Transport protocols

2017/18 Q2

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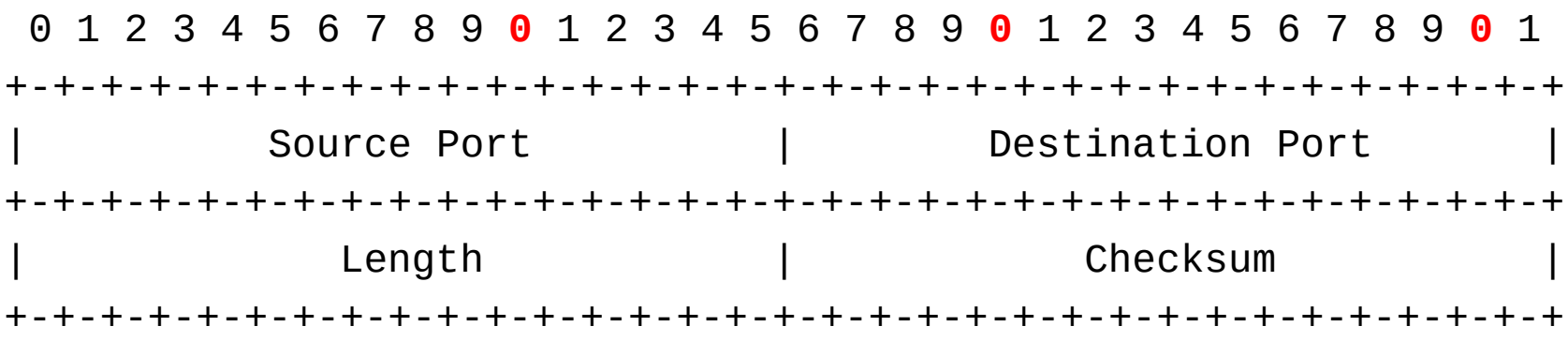
DAC – UPC

Contents

- UDP (User Datagram Protocol)
- ARQ (Automatic Repeat reQuest)
- TCP (Transmission Control Protocol)

UDP Header


0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Source Port
Destination Port
Length
Checksum

ARQ (Automatic Repeat reQuest)

- Mecanismo básico:
  - EMISOR: Transmitir y esperar confirmación.
    Si no llega (esperar un tiempo), retransmitir.
  - RECEPTOR: Transmitir confirmación.

  (Confirmación / Reconocimiento / Acknowledgement / ACK)

- Transmisión de datos →
- … Propagación
- Transmisión de ACK ←
- … Propagación

- T_C (tiempo de ciclo) o **RTT** (Round Trip Time)

ARQ (Automatic Repeat reQuest)

- Mecanismo básico:
  - EMISOR: Transmitir y esperar ACK.
    Si no llega (esperar un tiempo), retransmitir.
  - RECEPTOR: Transmitir ACK.

- Mejoras:
  - "Arriesgarse" a seguir transmitiendo antes de recibir ACKs.
- Soluciones a problemas:
  - Retransmitir ACKs si no llegan datos.

ARQ (Automatic Repeat reQuest)

- Tiempo de proceso → 0
- Tiempo de propagación: t_p
  (depende de la velocidad del medio y la distancia)
- Tiempo de transmisión de datos: t_t
  (depende de la cantidad de datos)
- Tiempo de transmisión de ACKs: t_a
  (normalmente ACK << datos)
- Tiempo de espera (temporizador): T_{out}
  (RTO: Retransmission TimeOut)

ARQ (Automatic Repeat reQuest)

- Protocolos:
  - Stop & Wait (S&W)
  - Transferencia continua:
    - Go back N (GbN)
    - Retransmisión Selectiva (RS)

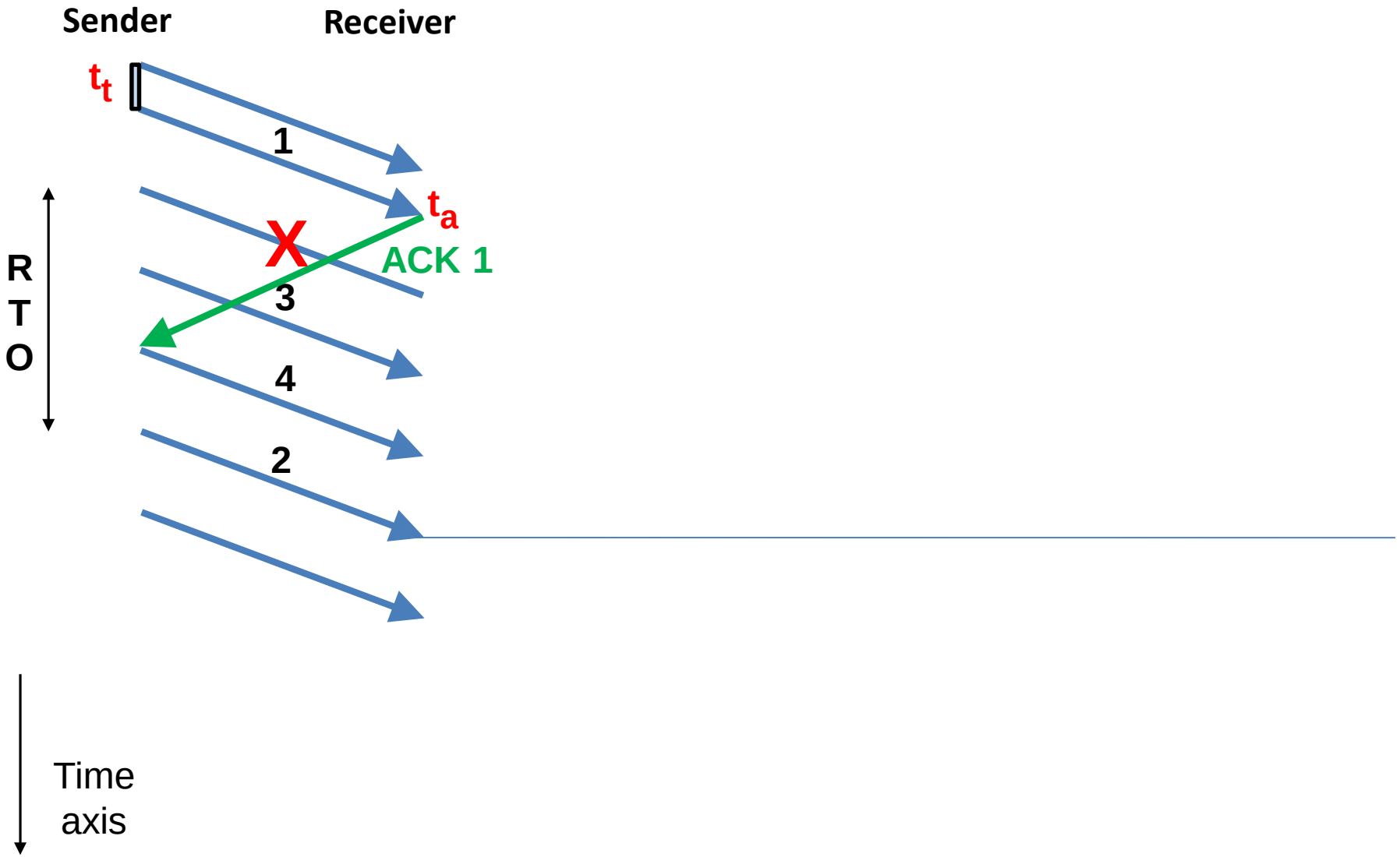
ARQ (Automatic Repeat reQuest)

- Protocolos:
  - Stop & Wait (S&W)
  - Transferencia continua:
    - Go back N (GbN): Descarta desordenados.
    - Retransmisión Selectiva (RS): “Reordena”.

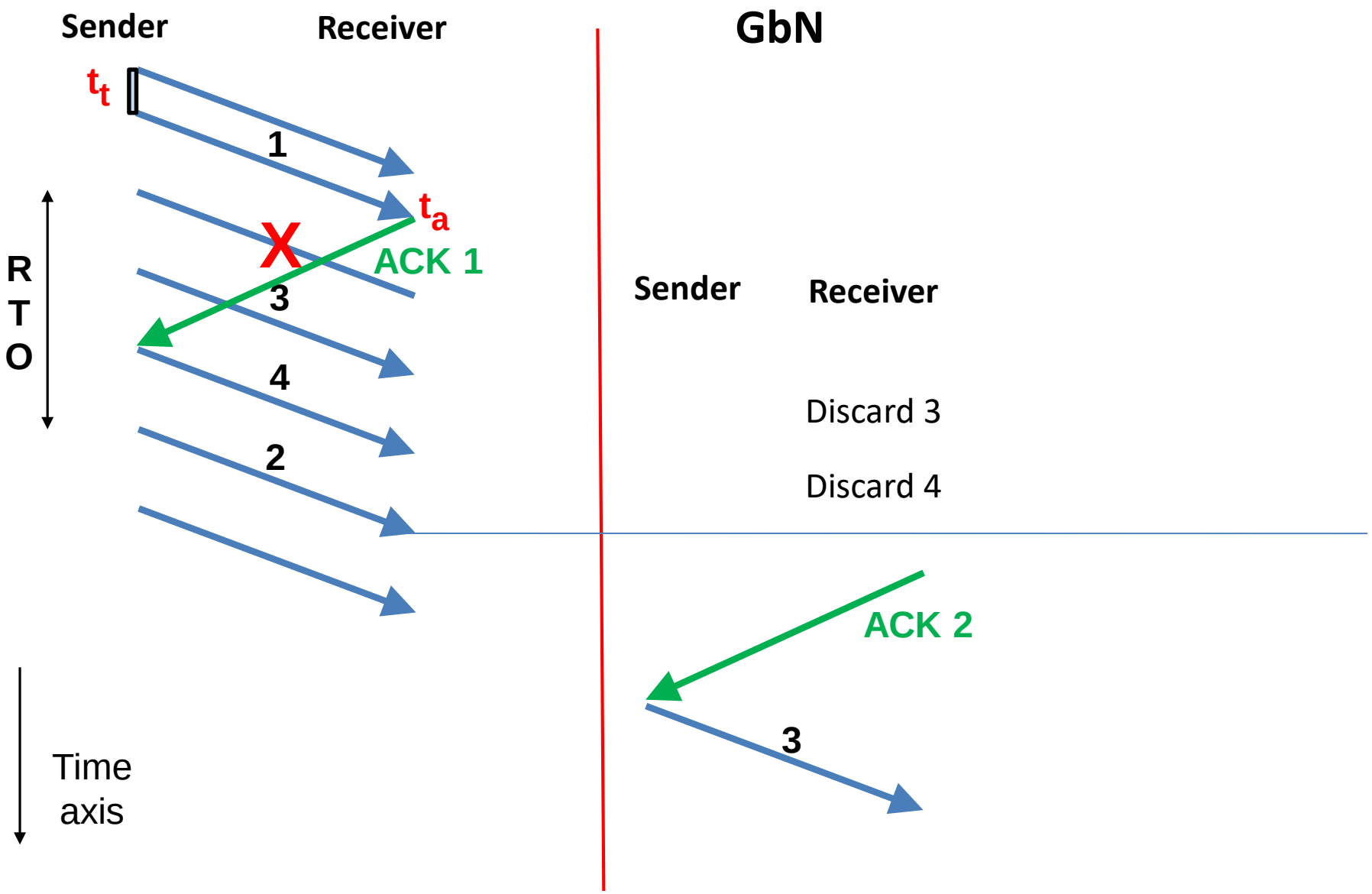
(ACKs siempre “acumulados” *(“han llegado **todos** los anteriores”)*)

(Siempre se descartan duplicados)

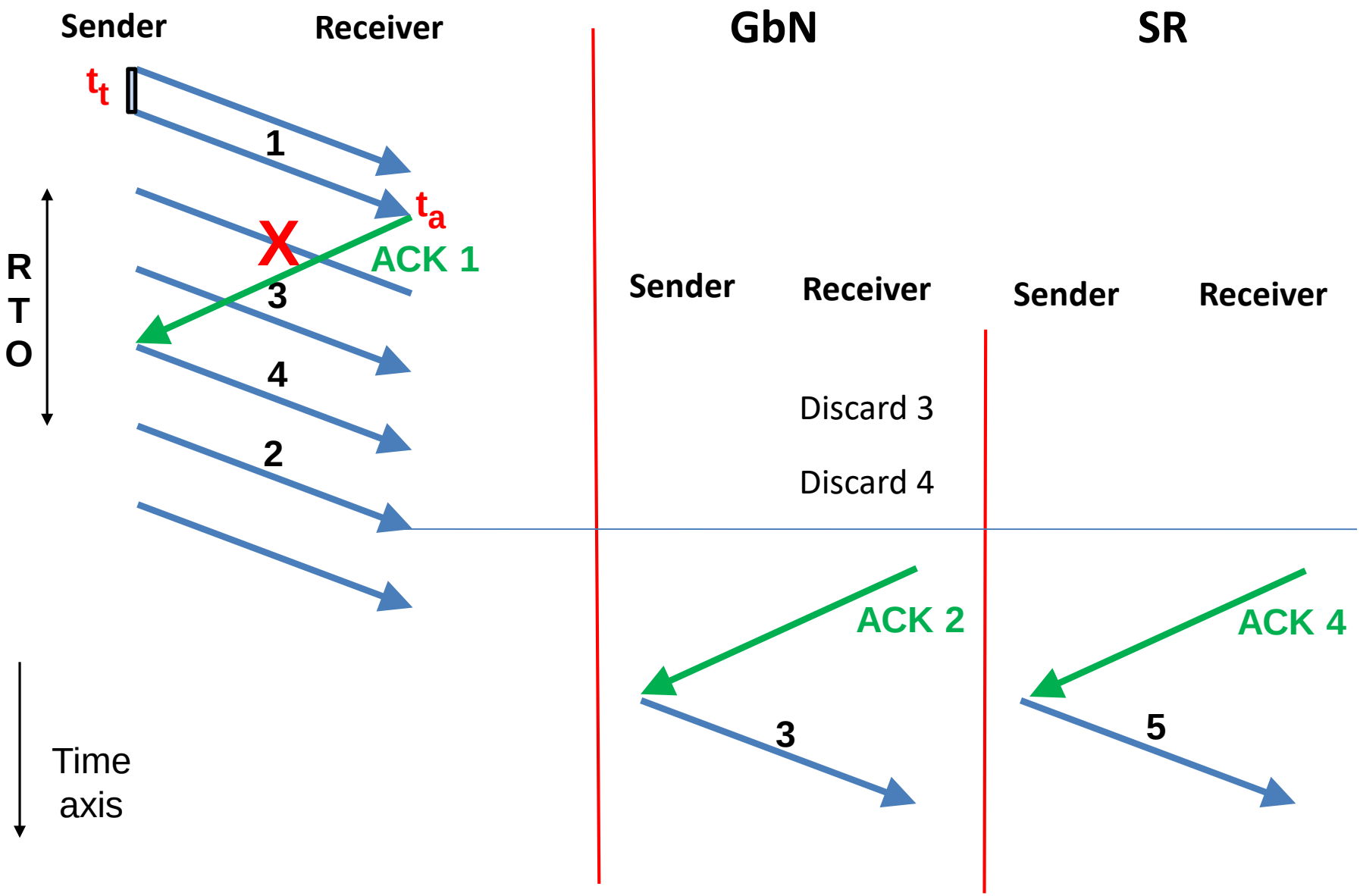
Go back N / Selective Retransmission



Go back N / Selective Retransmission



Go back N / Selective Retransmission



Datos

- Subíndices
  - t: transmisión de datos; p: propagación; C: ciclo
- $\mathbf{t_t}$, $\mathbf{t_p}$ (tiempo); $\mathbf{L_t}$ (longitud); $\mathbf{v_t}$, $\mathbf{v_p}$ (velocidad)
- **D** (distancia) , **T** (tiempo o periodo), **E** (eficiencia)
- *T_C: Tiempo mínimo para transmitir una PDU (Protocol Data Unit)*

- $\mathbf{t_t = L_t / v_t}$ L_t en bits, v_t en bps
- $\mathbf{t_p = D / v_p}$ D en m, v_p en m/s

Eficiencia sin errores

- Stop & Wait (S&W):
  - $\mathbf{E_{S\&W} = t_t / T_c = t_t / (t_t + t_a + 2\,t_p)}$ (tiende a 1 si t_a y t_p <<< t_t)
- Go back N (GbN):
  - $\mathbf{E_{GbN} = t_t / T_c \approx 1}$, ya que Tc ≈ t_t

    (si se envían n PDUs, T_c (n) = (n*t_t) + (t_a+2t_p) Si n>>, T_c(1)≈t_t)
- Retransmisión Selectiva (RS):
  - $\mathbf{E_{RS} = t_t / T_c \approx 1}$, por las mismas razones que GbN

Eficiencia con errores

- *T_T: Tiempo total real para transmitir una PDU (Protocol Data Unit)*
- ***$T_T = (N_t - 1) * T_{out} + T_C$*** *$T_{out} > T_C$*
- *N_t: Número total de transmisiones (media);*
  (Nt – 1): Número de transmisiones fallidas (media).

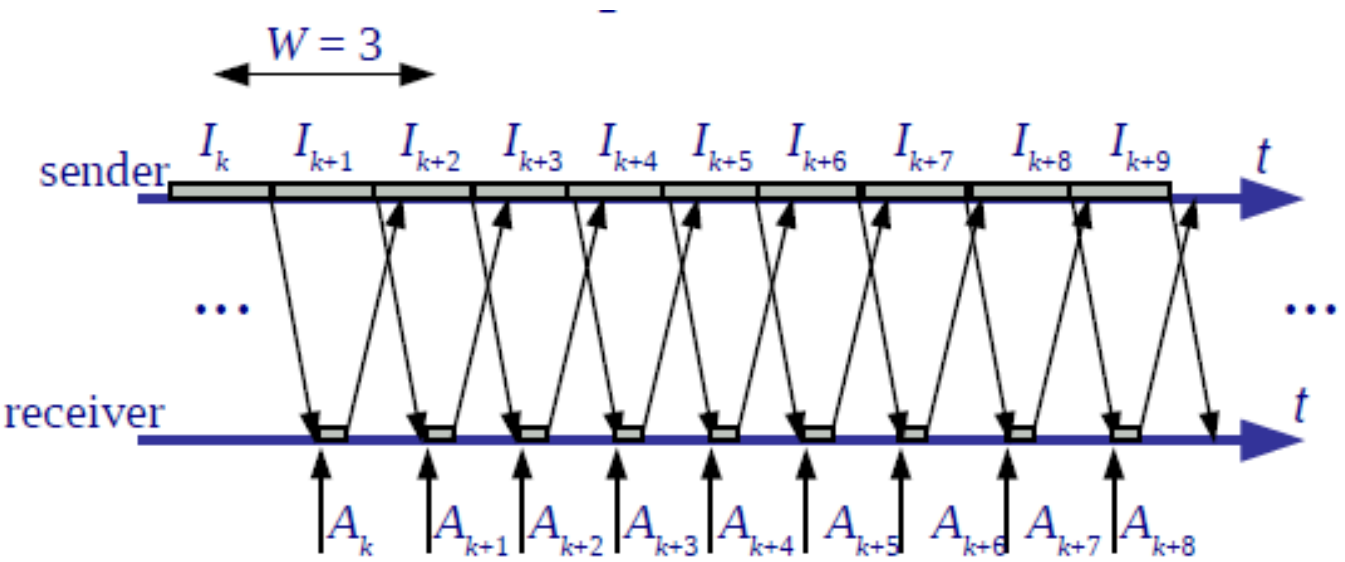
- Stop & Wait (S&W):
  - **$E_{S\&W\text{-}errores} = t_t / T_T = t_t / ((N_t - 1) * T_{out} + T_c)$**
- Go back N (GbN):
  - **$E_{GbN\text{-}errores} = t_t / T_T = t_t / ((N_t - 1) * T_{out} + t_t)$**
- Retransmisión Selectiva (RS):
  - **$E_{RS\text{-}errores} = t_t / T_T = t_t / (N_t * t_t) = 1 / N_t$**

Control de flujo

- Control de flujo vs. Recuperación de errores:
  - ARQ = CF + RE
- Control de flujo → Adaptación de $\mathbf{v_t}$
- Protocolos de ventana:
  - Ventana de transmisión: "Cantidad de *datos* que se pueden enviar sin esperar su ACK"
  - Ventana **óptima**:

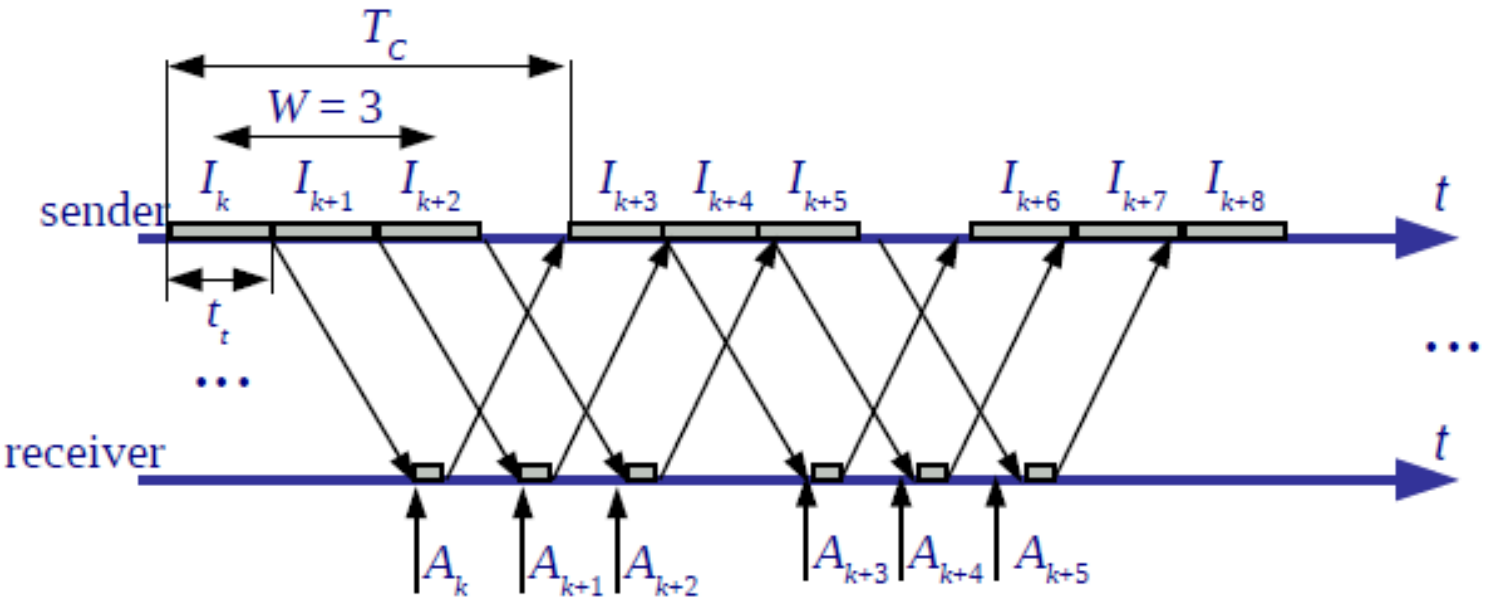
    mínima en tamaño, máxima en velocidad.

Ventana óptima



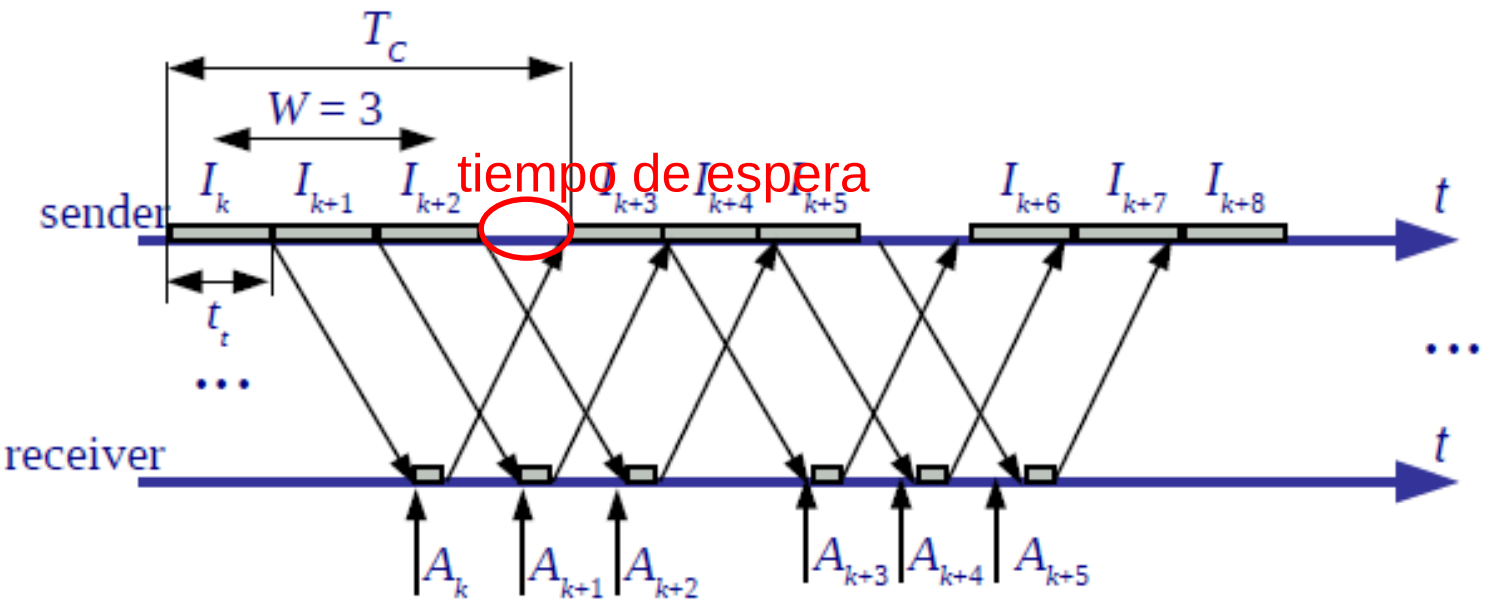
No hay “esperas”

