



دانشکده علوم ریاضی

شبکه‌های کامپیوتروی

نیم‌سال اول ۱۳۹۹-۱۴۰۰

مدرس: دکتر لاله ارشدی

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شماره دانشجویی: ۹۷۱۰۳۷۷۹

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- ۱

sender

data from above

- if next available sequence number in window, send packet.

timeout(n)

- mark packet n as received.
- if n smallest unreceived packet, advance window base to next unreceived sequence number.

NACK(n)

- resend packet n , restart timer.

receiver

packet n in [textrcvbase, rcvbase+N-1]

- out-of-order: buffer, NACK($n-1$), set timer.
- in-order: deliver (deliver buffered, in order packets and advance window to not-yet-received packet).

otherwise

- ignore

timeout(n)

- NACK(n)
- reset timer

هر بار که درخواستی گم می‌شود باید گیرنده متوجه آن شود (در حین دریافت بسته‌های بعدی) و آن را دوباره بخواهد و اگر بسته بعد از بسته گم شده ارسال شده باشد زمان تکمیل بسته‌های ما هم بسیار طولانی می‌شود. اما در شرایطی که درخواست‌های زیادی گم نمی‌شوند این پروتکل بسیار خوب عمل می‌کند و در اکثر موقعیت‌های نیازی به پاسخ ندارد.

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آ مثلا درخواست دو فایل A و B را می‌دهیم و پاسخ A یا گم می‌شود یا زمانی که باید به ما می‌رسید سیستم ما خاموش شده است. زمانی که روشن می‌شویم همچنان منتظر پاسخ A هستیم اما پاسخ B را دریافت می‌کنیم. یا مثلا وقتی که درخواست این دو فایل را می‌دهیم اما پاسخ B زودتر می‌رسد.

ب راه حل این است که به هر درخواست قبل ارسال یک شماره‌ای نسبت بدھیم و سرور در پاسخ‌هایش مشخص کند که این پاسخ به چه فایلی است. و بدین ترتیب کلاینت می‌تواند تشخیص دهد پاسخ کدام فایل را گرفته است.

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آ بسته سوم (۲۰۰) با موفقیت ارسال شده اما قبل از رسیدن پاسخ مثبت آن سرور تایم‌اوت شده و آن را دوباره می‌فرستد. و پاسخی مثبت اولیه کلاینت در زمانی بعد ۳۰۰ می‌رسد پس سرور دیگر برای بار سوم ارسال نمی‌کند. برای بسته چهارم نیز سناریو کاملا مشابه رخ می‌دهد و ده میلی ثانیه قبل رسیدن ack آن دوباره retransmit می‌شود.

(ج)

Send	Receive	RTT	Estimated RTT	dif	DevRTT
0	200	200	$100*7/8 + 200/8 = 112.5$	87.5	21.875
10	220	210	$112.5*7/8 + 210/8 = 124.7$	85.3	37.73
20	310	-	-	-	-
30	320	-	-	-	-
320	340	20	$124.7 *7/8 + 20/8 = 111.6$	91.6	51.19

قابل توجه است برای بسته های ۳ و ۴ که retransmit شدند دیگر EstimatedRTT محاسبه نکردیم.
(د)
(ه)

RTT	Estimated RTT		
	$\alpha = 0$	$\alpha = 0.125$	$\alpha = 1$
-	100	112.5	200
200	100	124.7	210
210	100	111.6	20
20	100	111.6	20

از تغیرات زیاد rtt estimated جلوگیری می‌کند و مقداری بینابین حدس قبلی و اخرين rtt میدهد.

