

P7

- For each request, the client should first start up a TCP connection with the server. The total response time for the scenario illustrated in Figure 2.19 is $TT_1 + 3RTT_r$.
- Similarly, the total response time for the scenario illustrated in Figure 2.20 is $TT_1 + 3RTT_r$.
- If the DNS record for the requested name is cached, the client needs only request the LDNS to get the IP, i.e. the total response time is TT_1 for both scenarios.

P8

For this problem, we assume that the RTT to the server is RTT_s

- The non-persistent HTTP with no parallel TCP connections for each object will take $2RTT_s$ (one for handshaking and one for request). As there are 8 objects the HTML references and the HTML file itself, the time for obtaining these items is $9 \times 2RTT_s$. To get the IP address of the server, it takes $TT_1 + 3RTT_r$. Therefore, the total time is $18RTT_s + TT_1 + 3RTT_r$.
- In this case, the time for obtaining 8 objects is $2 \times 2RTT_s$ and the time for obtaining the HTML file is $2RTT_s$. Therefore, the total time is $6RTT_s + TT_1 + 3RTT_r$.
- With persistent HTTP, the request can be sent in one TCP connection, back-to-back. Hence, it only takes $2RTT_s + RTT_s$ (two for handshaking and get HTML file, one for requesting 8 objects) to get the HTML and 8 objects. Therefore, the total time is $3RTT_s + TT_1 + 3RTT_r$.

P14

Because the destination mail server may be down when SMTP server tries to transmit a message and the TCP connection fails to start up.

P18

- According to the wikipedia, a whois database stores the registered users or assignees of an Internet resource, such as a domain name, an IP address block or an autonomous system, but is also used for a wider range of other information.
- The whois databases I found are APNIC and ARIN. And I found DNS servers named OpenDNS(208.67.222.222) and AliDNS(223.5.5.5).
- I use the nslookup to send DNS queries to three DNS servers: AliDNS, OpenDNS and my local DNS server. And the result is shown in Figure 1. And it seems that it would take much longer time to get a IP address for a domain for the first time but much less time for the second time, which implies that the cache in DNS server plays a great role.
- I found that *baidu.com* has multiple IP addresses, but SJTU has only one IP address.

```

C:\> nslookup sjtu.edu.cn 223.5.5.5
Server: public1.alidns.com
Address: 223.5.5.5

Non-authoritative answer:
Name:   SJTU.edu.cn
Address: 202.112.26.54

C:\> nslookup sjtu.edu.cn 208.67.222.222
Server: resolver1.opendns.com
Address: 208.67.222.222

Non-authoritative answer:
Name:   sjtu.edu.cn
Address: 202.112.26.54

C:\> nslookup sjtu.edu.cn
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
Name:   sjtu.edu.cn
Address: 202.112.26.54

C:\> nslookup mail.sjtu.edu.cn 208.67.222.222
Server: resolver1.opendns.com
Address: 208.67.222.222

Non-authoritative answer:
Name:   mail-hk.sjtu.edu.cn
Address: 103.113.157.117
Aliases: mail.sjtu.edu.cn
         mail.dnslb.sjtu.edu.cn

C:\> nslookup mail.sjtu.edu.cn 223.5.5.5
Server: public1.alidns.com
Address: 223.5.5.5

Non-authoritative answer:
Name:   mail-edu.SJTU.edu.cn
Address: 202.112.26.54
Aliases: mail.SJTU.edu.cn
         mail.dnslb.SJTU.edu.cn

C:\> nslookup mail.sjtu.edu.cn
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
Name:   mail-sjtu.sjtu.edu.cn
Address: 202.120.2.188
Aliases: mail.sjtu.edu.cn
         mail.dnslb.sjtu.edu.cn

```

Figure 1: DNS queries for different type to different DNS servers

- e. The IP address range used by *China Education and Research Network* is 202.112.0.0 - 202.112.31.255
- f. The attacker can use the whois databases and the nslookup tool to find out every IP addresses owned by the target institution and launch an attack to all of the IP addresses.
- g. The whois databases should be publicly available because it is like a phone book for someone who wants to find out the registration, IP information and other Internet resources. Without it, it can be very difficult to find out who owns a certain domain, for example.