Ventana óptima

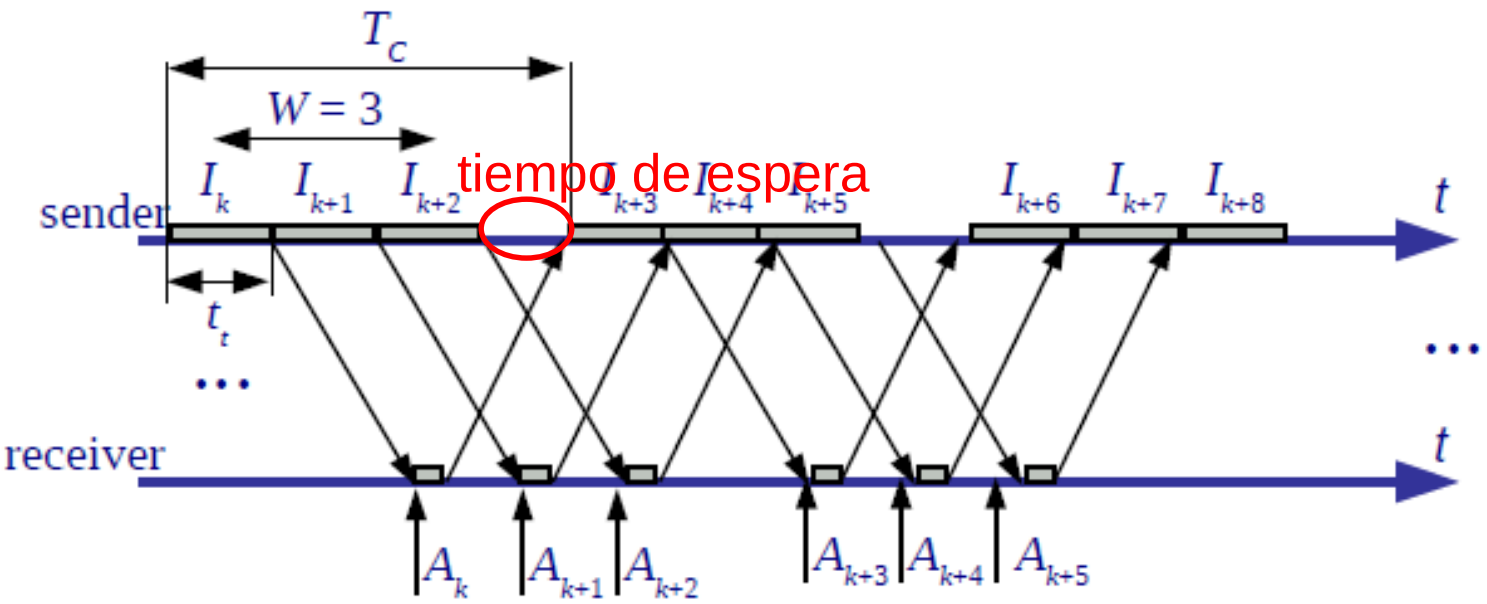


$$T_c = t_t + t_a + 2\,t_p$$

Ventana óptima



Ventana óptima



Cálculo W_{opt}:

$$W_{opt} = \left\lceil \frac{T_C}{t_t} \right\rceil$$

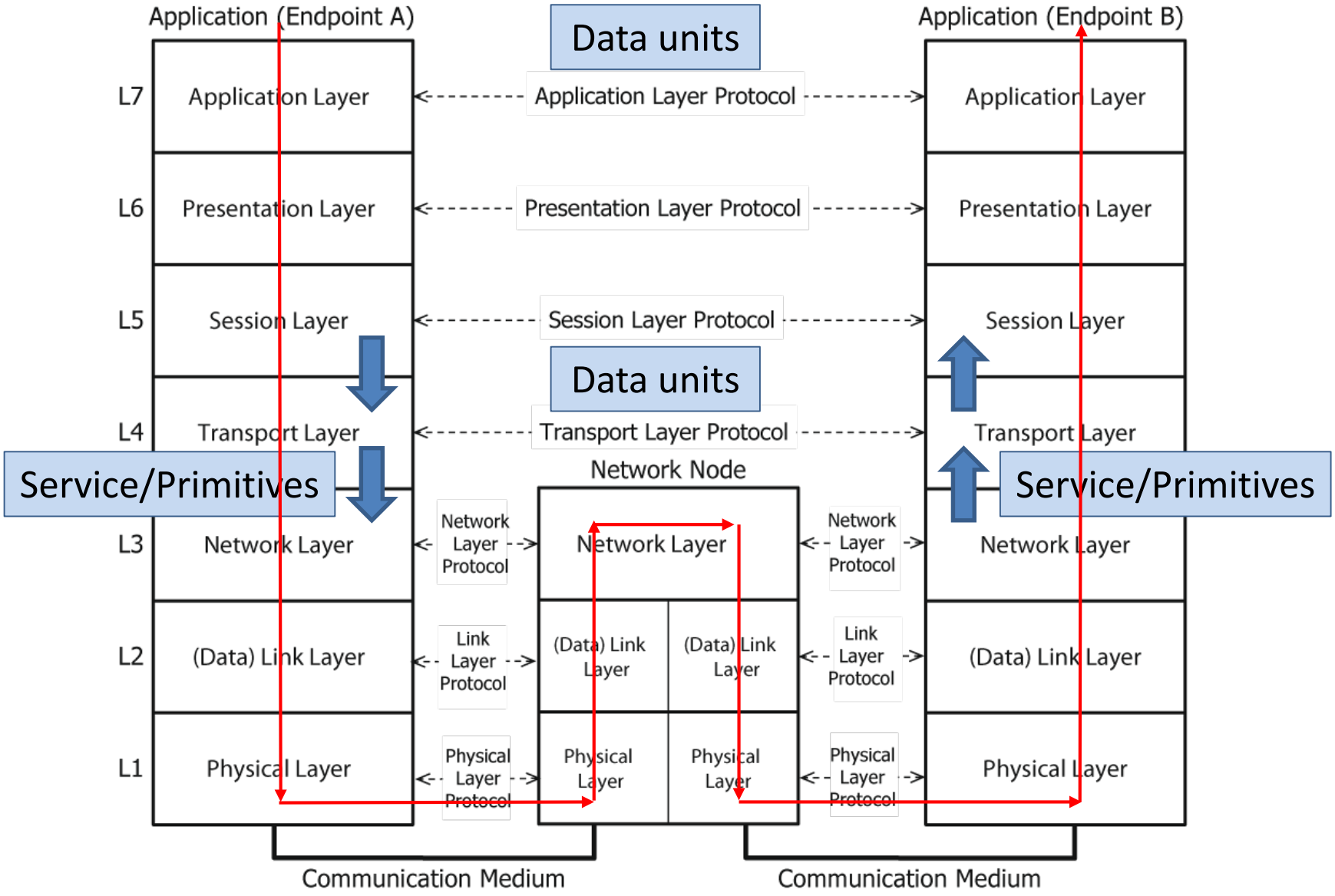
Contents

- UDP (User Datagram Protocol)
- ARQ (Automatic Repeat reQuest)
- **TCP (Transmission Control Protocol)**

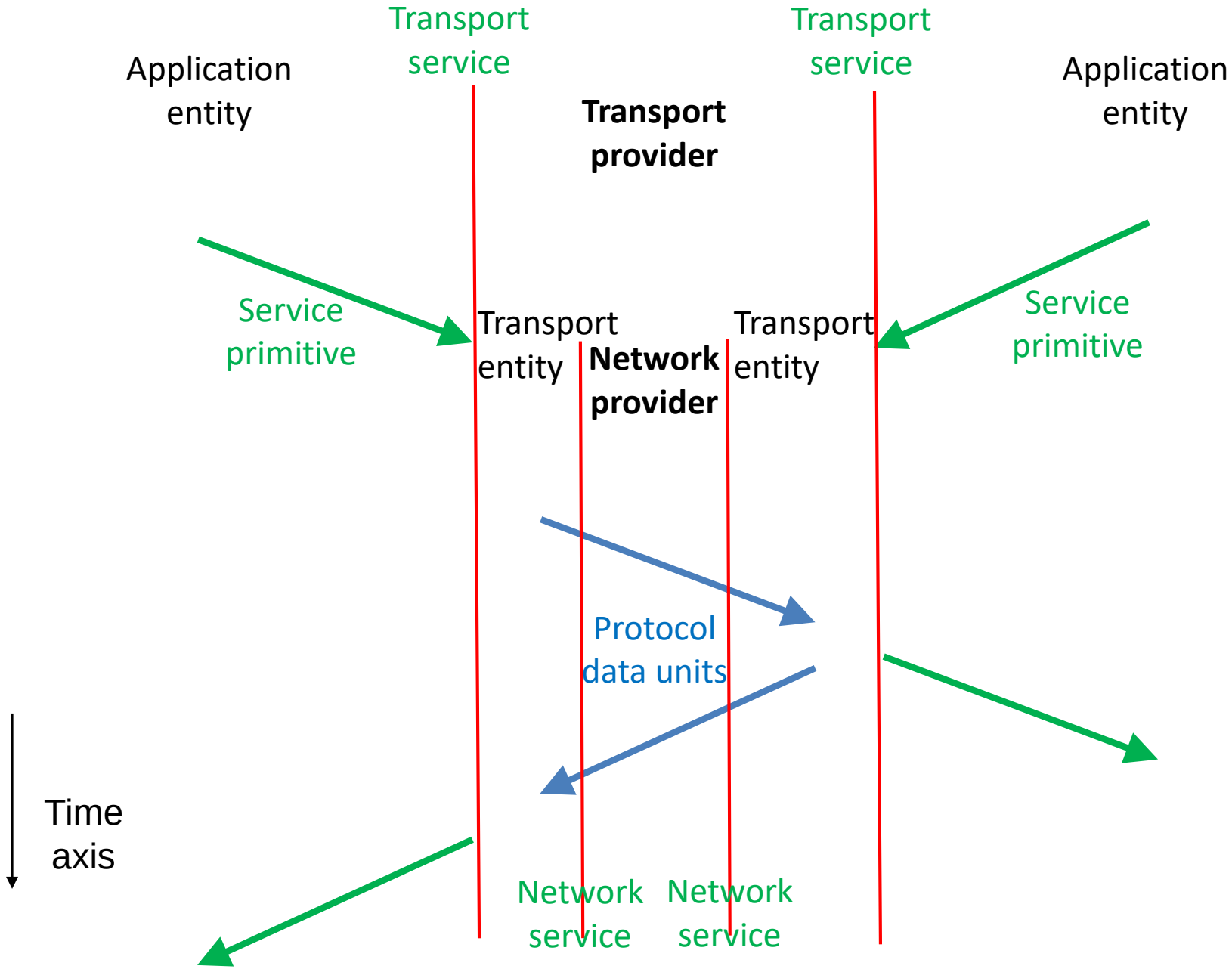
TCP - fases

- Establecimiento de la conexión
- Transferencia de datos
- Liberación de la conexión

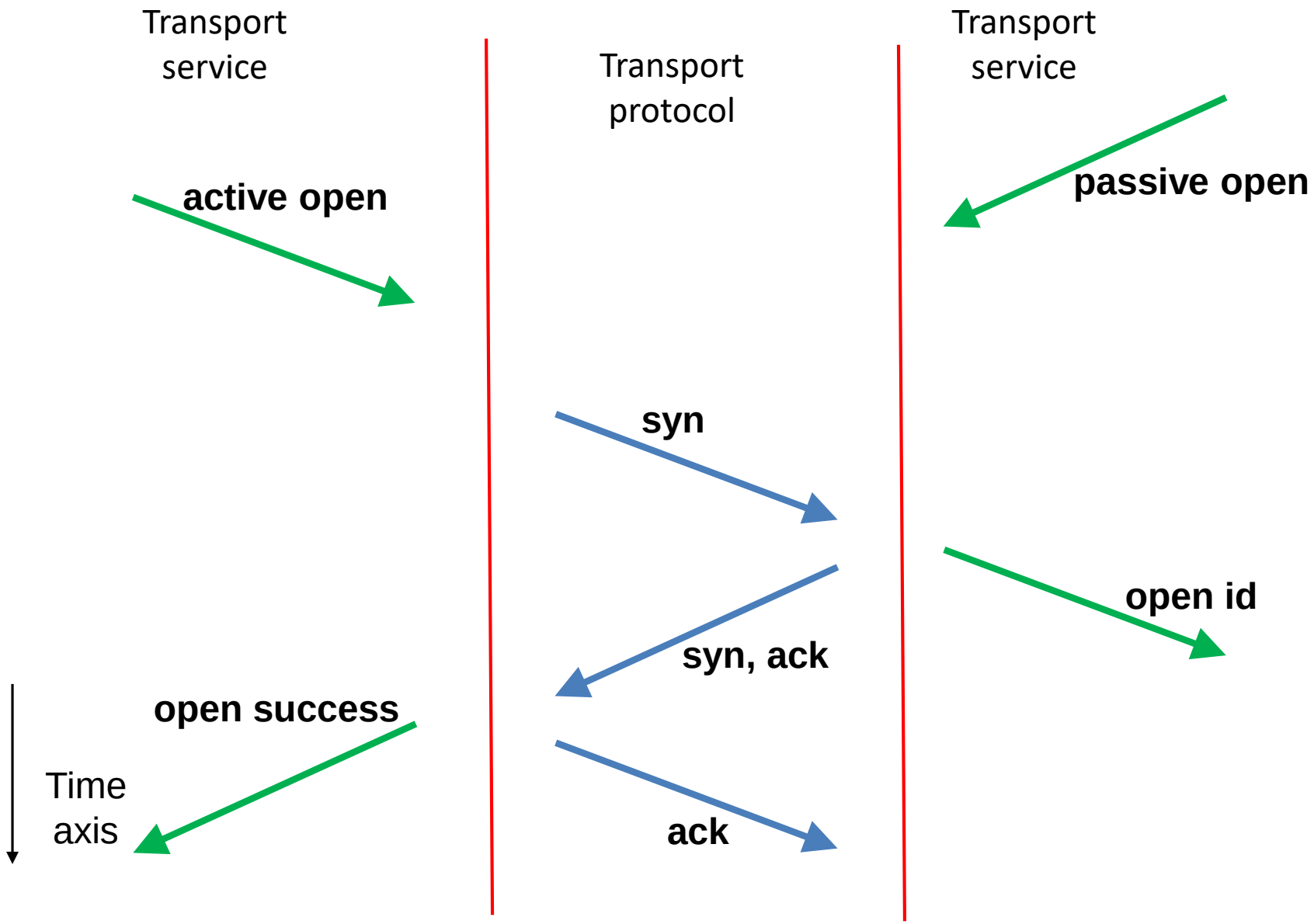
Communication



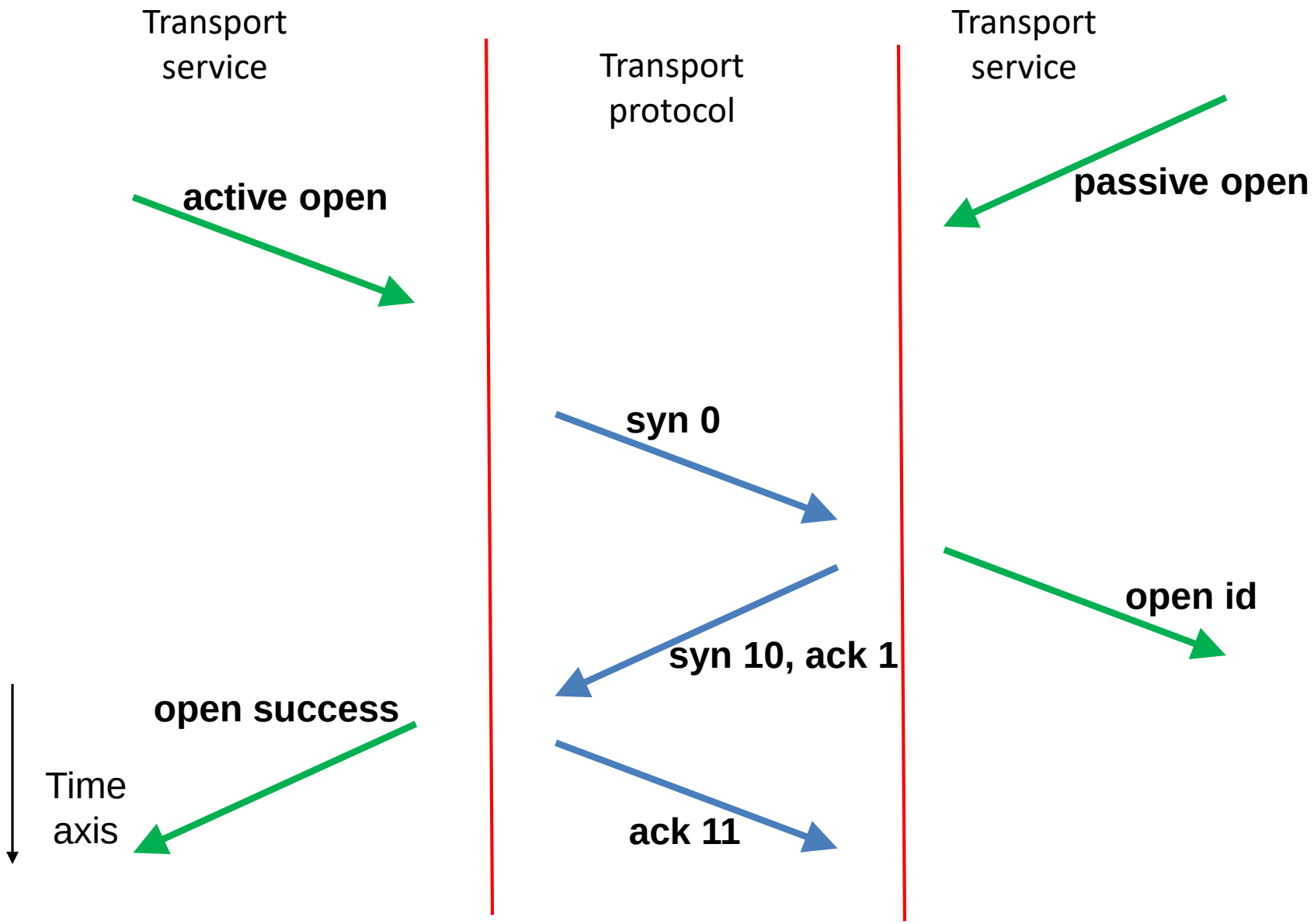
Service & Protocol



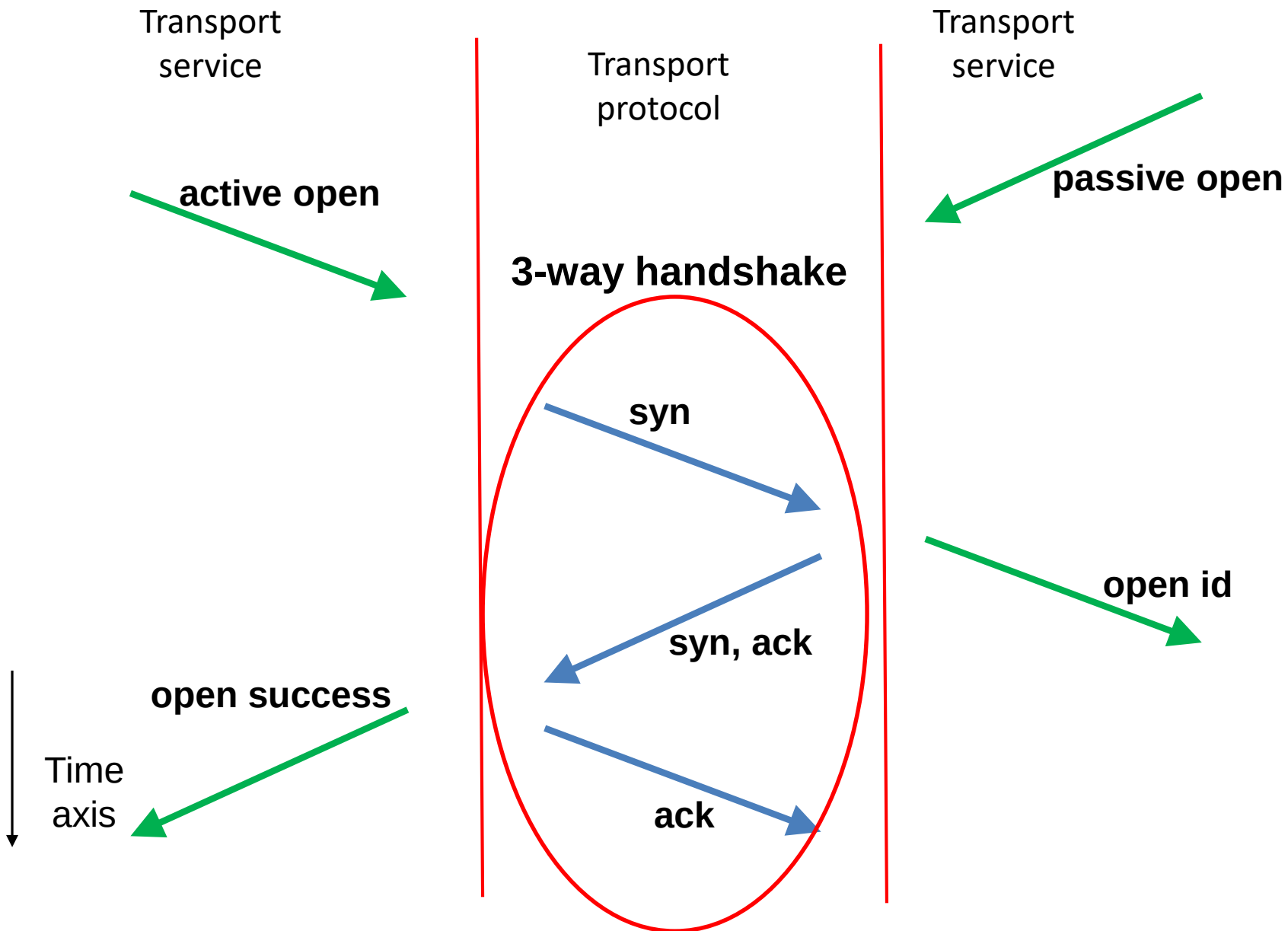
Connect


Transport service
Transport protocol
Transport service
active open
passive open
syn
open id
syn, ack
open success
Time axis
ack

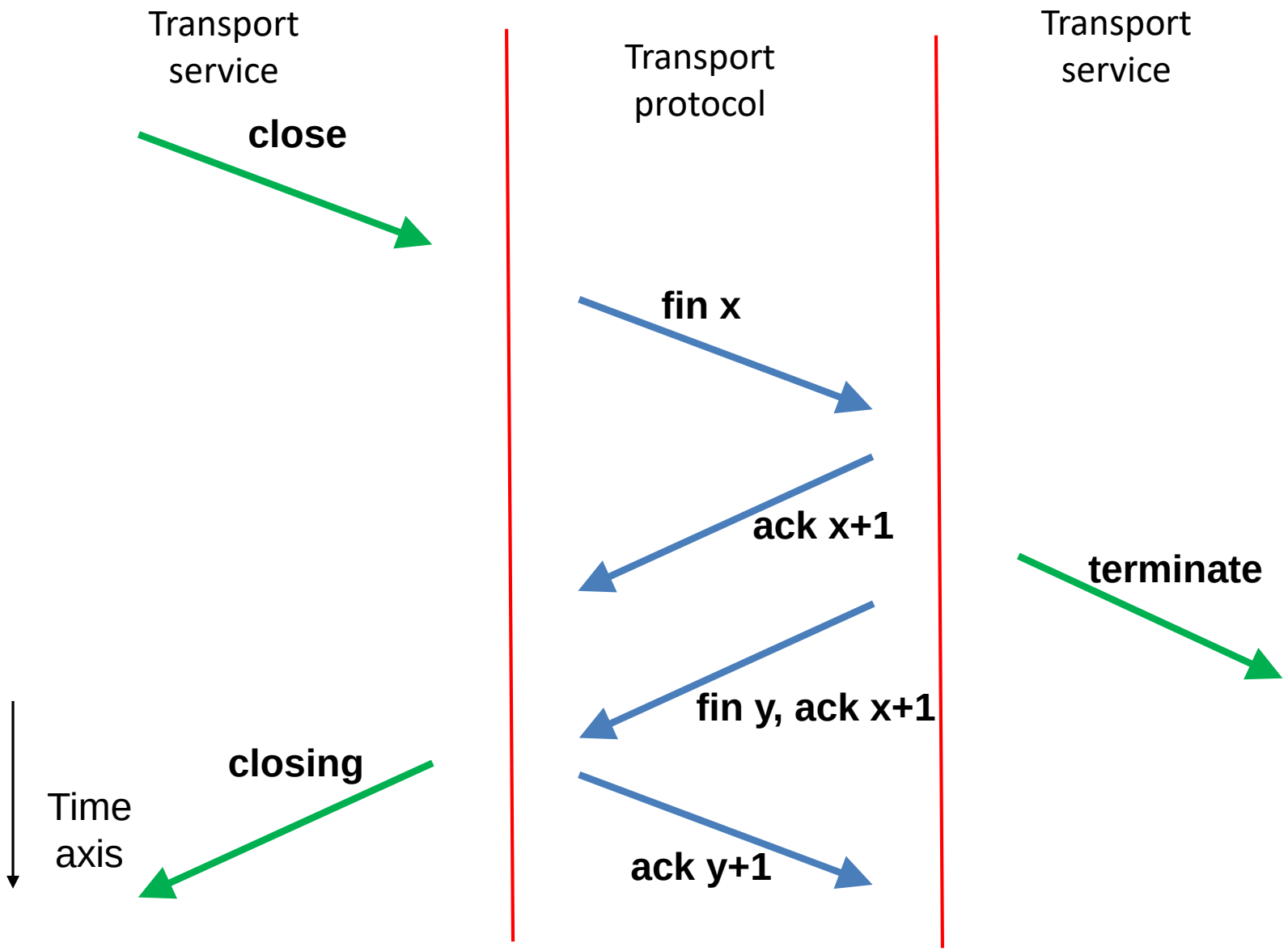
Connect


Transport service
Transport protocol
Transport service
active open
passive open
syn 0
open id
syn 10, ack 1
open success
Time axis
ack 11

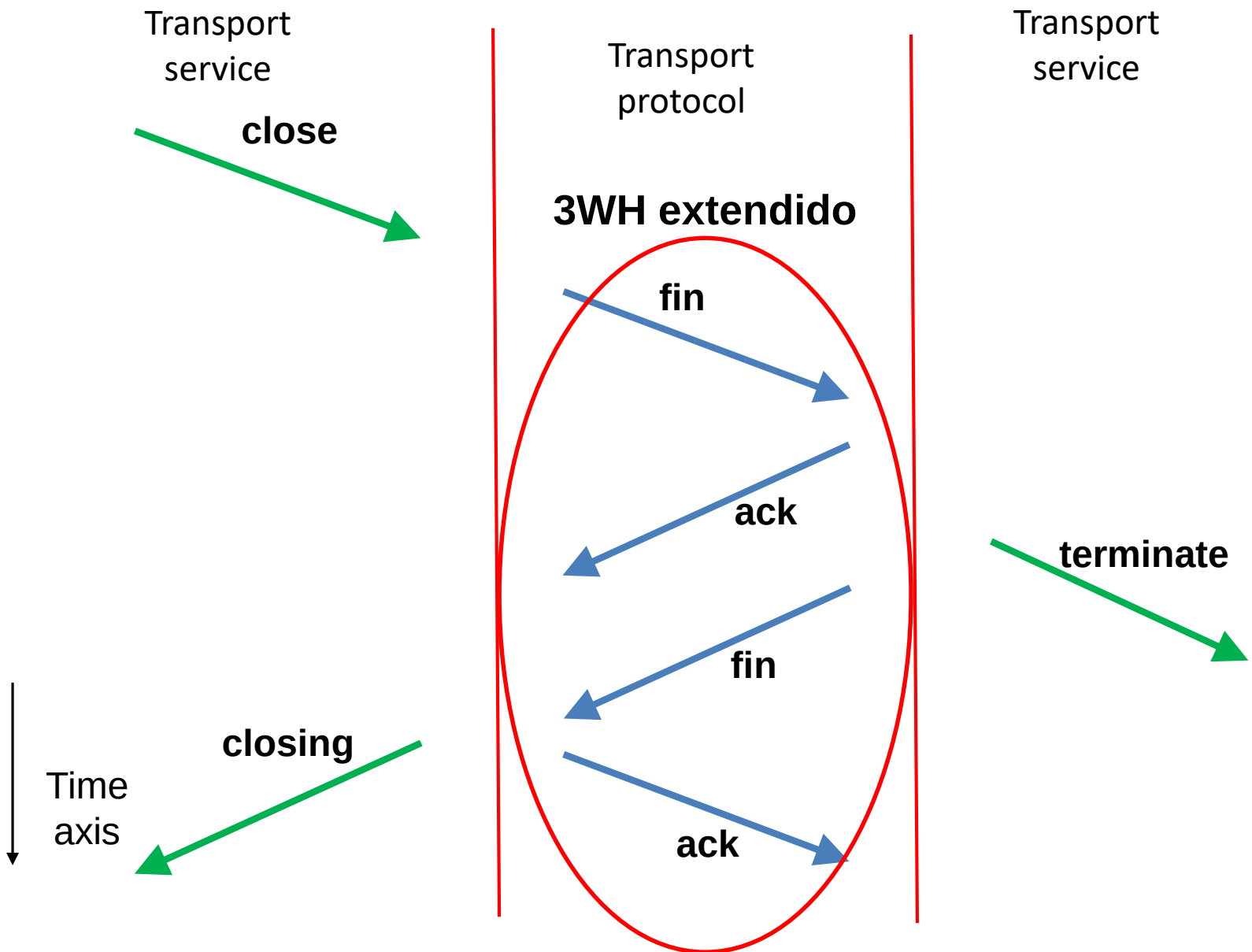
Connect


Transport service
Transport protocol
Transport service
active open
passive open
3-way handshake
syn
syn, ack
ack
open id
open success
Time axis