TCP ۱

پرسش ۱

IP:192.168.1.102

Port:1161

202 5.455830	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=164091 V
203 5.461175	128.119.245.12	192.168.1.102	HTTP	784 HTTP/1.1 200 OK (text/html)
204 5.500000	192.168.1.102	192.168.1.1	CCP	174 M SEARCH / HTTP/1.1

Wireshark - Packet 203 · tcp-ethereal-trace-1

▶ Frame 203: 784 bytes on wire (6272 bits), 784 bytes captured (6272 bits)
 ▶ Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
 ▶ Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
 ▶ Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 164091, Len: 730
 Source Port: 80
 Destination Port: 1161

پرسش ۲

IP:128.119.245.12

Port:80

192.168.1.102	128.119.245.12	TCP	326 1161 → 80 [A]
128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [A]
192.168.1.102	128.119.245.12	HTTP	104 POST /other

پرسش ۳

265 3.961750	51.158.65.241	192.168.43.29	TCP	66 443 → 52077 [A]
266 3.961848	192.168.43.29	51.158.65.241	TCP	1454 52077 → 443 [A]
267 3.961849	192.168.43.29	51.158.65.241	TCP	1454 52077 → 443 [A]
268 3.961849	192.168.43.29	51.158.65.241	TCP	1454 52077 → 443 [A]

▶ Frame 266: 1454 bytes on wire (11632 bits), 1454 bytes captured (11632 bits) on interface en0,
 ▶ Ethernet II, Src: Apple_42:f1:94 (3c:22:fb:42:f1:94), Dst: be:a5:8b:d0:e5:df (be:a5:8b:d0:e5:df)
 ▶ Internet Protocol Version 4, Src: 192.168.43.29, Dst: 51.158.65.241
 ▶ Transmission Control Protocol, Src Port: 52077, Dst Port: 443, Seq: 142479, Ack: 1, Len: 1388
 Source Port: 52077
 Destination Port: 443
 [Stream index: 11]

IP:192.168.43.29

Port:52077

پرسش ۴

```

TCP 66 52127 → 443 [FIN, ACK] Seq=78 Ack=79 Win=1
TCP 54 443 → 52127 [RST] Seq=79 Win=0 Len=0
TCP 78 52142 → 80 [SYN] Seq=0 Win=65535 Len=0 MS
TCP 78 52143 → 80 [SYN] Seq=0 Win=65535 Len=0 MS
TCP 78 52144 → 80 [SYN] Seq=0 Win=65535 Len=0 MS
TCP 74 80 → 52142 [SYN, ACK] Seq=0 Ack=1 Win=289
TCP 66 52142 → 80 [ACK] Seq=1 Ack=1 Win=131840 L
TCP 80 52142 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131840 L
[Stream index: 2]
[TCP Segment Len: 0]
Sequence Number: 0 (relative sequence number)
Sequence Number (raw): 2811026737
[Next Sequence Number: 1 (relative sequence number)]
Acknowledgment Number: 0
Acknowledgment number (raw): 0
1011 .... = Header Length: 44 bytes (11)
▼ Flags: 0x002 (SYN)
  000. .... .... = Reserved: Not set
  ...0 .... .... = Nonce: Not set
  .... 0.... .... = Congestion Window Reduced (CWR): Not set
  .... .0.... .... = ECN-Echo: Not set
  .... ..0.... .... = Urgent: Not set
  .... ...0.... .... = Acknowledgment: Not set
  .... ....0.... .... = Push: Not set
  .... .....0.... .... = Reset: Not set
  ► .... .... .1. .... = Syn: Set
  .... .... ..0.... .... = Fin: Not set
  [TCP Flags: .....S..]
Window: 65535

```

- a) sequence number = 0
b) the sequence number being zero and the syn flag being set.

پرسش ۵

```

1010 .... = header Length: 40 bytes (10)
▼ Flags: 0x012 (SYN, 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
  .... ....0.... .... = Push: Not set
  .... .....0.... .... = Reset: Not set
  ► .... .... .1. .... = Syn: Set
  .... .... ..0.... .... = Fin: Not set

```

(check previous figure) the sequence number is 0 in response to syn segment).
the value of acknowledgement field in synack is 1 (1+ sender sequence number).
the syn and ack fields being set to 1.

