

Server Sandbox

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Abstract

This is a pandoc test . . .

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1. Get Started

Service	Transport	Port	Package
DNS	TCP/UDP	53/UDP 53/TCP	bind9
SMTP	TCP	25/TCP 587/TCP (alternative) 465/TCP (SMTP)	exim4
POP3	TCP	110/TCP 995/TCP (encrypted)	dovecot
IMAP	TCP	143/TCP	-

Service	Transport	Port	Package
LDAP	TCP/UDP	220/TCP (IMAP3)	
		993/TCP (IMAPS)	
HTTP	TCP	389/TCP	slapd
SSH	TCP	389/UDP	
FTP	TCP	80/TCP	apache
		21/TCP	openssh
		20/TCP (Server DT)	-
		21/TCP (Server PI)	
IPSEC	-	-	-
TELNET	TCP	23/TCP	-
DHCP	UDP	67/UDP (client)	-
		68/UDP (server)	

Install the script

For each machine yo need to install the script. The steps to install the scripts are very easy.

- 1) Open a terminal and go to a PATH for store the script. cd \$HOME path is a good place.
- 2) Clone the repository from Github

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

Now is the moment to clone one virtual machine in two more :-)

- 2) Join in the folder with cd server-sandbox and edit settings.sh with your favorite editor. (If you haven't idea, you can use gedit settings.sh)

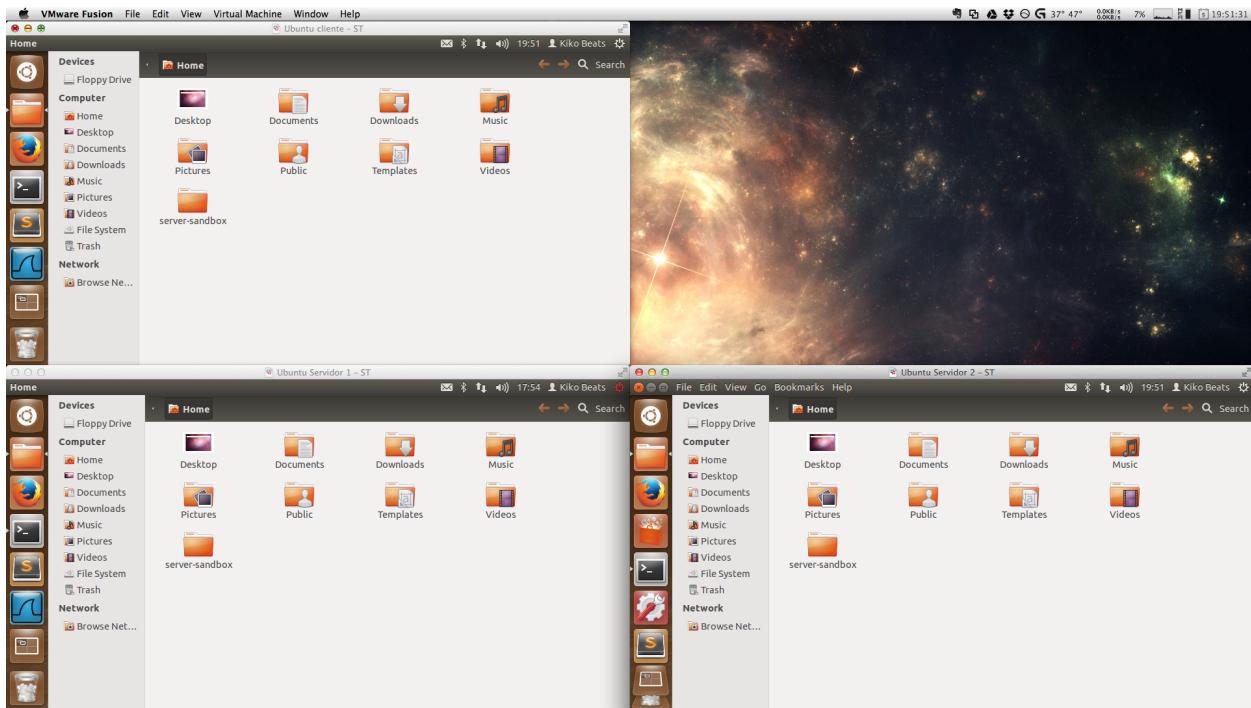
This are the following options:

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

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

## OPENSSL Settings
USERNAME="josefranciscoverdugamin"
```

Set the values:



- **DNS_NAME:** Name that you can use for your DNS. We are using `st.ubuntu` but you can use others like `server.dummie`, `server.dev` or whatever.
- **PRIMARY_DNS:** IP of your primary server. You know it using `ifconfig` command in terminal (In my case `eth0` corresponds to private network adapter).

```
josefranciscoverdugamin@ubuntu:~/server-for-dummies$ ifconfig
eth0      Link encap:Ethernet HWaddr 00:50:56:30:4d:05
          inet addr:172.16.22.141 Bcast:172.16.22.255 Mask:255.255.255.0
          inet6 addr: fe80::250:56ff:fe30:4d05/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:20933 errors:0 dropped:0 overruns:0 frame:0
            TX packets:12078 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:16335495 (16.3 MB) TX bytes:1018613 (1.0 MB)
            Interrupt:19 Base address:0x2000
```

- **SECONDARY_DNS:** Like PRIMARY_DNS but of your secondary server.
- **FORWARDERS:** IP of the DNS used to resend the DNS query if we can't resolve it. You can use [Google open DNS](#) for this (`8.8.8.8` and `8.8.4.4`).
- **LOCAL_NETWORK:** IP of the network used by VMWare/VirtualBox in the private network. You know this, see the IP's of the primary and secondary and the netmask. If your netmask is `255.55.555.0` you have a **Class C Network** and the network IP is `xxx.xxx.xxx.0/24`.
- **RELAY_DOMAINS:** Valid names for custom mail domains.
- **USERNAME:** The username of your virtual machine account used to check the validity of the certificate.

3) Run the script with administrator privileges `sudo sh init.sh`



```
Warning: check 'settings' file first!

1. Install Services
2. Uninstall Services
3. Restart Services
4. Test Services
0. Exit
:
```

Extra installation

In the Mail service, the mail account is associate with mail user account in the machine. For testing the mail, we recommended you create two accounts in the primary server. You can run:

```
sh ./Services/Mail/account
```

to create **user1** and **user2** accounts.

Configure sandbox

We are going to use 3 virtual machines for learn how to web services works.

The schema is formed by:

- **Virtual machine 1** – Main client
- **Virtual machine 2** – Primary DNS
- **Virtual machine 3** – Secondary DNS

We going to [VMWare software](#). You can download a free version of 30 days.

Its possible that you can use [VirtualBox](#). If you try with this, please feel free to send us a [feedback](#) :-)

About the machines, we are used the [lastest stable LTS version of Ubuntu](#). In own case, **Ubuntu 12.04**. You can this in the [Ubuntu Official Website](#) and you can use Windows, Linux or Mac for this.

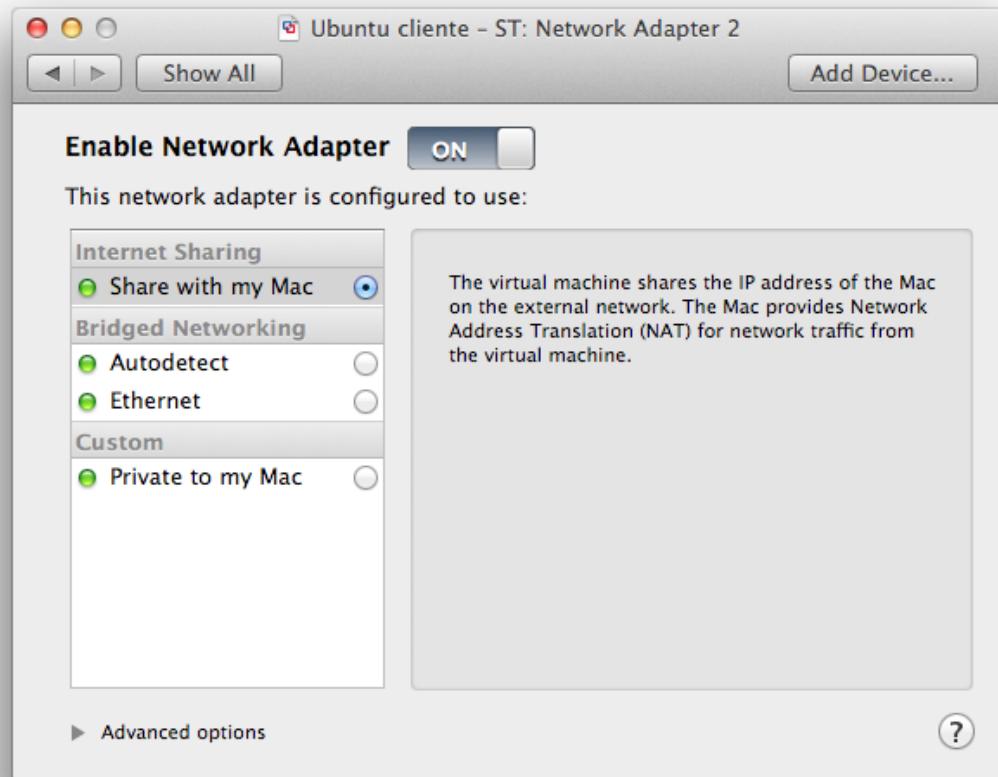
Configure network adapter in virtual machines

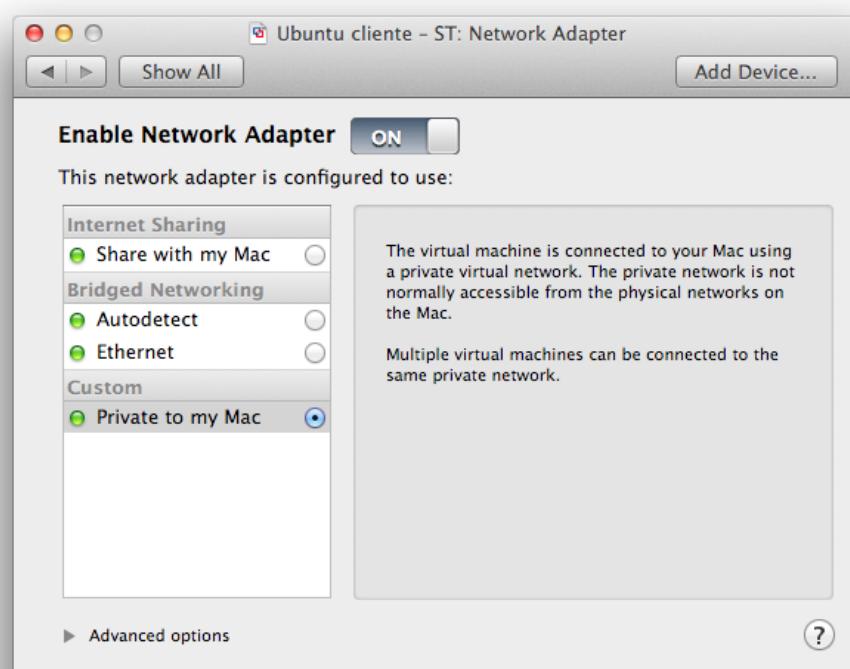
This step is important because we need to simulate that the machines are connected to each.

For configure this select the virtual machine and going to **Settings > Removable Devices** section.

You must have a primary **Network Adapter**:

But need to added other adapter too this. Go to button **Add Device**, select **Network Adapter** and configure it like **private**





Is necessary that you do it in the three machines. I recommended you install and configure one and later clone it in two more, but first wait to read `Install the script` section and you haven't the install the script thrice.

Test services

You can know if all services are run fine with 4. `Test Services` option in the script.

After you have selected the option you must indicate if you want run the tests in the `client` or in the `server`.

In the `client`:

- Check if **private cloud** works fine.
- Check if **server services** are accessible with `ping` command.
- Check if is possible search in the **LDAP** service.

In the `server`:

- Check if **DNS config file** is correct.
- Check if **DNS database file** is correct.
- Check if is possible search locally in the **LDAP** service.

Sample data

For testing services we added sample data for the follow services:

HTTP

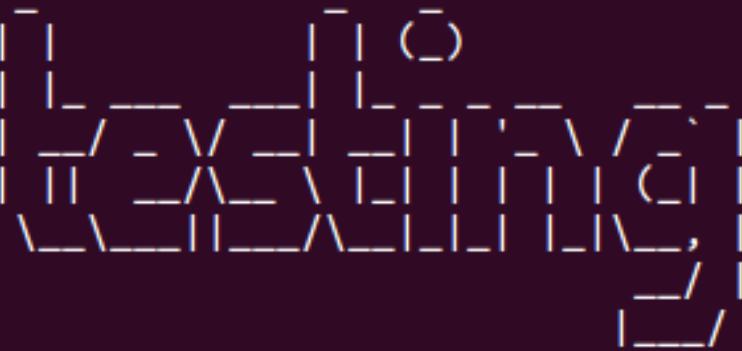
Dividided in: * www1.st.um – Basic domain * www2.st.um – Domain with HTTP authentication ([authorized users here](#)) * www3.st.um – Domain with HTTPS (check you are visiting https in the browser! automatic redirect isn't activated).

Mail

(remember run `./Services/Mail/account.sh` to create it at first time in the primary server).

LDAP

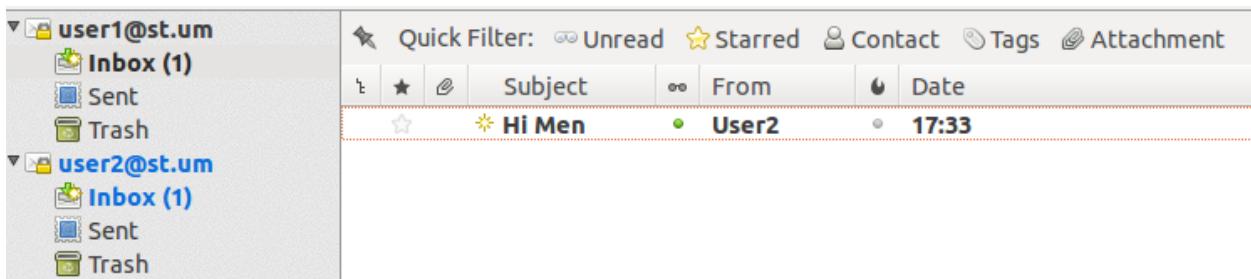
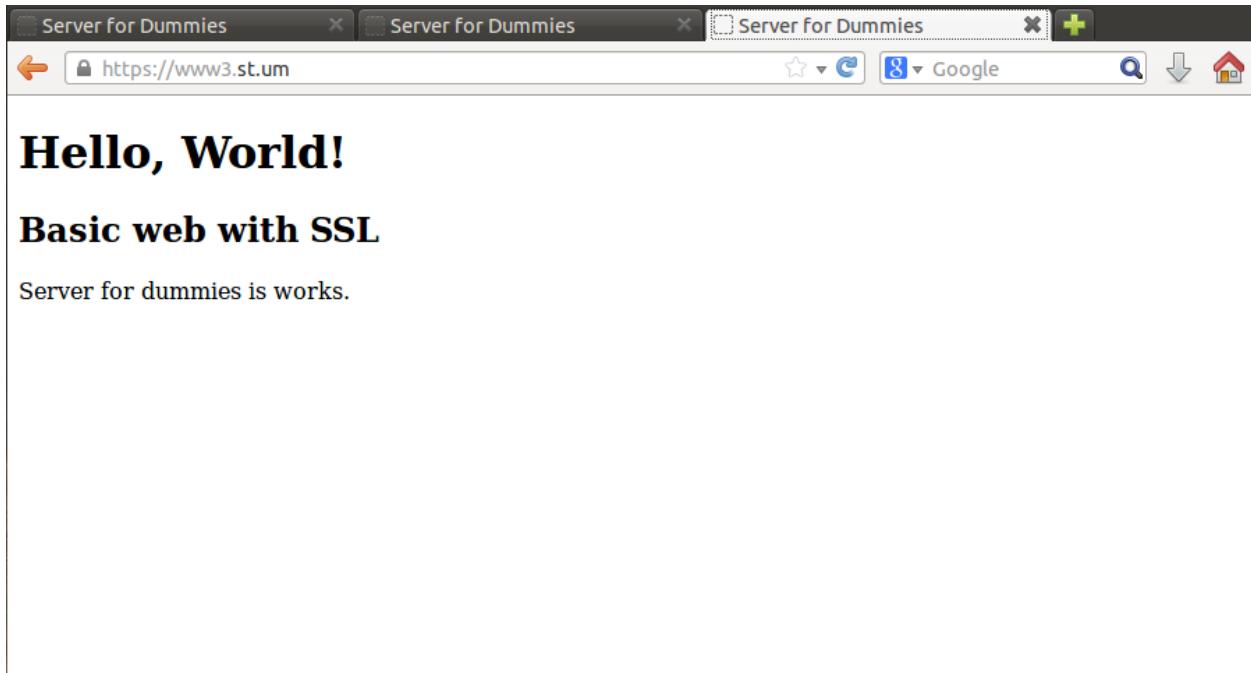
Sample data for check read and modify operations ([check here](#))



```
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... █
```



```
josefranciscoverdugamin@ubuntu:~/server-sandbox$ ldapsearch -x -H ldap://ldap.st.um -b "cn=User One,ou=st,o=um,c=es" mobile
# extended LDIF
#
# LDAPv3
# base <cn=User One,ou=st,o=um,c=es> with scope subtree
# filter: (objectclass=*)
# requesting: mobile
#
# User One, st, um, es
dn: cn=User One,ou=st,o=um,c=es
mobile: 627182818