P19

- a. Firstly I executed the command *dig @a.root-servers.net www.sjtu.edu.cn*. Figure 2 shows the result of the query for *www.sjtu.edu.cn* at *a.root-servers.net*.
Then I executed the command *dig @a.dns.cn www.sjtu.edu.cn*. Figure 3 shows the result of the query for *www.sjtu.edu.cn* at *a.dns.cn*
After executed the command *dig @dns.edu.cn www.sjtu.edu.cn*, Figure 4 shows the result of the query for *www.sjtu.edu.cn* at *dns.edu.cn*
Finally I executed the command *dig @dns.sjtu.edu.cn www.sjtu.edu.cn*, and I got the IP address of the website. Figure 5 shows the result of the query for *www.sjtu.edu.cn* at *dns.sjtu.edu.cn*.
- b. I executed *dig @a.root-servers.net www.google.com* and *dig @a.gtld-servers.net www.google.com*. And I got the IP address of *www.google.com*. Figure 6 and 7 show the results the two commands respectively.

```
;; AUTHORITY SECTION:
cn. 172800 IN NS e.dns.cn.
cn. 172800 IN NS ns.cernet.net.
cn. 172800 IN NS c.dns.cn.
cn. 172800 IN NS a.dns.cn.
cn. 172800 IN NS g.dns.cn.
cn. 172800 IN NS d.dns.cn.
cn. 172800 IN NS f.dns.cn.
cn. 172800 IN NS b.dns.cn.

;; ADDITIONAL SECTION:
a.dns.cn. 172800 IN A 203.119.25.1
b.dns.cn. 172800 IN A 203.119.26.1
c.dns.cn. 172800 IN A 203.119.27.1
d.dns.cn. 172800 IN A 203.119.28.1
e.dns.cn. 172800 IN A 203.119.29.1
f.dns.cn. 172800 IN A 195.219.8.90
g.dns.cn. 172800 IN A 66.198.183.65
ns.cernet.net. 172800 IN A 202.112.0.44
a.dns.cn. 172800 IN AAAA 2001:dc7::1
d.dns.cn. 172800 IN AAAA 2001:dc7:1000::1

;; Query time: 32 msec
;; SERVER: 198.41.0.4#53(198.41.0.4)
;; WHEN: Mon Oct 15 19:29:27 DST 2018
;; MSG SIZE rcvd: 399
```

Figure 2: Query for *www.sjtu.edu.cn* at *a.root-servers.net*

```
;; AUTHORITY SECTION:
sjtu.edu.cn. 172800 IN NS dns.sjtu.edu.cn.
sjtu.edu.cn. 172800 IN NS apple.sjtu.edu.cn.

;; ADDITIONAL SECTION:
dns.sjtu.edu.cn. 172800 IN A 202.120.2.90
apple.sjtu.edu.cn. 172800 IN A 202.112.26.43
dns.sjtu.edu.cn. 172800 IN AAAA 2001:da8:8000:1:202:120:2:90
apple.sjtu.edu.cn. 172800 IN AAAA 2001:da8:8000:6180:150:112:26:43

;; Query time: 28 msec
;; SERVER: 202.112.0.35#53(202.112.0.35)
;; WHEN: Mon Oct 15 19:47:49 DST 2018
;; MSG SIZE rcvd: 198
```

Figure 4: Query for *www.sjtu.edu.cn* at *dns.sjtu.edu.cn*

```
;; AUTHORITY SECTION:
edu.cn. 172800 IN NS dns2.edu.cn.
edu.cn. 172800 IN NS dns.edu.cn.
edu.cn. 172800 IN NS ns2.cuhk.hk.
edu.cn. 172800 IN NS ns2.cernet.net.
edu.cn. 172800 IN NS deneb.dfn.de.

;; ADDITIONAL SECTION:
dns.edu.cn. 172800 IN A 202.112.0.35
dns2.edu.cn. 172800 IN A 202.112.0.13

;; Query time: 28 msec
;; SERVER: 203.119.25.1#53(203.119.25.1)
;; WHEN: Mon Oct 15 19:42:45 DST 2018
;; MSG SIZE rcvd: 192
```

Figure 3: Query for *www.sjtu.edu.cn* at *a.dns.cn*

```
; ANSWER SECTION:
ww.sjtu.edu.cn. 3600 IN A 202.120.2.119

; Query time: 4 msec
; SERVER: 202.120.2.90#53(202.120.2.90)
; WHEN: Mon Oct 15 19:51:24 DST 2018
; MSG SIZE rcvd: 60
```