پرسش ۶

```

20 4.235835 8.8.4.4 192.168.43.29 DNS 93 Standard query response 0xcfa A gai
21 4.236388 192.168.43.29 128.119.245.12 TCP 78 52142 → 80 [SYN] Seq=0 Win=65535 Len=
22 4.236836 192.168.43.29 128.119.245.12 TCP 78 52143 → 80 [SYN] Seq=0 Win=65535 Len=
23 4.270799 216.58.209.142 192.168.43.29 UDP 67 443 → 58408 Len=25
24 4.419713 192.168.43.29 128.119.245.12 TCP 78 52144 → 80 [SYN] Seq=0 Win=65535 Len=
25 4.427296 128.119.245.12 192.168.43.29 TCP 74 80 → 52142 [SYN, ACK] Seq=0 Ack=1 Win=1
26 4.427399 192.168.43.29 128.119.245.12 TCP 66 52142 → 80 [ACK] Seq=1 Ack=1 Win=1318
27 4.427811 192.168.43.29 128.119.245.12 TCP 800 52142 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1
28 4.427931 192.168.43.29 128.119.245.12 TCP 1454 52142 → 80 [ACK] Seq=735 Ack=1 Win=13
29 4.427931 192.168.43.29 128.119.245.12 TCP 1454 52142 → 80 [ACK] Seq=2123 Ack=1 Win=1
30 4.432839 128.119.245.12 192.168.43.29 TCP 74 80 → 52143 [SYN, ACK] Seq=0 Ack=1 Win=1
[31. Cumulative 21 192.168.43.29 128.119.245.12 TCP 66 52142 → 80 [ACK] Seq=1 Ack=1 Win=1318
[TCP Segment Len: 734]
Sequence Number: 1 (relative sequence number)
Sequence Number (raw): 2811026738
[Next Sequence Number: 735 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 4070700690
1000 .... = Header Length: 32 bytes (8)
▶ Flags: 0x018 (PSH, ACK)
Window: 2060
[Calculated window size: 131840]
[Window size scaling factor: 64]
Checksum: 0x26ad [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
▶ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
▶ [SEQ/ACK analysis]
▶ [Timestamps]
TCP payload (734 bytes)
▼ Data (734 bytes)
Data: 504f5354202f77697265736861726b2d6c6162732f6c6162332d312d7265706c792e6874...
[Length: 734]
0040 89 17 50 4f 53 54 20 2f 77 69 72 65 73 68 61 72 · POST / wireshar
● Data (data), 734 bytes
● Packets: 297 · Displayed: 297 (100.0%) · Dropped: 0 (0.0%)

```

sequence number = 1

پرسش ۷

Seq #	Send	Receive	RTT	Estimated RTT
1	4.427811	4.626372	0.198561	0.198561
735	4.427931	4.629205	0.201274	0.198900
2123	4.427931	4.631127	0.203196	0.199437
3511	4.626465	4.933905	0.307440	0.212937
4899	4.629273	4.933909	0.304636	0.224399
6287	4.629273	4.933910	0.304636	0.234429

