Cisco Internetwork Operating System Command list

Get the latest version of the note here

        - Set maximum addresses
        - Configure trusted MAC Addresses
            - Manual
            - Dynamic
            - Sticky Dynamic
        - Port Aging
            - Configure expiration life
            - Configure expiration type
        - Setting up violation protocol
            - Example: Setting the restrict mode
        - Viewing the logs
            - Overall
            - Specific Interface
    - Dynamic ARP Inspection //TODO
- Cisco Layer-3 router commands
    - Configuring port addresses
    - Static routing
        - About
        - Designating next-hop addresses
    - Inter-vLAN routing
        - Configuring sub-interfaces
        - Enable 802.1Q inter-vLAN routing
    - Setting up HSRP
        - Choosing the HSRP version
        - Configuring the virtual HSRP group
        - Designating the Active Router
        - Preemptively reassume original role
    - Setting up DHCPv4
        - Toggling DHCP service
            - Disabling DHCP
            - Enabling DHCP
        - Excluding IPv4 Addresses from the pool
            - Single address exclusion
            - Multi-address exclusion
        - Defining DHCP Pool name
        - DHCP Server Options
            - Define address pool
            - Define default gateway
            - Define other DNS Servers
            - Define DNS domain name
        - Viewing if DHCP is operational
    - Setting up DHCPv6
        - Enable IPv6 routing
        - Define a DHCPv6 pool name
        - Other DHCPv6 options
            - IPv6 Address pool(*Stateful DHCP*)

Basic IOS operations

Entering privilege mode

Most cisco device operations requires the user to be in priveleged mode, especially configurations to the device. To enter this mode, use `enter`

```
Switch> enable
Switch#
```

Entering configuration mode

To make any configurations to the cisco device, you have to enter config mode using `configure` in privilege mode.

From there on, a prompt will be shown asking for which location to configure, typically we simply put in `terminal`.

```
Router# configure terminal
```

Saving the configuration

There are two types of configurations, the **running** config and the **startup** config, as their name implies, one is temporary.

ANY CONFIGURATIONS YOU MADE ARE STORED IN THE RUNNING CONFIG, it will erase on shutdown of the device.

You can copy a configuration using the `copy` function.

```
Router# copy running-config startup-config
```

This example copied `running-config` onto `startup-config`, this is also how you effectively **save configurations**. If you need to, you can do it in the other way around.

Deleting configurations

Similar to copying a configuration, simply call the `erase` function and the configuration you want to remove.

```
```

```
Router# erase startup-config
```

Restarting the device

Calling `reload` will force the router to restart. The running configuration will be lost in the process, so this is one way to test a configuration and get rid of it if you don't like it.

```
Switch# reload
```

Referencing multiple interfaces

In most cases, you need to configure interfaces in batches. Normally we configure individiual interfaces like so:

```
Router(config)# interface FastEthernet0/0
```

But using the `range` keyword, we can specify the batch.

```
Router(config)# interface range fastEthernet0/0-4
```

You can also specify multiple batches using `,` as the seperator

```
Router(config)# interface range FastEthernet0/0-4, GigabitEthernet0/0-2
```

See function parameters

You can see the available options for a function using the `?` symbol. For example:

```
Switch(config)# Ip ?
```

This displays the available options for the `Ip` command.

Basic IOS diagnostics

Show the MAC Table

```
Switch# show mac address-table
```

Show the ARP Table

```
Switch# show arp
```

Show the IP Configurations on the ports

```
Router# show ip interface brief
```

Show the vLAN configurations

```
Switch# show vlan brief
```

Show all configurations

```
Switch# show running-config
```

IOS Device configurations

Setting a hostname

The hostname of a cisco device can be changed with the `hostname` function. Simply provide the new hostname as an argument.

```
Switch(config)# hostname SampleName-1
```

As far as guidelines go, let the name start with a letter, don't contain spaces or wacky symbols and keep it below 64 chars.

