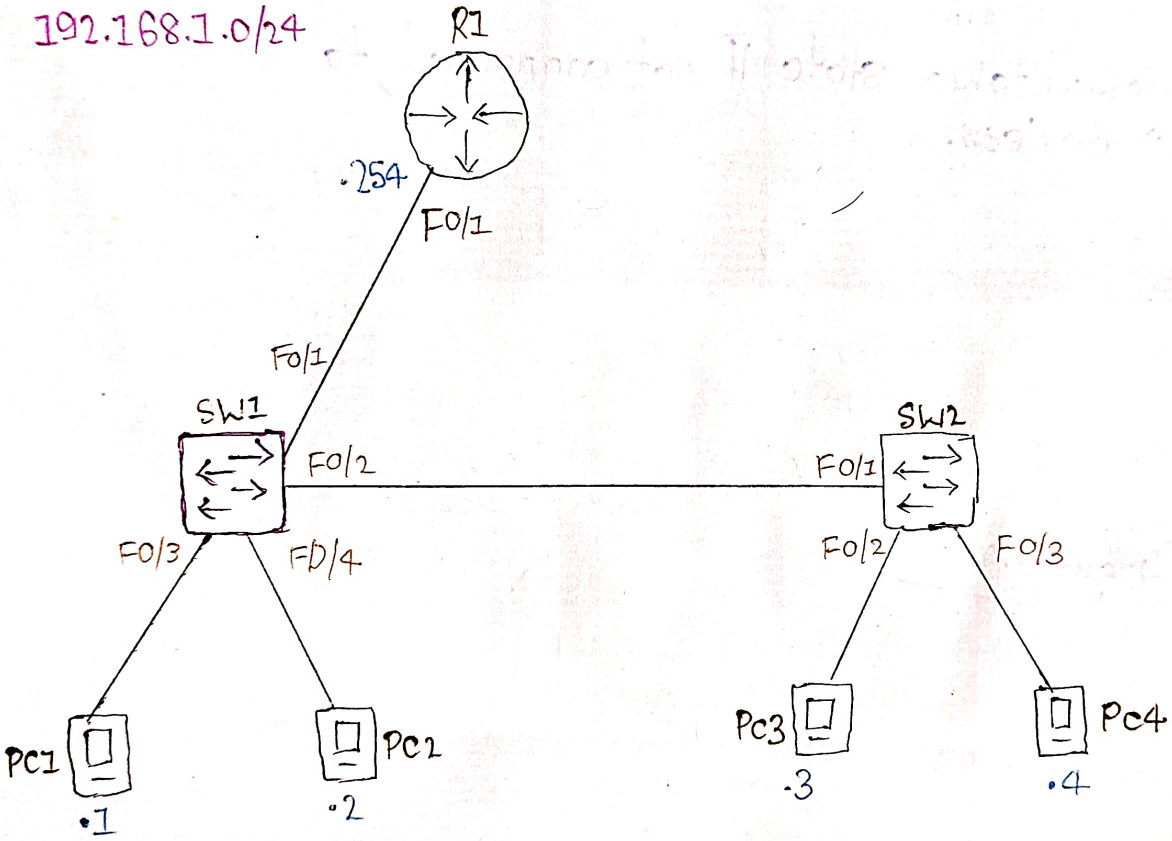
Switch Interface

Network Topology



This is a single LAN, 192.168.1.0/24 with one router R1, 2 switches, SW1 & SW2 and 4 PC's (PC1, PC2, PC3, PC4)

SW1 is the device we're going to focus on today & configuring its network interfaces, including (F0/1, F0/2, F0/3 & F0/4) which are connected, as well as the remaining inteface which are not connected at the moment

→ Let's goto the CLI of SW1.

→ First I used 'enable' to enter priviledge exec mode

→ Then 'show ip interface brief.'

→ Routers intefaces have the shutdown command applied by default, will be in the administratively down/down state by default.