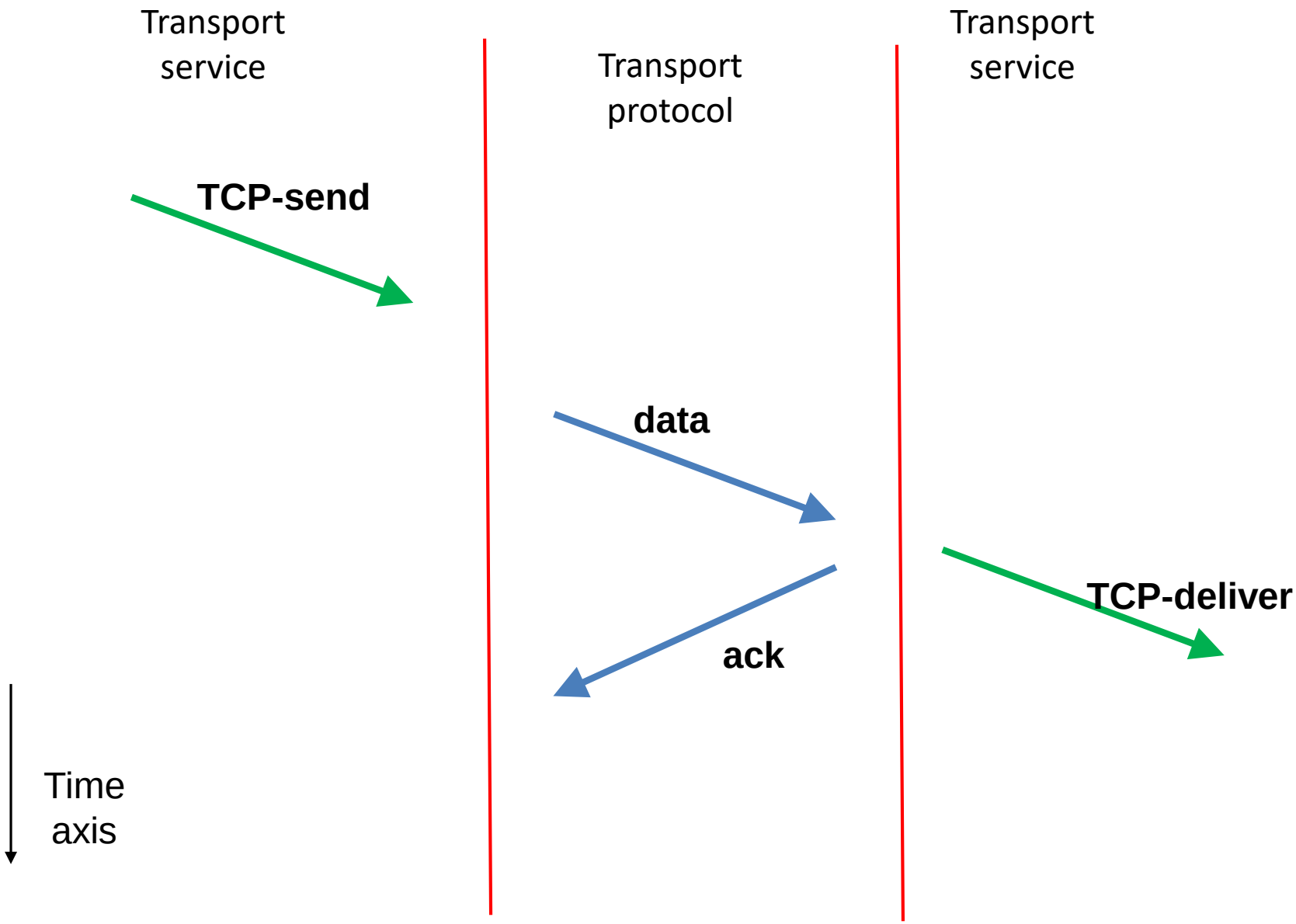
Disconnect / Release



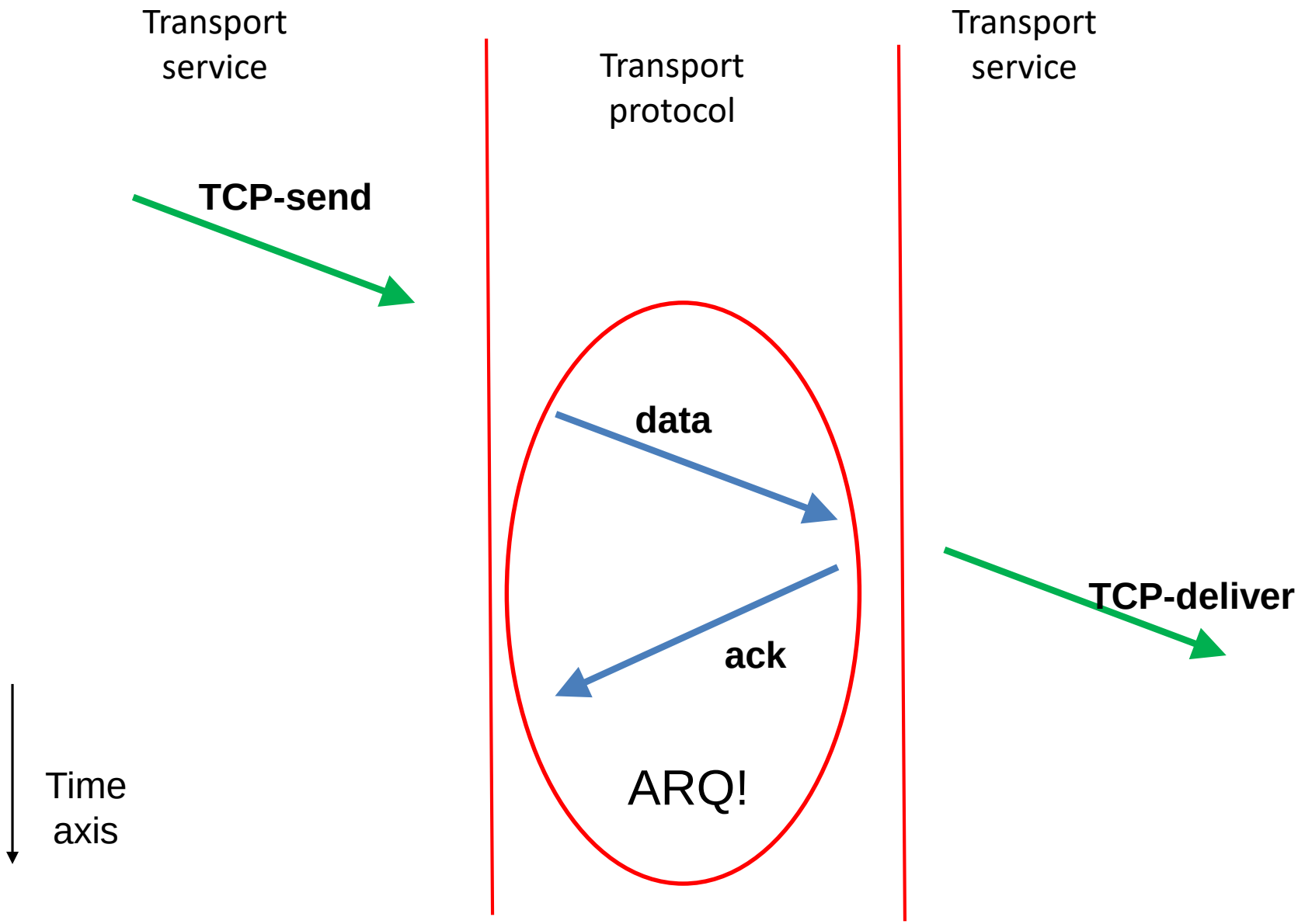
Disconnect / Release



Data transfer



Data transfer

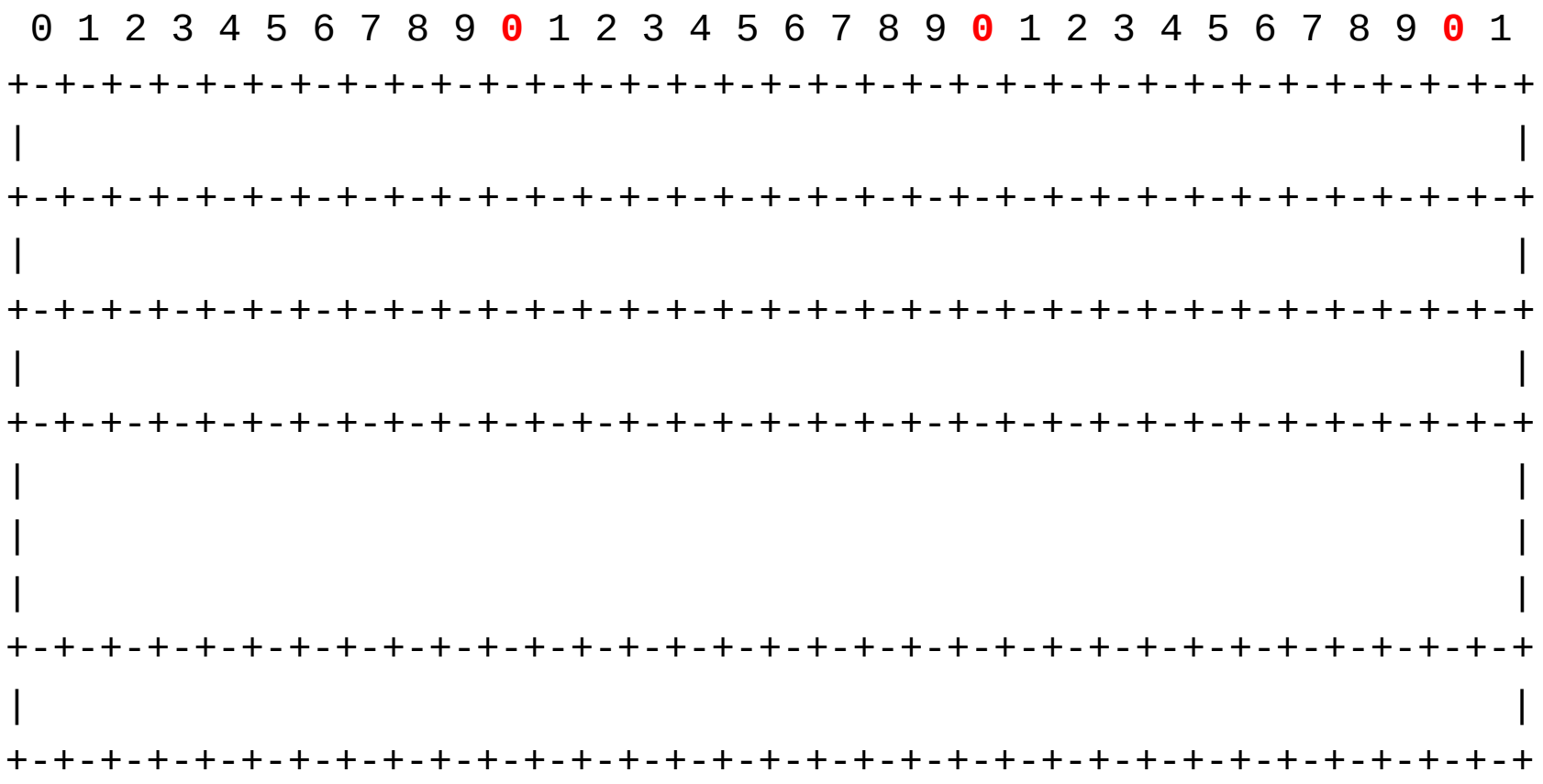


TCP - conceptos

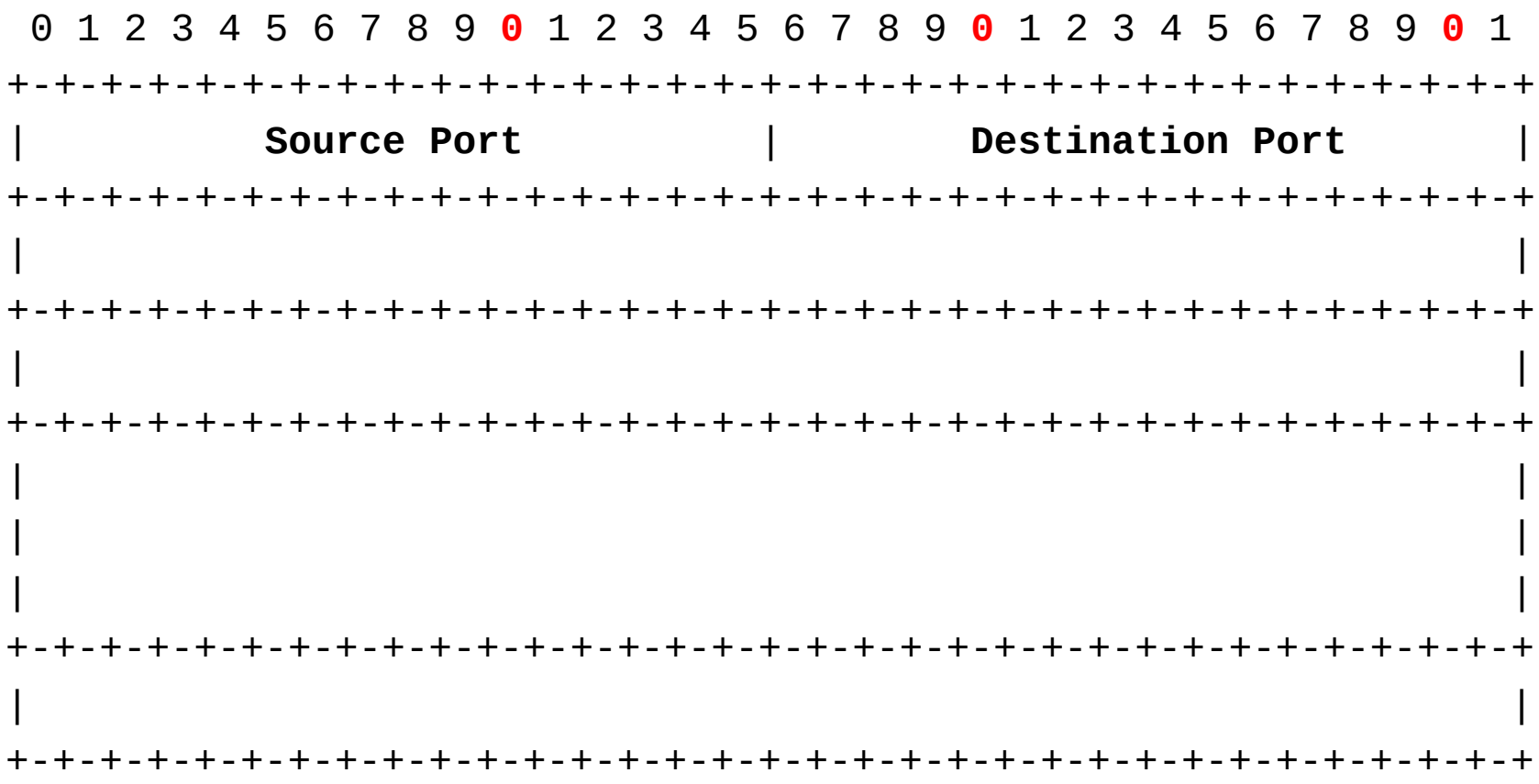
- Ports: “Well-known” (<1024) vs. Efímeros
- “Stream” de datos – Cabeceras
- Flags: SYN, ACK, FIN, …
- Opciones en establecimiento de conexión …
- ISN (Initial Sequence Number)
- Números de secuencia. SYN, FIN

Cabecera TCP

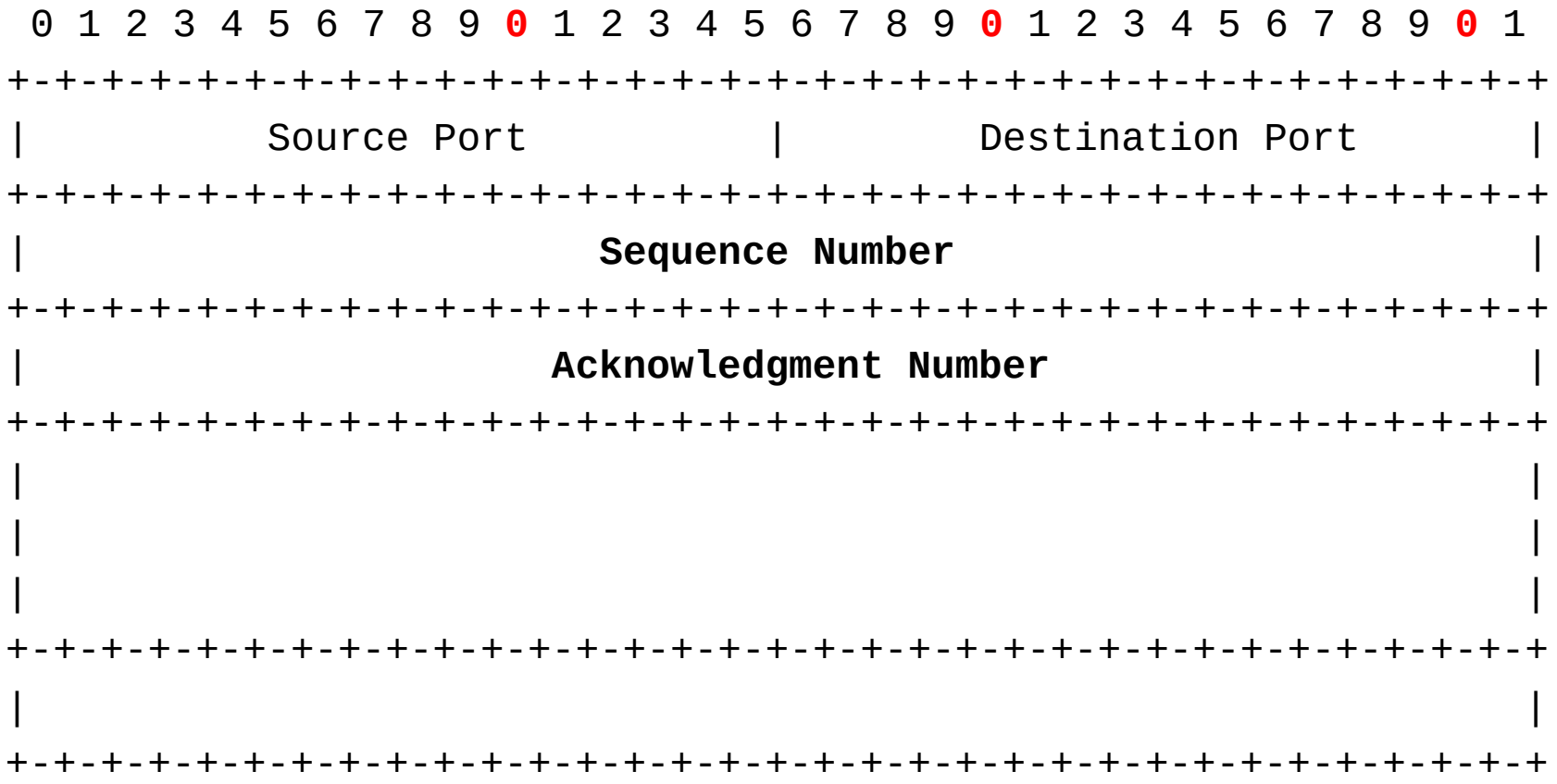
20 octetos: 5 palabras de 32 bits



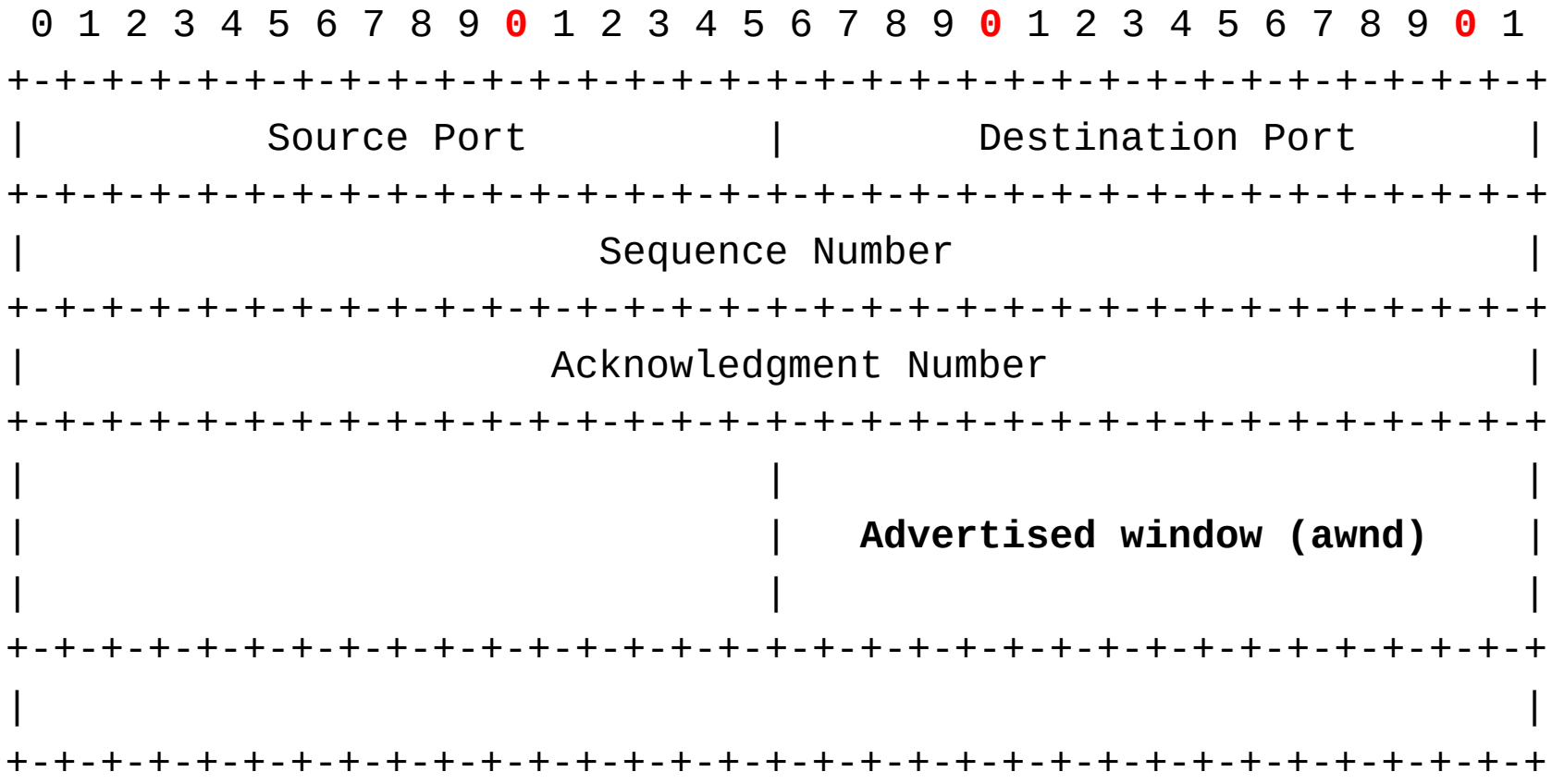
Ports (direcciones TCP)