Setting a message of the day

You can set a message by using the `banner` function, pass in the `motd` keyword and the message enclosed in '#' symbols to signify start and stop. It is important to warn visitors that only authorized members are allowed to access.

```
Switch(config)# banner motd #Message of the day#
```

> The reason it is important to make it clear unauthorized users are not allowed is because there was one case where a hacker exploited a loophole in the legal system by claiming the company he hacked never explicitly mentioned he was unwelcome, therefore he claimed he was welcomed in.

Basic password authentication

Do note that there are 2 passwords, the `password` for **user** mode and `secret` for **privilege** mode.

User mode password

You need to configure the password for each line access method using the `password` function.

This is an example for configuring the **console** cable connections:

```
Switch(config)# line console 0
Switch(config-line)# password UserPassword
Switch(config-line)# login
Switch(config-line)# end
```

Computer now connecting via the rollover cable need to input a password to access the terminal.

> For direct **console** connections, there is usually only one port available, so we call **line console 0**. For remote connections through telnet or ssh, we usually instead call **line vty 0 15**.
>
> ```
> Switch# configure terminal
> Switch(config)# line vty 0 15
> Switch(config-line)# password UserPassword
> Switch(config-line)# login
> Switch(config-line)# end
> ```
>
> In this case, the **vty** is numbered from 0 to 15. This is because most cisco switches can have **16 users for remote connections**. Make sure you check with your manual to find out the number.

Privilege mode password

This password is more important as it gives you privilege to edit the configurations of the router.

```
Router(config)# enable secret SuperPassword
```

Encrypting passwords

This is a function invokable in **global config mode**

Passwords created are usually stored in plaintext. Wow.

You can invoke `service password-encryption` to encrypt them:

```
Router(config)# service password-encryption
```

Setting up SSH

The default connection type for devices is the insecure **telnet**, everything sent over the internet is in plaintext. Preferrably remote management should be done in encrypted **SSH**.

First make sure the hostname has been configured because the default name cannot be used, read more here.

Adding a domain name

```
myRouter(config)# ip domain-name cisco.com
```

Generating RSA key pairs

When generating the key pairs, the prompt will usually ask for the length of the modulus. While the default is 512, a higher number is more secure, but also takes longer to create and use. 1024 is a popular number.

```
myRouter(config)# crypto key generate rsa
How many bits in the modulus [512]: 1024
```

Configure a user account

Start by specifying a username after the `username` keyword, in this case its **admin**, then the password after the `secret` keyword, in this example is **ccna**.

```
myRouter(config)# username admin secret ccna
```

Configure vty lines to use SSH

Because telnet is insecure, we want to make sure vty connections use SSH instead of telnet

```
myRouter(config)# line vty 0 15
myRouter(config-line)# transport input ssh
myRouter(config-line)# login local
myRouter(config-line)# exit
```

> `login local` is used instead of `login` to compare the new username created for SSH.

Changing SSH version

By default, SSH is usually set in version 1.99. Optionally you can change it to version 2.00

```
myRouter(config)# ip ssh version 2
```

Toggling interfaces

Most interfaces in cisco devices can be turned on and off using the `shutdown` keyword.

To keep an interface open:

```
Switch(config-if)# no shutdown
```

To turn the interface off:

```
Router(config-if)# shutdown
```

Enable DHCPv6 Addressing

Enable unicast routing

```
Router(config)# ipv6 unicast-routing
```

Create Link-local address

```
Router(config-if)# ipv6 enable
```

Enable SLAAC or stateful address config

Stateless config

```
Router(config-if)# ipv6 address autoconfig
```

Stateful config

```
Router(config-if)# ipv6 address dhcp
```

Reconnaissance tools

These commands allow you to perform Layer-2 discovery, and see what devices are connected to each other.

Toggle CDP

The Cisco Discovery Protocol(CDP) allows other devices with CDP to discover eachother and configure networks.

CDP information is sent out CDP-enabled ports in a periodic, unencrypted multicast.

That means hackers who are connected in the network can send false CDP information and trick the devices into thinking they are connected in a certain way.

