

Отчёт по лабораторной работе «Механизмы протокола ТСР»

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1. Установка и разрыв соединения

Слушаем на c2 и c3 eth0

```
| tcpdump -n -i eth0 tcp
```

Устанавливаем tcp соединение между c1 и c6 (discard сервером на порту 9)

```
| c1:~# telnet 10.50.0.2 9
Trying 10.50.0.2...
Connected to 10.50.0.2.
```

На c2 (равно как и на c3) видим перехваченные дампы (syn, syn/ack, ack):

```

17:36:03.146114 IP 10.10.0.2.39971 > 10.50.0.2.9: S 57240539:57240539(0) win 5840
<mss 1460,sackOK,timestamp 15503 0,nop,wscale 1>
17:36:03.147086 IP 10.50.0.2.9 > 10.10.0.2.39971: S 61705612:61705612(0) ack 57240540
win 5792 <mss 536,sackOK,timestamp 15415 15503,nop,wscale 1>
17:36:03.147397 IP 10.10.0.2.39971 > 10.50.0.2.9: . ack 1 win 2920

```

Здесь с1 отправляет SYN с SEQ=57240539, MSS вычисляется как MTU сети, к которой подключена с1 минус 40 байт. с6 отправляет обратно SYN/ACK со своим SEQ=61705612 и ACK = SEQ(c1) + 1 = 57240540. MSS отправляется равным 536 - наименьшее MTU, встраившееся на пути пакета с с1 к с6, (576) минус 40 байт. Получив SYN/ACK от с6, с1 шлёт ему ACK=1 (далее tcpdump отображает относительные значения SYN и ACK) Отправим с с1 сообщение, на с2 видим:

```

hey you
17:42:35.183501 IP 10.10.0.2.39971 > 10.50.0.2.9: P 1:10(9) ack 1 win 2920
17:42:35.204805 IP 10.50.0.2.9 > 10.10.0.2.39971: . ack 10 win 2896

bye
18:43:54.602388 IP 10.10.0.2.39971 > 10.50.0.2.9: P 10:15(5) ack 1 win 2920
18:43:54.646041 IP 10.50.0.2.9 > 10.10.0.2.39971: . ack 15 win 2896

!
18:44:40.495356 IP 10.10.0.2.39971 > 10.50.0.2.9: P 15:18(3) ack 1 win 2920
18:44:40.496734 IP 10.50.0.2.9 > 10.10.0.2.39971: . ack 18 win 2896

```

Здесь видим отправку сегментов 1:10, 10:15 и 15:18 соответственно на строки **hey you**, **bye** и **!**. Размер данных на 2 больше длины строки, вероятно, из-за ...

Завершим соединение.

```

18:53:51.739406 IP 10.10.0.2.39971 > 10.50.0.2.9: F 18:18(0) ack 1 win 2920
18:53:51.784869 IP 10.50.0.2.9 > 10.10.0.2.39971: F 1:1(0) ack 19 win 2896
18:53:51.785461 IP 10.10.0.2.39971 > 10.50.0.2.9: . ack 2 win 2920

```

Здесь с1 получает close() и tcp отправляет FIN/ACK на с6. с6 по RFC должен отправить ACK, затем user должен вызвать close() и tcp отправляет FIN/ACK в ответ. Здесь, видимо, эти команды выполняются "за раз" и от с6 к с1 идёт одно сообщение. с1, получив FIN/ACK, отправляет обратно ACK. После этого соединение считается закрытым.

2. Окно получателя

На с3:eth0 запускаем tcpdump. На с4 запускаем сервере ./win 3002 2 10 На с1 запускаем клиента: netcat 10.30.0.2 3002 </dev/zero

Вывод tcpdump целиком:

```

21:55:20.619273 IP 10.10.0.2.45579 > 10.30.0.2.3002: S 2890309802:2890309802(0) win 5840
<mss 1460,sackOK,timestamp 1211255 0,nop,wscale 1>

