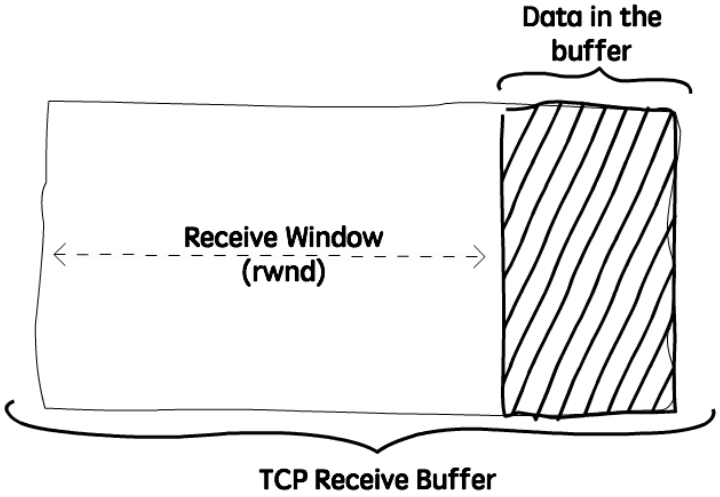
TCP & UDP Performance

Metrics

- Latency
  - time required to transmit a packet across a network
- Throughput
  - quantity of data being sent/received by unit of time
- Packet loss
  - number of packets lost per 100 packets sent by a host

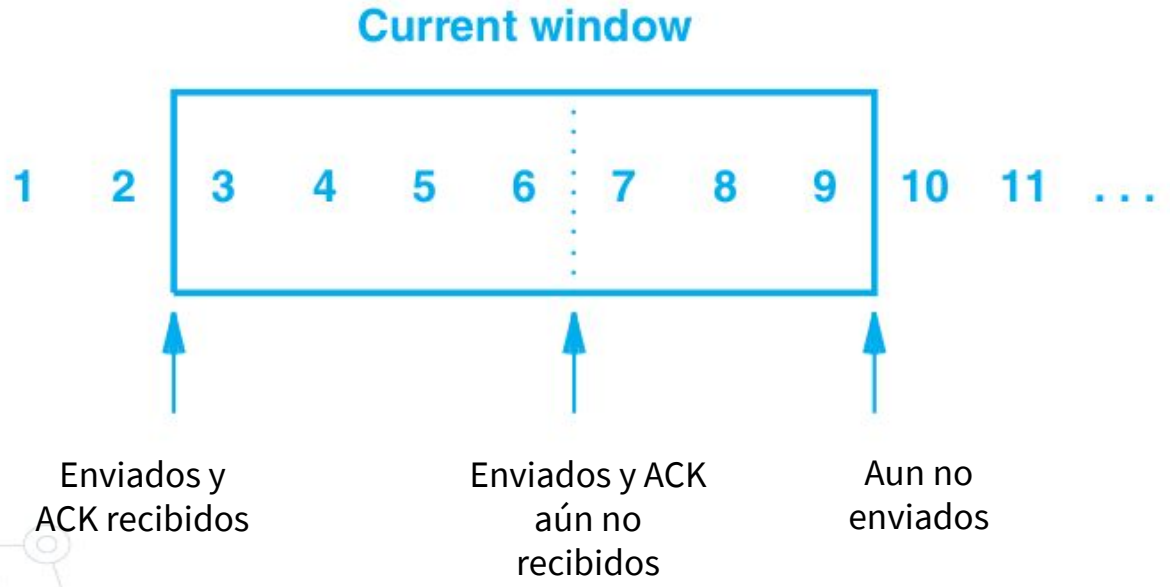
TCP Flow Control

- The receptor adds reception window size in ACK packets
- The sender adjust its window size as reception window size, in order to not overload to receptor buffer



TCP Congestion Window

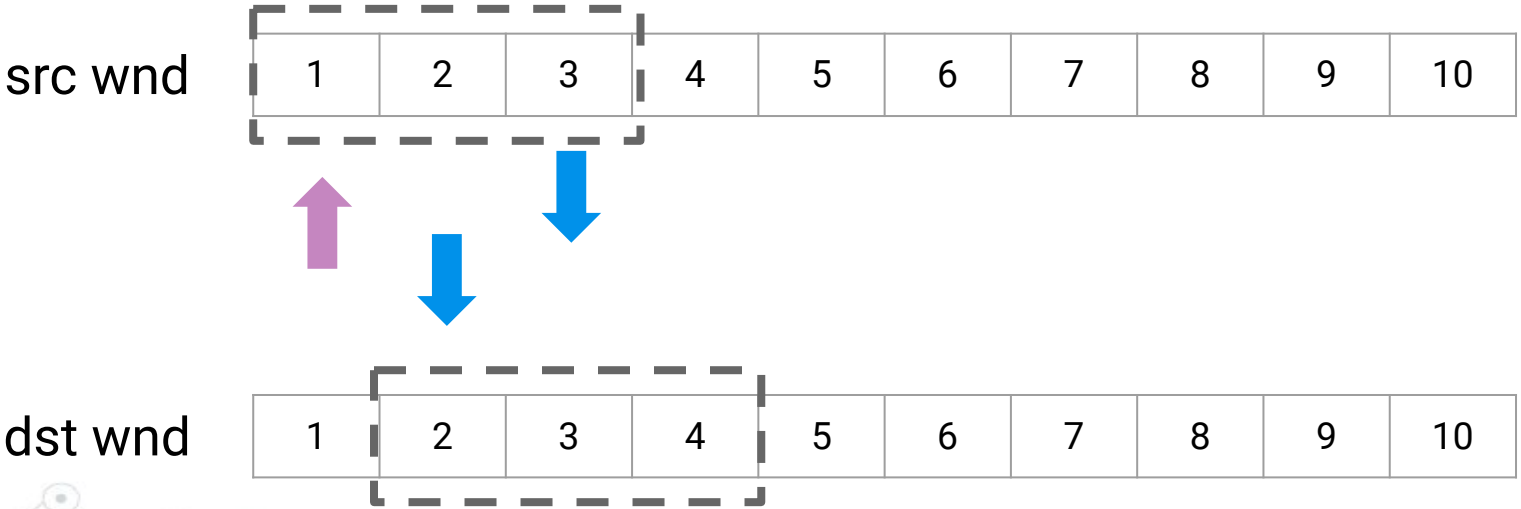
- Manage the number of packets that may be sent before receiving the corresponding acknowledgement packet.
- The transmisor have 3 pointers



