



UNSW
A U S T R A L I A

COMP3331: Networks

ASSIGNMENT 1 REPORT: STP PROTOCOL

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Features

My STP Protocol has been implemented for both a Sender and a Receiver, with features very similar to the standard TCP Protocol. The Sender side of the protocol uses three concurrent threads, a main thread to pass in and send out segments, a receiver thread to concurrently receive acknowledgements from the receiver and a timer thread to timeout un-acked segments. The Receiver is much simpler and just waits for segments to be received, sending acknowledgements back to the Sender and buffering segments until they may be written to the file. Note, this Protocol was written in *Java*.

Initiation

Like with TCP, the STP Protocol uses a three stage SYN, SYN-ACK, ACK handshake to startup. Once both the Sender and Receiver have started up, the respective UDP sockets are passed on to the main bodies of each side to prepare for the file transfer

Segment Creation

In order to send the file, the STP Protocol breaks it down into segments. Using a java class, I provide the necessary headers and data (as limited by the Maximum Segment Size), which is then converted into a byte stream to be transferred. This occurs for both the Sender and the Receiver, both of which also have access to the necessary methods to convert a received Datagram Byte Stream back into a Segment object to be read.

Segment Windows

In order to keep track of un-acked segments on the Sender side, and to buffer out of order segments on the receiver side, I have implemented a Window class (where each the Sender and the Receiver have a respective sub-class), which stores Segments in order of sequence number. For the sender, this facilitates the transmission and retransmission processes, and for the receiver, the Window class allows for out of buffering out of order segments, until they are able to be read to the file. The Sender window is limited in size by the Maximum Window Size argument, in bytes (excluding segment headers).

Timeout “Watchdog”

I have also implemented a timeout “watchdog” which will keep track of the oldest Segment in the window, and re-transmit it after a user-defined amount of time. This runs concurrently to both the Segment Main thread, and the Sender acknowledgement receiver thread.

Fast-Retransmit

The receiver thread also keeps track of contiguous acknowledgements, and when three consecutive ACK numbers are identical, the corresponding segment is retransmitted.

Checksum

In addition to many of the standard features of STP, I also implemented a Checksum feature. Despite the fact that the transmission will be very reliable, it is still a critical feature of TCP.

Segments

Each Segment has the following header format

Source Port				
Destination Port				
Sequence Number				
Acknowledgement Number				
Check Sum				
SYN	FIN	ACK	Header Length	Unused
Data				

This diagram is 32 bits wide

- Source Port/ Destination Port: The respective ports at either end of the connection, and dependent on the direction of the data travel.
- Sequence Number: The cumulative number of bytes that have been transferred, starting from some randomly selected number from 0-1000
- Acknowledgement Number: The sequence number of the segment which the sender is next expecting from the recipient
- Check Sum: An integer used to determine if some (small) corruption occurred in-flight
- SYN/FIN/ACK: Boolean values determining the type of the segment
- Header Length: The length (in bytes) of the header

It is notable that to transfer this header using the Java Byte Stream, all of these values were converted into standard Java 32 bit integers, meaning that headers are actually 36 bytes, instead of 28.

Questions

- A. After running tests with timeouts of 2, 10 and 100 ms, I have determined that around the 10ms mark is close to optimal timeout. A very small timeout will cause many segments to be resent, whereas a large timeout will cause large delays, if a dropped segment is never caught by the fast retransmission.

Using this value of 10ms, I obtained the following results at the receiver:

rcv 000.006 S 743 0 0	rcv 104.788 D 1695 50 910
rcv 058.017 A 744 0 899	rcv 106.969 D 1745 50 911
rcv 068.301 D 745 50 899	rcv 109.252 D 1795 50 912
rcv 070.613 D 795 50 899	rcv 111.950 D 1845 50 912
rcv 072.655 D 845 50 899	rcv 113.918 D 1395 50 906
rcv 074.599 D 895 50 900	rcv 116.213 D 1395 50 906
rcv 076.663 D 945 50 900	rcv 118.300 D 1395 50 906
rcv 078.572 D 995 50 901	rcv 120.951 D 1395 50 906
rcv 080.609 D 1045 50 902	rcv 122.879 D 1895 50 913
rcv 082.525 D 1095 50 902	rcv 124.872 D 1945 50 922
rcv 084.562 D 1145 50 903	rcv 126.787 D 1995 50 922
rcv 086.461 D 1195 50 904	rcv 128.763 D 1895 50 913
rcv 088.482 D 1245 50 904	rcv 130.720 D 2095 50 923
rcv 090.397 D 1295 50 905	rcv 133.291 D 2145 50 924
rcv 092.431 D 1345 50 906	rcv 135.234 D 2245 50 925
rcv 094.347 D 1445 50 907	rcv 137.839 D 2295 42 926
rcv 096.352 D 1495 50 908	rcv 141.576 D 2045 50 923
rcv 098.851 D 1545 50 908	rcv 152.408 D 2195 50 925
rcv 100.734 D 1595 50 909	rcv 155.562 F 2337 0 935
rcv 102.894 D 1645 50 910	rcv 157.518 A 2338 0 936

From this, it is clear to see that packets 1395, 1895 & 2195 were dropped, as they are received out of order, and would have either been retransmitted after 10ms, or after 3 consecutive ACK's

By increasing the pdrop of this experiment from 0.1 to 0.3 we obtain the following results:

rcv 000.006 S 743 0 0	rcv 118.594 D 1445 50 993
rcv 057.177 A 744 0 981	rcv 121.930 D 1495 50 993
rcv 063.892 D 745 50 981	rcv 125.260 D 1595 50 993
rcv 067.821 D 795 50 981	rcv 128.634 D 1195 50 982
rcv 071.276 D 945 50 981	rcv 134.992 D 1695 50 994
rcv 074.759 D 995 50 982	rcv 136.318 D 1745 50 998
rcv 079.498 D 1045 50 982	rcv 138.522 D 1345 50 983
rcv 082.998 D 1095 50 982	rcv 142.315 D 1845 50 998
rcv 087.577 D 1145 50 982	rcv 144.578 D 1945 50 1001
rcv 091.224 D 1245 50 983	rcv 146.802 D 1995 50 1001
rcv 095.898 D 1295 50 983	rcv 149.047 D 1545 50 993
rcv 099.374 D 845 50 981	rcv 181.206 D 1645 50 994
rcv 102.995 D 845 50 981	rcv 183.815 D 2145 50 1005
rcv 112.480 D 895 50 981	rcv 185.598 D 2245 50 1006
rcv 116.294 D 1395 50 991	rcv 187.609 D 1795 50 998