# search result
search: 2
result: 0 Success

# numResponses: 2
# numEntries: 1
```

```
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  
$ █
```

SSH

Understand

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 different 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.

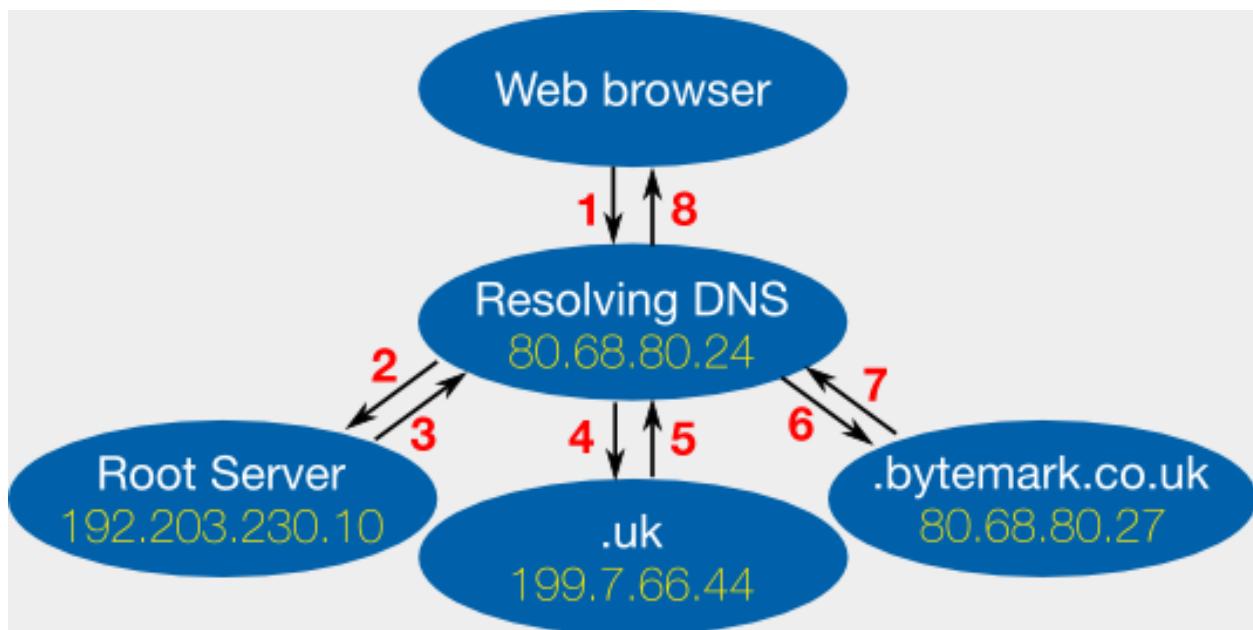
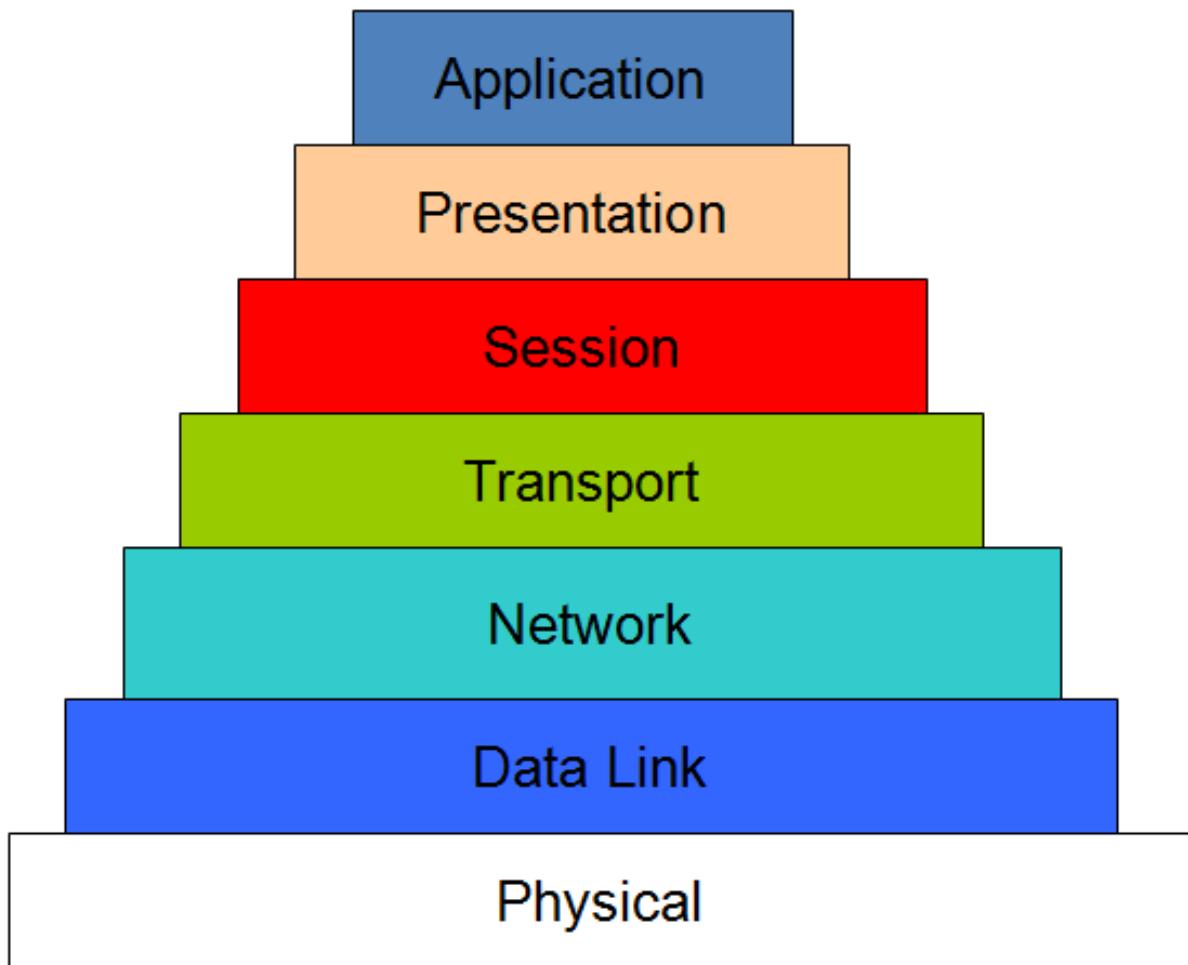
Other important networks elements are routers, switches and host and using different protocols (BGP, RIP, OSPF) to communicate with each one and make internet a network of computers that understands how a package travels from EEUU to Spain.

But this is not important here. You'll need to understand how to set up your machine to be accessible 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 application 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!



Important 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

Common commands

General

- `netstat -a | more` show ports and services that you are using.
- `ifconfig` Know network options.

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

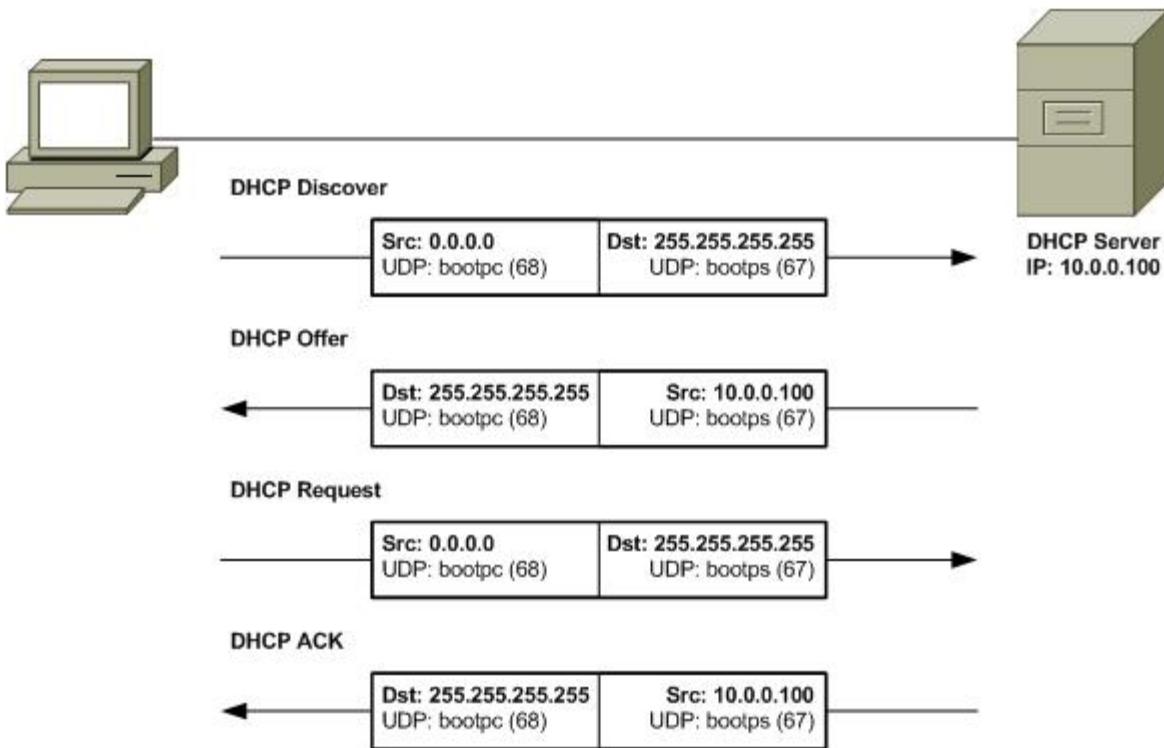
- `ldapsearch -x -H ldap://LDAP_IP -b "cn=' ',ou=' ',o=' ',c=' '"` FIELD Search in the LDAP IP.

HTTP

- `curl -I www.domain.com` Get HTTP head of the response.

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.pem -text` Check that your server certificate is standard by x509
- `openssl rsa -in cakey.pem -text` Check 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



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.

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

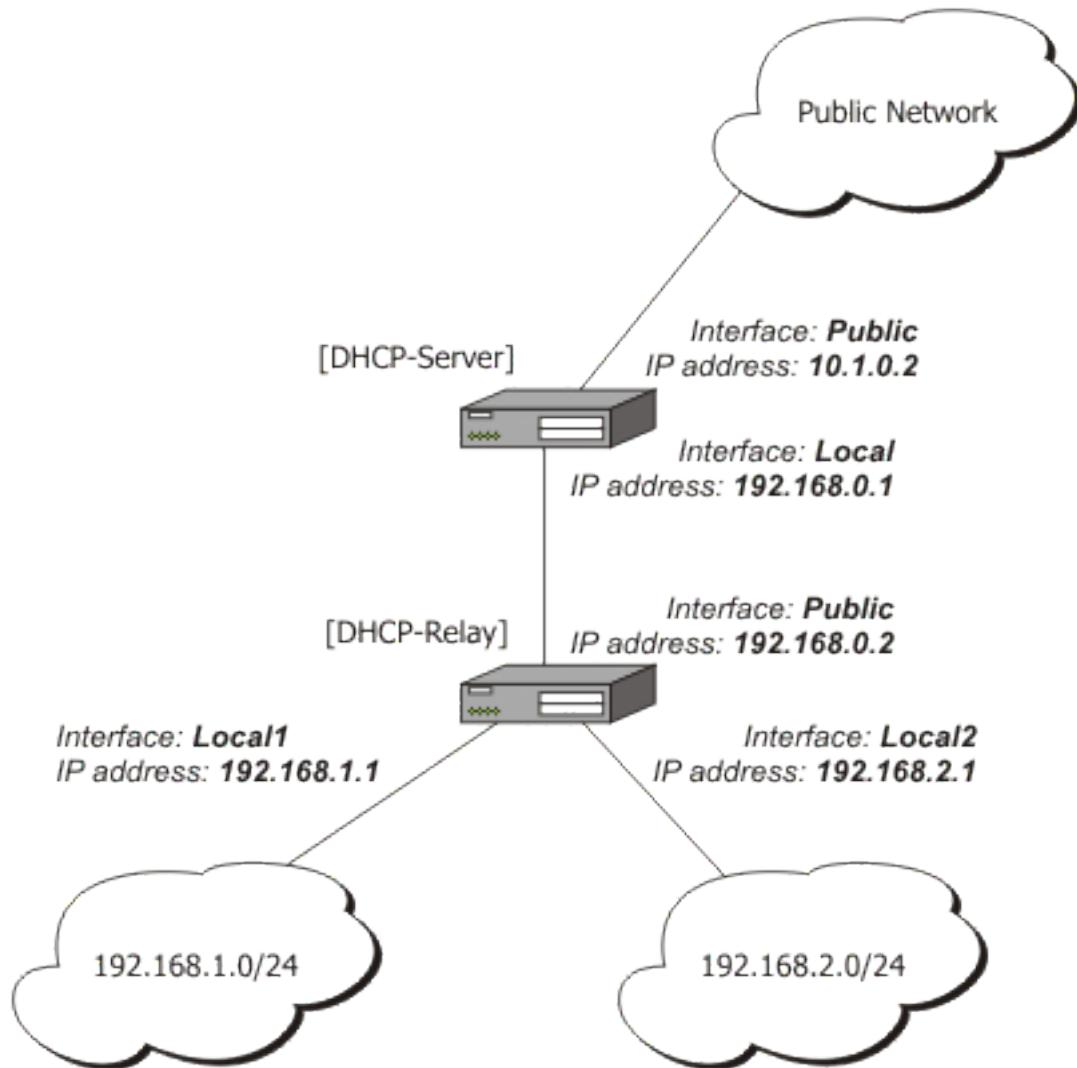
DHCPDiscover

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.

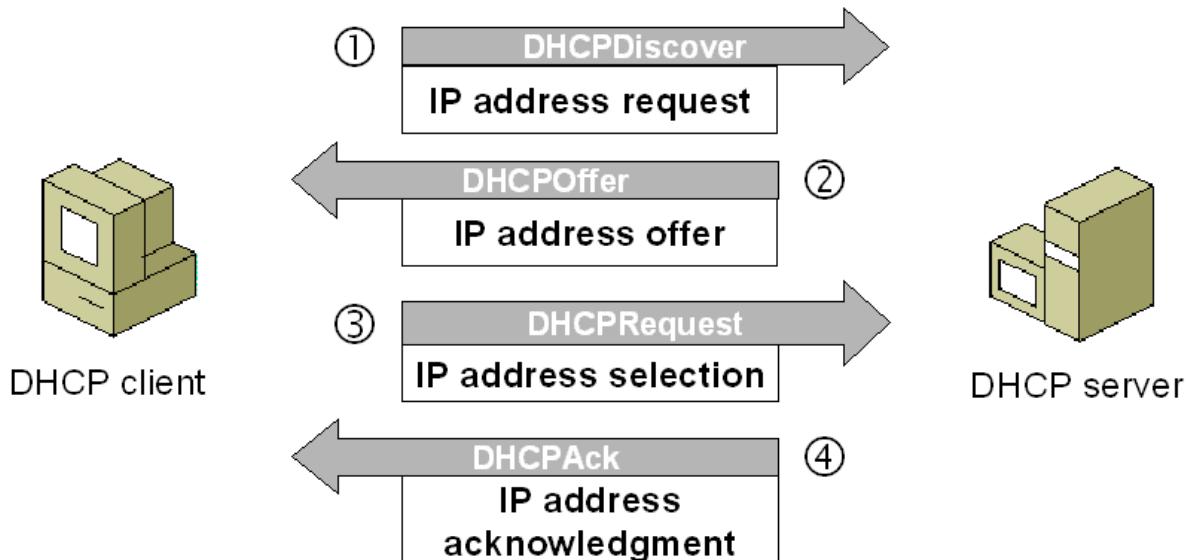
DHCPRelease

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.

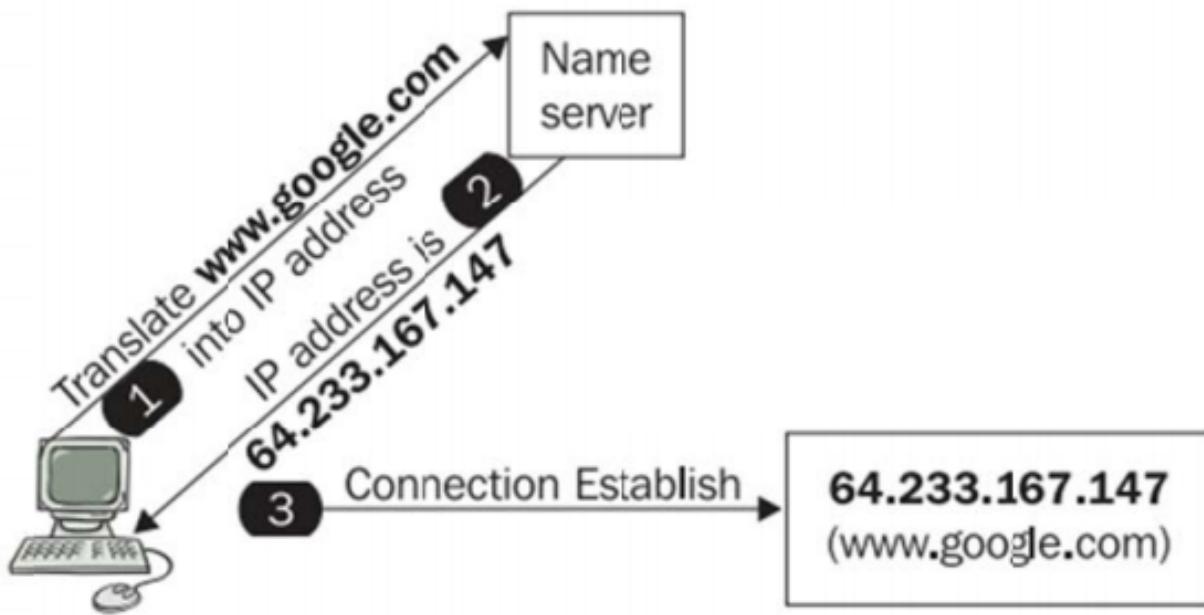
Simply process in one image:



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 than remember a name.

At first for to do it the first computers had a simple 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 simple 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 to understand how ICANN regulates 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 has different **records** for the domain. A record is the basic data component in DNS. Resource records define not only names and IP addresses but domains, servers, zones, and services as well. This list shows you the most common types of resource records:

Type

Purpose

A

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

CNAME

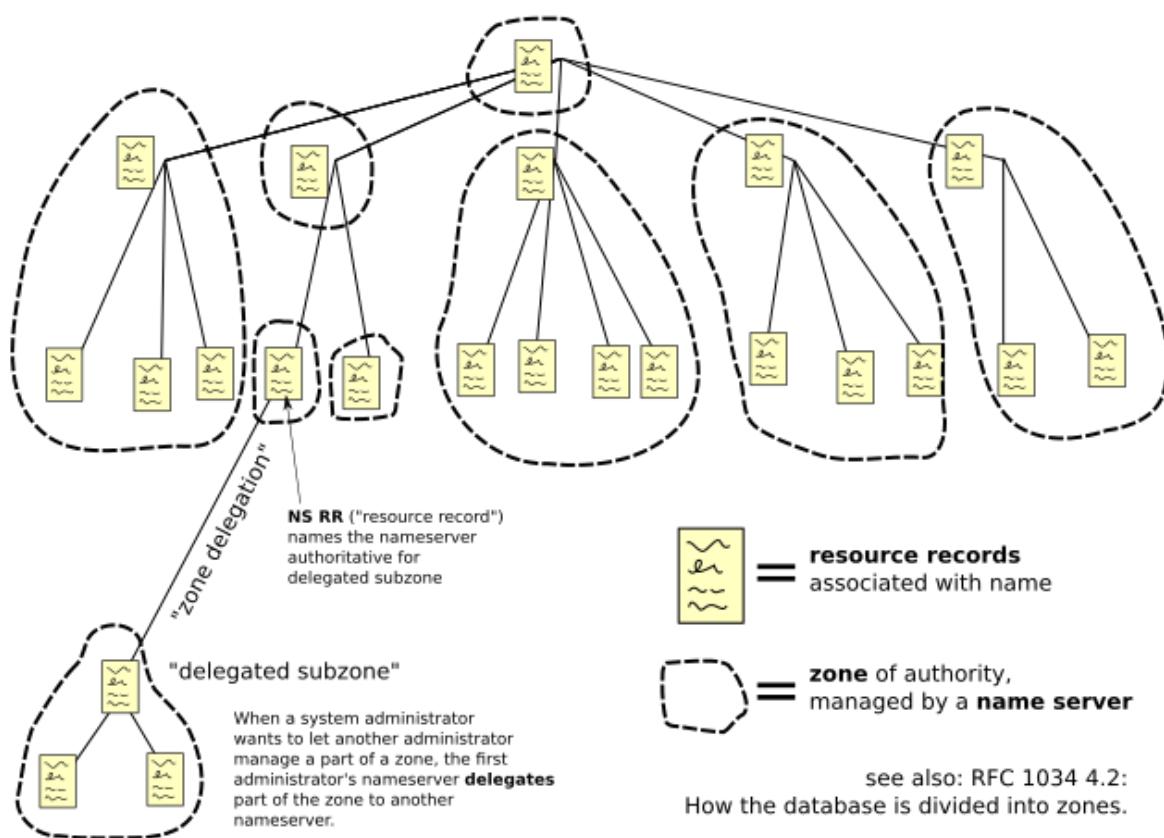
Canonical name resource records associate a nickname to a host name.

MX

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

NS

Domain Name Space



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.

DNS Query

The better way to explain the process is with a example.

You need to know the resolve of `www.google.com` domain.

Iterative Query

- Client query here local DNS. (1)
- If the local DNS don't know the domain, answer the root nameserver. (2)
- Root Nameserves indicate the node that have `.com > google` register.
- Local DNS talk with the node and obtain the DNS authority nameserver. (4)(5)
- Local DNS contact with DNS authority nameserver for resolve `www`
- DNS authority nameserver respond local DNS.

This is normally to process to resolve a query.

Recursive Query

The process with recursive query is similar, but now the DNS local doesn't handle all calls: The DNS servers delegate in others DNS server to resolve the query.

DNS Respond

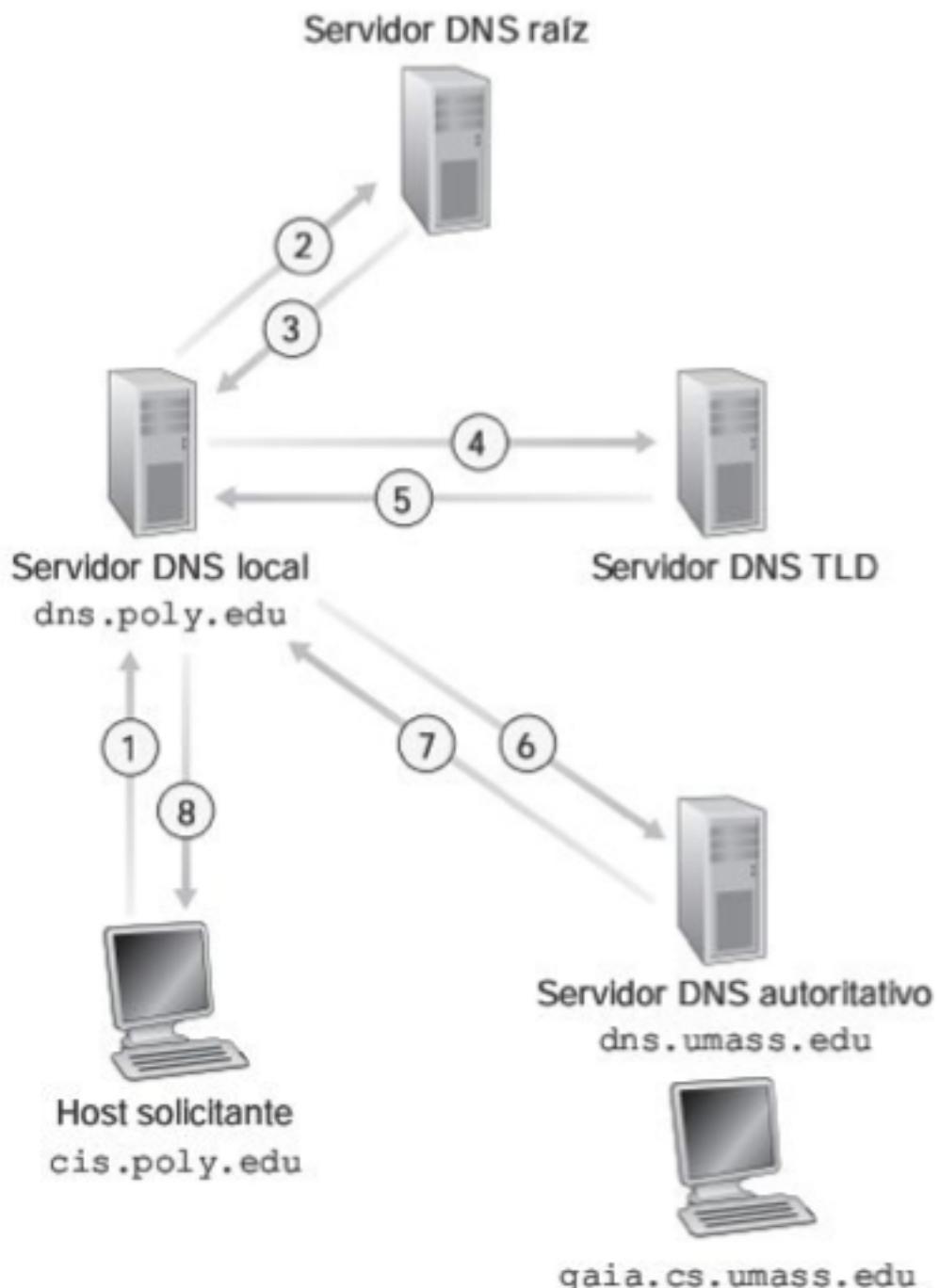
The server that respond the query is indicate in the **AA** (*Authoritative Answer*). Its possible that for each zone have more than one DNS name server. This is known as **Primary** and **Secondary** DNS of the zone and data redundancy is a measure of safety and reliability.

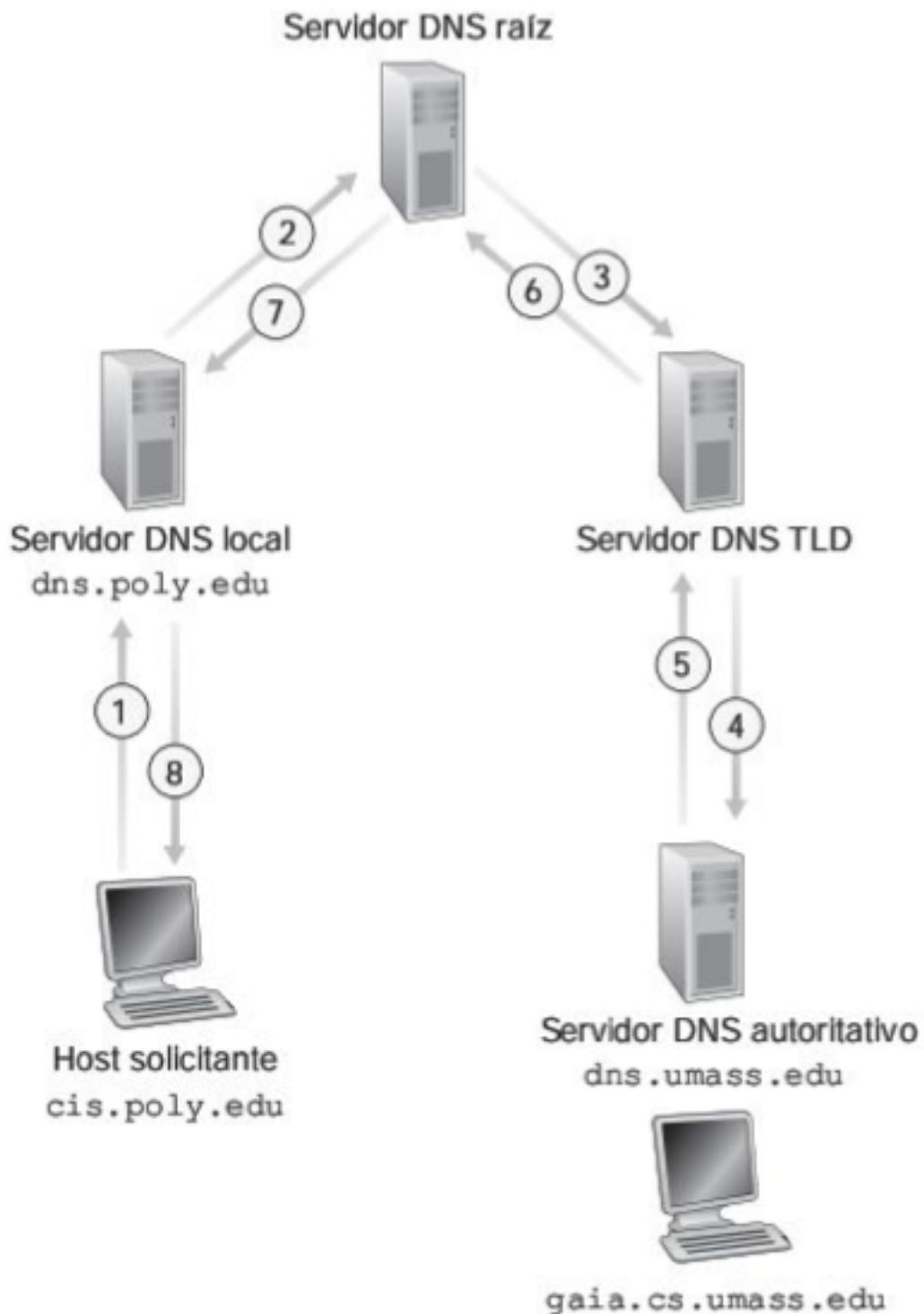
In easy see this in the DNS response message:

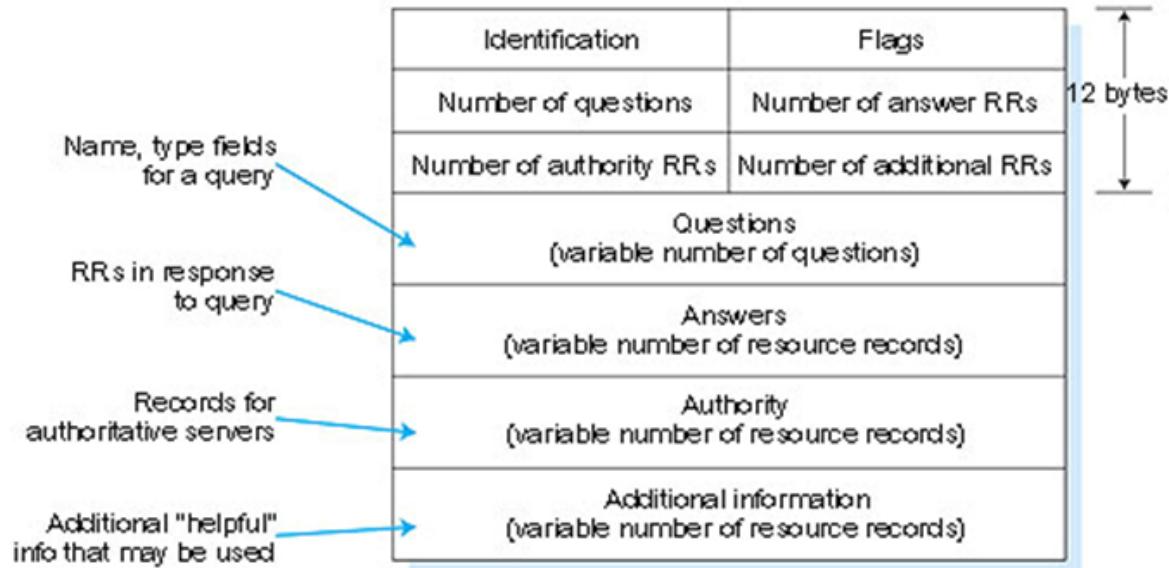
Your DNS in the client

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`







