

מטלה 4

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First Part:

1. הציגו יתרון אחד לשימוש ב-DoH והסבירו אותו (כמובן, מעבר לעובדה שהוא מאובטח ומוצפן)

Beyond data encryption, DOH has the advantage of increasing performance, and even in the case of packet loss, it is faster at sending information.

When using it we notice that web pages load fastest than when we use Do53.

2. הציגו והסבירו על שני חסרונות לשימוש בשיטת DoH לעומת DNS הרגיל.

a) One of the first inconvenient of DOH is that with conventional DNS today, most users are assigned the IP addresses of several recursive resolvers via DHCP or similar network bootstrapping mechanism and there is currently no equivalent to this for DOH.

b) The use of DOH makes the network slower and less efficient because the information passes through a remote network.

3. בחרו אחד מהחסרונות משאלה (2), הציעו דרך למתן\לעקוף\לפתור חיסרון זה והסבירו אותה.

About the problem that there is no IP assignment in DOH, users sometimes also change to third-party recursive resolvers or even operate their own local resolver. Also, they could use a raspberry pie and Pie hole to configurate both DOH and DHCP on it or use GEODN that is a routing logic that improves domain name search by address resolution based on customer's geographic location (and can also make the use of DOH to be less slow).

4. ישנן 4 דרכים בהן ניתן לשלב את שיטת ה-DoH באינטרנט שלנו:

- a. מימוש DoH ברמת האפליקציות (לדוגמא: לעדכן את קוד הדפדפן כך שישלחו שאילתות דרך HTTPS)
 - b. מימוש DoH ברמת שרת proxy* ברשת (מהמחשב לשרת נשלח לפורט 53 והלאה, כבר 443)
 - c. מימוש DoH ברמת שרת proxy מקומי (על המכונה רץ שרת proxy)
 - d. התקנת plugin המממש DoH ברמת הגדרות המחשב ("מעכשיו, אתה שולח רק DoH")
- כתבו השוואה בין כל ארבעת השיטות, בהשוואתכם הראו יתרונות וחסרונות לכל שיטה והציגו מהי, לדעתכם, השיטה המועדפת מבין הארבעה. כלומר, הציגו את השיטה בה, לדעתכם, היתרונות הגדולים ביותר לעומת החסרונות הקטנים ביותר.

a) Advantages: The DNS protocol can be implemented in supported applications and using it on the app level instead of the operating system level allows DOH queries to be sent to a specific list of DNS servers and bypass ISP-level DNS default settings.

Inconvenient: If the user ignores requests, the application will not be able to view the user who ignored it.

b) Advantage: The proxy is a path that allows you to become anonymous (DNS queries are sent via an encrypted HTTPS connection for example). This use gives the user the possibility that their IP, and therefore their identity, remains unknown.

Inconvenient: Neighbor users identified with the same network have access to the information.

c) Advantage: Even if the users are connected to the same network, the requests will be encrypted so the attack will be more difficult to perform.

Inconvenient: General installation locally can create congestion.

d) Advantages: Unlike a proxy, being a plugin module, it does not need to be installed on all machines separately.

Inconvenient: Not all operating systems support the plugin.

In our opinion, it seems to be best to save time and avoid any kind of congestion so, the most helpful solution for us seems to be the plugin.

5. נניח שאנו ברשת שקיים בה איבוד פקטות (packet loss) באחוז לא ידוע ואנו רוצים לטעון דף שצריך 25 שאילתות כדי לבקש את כל המשאבים שבו. הציגו יתרון ברור שיש ל-DoH לעומת Do53. (רמז: מנגנון הקיים ב-TCP)

The Do53 process uses the UDP protocol and does not have the same characteristics.

When DoH is used during packet loss, a mechanism sends a signal to the package before it is lost, so it can be sent again without any problem.

In general, TCP enables DOH to outperform Do53 in page load times, despite higher response times and particularly when there is significant packet loss.

Second Part:

Without packet loss:

```
llansouffir@llansouffir-VirtualBox: ~/Desktop/Ex4
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ cd Desktop
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ cd Ex4
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc del dev lo root netem
[sudo] password for llansouffir:
Error: Invalid qdisc name.
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc add dev lo root netem
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...
Received 1048576 bytes from file 1 in 1.023003 seconds
Received 1048576 bytes from file 2 in 1.015230 seconds
Received 1048576 bytes from file 3 in 1.022578 seconds
Received 1048576 bytes from file 4 in 1.022591 seconds
Received 1048576 bytes from file 5 in 1.033473 seconds
Average time for Cubic algorithm is: 1.023375
Received 1048576 bytes from file 1 in 1.016338 seconds
Received 1048576 bytes from file 2 in 1.010064 seconds
Received 1048576 bytes from file 3 in 1.016513 seconds
Received 1048576 bytes from file 4 in 1.016814 seconds
Received 1048576 bytes from file 5 in 1.014998 seconds
Average time for Reno algorithm is: 1.015745
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$
```

```
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 4 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 5 (1048576 bytes)
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 6 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 7 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 8 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 9 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 10 (1048576 bytes)
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$
```