Figure 5: Query for *www.sjtu.edu.cn* at

```

;; AUTHORITY SECTION:
com.      172800 IN      NS      k.gtld-servers.net.
com.      172800 IN      NS      b.gtld-servers.net.
com.      172800 IN      NS      h.gtld-servers.net.
com.      172800 IN      NS      i.gtld-servers.net.
com.      172800 IN      NS      d.gtld-servers.net.
com.      172800 IN      NS      f.gtld-servers.net.
com.      172800 IN      NS      j.gtld-servers.net.
com.      172800 IN      NS      g.gtld-servers.net.
com.      172800 IN      NS      c.gtld-servers.net.
com.      172800 IN      NS      a.gtld-servers.net.
com.      172800 IN      NS      l.gtld-servers.net.
com.      172800 IN      NS      e.gtld-servers.net.
com.      172800 IN      NS      m.gtld-servers.net.

;; ADDITIONAL SECTION:
a.gtld-servers.net. 172800 IN      A      192.5.6.30
b.gtld-servers.net. 172800 IN      A      192.33.14.30
c.gtld-servers.net. 172800 IN      A      192.26.92.30
d.gtld-servers.net. 172800 IN      A      192.31.80.30
e.gtld-servers.net. 172800 IN      A      192.12.94.30
f.gtld-servers.net. 172800 IN      A      192.35.51.30
g.gtld-servers.net. 172800 IN      A      192.42.93.30
h.gtld-servers.net. 172800 IN      A      192.54.112.30
i.gtld-servers.net. 172800 IN      A      192.43.172.30
j.gtld-servers.net. 172800 IN      A      192.48.79.30
k.gtld-servers.net. 172800 IN      A      192.52.178.30
l.gtld-servers.net. 172800 IN      A      192.41.162.30
m.gtld-servers.net. 172800 IN      A      192.55.83.30
a.gtld-servers.net. 172800 IN      AAAA   2001:503:a83a::2:30
b.gtld-servers.net. 172800 IN      AAAA   2001:503:231d::2:30
c.gtld-servers.net. 172800 IN      AAAA   2001:503:83eb::30
d.gtld-servers.net. 172800 IN      AAAA   2001:500:856e::30
e.gtld-servers.net. 172800 IN      AAAA   2001:502:1ca1::30
f.gtld-servers.net. 172800 IN      AAAA   2001:503:d414::30
g.gtld-servers.net. 172800 IN      AAAA   2001:503:eea3::30
h.gtld-servers.net. 172800 IN      AAAA   2001:502:8cc::30
i.gtld-servers.net. 172800 IN      AAAA   2001:502:39c1::30
j.gtld-servers.net. 172800 IN      AAAA   2001:502:709d::30
k.gtld-servers.net. 172800 IN      AAAA   2001:503:d2d::30
l.gtld-servers.net. 172800 IN      AAAA   2001:500:d937::30
m.gtld-servers.net. 172800 IN      AAAA   2001:501:b1f9::30

;; Query time: 33 msec
;; SERVER: 198.41.0.4#53(198.41.0.4)
;; WHEN: Mon Oct 15 20:00:12 DST 2018
;; MSG SIZE rcvd: 867

```

```

;; QUESTION SECTION:
;www.google.com.      IN      A

;; ANSWER SECTION:
www.google.com.      201 IN      A      69.171.245.49

;; Query time: 29 msec
;; SERVER: 192.5.6.30#53(192.5.6.30)
;; WHEN: Mon Oct 15 20:01:52 DST 2018
;; MSG SIZE rcvd: 48

```

Figure 7: Query for *www.google.com* at *a.gtld-servers.net*

Figure 6: Query for *www.google.com* at *a.root-servers.net*

P27

- If I run TCPClient before I run TCPServer, the TCPClient will try to start up a TCP connection but fail, as TCP connection needs a successful handshaking.
- If I run UDPClient before I run UDPServer, the UDPClient will send a UDP messages without noticing that the message can not reach the server, as it never starts a TCP connection between it and the server.
- If I use different port numbers, for TCP, the client will tries to establish a TCP connection with a wrong process or a non-existent process which will raise an error. On the other hand, for UDP, the client will send UDP message to the wrong port, i.e. a wrong process or a non-existent process. In that case it will look fine on the client side but may cause some error to the process who get the message on the server side.

P30

Advantage of byte-oriented API is that for application that needs only byte streams, like http, smtp and so on, a message boundary is useless and improve the performance a little bit since the protocol does not need to be bothered by recognizing the boundary and seperate the message.

However the disadvantage of it is that for some message-oriented applications, they should create a machanism to seperate the message they get, which may be harder to implement it in transport layer.