

# Home work 9

## 1.1 ping

1. Source: 192.168.1.4, Destination [onepiece.store]: 194.233.73.67

No.	Time	Source	Destination	Protocol	Length	Info
8	0.215115825	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=1/256, ttl=64 (reply in 26)
26	0.403060544	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=1/256, ttl=56 (request in 8)
42	1.216521446	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=2/512, ttl=64 (reply in 47)
47	1.405091942	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=2/512, ttl=56 (request in 42)
50	2.218066092	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=3/768, ttl=64 (reply in 53)
53	2.455015620	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=3/768, ttl=56 (request in 50)
54	3.219049077	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=4/1024, ttl=64 (reply in 55)
55	3.479390114	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=4/1024, ttl=56 (request in 54)
90	4.228146021	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=5/1280, ttl=64 (reply in 92)
92	4.503202217	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=5/1280, ttl=56 (request in 90)
93	5.221091237	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=6/1536, ttl=64 (reply in 97)
97	5.426922899	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=6/1536, ttl=56 (request in 93)
112	6.222929784	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=7/1792, ttl=64 (reply in 146)
146	6.406556638	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=7/1792, ttl=56 (request in 112)
149	7.224582563	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=8/2048, ttl=64 (reply in 150)
150	7.472422819	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=8/2048, ttl=56 (request in 149)
153	8.226408250	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=9/2304, ttl=64 (reply in 158)
158	8.416772545	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=9/2304, ttl=56 (request in 153)
164	9.227749079	192.168.1.4	194.233.73.67	ICMP	98	Echo (ping) request id=0x0002, seq=10/2560, ttl=64 (reply in 165)
165	9.520614081	194.233.73.67	192.168.1.4	ICMP	98	Echo (ping) reply id=0x0002, seq=10/2560, ttl=56 (request in 164)

2. Номера портов для транспортного уровня, а ICMP на сетевом
3. Type: 8 (Echo (ping) request); Code: 0; Checksum: 0x197d [correct]; Identifier (BE): 2 (0x0002) Identifier (LE): 512 (0x0200); Sequence number (BE): 1 (0x0001); Sequence number (LE): 256 (0x0100) ; по 2 байта

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> Frame 8: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface wlo1, id 0
> Ethernet II, Src: 64:6e:e0:a2:6f:89 (64:6e:e0:a2:6f:89), Dst: Netgear_0a:c2:48 (c4:04:15:0a:c2:48)
> Internet Protocol Version 4, Src: 192.168.1.4, Dst: 194.233.73.67
> Internet Control Message Protocol
  Type: 8 (Echo (ping) request)
  Code: 0
  Checksum: 0x197d [correct]
  [Checksum Status: Good]
  Identifier (BE): 2 (0x0002)
  Identifier (LE): 512 (0x0200)
  Sequence number (BE): 1 (0x0001)
  Sequence number (LE): 256 (0x0100)
  [Response frame: 26]
  Timestamp from icmp data: Apr 23, 2022 19:49:58.000000000 MSK
  [Timestamp from icmp data (relative): 0.334994800 seconds]
> Data (48 bytes)