```
(o)          [ ]       [ ]  
[ ]---[ ]---[ ]---[ ]  
|   |   V   |   /   |  
|   |   \   |   (   |  
|   |   /   \   ,   |  
  
client or server? [client/server]: client  
Can you configure DNS? [yes/no]: yes  
* Configuring DNS client...
```

This is translate in the script to write in your client the IP of your primary DNS in the system file /etc/resolv.conf that is used to resolve queries:

```
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
```

You can check connectivity in the client with two commands, both in the client:

```
josefranciscovardugambin@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
```

```
josefranciscovardugambin@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
```

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]

```

client or server? [client/server]: server
Can you configure DNS? [yes/no]: yes
* Installing DNS...
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  bind9utils
Suggested packages:
  bind9-doc
The following NEW packages will be installed:
  bind9 bind9utils
0 upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 0 B/440 kB of archives.
After this operation, 1.220 kB of additional disk space will be used.
Preconfiguring packages ...
Selecting previously unselected package bind9utils.
(Reading database ... 416873 files and directories currently installed.)
Unpacking bind9utils (from .../bind9utils_1%3a9.8.1.dfsg.P1-4ubuntu0.8_i386.deb) ...
Selecting previously unselected package bind9.
Unpacking bind9 (from .../bind9_1%3a9.8.1.dfsg.P1-4ubuntu0.8_i386.deb) ...
Processing triggers for man-db ...
Processing triggers for ureadahead ...
Processing triggers for ufw ...
Setting up bind9utils (1:9.8.1.dfsg.P1-4ubuntu0.8) ...
Setting up bind9 (1:9.8.1.dfsg.P1-4ubuntu0.8) ...
Adding group `bind' (GID 116) ...
Done.
Adding system user `bind' (UID 115) ...
Adding new user `bind' (UID 115) with group `bind' ...
Not creating home directory `/var/cache/bind'.
wrote key file "/etc/bind/rndc.key"
#
* Starting domain name service... bind9                                         [ OK ]
Can you configure DNS? [primary/secondary]: █

```

Primary DNS

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\";
}

```

```
Can you configure DNS? [primary/secondary]: primary
* Configuring local resolv...
* Configuring DNS client...
* Configuring local file...
* Configuring local options...
* Configuring zone file...
```

```
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
}
```

Secondary DNS

```
Can you configure DNS? [primary/secondary]: secondary
* Configuring local resolv...
* Configuring DNS client...
* Configuring local file...
```

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

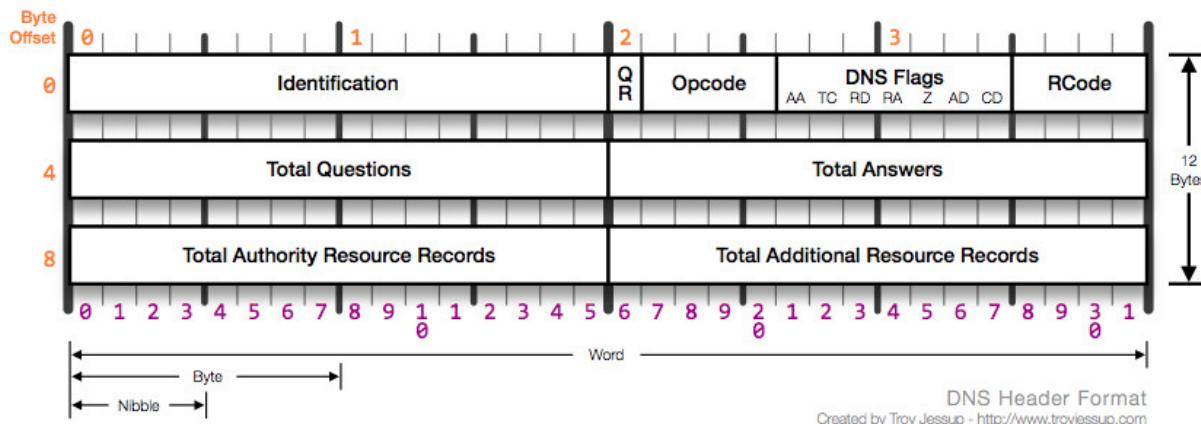
```

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
}

```

How DNS works

DNS Header



Internal query

For the example, I run `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 translate `st.um` address (of type A)

The server respond me with same useful information: * In **Answer** section, server response my query and say 'Hey, the register A of the domain is 172.16.22.135. * In **AA** **nameserver** section indicate what server responde the query. In this case, my primary (`ns1.st.um`) and secondary (`ns2.st.um`) server. * In **Additional Record** section indicate additional information like the IP of the nameservers.

