

DEPARTAMENTO DE ELECTRÓNICA, TELECOMUNICAÇÕES E INFORMÁTICA LICENCIATURA EM ENG. DE COMPUTADORES E INFORMÁTICA

REDES DE COMUNICAÇÕES I

COMMAND GUIDE

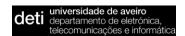
CONFIGURE PCS NETWORK INTERFACES

BASIC NETWORKING COMMANDS

CISCO ROUTERS COMMAND LINE

Purpose

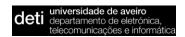
- How to configure IP parameters on the PCs interfaces
- o Basic guide on basic networking tools: ping, traceroute and nslookup
- o Basic list of Cisco Command Line instructions
- o DELL Switch operation





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1. Using ipconfig, ifconfig, and arp Commands

This section provides an overview of ipconfig, ifconfig, and arp commands, their options, and how they can be used to troubleshoot network issues, view MAC addresses, configure IP settings, and manage network interfaces.

To configure an IP address, subnet mask, default gateway, and DNS server on Windows 10/11, Linux, and macOS using both GUI and command-line methods. Ensure administrative/root permissions when modifying network settings.

1.1. ipconfig (Windows)

ipconfig is a command-line tool used to display and manage IP configuration settings on a Windows machine.

Basic Commands:

Display basic IP configuration: ipconfig

This shows IPv4/IPv6 addresses, subnet mask, and default gateway.

Display detailed network configuration: ipconfig /all

This provides additional details such as MAC address, DHCP, DNS, and lease expiration.

Release current IP configuration (for DHCP networks): ipconfig /release

This disconnects the IP address assigned by the DHCP server.

Renew IP configuration (request a new address from DHCP): ipconfig /renew

Flush the DNS resolver cache: ipconfig /flushdns

Clears the DNS cache, resolving DNS-related issues.

Display DNS cache: ipconfig /displaydns

Show all active TCP/IP connections and ports: netstat -an

Checking MAC Address:

Find the MAC address of all network interfaces: ipconfig /all | findstr "Physical"

The **Physical Address** field corresponds to the MAC address.

To configure the Gateway of the PC, execute the following command (administrator):

```
route add <NETWORK> mask <MASK> <GW IPaddress>
```

The command route print shows the routing table of the PC and the configured *Gateways*.





1.2. ifconfig (Linux/macOS)

ifconfig is used to configure network interfaces in Linux and macOS. On newer Linux distributions, ip is preferred over ifconfig.

Basic Commands:

Display network interfaces and IP configuration: ifconfig

Shows interface names, IP addresses, and MAC addresses.

Show detailed information for a specific interface: ifconfig eth0

Replace eth0 with the relevant interface name.

Enable a network interface: sudo ifconfig eth0 up

Disable a network interface: sudo ifconfig eth0 down

Assign a static IP address: sudo ifconfig eth0 192.168.1.100 netmask 255.255.255.0

Change the MAC address (requires root privileges): sudo ifconfig eth0 hw ether 00:1A:2B:3C:4D:5E

View MAC addresses of all interfaces: ifconfig | grep ether

The ether field shows the MAC address.

View only active network interfaces: ifconfig -a

To configure the Gateway of the PC, execute the following command:

```
sudo route add default gw <IPaddress>
```

The command route -n shows the routing table of the PC and the configured Gateways.

Alternative (ip command for Linux):

Since if config is deprecated in some Linux distributions, the ip command is recommended:

Show all interfaces: ip a

Bring an interface up/down:

```
sudo ip link set eth0 up
sudo ip link set eth0 down
```

Show MAC address: ip link show eth0





1.3. arp (Address Resolution Protocol)

The arp command is used to view and manipulate the ARP table, which maps IP addresses to MAC addresses.

1.3.1. Windows:

Display the ARP table: arp -a

Lists known IP-to-MAC address mappings.