پرسش ۸

پرسش ۹

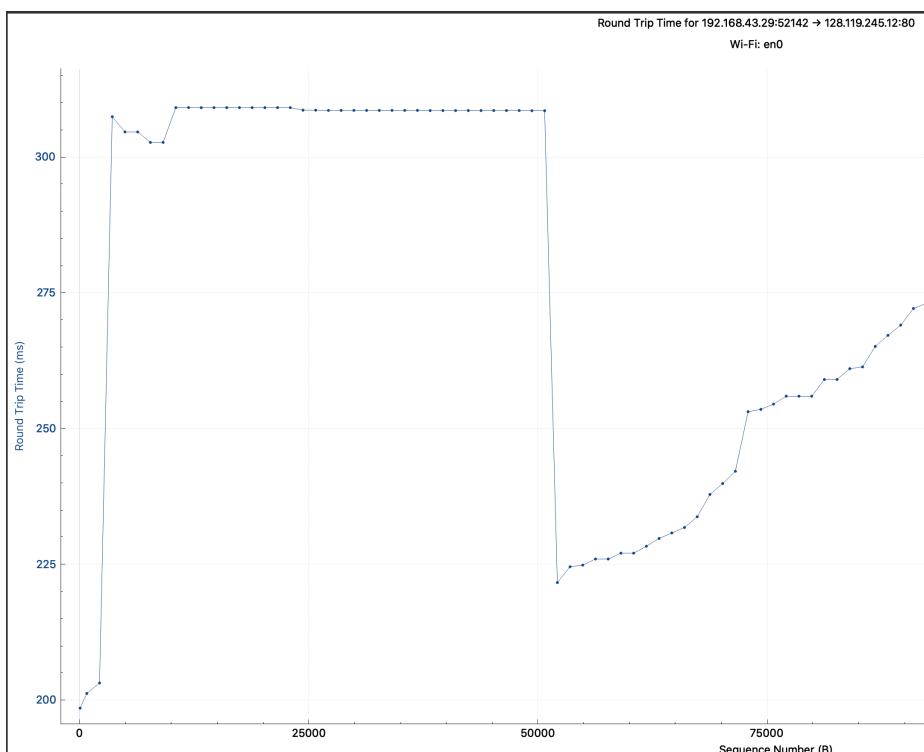
پرسش ۱۰

پرسش ۱۱

26	4.427399	192.168.43.29	128.119.245.12	TCP	66	52142 → 80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1
27	4.427811	192.168.43.29	128.119.245.12	TCP	800	52142 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131840 Len=734
28	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=735 Ack=1 Win=131840 Len=1388 TS
29	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=2123 Ack=1 Win=131840 Len=1388 T
30	4.432839	128.119.245.12	192.168.43.29	TCP	74	80 → 52143 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS
31	4.432951	192.168.43.29	128.119.245.12	TCP	66	52143 → 80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1
32	4.624820	128.119.245.12	192.168.43.29	TCP	74	80 → 52144 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS
33	4.624886	192.168.43.29	128.119.245.12	TCP	66	52144 → 80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1
34	4.626372	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=735 Win=30464 Len=0 TSval=
35	4.626465	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=3511 Ack=1 Win=131840 Len=1388 T
36	4.629205	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=2123 Win=33408 Len=0 TSval
37	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=4899 Ack=1 Win=131840 Len=1388 T
38	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=6287 Ack=1 Win=131840 Len=1388 T
39	4.631127	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=3511 Win=36224 Len=0 TSval
40	4.631197	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=7675 Ack=1 Win=131840 Len=1388 T
41	4.631198	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=9063 Ack=1 Win=131840 Len=1388 T
42	4.933905	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=4899 Win=39168 Len=0 TSval
43	4.933909	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=6287 Win=42112 Len=0 TSval
44	4.933909	128.119.245.12	192.168.43.29	TCP	78	[TCP Window Update] 80 → 52142 [ACK] Seq=1 Ack=6287 Win=42112
45	4.933910	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=9063 Win=47872 Len=0 TSval
46	4.933911	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=10451 Win=50816 Len=0 TSval
47	4.933967	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=10451 Ack=1 Win=131840 Len=1388

▶ Frame 193: 1095 bytes on wire (8760 bits), 1095 bytes captured (8760 bits) on interface en0, id 0
 ▶ Ethernet II, Src: Apple_42:f1:94 (3c:22:fb:42:f1:94), Dst: be:a5:8b:d0:e5:df (be:a5:8b:d0:e5:df)
 ▶ Destination: be:a5:8b:d0:e5:df (be:a5:8b:d0:e5:df)
 Address: be:a5:8b:d0:e5:df (be:a5:8b:d0:e5:df)
1. = LG bit: Locally administered address (this is NOT the factory default)
0. = IG bit: Individual address (unicast)
 ▶ Source: Apple_42:f1:94 (3c:22:fb:42:f1:94)
 Address: Apple_42:f1:94 (3c:22:fb:42:f1:94)
0. = LG bit: Globally unique address (factory default)
0. = IG bit: Individual address (unicast)
 Type: IPv4 (0x0800)
 ▶ Internet Protocol Version 4, Src: 192.168.43.29, Dst: 128.119.245.12
 ▶ Transmission Control Protocol, Src Port: 52142, Dst Port: 80, Seq: 152027, Ack: 1, Len: 1029
 ▶ [111 Reassembled TCP Segments (153055 bytes): #27(734), #28(1388), #29(1388), #35(1388), #37(1388), #38(1388), #40(1388), #41(1388), #42(1388), #43(1388), #44(1388), #45(1388), #46(1388), #47(1388)]
 [Frame: 27, payload: 0-733 (734 bytes)]
 [Frame: 28, payload: 734-2121 (1388 bytes)]