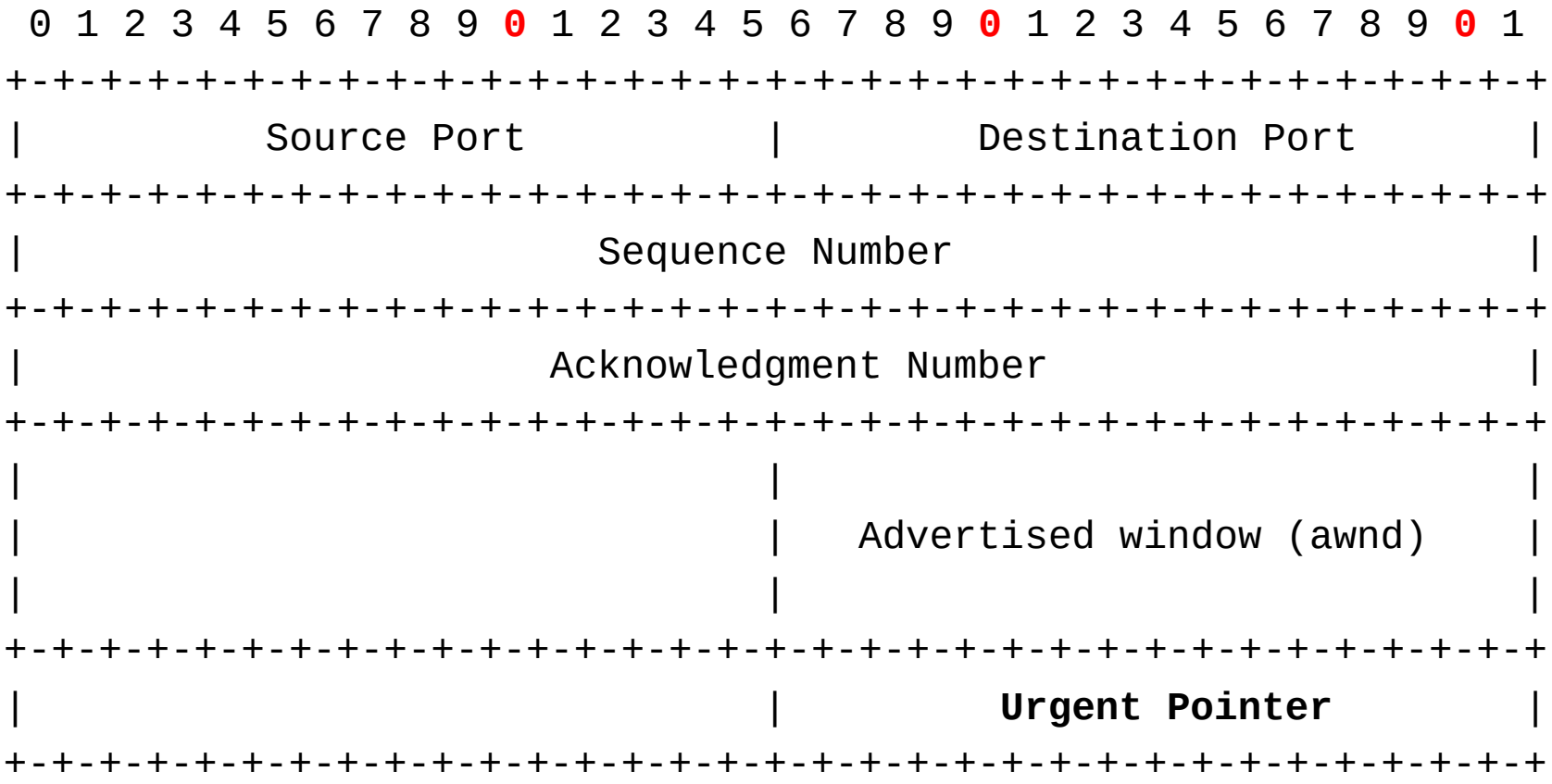
Números de secuencia y de ACK



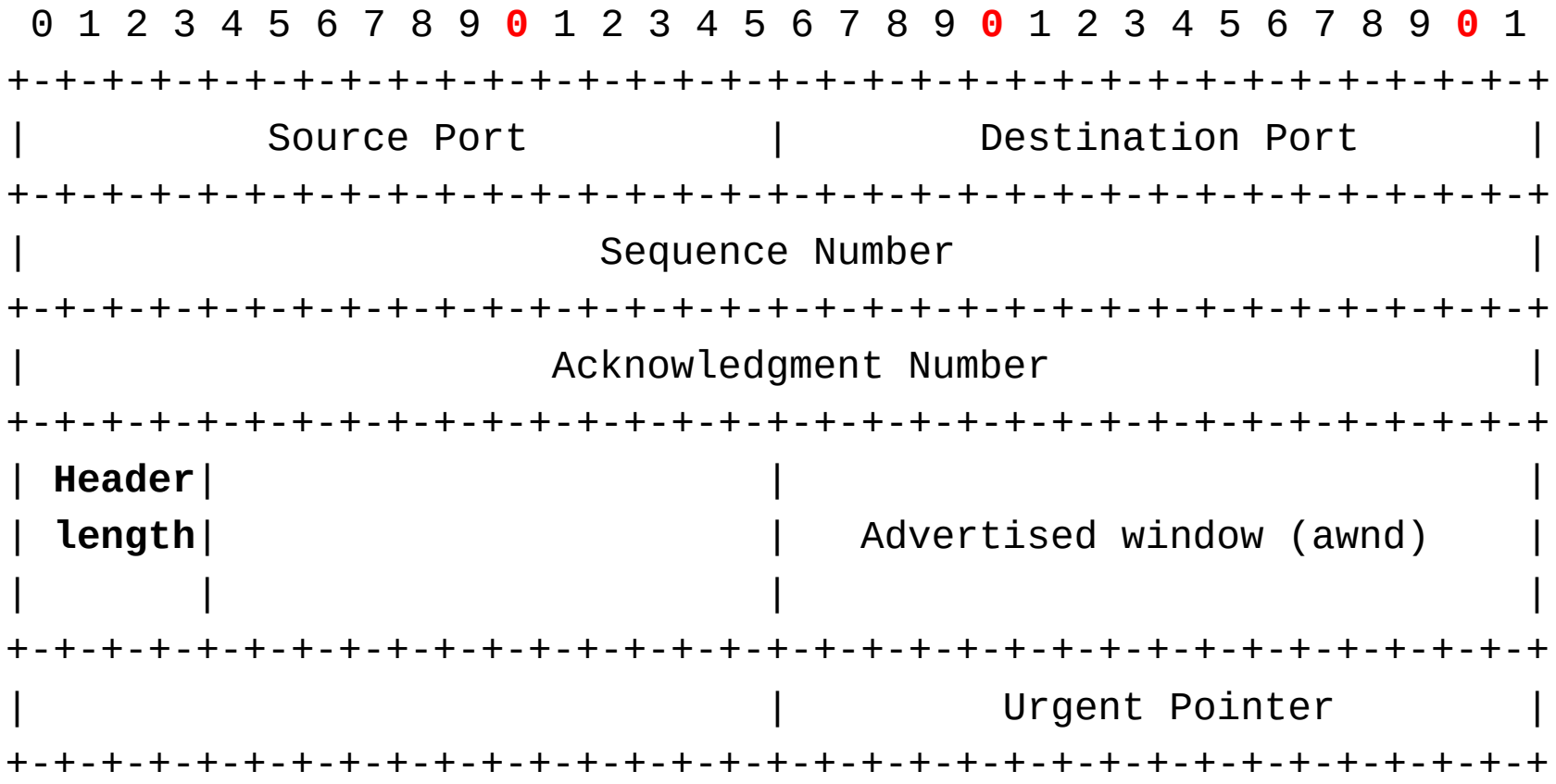
Ventana anunciada



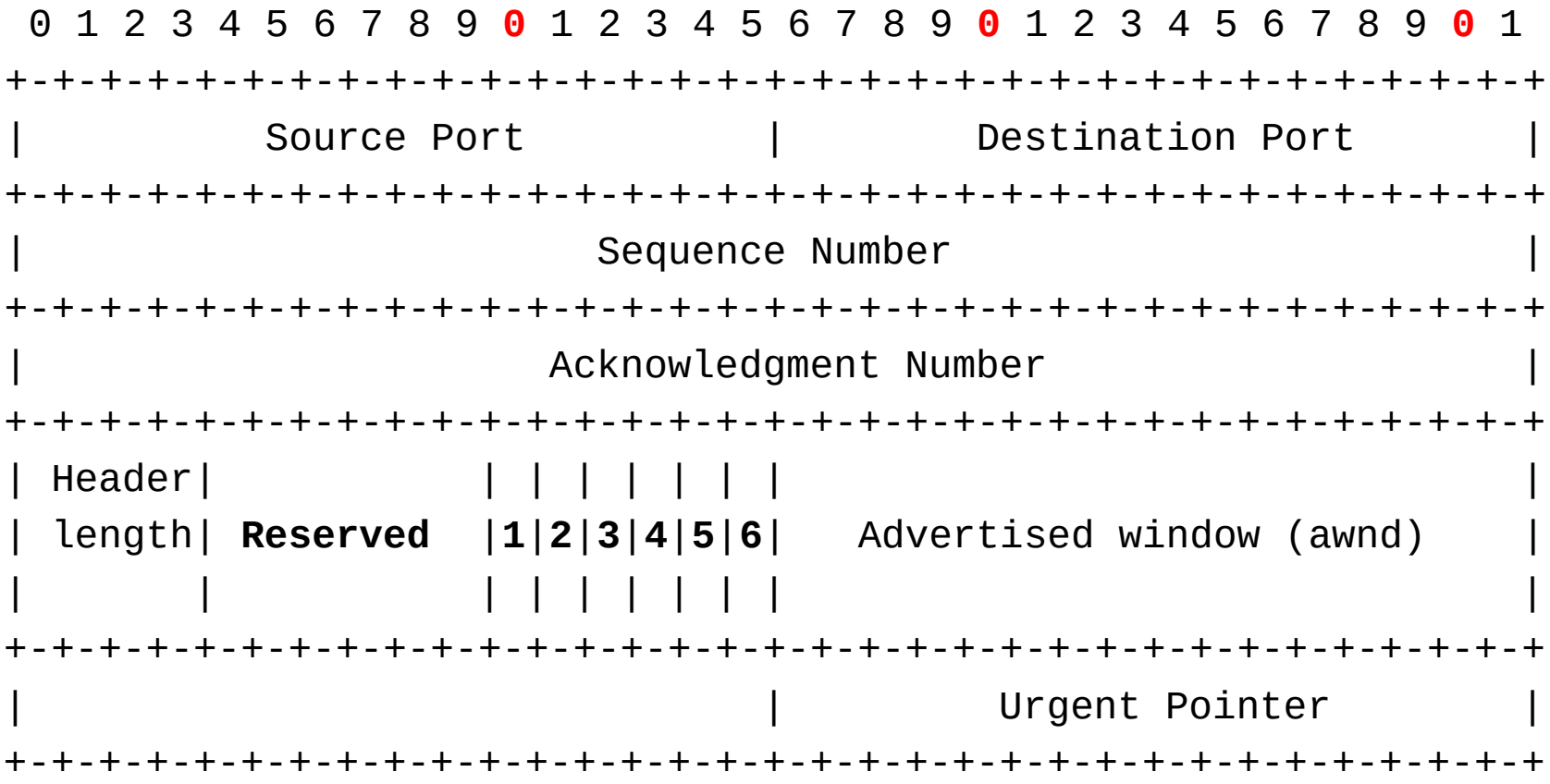
Puntero urgente



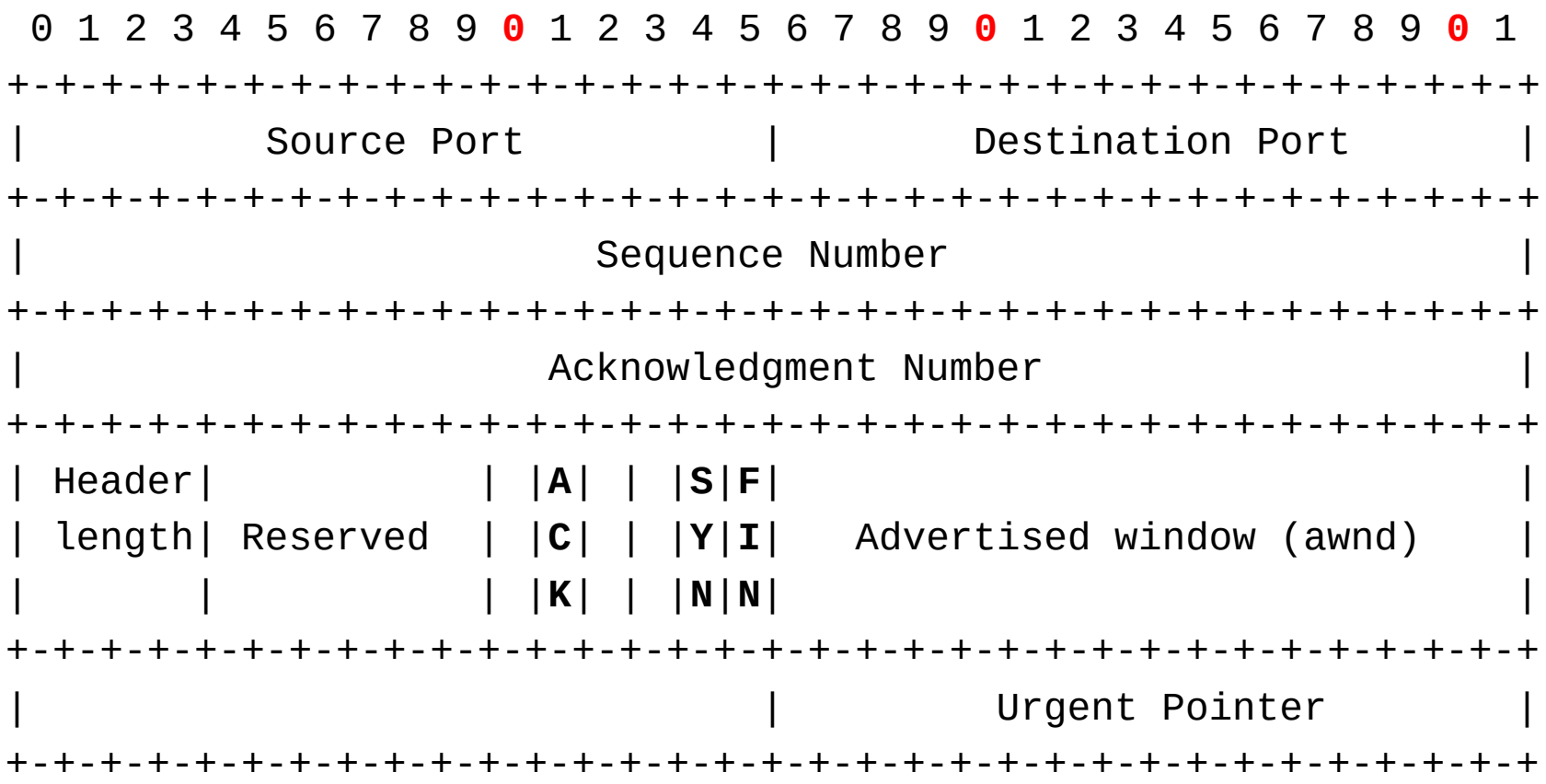
Longitud cabecera



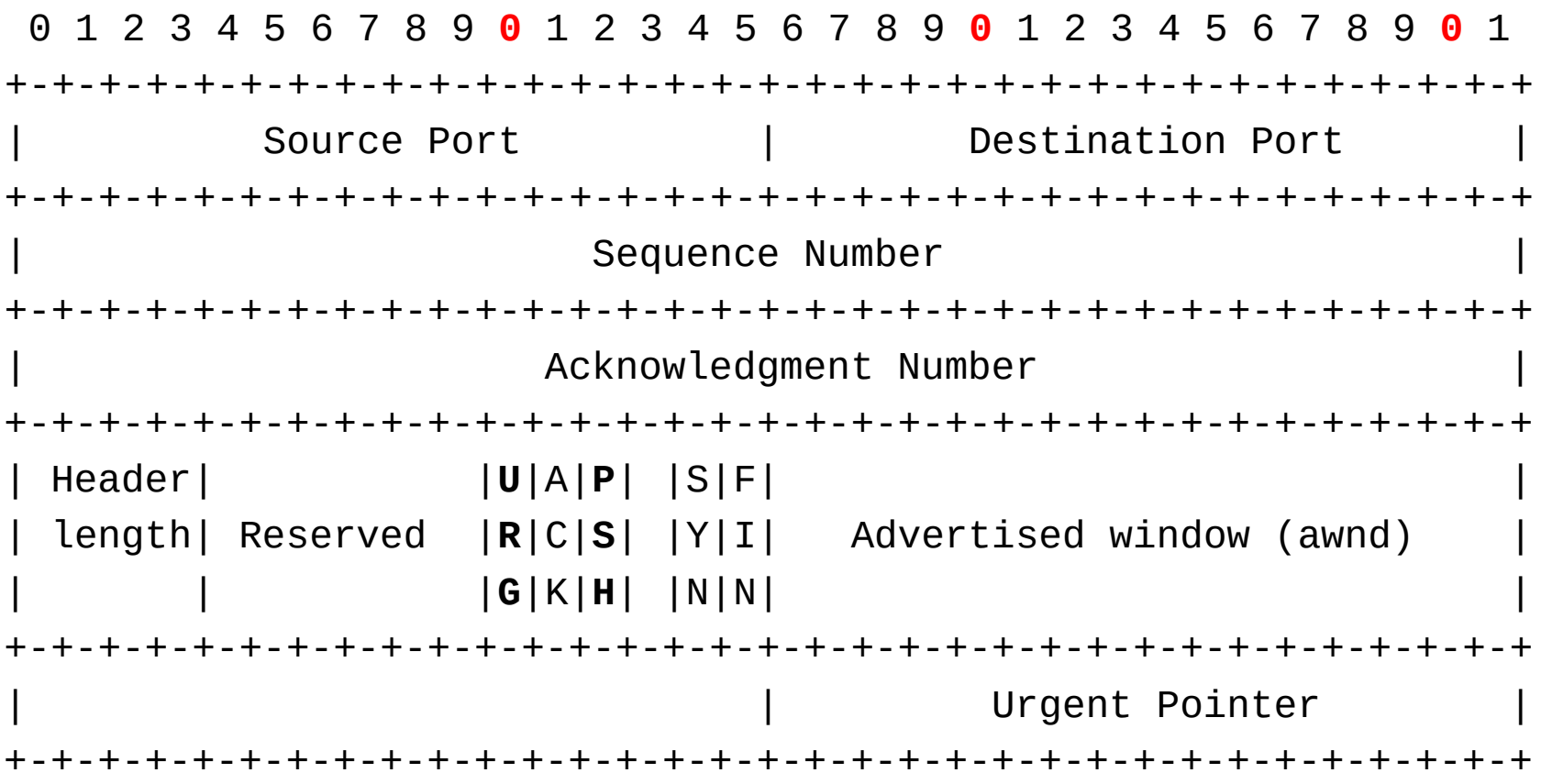
Flags


0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Source Port
Destination Port
Sequence Number
Acknowledgment Number
Header length
Reserved
1 2 3 4 5 6
Advertised window (awnd)
Urgent Pointer

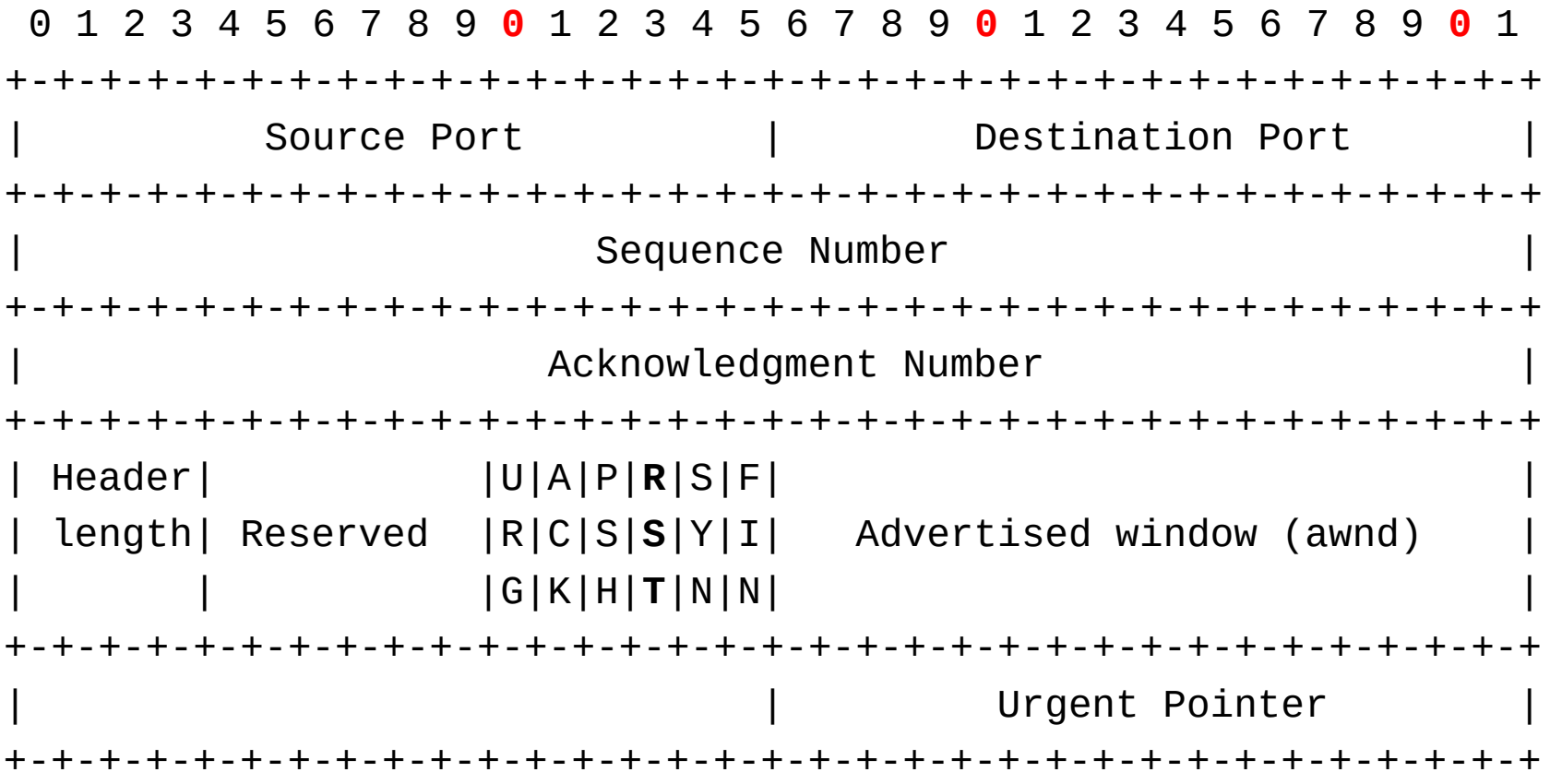
Flags: ACK, SYN, FIN



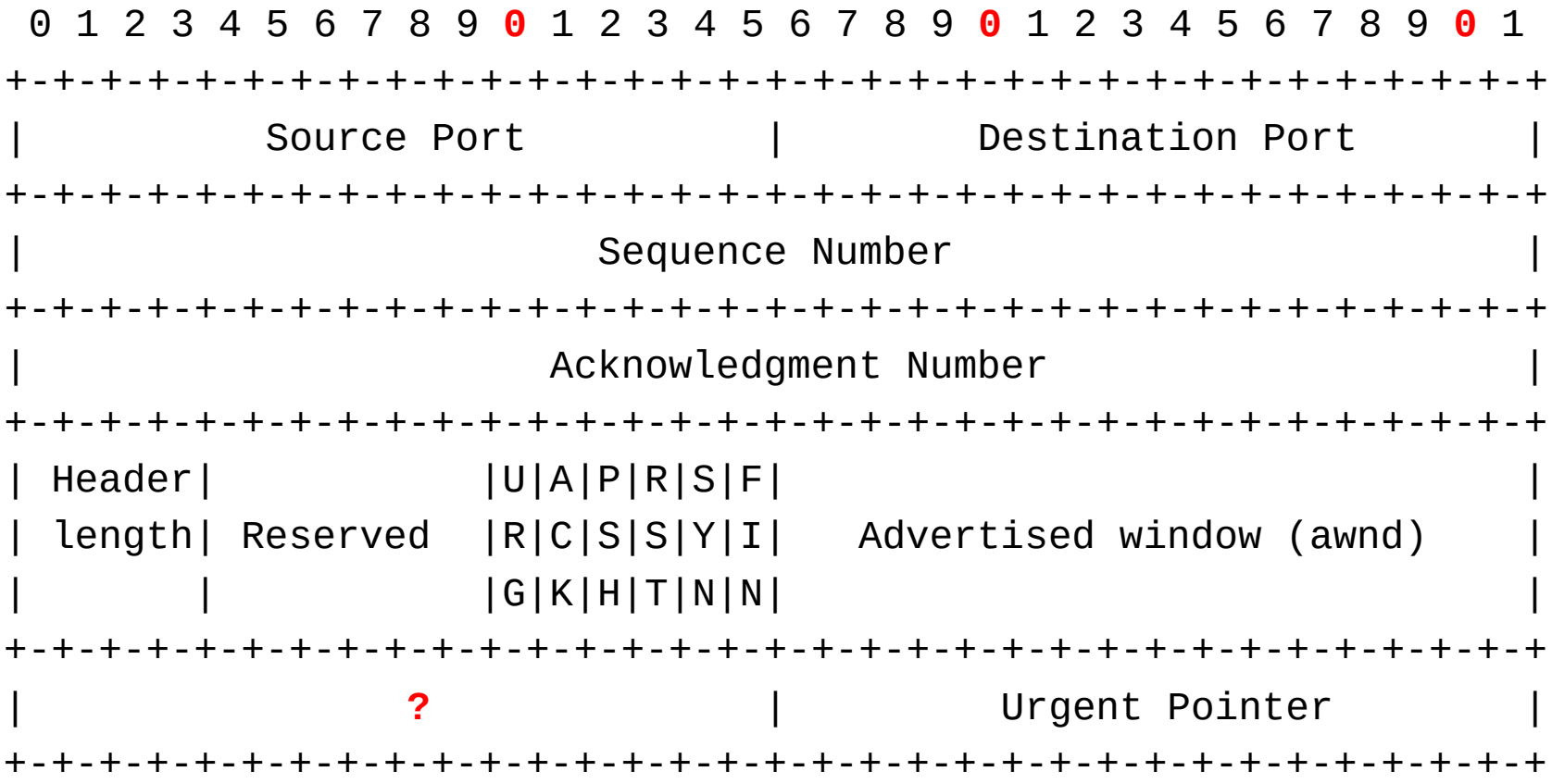
Flags: URG, PSH



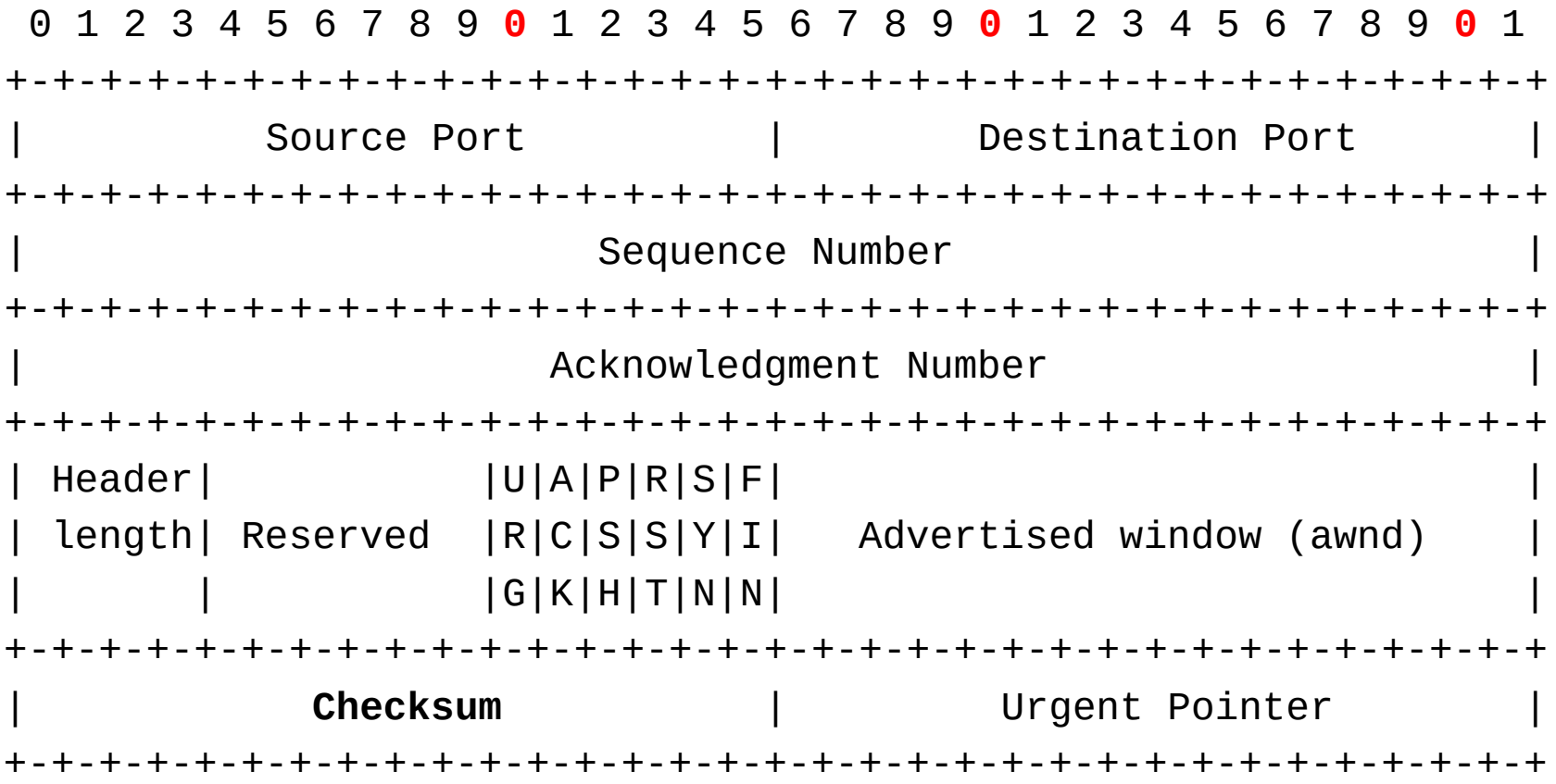
Flags: RST


0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Source Port
Destination Port
Sequence Number
Acknowledgment Number
Header length
Reserved
U R G
A C K
P S H
R S T
S Y N
F I N
Advertised window (awnd)
Urgent Pointer

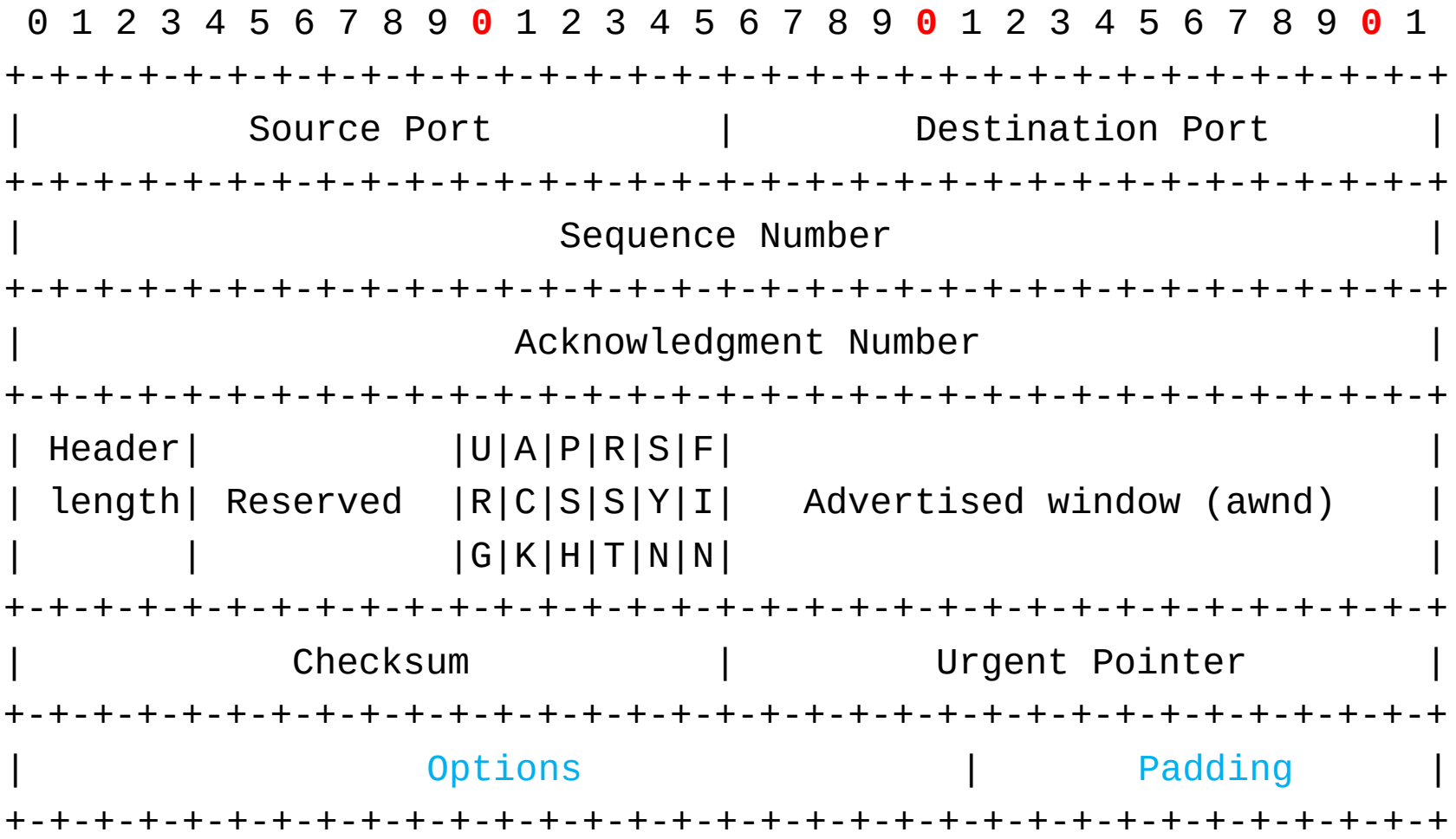
Cabecera TCP



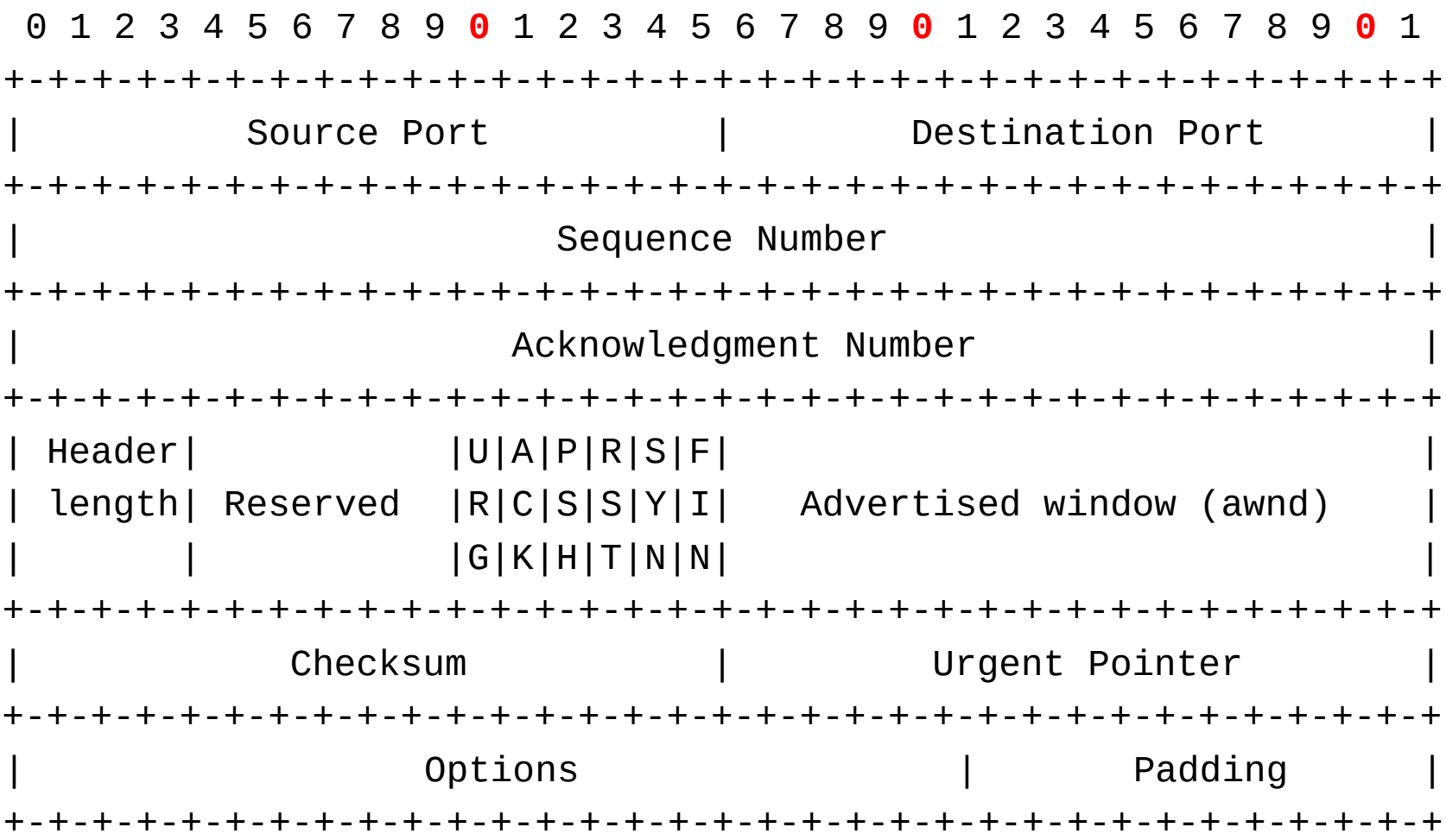
Checksum


0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Source Port
Destination Port
Sequence Number
Acknowledgment Number
Header length
Reserved
U R G
A C K
P S H
R S T
S Y N
F I N
Advertised window (awnd)
Checksum
Urgent Pointer

