

## به نام خالق رنگین کمان

ستاره باباجانی - زهرا طباطبائی - گزارش تمرین سری 7

بخش 2 ب: در این مرحله اقدام به محدودسازی پهنای باند اینترفیس eth1 به 3Mbps می‌کنیم. این کار را با استفاده از دستور زیر انجام می‌دهیم.

---

*link.r1sw2.intf1.config(bw=3)*

---

```
info('\n** Modifying Link Parameters \n')
"""
    Default parameters for links:
    bw = None,
    delay = None,
    jitter = None,
    loss = None,
    disable_gro = True,
    speedup = 0,
    use_hfsc = False,
    use_tbf = False,
    latency_ms = None,
    enable_ecn = False,
    enable_red = False,
    max_queue_size = None
"""
link_r1sw2.intf1.config(bw=3, enable_red=True, enable_ecn=True)

net.start()
```

توپولوژی قبلی را clean-up کرده و مجدداً فایل پایتون را اجرا می‌کنیم تا تغییرات اعمال شود.

سوال 4: همانطور که مشاهده می‌شود، در ستون length مقدار فریم‌های Ethernet مقدار 1042 بایت است که با مقدار تئوری همخوانی دارد.

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length	Info
26734	8.619134927	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26735	8.623083419	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26736	8.624673451	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26737	8.634138064	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26738	8.634142636	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26739	8.644239261	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26740	8.644244725	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26741	8.646707394	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26742	8.648478389	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26743	8.651192132	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26744	8.654208011	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26745	8.659075294	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26746	8.659812726	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26747	8.664477379	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26748	8.666078752	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26749	8.668044319	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26750	8.671929825	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26751	8.673565291	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26752	8.677201587	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26753	8.679940819	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26754	8.681954355	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26755	8.687872400	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26756	8.687876190	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26757	8.689992058	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26758	8.694491150	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26759	8.696340951	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26760	8.698443497	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26761	8.701338125	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26762	8.707195986	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26763	8.707201296	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26764	8.736152602	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000
26765	8.736159157	10.10.0.1	10.10.1.3	UDP	1042	49693 → 10000 Len=1000

سوال 5: برای محاسبه‌ی حداکثر مقدار قابل دستیابی برای گزردهی داده‌های کاربردی (goodput) داریم:

$$goodput = bw \times \frac{1000}{1042} = 3 \times 0.96 = 2.88 \text{ Mbps}$$

سوال 6: پس از راه‌اندازی مجدد سرور UDP با پورت 10000 روی h3 و کلاینت UDP روی h1 با نرخ 100Kbps داریم:

"host: h1"			x	"host: h3"			x
9.4s	- sent:	118 pkts, 100.1 kbits/s		31.1s	- received:	118/ sent: 118 pkts (loss 0.000%), 100.0 kbit/s	
10.4s	- sent:	131 pkts, 100.2 kbits/s		32.2s	- received:	131/ sent: 131 pkts (loss 0.000%), 100.0 kbit/s	
11.4s	- sent:	144 pkts, 100.3 kbits/s		33.2s	- received:	144/ sent: 144 pkts (loss 0.000%), 100.0 kbit/s	
12.5s	- sent:	157 pkts, 99.8 kbits/s		34.3s	- received:	157/ sent: 157 pkts (loss 0.000%), 100.0 kbit/s	
13.5s	- sent:	170 pkts, 100.1 kbits/s		35.3s	- received:	170/ sent: 170 pkts (loss 0.000%), 100.0 kbit/s	
14.6s	- sent:	183 pkts, 100.0 kbits/s		36.3s	- received:	183/ sent: 183 pkts (loss 0.000%), 100.0 kbit/s	
15.6s	- sent:	196 pkts, 100.3 kbits/s		37.4s	- received:	196/ sent: 196 pkts (loss 0.000%), 100.0 kbit/s	
16.6s	- sent:	209 pkts, 100.0 kbits/s		38.4s	- received:	209/ sent: 209 pkts (loss 0.000%), 100.0 kbit/s	
17.7s	- sent:	222 pkts, 99.9 kbits/s		39.5s	- received:	222/ sent: 222 pkts (loss 0.000%), 100.0 kbit/s	
18.7s	- sent:	235 pkts, 100.2 kbits/s		40.5s	- received:	235/ sent: 235 pkts (loss 0.000%), 99.9 kbit/s	
19.8s	- sent:	248 pkts, 99.8 kbits/s		41.5s	- received:	248/ sent: 248 pkts (loss 0.000%), 100.1 kbit/s	
20.8s	- sent:	261 pkts, 100.1 kbits/s		42.6s	- received:	261/ sent: 261 pkts (loss 0.000%), 100.0 kbit/s	
21.8s	- sent:	274 pkts, 100.3 kbits/s		43.6s	- received:	274/ sent: 274 pkts (loss 0.000%), 99.9 kbit/s	
22.9s	- sent:	287 pkts, 99.8 kbits/s		44.7s	- received:	287/ sent: 287 pkts (loss 0.000%), 100.1 kbit/s	
23.9s	- sent:	300 pkts, 100.1 kbits/s		45.7s	- received:	300/ sent: 300 pkts (loss 0.000%), 100.0 kbit/s	
25.0s	- sent:	313 pkts, 100.2 kbits/s		46.7s	- received:	313/ sent: 313 pkts (loss 0.000%), 100.0 kbit/s	
26.0s	- sent:	326 pkts, 100.3 kbits/s		47.8s	- received:	326/ sent: 326 pkts (loss 0.000%), 100.0 kbit/s	
27.0s	- sent:	339 pkts, 100.1 kbits/s		48.8s	- received:	339/ sent: 339 pkts (loss 0.000%), 100.1 kbit/s	
28.1s	- sent:	352 pkts, 100.0 kbits/s		49.9s	- received:	352/ sent: 352 pkts (loss 0.000%), 100.0 kbit/s	
29.1s	- sent:	365 pkts, 100.0 kbits/s		50.9s	- received:	365/ sent: 365 pkts (loss 0.000%), 100.0 kbit/s	
30.2s	- sent:	378 pkts, 100.2 kbits/s		51.9s	- received:	378/ sent: 378 pkts (loss 0.000%), 99.8 kbit/s	
31.2s	- sent:	391 pkts, 100.0 kbits/s		53.0s	- received:	391/ sent: 391 pkts (loss 0.000%), 100.2 kbit/s	
^Cpackets sent = 396, avg rate= 100.0kbps				packet received = 396 / 396 sent: 0.000% loss			

همانطور که مشاهده می‌شود، مقدار loss صفر و مقدار goodput حدود 100Kbps می‌باشد.

سوال 7: پس از اجرای عملیات بالا در نرخ‌های 3Mbps و 10Mbps داریم:

- اجرا با نرخ 3Mbps: همانطور که مشاهده می‌شود، مقدار goodput حدود بازه‌ی 2850-2860 است که بسیار به عددی که به دست آوردیم (2.88 Mbps) نزدیک است و تقریباً همخوانی دارد چون مقدار packet loss کم است.

