

Summer School 2025

# Introducción a las redes telemáticas

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## Repaso capa a capa

- Capa física: CSMA/CD, CSMA/CA.
- Capa de enlace de datos: 802.3, 802.11, ARP, STP.
- Capa de red: IP, ICMP, subnetting, routing básico.
- Capa de transporte: UDP, TCP, QUIC.

# Modelos por capas



## OSI Model



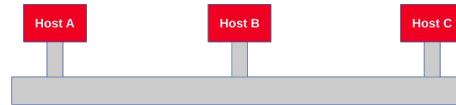
## TCP/IP Model



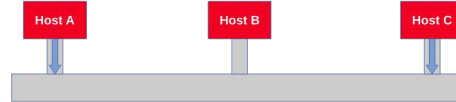
# Capa física: CSMA/CD



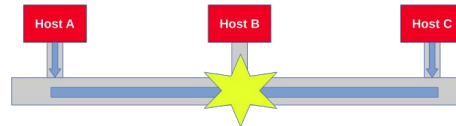
## 1) Carrier Sense



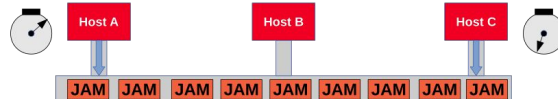
## 2) Multiple Access



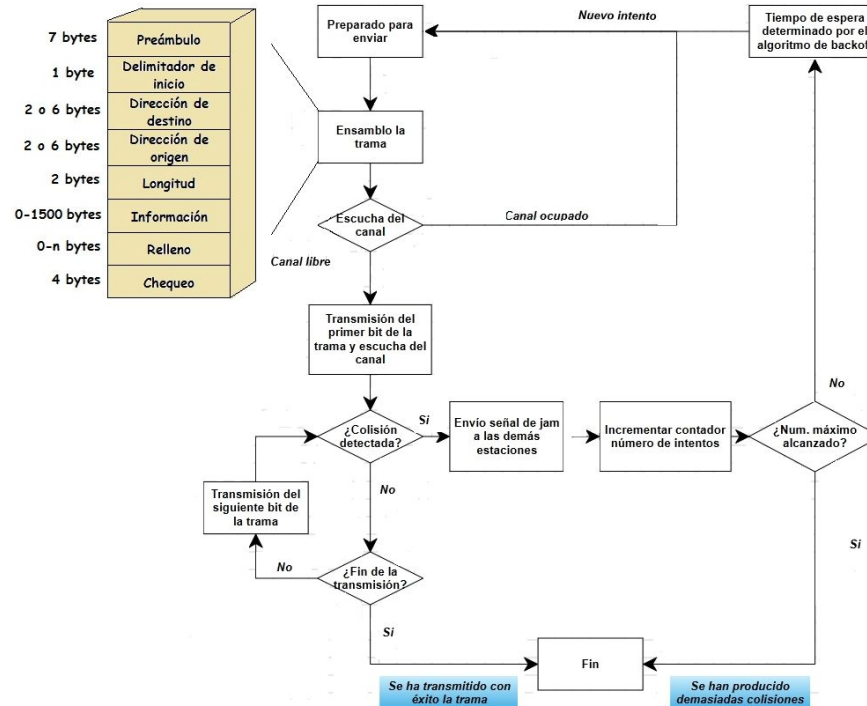
## 3) Collision



## 4) Collision Detection (Back off Algorithmus)



# Capa física: CSMA/CD

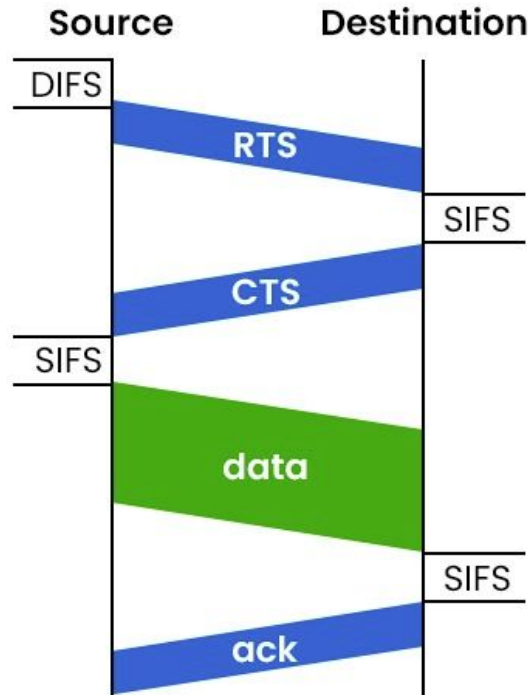


# Capa física + MAC: 802.3

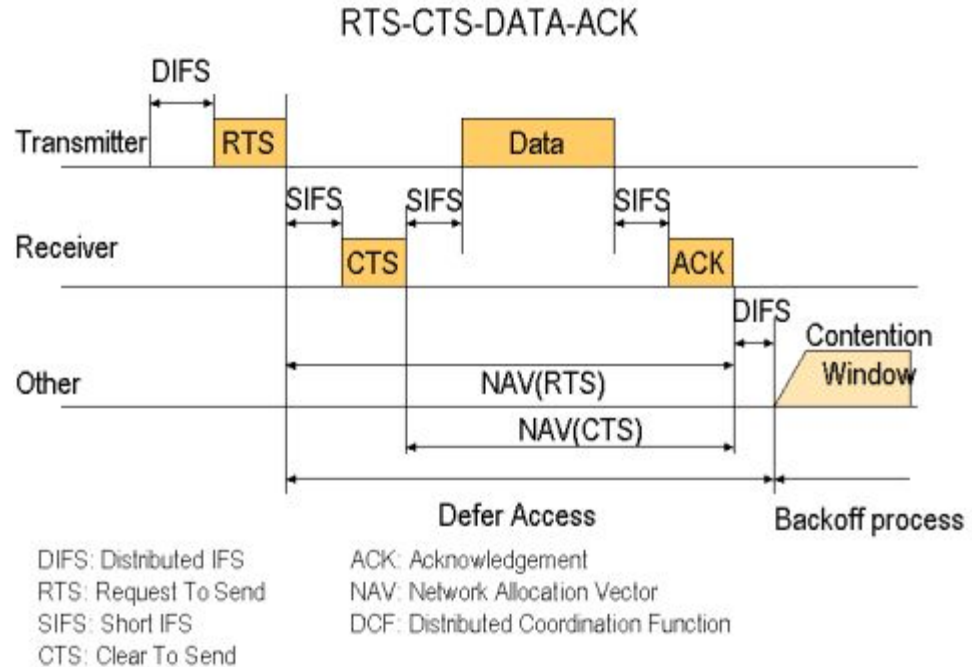


PARÁMETROS DE CSMA/CD NORMA IEEE 802.3	
Velocidad de transmisión	10Mbps
Slot time	51.2 microseg (512 bits)
Límite de intentos	16
Longitud de jam	32 bits
Longitud máxima de la trama	1518 bytes
Longitud mínima de la trama	64 bytes
Intervalo entre tramas	9.6 microseg