```

```

20:55:20.619727 IP 10.30.0.2.3002 > 10.10.0.2.45579: S 2885037320:2885037320(0) ack 2890309803
      win 2096 <mss 536,sackOK,timestamp 1211109 1211255,nop,wscale 1>
20:55:20.635088 IP 10.10.0.2.45579 > 10.30.0.2.3002: . ack 1 win 2920
20:55:20.635125 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 1:525(524) ack 1 win 2920
20:55:20.635133 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 525:1049(524) ack 1 win 2920
20:55:20.635685 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 525 win 1572
20:55:20.635713 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 1049 win 2096
20:55:20.636650 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 1049:1573(524) ack 1 win 2920
20:55:20.636705 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 1573:2097(524) ack 1 win 2920
20:55:20.636715 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 2097:2621(524) ack 1 win 2920
20:55:20.636719 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 2621:3145(524) ack 1 win 2920
20:55:20.636851 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 1573 win 2620
20:55:20.636867 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 2097 win 3144
20:55:20.636885 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 2621 win 3668
20:55:20.637001 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 3145 win 4192
20:55:20.637383 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 3145:3669(524) ack 1 win 2920
20:55:20.637402 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 3669:4193(524) ack 1 win 2920
20:55:20.637407 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 4193:4717(524) ack 1 win 2920
20:55:20.637411 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 4717:5241(524) ack 1 win 2920
20:55:20.637420 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 5241:5765(524) ack 1 win 2920
20:55:20.637590 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 5765:6289(524) ack 1 win 2920
20:55:20.637604 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 6289:6813(524) ack 1 win 2920
20:55:20.637608 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 6813:7337(524) ack 1 win 2920
20:55:20.637778 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 3669 win 4716
20:55:20.637790 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 4193 win 5240
20:55:20.637793 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 4717 win 5764
20:55:20.637800 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 5241 win 6288
20:55:20.637921 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 5765 win 6812
20:55:20.637932 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 6289 win 7336
20:55:20.637935 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 6813 win 7860
20:55:20.637942 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 7337 win 8384
20:55:20.638320 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 7337:7861(524) ack 1 win 2920
20:55:20.638342 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 7861:8385(524) ack 1 win 2920
20:55:20.638346 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 8385:8909(524) ack 1 win 2920
20:55:20.638349 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 8909:9433(524) ack 1 win 2920
20:55:20.638352 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 9433:9957(524) ack 1 win 2920
20:55:20.638355 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 9957:10481(524) ack 1 win 2920
20:55:20.638357 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 10481:11005(524) ack 1 win 2920
20:55:20.638360 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 11005:11529(524) ack 1 win 2920
20:55:20.638368 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 11529:12053(524) ack 1 win 2920
20:55:20.638372 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 12053:12577(524) ack 1 win 2920
20:55:20.638378 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 12577:13101(524) ack 1 win 2920
20:55:20.638388 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 13101:13625(524) ack 1 win 2920
20:55:20.638572 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 7861 win 8384
20:55:20.638589 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 8385 win 8384
20:55:20.638621 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 9433 win 8384
20:55:20.638737 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 10481 win 8384
20:55:20.639009 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 13625:14149(524) ack 1 win 2920
20:55:20.639052 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 14149:14673(524) ack 1 win 2920
20:55:20.639064 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 14673:15197(524) ack 1 win 2920

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20:55:20.639067 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 15197:15721(524) ack 1 win 2920
20:55:20.639070 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 15721:16245(524) ack 1 win 2920
20:55:20.639081 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 16245:16769(524) ack 1 win 2920
20:55:20.639084 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 16769:17293(524) ack 1 win 2920
20:55:20.639184 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 11529 win 8384
20:55:20.639195 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 12577 win 8384
20:55:20.639198 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 13625 win 8384
20:55:20.639300 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 14673 win 8384
20:55:20.639311 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 15721 win 8384
20:55:20.639318 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 16769 win 8384
20:55:20.639714 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 17293:17817(524) ack 1 win 2920
20:55:20.639737 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 17817:18341(524) ack 1 win 2920
20:55:20.639741 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 18341:18865(524) ack 1 win 2920
20:55:20.639743 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 18865:19389(524) ack 1 win 2920
20:55:20.639746 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 19389:19913(524) ack 1 win 2920
20:55:20.639749 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 19913:20437(524) ack 1 win 2920
20:55:20.639751 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 20437:20961(524) ack 1 win 2920
20:55:20.639760 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 20961:21485(524) ack 1 win 2920
20:55:20.639763 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 21485:22009(524) ack 1 win 2920
20:55:20.639769 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 22009:22533(524) ack 1 win 2920
20:55:20.639783 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 22533:23057(524) ack 1 win 2920
20:55:20.639949 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 23057:23581(524) ack 1 win 2920
20:55:20.639956 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 23581:24105(524) ack 1 win 2920
20:55:20.639959 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 24105:24629(524) ack 1 win 2920
20:55:20.639975 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 24629:25153(524) ack 1 win 2920
20:55:20.639982 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 25153:25677(524) ack 1 win 2920
20:55:20.639984 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 25677:26201(524) ack 1 win 2920
20:55:20.639988 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 26201:26725(524) ack 1 win 2920
20:55:20.639991 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 26725:27249(524) ack 1 win 2920
20:55:20.639994 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 27249:27773(524) ack 1 win 2920
20:55:20.639996 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 27773:28297(524) ack 1 win 2920
20:55:20.640135 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 17817 win 8384
20:55:20.640147 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 18865 win 8384
20:55:20.640284 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 27773 win 3930
20:55:20.640445 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 28297:28821(524) ack 1 win 2920
20:55:20.640459 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 28821:29345(524) ack 1 win 2920
20:55:20.640488 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 29345:29869(524) ack 1 win 2920
20:55:20.640534 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 29869:30393(524) ack 1 win 2920
20:55:20.640541 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 30393:30917(524) ack 1 win 2920
20:55:20.640544 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 30917:31441(524) ack 1 win 2920
20:55:20.640620 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 28297 win 3668
20:55:20.640630 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 28821 win 3406
20:55:20.640647 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 29345 win 3144
20:55:20.641009 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 31441:31965(524) ack 1 win 2920
20:55:20.641031 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 31965:32489(524) ack 1 win 2920
20:55:20.641035 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 32489:33013(524) ack 1 win 2920
20:55:20.641038 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 33013:33537(524) ack 1 win 2920
20:55:20.641041 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 33537:34061(524) ack 1 win 2920
20:55:20.641044 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 34061:34585(524) ack 1 win 2920
20:55:20.641052 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 34585:35109(524) ack 1 win 2920

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20:55:20.641056 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 35109:35633(524) ack 1 win 2920
20:55:20.641146 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 29869 win 3144
20:55:20.641157 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 30393 win 3668
20:55:20.641160 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 30917 win 4192
20:55:20.641167 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 31441 win 4716
20:55:20.641311 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 31965 win 5240
20:55:20.641321 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 32489 win 5764
20:55:20.641324 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 33013 win 6288
20:55:20.641331 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 33537 win 6812
20:55:20.641444 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 34061 win 7336
20:55:20.641671 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 35633:36157(524) ack 1 win 2920
20:55:20.641684 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 36157:36681(524) ack 1 win 2920
20:55:20.641688 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 36681:37205(524) ack 1 win 2920
20:55:20.641694 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 37205:37729(524) ack 1 win 2920
20:55:20.641750 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 37729:38253(524) ack 1 win 2920
20:55:20.641756 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 38253:38777(524) ack 1 win 2920
20:55:20.641759 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 38777:39301(524) ack 1 win 2920
20:55:20.641767 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 39301:39825(524) ack 1 win 2920
20:55:20.641769 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 39825:40349(524) ack 1 win 2920
20:55:20.641803 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 40349:40873(524) ack 1 win 2920
20:55:20.641808 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 40873:41397(524) ack 1 win 2920
20:55:20.641816 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 41397:41921(524) ack 1 win 2920
20:55:20.641819 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 41921:42445(524) ack 1 win 2920
20:55:20.641828 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 42445:42969(524) ack 1 win 2920
20:55:20.641881 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 42969:43493(524) ack 1 win 2920
20:55:20.641888 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 43493:44017(524) ack 1 win 2920
20:55:20.641891 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 44017:44541(524) ack 1 win 2920
20:55:20.641894 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 44541:45065(524) ack 1 win 2920
20:55:20.641901 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 45065:45589(524) ack 1 win 2920
20:55:20.641904 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 45589:46113(524) ack 1 win 2920
20:55:20.641910 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 46113:46637(524) ack 1 win 2920
20:55:20.641960 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 46637:47161(524) ack 1 win 2920
20:55:20.642158 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 34585 win 7860
20:55:20.642210 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 47161:47685(524) ack 1 win 2920
20:55:20.642226 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 47685:48209(524) ack 1 win 2920
20:55:20.642256 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 48209:48733(524) ack 1 win 2920
20:55:20.642415 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 35109 win 8384
20:55:20.642535 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 48733:49257(524) ack 1 win 2920
20:55:20.642579 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 49257:49781(524) ack 1 win 2920
20:55:20.642676 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 36157 win 8384
20:55:20.642785 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 49781:50305(524) ack 1 win 2920
20:55:20.642792 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 50305:50829(524) ack 1 win 2920
20:55:20.642800 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 37205 win 8384
20:55:20.642938 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 50829:51353(524) ack 1 win 2920
20:55:20.642949 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 51353:51877(524) ack 1 win 2920
20:55:20.642999 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 51877:52401(524) ack 1 win 2920
20:55:20.643223 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 52401:52925(524) ack 1 win 2920
20:55:20.643245 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 52925:53449(524) ack 1 win 2920
20:55:20.643250 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 53449:53973(524) ack 1 win 2920
20:55:20.668429 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 53973 win 4118

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20:55:20.669550 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 53973:54497(524) ack 1 win 2920
20:55:20.669578 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 54497:55021(524) ack 1 win 2920
20:55:20.669585 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 55021:55545(524) ack 1 win 2920
20:55:20.669591 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 55545:56069(524) ack 1 win 2920
20:55:20.669596 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 56069:56593(524) ack 1 win 2920
20:55:20.669601 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 56593:57117(524) ack 1 win 2920
20:55:20.669606 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 57117:57641(524) ack 1 win 2920
20:55:20.669611 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 57641:58165(524) ack 1 win 2920
20:55:20.669616 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 58165:58689(524) ack 1 win 2920
20:55:20.669622 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 58689:59213(524) ack 1 win 2920
20:55:20.669627 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 59213:59737(524) ack 1 win 2920
20:55:20.670826 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 64453:64977(524) ack 1 win 2920
20:55:20.670837 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 64977:65501(524) ack 1 win 2920
20:55:20.670898 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 65501:66025(524) ack 1 win 2920
20:55:20.671058 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 66025:66549(524) ack 1 win 2920
20:55:20.671064 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 66549:67073(524) ack 1 win 2920
20:55:20.671123 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 67073:67597(524) ack 1 win 2920
20:55:20.671335 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 67597:68121(524) ack 1 win 2920
20:55:20.671348 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 68121:68645(524) ack 1 win 2920
20:55:20.671352 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 68645:69169(524) ack 1 win 2920
20:55:20.671354 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 69169:69693(524) ack 1 win 2920
20:55:20.671495 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 69693:70217(524) ack 1 win 2920
20:55:20.708650 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 70217 win 1322
20:55:20.709580 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 70217:70741(524) ack 1 win 2920
20:55:20.709608 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 70741:71265(524) ack 1 win 2920
20:55:20.709615 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 71265:71789(524) ack 1 win 2920
20:55:20.709860 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 71789:72313(524) ack 1 win 2920
20:55:20.709880 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 72313:72837(524) ack 1 win 2920
20:55:20.710095 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 72837 win 1572
20:55:20.710883 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 72837:73361(524) ack 1 win 2920
20:55:20.710901 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 73361:73885(524) ack 1 win 2920
20:55:20.710906 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 73885:74409(524) ack 1 win 2920
20:55:20.711066 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 74409:74933(524) ack 1 win 2920
20:55:20.711089 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 74933:75457(524) ack 1 win 2920
20:55:20.711240 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 75457:75981(524) ack 1 win 2920
20:55:20.711254 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 73361 win 1856
20:55:20.711806 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 75981:76505(524) ack 1 win 2920
20:55:20.711823 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 76505:77029(524) ack 1 win 2920
20:55:20.747912 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77029 win 350
20:55:20.749306 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 77029:77553(524) ack 1 win 2920
20:55:20.797258 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77553 win 88
20:55:21.010831 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 77553:77729(176) ack 1 win 2920
20:55:21.011329 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77729 win 0
20:55:21.230573 IP 10.10.0.2.45579 > 10.30.0.2.3002: . ack 1 win 2920
20:55:21.231012 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77729 win 0
20:55:21.670835 IP 10.10.0.2.45579 > 10.30.0.2.3002: . ack 1 win 2920
20:55:21.671102 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77729 win 0
20:55:22.550253 IP 10.10.0.2.45579 > 10.30.0.2.3002: . ack 1 win 2920
20:55:22.550740 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77729 win 0
20:55:22.648060 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 77729 win 572

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20:55:22.648710 IP 10.10.0.2.45579 > 10.30.0.2.3002: P 77729:78077(348) ack 1 win 2920
20:55:22.648758 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 78077:78601(524) ack 1 win 2920
20:55:22.649192 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 78077 win 398
20:55:22.649205 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 78601 win 1048
20:55:22.650238 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 78601:79125(524) ack 1 win 2920
20:55:22.650288 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 79125:79649(524) ack 1 win 2920
20:55:22.650322 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 79649:80173(524) ack 1 win 2920
20:55:22.650351 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 80173:80697(524) ack 1 win 2920
20:55:22.650966 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 79125 win 1572
20:55:22.650980 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 80697 win 1572
20:55:22.652477 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 80697:81221(524) ack 1 win 2920
20:55:22.652539 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 81221:81745(524) ack 1 win 2920
20:55:22.652572 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 81745:82269(524) ack 1 win 2920
20:55:22.652603 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 82269:82793(524) ack 1 win 2920
20:55:22.652633 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 82793:83317(524) ack 1 win 2920
20:55:22.652663 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 83317:83841(524) ack 1 win 2920
20:55:22.652939 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 83841 win 1572
20:55:22.654378 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 83841:84365(524) ack 1 win 2920
20:55:22.654452 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 84365:84889(524) ack 1 win 2920
20:55:22.654644 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 84889:85413(524) ack 1 win 2920
20:55:22.654684 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 85413:85937(524) ack 1 win 2920
20:55:22.654715 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 85937:86461(524) ack 1 win 2920
20:55:22.654744 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 86461:86985(524) ack 1 win 2920
20:55:22.655023 IP 10.30.0.2.3002 > 10.10.0.2.45579: . ack 84365 win 1682
20:55:22.656419 IP 10.10.0.2.45579 > 10.30.0.2.3002: . 86985:87509(524) ack 1 win 2920
20:55:22.656546 IP 10.30.0.2.3002 > 10.10.0.2.45579: R 1:1(0) ack 86985 win 1048
20:55:22.659015 IP 10.30.0.2.3002 > 10.10.0.2.45579: R 2885037321:2885037321(0) win 0