شكل ١: packets of http message shown with dot



شكل ٢: RTT Change

25	4.427296	128.119.245.12	192.168.43.29	TCP	74	80 → 52142	[S]
26	4.427399	192.168.43.29	128.119.245.12	TCP	66	52142 → 80	[P]
27	4.427811	192.168.43.29	128.119.245.12	TCP	800	52142 → 80	[P]
28	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
29	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
30	4.432839	128.119.245.12	192.168.43.29	TCP	74	80 → 52143	[S]
31	4.432951	192.168.43.29	128.119.245.12	TCP	66	52143 → 80	[P]
32	4.624820	128.119.245.12	192.168.43.29	TCP	74	80 → 52144	[S]
33	4.624886	192.168.43.29	128.119.245.12	TCP	66	52144 → 80	[P]
34	4.626372	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[P]
35	4.626465	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
36	4.629205	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]
37	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
38	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
39	4.631127	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]
40	4.631197	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
41	4.631198	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
42	4.933905	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]

.....0..... = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
► Internet Protocol Version 4, Src: 192.168.43.29, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 52142, Dst Port: 80, Seq: 1, Ack: 1, Len: 734
 Source Port: 52142
 Destination Port: 80
 [Stream index: 2]
 [TCP Segment Len: 734]
 Sequence Number: 1 (relative sequence number)
 Sequence Number (raw): 2811026738

شكل ٣ : tcp segment len: 734

26	4.427399	192.168.43.29	128.119.245.12	TCP	66	52142 → 80	[P]
27	4.427811	192.168.43.29	128.119.245.12	TCP	800	52142 → 80	[P]
28	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
29	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
30	4.432839	128.119.245.12	192.168.43.29	TCP	74	80 → 52143	[S]
31	4.432951	192.168.43.29	128.119.245.12	TCP	66	52143 → 80	[A]
32	4.624820	128.119.245.12	192.168.43.29	TCP	74	80 → 52144	[S]
33	4.624886	192.168.43.29	128.119.245.12	TCP	66	52144 → 80	[A]
34	4.626372	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]
35	4.626465	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
36	4.629205	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]
37	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
38	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
39	4.631127	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]
40	4.631197	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
41	4.631198	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[A]
42	4.933905	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[A]

.....0..... = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
► Internet Protocol Version 4, Src: 192.168.43.29, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 52142, Dst Port: 80, Seq: 735, Ack: 1, Len: 1388
 Source Port: 52142
 Destination Port: 80
 [Stream index: 2]
 [TCP Segment Len: 1388]
 Sequence Number: 735 (relative sequence number)
 Sequence Number (raw): 2811027472

شكل ٤ : tcp segment len of the rest: 1388

26	4.427399	192.168.43.29	128.119.245.12	TCP	66	52142 → 80	[ACK]
27	4.427811	192.168.43.29	128.119.245.12	TCP	800	52142 → 80	[PSH]
28	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
29	4.427931	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
30	4.432839	128.119.245.12	192.168.43.29	TCP	74	80 → 52143	[SYN]
31	4.432951	192.168.43.29	128.119.245.12	TCP	66	52143 → 80	[ACK]
32	4.624820	128.119.245.12	192.168.43.29	TCP	74	80 → 52144	[SYN]
33	4.624886	192.168.43.29	128.119.245.12	TCP	66	52144 → 80	[ACK]
34	4.626372	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[ACK]
35	4.626465	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
36	4.629205	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[ACK]
37	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
38	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
39	4.631127	128.119.245.12	192.168.43.29	TCP	66	80 → 52142	[ACK]
40	4.631197	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]
41	4.631198	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80	[ACK]