Clear the ARP cache: netsh interface ip delete arpcache

Add a static ARP entry: arp -s <IP address> <MAC address>

Example: arp -s 192.168.1.100 00-14-22-01-23-45

Delete a specific ARP entry: arp -d <IP_address>

Example: arp -d 192.168.1.100

1.3.2. Linux/macOS:

Display the ARP table: arp -a

Delete a specific ARP entry: sudo arp -d <IP address>

Add a static ARP entry: sudo arp -s <IP_address> <MAC_address>

Example: sudo arp -s 192.168.1.100 00:14:22:01:23:45

View ARP entries for a specific interface: arp -i eth0 -a

Show detailed ARP table information: ip neigh show





2. Basic Networking Tools: Ping, Traceroute, and Nslookup

This section provides a detailed explanation of the ping, traceroute, and nslookup commands across different operating systems, including how to modify relevant parameters for troubleshooting and analysis. Ensure you have appropriate permissions to execute these commands effectively.

2.1. Ping Command

The ping command is used to test network connectivity between devices by sending ICMP (Internet Control Message Protocol) echo requests and waiting for a reply.

2.1.1. Windows: ping <IP address or domain>

Example: ping 8.8.8.8

Change packet size: ping -1 <size> <IP address or domain>

Example: ping -1 1500 google.com

Set number of packets: ping -n <count> <IP address or domain>

Example: ping -n 5 google.com

Modify Time-To-Live (TTL): ping -i <TTL value> <IP address or domain>

Example: ping -i 64 google.com

2.1.2. Linux/macOS: ping <IP address or domain>

Example: ping google.com

Change packet size: ping -s <size> <IP address or domain>

Example: ping -s 1500 google.com

Set number of packets: ping -c <count> <IP_address_or_domain>

Example: ping -c 5 google.com

Modify TTL: ping -t <TTL_value> <IP_address_or_domain>

Example: ping -t 64 google.com

Ping using IPv6: ping6 <IPv6 address or domain>

Example: ping6 ipv6.google.com





2.2. Traceroute Command

The traceroute (or tracert in Windows) command is used to track the route packets take to reach a destination.

2.2.1. Windows:

tracert <IP_address_or_domain>

Example: tracert google.com

Modify number of hops: tracert -h <max_hops> <IP_address_or_domain>

Example: tracert -h 30 google.com

Change timeout value: tracert -w <timeout ms> <IP address or domain>

Example: tracert -w 500 google.com

2.2.2. Linux/macOS:

traceroute <IP_address_or_domain>

Example: traceroute google.com

Modify number of hops: traceroute -m <max_hops> <IP_address_or_domain>

Example: traceroute -m 30 google.com

Use ICMP packets (similar to Windows tracert): traceroute -I <IP address or domain>

Example: traceroute -I google.com

Traceroute using IPv6: traceroute6 <IPv6_address_or_domain>

Example: traceroute6 ipv6.google.com

2.3. Nslookup Command

The nslookup command queries the DNS (Domain Name System) to resolve domain names to IP addresses and vice versa.

2.3.1. Windows/Linux/macOS:

nslookup <domain>

Example: nslookup google.com

Advanced Usage

Find Mail Exchange (MX) records: nslookup -query=mx <domain>

Example: nslookup -query=mx gmail.com

Find Name Server (NS) records: nslookup -query=ns <domain>





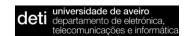
Example: nslookup -query=ns google.com

Find Start of Authority (SOA) records: nslookup -query=soa <domain>

Example: nslookup -query=soa example.com

Use a specific DNS server for queries: nslookup <domain> <DNS server>

Example: nslookup google.com 8.8.8.8





3. Simple CLI Guide for Cisco IOS

3.1. Basic Command Line Navigation

3.2. Using Auto-Complete and "?" in Cisco CLI

```
<Tab> // Auto-completes a partially typed command ? // Displays possible commands or parameters
```

Example:

```
Router# show ip ? // Displays possible subcommands for "show ip"
```