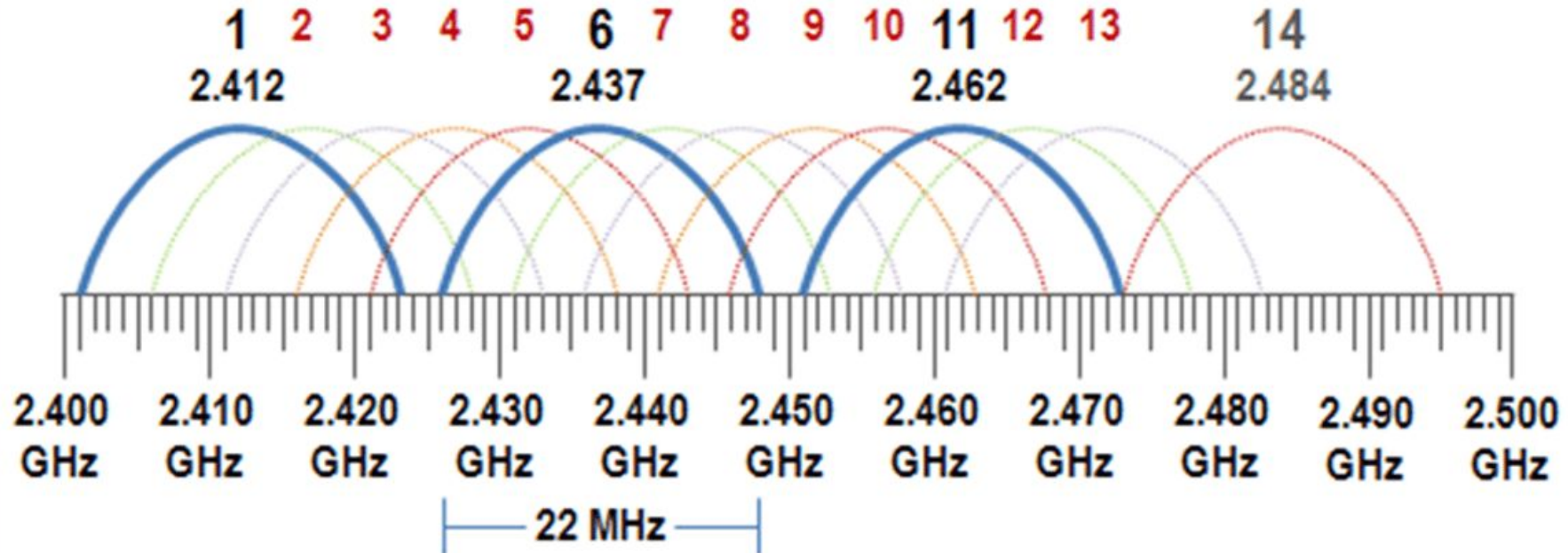
# Capa física: CSMA/CA



CSMA CA



# Capa física + MAC: 802.11



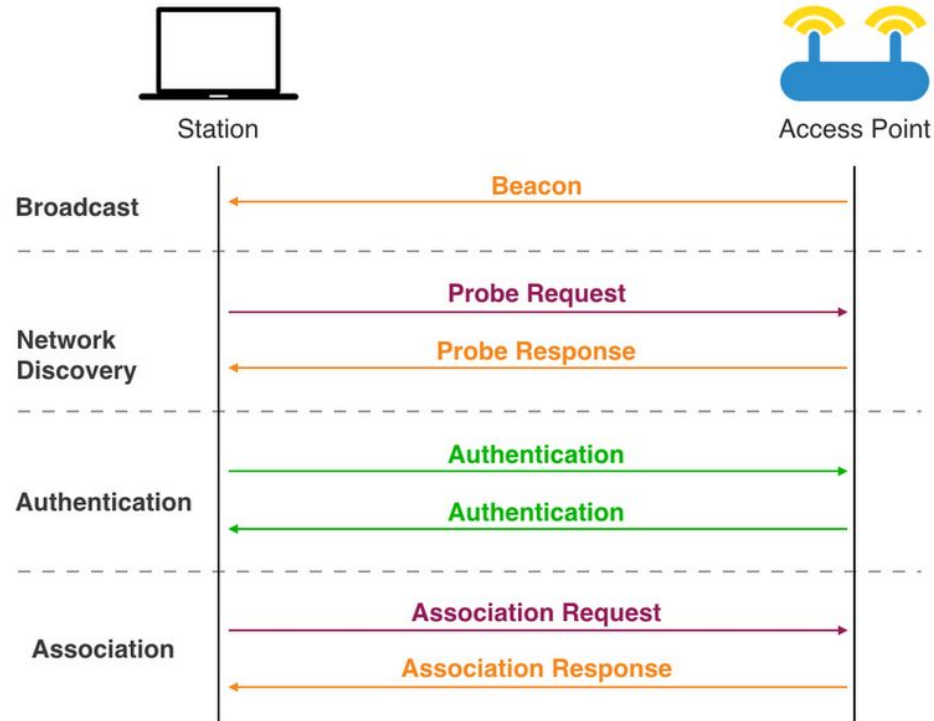


# Capa física + MAC: 802.11

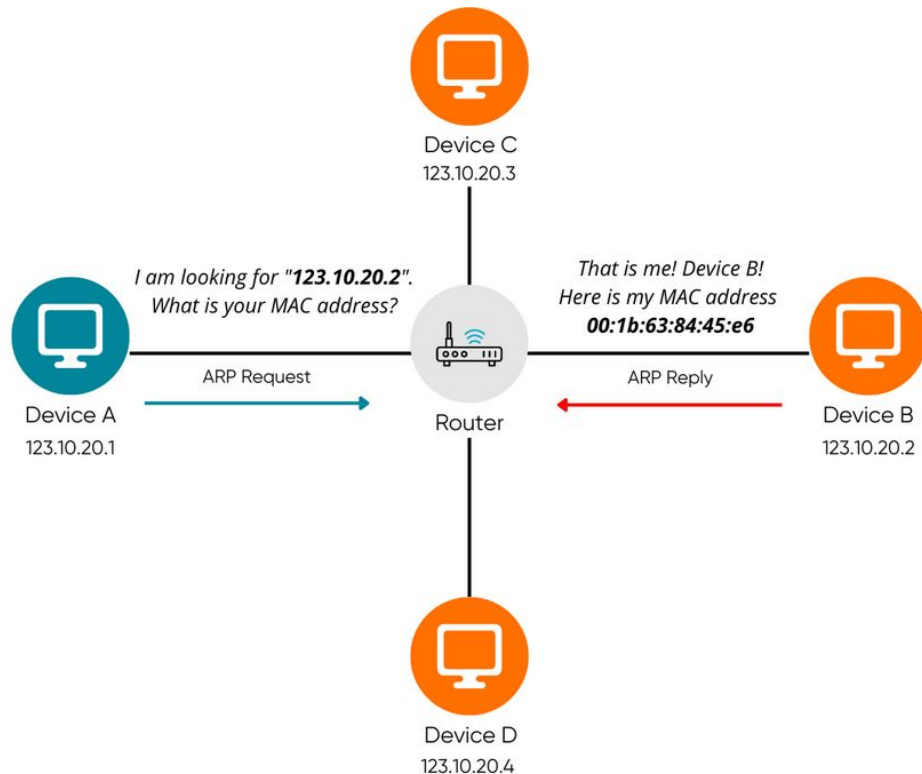


<i>PHY Version</i>	<i>Max PHY Rate</i>	<i>PHY Rate Enhancement</i>	<i>Bandwidth/ number of spatial streams (SS)</i>	<i>Operating Bands (GHz)</i>
