

75.43 Introducción a los Sistemas Distribuidos

95.60 Redes y Aplicaciones Distribuidas

TA048 Redes

Tema: Capa de Transporte (I)

Capítulo 3 (hasta 3.4 inclusive) de *Computer Networking : A Top-Down Approach*. James Kurose and Keith Ross. Publisher: Pearson Edition: 8th, 2021.

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La capa de **Transporte** permite a las **Aplicaciones comunicarse: multiplexar y demultiplexar**

El transporte en Internet: *best effort* (intenta lo mejor que puede)

- *Best Effort*: es una propiedad heredada de la capa de Red
 - Facilita en diseño de la red: **equipos** más simples, **protocolos** menos complejos
 - Hizo **crecer** a Internet, dominando la tecnología de redes de comunicaciones
- Proporciona: **multiplexado** de las comunicaciones, y **verificación de errores** mínima
- Puede proveer:
 - **confiabilidad** de las comunicaciones
 - **control de flujo**
 - **seguridad**

Demostración del uso de Puertos (netstat -an, wireshark & nmap)

```
ihameli@aleph ~ % netstat -an| less
```

Active Internet connections (including servers)					
Proto	Recv-Q	Send-Q	Local Address	Foreign Address	(state)
tcp4	0	0	192.168.0.7.50510	17.253.13.210.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50509	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50508	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50507	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50505	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50501	2620:149:a41:505.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50491	2800:3f0:4003:c0.993	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50490	2800:3f0:4003:c0.993	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50473	2800:3f0:4003:c0.993	ESTABLISHED
tcp6	0	0	fdaa:bbcc:ddee:0.50462	fdaa:bbcc:ddee:0.55876	CLOSE_WAIT
tcp6	0	0	2800:810:5e8:129.50423	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50410	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50409	2001:4860:4860::.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50311	2620:149:a41:501.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50239	2800:3f0:4002:80.443	ESTABLISHED
tcp4	0	0	192.168.0.7.50035	157.92.58.2.143	ESTABLISHED
tcp4	0	0	192.168.0.7.50032	157.92.58.2.143	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50031	2800:3f0:4003:c0.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.50029	2800:3f0:4003:c0.443	ESTABLISHED
tcp4	0	0	192.168.0.7.49932	192.168.0.2.51494	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49982	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49979	2800:3f0:4003:c0.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49978	2800:3f0:4003:c0.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49973	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49972	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49971	2800:3f0:4002:80.443	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49969	2800:3f0:4003:c0.993	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49956	2800:3f0:4003:c0.993	ESTABLISHED
tcp6	0	0	2800:810:5e8:129.49951	2a03:2880:f210:c.443	ESTABLISHED

tcp4	0	0	192.168.0.7.49932	192.168.0.4.55843	ESTAB
tcp4	0	0	192.168.0.7.49934	172.217.192.188.5228	ESTAB
tcp6	0	0	*.49932	*.*	LISTE
tcp4	0	0	*.49932	*.*	LISTE
tcp4	0	0	192.168.0.7.54634	17.57.144.36.5223	ESTAB
tcp4	0	0	127.0.0.1.53533	*.*	LISTE
tcp46	0	0	*.33060	*.*	LISTE
tcp46	0	0	*.3306	*.*	LISTE
tcp4	0	0	*.5432	*.*	LISTE
tcp6	0	0	*.5432	*.*	LISTE
tcp6	0	0	2800:810:5e8:129.50511	2620:149:a41:50a.443	TIME_
tcp4	0	0	192.168.0.7.50475	17.248.184.199.443	TIME_
tcp6	0	0	2800:810:5e8:129.50427	2800:3f0:4002:80.443	TIME_
tcp6	0	0	2800:810:5e8:129.50364	2800:3f0:4002:80.443	TIME_
tcp4	0	0	192.168.0.7.50256	186.33.228.41.443	TIME_
udp4	0	0	*.51661	*.*	
udp4	0	0	*.*	*.*	
udp4	0	0	*.*	*.*	
udp4	0	0	*.49693	*.*	
udp4	0	0	*.3722	*.*	
udp46	0	0	*.5353	*.*	
udp46	0	0	*.5353	*.*	
udp46	0	0	*.5353	*.*	
udp46	0	0	*.5353	*.*	
udp46	0	0	*.5353	*.*	

