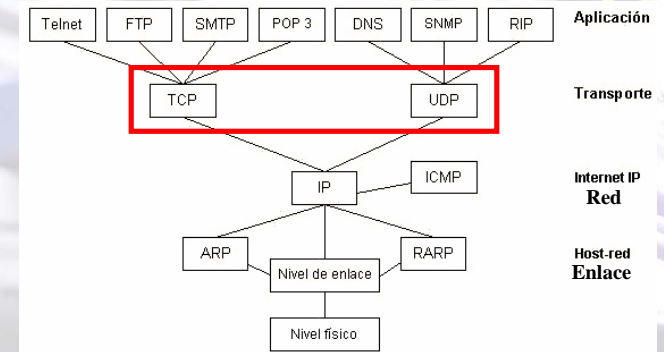


# Práctica 3

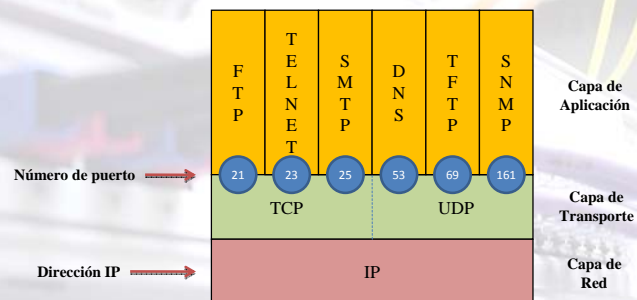
Redes  
Ing. en Informática

Profesor: Gabriel J. García Gómez  
Grupo de Innovación Educativa en Automática  
E-mail: gjgg@ua.es

## Modelo TCP/IP



## Número de puertos



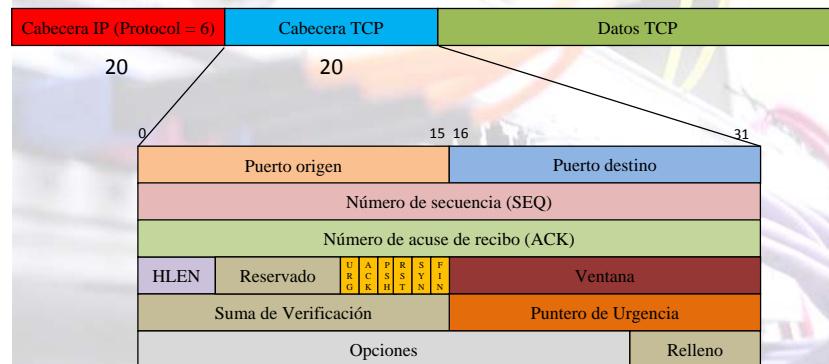
## Protocolo TCP

Características:

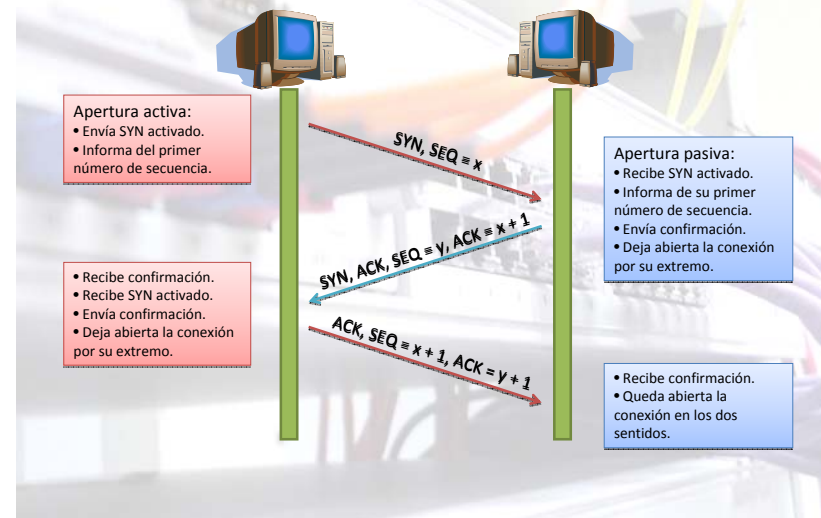
- Trabaja con un flujo de bytes.
- Transmisión orientada a conexión.
- Fiable.
- Flujo de bytes ordenado.



