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## IERG\_4180\_Project4\_Report

Note:

- This lab also implemented HTTP UDP mode.
- The generated certificate-related files are placed in the certificate/ directory of the main directory.

Experiment 1: Investigate the system performance impact of HTTPS over HTTP.

HTTP:

Command1.1: `httpperf --server localhost --port 4080 --num-conns=10000`

Output:

```
(base) root@LAPTOP-QJKHNRH9:/mnt/c/Users/jerry/Desktop/IERG_4180/Project/IERG_4180_Project4/httpperf# httpperf --server localhost --port 4080 --num-conns=10000
httpperf --client=0/1 --server=localhost --port=4080 --uri=/ --send-buffer=4096 --recv-buffer=16384 --ssl-protocol=auto --num-conns=10000 --num-calls=1
Maximum connect burst length: 1

Total: connections 10000 requests 10000 replies 10000 test-duration 2.836 s

Connection rate: 3526.5 conn/s (0.3 ms/conn, <=1 concurrent connections)
Connection time [ms]: min 0.2 avg 0.3 max 1.6 median 0.5 stddev 0.1
Connection time [ms]: connect 0.1
Connection length [replies/conn]: 1.000

Request rate: 3526.5 req/s (0.3 ms/req)
Request size [B]: 62.0

Reply rate [replies/s]: min 0.0 avg 0.0 max 0.0 stddev 0.0 (0 samples)
Reply time [ms]: response 0.2 transfer 0.0
Reply size [B]: header 45.0 content 955.0 footer 0.0 (total 1000.0)
Reply status: 1xx=0 2xx=10000 3xx=0 4xx=0 5xx=0

CPU time [s]: user 0.82 system 2.01 (user 29.1% system 70.7% total 99.8%)
Net I/O: 3657.3 KB/s (30.0*10^6 bps)

Errors: total 0 client-timo 0 socket-timo 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

Command1.2: `httpperf --server localhost --port 4080 --num-conns=100000`

Output:

```
(base) root@LAPTOP-QJKHNRH9:/mnt/c/Users/jerry/Desktop/IERG_4180/Project/IERG_4180_Project4/httpperf# httpperf --server localhost --port 4080 --num-conns=100000
httpperf --client=0/1 --server=localhost --port=4080 --uri=/ --send-buffer=4096 --recv-buffer=16384 --ssl-protocol=auto --num-conns=100000 --num-calls=1
Maximum connect burst length: 1

Total: connections 100000 requests 100000 replies 100000 test-duration 29.532 s

Connection rate: 3386.1 conn/s (0.3 ms/conn, <=1 concurrent connections)
Connection time [ms]: min 0.1 avg 0.3 max 37.7 median 0.5 stddev 0.2
Connection time [ms]: connect 0.1
Connection length [replies/conn]: 1.000

Request rate: 3386.1 req/s (0.3 ms/req)
Request size [B]: 62.0

Reply rate [replies/s]: min 3369.0 avg 3396.9 max 3441.2 stddev 32.0 (5 samples)
Reply time [ms]: response 0.2 transfer 0.0
Reply size [B]: header 45.0 content 955.0 footer 0.0 (total 1000.0)
Reply status: 1xx=0 2xx=100000 3xx=0 4xx=0 5xx=0

CPU time [s]: user 9.13 system 20.36 (user 30.9% system 68.9% total 99.8%)
Net I/O: 3511.8 KB/s (28.8*10^6 bps)

Errors: total 0 client-timo 0 socket-timo 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

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HTTPs:

Command2.1: `httpperf --server localhost --port 4081 --num-conns=10000 --ssl`

Output:

```
(base) root@LAPTOP-QJKHNRH9:/mnt/c/Users/jerry/Desktop/IERG_4180/Project/IERG_4180_Project4/httpperf# httpperf --server localhost --port 4081 --num-conns=10000 --ssl
httpperf --client=0/1 --server=localhost --port=4081 --uri=/ --send-buffer=4096 --recv-buffer=16384 --ssl --ssl-protocol=auto --num-conns=10000 --num-calls=1
Maximum connect burst length: 1

Total: connections 10000 requests 10000 replies 10000 test-duration 30.603 s

Connection rate: 326.8 conn/s (3.1 ms/conn, <=1 concurrent connections)
Connection time [ms]: min 2.4 avg 3.0 max 9.8 median 2.5 stddev 0.3
Connection time [ms]: connect 2.6
Connection length [replies/conn]: 1.000

Request rate: 326.8 req/s (3.1 ms/req)
Request size [B]: 62.0

Reply rate [replies/s]: min 311.4 avg 326.6 max 331.8 stddev 7.9 (6 samples)
Reply time [ms]: response 0.3 transfer 0.0
Reply size [B]: header 45.0 content 955.0 footer 0.0 (total 1000.0)
Reply status: 1xx=0 2xx=10000 3xx=0 4xx=0 5xx=0

CPU time [s]: user 17.74 system 12.86 (user 58.0% system 42.0% total 100.0%)
Net I/O: 338.9 KB/s (2.8*10^6 bps)

Errors: total 0 client-timo 0 socket-timo 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

Command2.2: `httpperf --server localhost --port 4081 --num-conns=100000 --ssl`

Output:

```
(base) root@LAPTOP-QJKHNRH9:/mnt/c/Users/jerry/Desktop/IERG_4180/Project/IERG_4180_Project4/httpperf# httpperf --server localhost --port 4081 --num-conns=100000 --ssl
httpperf --client=0/1 --server=localhost --port=4081 --uri=/ --send-buffer=4096 --recv-buffer=16384 --ssl --ssl-protocol=auto --num-conns=100000 --num-calls=1
Maximum connect burst length: 1

Total: connections 100000 requests 100000 replies 100000 test-duration 305.262 s

Connection rate: 327.6 conn/s (3.1 ms/conn, <=1 concurrent connections)
Connection time [ms]: min 2.4 avg 3.0 max 41.5 median 2.5 stddev 0.5
Connection time [ms]: connect 2.6
Connection length [replies/conn]: 1.000

Request rate: 327.6 req/s (3.1 ms/req)
Request size [B]: 62.0

Reply rate [replies/s]: min 311.6 avg 327.6 max 333.6 stddev 4.5 (61 samples)
Reply time [ms]: response 0.3 transfer 0.0
Reply size [B]: header 45.0 content 955.0 footer 0.0 (total 1000.0)
Reply status: 1xx=0 2xx=100000 3xx=0 4xx=0 5xx=0

CPU time [s]: user 179.64 system 125.60 (user 58.8% system 41.1% total 100.0%)
Net I/O: 339.7 KB/s (2.8*10^6 bps)

Errors: total 0 client-timo 0 socket-timo 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

Setting:

- Both httpperf and netprobserver are run locally
- Unplug the power of my laptop to add some degree of latency for measurement.
- The response packet of http and https is 1000 bytes.
- We performed two experiments for HTTP and HTTPS, with 10000 and 100000 HTTP requests in total, and observed the output.

Observation:

- Overall we can see that the performance of the HTTP is about 10 times faster than the HTTPS.
- For HTTP, the connection rate is around 3530 connections/second, and the reply rate is around 3370 replies/second.

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- For HTTPS, the connection rate is around 327 connections/second, and the reply rate is around 311 replys/second.
- We also observed that the number of HTTP/HTTPS requests sent from httpperf does not impact the performance overall.