Disable CDP entirely

```
Switch(config)# no cdp run
```

Disable CDP on a port

```
Router(config-if)# no cdp enable
```

Show CDP Results

```
show cdp neighbors
```

Toggle LLDP

Similar to CDP, the open standard LLDP is open to exploits from hackers sending false LLDP information.

Disable LLDP Entirely

```
Switch(config)# no lldp run
```

Disable LLDP on a port

```

```

```
Router(config-if)# no lldp transmit
Router(config-if)# no lldp receive
```

Show the LLDP results

```
do show lldp neighbour
```

Cisco Layer-2 switch commands

Exclusive diagnostics //TODO

```
Switch# show interfaces | include Ethernet
```

```
Switch# show interface status
```

Show information about the trunked ports.

```
Switch# show interfaces trunk
```

Configuring duplex mode

To configure the operational duplex mode, first choose a port to configure, then using `duplex` keyword specify either `half` or `full`.

Then you can use the `speed` keyword to configure the speed for that port in **Mbps**

```
Switch(config-if)# duplex full
Switch(config-if)# speed 100
```

Creating and Renaming vLANs

Creating vLANs

vLANs are actually all created already, they simply lack a name and thus appear invisible. **vLAN 1** however is the exception, it is the default vLAN and cannot be removed.

```

```

```
Switch(config)# vlan 50
Switch(config-if)# name myVLAN
```

Enabling auto-mdix

Auto-mdix is used to avoid the need to worry about a straight-through or crossover cable.

Configuring the switch virtual interface address

You may need to assign an ip address in order to remotely control the switch. Choose the native vlan and assign an ip address.

```
Switch(config)# interface vlan 50
Switch(config-if)# ip address 192.168.0.1 255.255.255.0
```

> Do keep in mind there is a very big difference between invoking `vlan 50` and `interface vlan 50`. Generally jsut invoking `vlan` is to configure its name, invoking `interface vlan 50` allows you to configure the logical address instead.

Toggling the vLAN

To keep it open:

```
Switch(config-if)# no shutdown
```

To turn the vLAN off:

```
Switch(config-if)# shutdown
```

Configuring Data and Voice vLAN

Configuring trunking

Configuring many ports at once

This can be done using `range`, read more here.

```
Switch(config)# interface range FastEthernet0/1, FastEthernet0/15
```

Access and Trunk mode

To put a port in access mode, where each port serves one device and will foward frames to another vlan, use the `access` keyword. Then you can assign a vlan number to isolate those devices.

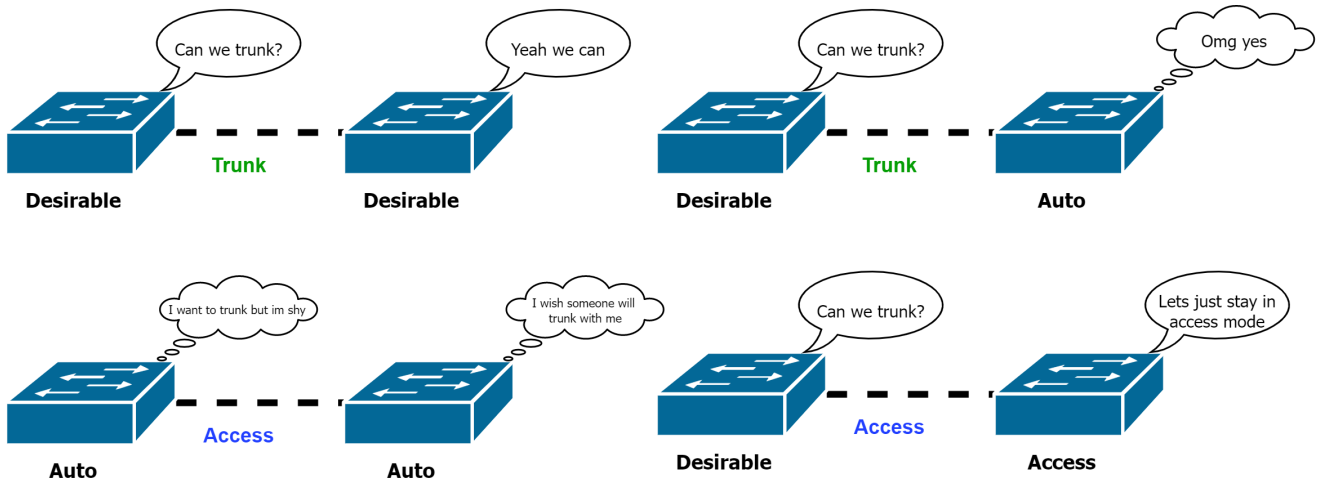
```
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
```