```

Прделаем тот же эксперимент, только клиент и сервер работают на c4:lo tcpdump тоже запускаем на c4:lo

```

listening on lo, link-type EN10MB (Ethernet), capture size 96 bytes
21:30:54.066659 IP 127.0.0.1.43808 > 127.0.0.1.3002: S 1983427810:1983427810(0) win 32792
    <mss 16396,sackOK,timestamp 1424474 0,nop,wscale 1>
21:30:54.066671 IP 127.0.0.1.3002 > 127.0.0.1.43808: S 1972516637:1972516637(0) ack 1983427811
    win 32768 <mss 16396,sackOK,timestamp 1424474 1424474,nop,wscale 1>
21:30:54.066680 IP 127.0.0.1.43808 > 127.0.0.1.3002: . ack 1 win 16396
21:30:54.068527 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 1:8193(8192) ack 1 win 16396
21:30:54.068533 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 8193 win 24576
21:30:54.068980 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 8193:16385(8192) ack 1 win 16396
21:30:54.068986 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 16385 win 24576
21:30:54.069299 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 16385:24577(8192) ack 1 win 16396
21:30:54.069303 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 24577 win 23120
21:30:54.069567 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 24577:32769(8192) ack 1 win 16396
21:30:54.070279 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 32769:49153(16384) ack 1 win 16396
21:30:54.070727 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 49153:65537(16384) ack 1 win 16396
21:30:54.078551 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 65537 win 2640
21:30:54.295415 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 65537:70817(5280) ack 1 win 16396
21:30:54.295435 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 70817 win 0
21:30:54.517995 IP 127.0.0.1.43808 > 127.0.0.1.3002: . ack 1 win 16396

```

```

21:30:54.518012 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 70817 win 0
21:30:54.954925 IP 127.0.0.1.43808 > 127.0.0.1.3002: . ack 1 win 16396
21:30:54.954942 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 70817 win 0
21:30:55.840367 IP 127.0.0.1.43808 > 127.0.0.1.3002: . ack 1 win 16396
21:30:55.840386 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 70817 win 0
21:30:56.078142 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 70817 win 8420
21:30:56.078166 IP 127.0.0.1.43808 > 127.0.0.1.3002: P 70817:81921(11104) ack 1 win 16396
21:30:56.078178 IP 127.0.0.1.3002 > 127.0.0.1.43808: . ack 81921 win 2868
21:30:56.082763 IP 127.0.0.1.3002 > 127.0.0.1.43808: R 1:1(0) ack 81921 win 24576