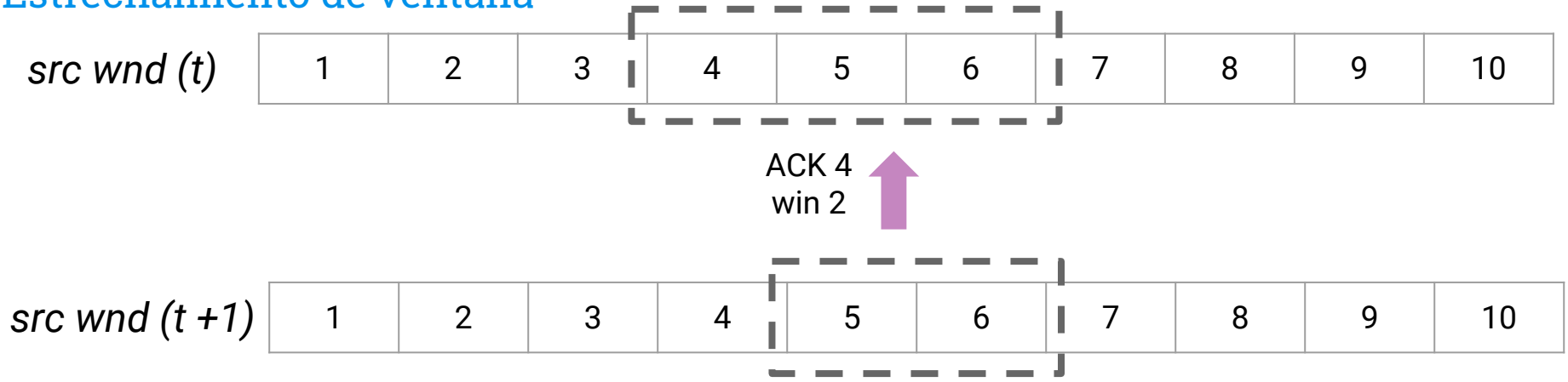
TCP Congestion Window

15 KBytes → 10 paquetes

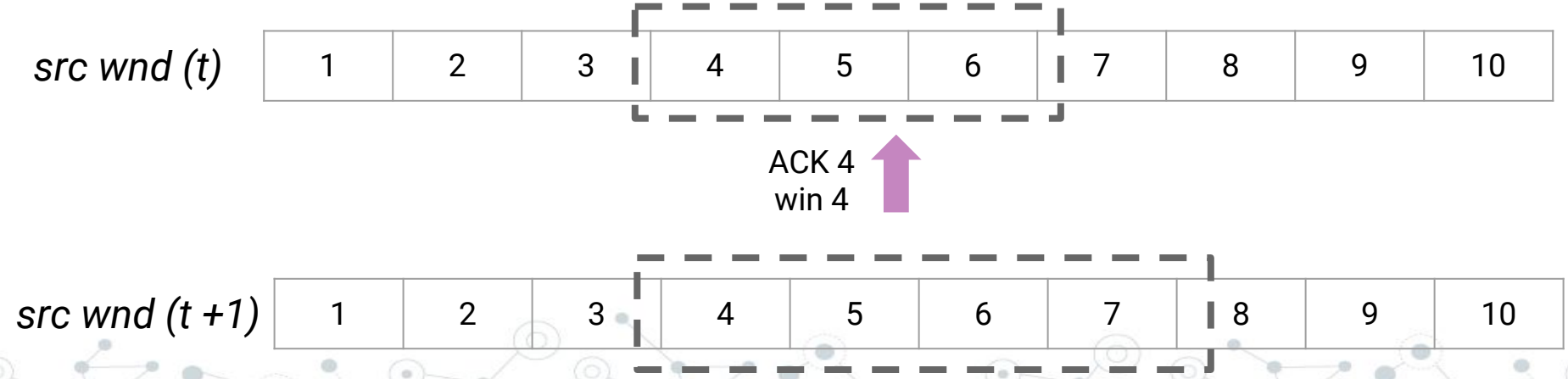
rwnd → 4,5 KBytes → 3 paquetes



Estrechamiento de ventana



Ampliación de ventana



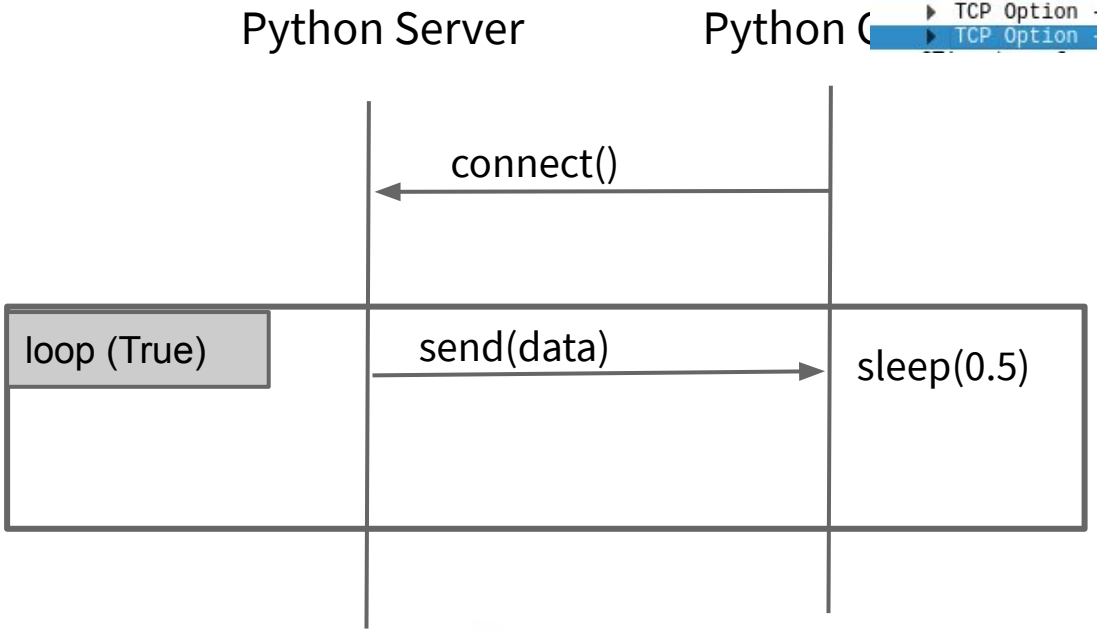
Lab!

TCP Performance

Escenario TCP

- Variación de la Ventana de congestión de TCP

```
Flags: 0x002 (SYN)
Window size value: 29200
[Calculated window size: 29200]
Checksum: 0xd6c5 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
Options: (20 bytes), Maximum segment size, SACK permitte
  TCP Option - Maximum segment size: 1460 bytes
  TCP Option - SACK permitted
  TCP Option - Timestamps: TSval 3540020719, TSecr 0
  TCP Option - No-Operation (NOP)