802.11b	11 Mbps		22 MHz, 1 SS	2.4
802.11a/g	54 Mbps	5x	20 MHz, 1 SS	2.4(g)/5(a)
802.11n	600 Mbps	11x	40 MHz, 4 SS	2.4/5
802.11ac	6.9 Gbps	11x	160 MHz, 8 SS	5
802.11ax	9.6 Gbps	1.4x	160 MHz, 8 SS	2.4/5

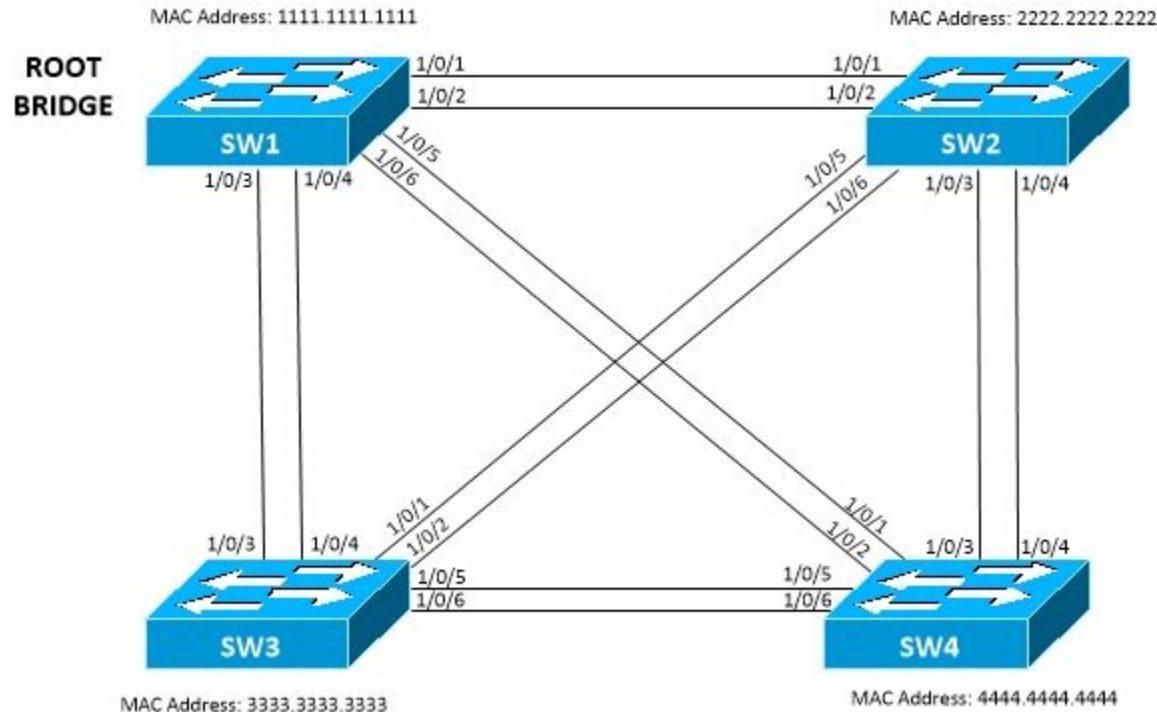
# Capa física + MAC: 802.11



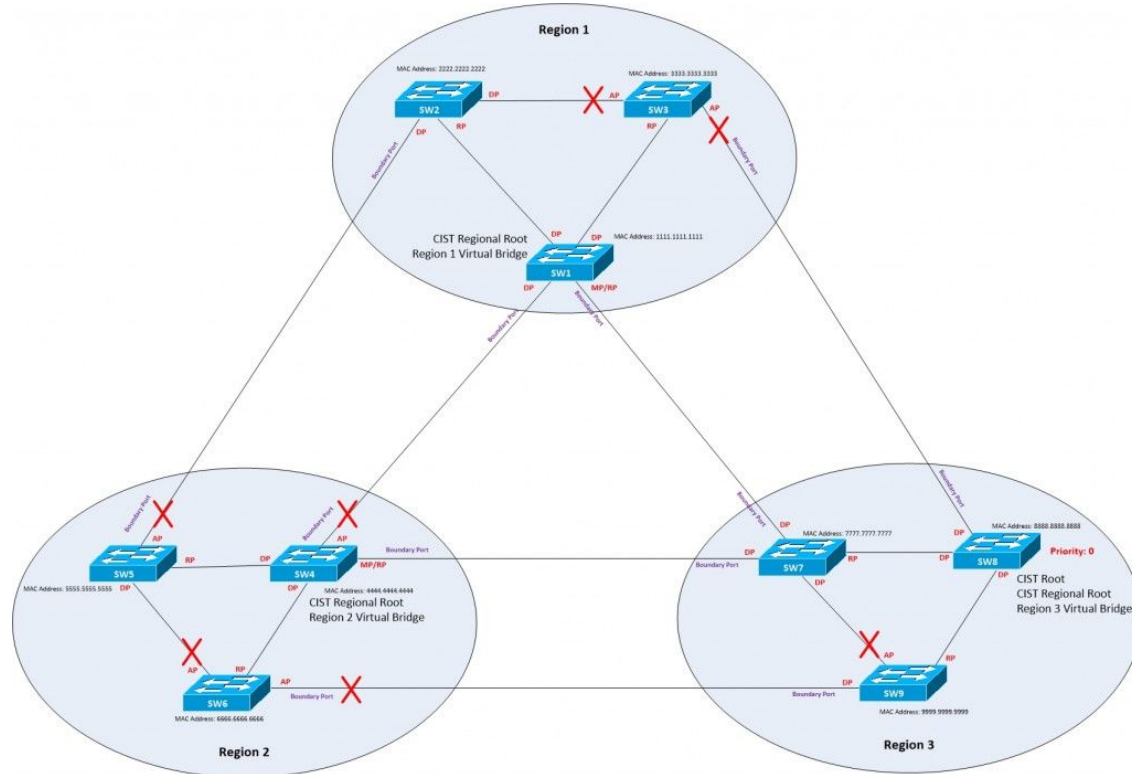
# Capa MAC: ARP, Address Resolution Protocol