→ Switches interfaces do Not have the 'shutdown' command applied by default, will be in the up/up state if connected to another device

OR

in the down/down state if not connected to another devices.

```
SW1>en
SW1#sh ip int br
Interface              IP-Address      OK? Method Status                Protocol
Vlan 1                 unassigned      YES unset  up                    up
FastEthernet0/1        unassigned      YES unset  up                    up
FastEthernet0/2        unassigned      YES unset  up                    up
FastEthernet0/3        unassigned      YES unset  up                    up
FastEthernet0/4        unassigned      YES unset  up                    up
FastEthernet0/5        unassigned      YES unset  down                  down
FastEthernet0/6        unassigned      YES unset  down                  down
FastEthernet0/7        unassigned      YES unset  down                  down
FastEthernet0/8        unassigned      YES unset  down                  down
FastEthernet0/9        unassigned      YES unset  down                  down
FastEthernet0/10       unassigned      YES unset  down                  down
FastEthernet0/11       unassigned      YES unset  down                  down
FastEthernet0/12       unassigned      YES unset  down                  down
```

show ip interface brief

→ Another useful command 'show interface status'
→ let's see all the columns of the output

→ First I, The Port field simply lists each interface
→ Second, Name field → Well, its description of the interface
→ Third, Status field, As you see it is diffsent than the status field of 'show ip interface brief. The 4 connected interface show 'connected' and the rest is unconnected. interface show 'not connected'

→ Four, Vlan → Later video.

→ Fifthy, Duplex field, as I mentioned before indicates whether the device is capable of both sending or receiving data at the same time, which is known as full-duplex or if it's not, which is called half-duplex

- Duplex is 'auto' by default on Cisco switches meaning it will negotiate with the neighboring device & use full-duplex if possible. Notice that all of the unconnected interfaces have a duplex of auto, and the connected interface is 'a-full' which means a → auto & its mean automatically negotiated a duplex of auto with the neighboring device

→ Sixthy, Speed field. which is defaut set as 'auto'
These are fastethesnet interfaces, so they are capable of speed up to 100 megabit per second. However, they are also capable of operating at 10 megabits per sec.

Auto means they are able to negotiate with the device they are connected to & use the fastest speed both devices are capable of.

This time, we see' a-100' meaning a speed of 100 megabits per sec: was auto-negotiated with the neighboring device
later more in detail about auto negotiation.

→ Last, Type field These are all RJ45 interfaces for a copper UTP cables, but if they were small form-factor pluggable or SFP modules. you'd see that here instead.

In this case we see, 10/100BASE-TX. the 10/100 of course referring the speed at which these interfaces can operate.

```
SW1#show interfaces status
Port      Name               Status       Vlan       Duplex  Speed Type
Fa0/1                        connected    1          a-full  a-100 10/100BaseTX
Fa0/2                        connected    trunk      a-full  a-100 10/100BaseTX
Fa0/3                        connected    1          a-full  a-100 10/100BaseTX
Fa0/4                        connected    1          a-full  a-100 10/100BaseTX
Fa0/5                        notconnect   1            auto    auto 10/100BaseTX
Fa0/6                        notconnect   1            auto    auto 10/100BaseTX
Fa0/7                        notconnect   1            auto    auto 10/100BaseTX
Fa0/8                        notconnect   1            auto    auto 10/100BaseTX
Fa0/9                        notconnect   1            auto    auto 10/100BaseTX
Fa0/10                       notconnect   1            auto    auto 10/100BaseTX
Fa0/11                       notconnect   1            auto    auto 10/100BaseTX
Fa0/12                       notconnect   1            auto    auto 10/100BaseTX
```

Configuring interfaces speed & Duplex

→ Autonegotiation works well,. but let's go & Manually configure the speed & Duplex of an Interface, F0/1 which is connected to R1.

Command→ Enable
→ conf t
→ interface f0/1

```
SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)#int f0/1
SW1(config-if)#speed ?
10                  Force 10 Mbps operation
100                 Force 100 Mbps operation
auto                Enable AUTO speed configuration
SW1(config-if)#speed 100
SW1(config-if)#duplex ?
auto                Enable AUTO duplex configuration
full                Force full duplex operation
half                Force half-duplex operation
SW1(config-if)#duplex full
SW1(config-if)#description ## to R1 ##
```

→ Do, test three F0/2, F0/3, F0/4

→ Now, how about the unused interfaces?