```

3. Окно отправителя

На с5 уменьшаем время задержки до 100мс

```
c5:~# /etc/delay 100
```

На с2 запускаем прослушку

```
c2:~# tcpdump -n -i eth0 tcp
```

На с1 выполняем

```

c1:~# ./nagle nodelay 10.40.0.2 9 1 20
c1:~# ./nagle nodelay 10.40.0.2 9 1 50
c1:~# ./nagle nodelay 10.40.0.2 9 1 100

```

На с2 видим следующий перехват:

```

21:06:11.174923 IP 10.10.0.2.42974 > 10.40.0.2.9: S 2388811955:2388811955(0) win 5840
      <mss 1460,sackOK,timestamp 240726 0,nop,wscale 1>
21:06:11.408666 IP 10.40.0.2.9 > 10.10.0.2.42974: S 2394415705:2394415705(0) ack 2388811956
      win 5792 <mss 1460,sackOK,timestamp 240478 240726,nop,wscale 1>
21:06:11.408918 IP 10.10.0.2.42974 > 10.40.0.2.9: . ack 1 win 2920
21:06:11.410276 IP 10.10.0.2.42974 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
21:06:11.420507 IP 10.10.0.2.42974 > 10.40.0.2.9: P 101:201(100) ack 1 win 2920
21:06:11.518999 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 101 win 2896
21:06:11.519167 IP 10.10.0.2.42974 > 10.40.0.2.9: P 201:1201(1000) ack 1 win 2920
21:06:11.527472 IP 10.10.0.2.42974 > 10.40.0.2.9: P 1201:1301(100) ack 1 win 2920
21:06:11.535452 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 201 win 2896
21:06:11.535646 IP 10.10.0.2.42974 > 10.40.0.2.9: P 1301:1401(100) ack 1 win 2920
21:06:11.543399 IP 10.10.0.2.42974 > 10.40.0.2.9: P 1401:1501(100) ack 1 win 2920
21:06:11.602526 IP 10.10.0.2.42974 > 10.40.0.2.9: FP 1501:2001(500) ack 1 win 2920
21:06:11.621035 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 1201 win 3896
21:06:11.629038 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 1301 win 3896
21:06:11.638556 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 1401 win 3896
21:06:11.648815 IP 10.40.0.2.9 > 10.10.0.2.42974: . ack 1501 win 3896
21:06:11.718524 IP 10.40.0.2.9 > 10.10.0.2.42974: F 1:1(0) ack 2002 win 4896
21:06:11.718800 IP 10.10.0.2.42974 > 10.40.0.2.9: . ack 2 win 2920