3.3. Cisco prompt and levels

Cisco IOS has different command-line interface (CLI) prompt levels, known as **privilege levels**, that control access to various commands. The three most common levels are:

3.3.1. User EXEC Mode (Privilege Level 1)

Prompt: Router>

Access: Basic monitoring and connectivity commands (e.g., ping, show version)

Restrictions: Cannot modify the configuration or view sensitive details

To enter: Automatically accessed after login

Exit command: logout or exit

3.3.2. Privileged EXEC Mode (Privilege Level 15)

Prompt: Router#

Access: Full access to view and troubleshoot the device (e.g., show running-config)

To enter: Type enable in User EXEC mode (requires a password if configured)

Exit command: disable (returns to User EXEC mode)

3.3.3. Global Configuration Mode

Prompt: Router (config) #

Access: Allows modification of the device configuration

To enter: Type configure terminal or conf t in Privileged EXEC mode





Exit command: exit (returns to Privileged EXEC mode)

3.3.4. Other Configuration Modes

Interface Configuration Mode (Router (config-if) #) - Configures specific interfaces like Ethernet or serial ports.

Line Configuration Mode (Router (config-line) #) - Configures terminal lines (e.g., console, vty).

Router Configuration Mode (Router (config-router) #) — Configures dynamic routing protocols like OSPF, EIGRP.

3.4. Global Configuration Commands

3.4.1. Enabling IPv6 Routing

ipv6 unicast-routing // Enable global IPv6 routing

3.4.2. Allow the Use of Subnet Zero

By default, older Cisco routers do not allow the use of **subnet zero**. To enable it:

```
Router(config) # ip subnet-zero
```

This command allows the use of the first subnet (e.g., 192.168.1.0/26).

3.4.3. Enable and Disable IP Domain Lookup

By default, Cisco routers attempt to resolve mistyped commands as domain names, causing delays. To **disable IP domain lookup**:

```
Router(config) # no ip domain-lookup
```

To **enable IP domain lookup** (if disabled):

```
Router(config)# ip domain-lookup
```

3.5. Configure a DNS Server

To configure a DNS server on the router:

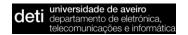
```
Router(config) # ip name-server 8.8.8.8 8.8.4.4 ! Set Google DNS servers
Router(config) # ip domain-lookup ! Ensure domain lookup is enabled
Router(config) # ip domain-name example.com ! Define a default domain name
```

To test DNS resolution:

```
Router# ping google.com
```

3.6. Enable DHCP Service on a Cisco Router

By default, the DHCP service is enabled on Cisco routers, but if it has been disabled, you can enable it with the following command:



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Router(config) # service dhcp

To disable the DHCP service, use:

```
Router(config) # no service dhcp
```

To verify that DHCP is running, use:

```
Router# show ip dhcp server statistics
Router# show running-config | include dhcp
```

3.7. Configuring IPv4 and IPv6 on Physical and VLAN Interfaces

3.7.1. IPv4 Configuration

3.7.2. IPv6 Configuration

3.7.3. VLAN Interface Configuration

```
interface vlan 10
ip address 192.168.10.1 255.255.255.0
no shutdown
evit
```

3.7.4. Configuring Sub-Interfaces for VLANs (Single VLAN)

3.8. Configuring a DHCP Server

3.8.1. Enable and Configure a DHCP Server for IPv4

To configure the router as a **DHCP server**, follow these steps:

```
Router(config) # ip dhcp excluded-address 192.168.1.1 192.168.1.10 ! Exclude addresses (e.g., reserved for static IPs)

Router(config) # ip dhcp pool MYPOOL ! Create a DHCP pool

Router(dhcp-config) # network 192.168.1.0 255.255.255.0 ! Define subnet

Router(dhcp-config) # default-router 192.168.1.1 ! Set default gateway

Router(dhcp-config) # dns-server 8.8.8.8 8.8.4.4 ! Define DNS servers

Router(dhcp-config) # lease 7 ! Lease time (7 days)

Router(dhcp-config) # exit
```