Although the fact that switch interfaces are enabled by default is convenient, as you can just plug a device in & use it straight away. it can be a security concern. Really you should disable the interfaces, fortunately instead of having to configure each of the 8 interface one by one, there is a way to configure all 8 interface at once.

from global config mode type 'interface range f0/5 - 12' I am brought to interface range config mode and I enter a description, & then shutdown

```
range f0/5 - 12
description ## not in use ##
shutdown
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/7, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/8, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/9, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/10, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/11, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/12, changed state to administratively down
```

```
SW1(config-if-range)#do sh int status
Port      Name               Status       Vlan       Duplex  Speed Type
Fa0/1     ## to R1 ##        connected    1            full    100 10/100BaseTX
Fa0/2     ## to SW2 ##       connected    trunk      a-full a-100 10/100BaseTX
Fa0/3     ## to end hosts ## connected    1          a-full a-100 10/100BaseTX
Fa0/4     ## to end hosts ## connected    1          a-full a-100 10/100BaseTX
Fa0/5     ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/6     ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/7     ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/8     ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/9     ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/10    ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/11    ## not in use ##   disabled     1            auto   auto 10/100BaseTX
Fa0/12    ## not in use ##   disabled     1            auto   auto 10/100BaseTX
```

Full/Half Duplex

→ Half duplex: The device cannot send & receive data at the same time if it is receiving a frame, it must wait before sending a frame.

- Devices attached to a hub must operate in half duplex.

→ Full duplex: The Device can send & receive data at the same time. It does not have to wait

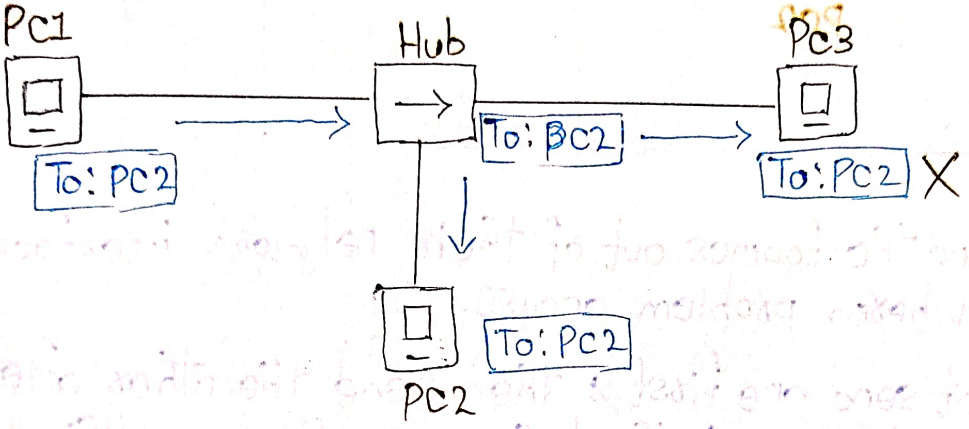
Devices attached to a switch can operate in full duplex.

LAN Hubs

→ Where is Half-duplex used?

Well in modern day network, almost nowhere.
But to understand half-duplex let me introduce you to an old typ of network device which was around before the network switch

→ The hub is much simpler than a switch, in fact it is simply a repeater. Any frame it receives, it floods like a switch does with broadcast or unknown unicast frame.



For Example:-

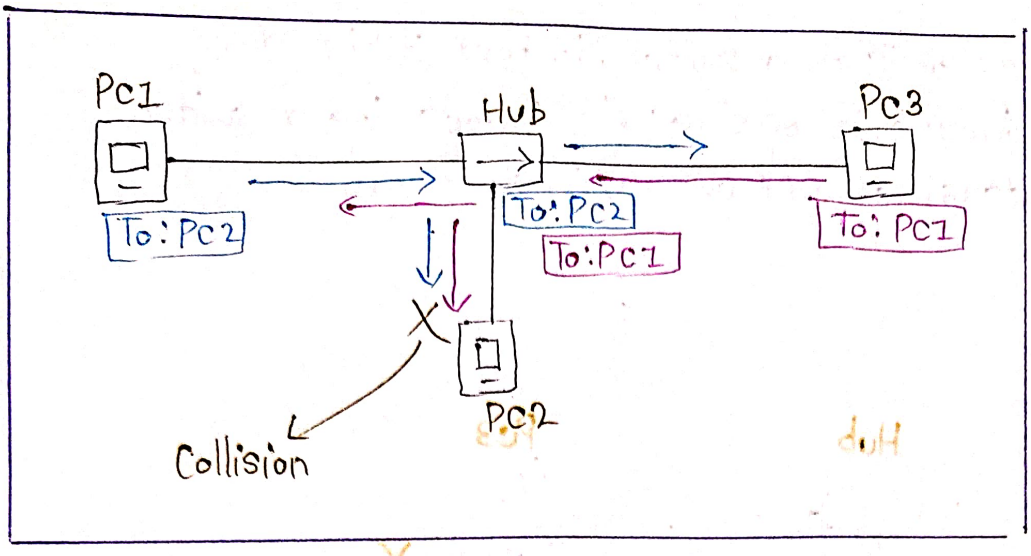
STEP 1: If PC1 wants to send a frame to PC2, it will send the frame out of its network interface