```

Это вывод после отправки первых 20 пакетов. Здесь можно оценить максимальный размер окна отправителя как 1700 (после подтверждения на 201, отправляем вплоть до 2001)


```

21:07:49.327430 IP 10.10.0.2.42975 > 10.40.0.2.9: S 3922061218:3922061218(0) win 5840
    <mss 1460,sackOK,timestamp 250543 0,nop,wscale 1>
21:07:49.428682 IP 10.40.0.2.9 > 10.10.0.2.42975: S 3917904989:3917904989(0) ack 3922061219
    win 5792 <mss 1460,sackOK,timestamp 250280 250543,nop,wscale 1>
21:07:49.429453 IP 10.10.0.2.42975 > 10.40.0.2.9: . ack 1 win 2920
21:07:49.429567 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
21:07:49.436816 IP 10.10.0.2.42975 > 10.40.0.2.9: P 101:201(100) ack 1 win 2920
21:07:49.441780 IP 10.10.0.2.42975 > 10.40.0.2.9: P 201:301(100) ack 1 win 2920
21:07:49.538737 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 101 win 2896
21:07:49.538750 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 201 win 2896
21:07:49.539249 IP 10.10.0.2.42975 > 10.40.0.2.9: P 301:1201(900) ack 1 win 2920
21:07:49.547149 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1201:1301(100) ack 1 win 2920
21:07:49.551495 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1301:1401(100) ack 1 win 2920
21:07:49.561860 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1401:1501(100) ack 1 win 2920
21:07:49.561909 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 301 win 2896
21:07:49.572014 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1501:1601(100) ack 1 win 2920
21:07:49.581854 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1601:1701(100) ack 1 win 2920
21:07:49.648677 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1201 win 3796
21:07:49.648693 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1301 win 3796
21:07:49.649160 IP 10.10.0.2.42975 > 10.40.0.2.9: P 1701:2301(600) ack 1 win 2920
21:07:49.657496 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2301:2401(100) ack 1 win 2920
21:07:49.661499 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2401:2501(100) ack 1 win 2920
21:07:49.669685 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1401 win 3796
21:07:49.669696 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1501 win 3796
21:07:49.678092 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2501:2601(100) ack 1 win 2920
21:07:49.681890 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2601:2701(100) ack 1 win 2920
21:07:49.689356 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1601 win 3796
21:07:49.689367 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 1701 win 3796
21:07:49.691663 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2701:2801(100) ack 1 win 2920
21:07:49.701503 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2801:2901(100) ack 1 win 2920
21:07:49.711763 IP 10.10.0.2.42975 > 10.40.0.2.9: P 2901:3001(100) ack 1 win 2920
21:07:49.721565 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3001:3101(100) ack 1 win 2920
21:07:49.758572 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2301 win 4696
21:07:49.758586 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2401 win 4696
21:07:49.759081 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3101:3201(100) ack 1 win 2920
21:07:49.767367 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3201:3301(100) ack 1 win 2920
21:07:49.771797 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3301:3401(100) ack 1 win 2920
21:07:49.780044 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2501 win 4696
21:07:49.780055 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2601 win 4696
21:07:49.782711 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3401:3501(100) ack 1 win 2920
21:07:49.789496 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2701 win 4696
21:07:49.791781 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3501:3601(100) ack 1 win 2920
21:07:49.801085 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2801 win 4696
21:07:49.801622 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3601:3701(100) ack 1 win 2920
21:07:49.808433 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 2901 win 4696
21:07:49.816829 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3701:3801(100) ack 1 win 2920
21:07:49.819124 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3001 win 4696
21:07:49.824064 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3801:3901(100) ack 1 win 2920
21:07:49.831734 IP 10.10.0.2.42975 > 10.40.0.2.9: P 3901:4001(100) ack 1 win 2920
21:07:49.835650 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3101 win 4696

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21:07:49.845975 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4001:4101(100) ack 1 win 2920
21:07:49.851859 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4101:4201(100) ack 1 win 2920
21:07:49.860145 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3201 win 4696
21:07:49.867990 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4201:4301(100) ack 1 win 2920
21:07:49.871972 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4301:4401(100) ack 1 win 2920
21:07:49.878702 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3301 win 4696
21:07:49.878715 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3401 win 4696
21:07:49.888969 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3501 win 4696
21:07:49.889540 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4401:4501(100) ack 1 win 2920
21:07:49.891770 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4501:4601(100) ack 1 win 2920
21:07:49.901694 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4601:4701(100) ack 1 win 2920
21:07:49.902100 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3601 win 4696
21:07:49.902120 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3701 win 4696
21:07:49.913050 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4701:4801(100) ack 1 win 2920
21:07:49.921879 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4801:4901(100) ack 1 win 2920
21:07:49.930176 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3801 win 4696
21:07:49.930190 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 3901 win 4696
21:07:49.938303 IP 10.10.0.2.42975 > 10.40.0.2.9: P 4901:5001(100) ack 1 win 2920
21:07:49.938689 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4001 win 4696
21:07:49.942778 IP 10.10.0.2.42975 > 10.40.0.2.9: F 5001:5001(0) ack 1 win 2920
21:07:49.955358 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4101 win 4696
21:07:49.955370 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4201 win 4696
21:07:49.968692 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4301 win 4696
21:07:49.978761 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4401 win 4696
21:07:49.999025 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4501 win 4696
21:07:49.999037 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4601 win 4696
21:07:50.009127 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4701 win 4696
21:07:50.018994 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4801 win 4696
21:07:50.028730 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 4901 win 4696
21:07:50.038762 IP 10.40.0.2.9 > 10.10.0.2.42975: . ack 5001 win 4696
21:07:50.049081 IP 10.40.0.2.9 > 10.10.0.2.42975: F 1:1(0) ack 5002 win 4696
21:07:50.049559 IP 10.10.0.2.42975 > 10.40.0.2.9: . ack 2 win 2920

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При отправке 50 пакетов, максимальный размер окна можно оценить как 1400.

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21:07:53.168367 IP 10.10.0.2.42976 > 10.40.0.2.9: S 3981464291:3981464291(0) win 5840
    <mss 1460,sackOK,timestamp 250928 0,nop,wscale 1>
21:07:53.278812 IP 10.40.0.2.9 > 10.10.0.2.42976: S 3985622848:3985622848(0) ack 3981464292
    win 5792 <mss 1460,sackOK,timestamp 250664 250928,nop,wscale 1>
21:07:53.279449 IP 10.10.0.2.42976 > 10.40.0.2.9: . ack 1 win 2920
21:07:53.279475 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
21:07:53.289598 IP 10.10.0.2.42976 > 10.40.0.2.9: P 101:201(100) ack 1 win 2920
21:07:53.291548 IP 10.10.0.2.42976 > 10.40.0.2.9: P 201:301(100) ack 1 win 2920
21:07:53.388560 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 101 win 2896
21:07:53.388846 IP 10.10.0.2.42976 > 10.40.0.2.9: P 301:1201(900) ack 1 win 2920
21:07:53.397013 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1201:1301(100) ack 1 win 2920
21:07:53.405820 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 201 win 2896
21:07:53.405838 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 301 win 2896
21:07:53.406109 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1301:1401(100) ack 1 win 2920
21:07:53.413768 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1401:1501(100) ack 1 win 2920

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21:07:53.421873 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1501:1601(100) ack 1 win 2920
21:07:53.432073 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1601:1701(100) ack 1 win 2920
21:07:53.498428 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1201 win 3796
21:07:53.498446 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1301 win 3796
21:07:53.498703 IP 10.10.0.2.42976 > 10.40.0.2.9: P 1701:2301(600) ack 1 win 2920
21:07:53.506886 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2301:2401(100) ack 1 win 2920
21:07:53.511909 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2401:2501(100) ack 1 win 2920
21:07:53.520824 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1401 win 3796
21:07:53.520840 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1501 win 3796
21:07:53.522768 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2501:2601(100) ack 1 win 2920
21:07:53.529194 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1601 win 3796
21:07:53.537060 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2601:2701(100) ack 1 win 2920
21:07:53.541754 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2701:2801(100) ack 1 win 2920
21:07:53.549716 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 1701 win 3796
21:07:53.558598 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2801:2901(100) ack 1 win 2920
21:07:53.561518 IP 10.10.0.2.42976 > 10.40.0.2.9: P 2901:3001(100) ack 1 win 2920
21:07:53.571899 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3001:3101(100) ack 1 win 2920
21:07:53.610152 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2301 win 4696
21:07:53.610168 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2401 win 4696
21:07:53.610430 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3101:3201(100) ack 1 win 2920
21:07:53.618655 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3201:3301(100) ack 1 win 2920
21:07:53.618737 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2501 win 4696
21:07:53.622452 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3301:3401(100) ack 1 win 2920
21:07:53.632298 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3401:3501(100) ack 1 win 2920
21:07:53.641633 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3501:3601(100) ack 1 win 2920
21:07:53.650871 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2601 win 4696
21:07:53.650894 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2701 win 4696
21:07:53.650900 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2801 win 4696
21:07:53.661165 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3601:3701(100) ack 1 win 2920
21:07:53.671983 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3701:3801(100) ack 1 win 2920
21:07:53.672011 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 2901 win 4696
21:07:53.672017 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3001 win 4696
21:07:53.679686 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3101 win 4696
21:07:53.687662 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3801:3901(100) ack 1 win 2920
21:07:53.691429 IP 10.10.0.2.42976 > 10.40.0.2.9: P 3901:4001(100) ack 1 win 2920
21:07:53.701753 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4001:4101(100) ack 1 win 2920
21:07:53.711620 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4101:4201(100) ack 1 win 2920
21:07:53.720100 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3201 win 4696
21:07:53.720125 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3301 win 4696
21:07:53.730461 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4201:4301(100) ack 1 win 2920
21:07:53.730490 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3401 win 4696
21:07:53.732283 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4301:4401(100) ack 1 win 2920
21:07:53.740617 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3501 win 4696
21:07:53.748495 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3601 win 4696
21:07:53.756370 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4401:4501(100) ack 1 win 2920
21:07:53.761764 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4501:4601(100) ack 1 win 2920
21:07:53.771682 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4601:4701(100) ack 1 win 2920
21:07:53.771721 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3701 win 4696
21:07:53.778719 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3801 win 4696
21:07:53.787280 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4701:4801(100) ack 1 win 2920

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21:07:53.790710 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 3901 win 4696
21:07:53.795500 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4801:4901(100) ack 1 win 2920
21:07:53.802566 IP 10.10.0.2.42976 > 10.40.0.2.9: P 4901:5001(100) ack 1 win 2920
21:07:53.802789 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4001 win 4696
21:07:53.802831 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4101 win 4696
21:07:53.812656 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5001:5101(100) ack 1 win 2920
21:07:53.821559 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5101:5201(100) ack 1 win 2920
21:07:53.831983 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5201:5301(100) ack 1 win 2920
21:07:53.832006 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4201 win 4696
21:07:53.832011 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4301 win 4696
21:07:53.838507 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4401 win 4696
21:07:53.846685 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5301:5401(100) ack 1 win 2920
21:07:53.851830 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5401:5501(100) ack 1 win 2920
21:07:53.860295 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4501 win 4696
21:07:53.868776 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5501:5601(100) ack 1 win 2920
21:07:53.868813 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4601 win 4696
21:07:53.872058 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5601:5701(100) ack 1 win 2920
21:07:53.881410 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5701:5801(100) ack 1 win 2920
21:07:53.889810 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4701 win 4696
21:07:53.889829 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4801 win 4696
21:07:53.898841 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5801:5901(100) ack 1 win 2920
21:07:53.898868 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 4901 win 4696
21:07:53.901883 IP 10.10.0.2.42976 > 10.40.0.2.9: P 5901:6001(100) ack 1 win 2920
21:07:53.911614 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6001:6101(100) ack 1 win 2920
21:07:53.911823 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5001 win 4696
21:07:53.918707 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5101 win 4696
21:07:53.927340 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6101:6201(100) ack 1 win 2920
21:07:53.929597 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5201 win 4696
21:07:53.934475 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6201:6301(100) ack 1 win 2920
21:07:53.941537 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6301:6401(100) ack 1 win 2920
21:07:53.941835 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5301 win 4696
21:07:53.948705 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5401 win 4696
21:07:53.957010 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6401:6501(100) ack 1 win 2920
21:07:53.959600 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5501 win 4696
21:07:53.964884 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6501:6601(100) ack 1 win 2920
21:07:53.971702 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6601:6701(100) ack 1 win 2920
21:07:53.981274 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5601 win 4696
21:07:53.981384 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5701 win 4696
21:07:53.981750 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6701:6801(100) ack 1 win 2920
21:07:53.988450 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5801 win 4696
21:07:53.997178 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6801:6901(100) ack 1 win 2920
21:07:53.999462 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 5901 win 4696
21:07:54.004511 IP 10.10.0.2.42976 > 10.40.0.2.9: P 6901:7001(100) ack 1 win 2920
21:07:54.012463 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7001:7101(100) ack 1 win 2920
21:07:54.012498 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6001 win 4696
21:07:54.012506 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6101 win 4696
21:07:54.022317 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7101:7201(100) ack 1 win 2920
21:07:54.031811 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7201:7301(100) ack 1 win 2920
21:07:54.032129 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6201 win 4696
21:07:54.038699 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6301 win 4696

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21:07:54.046889 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7301:7401(100) ack 1 win 2920
21:07:54.052753 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7401:7501(100) ack 1 win 2920
21:07:54.061404 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6401 win 4696
21:07:54.061448 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6501 win 4696
21:07:54.061653 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7501:7601(100) ack 1 win 2920
21:07:54.069370 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6601 win 4696
21:07:54.078638 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6701 win 4696
21:07:54.078657 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7601:7701(100) ack 1 win 2920
21:07:54.082095 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7701:7801(100) ack 1 win 2920
21:07:54.092011 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7801:7901(100) ack 1 win 2920
21:07:54.101525 IP 10.10.0.2.42976 > 10.40.0.2.9: P 7901:8001(100) ack 1 win 2920
21:07:54.110026 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6801 win 4696
21:07:54.110052 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 6901 win 4696
21:07:54.110060 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7001 win 4696
21:07:54.119003 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7101 win 4696
21:07:54.119040 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8001:8101(100) ack 1 win 2920
21:07:54.122123 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8101:8201(100) ack 1 win 2920
21:07:54.131480 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8201:8301(100) ack 1 win 2920
21:07:54.142172 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7201 win 4696
21:07:54.142200 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7301 win 4696
21:07:54.142216 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8301:8401(100) ack 1 win 2920
21:07:54.149387 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7401 win 4696
21:07:54.157427 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8401:8501(100) ack 1 win 2920
21:07:54.159579 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7501 win 4696
21:07:54.164094 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8501:8601(100) ack 1 win 2920
21:07:54.171403 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7601 win 4696
21:07:54.171822 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8601:8701(100) ack 1 win 2920
21:07:54.181706 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8701:8801(100) ack 1 win 2920
21:07:54.192213 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8801:8901(100) ack 1 win 2920
21:07:54.192508 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7701 win 4696
21:07:54.192528 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7801 win 4696
21:07:54.192535 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 7901 win 4696
21:07:54.202257 IP 10.10.0.2.42976 > 10.40.0.2.9: P 8901:9001(100) ack 1 win 2920
21:07:54.212064 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9001:9101(100) ack 1 win 2920
21:07:54.221928 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9101:9201(100) ack 1 win 2920
21:07:54.222670 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8001 win 4696
21:07:54.222684 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8101 win 4696
21:07:54.222688 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8201 win 4696
21:07:54.232897 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9201:9301(100) ack 1 win 2920
21:07:54.241741 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9301:9401(100) ack 1 win 2920
21:07:54.250557 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8301 win 4696
21:07:54.250585 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8401 win 4696
21:07:54.259323 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8501 win 4696
21:07:54.259350 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9401:9501(100) ack 1 win 2920
21:07:54.262318 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9501:9601(100) ack 1 win 2920
21:07:54.271988 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8601 win 4696
21:07:54.272035 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9601:9701(100) ack 1 win 2920
21:07:54.272231 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8701 win 4696
21:07:54.284192 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9701:9801(100) ack 1 win 2920
21:07:54.295398 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8801 win 4696