But if a single port is expected to foward frames from multiple devices in a vLAN or vLANs, use the `trunk` mode instead. You will need to reserve one vLAN for native mode, the other device on the other end must also have the same vLAN.

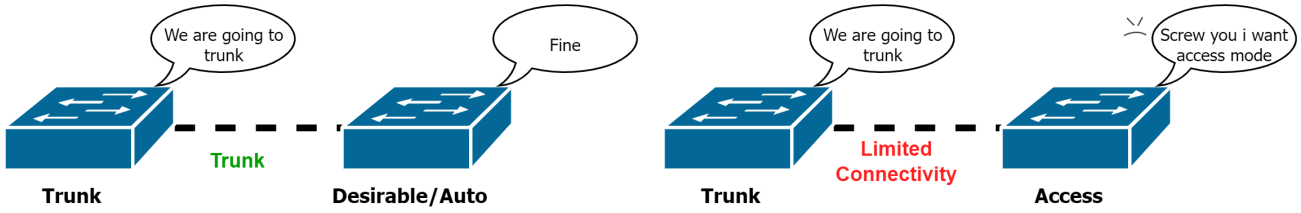
```
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk native vlan 88
```

Dynamic trunking protocol

Switch consent



*Both switches are shy to talk, they ended up in access mode



*The switches have a disagreement, connection is disrupted

In general, the desirable switch will actively negotiate for trunk mode. The auto switch will go with anything. Trunk and access modes are static and having 2 switches with those modes will result in connection disruption.

Configuring DTP mode

Auto DTP mode, the link is alright with becoming a trunk.

```
Switch(config-if)# switchport mode dynamic auto
```

Desirable DTP mode, the link actively tries to make it a trunk.

```
Switch(config-if)# switchport mode dynamic desirable
```

Disabling DTP

To disable DTP, set the port back to access or trunk mode.

Then use `nonegotiate` to avoid DTP negotiation.

```
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport nonegotiate
```

Assigning vLANs to ports

Single vlan assignments

For access ports, it is done using the `access` keyword

```
Switch(config-if)# switchport access vlan 50
```

For trunk ports.

```
Switch(config-if)# switchport trunk vlan 50
```

For native trunk ports, you need the `native` keyword.

```
Switch(config-if)# switchport trunk native vlan 50
```

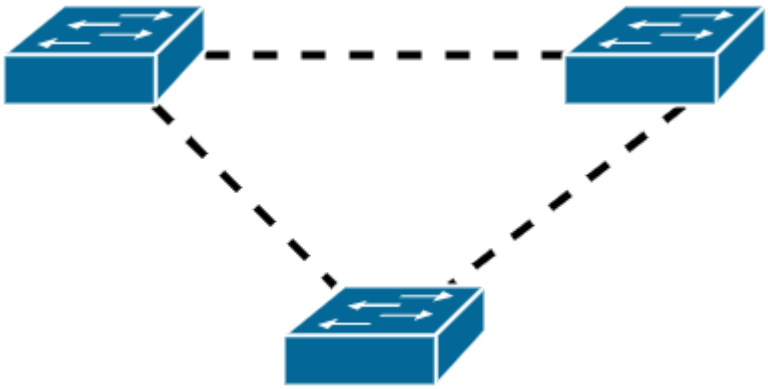
Allowing vLANs to pass through the trunk

```
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk native vlan 99
Switch(config-if)# switchport trunk allowed vlan 10,20,30,99
```

Configuring the spanning tree protocol

About the STP

The Spanning Tree Protocol (STP) is a protocol used to prevent endlessly travelling **frames**. This occurs in networks that have many redundant connections and a **cycle** or **loop** between switches in the network is made.



