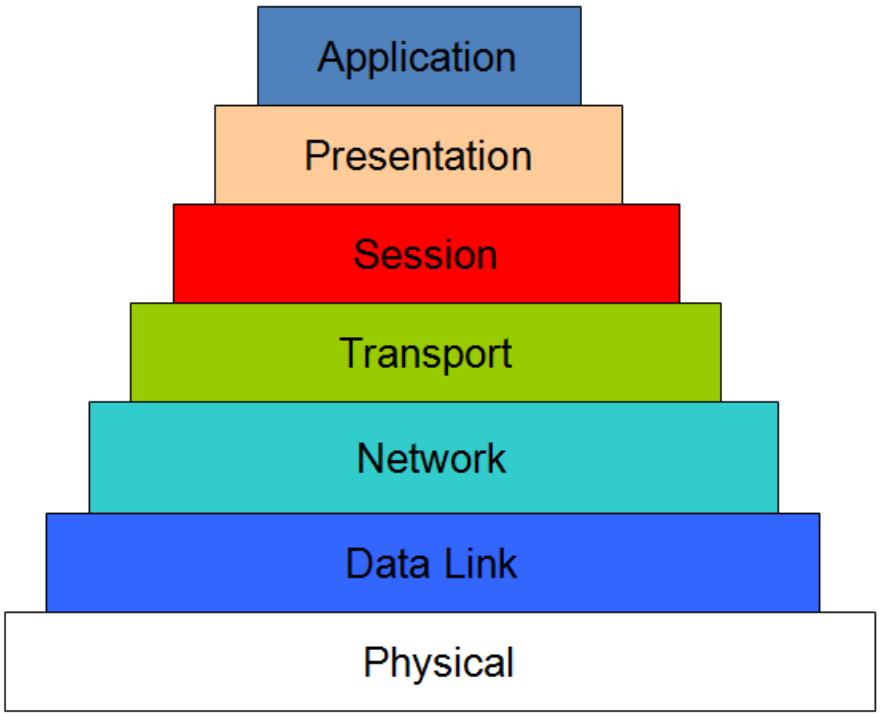
Top-level layers need their lower layer to offer a service. Your browser doesn't load a website if its transfer protocol doesn't work correctly.


client or server? [client/server]: client
[Private Cloud]
* Connectivity Primary DNS Private Cloud...OK
* Connectivity Secundary DNS Private Cloud...OK
[DNS]
* Connectivity DNS Name...OK
* Connectivity Primary DNS Name...OK
* Connectivity Secondary DNS Name...OK
[LDAP]
* Connectivity LDAP Server...OK
* Check read LDAP...OK
[SMTP]
* Connectivity SMTP Server...OK
[POP]
* Connectivity POP Server...OK
[HTTP]
* Connectivity HTTP Server...OK
* Connectivity www.st.um...OK
* Connectivity www1.st.um...OK
* Connectivity www2.st.um...OK
* Connectivity www3.st.um...OK
Test finished. Press any key to continue...






```
user1@st.um's password:
Welcome to Ubuntu 12.04.4 LTS (GNU/Linux 3.8.0-39-generic i686)

 * Documentation:  https://help.ubuntu.com/


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

$ whoami
user1
$ echo "I am a dummie"
I am a dummie
$
```



Other important networks elements are routers, switches and host and using different protocols (BGP, RIP, OSPF) to communicate with each one and make internet a network of computers that understands how a package travles from EEUU to Spain.

But this is not important here. You'll need to understand how to set up your machine to be accesible for the others and to offer your services for resolving names, having mails accounts under your domain...

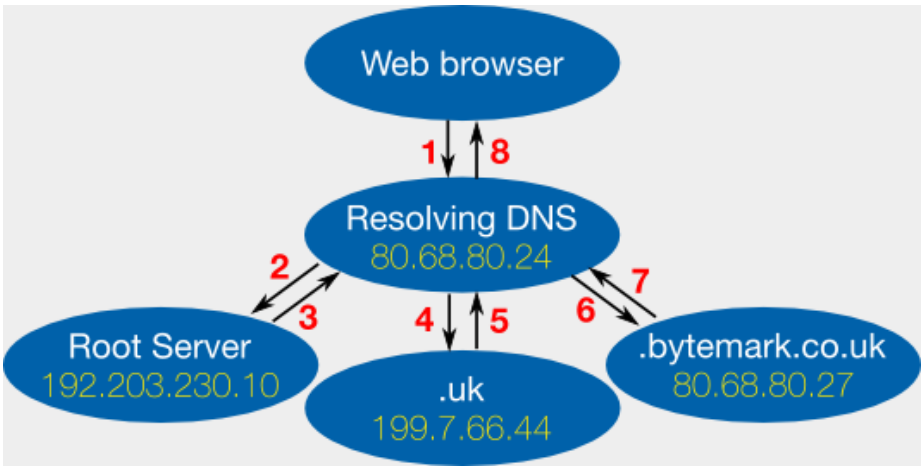
The services that you intend to use belong to the application layer. As I said before, this services use services or protocols of lower layers of the OSI model. For example, DNS is an aplication service, but it needs a transport protocol to resolve name to IP. By the other hand, IP is based on network layer IPv4 (or better, IPv6) to be operative for the application layer.

At the end, all is a stack of abstraction. The purpose is having an application layer available, secure and operative.

Now, is time to take action!

2.2. Files

DNS



- `/etc/resolv.conf`
- `/etc/bind/named.conf.options`
- `/etc/bind/named.conf.local`
- `/etc/bind/db."$DNS_NAME".zone`

SMTP

- `/etc/exim4/update-exim4.conf.conf` # Exim4 settings

POP

- `/etc/dovecot/conf.d/10-mail.conf` # Dovecot settings
- `/etc/dovecot/conf.d/10-auth.conf` # Dovecot settings

LDAP

- `ldapmodify -Y EXTERNAL -H ldapi:/// -f FILE` # Modify LDAP settings
- `ldapadd -Y EXTERNAL -H ldapi:/// -f FILE` # Load database data

HTTP

- `/etc/apache2/sites-available` # Apache virtual hosts
- `/var/www/` # Apache websites data
- `/etc/apache2/groups` # Apache authentication

SSL

- `usr/lib/ssl/openssl.cnf` # Configuration file of SSL

SSH

- `~/.ssh` # Content SSH keys

2.3. Commands

General

`netstat -a | more` # show ports and services that you are using.

DNS

- `dig www.domain.com` # do DNS query
- `host www.domain.com` # know the IP of a name
- `nslookup www.domain.com` # check if DNS is resolve correctly

SMTP

- `telnet xxx.xxx.xxx.xxx 25` # basic query to SMTP service

POP

- `telnet xxx.xxx.xxx.xxx 110` # basic query to POP service

LDAP

- `ldapsearch -x -H ldap://LDAP_IP -b "cn='',ou='',o='',c=''" FIELD` # Search in the LDAP IP

HTTP

- `curl www.domain.com` # get HTTP source code of a domain

SSL

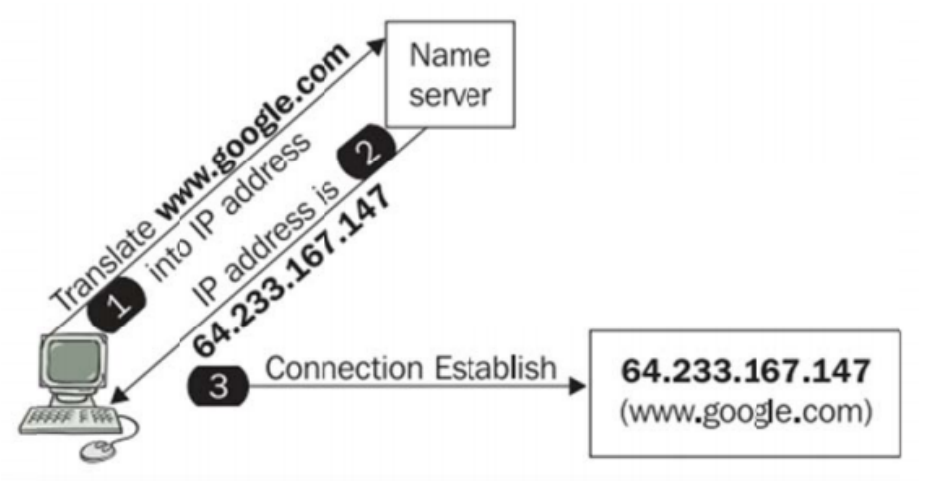
- `openssl version -d` # report your SSL directory
- `openssl req -x509 -newkey rsa:2048 -keyout cakey.pem -days 3650 -out cacert.pem` # generate CA autosign in the server
- `openssl x509 -in cacert.perm -text` # Check that your server certificate is standard by x509

- `openssl rsa -in cakey.perm -text` # Cehck taht your server certificate is RSA correct
- `openssl req -new -nodes -newkey rsa:1024 -keyout serverkey.pem -out servercsr.pem` # Generate certificate client
- `openssl ca -keyfile cakey.pem -in servercsr.pem -out servercert.pem` # Sign certificate client by the server
- `openssl s_server -cert servercert.pem -key serverkey.pem -www` # Check that your client certificate is valid

3. DNS

DNS is one of the most important services for internet because is necessary to convert a name of one web in its IP for simply question: Remember a IP is very most difficult that remember a name.

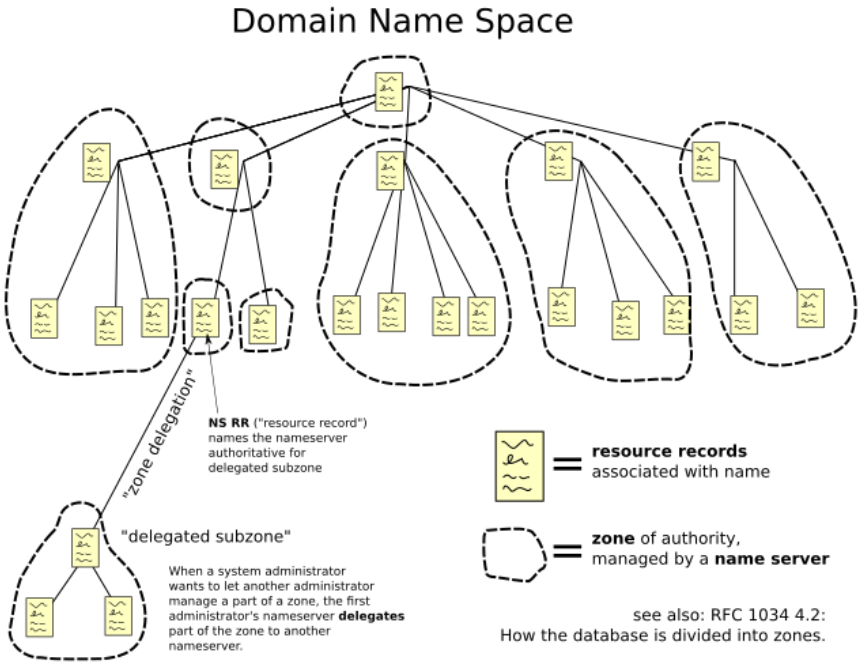
At first for to do it the first computers had a simply file called `host.txt` that works similar to key/value dictionary: One name have one IP translation. And one of this old computers is used to serve the HOSTS.txt updated of the rest of old computers. This is the concept.



This is simply if you have less than 10 computers in the world. But now, this is a bit complicated with too much computers.

The DNS service is regulated by the ICANN since 1988.

Basically for understand how ICANN regulated it you must know that she designates a root nodes to keep all information about how to resolve whatever domain. When you go to website to register a website name, actually you are recording your domain in the ICANN nodes.



Each domain have different **records** for the dommain. A record is the basic data component in DNS. Resource records define not only names and IP addresses but domains, servers, zone, and services as well. This list shows you the most common types of resource records:

Type

Purpose

A

Address resource records match an IP address to a host name.

CNAME

Canonical name resource records associate a nickname to a host name.

MX

Mail exchange resource records identify mail servers for the specified domain.

NS

Name server resource records identify servers (other than the SOA server) that contain zone information files.

PTR

Pointer resource records match a host name to a given IP address. This is the opposite of an Address record, which matches an IP address to the supplied host name.

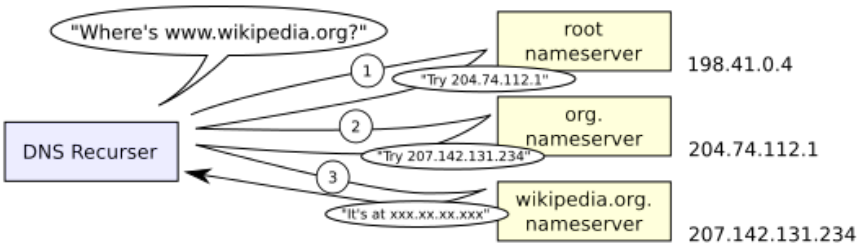
SOA

Start of authority resource records specify which server contains the zone file for a domain.

SRV

Service resource records identify servers that provide special services to the domain.

When you need to know the IP about a record, you request this at your DNS with a query. The query is recursive request and is completed when DNS found the record of the domain that you need:



Check typical DNS records here.

3.1. Mount your own DNS

Only need have set up your service locally and this will connect with ICANN nodes to resolve web adress. And you can resolve custom name locally if you have not bought the domain name.

3.1.1. Your DNS in the client

You need to say at your client that use your DNS to resolve names. Run the script and select this options:

```
1. Install Services > client > DNS
```

Now, you have said in your client that use the IP of your server to resolve names. This is in the file `/etc/resolv.conf`:

```
echo " * Configuring DNS client..."
echo "# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
# DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver $PRIMARY_DNS
nameserver $SECONDARY_DNS
#search localdomain
" > /etc/resolv.conf
```

In my case have two servers for primary and secondary DNS.

3.1.2. Your DNS in the server

Server configuration is also simple, but it requires a few extra steps.

```
1. Install Services > client > DNS > [Select primary or secondary]
```

The script do this:

1. Install **bind9**, a application to provide DNS services
2. Edit `/etc/resolv.conf` file and add your own direction
3. Set up **bind9** to define your domain database and your secondary IP if is defined.

```
write_config_local_server(){
echo "zone \"$DNS_NAME.\" IN {
  type master;
  file \"/etc/bind/db.$DNS_NAME.zone\";
  allow-transfer {$SECONDARY_DNS;};
  }; " > /etc/bind/named.conf.local
}
```

4. In the domain database write entries to be resolubles main services that use DNS to access it:

```
write_database(){
echo "\$TTL  604800
@ IN  SOA ns1.$DNS_NAME. root.ns1.$DNS_NAME. (
            1   ; Serial
       604800   ; Refresh
        86400   ; Retry
      2419200   ; Expire
       604800 ) ; Negative Cache TTL
```

```
@               IN      NS          ns1.$DNS_NAME.
ns1             IN      A           $PRIMARY_DNS
@               IN      NS          ns2.$DNS_NAME.

ns2             IN      A           $SECONDARY_DNS
$DNS_NAME.      IN      A           $PRIMARY_DNS

smtp            IN      CNAME       $DNS_NAME.
pop3            IN      CNAME       $DNS_NAME.
ldap            IN      CNAME       $DNS_NAME.
www             IN      CNAME       $DNS_NAME.
www1            IN      CNAME       $DNS_NAME.
www2            IN      CNAME       $DNS_NAME.
www3            IN      CNAME       $DNS_NAME.
" > /etc/bind/db."$DNS_NAME".zone
}
```

For the secondary server, the configuration is more easy because this use primary server to get information and don't need too more:

```
write_config_local_client(){
echo "zone \"$DNS_NAME.\" IN {
  type slave;
  file \"/var/cache/bind/db.$DNS_NAME.zone\";
  masters {$PRIMARY_DNS;};
};
" > /etc/bind/named.conf.local
}
```

3.2. Check connectivity

You can check connectivity in the client with two commands:

3.3. How DNS works

3.3.1. Internal query

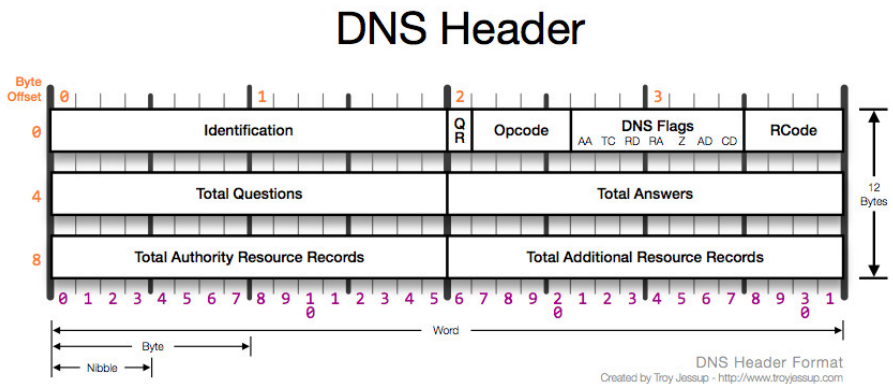
For the example, I runt `dig st.um` command and see in the wireshark what happens:

The client do standard query connection at default DNS server (my server). In the header I say that I want to transalte `st.um` adress (of type `A`)

The server respond me. In the `answer` entry of the header you can see the IP of my request name, and the adress of the DNS server that serve the information:

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies$ dig www.st.um

; <<>> DiG 9.8.1-P1 <<>> www.st.um
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 9712
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 2, ADDITIONAL: 2

;; QUESTION SECTION:
;www.st.um.                     IN      A

;; ANSWER SECTION:
www.st.um.              604800  IN      CNAME   st.um.
st.um.                  604800  IN      A       172.16.22.135

;; AUTHORITY SECTION:
st.um.                  604800  IN      NS      ns2.st.um.
st.um.                  604800  IN      NS      ns1.st.um.

;; ADDITIONAL SECTION:
ns1.st.um.              604800  IN      A       172.16.22.135
ns2.st.um.              604800  IN      A       172.16.22.137

;; Query time: 0 msec
;; SERVER: 172.16.22.135#53(172.16.22.135)
;; WHEN: Sun May 18 19:44:35 2014
```

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies$ nslookup www.st.um
Server:         172.16.22.135
Address:        172.16.22.135#53

www.st.um       canonical name = st.um.
Name:   st.um
Address: 172.16.22.135
```



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	172.16.22.136	172.16.22.135	DNS	65	Standard query A st.um
2	0.000410	172.16.22.135	172.16.22.136	DNS	149	Standard query response A 172.16.22.135

```
▸ Frame 1: 65 bytes on wire (520 bits), 65 bytes captured (520 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ User Datagram Protocol, Src Port: 35522 (35522), Dst Port: domain (53)
▾ Domain Name System (query)
    [Response In: 2]
    Transaction ID: 0x1fef
  ▾ Flags: 0x0100 (Standard query)
      0... .... .... .... = Response: Message is a query
      .000 0... .... .... = Opcode: Standard query (0)
      .... ..0. .... .... = Truncated: Message is not truncated
      .... ...1 .... .... = Recursion desired: Do query recursively
      .... .... .0.. .... = Z: reserved (0)
      .... .... ...0 .... = Non-authenticated data: Unacceptable
    Questions: 1
    Answer RRs: 0
    Authority RRs: 0
    Additional RRs: 0
  ▾ Queries
    ▾ st.um: type A, class IN
        Name: st.um
        Type: A (Host address)
        Class: IN (0x0001)
```

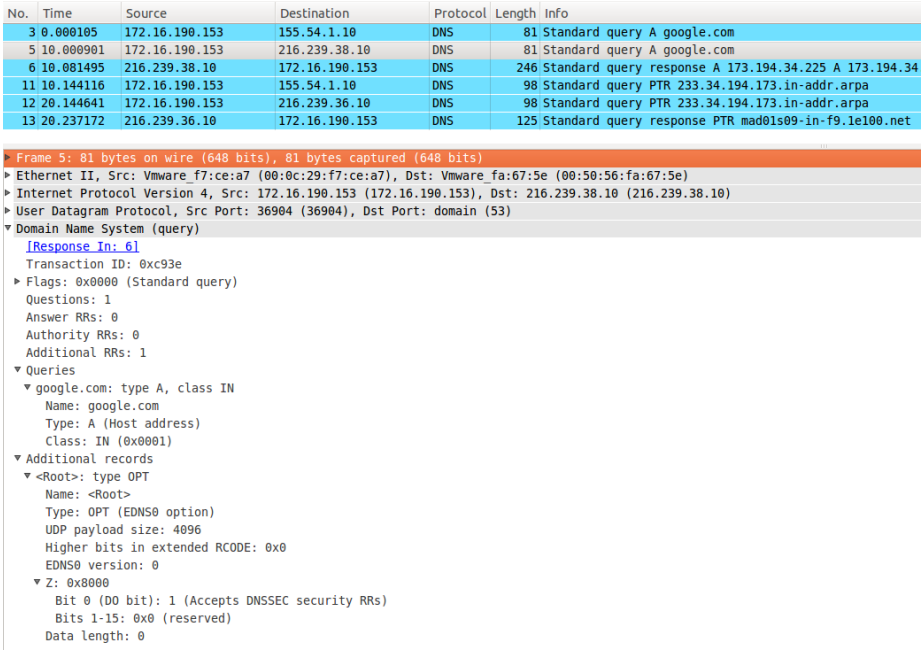
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	172.16.22.136	172.16.22.135	DNS	65	Standard query A st.um
2	0.000410	172.16.22.135	172.16.22.136	DNS	149	Standard query response A 172.16.22.135

```
▸ Frame 2: 149 bytes on wire (1192 bits), 149 bytes captured (1192 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ User Datagram Protocol, Src Port: domain (53), Dst Port: 35522 (35522)
▾ Domain Name System (response)
    [Request In: 1]
    [Time: 0.000410000 seconds]
    Transaction ID: 0x1fef
  ▾ Flags: 0x8580 (Standard query response, No error)
      1... .... .... .... = Response: Message is a response
      .000 0... .... .... = Opcode: Standard query (0)
      .... .1.. .... .... = Authoritative: Server is an authority for domain
      .... ..0. .... .... = Truncated: Message is not truncated
      .... ...1 .... .... = Recursion desired: Do query recursively
      .... .... 1... .... = Recursion available: Server can do recursive queries
      .... .... .0.. .... = Z: reserved (0)
      .... .... ..0. .... = Answer authenticated: Answer/authority portion was not authenticated by the server
      .... .... ...0 .... = Non-authenticated data: Unacceptable
      .... .... .... 0000 = Reply code: No error (0)
    Questions: 1
    Answer RRs: 1
    Authority RRs: 2
    Additional RRs: 2
  ▾ Queries
    ▾ st.um: type A, class IN
        Name: st.um
        Type: A (Host address)
        Class: IN (0x0001)
  ▾ Answers
    ▸ st.um: type A, class IN, addr 172.16.22.135
  ▾ Authoritative nameservers
    ▸ st.um: type NS, class IN, ns ns2.st.um
    ▸ st.um: type NS, class IN, ns ns1.st.um
  ▾ Additional records
    ▸ ns1.st.um: type A, class IN, addr 172.16.22.135
    ▸ ns2.st.um: type A, class IN, addr 172.16.22.137
```

3.3.2. External query

This process is similar to internal query, but now depend of external DNS.

