

# FUNDAMENTOS DE REDES

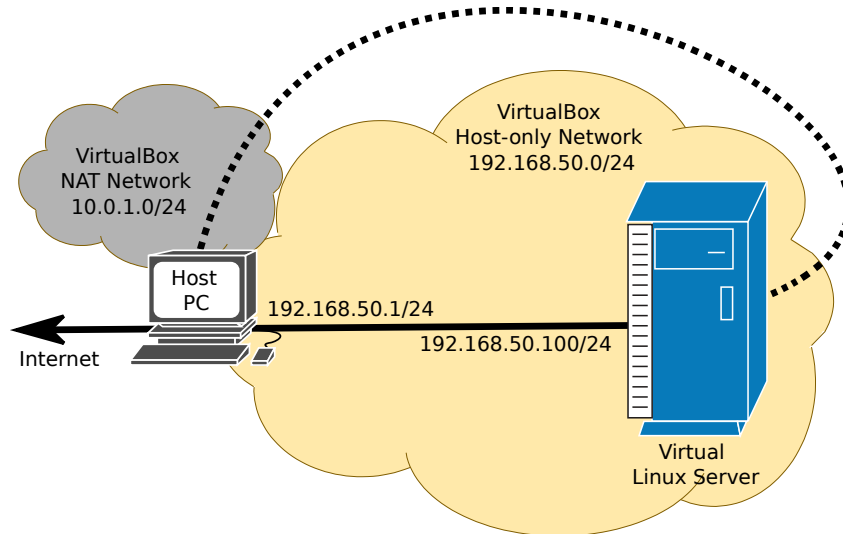
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## Objectives

- Study of UDP and TCP transport protocols.
- Service deployment and study of TFTP, FTP, DNS; and HTTP.

## IPv4 Network Services

Install VirtualBox, start it and import a Linux Server appliance (File → Import Appliance). Create a Host-only network to VirtualBox (File → Host Network Manager... → Create). Configure the respective IPv4 network according to the diagram bellow, and disable the DHCP server. In the Virtual server network settings, activate and connect one virtual network adapter connected to the NAT network (to provide Internet access through the host machine), and a second one to the new Host-only network (you may use the default IPv4 network prefix).



Start the Virtual Linux Server, start a terminal, and verify the network connections:

```
ip link #shows active interfaces
ip addr #shows active interfaces' addresses
```

Note: interface eth0 should be the NAT network connection, and eth1 the Host-only connection.

Two Ethernet (eth) interfaces must be active. One for the NAT network, and another for the Host-only network. The NAT network should acquire the IPv4 address (and gateway) automatically. However, the IPv4 address (gateway is not required) for the Host-only network must be configured:

```
sudo ip link set enp0s8 up #activates ethernet interface
sudo ip addr add 192.168.50.100/24 dev enp0s8 #configures IPv4 address
```

Test the server connectivity with the Internet and Host PC (192.168.50.1).

Note: Windows Host PCs' Firewall may be blocking ICMP Echo (ping) request packets.

## TFTP

1. At the server, verify if the TFTP service is installed and active with the command:

```
sudo systemctl status atftpd
```

To install, run the following commands (with sudo):

```
sudo apt-get update
sudo apt-get install atftpd
```

To start service, first, edit the file /etc/default/atftpd by adding the following line (at top):

```
USE_INETD=false
```

After, start the TFTP service and recheck the status of the service:

```
sudo systemctl start atftpd
sudo systemctl status atftpd
```

Note: The TFTP service root folder is /srv/tftp.

2. Verify which IPv4 services are active at the server listing all the UDP open ports and TCP ports in LISTEN state, with the command:

```
netstat -lnutp4
```

Note: UDP port 69 is (by default) the TFTP service assign UDP port

3. At the server, in the folder (/srv/tftp/), create two files with random content, one with 1500 bytes and another with 1024 bytes,

```
sudo su
cd /srv/tftp/
dd if=/dev/urandom of=file1500 bs=1 count=1500
dd if=/dev/urandom of=file1024 bs=1 count=1024
chown nobody:nogroup *
```

At the Host PC, start a Wireshark capture in the interface that connects to the server (Host-only adapter).