  TCP Option - Window scale: 7 (multiply by 128)
```



Pasos :

1. Con Wireshark analizar la interfaz loopback
2. Configurar wireshark con el filtro “tcp”
3. Iniciar python server.py
4. Iniciar python client.py
5. Esperar que la ventana en Wireshark alcance a cero y dejar que corra al menos 30 segundos así
6. Detener los scripts y analizar los resultados

https://gist.github.com/NatiTomattis/85a36e75dc79960c5ca7119bd546e83e

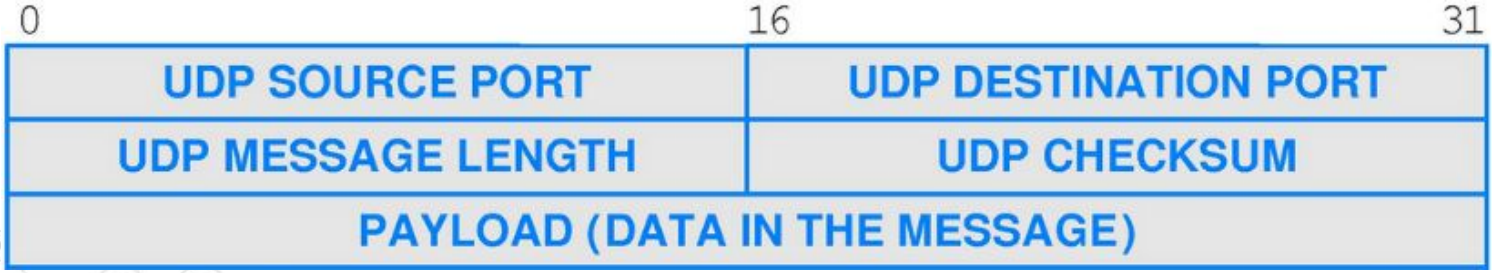
Escenario 2: Transmisión de un stream de bytes sobre TCP

UDP

- Protocolo “best-effort”
- No orientado a la conexión
- Checksum?

Performance UDP. Cuando se prefiere UDP?

Escenarios donde la velocidad importe más que la fiabilidad.