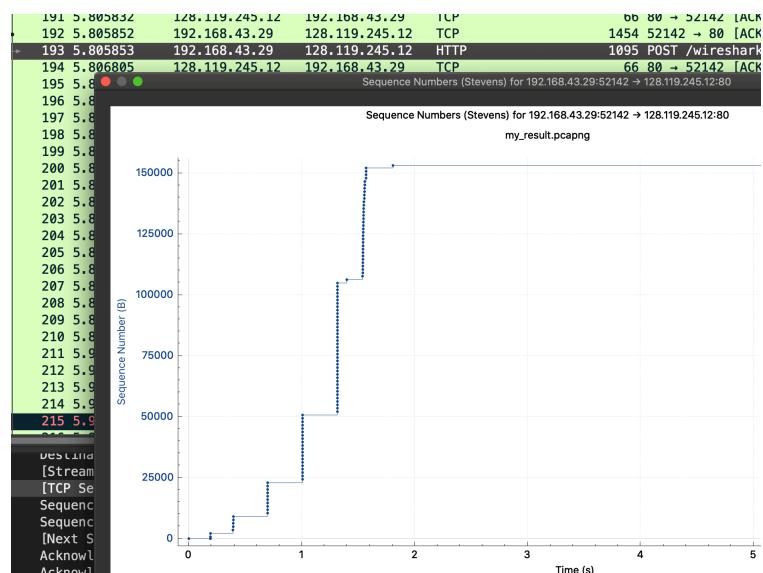
شکل ۵: len with headers: 800, 1454, 1454, 1454, 1454, 1454 : ۵

31	4.432951	192.168.43.29	128.119.245.12	TCP	66	52143 → 80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1168505513 TSecr=2886502686	521...
32	4.624820	128.119.245.12	192.168.43.29	TCP	74	80 → 52144 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1400 SACK_PERM=1 TSval=2886502860	80
33	4.624886	192.168.43.29	128.119.245.12	TCP	66	52144 → 80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1168505704 TSecr=2886502860	521...
34	4.626372	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=735 Win=30464 Len=0 TSval=2886502878 TSecr=1168505508	80
35	4.626465	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=3511 Ack=1 Win=131840 Len=1388 TSval=1168505705 TSecr=2886502878 [...]	521...
36	4.629205	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=2123 Win=33408 Len=0 TSval=2886502881 TSecr=1168505508	80
37	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=4899 Ack=1 Win=131840 Len=1388 TSval=1168505707 TSecr=2886502881 [...]	521...
38	4.629273	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=6287 Ack=1 Win=131840 Len=1388 TSval=1168505707 TSecr=2886502881 [...]	521...
39	4.631127	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=751 Win=36044 Len=0 TSval=2886502893 TSecr=1168505508	80

initial receiver window size of 28960 bytes.

شکل ۶

sender never throttles because receiver's window size is (far) smaller.



شکل ۷: no, the sequence numbers are only increasing. :۷

	Time	Source	Destination	Protocol	Length	Info
144	5.752291	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=104853 ACK=1 Win=131840 Len=1388 TSva
145	5.634790	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=106223 Ack=1 Win=131840 Len=1388 TSva
146	5.773781	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=53479 Win=140288 Len=0 TSval=288
147	5.773853	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=107611 Ack=1 Win=131840 Len=1388 TSva
148	5.776691	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=54867 Win=143232 Len=0 TSval=288
149	5.776771	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=108999 Ack=1 Win=131840 Len=1388 TSva
150	5.776772	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=110387 Ack=1 Win=131840 Len=1388 TSva
151	5.777008	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=56255 Win=146048 Len=0 TSval=288
152	5.777061	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=111775 Ack=1 Win=131840 Len=1388 TSva
153	5.777062	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=113163 Ack=1 Win=131840 Len=1388 TSva
154	5.778125	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=59031 Win=151936 Len=0 TSval=288
155	5.778175	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=114551 Ack=1 Win=131840 Len=1388 TSva
156	5.778176	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=115939 Ack=1 Win=131840 Len=1388 TSva
157	5.778176	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=117327 Ack=1 Win=131840 Len=1388 TSva
158	5.778177	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=118715 Ack=1 Win=131840 Len=1388 TSva

typically it's 1388 bytes. sometimes (as highlighted) it's more. as it can be seen here : ٨ شكل
more than a packet (two) was acked altogether here.