In this case, I do a `ping google.com` and in this process I need first translate `google.com` name into a IP name:



The DNS server respond me with a list of availables IPs for `google.com` domain:

Now, I can continue with my ping!

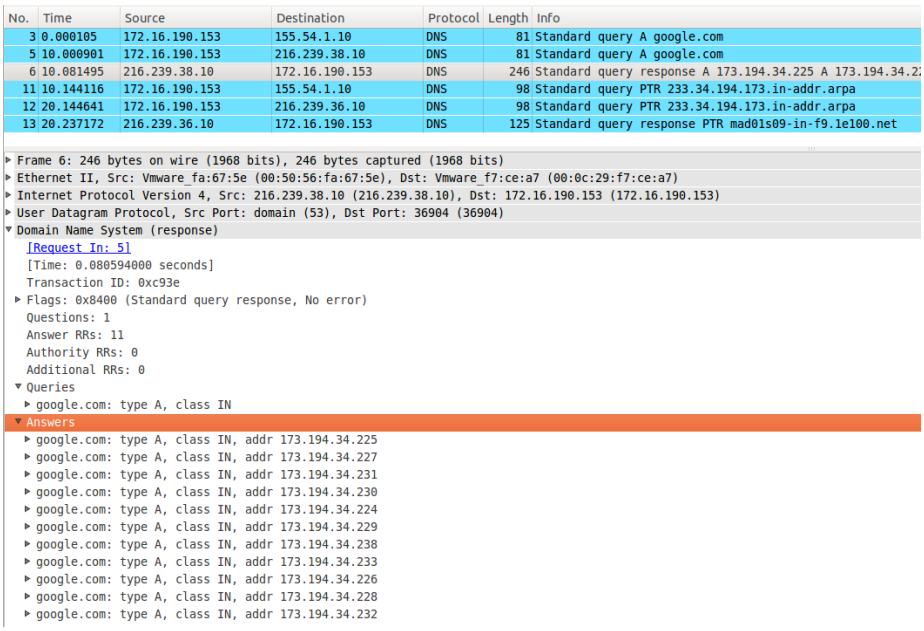
4. HTTP

HTTP (short for *HyperText Transfer Protocol*) is the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. For example, when you enter a URL in your browser, this actually sends an HTTP command to the Web server directing it to fetch and transmit the requested Web page.

All parameter of the protocol are specified in the **HTTP header**

Client Request:

```
GET /index.html HTTP/1.1
```




```
Host: www.example.com
```

Server Response:

```
HTTP/1.1 200 OK
Date: Mon, 23 May 2005 22:38:34 GMT
Server: Apache/1.3.3.7 (Unix) (Red-Hat/Linux)
Last-Modified: Wed, 08 Jan 2003 23:11:55 GMT
ETag: "3f80f-1b6-3e1cb03b"
Content-Type: text/html; charset=UTF-8
Content-Length: 131
Accept-Ranges: bytes
Connection: close

<html>
<head>
  <title>An Example Page</title>
</head>
<body>
  Hello World, this is a very simple HTML document.
</body>
</html>
```

A message in HTTP have 3 parts:

1. First line with *HTTP_Method*, *Resource ID* adn *HTTP Version*.
2. Information about the client and the petition.
3. Body request if the client need to transfer data to the server.

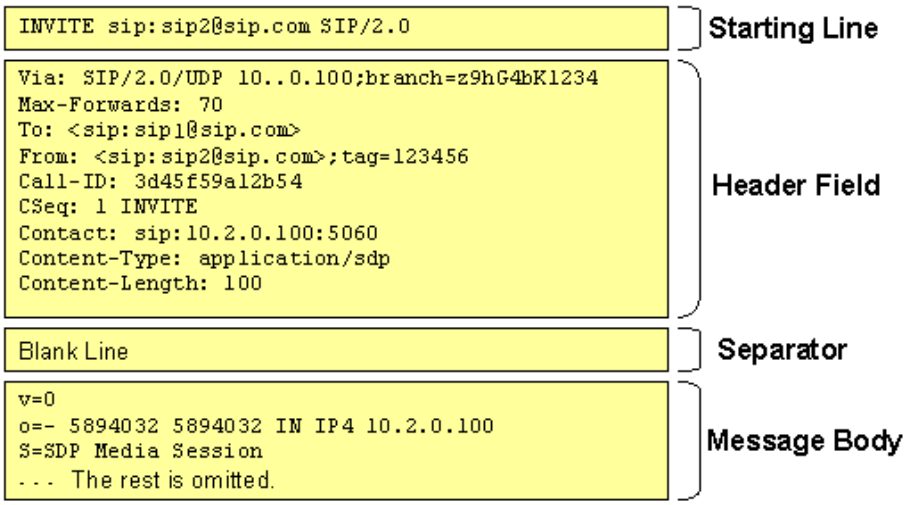


Figure 1: image

The HTTP methods are different for different actions:

Command	Meaning
GET	Return the requested item
HEAD	Request only the header information of an item
OPTIONS	Request communications options of an item
POST	Supply input to a server-side command and return the result
PUT	Store an item on the server
DELETE	Delete an item on the server
TRACE	Trace server communication

And each client request is response with status code:

- **1xx** Informational
- **2xx** Success
- **3xx** Redirection

- **4xx** Client Error
- **5xx** Server Error

Special mention to:

```
418 I'm a teapot (RFC 2324)
This code was defined in 1998 as one of the traditional IETF April Fools' jokes, in RFC 2324,
```

4.1. Mount your HTTP

4.1.1. Your HTTP in the client

If you have a Browser and/or terminal, you don't need additional things.

4.1.2. Your HTTP in the server

We use **apache** and **php**.

apache is used to service files and can be resolve in the client. Also, we can configure it to mount differents domains separated but under the same machine.

For do it, first need define **virtual hosts**. In the example we use 3 virtual hosts:

- virtual host to www1.st.um and basic website.
- virtual host to www2.st.um and basic apache authentication.
- virtual host to www3.st.um to get a secure HTTP based on SSL certificate (HTTPS).

This files are defined in `Services/example/` and with the script we go to copy differents files to differents folders:

- We copy the files of the virtual hosts `Services/example/vhost` to `/etc/apache2/sites-available`
- We copy the files of the websites `Services/example/sites` to `/var/www/`
- We copy the files of the apache authentication methd `Services/example/groups` to `/etc/apache2/groups`

4.2. Check connectivity

Run client browser and go to url examples:

1) Basic website:

Informational Status Codes

100 – Continue [The server is ready to receive the rest of the request.]

101 – Switching Protocols [Client specifies that the server should use a certain protocol and the server will give this response when it is ready to switch.]

Client Request Successful

200 – OK [Success! This is what you want.]

201 – Created [Successfully created the URI specified by the client.]

202 – Accepted [Accepted for processing but the server has not finished processing it.]

203 – Non-Authoritative Information [Information in the response header did not originate from this server. Copied from another server.]

204 – No Content [Request is complete without any information being sent back in the response.]

205 – Reset Content [Client should reset the current document. Ie. A form with existing values.]

206 – Partial Content [Server has fulfilled the partial GET request for the resource. In response to a Range request from the client. Or if someone hits stop.]

Request Redirected

300 – Multiple Choices [Requested resource corresponds to a set of documents. Server sends information about each one and a URL to request them from so that the client can choose.]

301 – Moved Permanently [Requested resource does not exist on the server. A Location header is sent to the client to redirect it to the new URL. Client continues to use the new URL in future requests.]

302 – Moved Temporarily [Requested resource has temporarily moved. A Location header is sent to the client to redirect it to the new URL. Client continues to use the old URL in future requests.]

303 – See Other [The requested resource can be found in a different location indicated by the Location header, and the client should use the GET method to retrieve it.]

304 – Not Modified [Used to respond to the If-Modified-Since request header. Indicates that the requested document has not been modified since the the specified date, and the client should use a cached copy.]

305 – Use Proxy [The client should use a proxy, specified by the Location header, to retrieve the URL.]

307 – Temporary Redirect [The requested resource has been temporarily redirected to a different location. A Location header is sent to redirect the client to the new URL. The client continues to use the old URL in future requests.]

Client Request Incomplete

400 – Bad Request [The server detected a syntax error in the client's request.]

401 – Unauthorized [The request requires user authentication. The server sends the WWW-Authenticate header to indicate the authentication type and realm for the requested resource.]

402 – Payment Required [reserved for future.]

403 – Forbidden [Access to the requested resource is forbidden. The request should not be repeated by the client.]

404 – Not Found [The requested document does not exist on the server.]

405 – Method Not Allowed [The request method used by the client is unacceptable. The server sends the Allow header stating what methods are acceptable to access the requested resource.]

406 – Not Acceptable [The requested resource is not available in a format that the client can accept, based on the accept headers received by the server. If the request was not a HEAD request, the server can send Content-Language, Content-Encoding and Content-Type headers to indicate which formats are available.]

407 – Proxy Authentication Required [Unauthorized access request to a proxy server. The client must first authenticate itself with the proxy. The server sends the Proxy-Authenticate header indicating the authentication scheme and realm for the requested resource.]

408 – Request Time-Out [The client has failed to complete its request within the request timeout period used by the server. However, the client can re-request.]

409 – Conflict [The client request conflicts with another request. The server can add information about the type of conflict along with the status code.]

410 – Gone [The requested resource is permanently gone from the server.]

411 – Length Required [The client must supply a Content-Length header in its request.]

412 – Precondition Failed [When a client sends a request with one or more If... headers, the server uses this code to indicate that one or more of the conditions specified in these headers is FALSE.]

413 – Request Entity Too Large [The server refuses to process the request because its message body is too large. The server can close connection to stop the client from continuing the request.]

414 – Request-URI Too Long [The server refuses to process the request, because the specified URI is too long.]

415 – Unsupported Media Type [The server refuses to process the request, because it does not support the message body's format.]

417 – Expectation Failed [The server failed to meet the requirements of the Expect request-header.]

Server Errors

500 – Internal Server Error [A server configuration setting or an external program has caused an error.]

501 – Not Implemented [The server does not support the functionality required to fulfill the request.]

502 – Bad Gateway [The server encountered an invalid response from an upstream server or proxy.]

503 – Service Unavailable [The service is temporarily unavailable. The server can send a Retry-After header to indicate when the service may become available again.]

504 – Gateway Time-Out [The gateway or proxy has timed out.]

505 – HTTP Version Not Supported [The version of HTTP used by the client is not supported.]

Unused status codes

306- Switch Proxy

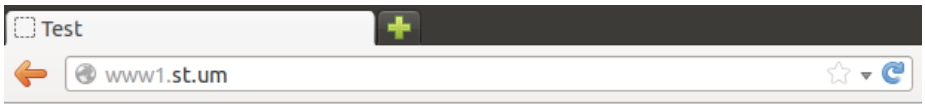
416- Requested range not satisfiable

506- Redirection failed

HTTP protocol version 1.1 Server Response Codes

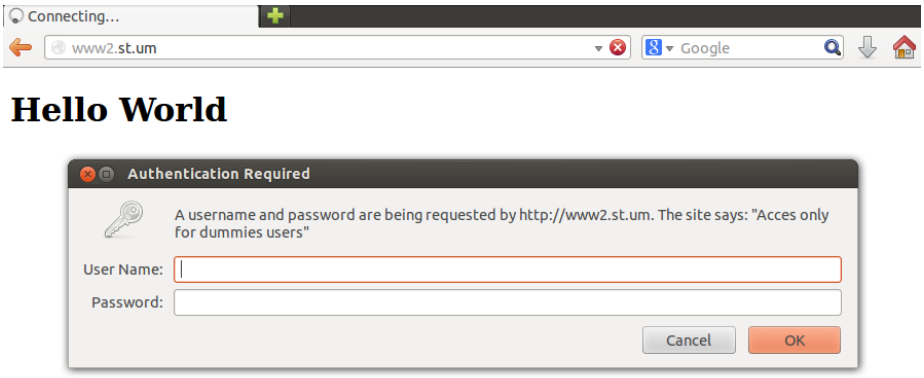
http://www.w3.org/Protocols/rfc2616/rfc2616.html

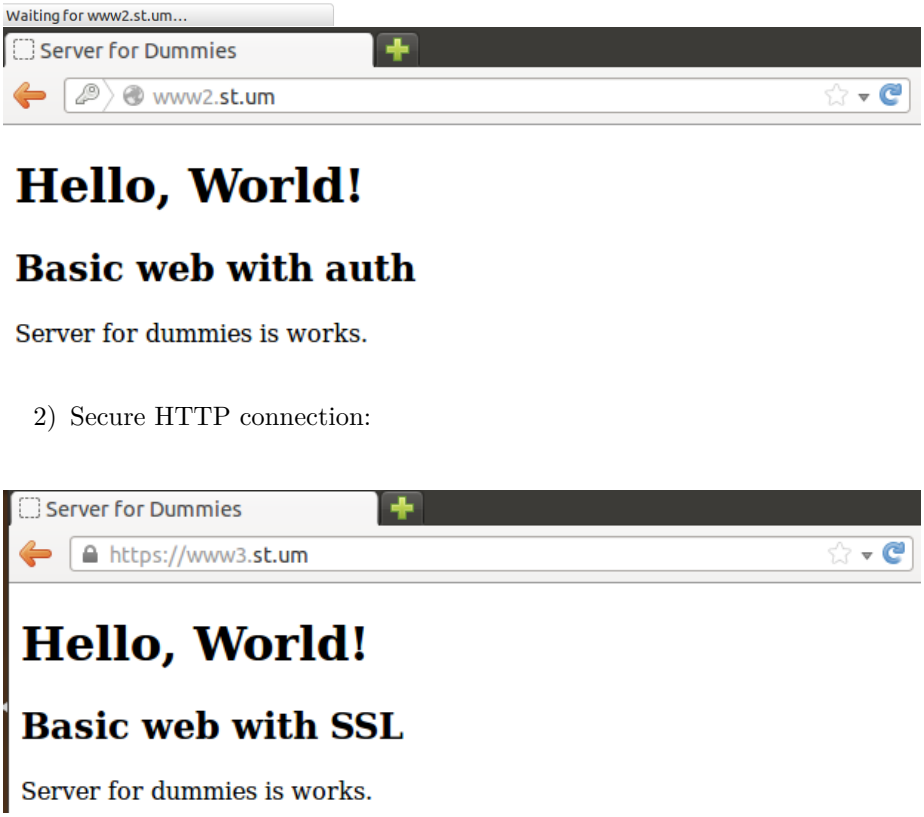
Chart created September 5, 2000 by Suso Banderas(suso@suso.org). Most of the summary information was gathered from Appendix A of "Apache Server Administrator's Handbook" by Mohammed J. Kabir.



Hello World

2) Basic Apache authentication:



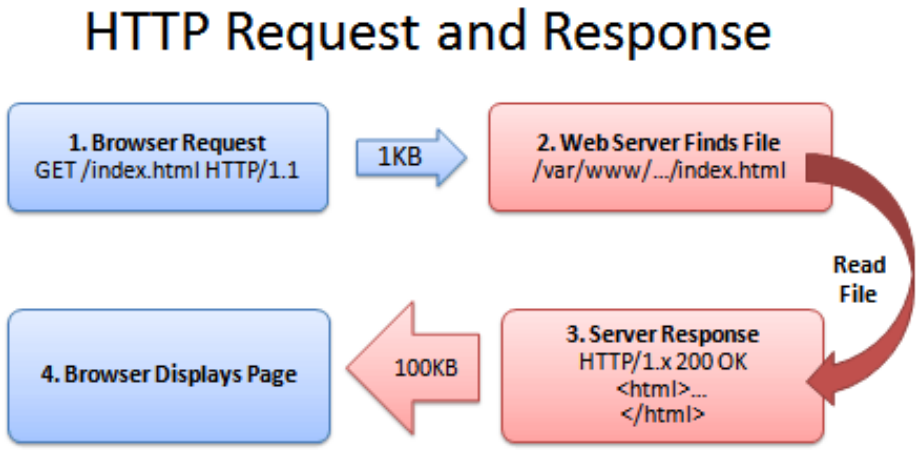


2) Secure HTTP connection:

Alternative you can do it with terminal and you get the source code of the website:

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies$ curl www1.st.um
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xht
ml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
  <title>Test</title>
</head>

<body>
  <h1>Hello World</h1>
</body>
</html>
```

4.3. How HTTP works



No.	Time	Source	Destination	Protocol	Length	Info
10	0.001401	172.16.22.138	172.16.22.139	HTTP	226	GET / HTTP/1.1
12	0.001960	172.16.22.139	172.16.22.138	HTTP	672	HTTP/1.1 200 OK (text/html)

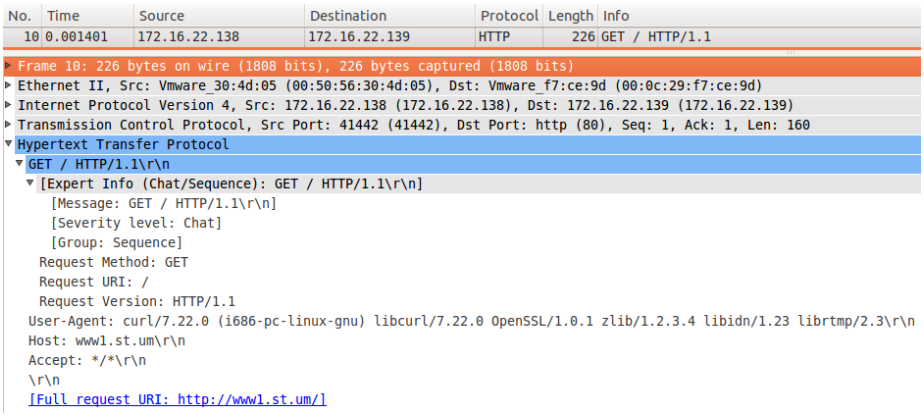
1) HTTP Request (GET Command)

2) HTTP Response (200 OK code status)

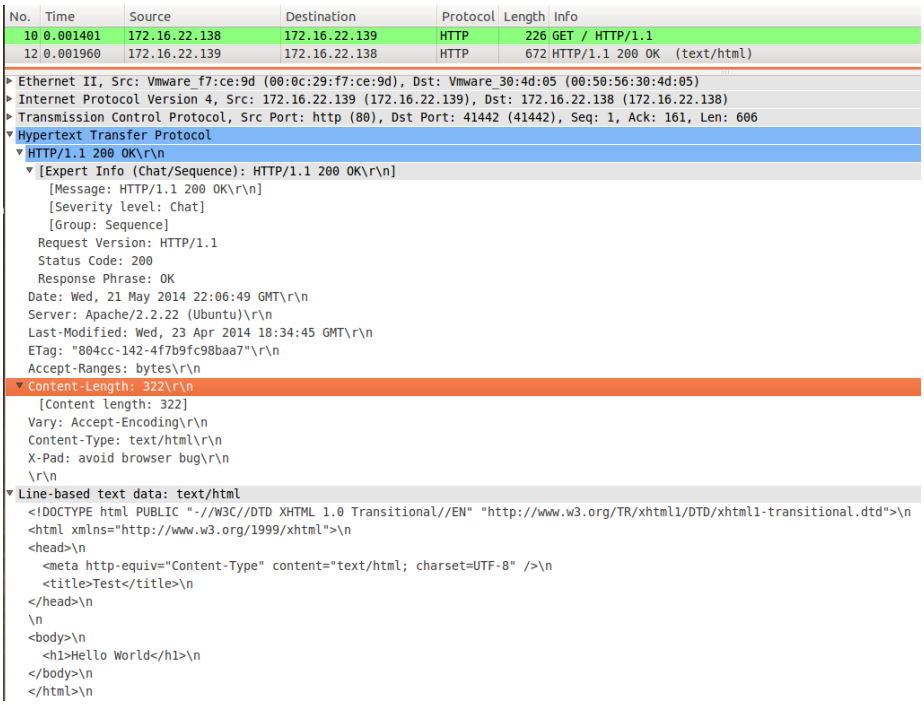
5. SSL

SSL (*Secure Sockets Layer*) is the standard security technology for establishing an encrypted link between a web server and a browser. This link ensures that all data passed between the web server and browsers remain private and integral. SSL is an industry standard and is used by millions of websites in the protection of their online transactions with their customers.

SSL does two things:



```
No.  Time      Source          Destination     Protocol  Length  Info
  10 0.001401  172.16.22.138   172.16.22.139   HTTP         226  GET / HTTP/1.1

Frame 10: 226 bytes on wire (1808 bits), 226 bytes captured (1808 bits)
Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
Internet Protocol Version 4, Src: 172.16.22.138 (172.16.22.138), Dst: 172.16.22.139 (172.16.22.139)
Transmission Control Protocol, Src Port: 41442 (41442), Dst Port: http (80), Seq: 1, Ack: 1, Len: 160
Hypertext Transfer Protocol
  GET / HTTP/1.1\r\n
    [Expert Info (Chat/Sequence): GET / HTTP/1.1\r\n]
      [Message: GET / HTTP/1.1\r\n]
      [Severity level: Chat]
      [Group: Sequence]
    Request Method: GET
    Request URI: /
    Request Version: HTTP/1.1
  User-Agent: curl/7.22.0 (i686-pc-linux-gnu) libcurl/7.22.0 OpenSSL/1.0.1 zlib/1.2.3.4 libidn/1.23 librtmp/2.3\r\n
  Host: www1.st.um\r\n
  Accept: */*\r\n
  \r\n
  [Full request URI: http://www1.st.um/]
```