"host: h1"	"host: h3"
55.1s - sent: 20675 pkts, 3001.4 kbits/s	136.8s - received: 19724/ sent: 20628 pkts (loss 4.382%), 2855.7 kbit/s
56.1s - sent: 21051 pkts, 3002.9 kbits/s	137.8s - received: 20082/ sent: 21003 pkts (loss 4.385%), 2856.4 kbit/s
57.1s - sent: 21427 pkts, 3006.8 kbits/s	138.8s - received: 20440/ sent: 21379 pkts (loss 4.392%), 2857.0 kbit/s
58.1s - sent: 21803 pkts, 3002.1 kbits/s	139.8s - received: 20798/ sent: 21755 pkts (loss 4.399%), 2860.2 kbit/s
59.1s - sent: 22179 pkts, 3002.7 kbits/s	140.8s - received: 21156/ sent: 22130 pkts (loss 4.401%), 2857.2 kbit/s
60.1s - sent: 22555 pkts, 3001.4 kbits/s	141.8s - received: 21513/ sent: 22506 pkts (loss 4.412%), 2855.4 kbit/s
61.1s - sent: 22930 pkts, 2999.9 kbits/s	142.8s - received: 21872/ sent: 22882 pkts (loss 4.414%), 2868.5 kbit/s
62.1s - sent: 23306 pkts, 3004.6 kbits/s	143.8s - received: 22229/ sent: 23256 pkts (loss 4.416%), 2851.5 kbit/s
63.2s - sent: 23682 pkts, 3004.3 kbits/s	144.8s - received: 22588/ sent: 23633 pkts (loss 4.422%), 2864.0 kbit/s
64.2s - sent: 24057 pkts, 2999.5 kbits/s	145.8s - received: 22945/ sent: 24007 pkts (loss 4.424%), 2848.6 kbit/s
65.2s - sent: 24433 pkts, 3005.8 kbits/s	146.8s - received: 23302/ sent: 24384 pkts (loss 4.437%), 2850.7 kbit/s
66.2s - sent: 24809 pkts, 3001.6 kbits/s	147.9s - received: 23659/ sent: 24759 pkts (loss 4.443%), 2855.1 kbit/s
67.2s - sent: 25184 pkts, 2999.5 kbits/s	148.9s - received: 24016/ sent: 25134 pkts (loss 4.448%), 2852.2 kbit/s
68.2s - sent: 25560 pkts, 3004.8 kbits/s	149.9s - received: 24374/ sent: 25511 pkts (loss 4.457%), 2857.2 kbit/s
69.2s - sent: 25936 pkts, 3000.7 kbits/s	150.9s - received: 24732/ sent: 25887 pkts (loss 4.462%), 2857.2 kbit/s
70.2s - sent: 26312 pkts, 3003.2 kbits/s	151.9s - received: 25089/ sent: 26262 pkts (loss 4.467%), 2854.8 kbit/s
71.2s - sent: 26688 pkts, 3005.3 kbits/s	152.9s - received: 25446/ sent: 26637 pkts (loss 4.471%), 2853.1 kbit/s
72.2s - sent: 27064 pkts, 3000.3 kbits/s	153.9s - received: 25803/ sent: 27012 pkts (loss 4.476%), 2850.5 kbit/s
73.2s - sent: 27440 pkts, 3001.5 kbits/s	154.9s - received: 26161/ sent: 27388 pkts (loss 4.484%), 2858.3 kbit/s
74.2s - sent: 27816 pkts, 3001.9 kbits/s	155.9s - received: 26518/ sent: 27764 pkts (loss 4.488%), 2855.8 kbit/s
75.2s - sent: 28192 pkts, 3006.0 kbits/s	156.9s - received: 26876/ sent: 28140 pkts (loss 4.492%), 2861.1 kbit/s
76.2s - sent: 28567 pkts, 2999.7 kbits/s	157.9s - received: 27234/ sent: 28515 pkts (loss 4.492%), 2858.5 kbit/s
^Cpackets sent = 28642, avg rate=2936.6kbps	
root@mininet-vm:/home/mininet/lab5/lab5/udp#	
packet received = 27353 / 28642 sent; 4.500% loss	

- اجرا با نرخ 10Mbps:

"host: h1"	"host: h3"
43.1s - sent: 53849 pkts, 10011.1 kbits/s	221.2s - received: 14911/ sent: 52872 pkts (loss 71.798%), 2891.4 kbit/s
44.1s - sent: 55101 pkts, 10009.6 kbits/s	222.2s - received: 15271/ sent: 54123 pkts (loss 71.785%), 2878.0 kbit/s
45.1s - sent: 56354 pkts, 10018.5 kbits/s	223.2s - received: 15631/ sent: 55374 pkts (loss 71.772%), 2879.1 kbit/s
46.1s - sent: 57608 pkts, 10026.2 kbits/s	224.2s - received: 15984/ sent: 57368 pkts (loss 72.347%), 1183.5 kbit/s
47.1s - sent: 58860 pkts, 10015.8 kbits/s	225.8s - received: 16225/ sent: 58935 pkts (loss 72.310%), 2882.1 kbit/s
48.1s - sent: 60111 pkts, 10007.1 kbits/s	226.8s - received: 16585/ sent: 59846 pkts (loss 72.287%), 2879.2 kbit/s
49.1s - sent: 61363 pkts, 10010.6 kbits/s	227.8s - received: 16945/ sent: 61097 pkts (loss 72.265%), 2878.9 kbit/s
50.1s - sent: 62614 pkts, 10007.8 kbits/s	228.8s - received: 17305/ sent: 62347 pkts (loss 72.244%), 2879.5 kbit/s
51.1s - sent: 63865 pkts, 10006.5 kbits/s	229.8s - received: 17665/ sent: 63598 pkts (loss 72.224%), 2879.2 kbit/s
52.1s - sent: 65117 pkts, 10009.1 kbits/s	230.8s - received: 18025/ sent: 64848 pkts (loss 72.204%), 2879.2 kbit/s
53.1s - sent: 66368 pkts, 10007.5 kbits/s	231.8s - received: 18385/ sent: 66099 pkts (loss 72.183%), 2875.8 kbit/s
54.1s - sent: 67619 pkts, 10006.0 kbits/s	232.8s - received: 18745/ sent: 67351 pkts (loss 72.168%), 2879.2 kbit/s
55.1s - sent: 68871 pkts, 10008.9 kbits/s	233.8s - received: 19105/ sent: 68601 pkts (loss 72.151%), 2878.9 kbit/s
56.1s - sent: 70123 pkts, 10010.0 kbits/s	234.8s - received: 19465/ sent: 69852 pkts (loss 72.134%), 2873.0 kbit/s
57.1s - sent: 71375 pkts, 10044.5 kbits/s	235.8s - received: 19825/ sent: 71105 pkts (loss 72.119%), 2877.9 kbit/s
58.1s - sent: 72627 pkts, 10017.6 kbits/s	236.8s - received: 20186/ sent: 72359 pkts (loss 72.103%), 2880.1 kbit/s
59.1s - sent: 73880 pkts, 10009.6 kbits/s	237.8s - received: 20543/ sent: 73610 pkts (loss 72.092%), 2850.1 kbit/s
60.1s - sent: 75132 pkts, 10008.8 kbits/s	238.8s - received: 20903/ sent: 74863 pkts (loss 72.078%), 2877.6 kbit/s
61.1s - sent: 76384 pkts, 10008.5 kbits/s	239.8s - received: 21264/ sent: 76117 pkts (loss 72.064%), 2880.7 kbit/s
62.1s - sent: 77640 pkts, 10008.0 kbits/s	240.8s - received: 21624/ sent: 77367 pkts (loss 72.050%), 2877.3 kbit/s
63.1s - sent: 78891 pkts, 10006.2 kbits/s	241.8s - received: 21984/ sent: 78619 pkts (loss 72.037%), 2879.2 kbit/s
64.1s - sent: 80143 pkts, 10015.4 kbits/s	242.8s - received: 22344/ sent: 79869 pkts (loss 72.024%), 2879.2 kbit/s
^Cpackets sent = 80233, avg rate=9985.4kbps	
root@mininet-vm:/home/mininet/lab5/lab5/udp#	
packet received = 22448 / 80231 sent; 72.021% loss	

همانطور که مشاهده می‌شود، مقدار **goodput** حدود بازه‌ی 2870-2880 است که اگر از نظر تئوری بخواهیم محاسبه کنیم، داریم:

$$goodput = bw \times \frac{1000}{1042} = 10 \times 0.96 = 9.6 \text{ Mbps}$$

عددی که به طور تئوری به دست آمده است، بسیار با چیزی که در عمل می‌بینیم فاصله دارد که علت آن این است که حجم بسیار زیادی از داده‌ها و بسته‌ها **loss** می‌شوند. (نرخ **packet loss** حدود 72 درصد است.)

سوال 8: با گوش دادن به بسته‌ها در سمت سرور درستی فرضیه را به طور عملی اطمینان پیدا می‌کنیم. همانطور که در تصاویر زیر مشاهده می‌شود، مقدار هدر IP برابر 20 بایت، مقدار هدر اترنت برابر 14 بایت و مقدار هدر TCP برابر 32 بایت است:

No.	Time	Source	Destination	Protocol
2088	8.300412296	10.10.1.3	10.10.0.1	TCP
2089	8.308457832	10.10.0.1	10.10.1.3	TCP
2090	8.308477971	10.10.1.3	10.10.0.1	TCP
2091	8.316949954	10.10.0.1	10.10.1.3	TCP
2092	8.316977265	10.10.1.3	10.10.0.1	TCP
2093	8.325170747	10.10.0.1	10.10.1.3	TCP
2094	8.325199665	10.10.1.3	10.10.0.1	TCP
2095	8.333108413	10.10.0.1	10.10.1.3	TCP
2096	8.333137103	10.10.1.3	10.10.0.1	TCP
2097	8.340809881	10.10.0.1	10.10.1.3	TCP
2098	8.340842987	10.10.1.3	10.10.0.1	TCP
2099	8.340909362	10.10.0.1	10.10.1.3	TCP
2100	8.349164538	10.10.1.3	10.10.0.1	TCP
2101	8.356919434	10.10.0.1	10.10.1.3	TCP
2102	8.356982568	10.10.1.3	10.10.0.1	TCP
2103	8.357101570	10.10.1.3	10.10.0.1	TCP
2104	8.360972570	10.10.0.1	10.10.1.3	TCP

Frame 1: 2092 bytes on wire (23696 bits), 2092 bytes captured (23696 bits) on interface 0, capture filter is 'eth0', packet 2092 of 2104 captured on interface 0

Ethernet II, Src: f6:f6:eb:fb:db:ec (f6:f6:eb:fb:db:ec), Dst: 08:00:00:00:00:00 (08:00:00:00:00:00)

Internet Protocol Version 4, Src: 10.10.0.1, Dst: 10.10.1.3

Transmission Control Protocol, Src Port: 55840, Dst Port: 10001, Seq: 2896, Len: 2896

Data (2896 bytes)

0000 86 aa 47 79 95 f0 f6 f6 eb fb db ec 08 00 45 00 ..Gy.....E..

0010 0b 84 94 a4 40 00 3f 06 86 b8 0a 0a 00 01 0a 0a ...@?.....

Ethernet (eth), 14 bytes

No.	Time	Source	Destination	Protocol
2088	8.300412296	10.10.1.3	10.10.0.1	TCP
2089	8.308457832	10.10.0.1	10.10.1.3	TCP
2090	8.308477971	10.10.1.3	10.10.0.1	TCP
2091	8.316949954	10.10.0.1	10.10.1.3	TCP
2092	8.316977265	10.10.1.3	10.10.0.1	TCP
2093	8.325170747	10.10.0.1	10.10.1.3	TCP
2094	8.325199665	10.10.1.3	10.10.0.1	TCP
2095	8.333108413	10.10.0.1	10.10.1.3	TCP
2096	8.333137103	10.10.1.3	10.10.0.1	TCP
2097	8.340809881	10.10.0.1	10.10.1.3	TCP
2098	8.340842987	10.10.1.3	10.10.0.1	TCP
2099	8.340909362	10.10.0.1	10.10.1.3	TCP
2100	8.349164538	10.10.1.3	10.10.0.1	TCP
2101	8.356919434	10.10.0.1	10.10.1.3	TCP
2102	8.356982568	10.10.1.3	10.10.0.1	TCP
2103	8.357101570	10.10.1.3	10.10.0.1	TCP
2104	8.360972570	10.10.0.1	10.10.1.3	TCP

Frame 1: 2092 bytes on wire (23696 bits), 2092 bytes captured (23696 bits) on interface 0, capture filter is 'eth0', packet 2092 of 2104 captured on interface 0

Ethernet II, Src: f6:f6:eb:fb:db:ec (f6:f6:eb:fb:db:ec), Dst: 08:00:00:00:00:00 (08:00:00:00:00:00)

Internet Protocol Version 4, Src: 10.10.0.1, Dst: 10.10.1.3

Transmission Control Protocol, Src Port: 55840, Dst Port: 10001, Seq: 2896, Len: 2896

Data (2896 bytes)

0000 86 aa 47 79 95 f0 f6 f6 eb fb db ec 08 00 45 00 ..Gy.....E..

0010 0b 84 94 a4 40 00 3f 06 86 b8 0a 0a 00 01 0a 0a ...@?.....