0000 c4 04 15 0a c2 48 64 6e e0 a2 6f 89 08 00 45 00  ....Hdn...o...E
0010 00 54 80 0d 40 00 40 01 ec c2 c0 a8 01 04 c2 e9  -T...@.....
0020 49 43 08 00 19 7d 00 02 00 01 36 2e 64 62 00 00  IC...}...6.db..
0030 00 00 80 1c 05 00 00 00 00 00 10 11 12 13 14 15  ....
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25  .....!#$%&'()*+,-./012345
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35  67
0060 36 37
```

4. Type: 0 (Echo (ping) reply); Code: 0; такие же еще, как выше, по 2 байта также

## 1.2 traceroute

1. отличаются ttl, id, checksum

icmp						
No.	Time	Source	Destination	Protocol	Length	Info
22	0.949473731	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=1/256, ttl=1 (no response found!)
23	0.949508067	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=2/512, ttl=1 (no response found!)
24	0.949517903	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=3/768, ttl=1 (no response found!)
25	0.949527871	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=4/1024, ttl=2 (no response found!)
26	0.949536333	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=5/1280, ttl=2 (no response found!)
27	0.949544683	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=6/1536, ttl=2 (no response found!)
28	0.949554167	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=7/1792, ttl=3 (no response found!)
29	0.949562682	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=8/2048, ttl=3 (no response found!)
30	0.949571262	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=9/2304, ttl=3 (no response found!)
31	0.949580932	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=10/2560, ttl=4 (no response found!)
32	0.949589245	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=11/2816, ttl=4 (no response found!)
33	0.949597443	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=12/3072, ttl=4 (no response found!)
34	0.949607399	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=13/3328, ttl=5 (no response found!)
35	0.949616134	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=14/3584, ttl=5 (no response found!)
36	0.949624533	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=15/3840, ttl=5 (no response found!)
37	0.949634189	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=16/4096, ttl=6 (no response found!)
38	1.030755728	192.168.1.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
40	1.031626074	192.168.1.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
41	1.031760574	192.168.1.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
42	1.032032382	192.168.100.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
43	1.035275801	192.168.100.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
44	1.035435877	192.168.100.1	192.168.1.4	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
45	1.035924177	95.55.24.1	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
46	1.036510440	95.55.24.1	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
47	1.036510643	95.55.24.1	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
48	1.038112411	212.48.204.164	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
49	1.038543565	212.48.204.164	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
50	1.038543746	212.48.204.164	192.168.1.4	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
52	1.042631401	192.168.1.4	194.233.73.67	ICMP	74	Echo (ping) request id=0x0003, seq=17/4352, ttl=6 (no response found!)
Fragment offset: 0						
Time to live: 1						
Protocol: ICMP (1)						
Header checksum: 0xf2a1 [validation disabled]						
[Header checksum status: Unverified]						
Source: 192.168.1.4						
Destination: 194.233.73.67						
Internet Control Message Protocol						
Type: 8 (Echo (ping) request)						
Code: 0						
Checksum: 0x8276 [correct]						
[Checksum Status: Good]						
Identifier (BE): 3 (0x0003)						
Identifier (LE): 768 (0x0300)						
Sequence number (BE): 1 (0x0001)						
Sequence number (LE): 256 (0x0100)						
[No response seen]						
Data (32 bytes)						

2. -

3. Отличие есть, потому что дошли до хоста. Отличаются тип, TTL

Frame 93: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface wlo1, id 0	
Ethernet II, Src: Netgear_0a:c2:48 (c4:04:15:0a:c2:48), Dst: 64:6e:e0:a2:6f:89 (64:6e:e0:a2:6f:89)	
Internet Protocol Version 4, Src: 194.233.73.67, Dst: 192.168.1.4	
Internet Control Message Protocol	
Type: 0 (Echo (ping) reply)	
Code: 0	
Checksum: 0x8a57 [correct]	
[Checksum Status: Good]	
Identifier (BE): 3 (0x0003)	
Identifier (LE): 768 (0x0300)	
Sequence number (BE): 32 (0x0020)	
Sequence number (LE): 8192 (0x2000)	
[Request frame: 82]	
[Response time: 204.717 ms]	
Data (32 bytes)	

4. from Sweden to Singapore

Traceroute to onepiece.store (194.233.73.67), 30 hops max, 60 byte packets						
1	gateway (192.168.1.1)	81.308 ms	82.122 ms	82.192 ms		
2	192.168.100.1 (192.168.100.1)	85.679 ms	85.742 ms	85.894 ms		
3	95-55-24-1.dynamic.avangardsl.ru (95.55.24.1)	86.374 ms	86.951 ms	86.943 ms		
4	bbn.212-48-204-164.nwtelecom.ru (212.48.204.164)	88.535 ms	88.958 ms	88.949 ms		
5	87.226.133.136 (87.226.133.136)	111.562 ms	111.553 ms	111.545 ms		
6	***					
7	***					
8	100ge14-2.core1.sin1.he.net (184.105.65.13)	259.514 ms	259.505 ms	259.497 ms		
9	contabo-asia-private-limited.e0-18.switch2.sin2.he.net (184.104.212.82)	257.013 ms	257.073 ms	257.186 ms		
10	vmi694973.contaboserver.net (194.233.73.67)	257.452 ms	246.580 ms	246.785 ms		

## 3

### 1.1.

Отправим пакетов

$$\sum_{i=0}^{W/2} \left( \frac{W}{2} + i \right) = \frac{W}{2} \left( \frac{W}{2} + 1 \right) + \sum_{i=0}^{W/2} i = \frac{W}{2} \left( \frac{W}{2} + 1 \right) + \frac{W}{2} \cdot \left( \frac{\frac{W}{2} + 1}{2} \right) = \frac{W^2}{4} + \frac{W}{2} + \frac{W^2}{8} + \frac{W}{4} = \frac{3W^2}{8} +$$

А  $L$  по определению — сколько потеряли поделить на сколько отправили, а потеряли один пакет.

## 1.2.

Почти всегда  $\frac{3W}{4}$  можно пренебречь, поэтому  $W \approx \sqrt{\frac{8}{3L}}$

Откуда средняя скорость

$$\frac{3}{4} \cdot \sqrt{\frac{8}{3L}} \cdot \frac{MSS}{RTT}$$

А это то, что нужно.

## 2.1. То же самое, что в предыдущей домашке

Пакетов отправим во время расширения

$$N = \sum_{i=0}^{\log_{a+1} 2} \frac{w}{2} \cdot (1+a)^i = w \cdot \frac{2a+1}{2a}$$

Искомая зависимость — обратная к  $N$ :  $\frac{2a}{w \cdot (2a+1)}$

## 2.2.

Времени нужно для расширения окна

$$RTT \cdot \log_{a+1} 2$$

Видно, что оно зависит только от  $RTT$  и  $a$ .