3ra Clase 31/3/2021

75.43 Introducción a los Sistemas Distribuidos
73.33 Redes y Teleprocesamientos I
95.60 Redes y Aplicaciones Distribuidas

Tema: Capa de Transporte (I)

Capítulo 3 (hasta 3.4 inclusive) de *Computer Networking : A Top-Down Approach with Access . James Kurose and Keith Ross. Publisher: Pearson Edition: 7th, 2016.*

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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 ... <⌘/>

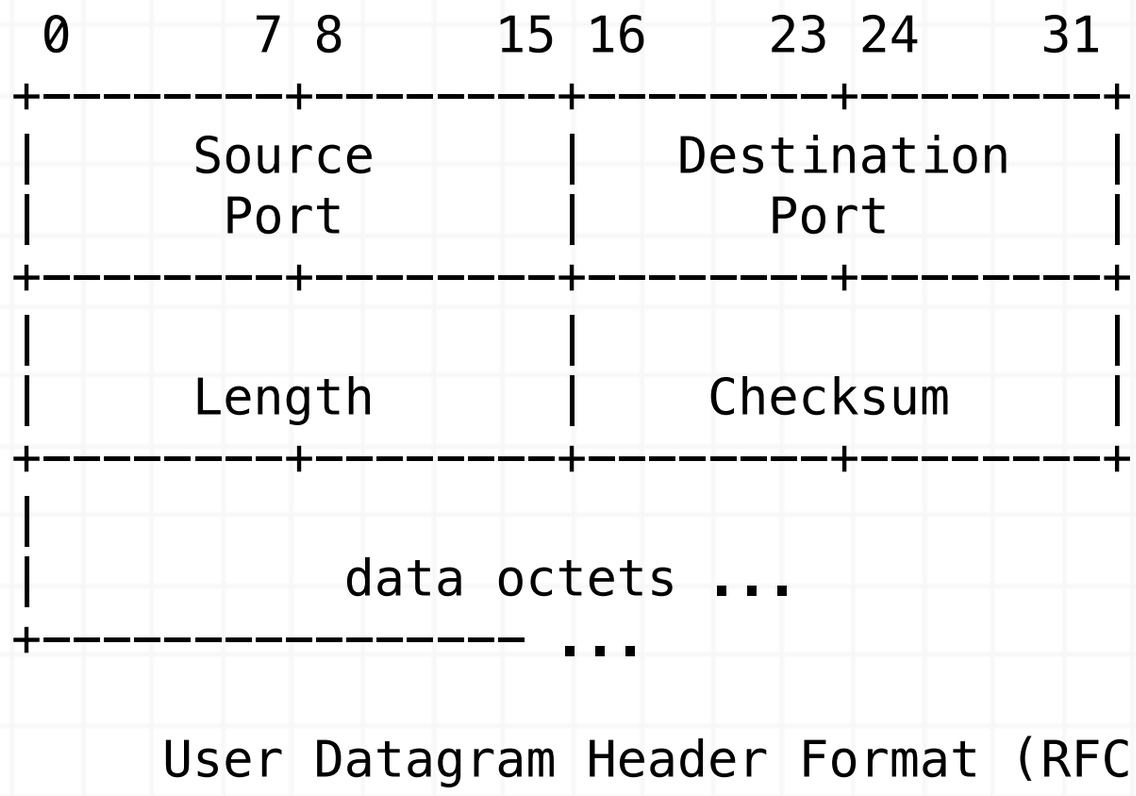
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.0.7	157.92.49.38	TCP	78	59240 → 80 [SYN] Seq=0 Win=65535 L…
2	0.027711	157.92.49.38	192.168.0.7	TCP	74	80 → 59240 [SYN, ACK] Seq=0 Ack=1 …
3	0.028122	192.168.0.7	157.92.49.38	TCP	66	59240 → 80 [ACK] Seq=1 Ack=1 Win=1…
4	0.028216	192.168.0.7	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: 7617 · Displayed: 7617 (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 manter 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

Para hacer (no es obligatorio): usar el comando “`dig`" con las opciones iterativa, autorizada y verborrágica capturando por la pantalla de la terminal y también mediante "`Wireshark`". Subirlo al Campus un informe en formato PDF.

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