Internet Protocol Version 4 (ip), 20 bytes

No.	Time	Source	Destination	Protocol
2088	8.300412296	10.10.1.3	10.10.0.1	TCP
2089	8.308457832	10.10.0.1	10.10.1.3	TCP
2090	8.308477971	10.10.1.3	10.10.0.1	TCP
2091	8.316949954	10.10.0.1	10.10.1.3	TCP
2092	8.316977265	10.10.1.3	10.10.0.1	TCP
2093	8.325170747	10.10.0.1	10.10.1.3	TCP
2094	8.325199665	10.10.1.3	10.10.0.1	TCP
2095	8.333108413	10.10.0.1	10.10.1.3	TCP
2096	8.333137103	10.10.1.3	10.10.0.1	TCP
2097	8.340809881	10.10.0.1	10.10.1.3	TCP
2098	8.340842987	10.10.1.3	10.10.0.1	TCP
2099	8.340909362	10.10.0.1	10.10.1.3	TCP
2100	8.349164538	10.10.1.3	10.10.0.1	TCP
2101	8.356919434	10.10.0.1	10.10.1.3	TCP
2102	8.356982568	10.10.1.3	10.10.0.1	TCP
2103	8.357101570	10.10.1.3	10.10.0.1	TCP
2104	8.360972570	10.10.0.1	10.10.1.3	TCP

Frame 1: 2092 bytes on wire (23696 bits), 2092 bytes captured (23696 bits) on interface 0, capture filter is 'eth0', packet 2092 of 2104 captured on interface 0

Ethernet II, Src: f6:f6:eb:fb:db:ec (f6:f6:eb:fb:db:ec), Dst: 08:00:00:00:00:00 (08:00:00:00:00:00)

Internet Protocol Version 4, Src: 10.10.0.1, Dst: 10.10.1.3

Transmission Control Protocol, Src Port: 55840, Dst Port: 10001, Seq: 2896, Len: 2896

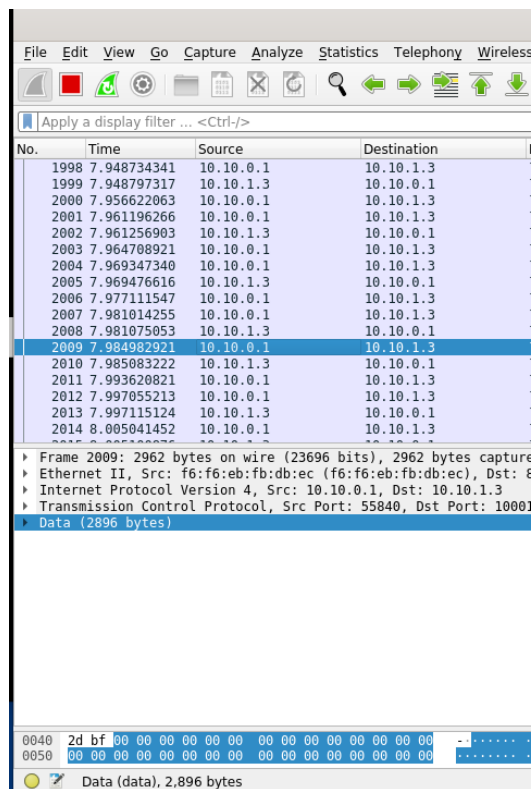
Data (2896 bytes)

0000 01 03 da 26 27 11 be a4 e4 c9 d3 42 b8 88 80 18 ..@.....S....

0010 00 53 20 8e 00 60 01 01 00 6a 56 59 e4 66 dd ad ...S.....

Transmission Control Protocol (tcp), 32 bytes

اما این قضیه درمورد data صدق نمی کند و مشاهده می کنیم مقدار Data برابر 2896 بایت می باشد:



The image shows a Wireshark packet capture interface. The packet list on the left shows a series of packets from 1998 to 2014. Packet 2009 is selected, showing details of an Ethernet II frame, an Internet Protocol Version 4 packet, and a Transmission Control Protocol (TCP) segment. The TCP segment details show a source port of 55840 and a destination port of 10001. The data field of the TCP segment is highlighted, showing a large data segment of 2896 bytes.