. 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:

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:

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)

```

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

Now, I can continue with my ping!

FTP

The **File Transfer Protocol (FTP)** is a standard network protocol used to transfer computer files from one host to another host over a TCP-based network, such as the Internet.

The FTP protocol is divided in two ways: **Protocol interpreter** and **data transfer process**.

In the client, the ports for PI and DTP are not established. Can be any free port. In the server is typical use 21 and 20 port respectively. Also, FTP can work in two modes:

FTP in Active mode

In active mode, the client have to open a port to communicate with the server.

- Client init connection with server PI and send command `PORT` to indicate the port that server need to init a TCP connection.
- Server create TCP connection and delegate in DTP to send the data.

This mode has two inconveniences:

- The client connection is not secure. Client have to accept all traffic in the port of the data, and this is very dangerous.
- Don't work fine if client have a firewall.

FTP in Passive mode

The idea is fix problem in active mode. In this case, the client negotiate the TCP connection with the server and say him that open a port for transfer data.

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

No.	Time	Source	Destination	Protocol	Length	Info
3	0.000105	172.16.190.153	155.54.1.10	DNS	81	Standard query A google.com
5	10.000901	172.16.190.153	216.239.38.10	DNS	81	Standard query A google.com
6	10.081495	216.239.38.10	172.16.190.153	DNS	246	Standard query response A 173.194.34.225 A 173.194.34.100
11	10.144116	172.16.190.153	155.54.1.10	DNS	98	Standard query PTR 233.34.194.173.in-addr.arpa
12	20.144641	172.16.190.153	216.239.36.10	DNS	98	Standard query PTR 233.34.194.173.in-addr.arpa
13	20.237172	216.239.36.10	172.16.190.153	DNS	125	Standard query response PTR mad01s09-in-f9.1e100.net

► Frame 5: 81 bytes on wire (648 bits), 81 bytes captured (648 bits)

► Ethernet II, Src: VMware_f7:ce:a7 (00:0c:29:f7:ce:a7), Dst: VMware_fa:67:5e (00:50:56:fa:67:5e)

► Internet Protocol Version 4, Src: 172.16.190.153 (172.16.190.153), Dst: 216.239.38.10 (216.239.38.10)

► User Datagram Protocol, Src Port: 36904 (36904), Dst Port: domain (53)

▼ Domain Name System (query)

 [Response In: 6]

 Transaction ID: 0xc93e

 Flags: 0x0000 (Standard query)

 Questions: 1

 Answer RRs: 0

 Authority RRs: 0

 Additional RRs: 1

 ▼ Queries

 ▼ google.com: type A, class IN

 Name: google.com

 Type: A (Host address)

 Class: IN (0x0001)

 ▼ Additional records

 ▼ <Root>: type OPT

 Name: <Root>

 Type: OPT (EDNS0 option)

 UDP payload size: 4096

 Higher bits in extended RCODE: 0x0

 EDNS0 version: 0

 ▼ Z: 0x8000

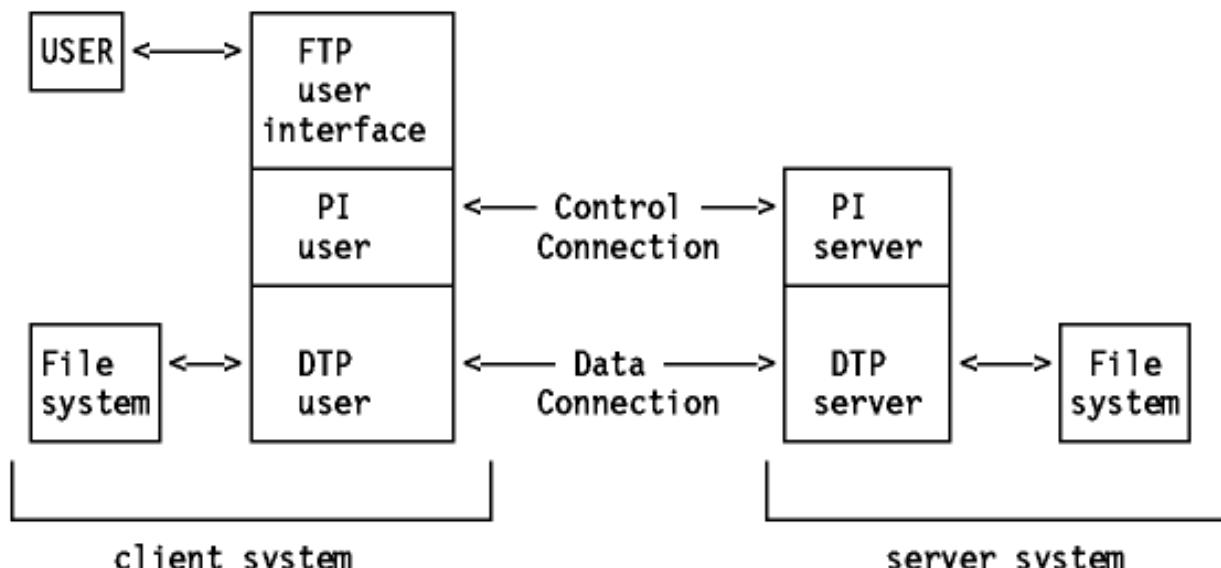
 Bit 0 (DO bit): 1 (Accepts DNSSEC security RRs)

 Bits 1-15: 0x0 (reserved)

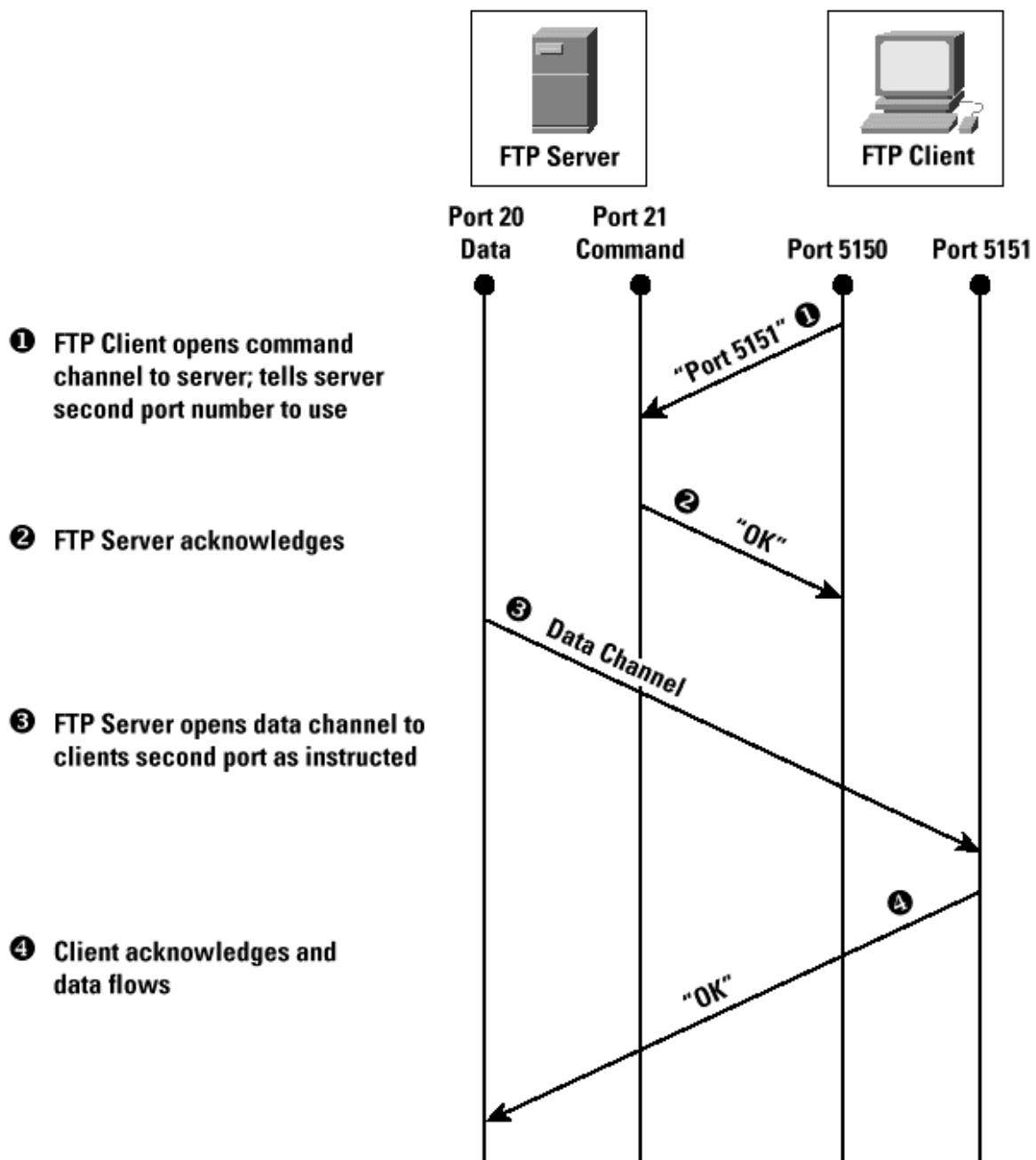
 Data length: 0

No.	Time	Source	Destination	Protocol	Length	Info
3	0.000105	172.16.190.153	155.54.1.10	DNS	81	Standard query A google.com
5	10.000901	172.16.190.153	216.239.38.10	DNS	81	Standard query A google.com
6	10.081495	216.239.38.10	172.16.190.153	DNS	246	Standard query response A 173.194.34.225 A 173.194.34.225
11	10.144116	172.16.190.153	155.54.1.10	DNS	98	Standard query PTR 233.34.194.173.in-addr.arpa
12	20.144641	172.16.190.153	216.239.36.10	DNS	98	Standard query PTR 233.34.194.173.in-addr.arpa
13	20.237172	216.239.36.10	172.16.190.153	DNS	125	Standard query response PTR mad01s09-in-f9.1e100.net

► Frame 6: 246 bytes on wire (1968 bits), 246 bytes captured (1968 bits)
 ► Ethernet II, Src: Vmware_fa:67:5e (00:50:56:fa:67:5e), Dst: Vmware_f7:ce:a7 (00:0c:29:f7:ce:a7)
 ► Internet Protocol Version 4, Src: 216.239.38.10 (216.239.38.10), Dst: 172.16.190.153 (172.16.190.153)
 ► User Datagram Protocol, Src Port: domain (53), Dst Port: 36904 (36904)
 ▾ Domain Name System (response)
 [Request In: 5]
 [time: 0.080594000 seconds]
 Transaction ID: 0xc93e
 ► Flags: 0x8400 (Standard query response, No error)
 Questions: 1
 Answer RRs: 11
 Authority RRs: 0
 Additional RRs: 0
 ▾ Queries
 ► google.com: type A, class IN
 ▾ Answers
 ► google.com: type A, class IN, addr 173.194.34.225
 ► google.com: type A, class IN, addr 173.194.34.227
 ► google.com: type A, class IN, addr 173.194.34.231
 ► google.com: type A, class IN, addr 173.194.34.230
 ► google.com: type A, class IN, addr 173.194.34.224
 ► google.com: type A, class IN, addr 173.194.34.229
 ► google.com: type A, class IN, addr 173.194.34.238
 ► google.com: type A, class IN, addr 173.194.34.233
 ► google.com: type A, class IN, addr 173.194.34.226
 ► google.com: type A, class IN, addr 173.194.34.228
 ► google.com: type A, class IN, addr 173.194.34.232



PI : protocol interpreter
 DTP: data transfer process



- The process is similar to Active mode but in the case client send the command **PASV** to indicate passive mode and the server response with the number of port that can be used. (>1024).
- The client init the TCP connection with the server port.

Access control commands

Command

Description

USER

Character string allowing the user to be identified. User identification is necessary to establish communication over the data channel.

PASS

Character string specifying the user's password. This command must immediately precede the **USER** command. It falls to the client to hide the display of this command for security reasons.

ACCT

Character string representing the user's account. The command is generally not necessary. During the response accepting the password, if the response is 230 this stage is not necessary, if the response is 332, it is.

CWD

Change Working Directory: this command enables the current directory to be changed. This command requires the directory's access path

to be fulfilled as an argument.

CDUP

Change to Parent Directory: this command allows you to go back to the parent directory. It was introduced to solve problems of naming the parent directory according to the system (generally “..”).

SMNT

Structure Mount:

REIN

Reinitialize:

QUIT

Command enabling the current session to be terminated. The server waits to finish the transfer in progress if the need arises, then supplies a response before closing the connection.

Transfer parameter commands

Command

Description

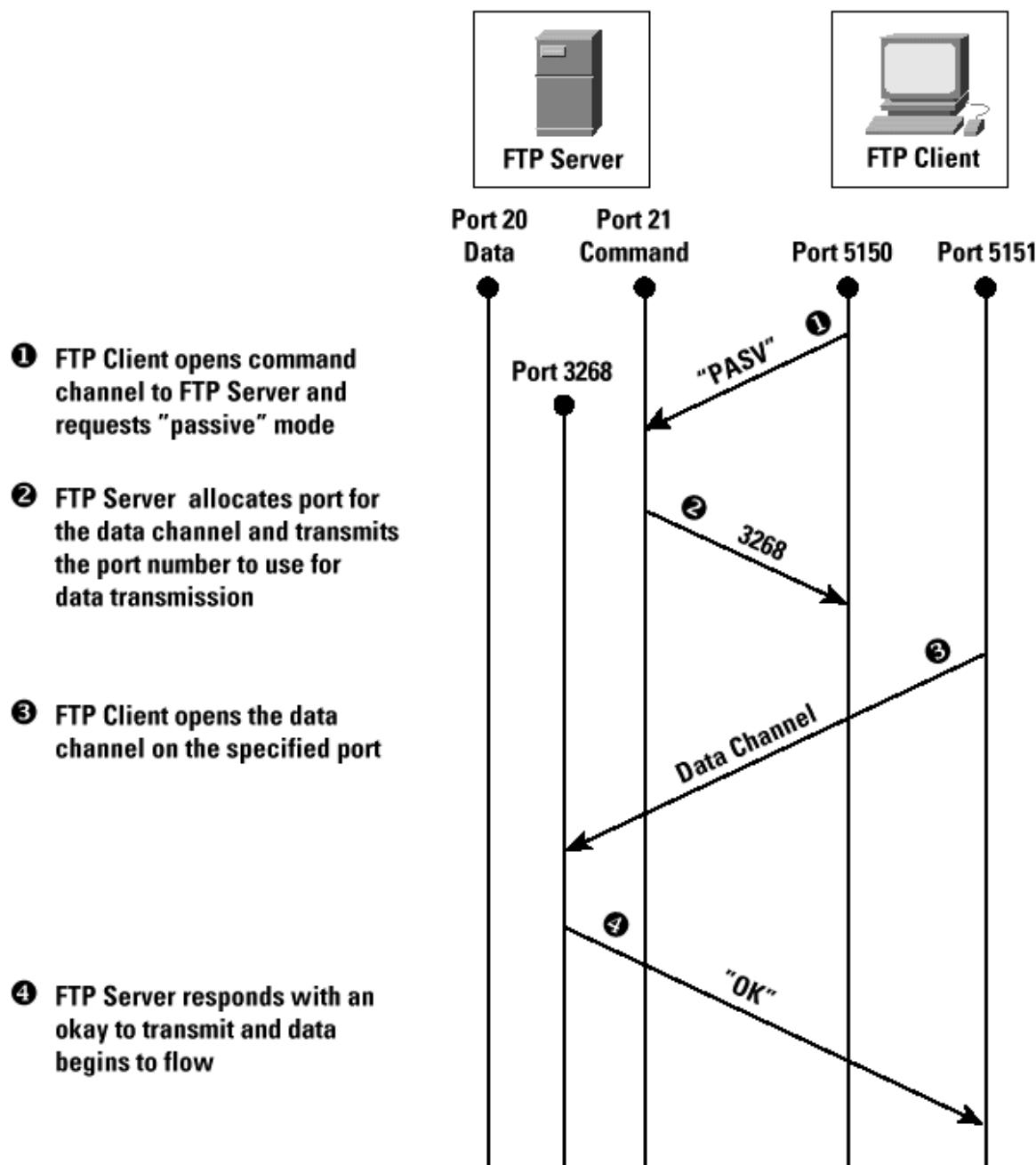
PORT

Character string allowing the port number used to be specified.

PASV

Command making it possible to indicate to the DTP server to stand by for a connection on a specific port chosen randomly from among the available ports. The response to this command is the IP address of the machine and port.

TYPE



This command enables the type of format in which the data will be sent to be specified.

STRU

Telnet character specifying the file structure (F for File, R for Record, P for Page).

MODE

Telnet character specifying data transfer method (S for Stream, B for Block, C for Compressed).

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

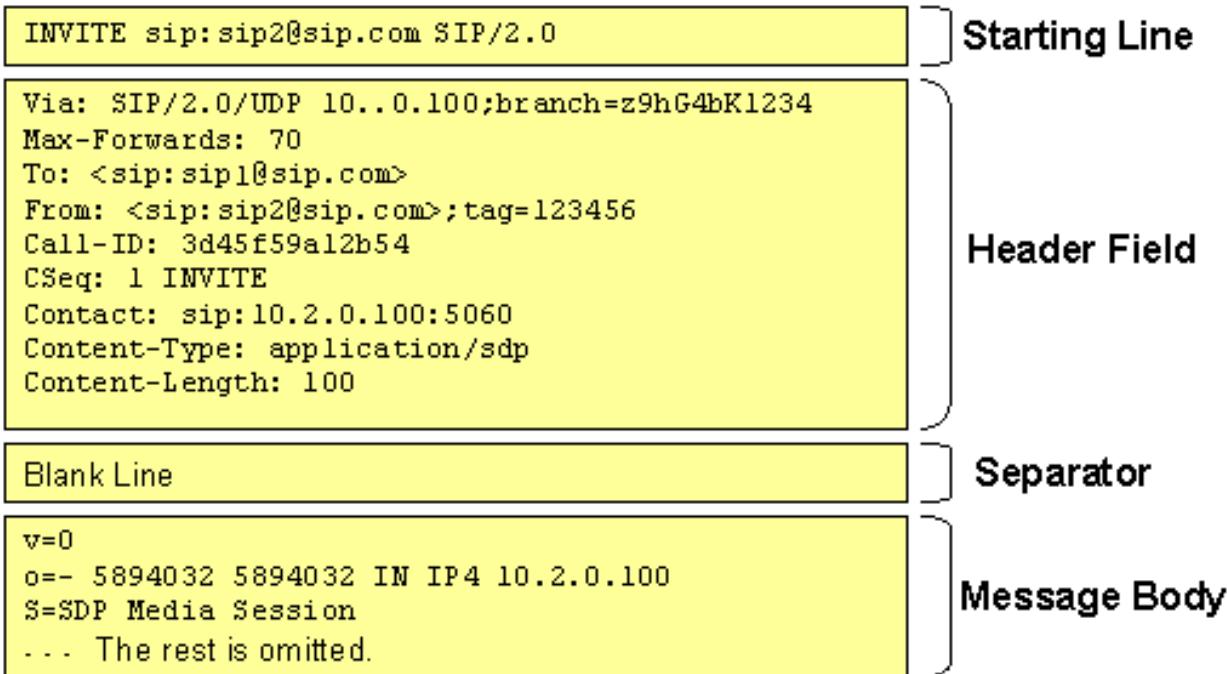
<html>
<head>
  <title>An Example Page</title>
</head>
<body>
  Hello World, this is a very simple HTML document.
</body>
</html>
```