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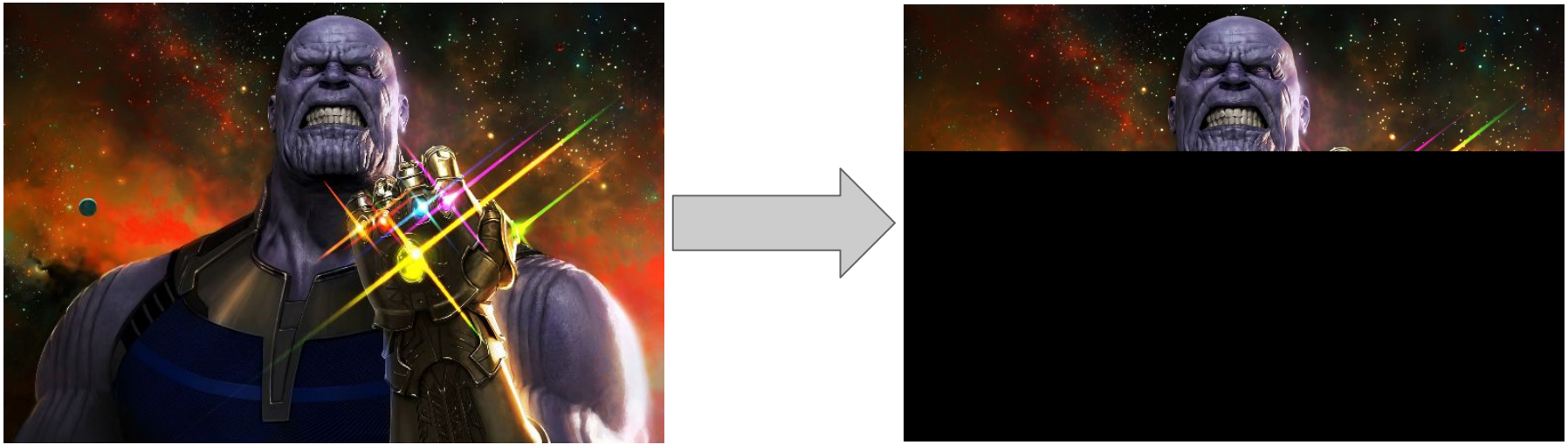
UDP Performance

Escenario UDP

- Envío de imagen por UDP.
- Remoto y local.



Rendimientos comparación

Iperf:

- Rendiemito : transfer
- Bandwidth : velocidad de transferencia

```
$iperf -i 1 --bandwidth 10M -c www.portal.efn.uncor.edu -p 80
------------------------------------------------------------
Client connecting to www.portal.efn.uncor.edu, TCP port 80
TCP window size: 85.0 KByte (default)
------------------------------------------------------------
[  3] local 172.16.0.94 port 48070 connected with 200.16.19.6 port 80
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  1.12 MBytes  9.44 Mbits/sec
[  3]  1.0- 2.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  2.0- 3.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  3.0- 4.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  4.0- 5.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  5.0- 6.0 sec  1.12 MBytes  9.44 Mbits/sec
[  3]  6.0- 7.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  7.0- 8.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  8.0- 9.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  9.0-10.0 sec  1.00 MBytes  8.39 Mbits/sec
[  3]  0.0-10.0 sec  10.2 MBytes  8.56 Mbits/sec
```

```
$iperf -i 1 --bandwidth 10M -c www.portal.efn.uncor.edu -p 80 --udp
------------------------------------------------------------
Client connecting to www.portal.efn.uncor.edu, UDP port 80
Sending 1470 byte datagrams, IPG target: 1121.52 us (kalman adjust)
UDP buffer size:  208 KByte (default)
------------------------------------------------------------
[  3] local 172.16.0.94 port 37562 connected with 200.16.19.6 port 80
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  1.0- 2.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  2.0- 3.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  3.0- 4.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  4.0- 5.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  5.0- 6.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  6.0- 7.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  7.0- 8.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  8.0- 9.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  9.0-10.0 sec  1.25 MBytes  10.5 Mbits/sec
[  3]  0.0-10.0 sec  12.5 MBytes  10.5 Mbits/sec
[  3] Sent 8918 datagrams
[  3] WARNING: did not receive ack of last datagram after 10 tries.
```