```

```

21:07:54.295639 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9801:9901(100) ack 1 win 2920
21:07:54.302297 IP 10.10.0.2.42976 > 10.40.0.2.9: P 9901:10001(100) ack 1 win 2920
21:07:54.310140 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 8901 win 4696
21:07:54.310153 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9001 win 4696
21:07:54.318271 IP 10.10.0.2.42976 > 10.40.0.2.9: F 10001:10001(0) ack 1 win 2920
21:07:54.318513 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9101 win 4696
21:07:54.337866 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9201 win 4696
21:07:54.337877 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9301 win 4696
21:07:54.349105 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9401 win 4696
21:07:54.361740 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9501 win 4696
21:07:54.368774 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9601 win 4696
21:07:54.378901 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9701 win 4696
21:07:54.388653 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9801 win 4696
21:07:54.398412 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 9901 win 4696
21:07:54.408776 IP 10.40.0.2.9 > 10.10.0.2.42976: . ack 10001 win 4696
21:07:54.428544 IP 10.40.0.2.9 > 10.10.0.2.42976: F 1:1(0) ack 10002 win 4696
21:07:54.428702 IP 10.10.0.2.42976 > 10.40.0.2.9: . ack 2 win 2920

```

При отправке 100 пакетов ситуация особо не меняется. Размер окна также достигает 1400 и не превышает этого значения.