# Capa MAC: STP, Spanning Tree Protocol



# Capa MAC: STP, Spanning Tree Protocol



# Capa de red: IP, Internet Protocol



**Formato de la Cabecera IP (Versión 4)**

0-3	4-7	8-15	16-18	19-31
Versión	Tamaño Cabecera	Tipo de Servicio	Longitud Total	
Identificador			Flags	Posición de Fragmento
Tiempo de vida		Protocolo	Suma de Control de Cabecera	
Dirección IP de Origen				
Dirección IP de Destino				
Opciones				Relleno

# Capa de red: IP, Internet Protocol



Dirección IPv4

**172 . 16 . 254 . 1**



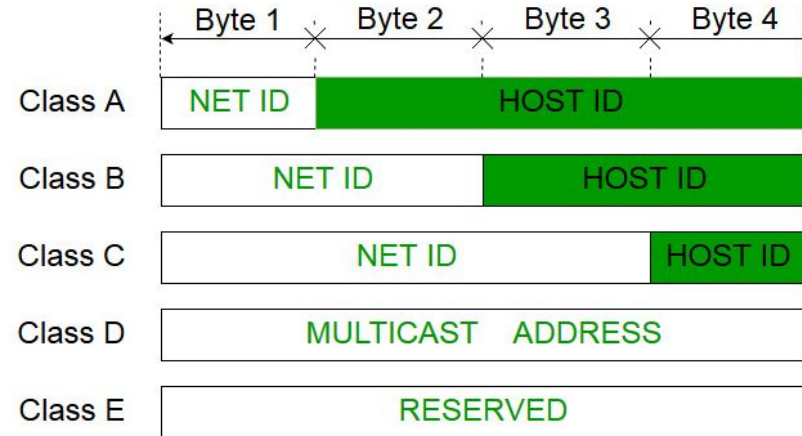
10101100.00010000.11111110.00000001



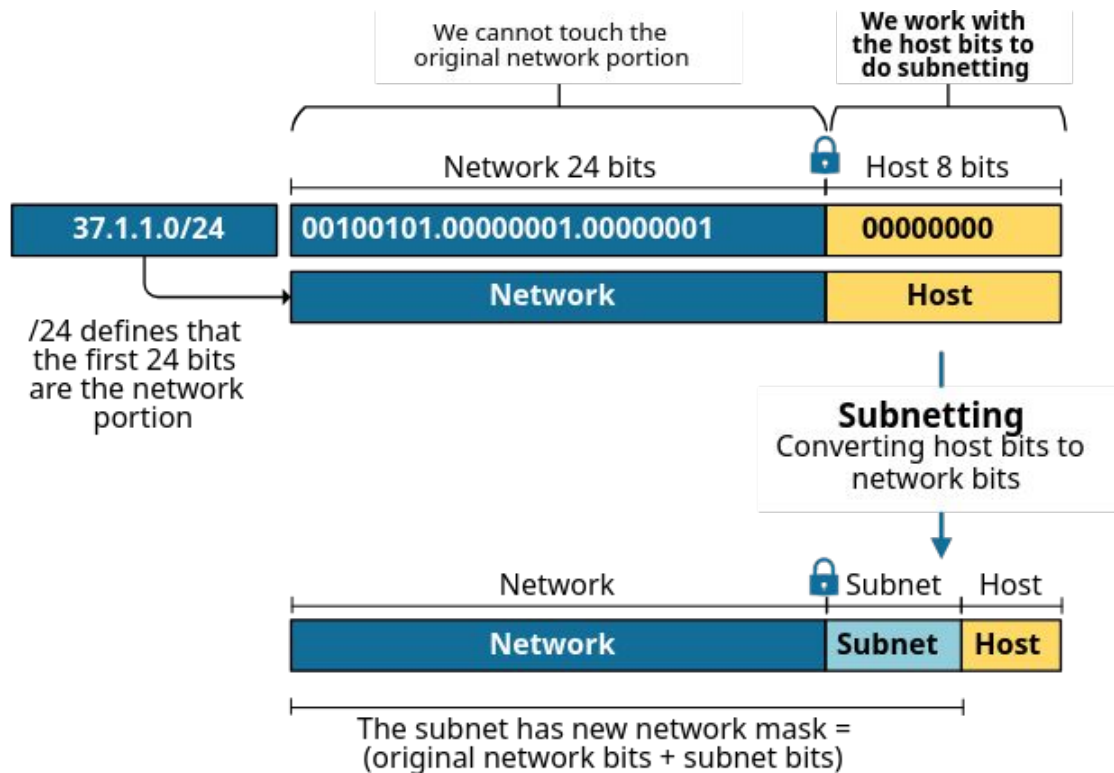
Un byte= Ocho bits



Treinta y dos bits (4 x 8), o 4 bytes



# Capa de red: subnetting



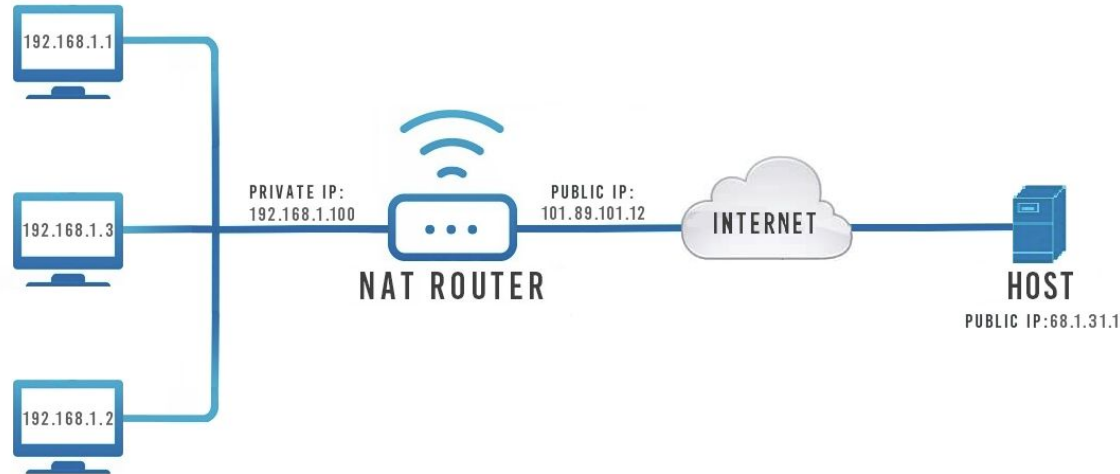


# Capa de red: IPs privadas



Class	Starting IP Address	Ending IP Address	# of Hosts
A	10.0.0.0	10.255.255.255	16,777,216
B	172.16.0.0	172.31.255.255	1,048,576
C	192.168.0.0	192.168.255.255	65,536