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.

The HTTP methods are different for different actions:

And each client request is response with status code:



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

- **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, Hyper Text Coffe

Your HTTP in the client

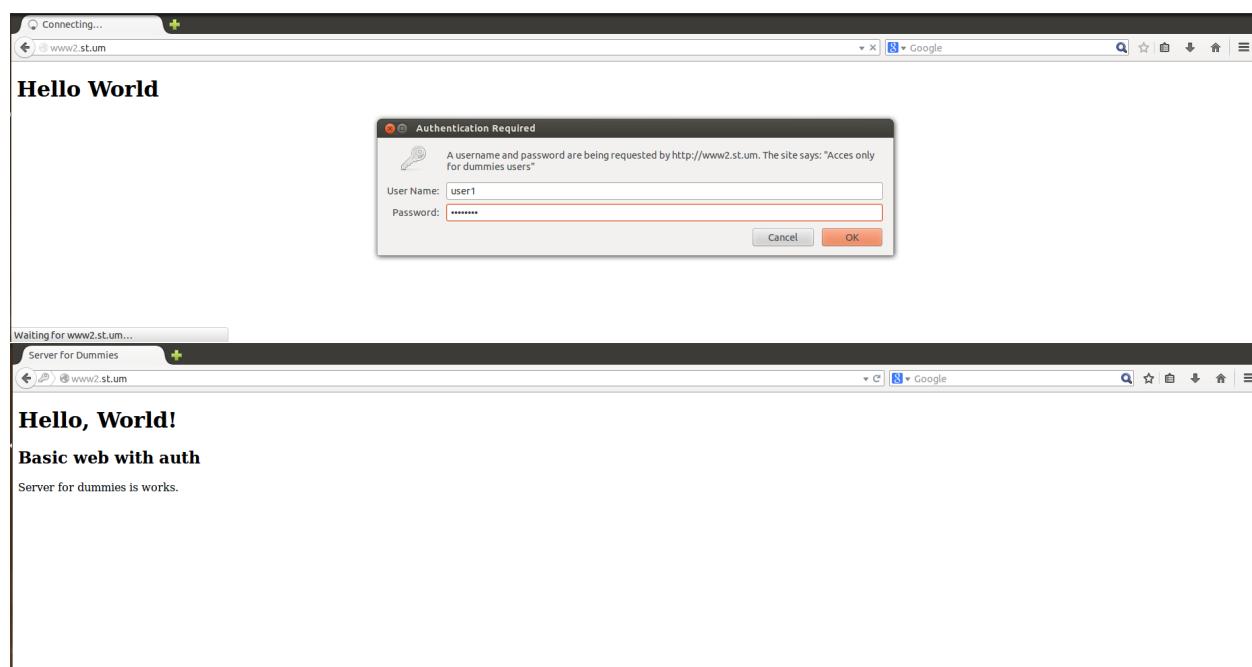
If you have a browser and/or terminal, you don't need additional things.

When you install your server configuration can check this

With browser

HTTP Simple (<http://www1.st.um>)

HTTP Simple with authentication (<http://www2.st.um>)



HTTP with SSL (<https://www3.st.um>)

With terminal

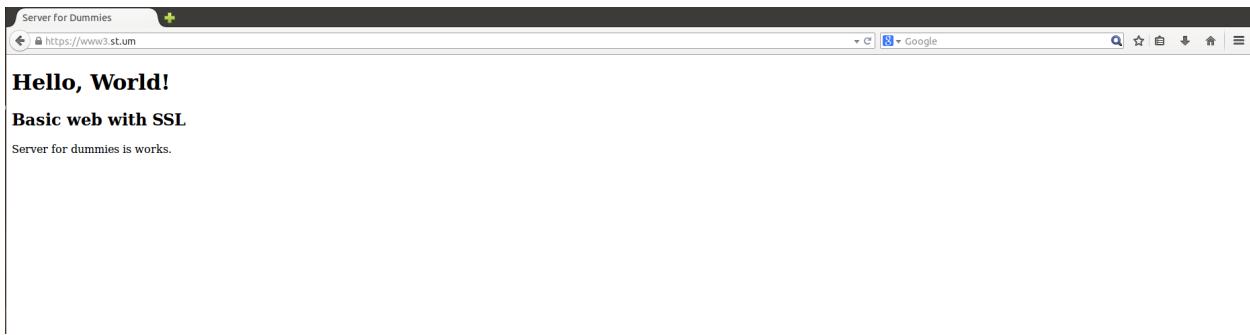
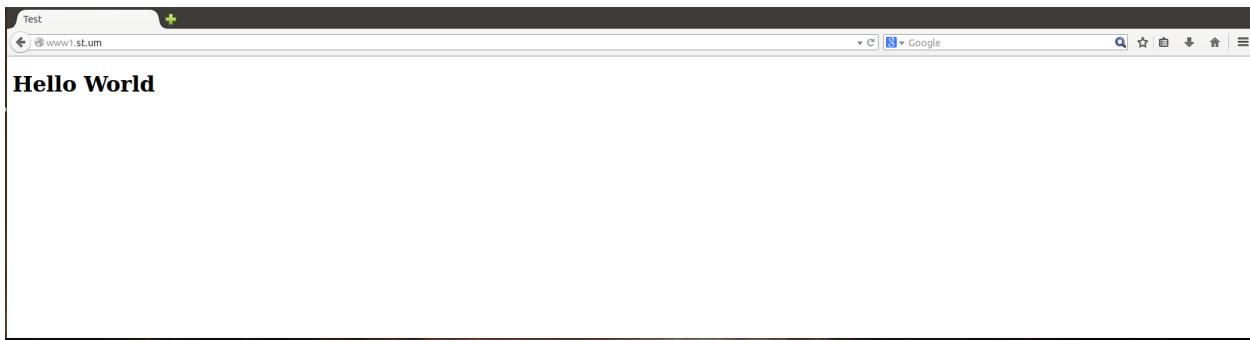
With the browser url access is sufficient, but you need feel like a *hacker*, you can do the same but in terminal

Informational Status Codes	Client Request Incomplete	Server Errors
<p>100 – Continue [The server is ready to receive the rest of the request.]</p> <p>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.]</p>	<p>400 – Bad Request [The server detected a syntax error in the client's request.]</p> <p>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.]</p> <p>402 – Payment Required [reserved for future.]</p>	<p>500 – Internal Server Error [A server configuration setting or an external program has caused an error.]</p>
<p>Client Request Successful</p> <p>200 – OK [Success! This is what you want.]</p> <p>201 – Created [Successfully created the URI specified by the client.]</p> <p>202 – Accepted [Accepted for processing but the server has not finished processing it.]</p> <p>203 – Non-Authoritative Information [Information in the response header did not originate from this server. Copied from another server.]</p> <p>204 – No Content [Request is complete without any information being sent back in the response.]</p> <p>205 – Reset Content [Client should reset the current document. Ie. A form with existing values.]</p> <p>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.]</p>	<p>403 – Forbidden [Access to the requested resource is forbidden. The request should not be repeated by the client.]</p> <p>404 – Not Found [The requested document does not exist on the server.]</p> <p>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.]</p> <p>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.]</p> <p>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.]</p>	<p>501 – Not Implemented [The server does not support the functionality required to fulfill the request.]</p> <p>502 – Bad Gateway [The server encountered an invalid response from an upstream server or proxy.]</p> <p>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.]</p> <p>504 – Gateway Time-Out [The gateway or proxy has timed out.]</p>
<p>Request Redirected</p> <p>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.]</p> <p>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.]</p> <p>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.]</p> <p>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.]</p> <p>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.]</p> <p>305 – Use Proxy [The client should use a proxy, specified by the Location header, to retrieve the URL.]</p> <p>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.]</p>	<p>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.]</p> <p>409 – Conflict [The client request conflicts with another request. The server can add information about the type of conflict along with the status code.]</p> <p>410 – Gone [The requested resource is permanently gone from the server.]</p> <p>411 – Length Required [The client must supply a Content-Length header in its request.]</p> <p>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.]</p> <p>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.]</p> <p>414 – Request-URI Too Long [The server refuses to process the request, because the specified URI is too long.]</p> <p>415 – Unsupported Media Type [The server refuses to process the request, because it does not support the message body's format.]</p> <p>417 – Expectation Failed [The server failed to meet the requirements of the Expect request-header.]</p>	<p>Unused status codes</p> <p>306- Switch Proxy</p> <p>416- Requested range not satisfiable</p> <p>506- Redirection failed</p>

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.



```
josefranciscovardugamin@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/xhtml1-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>
```

```
josefranciscovardugamin@ubuntu:~/server-sandbox$ curl -I www1.st.um
HTTP/1.1 200 OK
Date: Thu, 05 Jun 2014 18:59:04 GMT
Server: Apache/2.2.22 (Ubuntu)
Last-Modified: Wed, 23 Apr 2014 18:34:45 GMT
ETag: "804cc-142-4f7b9fc98baa7"
Accept-Ranges: bytes
Content-Length: 322
Vary: Accept-Encoding
Content-Type: text/html
X-Pad: avoid browser bug
```

Your HTTP in the server

We use **apache** and **php** for render dynamic code.

Also, we can configure it to mount different 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).

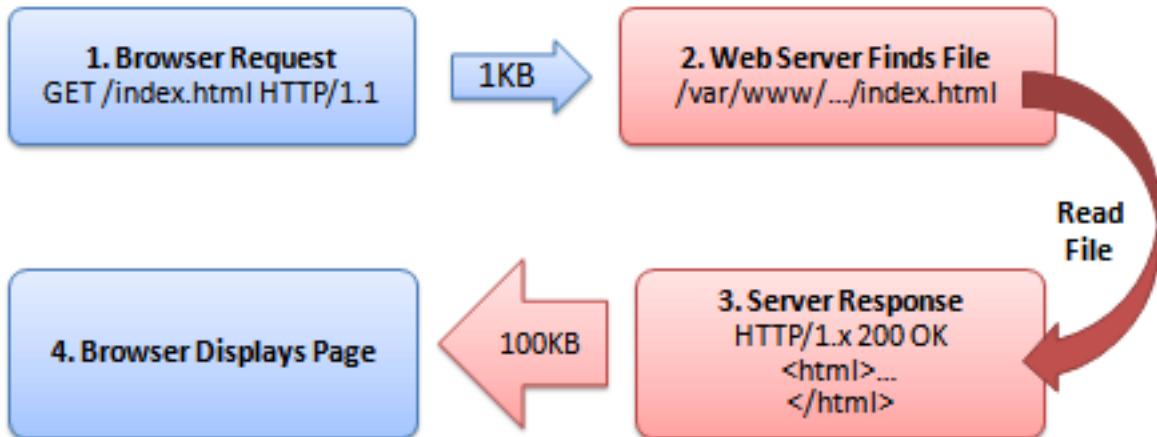
This files are defined in `Services/example/` and with the script we go to copy differents files to differents folders:

- 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`.

The SSL Certificate is a case of study that you will see in SSL Chapter.

How HTTP works

HTTP Request and Response



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)

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						

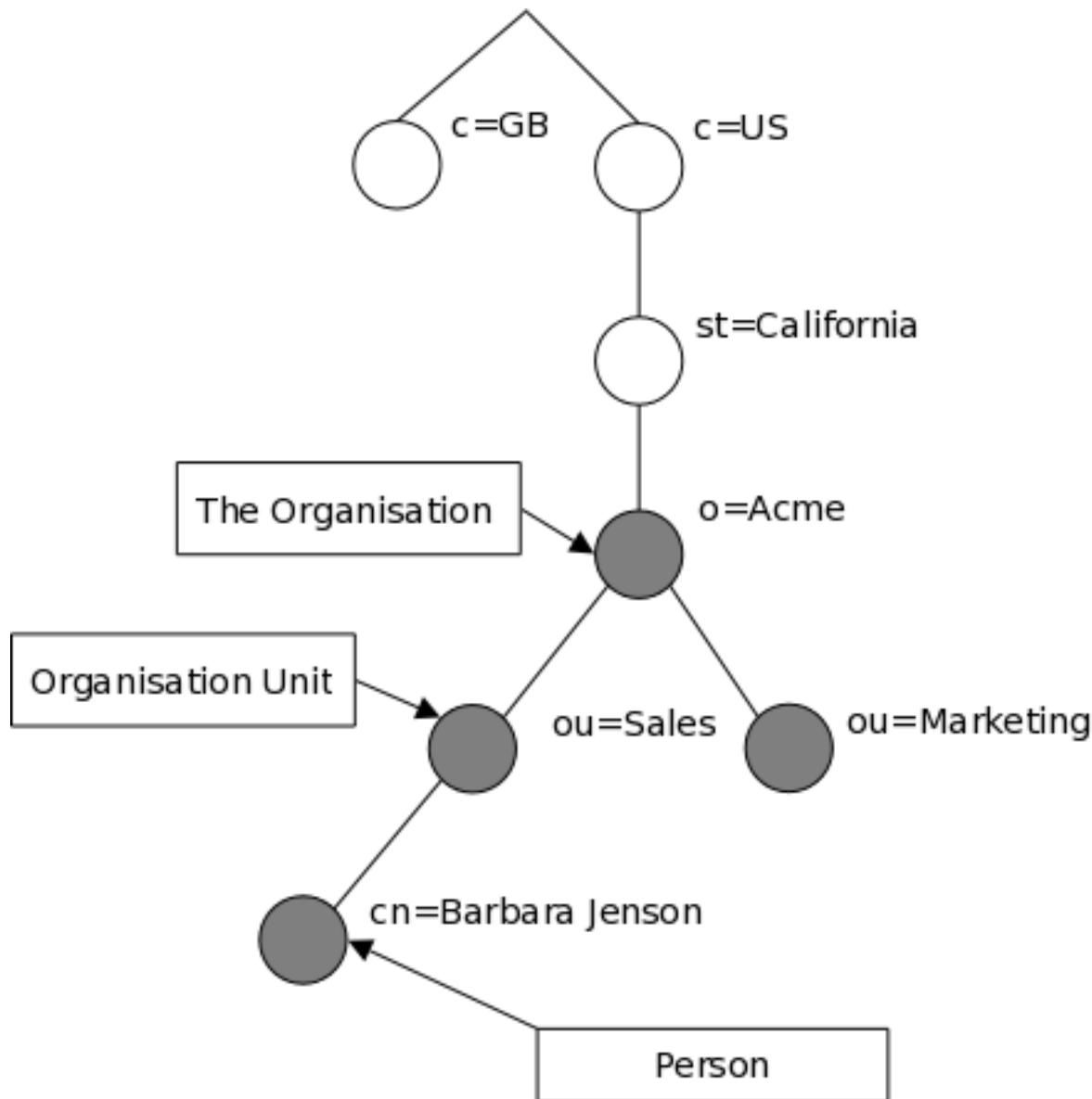
LDAP

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

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

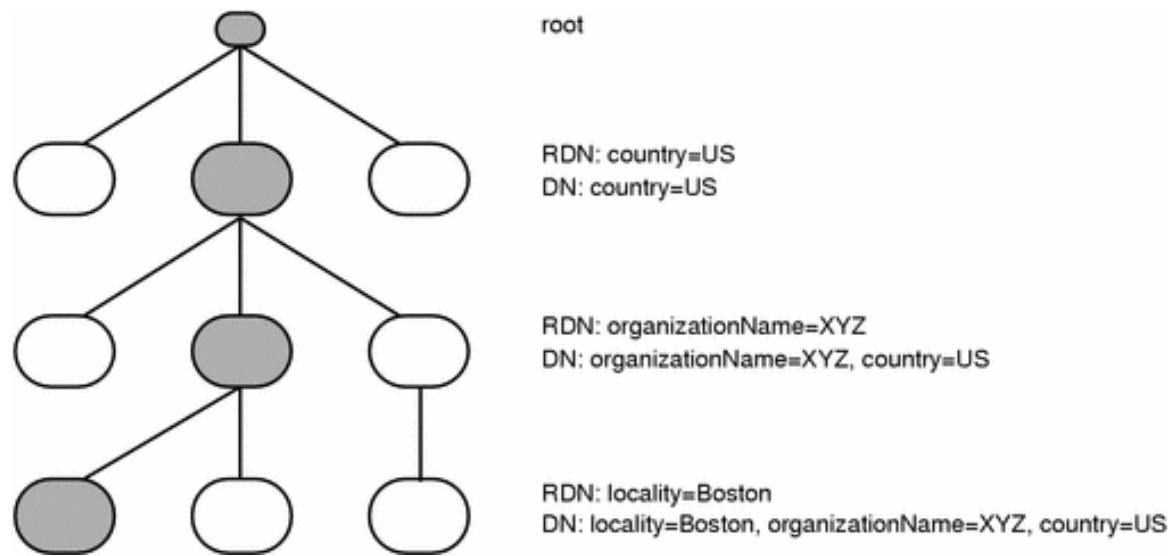
As Internet, LDAP is your adress book. And you can use LDAP for this. Your Adress book online!