10% :

```
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ cd Desktop
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ cd Ex4
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 10%
[sudo] password for llansouffir:
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...
Received 1048576 bytes from file 1 in 1.015210 seconds
Received 1048576 bytes from file 2 in 1.014440 seconds
Received 1048576 bytes from file 3 in 1.039274 seconds
Received 1048576 bytes from file 4 in 1.010869 seconds
Received 1048576 bytes from file 5 in 1.014576 seconds
Average time for Cubic algorithm is: 1.018875
Received 1048576 bytes from file 1 in 1.010271 seconds
Received 1048576 bytes from file 2 in 1.014124 seconds
Received 1048576 bytes from file 3 in 1.375975 seconds
Received 1048576 bytes from file 4 in 1.016684 seconds
Received 1048576 bytes from file 5 in 1.045337 seconds
Average time for Reno algorithm is: 1.094078
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$
```

```
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
bash: ./sender: No such file or directory
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ cd Desktop/Ex4
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 4 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 5 (1048576 bytes)
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 6 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 7 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 8 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 9 (1048576 bytes)
Server accepted...
Waiting for file to be sent...
Sending file number 10 (1048576 bytes)
llansouffir@llansouffir-VirtualBox:~/Desktop/Ex4$
```

15% :

```
ilansouffir@ilansouffir-VirtualBox: ~/Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 15%
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...

Received 1048576 bytes from file 1 in 1.015275 seconds
Received 1048576 bytes from file 2 in 1.013480 seconds
Received 1048576 bytes from file 3 in 1.030126 seconds
Received 1048576 bytes from file 4 in 1.019628 seconds
Received 1048576 bytes from file 5 in 10.754912 seconds

Average time for cubic algorithm is: 2.966684

Received 1048576 bytes from file 1 in 1.030424 seconds
Received 1048576 bytes from file 2 in 1.233102 seconds
Received 1048576 bytes from file 3 in 1.017520 seconds
Received 1048576 bytes from file 4 in 1.017518 seconds
Received 1048576 bytes from file 5 in 1.222254 seconds

Average time for Reno algorithm is: 1.104104
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 4 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 5 (1048576 bytes)

Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 6 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 7 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 8 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 9 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 10 (1048576 bytes)

ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

20% :

```
ilansouffir@ilansouffir-VirtualBox: ~/Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 20%
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...

Received 1048576 bytes from file 1 in 1.688454 seconds
Received 1048576 bytes from file 2 in 55.711893 seconds
Received 1048576 bytes from file 3 in 2.168860 seconds
Received 1048576 bytes from file 4 in 1.308335 seconds
Received 1048576 bytes from file 5 in 1.023473 seconds

Average time for cubic algorithm is: 12.378283

Received 1048576 bytes from file 1 in 1.243170 seconds
Received 1048576 bytes from file 2 in 4.636359 seconds
Received 1048576 bytes from file 3 in 1.011763 seconds
Received 1048576 bytes from file 4 in 1.117166 seconds
Received 1048576 bytes from file 5 in 1.228219 seconds

Average time for Reno algorithm is: 1.847335
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 4 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 5 (1048576 bytes)

Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 6 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 7 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 8 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 9 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 10 (1048576 bytes)

ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

25% :

```
ilansouffir@ilansouffir-VirtualBox: ~/Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 25%
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...

Received 1048576 bytes from file 1 in 2.689672 seconds
Received 1048576 bytes from file 2 in 8.878257 seconds
Received 1048576 bytes from file 3 in 7.719277 seconds
Received 1048576 bytes from file 4 in 1.428752 seconds
Received 1048576 bytes from file 5 in 4.878578 seconds

Average time for Cubic algorithm is: 5.114107

Received 1048576 bytes from file 1 in 40.299932 seconds
Received 1048576 bytes from file 2 in 24.953688 seconds
Received 1048576 bytes from file 3 in 15.218825 seconds
Received 1048576 bytes from file 4 in 104.158124 seconds
Received 1048576 bytes from file 5 in 1.014983 seconds

Average time for Reno algorithm is: 49.128936
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 4 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 5 (1048576 bytes)

Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 6 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 7 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 8 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 9 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 10 (1048576 bytes)
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$
```

30% :

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ cd Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 30%
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
[sudo] password for ilansouffir:
Socket opened...
Binding was successful!
Waiting for TCP-connections...