# Capa de red: NAT



NAT TABLE		
INSIDE PRIVATE IP:PORT	INSIDE PUBLIC IP:PORT	OUTSIDE PUBLIC IP:PORT
192.168.1.1:9688	101.89.101.12:8801	68.1.31.1:23
192.168.1.2:1253	101.89.101.12:5123	68.1.31.1:23
192.168.1.3:1025	101.89.101.12:102	68.1.31.1:23

## IPv6 address

**2001 : 0DC8 : E004 : 0001 : 0000 : 0000 : 0000 : F00A**

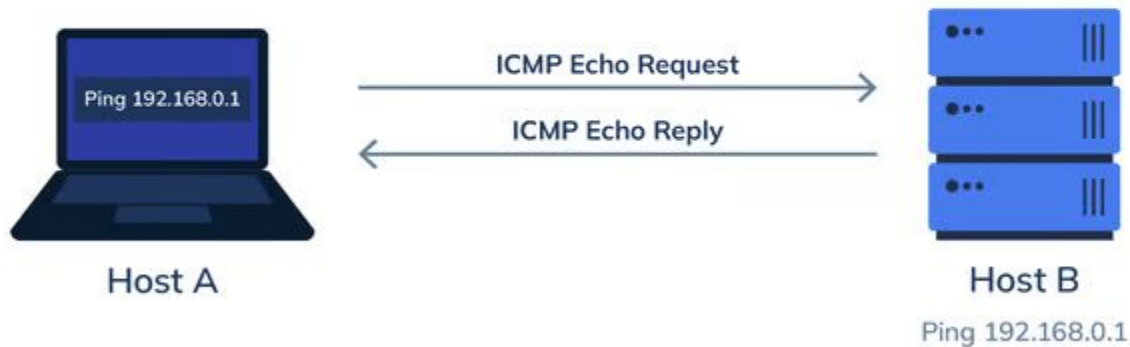
16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits

**128 Bits**

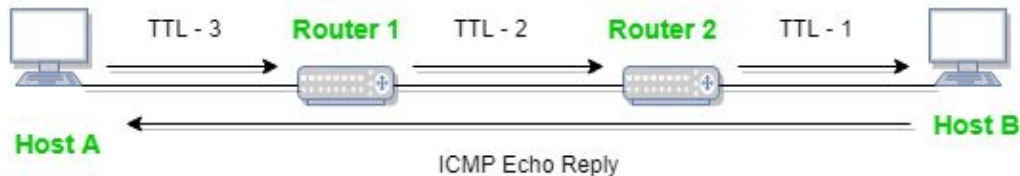
# Capa de red: ICMP, Internet Control Message Protocol