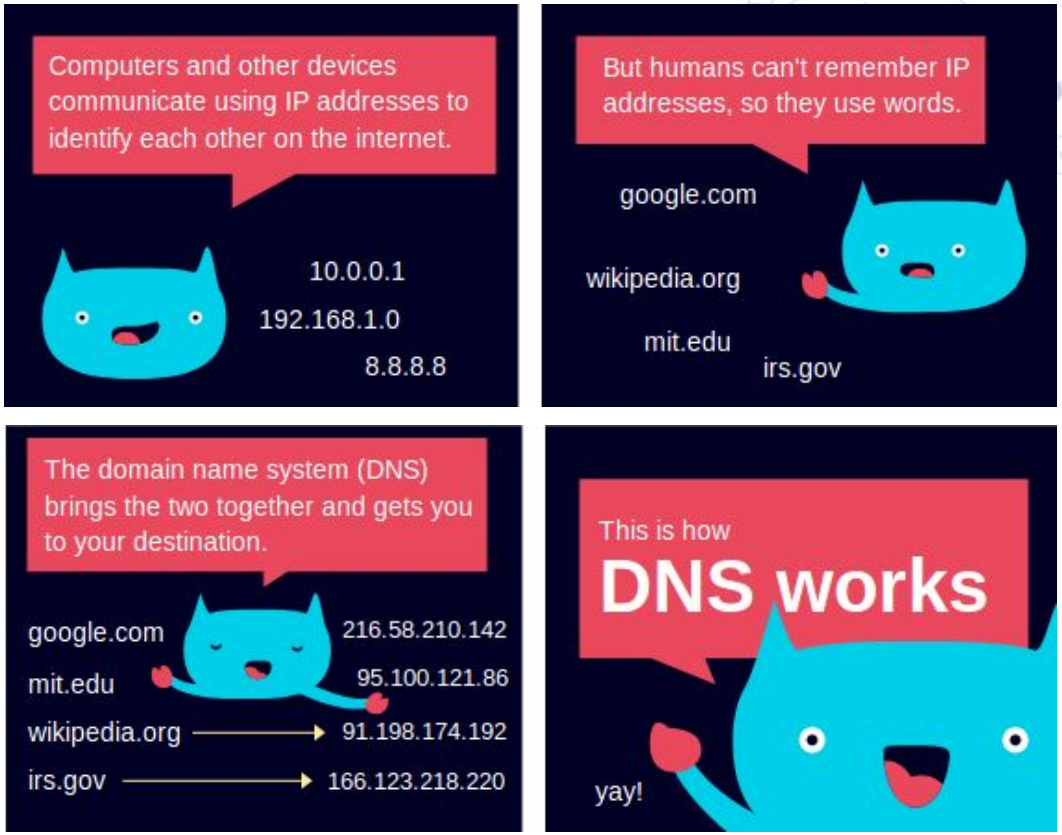
DNS

DNS

- **¿Qué es y cuál es la motivación del DNS?**
  - Usos
- **¿Cómo funciona?**
  - Base de datos jerárquica y distribuida
  - DNS cache
  - Tipos de registros

DNS - Usos

- Referir un host
- Referir un alias
- Balanceo de cargas
- Otros



DNS - ¿Cómo funciona?

- Capa de aplicacion. Puerto 53.
- UDP como transporte. *¿Y entre servidores DNS?*
- Registros. ¿Que son? ¿Para qué sirven?

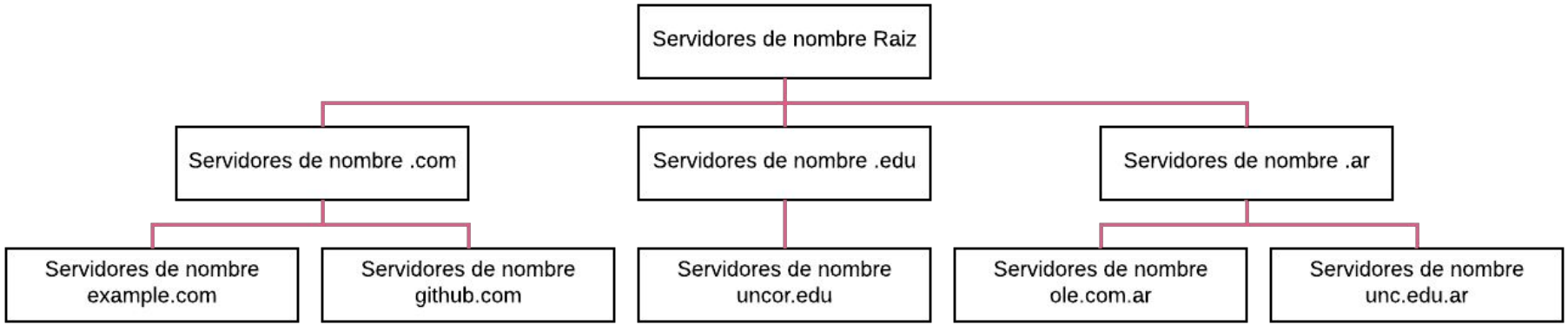
  A, AAAA, MX, NS, CNAME, PTR, etc.

nombre	clase	tipo	valor
lb.unc.edu.ar.	IN	A	200.16.16.60
www.unc.edu.ar.	IN	CNAME	lb.unc.edu.ar
unc.edu.ar.	IN	MX	valor1 valor2
unc.edu.ar.	IN	NS	ns1.unc.edu.ar ns2.unc.edu.ar

DNS - ¿Cómo funciona?

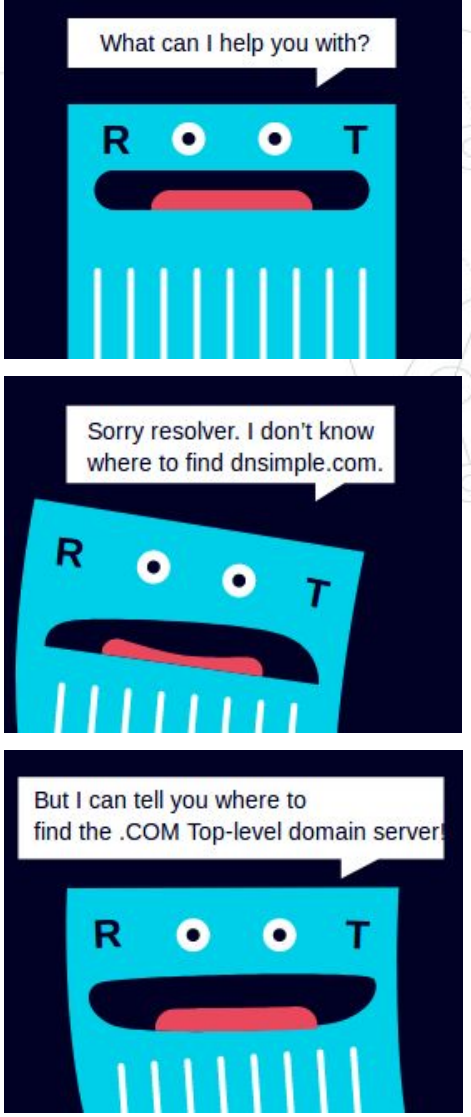
- DNS, servicio centralizado?

  Qué sucede si mi resolver DNS no tiene la respuesta a mi consulta?