STEP 2: And After the hub receives it, it will repeat the frame out of its other interfaces to PC2 & PC3

STEP 3: PC3 will recognize that the destination MAC Address is not its own and ignore the frame and PC2 will receive it normally

Now what if two PCs try to send frames at the same times?

In this case, PC1 is trying to send a frame to PC2 & PC3 is trying to send a frame to PC1



STEP1: They both send the frames out of their network interface and this is whereas problem occurs.

STEP2: The hub won't send one first & then send the other after, it simply tries to flood both at the same time, and this will result in a collision on the interface.

STEP3: And PC2 won't recive either frame intact.

→ All devices connected to a hub are part of what's called a collision domain The frame they send could collide with frames any of the other devices connected to the hub send.

→ To deal with the collision in a half-duplex situation like this, Ethernet devices use a mechanism called 'CSMA/CD'

CSMA/CD

→ CSMA/CD [Carries Sense Multiple Access with Collision Detection]

→ It describe how devices avoid collisions in a half-duplex situation and how they react if collision do occurs.

→ It works like that before sending frame, devices 'listen' to the collision domain until they detect that other devices are not sending.

→ If a collision does occurs, the device sends a jamming signal to inform the other devices that a collision happend.

Each device will wait a random period of time before sending frames again.

The process then repeats, with each device listening to check if other devices are sending frame before sending their own frame

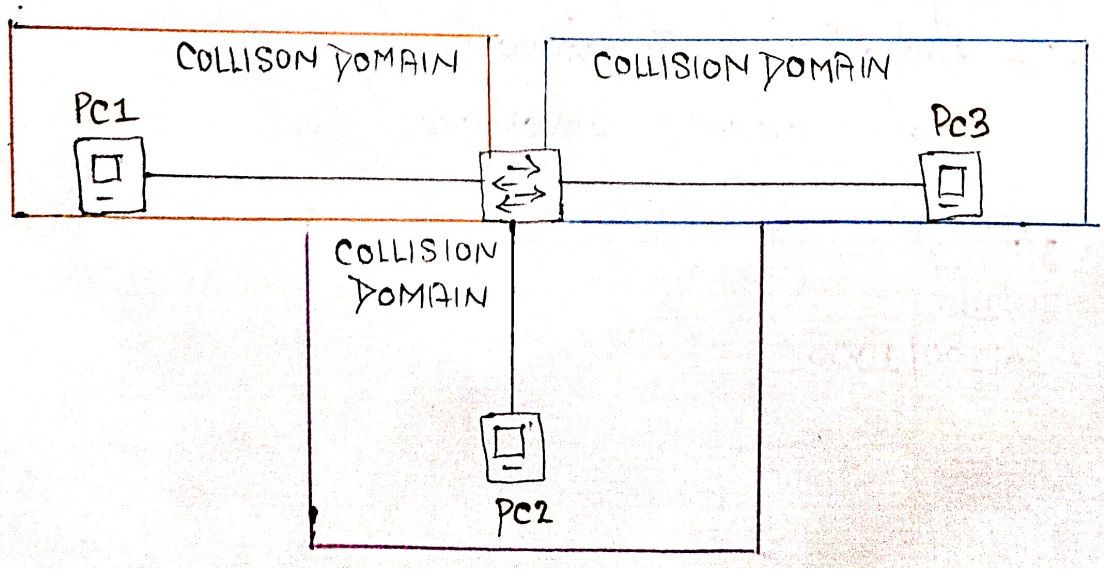
Now, that the process works, & it was how networks operated for a long time.

Collision Domains

But, switches are more sophisticated than hubs.

Hubs are simple repeaters which operate at Layer 1. repeating whatever signal they receive. Switches operate at Layer 2, using Layer 2 addressing. MAC addresses, to send frame to specific hosts.

They also won't try to send two frame to the same host at once So, this network which was on collision domain when connected to a hub, is now 1, 2, 3 Collision Domains.



