

Cisco CCNA2 Command Overview

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 Basteyns

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

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`

1. Router# `conf t`
2. 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`

1. Router# `conf t`
2. 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`

1. Router# `conf t`
2. Router (config)# `ip (destination-ip) (subnet-mask) (ip-address-next-router | exit-int)`
3. 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`

```
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)
```

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`

```
1. Router# conf t
2. Router (config)# ipv6 unicast-routing
3. 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
-

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

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 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)