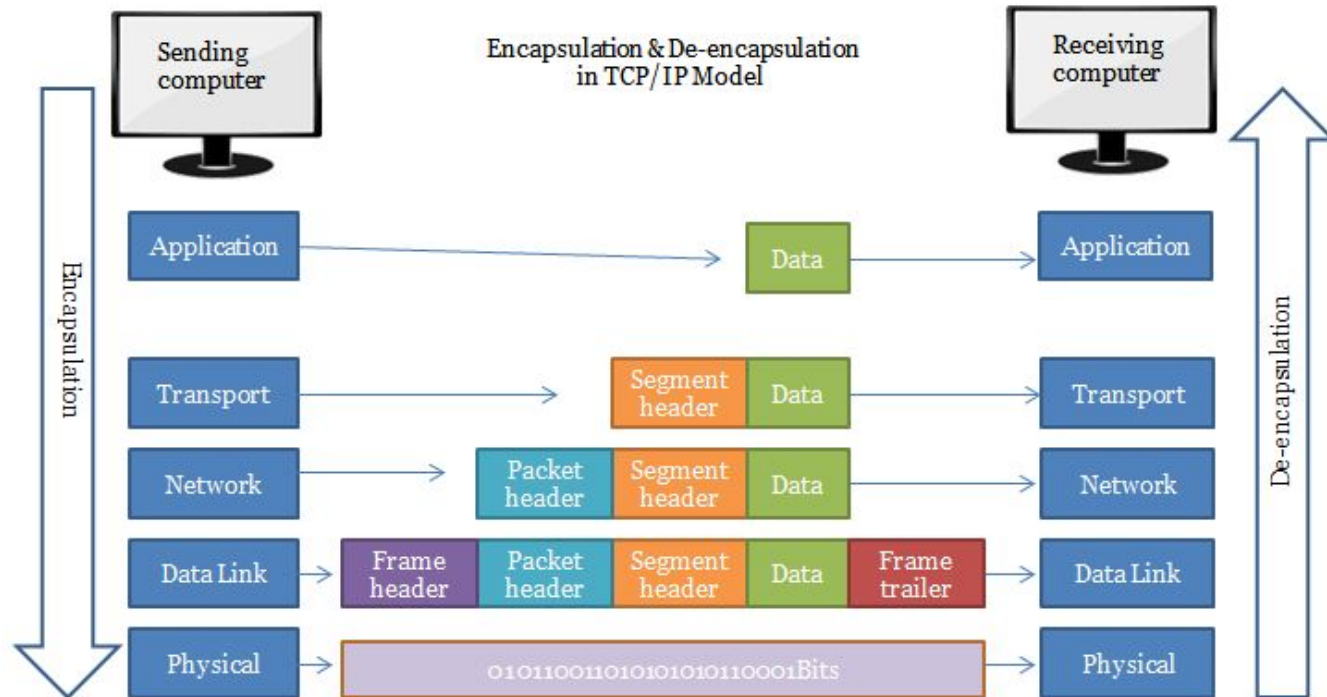
## Ping Command



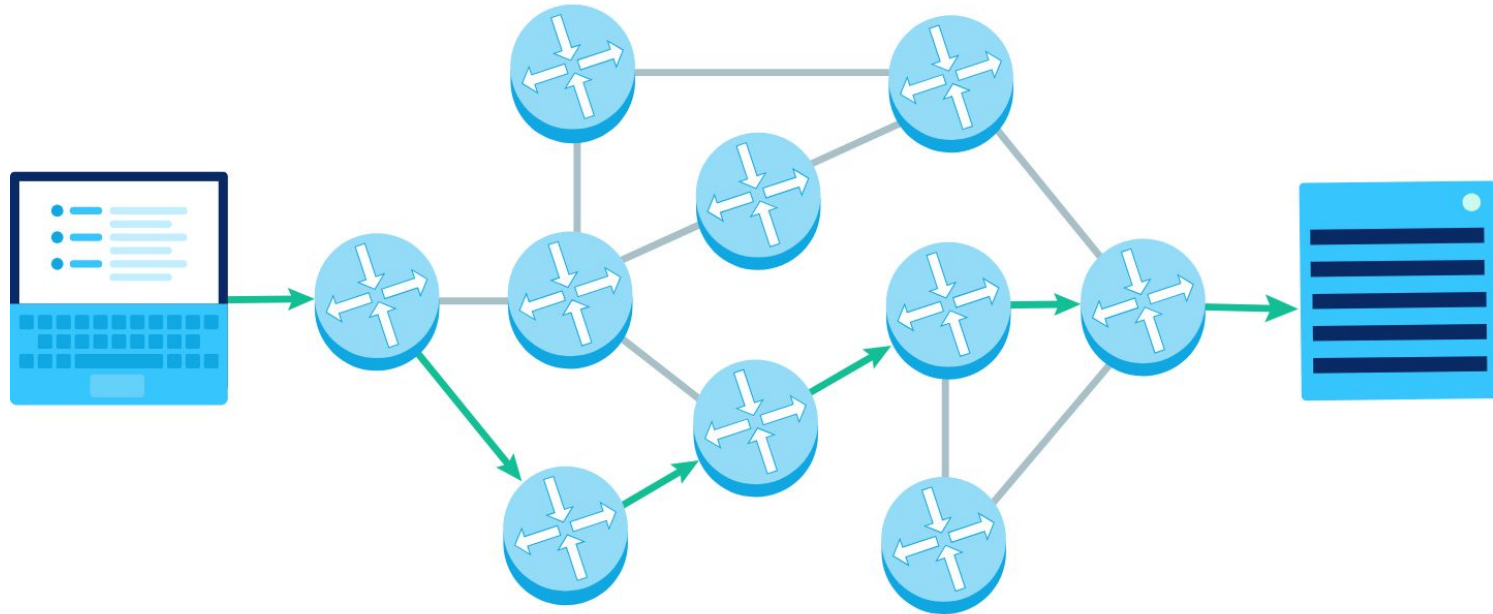
# Capa de red: ICMP, Internet Control Message Protocol



# Encapsulamiento



# Capa de red: enrutamiento



# Capa de red: enrutamiento

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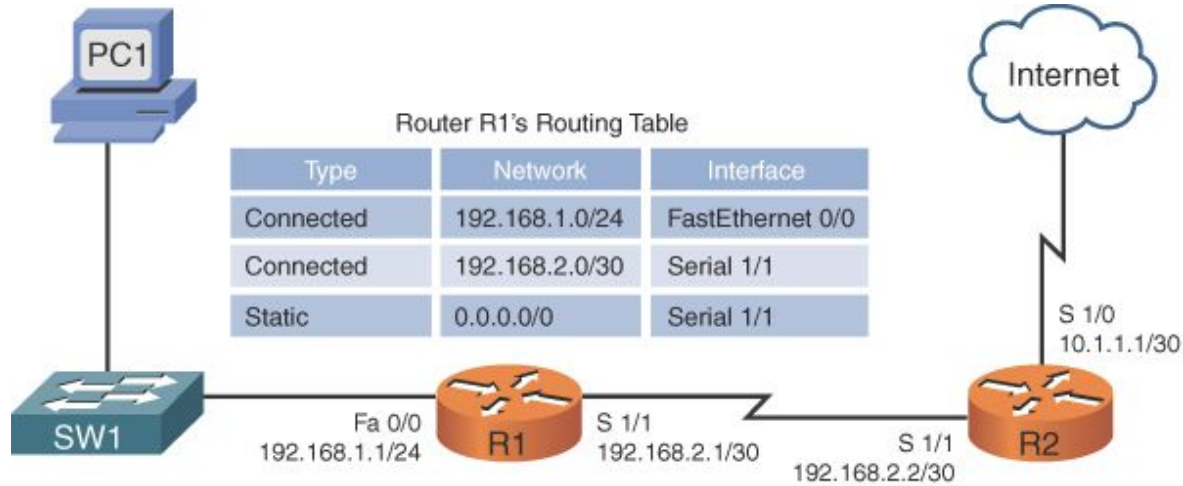
root@OpenWrt:~# ip r
default via 192.168.1.254 dev eth0.2 src 192.168.1.64
172.18.0.0/24 via 172.31.100.1 dev tap0
172.31.100.0/24 via 172.31.100.1 dev tap0
172.31.100.0/24 dev tap0 scope link src 172.31.100.5
192.168.0.0/24 dev br-lan scope link src 192.168.0.1
192.168.1.0/24 dev eth0.2 scope link src 192.168.1.64
root@OpenWrt:~# ip r del 172.18.0.0/24 via 172.31.100.1
root@OpenWrt:~# ip r
default via 192.168.1.254 dev eth0.2 src 192.168.1.64
172.31.100.0/24 via 172.31.100.1 dev tap0
172.31.100.0/24 dev tap0 scope link src 172.31.100.5
192.168.0.0/24 dev br-lan scope link src 192.168.0.1
192.168.1.0/24 dev eth0.2 scope link src 192.168.1.64
root@OpenWrt:~# ping -c2 172.18.0.2
PING 172.18.0.2 (172.18.0.2): 56 data bytes

--- 172.18.0.2 ping statistics ---
2 packets transmitted, 0 packets received, 100% packet loss
root@OpenWrt:~# █