	Time	Source	Destination	Protocol	Length	Info
187	5.779131	128.119.245.12	192.168.43.29	TCP	1454	52142 → 80 [ACK] Seq=116775 Ack=1 Win=131840 Len=1388 TSva
188	5.805404	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=74296 Win=183296 Len=0 TS
189	5.805455	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=147863 Ack=1 Win=131840 Len=1388 TSva
190	5.805455	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=149251 Ack=1 Win=131840 Len=1388 TSva
191	5.805832	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=75687 Win=183296 Len=0 TS
192	5.805852	192.168.43.29	128.119.245.12	TCP	1454	52142 → 80 [ACK] Seq=150639 Ack=1 Win=131840 Len=1388 TSva
193	5.805853	192.168.43.29	128.119.245.12	HTTP	1095	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text)
194	5.806805	128.119.245.12	192.168.43.29	TCP	66	80 → 52142 [ACK] Seq=1 Ack=77075 Win=183296 Len=0 TS

$$75687 / (5.8058 - 4.624886) = 64.091 \text{ Kbyte/sec.} : ٩ \text{ شكل}$$

UDP ٢

- ١

16	4.175035	216.58.209.142	192.168.43.29	UDP	221	443 → 58408 Len=179
17	4.175294	216.58.209.142	192.168.43.29	UDP	67	443 → 58408 Len=25
18	4.175308	192.168.43.29	216.58.209.142	UDP	77	58408 → 443 Len=35
19	4.201882	192.168.43.29	216.58.209.142	UDP	75	58408 → 443 Len=33
20	4.235835	8.8.4.4	192.168.43.29	DNS	93	Standard query response 0
22	4.270700	216.58.209.142	192.168.43.29	UDP	67	443 → 58408 Len=25

► Frame 17: 67 bytes on wire (536 bits), 67 bytes captured (536 bits) on interface en0, id 0
 ► Ethernet II, Src: be:a5:8b:d0:e5:df (be:a5:8b:d0:e5:df), Dst: Apple_42:f1:94 (3c:22:fb:42:f1:94)
 ► Internet Protocol Version 4, Src: 216.58.209.142, Dst: 192.168.43.29
 ▾ User Datagram Protocol, Src Port: 443, Dst Port: 58408
 Source Port: 443
 Destination Port: 58408
 Length: 33
 Checksum: 0x1b14 [unverified]
 [Checksum Status: Unverified]
 [Stream index: 1]
 ▼ [Timestamps]
 [Time since first frame: 0.258750000 seconds]
 [Time since previous frame: 0.000259000 seconds]
 UDP payload (25 bytes)
 ▾ Data (25 bytes)

fields source port, destination port, length, checksum

- ٢

0010	00	35	00	00	40	00	34	11	b0	a9	d8	3a
0020	2b	1d	01	bb	e4	28	00	21	1b	14	57	18
0030	dc	0d	d8	cb	c1	d9	f0	eb	ba	45	5c	8c
0040	f6	e0	70									

User Datagram Protocol (udp), 8 bytes

length of header fields each 2 bytes in size, with a total of 8

- ↗

0010	00	35	00	00	40	00	34	11	b0	a9	d8	3a
0020	2b	1d	01	bb	e4	28	00	21	1b	14	57	18
0030	dc	0d	d8	cb	c1	d9	f0	eb	ba	45	5c	8c
0040	f6	e0	70									

User Datagram Protocol (udp), 8 bytes

length field it's sum of udp header length and payload ($8 + 25$ bytes payload) .

4- max payload size 2 bytes for showing length, resulting in 2^{16} distinct numbers. (excluding 8 bytes for header)

5- biggest port number 2^{16} bytes = 64 KB

6- protocol number 17 (0x11)

7- ports ports from each ip stays the same.

15	4.175035	192.108.43.29	216.58.209.142	192.168.43.29	UDP	/5 58408 → 443 Len=35
16	4.175294	216.58.209.142	192.168.43.29	216.58.209.142	UDP	221 443 → 58408 Len=179
17	4.175308	192.168.43.29	216.58.209.142	192.168.43.29	UDP	67 443 → 58408 Len=25