At the Host PC install and run a TFTP client:

#### (Linux)

Install: apt install tftp

Connect the TFTP client to the service and activate binary transference:

```
tftp 192.168.50.100
bin
```

Download the two files from the server:

```
get file1500
get file1024
```

Upload both files to the server:

```
put file1500
put file1024
```

#### (Windows)

Install: Control Panel → Programs → Turn Windows features on and off → Activate TFTP client.

Download the two files from the server:

```
tftp -i 192.168.50.100 GET file1500
tftp -i 192.168.50.100 GET file1024
```

Upload both files to the server:

```
tftp -i 192.168.50.100 PUT file1500
tftp -i 192.168.50.100 PUT file1024
```

Note: you may need to disable the Windows Firewall.

>>Analyze the sequence of exchanged TFTP packets. Explain the UDP ports chosen to transfer files. Explain why a packet with zero data bytes is transmitted at the end of the 1024 bytes file transference. Explain why some TFTP packets are padded with zeros.

## FTP

4. At the server, verify if the FTP service is installed and active with the command:

```
sudo systemctl status vsftpd
```

To install, run the following commands (with sudo):

```
apt-get update
apt-get install vsftpd
```

To start the FTP service and recheck the status of the service:

```
sudo systemctl start vsftpd
sudo systemctl status vsftpd
```

Edit the file /etc/vsftpd.conf and uncomment the line "write\_enable=YES" to enable write commands. Restart the service:

```
sudo systemctl restart vsftpd
```

Note: The FTP service maps each user folder as respective root (i.e., for labcom user is /home/labcom/).

5. At the server, in the home folder (/home/labcom/), create one file with 15K bytes:

```
dd if=/dev/urandom of=file15K bs=1k count=15
```

At the Host PC, start a Wireshark capture in the interface that connects to the server (Host-only adapter), start the FTP client and activate the binary mode of transference:

```
ftp 192.168.50.100
bin
```

Download file file15 from the server:

```
get file15k
```

Upload the same file to the server:

```
put file15K
```

>> Based on the captured packets, identify and analyze the TCP sessions (including sequence and acknowledge numbers and flags).

>> Analyze the exchanged FTP commands.

Note: Wireshark packet decoding (by default) uses relative TCP sequence numbers, i.e., the first packet TCP sequence number is always shown as zero and all following sequence numbers are adjusted accordingly. In reality, the first sequence number is not zero.

6. Activate the passive FTP transference mode (PASV), and upload the file file15K to the server:

**(Linux – at the FTP client prompt)**

```
passive
put file15k
```

**(Windows)**

The FTP command line in Windows does not support the passive mode. Download and install another FTP client. For example: FileZilla: <https://filezilla-project.org/> , File → Network Configuration Wizard.... Note: FTP passive mode is FileZilla's default.

>> Analyze the differences between passive and non-passive TFP transfer modes. In which scenarios is the passive mode essential?

## DNS

7. At the server, verify if the DNS (bind9) service is installed and active with the command:

```
sudo systemctl status bind9
```

To install, run the following commands (with sudo):

```
apt-get update
apt-get install bind9
```

To start the FTP service and recheck the status of the service:

```
sudo systemctl start bind9
sudo systemctl status bind9
```

8. Assuming that you have the domain ArqRedes.pt, configure your DNS server as master with authority over this domain. Start by creating the zone for the domain by adding to the configuration file /etc/bind/named.conf.local the following definitions:

```
zone "arqredes.pt" in{
    type master;                //define the zone as master
    file "/etc/bind/db.arqredes.pt";    //file with the domain records
};
```