One nightmare that can spawn is a broadcast storm. Imagine if a switch fowards a broadcast, after fowarding it, the other switches foward the same frame again endlessly. Unlike IPv4 or IPv6, there is no Time to Live or Hop Limit, the switches will never know when to drop the frame.

However the solution shouldn't be to remove redundancy, because redundancy allows a network to keep operating even if failures occur.

Show the spanning tree configuration

You can use this command to know the status of each port and the status of the switch itself.

```
Switch# show spanning-tree vlan 1
```

Enable or disable the STP

By default, every switch port is configured to calculate a spanning tree. For some reason if you need it off, you can use the command below.

```
Switch(config)# no spanning-tree vlan 1
```

To turn it back on, simply call the `spanning-tree` function again.

```
Switch(config)# spanning-tree vlan 1
```

Configuring priority manually

By default, all switches are configured with their priority value at 32768. This number is important for switches to figure out which switch needs to be the root bridge.

If you otherwise want to manually elect a switch as a root, you can use `priority`.

```
Switch(config)# spanning-tree vlan 1 priority 4096
```

> The value for priority must be a multiple of **4096**, the lower the value, the more prioritized the switch is to take the role of a root bridge.

Primary and secondary root bridges

You can also use the `root` keyword instead of manually putting in a priority value.

To set a switch as the **primary** root bridge,

```
Switch(config)# spanning-tree vlan 1 root primary
```

This sets the priority value to 24576.

To set a switch as a **secondary** or backup root bridge,

```
Switch(config)# spanning-tree vlan 1 root secondary
```

Enabling portfast

```
Switch(config-if)# spanning-tree portfast
```

Enabling BPDU guard

```
Switch(config-if)# spanning-tree bpduguard enable
```

Configuring an EtherChannel

Grouping interfaces into a port channel with LACP

To group interfaces into one port channel, first go into config mode for the interfaces using `range`.

```
Switch(config)# interface range FastEthernet 0/1 - 2
```

Then create a new port channel and specify the LACP mode. Which can be `active`, `passive`, or `on`.

```
Switch(config-if-range)# channel-group 1 mode active
Switch(config-if-range)# exit
```

Configuring a port channel

You cna configure the port-channel in a similar fashion to other interfaces using `interface`.

```
Switch(config)# interface port-channel 1
```

Configuring multi-vLAN trunk

```
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan 1,2,20
```

Assigning a default gateway to the switch

Swithes still need a default-gateway to be able to be controlled remotely.

```
Switch(config)# ip default-gateway 192.168.0.1
```

Port Security

About

You can bind a device to a port, so that only that computer alone may access the port.

This prevents an attacker being able to carry out attacks on the network, for example, DoS attacks by sending out bogus BPDUs, or faking a trunk connection to be able to spy on everyone.

Define maximum MAC Addresses

```
S1(config-if)# Switchport Port-security maximum 1
```

Set the trusted MAC Addresses

```
S1(config-if)# Switchport Port-security mac-address-sticky
```

Set Action on Violation

```
S1(config-if)# Switchport Port-security violation ?
```

Port Security

One way hackers can attack a network is by providing bogus MAC replies.

Hackers can cause a DoS by flooding the switch's MAC Table with fake addresses, new legit clients are unable to forward to be fowarded to because the switch cant remember any more mac addresses.

Or hackers can fake a machine identity by providing the mac address of a legit computer, causing the fowarded frames to be sent to the hacker.

Port security allows the switch to check if the mac address is truted before fowarding.

