

# Cisco CCNA2 Command Overview

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## About

Round brackets () indicate required variables, square brackets [] indicate optional variables.

Piping symbols | indicate options.

All types of backquotes and asterisks in this source file are to be ignored; they are only relevant for Markdown rendering.

The command list presents the command, followed by a basic description of its functionality.

## List of Commands

### Chapter 2

Compiled By: Maikel Tielens

#### Configuring Switch Management

1. Router# conf terminal
2. Router (config)# interface vlan 99  
Management is preferred to be configured on a VLAN
3. Router (config-if)# ip address (address) (subnet)
4. Router (config-if)# no shut
5. Router (config-if)# end

#### Configuring Switch Default Gateway

1. Router# conf terminal
2. Router (config)# ip default-gateway (address)
3. Router (config)# end

#### Verifying Interface configuration

- Router# show ip interface brief

#### Configuring Duplex Mode

1. Router# conf terminal
2. Router (config)# interface (interface)
3. Router (config-if)# duplex full

4. Router (config-if)# speed (speed)
5. Router (config-if)# end

## Configuring Auto-MDIX

1. Duplex mode and speed has to be set to AUTO
  1. Router (config-if)# duplex auto
  2. Router (config-if)# speed auto
2. Router (config-if)# mdix auto

## Verification Commands

- Router# show
- Router# interfaces
- Router# start-up config
- Router# running-config
- Router# flash
- Router# version
- Router# history
- Router# ip
- Router# ip ssh
- Router# mac-address-table
- Router# port-security interface interface

## Configuring SSH

1. Router# config terminal
2. Router (config)# crypto key generate rsa keys 12024
3. Router (config)# username (username) secret (password)
4. Router (config)# line vty 0 15
5. Router (config-line)# transport input ssh
6. Router (config-line)# login local
7. Router (config-line)# exit
8. Router (config)# ip ssh version 2

## DHCP Snooping

This is a Cisco Catalyst feature determining which switch ports can respond to DHCP requests. This makes it harder for hackers to create a DHCP Spoofing attack in a network.

1. Router (config)# ip dhcp snooping
2. Router (config)# ip dhcp snooping vlan (vlan-id)
3. Router (config)# interface (interface)

4. Router (config-if)# ip dhcp snooping trust

5. Router (config-if)# interface (interface)

6. Router (config-if)# ip dhcp snooping limit (rate)

This limits the rate at which the attacker can send DHCP requests to the DHCP server

## Port-Security

1. Enabling Port-Security

Router (config-if)# switchport Port-security

2. Adjusting port-security:

Router (config-if)# switchport port-security maximum (value)

3. This only allows a number of mac-addresses on the port

Router (config-if)# switchport port-security mac-address

4. This only allows the given mac-address to send/receive data on the interface port

Router (config-if)# switchport port-security mac-address sticky

5. This allows mac-addresses to be learnt dynamically and also allows you to manually set a MAC address

Router (config-if)# port-violation

6. Router (config-if)# switchport port-security violation protect

7. Router (config-if)# switchport port-security violation restrict

8. Router (config-if)# switchport port-security violation shutdown

## Chapter 3

Compiled By: Maikel Tielens

### Creating a VLAN

1. Router (config)# vlan vlan-id

2. Router (config-vlan)# name (name)

### Assigning a VLAN to a Port

1. Router (config-if)# switchport mode access

2. Router (config-if)# switchport access vlan (vlan-id)

Note: All ports with the same VLAN should be in the same Subnet.

### Deleting VLANs

- Single VLAN: Router (config)# no vlan (vlan-id)

- All VLANs:

1. Router (config)# delete vlan.dat

2. Router (config)# erase startup-config

### View VLANs

- Router# show vlan brief
- Router# show interfaces interface vlan (vlan-id)
- Router# show interfaces interface switchport
- Router# show interfaces interface trunk

## Configuring Trunks

1. Router (config-if)# switchport mode trunk

(Optional)

- Router (config-if)# switchport trunk native vlan (vlan-id)
- Router (config-if)# switchport trunk allowed vlan (vlan-ids)

## Configuring PVLAN

- Router (config-if)# switchport protected
- 

# Chapter 4

Compiled By: Tobias Basteys

## Initial Router Configuration

1. Switch (config)# interface vlan (vlan-id)
2. Switch (config-if)# ip address (address) (netmask)
3. Switch (config-if)# no shutdown
4. Switch (config-if)# exit
5. Switch (config)# ip default-gateway (address)

