

Home work 9

1.1 ping

- 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 | 1.406091942 | 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 | 4.220146021 | 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) |

- Номера портов для транспортного уровня, а ICMP на сетевом
- 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

▶ 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 00Hdn ..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 !"#%&

0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345

0060 36 37 67

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

1.2 traceroute

- 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 | 1.031706574 | 192.168.1.1 | 192.168.1.4 | ICMP | 102 | Time-to-live exceeded (Time to live exceeded in transit) |
| 42 | 1.035203282 | 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

| |
|---|
| <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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

| | | | | |
|---|---|------------|------------|------------|
| tracert 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.avangarddsl.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

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

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 .