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rcv 190.242 D 2295 42 1006
rcv 200.024 D 1895 50 1001
rcv 233.190 D 2045 50 1001
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rcv 245.226 D 2095 50 1005
rcv 257.194 D 2195 50 1006
rcv 260.878 F 2337 0 1014
rcv 263.415 A 2338 0 1015
```

It can be seen that significantly more packets were dropped, but these packets were simply resent out of order by either the timeout or fast-retransmit features of the sender. This caused delays of up to 100ms, but overall, there was a very similar number of segments sent.

B. The following table outlines the results of the three experiments

	Experiment i	Experiment ii	Experiment iii
Command	java Sender 127.0.0.1 2000 test2.txt 500 50 10 0.1 300	java Sender 127.0.0.1 2000 test2.txt 500 50 40 0.1 300	java Sender 127.0.0.1 2000 test2.txt 500 50 3 0.1 300
Packets Sent (Sent + Re Transmitted)	44 + 13 = 57	44 + 12 = 56	54 + 93 = 147
Total Time	159ms	244ms	309ms

Looking at these results, it is clear that the optimal solution is to have a small timeout, but one that big enough to give reasonable times for ACK's to be received and processed.

Experiment ii showed that having a large timeout would allow significant time for ack's to be processed, eliminating un-necessary re-transmissions. However, it is clear that the re-transmission was being delayed longer than in needed to be, and this is due to the fact that re-transmissions were occurring only after 40ms, or after 3 consecutive ACK's, which requires at least $3 \times \text{RTT}$ ms.

Experiment iii showed that having a very small timeout is even worse than a large timeout, as it cause many packets to be unnecessarily retransmitted. Several packets were being timed-out, despite the fact that an was in-flight, or even being processed by the sender. Especially when having 3 concurrent threads, an ACK may take a few ms to be processed, and therefore Segments to be removed from the window, causing un-necessary re-transmissions.

Appendices

Question 3a

The following logs were produced from the following commands

java Sender 127.0.0.1 2000 test1.txt 500 50 10 0.1 300

snd 000.011 S 743 0 0	rcv 101.051 A 907 0 1345
rcv 058.440 SA 895 0 744	snd 102.016 D 1795 50 907
snd 059.087 A 744 0 896	rcv 104.586 A 908 0 1395
snd 065.065 D 745 50 896	snd 105.535 D 1845 50 908
snd 065.740 D 795 50 896	rcv 108.064 A 909 0 1395
snd 066.400 D 845 50 896	rcv 111.542 A 910 0 1395
snd 067.038 D 895 50 896	snd 112.813 D 1395 50 900
snd 067.667 D 945 50 896	rcv 116.232 A 911 0 1395
snd 068.298 D 995 50 896	rcv 119.687 A 912 0 1395
snd 068.945 D 1045 50 896	snd 120.887 D 1395 50 900
snd 069.629 D 1095 50 896	rcv 124.346 A 913 0 1395
snd 070.294 D 1145 50 896	rcv 127.809 A 914 0 1395
rcv 070.464 A 896 0 795	snd 129.018 D 1395 50 900
snd 070.957 D 1195 50 896	rcv 132.455 A 915 0 1395
rcv 071.892 A 897 0 845	rcv 135.943 A 916 0 1395
snd 072.405 D 1245 50 897	snd 137.135 D 1395 50 900
rcv 073.165 A 898 0 895	rcv 140.568 A 917 0 1395
snd 073.734 D 1295 50 898	rcv 144.577 A 918 0 1895
rcv 074.515 A 899 0 945	snd 145.554 D 1895 50 909
snd 075.092 D 1345 50 899	snd 146.193 D 1945 50 919
rcv 076.132 A 900 0 995	snd 146.847 D 1995 50 919
drop 076.418 D 1395 50 900	drop 147.470 D 2045 50 919
snd 077.651 D 1445 50 901	snd 148.071 D 2095 50 919
rcv 079.683 A 901 0 1045	rcv 148.156 A 919 0 1895
snd 080.612 D 1495 50 901	snd 148.718 D 2145 50 919
rcv 083.187 A 902 0 1095	snd 150.037 D 2195 50 920
snd 084.119 D 1545 50 902	drop 150.700 D 2245 50 920
rcv 086.662 A 903 0 1145	snd 151.325 D 2295 42 920
snd 087.584 D 1595 50 903	rcv 151.594 A 920 0 1895
rcv 090.112 A 904 0 1195	snd 152.985 D 1895 50 909
snd 091.051 D 1645 50 904	rcv 156.291 A 921 0 1895
rcv 093.596 A 905 0 1245	rcv 159.765 A 922 0 1945
snd 094.568 D 1695 50 905	rcv 163.286 A 923 0 1995
rcv 097.506 A 906 0 1295	rcv 167.204 A 924 0 2045
snd 098.455 D 1745 50 906	rcv 170.647 A 925 0 2045

rcv 174.095 A 926 0 2045
drop 175.291 D 2045 50 919
rcv 181.135 A 927 0 2045
rcv 182.103 A 928 0 2045
snd 183.298 D 2045 50 919
rcv 184.438 A 929 0 2045
rcv 189.279 A 930 0 2245
snd 200.498 D 2245 50 920
rcv 202.012 A 931 0 2337

snd 204.152 F 2337 0 932
rcv 206.389 FA 932 0 2337
snd 207.569 A 2338 0 933
Total bytes sent: 1592
Total Segments sent: 36
Total Segments dropped: 4
Total Segments Retransmitted: 8
Total Duplicate Acks: 17

java Sender 127.0.0.1 2000 test1.txt 500 50 100 0.1 300

snd 000.012 S 743 0 0
rcv 058.734 SA 689 0 744
snd 059.932 A 744 0 690
