

ש.ב.1

איתמר גפן ורועי כהן

חלק 1

1 + תחילת 2) סיננו את התעבורה הרצויה בין הרשת והלקוח ויצאנו את התעבורה בקובץ תחת השם "trace1.pcapng" שמצורף במודל, לאחר פתיחת הקובץ דרך wireshark יפתח המסך להלן:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	UDP	103	37371 → 12345 Len=59
2	0.000001825	127.0.0.1	127.0.0.1	UDP	103	12345 → 37371 Len=59

- * Frame 1: 103 bytes on wire (824 bits), 103 bytes captured (824 bits) on interface any, id 0
- * Linux cooked capture
- * Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
- * User Datagram Protocol, Src Port: 37371, Dst Port: 12345
- * Data (59 bytes)

0000	00 00 03 04 00 06 00 00	00 00 00 00 69 d4 08 00	-----i---
0010	45 00 00 57 80 12 40 00	40 11 bc 81 7f 00 00 01	E..W..@. @-----
0020	7f 00 00 01 91 fb 30 39	00 43 fe 56 72 6f 65 6909 .C.Vroei
0030	20 63 6f 68 65 6e 20 3d	3e 20 33 32 35 37 31 34	cohen = > 325714
0040	31 35 32 2a 2a 2a 2a 2a	2a 2a 2a 2a 2a 2a 69 74	152***** ****it
0050	61 6d 61 72 20 67 65 66	65 6e 20 3d 3e 20 33 32	amar gef en => 32
0060	36 33 30 30 37 33 38		6300738

2) איך הסנפנו את התעבורה בין הלקוח לשרת? פתחנו ווירשרק, בחרנו להאזין ל any, כלומר כל כרטיס רשת עם הפילטר

`udp && udp.port == 12345`

סינון זה מוודא שנסינף רק חבילות udp שעוברות דרך פורט 12345 שאנחנו עשינו לו bind בשרת שלנו.

3) השרת השתמש בפורט 12345. זה בא לידי ביטוי בקוד בפונקציה bind שקושרת את הסוקט לפורט.

בקוד של הלקוח אפשר לראות ששולחים לפורט 12345.

הלקוח לא עושה bind לפורט מסוים – הוא מקבל פורט כלשהו ממערכת ההפעלה, והשרת יכול לענות לו כי הלקוח רושם את מספר הפורט שלו בהודעה שהוא שולח לשרת בשכבת התעבורה.

הפורט משמש בשכבת התעבורה. הוא משמש כמזהה יחודי לסוקט (האובייקט שדרכו האפליקציה מקבלת ומעבירה הודעות). בעזרתו שכבת התעבורה בצד המקבל יודעת לאיזה סוקט (אפליקציה) להעביר את ההודעה.

החבילה שהלקוח שלח לשרת:

source port
הפורט שהלקוח קיבל ממערכת ההפעלה

destination port
הפורט של השרת, הלקוח שולח אליו את ההודעה

```
[Time delta from previous displayed frame: 0.00000000 seconds]
[Time since reference or first frame: 11.575046076 seconds]
Frame Number: 19
Frame Length: 87 bytes (696 bits)
Capture Length: 87 bytes (696 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: sll:ethertype:ip:udp:data]
[Coloring Rule Name: UDP]
[Coloring Rule String: udp]
↳ Linux cooked capture v1
↳ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
↳ User Datagram Protocol, Src Port: 36773, Dst Port: 12345
  Source Port: 36773
  Destination Port: 12345
  Length: 51
  Checksum: 0xfe46 [unverified]
  [Checksum Status: Unverified]
  [Stream index: 6]
  [Timestamps]
    [Time since first frame: 0.000000000 seconds]
    [Time since previous frame: 0.000000000 seconds]
  UDP payload (43 bytes)
  Data: 526f656920436f68656e20333235373134313532204974616d617220476566656e203332
    [Length: 43]
0000 00 00 03 04 00 06 00 00 00 00 00 00 00 08 00  E..G..0..0.Gj....
0010 45 00 00 47 f5 39 40 00 40 11 47 6b 7f 00 00 01  ...09...3.FROEI
0020 7f 00 00 01 8f a5 00 33 fe 46 52 4f 45 49  ....09...3.FROEI
0030 20 43 6f 68 65 6e 20 33 32 35 37 31 34 31 35 32  COHEN 3 25714152
0040 20 49 74 61 6d 61 72 20 47 65 66 65 6e 20 33 32  ITAMAR  GEFEN 32
0050 36 33 30 30 37 33 38 6300738
```

כמו שנאמר לעיל, ניתן לראות בתמונה שבתחילית ששיכת לשכבת התעבורה מצוין שהלקוח שולח את החבילה לפורט מספר 12345 (דסטיניטיון פורט), ורושם גם את הפורט שלו (סורס פורט).