Parte opcional



TCP Header

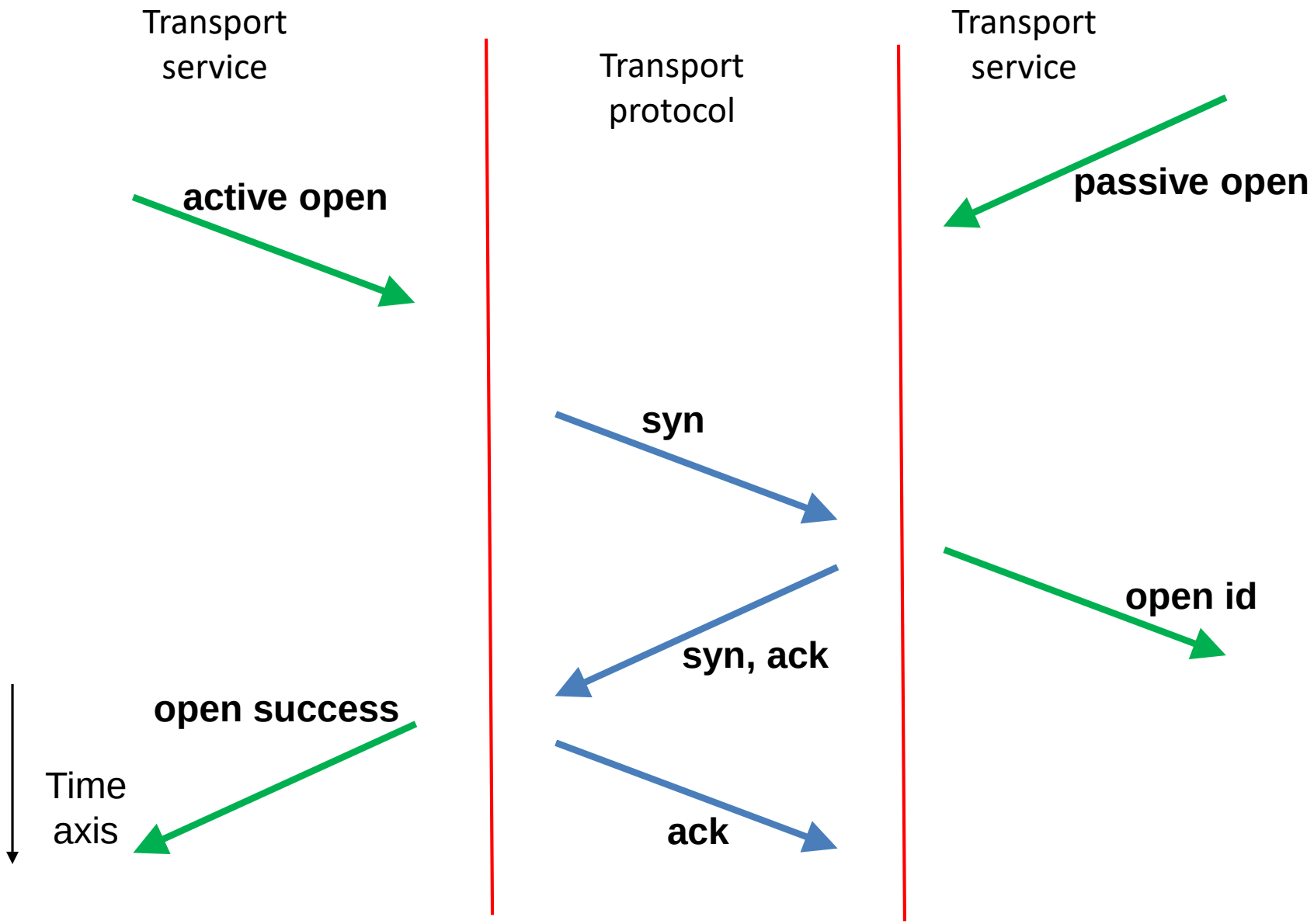

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Source Port
Destination Port
Sequence Number
Acknowledgment Number
Header length
Reserved
U R G
A C K
P S H
R S T
S Y N
F I N
Advertised window (awnd)
Checksum
Urgent Pointer
Options
Padding

TCP - options

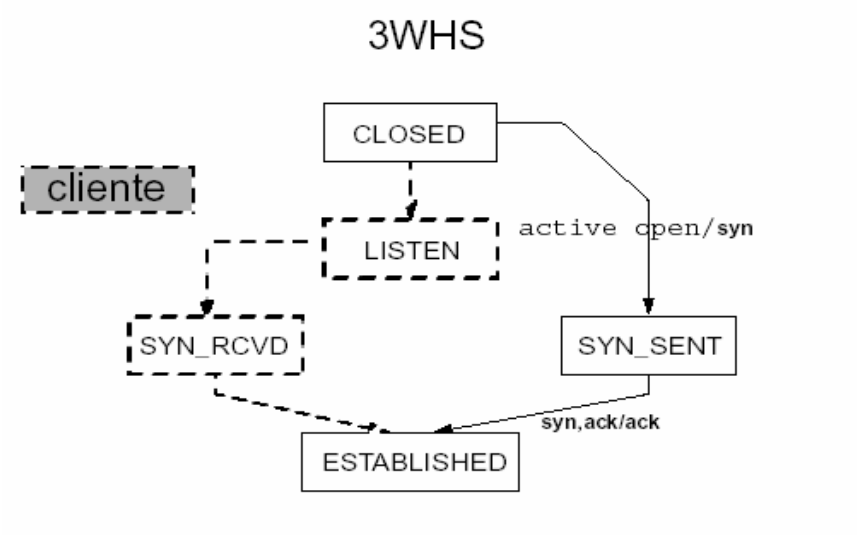
- MSS (Maximum Segment Size)
- WS (Window Scale) factor
- Timestamp
- SACK

State diagrams

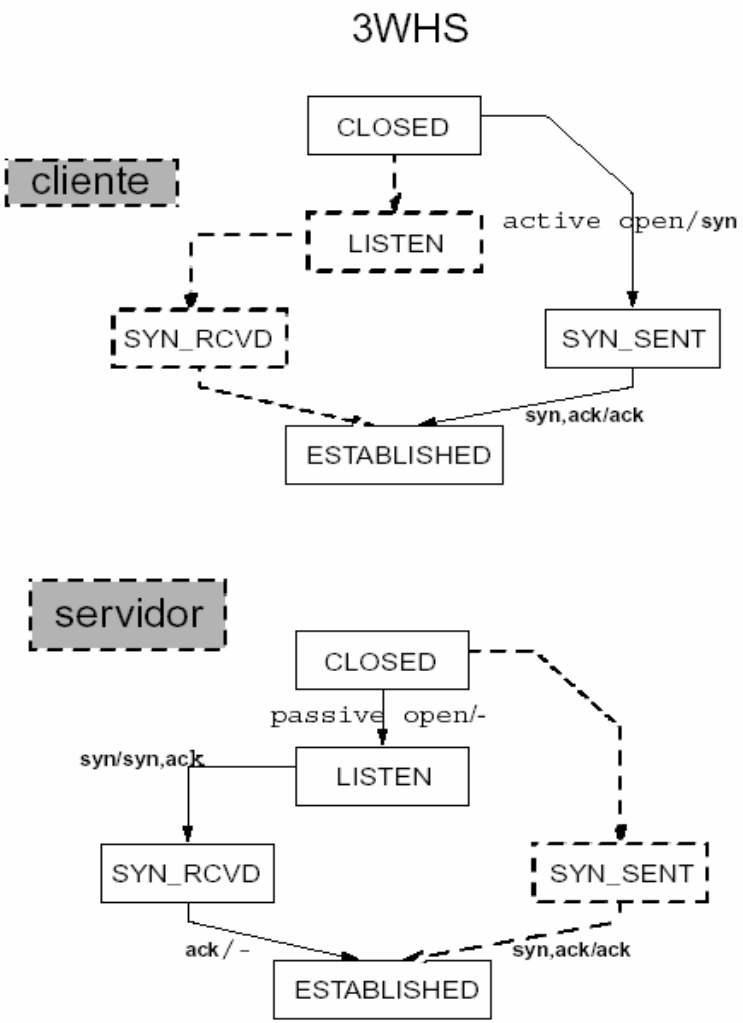
Connect


Transport service
Transport protocol
Transport service
active open
passive open
syn
open id
syn, ack
open success
Time axis
ack

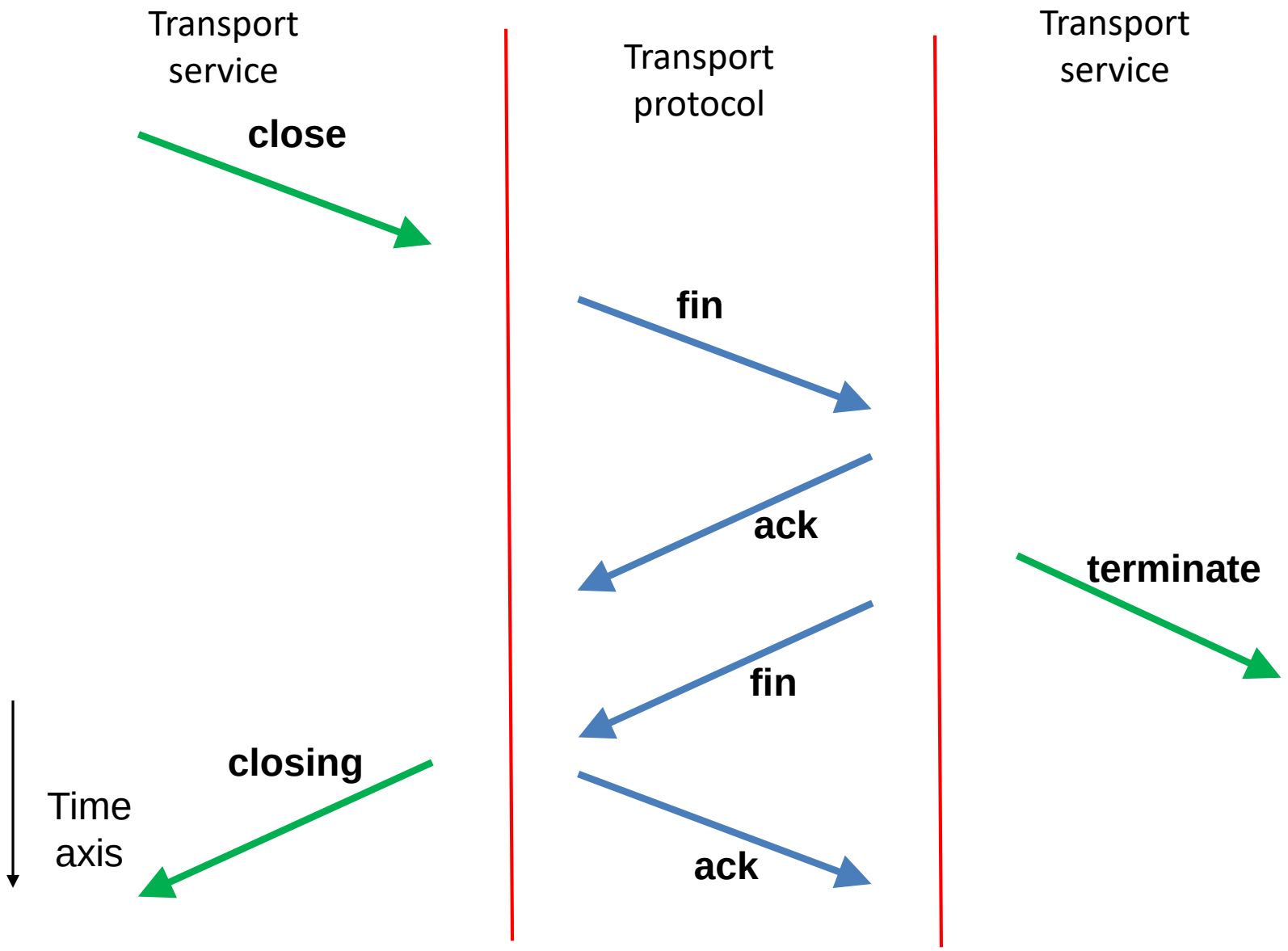
Connect - Client



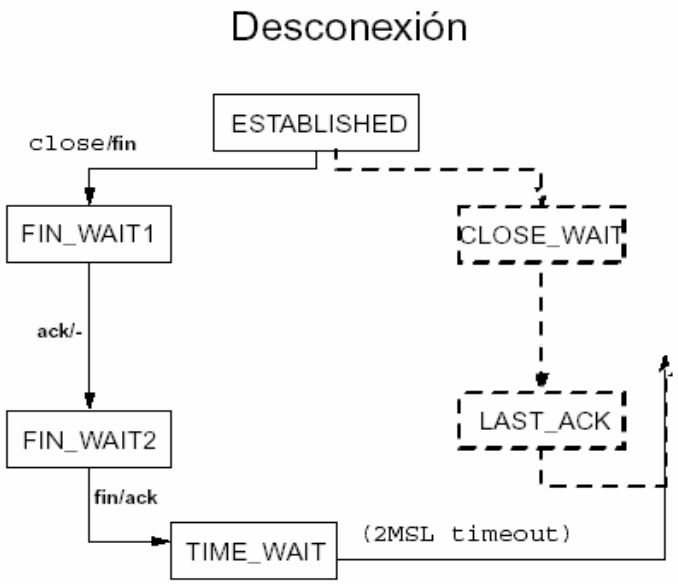
Connect - Client/Server



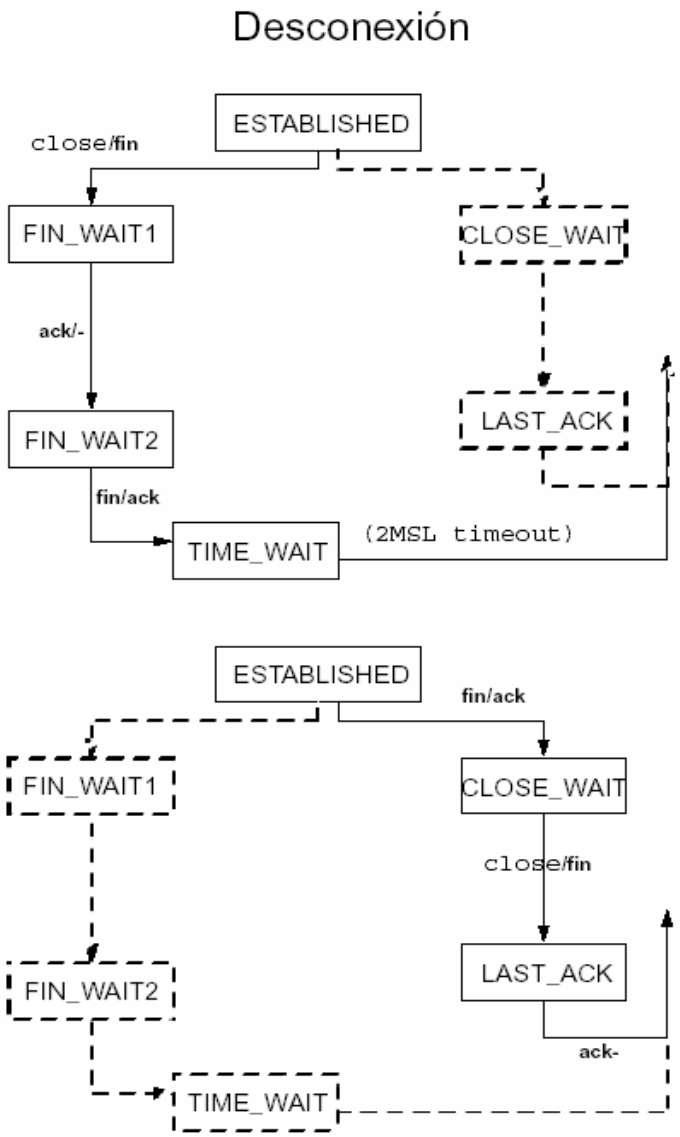
Disconnect / Release



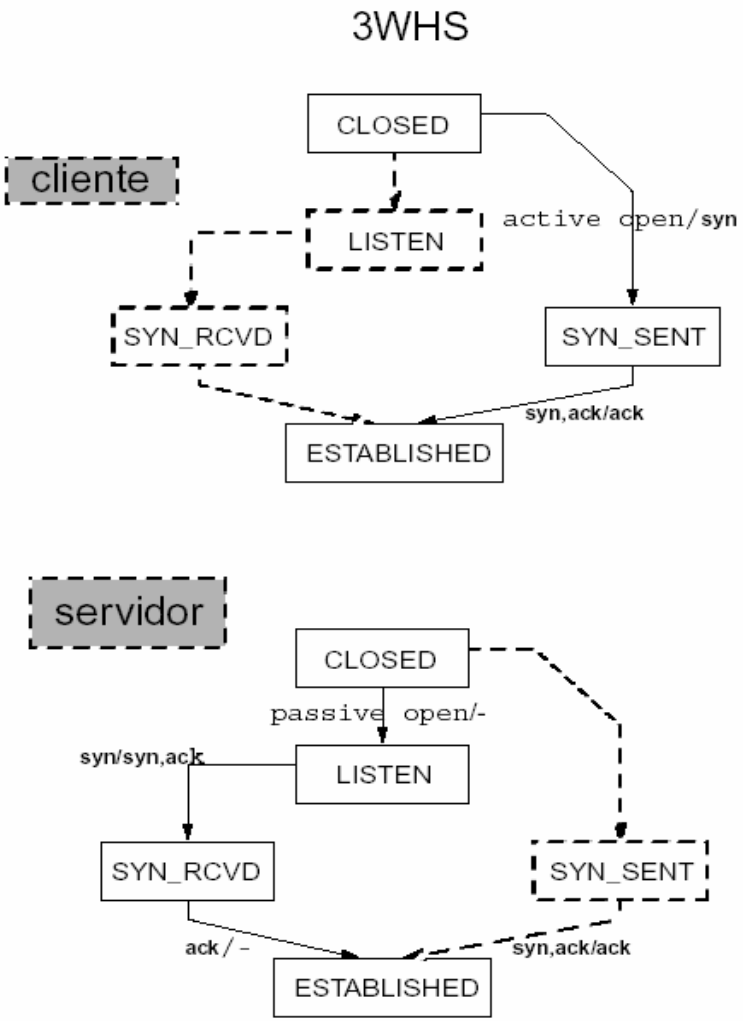
Disconnect - Client

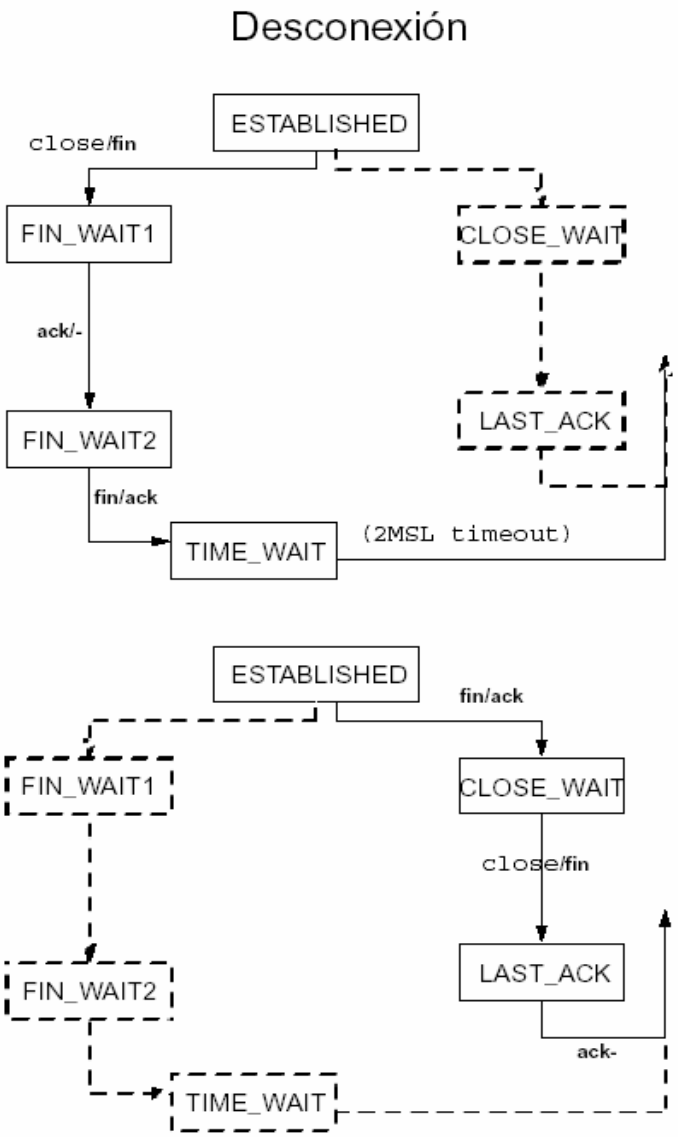


Disconnect – Client/Server



Connect/Disconnect - Client/Server





Temporizadores

Temporizadores

ENVÍO:

- **Retransmisión**: Segmento no confirmado

Temporizadores

ENVÍO:

- **Retransmisión**: Segmento no confirmado
- **Persistencia**: Abortar conexión cuando no hay ACKs

Temporizadores

ENVÍO:

- **Retransmisión**: Segmento no confirmado
- **Persistencia**: Abortar conexión cuando no hay ACKs

RECEPCIÓN:

- **Ventana**: Tiempo máximo entre envíos ACK/Crédito

Temporizadores

ENVÍO:

- **Retransmisión**: Segmento no confirmado
- **Persistencia**: Abortar conexión cuando no hay ACKs

RECEPCIÓN:

- **Ventana**: Tiempo máximo entre envíos ACK/Crédito
- **Inactividad**: Abortar conexión cuando no hay datos

Temporizadores

ENVÍO:

- **Retransmisión**: Segmento no confirmado
- **Persistencia**: Abortar conexión cuando no hay ACKs

RECEPCIÓN:

- **Ventana**: Tiempo máximo entre envíos ACK/Crédito
- **Inactividad**: Abortar conexión cuando no hay datos

ESPECIALES CONEXIÓN/DESCONEXIÓN:

- **Reconexión**: Tiempo mínimo entre conexiones "correctas" (con la misma dirección destino)
- **Retransmisión de conexión**: Tiempo mínimo entre intentos de establ. de conexión (retransmisión de SYNs)

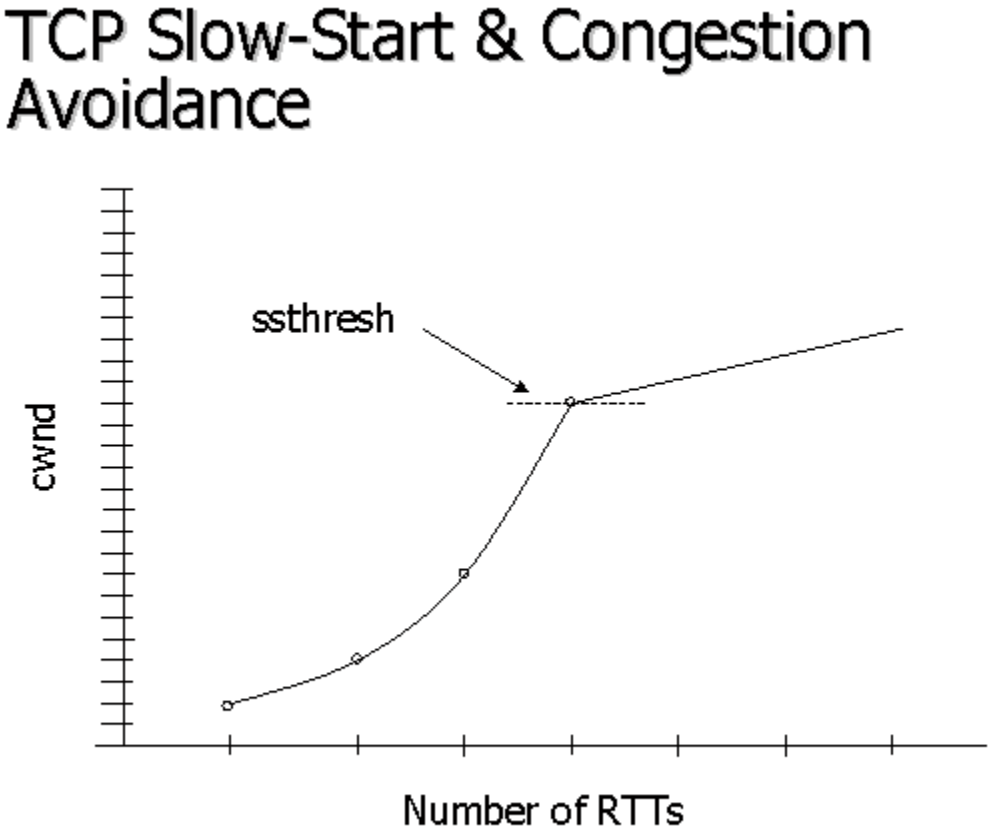
Control de Congestión

SLOW START / CONGESTION AVOIDANCE (SS/CA)

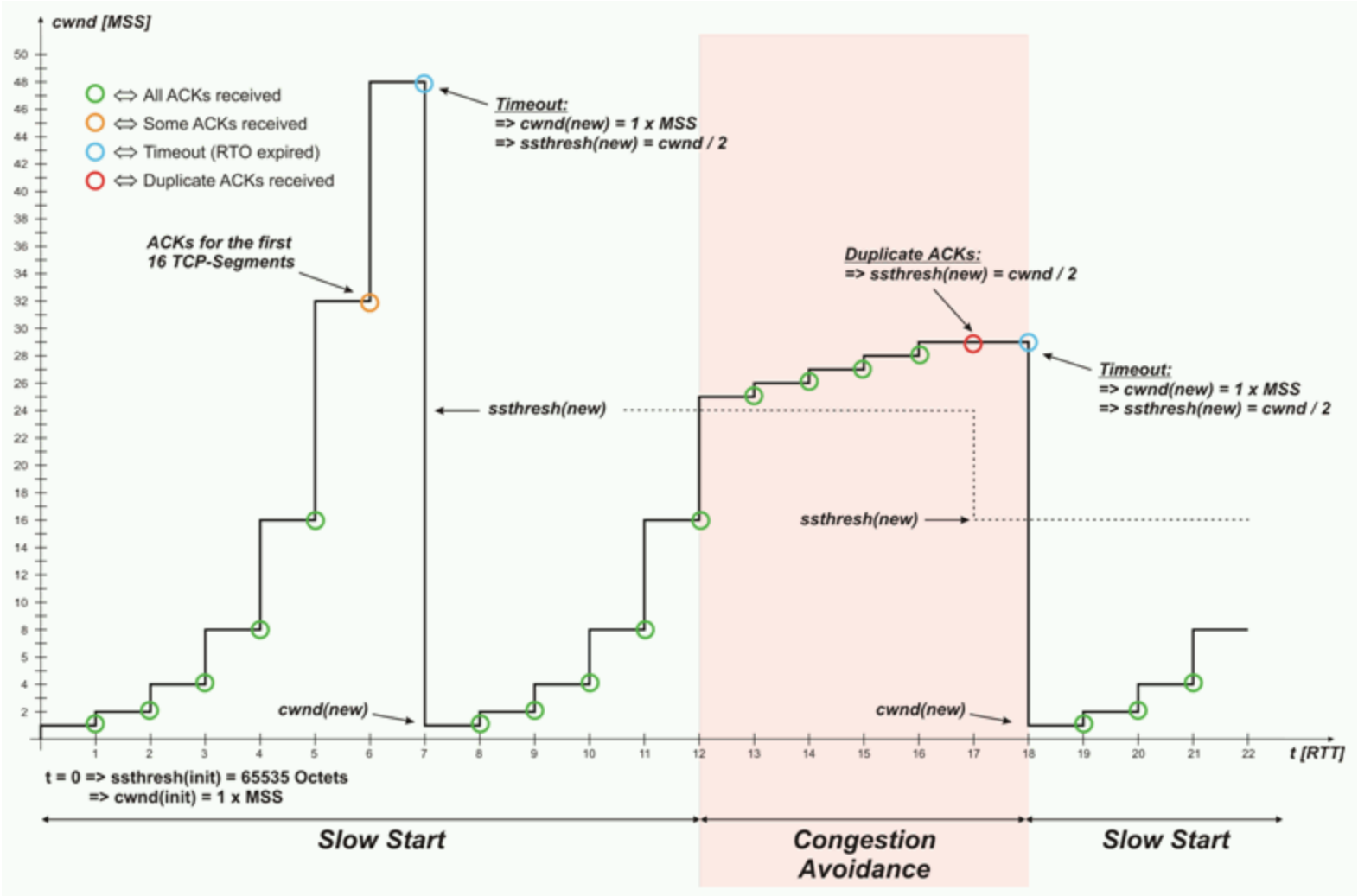
SS inicial - Si Tout, paso a SS reinicio - Cuando Vc = umbral, paso a CA

```
Vc := 1 MSS;                    [V: ventana; c: congestión, a: anunciada, r: real]
umbral := infinito;
para cada ACK nuevo
    si Vc < umbral entonces
        Vc := Vc + MSS                  [Fase SS] [MSS: Maximum Segment Size]
    sino
        Vc := Vc + MSS * MSS/Vc;        [Fase CA] [En MSSs: Vc:=Vc+(1/Vc)]
fpara;                                  (Vc incrementa en 1 cuando recibe Vc octetos)
cuando hay Tout
    (se retransmite el segmento que no ha recibido ACK)
    umbral := max (min (Va, Vc)/2, 2 MSS);
                        [La mitad de la Vr en el momento de la pérdida]
    Vc := 1 MSS;
fcuando;
```