Received 1048576 bytes from file 1 in 16.991377 seconds
Received 1048576 bytes from file 2 in 7.454739 seconds
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ cd Desktop/Ex4
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ sudo tc qdisc change dev lo root netem loss 30%
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./measure
Socket opened...
Binding was successful!
Waiting for TCP-connections...

Received 1048576 bytes from file 1 in 16.991377 seconds
Received 1048576 bytes from file 2 in 7.454739 seconds
```

```
ilansouffir@ilansouffir-VirtualBox:~/Desktop/Ex4$ ./sender
Socket is opened...
Server accepted...
Waiting for file to be sent...
Sending file number 1 (1048576 bytes)

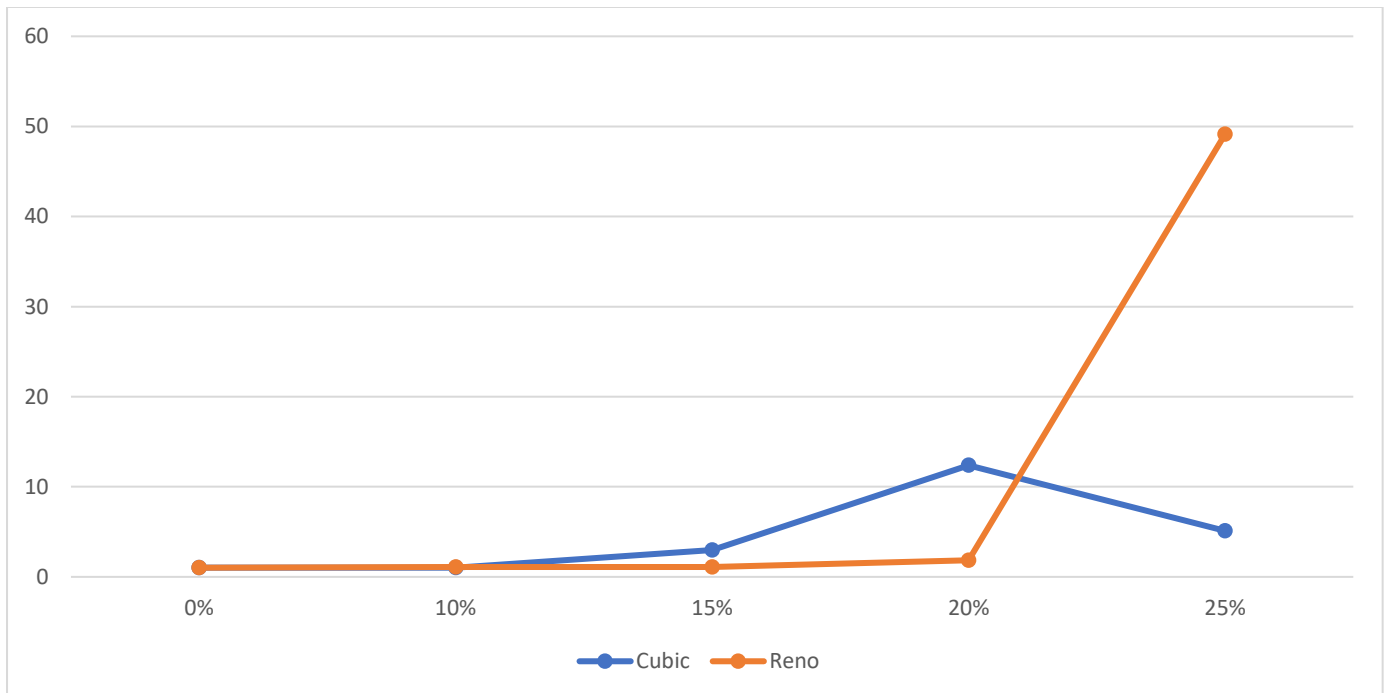
Server accepted...
Waiting for file to be sent...
Sending file number 2 (1048576 bytes)

Server accepted...
Waiting for file to be sent...
Sending file number 3 (1048576 bytes)
```

We can see that with 30% loss it's never End, I start at 12:36 and it's still waiting to receive the 3rd packet at 12:57.

Graphic of the results :

	<u>0%</u>	<u>10%</u>	<u>15%</u>	<u>20%</u>	<u>25%</u>	<u>30%</u>
<u>Cubic</u>	1.023375 sec	1.018875 sec	2.966684 sec	12.378283 sec	5.114107 sec	
<u>Reno</u>	1.015745 sec	1.094078 sec	1.104164 sec	1.847335 sec	49.128930 sec	



We can see that when using Reno's algorithm, more packets are sent per second than when using Cubic up to 20%. We can assume that Reno is more efficient than Cubic in the case that we have a packet loss up to 20% then if it's bigger than 20%, it's the Cubic that is more efficient.