החבילה שהשרת החזיר ללקוח:

```
↳ User Datagram Protocol, Src Port: 12345, Dst Port: 36773
  Source Port: 12345
  Destination Port: 36773
  Length: 51
  Checksum: 0xfe46 [unverified]
  [Checksum Status: Unverified]
0000 00 00 03 04 00 06 00 00 00 00 00 00 00 08 00  E..G..0..0.Gj....
0010 45 00 00 47 f5 39 40 00 40 11 47 6a 7f 00 00 01  ...09...3.FROEI
0020 7f 00 00 01 8f a5 00 33 fe 46 52 4f 45 49  ....09...3.FROEI
0030 20 43 4f 48 45 4e 20 33 32 35 37 31 34 31 35 32  COHEN 3 25714152
0040 20 49 54 41 4d 41 52 20 47 45 46 45 4e 20 33 32  ITAMAR  GEFEN 32
0050 36 33 30 30 37 33 38 6300738
```

ניתן לראות שבתחילית של שכבת התעבורה כתוב שהשרת שולח את החבילה לפורט מספר 36773 (דסטיניטיון פורט) – שזה מה שהיה הסורס פורט בהודעה הקודמת (שהלקוח שלח לשרת).

4) בגלל שהרצנו את הלקוח והשרת על אותו מחשב, הם שלחו אל ומכתובת ה-127.0.0.1. זאת כתובת מיוחדת שמשמעותה "אני". משתמשים בה לתעבורה בין אפליקציות שונות באותו מחשב – כשאינן צורך להוציא את המידע החוצה. אפשר לראות את זה בחבילות שהסנפנו בוויזרשק:

```
↳ Frame 20: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface any, id 0
↳ Linux cooked capture v1
↳ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  ↳ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    0000 00.. = Differentiated Services Codepoint: Default (0)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
  Total Length: 71
  Identification: 0xf539 (62777)
  ↳ Flags: 0x40, Don't fragment
    0... .... = Reserved bit: Not set
    .1.. .... = Don't fragment: Set
    ..0. .... = More fragments: Not set
  Fragment Offset: 0
  Time to Live: 64
  Protocol: UDP (17)
  Header Checksum: 0x476a [validation disabled]
  [Header checksum status: Unverified]
  Source Address: 127.0.0.1
  Destination Address: 127.0.0.1
↳ User Datagram Protocol, Src Port: 12345, Dst Port: 36773
↳ Data (43 bytes)
0000 00 00 03 04 00 06 00 00 00 00 00 00 00 08 00  E..G..0..0.Gj....
0010 45 00 00 47 f5 39 40 00 40 11 47 6a 7f 00 00 01  ...09...3.FROEI
0020 7f 00 00 01 30 39 8f a5 00 33 fe 46 52 4f 45 49  ....09...3.FROEI
0030 20 43 4f 48 45 4e 20 33 32 35 37 31 34 31 35 32  COHEN 3 25714152
0040 20 49 54 41 4d 41 52 20 47 45 46 45 4e 20 33 32  ITAMAR  GEFEN 32
0050 36 33 30 30 37 33 38 6300738
```

הפלט של הפקודה מציג 2 כרטיסים.

הראשון הוא כרטיס הרשת "האמיתי" שאיתו מתקשרים עם מחשבים אחרים, וה-קו שלו הוא 10.0.2.255

השני הוא כרטיס ה loopback שנועד לשליחת הודעות בתוך אותו מחשב, שבו השתמשנו (כיוון שהשרת והלקוח שניהם רצו על אותו מחשב), ואכן ה-קו שלו הוא 127.0.0.1

הפלט של ifconfig:

חלק 2

הרצת משימה 1 – “playing nice”