Because of the improved functionality of switches over hubs, these devices can now operate in full-duplex, meaning they don't have to worry about whether or not other devices are sending data at the same time, they can send data freely.

Although problem like collision still do occurs, they are rare usually are a sign of a problem, like a misconfiguration, rather than a regular occurrence like in a half-duplex networks.

Speed/Duplex Autonegotiation

Let's talk about speed & Duplex Autonegotiation on interfaces and this applies to both routers & switches by the way.

→ Interface that can run at different speed (10/100 or 10/100/1000) have default settings of speed auto & duplex auto

→ Interfaces 'advertise' their capabilities to the neighboring device, and they negotiate the best speed & Duplex setting they are both capable of.

Let's look at an Example

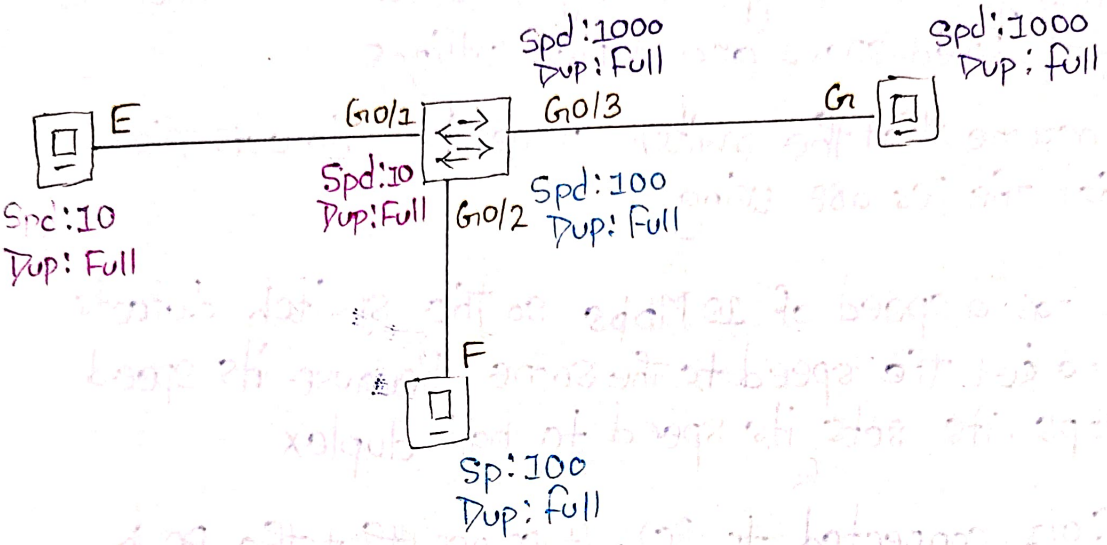
→ E, stand for regular Ethernet Interface
→ F, stand for fastethernet. Interface
→ G, stand for gigabit ethernet Interface

E = 10
F = 10/100
G = 10/100/1000

→ G0/1 and the Pc will negotiate to a speed of 10 megabits per second & full-duplex.

→ G0/2 and the Pc will negotiate to a speed of 100 & full-duplex.

→ G/0/3 and the Pc will negotiate to a speed of 1000 & full-duplex.



→ The Pcs are all able to use the max speed of their network interface, & the switch adjusts the speed of its interfaces to match.

→ In Network like this with all pcs and switches, there's no reason to use half-duplex, so

Let's see another situation.

→ What if autonegotiation is disabled on the device connected to the switch?
↳ So, the switch is toying to autonegotiate, but the other device don't respond

Well, this is how the switch will respond
For SPEED: the switch toy to sense the speed that the other device is operating at
if if fails to sense the speed, it will use the slowest supported speed.
(i.e 10 Mbs on a 10/100/1000 interface)

FOR DUPLEX: If the speed is 10 or 100 Mbps, the switch will use half-duplex.
If the speed is 1000 Mbps or greater, use full duplex

Let's see how they works?