```
No.  Time      Source          Destination     Protocol  Length  Info
  10 0.001401  172.16.22.138   172.16.22.139   HTTP         226  GET / HTTP/1.1
  12 0.001960  172.16.22.139   172.16.22.138   HTTP         672  HTTP/1.1 200 OK  (text/html)

Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
Internet Protocol Version 4, Src: 172.16.22.139 (172.16.22.139), Dst: 172.16.22.138 (172.16.22.138)
Transmission Control Protocol, Src Port: http (80), Dst Port: 41442 (41442), Seq: 1, Ack: 161, Len: 606
Hypertext Transfer Protocol
  HTTP/1.1 200 OK\r\n
    [Expert Info (Chat/Sequence): HTTP/1.1 200 OK\r\n]
      [Message: HTTP/1.1 200 OK\r\n]
      [Severity level: Chat]
      [Group: Sequence]
    Request Version: HTTP/1.1
    Status Code: 200
    Response Phrase: OK
  Date: Wed, 21 May 2014 22:06:49 GMT\r\n
  Server: Apache/2.2.22 (Ubuntu)\r\n
  Last-Modified: Wed, 23 Apr 2014 18:34:45 GMT\r\n
  ETag: "804cc-142-4f7b9fc98baa7"\r\n
  Accept-Ranges: bytes\r\n
  Content-Length: 322\r\n
    [Content length: 322]
  Vary: Accept-Encoding\r\n
  Content-Type: text/html\r\n
  X-Pad: avoid browser bug\r\n
  \r\n
Line-based text data: text/html
  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">\n
  <html xmlns="http://www.w3.org/1999/xhtml">\n
  <head>\n
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />\n
    <title>Test</title>\n
  </head>\n
  \n
  <body>\n
    <h1>Hello World</h1>\n
  </body>\n
  </html>\n
```

1. **Authenticates the server to the client.** (*Handshake*)
2. Encrypts your HTTP session.

We go to explain **Handshake** process:

- Client send `clientHello` message specifying encrypted options: SSL version, compress method,… and sending random numbers that they use later.
- The server receive the message and select:
  - What simetric algorythm (**secret key**) use (e.g. AES, 3DES, RC5).
  - What asimetric algorythm (**public key**) use (e.g. RSA.
  - What MAC algorythm use (SHA).

Why select simetric and asimetric algorythm? Why not use only one?

When client finally send data to the server, they use simetric algorythm, but first, to get it, they need to negotiate and exchange confidence information. This proceed is known as **Pre Master Key**.

There are two ways to do Pre Master Key process:

1. With **Diffie-Helman**: Client and server exchange `SERVER_KEY_EXCHANGE` and `CLIENT_KEY_EXCHANGE` and both parts know the information to operate with simetric algorythm.
2. With **RSA**: The client catch the public key of the Server Certificate (message `CERTIFICATE`)and encrypted the master key. Only the server can desncrypted this with her private key.

And send to the client `serverHello` with this options, distinctive server number and their certificates to check the identify of the server domain.

But, one moment… Why am I going to trust the server? and if not who he claims to be?

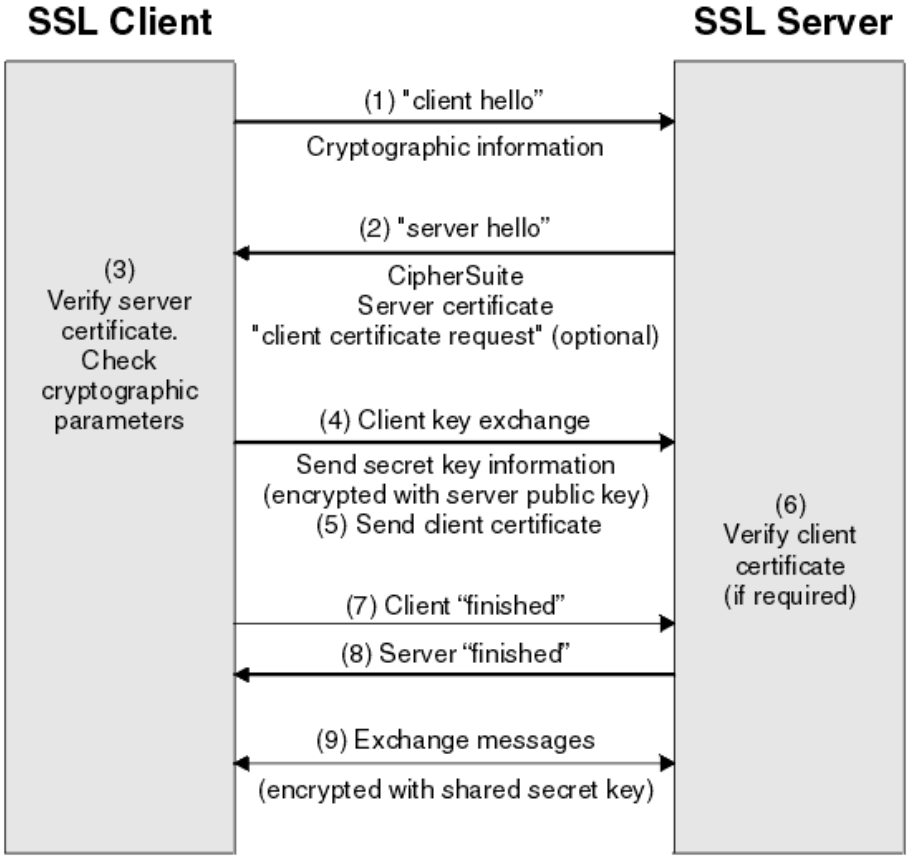
Before Pre Master Key process is necessary for the server to authenticate it, for do it is also necessay asimetric algorythm, normally with RSA. And then, thec MAC algorythm is use to verify that data of the session is authenticathed.

We can resume all the process with two variants of message:

- **TLSv1_RSA_WITH_AES_128_CBC_SHA**
  - **TLSv1**: version of TLS (SSL protocol)
  - **RSA**: For server authentication and pre master key process.
  - **AES**: For simetric algorythm after master key
  - **SHA**: For MAC encryptation

- **TLSv1_DHE_RSA_WITH_AES_256_CBC_SHA**
  - **TLSv1**: version of TLS (SSL protocol)
  - **DHE**: For server authentication based of Diffie-Helman for pre master key.
  - **RSA**: For server authentication.
  - **AES**: For simetric algorythm after master key.
  - **SHA**: For MAC encryptation.

The resume of the process in one image:



The complexities of the SSL protocol remain invisible to your customers. Instead their browsers provide them with a key indicator to let them know they are currently protected by an SSL encrypted session - the lock icon in the lower right-hand corner, clicking on the lock icon displays your SSL Certificate and the details about it. All SSL Certificates are issued to either companies or legally accountable individuals.

5.1. Mount your SSL

5.1.1. SSL in the client

If the server has done its homework anything is necessary in the client, only have a modern browser and the `*.pem` to load it (see part of SSL in the server).

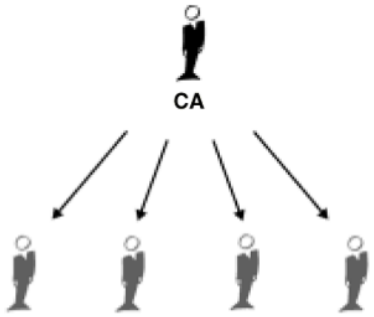
5.1.2. SSL in the server

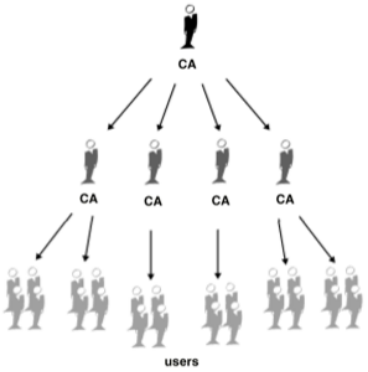
For have SSL in HTTP known as HTTPS first you need to have HTTP service.

For have HTTPS you need a certificate to expose that your domain is secure and you are your owner.

Now we are to explain how to generate your certificate for do a illustrative example, but in the practice the SSL certificate is created by **Certification Authority** (*CA*) that typically are companies of hosting. Remember this.

The CA establishes a chain of trust between he and domains of users:





About what your need in your server we use **openssl** that is typically installed in UNIX systems by default.

The process is divided in two steps: First need to generate the CA autosign for the server and later generate the clien certificate and sign it with serve CA.

Typically an SSL Certificate will contain your domain name, your company name, your address, your city, your state and your country. It will also contain the expiration date of the Certificate and details of the Certification Authority responsible for the issuance of the Certificate. When a browser connects to a secure site it will retrieve the site's SSL Certificate and check that it has not expired, it has been issued by a Certification Authority the browser trusts, and that it is being us.

CA Certificate in the server

first need to know OpenSSL directory. In terminal type:

```
openssl version -d
```

And report you the directory, typically `usr/lib/ssl`. Now we need to edit `openssl.cnf` and update this entries with your values. In my case this are my values:

```
....
[ CA_default ]
...
dir = ./demoCA
countryName_default = ES
stateOrProvinceName_default =
0. organizationalName_default = UMU
organizationalUnitName_default = ST
...
```

because my domain is a Spanish domain and the domian for the exmaple is `st@um`.

Now go to adjust options to generate a certificate. in the same file and go to `[ policy_match ]` section and update set `stateOrProvinceName` value to `optional`.

Go to the path of CA_default and create `demoCA` folder with this structure:

```
cd $HOME
mkdir -p demoCA && cd demoCA
mkdir -p newcerts
mkdir -p certs
touch index.txt
echo "00" > clrnumber
echo "01" > serial
```

Now you are ready to generate the certificate. To do it, run the appropriate command:

```
openssl req -x509 -newkey rsa:2048 -keyout cakey.pem -days 3650 -out
cacert.pem
```

You can check that your certificate is correct with this commands:

```
openssl x509 -in cacert.perm -text
openssl rsa -in cakey.perm -text
```

CA Certificate in the client

First generate it:

```
openssl req -new -nodes -newkey rsa:1024 -keyout serverkey.pem -out servercsr.pem
```

And later sign it:

```
openssl ca -keyfile cakey.pem -in servercsr.pem -out servercert.pem
```

The certificate on `*.pem` is necessary because is the format that the browser can read the certificate.

You can check that certificate is valid running this command:

```
openssl s_server -cert servercert.pem -key serverkey.pem -CAfile clientcert.pem
```

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies/Services/HTTP/example/demoCA$ openssl s_serve
r -cert servercert.pem -key serverkey.pem -CAfile clientcert.pem
Using default temp DH parameters
Using default temp ECDH parameters
ACCEPT
```

5.2. Check connectivity

5.3. How SSL Works

Resume of the process:

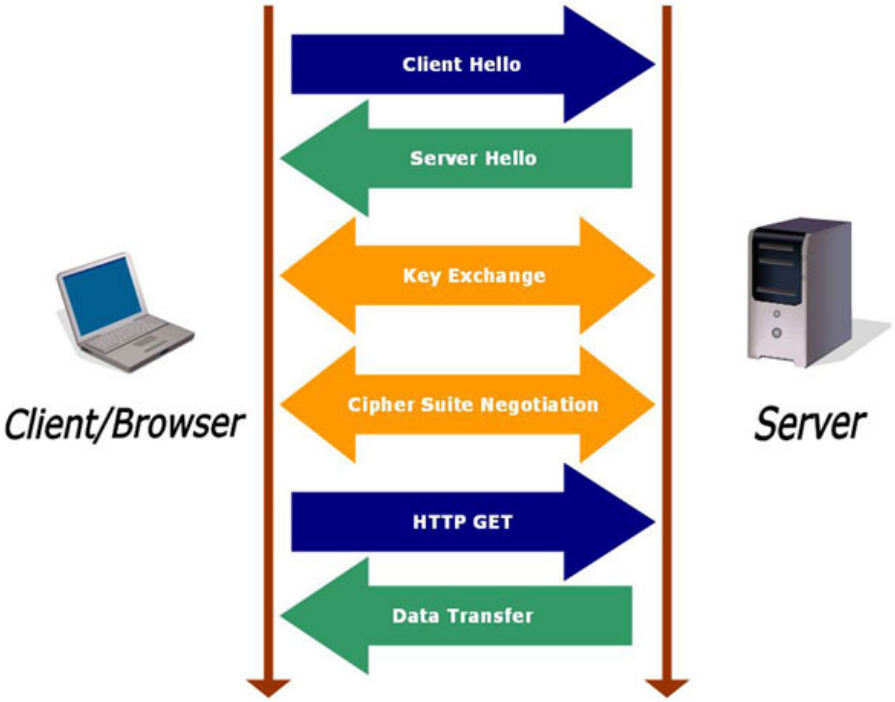
Resume of messages:

1) Client send `HELLO` message with distinctive random number and information about what compression and Cipher suites support and request to the server the X509 certificate to trust him.

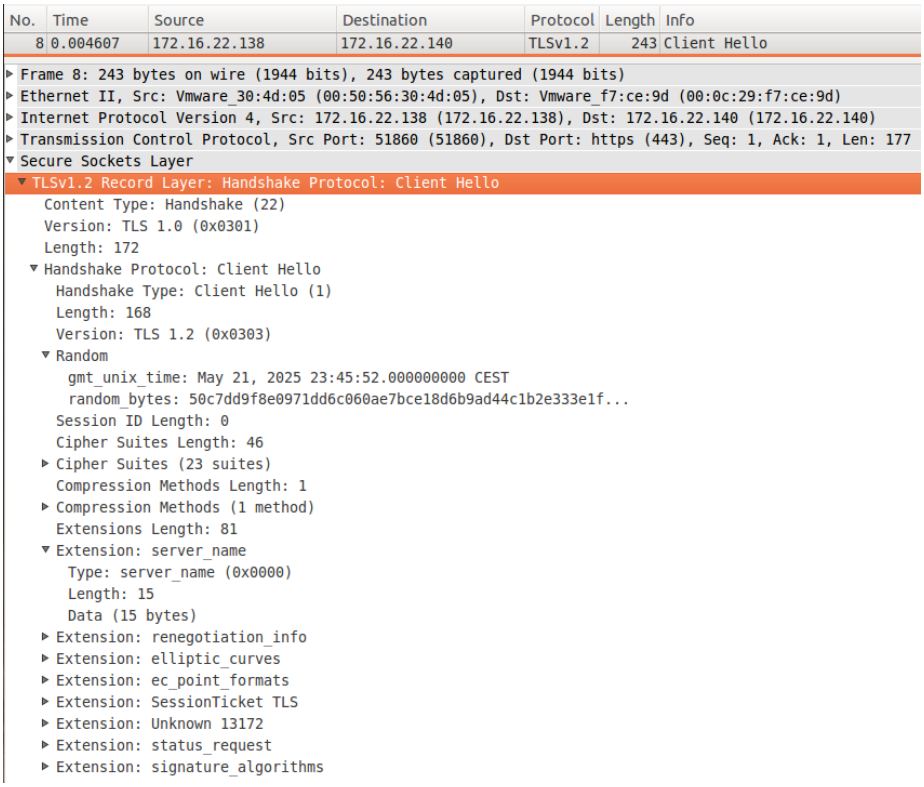
2) The server receive the message and:

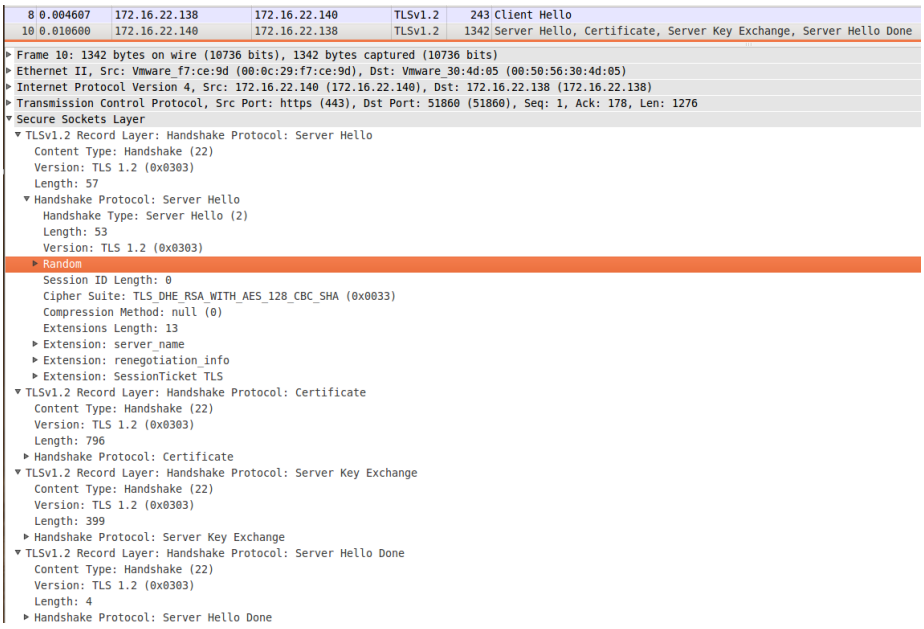
1. Read the `HELLO` message of the client and select the options of the session.
2. Send to the client the Certificate to show that you can trust him.
3. do `SERVER_KEY_EXCHANGE` as part of the process of Pre Master Key

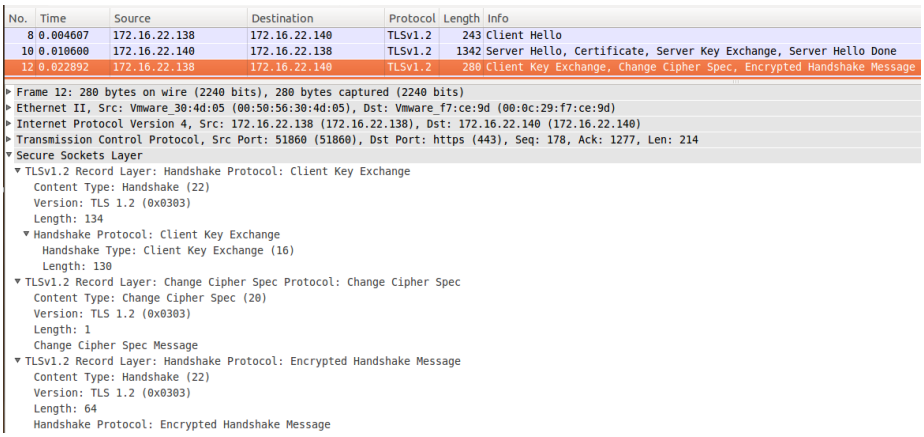
3) Client receive server message and proceed to:



No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
15	0.033750	172.16.22.140	172.16.22.138	TLSv1.2	710	Application Data, Application Data, Application Data, Application Data
17	0.072971	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
18	0.073772	172.16.22.140	172.16.22.138	TLSv1.2	742	Application Data, Application Data, Application Data, Application Data
20	5.074473	172.16.22.140	172.16.22.138	TLSv1.2	119	Encrypted Alert


No. Time Source Destination Protocol Length Info
8 0.004607 172.16.22.138 172.16.22.140 TLSv1.2 243 Client Hello
Frame 8: 243 bytes on wire (1944 bits), 243 bytes captured (1944 bits)
Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
Internet Protocol Version 4, Src: 172.16.22.138 (172.16.22.138), Dst: 172.16.22.140 (172.16.22.140)
Transmission Control Protocol, Src Port: 51860 (51860), Dst Port: https (443), Seq: 1, Ack: 1, Len: 177
Secure Sockets Layer
TLSv1.2 Record Layer: Handshake Protocol: Client Hello
Content Type: Handshake (22)
Version: TLS 1.0 (0x0301)
Length: 172
Handshake Protocol: Client Hello
Handshake Type: Client Hello (1)
Length: 168
Version: TLS 1.2 (0x0303)
Random
gmt_unix_time: May 21, 2025 23:45:52.000000000 CEST
random_bytes: 50c7dd9f8e0971dd6c060ae7bce18d6b9ad44c1b2e333e1f...
Session ID Length: 0
Cipher Suites Length: 46
Cipher Suites (23 suites)
Compression Methods Length: 1
Compression Methods (1 method)
Extensions Length: 81
Extension: server_name
Type: server_name (0x0000)
Length: 15
Data (15 bytes)
Extension: renegotiation_info
Extension: elliptic_curves
Extension: ec_point_formats
Extension: SessionTicket TLS
Extension: Unknown 13172
Extension: status_request
Extension: signature_algorithms

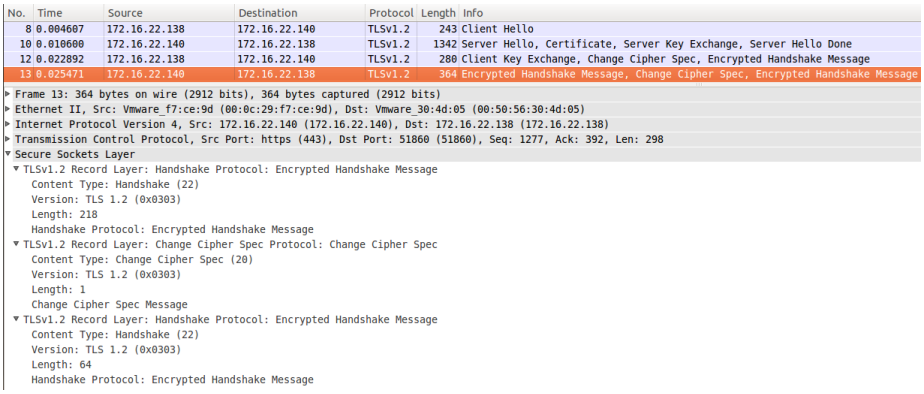

8 0.004607 172.16.22.138 172.16.22.140 TLSv1.2 243 Client Hello
10 0.010600 172.16.22.140 172.16.22.138 TLSv1.2 1342 Server Hello, Certificate, Server Key Exchange, Server Hello Done
Frame 10: 1342 bytes on wire (10736 bits), 1342 bytes captured (10736 bits)
Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
Internet Protocol Version 4, Src: 172.16.22.140 (172.16.22.140), Dst: 172.16.22.138 (172.16.22.138)
Transmission Control Protocol, Src Port: https (443), Dst Port: 51860 (51860), Seq: 1, Ack: 178, Len: 1276
Secure Sockets Layer
TLSv1.2 Record Layer: Handshake Protocol: Server Hello
Content Type: Handshake (22)
Version: TLS 1.2 (0x0303)
Length: 57
Handshake Protocol: Server Hello
Handshake Type: Server Hello (2)
Length: 53
Version: TLS 1.2 (0x0303)
Random
Session ID Length: 0
Cipher Suite: TLS_DHE_RSA_WITH_AES_128_CBC_SHA (0x0033)
Compression Method: null (0)
Extensions Length: 13
Extension: server_name
Extension: renegotiation_info
Extension: SessionTicket TLS
TLSv1.2 Record Layer: Handshake Protocol: Certificate
Content Type: Handshake (22)
Version: TLS 1.2 (0x0303)
Length: 796
Handshake Protocol: Certificate
TLSv1.2 Record Layer: Handshake Protocol: Server Key Exchange
Content Type: Handshake (22)
Version: TLS 1.2 (0x0303)
Length: 399
Handshake Protocol: Server Key Exchange
TLSv1.2 Record Layer: Handshake Protocol: Server Hello Done
Content Type: Handshake (22)
Version: TLS 1.2 (0x0303)
Length: 4
Handshake Protocol: Server Hello Done



1. Validate the identity of the server.
2. do `CLIENT_KEY_ECHANGE` as part of the process of Pre Master Key.

at this moment client can be calculate the **Master Key**.