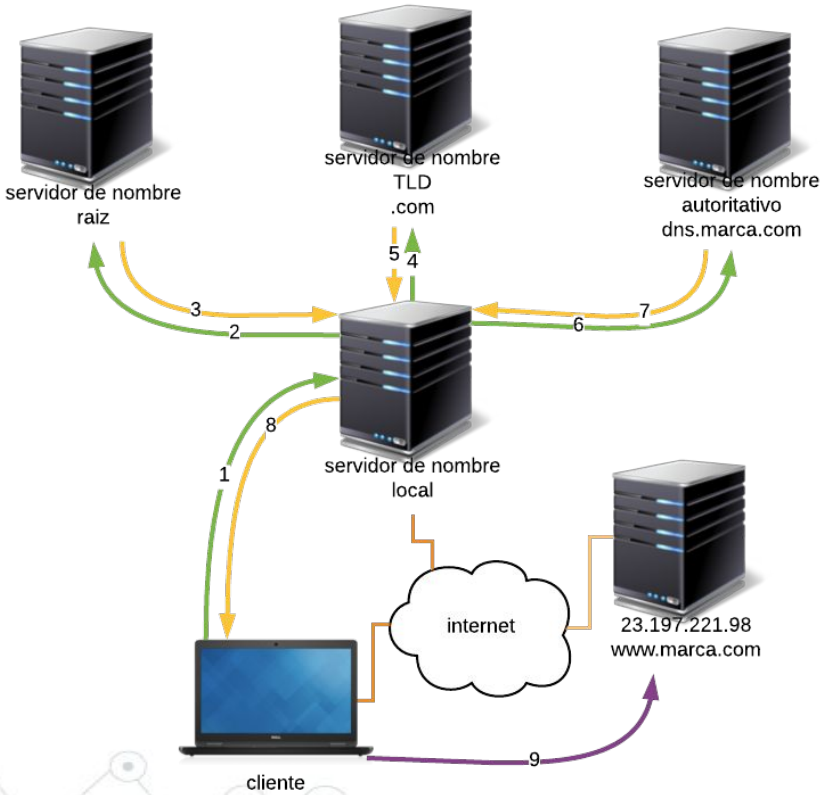


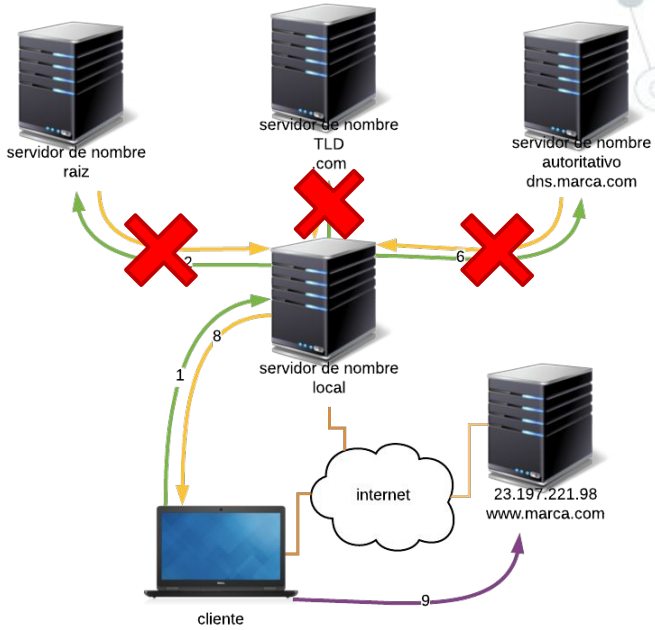
DNS - ¿Cómo funciona?

- Se consulta a **uno** de los DNS Servers **ROOT.**
  - *Tiene información de servidores **TLD**.*
- Se consulta ahora a un **TLD**.
  - *Tiene información de **Name Servers.***
- Finalmente, el Name Server me da la dir IP.



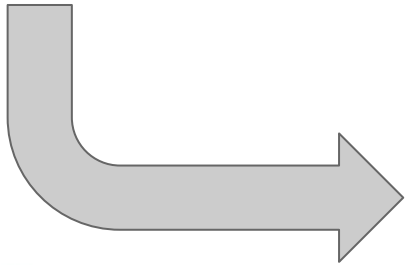
DNS - ¿Cómo funciona?





DNS - ¿Cómo funciona?

- Las consultas las realiza mi host o las resuelve por completo mi DNS resolver?
  - Consultas Iterativas y Consultas recursivas.
- Time-to-Live en registros, caché, etc.
- **dig**, **dig +trace**, **nslookup**



```
; <<>> DiG 9.10.3-P4-Ubuntu <<>> A unc.edu.ar @1.1.1.1
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 48852
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1452
;; QUESTION SECTION:
;unc.edu.ar.                    IN      A

;; ANSWER SECTION:
unc.edu.ar.             126     IN      A       200.16.16.60

;; Query time: 22 msec
;; SERVER: 1.1.1.1#53(1.1.1.1)
;; WHEN: Mon Apr 22 15:45:42 -03 2019
;; MSG SIZE  rcvd: 55
```