## Naming a Device

1. Router# configure terminal
2. Switch (config)# hostname (hostname)

## Secure Management Access

1. Router (config)# enable secret class
2. Router (config)# line console 0
3. Router (config-line)# password (password)
4. Router (config-line)# login
5. Router (config-line)# exit
6. Router (config)# line vty 0 4
7. Router (config-line)# password (password)
8. Router (config-line)# login

9. Router (config-line)# exit
10. Router (config)# service password-encryption

## Configure a Banner

- Router (config)# banner motd (banner)

## Save the Configuration

- Router# Copy running-config startup-config

## Configuring an Interface - IPv4

1. Router (config)# interface (interface)
2. Router (config-if)# description (description)
3. Router (config-if)# ip address (address) (netmask)
4. Router (config-if)# no shutdown
5. Router (config-if)# exit

Note: Serial interfaces have an extra command: Router (config-if)# clock rate (boud-rate)

## Configuring an Interface - IPv6

1. Router (config)# interface (interface)
2. Router (config-if)# description (description)
3. Router (config-if)# ipv6 address (address)
4. Router (config-if)# no shutdown
5. Router (config-if)# exit

## Show IP Configuration

- Router# show ip interface brief

## Create Static Default Route

- Router (config)# ip route (address) (netmask) (interface)

Note: Static routes can also route two addresses: Router (config)# ip route (address) (netmask) (address)

IPv6 Routes do not require netmasks, but /xx indicators. Eg.: R2 (config) # ipv6 route 2001:0DB8:ACAD:2::/64 s0/0/0

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## Chapter 5

Compiled By: Tobias Basteyns

## Configuring Legacy Inter-VLAN Routing

1. Switch (config)# interface (interface)
2. Switch (config-if)# switchport access vlan (vlan-id)

### Configuring ROAS (Router On A Stick)

1. Router (config)# interface (subinterface)
  2. Router (config-subif)# encapsulation dot1q (vlan-id)
  3. Router (config-subif)# ip address (address) (netmask)
  4. Router (config-subif)# interface (other-subinterface)
  5. Router (config-subif)# encapsulation dot1q (other-vlan-id)
  6. Router (config-subif)# ip address (other-address) (netmask)
- 

## Chapter 6 - Static Routing

Compiled By: Rob Oosthoek

### IPv4

#### Verify Setup

- Router# show ip route
- Router# show ip route static
- Router# show running-config | section ip route

#### Static Routes

- Next-Hop: use ip-address-next-router
- Directly-Connected: use exit-int
- Router# conf t
- Router (config)# ip route (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)

#### Fully Specified Static Routes

1. Router# conf t
2. Router (config)# ip route (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)

#### Default Static Routes

- Next-Hop: use ip-address-next-router
- Directly-Connected: use exit-int
- Router# conf t

- Router (config)# ip route (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)

### Static Routes Summarized

Attention: use the correct number of networking-bits with the subnet

1. Router# conf t
2. Router (config)# ip route (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)

### Floating Static Routes

- Next-Hop: ip-address-next-router
- Directly-Connected: exit-int
- Router# conf t
- Router (config)# ip (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)
- Router (config)# ip (destination-ip) (subnet-mask) (ip-address-next-router | exit-int) (admin-distance)

Note: Routes configured with admin-distance will be used as backups should the primary route fail.

## IPv6

### Verifying

1. Router# show ipv6 route
2. Router# show ipv6 route static
3. Router# show running-config | section ipv6 route

### Static Routes

- Next-Hop: use ipv6-address-next-router
- Directly-Connected: use exit-int
- Router# conf t
- Router (config)# ipv6 unicast-routing
- Router (config)# ipv6 route (destination-ipv6/prefix-length) (ipv6-address-next-router | exit-int)

### Fully Specified Static Routes

1. Router# conf t
2. Router (config)# ipv6 unicast-routing
3. Router (config)# ipv6 route (destination-ipv6/prefix-length) (subnet-mask)

```
(exit-int) (link-local-next-router)
```

### Default Static Routes

- Next-Hop: use ip-address-next-router
- Directly-Connected: use exit-int
- Router# conf t
- Router (config)# ipv6 unicast-routing
- Router (config)# ipv6 route ::/0 (ip-address-next-router | exit-int)

### Static Routes Summarized

Attention: use the correct number of networking-bits with the subnet

1. Router# conf t
  2. Router (config)# ipv6 unicast-routing
  3. Router (config)# ipv6 route (destination-ipv6/prefix-length) (ipv6-address-next-router | exit-int)
- 

## Chapter 7 - Routing Dynamically

Compiled By: Rob Oosthoek

### IPV4 RIPv1/RIPv2

#### Configuring RIP

1. Router# conf t
2. Router (config)# router rip
3. Router (config-router)# ?

#### Advertising Networks

1. Router# conf t
2. Router (config)# router rip
3. Router (config-router)# network 192.168.1.0
4. Router (config-router)# network 192.168.2.0

What interfaces the Router should use to communicate with other routers. These're also advertised.