Create the file /etc/bind/db.arqredes.pt and add to it the following definitions and DNS records:

```
$TTL 604800
```

```
$ORIGIN arqredes.pt.
```

```
@      IN      SOA    ns1.arqredes.pt. adm.arqredes.pt. (
                                2          ; Serial
                                604800    ; Refresh
                                86400     ; Retry
                                2419200   ; Expire
                                604800)   ; Negative Cache TTL
```

```
ns1     IN      NS     ns1.arqredes.pt.
```

```
ns1     IN      A      192.168.50.100
```

```
@       IN      A      192.168.50.100
```

```
www     IN      A      192.168.50.100
```

```
siteA   IN      A      192.168.50.100
```

```
hostPC  IN      A      192.168.50.1
```

Verify if the file with the zone definitions is correctly constructed:

```
named-checkzone arqredes.pt db.arqredes.pt
```

Restart the DNS server:

```
sudo systemctl restart bind9
```

At the Host PC, define your Virtual Server as main DNS server, start a Wireshark capture in the interface that connects to the server (Host-only adapter), perform the following DNS queries:

```
nslookup arqredes.pt
```

```
nslookup www.arqredes.pt
nslookup siteA.arqredes.pt
nslookup hostPC.arqredes.pt
```

Note: To configure the DNS server in Linux edit the file `/etc/resolv.conf` with the Virtual Server address.

>> Analyze the captured DNS packets.

## HTTP

9. At the server, verify if the DNS (apache2) service is installed and active with the command:

```
sudo systemctl status apache2
```

To install, run the following commands (with sudo):

```
apt-get update
apt-get install apache2
```

To start the FTP service and recheck the status of the service:

```
sudo systemctl start apache2
sudo systemctl status apache2
```

Analyze the content of the apache2 main configuration file (`/etc/apache2/apache2.conf`). At the Host PC, start a Wireshark capture in the interface that connects to the server (Host-only adapter), and test the HTTP server accessing the following URL (with a browser):

```
http://192.168.50.100
http://arqredes.pt
http://www.arqredes.pt
http://siteA.arqredes.pt
```

>> Based on the captured packets, identify and analyze the TCP sessions (including sequence and acknowledge numbers and flags), and the content of the HTTP packets. Explain how the HTTP server identifies the webpage/data to sent to the client.

10. In the apache2 default content folder `/var/www/html/`, create a new folder named "arqredes.pt-80" (name format is not mandatory, but it is import to maintain consistence, e.g., *domain-port*) to store the webpage associated with the domain arqredes.pt. Inside the new folder create a new HTML file named `index.html` (default webpage name) with the following content (you may change it):

```
<html>
<body>
<h1>arqredes.pt</h1>
<h2>Porto 80</h2>
</body>
</html>
```

In order to create a new website at the server it is required to define a new apache2 Virtual Host. in the folder `/etc/apache2/sites-available/` create a new file (named `arqredes.pt-80.conf`) with the following content:

```
<VirtualHost *:80>
    DocumentRoot /var/www/html/arqredes.pt-80
    ServerName arqredes.pt
</VirtualHost>
```

Enable the new domain/site and restart the HTTP server:

```
sudo a2ensite arqredes.pt-80
sudo systemctl restart apache2
```

Test the HTTP server accessing the following URL (with a browser):

```
http://192.168.50.100
http://arqredes.pt
http://www.arqredes.pt
http://siteA.arqredes.pt
```

>> What do you conclude?

11. At the Virtual Host definition (arqredes.pt-80) add the following directive (below ServerName):

```
ServerAlias www.arqredes.pt
```

Restart the HTTP server:

```
service apache2 restart
```

Test the HTTP server accessing the following URL:

```
http://192.168.50.100
```

```
http://arqredes.pt
```

```
http://www.arqredes.pt
```

```
http://siteA.arqredes.pt
```

>> What do you conclude?

12. Create a different site/webpage for the subdomain siteA.arqredes.pt.