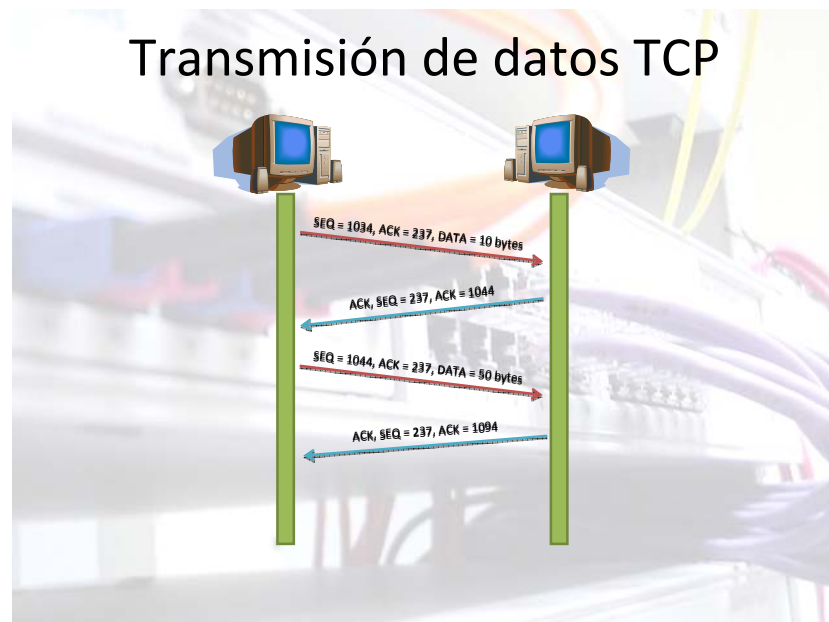
## Segmento TCP



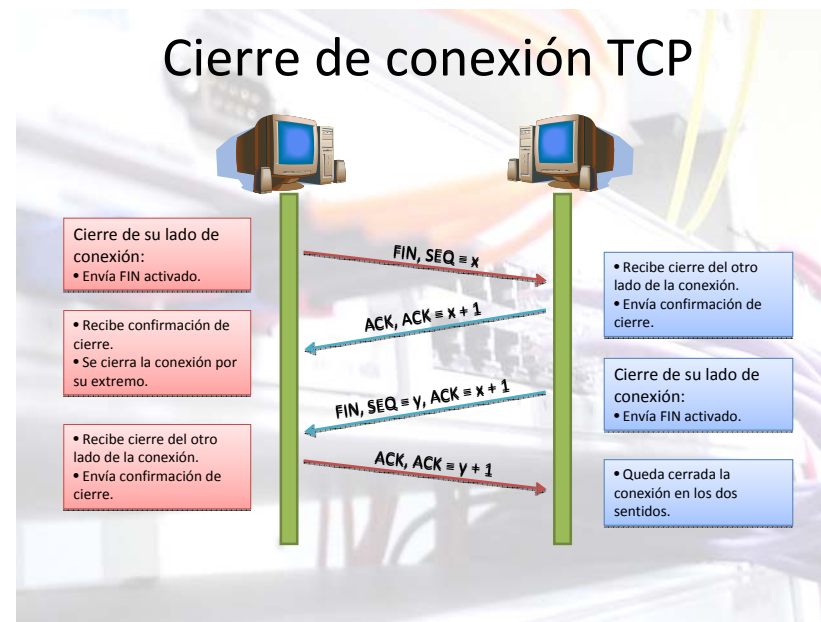
## Apertura de conexión TCP



## Transmisión de datos TCP

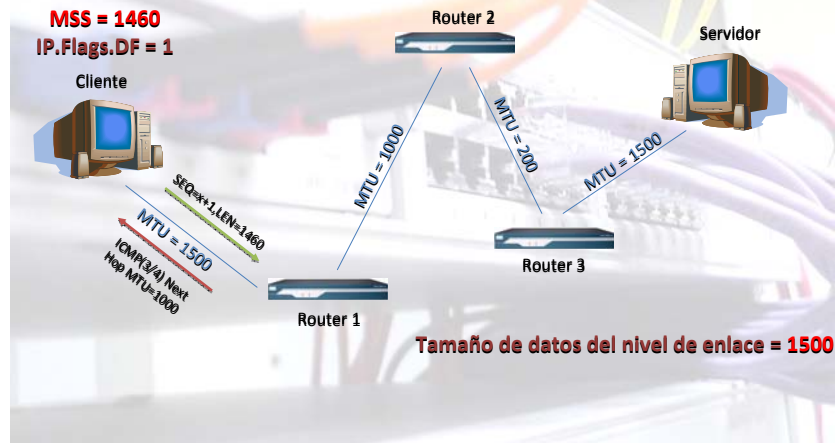


## Cierre de conexión TCP



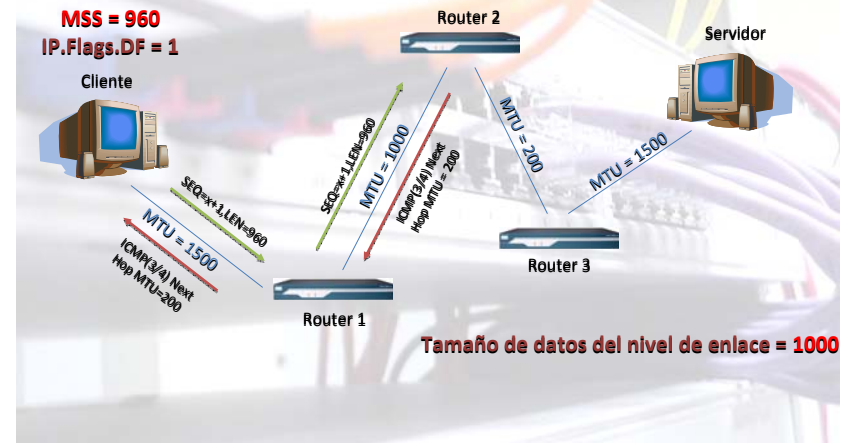