Enable port secuirty

```
S1(config-if)# switchport mode access
S1(config-if)# switchport port-security
```

Set maximum addresses

Set maximum number of addresses able to use the port

```
Switch(config-if)# switchport port-security maximum 8192
```

Configure trusted MAC Addresses

Manual

```
Switch(config-if)# switchport port-security mac-address 68-ff-7b-1d-3d-e9
```

Dynamic

The device remembers whatever address was in the mac table. So the currently connected device is trusted.

However this information is lost on reboot

```
Switch(config-if)# switchport port-security
```

Sticky Dynamic

The dynamically learned addresses are saved to the running config, which you can later save to the startup.

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

Port Aging

You can also configure the trusted mac addresses to expire. Whether static or dynamic.

Configure expiration life

The time range is anywhere from 0 to 1440 minutes.

```
S1(config-if)# switchport port-security aging time 10
```

Configure expiration type

There are 2 types of expiration

- **inactivity**, secure addresses are removed when no traffic with the source address exists for some time.
- **absolute**, secure addresses are removed at a certain time, regardless active or inactive.

```
S1(config-if)# switchport port-security aging type inactivity
```

Setting up violation protocol

In case an attacker does actually try to attack. Some protocol is needed on what to do next.

The options are:

Mode	Protocol
Protect	On violation, the port drops the untrusted frame, then immediately goes into error-disabled state and logs the incident, you will need to use `no shutdown` to restore to operation.
Restrict	Drops frames with untrusted source address, increments the Security Violation counter and logs the violation.
Shutdown	Simply just drop the untrusted source frames, no logging.

Example: Setting the restrict mode

```
Switch(config-if)# switchport port-security violation restrict
```

Viewing the logs

You can view the port security configurations and violations.

Overall

```
S1# show port-security
```

Specific Interface

```
S1# show port-security interface fa0/1
```

Output

```
Port Security              : Enabled
Port Status                : Secure-shutdown
Violation Mode             : Shutdown
Aging Time                 : 10 mins
Aging Type                 : Inactivity
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 2
Total MAC Addresses        : 2
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 1
Last Source Address:Vlan   : a41f.7273.018c:1
Security Violation Count   : 1
```

Dynamic ARP Inspection //TODO

A security measure against ARP attacks.

Cisco Layer-3 router commands

Configuring port addresses

Routers have the important job of acting as the default gateway for devices in a network to route the packets to remote networks. Computers need to know the ip address of the router's ports in order to establish a default gateway.