snd 069.662 D 745 50 690
snd 070.902 D 795 50 690
snd 072.159 D 845 50 690
rcv 072.299 A 690 0 795
snd 073.594 D 895 50 690
rcv 074.528 A 691 0 845
snd 075.333 D 945 50 691
snd 077.031 D 995 50 692
snd 078.274 D 1045 50 692
snd 079.459 D 1095 50 692
snd 080.674 D 1145 50 692
snd 082.015 D 1195 50 692
rcv 082.866 A 692 0 895
snd 083.231 D 1245 50 692
rcv 083.843 A 693 0 945
snd 085.001 D 1295 50 693
rcv 085.556 A 694 0 995
snd 086.692 D 1345 50 694
rcv 087.255 A 695 0 1045
drop 088.406 D 1395 50 695
rcv 088.947 A 696 0 1095
snd 090.035 D 1445 50 696
rcv 090.630 A 697 0 1145
snd 091.811 D 1495 50 697
rcv 092.402 A 698 0 1195
snd 093.551 D 1545 50 698
rcv 094.099 A 699 0 1245
snd 095.234 D 1595 50 699

rcv 095.777 A 700 0 1295
snd 096.926 D 1645 50 700
rcv 097.479 A 701 0 1345
snd 098.619 D 1695 50 701
rcv 099.153 A 702 0 1395
snd 100.338 D 1745 50 702
rcv 101.264 A 703 0 1395
snd 102.047 D 1795 50 703
rcv 103.503 A 704 0 1395
snd 103.738 D 1845 50 704
snd 104.769 D 1395 50 695
rcv 106.133 A 705 0 1395
rcv 108.056 A 706 0 1395
snd 109.251 D 1395 50 695
rcv 110.357 A 707 0 1395
rcv 112.606 A 708 0 1395
snd 113.803 D 1395 50 695
rcv 114.961 A 709 0 1395
rcv 117.212 A 710 0 1395
snd 118.401 D 1395 50 695
rcv 119.982 A 711 0 1845
snd 120.947 D 1895 50 704
snd 122.146 D 1945 50 712
rcv 122.216 A 712 0 1895
snd 123.360 D 1995 50 712
rcv 124.472 A 713 0 1895
drop 125.062 D 2045 50 713
snd 126.702 D 2095 50 714
rcv 126.784 A 714 0 1895
snd 127.903 D 2145 50 714
snd 128.788 D 1895 50 704

drop 130.205 D 2195 50 714
rcv 130.241 A 715 0 1895
snd 131.383 D 2245 50 715
rcv 131.981 A 716 0 1945
snd 133.162 D 2295 42 716
rcv 133.827 A 717 0 1995
rcv 135.834 A 718 0 2045
rcv 138.043 A 719 0 2045
rcv 140.299 A 720 0 2045
drop 141.474 D 2045 50 713
rcv 142.490 A 721 0 2045
rcv 144.784 A 722 0 2045

snd 145.969 D 2045 50 713
rcv 147.086 A 723 0 2045
rcv 152.529 A 724 0 2195
snd 253.196 D 2195 50 714
rcv 255.293 A 725 0 2337
snd 257.548 F 2337 0 726
rcv 259.832 FA 726 0 2337
snd 261.019 A 2338 0 727
Total bytes sent: 1592
Total Segments sent: 36
Total Segments dropped: 4
Total Segments Retransmitted: 8
Total Duplicate Acks: 17

java Sender 127.0.0.1 2000 test1.txt 500 50 2 0.1 300

snd 000.005 S 743 0 0
rcv 035.326 SA 596 0 744
snd 035.963 A 744 0 597
snd 042.008 D 745 50 597
rcv 043.394 A 597 0 795
snd 044.024 D 795 50 598
snd 044.117 D 745 50 597
rcv 045.518 A 598 0 795
snd 044.708 D 845 50 598
snd 046.720 D 895 50 599
rcv 046.748 A 599 0 845
snd 047.402 D 945 50 599
snd 048.264 D 995 50 600
rcv 048.534 A 600 0 895
snd 049.082 D 845 50 598
snd 048.914 D 1045 50 600
snd 050.266 D 1095 50 601
rcv 050.388 A 601 0 945
snd 051.077 D 895 50 599
snd 050.904 D 1145 50 601
rcv 052.147 A 602 0 995
snd 052.241 D 1195 50 602
drop 053.252 D 1245 50 603
snd 053.862 D 1295 50 603
snd 054.091 D 995 50 600
rcv 053.923 A 603 0 1045
snd 054.535 D 1345 50 603
rcv 055.757 A 604 0 1045

snd 055.884 D 1395 50 604
snd 056.855 D 1445 50 605
snd 057.075 D 1045 50 600
rcv 057.582 A 605 0 1095
snd 057.520 D 1495 50 605
snd 058.861 D 1545 50 606
rcv 059.399 A 606 0 1145
snd 059.986 D 1595 50 606
snd 060.078 D 1145 50 601
rcv 061.298 A 607 0 1145
snd 062.089 D 1145 50 601
rcv 063.095 A 608 0 1195
snd 063.599 D 1645 50 607
rcv 064.890 A 609 0 1245
snd 065.125 D 1195 50 602
snd 065.399 D 1695 50 609
rcv 066.703 A 610 0 1245
snd 067.082 D 1245 50 603
rcv 068.479 A 611 0 1245
snd 069.077 D 1245 50 603
drop 069.108 D 1245 50 603
rcv 070.857 A 612 0 1245
snd 071.074 D 1245 50 603
rcv 072.686 A 613 0 1245
snd 073.075 D 1245 50 603
snd 073.324 D 1245 50 603
drop 075.064 D 1245 50 603
rcv 075.175 A 614 0 1245

rcv 076.944 A 615 0 1245
snd 077.078 D 1245 50 603
snd 077.577 D 1245 50 603
drop 079.060 D 1245 50 603
rcv 079.136 A 616 0 1245
rcv 080.321 A 617 0 1245
snd 080.929 D 1245 50 603
rcv 081.505 A 618 0 1245
snd 082.084 D 1245 50 603
snd 084.073 D 1245 50 603
snd 086.089 D 1245 50 603
rcv 086.721 A 619 0 1245
snd 088.072 D 1245 50 603
snd 090.116 D 1245 50 603
snd 090.312 D 1245 50 603
rcv 091.034 A 620 0 1245
rcv 091.530 A 621 0 1245
snd 092.072 D 1245 50 603
drop 092.141 D 1245 50 603
rcv 092.976 A 622 0 1245
rcv 093.464 A 623 0 1245
snd 094.107 D 1245 50 603
snd 094.109 D 1245 50 603
snd 096.081 D 1245 50 603
snd 098.093 D 1245 50 603
rcv 098.248 A 624 0 1745
snd 099.049 D 1745 50 610
snd 099.685 D 1795 50 625
rcv 100.046 A 625 0 1745
snd 100.323 D 1845 50 625
snd 101.208 D 1895 50 626
snd 101.837 D 1945 50 626
snd 102.093 D 1745 50 610
rcv 101.854 A 626 0 1745