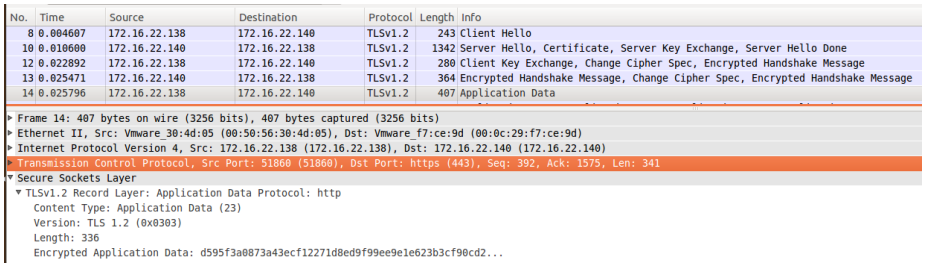
4) Server receive client message and can calculate **Master Key**. From here both part have a shared secret



5) The information from here can travel encrypted. Is not posible see the data content

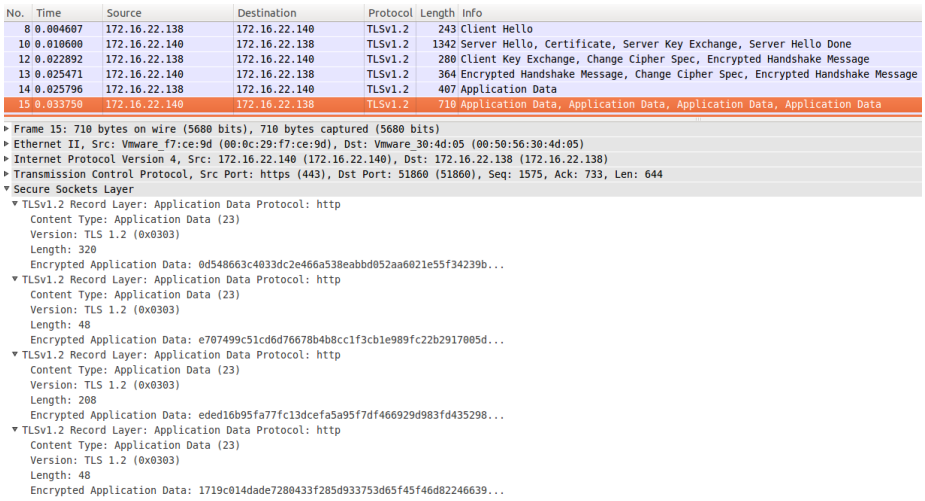
6. LDAP

Maybe at this moment you don't know what is a LDAP but maybe use LDAP in the real life.



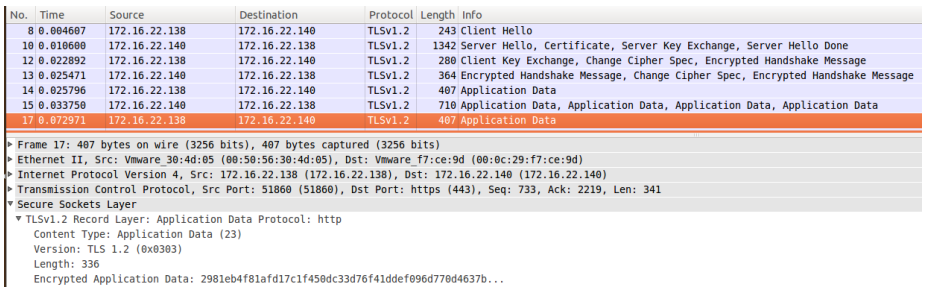
No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data

```
▸ Frame 14: 407 bytes on wire (3256 bits), 407 bytes captured (3256 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.138 (172.16.22.138), Dst: 172.16.22.140 (172.16.22.140)
▸ Transmission Control Protocol, Src Port: 51860 (51860), Dst Port: https (443), Seq: 392, Ack: 1575, Len: 341
▾ Secure Sockets Layer
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 336
      Encrypted Application Data: d595f3a0873a43ecf12271d8ed9f99ee9e1e623b3cf90cd2...
```



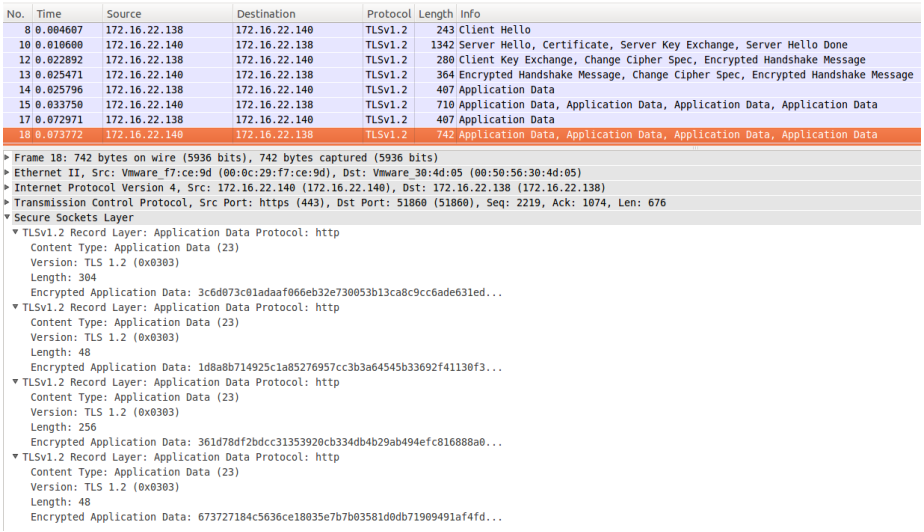
No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
15	0.033750	172.16.22.140	172.16.22.138	TLSv1.2	710	Application Data, Application Data, Application Data, Application Data

```
▸ Frame 15: 710 bytes on wire (5680 bits), 710 bytes captured (5680 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.140 (172.16.22.140), Dst: 172.16.22.138 (172.16.22.138)
▸ Transmission Control Protocol, Src Port: https (443), Dst Port: 51860 (51860), Seq: 1575, Ack: 733, Len: 644
▾ Secure Sockets Layer
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 320
      Encrypted Application Data: 0d548663c4033dc2e466a538eabbd052aa6021e55f34239b...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 48
      Encrypted Application Data: e707499c51cd6d76678b4b8cc1f3cb1e989fc22b2917005d...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 208
      Encrypted Application Data: eded16b95fa77fc13dcefa5a95f7df466929d983fd435298...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 48
      Encrypted Application Data: 1719c014dade7280433f285d933753d65f45f46d82246639...
```



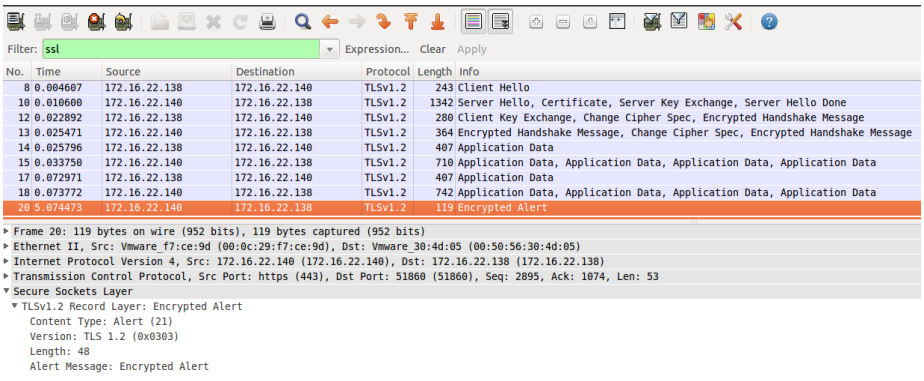
No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
15	0.033750	172.16.22.140	172.16.22.138	TLSv1.2	710	Application Data, Application Data, Application Data, Application Data
17	0.072971	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data

```
▸ Frame 17: 407 bytes on wire (3256 bits), 407 bytes captured (3256 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.138 (172.16.22.138), Dst: 172.16.22.140 (172.16.22.140)
▸ Transmission Control Protocol, Src Port: 51860 (51860), Dst Port: https (443), Seq: 733, Ack: 2219, Len: 341
▾ Secure Sockets Layer
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 336
      Encrypted Application Data: 2981eb4f81afd17c1f450dc33d76f41ddef096d770d4637b...
```



No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
15	0.033750	172.16.22.140	172.16.22.138	TLSv1.2	710	Application Data, Application Data, Application Data, Application Data
17	0.072971	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
18	0.073772	172.16.22.140	172.16.22.138	TLSv1.2	742	Application Data, Application Data, Application Data, Application Data

```
▸ Frame 18: 742 bytes on wire (5936 bits), 742 bytes captured (5936 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.140 (172.16.22.140), Dst: 172.16.22.138 (172.16.22.138)
▸ Transmission Control Protocol, Src Port: https (443), Dst Port: 51860 (51860), Seq: 2219, Ack: 1074, Len: 676
▾ Secure Sockets Layer
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 304
      Encrypted Application Data: 3c6d073c01adaaf066eb32e730053b13ca8c9cc6ade631ed...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 48
      Encrypted Application Data: 1d8a8b714925c1a85276957cc3b3a64545b33692f41130f3...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 256
      Encrypted Application Data: 361d78df2bdcc31353920cb334db4b29ab494efc816888a0...
  ▾ TLSv1.2 Record Layer: Application Data Protocol: http
      Content Type: Application Data (23)
      Version: TLS 1.2 (0x0303)
      Length: 48
      Encrypted Application Data: 673727184c5636ce18035e7b7b03581d0db71909491af4fd...
```



Filter: ssl Expression... Clear Apply

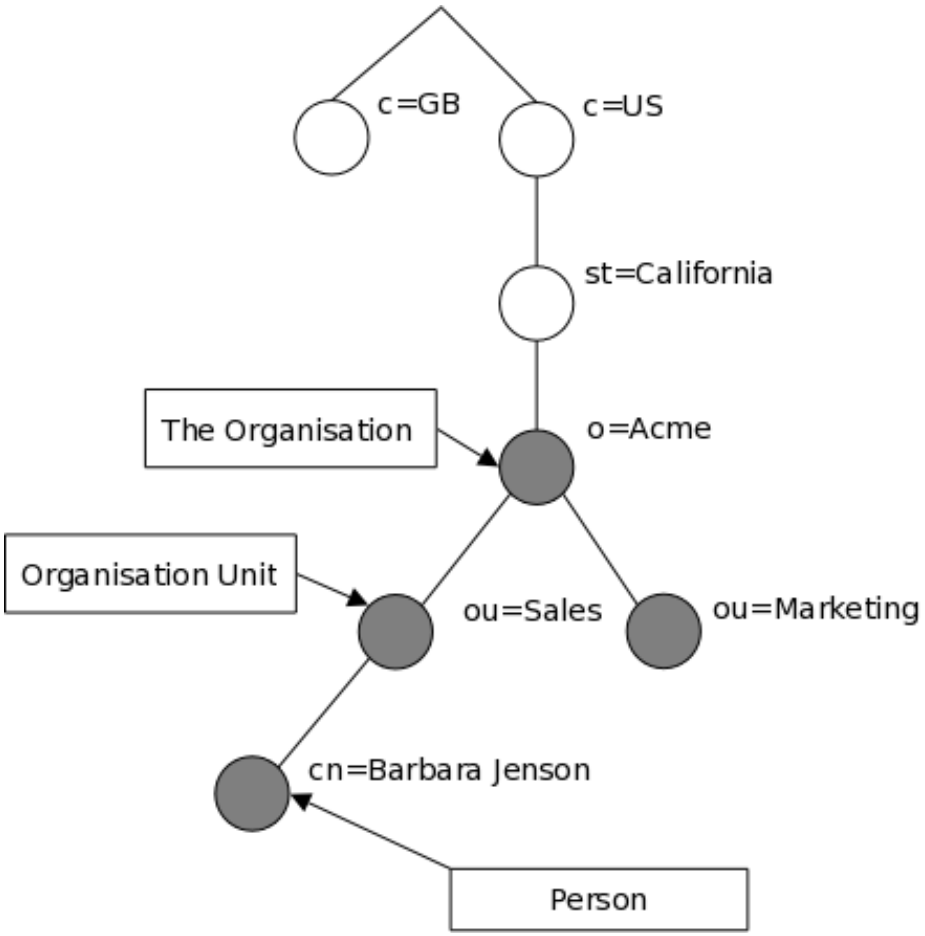
No.	Time	Source	Destination	Protocol	Length	Info
8	0.004607	172.16.22.138	172.16.22.140	TLSv1.2	243	Client Hello
10	0.010600	172.16.22.140	172.16.22.138	TLSv1.2	1342	Server Hello, Certificate, Server Key Exchange, Server Hello Done
12	0.022892	172.16.22.138	172.16.22.140	TLSv1.2	280	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
13	0.025471	172.16.22.140	172.16.22.138	TLSv1.2	364	Encrypted Handshake Message, Change Cipher Spec, Encrypted Handshake Message
14	0.025796	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
15	0.033750	172.16.22.140	172.16.22.138	TLSv1.2	710	Application Data, Application Data, Application Data, Application Data
17	0.072971	172.16.22.138	172.16.22.140	TLSv1.2	407	Application Data
18	0.073772	172.16.22.140	172.16.22.138	TLSv1.2	742	Application Data, Application Data, Application Data, Application Data
20	5.074473	172.16.22.140	172.16.22.138	TLSv1.2	119	Encrypted Alert

```
▸ Frame 20: 119 bytes on wire (952 bits), 119 bytes captured (952 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.140 (172.16.22.140), Dst: 172.16.22.138 (172.16.22.138)
▸ Transmission Control Protocol, Src Port: https (443), Dst Port: 51860 (51860), Seq: 2895, Ack: 1074, Len: 53
▾ Secure Sockets Layer
  ▾ TLSv1.2 Record Layer: Encrypted Alert
      Content Type: Alert (21)
      Version: TLS 1.2 (0x0303)
      Length: 48
      Alert Message: Encrypted Alert
```

LDAP *(Lightweight Directory Protocol)* concept is similar to use a address book to annotate information about people around you: Adress, email, work mobile,...

As Internet, LDAP is your adress book. And you can use LDAP for this. Your Adress book online!

LDAP is like database, but is specially designed for queries and put public information about employees of an organization or similar. The tree structure of a LDAP is known as **Directory Information Tree** (*DIT*):

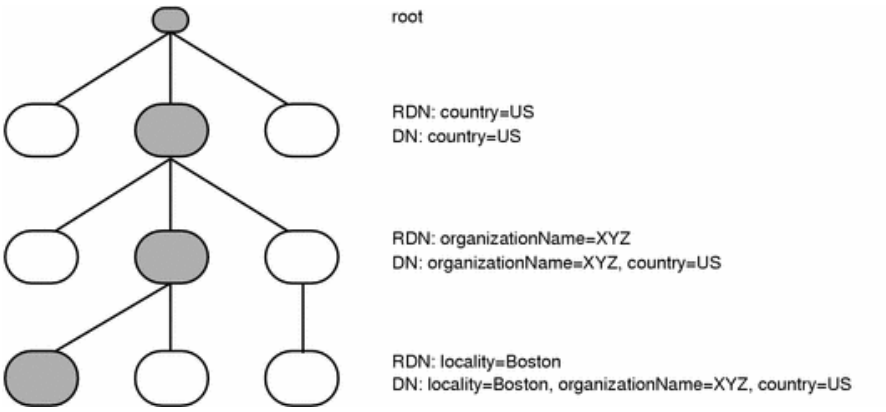


LDAP object are referenced by its **Distinguished Name** (*DN*). A DN is a sequence of **Relative Distinguished Names** (*RDN*) connected by commas.

An RDN is an attribute with an associated value in the form attribute=value; normally expressed in a UTF-8 string format.

Commonly Used Attributes

String



Attribute type

DC

domainComponent

CN

commonName

OU

organizationalUnitName

O

organizationName

STREET

streetAddress

L

localityName

ST

stateOrProvinceName

C

countryName

UID

userid

6.1. Mount your LDAP

6.1.1. Your LDAP in the client

For search in the LDAP client need to install **ldap-utils** command. Later We can configure your typical mail client (Thunderbild, for example) to search in the LDAP when you need a compose a mail and need to know the destination account.

6.1.2. Your LDAP in the server

In the server need to install **slapd** service configue the database schema and insert sample data. In this case we have the defintions of the data and the information in the `Services/LDAP/*.dif` files and use `Services/LDAP/server.sh` for boostrapping process. This is set up when you choice install LDAP:

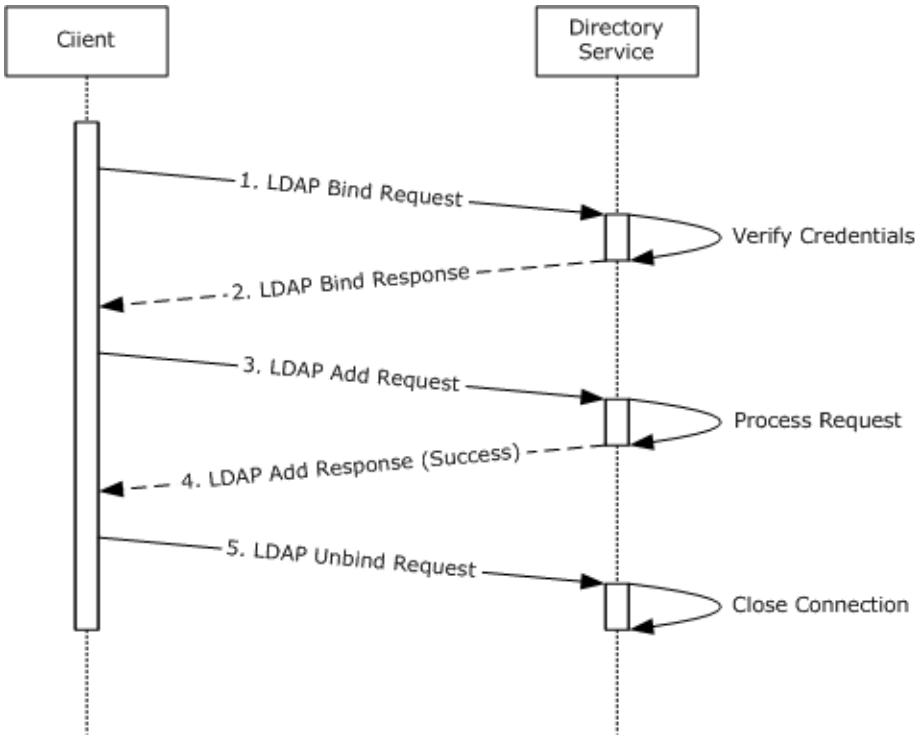
```
echo " * Installing LDAP..."
apt-get -y install slapd ldap-utils

echo " * Adding LDAP database..."
# Load database
sudo ldapmodify -Y EXTERNAL -H ldapi:/// -f "$DIR"/loadDBD.ldif;

echo " * Loading LDAP example schema..."
# Load database models schema
sudo ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/ldap/schema/inetorgperson.ldif;
sudo ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/ldap/schema/cosine.ldif;

echo " * Adding LDAP custom schema ..."
# Load own schema for the example
sudo ldapadd -Y EXTERNAL -H ldapi:/// -f "$DIR"/stSchema.ldif;

echo " * Configuring LDAP database..."
# Load database configuration
sudo ldapmodify -Y EXTERNAL -H ldapi:/// -f "$DIR"/confDatabase.ldif;

echo " * Inserting LDAP data..."
# Insert fake data for the example
sudo ldapmodify -D "cn=admin,o=um,c=es" -W -H ldap:/// -f "$DIR"/st.ldif;
```

6.2. Check connectivity

6.3. How LDAP works

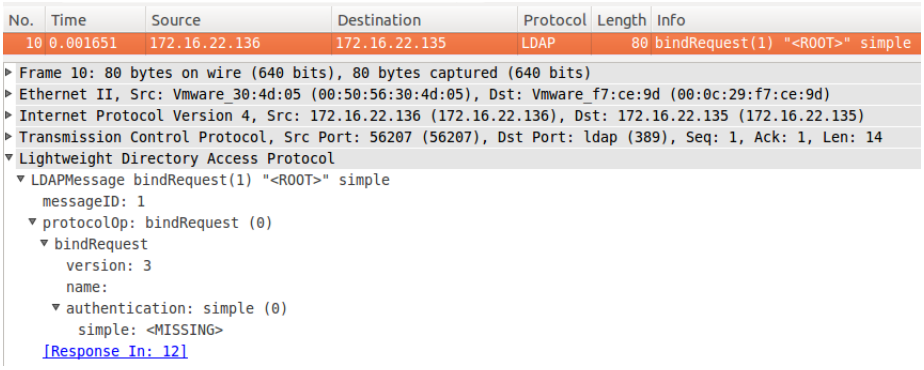
Resume:

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies$ sudo ldapsearch -x -H ldap://ldap.st.um -b "
cn=Server Administrator,ou=st,o=um,c=es" mobile
# extended LDIF
#
# LDAPv3
# base <cn=Server Administrator,ou=st,o=um,c=es> with scope subtree
# filter: (objectclass=*)
# requesting: mobile
#