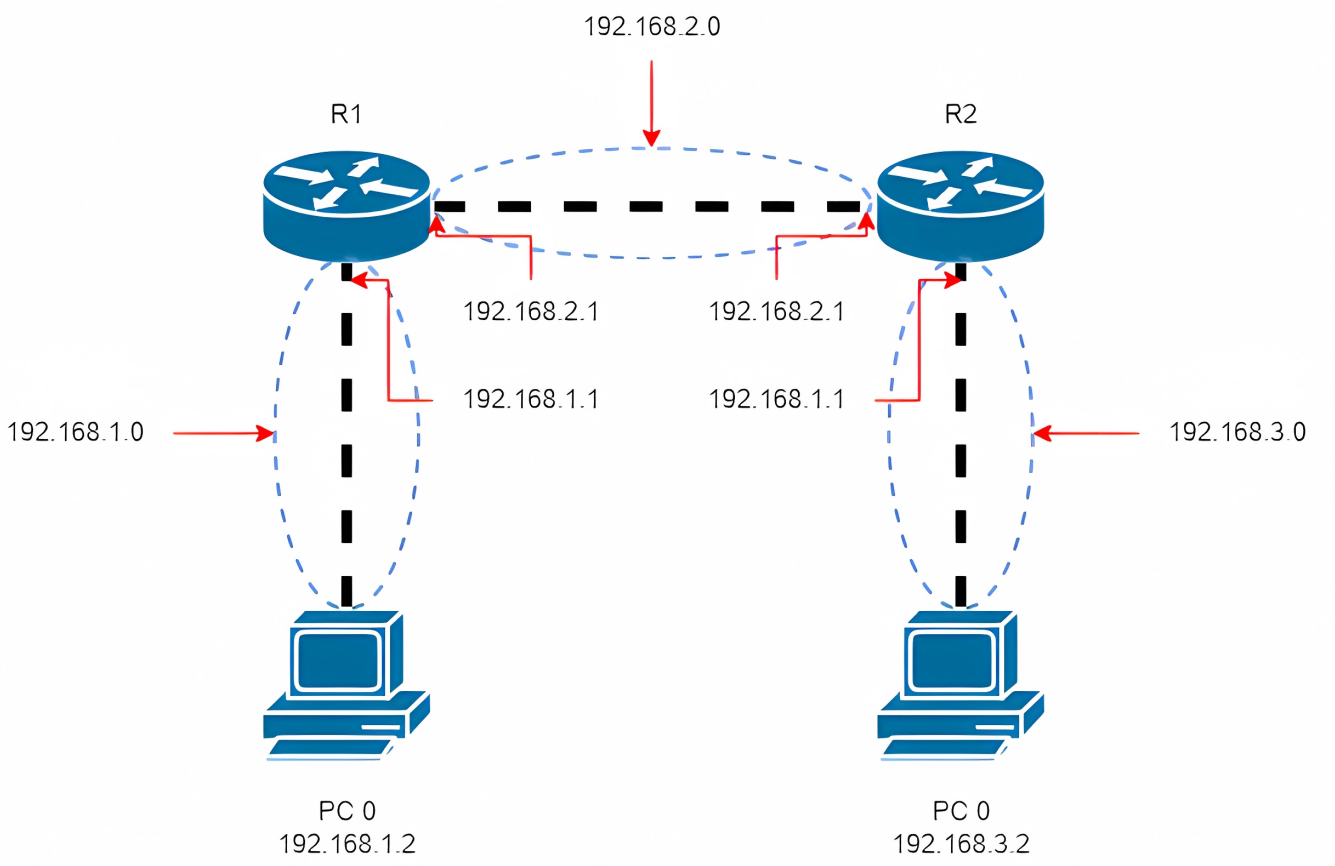
First choose a port to configure, then simply add the ip address and make sure the interface is not off.

```
Router(config)# interface GigabitEthernet0/1
Router(config-if)# ip Sddresswitch92.168.0.1 255.255.255.0
Router(config-if)# no shutdown
```

Static routing

About

To set a static route, you need to reference a remote network and the expected port it will come from.



Take the above scenario as an example, if we want PC 0 and PC 1 to be able to communicate, both Router and R2 must be configured to have static routing.

The `ip-route` command has the parameters:

- *[Remote network address]*
- *[Remote subnet]*
- *[Outcoming router port address]*

Designating next-hop addresses

```
Router(config)# ip route 192.168.3.0 255.255.255.0 192.168.2.2
```

The command above tells Router that it can expect packets from the **remote** 192.168.3.0 network to come from the 192.168.2.2 port of R2.

Likewise, in R2, we need to use

```
R2(config)# ip route 192.168.1.0 255.255.255.0 192.168.2.1
```

> It is quite counter-intuitive, normally you would expect the router to find out which networks the packets are coming from and what port to foward it to.

Inter-vLAN routing

Configuring sub-interfaces

Ports in a router that is expected to handle traffic from multiple vLANs can be configured as sub-interface. Simply add a `.` followed by the number to the interface port number. Usually the sub-interface number is kept the same as the vLAN number from the switches to keep things neat. In this case, it is `.10`

```
Router(config)# interface GigabitEthernet0/1.10
```

Enable 802.1Q inter-vLAN routing

After choosing a subinterface to configure, simply invoke the command to enable inter-vLAN routing via the 802.1Q protocol followed by the number.

```
Router(config-subif)# encapsulation dot1Q 10
```

If you are to configure the port to accept trunk lines from switches as well, you would need the `native` keyword.

```
Router(config)# interface GigabitEthernet0/1.88
Router(config-subif)# encapsulation dot1Q 88 native
```

> Sub-interfaces still need to be configured with an ip address
>
> ```
> Router(config-subif)# ip address 192.168.0.1 255.255.255.0
> ```
>
> Computers coming from different vLAN may have traffic sent to one port in the router, but they can use different addresses.