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.



Each entry is a **ObjectClass** that can contain a define type of attributes.

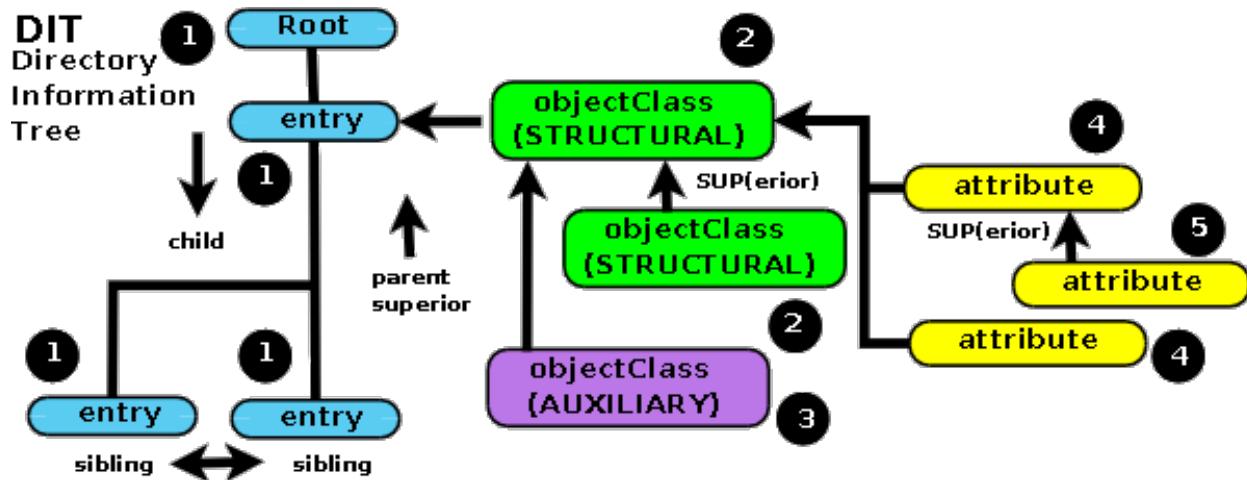
LDAP Structure

LDAP is structured in entry. The first entry of a LDAP is simulated.

Typically LDAP have the form of a tree, but not always is it because can be entries that are *alias* of a other entry.

The entry of a LDAP is limited:

- **STRUCTURAL**: Is the ObjectClass that define the entry
- **AUXILIARY**: When the Objectclass is a parent of a other ObjectClass. The *root ObjectClass* is top
- **ABSTRACT**: Optional ObjectClass that the entry can be container.



Commonly Used ObjectClass

Type	Top	Atribute required	Atribute Optional
top		objectClass	
alias	top	aliasedObjectClass	
person	top		description, seeAlso, telephoneNumber, userPassword
organizationalPerson	person		l, ou, postalAdress, postalCode, st, street, title
inetOrgPerson	organizationalPerson		jpegPhoto, mail, uid, o, userCertificate,...

Commonly Used Attributes

String
 Attribute type
 DC
 domainComponent
 CN
 commonName
 OU
 organizationalUnitName
 O
 organizationName
 STREET
 streetAddress
 L
 localityName
 ST
 stateOrProvinceName
 C
 countryName
 UID
 userid

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.

```
josefrancisco@verdugamin:~/server-sandbox$ ldapsearch -x -H ldap://ldap.st.um -b "cn=User One,ou=st,o=um,c=es" mobile
# extended LDIF
#
# LDAPv3
# base <cn=User One,ou=st,o=um,c=es> with scope subtree
# filter: (objectclass=*)
# requesting: mobile
#
# User One, st, um, es
dn: cn=User One,ou=st,o=um,c=es
mobile: 627182818

# search result
search: 2
result: 0 Success

# numResponses: 2
# numEntries: 1
```

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;

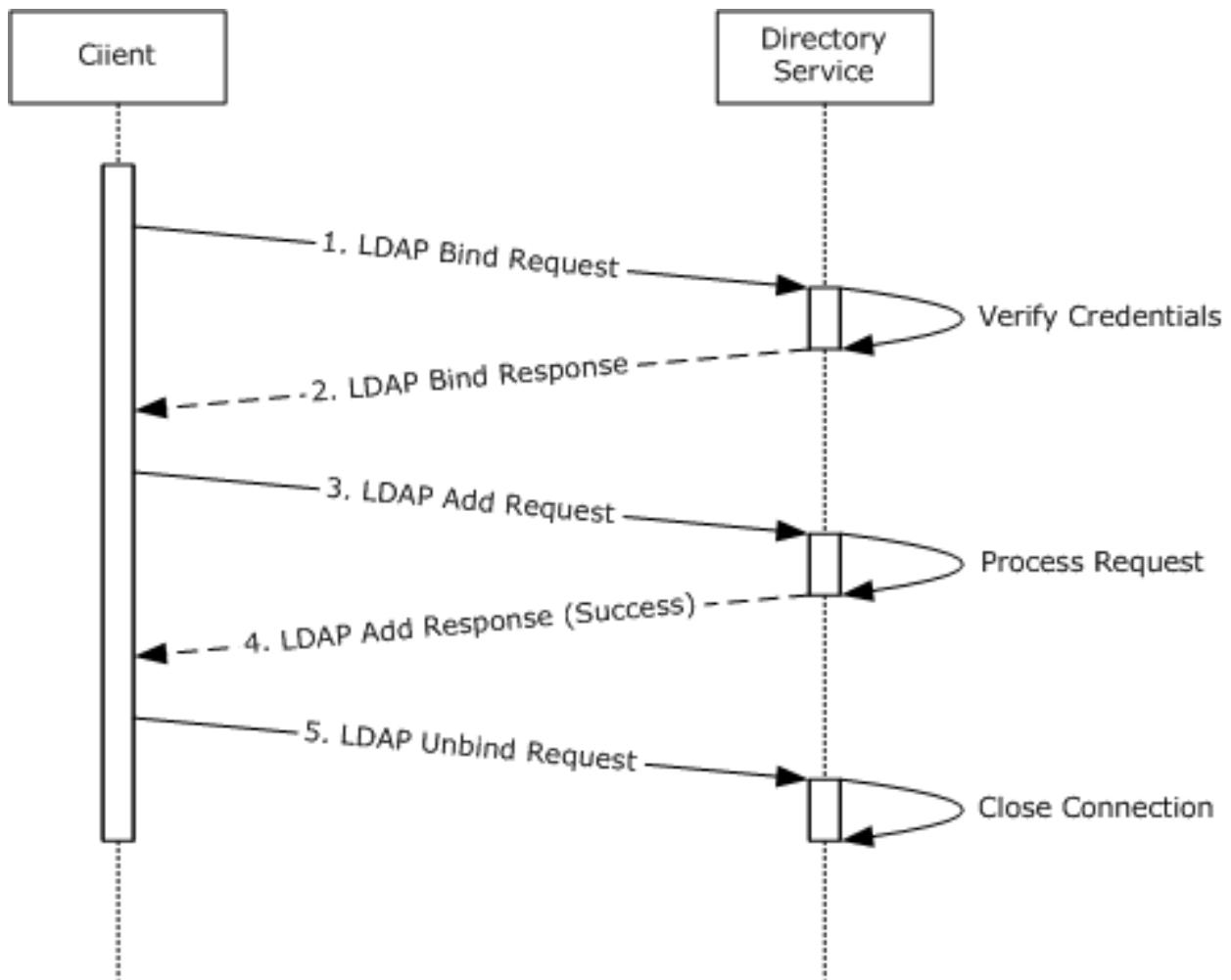
echo " * Configuring LDAP database..."
# Load database configuration
sudo ldapmodify -Y EXTERNAL -H ldapi:/// -f "$DIR"/confDatabase.ldif;

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;
```

How LDAP works

Resume:

- 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
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	172.16.22.136	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)

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]						

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]

2) BindResponse

3) SearchRequest

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
 [\[Response In: 15\]](#)

4) SearchResponse

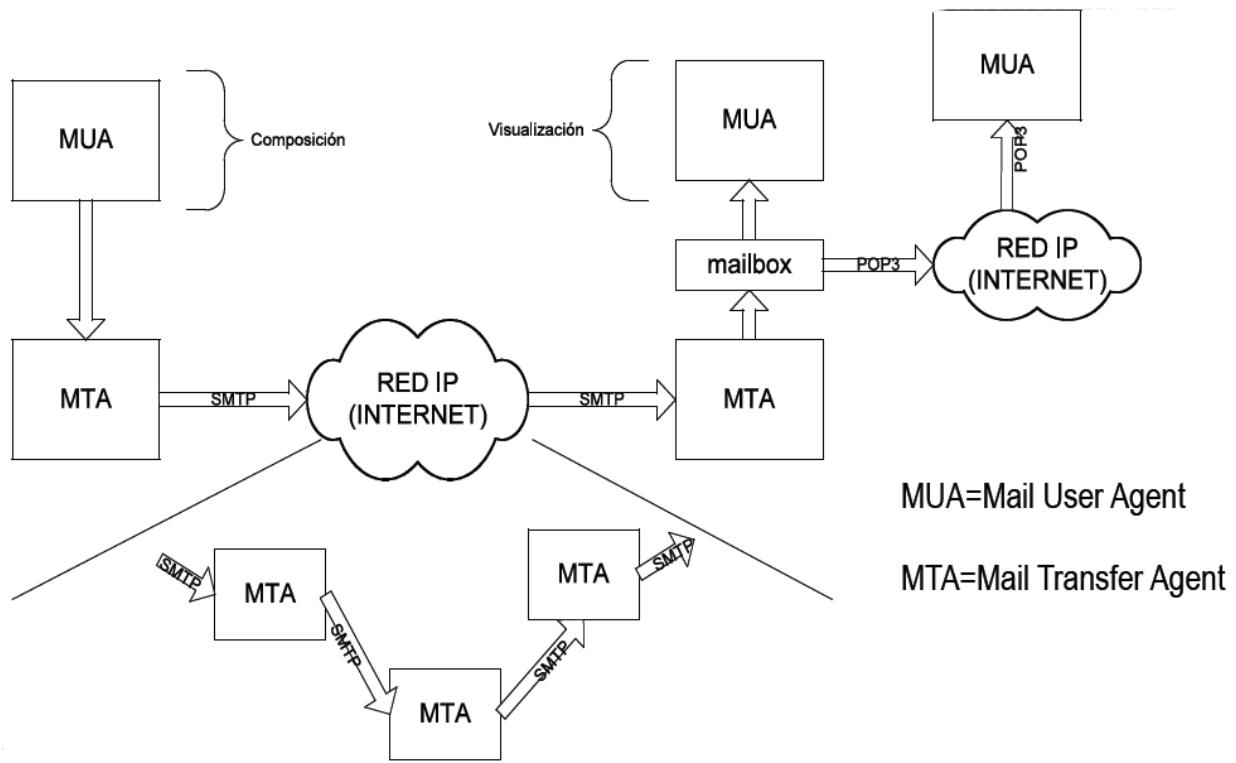
5) SearchDone

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
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	172.16.22.135	172.16.22.136	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						



Mail

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

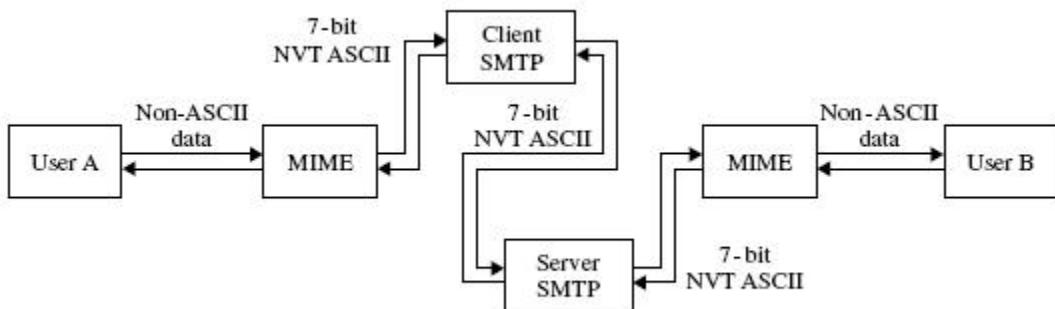
When you want to send a mail, you going to deposit the mail in the receive mailbox of the receiver, but have a little problem: don't know the address of the destination mailbox.

For know it, you need to use DNS query of the server name of the mailbox address, and he say you the direction where you can 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.

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

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

- base64
- quoted-printable
- 7bit
- 8bit
- binary

The Content-Type can be:

- text
- image
- audio
- video
- application
- 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.

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:

Your Mail in the client

With Mail client

Open mail client like **Thunderbird** (Installed by default in Ubuntu) and add two new accounts for `user1@st.um` and `user2@st.um` and try to send and receive messages.

With terminal

Yea, I know. You need feel like a *hacker* again.