4. Нейгл и Мишналь

С с1 выполним:

```
c1:~# ./nagle default 10.40.0.2 9 0 30
```

На с2 видим вывод tcpdump:

```

19:00:05.662440 IP 10.10.0.2.54752 > 10.40.0.2.9: S 1383349128:1383349128(0) win 5840
    <mss 1460,sackOK,timestamp 28232 0,nop,wscale 1>
19:00:06.085832 IP 10.40.0.2.9 > 10.10.0.2.54752: S 1395252307:1395252307(0) ack 1383349129
    win 5792 <mss 1460,sackOK,timestamp 28122 28232,nop,wscale 1>
19:00:06.086281 IP 10.10.0.2.54752 > 10.40.0.2.9: . ack 1 win 2920
19:00:06.086640 IP 10.10.0.2.54752 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
19:00:06.141530 IP 10.10.0.2.54752 > 10.40.0.2.9: . 101:1549(1448) ack 1 win 2920
19:00:06.296874 IP 10.40.0.2.9 > 10.10.0.2.54752: . ack 101 win 2896
19:00:06.297489 IP 10.10.0.2.54752 > 10.40.0.2.9: . 1549:2997(1448) ack 1 win 2920
19:00:06.297519 IP 10.10.0.2.54752 > 10.40.0.2.9: FP 2997:3001(4) ack 1 win 2920
19:00:06.345719 IP 10.40.0.2.9 > 10.10.0.2.54752: . ack 1549 win 4344
19:00:06.505500 IP 10.40.0.2.9 > 10.10.0.2.54752: . ack 2997 win 5792
19:00:06.505585 IP 10.40.0.2.9 > 10.10.0.2.54752: F 1:1(0) ack 3002 win 5792
19:00:06.506148 IP 10.10.0.2.54752 > 10.40.0.2.9: . ack 2 win 2920

```

Первый пакет пушится сразу, потому что нет неподтверждённых данных (это, как раз, Нейгл). Дальше пакеты буферизуются и отправляются по всей видимости при заполнении буфера. Лучше можно проследить Нейгла с небольшой задержкой:

```

19:27:47.924580 IP 10.10.0.2.51488 > 10.40.0.2.9: S 1699944395:1699944395(0) win 5840
    <mss 1460,sackOK,timestamp 194461 0,nop,wscale 1>

```

```

19:27:48.137104 IP 10.40.0.2.9 > 10.10.0.2.51488: S 1687816892:1687816892(0) ack 1699944396
      win 5792 <mss 1460,sackOK,timestamp 194336 194461,nop,wscale 1>
19:27:48.137845 IP 10.10.0.2.51488 > 10.40.0.2.9: . ack 1 win 2920
19:27:48.138826 IP 10.10.0.2.51488 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
19:27:48.245594 IP 10.40.0.2.9 > 10.10.0.2.51488: . ack 101 win 2896
19:27:48.246151 IP 10.10.0.2.51488 > 10.40.0.2.9: P 101:1101(1000) ack 1 win 2920
19:27:48.355664 IP 10.40.0.2.9 > 10.10.0.2.51488: . ack 1101 win 3896
19:27:48.356130 IP 10.10.0.2.51488 > 10.40.0.2.9: P 1101:2201(1100) ack 1 win 2920
19:27:48.441434 IP 10.10.0.2.51488 > 10.40.0.2.9: FP 2201:3001(800) ack 1 win 2920
19:27:48.471974 IP 10.40.0.2.9 > 10.10.0.2.51488: . ack 2201 win 4996
19:27:48.566365 IP 10.40.0.2.9 > 10.10.0.2.51488: F 1:1(0) ack 3002 win 6096
19:27:48.566642 IP 10.10.0.2.51488 > 10.40.0.2.9: . ack 2 win 2920

```

Здесь пакеты буферизуются и отправляются сразу же, как только приходит подтверждение на предыдущие.

Для прослеживания Миншала, если я всё правильно понимаю, надо увеличить размер отсылаемых данных, чтобы tcp их сегментировал. Тогда можно судить о подтверждении неполных сегментов. Поставим размер массива 2000 (вместо 100)

```
./nagle default 10.40.0.2 9 3 10
```

Видим следующий дамп

```

...
19:56:57.606970 IP 10.10.0.2.60059 > 10.40.0.2.9: . 1:1449(1448) ack 1 win 2920
19:56:57.607039 IP 10.10.0.2.60059 > 10.40.0.2.9: P 1449:2001(552) ack 1 win 2920
19:56:57.715914 IP 10.40.0.2.9 > 10.10.0.2.60059: . ack 1449 win 4344
...

```

Здесь можно наблюдать, что неполный сегмент пушится сразу. Потому что до него все неполные сегменты уже подтверждены, несмотря на то, что подтверждение на предыдущий полный сегмент пришло уже после.

5. Агрессивная буферизация

```
./nagle cork 10.40.0.2 9 400 30
```

```

20:05:15.934997 IP 10.10.0.2.52931 > 10.40.0.2.9: S 2569690568:2569690568(0) win 5840
      <mss 1460,sackOK,timestamp 419260 0,nop,wscale 1>
20:05:16.155840 IP 10.40.0.2.9 > 10.10.0.2.52931: S 2580144875:2580144875(0) ack 2569690569
      win 5792 <mss 1460,sackOK,timestamp 419138 419260,nop,wscale 1>
20:05:16.156408 IP 10.10.0.2.52931 > 10.40.0.2.9: . ack 1 win 2920
20:05:16.954124 IP 10.10.0.2.52931 > 10.40.0.2.9: P 1:201(200) ack 1 win 2920
20:05:17.058757 IP 10.40.0.2.9 > 10.10.0.2.52931: . ack 201 win 3432
20:05:17.831226 IP 10.10.0.2.52931 > 10.40.0.2.9: P 201:501(300) ack 1 win 2920
.....
20:05:28.075724 IP 10.40.0.2.9 > 10.10.0.2.52931: . ack 3001 win 4504
20:05:28.341628 IP 10.10.0.2.52931 > 10.40.0.2.9: F 3001:3001(0) ack 1 win 2920
20:05:28.455625 IP 10.40.0.2.9 > 10.10.0.2.52931: F 1:1(0) ack 3002 win 4504
20:05:28.455931 IP 10.10.0.2.52931 > 10.40.0.2.9: . ack 2 win 2920

```

Небольшая буферизация присутствует. Пуш при получении ACK не производится. При задержке 520 буферизация не прослеживается.

6. Отправка без задержки

Всё так же слушаем на c2:eth0, с c1 выполним

```
| ./nagle nodelay 10.40.0.2 9 -1 30
```

Изучим дамп

```
| 20:13:38.096749 IP 10.10.0.2.54809 > 10.40.0.2.9: S 1871442470:1871442470(0) win 5840
    <mss 1460,sackOK,timestamp 469475 0,nop,wscale 1>
20:13:38.205970 IP 10.40.0.2.9 > 10.10.0.2.54809: S 1854933614:1854933614(0) ack 1871442471
    win 5792 <mss 1460,sackOK,timestamp 469342 469475,nop,wscale 1>
20:13:38.206434 IP 10.10.0.2.54809 > 10.40.0.2.9: . ack 1 win 2920
20:13:38.210594 IP 10.10.0.2.54809 > 10.40.0.2.9: P 1:101(100) ack 1 win 2920
20:13:38.210844 IP 10.10.0.2.54809 > 10.40.0.2.9: P 101:201(100) ack 1 win 2920
20:13:38.210978 IP 10.10.0.2.54809 > 10.40.0.2.9: P 201:301(100) ack 1 win 2920
20:13:38.315267 IP 10.40.0.2.9 > 10.10.0.2.54809: . ack 101 win 2896
20:13:38.315298 IP 10.40.0.2.9 > 10.10.0.2.54809: . ack 201 win 2896
20:13:38.315306 IP 10.40.0.2.9 > 10.10.0.2.54809: . ack 301 win 2896
20:13:38.315818 IP 10.10.0.2.54809 > 10.40.0.2.9: . 301:1749(1448) ack 1 win 2920
20:13:38.315850 IP 10.10.0.2.54809 > 10.40.0.2.9: FP 1749:3001(1252) ack 1 win 2920
20:13:38.427176 IP 10.40.0.2.9 > 10.10.0.2.54809: . ack 1749 win 4344
20:13:38.427561 IP 10.40.0.2.9 > 10.10.0.2.54809: F 1:1(0) ack 3002 win 5792
20:13:38.427741 IP 10.10.0.2.54809 > 10.40.0.2.9: . ack 2 win 2920
```

Первые сегменты не буферизуются. Потом за время ожидания подтверждений данные успевают накопиться в буфере и отправляется целая пачка (301:1749). Оставшаяся часть (1749:3001) отправляется с флагом F, т.к. это конец данных.