drop 102.514 D 1995 50 626
snd 103.400 D 1745 50 610
snd 104.098 D 2045 50 626
rcv 104.333 A 627 0 1745
snd 104.752 D 2095 50 627
snd 105.076 D 1745 50 610
snd 105.661 D 2145 50 628
rcv 106.111 A 628 0 1745
snd 106.564 D 2195 50 628

snd 106.970 D 1745 50 610
drop 108.061 D 1745 50 610
rcv 108.545 A 629 0 1745
snd 110.090 D 1745 50 610
rcv 110.330 A 630 0 1745
snd 111.154 D 1745 50 610
drop 113.057 D 1745 50 610
rcv 114.266 A 631 0 1745
snd 115.172 D 1745 50 610
rcv 116.015 A 632 0 1745
snd 116.638 D 1745 50 610
snd 118.104 D 1745 50 610
rcv 118.427 A 633 0 1745
snd 120.073 D 1745 50 610
rcv 120.227 A 634 0 1745
drop 121.123 D 1745 50 610
rcv 122.585 A 635 0 1745
snd 123.082 D 1745 50 610
rcv 124.320 A 636 0 1745
snd 124.956 D 1745 50 610
snd 126.099 D 1745 50 610
rcv 127.437 A 637 0 1745
drop 128.059 D 1745 50 610
rcv 129.180 A 638 0 1745
snd 129.799 D 1745 50 610
snd 131.074 D 1745 50 610
rcv 131.290 A 639 0 1745
rcv 133.017 A 640 0 1745
snd 133.074 D 1745 50 610
snd 133.667 D 1745 50 610
snd 135.080 D 1745 50 610
rcv 135.420 A 641 0 1745
snd 137.077 D 1745 50 610
rcv 137.193 A 642 0 1745
snd 138.142 D 1745 50 610
rcv 139.990 A 643 0 1795
snd 140.153 D 1745 50 610
snd 141.033 D 2245 50 628
drop 143.065 D 1795 50 625
rcv 143.521 A 644 0 1845
snd 144.461 D 2295 42 644
snd 146.089 D 1845 50 625
rcv 146.984 A 645 0 1895

snd 149.087 D 1895 50 626
rcv 150.391 A 646 0 1945
snd 151.085 D 1895 50 626
drop 153.059 D 1945 50 626
rcv 153.794 A 647 0 1945
drop 155.062 D 1945 50 626
snd 157.077 D 1945 50 626
rcv 157.244 A 648 0 1995
snd 160.079 D 1995 50 626
rcv 160.648 A 649 0 1995
drop 162.083 D 1995 50 626
rcv 164.008 A 650 0 1995
snd 164.077 D 1995 50 626
snd 165.251 D 1995 50 626
snd 166.104 D 1995 50 626
rcv 171.078 A 651 0 1995
snd 171.339 D 1995 50 626
rcv 172.052 A 652 0 1995
snd 173.245 D 1995 50 626
snd 174.074 D 1995 50 626
drop 175.227 D 1995 50 626
rcv 175.632 A 653 0 1995
snd 177.243 D 1995 50 626
rcv 177.324 A 654 0 1995
snd 179.236 D 1995 50 626
snd 179.301 D 1995 50 626
rcv 180.983 A 655 0 1995
snd 181.238 D 1995 50 626
rcv 181.931 A 656 0 1995
snd 183.243 D 1995 50 626
snd 183.938 D 1995 50 626
snd 185.252 D 1995 50 626
rcv 185.404 A 657 0 1995
rcv 187.119 A 658 0 1995
snd 187.237 D 1995 50 626
snd 188.341 D 1995 50 626
rcv 189.797 A 659 0 1995
snd 190.266 D 1995 50 626
rcv 190.797 A 660 0 1995
snd 192.242 D 1995 50 626
snd 192.771 D 1995 50 626
snd 194.261 D 1995 50 626
drop 196.216 D 1995 50 626

rcv 194.629 A 661 0 1995
rcv 198.016 A 662 0 1995
snd 198.269 D 1995 50 626
snd 198.666 D 1995 50 626
rcv 199.810 A 663 0 1995
snd 200.243 D 1995 50 626
rcv 200.294 A 664 0 1995
snd 201.694 D 1995 50 626
rcv 202.290 A 665 0 1995
rcv 202.779 A 666 0 1995
snd 203.087 D 1995 50 626
snd 203.421 D 1995 50 626
rcv 204.179 A 667 0 1995
rcv 204.662 A 668 0 1995
snd 205.086 D 1995 50 626
snd 205.296 D 1995 50 626
rcv 206.029 A 669 0 1995
rcv 206.528 A 670 0 1995
snd 207.093 D 1995 50 626
snd 207.147 D 1995 50 626
rcv 208.014 A 671 0 1995
rcv 208.503 A 672 0 1995
snd 209.096 D 1995 50 626
snd 209.123 D 1995 50 626
rcv 210.025 A 673 0 1995
rcv 210.524 A 674 0 1995
snd 211.090 D 1995 50 626
snd 211.143 D 1995 50 626
rcv 212.015 A 675 0 1995
rcv 212.503 A 676 0 1995
snd 213.094 D 1995 50 626
snd 213.126 D 1995 50 626
rcv 214.017 A 677 0 1995
rcv 214.519 A 678 0 1995
snd 215.094 D 1995 50 626
snd 215.146 D 1995 50 626
rcv 216.027 A 679 0 2337
rcv 216.588 A 680 0 2337
snd 216.780 F 2337 0 680
rcv 217.567 A 681 0 2337
snd 218.013 F 2337 0 680
rcv 218.531 A 682 0 2337
snd 218.992 F 2337 0 680

rcv 219.483 A 683 0 2337
snd 219.912 F 2337 0 680
rcv 220.410 A 684 0 2337
snd 220.841 F 2337 0 680
rcv 221.322 A 685 0 2337
snd 221.751 F 2337 0 680
rcv 222.258 A 686 0 2337
snd 222.690 F 2337 0 680
rcv 223.174 A 687 0 2337
snd 223.604 F 2337 0 680
rcv 224.088 A 688 0 2337
snd 224.530 F 2337 0 680
rcv 225.013 A 689 0 2337
snd 225.458 F 2337 0 680
rcv 225.943 A 690 0 2337
snd 226.396 F 2337 0 680
rcv 226.880 A 691 0 2337
snd 227.310 F 2337 0 680
rcv 227.793 A 692 0 2337
snd 228.234 F 2337 0 680
rcv 228.718 A 693 0 2337
snd 229.149 F 2337 0 680
rcv 229.631 A 694 0 2337
snd 230.082 F 2337 0 680
rcv 230.568 A 695 0 2337
snd 230.999 F 2337 0 680
rcv 231.491 A 696 0 2337
snd 231.923 F 2337 0 680
rcv 232.455 A 697 0 2337
snd 232.890 F 2337 0 680
rcv 233.373 A 698 0 2337
snd 233.803 F 2337 0 680
rcv 234.312 A 699 0 2337
snd 234.744 F 2337 0 680
rcv 235.247 A 700 0 2337
snd 235.680 F 2337 0 680
rcv 236.163 A 701 0 2337