Wi-Fi: en0 (tcp port http)

Apply a display filter ... <36/>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.0.7	157.92.49.38	TCP	78	59240 → 80 [SYN] Seq=0 Win=65535 L...
2	0.027711	157.92.49.38	192.168.0.7	TCP	74	80 → 59240 [SYN, ACK] Seq=0 Ack=1 ...
3	0.028122	192.168.0.7	157.92.49.38	TCP	66	59240 → 80 [ACK] Seq=1 Ack=1 Win=1...
4	0.028216	192.168.0.7	157.92.49.38	TCP	54	59240 → 80 [RST, ACK] Seq=1 Ack=1 ...
5	4.849353	192.168.0.7	129.105.44.81	HTTP	227	GET /data/dasu/dynamic/externalip...
6	11.047058	192.168.0.7	157.92.49.38	TCP	78	59268 → 80 [SYN] Seq=0 Win=65535 L...
7	11.072847	157.92.49.38	192.168.0.7	TCP	74	80 → 59268 [SYN, ACK] Seq=0 Ack=1 ...
8	11.073069	192.168.0.7	157.92.49.38	TCP	66	59268 → 80 [ACK] Seq=1 Ack=1 Win=1...
9	11.073070	192.168.0.7	157.92.49.38	TCP	54	59268 → 80 [RST, ACK] Seq=1 Ack=1 ...
10	15.424543	192.168.0.7	157.92.49.38	TCP	78	59273 → 80 [SYN] Seq=0 Win=65535 L...
11	15.425955	192.168.0.7	157.92.49.38	TCP	78	59274 → 80 [SYN] Seq=0 Win=65535 L...
12	15.451477	157.92.49.38	192.168.0.7	TCP	74	80 → 59274 [SYN, ACK] Seq=0 Ack=1 ...
13	15.451483	157.92.49.38	192.168.0.7	TCP	74	80 → 59273 [SYN, ACK] Seq=0 Ack=1 ...
14	15.451617	192.168.0.7	157.92.49.38	TCP	66	59274 → 80 [ACK] Seq=1 Ack=1 Win=1...
15	15.451618	192.168.0.7	157.92.49.38	TCP	66	59273 → 80 [ACK] Seq=1 Ack=1 Win=1...

> Frame 10: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

> Ethernet II, Src: 8c:85:90:0e:5e:fe (8c:85:90:0e:5e:fe), Dst: a8:6a:bb:cb:f1:d4 (a8:6a:bb:cb:f1:d4)

> Internet Protocol Version 4, Src: 192.168.0.7, Dst: 157.92.49.38

> Transmission Control Protocol, Src Port: 59273 (59273), Dst Port: 80 (80), Seq: 0, Len: 0

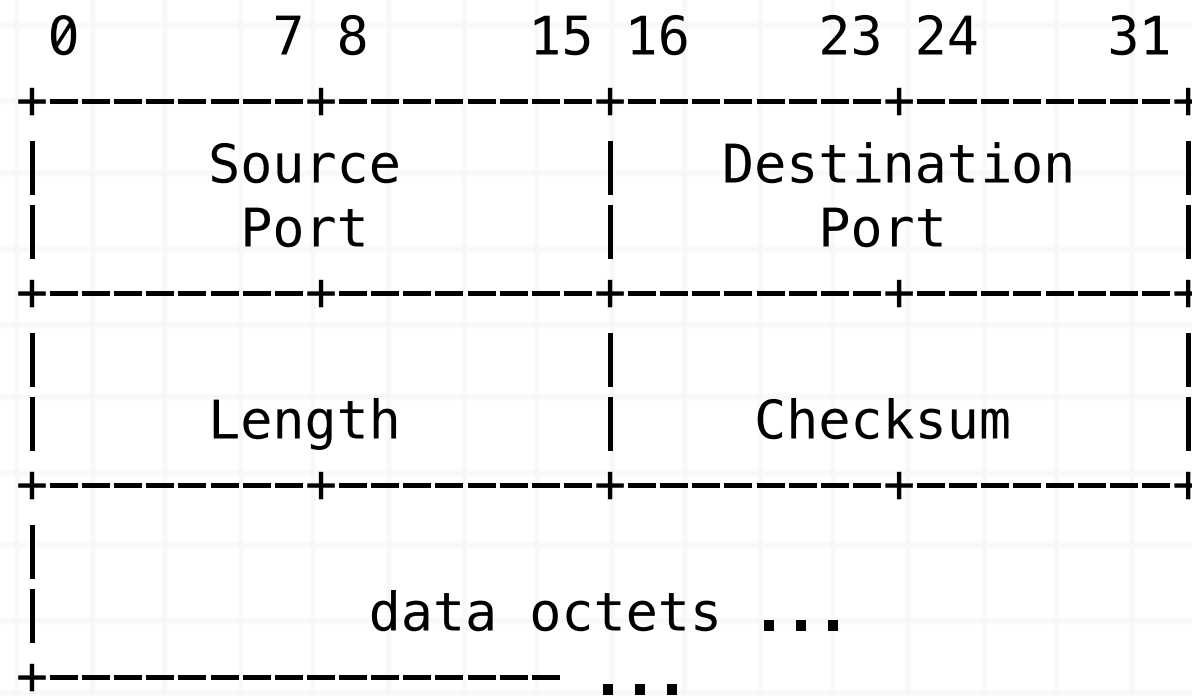
Wireshark: pcapng_en0_20210427201945_63Uz14