# Server Administrator, st, um, es
dn: cn=Server Administrator,ou=st,o=um,c=es
mobile: 611111111

# search result
search: 2
result: 0 Success

# numResponses: 2
# numEntries: 1
```



No.	Time	Source	Destination	Protocol	Length	Info
10	0.001651	172.16.22.136	172.16.22.135	LDAP	80	bindRequest(1) "<ROOT>" simple
12	0.002139	172.16.22.135	172.16.22.136	LDAP	80	bindResponse(1) success
14	0.002668	172.16.22.136	172.16.22.135	LDAP	152	searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
15	0.003105	172.16.22.135	172.16.22.136	LDAP	139	searchResEntry(2) "cn=Server Administrator,ou=st,o=um,c=es"
16	0.003198	172.16.22.135	172.16.22.136	LDAP	80	searchResDone(2) success [1 result]
18	0.003808	172.16.22.136	172.16.22.135	LDAP	73	unbindRequest(3)

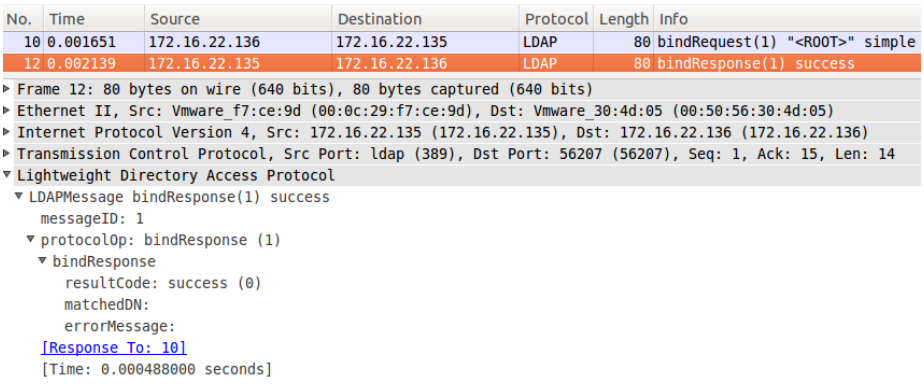
1) BindRequest (Authentication)



No.	Time	Source	Destination	Protocol	Length	Info
10	0.001651	172.16.22.136	172.16.22.135	LDAP	80	bindRequest(1) "<ROOT>" simple

```
▸ Frame 10: 80 bytes on wire (640 bits), 80 bytes captured (640 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 56207 (56207), Dst Port: ldap (389), Seq: 1, Ack: 1, Len: 14
▾ Lightweight Directory Access Protocol
  ▾ LDAPMessage bindRequest(1) "<ROOT>" simple
      messageID: 1
    ▾ protocolOp: bindRequest (0)
      ▾ bindRequest
          version: 3
          name:
        ▾ authentication: simple (0)
            simple: <MISSING>
      [Response In: 12]
```

2) BindResponse



No.	Time	Source	Destination	Protocol	Length	Info
10	0.001651	172.16.22.136	172.16.22.135	LDAP	80	bindRequest(1) "<ROOT>" simple
12	0.002139	172.16.22.135	172.16.22.136	LDAP	80	bindResponse(1) success

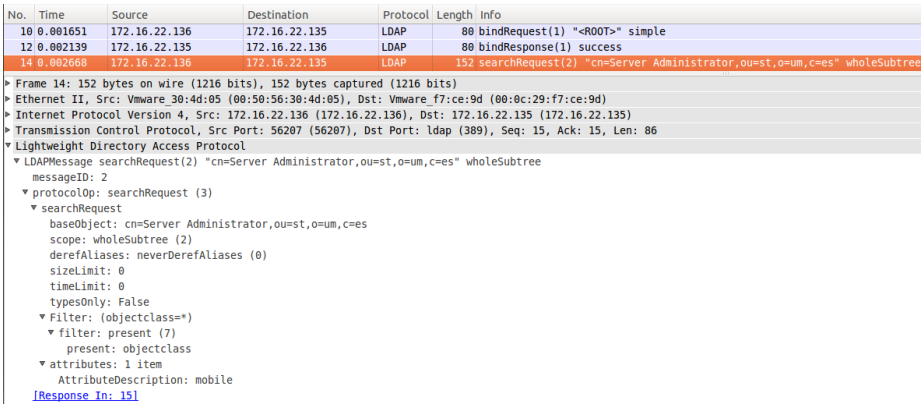
```
▸ Frame 12: 80 bytes on wire (640 bits), 80 bytes captured (640 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: ldap (389), Dst Port: 56207 (56207), Seq: 1, Ack: 15, Len: 14
▾ Lightweight Directory Access Protocol
  ▾ LDAPMessage bindResponse(1) success
      messageID: 1
    ▾ protocolOp: bindResponse (1)
      ▾ bindResponse
          resultCode: success (0)
          matchedDN:
          errorMessage:
      [Response To: 10]
      [Time: 0.000488000 seconds]
```

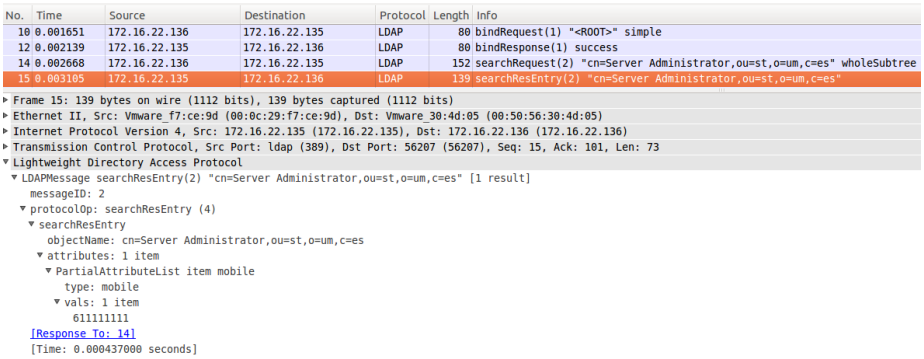
3) SearchRequest

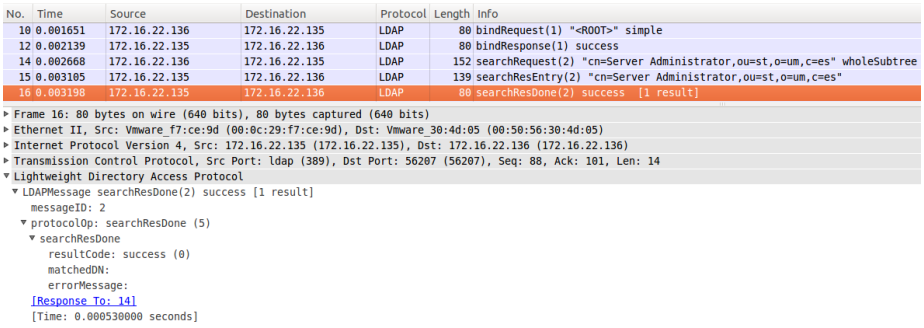
4) SearchResponse

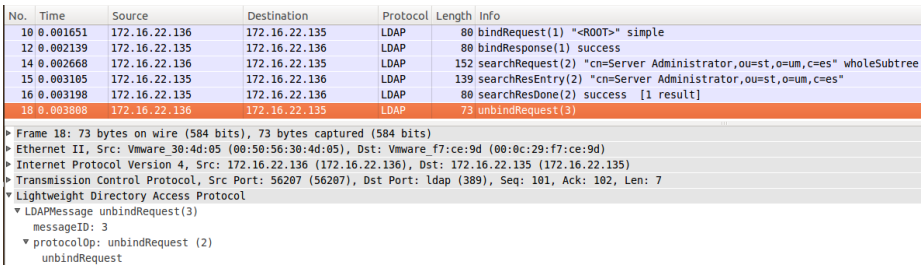
5) SearchDone

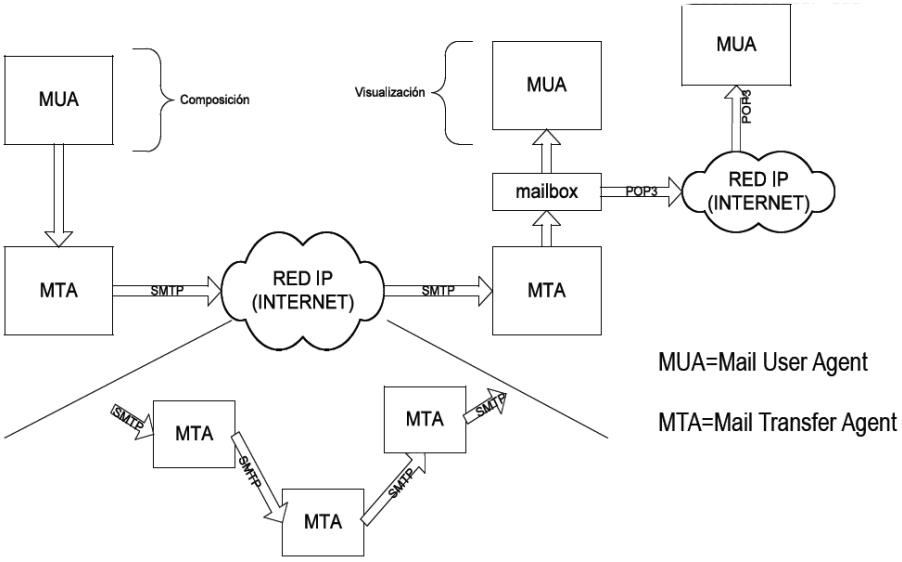
6) unbinRequest


No. Time Source Destination Protocol Length Info
10 0.001651 172.16.22.136 172.16.22.135 LDAP 80 bindRequest(1) "<ROOT>" simple
12 0.002139 172.16.22.135 172.16.22.136 LDAP 80 bindResponse(1) success
14 0.002668 172.16.22.136 172.16.22.135 LDAP 152 searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
Frame 14: 152 bytes on wire (1216 bits), 152 bytes captured (1216 bits)
Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
Transmission Control Protocol, Src Port: 56207 (56207), Dst Port: ldap (389), Seq: 15, Ack: 15, Len: 86
Lightweight Directory Access Protocol
LDAPMessage searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
messageID: 2
protocolOp: searchRequest (3)
searchRequest
baseObject: cn=Server Administrator,ou=st,o=um,c=es
scope: wholeSubtree (2)
derefAliases: neverDerefAliases (0)
sizeLimit: 0
timeLimit: 0
typesOnly: False
Filter: (objectclass=*)
filter: present (7)
present: objectclass
attributes: 1 item
AttributeDescription: mobile
[Response In: 15]


No. Time Source Destination Protocol Length Info
10 0.001651 172.16.22.136 172.16.22.135 LDAP 80 bindRequest(1) "<ROOT>" simple
12 0.002139 172.16.22.135 172.16.22.136 LDAP 80 bindResponse(1) success
14 0.002668 172.16.22.136 172.16.22.135 LDAP 152 searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
15 0.003105 172.16.22.135 172.16.22.136 LDAP 139 searchResEntry(2) "cn=Server Administrator,ou=st,o=um,c=es"
Frame 15: 139 bytes on wire (1112 bits), 139 bytes captured (1112 bits)
Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
Transmission Control Protocol, Src Port: ldap (389), Dst Port: 56207 (56207), Seq: 15, Ack: 101, Len: 73
Lightweight Directory Access Protocol
LDAPMessage searchResEntry(2) "cn=Server Administrator,ou=st,o=um,c=es" [1 result]
messageID: 2
protocolOp: searchResEntry (4)
searchResEntry
objectName: cn=Server Administrator,ou=st,o=um,c=es
attributes: 1 item
PartialAttributeList item mobile
type: mobile
vals: 1 item
611111111
[Response To: 14]
[Time: 0.000437000 seconds]


No. Time Source Destination Protocol Length Info
10 0.001651 172.16.22.136 172.16.22.135 LDAP 80 bindRequest(1) "<ROOT>" simple
12 0.002139 172.16.22.135 172.16.22.136 LDAP 80 bindResponse(1) success
14 0.002668 172.16.22.136 172.16.22.135 LDAP 152 searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
15 0.003105 172.16.22.135 172.16.22.136 LDAP 139 searchResEntry(2) "cn=Server Administrator,ou=st,o=um,c=es"
16 0.003198 172.16.22.135 172.16.22.136 LDAP 80 searchResDone(2) success [1 result]
Frame 16: 80 bytes on wire (640 bits), 80 bytes captured (640 bits)
Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
Transmission Control Protocol, Src Port: ldap (389), Dst Port: 56207 (56207), Seq: 88, Ack: 101, Len: 14
Lightweight Directory Access Protocol
LDAPMessage searchResDone(2) success [1 result]
messageID: 2
protocolOp: searchResDone (5)
searchResDone
resultCode: success (0)
matchedDN:
errorMessage:
[Response To: 14]
[Time: 0.000530000 seconds]


No. Time Source Destination Protocol Length Info
10 0.001651 172.16.22.136 172.16.22.135 LDAP 80 bindRequest(1) "<ROOT>" simple
12 0.002139 172.16.22.135 172.16.22.136 LDAP 80 bindResponse(1) success
14 0.002668 172.16.22.136 172.16.22.135 LDAP 152 searchRequest(2) "cn=Server Administrator,ou=st,o=um,c=es" wholeSubtree
15 0.003105 172.16.22.135 172.16.22.136 LDAP 139 searchResEntry(2) "cn=Server Administrator,ou=st,o=um,c=es"
16 0.003198 172.16.22.135 172.16.22.136 LDAP 80 searchResDone(2) success [1 result]
18 0.003808 172.16.22.136 172.16.22.135 LDAP 73 unbindRequest(3)
Frame 18: 73 bytes on wire (584 bits), 73 bytes captured (584 bits)
Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
Transmission Control Protocol, Src Port: 56207 (56207), Dst Port: ldap (389), Seq: 101, Ack: 102, Len: 7
Lightweight Directory Access Protocol
LDAPMessage unbindRequest(3)
messageID: 3
protocolOp: unbindRequest (2)
unbindRequest



7. Mail

Mail is the basic, oldest and most popular service of the internet.

When you want to send a mail, you going to deposit the mail in the receive mailbox of the receiver, but have a little problem: don't know the adress of the destination mailbox.

For know it, you need to use DNS query of the server name of the mailbox adress, and he say you the direction where you cand send the mail. And also the process is similar when you want to check your mail account. You can see this more later when We analyze the traffic with wireshark.

For support mail, you need support DNS before. This is because mail is based on mailbox concept: All mail accounts need a mailbox for send (**SMTP**) and receive (**POP3** or **IMAP**).

SMTP

Define the protocol necessary that transmit the message to the mailbox.

The options about how the message have to be interpreted is described in the **MIME** header.

`Content-Transfer-Encoding` s to avoid problems relaying the message for differents MTA. Can be:

- base64
- quoted-printable

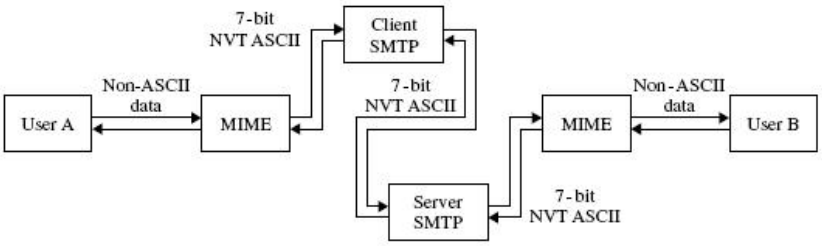


Figure 2: image

Header	Meaning
MIME-Version:	Identifies the MIME version
Content-Description:	Human-readable string telling what is in the message
Content-Id:	Unique identifier
Content-Transfer-Encoding:	How the body is wrapped for transmission
Content-Type:	Type and format of the content

- 7bit
- 8bit
- binary

The `Content-Type` can be:

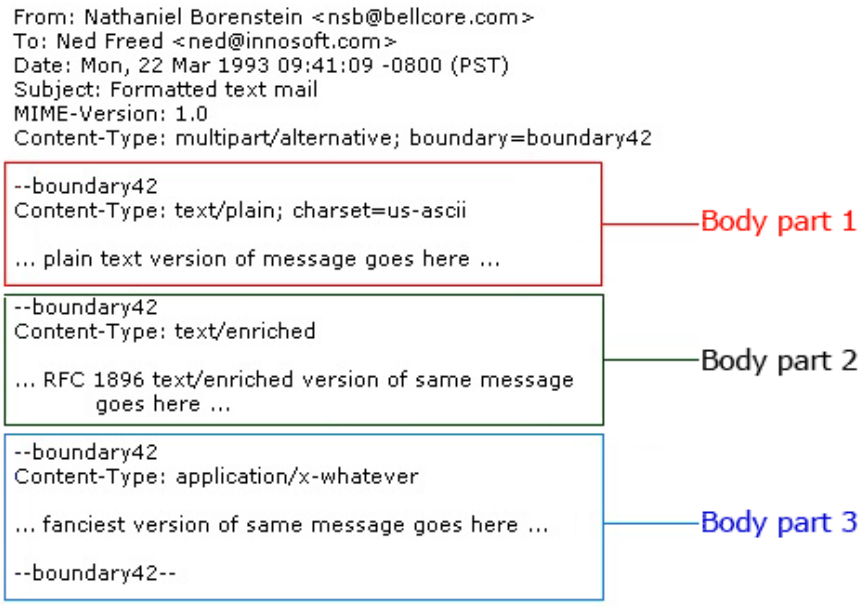
- text
- image
- audio
- video
- applitacion
- message
- multipart

Is necesary define `Content-Type` for multipart messages that contains different type (for example text and attachment)

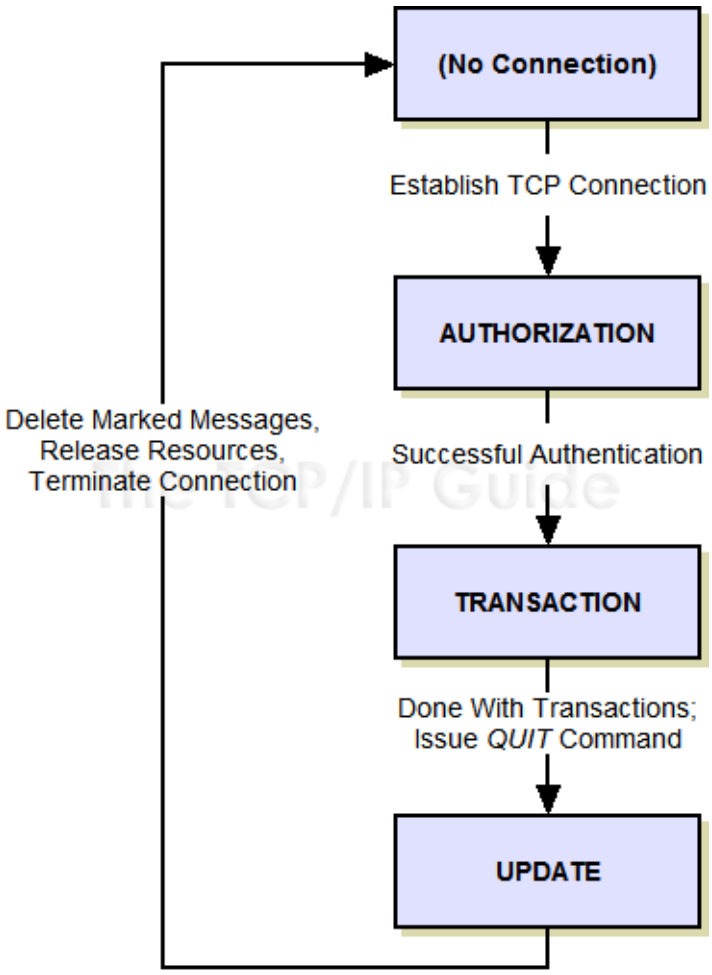
POP3

IMAP

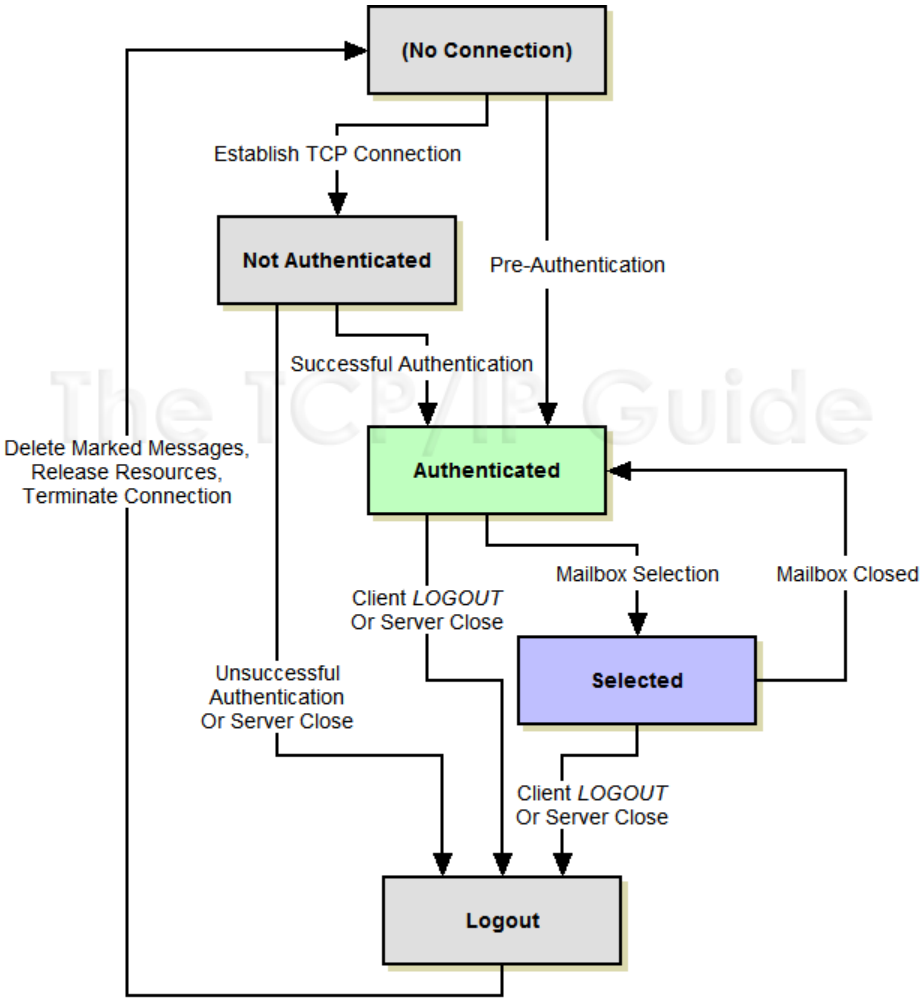
IMAP keep more stuff in the server, for example, structure of folders and messages that you want to recovery for read it.



All Body parts refer to the same data but in different formats with increasing complexiety.


(No Connection)
Establish TCP Connection
AUTHORIZATION
Successful Authentication
TRANSACTION
Done With Transactions;
Issue QUIT Command
UPDATE
Delete Marked Messages,
Release Resources,
Terminate Connection

The protocol established different states for the connection. Internally, when the connection is established, the server interprets the command that is contained in the messages and do the actions:



7.1. Mount your Mail

7.1.1 Your Mail in the server

we will set up two typical services for mail:

- **SMTP** is the protocol to can send emails.

- **POP3** is one of the posibles protrocols to receive mails that we are to use. The other common protocol is **IMAP**.

The differences between POP3 and IMAP are littles but importants:

POP3

IMAP

Since email needs to be downloaded into desktop PC before being displayed, you may have the following problems for POP3 access:

You need to download all email again when using another desktop PC to check your email.

May get confused if you need to check email both in the office and at home.

The downloaded email may be deleted from the server depending on the setting of your email client.

Since email is kept on server, it would gain the following benefits for IMAP access:

No need to download all email when using other desktop PC to check your email.

Easier to identify the unread email.

All messages as well as their attachments will be downloaded into desktop PC during the 'check new email' process.

A whole message will be downloaded only when it is opened for display from its content.

Mailboxes can only be created on desktop PC. There is only one mailbox (INBOX) exists on the server.

Multiple mailboxes can be created on the desktop PC as well as on the server.

Filters can transfer incoming/outgoing messages only to local mailboxes.

Filters can transfer incoming/outgoing messages to other mailboxes no matter where the mailboxes locate (on the server or the PC).

Outgoing email is stored only locally on the desktop PC.

Outgoing email can be filtered to a mailbox on server for accessibility from other machine.

Messages are deleted on the desktop PC. Comparatively, it is inconvenient to clean up your mailbox on the server.

Messages can be deleted directly on the server to make it more convenient to clean up your mailbox on the server.

Messages may be reloaded onto desktop PC several times due to the corruption of system files.

The occurrence of reloading messages from the server to PC is much less when compared to POP3.

7.1.2. Configuring POP3

1. Install the service **dovecot** for use POP3 in your server.
2. Configure defaults options in `/etc/dovecot/conf.d/10-auth.conf` and `/etc/dovecot/conf.d/10-mail.conf`.

7.1.3. Configuring SMTP

1. Install the service **exim4**
2. Configure standards options in `/etc/exim4/update-exim4.conf.conf` about your DNS:

```
dc_eximconfig_configtype='internet'
dc_other_hostnames='$DNS_NAME'
dc_local_interfaces=''
dc_readhost=''
dc_relay_domains='$RELAY_DOMAINS'
dc_minimaldns='false'
```


_ _ _
(_) | | | | |
_ _ __ ___| |_ __ _| | |
	'_ \/ __	__/ _`		
			__ \ || (_|		
_	_		_	___/____,_	_	_
client or server? [client/server]: server
Can you configure DNS? [yes/no]: no
Can you configure LDAP? [yes/no]: no
Can you configure SSH? [yes/no]: no
Can you configure SMTP? [yes/no]: yes
* Installing SMTP...
Reading package lists... Done
Building dependency tree
Reading state information... Done
exim4 is already the newest version.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
* Configuring...
Can you configure POP3? [yes/no]: yes
* Installing POP3...
Reading package lists... Done
Building dependency tree
Reading state information... Done
dovecot-pop3d is already the newest version.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
* Configuring...

```
dc_relay_nets='$LOCAL_NETWORK'
dc_smarthost=''
CFILEMODE='644'
dc_use_split_config='false'
dc_hide_mailname=''
dc_mailname_in_oh='true'
dc_localdelivery='maildir_home'
```

7.2. Check connectivity

For the test first we ping the DNS service and later do a telnet in the port of the service.

7.2.1. SMTP

```
josefranciscoverdugambin@ubuntu:~/server-for-dummies$ telnet 172.16.22.135 25
Trying 172.16.22.135...
Connected to 172.16.22.135.
Escape character is '^]'.
220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 20:58:08 +0200
HELO st.um
250 ubuntu Hello st.um [172.16.22.136]
MAIL FROM:<user1@st.um>
250 OK
RCPT TO:<user2@st.um>
250 Accepted
DATA
354 Enter message, ending with "." on a line by itself
Hello dummie!
.
250 OK id=1Wm6J3-0001mA-5P
QUIT
221 ubuntu closing connection
Connection closed by foreign host.
```

7.2.2. POP3

7.3. How Mail Works

7.3.1. SMTP

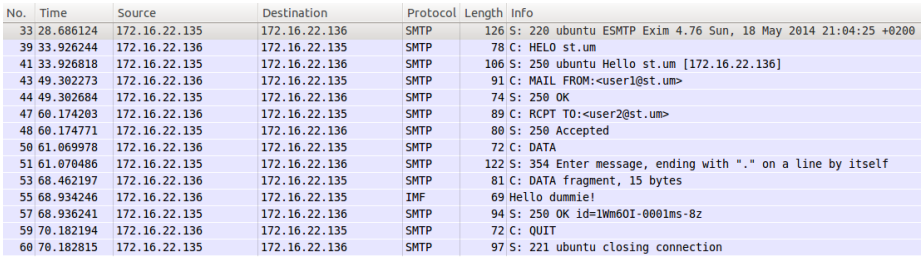
Resume

1) Server presentation

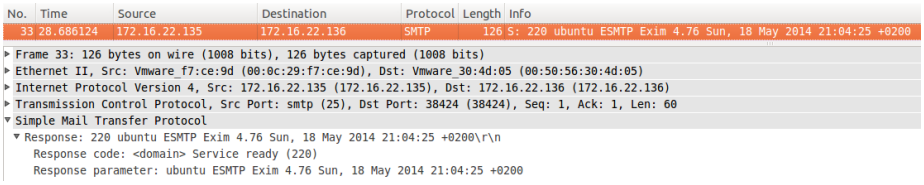
2) Client HELO and sending his IP

```
josefranciscoverdugambin@ubuntu:~$ telnet 172.16.22.135 110
Trying 172.16.22.135...
Connected to 172.16.22.135.
Escape character is '^]'.
+OK Dovecot ready.
USER user2
+OK
PASS password
+OK Logged in.
STAT
+OK 5 2453
LIST
+OK 5 messages:
1 633
2 621
3 401
4 397
5 401
.
RETR 5
+OK 401 octets
Return-path: <user1@st.um>
Envelope-to: user2@st.um
Delivery-date: Sun, 18 May 2014 21:05:06 +0200
Received: from [172.16.22.136] (helo=st.um)
        by ubuntu with smtp (Exim 4.76)
        (envelope-from <user1@st.um>)
        id 1Wm6OI-0001ms-8z
        for user2@st.um; Sun, 18 May 2014 21:05:06 +0200
Message-Id: <E1Wm6OI-0001ms-8z@ubuntu>
From: user1@st.um
Date: Sun, 18 May 2014 21:05:06 +0200

Hello dummie!
.
DELE 1
+OK Marked to be deleted.
QUIT
+OK Logging out, messages deleted.
Connection closed by foreign host.
```

Header	Meaning
To:	E-mail address(es) of primary recipient(s)
Cc:	E-mail address(es) of secondary recipient(s)
Bcc:	E-mail address(es) for blind carbon copies
From:	Person or people who created the message
Sender:	E-mail address of the actual sender
Received:	Line added by each transfer agent along the route
Return-Path:	Can be used to identify a path back to the sender

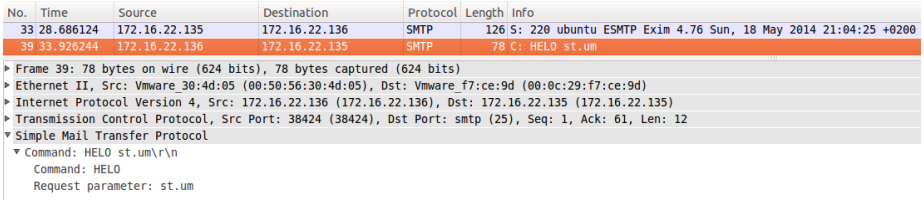


No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes
55	68.934246	172.16.22.136	172.16.22.135	IMF	69	Hello dummie!
57	68.936241	172.16.22.135	172.16.22.136	SMTP	94	S: 250 OK id=1Wm6OI-0001ms-8z
59	70.182194	172.16.22.136	172.16.22.135	SMTP	72	C: QUIT
60	70.182815	172.16.22.135	172.16.22.136	SMTP	97	S: 221 ubuntu closing connection



No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200

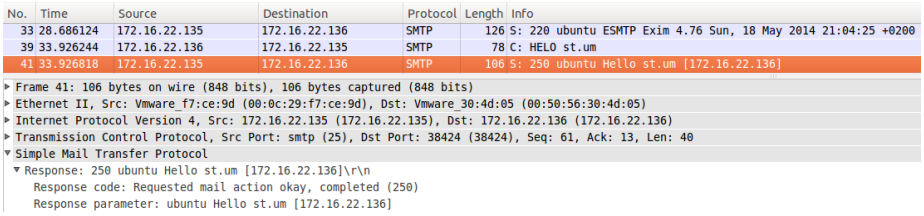
```
▸ Frame 33: 126 bytes on wire (1008 bits), 126 bytes captured (1008 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: smtp (25), Dst Port: 38424 (38424), Seq: 1, Ack: 1, Len: 60
▾ Simple Mail Transfer Protocol
  ▾ Response: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200\r\n
      Response code: <domain> Service ready (220)
      Response parameter: ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
```



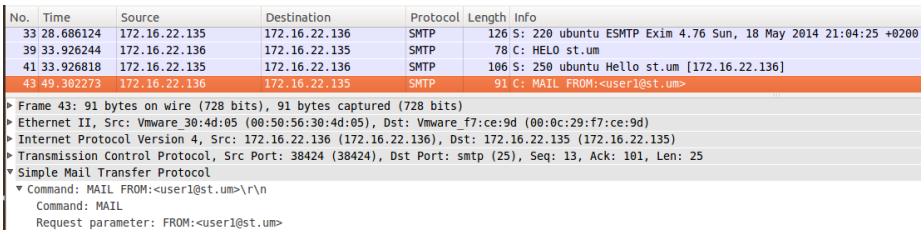
No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um

```
▸ Frame 39: 78 bytes on wire (624 bits), 78 bytes captured (624 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 1, Ack: 61, Len: 12
▾ Simple Mail Transfer Protocol
  ▾ Command: HELO st.um\r\n
      Command: HELO
      Request parameter: st.um
```

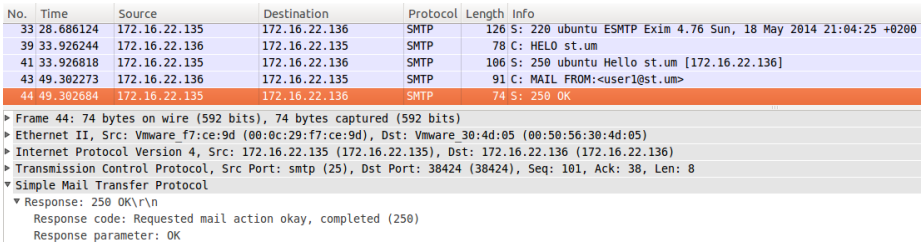
3) Server reply



4) Client FROM mail account

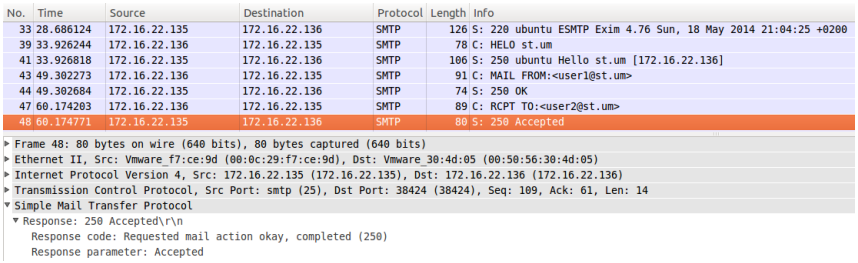


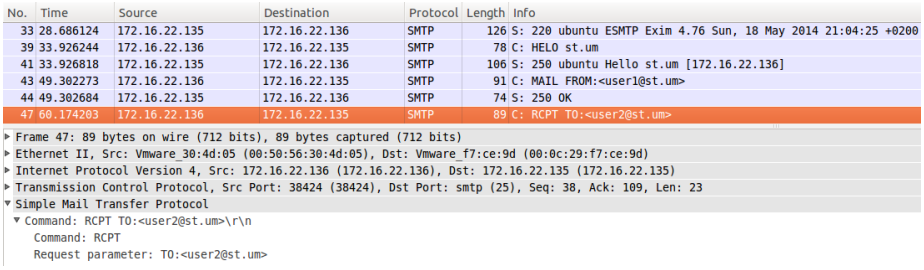
5) Server reply



6) Client send RCTP mail account

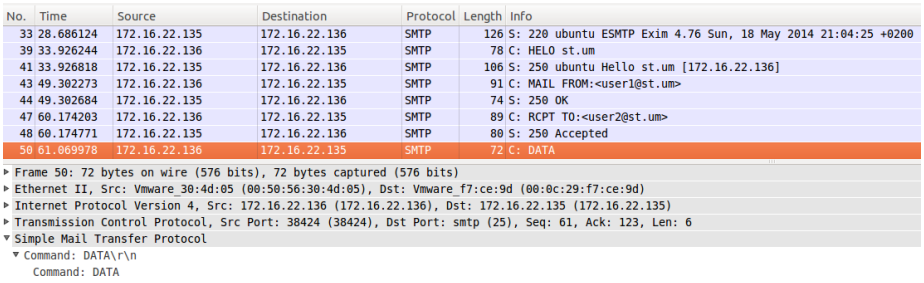
7) Server reply





No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>

```
▸ Frame 47: 89 bytes on wire (712 bits), 89 bytes captured (712 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 38, Ack: 109, Len: 23
▾ Simple Mail Transfer Protocol
  ▾ Command: RCPT TO:<user2@st.um>\r\n
      Command: RCPT
      Request parameter: TO:<user2@st.um>
```

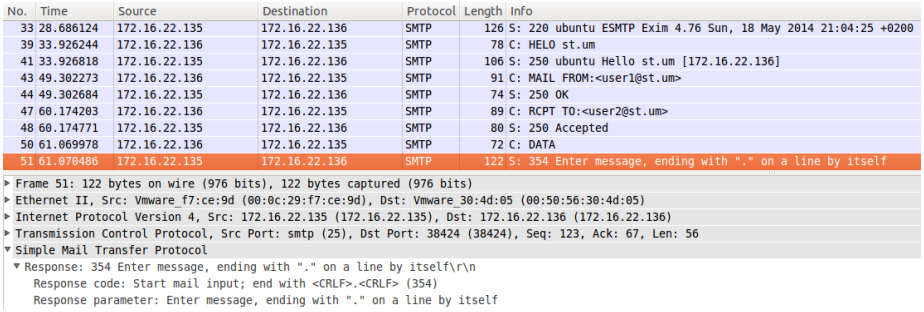


No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA

```
▸ Frame 50: 72 bytes on wire (576 bits), 72 bytes captured (576 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 61, Ack: 123, Len: 6
▾ Simple Mail Transfer Protocol
  ▾ Command: DATA\r\n
      Command: DATA
```

8) Client prepare to send DATA

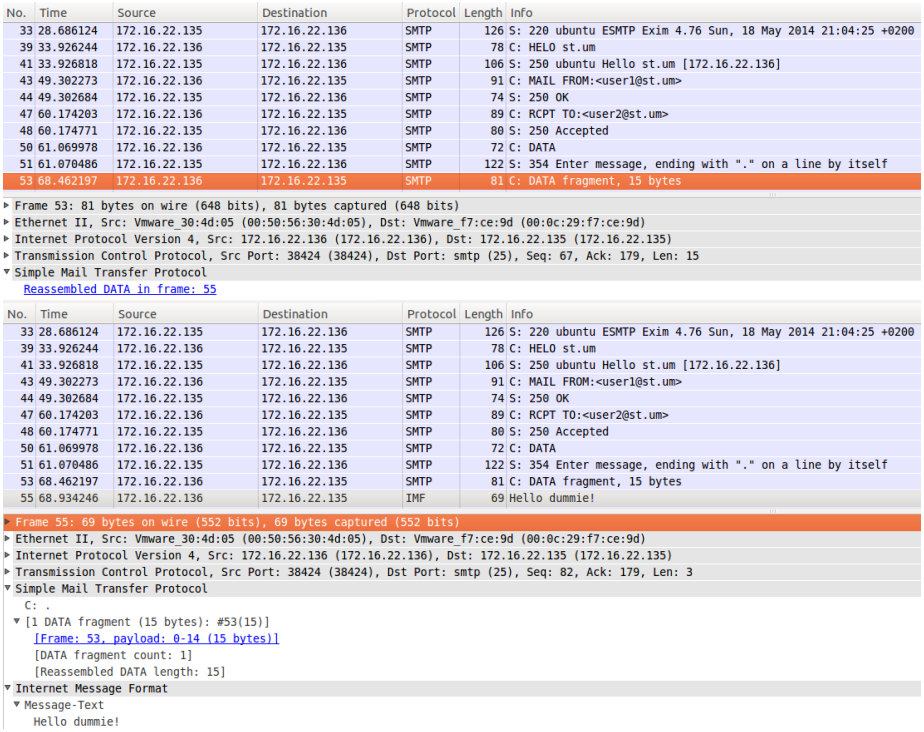
9) Server reply and say that write a “.” to finish the message



No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself

```
▸ Frame 51: 122 bytes on wire (976 bits), 122 bytes captured (976 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: smtp (25), Dst Port: 38424 (38424), Seq: 123, Ack: 67, Len: 56
▾ Simple Mail Transfer Protocol
  ▾ Response: 354 Enter message, ending with "." on a line by itself\r\n
      Response code: Start mail input; end with <CRLF>.<CRLF> (354)
      Response parameter: Enter message, ending with "." on a line by itself
```

10) Client send the text of the message



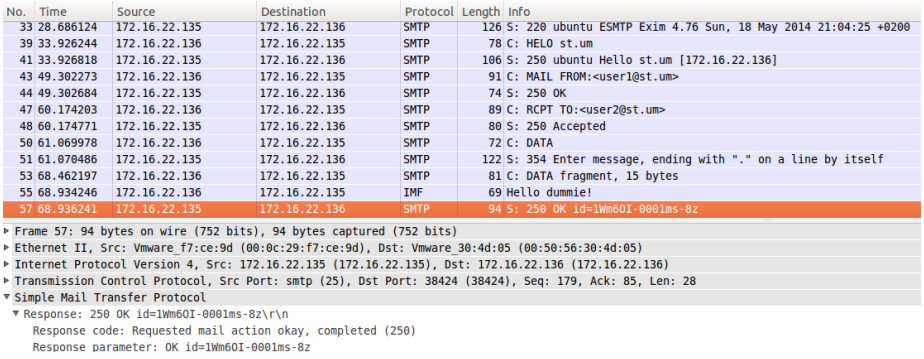
No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes

```
▸ Frame 53: 81 bytes on wire (648 bits), 81 bytes captured (648 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 67, Ack: 179, Len: 15
▾ Simple Mail Transfer Protocol
    Reassembled DATA in frame: 55
```

No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes
55	68.934246	172.16.22.136	172.16.22.135	IMF	69	Hello dummie!