## Fragmentación TCP: MSS

$$MSS = MTU - \text{Cabecera TCP} - \text{Cabecera IP} = MTU - 20 - 20 = MTU - 40$$



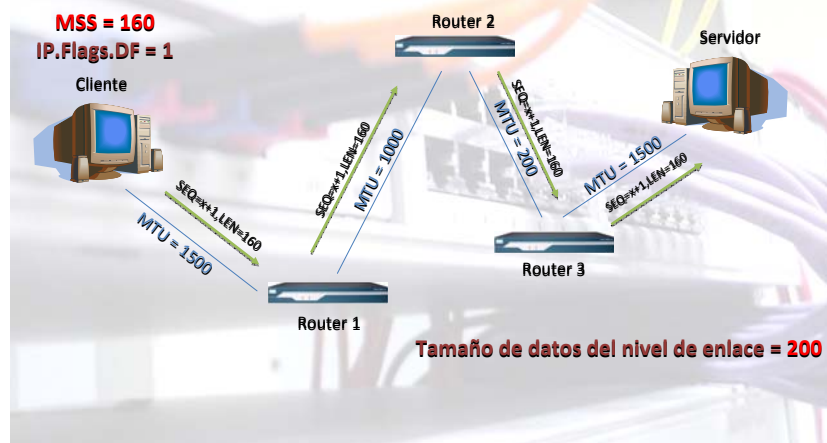
## Fragmentación TCP: MSS

$$MSS = MTU - \text{Cabecera TCP} - \text{Cabecera IP} = MTU - 20 - 20 = MTU - 40$$