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# Capa de red: enrutamiento



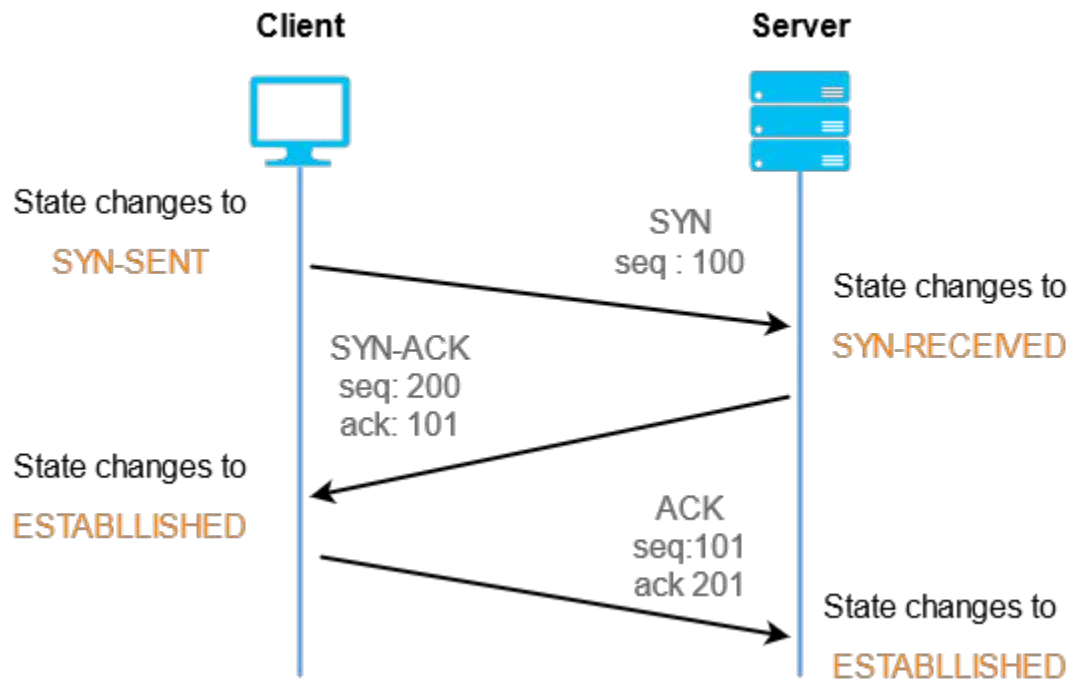
Router R1's Routing Table

Type	Network	Interface
Connected	192.168.1.0/24	FastEthernet 0/0
Connected	192.168.2.0/30	Serial 1/1
Static	0.0.0.0/0	Serial 1/1

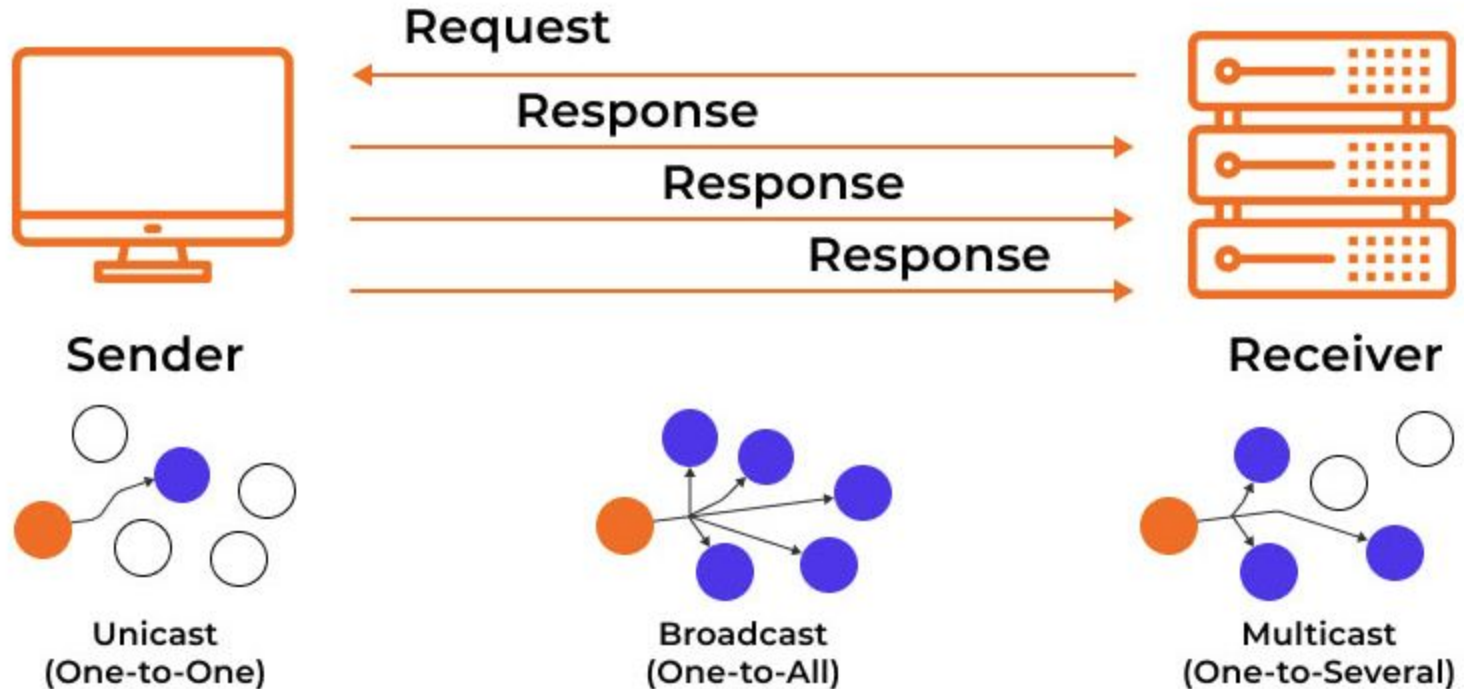
Router R2's Routing Table

Type	Network	Interface
Connected	10.1.1.0/30	Serial 1/0
Connected	192.168.2.0/30	Serial 1/1
Static	0.0.0.0/0	Serial 1/0
Static	192.168.1.0/24	Serial 1/1