```
▸ Frame 55: 69 bytes on wire (552 bits), 69 bytes captured (552 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 82, Ack: 179, Len: 3
▾ Simple Mail Transfer Protocol
    C: .
  ▾ [1 DATA fragment (15 bytes): #53(15)]
      [Frame: 53, payload: 0-14 (15 bytes)]
      [DATA fragment count: 1]
      [Reassembled DATA length: 15]
▾ Internet Message Format
  ▾ Message-Text
      Hello dummie!
```

11) Server reply when the client finish to send the message

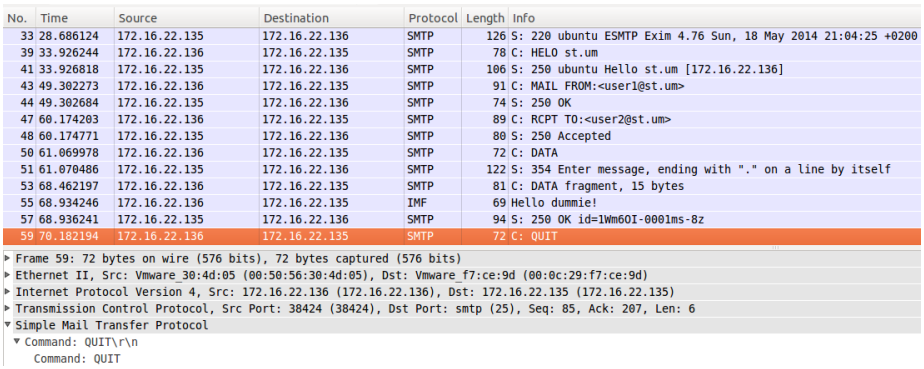


No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes
55	68.934246	172.16.22.136	172.16.22.135	IMF	69	Hello dummie!
57	68.936241	172.16.22.135	172.16.22.136	SMTP	94	S: 250 OK id=1Wm6OI-0001ms-8z

```
▸ Frame 57: 94 bytes on wire (752 bits), 94 bytes captured (752 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: smtp (25), Dst Port: 38424 (38424), Seq: 179, Ack: 85, Len: 28
▾ Simple Mail Transfer Protocol
  ▾ Response: 250 OK id=1Wm6OI-0001ms-8z\r\n
      Response code: Requested mail action okay, completed (250)
      Response parameter: OK id=1Wm6OI-0001ms-8z
```

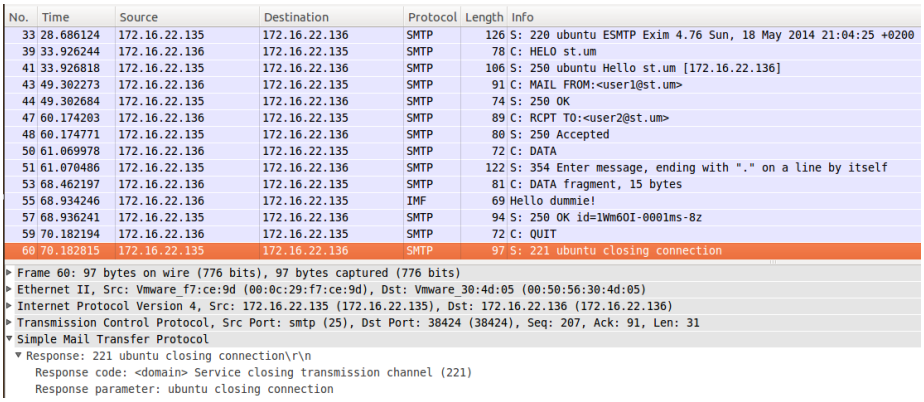
12) Client termiante the connection

13) Server reply



No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes
55	68.934246	172.16.22.136	172.16.22.135	IMF	69	Hello dummie!
57	68.936241	172.16.22.135	172.16.22.136	SMTP	94	S: 250 OK id=1Wm6OI-0001ms-8z
59	70.182194	172.16.22.136	172.16.22.135	SMTP	72	C: QUIT

```
▸ Frame 59: 72 bytes on wire (576 bits), 72 bytes captured (576 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 38424 (38424), Dst Port: smtp (25), Seq: 85, Ack: 207, Len: 6
▾ Simple Mail Transfer Protocol
  ▾ Command: QUIT\r\n
      Command: QUIT
```



No.	Time	Source	Destination	Protocol	Length	Info
33	28.686124	172.16.22.135	172.16.22.136	SMTP	126	S: 220 ubuntu ESMTP Exim 4.76 Sun, 18 May 2014 21:04:25 +0200
39	33.926244	172.16.22.136	172.16.22.135	SMTP	78	C: HELO st.um
41	33.926818	172.16.22.135	172.16.22.136	SMTP	106	S: 250 ubuntu Hello st.um [172.16.22.136]
43	49.302273	172.16.22.136	172.16.22.135	SMTP	91	C: MAIL FROM:<user1@st.um>
44	49.302684	172.16.22.135	172.16.22.136	SMTP	74	S: 250 OK
47	60.174203	172.16.22.136	172.16.22.135	SMTP	89	C: RCPT TO:<user2@st.um>
48	60.174771	172.16.22.135	172.16.22.136	SMTP	80	S: 250 Accepted
50	61.069978	172.16.22.136	172.16.22.135	SMTP	72	C: DATA
51	61.070486	172.16.22.135	172.16.22.136	SMTP	122	S: 354 Enter message, ending with "." on a line by itself
53	68.462197	172.16.22.136	172.16.22.135	SMTP	81	C: DATA fragment, 15 bytes
55	68.934246	172.16.22.136	172.16.22.135	IMF	69	Hello dummie!
57	68.936241	172.16.22.135	172.16.22.136	SMTP	94	S: 250 OK id=1Wm6OI-0001ms-8z
59	70.182194	172.16.22.136	172.16.22.135	SMTP	72	C: QUIT
60	70.182815	172.16.22.135	172.16.22.136	SMTP	97	S: 221 ubuntu closing connection

```
▸ Frame 60: 97 bytes on wire (776 bits), 97 bytes captured (776 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: smtp (25), Dst Port: 38424 (38424), Seq: 207, Ack: 91, Len: 31
▾ Simple Mail Transfer Protocol
  ▾ Response: 221 ubuntu closing connection\r\n
      Response code: <domain> Service closing transmission channel (221)
      Response parameter: ubuntu closing connection
```

7.3.2. POP3

The most commonly used commands in a POP3 connection are as follows:

USER PASS Command to make login with a username and password. The server response if the login is correct or not.

STAT STAT simply responds with a single line consisting of two numbers: the number of messages in the box and the total size of those messages in bytes. It's useful for human beings, but less so for automatic clients, which are likely to jump straight to the LIST command.

LIST LIST lists the contents of the mailbox, naturally enough. It does so by using the standard POP3 multi-line response format. Here's an example: LIST +OK Mailbox contents follow 1 7774 2 513 3 10493 . The terminating line is a period on a line by itself, which is pretty standard for mail protocols in general. Each line consists of the mail message number (if you delete one, it won't appear in the list, so don't fall into the trap that the numbers are sequential and can thus be ignored!) followed by the size of the message in bytes. LIST plus a message number will simply act like STAT for that message.

RETR msg RETR retrieves a message. Use the message number from LIST. Note that you'll receive the true text of the message, headers followed by a blank line followed by the body, followed by a period on a line by itself. If the body actually contains a period on a line by itself, the mail server will already have doubled that period. So your client needs to undouble it.

DELE msg DELE deletes a message. It won't actually be deleted until you QUIT the session, and you can undelete everything you've deleted (in case of a mistake) by using RSET.

RSET You can reset the session to its initial state using the RSET command. This will undelete all messages deleted using DELE.

TOP msg n TOP is actually an optional command, but most servers support it now. It returns the headers of message msg plus n lines of the body. If n is zero, of course, you just get the headers, which is nice for doing filtering without having to get the entire message.

QUIT QUIT terminates the session and deletes any messages marked with DELE.

Resume

1) Server presentation2.

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets
353	2581.114184	172.16.22.136	172.16.22.135	POP	74	C: DELE 1
354	2581.114575	172.16.22.135	172.16.22.136	POP	93	S: +OK Marked to be deleted.
356	2585.346207	172.16.22.136	172.16.22.135	POP	72	C: QUIT
357	2585.347721	172.16.22.135	172.16.22.136	POP	102	S: +OK Logging out, messages deleted.

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.

```
▸ Frame 329: 86 bytes on wire (688 bits), 86 bytes captured (688 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 1, Ack: 1, Len: 20
▾ Post Office Protocol
  ▸ +OK Dovecot ready.\r\n
```

2) Client identify with USER command

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2

```
▸ Frame 335: 78 bytes on wire (624 bits), 78 bytes captured (624 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 1, Ack: 21, Len: 12
▾ Post Office Protocol
  ▾ USER user2\r\n
      Request command: USER
      Request parameter: user2
```

3) Server reply

4) Client type password with PASS command

5) Server reply and say that loggin is correct

6) Client use STAT command

7) Server Reply

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK

```
▸ Frame 337: 71 bytes on wire (568 bits), 71 bytes captured (568 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 21, Ack: 13, Len: 5
▾ Post Office Protocol
  ▾ +OK\r\n
      Response indicator: +OK
```

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password

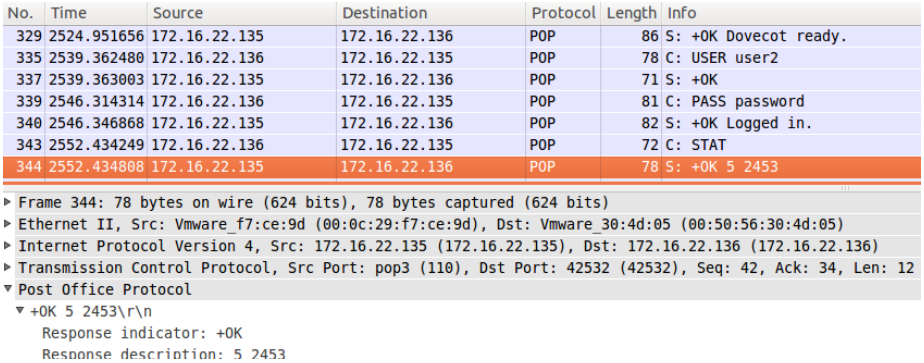
```
▸ Frame 339: 81 bytes on wire (648 bits), 81 bytes captured (648 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 13, Ack: 26, Len: 15
▾ Post Office Protocol
  ▾ PASS password\r\n
      Request command: PASS
      Request parameter: password
```

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.

```
▸ Frame 340: 82 bytes on wire (656 bits), 82 bytes captured (656 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 26, Ack: 28, Len: 16
▾ Post Office Protocol
  ▾ +OK Logged in.\r\n
      Response indicator: +OK
      Response description: Logged in.
```

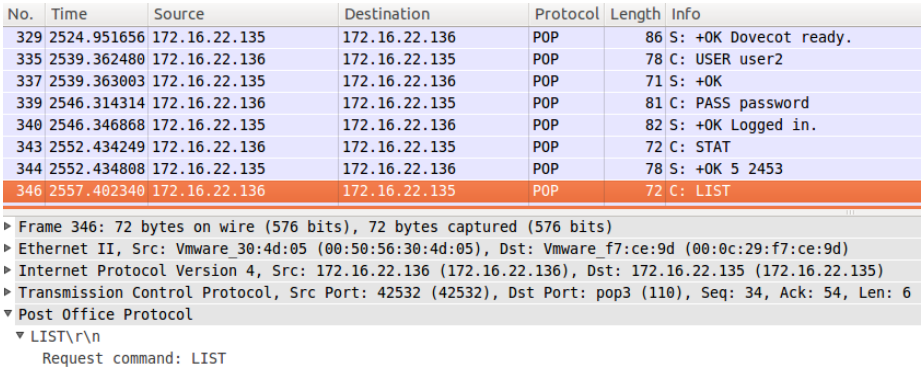
No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT

```
▸ Frame 343: 72 bytes on wire (576 bits), 72 bytes captured (576 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 28, Ack: 42, Len: 6
▾ Post Office Protocol
  ▾ STAT\r\n
      Request command: STAT
```



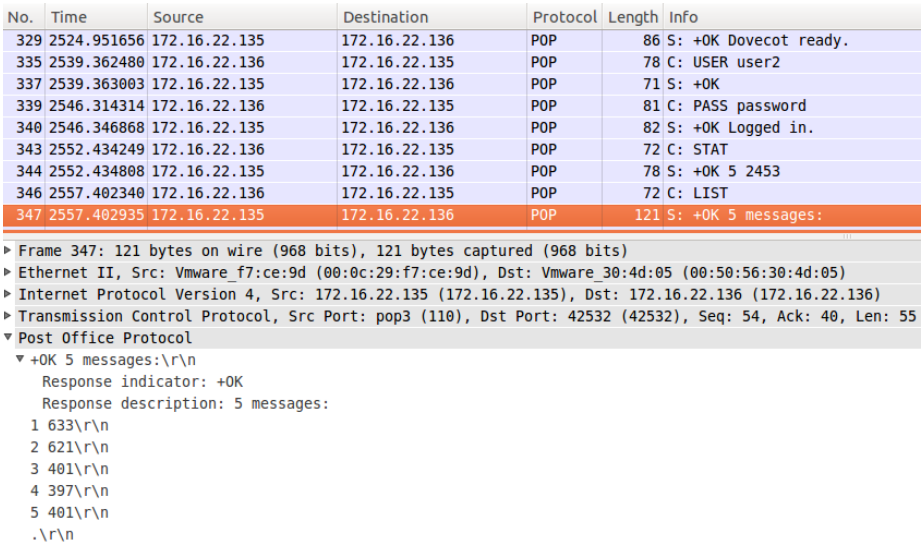
No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453

```
▸ Frame 344: 78 bytes on wire (624 bits), 78 bytes captured (624 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 42, Ack: 34, Len: 12
▾ Post Office Protocol
  ▾ +OK 5 2453\r\n
      Response indicator: +OK
      Response description: 5 2453
```



No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST

```
▸ Frame 346: 72 bytes on wire (576 bits), 72 bytes captured (576 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 34, Ack: 54, Len: 6
▾ Post Office Protocol
  ▾ LIST\r\n
      Request command: LIST
```



No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:

```
▸ Frame 347: 121 bytes on wire (968 bits), 121 bytes captured (968 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 54, Ack: 40, Len: 55
▾ Post Office Protocol
  ▾ +OK 5 messages:\r\n
      Response indicator: +OK
      Response description: 5 messages:
    1 633\r\n
    2 621\r\n
    3 401\r\n
    4 397\r\n
    5 401\r\n
    .\r\n
```

8) Client use LIST command

9) Server reply with list of messages

10) Client say that want to see the message No.5

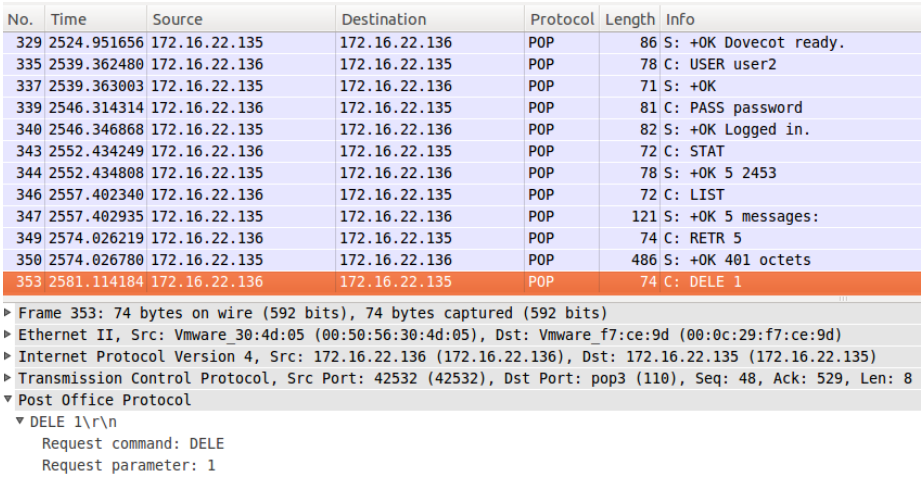
No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5

```
▸ Frame 349: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 40, Ack: 109, Len: 8
▾ Post Office Protocol
  ▾ RETR 5\r\n
      Request command: RETR
      Request parameter: 5
```

11) Server reply with the message content

No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot re
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets

```
▸ Frame 350: 486 bytes on wire (3888 bits), 486 bytes captured (3888 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 109, Ack
▾ Post Office Protocol
  ▾ +OK 401 octets\r\n
      Response indicator: +OK
      Response description: 401 octets
    Return-path: <user1@st.um>\r\n
    Envelope-to: user2@st.um\r\n
    Delivery-date: Sun, 18 May 2014 21:05:06 +0200\r\n
    Received: from [172.16.22.136] (helo=st.um)\r\n
    \tby ubuntu with smtp (Exim 4.76)\r\n
    \t(envelope-from <user1@st.um>)\r\n
    \tid 1Wm6OI-0001ms-8z\r\n
    \tfor user2@st.um; Sun, 18 May 2014 21:05:06 +0200\r\n
    Message-Id: <E1Wm6OI-0001ms-8z@ubuntu>\r\n
    From: user1@st.um\r\n
    Date: Sun, 18 May 2014 21:05:06 +0200\r\n
    \r\n
    Hello dummie!\r\n
    .\r\n
```

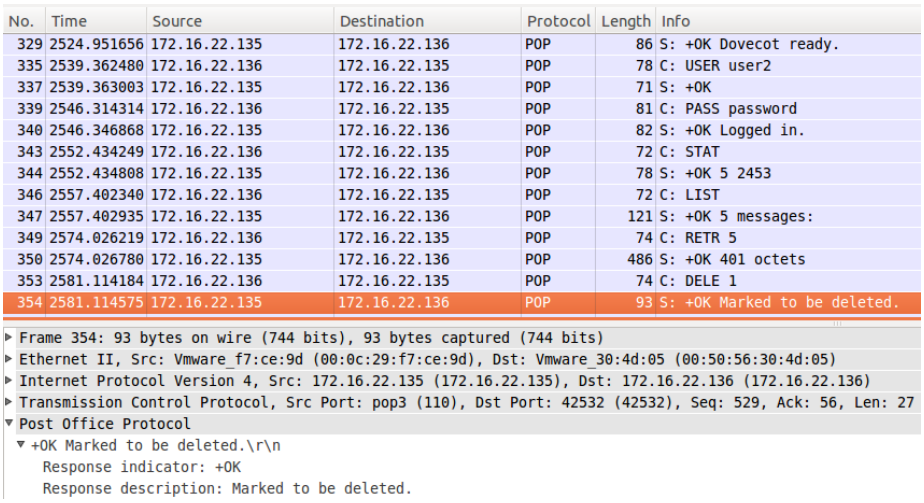


No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets
353	2581.114184	172.16.22.136	172.16.22.135	POP	74	C: DELE 1

```
▸ Frame 353: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 48, Ack: 529, Len: 8
▾ Post Office Protocol
  ▾ DELE 1\r\n
      Request command: DELE
      Request parameter: 1
```

12) Client use DELE command

13) Server reply

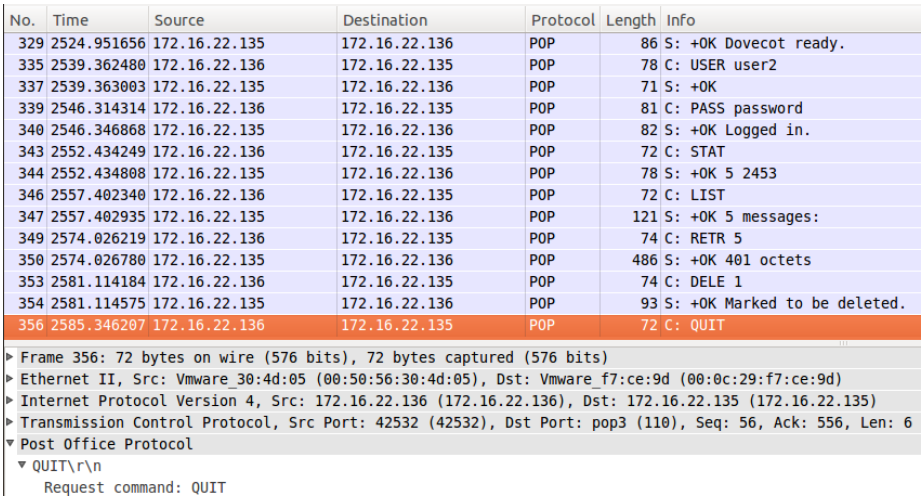


No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets
353	2581.114184	172.16.22.136	172.16.22.135	POP	74	C: DELE 1
354	2581.114575	172.16.22.135	172.16.22.136	POP	93	S: +OK Marked to be deleted.

```
▸ Frame 354: 93 bytes on wire (744 bits), 93 bytes captured (744 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 529, Ack: 56, Len: 27
▾ Post Office Protocol
  ▾ +OK Marked to be deleted.\r\n
      Response indicator: +OK
      Response description: Marked to be deleted.
```

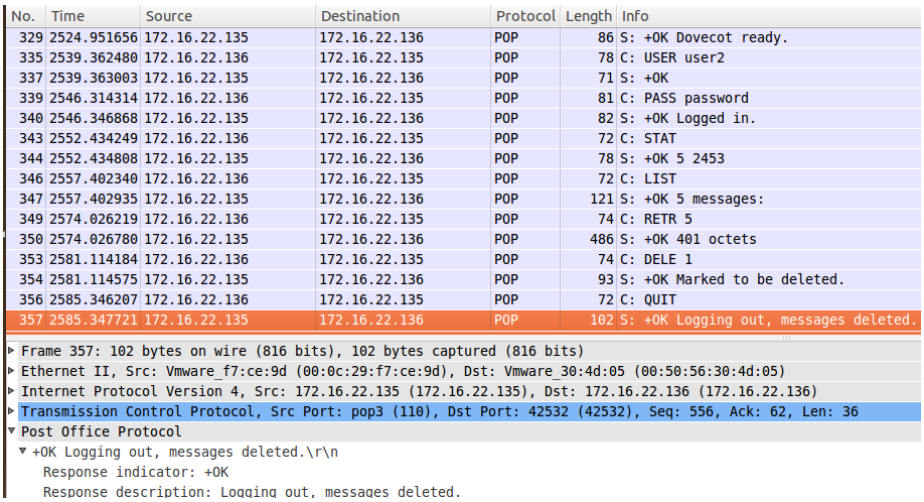
14) Client use QUIT command for desconnection

15) Server reply



No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets
353	2581.114184	172.16.22.136	172.16.22.135	POP	74	C: DELE 1
354	2581.114575	172.16.22.135	172.16.22.136	POP	93	S: +OK Marked to be deleted.
356	2585.346207	172.16.22.136	172.16.22.135	POP	72	C: QUIT

```
▸ Frame 356: 72 bytes on wire (576 bits), 72 bytes captured (576 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.136 (172.16.22.136), Dst: 172.16.22.135 (172.16.22.135)
▸ Transmission Control Protocol, Src Port: 42532 (42532), Dst Port: pop3 (110), Seq: 56, Ack: 556, Len: 6
▾ Post Office Protocol
  ▾ QUIT\r\n
      Request command: QUIT
```



No.	Time	Source	Destination	Protocol	Length	Info
329	2524.951656	172.16.22.135	172.16.22.136	POP	86	S: +OK Dovecot ready.
335	2539.362480	172.16.22.136	172.16.22.135	POP	78	C: USER user2
337	2539.363003	172.16.22.135	172.16.22.136	POP	71	S: +OK
339	2546.314314	172.16.22.136	172.16.22.135	POP	81	C: PASS password
340	2546.346868	172.16.22.135	172.16.22.136	POP	82	S: +OK Logged in.
343	2552.434249	172.16.22.136	172.16.22.135	POP	72	C: STAT
344	2552.434808	172.16.22.135	172.16.22.136	POP	78	S: +OK 5 2453
346	2557.402340	172.16.22.136	172.16.22.135	POP	72	C: LIST
347	2557.402935	172.16.22.135	172.16.22.136	POP	121	S: +OK 5 messages:
349	2574.026219	172.16.22.136	172.16.22.135	POP	74	C: RETR 5
350	2574.026780	172.16.22.135	172.16.22.136	POP	486	S: +OK 401 octets
353	2581.114184	172.16.22.136	172.16.22.135	POP	74	C: DELE 1
354	2581.114575	172.16.22.135	172.16.22.136	POP	93	S: +OK Marked to be deleted.
356	2585.346207	172.16.22.136	172.16.22.135	POP	72	C: QUIT
357	2585.347721	172.16.22.135	172.16.22.136	POP	102	S: +OK Logging out, messages deleted.