To verify DHCP leases:

```
Router# show ip dhcp binding
```





3.8.2. Using IP Helper Address (Forward DHCP Requests)

interface vlan 10
ip helper-address 192.168.2.1 // Forward DHCP requests to DHCP server

3.9. Routing

3.9.1. Configuring Static Routing

ip route 192.168.2.0 255.255.255.0 192.168.1.2 // Static route to network 192.168.2.0

For IPv6:

ipv6 route 2001:db8:1::/64 2001:db8::2 // Static route for IPv6

3.9.2. Configuring RIP

3.9.2.1. RIP for IPv4

router rip
version 2 // Enable RIPv2
network 192.168.1.0
network 192.168.2.0
no auto-summary
redistribute connected subnets
redistribute static subnets

3.9.2.2. RIP for IPv6

ipv6 router rip MYRIP
 redistribute connected
 redistribute static
 interface GigabitEthernet0/1
 ipv6 rip MYRIP enable

3.9.3. Configuring Basic OSPF

3.9.3.1. OSPF for IPv4

router ospf 1 // OSPF process ID
network 192.168.1.0 0.0.0.255 area 0 // Define OSPF area
network 192.168.2.0 0.0.0.255 area 0
redistribute connected subnets
redistribute static subnets

3.9.3.2. *OSPF for IPv6*

ipv6 router ospf 1
 router-id 1.1.1.1
 interface GigabitEthernet0/1
 ipv6 ospf 1 area 0

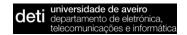
3.10. Cisco ESW: Routing vs. Switching Interfaces

In Cisco IOS 12.1, VLANs were traditionally configured using the VLAN database mode instead of the modern config mode used in newer IOS versions. Here's how you can create VLANs using the VLAN database mode in IOS 12.1:

3.10.1. Step-by-Step VLAN Creation on VLAN Database Mode

Enter VLAN database mode:

Router# vlan database





The prompt will change to:

```
Router(vlan)#
```

Create a VLAN and assign a name (optional):

```
Router(vlan)# vlan 10 name SALES
Router(vlan)# vlan 20 name HR
Router(vlan)# vlan 30 name IT
```

- o vlan 10 name SALES creates VLAN 10 and names it SALES.
- o You can create multiple VLANs in the same way.

Apply and save the VLAN configuration:

```
Router(vlan) # exit
```

This saves the VLAN database to **NVRAM**.

Verify VLAN creation:

```
Router# show vlan or Router# show vlan brief
```

3.10.2. Assign VLANs to Interfaces

Once VLANs are created, you need to assign them to interfaces:

Enter interface configuration mode:

```
Router(config) # interface FastEthernet1/0
```

Set the interface as an access port and assign a VLAN:

```
Router(config-if)# switchport mode access
Router(config-if)# switchport access vlan 10
```

Repeat for other interfaces and VLANs as needed.

3.10.3. Configuring a Trunk Interface

```
Router(config) # interface FastEthernet1/14
Router(config-if) # switchport mode trunk // Set interface as trunk
Router(config-if) # switchport trunk allowed vlan 10,20,30 //Allow specific
VLANs (optional)
Router(config-if) #exit
```

Important Notes

VLAN database mode was **deprecated in later IOS versions** (after 12.2) in favor of configuring VLANs in **global configuration mode**.

VLANs stored in the VLAN database are not affected by write erase and reload unless manually deleted.

To delete a VLAN in VLAN database mode: Router(vlan) # no vlan 10





4. D-LINK Switch Operation

Connect the Switch to the PC. After a while, the Switch prompt will appear:

#

To configure the IP address of the Switch, execute the following command:

```
#config ipif System ipaddress 192.1.1.21/24
#show ipif

To show the switching table of the switch:
    #show fdb

To create a default gateway on the switch:
#create iproute default 192.1.1.11
```

Execution of command ping

#show iproute

#ping 192.1.1.1 times 4