CS536: Data Communication and Computer Networks

Lab2 Answers

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September 29, 2019

1 Problem 3

1.1 average RTT and file size

For type B test, the average RTT is **1.090** ms in a consecutive 10 pings from a pod machine to an escher machine. We transmit 1471 bytes at each RTT, so the total file size should be $1471 \times (4000/1.090) \approx 5400000$ bytes.

The average RTT for type A test is about **0.213** ms in a consecutive 10 pings. The average RTT for type B test is about **1.090** ms in a consecutive 10 pings.

1.2 Baseline

1. For type A test, **2 * RTT = 426**. Table 1 shows the result of 3 tests. From the result, we can see that there is little duplicate bytes, which means that the sender is able to send a data package and receive an expected ACK less than 2 * RTT. The variance is small in these 3 tests because the distance between two machines is close enough, which means there is not too much noise or disturbance in the connection.

2. For type B test, **2 * RTT = 2180**. Table 2 shows the result of 3 tests. Similar to type A test, there is no duplicate package. However, sometimes the completion time is more than 4 seconds and have some duplicates bytes. I believe it is because the disturbance in the connection between the pod machine and the escher machine.

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	4413	601.582	71810659.229
2	5400000	5884	616.816	70037093.720
3	5400000	4413	599.352	72077844.072

Table 1: *Baseline* for type A test

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	1471	4120.550	10484037.325
2	5400000	0	3994.285	10815452.578
3	5400000	0	3878.163	11139294.558

Table 2: *Baseline* for type B test

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	607523	803.753	53747855.373
2	5400000	604581	818.048	52808637.146
3	5400000	607523	810.000	53333333.333

Table 3: *Drops* for type A test

3. Comparison:

   (a) The average completion time for type A test is much shorter than the type B test, since the RTT of type A is shorter than that of type B. The difference of completion time is the same as the difference of RTT, and therefore the speed has the same difference. RTT determines the completion time and speed in ideal condition.

   (b) Type A test is more stable than that of type B test. Type B would show a extreme cases in several consecutive tests. It is because the connection between two farther machines is not stable enough, so the sender cannot get the ACK in a timely manner, which will cause duplicate bytes and overhead.

1.3 Drop

1. For type A test, **2 * RTT = 426**. Table 3 shows the result of 3 tests. The client receives about 11% duplicates bytes. It is slightly larger than 10% because 10% of duplicate packages won't get an ACK under the drop policy. Hence the total drop rate would be around 11%. The completion time in this scenario is larger than that in ideal condition.

2. For type B test, **2 * RTT = 2180**. Table 4 shows the result of 3 tests. Here is the similar scenario. About 11% duplicate bytes are received by the receiver side. The completion time is longer and the speed is slower.

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	600168	4630.375	9329697.919
2	5400000	657537	4980.359	8674073.496
3	5400000	598697	4780.768	9036205.062

Table 4: *Drops* for type B test

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	30891	613.246	70444813.338
2	5400000	26478	619.758	69704626.645
3	5400000	19123	611.255	70674268.513

Table 5: *Jumping the gun* for type A test

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	5400000	161810	3973.397	10872309.009
2	5400000	361866	4111.689	10506631.217
3	5400000	341272	4089.371	10563971.819

Table 6: *Jumping the gun* for type B test

3. Comparison:

   (a) Both two types of test have the similar behavior. The client side would receive duplicate bytes and the duplicate rate is also similar.

   (b) The increment rate of completion time in type B is less than that in type A, which means the overhead of dealing with duplicate bytes has more impact for type A test.

1.4 Jumping the gun

1. For type A test, **1.2 * RTT = 255**. Table 5 shows the result of 3 tests. From this result, we can see about 0.5% of total bytes are duplicate. It means the connection between two pod machines is relatively stable. Only 0.5% RTTs are larger than the timeout.

2. For type B test, **1.2 * RTT = 1308**. Table 6 shows the result of 3 tests. This result shows that more than 5% of total bytes are duplicate, which means that the connection is not as stable as the connection in type A. This is reasonable, because the distance between a pod machine and an escher machine is larger and it is more likely to be disturbed.

3. Comparison:

   (a) The number of duplicate bytes of both tests is notably larger than the baseline condition. It is because sometime the network condition is disturbed and slower than normal, in which case the sender cannot get ACK on time. Hence, duplicate bytes will produce.

   (b) The completion time of both tests is not influenced too much by the jumping the gun. They can almost finish in time, compared with the ideal condition.

   (c) If the distance between two machines are large, there would be more likely that the sender would not get ACK on time. The larger the distance, the more variance of RTT. Network is not a perfect and ideal world. The RTT is different at each time and an extreme case would happen at any time.

Try	Total Bytes	Duplicate Bytes	Completion Time (ms)	Speed (bps)
1	100000	0	15578.616	51352.444
2	100000	0	15567.835	51388.006
3	100000	0	15718.082	50896.795

Table 7: *Baseline* for remote client test

2 Bonus Problem

The client's computing environment is an Alibaba server located in Hangzhou, China. It has 1 CPU (Intel(R) Xeon(R) CPU E5-2650 v2 @ 2.60GHz) with 2 cores and has 2GB memory. It runs Ubuntu 14.04.6 LTS with GNU/Linux 3.13.0-32-generic x86_64 kernel. The public IPv4 address is 123.56.10.176. We do not have to change the client code since the kernel is similar.

The average RTT is about 233 ms in a 10 consecutive pings.

```
--- 123.56.10.176 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9010ms
rtt min/avg/max/mdev = 230.708/233.005/234.247/1.557 ms
```

Since the RTT is much larger than machines around Purdue campus, we set the file size a little smaller. 100000 is a reasonable size as the completion time is around 15 seconds.

Table 7 shows the result of baseline test. The result verifies the stop and wait formula: $100000/1471 * 233 \approx 15839$. All the completion time is around this time. The network connection is stable though the RTT is large. During the test, the time in China is midnight, so there is not too much disturbance and the variance is very small. If we perform a ssh login during the test at the same time, a duplicate package might happen since the bandwidth between the United States and China is limited.