```
▸ Frame 357: 102 bytes on wire (816 bits), 102 bytes captured (816 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.135 (172.16.22.135), Dst: 172.16.22.136 (172.16.22.136)
▸ Transmission Control Protocol, Src Port: pop3 (110), Dst Port: 42532 (42532), Seq: 556, Ack: 62, Len: 36
▾ Post Office Protocol
  ▾ +OK Logging out, messages deleted.\r\n
      Response indicator: +OK
      Response description: Logging out, messages deleted.
```

8. SSH

SSH (*Secure Shell*) is a cryptographic network protocol for secure data communication, remote command-line login, remote command execution, and other secure network services between two networked computers.

It was designed as a replacement for Telnet and other insecure remote shell protocols such as the Berkeley rsh and rexec protocols, which send information, notably passwords, in plaintext, rendering them susceptible to interception and disclosure using packet analysis. The encryption used by SSH is intended to provide confidentiality and integrity of data over an unsecured network, such as the Internet.

8.1. Mount your SSH

8.1.1. Your SSH in the client

The client needs **openssh-client** that is usually installed on UNIX systems default

Also need to generate a **SSH public key** to identify the computer. SSH keys are a way to identify trusted computers, without involving passwords.

Check your SSH keys

```
cd ~/.ssh
ls -al
# Lists the files in your .ssh directory
```

Generate a new SSH key

```
ssh-keygen -t rsa -C "your_email@example.com"
# Creates a new ssh key, using the provided email as a label
# Generating public/private rsa key pair.
# Enter file in which to save the key (/Users/you/.ssh/id_rsa): [Press enter]
Enter passphrase (empty for no passphrase): [Type a passphrase]
# Enter same passphrase again: [Type passphrase again]
Your identification has been saved in /Users/you/.ssh/id_rsa.
# Your public key has been saved in /Users/you/.ssh/id_rsa.pub.
# The key fingerprint is:
# 01:0f:f4:3b:ca:85:d6:17:a1:7d:f0:68:9d:f0:a2:db your_email@example.com
```

8.1.2. Your SSH in the server

Only need to install **openssh-server**.

8.2. Check connectivity

```
josefranciscoverdugambin@ubuntu:~$ ssh user1@st.um
The authenticity of host 'st.um (172.16.22.142)' can't be established.
ECDSA key fingerprint is 16:04:38:b4:08:ed:ca:80:2f:59:e0:c3:30:2e:b2:2e.
Are you sure you want to continue connecting (yes/no)? yes
Failed to add the host to the list of known hosts (/home/josefranciscoverdugambin/.ssh/known_hosts)
.
user1@st.um's password:
Welcome to Ubuntu 12.04.4 LTS (GNU/Linux 3.8.0-39-generic i686)

 * Documentation:  https://help.ubuntu.com/

Last login: Fri May 23 16:17:24 2014 from 172.16.22.141
$ ls -l
total 48
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Desktop
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Documents
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Downloads
drwx------ 5 user1 user1 4096 may 18 21:02 Maildir
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Music
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Pictures
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Public
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Templates
drwxr-xr-x 2 user1 user1 4096 may 18 17:22 Videos
-rw-r--r-- 1 user1 user1 8445 abr 16  2012 examples.desktop
$
```

8.3. How SSH works

Resume of messages:

No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH 5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init
16	0.007561	172.16.22.142	172.16.22.141	SSHv2	1050	Server: Key Exchange Init
17	0.008331	172.16.22.141	172.16.22.142	SSHv2	146	Client: Diffie-Hellman Key Exchange Init
18	0.010465	172.16.22.142	172.16.22.141	SSHv2	378	Server: New Keys
20	1.597953	172.16.22.141	172.16.22.142	SSHv2	82	Client: New Keys
22	1.635517	172.16.22.141	172.16.22.142	TCP	114	[TCP segment of a reassembled PDU]
24	1.635864	172.16.22.142	172.16.22.141	TCP	114	[TCP segment of a reassembled PDU]

1) Client first message

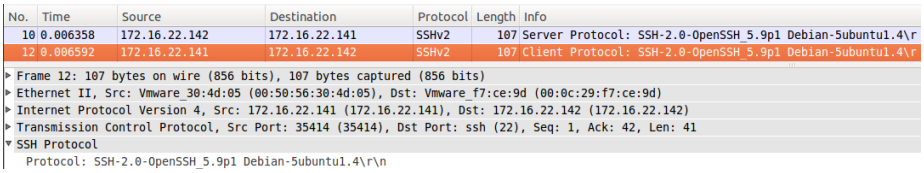
No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH 5.9p1 Debian-5ubuntu1.4\r

```
▸ Frame 10: 107 bytes on wire (856 bits), 107 bytes captured (856 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.142 (172.16.22.142), Dst: 172.16.22.141 (172.16.22.141)
▸ Transmission Control Protocol, Src Port: ssh (22), Dst Port: 35414 (35414), Seq: 1, Ack: 1, Len: 41
▾ SSH Protocol
    Protocol: SSH-2.0-OpenSSH 5.9p1 Debian-5ubuntu1.4\r\n
```

2) Server first message

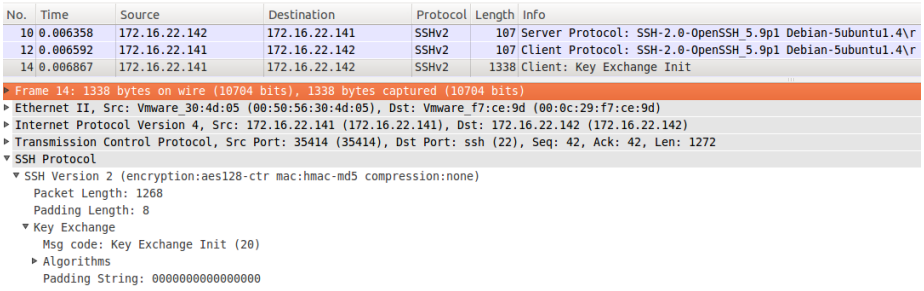
3) Client send `CLIENT_KEY_EXCHANGE`

4) Server send `CLIENT_KEY_EXCHANGE`



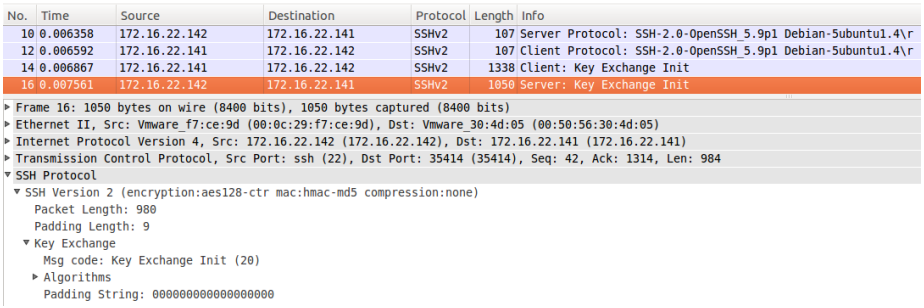
No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r

```
▸ Frame 12: 107 bytes on wire (856 bits), 107 bytes captured (856 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.141 (172.16.22.141), Dst: 172.16.22.142 (172.16.22.142)
▸ Transmission Control Protocol, Src Port: 35414 (35414), Dst Port: ssh (22), Seq: 1, Ack: 42, Len: 41
▾ SSH Protocol
    Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r\n
```



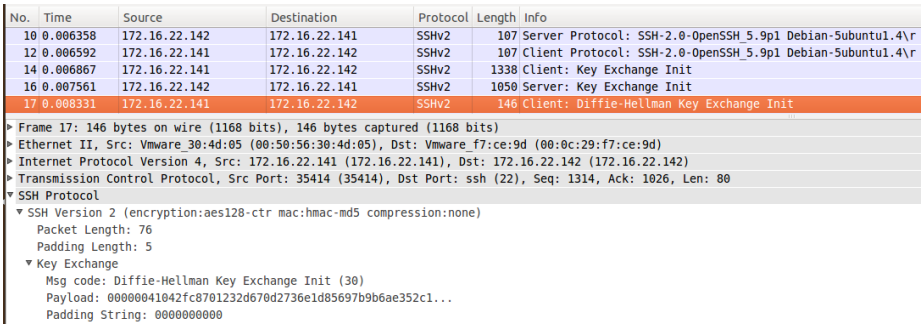
No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init

```
▸ Frame 14: 1338 bytes on wire (10704 bits), 1338 bytes captured (10704 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.141 (172.16.22.141), Dst: 172.16.22.142 (172.16.22.142)
▸ Transmission Control Protocol, Src Port: 35414 (35414), Dst Port: ssh (22), Seq: 42, Ack: 42, Len: 1272
▾ SSH Protocol
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 1268
      Padding Length: 8
    ▾ Key Exchange
        Msg code: Key Exchange Init (20)
      ▸ Algorithms
        Padding String: 0000000000000000
```



No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init
16	0.007561	172.16.22.142	172.16.22.141	SSHv2	1050	Server: Key Exchange Init

```
▸ Frame 16: 1050 bytes on wire (8400 bits), 1050 bytes captured (8400 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.142 (172.16.22.142), Dst: 172.16.22.141 (172.16.22.141)
▸ Transmission Control Protocol, Src Port: ssh (22), Dst Port: 35414 (35414), Seq: 42, Ack: 1314, Len: 984
▾ SSH Protocol
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 980
      Padding Length: 9
    ▾ Key Exchange
        Msg code: Key Exchange Init (20)
      ▸ Algorithms
        Padding String: 000000000000000000
```

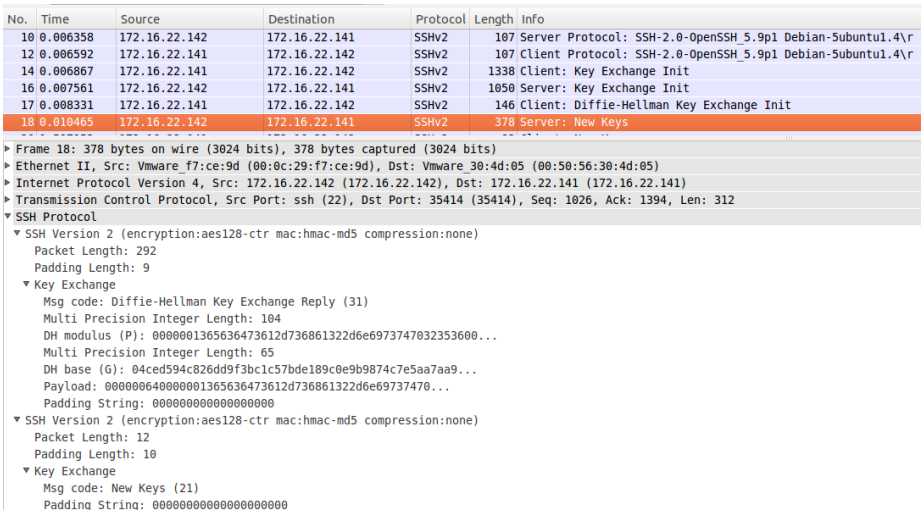


No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init
16	0.007561	172.16.22.142	172.16.22.141	SSHv2	1050	Server: Key Exchange Init
17	0.008331	172.16.22.141	172.16.22.142	SSHv2	146	Client: Diffie-Hellman Key Exchange Init

```
▸ Frame 17: 146 bytes on wire (1168 bits), 146 bytes captured (1168 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.141 (172.16.22.141), Dst: 172.16.22.142 (172.16.22.142)
▸ Transmission Control Protocol, Src Port: 35414 (35414), Dst Port: ssh (22), Seq: 1314, Ack: 1026, Len: 80
▾ SSH Protocol
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 76
      Padding Length: 5
    ▾ Key Exchange
        Msg code: Diffie-Hellman Key Exchange Init (30)
        Payload: 00000041042fc8701232d670d2736e1d85697b9b6ae352c1...
        Padding String: 0000000000
```

5) Exchange sucess!

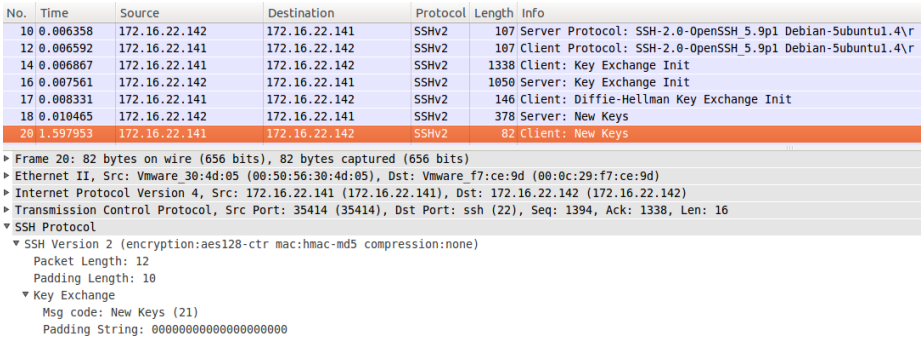
6)



No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init
16	0.007561	172.16.22.142	172.16.22.141	SSHv2	1050	Server: Key Exchange Init
17	0.008331	172.16.22.141	172.16.22.142	SSHv2	146	Client: Diffie-Hellman Key Exchange Init
18	0.010465	172.16.22.142	172.16.22.141	SSHv2	378	Server: New Keys

```
▸ Frame 18: 378 bytes on wire (3024 bits), 378 bytes captured (3024 bits)
▸ Ethernet II, Src: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d), Dst: Vmware_30:4d:05 (00:50:56:30:4d:05)
▸ Internet Protocol Version 4, Src: 172.16.22.142 (172.16.22.142), Dst: 172.16.22.141 (172.16.22.141)
▸ Transmission Control Protocol, Src Port: ssh (22), Dst Port: 35414 (35414), Seq: 1026, Ack: 1394, Len: 312
▾ SSH Protocol
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 292
      Padding Length: 9
    ▾ Key Exchange
        Msg code: Diffie-Hellman Key Exchange Reply (31)
        Multi Precision Integer Length: 104
        DH modulus (P): 00000013656364736l2d736861322d6e6973747032353600...
        Multi Precision Integer Length: 65
        DH base (G): 04ced594c826dd9f3bc1c57bde189c0e9b9874c7e5aa7aa9...
        Payload: 000000640000001365636473612d736861322d6e69737470...
        Padding String: 0000000000000000
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 12
      Padding Length: 10
    ▾ Key Exchange
        Msg code: New Keys (21)
        Padding String: 0000000000000000000
```

7)

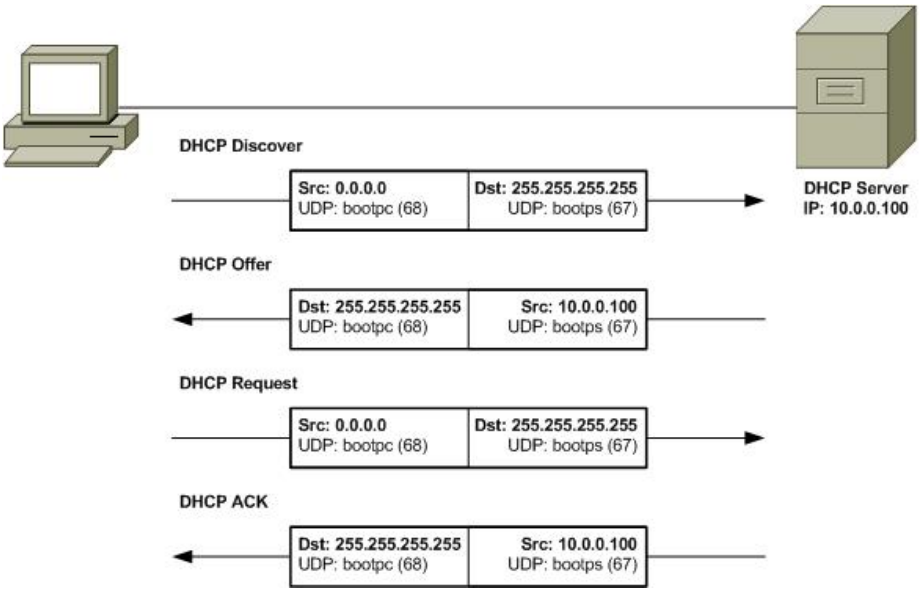


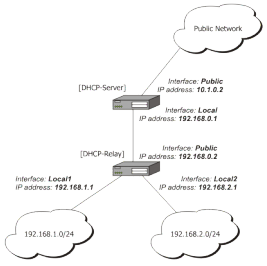
No.	Time	Source	Destination	Protocol	Length	Info
10	0.006358	172.16.22.142	172.16.22.141	SSHv2	107	Server Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-5ubuntu1.4\r
14	0.006867	172.16.22.141	172.16.22.142	SSHv2	1338	Client: Key Exchange Init
16	0.007561	172.16.22.142	172.16.22.141	SSHv2	1050	Server: Key Exchange Init
17	0.008331	172.16.22.141	172.16.22.142	SSHv2	146	Client: Diffie-Hellman Key Exchange Init
18	0.010465	172.16.22.142	172.16.22.141	SSHv2	378	Server: New Keys
20	1.597953	172.16.22.141	172.16.22.142	SSHv2	82	Client: New Keys

```
▸ Frame 20: 82 bytes on wire (656 bits), 82 bytes captured (656 bits)
▸ Ethernet II, Src: Vmware_30:4d:05 (00:50:56:30:4d:05), Dst: Vmware_f7:ce:9d (00:0c:29:f7:ce:9d)
▸ Internet Protocol Version 4, Src: 172.16.22.141 (172.16.22.141), Dst: 172.16.22.142 (172.16.22.142)
▸ Transmission Control Protocol, Src Port: 35414 (35414), Dst Port: ssh (22), Seq: 1394, Ack: 1338, Len: 16
▾ SSH Protocol
  ▾ SSH Version 2 (encryption:aes128-ctr mac:hmac-md5 compression:none)
      Packet Length: 12
      Padding Length: 10
    ▾ Key Exchange
        Msg code: New Keys (21)
        Padding String: 0000000000000000000
```

9. DHCP

The Dynamic Host Configuration Protocol (*DHCP*) is a standardized networking protocol used on Internet Protocol (IP) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP server, reducing the need for a network administrator or a user to configure these settings manually.


DHCP Discover
Src: 0.0.0.0
UDP: bootpc (68)
Dst: 255.255.255.255
UDP: bootps (67)
DHCP Server
IP: 10.0.0.100
DHCP Offer
Dst: 255.255.255.255
UDP: bootpc (68)
Src: 10.0.0.100
UDP: bootps (67)
DHCP Request
Src: 0.0.0.0
UDP: bootpc (68)
Dst: 255.255.255.255
UDP: bootps (67)
DHCP ACK
Dst: 255.255.255.255
UDP: bootpc (68)
Src: 10.0.0.100
UDP: bootps (67)


Public Network
[DHCP-Server]
Interface: Public
IP address: 10.1.0.2
Interface: Local
IP address: 192.168.0.1
[DHCP-Relay]
Interface: Public
IP address: 192.168.0.2
Interface: Local1
IP address: 192.168.1.1
Interface: Local2
IP address: 192.168.2.1
192.168.1.0/24
192.168.2.0/24

Normally is necessary that DHCP is in the same network, but is possible to set this in external network using **DHCP relay** like proxy:

The different message for DHCP protocol are:

Message Type

Description

DHCPDiscover

The first time a DHCP client computer attempts to log on to the network, it requests IP address information from a DHCP server by broadcasting a DHCPDiscover packet. The source IP address in the packet is 0.0.0.0 because the client does not yet have an IP address. The message is either 342 or 576 bytes long—older versions of Windows use a longer message frame.

DHCPOffer

Each DHCP server that receives the client DHCPDiscover packet responds with a DHCPOffer packet containing an unleased IP address and additional TCP/IP configuration information, such as the subnet mask and default gateway. More than one DHCP server can respond with a DHCPOffer packet. The client will accept the first DHCPOffer packet it receives. The message is 342 bytes long.

DHCPRequest

When a DHCP client receives a DHCPOffer packet, it responds by broadcasting a DHCPRequest packet that contains the offered IP address, and shows acceptance of the offered IP address. The message is either 342 or 576 bytes long, depending on the length of the corresponding DHCPDiscover message.

DHCPAcknowledge (DHCPAck)

The selected DHCP server acknowledges the client DHCPRequest for the IP address by sending a DHCPAck packet. At this time the server also forwards any optional configuration parameters. Upon receipt of the DHCPAck, the client can participate on the TCP/IP network and complete its system startup. The message is 342 bytes long.

DHCPNak

If the IP address cannot be used by the client because it is no longer valid or is now used by another computer, the DHCP server responds with a DHCPNak packet, and the client must begin the lease process again. Whenever a DHCP server receives a request for an IP address that is invalid according to the scopes that it is configured with, it sends a DHCPNak message to the client.

DHCPDecline

If the DHCP client determines the offered configuration parameters are invalid, it sends a DHCPDecline packet to the server, and the client must begin the lease process again.

DHCPRelease

A DHCP client sends a DHCPRelease packet to the server to release the IP address and cancel any remaining lease.

DHCPInform

DHCPInform is a new DHCP message type, defined in RFC 2131, used by computers on the network to request and obtain information from a DHCP server for use in their local configuration. When this message type is used, the sender is already externally configured for its IP address on the network, which may or may not have been obtained using DHCP. This message type is not currently supported by the DHCP service provided in earlier versions of Windows NT Server and may not be recognized by third-party implementations of DHCP software.

Simply process in one image:

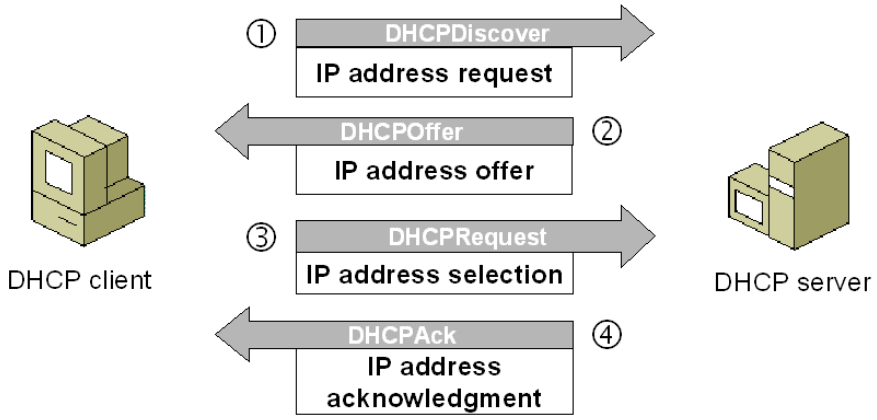


Figure 3: image

10. FTP