No.	Time	Source	Destination
1998	7.948734341	10.10.0.1	10.10.1.3
1999	7.948797317	10.10.1.3	10.10.0.1
2000	7.956622063	10.10.0.1	10.10.1.3
2001	7.961196266	10.10.0.1	10.10.1.3
2002	7.961256903	10.10.1.3	10.10.0.1
2003	7.964708921	10.10.0.1	10.10.1.3
2004	7.969347340	10.10.0.1	10.10.1.3
2005	7.969476616	10.10.1.3	10.10.0.1
2006	7.977111547	10.10.0.1	10.10.1.3
2007	7.981014255	10.10.0.1	10.10.1.3
2008	7.981075053	10.10.1.3	10.10.0.1
2009	7.984982921	10.10.0.1	10.10.1.3
2010	7.985083222	10.10.1.3	10.10.0.1
2011	7.993620821	10.10.0.1	10.10.1.3
2012	7.997055213	10.10.0.1	10.10.1.3
2013	7.997115124	10.10.1.3	10.10.0.1
2014	8.005041452	10.10.0.1	10.10.1.3

Frame 2009: 2962 bytes on wire (23696 bits), 2962 bytes capture  
Ethernet II, Src: f6:f6:eb:fb:db:ec (f6:f6:eb:fb:db:ec), Dst: 8  
Internet Protocol Version 4, Src: 10.10.0.1, Dst: 10.10.1.3  
Transmission Control Protocol, Src Port: 55840, Dst Port: 10001  
Data (2896 bytes)

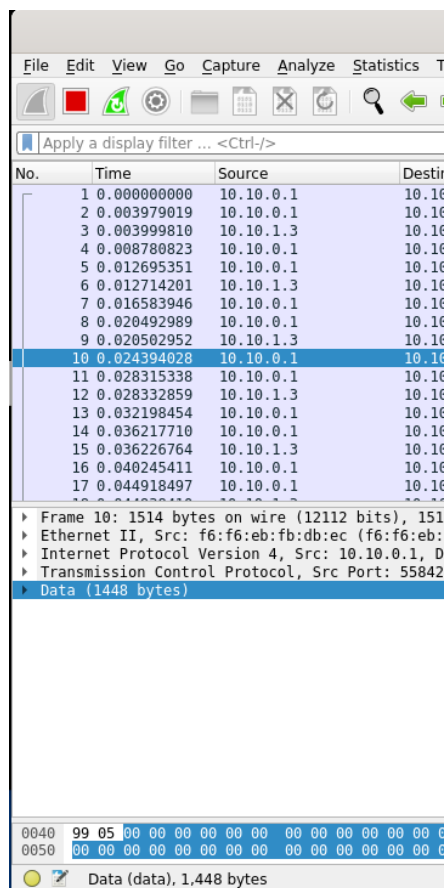
با توجه به توضیحات داخل گزارش کار، این موضوع به دلیل فعال بودن TCP Large Segment Offload است که برای غیرفعال کردن آن از دستور زیر استفاده می کنیم.

---

```
ethtool -K h1-eth0 tx off sg off tso off
```

---

پس از اجرای دستور زیر، مجدداً در Wireshark به بررسی بسته‌ها می‌پردازیم. همانطور که مشاهده می‌شود، مشکل مربوطه برطرف شده است و هدر Data هم مقدار درست یعنی بایت را نمایش می‌دهد:



سوال 9: برای محاسبه‌ی مقدار **goodput** به صورت تئوری در پروتکل TCP به این صورت باید عمل کنیم که مقدار پهنای باند را در حاصل تقسیم اندازه‌ی داده‌های کاربردی بر اندازه‌ی کل فریم اترنتی به دست آوریم. همانطور که می‌دانیم، اندازه‌ی داده‌های کاربردی 1448 و اندازه‌ی کل فریم اترنتی 1514 بایت به دست آمده است. با در نظر گرفتن 3Mbps به عنوان پهنای باند داریم:

$$goodput = bw \times \frac{1448}{1514} = 3 \times 0.956 = 2.86 \text{ Mbps}$$

سوال 10: پس از راه اندازی مجدد سرور TCP با پورت 10001 روی h3 و کلاینت TCP روی h1 داریم:

"host: h1"	"host: h3"
38.1: 2786.3kbps avg ( 2779.9[inst], 2786.4[mov.avg]) cwnd 19 rtt 73.6ms	239.8s - received: 21264/ sent: 76117 pkts (loss 72.064%), 2880.7 kbit/s
38.4: 2786.8kbps avg ( 2803.7[inst], 2788.1[mov.avg]) cwnd 21 rtt 80.4ms	240.8s - received: 21624/ sent: 77367 pkts (loss 72.050%), 2877.3 kbit/s
38.8: 2786.8kbps avg ( 2803.7[inst], 2788.1[mov.avg]) cwnd 16 rtt 76.1ms	241.8s - received: 21984/ sent: 78619 pkts (loss 72.037%), 2879.2 kbit/s
39.2: 2786.8kbps avg ( 2803.7[inst], 2788.1[mov.avg]) cwnd 19 rtt 71.2ms	242.8s - received: 22344/ sent: 79869 pkts (loss 72.024%), 2879.2 kbit/s
39.5: 2786.7kbps avg ( 2784.5[inst], 2787.7[mov.avg]) cwnd 20 rtt 79.0ms	packet received = 22448 / 80231 sent: 72.021% loss
39.9: 2786.7kbps avg ( 2784.5[inst], 2787.7[mov.avg]) cwnd 15 rtt 82.2ms	^C
40.3: 2786.7kbps avg ( 2784.5[inst], 2787.7[mov.avg]) cwnd 18 rtt 72.3ms	root@mininet-vm:/home/mininet/lab5/lab5# cd ..
40.6: 2787.0kbps avg ( 2798.0[inst], 2788.8[mov.avg]) cwnd 20 rtt 80.5ms	root@mininet-vm:/home/mininet/lab5/lab5# ls
41.1: 2787.0kbps avg ( 2798.0[inst], 2788.8[mov.avg]) cwnd 15 rtt 84.4ms	lab5_network.py tcp udp
41.3: 2787.0kbps avg ( 2798.0[inst], 2788.8[mov.avg]) cwnd 18 rtt 69.7ms	root@mininet-vm:/home/mininet/lab5/lab5# cd ..
41.7: 2787.0kbps avg ( 2786.8[inst], 2788.6[mov.avg]) cwnd 20 rtt 78.4ms	root@mininet-vm:/home/mininet/lab5# ls
42.1: 2787.0kbps avg ( 2786.8[inst], 2788.6[mov.avg]) cwnd 22 rtt 84.0ms	lab5
42.4: 2787.0kbps avg ( 2786.8[inst], 2788.6[mov.avg]) cwnd 17 rtt 65.6ms	root@mininet-vm:/home/mininet/lab5# cd lab5/
42.8: 2787.4kbps avg ( 2802.5[inst], 2790.0[mov.avg]) cwnd 19 rtt 75.3ms	root@mininet-vm:/home/mininet/lab5/lab5# ls
43.2: 2787.4kbps avg ( 2802.5[inst], 2790.0[mov.avg]) cwnd 21 rtt 81.9ms	lab5_network.py tcp udp
43.5: 2787.4kbps avg ( 2802.5[inst], 2790.0[mov.avg]) cwnd 16 rtt 71.1ms	root@mininet-vm:/home/mininet/lab5/lab5# cd tcp/
43.9: 2787.7kbps avg ( 2800.3[inst], 2791.0[mov.avg]) cwnd 19 rtt 71.9ms	root@mininet-vm:/home/mininet/lab5/lab5/tcp# ls
44.3: 2787.7kbps avg ( 2800.3[inst], 2791.0[mov.avg]) cwnd 21 rtt 80.3ms	Makefile tcpclient tcpserver
44.6: 2787.7kbps avg ( 2800.3[inst], 2791.0[mov.avg]) cwnd 15 rtt 82.2ms	root@mininet-vm:/home/mininet/lab5/lab5/tcp# ./tcpserver 10001
45.0: 2787.8kbps avg ( 2782.8[inst], 2790.2[mov.avg]) cwnd 18 rtt 76.4ms	Handling client 10.10.0.1
45.4: 2787.8kbps avg ( 2782.8[inst], 2790.2[mov.avg]) cwnd 20 rtt 80.7ms	with child process: 2361
45.7: 2787.8kbps avg ( 2782.8[inst], 2790.2[mov.avg]) cwnd 22 rtt 87.7ms	Handling client 10.10.0.1
46.1: 2787.5kbps avg ( 2781.6[inst], 2789.3[mov.avg]) cwnd 12 rtt 43.9ms	with child process: 2373

همانطور که مشاهده می شود، مقدار Goodput در این ارتباط حدود 2787Kbps به دست آمده است که بسیار نزدیک به مقدار تئوری ( 2.86 Mbps) است. دلیل آن هم این است که مقدار packet loss در آزمایش انجام شده بسیار کم است و حداکثر بسته ها ارسال می شوند.