snd 236.592 F 2337 0 680
rcv 237.074 A 702 0 2337
snd 237.503 F 2337 0 680
rcv 237.985 A 703 0 2337
snd 238.441 F 2337 0 680
rcv 238.925 A 704 0 2337
snd 239.357 F 2337 0 680
rcv 239.841 A 705 0 2337
snd 240.285 F 2337 0 680
rcv 240.770 A 706 0 2337
snd 241.201 F 2337 0 680
rcv 241.684 A 707 0 2337
snd 242.134 F 2337 0 680
rcv 242.619 A 708 0 2337
snd 243.049 F 2337 0 680
rcv 243.530 A 709 0 2337
snd 243.959 F 2337 0 680
rcv 244.453 A 710 0 2337
snd 244.885 F 2337 0 680
rcv 245.385 A 711 0 2337
snd 245.818 F 2337 0 680
rcv 246.323 A 712 0 2337
snd 246.755 F 2337 0 680
rcv 247.238 A 713 0 2337
snd 247.666 F 2337 0 680
rcv 248.236 A 714 0 2337
snd 248.674 F 2337 0 680
rcv 249.158 A 715 0 2337
snd 249.588 F 2337 0 680
rcv 250.091 A 716 0 2337
snd 250.526 F 2337 0 680
rcv 251.010 FA 717 0 2337
snd 251.599 A 2338 0 717

Total bytes sent: 1592

Total Segments sent: 72

Total Segments dropped: 20

Total Segments Retransmitted: 143

Total Duplicate Acks: 141

The following logs were produced by the two subsequent tests at the receiver end.

java Sender 127.0.0.1 2000 test1.txt 500 50 10 0.1 300

rcv 000.006 S 743 0 0	snd 106.292 A 917 0 1395
snd 055.261 SA 898 0 744	rcv 106.969 D 1745 50 911
rcv 058.017 A 744 0 899	snd 108.629 A 918 0 1395
rcv 068.301 D 745 50 899	rcv 109.252 D 1795 50 912
snd 069.340 A 899 0 795	snd 111.332 A 919 0 1395
rcv 070.613 D 795 50 899	rcv 111.950 D 1845 50 912
snd 071.472 A 900 0 845	snd 113.291 A 920 0 1395
rcv 072.655 D 845 50 899	rcv 113.918 D 1395 50 906
snd 073.958 A 901 0 895	snd 115.589 A 921 0 1895
rcv 074.599 D 895 50 900	rcv 116.213 D 1395 50 906
snd 075.486 A 902 0 945	snd 117.067 A 922 0 1895
rcv 076.663 D 945 50 900	rcv 118.300 D 1395 50 906
snd 077.932 A 903 0 995	snd 119.789 A 923 0 1895
rcv 078.572 D 995 50 901	rcv 120.951 D 1395 50 906
snd 079.420 A 904 0 1045	snd 121.705 A 924 0 1895
rcv 080.609 D 1045 50 902	rcv 122.879 D 1895 50 913
snd 081.889 A 905 0 1095	snd 123.695 A 925 0 1945
rcv 082.525 D 1095 50 902	rcv 124.872 D 1945 50 922
snd 083.346 A 906 0 1145	snd 126.151 A 926 0 1995
rcv 084.562 D 1145 50 903	rcv 126.787 D 1995 50 922
snd 085.823 A 907 0 1195	snd 128.136 A 927 0 2045
rcv 086.461 D 1195 50 904	rcv 128.763 D 1895 50 913
snd 087.298 A 908 0 1245	snd 130.080 A 928 0 2045
rcv 088.482 D 1245 50 904	rcv 130.720 D 2095 50 923
snd 089.758 A 909 0 1295	snd 132.667 A 929 0 2045
rcv 090.397 D 1295 50 905	rcv 133.291 D 2145 50 924
snd 091.248 A 910 0 1345	snd 134.612 A 930 0 2045
rcv 092.431 D 1345 50 906	rcv 135.234 D 2245 50 925
snd 093.705 A 911 0 1395	snd 137.218 A 931 0 2045
rcv 094.347 D 1445 50 907	rcv 137.839 D 2295 42 926
snd 095.172 A 912 0 1395	snd 139.162 A 932 0 2045
rcv 096.352 D 1495 50 908	rcv 141.576 D 2045 50 923
snd 098.200 A 913 0 1395	snd 142.353 A 933 0 2195
rcv 098.851 D 1545 50 908	rcv 152.408 D 2195 50 925
snd 100.117 A 914 0 1395	snd 153.257 A 934 0 2337
rcv 100.734 D 1595 50 909	rcv 155.562 F 2337 0 935
snd 102.269 A 915 0 1395	snd 156.239 FA 935 0 2337
rcv 102.894 D 1645 50 910	rcv 157.518 A 2338 0 936
snd 104.170 A 916 0 1395	Total Bytes Received: 1592
rcv 104.788 D 1695 50 910	Total Segments Received: 40
	Total Duplicate Segments: 4

java Sender 127.0.0.1 2000 test1.txt 500 50 10 0.3 300

rcv 000.006 S 743 0 0
snd 056.117 SA 980 0 744
rcv 057.177 A 744 0 981
rcv 063.892 D 745 50 981
snd 066.596 A 981 0 795
rcv 067.821 D 795 50 981
snd 069.254 A 982 0 845
rcv 071.276 D 945 50 981
snd 073.570 A 983 0 845
rcv 074.759 D 995 50 982
snd 078.314 A 984 0 845
rcv 079.498 D 1045 50 982
snd 081.821 A 985 0 845
rcv 082.998 D 1095 50 982
snd 086.396 A 986 0 845
rcv 087.577 D 1145 50 982
snd 090.037 A 987 0 845
rcv 091.224 D 1245 50 983
snd 094.680 A 988 0 845
rcv 095.898 D 1295 50 983
snd 098.188 A 989 0 845
rcv 099.374 D 845 50 981
snd 101.814 A 990 0 895
rcv 102.995 D 845 50 981
snd 105.373 A 991 0 895
rcv 112.480 D 895 50 981
snd 115.058 A 992 0 1195
rcv 116.294 D 1395 50 991
snd 117.475 A 993 0 1195
rcv 118.594 D 1445 50 993
snd 120.351 A 994 0 1195
rcv 121.930 D 1495 50 993
snd 123.644 A 995 0 1195
rcv 125.260 D 1595 50 993
snd 127.001 A 996 0 1195
rcv 128.634 D 1195 50 982
snd 132.341 A 997 0 1345

rcv 134.992 D 1695 50 994
snd 135.687 A 998 0 1345
rcv 136.318 D 1745 50 998
snd 136.929 A 999 0 1345
rcv 138.522 D 1345 50 983
snd 139.931 A 1000 0 1545
rcv 142.315 D 1845 50 998
snd 143.493 A 1001 0 1545
rcv 144.578 D 1945 50 1001
snd 145.737 A 1002 0 1545
rcv 146.802 D 1995 50 1001
snd 147.980 A 1003 0 1545
rcv 149.047 D 1545 50 993
snd 150.316 A 1004 0 1645