#### Examining Default RIP Settings

1. Router# Show ip protocols
2. Router# Show ip route | begin Gateway

#### Enabling RIPv2



1. Router# conf t
2. Router (config)# router rip
3. Router (config)# version 2

### Disabling Auto Summarization

1. Router# conf t
2. Router (config)# router rip
3. Router (config)# no auto-summary  
RIPv2 must be enabled to do this.

### Configuring Passive Interfaces

1. Router# conf t
2. Router (config)# router rip
3. Router (config)# passive-interface g0/0  
RIP should only be sending updates to other routers. Int g0/0 no longer sends/receives updates.

### Propagating A Default Route

1. Router# conf t
2. Router (config)# ip route 0.0.0.0 0.0.0.0 exit-int next-hop-ip
3. Router (config)# router rip
4. Router (config)# default-information originate  
This is like a Static Default Route, advertised to other routers.

## IPv6 RIPv6

### Advertising IPv6 Networks

1. Router# conf t
2. Router (config)# ipv6 unicast-routing
3. Router (config)# interface g0/0
4. Router (config-if)# ipv6 rip (domain-name) enable
5. Router (config)# interface s0/0/0
6. Router (config-if)# ipv6 rip (domain-name) enable
7. Router (config-if)# no shutdown

### Propagating A Default Route

1. Router# conf t
2. Router (config)# ipv6 unicast-routing
3. Router (config)# ipv6 route 0::/0 2001:DB8:FEED:1::1 (ip-address-next-router -> niet zeker :S)
4. Router (config)# interface s0/0/0

5. Router (config-if)# ipv6 rip (domain-name) default-information originate  
7.3.2.1 anyone? plz? XD

### Examining RIPv6 Configuration

1. Router# show ipv6 protocols
  2. Router# show ipv6 route
  3. Router# show ipv6 route rip
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## Chapter 8

Compiled By: Michael Bergs

### Adjacency Database

- Router# show ip ospf neighbor

### Link-State Database(LSDB)

- Router# show ip ospf database

### Forwarding Database

- Router# show ip route

### Assigning a Router ID

1. Router# conf t
2. Router (config)# router ospf <id>  
Id should be a value within the 1 - 65535 range.
3. Router (config-router)# router-id 1.1.1.1
4. Router (config-router)# end

### Show router ID

- Router# show ip protocols

### Clear OSPF processes

- Router# clear ip ospf process
- Reset ALL OSPF processes? [no]: y

### Show ONLY router ID

- Router# show ip protocols | section router ID

### Configuring a Loopback interface

1. Router# conf t
2. Router (config)# interface loopback 0
3. Router (config-if)# ip address (ip-address) (netmask)
4. Router (config-if)# end

## Advertising Networks in OSPF

(Requires clarification)

1. Router# conf t
2. Router (config)# router ospf 10
3. Router (config-router)# network 172.16.2.0 0.0.0.255 area 0
4. Router (config-router)# network 172.16.3.0 0.0.0.3 area 0
5. Router (config-router)# network 192.168.10.8 0.0.0.3 area 0
6. Router (config-router)# end

## Configuring Passive Interfaces

1. Router# conf t
2. Router (config)# router ospf 10
3. Router (config-router)# passive-interface GigabitEthernet 0/0
4. Router (config-router)# end
5. Router# conf t
6. Router (config)# router ospf 10
7. Router (config-router)# passive-interface default
8. Router (config-router)# end

## Adjusting Serial Interface

1. Router# conf t
2. Router (config)# int s0/0/1
3. Router (config-if)# bandwidth 64
4. Router (config-if)# end

## Setting ospf cost

1. Router# conf t
2. Router (config)# int s0/0/1
3. Router (config-if)# no bandwidth 64
4. Router (config-if)# ip ospf cost 15625
5. Router (config-if)# end