> Not only that, you must enable the entire interface for the sub interfaces to work
>
> ```
> Router(config)# int GigabitEthernet0/1
> Router(config-if)# no shut
> ```

Setting up HSRP

Choosing the HSRP version

First you need to choose an interface to configure HSRP for. Then you need to specify the version of HSRP. At the time of writing, the latest HSRP version is 2.

> HSRP V1 only supports IPv4 addressing

```
R1(config)# Interface GigabitEthernet0/0
R1(config-if)# Standby Version 2
```

Configuring the virtual HSRP group

Then you need to provide a **group number** followed by an **IP address**.

The interfaces of routers that intend to belong to the same group must have the same configuration.

```
R1(config-if)# Standby Version 1 192.168.1.1
```

Designating the Active Router

Now that you have chosen a few routers to serve as redundant backup. We should also choose which router will actively serve for now.

The default priority value is 100. A higher value will determine which router is the active router. If the priorities of the routers in the HSRP group are the same, then the router with the highest configured IP address will become the active router.

```
R1(config-if)# Standby 1 priority 100
```

Preemptively reassume original role

You can also configure the router to take back its original active role when it becomes operational once more.

```
R1(config-if)# standby 1 preempt
```

Setting up DHCPv4

Toggling DHCP service

Disabling DHCP

```
R1(config)# no service dhcp
```

Enabling DHCP

```
R1(config)# service dhcp
```

Excluding IPv4 Addresses from the pool

Single address exclusion

```
Router(config)# ip dhcp excluded-address 192.168.0.1
```

Multi-address exclusion

```
Router(config)# ip dhcp excluded-address 192.168.0.1 192.168.0.200
```

> The command can be invoked multiple times to exlcude multiple ranges or multiple addresses

Defining DHCP Pool name

```
Router(config)# ip dhcp pool pool-name
Router(dhcp-config)#
```

DHCP Server Options

Define address pool

```
R1(dhcp-config)# network 192.168.10.0 255.255.255.0
```

Define default gateway

```
R1(dhcp-config)# default-router 192.168.10.1
```

Define other DNS Servers

```
R1(dhcp-config)# dns-server 192.168.11.5
```

Define DNS domain name

```
R1(dhcp-config)# domain-name example.com
```

Viewing if DHCP is operational

```
Router# show ip interface g0/0/1
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 209.165.201.12/27
  Broadcast address is 255.255.255.255
  Address determined by DHCP
...
```

Setting up DHCPv6

Enable IPv6 routing

Needed for sourcing ICMPv6 RA Messages.

```
R1(config)# ipv6 unicast-routing
```

Define a DHCPv6 pool name

```
R1(config)# ipv6 dhcp pool pool-name
R1(config-dhcpv6)#
```

Other DHCPv6 options

IPv6 Address pool(*Stateful DHCP*)

```
R1(config-dhcpv6)# address prefix 2001:db8:acad:1::/64
```

DNS Server

```
R1(config-dhcpv6)# dns-server 2001:db8:acad:1::254
```

Domain name

```
R1(config-dhcpv6)# domain-name example.com
```

Binding DHCPv6 to a router interface

Stateless binding

```
R1(config-if)# ipv6 nd other-config-flag
R1(config-if)# ipv6 dhcp server IPV6-STATELESS
```

Stateful binding

```
R1(config-if)# ipv6 nd managed-config-flag
R1(config-if)# ipv6 nd prefix default no-autoconfig
R1(config-if)# ipv6 dhcp server IPV6-STATEFUL
```

> SLAAC(stateless) is only available for IPv6 Systems.

You cna also configure routers to foward several information that they otherwise would have blocked. For example,

DHCP Broadcasts

```
R1(config-if)#ip helper-address 10.1.1.2
```

You have reached the end