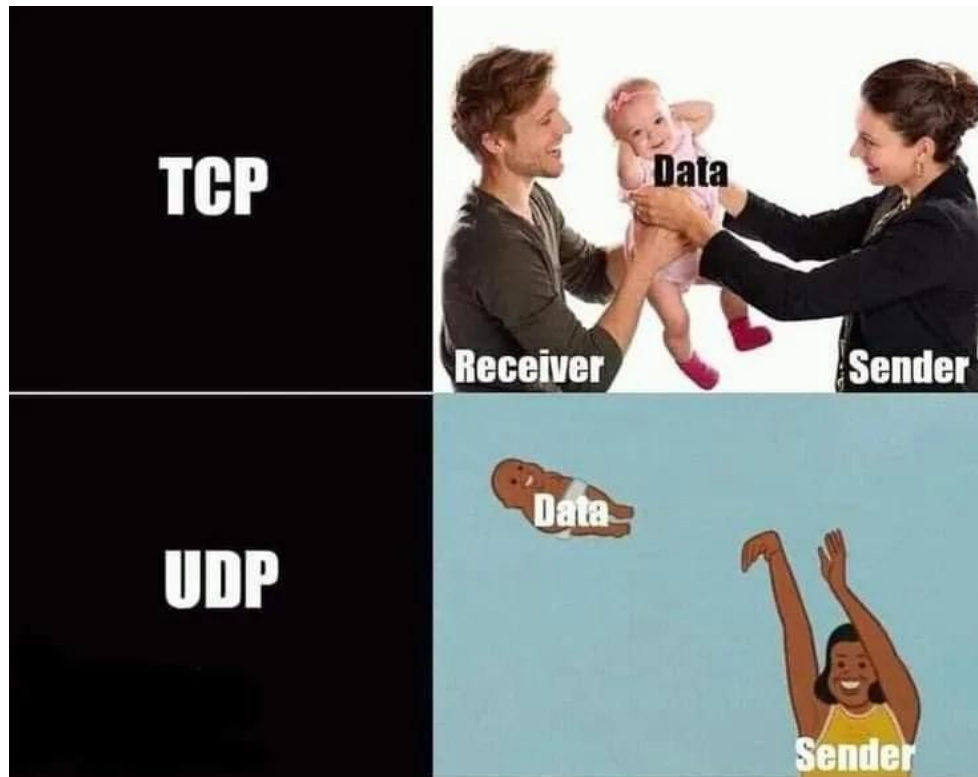
# Capa de transporte: TCP



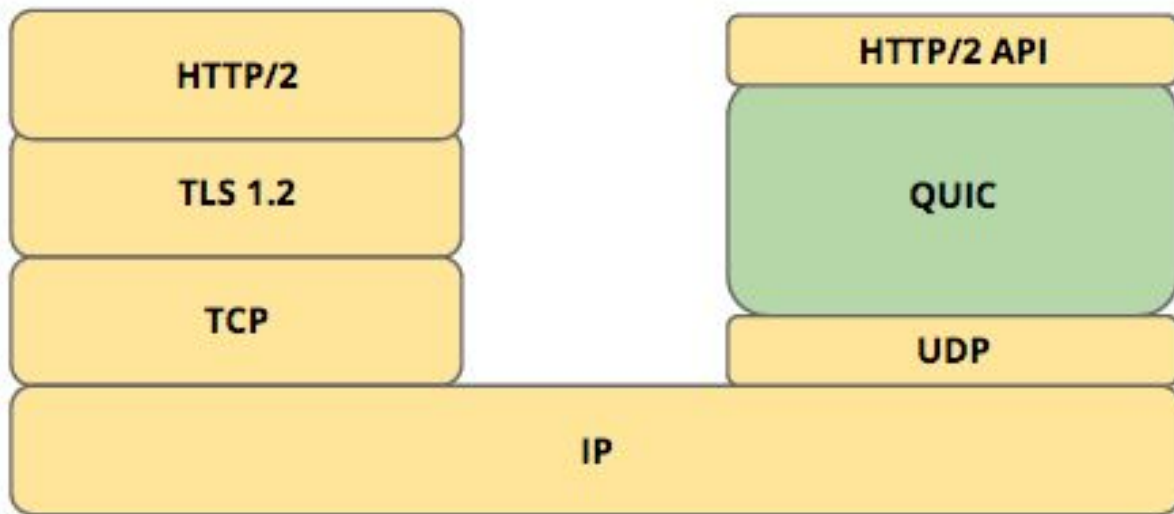
# Capa de transporte: UDP



# Capa de transporte: TCP vs UDP



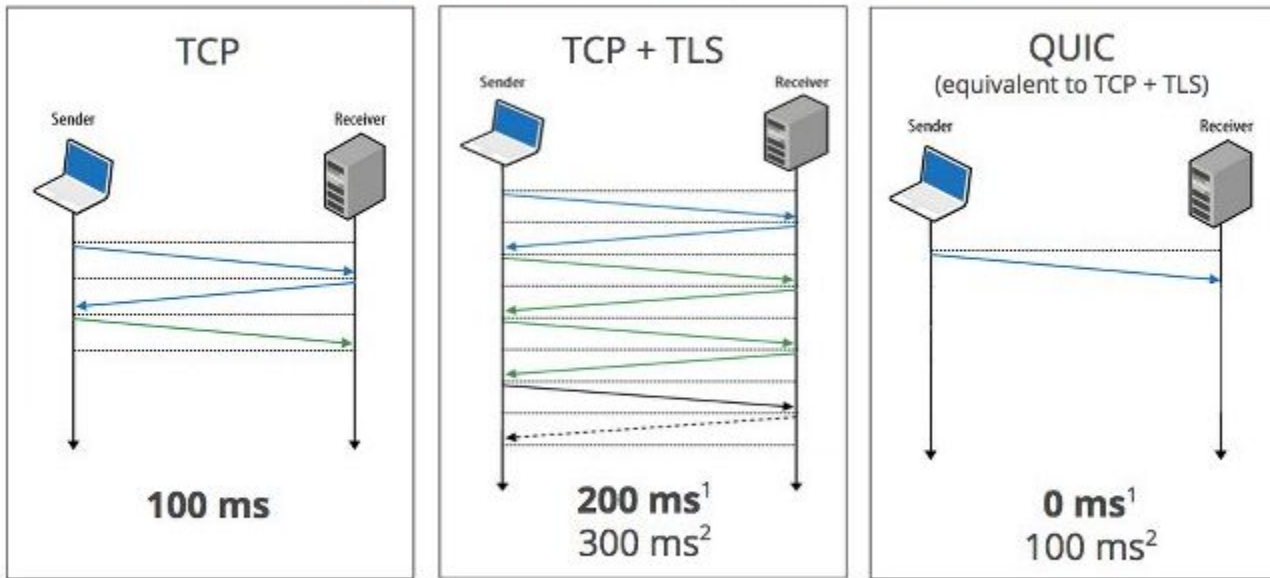
# Capa de transporte: QUIC



# Capa de transporte: QUIC



## Zero RTT Connection Establishment



1. Repeat connection
2. Never talked to server before

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## Para saber más

- <https://www.warriorsofthe.net/>
- <https://beej.us/guide/bgnet/>
- TCP/IP Guide. A Comprehensive, Illustrated Internet Protocols Reference. Charles M. Kozierok. No Starch Press.
- Network Warrior: Everything You Need to Know That Wasn't on the CCNA Exam 2nd Edition. Gary Donahue. O'Reilly.
- Networking ACK + Bite size networking. Julia Evans. e-zine.

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# Muchas gracias :)

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