```
From: Nathaniel Borenstein <nsb@bellcore.com>
To: Ned Freed <ned@innosoft.com>
Date: Mon, 22 Mar 1993 09:41:09 -0800 (PST)
Subject: Formatted text mail
MIME-Version: 1.0
Content-Type: multipart/alternative; boundary=boundary42
```

```
--boundary42
Content-Type: text/plain; charset=us-ascii
... plain text version of message goes here ...
```

Body part 1

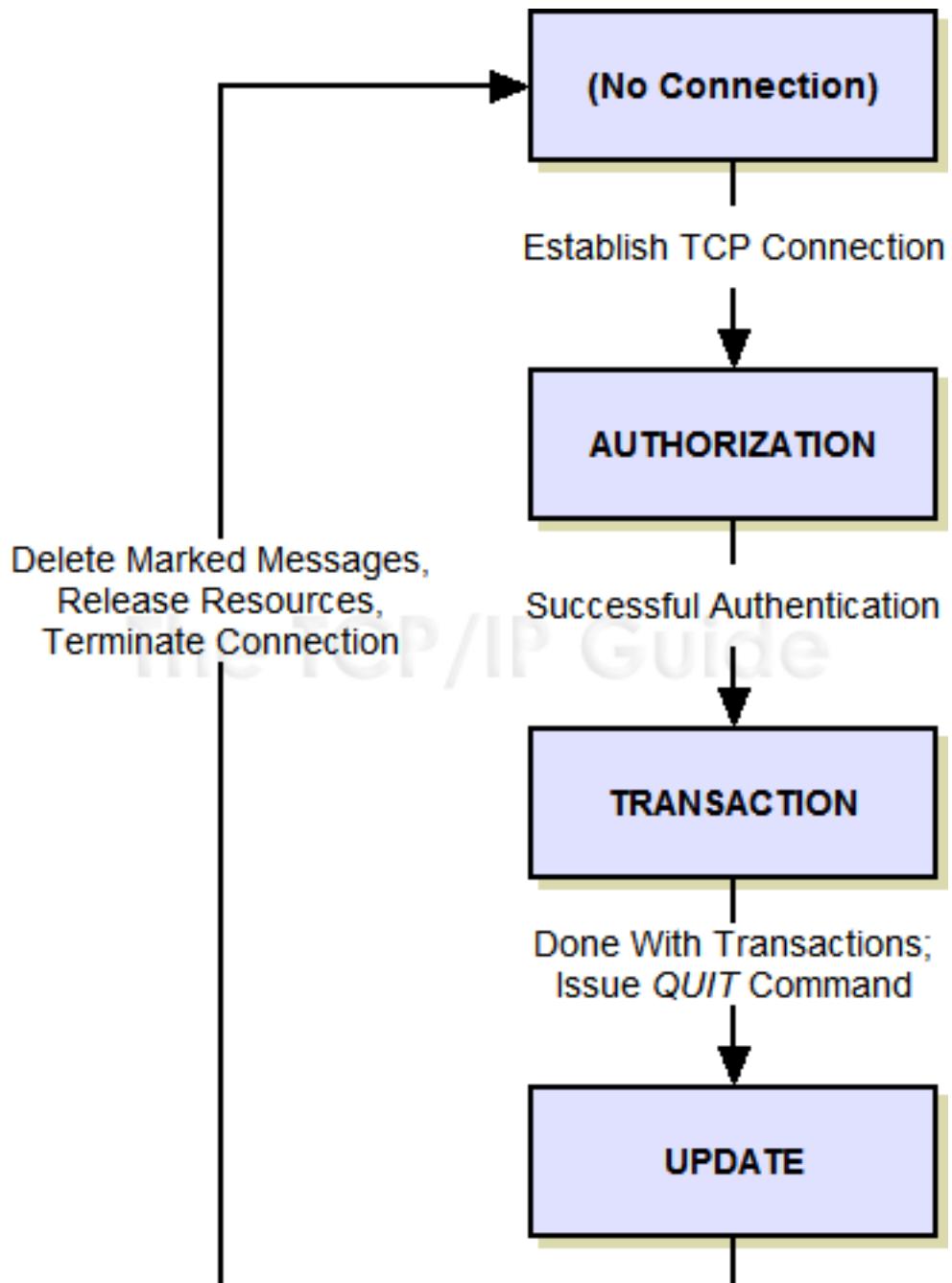
```
--boundary42
Content-Type: text/enriched
... RFC 1896 text/enriched version of same message
goes here ...
```

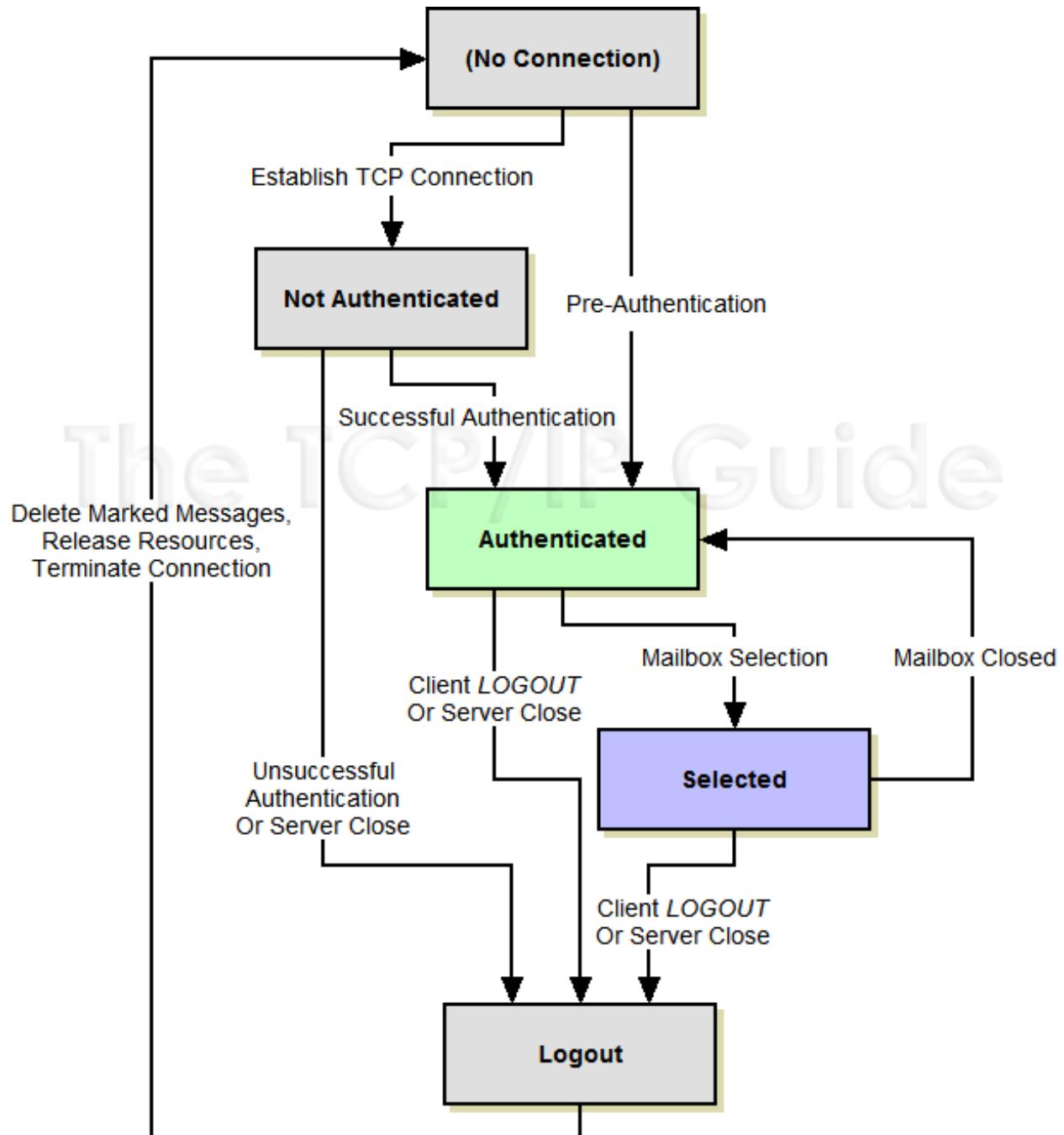
Body part 2

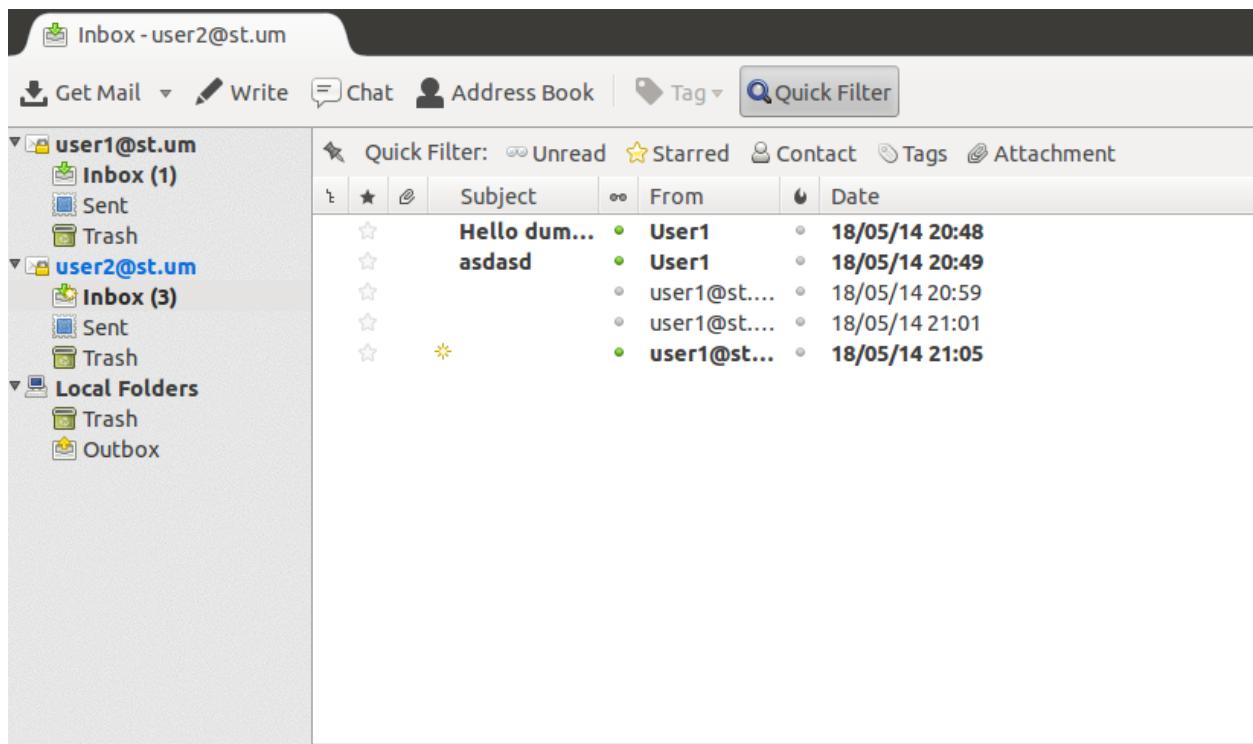
```
--boundary42
Content-Type: application/x-whatever
... fanciest version of same message goes here ...
--boundary42--
```

Body part 3

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







SMTP

POP3

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 possibles protocols 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.

```
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 dummy!
.
250 OK id=1Wm6J3-0001mA-5P
QUIT
221 ubuntu closing connection
Connection closed by foreign host.
```

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.

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**.

Configuring SMTP

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

```
josefranciscovardugamin@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 1Wm60I-0001ms-8z
          for user2@st.um; Sun, 18 May 2014 21:05:06 +0200
Message-Id: <E1Wm60I-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.
```

```

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| |---\ \ / | / | | | | |
| | | | \ \ / | | | |
|_|_|_|_/_\_\_,_|_|_|_|

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]:

```

```

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

```

How Mail Works

SMTP

Resume

- 1) Server presentation
- 2) Client HELO and sending his IP

```
(-) [ - ] [ - ] [ - ]
[ - ] [ - ] [ - ] [ - ]
[ - ] [ - ] [ - ] [ - ]
[ - ] [ - ] [ - ] [ - ]

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...
```

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=1Wm60I-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						

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]
▶ Frame 41: 106 bytes on wire (848 bits), 106 bytes captured (848 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: 61, Ack: 13, Len: 40						
▼ Simple Mail Transfer Protocol						
▼ Response: 250 ubuntu Hello st.um [172.16.22.136]\r\n						
Response code: Requested mail action okay, completed (250)						
Response parameter: ubuntu Hello st.um [172.16.22.136]						

3) Server reply

4) Client FROM mail account

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>

► Frame 43: 91 bytes on wire (728 bits), 91 bytes captured (728 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: 13, Ack: 101, Len: 25
 ▾ Simple Mail Transfer Protocol
 ▾ Command: MAIL FROM:<user1@st.um>\r\n
 Command: MAIL
 Request parameter: FROM:<user1@st.um>

5) 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

► Frame 44: 74 bytes on wire (592 bits), 74 bytes captured (592 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: 101, Ack: 38, Len: 8
 ▾ Simple Mail Transfer Protocol
 ▾ Response: 250 OK\r\n
 Response code: Requested mail action okay, completed (250)
 Response parameter: OK

6) Client send RCPT mail account

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	172.16.22.136	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

```

▶ Frame 48: 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: smtp (25), Dst Port: 38424 (38424), Seq: 109, Ack: 61, Len: 14
▼ Simple Mail Transfer Protocol
  ▶ Response: 250 Accepted\r\n
    Response code: Requested mail action okay, completed (250)
    Response parameter: Accepted
  
```

7) Server reply

8) Client prepare to send DATA

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
  
```

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!

► 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=1Wm60I-0001ms-8z\r\n
 Response code: Requested mail action okay, completed (250)
 Response parameter: OK id=1Wm60I-0001ms-8z

12) Client terminate 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=1Wm60I-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=1Wm60I-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

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

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.

- 1) Server presentation2.
- 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.
► 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						

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						

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						

3) Server reply

4) Client type password with PASS 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
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
  
```

5) Server reply and say that loggin is correct

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.
  
```

6) Client use STAT command

7) Server Reply

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

► 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

```

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

```

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 messages:
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: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: 486
 ▼ 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 1Wm60I-0001ms-8z\r\n
 \tfor user2@st.um; Sun, 18 May 2014 21:05:06 +0200\r\n
 Message-ID: <E1Wm60I-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

11) Server reply with the message content

12) Client use DELE 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
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 messages:
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

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 disconnection

15) Server reply

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.

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
```

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

```

▶ 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.

```

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
```

Now you can connect with your server with `ssh` command:

```
josefranciscovardugambin@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/josefranciscovardugambin/.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
$
```

Your SSH in the server

Only need to install `openssh-server`.

How SSH works

Resume of messages:

- 1) Client first message

- 2) Server 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-Slubuntu1.4\r\n
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-Slubuntu1.4\r\n
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]

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-Slubuntu1.4\r\n
► 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-Slubuntu1.4\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-Slubuntu1.4\r\n
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-Slubuntu1.4\r\n
► 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-Slubuntu1.4\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-Slubuntu1.4\r\n
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-Sluntu1.4\r\n
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						

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-Slubuntul.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-Slubuntul.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: 00000000000000000000

```

5) Exchange sucess!

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-Slubuntul.4\r
12	0.006592	172.16.22.141	172.16.22.142	SSHv2	107	Client Protocol: SSH-2.0-OpenSSH_5.9p1 Debian-Slubuntul.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

```

6)

7)

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:

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

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\n
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\n
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): 0000001365636473612d736861322d6e6973747032353600...

 Multi Precision Integer Length: 65

 DH base (G): 04ced594c826dd9f3bc1c57bde189c0e9b9874c7e5aa7aa9...

 Payload: 000000640000001365636473612d736861322d6e69737470...

 Padding String: 00000000000000000000

 ▼ 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: 00000000000000000000

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\n
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\n
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: 00000000000000000000

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?

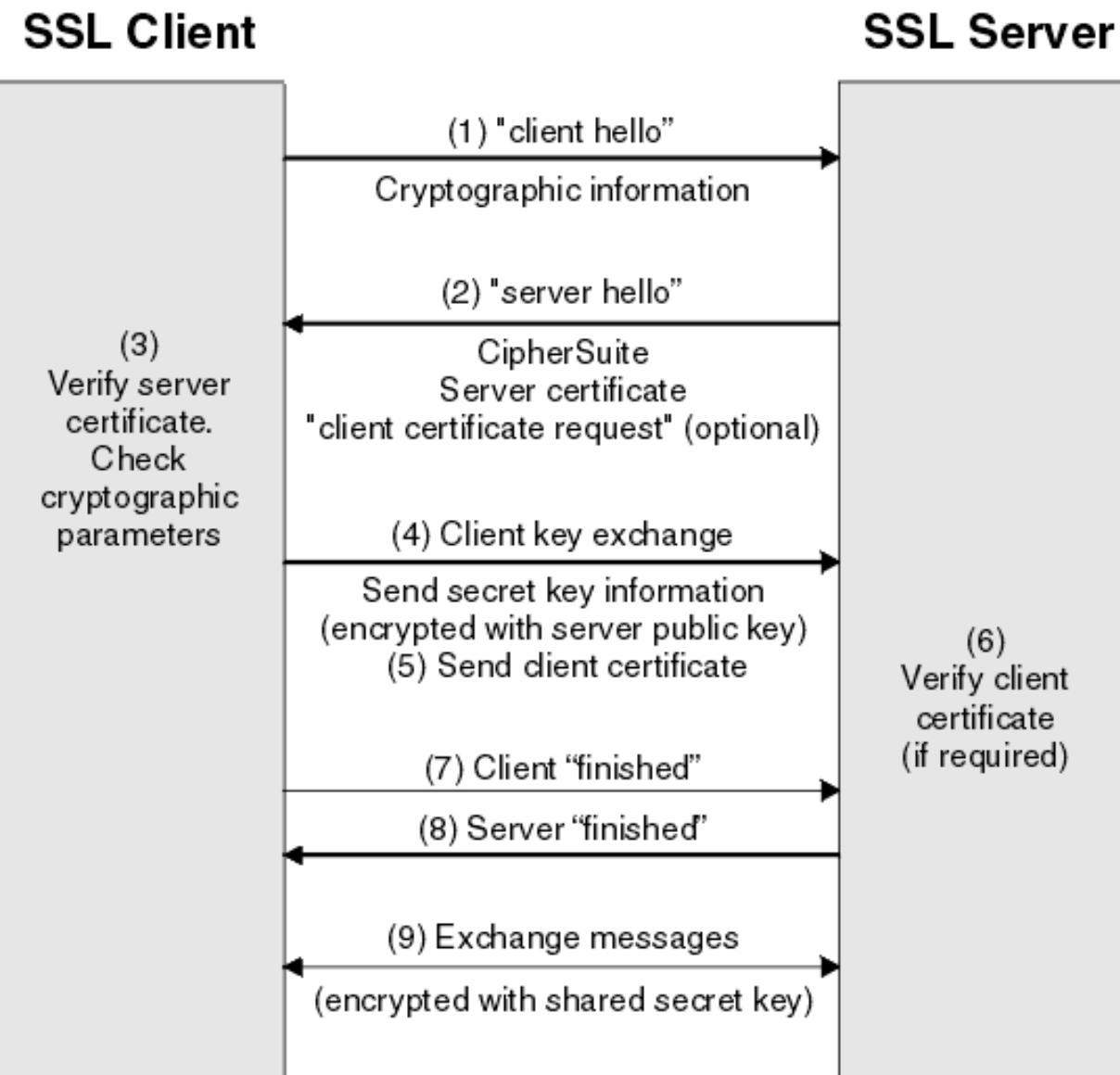
Before Pre Master Key process is necessary for the server to authenticate it, for do it is also necessay asimetric algorythm, normally with RSA. And then, thec MAC algorythm is use to verify that data of the session is authenticathed.