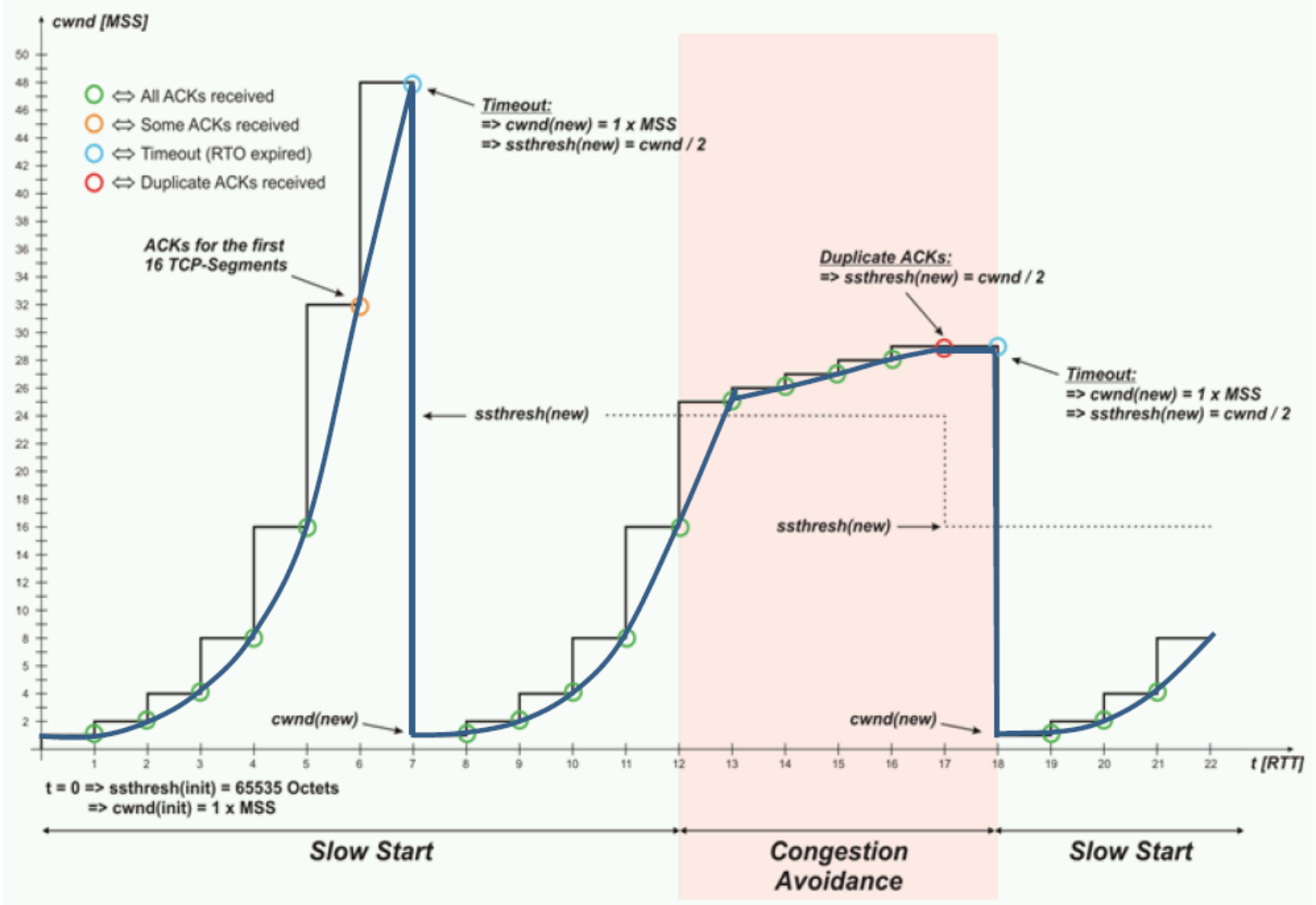
SLOW START / CONGESTION AVOIDANCE (SS/CA)



SLOW START / CONGESTION AVOIDANCE (SS/CA)



SLOW START / CONGESTION AVOIDANCE (SS/CA)



Transparencias adicionales TCP de otros profesores

Slow Start and Congestion Avoidance

INIT

cwnd = MSS
ssthres = infinite

Algorithm

If ack confirms new data (1 or more segments)
If (cwnd < ssthres)
then cwnd = cwnd + MSS
else cwnd = cwnd + MSS*(MSS/cwnd)
Stop RTO
If unack'd segments restart RTO

If RTO timeout **then**
retransmit oldest unack'd segment
ssthres = max(min(awnd,cwnd)/2; 2MSS)
cwnd = MSS

INIT (normalized to MSS)

cwnd = 1
ssthres = infinite

SS

Algorithm

If ack confirms new data (1 or more segments)
If (cwnd < ssthres)
then cwnd = cwnd + 1
else cwnd = cwnd + (1/cwnd)
Stop RTO
If unack'd segments restart RTO

SS
CA

If RTO timeout **then**
retransmit oldest unack'd segment
ssthres = max(min(awnd,cwnd)/2;2)
cwnd = 1

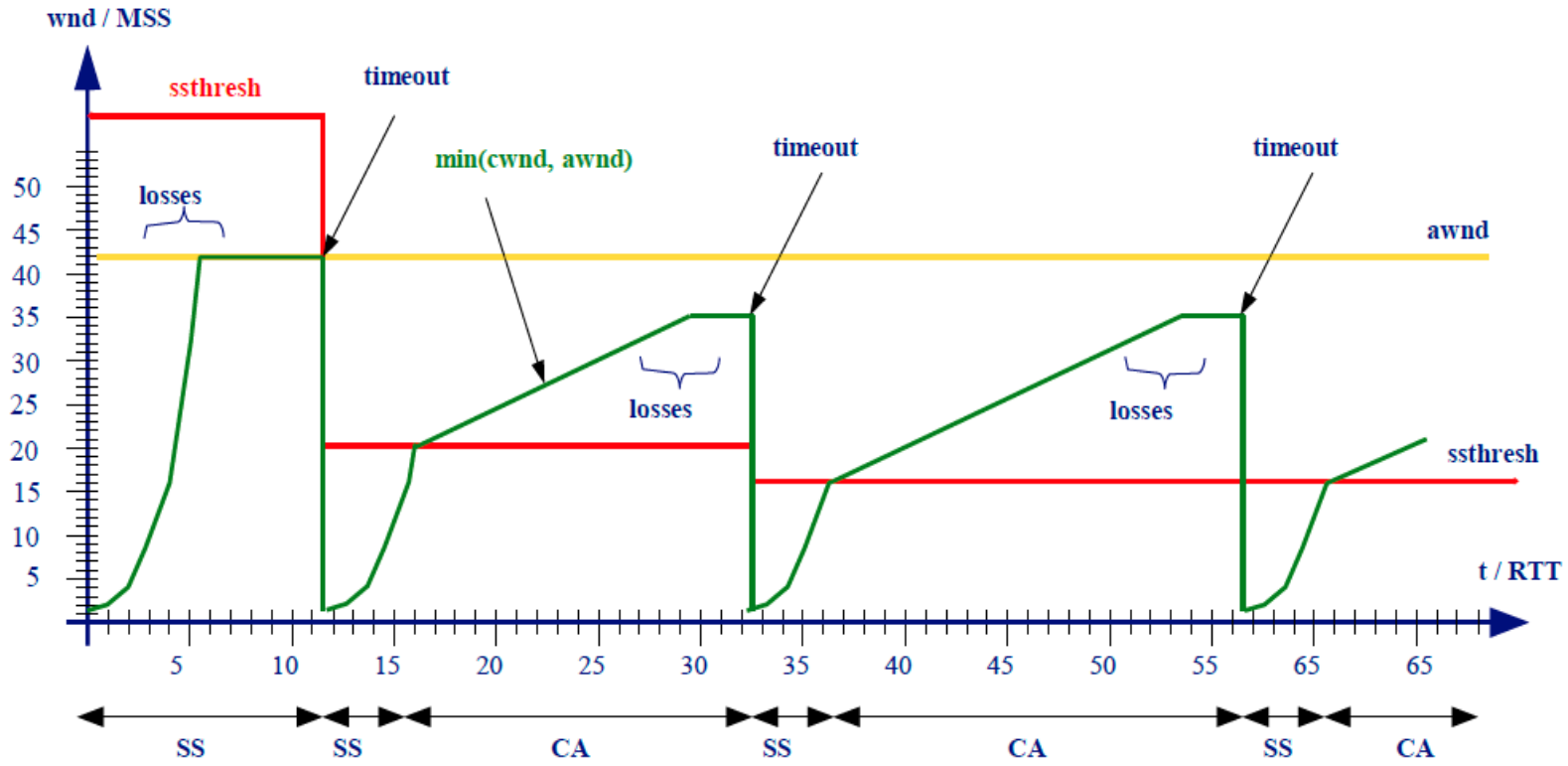
SS

TCP Protocol – Slow Start / Congestion Avoidance (SS/CA)

- During SS cwnd increases rapidly up to the "operational point" or awnd (flow control).
- During CA cwnd increases slowly looking for more available bandwidth.

Each RTT cwnd is duplicated

Each RTT cwnd grows by 1



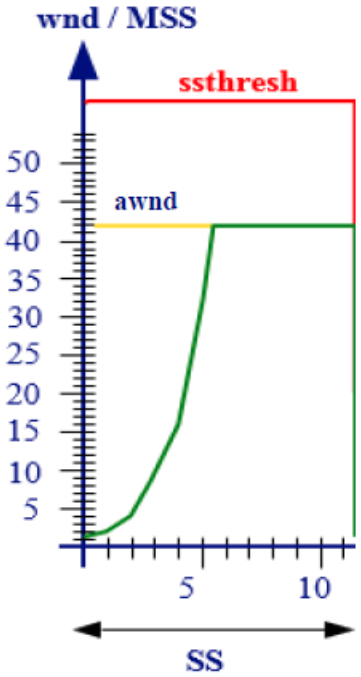
TCP behaviour

No congestion (no loses)

cwnd doubles every RTT up to awnd (control flow)

Vef = awnd/RTT (in steady state, after SS)

Vef = area under cwnd curve / total time

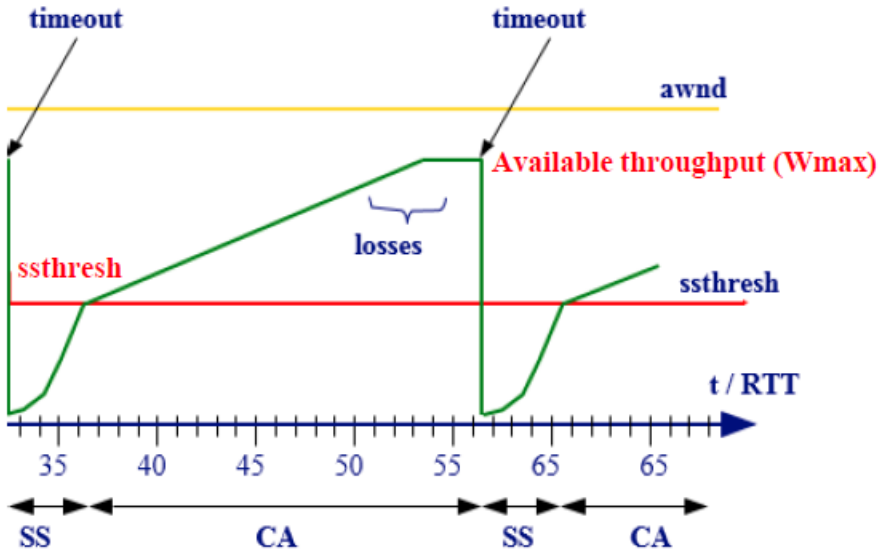


Congestion

After reaching ssthresh (SS =>CA) and cwnd increments by one every RTT

When cwnd reaches Wmax there is congestion (and loses)

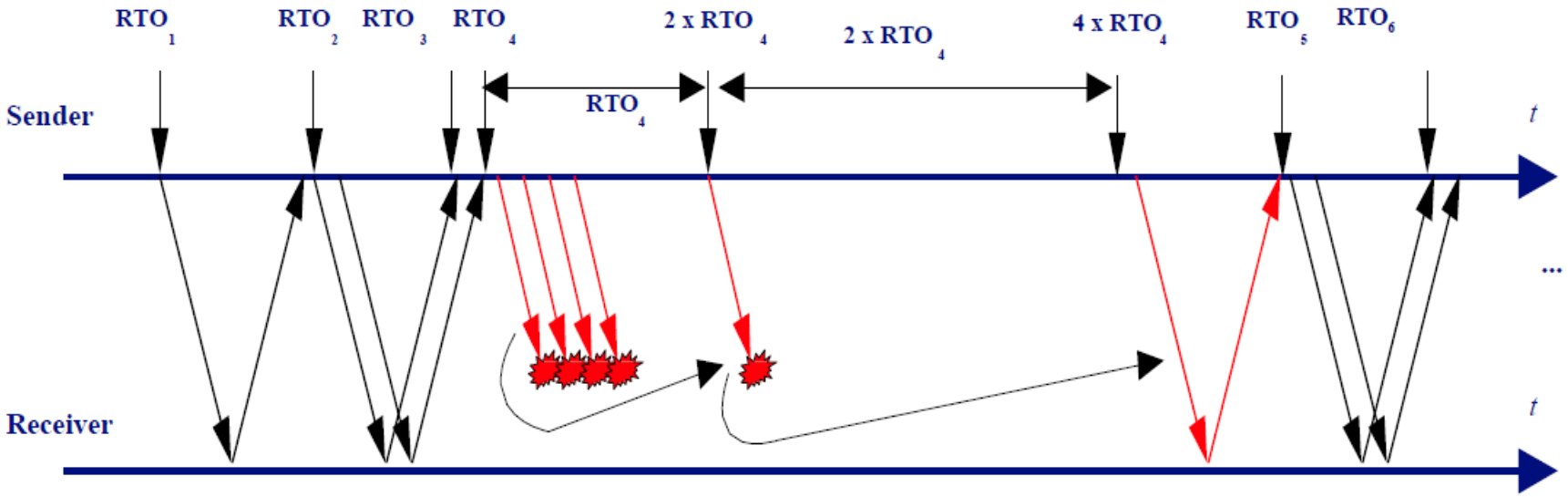
Wmax results from sharing capacity among all competing TCP connections



TCP Protocol – Retransmission time-out (RTO)

- Activation:
  - RTO is active whenever there are pending acks.
  - When RTO is active, it is continuously decreased, and a ReTx occurs when RTO reaches zero.
  - Each time an ack confirming new data arrives:
    - RTO is computed.
    - RTO is restarted if there are pending acks, otherwise, RTO is stopped.
- Computation of RTO:
  - The TCP sender measures the RTT mean (srtt) and variance (rttvar).
  - The retransmission time-out is given by: RTO = srtt + 4 x rttvar.
  - RTO is duplicated each retransmitted segment (exponential backoff).
- RTT measurements:
  - Using "slow-timer tics" (coarse).
  - Using the TCP timestamp option.

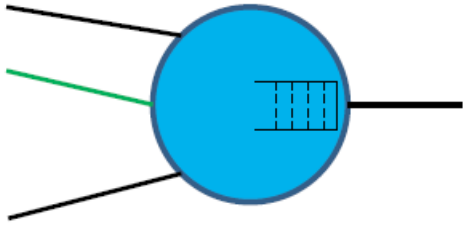
TCP Protocol – Retransmission time-out (RTO)



TCP performance & evaluation

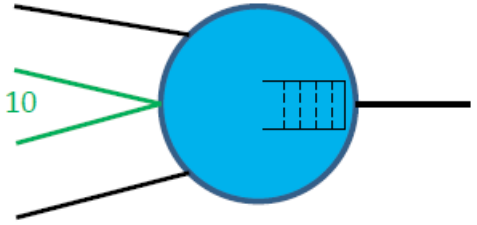
TCP performance

10 TCP competing connections
In the long term each TCP connection gets BW/10, that is, 10Mbps.
Average throughput for the green connection: 10Mbps



The available capacity is shared fairly among all competing TCP connections

20 TCP competing connections
In the long term each TCP connection gets BW/20, that is, 5Mbps.
Average throughput for the 10 green connections: 50Mbps

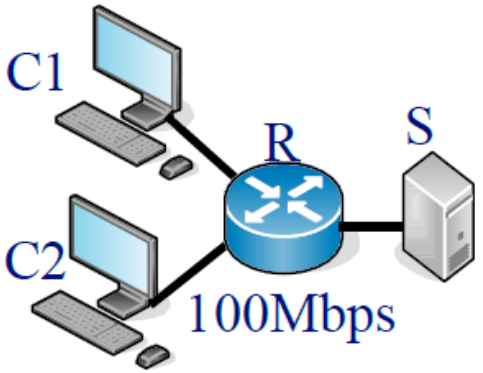


TCP evaluation – no losses

- Preliminaries:
  - TCP sends the entire window, W (in several segments)
  - The segments accumulate in the queues of the interfaces where there are bottlenecks
  - Steady state: the TCP connection started time ago
  - In general, we can assume that, on the average, is fulfilled vef = W / RTT
  - If there are no losses, W will be awnd, otherwise W follows a "saw tooth"

Example: C1 and C2 send to S, each with a TCP connection, awnd=64kB.

- The bottleneck is the link R-S
- For each connection vef = 100/2 = 50 Mbps
- Since propagation delays in the links are negligible, if no losses occur in the queue of the router there will be 128 kB (the 2 TCP windows)
- The RTT is the time in the queue of the router:
  - RTT=128 kB/100 Mbps = 10,24 ms
- Check that vef=W/RTT = 64 kB/10,24 ms = 50 Mbps

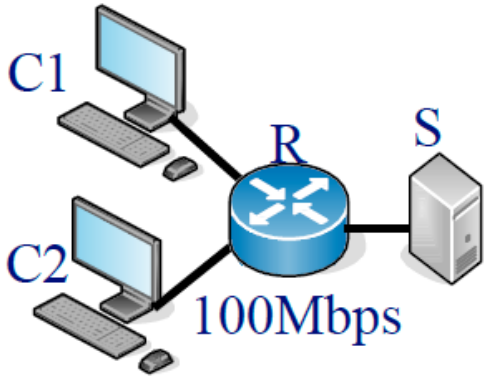


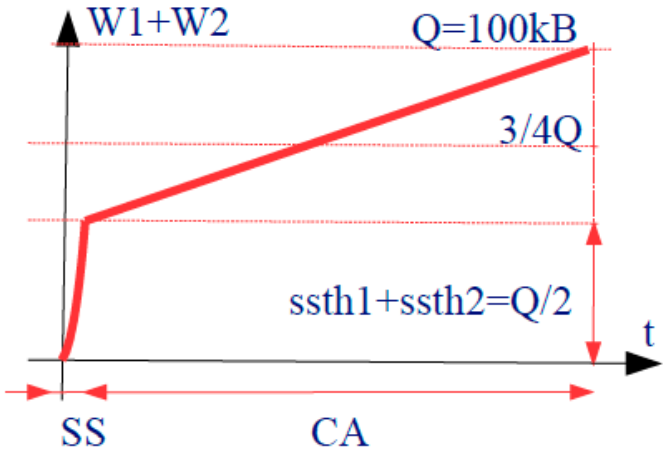
TCP evaluation – losses

- Example with losses: C1 and C2 send to S, each with a TCP connection, awnd=64kB. Assume now that the interface queue of the router is limited to Q=100 kB
  - The bottleneck is the link R-S
  - For each connection vef = 100/2 = 50 Mbps
  - There will be losses, because when both TCP windows add to 100kB, there will be no space left in the router queue.
  - The figure shows a possible evolution of the queue in the router, which stores the window of both connections: W1+W2. When the queue is full, both connections have losses and reduce the ssth to the half. Therefore, the average queue size in the router will be, approximately:

    (Q/2+Q)/2=3/4Q=75 kB
  - Thus, the average RTT will be:
    - $\overline{RTT}$=75 kB/100 Mbps = 6 ms
  - Note that the average window of each connection will be:

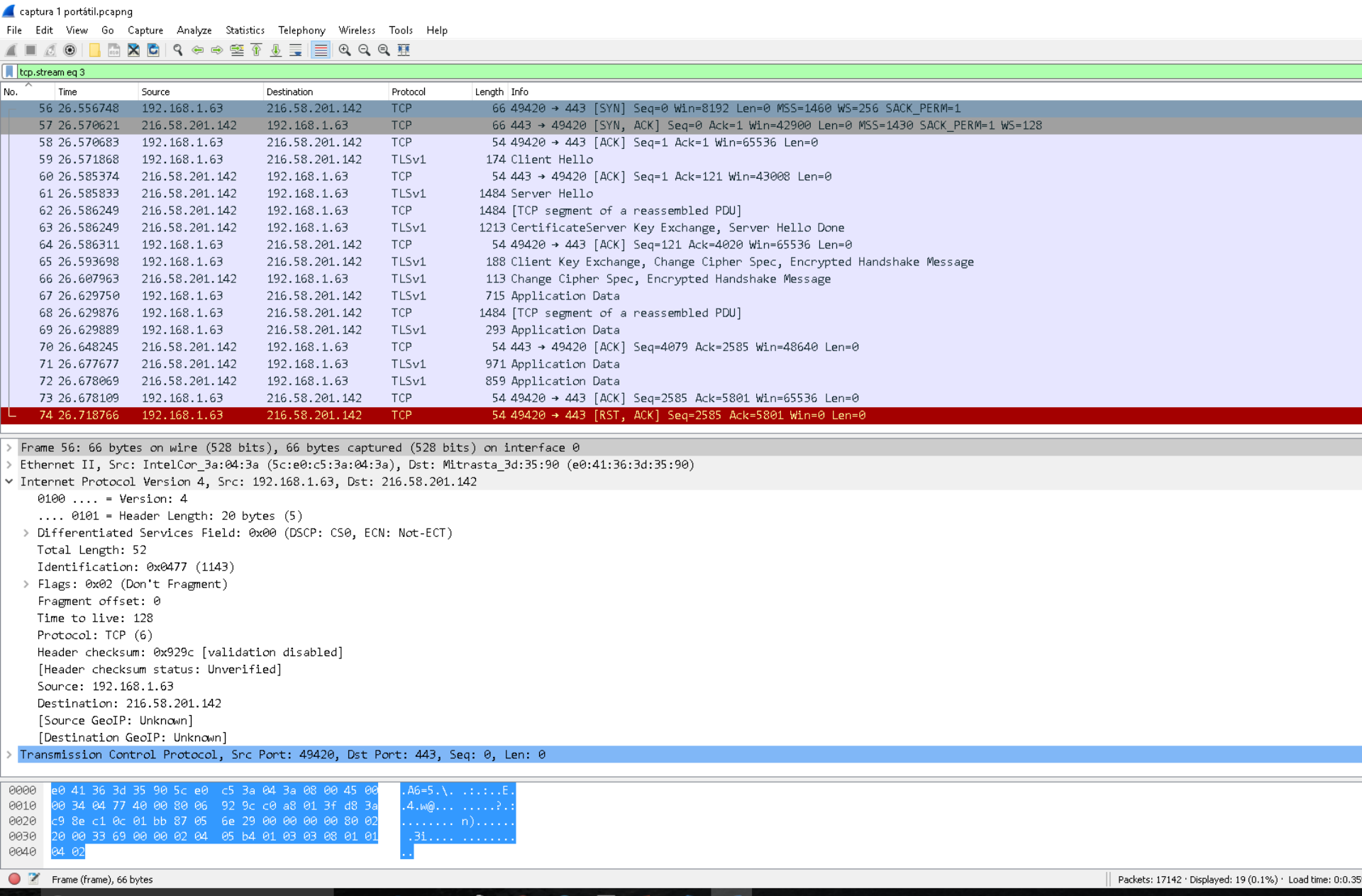
    $\overline{W1}=\overline{W2}$=75 kB/2=37,5 kB
  - Check that vef=$\overline{W}/\overline{RTT}$ = 37,5 kB/6 ms = 50 Mbps





Capturas WireShark

TCP IP


captura 1 portátil.pcapng
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tcp.stream eq 3
No. Time Source Destination Protocol Length Info
56 26.556748 192.168.1.63 216.58.201.142 TCP 66 49420 → 443 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
57 26.570621 216.58.201.142 192.168.1.63 TCP 66 443 → 49420 [SYN, ACK] Seq=0 Ack=1 Win=42900 Len=0 MSS=1430 SACK_PERM=1 WS=128
58 26.570683 192.168.1.63 216.58.201.142 TCP 54 49420 → 443 [ACK] Seq=1 Ack=1 Win=65536 Len=0
59 26.571868 192.168.1.63 216.58.201.142 TLSv1 174 Client Hello
60 26.585374 216.58.201.142 192.168.1.63 TCP 54 443 → 49420 [ACK] Seq=1 Ack=121 Win=43008 Len=0
61 26.585833 216.58.201.142 192.168.1.63 TLSv1 1484 Server Hello
62 26.586249 216.58.201.142 192.168.1.63 TCP 1484 [TCP segment of a reassembled PDU]
63 26.586249 216.58.201.142 192.168.1.63 TLSv1 1213 CertificateServer Key Exchange, Server Hello Done
64 26.586311 192.168.1.63 216.58.201.142 TCP 54 49420 → 443 [ACK] Seq=121 Ack=4020 Win=65536 Len=0
65 26.593698 192.168.1.63 216.58.201.142 TLSv1 188 Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
66 26.607963 216.58.201.142 192.168.1.63 TLSv1 113 Change Cipher Spec, Encrypted Handshake Message
67 26.629750 192.168.1.63 216.58.201.142 TLSv1 715 Application Data
68 26.629876 192.168.1.63 216.58.201.142 TCP 1484 [TCP segment of a reassembled PDU]
69 26.629889 192.168.1.63 216.58.201.142 TLSv1 293 Application Data
70 26.648245 216.58.201.142 192.168.1.63 TCP 54 443 → 49420 [ACK] Seq=4079 Ack=2585 Win=48640 Len=0
71 26.677677 216.58.201.142 192.168.1.63 TLSv1 971 Application Data
72 26.678069 216.58.201.142 192.168.1.63 TLSv1 859 Application Data
73 26.678109 192.168.1.63 216.58.201.142 TCP 54 49420 → 443 [ACK] Seq=2585 Ack=5801 Win=65536 Len=0
74 26.718766 192.168.1.63 216.58.201.142 TCP 54 49420 → 443 [RST, ACK] Seq=2585 Ack=5801 Win=0 Len=0
Frame 56: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: IntelCor_3a:04:3a (5c:e0:c5:3a:04:3a), Dst: Mitrasta_3d:35:90 (e0:41:36:3d:35:90)
Internet Protocol Version 4, Src: 192.168.1.63, Dst: 216.58.201.142
0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 52
Identification: 0x0477 (1143)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 128
Protocol: TCP (6)
Header checksum: 0x929c [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.63
Destination: 216.58.201.142
[Source GeoIP: Unknown]
[Destination GeoIP: Unknown]
Transmission Control Protocol, Src Port: 49420, Dst Port: 443, Seq: 0, Len: 0
0000 e0 41 36 3d 35 90 5c e0 c5 3a 04 3a 08 00 45 00 .A6=5.\. .:.:..E.
0010 00 34 04 77 40 00 80 06 92 9c c0 a8 01 3f d8 3a .4.w@... .....?.:
0020 c9 8e c1 0c 01 bb 87 05 6e 29 00 00 00 00 80 02 .... n)......
0030 20 00 33 69 00 00 02 04 05 b4 01 03 03 08 01 01 .3i..... ....
0040 04 02 ..
Frame (frame), 66 bytes
Packets: 17142 · Displayed: 19 (0.1%) · Load time: 0:0.35