## Verifying ospf protocols

- Router# show ip protocols

## Verifying ospf process Information

- Router# show ip ospf
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## Chapter 9

Compiled By: Michael Bergs

### The "any" and "host" Keywords

1. Router# conf t
2. Router (config)# access-list 1 permit 0.0.0.0 255.255.255.255
3. Router (config)# access-list 1 permit any
4. Router# conf t
5. Router (config)# access-list 1 permit 0.0.0.0 255.255.255.255
6. Router (config)# access-list 1 permit host 192.168.10.10
7. Router# conf t
8. Router (config)# access-list 1 permit 0.0.0.0 255.255.255.255
9. Router (config)# access-list 1 deny any

### Removing an ACL

1. Router# conf t
2. Router (config)# no access-list 10
3. Router (config)# exit

### Show an ACL

- Router# show access-lists

### Permit a specific Subnet

1. Router# conf t
2. Router (config)# access-list 1 permit 0.0.0.0 255.255.255.255
3. Router (config)# interface s0/0/0
4. Router (config-if)# ip access-group 1 out

### Deny a specific Subnet

1. Router# conf t
2. Router (config)# access-list 1 deny host 0.0.0.0
3. Router (config)# access-list 1 permit any
4. Router (config)# interface s0/0/0
5. Router (config-if)# ip access-group 1 in

### Creating named ACLs

1. Router# conf t
2. Router (config)# ip access-list standard NO\_ACCESS
3. Router (config-std-nacl)# deny host 192.168.11.10
4. Router (config-std-nacl)# permit any
5. Router (config-std-nacl)# exit

### Commenting ACLs

1. Router# conf t
2. Router (config)# access-list 1 remark Do not allowed Guest workstation through
3. Router (config)# access-list 1 deny host 192.168.10.10

### Securing VTY ports with a standard ipv4 ACL

1. Router# conf t
2. Router (config)# line vty 0 4
3. Router (config-line)# login local
4. Router (config-line)# transport input ssh
5. Router (config-line)# access-class 21 in
6. Router (config-line)# exit
7. Router (config)# access-list 21 permit 192.168.10.0. 0.0.0.255
8. Router (config)# access-list 21 deny any

### Configuring extended ACLs

1. Router# conf t
2. Router (config)# access-list 103 permit tcp 192.168.10.0. 0.0.0.255 any eq 80
3. Router (config)# access-list 103 permit tcp 192.168.10.0. 0.0.0.255 any eq 443
4. Router (config)# access-list 104 permit tcp any 192.168.10.0. 0.0.0.255 established

ACL 103 allows ports 80 and 443

ACL 104 establishes http and https replies

### Creating named Extended ACLs

1. Router# conf t
  2. Router (config)# ip access-list extended SURFING
  3. Router (config-ext-nacl)# permit tcp 192.168.10.0 0.0.0.255 any eq 80
  4. Router (config-ext-nacl)# permit tcp 192.168.10.0 0.0.0.255 any eq 443
  5. Router (config-ext-nacl)# exit
  6. Router (config)# ip access-list extended BROWSING
  7. Router (config-ext-nacl)# permit tcp 192.168.10.0 0.0.0.255 established
  8. Router (config-ext-nacl)# exit
  9. Router (config)# interface g0/0
  10. Router (config-if)# ip access-group SURFING in
  11. Router (config-if)# ip access-group BROWSING out
- 

## Chapter 10

Compiled By: Gerard van Kempen

### Basic PC/DOS Commands

1. ipconfig /all  
Shows the complete running network configuration.
2. ipconfig /release  
Releases all network settings so a new can be set up.
3. ipconfig /renew  
Sets up a new network configuration.

### Basic DHCPv4 Configuration

#### Standard Router Configuration

1. Router (config)# ip dhcp excluded-address (low-address) [high-address]  
Excludes a single multiple addresses from the DHCP-pool.
2. Router (config)# ip dhcp pool (poolname)  
Creates a DHCP pool with the specified name and puts the router in DHCP-config mode.
3. Router (dhcp-config)# network (network-address) [network mask | /prefix length]  
Defines the address pool for the DHCP server.
4. Router (dhcp-config)# default-router (address) [fallback-address1 ... fallback-address7]  
Defines the default router or gateway for the DHCP server.
5. Router (dhcp-config)# dns-server (address) [fallback-address1 ... fallback-address7]  
Defines the DNS server for the DHCP server.
6. Router (dhcp-config)# domain-name (name)  
Change the domain name used by the DHCP server.