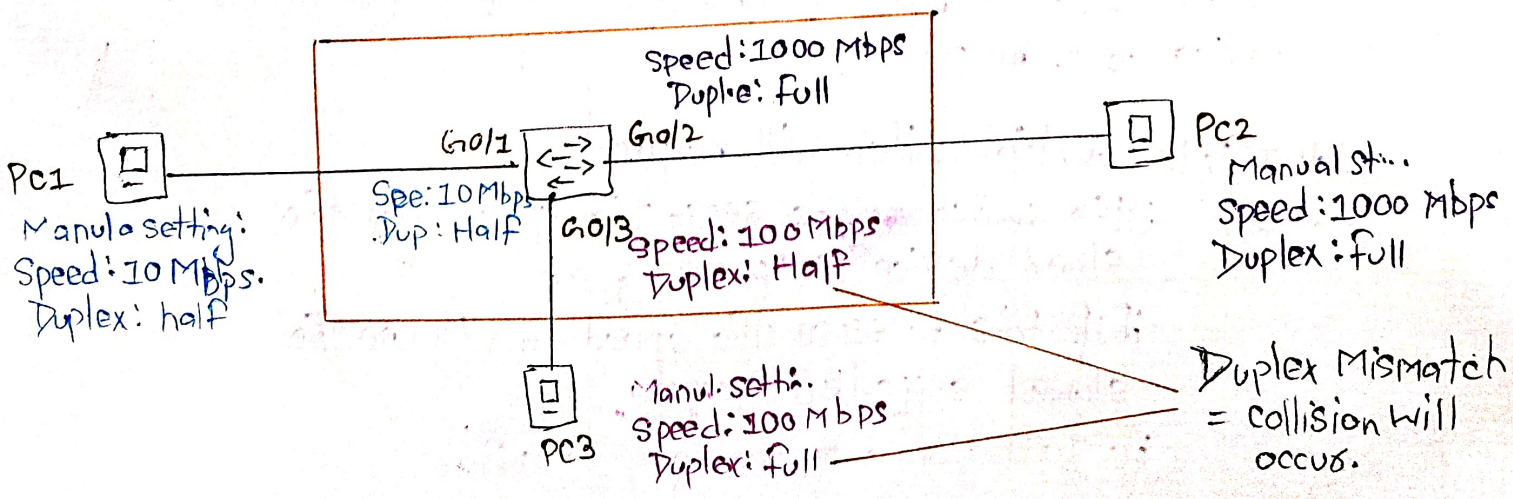
→ In this case only switch using autonegotiation and the three PCs have manual, fixed speed and duplex settings

→ We'll also assume that the switch successfully detects the speed that the PCs are using

- The PC1 has a speed of 10 Mbps, so the switch detects that and set the speed to the same Because its speed is 10 Mbps, its sets its speed to half duplex

- Now, G0/2, connected to PC2. It sense that the PC is using a speed of 1000 Mbps so it uses the same. Because the speed is 1000 Mbps. it uses full-duplex.

- Now G0/3 connected to PC3. It sense the speed of 100 mbps but then what about the duplex?
  ↳ The PC is using full duplex, but without autonegotiation the switch can't sense that, so Because the speed is 100 Mbps, the switch uses half-duplex.
  This result in a duplex mismatch, which will cause collision to occur, resulting in poor network performance.



Interface Errors

→ Now, let's take a look at some of the errors that can show up on interfaces that otherwise seem to be working.

→ The switch will take taunt of some of these things and you can view them with the 'show interfaces' command

```
SW1#show interfaces f0/2
FastEthernet0/2 is up, line protocol is up
  Hardware is Fast Ethernet, address is 000C.3168.8461 (bia 000C.3168.8461)
  Description: ## to SW2 ##
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Auto-duplex, Auto-speed
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 02:29:44, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queuing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     269 packets input, 71059 bytes, 0 no buffer
     Received 6 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     7290 packets output, 429075 bytes, 0 underruns
     0 output errors, 3 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

→ This time, let's focus on some of these statistics at the bottom. These are lots of different kinds of counters shown here and you don't have to know all of them at this point.

→ First up, not errors, but you can see the total no. of Packet received on the interface, & the total no. of bytes in those packet

→ Runts: frame that are smaller than the minimum frame size (64 bytes)

→ Giants: frame that are larger tha. the maximum frame size (1518 bytes)

→ CRC: which counts frame which failed their CRC check.
CRC (Cyclic Redundancy check) done via FCS (frame check sequence) in the trailer of an ethernet frame. Its used to detect error, and if an error is dectected the counter goes up.

→ frame: which count frame that have an incorrect or illegal format

→ Input errors: Total of various counters, such as the above four

→ Output errors: counts frame the switch tried to send, but failed due to an error

NOTE: Im showing you all of these counters on a switch but they are same on a router