Assignment 1: TCP/IP basics

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Exercise 1: DHCP network

1.1 Plan of the activities

1.1.1 Configure DHCP server

A new configuration file must be supplied, as the default one does not comply with the specifications. The address range is 192.168.10.18-192.168.10.22 as the router's internal interface must be configured statically.

1.1.2 Configure router's internal interface

The router's internal interface must be configured with a static address, as a DHCP server may not respect reservations.

1.1.3 Configure terminals' interfaces

Terminals' interface must be configured in order to receive the configuration from a DHCP server.

1.2 Implementation

1.2.1 `boundary.startup`

The DHCP server *udhcpd* is installed through *apt-get* (it requires an internet connection).

Then, the *networking* service is restarted through `/etc/init.d/networking stop; /etc/init.d/networking start` in order to apply the changes in file `/etc/network/interfaces`.

Lastly, the DHCP server is launched with the new configuration file `/etc/udhcpd-custom.conf`.

1.2.2 `boundary/etc/network/interfaces`

The interface `eth1` has been configured according to specification with the static address 192.168.10.17.

1.2.3 `boundary/etc/udhcpd-custom.conf`

In this file are stored the options for *udhcp*, the DHCP server. With respect to the original configuration file few edits have been made: address range and router's address have been updated as per specifications and and interface has been modified to comply to the network topology.

1.2.4 `pcX.startup`

The *networking* service is restarted in order to apply the changes in file `/etc/network/interfaces`.

1.2.5 `pcX/etc/network/interfaces`

The only interface is configured so to request an IP address to a DHCP server.

1.3 Testing procedure

In every host the local IP address is retrieved using `ip addr show`, then every host pings every other hosts and 1.1.1.1. The test is successful if and only if all pings are successful.

1.4 Final remarks

The command `/etc/init.d/networking restart` has been deprecated from years. However, it has never been removed and can be safely replace the expression `/etc/init.d/networking stop; /etc/init.d/networking start`.

Since hosts' addresses change at every reboot, no simple automatic test mechanism can be defined.

Exercise 2: Network with static addressing

2.1 Plan of the activities

2.1.1 Find the IP addresses for all hosts

The IP addresses are stored in `dns/etc/bind/db.pndeflab.edu`, which corresponds to `/etc/bind/db.pndeflab.edu` in the DNS server.

2.1.2 Assign an IP address to each host

IP addresses are assigned based on the ones found in the previous activity. For example, the IP address specified in resource record `pc1 IN A 192.168.37.100` is assigned to terminal `pc1`.

2.1.3 Define static routes

Each host need to communicate with the others, therefore it needs a routing method.

2.1.4 Define the DNS servers

All hosts need to know the DNS server for the network and for internet (host `dns` included).

2.2 Implementation

IP addresses and routes are assigned statically using the `ip` command, namely `ip addr add` ⟨`address`⟩ `dev` ⟨`interface`⟩, `ip route add` ⟨`address`⟩ `dev` ⟨`interface`⟩ and `ip route add default via` ⟨`address`⟩. `dns`, `pc1` and `pc2` have only interface `eth0`, while `boundary` is connected to the local network via interface `eth1`.

The DNS servers have been specified in `/etc/resolv.conf` in all hosts. Host `dns` provides services for the local network, while Cloudflare's 1.1.1.1 provides services for internet.

2.3 Testing procedure

A script `test.sh` has included in the root directory of every host. It pings all hosts (using the names specified in the resource records) and google.com; it exits correctly if and only if all pings are successful.

2.4 Final remarks

Given the size of the network all tasks have been performed manually. In larger networks the activities must have been automatised.

Exercise 3: Two networks with static routes

3.1 Plan of the activities

3.1.1 Determine the subnet

The network is composed by two LANs, which are connected to internet (through the router `border`) and each other. It stands to reason that each LAN should have the possibility to act as an independent network.

It is necessary to determine a subnet for `lan1`, another for `lan2` and a supernet encompassing LANs and routers.

3.1.2 Implement the network

Since no dynamic routing mechanisms is in place, it is necessary to implement statically addresses and routes in every host.

3.2 Implementation

3.2.1 Network

Each LAN is composed by two terminals plus a router, therefore it needs a /29 subnet. Given that in a /28 subnet there can be only two /29 subnets, it is necessary to allocate a /27 subnet for covering the whole local network.

To the routers' interfaces in `internal` have been assigned the highest addresses (.30, .29 and .28) in order to free 192.168.12.16/29 for future expansions.

3.2.2 `border.startup`

The address `192.168.12.30` is assigned statically to `eth1` using the command `ip addr add 192.168.12.30 dev eth1`.

It is defined the route to each LAN using the commands `ip route add` ⟨`router address`⟩ `dev eth0` (where `router address` is router's address in `internal`) and `ip route add` ⟨`lan address`⟩ `via` ⟨`router address`⟩

3.2.3 `routerX.startup`

The address 192.168.12.`Y`, where $\texttt{Y} = 8(\texttt{X}-1)+1$, is statically assigned to the interface in the LAN using the command `ip addr add` ⟨`address`⟩ `dev eth1`. Then, `eth1` is made the default interface for communicating with the rest of the LAN through `ip route add` ⟨`lan address`⟩ `dev eth1`.

The address 192.168.12.`Z`, where $\texttt{Z} = 30 - \texttt{X}$, is statically assigned to the interface in `internal` using the command `ip addr add` ⟨`address`⟩ `dev eth0`.

`border` is made the default gateway through `ip addr add 192.168.12.30 dev eth0` and `ip route add default via 192.168.12.30`.

Lastly, the route for the other LAN is defined using `ip addr add` ⟨`router address`⟩ `dev eth1`, where `router address` is the router's address in `internal`, and `ip route add` ⟨`lan address`⟩`/29 via` ⟨`router address`⟩.

3.2.4 `lanXpcY.startup`

The address `192.168.12.Z` is assigned statically to the only interface using the command `ip addr add` ⟨`address`⟩ `dev eth0`. Terminals in `lan1` receive IP address such that $Z \in [1, 6]$, while terminals in `lan2` receive address such that $Z \in [9, 14]$.

The route to the router is assigned statically through `ip route add` ⟨`router address`⟩ `dev eth0`. The router is then elected as the default gateway using the command `ip route add default via` ⟨`router address`⟩.

3.3 Testing procedure

A script `test.sh` has included in the root directory of every host. It pings all hosts and 1.1.1.1; it exits correctly if and only if all pings are successful.

3.4 Final remarks

Given the small size of the network, all addresses and routes have been statically defined, In larger network, it is necessary to implement automatised routing and network management protocols.