rcv 181.206 D 1645 50 994
snd 181.899 A 1005 0 1795
rcv 183.815 D 2145 50 1005
snd 184.461 A 1006 0 1795
rcv 185.598 D 2245 50 1006
snd 186.227 A 1007 0 1795
rcv 187.609 D 1795 50 998
snd 188.304 A 1008 0 1895
rcv 190.242 D 2295 42 1006
snd 190.873 A 1009 0 1895
rcv 200.024 D 1895 50 1001
snd 201.346 A 1010 0 2045
rcv 233.190 D 2045 50 1001
snd 234.427 A 1011 0 2095
rcv 245.226 D 2095 50 1005
snd 246.488 A 1012 0 2195
rcv 257.194 D 2195 50 1006
snd 258.508 A 1013 0 2337
rcv 260.878 F 2337 0 1014
snd 261.556 FA 1014 0 2337
rcv 263.415 A 2338 0 1015
Total Bytes Received: 1592
Total Segments Received: 37
Total Duplicate Segments: 1

Question 3b

The following logs were obtained for the three tests for test2.txt:

java Sender 127.0.0.1 2000 test2.txt 500 50 10 0.1 300

snd 000.007 S 743 0 0	snd 069.226 D 1845 50 232
rcv 032.702 SA 219 0 744	rcv 070.906 A 233 0 1395
snd 033.362 A 744 0 220	rcv 073.159 A 234 0 1395
snd 039.625 D 745 50 220	snd 073.833 D 1395 50 226
rcv 041.029 A 220 0 795	rcv 075.488 A 235 0 1395
snd 041.656 D 795 50 220	rcv 077.684 A 236 0 1395
rcv 042.880 A 221 0 845	snd 078.310 D 1395 50 226
snd 043.560 D 845 50 222	rcv 080.008 A 237 0 1395
rcv 044.775 A 222 0 895	rcv 083.635 A 238 0 1395
snd 045.425 D 895 50 223	snd 084.852 D 1395 50 226
snd 046.069 D 945 50 223	rcv 086.990 A 239 0 1395
snd 046.704 D 995 50 223	rcv 089.763 A 240 0 1395
rcv 048.008 A 223 0 945	snd 090.425 D 1395 50 226
rcv 049.206 A 224 0 995	rcv 092.243 A 241 0 1395
rcv 050.382 A 225 0 1045	rcv 094.295 A 242 0 1895
snd 051.057 D 1045 50 223	snd 094.813 D 1895 50 233
snd 051.708 D 1095 50 226	snd 095.479 D 1945 50 243
snd 052.330 D 1145 50 226	snd 096.110 D 1995 50 243
snd 052.948 D 1195 50 226	rcv 096.154 A 243 0 1895
snd 053.576 D 1245 50 226	drop 096.739 D 2045 50 243
snd 054.209 D 1295 50 226	snd 097.636 D 2095 50 244
snd 054.834 D 1345 50 226	rcv 097.968 A 244 0 1895
rcv 054.941 A 226 0 1095	snd 098.310 D 2145 50 244
drop 055.551 D 1395 50 226	snd 098.733 D 1895 50 233
snd 056.384 D 1445 50 227	drop 099.517 D 2195 50 244
snd 057.023 D 1495 50 227	snd 100.126 D 2245 50 245
rcv 057.316 A 227 0 1145	rcv 100.475 A 245 0 1895
snd 057.675 D 1545 50 227	snd 100.775 D 2295 50 245
snd 058.606 D 1595 50 228	drop 101.659 D 2345 50 246
rcv 059.555 A 228 0 1195	rcv 102.319 A 246 0 1945
snd 060.043 D 1645 50 228	snd 102.824 D 2395 50 246
rcv 061.756 A 229 0 1245	rcv 104.158 A 247 0 1995
snd 062.260 D 1695 50 229	snd 104.674 D 2445 50 247
rcv 064.025 A 230 0 1295	rcv 105.990 A 248 0 2045
snd 064.562 D 1745 50 230	snd 106.488 D 2495 50 248
rcv 066.301 A 231 0 1345	rcv 107.799 A 249 0 2045
snd 066.822 D 1795 50 231	rcv 109.605 A 250 0 2045
rcv 068.715 A 232 0 1395	snd 110.254 D 2045 50 243

rcv 111.947 A 251 0 2045
rcv 113.739 A 252 0 2045
snd 114.360 D 2045 50 243
rcv 116.221 A 253 0 2045
rcv 119.468 A 254 0 2045
snd 120.103 D 2045 50 243
rcv 121.834 A 255 0 2045
rcv 123.605 A 256 0 2045
snd 124.234 D 2045 50 243
rcv 126.069 A 257 0 2195
snd 126.591 D 2545 50 249
drop 127.245 D 2595 50 258
snd 127.878 D 2645 50 258
rcv 127.889 A 258 0 2195
rcv 129.652 A 259 0 2195
snd 130.288 D 2195 50 244
rcv 132.051 A 260 0 2195
rcv 133.815 A 261 0 2195

snd 134.453 D 2195 50 244
rcv 136.218 A 262 0 2195
rcv 138.067 A 263 0 2345
snd 138.584 D 2695 3 258
rcv 139.880 A 264 0 2345
rcv 141.708 A 265 0 2345
snd 142.336 D 2345 50 246
rcv 144.241 A 266 0 2595
snd 154.410 D 2595 50 258
rcv 155.355 A 267 0 2698
snd 156.985 F 2698 0 268
rcv 158.252 FA 268 0 2698
snd 158.867 A 2699 0 269
Total bytes sent: 1953
Total Segments sent: 44
Total Segments dropped: 5
Total Segments Retransmitted: 13
Total Duplicate Acks: 27

java Sender 127.0.0.1 2000 test2.txt 500 50 3 0.1 300

snd 000.011 S 743 0 0
rcv 058.250 SA 592 0 744
snd 058.933 A 744 0 593
snd 064.734 D 745 50 593
snd 065.410 D 795 50 593
snd 066.040 D 845 50 593
snd 066.703 D 895 50 593
rcv 066.983 A 593 0 795
snd 067.420 D 945 50 593
snd 067.362 D 745 50 593
snd 068.805 D 995 50 594
snd 070.171 D 1045 50 594
snd 070.810 D 1095 50 594
rcv 070.815 A 594 0 845
snd 071.492 D 1145 50 594
snd 071.283 D 795 50 593
snd 072.811 D 1195 50 595
snd 074.157 D 1245 50 595
rcv 074.285 A 595 0 895
snd 075.265 D 845 50 593
drop 074.822 D 1295 50 595

snd 076.924 D 1345 50 596
rcv 077.732 A 596 0 945
snd 078.308 D 895 50 593
snd 078.702 D 1395 50 596
rcv 081.234 A 597 0 945
snd 081.290 D 945 50 593
rcv 083.514 A 598 0 995
snd 084.039 D 1445 50 597
snd 084.274 D 995 50 594
rcv 085.339 A 599 0 1045
snd 085.853 D 1495 50 599