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 encryption
- **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 encryption.

The resume of the process in one image:

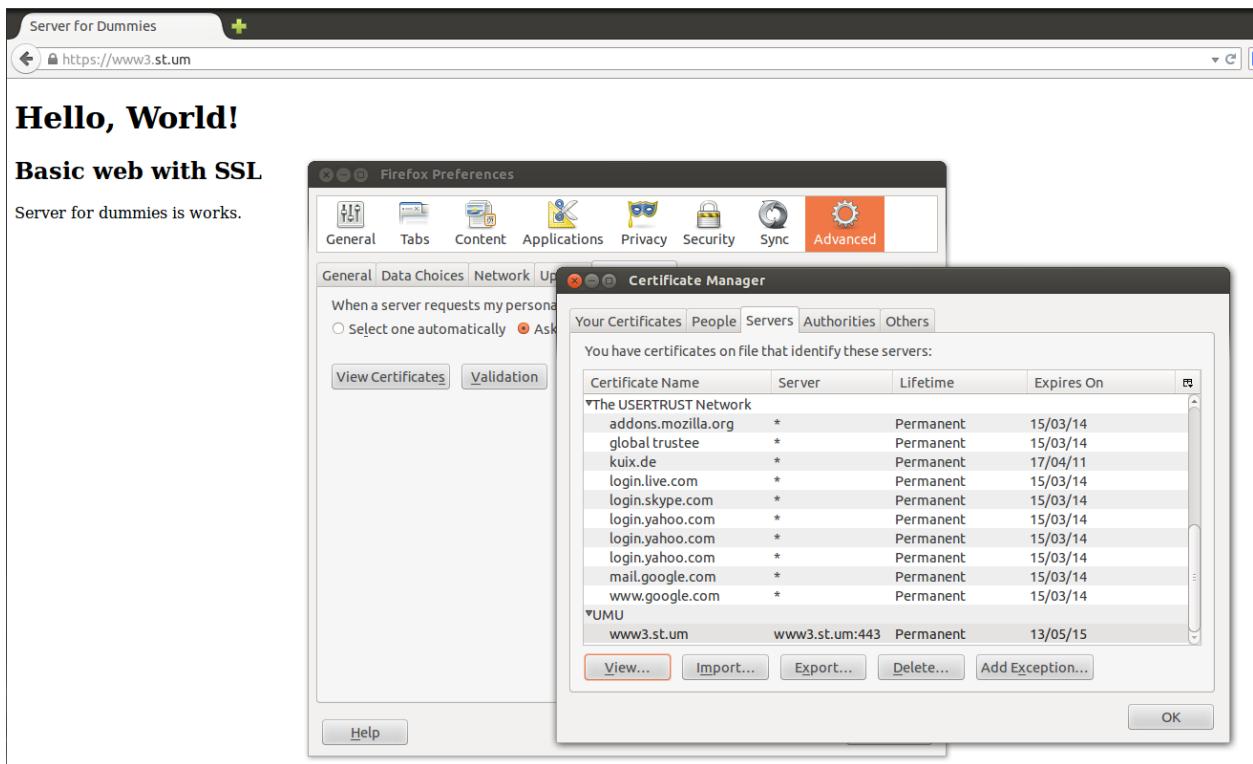
The complexities of the SSL protocol remain invisible to your customers. Instead their browsers provide them with a key indicator to let them know they are currently protected by an SSL encrypted session - the lock icon in the lower right-hand corner, clicking on the lock icon displays your SSL Certificate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



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).

When you join in the HTTPS website the certificate is downloaded automatically



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.

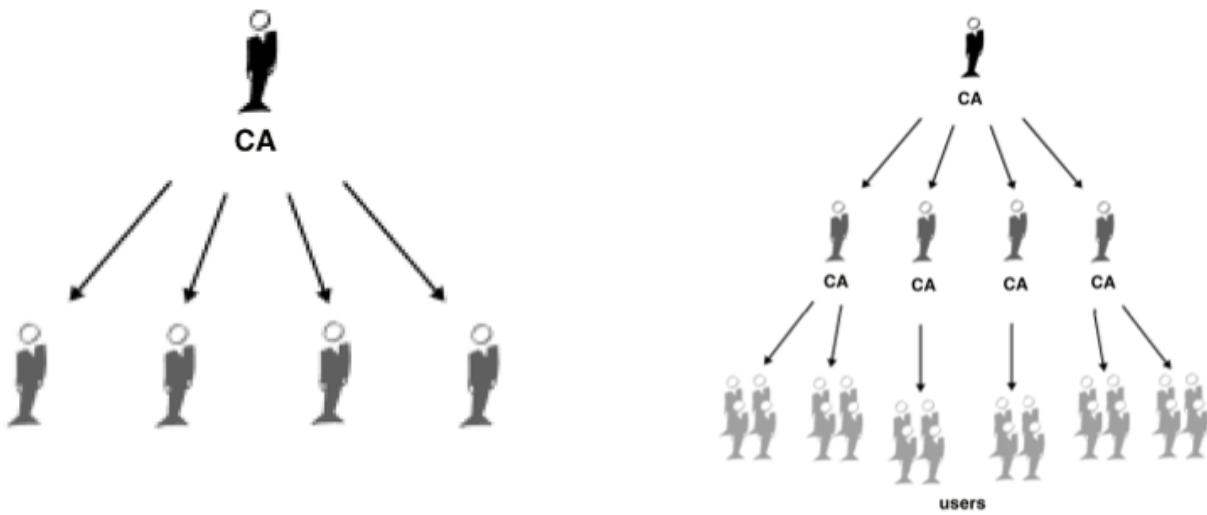
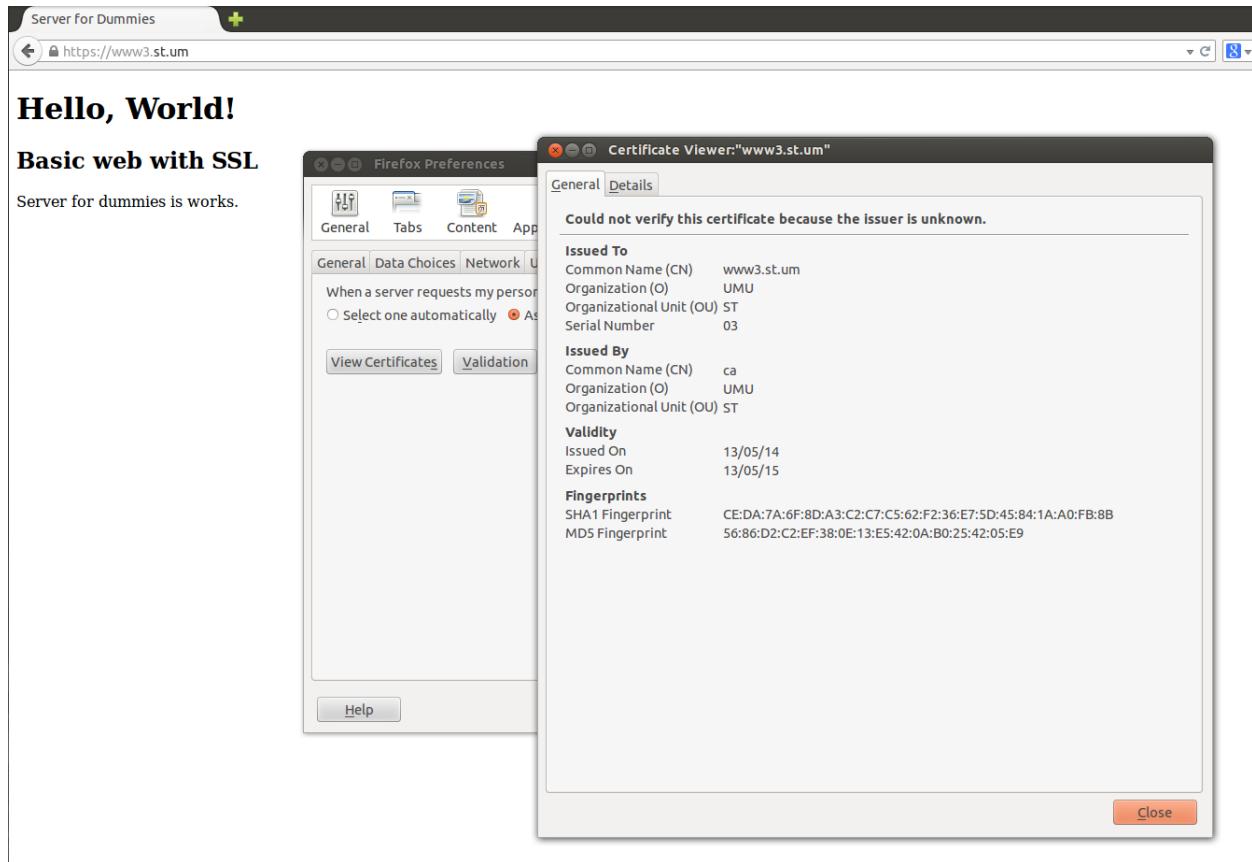
The CA establishes a chain of trust between he and domains of users:

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 client 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 used.

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.pem -text  
openssl rsa -in cakey.pem -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.

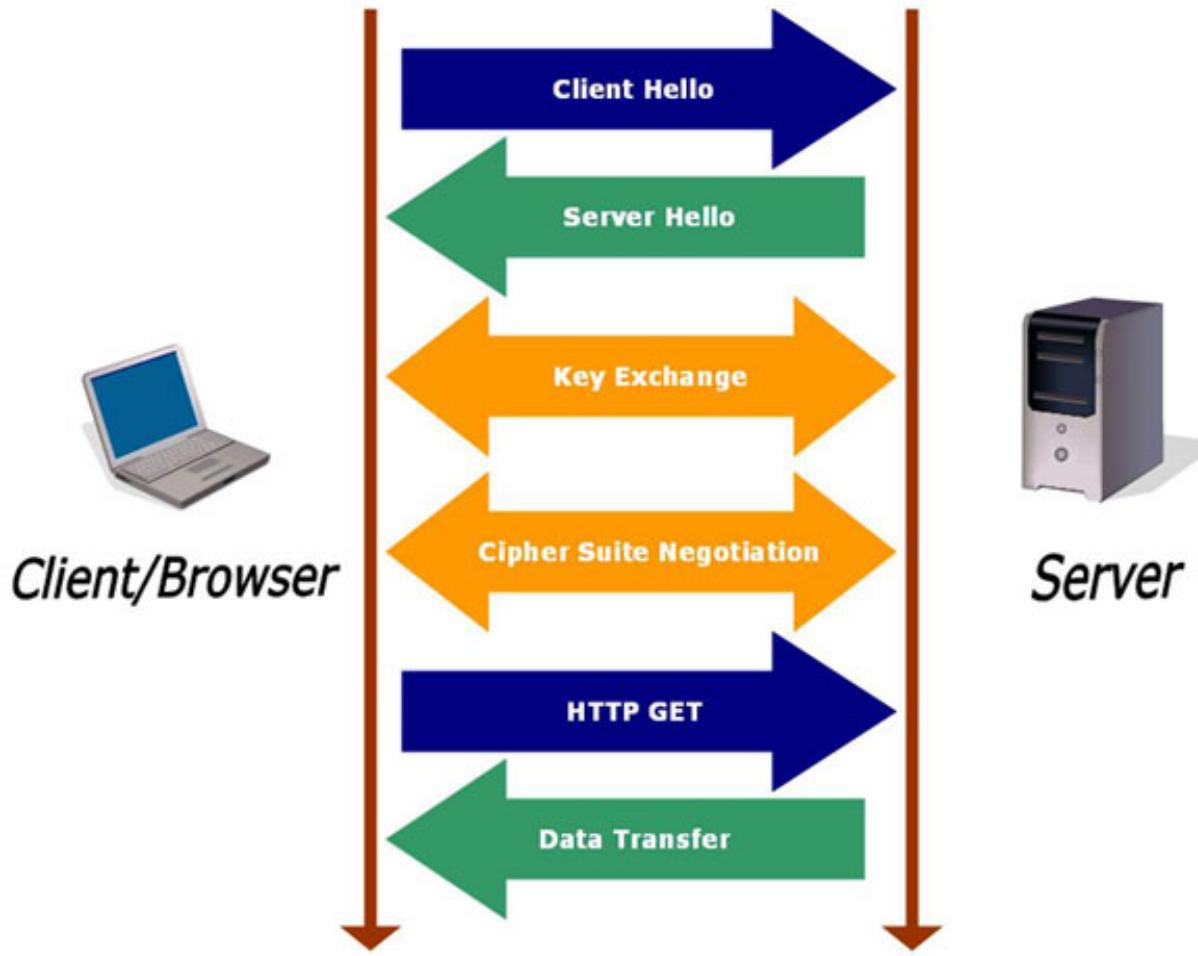
You can check that certificate is valid running this command:

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

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

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.

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				

3. do SERVER_KEY_EXCHANGE as part of the process of Pre Master Key

3) Client receive server message and proceed to:

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 possible see the data content

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
► Frame 12: 280 bytes on wire (2240 bits), 280 bytes captured (2240 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: 178, Ack: 1277, Len: 214						
▼ Secure Sockets Layer						
▼ TLSv1.2 Record Layer: Handshake Protocol: Client Key Exchange						
Content Type: Handshake (22)						
Version: TLS 1.2 (0x0303)						
Length: 134						
▼ Handshake Protocol: Client Key Exchange						
Handshake Type: Client Key Exchange (16)						
Length: 130						
▼ TLSv1.2 Record Layer: Change Cipher Spec Protocol: Change Cipher Spec						
Content Type: Change Cipher Spec (20)						
Version: TLS 1.2 (0x0303)						
Length: 1						
Change Cipher Spec Message						
▼ TLSv1.2 Record Layer: Handshake Protocol: Encrypted Handshake Message						
Content Type: Handshake (22)						
Version: TLS 1.2 (0x0303)						
Length: 64						
Handshake Protocol: Encrypted Handshake Message						

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
► Frame 13: 364 bytes on wire (2912 bits), 364 bytes captured (2912 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: 1277, Ack: 392, Len: 298						
▼ Secure Sockets Layer						
▼ TLSv1.2 Record Layer: Handshake Protocol: Encrypted Handshake Message						
Content Type: Handshake (22)						
Version: TLS 1.2 (0x0303)						
Length: 218						
Handshake Protocol: Encrypted Handshake Message						
▼ TLSv1.2 Record Layer: Change Cipher Spec Protocol: Change Cipher Spec						
Content Type: Change Cipher Spec (20)						
Version: TLS 1.2 (0x0303)						
Length: 1						
Change Cipher Spec Message						
▼ TLSv1.2 Record Layer: Handshake Protocol: Encrypted Handshake Message						
Content Type: Handshake (22)						
Version: TLS 1.2 (0x0303)						
Length: 64						
Handshake Protocol: Encrypted Handshake Message						

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

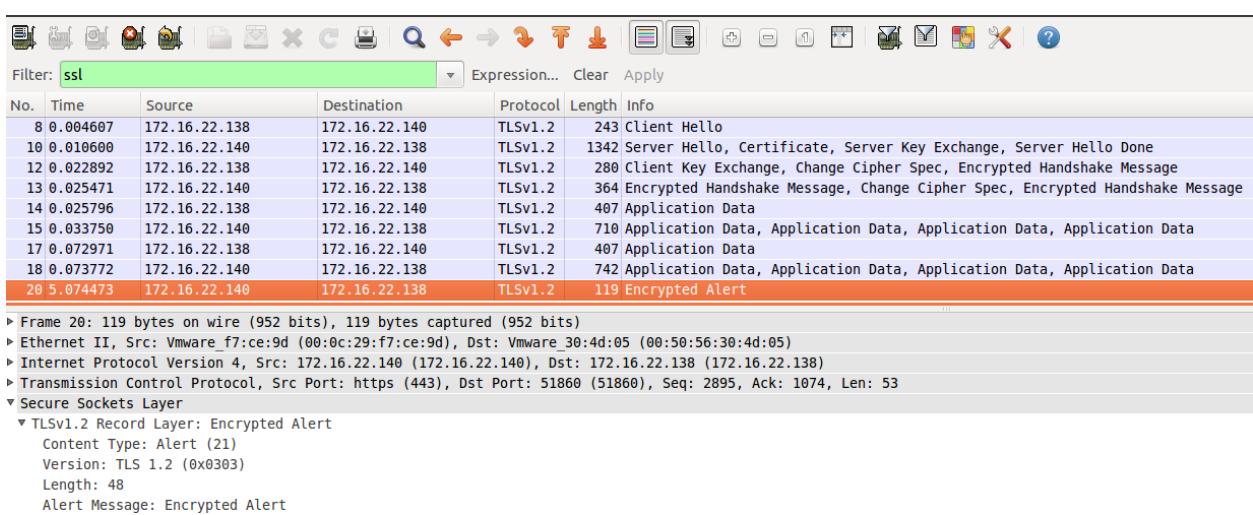
► Frame 17: 407 bytes on wire (3256 bits), 407 bytes captured (3256 bits)
 ► Ethernet II, Src: VMware_30:4d:05 (00:50:56:30:4d:05), Dst: VMware_f7:ce:9d (00:0c:29:f7:ce:9d)
 ► Internet Protocol Version 4, Src: 172.16.22.138 (172.16.22.138), Dst: 172.16.22.140 (172.16.22.140)
 ► Transmission Control Protocol, 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: 2981eb4f81afdf17c1f450dc33d76f41ddef096d770d4637b...

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...



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