7. Быстрый повтор

```
| c3:~# /etc/drop 11
I will drop every 11 packet (counting from 1).
c3:~# tcpdump -n -i eth0 tcp

c1:~# tcpdump -n -i eth0 tcp >dump
c1:~# ./nagle nodelay 10.30.0.2 9 1 30
```

Дамп с c1

```
| 21:08:48.901424 IP 10.10.0.2.41892 > 10.30.0.2.9: P 401:501(100) ack 1 win 2920
21:08:48.911569 IP 10.10.0.2.41892 > 10.30.0.2.9: P 501:601(100) ack 1 win 2920
21:08:48.921417 IP 10.10.0.2.41892 > 10.30.0.2.9: P 601:701(100) ack 1 win 2920
21:08:48.923366 IP 10.30.0.2.9 > 10.10.0.2.41892: . ack 501 <sack 1 601:701>
21:08:48.933288 IP 10.10.0.2.41892 > 10.30.0.2.9: P 701:801(100) ack 1 win 2920
21:08:48.935225 IP 10.30.0.2.9 > 10.10.0.2.41892: . ack 501 <sack 1 601:801>
21:08:48.941478 IP 10.10.0.2.41892 > 10.30.0.2.9: P 801:901(100) ack 1 win 2920
21:08:48.943258 IP 10.30.0.2.9 > 10.10.0.2.41892: . ack 501 <sack 1 601:901>
21:08:48.943286 IP 10.10.0.2.41892 > 10.30.0.2.9: P 501:601(100) ack 1 win 2920
21:08:48.945188 IP 10.30.0.2.9 > 10.10.0.2.41892: . ack 901
21:08:48.955458 IP 10.10.0.2.41892 > 10.30.0.2.9: P 901:1001(100) ack 1 win 2920
21:08:48.957441 IP 10.30.0.2.9 > 10.10.0.2.41892: . ack 1001
```


Видно, что быстрый повтор сработал, но также в опциях видит SACK. Они работают вместе? На с3 дамп точно такой же.

8. Обычный повтор

```
c3:~# /etc/drop 21
I will drop every 21 packet (counting from 1).
c3:~# tcpdump -n -i eth0 tcp
```

Повторилась отправка пакета с FIN. таймер повтора 200мс

```
21:29:20.776655 IP 10.30.0.2.9 > 10.10.0.2.36275: . ack 1001 win 1048
21:29:20.783858 IP 10.10.0.2.36275 > 10.30.0.2.9: F 1001:1001(0) ack 1 win 2920
21:29:20.992095 IP 10.10.0.2.36275 > 10.30.0.2.9: F 1001:1001(0) ack 1 win 2920
21:29:20.993831 IP 10.30.0.2.9 > 10.10.0.2.36275: . ack 1002 win 1048 <sack 1 1001:1002>
21:29:20.993863 IP 10.30.0.2.9 > 10.10.0.2.36275: F 1:1(0) ack 1002 win 1048
21:29:20.993877 IP 10.10.0.2.36275 > 10.30.0.2.9: . ack 2 win 2920
```

9. Неудачная попытка соединени с портом

С с1 вызовем

```
c1:~# ./nagle nodelay 10.30.0.2 8 -1 1
connect: Connection refused
```

```
21:35:27.134881 IP 10.10.0.2.41223 > 10.30.0.2.8: S 1548917762:1548917762(0) win 5840
21:35:27.146835 IP 10.30.0.2.8 > 10.10.0.2.41223: R 0:0(0) ack 1548917763 win 0
```

10. Опыт с PMTU

Для опыта нужно на с3 и с4 отключить tcpclump. Надеюсь тут поможет команда iptables -F. Для сброса кеша MSS на с1 его можно тупо перегрузить.

После этих подготовительных действий мы наверное увидим pmtu в действии при попытке соединится с с1 на с6.

```
c1:~# ./nagle cork 10.50.0.2 9 0 30
c2:~# tcpdump -n -i eth0 tcp or icmp
21:48:29.433094 IP 10.10.0.2.40012 > 10.50.0.2.9: S 921678948:921678948(0) win 5840 <mss 1460>
21:48:29.473281 IP 10.50.0.2.9 > 10.10.0.2.40012: S 916098838:916098838(0) ack 921678949 <mss 1460>
21:48:29.473784 IP 10.10.0.2.40012 > 10.50.0.2.9: . ack 1 win 2920
21:48:29.520879 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1:1449(1448) ack 1 win 2920
21:48:29.520937 IP 10.10.0.1 > 10.10.0.2: ICMP 10.50.0.2 unreachable - need to frag (mtu 1492),
21:48:29.521763 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1:1441(1440) ack 1 win 2920
21:48:29.521842 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1441:1449(8) ack 1 win 2920
21:48:29.522394 IP 10.20.0.2 > 10.10.0.2: ICMP 10.50.0.2 unreachable - need to frag (mtu 576),
21:48:29.523409 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 1 win 2896 <sack 1 1441:1449>
21:48:29.523921 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1:525(524) ack 1
21:48:29.524033 IP 10.10.0.2.40012 > 10.50.0.2.9: . 525:1049(524) ack 1
```

```
21:48:29.525422 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 525 win 3432 <sack 1 1441:1449>
21:48:29.525451 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 1049 win 3956 <sack 1 1441:1449>
21:48:29.525826 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1049:1441(392) ack 1
21:48:29.528021 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 1449 win 4480
21:48:29.541722 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1449:1973(524) ack 1
21:48:29.543223 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 1973 win 5004
21:48:29.566466 IP 10.10.0.2.40012 > 10.50.0.2.9: . 1973:2497(524) ack 1
21:48:29.568628 IP 10.50.0.2.9 > 10.10.0.2.40012: . ack 2497 win 5528
21:48:29.582677 IP 10.10.0.2.40012 > 10.50.0.2.9: FP 2497:3001(504) ack 1
21:48:29.586586 IP 10.50.0.2.9 > 10.10.0.2.40012: F 1:1(0) ack 3002
21:48:29.587849 IP 10.10.0.2.40012 > 10.50.0.2.9: . ack 2 win 2920
```