rcv 087.155 A 600 0 1095
snd 087.698 D 1545 50 600
rcv 089.003 A 601 0 1145
snd 089.510 D 1595 50 601
rcv 090.816 A 602 0 1145
snd 092.287 D 1145 50 594
rcv 092.612 A 603 0 1195
snd 093.635 D 1645 50 602
rcv 094.419 A 604 0 1245
snd 094.933 D 1695 50 604

rcv 096.260 A 605 0 1295
snd 096.765 D 1745 50 605
rcv 098.085 A 606 0 1295
snd 099.290 D 1295 50 595
rcv 099.858 A 607 0 1295
snd 100.761 D 1295 50 595
rcv 102.444 A 608 0 1295
drop 103.258 D 1295 50 595
rcv 104.298 A 609 0 1295
snd 104.916 D 1295 50 595
rcv 106.712 A 610 0 1295
snd 107.284 D 1295 50 595
rcv 108.537 A 611 0 1295
snd 109.157 D 1295 50 595
rcv 110.980 A 612 0 1295
drop 112.261 D 1295 50 595
rcv 112.794 A 613 0 1295
snd 113.683 D 1295 50 595
rcv 115.143 A 614 0 1295
snd 116.285 D 1295 50 595
rcv 116.939 A 615 0 1295
drop 117.731 D 1295 50 595
rcv 119.256 A 616 0 1295
snd 120.298 D 1295 50 595
rcv 121.048 A 617 0 1295
snd 121.746 D 1295 50 595
rcv 123.633 A 618 0 1295
snd 124.339 D 1295 50 595
rcv 125.433 A 619 0 1295
snd 126.049 D 1295 50 595
rcv 128.064 A 620 0 1795
snd 128.287 D 1295 50 595
snd 128.677 D 1795 50 606
rcv 129.905 A 621 0 1795
snd 129.994 D 1845 50 621
snd 131.008 D 1895 50 622
drop 131.641 D 1945 50 622
rcv 131.700 A 622 0 1795
snd 132.245 D 1995 50 622
snd 132.687 D 1795 50 606
snd 133.409 D 2045 50 622
snd 134.048 D 2095 50 623
rcv 134.156 A 623 0 1795

snd 134.719 D 2145 50 623
snd 135.276 D 1795 50 606
rcv 135.921 A 624 0 1795
snd 135.638 D 2195 50 624
snd 136.862 D 1795 50 606
snd 137.612 D 2245 50 624
rcv 138.371 A 625 0 1795
snd 139.293 D 1795 50 606
rcv 140.145 A 626 0 1795
drop 140.759 D 1795 50 606
snd 143.282 D 1795 50 606
rcv 144.157 A 627 0 1795
rcv 145.937 A 628 0 1795
snd 146.294 D 1795 50 606
snd 146.604 D 1795 50 606
rcv 148.325 A 629 0 1795
snd 149.284 D 1795 50 606
rcv 150.078 A 630 0 1795
snd 150.759 D 1795 50 606
rcv 152.469 A 631 0 1795
snd 153.288 D 1795 50 606
rcv 154.230 A 632 0 1845
snd 154.739 D 2295 50 625
rcv 156.012 A 633 0 1895
drop 156.524 D 2345 50 633
rcv 157.792 A 634 0 1945
snd 158.314 D 2395 50 634
rcv 159.596 A 635 0 1945
snd 161.286 D 1945 50 622
rcv 161.331 A 636 0 1945
drop 162.757 D 1945 50 622
rcv 163.678 A 637 0 1945
snd 165.280 D 1945 50 622
rcv 165.415 A 638 0 1945
snd 166.749 D 1945 50 622
rcv 167.771 A 639 0 1945
snd 169.288 D 1945 50 622
rcv 169.504 A 640 0 1945
snd 170.766 D 1945 50 622
rcv 171.895 A 641 0 1945
drop 173.255 D 1945 50 622
rcv 173.642 A 642 0 1945
snd 174.696 D 1945 50 622

rcv 176.031 A 643 0 1945
snd 177.291 D 1945 50 622
rcv 177.808 A 644 0 1945
snd 178.794 D 1945 50 622
rcv 180.205 A 645 0 1945
drop 181.255 D 1945 50 622
rcv 181.959 A 646 0 1945
snd 182.691 D 1945 50 622
rcv 184.421 A 647 0 1945
snd 185.287 D 1945 50 622
rcv 186.209 A 648 0 1945
snd 186.844 D 1945 50 622
rcv 188.599 A 649 0 1945
snd 189.286 D 1945 50 622
rcv 190.373 A 650 0 1945
snd 191.002 D 1945 50 622
rcv 192.740 A 651 0 1945
snd 193.283 D 1945 50 622
rcv 194.515 A 652 0 1945
snd 195.136 D 1945 50 622
rcv 197.070 A 653 0 2345
snd 197.581 D 2445 50 635
snd 198.251 D 2495 50 654
drop 198.883 D 2545 50 654
rcv 198.882 A 654 0 2345
snd 199.493 D 2595 50 654
snd 200.282 D 2345 50 633
rcv 200.638 A 655 0 2345
snd 201.734 D 2345 50 633
snd 200.429 D 2645 50 655
drop 202.853 D 2695 3 656
rcv 202.909 A 656 0 2345
drop 204.247 D 2345 50 633
rcv 204.644 A 657 0 2345
snd 205.686 D 2345 50 633
rcv 207.004 A 658 0 2345
snd 208.275 D 2345 50 633
rcv 208.798 A 659 0 2345
drop 209.729 D 2345 50 633
rcv 211.152 A 660 0 2345
snd 212.274 D 2345 50 633
rcv 213.500 A 661 0 2345
snd 214.154 D 2345 50 633

rcv 215.886 A 662 0 2345
snd 217.269 D 2345 50 633
rcv 217.638 A 663 0 2345
snd 218.776 D 2345 50 633
rcv 220.170 A 664 0 2345
snd 221.277 D 2345 50 633
rcv 221.926 A 665 0 2345
snd 222.754 D 2345 50 633
rcv 224.279 A 666 0 2345
drop 225.244 D 2345 50 633
rcv 226.021 A 667 0 2345
snd 226.655 D 2345 50 633
rcv 229.101 A 668 0 2345
snd 229.766 D 2345 50 633
rcv 230.188 A 669 0 2345
snd 230.836 D 2345 50 633
rcv 232.564 A 670 0 2345
snd 233.099 D 2345 50 633
rcv 234.454 A 671 0 2545
rcv 236.235 A 672 0 2545
snd 237.097 D 2545 50 654
rcv 238.023 A 673 0 2545
snd 238.653 D 2545 50 654
rcv 240.396 A 674 0 2545
snd 241.099 D 2545 50 654
rcv 242.172 A 675 0 2545
snd 242.786 D 2545 50 654
rcv 244.536 A 676 0 2545
snd 245.101 D 2545 50 654
rcv 246.313 A 677 0 2545
snd 246.985 D 2545 50 654
rcv 248.825 A 678 0 2545
snd 249.100 D 2545 50 654
rcv 250.610 A 679 0 2545
snd 251.222 D 2545 50 654
rcv 252.970 A 680 0 2545