## Fragmentación TCP: MSS

$$MSS = MTU - \text{Cabecera TCP} - \text{Cabecera IP} = MTU - 20 - 20 = MTU - 40$$



## Protocolo UDP

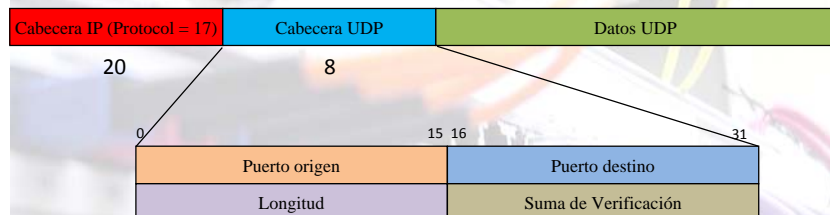
Características:

- Sin conexión.
- Trabaja con paquetes enteros, no con bytes individuales como TCP.
- No es fiable.
- Sencillo y con cabeceras muy simples → Poca carga adicional en la red.
- Fragmentación a cargo del nivel de red IP.
- Al no haber conexión permite direcciones de destino IP broadcast o multicast.





## Segmento UDP



## Rendimiento a nivel de transporte

Velocidad de transmisión:

$$V_t = \frac{B}{T_0}$$

- **B** es el número de bits **total** transmitidos por el medio físico.
- **T<sub>0</sub>** es el tiempo que tarda el paquete en ser transmitido por el canal (sólo ida).

Cadencia eficaz:

$$C_e = \frac{n}{T_0}$$

- **n** es el número de bits de **datos** transmitidos.
- **T<sub>0</sub>** es el tiempo que tarda el paquete en ser transmitido por el canal (sólo ida).

## Rendimiento a nivel de transporte

ping -l 1000 -n 3 172.20.43.230



Velocidad de transmisión:

$$B = (8 + 14 + 20 + 8 + 1000 + 4)$$

$$T_0 = \frac{4}{2} = 0.002 \text{ s}$$

Cadencia eficaz TCP:

$$n = (8 + 1000 - 20) \cdot 8$$

Cadencia eficaz UDP:

$$n = (8 + 1000 - 8) \cdot 8$$

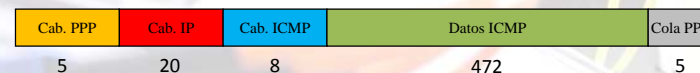
```

C:\Documents and Settings\EPS>ping -n 3 -l 1472 172.20.43.230
Haciendo ping a 172.20.43.230 con 1472 bytes de datos:
Respuesta desde 172.20.43.230: bytes=1472 tiempo=4ms TTL=255
Respuesta desde 172.20.43.230: bytes=1472 tiempo=4ms TTL=255
Respuesta desde 172.20.43.230: bytes=1472 tiempo=4ms TTL=255
Estadísticas de ping para 172.20.43.230:
    Paquetes: enviados = 3, recibidos = 3, perdidos = 0
    (0% perdidos),
    Tiempos aproximados de ida y vuelta en milisegundos:
        Mínimo = 4ms, Máximo = 4ms, Media = 4ms
C:\Documents and Settings\EPS>

```

## Rendimiento a nivel de transporte

ping -l 472 -n 3 10.3.2.0 (desde 10.3.7.0)



Velocidad de transmisión:

Cadencia eficaz TCP:

Cadencia eficaz UDP:

# Rendimiento a nivel de transporte

ping -l 472 -n 3 10.3.2.0 (desde 10.3.7.0)

|          |         |           |            |          |
|----------|---------|-----------|------------|----------|
| Cab. PPP | Cab. IP | Cab. ICMP | Datos ICMP | Cola PPP |
| 5        | 20      | 8         | 472        | 5        |

