Problem 1.4 Testing and Performance Evaluation

`rrunner` VS `myftp`

We use the following commands for `rrunner` benchmark. We run the server on `amber05.cs.purdue.edu` (`128.10.112.135`).

```
./rrunners 128.10.112.135 22222 123 <block-size> <window-size> 1000000
```

And we run the client on: `amber06.cs.purdue.edu` (`128.10.112.136`)

```
./rrunnerc 128.10.112.135 22222 testf 123 <block-size> <window-size>
```

We set the window size to 1 and 32 for comparison.

`myftp`

blocksize	64K bytes file throughput (bytes/ms)	64K bytes file completion time (ms)	64M bytes file throughput (bytes/ms)	64M bytes file completion time (ms)
512	480.2333165	136.467	715.7628418	93758.519
1024	798.6546102	82.058	1254.796654	53481.864
1471	1064.017015	61.593	1586.591925	42297.495

`rrunner`, `W=1`

blocksize	64K bytes file throughput (bytes/ms)	64K bytes file completion time (ms)	64M bytes file throughput (bytes/ms)	64M bytes file completion time (ms)
512	377.4571634	173.625	383.7349636	174883.371
1024	642.7870846	101.956	760.1632465	88282.174
1471	780.0697511	84.013	1148.341427	58439.818

`rrunner`, `W=32`

blocksize	64K bytes file throughput (bytes/ms)	64K bytes file completion time (ms)	64M bytes file throughput (bytes/ms)	64M bytes file completion time (ms)
512	2394.883976	27.365	124.2452503	540132.229
1024	5283.882932	12.403	223.6014495	300127.142

blocksize	64K bytes file throughput (bytes/ms)	64K bytes file completion time (ms)	64M bytes file throughput (bytes/ms)	64M bytes file completion time (ms)
1471	5891.405969	11.124	278.8880449	240630.121

The network status is unstable and thus `rrunner` has worse performance than `myftp` as multiple packets are dropped during the transmission. However, for small file size (64K bytes), since the number of dropped packets has significantly smaller, the performance is better than `myftp`.

There is another big factor for the completion time and throughput: network file system. All lab machines use network file system to access the user data. Thus, if the file system is busy or the connection is heavily loaded, the throughput in the statistics above will decreases significantly.

Performance with Different Window Sizes

We use the following commands for `rrunner` benchmark. We use the same machines mentioned above.

For the server, we run:

```
./rrunners 128.10.112.135 22222 123 1024 <window-size> 1000000
```

For the client, we run:

```
./rrunnerc 128.10.112.135 22222 testf 123 1024 <window-size>
```

We transfer a 10 M bytes file with 1, 2, 4, 8, 12, 16, 20 window sizes.

window size	throughput (bytes/s)	completion time (s)
1	273.9432852	3.738
2	421.7462932	2.428
4	595.0029053	1.721
8	912.6559715	1.122
12	292.0707359	3.506
16	222.6570994	4.599
20	166.1528476	6.163

As the window size increases, the penalty increases on UDP packets dropped. Thus, the best window size is approximately 8 and the throughput could reach 912.655 bytes/s.

The load of network file system is still a big factor for above statistics. Any network congestion would heavily impact the throughput and completion time.

Problem 2.3: Client authentication: implementation

The completion time of `v1` (without XOR authentication) and `v2` (with XOR authentication) are almost identical since we only add an XOR operation before file transmission, which is trivial for performance.

window size	completion time (s)
1	3.845
2	2.426
4	1.773

Bonus Problem

Still, the completion time of `v1` (without XOR authentication) and `v3` (with XOR authentication) are almost identical since we only XOR operation against file data and request command. The impact on performance is significantly smaller than other factors, such as network status.

window size	completion time (s)
1	3.935
2	2.606
4	1.783