Packets: 2617 · Displayed: 2617 (100.0%)

Profile: Default

```
ihameli@aleph ~ % nmap -v cnet.fi.uba.ar
Starting Nmap 7.91 ( https://nmap.org ) at 2021-04-27 20:07 -03
Initiating Ping Scan at 20:07
Scanning cnet.fi.uba.ar (157.92.58.2) [2 ports]
Completed Ping Scan at 20:07, 0.07s elapsed (1 total hosts)
Initiating Connect Scan at 20:07
Scanning cnet.fi.uba.ar (157.92.58.2) [1000 ports]
Discovered open port 443/tcp on 157.92.58.2
Discovered open port 587/tcp on 157.92.58.2
Discovered open port 80/tcp on 157.92.58.2
Discovered open port 143/tcp on 157.92.58.2
Discovered open port 25/tcp on 157.92.58.2
Discovered open port 22/tcp on 157.92.58.2
Completed Connect Scan at 20:08, 46.74s elapsed (1000 total ports)
Nmap scan report for cnet.fi.uba.ar (157.92.58.2)
Host is up (0.026s latency).
Not shown: 994 filtered ports
PORT      STATE SERVICE
22/tcp    open  ssh
25/tcp    open  smtp
80/tcp    open  http
143/tcp   open  imap
443/tcp   open  https
587/tcp   open  submission
```

Capa de transporte: UDP (*User Datagram Protocol*) <https://www.rfc-editor.org>



User Datagram Header Format (RFC 768)

¿Qué aplicaciones usarían UDP?

Principios de las comunicaciones confiables

- Conectadas vs. No-conectadas
- Asegurar la **entrega**
- Asegurar el **orden**
- Asegurar la **integridad**
- **Desempeño**
- **Control de flujo**
- **Compartir el canal equitativamente**

Tipos de flujo

- *Stop & Wait* (desempeño)
- Contínuo (desempeño)
- *Go-Back-N*
- *Selective Repeat*

Resumen de las variables y los mecanismos del flujo confiable de datos :

- Checksum ó CRC (*Cyclical Redundancy Check*) : verificación de integridad
- Temporizador (*Timer*): para detectar paquetes **perdidos** (puede haber duplicados)
- Número de secuencia: para mantener un **flujo** de **paquetes** y **detectar** los **perdidos**
- Acuse de Recibo (ACK): para avisar qué **paquetes** se han **recibido**
- Acuse Negativo de Recibo (NACK): para avisar que el **paquete** llegó **corrupto**
- Ventana deslizante: para implementar un **flujo** de datos con alto **desempeño**

Resumen de la clase de hoy:

Capa de Transporte

- Funciones, mínimas y posibles
- Análisis del tráfico
- UDP
- Análisis de los métodos de transmisión fiable

Lectura del libro para la próxima clase: concluir con el Capítulo 3.