Velocidad de transmisión:

$$B = (5 + 20 + 8 + 472 + 5) \cdot 10 = 513 \cdot 10 = 5130 \text{ bits}$$

Cadencia eficaz TCP:

$$n = (8 + 472 - 20) \cdot 8 = 460 \cdot 8 = 3680 \text{ bits}$$

Cadencia eficaz UDP:

$$n = (8 + 472 - 8) \cdot 8 = 472 \cdot 8 = 3776 \text{ bits}$$

|          |         |           |            |          |
|----------|---------|-----------|------------|----------|
| Cab. PPP | Cab. IP | Cab. ICMP | Datos ICMP | Cola PPP |
| 5        | 20      | 8         | 472        | 5        |

$$B = (5 + 20 + 8 + 472 + 5) \cdot 10 = 513 \cdot 10 = 5130 \text{ bits}$$
$$n = (8 + 472 - 20) \cdot 8 = 460 \cdot 8 = 3680 \text{ bits}$$
$$n = (8 + 472 - 8) \cdot 8 = 472 \cdot 8 = 3776 \text{ bits}$$

# Topología L24

The diagram illustrates a network topology labeled "Topología L24". It shows the following components and connections:

- Internet (rec EPS)**: Connected to the Cisco 2513 router via Ethernet0 (172.25.40.91, 172.25.40.92) with NAT.
- Router EPS**: Connected to the Cisco 2513 router via Serial 1 (10.4.2.5) and Serial 0 (10.4.2.2). It has a FastEthernet0 (00070EB8C8FF) interface (172.20.43.230) and a Serial 0 (10.4.2.6) interface. A note indicates the FastEthernet0 is a backup port for PCs assigned to the EPS.
- Cisco 2513**: A central router with interfaces Ethernet0, Serial 1, Serial 0, TokenRing0 (172.20.41.225), and TokenRing (172.20.41.224/28).
- Cisco 1720**: Connected to the Cisco 2513 via Serial 0 (10.4.2.6) and Serial 0 (10.4.2.1). It has a FastEthernet0 (00070EB8C8FF) interface (172.20.43.230) and a Serial 0 (10.4.2.6) interface.
- Cisco 1601**: Connected to the Cisco 2513 via TokenRing0 (172.20.41.225) and TokenRing (172.20.41.224/28). It has an ethernet0 (00020BAE06A3D) interface (172.20.43.231) and a TokenRing (172.20.41.224/28) interface.
- Switch EPS**: Connected to the Router EPS via 172.20.43.195 and to the Hub L24 via 172.20.43.198. It has a 172.20.43.227 interface.
- Hub L24**: Connected to the Cisco 1601 via 172.20.43.231 and to the Cisco 1720 via 172.20.43.230. It has an Ethernet (10Mbps) interface (172.20.43.192/26).
- Linux 1**: Connected to the Hub L24 via eth0 (172.20.41.241) and eth1 (172.20.41.242). It has a PPP (38400bps) interface (10.3.0.16) and a Hub interface (10.3.0.16).
- Linux 2**: Connected to the Hub L24 via eth0 (172.20.41.242) and eth1 (172.20.41.243). It has a Hub interface (10.3.0.16) and a Hub interface (10.3.0.16).
- Linux 3**: Connected to the Hub L24 via eth0 (00920A4C8611) and eth1 (0040335271DD). It has a Hub interface (10.3.0.16) and a Hub interface (10.3.0.16).
- PCs del laboratorio**: Connected to the Hub L24 via 172.20.43.198 and 172.20.43.227.

