LINUX NETWORKING BASICS

1. Linux network interface

a) A network interface is the point of connection between a computer and a network: it is how Linux joins the software side of networking to the hardware side.

b) There are two kinds of network interfaces:

- **Physical interfaces**, which represent a hardware device (a NIC, a wireless card or a modem).
- **Virtual interfaces**, which are not hardware but are linked to a physical or another virtual interface as for instance example the **loopback** interface identified by **lo**.

c) Interface names follow two styles:

- The old one -> eth0,eth1,wlan0, wlan1….
- The newer one based on hardware location → enp3s0, wlp2s0,…

d) Useful commands to inspect them:

- **ip link** shows their type and state.
- **ip addr** shows their IP addresses.

2. Basic network concepts: IP address, mask, gateway and DNS

IP address. A number that identifies the network interface of a host so devices can communicate. IPv4 is the fourth version of the Internet Protocol, which identifies each device on a network with a 32-bit address written as four numbers from 0 to 255 separated by dots (for example, 192.168.1.10)

Subnet mask. It marks which part of an address is the network and which is the host. It starts with ones (network) followed by zeros (host), for example 255.255.255.0, or /24 in short notation. Applying an AND between the IP and the mask gives the network address; the broadcast address is the last one of the range, and the number of usable hosts is two fewer than the addresses in the subnet (network and broadcast).

Gateway. The device that works as the exit point from the local network towards others (in practice, the router). A host without a default gateway can only talk to computers in its own network. Its address is usually the first available one in the network.

DNS. A service that translates domain names (such as www.dipolnet.com) into numeric IP addresses, so users do not have to remember the numbers. The computer asks a DNS server, receives the IP and then connects.

Ports. Integers from 1 to 65535 that identify services on a host. Well-known ports include 22 (SSH), 53 (DNS), 80 (HTTP), 443 (HTTPS), 25 (SMTP) and 67/68 (DHCP).

3. MAC (or hardware) address

a) A MAC (Media Access Control) address uniquely identifies a device on a network, like a postal address identifies a house. It belongs to the network interface controller (NIC), so a device with Ethernet and Wi-Fi has one MAC address per interface.

b) It is a 12-digit hexadecimal number, usually written in pairs separated by colons or hyphens (for example 2C:54:91:88:C9:E3).

c) It is found in the system or network settings; on Linux, **ip a** shows it as “link/ether”. Manufacturers sometimes call it Hardware ID, Wi-Fi Address, etc.

d) MAC vs IP:

- The **MAC address** is like your fingerprint: it is built into your network card and always identifies that specific device, wherever you take it.
- The **IP address** is like your home address: it depends on where you are connected. If you move your laptop from home to school, the MAC stays the same but the IP changes, because each network assigns its own.
- **MAC addresses** are used inside the local network; **IP addresses** are needed to reach other networks such as the Internet.