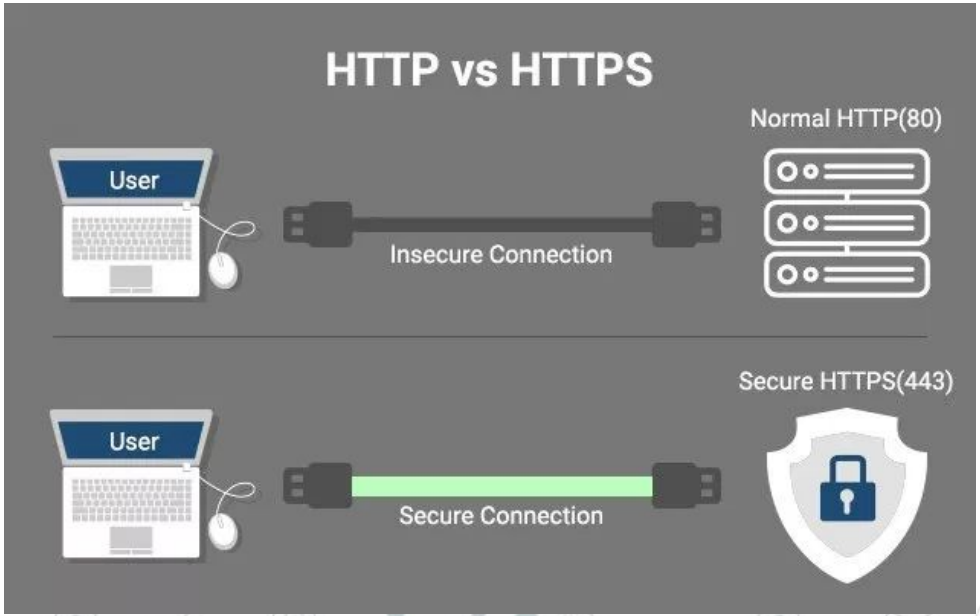
HTTP & HTTPS

HTTP

- The protocol used for communication between a browser and a web server on TCP
- Characteristics:
  - Request / Response, Stateless, Bi-Directional Transfer, Support For Caching and Intermediaries.
- Methods
  - HTTP/1.0
    - GET, HEAD, POST
  - HTTP/1.1
    - PUT, DELETE,OPTIONS, etc
- HTTP/1.1 cookies to allow HTTP to move from being a stateless protocol
- HTTP/2

HTTPS

- HTTPS is the secure version of HTTP that encrypts messages in transit by using the Transport Layer Security (TLS) protocol or Secure Sockets Layer (SSL).
- HTTPS adds three important concepts to HTTP messages
  - Encryption, Integrity and Authentication



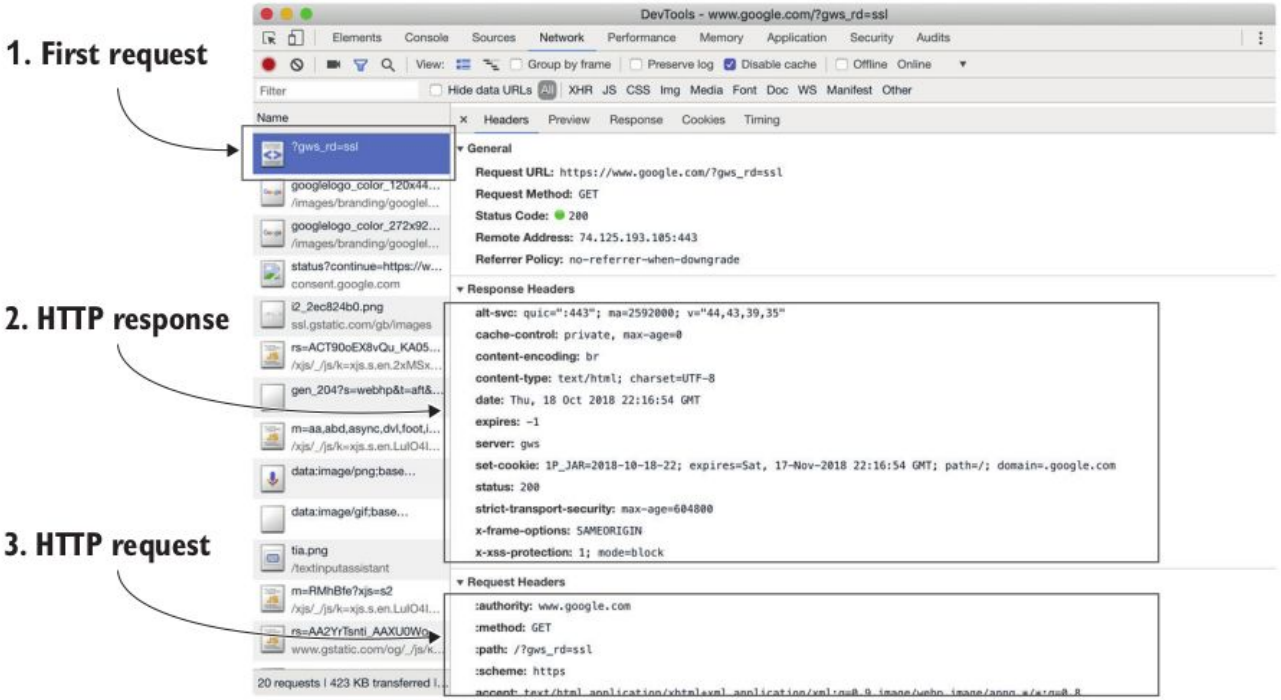
Lab!