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tcp.stream eq 3

	Time	Source	Destination	Protocol	Length	Info
56	26.556748	192.168.1.63	216.58.201.142	TCP	66	49420 → 443 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
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58	26.570683	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [ACK] Seq=1 Ack=1 Win=65536 Len=0
59	26.571868	192.168.1.63	216.58.201.142	TLSv1	174	Client Hello
60	26.585374	216.58.201.142	192.168.1.63	TCP	54	443 → 49420 [ACK] Seq=1 Ack=121 Win=43008 Len=0
61	26.585833	216.58.201.142	192.168.1.63	TLSv1	1484	Server Hello
62	26.586249	216.58.201.142	192.168.1.63	TCP	1484	[TCP segment of a reassembled PDU]
63	26.586249	216.58.201.142	192.168.1.63	TLSv1	1213	CertificateServer Key Exchange, Server Hello Done
64	26.586311	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [ACK] Seq=121 Ack=4020 Win=65536 Len=0
65	26.593698	192.168.1.63	216.58.201.142	TLSv1	188	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
66	26.607963	216.58.201.142	192.168.1.63	TLSv1	113	Change Cipher Spec, Encrypted Handshake Message
67	26.629750	192.168.1.63	216.58.201.142	TLSv1	715	Application Data
68	26.629876	192.168.1.63	216.58.201.142	TCP	1484	[TCP segment of a reassembled PDU]
69	26.629889	192.168.1.63	216.58.201.142	TLSv1	293	Application Data
70	26.648245	216.58.201.142	192.168.1.63	TCP	54	443 → 49420 [ACK] Seq=4079 Ack=2585 Win=48640 Len=0
71	26.677677	216.58.201.142	192.168.1.63	TLSv1	971	Application Data
72	26.678069	216.58.201.142	192.168.1.63	TLSv1	859	Application Data
73	26.678109	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [ACK] Seq=2585 Ack=5801 Win=65536 Len=0
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```
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Internet Protocol Version 4, Src: 192.168.1.63, Dst: 216.58.201.142
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  Total Length: 52
  Identification: 0x0477 (1143)
> Flags: 0x02 (Don't Fragment)
  Fragment offset: 0
  Time to live: 128
  Protocol: TCP (6)
  Header checksum: 0x929c [validation disabled]
  [Header checksum status: Unverified]
  Source: 192.168.1.63
  Destination: 216.58.201.142
  [Source GeoIP: Unknown]
  [Destination GeoIP: Unknown]
Transmission Control Protocol, Src Port: 49420, Dst Port: 443, Seq: 0, Len: 0
```
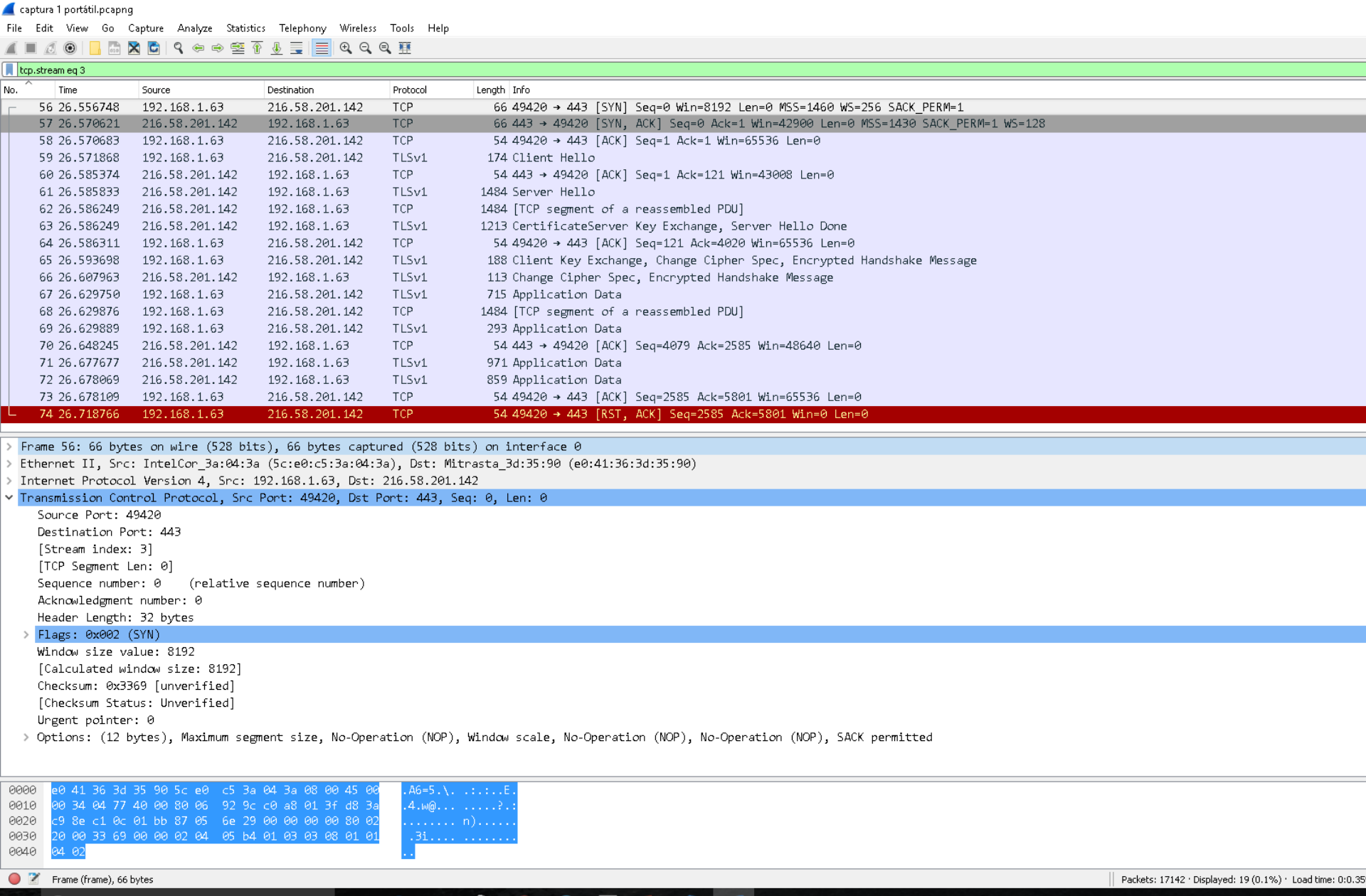

TCP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tcp.stream eq 3
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Internet Protocol Version 4, Src: 192.168.1.63, Dst: 216.58.201.142
Transmission Control Protocol, Src Port: 49420, Dst Port: 443, Seq: 0, Len: 0
Source Port: 49420
Destination Port: 443
[Stream index: 3]
[TCP Segment Len: 0]
Sequence number: 0 (relative sequence number)
Acknowledgment number: 0
Header Length: 32 bytes
Flags: 0x002 (SYN)
Window size value: 8192
[Calculated window size: 8192]
Checksum: 0x3369 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted
0000 e0 41 36 3d 35 90 5c e0 c5 3a 04 3a 08 00 45 00 .A6=5.\. .:.:..E.
0010 00 34 04 77 40 00 80 06 92 9c c0 a8 01 3f d8 3a .4.w@... .....?.:
0020 c9 8e c1 0c 01 bb 87 05 6e 29 00 00 00 00 80 02 .... n)......
0030 20 00 33 69 00 00 02 04 05 b4 01 03 03 08 01 01 .3i..... ....
0040 04 02 ..
Frame (frame), 66 bytes
Packets: 17142 · Displayed: 19 (0.1%) · Load time: 0:0.35

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No.	Time	Source	Destination	Protocol	Length	Info
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58	26.570683	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [ACK] Seq=1 Ack=1 Win=65536 Len=0
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61	26.585833	216.58.201.142	192.168.1.63	TLSv1	1484	Server Hello
62	26.586249	216.58.201.142	192.168.1.63	TCP	1484	[TCP segment of a reassembled PDU]
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66	26.607963	216.58.201.142	192.168.1.63	TLSv1	113	Change Cipher Spec, Encrypted Handshake Message
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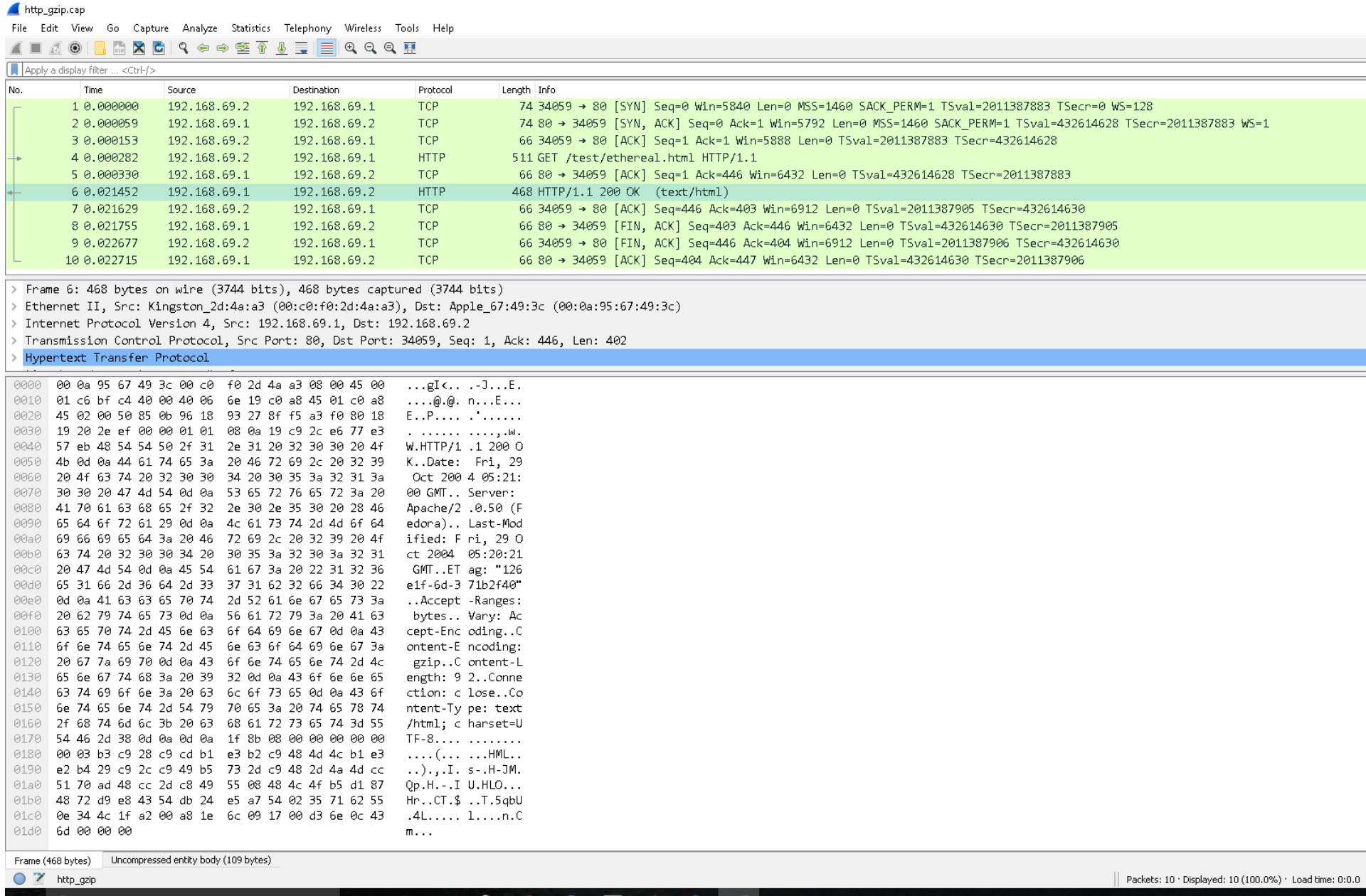
68	26.629876	192.168.1.63	216.58.201.142	TCP	1484	[TCP segment of a reassembled PDU]
69	26.629889	192.168.1.63	216.58.201.142	TLSv1	293	Application Data
70	26.648245	216.58.201.142	192.168.1.63	TCP	54	443 → 49420 [ACK] Seq=4079 Ack=2585 Win=48640 Len=0
71	26.677677	216.58.201.142	192.168.1.63	TLSv1	971	Application Data
72	26.678069	216.58.201.142	192.168.1.63	TLSv1	859	Application Data
73	26.678109	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [ACK] Seq=2585 Ack=5801 Win=65536 Len=0
74	26.718766	192.168.1.63	216.58.201.142	TCP	54	49420 → 443 [RST, ACK] Seq=2585 Ack=5801 Win=0 Len=0

```
> Frame 56: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
> Ethernet II, Src: IntelCor_3a:04:3a (5c:e0:c5:3a:04:3a), Dst: Mitrasta_3d:35:90 (e0:41:36:3d:35:90)
> Internet Protocol Version 4, Src: 192.168.1.63, Dst: 216.58.201.142
v Transmission Control Protocol, Src Port: 49420, Dst Port: 443, Seq: 0, Len: 0
    Source Port: 49420
    Destination Port: 443
    [Stream index: 3]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Acknowledgment number: 0
    Header Length: 32 bytes
  > Flags: 0x002 (SYN)
    Window size value: 8192
    [Calculated window size: 8192]
    Checksum: 0x3369 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  > Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted
```

HTTP


http_gzip.cap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
No. Time Source Destination Protocol Length Info
1 0.000000 192.168.69.2 192.168.69.1 TCP 74 34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 TSval=2011387883 TSecr=0 WS=128
2 0.000059 192.168.69.1 192.168.69.2 TCP 74 80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1460 SACK_PERM=1 TSval=432614628 TSecr=2011387883 WS=1
3 0.000153 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSval=2011387883 TSecr=432614628
4 0.000282 192.168.69.2 192.168.69.1 HTTP 511 GET /test/ethereal.html HTTP/1.1
5 0.000330 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Len=0 TSval=432614628 TSecr=2011387883
6 0.021452 192.168.69.1 192.168.69.2 HTTP 468 HTTP/1.1 200 OK (text/html)
7 0.021629 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=446 Ack=403 Win=6912 Len=0 TSval=2011387905 TSecr=432614630
8 0.021755 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=6432 Len=0 TSval=432614630 TSecr=2011387905
9 0.022677 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=6912 Len=0 TSval=2011387906 TSecr=432614630
10 0.022715 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=404 Ack=447 Win=6432 Len=0 TSval=432614630 TSecr=2011387906
Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
Hypertext Transfer Protocol
0000 00 0a 95 67 49 3c 00 c0 f0 2d 4a a3 08 00 45 00 ...gI<.. .-J...E.
0010 01 c6 bf c4 40 00 40 06 6e 19 c0 a8 45 01 c0 a8 ....@.@. n...E...
0020 45 02 00 50 85 0b 96 18 93 27 8f f5 a3 f0 80 18 E..P.... .'......
0030 19 20 2e ef 00 00 01 01 08 0a 19 c9 2c e6 77 e3 . ...,.w.
0040 57 eb 48 54 54 50 2f 31 2e 31 20 32 30 30 20 4f W.HTTP/1 .1 200 O
0050 4b 0d 0a 44 61 74 65 3a 20 46 72 69 2c 20 32 39 K..Date: Fri, 29
0060 20 4f 63 74 20 32 30 30 34 20 30 35 3a 32 31 3a Oct 200 4 05:21:
0070 30 30 20 47 4d 54 0d 0a 53 65 72 76 65 72 3a 20 00 GMT.. Server:
0080 41 70 61 63 68 65 2f 32 2e 30 2e 35 30 20 28 46 Apache/2 .0.50 (F
0090 65 64 6f 72 61 29 0d 0a 4c 61 73 74 2d 4d 6f 64 edora).. Last-Mod
00a0 69 66 69 65 64 3a 20 46 72 69 2c 20 32 39 20 4f ified: F ri, 29 O
00b0 63 74 20 32 30 30 34 20 30 35 3a 32 30 3a 32 31 ct 2004 05:20:21
00c0 20 47 4d 54 0d 0a 45 54 61 67 3a 20 22 31 32 36 GMT..ET ag: "126
00d0 65 31 66 2d 36 64 2d 33 37 31 62 32 66 34 30 22 e1f-6d-3 71b2f40"
00e0 0d 0a 41 63 63 65 70 74 2d 52 61 6e 67 65 73 3a ..Accept -Ranges:
00f0 20 62 79 74 65 73 0d 0a 56 61 72 79 3a 20 41 63 bytes.. Vary: Ac
0100 63 65 70 74 2d 45 6e 63 6f 64 69 6e 67 0d 0a 43 cept-Enc oding..C
0110 6f 6e 74 65 6e 74 2d 45 6e 63 6f 64 69 6e 67 3a ontent-E ncoding:
0120 20 67 7a 69 70 0d 0a 43 6f 6e 74 65 6e 74 2d 4c gzip..C ontent-L
0130 65 6e 67 74 68 3a 20 39 32 0d 0a 43 6f 6e 6e 65 ength: 9 2..Conne
0140 63 74 69 6f 6e 3a 20 63 6c 6f 73 65 0d 0a 43 6f ction: c lose..Co
0150 6e 74 65 6e 74 2d 54 79 70 65 3a 20 74 65 78 74 ntent-Ty pe: text
0160 2f 68 74 6d 6c 3b 20 63 68 61 72 73 65 74 3d 55 /html; c harset=U
0170 54 46 2d 38 0d 0a 0d 0a 1f 8b 08 00 00 00 00 00 TF-8.... ....
0180 00 03 b3 c9 28 c9 cd b1 e3 b2 c9 48 4d 4c b1 e3 ....(... ...HML..
0190 e2 b4 29 c9 2c c9 49 b5 73 2d c9 48 2d 4a 4d cc ..),.I. s-.H-JM.
01a0 51 70 ad 48 cc 2d c8 49 55 08 48 4c 4f b5 d1 87 Qp.H.-.I U.HLO...
01b0 48 72 d9 e8 43 54 db 24 e5 a7 54 02 35 71 62 55 Hr..CT.$ ..T.5qbU
01c0 0e 34 4c 1f a2 00 a8 1e 6c 09 17 00 d3 6e 0c 43 .4L..... l....n.C
01d0 6d 00 00 00 m...
Frame (468 bytes)
Uncompressed entity body (109 bytes)
http_gzip
Packets: 10 · Displayed: 10 (100.0%) · Load time: 0:0.0

HTTP

http_gzip.cap

ile Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

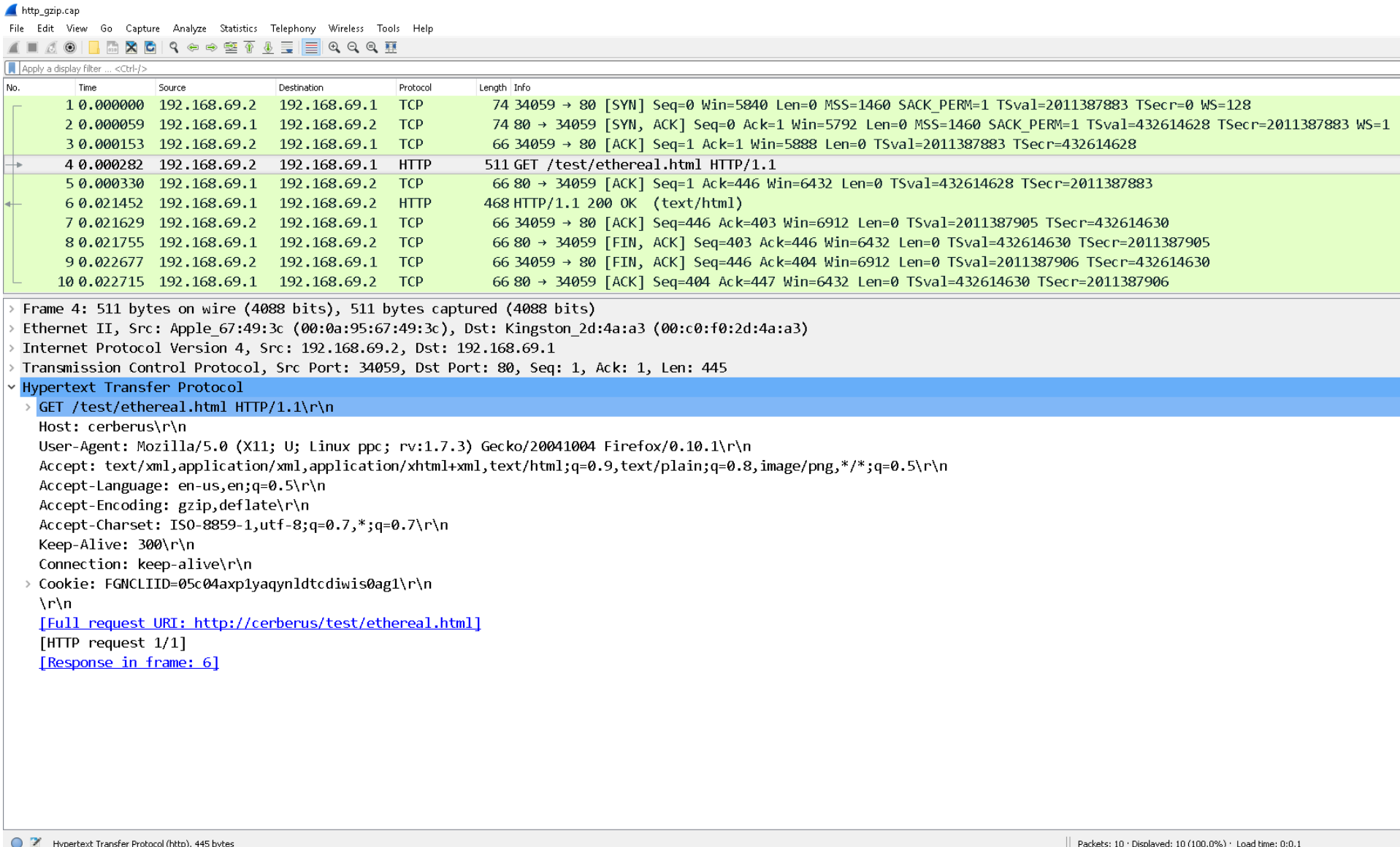
Apply a display filter ... <Ctrl-/>

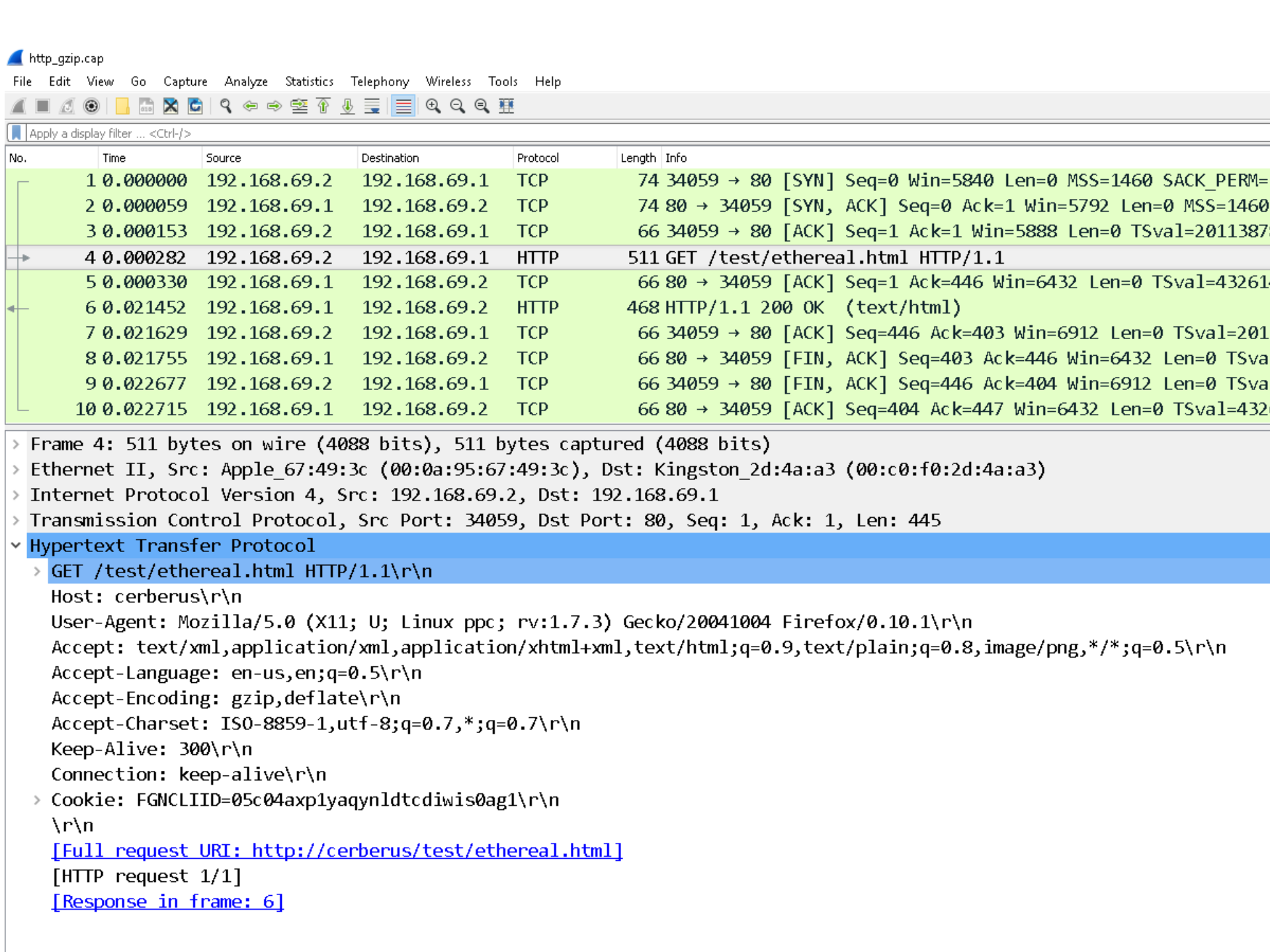
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.69.2	192.168.69.1	TCP	74	34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 TSval=2011387883 TSecr=0
2	0.000059	192.168.69.1	192.168.69.2	TCP	74	80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1460 SACK_PERM=1 TSval=43261462
3	0.000153	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSval=2011387883 TSecr=432614628
4	0.000282	192.168.69.2	192.168.69.1	HTTP	511	GET /test/ethereal.html HTTP/1.1
5	0.000330	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Len=0 TSval=432614628 TSecr=2011387883
6	0.021452	192.168.69.1	192.168.69.2	HTTP	468	HTTP/1.1 200 OK (text/html)
7	0.021629	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=446 Ack=403 Win=6912 Len=0 TSval=2011387905 TSecr=432614630
8	0.021755	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=6432 Len=0 TSval=432614630 TSecr=201138790
9	0.022677	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=6912 Len=0 TSval=2011387906 TSecr=43261463
10	0.022715	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=404 Ack=447 Win=6432 Len=0 TSval=432614630 TSecr=2011387906