snd 254.112 D 2545 50 654
rcv 254.793 A 681 0 2545
drop 255.391 D 2545 50 654
rcv 257.115 A 682 0 2545
snd 258.116 D 2545 50 654
rcv 258.904 A 683 0 2545
snd 259.516 D 2545 50 654

rcv 261.323 A 684 0 2545
snd 262.111 D 2545 50 654
rcv 263.137 A 685 0 2545
snd 263.750 D 2545 50 654
rcv 266.805 A 686 0 2695
rcv 267.308 A 687 0 2695
rcv 267.964 A 688 0 2695
snd 268.573 D 2695 3 656
rcv 270.387 A 689 0 2695
snd 271.097 D 2695 3 656
rcv 272.140 A 690 0 2695
snd 272.747 D 2695 3 656
rcv 274.508 A 691 0 2695
snd 275.095 D 2695 3 656
rcv 276.260 A 692 0 2695
snd 276.869 D 2695 3 656
rcv 278.638 A 693 0 2695
snd 279.123 D 2695 3 656
rcv 280.419 A 694 0 2695
snd 281.027 D 2695 3 656
rcv 282.789 A 695 0 2695
snd 283.093 D 2695 3 656
rcv 284.550 A 696 0 2695
snd 285.160 D 2695 3 656
rcv 286.923 A 697 0 2695
snd 288.098 D 2695 3 656
rcv 288.749 A 698 0 2695
snd 289.360 D 2695 3 656

rcv 291.175 A 699 0 2698
snd 292.771 F 2698 0 700
rcv 293.292 A 700 0 2698
snd 293.731 F 2698 0 700
rcv 294.240 A 701 0 2698
snd 294.671 F 2698 0 700
rcv 298.130 A 702 0 2698
snd 298.572 F 2698 0 700
rcv 299.057 A 703 0 2698
snd 299.483 F 2698 0 700
rcv 299.963 A 704 0 2698
snd 300.395 F 2698 0 700
rcv 301.922 A 705 0 2698
snd 302.389 F 2698 0 700
rcv 304.997 A 706 0 2698
snd 305.436 F 2698 0 700
rcv 305.920 A 707 0 2698
snd 306.369 F 2698 0 700
rcv 306.856 A 708 0 2698
snd 307.284 F 2698 0 700
rcv 308.034 A 709 0 2698
snd 308.469 F 2698 0 700
rcv 308.981 FA 710 0 2698
snd 309.579 A 2699 0 711
Total bytes sent: 1953
Total Segments sent: 54
Total Segments dropped: 16
Total Segments Retransmitted: 93
Total Duplicate Acks: 88

java Sender 127.0.0.1 2000 test2.txt 500 50 40 0.1 300

snd 000.006 S 743 0 0
rcv 058.644 SA 493 0 744
snd 059.909 A 744 0 494
snd 069.399 D 745 50 494
snd 070.671 D 795 50 494
rcv 071.265 A 494 0 795
snd 071.948 D 845 50 494
rcv 073.259 A 495 0 845
snd 073.323 D 895 50 495
snd 074.986 D 945 50 496

rcv 075.079 A 496 0 895
snd 076.210 D 995 50 496
rcv 076.877 A 497 0 945
snd 077.546 D 1045 50 497
rcv 078.675 A 498 0 995
snd 078.796 D 1095 50 498
snd 080.383 D 1145 50 499
rcv 080.502 A 499 0 1045
snd 081.615 D 1195 50 499
rcv 082.322 A 500 0 1095

snd 082.919 D 1245 50 500
snd 084.160 D 1295 50 501
rcv 084.178 A 501 0 1145
snd 085.392 D 1345 50 501
rcv 086.018 A 502 0 1195
drop 086.717 D 1395 50 502
rcv 087.818 A 503 0 1245
snd 087.952 D 1445 50 503
snd 089.509 D 1495 50 504
rcv 089.635 A 504 0 1295
snd 090.752 D 1545 50 504
rcv 091.473 A 505 0 1345
snd 092.273 D 1595 50 505
rcv 093.573 A 506 0 1395
snd 093.580 D 1645 50 506
snd 095.286 D 1695 50 507
rcv 095.380 A 507 0 1395
snd 096.511 D 1745 50 507
rcv 097.163 A 508 0 1395
snd 097.806 D 1795 50 508
snd 098.069 D 1395 50 502
snd 099.192 D 1845 50 508
rcv 100.004 A 509 0 1395
rcv 101.811 A 510 0 1395
snd 102.474 D 1395 50 502
rcv 104.198 A 511 0 1395
rcv 106.063 A 512 0 1395
snd 106.740 D 1395 50 502
rcv 108.541 A 513 0 1395
rcv 110.550 A 514 0 1795
snd 111.140 D 1895 50 509
snd 112.355 D 1945 50 515
rcv 112.428 A 515 0 1845
snd 113.573 D 1995 50 515
rcv 114.247 A 516 0 1895
snd 114.923 D 2045 50 516
rcv 116.085 A 517 0 1895
drop 116.185 D 2095 50 517
snd 117.721 D 2145 50 518
rcv 117.873 A 518 0 1895
snd 118.987 D 2195 50 518
snd 119.189 D 1895 50 509
drop 120.365 D 2245 50 518

rcv 120.430 A 519 0 1945
snd 121.556 D 2295 50 519
rcv 122.229 A 520 0 1995
snd 122.944 D 2345 50 520
rcv 124.147 A 521 0 2045
drop 124.159 D 2395 50 521
snd 125.791 D 2445 50 522
rcv 125.952 A 522 0 2095
snd 127.066 D 2495 50 522
rcv 127.736 A 523 0 2095
snd 128.311 D 2545 50 523
rcv 129.588 A 524 0 2095
snd 130.247 D 2095 50 517
rcv 132.034 A 525 0 2095
rcv 133.854 A 526 0 2095
snd 134.517 D 2095 50 517
rcv 136.307 A 527 0 2095
rcv 139.773 A 528 0 2095
snd 140.461 D 2095 50 517
rcv 142.178 A 529 0 2095
rcv 143.955 A 530 0 2095
snd 144.599 D 2095 50 517
rcv 146.398 A 531 0 2245
snd 147.001 D 2595 50 524
rcv 148.222 A 532 0 2245
drop 148.386 D 2645 50 532
snd 149.896 D 2695 3 533
rcv 150.009 A 533 0 2245
snd 151.402 D 2245 50 518
rcv 152.415 A 534 0 2245
rcv 154.208 A 535 0 2245
snd 154.874 D 2245 50 518
rcv 156.700 A 536 0 2245
rcv 158.573 A 537 0 2395
rcv 160.414 A 538 0 2395
snd 199.091 D 2395 50 521
rcv 200.017 A 539 0 2645
snd 240.054 D 2645 50 532
rcv 240.948 A 540 0 2698
snd 242.623 F 2698 0 541
rcv 243.605 FA 541 0 2698
snd 244.751 A 2699 0 542
Total bytes sent: 1953

Total Segments sent: 44
Total Segments dropped: 5

Total Segments Retransmitted: 12
Total Duplicate Acks: 23