HTTP

Lab

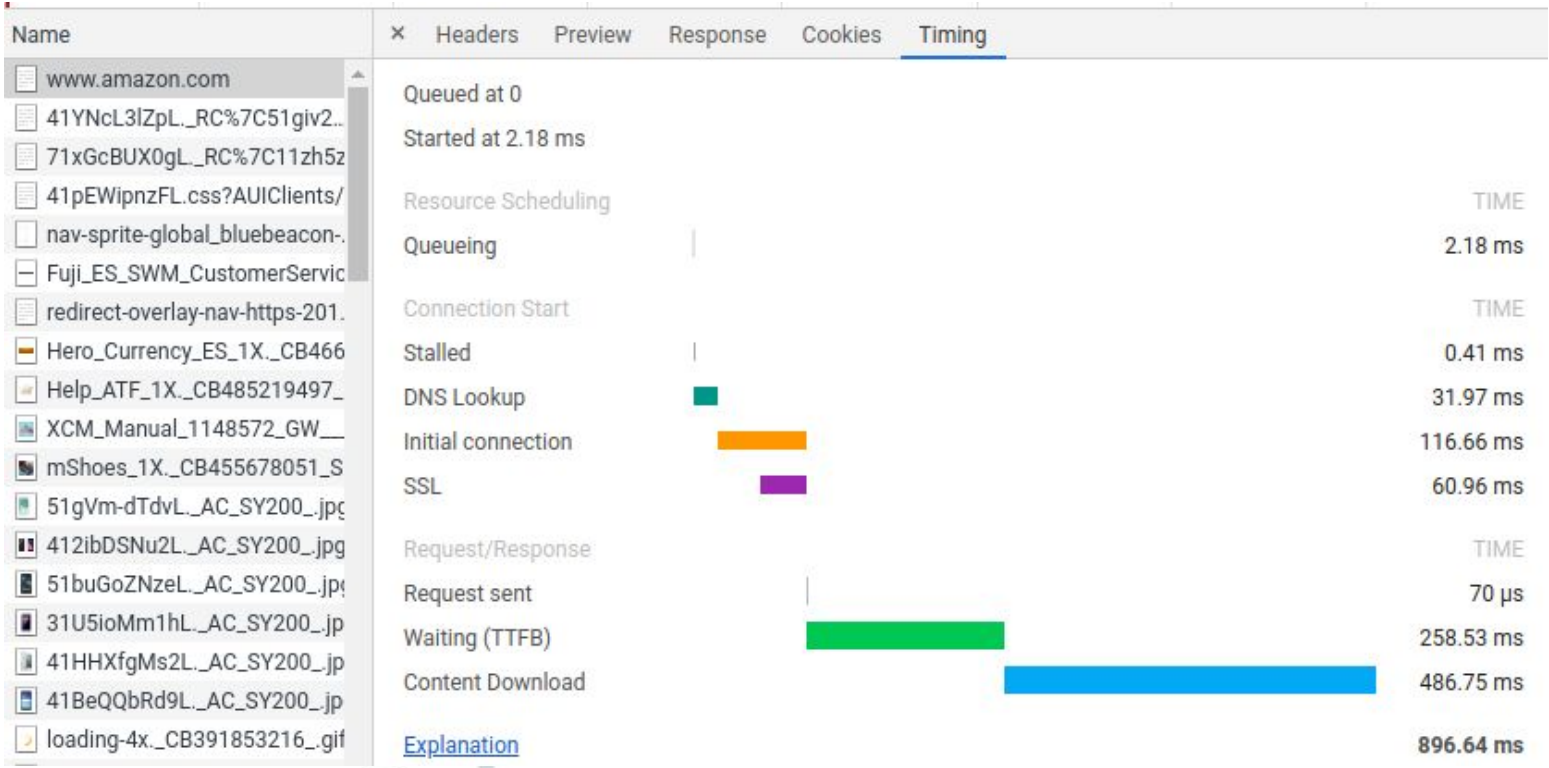
Using developer tools in web browsers

- You launch developer tools by pressing a keyboard shortcut (F12) -> Network -> headers



Lab

Timing


Name
www.amazon.com
41YNcL3lZpL._RC%7C51giv2..
71xGcBUX0gL._RC%7C11zh5z
41pEWipnzFL.css?AUIClients/
nav-sprite-global_bluebeacon-.
Fuji_ES_SWM_CustomerServic
redirect-overlay-nav-https-201.
Hero_Currency_ES_1X._CB466
Help_ATF_1X._CB485219497_
XCM_Manual_1148572_GW__
mShoes_1X._CB455678051_S
51gVm-dTdvL._AC_SY200_.jpg
412ibDSNu2L._AC_SY200_.jpg
51buGoZNzeL._AC_SY200_.jp
31U5ioMm1hL._AC_SY200_.jp
41HHXfgMs2L._AC_SY200_.jp
41BeQQbRd9L._AC_SY200_.jp
loading-4x._CB391853216_.gif
Headers
Preview
Response
Cookies
Timing
Queued at 0
Started at 2.18 ms
Resource Scheduling
TIME
Queueing
2.18 ms
Connection Start
TIME
Stalled
0.41 ms
DNS Lookup
31.97 ms
Initial connection
116.66 ms
SSL
60.96 ms
Request/Response
TIME
Request sent
70 µs
Waiting (TTFB)
258.53 ms
Content Download
486.75 ms
Explanation
896.64 ms

Bibliografia

- Douglas E. Commer - Internetworking with TCP-IP Volume One – 6ta Edición. Capítulo 23
- James F. Kurose and Keith W. Ross - Computer Networking A Top-Down Approach - 6ta Edición. Capítulo 2. Sección 5.
- https://howdns.works/


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
TASHAKKUR ATU
YAQHANYELAY
SUKSAMA
EKHMET
BİYAN
SHUKRIA
TINGKI
GRAZIE
MEHRBANI
KOMAPSUMNIDA
MAAKE
PALDIES
GOZAIMASHITA
EFCHARISTO
JUSPAXAR
BOLZÏN
MERCI
SPASSIBO
SHACHALHUYA
NUHUN
CHALTU
NABEEJA
MAITEKA
SPASIBO
DENKAUJA
HENACHALHYA
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