```
Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
Hypertext Transfer Protocol
```

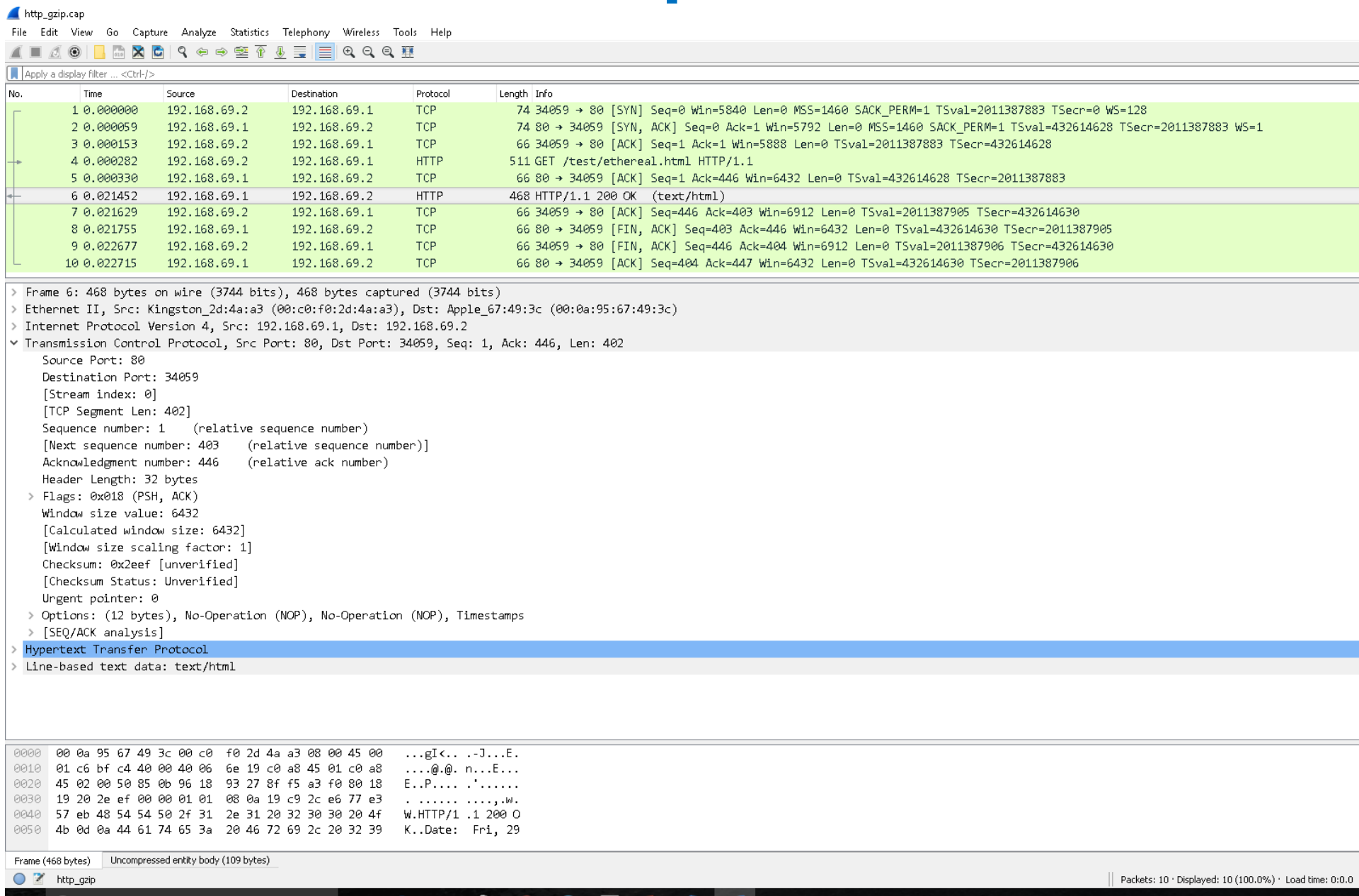
```
0000  00 0a 95 67 49 3c 00 c0  f0 2d 4a a3 08 00 45 00   ...gI<.. .-J...E.
0010  01 c6 bf c4 40 00 40 06  6e 19 c0 a8 45 01 c0 a8   ....@.@. n...E...
0020  45 02 00 50 85 0b 96 18  93 27 8f f5 a3 f0 80 18   E..P.... .'......
0030  19 20 2e ef 00 00 01 01  08 0a 19 c9 2c e6 77 e3   . ...... ....,.w.
0040  57 eb 48 54 54 50 2f 31  2e 31 20 32 30 30 20 4f   W.HTTP/1 .1 200 O
0050  4b 0d 0a 44 61 74 65 3a  20 46 72 69 2c 20 32 39   K..Date:  Fri, 29
0060  20 4f 63 74 20 32 30 30  34 20 30 35 3a 32 31 3a    Oct 200 4 05:21:
0070  30 30 20 47 4d 54 0d 0a  53 65 72 76 65 72 3a 20   00 GMT.. Server:
0080  41 70 61 63 68 65 2f 32  2e 30 2e 35 30 20 28 46   Apache/2 .0.50 (F
0090  65 64 6f 72 61 29 0d 0a  4c 61 73 74 2d 4d 6f 64   edora).. Last-Mod
00a0  69 66 69 65 64 3a 20 46  72 69 2c 20 32 39 20 4f   ified: F ri, 29 O
00b0  63 74 20 32 30 30 34 20  30 35 3a 32 30 3a 32 31   ct 2004  05:20:21
00c0  20 47 4d 54 0d 0a 45 54  61 67 3a 20 22 31 32 36    GMT..ET ag: "126
00d0  65 31 66 2d 36 64 2d 33  37 31 62 32 66 34 30 22   e1f-6d-3 71b2f40"
00e0  0d 0a 41 63 63 65 70 74  2d 52 61 6e 67 65 73 3a   ..Accept -Ranges:
00f0  20 62 79 74 65 73 0d 0a  56 61 72 79 3a 20 41 63    bytes.. Vary: Ac
0100  63 65 70 74 2d 45 6e 63  6f 64 69 6e 67 0d 0a 43   cept-Enc oding..C
0110  6f 6e 74 65 6e 74 2d 45  6e 63 6f 64 69 6e 67 3a   ontent-E ncoding:
0120  20 67 7a 69 70 0d 0a 43  6f 6e 74 65 6e 74 2d 4c    gzip..C ontent-L
0130  65 6e 67 74 68 3a 20 39  32 0d 0a 43 6f 6e 6e 65   ength: 9 2..Conne
0140  63 74 69 6f 6e 3a 20 63  6c 6f 73 65 0d 0a 43 6f   ction: c lose..Co
0150  6e 74 65 6e 74 2d 54 79  70 65 3a 20 74 65 78 74   ntent-Ty pe: text
```

HTTP Request




http_gzip.cap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
No. Time Source Destination Protocol Length Info
1 0.000000 192.168.69.2 192.168.69.1 TCP 74 34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=
2 0.000059 192.168.69.1 192.168.69.2 TCP 74 80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1460
3 0.000153 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSval=2011387
4 0.000282 192.168.69.2 192.168.69.1 HTTP 511 GET /test/ethereal.html HTTP/1.1
5 0.000330 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Len=0 TSval=43261
6 0.021452 192.168.69.1 192.168.69.2 HTTP 468 HTTP/1.1 200 OK (text/html)
7 0.021629 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=446 Ack=403 Win=6912 Len=0 TSval=201
8 0.021755 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=6432 Len=0 TSva
9 0.022677 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=6912 Len=0 TSva
10 0.022715 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=404 Ack=447 Win=6432 Len=0 TSval=432
Frame 4: 511 bytes on wire (4088 bits), 511 bytes captured (4088 bits)
Ethernet II, Src: Apple_67:49:3c (00:0a:95:67:49:3c), Dst: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3)
Internet Protocol Version 4, Src: 192.168.69.2, Dst: 192.168.69.1
Transmission Control Protocol, Src Port: 34059, Dst Port: 80, Seq: 1, Ack: 1, Len: 445
Hypertext Transfer Protocol
GET /test/ethereal.html HTTP/1.1\r\n
Host: cerberus\r\n
User-Agent: Mozilla/5.0 (X11; U; Linux ppc; rv:1.7.3) Gecko/20041004 Firefox/0.10.1\r\n
Accept: text/xml,application/xml,application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;q=0.5\r\n
Accept-Language: en-us,en;q=0.5\r\n
Accept-Encoding: gzip,deflate\r\n
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7\r\n
Keep-Alive: 300\r\n
Connection: keep-alive\r\n
Cookie: FGNCLIID=05c04axp1yaqynldtcdiwis0ag1\r\n
\r\n
[Full request URI: http://cerberus/test/ethereal.html]
[HTTP request 1/1]
[Response in frame: 6]

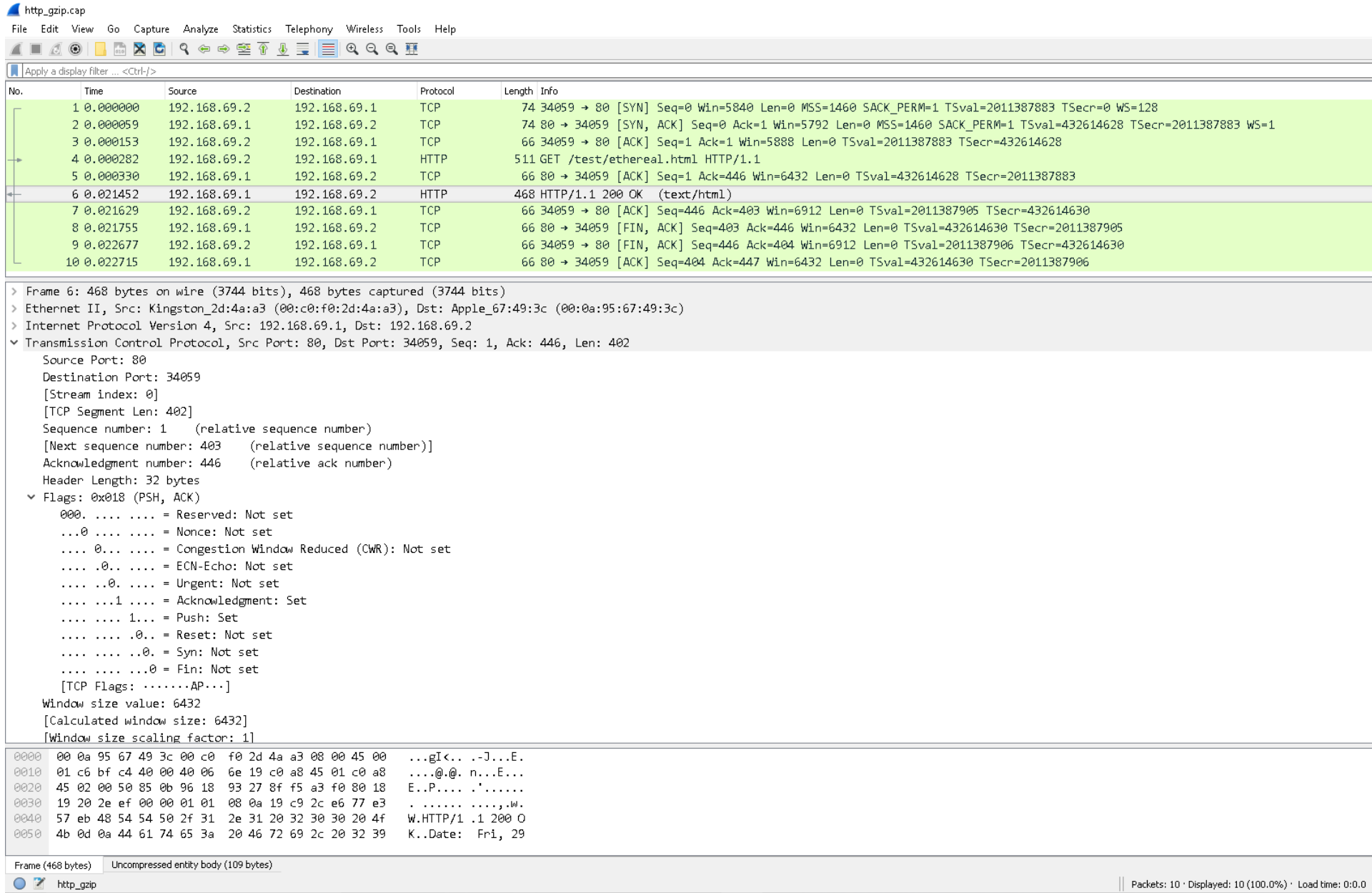
HTTP Response TCP



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.69.2	192.168.69.1	TCP	74	34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=
2	0.000059	192.168.69.1	192.168.69.2	TCP	74	80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792
3	0.000153	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=
4	0.000282	192.168.69.2	192.168.69.1	HTTP	511	GET /test/ethereal.html HTTP/1.1
5	0.000330	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Le
6	0.021452	192.168.69.1	192.168.69.2	HTTP	468	HTTP/1.1 200 OK (text/html)
7	0.021629	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=446 Ack=403 Win=6912
8	0.021755	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=
9	0.022677	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=
10	0.022715	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=404 Ack=447 Win=6432

```
> Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
> Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
> Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
v Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
    Source Port: 80
    Destination Port: 34059
    [Stream index: 0]
    [TCP Segment Len: 402]
    Sequence number: 1    (relative sequence number)
    [Next sequence number: 403    (relative sequence number)]
    Acknowledgment number: 446    (relative ack number)
    Header Length: 32 bytes
  > Flags: 0x018 (PSH, ACK)
    Window size value: 6432
    [Calculated window size: 6432]
    [Window size scaling factor: 1]
    Checksum: 0x2eef [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  > Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
  > [SEQ/ACK analysis]
> Hypertext Transfer Protocol
> Line-based text data: text/html
```

HTTP Response TCP Flags

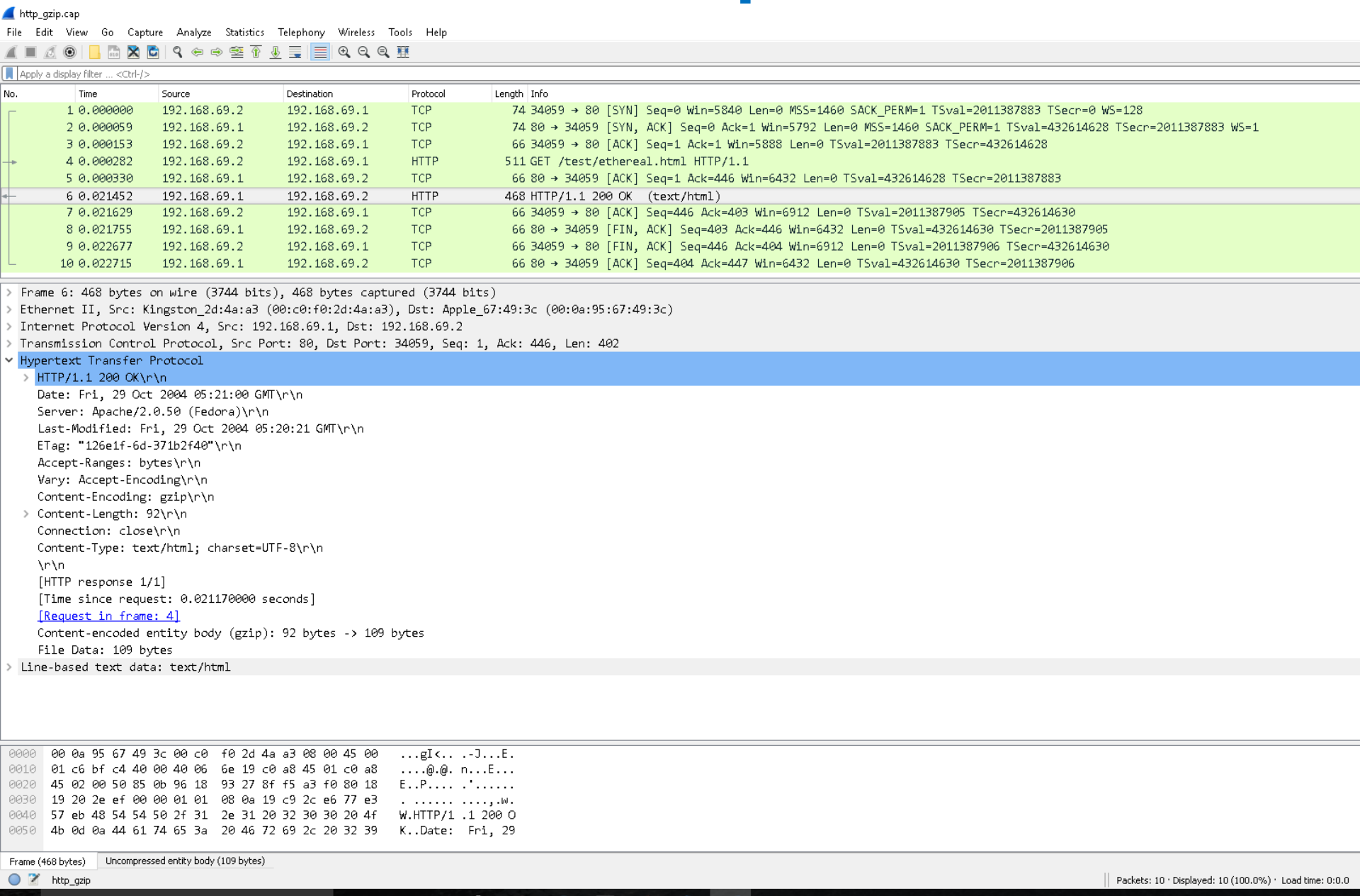


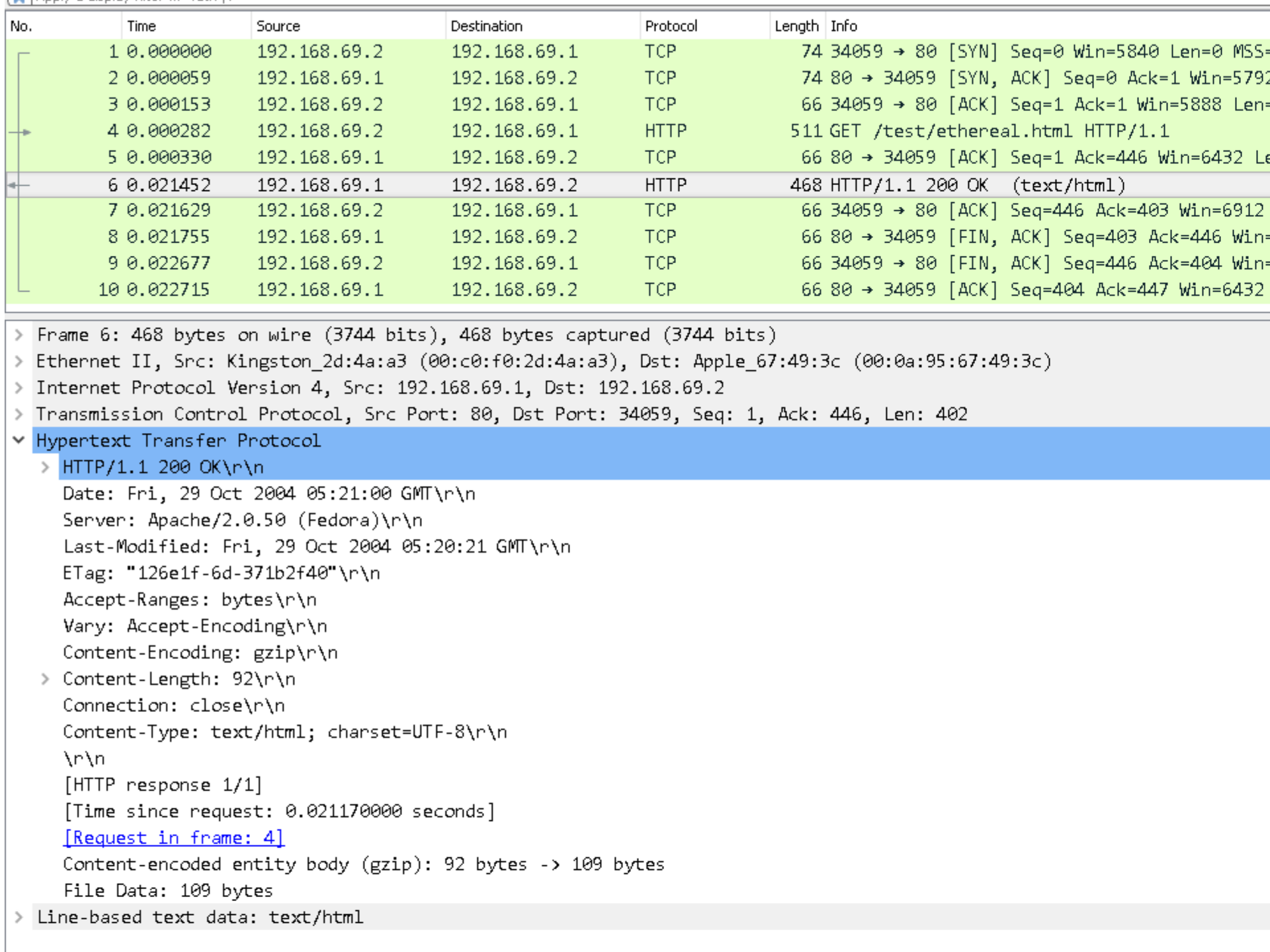
3	0.000153	192.168.69.2	192.168.69.1	TCP	66 34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=
4	0.000282	192.168.69.2	192.168.69.1	HTTP	511 GET /test/ethereal.html HTTP/1.1
5	0.000330	192.168.69.1	192.168.69.2	TCP	66 80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Le
6	0.021452	192.168.69.1	192.168.69.2	HTTP	468 HTTP/1.1 200 OK (text/html)
7	0.021629	192.168.69.2	192.168.69.1	TCP	66 34059 → 80 [ACK] Seq=446 Ack=403 Win=6912
8	0.021755	192.168.69.1	192.168.69.2	TCP	66 80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=
9	0.022677	192.168.69.2	192.168.69.1	TCP	66 34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=
10	0.022715	192.168.69.1	192.168.69.2	TCP	66 80 → 34059 [ACK] Seq=404 Ack=447 Win=6432

```
> Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
> Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
> Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
v Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
    Source Port: 80
    Destination Port: 34059
    [Stream index: 0]
    [TCP Segment Len: 402]
    Sequence number: 1    (relative sequence number)
    [Next sequence number: 403    (relative sequence number)]
    Acknowledgment number: 446    (relative ack number)
    Header Length: 32 bytes
  v Flags: 0x018 (PSH, ACK)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...1 .... = Acknowledgment: Set
      .... .... 1... = Push: Set
      .... .... .0.. = Reset: Not set
      .... .... ..0. = Syn: Not set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ·····AP···]
    Window size value: 6432
    [Calculated window size: 6432]
    [Window size scaling factor: 1]
```

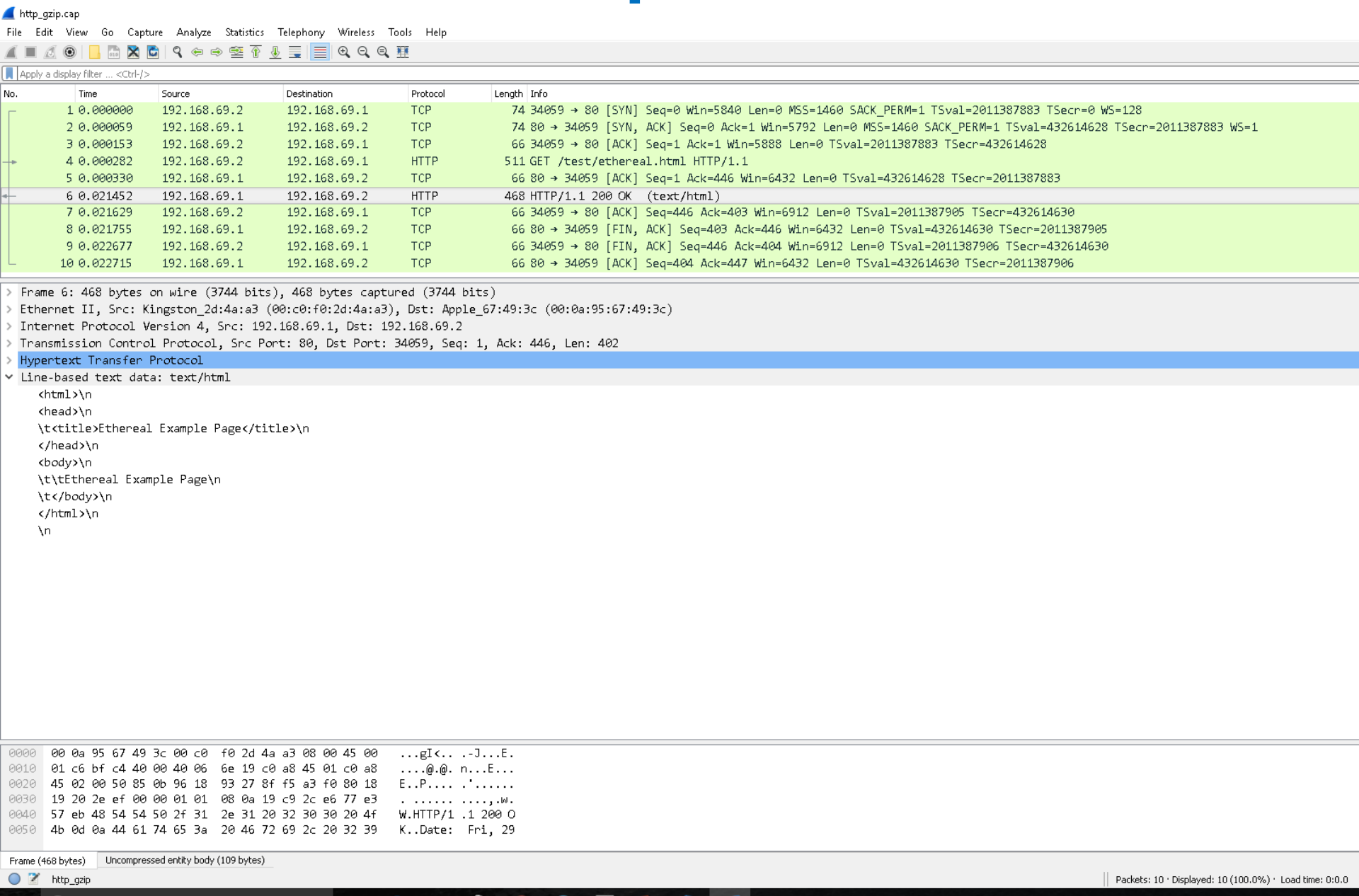
```
0000  00 0a 95 67 49 3c 00 c0  f0 2d 4a a3 08 00 45 00   ···gI<·· ·-J···E·
```

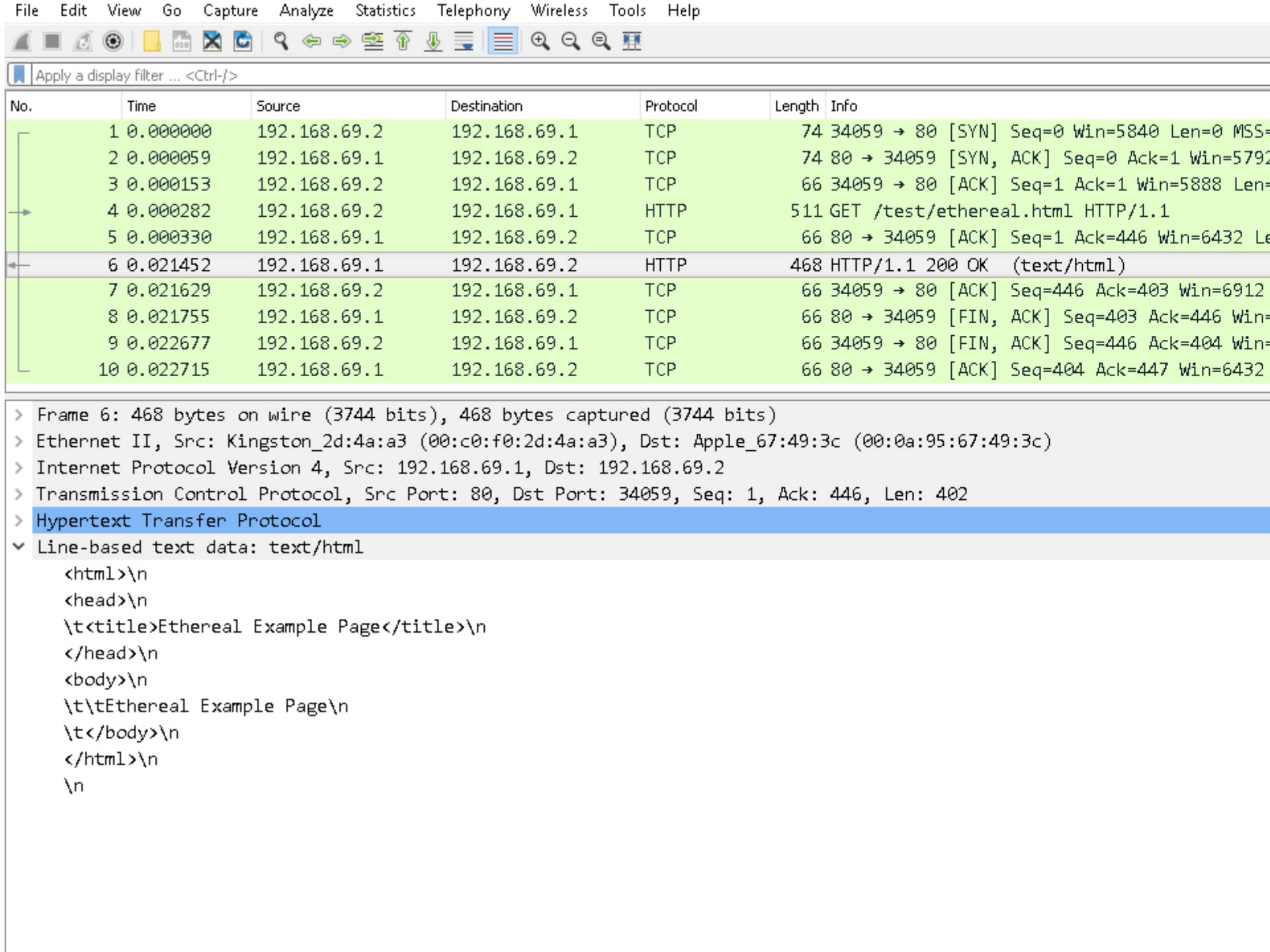
HTTP Response




No. Time Source Destination Protocol Length Info
1 0.000000 192.168.69.2 192.168.69.1 TCP 74 34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=
2 0.000059 192.168.69.1 192.168.69.2 TCP 74 80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792
3 0.000153 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=
4 0.000282 192.168.69.2 192.168.69.1 HTTP 511 GET /test/ethereal.html HTTP/1.1
5 0.000330 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Le
6 0.021452 192.168.69.1 192.168.69.2 HTTP 468 HTTP/1.1 200 OK (text/html)
7 0.021629 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=446 Ack=403 Win=6912
8 0.021755 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=
9 0.022677 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=
10 0.022715 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=404 Ack=447 Win=6432
Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
Hypertext Transfer Protocol
HTTP/1.1 200 OK\r\n
Date: Fri, 29 Oct 2004 05:21:00 GMT\r\n
Server: Apache/2.0.50 (Fedora)\r\n
Last-Modified: Fri, 29 Oct 2004 05:20:21 GMT\r\n
ETag: "126e1f-6d-371b2f40"\r\n
Accept-Ranges: bytes\r\n
Vary: Accept-Encoding\r\n
Content-Encoding: gzip\r\n
Content-Length: 92\r\n
Connection: close\r\n
Content-Type: text/html; charset=UTF-8\r\n
\r\n
[HTTP response 1/1]
[Time since request: 0.021170000 seconds]
[Request in frame: 4]
Content-encoded entity body (gzip): 92 bytes -> 109 bytes
File Data: 109 bytes
Line-based text data: text/html

HTTP Response HTML




File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
No. Time Source Destination Protocol Length Info
1 0.000000 192.168.69.2 192.168.69.1 TCP 74 34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=
2 0.000059 192.168.69.1 192.168.69.2 TCP 74 80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792
3 0.000153 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=
4 0.000282 192.168.69.2 192.168.69.1 HTTP 511 GET /test/ethereal.html HTTP/1.1
5 0.000330 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Le
6 0.021452 192.168.69.1 192.168.69.2 HTTP 468 HTTP/1.1 200 OK (text/html)
7 0.021629 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [ACK] Seq=446 Ack=403 Win=6912
8 0.021755 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=
9 0.022677 192.168.69.2 192.168.69.1 TCP 66 34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=
10 0.022715 192.168.69.1 192.168.69.2 TCP 66 80 → 34059 [ACK] Seq=404 Ack=447 Win=6432
Frame 6: 468 bytes on wire (3744 bits), 468 bytes captured (3744 bits)
Ethernet II, Src: Kingston_2d:4a:a3 (00:c0:f0:2d:4a:a3), Dst: Apple_67:49:3c (00:0a:95:67:49:3c)
Internet Protocol Version 4, Src: 192.168.69.1, Dst: 192.168.69.2
Transmission Control Protocol, Src Port: 80, Dst Port: 34059, Seq: 1, Ack: 446, Len: 402
Hypertext Transfer Protocol
Line-based text data: text/html
<html>\n
<head>\n
\t<title>Ethereal Example Page</title>\n
</head>\n
<body>\n
\t\tEthereal Example Page\n
\t</body>\n
</html>\n
\n