7. Router (dhcp-config)# lease (days) [hours] [minutes]  
Sets the DHCP lease duration. Default is 1 day.
8. Router (dhcp-config)# lease infinite  
Sets the DHCP lease duration to infinite.
9. Router (dhcp-config)# netbios-name-server (address) [fallback-address1 ... fallback-address7]  
Defines the netBIOS (<http://www.wikiwand.com/en/NetBIOS>) WINS server.

### Configuring a Router Port as DHCP Client

After selecting the interface to configure, enter:

```
Router (config-if)# ip address dhcp
```

### Basic DHCPv4 Verification

1. Router# show running-config | section dhcp  
Shows only the DHCP configuration of the running config.
2. Router# show ip dhcp binding  
Shows the MAC to IP address bindings provided by the DHCP server.
3. Router# show ip dhcp server statistics  
Displays information regarding the sent and received DHCP packets.  
This can be used to verify the DHCP configuration and activity.

### Setting up DHCPv4 Relaying

DHCP relaying enables another router to forward incoming DHCP requests to the router functioning as the actual DHCP server.

1. Select an interface to use as a relay interface  
Router (config)# interface (interface)
2. Define the ip helper-address  
Router (config-if)# ip helper-address (router-ip-address)
3. End configuration  
Router (config-if)# end
4. Verify the configuration  
Router# show ip interface (interface)

A line should inform you of the configuration, eg.:

```
Helper address is 192.198.1.1
```

Note: the ip helper-address command forwards the following UDP services by default:

- Port 37: Time
- Port 49: TACACS
- Port 53: DNS
- Port 67: DHCP/BOOTP client
- Port 68: DHCP/BOOTP server
- Port 69: TFTP

- Port 137: NetBIOS name service
- Port 138: NetBIOS datagram service

## Troubleshooting a DHCPv4 Configuration

1. Router# show ip dhcp conflict  
Returns all the address conflicts
2. Router# show running-config | include no service dhcp  
Checks whether no service dhcp has **not** been configured.  
If it has been configured, it would show up in the output.  
If all is OK, the output should remain empty.

## Troubleshooting Workflow According to Cisco

1. Resolve address conflicts
2. Verify physical connectivity
3. Test with static address(es)
4. Verify switch port configuration
5. Test for same subnet or VLAN

## Debugging a DHCPv4 Configuration

1. Create an ACL for debugging purposes:  
Router (config)# access-list (ACL-number) permit udp any any eq 67  
Router (config)# access-list (ACL-number) permit udp any any eq 68
2. Exit config and run:  
Router# debug ip packet (ACL-number)

Other useful command: debug ip dhcp server events

This command shows all server events related to DHCP requests.

## SLAAC and DHCPv6

1. ipv6 unicast-routing  
Enables IPv6 routing
2. no ipv6 nd managed-config-flag and no ipv6 nd other-config-flag  
Applied on interface configuration. Resets SLAAC for that interface.
3. ipv6 nd other-config-flag  
Modify RA message to indicate Stateless DHCPv6. Applied in interface configuration.
4. ipv6 nd managed-config-flag  
Modify RA message to indicate Stateful DHCPv6. Overrides Stateless flag.

## Notes on Stateless/Stateful DHCPv6

**Stateless DHCPv6 client** – The client sends a DHCPv6 INFORMATION-REQUEST message to the DHCPv6 server requesting only configuration parameters, such as DNS server address. The client generated its own IPv6 address using the prefix from the RA message and a self-generated Interface ID.



**Stateful DHCPv6 client** – The client sends a DHCPv6 REQUEST message to the server to obtain an IPv6 address and all other configuration parameters from the server.

## Basic DHCPv6 Configuration

### Stateless Server

1. Enable IPv6 routing: Router (config)# ipv6 unicast-routing
2. Configure DHCPv6 pool: Router (config)# ipv6 dhcp pool (pool-name)
3. Configure pool params: Router (dhcp-config)# dns-server (dns-address)
4. Configure DHCPv6 interface:
  1. Select interface
  2. Router (config-if)# ipv6 dhcp server (pool-name)
  3. Router (config-if)# ipv6 nd other-config-flag

### Stateless Client

1. Select interface
2. Router (config-if)# ipv6 enable
3. Router (config-if)# ipv6 address autoconfig
4. Verify config in privileged-exec: Router# show ipv6 dhcp pool