# Fragmentación TCP: MSS

$MSS = MTU - \text{Cabecera TCP} - \text{Cabecera IP} = MTU - 20 - 20 = MTU - 40$

**MSS = 1460**

The diagram shows a network topology with three routers (Router 1, Router 2, Router 3) and two endpoints (Cliente and Servidor). The Cliente is connected to Router 1, which is connected to Router 2, which is connected to Router 3, which is connected to the Servidor. The diagram illustrates the calculation of the Maximum Segment Size (MSS) for each link in the path. The Cliente has an MTU of 1500, Router 1 has an MTU of 1000, Router 2 has an MTU of 1200, and Router 3 has an MTU of 500. The MSS for each link is calculated as MTU - 40 (TCP header - IP header). The MSS values are: Cliente to Router 1 (1460), Router 1 to Router 2 (960), Router 2 to Router 3 (1160), and Router 3 to Servidor (460). The diagram also shows the fragmentation of a packet from the Cliente to the Servidor. The packet is fragmented into segments of size 1460, 960, 1160, and 460, which are then reassembled at the Servidor.

**Tamaño de datos del nivel de enlace = 48**

**MSS = 1460**

Diagram illustrating the MSS (Maximum Segment Size) calculation in a network topology:

- Client** (Left) connects to **Router 1** (Bottom) with **MTU = 1500**. The segment size is **SYN, SEQ=x, LEN=0**.
- Router 1** connects to **Router 2** (Top) with **MTU = 1000**. The segment size is **SYN, SEQ=x, LEN=0**.
- Router 2** connects to **Router 3** (Middle Right) with **MTU = 1200**. The segment size is **SYN, SEQ=x, LEN=0**.
- Router 3** connects to the **Servidor** (Right) with **MTU = 600**. The segment size is **SYN, SEQ=x, LEN=0**.

The **Tamaño de datos del nivel de enlace = 48** (Link layer data size = 48) is indicated at the bottom right.

# Fragmentación TCP: MSS

$MSS = MTU - \text{Cabecera TCP} - \text{Cabecera IP} = MTU - 20 - 20 = MTU - 40$

The diagram illustrates the process of determining the Maximum Segment Size (MSS) for a TCP connection across a network with three routers. The path starts from a **Cliente** (Client) on the left, passes through **Router 1**, **Router 2**, and **Router 3**, and ends at a **Servidor** (Server) on the right.

- Client to Router 1:** The link has an **MTU = 1500**. The outgoing packet is labeled **SYN, ACK, SEQ=x, ACK=y+1, LEN=0**.
- Router 1 to Router 2:** The link has an **MTU = 1000**. The outgoing packet is labeled **SYN, ACK, SEQ=x, ACK=y+1, LEN=0**.
- Router 2 to Router 3:** The link has an **MTU = 1200**. The outgoing packet is labeled **SYN, ACK, SEQ=x, ACK=y+1, LEN=0**.
- Router 3 to Server:** The link has an **MTU = 500**. The outgoing packet is labeled **SYN, ACK, SEQ=x, ACK=y+1, LEN=0**.

The **Servidor** is labeled with **MSS = 460**.

**Tamaño de datos del nivel de enlace = 48**

Diagrama de una red de tres routers (Router 1, Router 2, Router 3) conectados en un triángulo. Un Cliente está conectado a Router 1 y un Servidor a Router 3. Se muestran las MTU de los enlaces: Cliente-Router 1 (1500), Router 1-Router 2 (1000), Router 2-Router 3 (1200), y Router 3-Servidor (500). Se indican los parámetros de un paquete SYN: ACK=0, SEQ=y, y LEN=0. En la parte superior derecha, se muestra **MSS = 480**. En la parte inferior, se indica **Tamaño de datos del nivel de enlace = 48**.

**Tamaño de datos del nivel de enlace = 48**

# Fragmentación TCP: MSS

$$\text{MSS} = \text{MTU} - \text{Cabecera TCP} - \text{Cabecera IP} = \text{MTU} - 20 - 20 = \text{MTU} - 40$$

**MSS = 460**