### Stateful Server

1. Enable IPv6 routing: Router (config)# ipv6 unicast-routing
2. Configure DHCPv6 pool: Router (config)# ipv6 dhcp pool (pool-name)
3. Configure Pool params: Router (dhcp-config)# address prefix (ipv6-prefix) [lifetime] [valid-lifetime] [preferred-lifetime]  
note: Lifetime params can all be replaced by infinite if needed.
4. Configure the DHCPv6 interface:
  1. Select interface
  2. Router (config-if)# ipv6 dhcp server (pool-name)
  3. Router (config-if)# ipv6 nd managed-config-flag

### Stateful Client

1. Select interface
2. Router (config-if)# ipv6 enable
3. Router (config-if)# ipv6 address dhcp
4. Verify config in elevated-exec: Router# show ipv6 dhcp pool

Other useful command: Router# show ipv6 dhcp binding

This command displays the automatic binding between the link-local address of the client and the address assigned by the server.

## Setting up DHCPv6 Relaying

1. Select interface to use as relay
2. Router (config-if)# ipv6 dhcp relay destination (ipv6-server-address)
3. end

Verify relaying by running `show ipv6 dhcp interface (interface)`

### Troubleshooting a DHCPv6 Configuration

1. Router# show ipv6 dhcp conflict  
Returns all the address conflicts
2. Router# show ipv6 interface (interface)  
Verifies the method of address allocation indicated in the RA message as indicated by the settings of the M and O flags.

### Troubleshooting Workflow According to Cisco

1. Resolve address conflicts
2. Verify allocation method
3. Test with static address(es)
4. Verify switch port configuration
5. Test for same subnet or VLAN

### Debugging a DHCPv6 Configuration

1. Router# debug ipv6 dhcp detail
- 

## Chapter 11

Compiled By: Gerard van Kempen

### Configuring Static NAT

1. Router (config)# ip nat inside source static (local-ip) (global-ip)
2. Router (config)# interface (interface)  
Specifies inside interface.
3. Router (config-if)# ip nat inside  
Sets inside interface.
4. Router (config-if)# exit
5. Router (config)# interface (interface)  
Specifies outside interface.
6. Router (config-if)# ip nat outside  
Sets outside interface.

### Verifying Static NAT

- Option 1: Router# show ip nat translations

- Option 2:
  1. Router# clear ip nat statistics
  2. Router# show ip nat statistics

## Configuring Dynamic NAT

1. Router (config)# ip nat pool (name) [start-ip] [end-ip] [netmask (netmask) | prefix-length (prefixlength)]
2. Router (config)# access-list (ACL-number) permit (source) [source-wildcard]
3. Router (config)# ip nat inside source list (ACL-number) pool (name)
4. Select interface, then: Router (config-if)# ip nat inside
5. Select interface, then: Router (config-if)# ip nat outside

## Verifying Dynamic NAT

- Option 1: Router# show ip nat translations
- Option 2:
  1. Router# clear ip nat statistics
  2. Router# show ip nat statistics
- Option 3:
  1. Router# clear ip nat translations
  2. Router# show ip nat translations

## Configuring PAT

### Address Pool

1. Router (config)# ip nat pool (name) [start-ip] [end-ip] [netmask (netmask) | prefix-length (prefixlength)]
2. Router (config)# access-list (ACL-number) permit (source) [source-wildcard]
3. Router (config)# ip nat inside source list (ACL-number) pool (name) overload
4. Select interface, then: Router (config-if)# ip nat inside
5. Select interface, then: Router (config-if)# ip nat outside

### Single Address

1. Router (config)# access-list (ACL-number) permit (source) [source-wildcard]
2. Router (config)# ip nat inside source list (ACL-number) interface (interface) overload
3. Select interface, then: Router (config-if)# ip nat inside
4. Select interface, then: Router (config-if)# ip nat outside

## Verifying PAT

- Option 1:

1. Router# clear ip nat statistics
  2. Router# show ip nat statistics
- Option 2:
    1. Router# clear ip nat translations
    2. Router# show ip nat translations

## Port Forwarding in IOS

```
ip nat inside source static (tcp | udp [local-ip] [local-port] [global-ip] [global-port]) [extendable]
```

## Troubleshooting NAT

Use any combination of following commands to pinpoint the issue:

- Router# show ip nat translations
- Router# show ip nat statistics
- Router# clear ip nat translation \*
- Router# clear ip nat statistic
- Router# debug ip nat detailed(debugging)