foo לא מעכב חבילות ולא זורק אותן, לכל חבילה שהוא מקבל הוא מוודא שגודלה אינו עולה על 100 בתים (אם כן הוא זורק אותה) ומעביר אותה לנמען. תצלום הרצה:

```
roei@roei-virtual-machine: ~/Desktop/networking/ass1$ python3 server2.py 12345
Hello, it's me
I was wondering if after all these years you'd like to meet
To go over everything
They say that time's supposed to heal ya
But I ain't done much healing
Hello, can you hear me?
I'm in California dreaming about who we used to be
When we were younger and free
I've forgotten how it felt before the world fell at our feet
There's such a difference between us
And a million miles
Hello from the other side
I must've called a thousand times
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside
At least I can say that I've tried
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
Hello, how are you?
It's so typical of me to talk about myself, I'm sorry
I hope that you're well
Did you ever make it out of that town where nothing ever happened?
It's no secret that the both of us are running out of time
So hello from the other side
I must've called a thousand times
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
Ooh-ooh-ooh, anyone
Ooh-ooh-ooh, anyone
Ooh-ooh-ooh, anyone
Hello from the other side (Other side)
I must've called a thousand times (Thousand times)
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't
Phlllll, no drop... 93
Vay, no sleep... 7 100
Forwarded b"\x0b\x00\x00\x00 side (Other side)\nI must've called a thousand times (Thousand times)\nI to te
ll you I'm sorry for " from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 14
Vay, no sleep... 80 100
Forwarded b"\x0c\x00\x00\x00 everything that I've done\nBut when I call, you never seem to be home\nHello
from the outside (Out" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 49
Vay, no sleep... 16 100
Forwarded b"\x0c\x00\x00\x00 everything that I've done\nBut when I call, you never seem to be home\nHello
from the outside (Out" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 14
Vay, no sleep... 27 100
Forwarded b"\r\n\x00\x00\x00 side)\nAt least I can say that I've tried (I've tried)\nI to tell you I'm sorry f
or breaking your he" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 90
Vay, no sleep... 50 100
Forwarded b"\r\n\x00\x00\x00 side)\nAt least I can say that I've tried (I've tried)\nI to tell you I'm sorry f
or breaking your he" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 16
Vay, no sleep... 25 100
Forwarded b"\x0e\x00\x00\x00 side)\nBut it don't matter, it clearly doesn't tear you apart anymore\nOoh-ooh-
anyone\nOoh-ooh-ooh," from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 80
Vay, no sleep... 17 100
Forwarded b"\x0e\x00\x00\x00 side)\nBut it don't matter, it clearly doesn't tear you apart anymore\nOoh-ooh-
anyone\nOoh-ooh-ooh," from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 28
Vay, no sleep... 50
Forwarded b"\x0f\x00\x00\x00 anyone\nOoh-ooh, anyone\n\nHello from the other side (Other side)\n
I must've called a thou" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 50
Vay, no sleep... 51 100
Forwarded b"\x0f\x00\x00\x00 anyone\nOoh-ooh, anyone\n\nHello from the other side (Other side)\n
I must've called a thou" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 22
Vay, no sleep... 21 100
Forwarded b"\x10\x00\x00\x00 sand times (Thousand times)\nI to tell you I'm sorry for everything that I've d
one\nBut when I call," from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 25
Vay, no sleep... 3 100
Forwarded b"\x10\x00\x00\x00 sand times (Thousand times)\nI to tell you I'm sorry for everything that I've d
one\nBut when I call," from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 40
Vay, no sleep... 50 100
Forwarded b"\x11\x00\x00\x00 you never seem to be home\nHello from the outside (Outside)\nAt least I can
say that I've tried (" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 27
Vay, no sleep... 60 100
Forwarded b"\x11\x00\x00\x00 you never seem to be home\nHello from the outside (Outside)\nAt least I can
say that I've tried (" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 44
Vay, no sleep... 61 100
Forwarded b"\x12\x00\x00\x00 I've tried)\nI to tell you I'm sorry for breaking your heart\nBut it don't matt
er, it clearly doesn" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 5
Vay, no sleep... 68 100
Forwarded b"\x12\x00\x00\x00 I've tried)\nI to tell you I'm sorry for breaking your heart\nBut it don't matt
er, it clearly doesn" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Phlllll, no drop... 23
Vay, no sleep... 72 100
Forwarded b"\x13\x00\x00\x00 tear you apart anymore" from ('127.0.0.1', 38722) to ('127.0.0.1', 12345)
Phlllll, no drop... 1
Vay, no sleep... 19 100
Forwarded b"\x13\x00\x00\x00 tear you apart anymore" from ('127.0.0.1', 12345) to ('127.0.0.1', 38722)
Activate Windows
Go to Settings to activate Windows.
Show Applications
```


הרצת משימה 2 – זריקת חבילות באקראיות “playing basketball”

```
Activities Terminal
roei@roei-virtual-machine: ~/Desktop/networking/ass1
roei@roei-virtual-machine:~/Desktop/networking/ass1$ python3 server2.py 32571 127.0.0.1
Hello, it's me
I was wondering if after all these years you'd like to meet
To go over everything
They say that time's supposed to heal ya
But I ain't done much healing
Hello, can you hear me?
I'm in California dreaming about who we used to be
When we were younger and free
I've forgotten how it felt before the world fell at our feet
There's such a difference between us
And a million miles
Hello from the other side
I must've called a thousand times
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside
At least I can say that I've tried
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
Hello, how are you?
It's so typical of me to talk about myself, I'm sorry
I hope that you're well
Did you ever make it out of that town where nothing ever happened?
It's no secret that the both of us are running out of time
So hello from the other side (Other side)
I must've called a thousand times (Thousand times)
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
ooh-ooh, anyone
ooh-ooh, anyone
ooh-ooh, anyone
Hello from the other side (Other side)
I must've called a thousand times (Thousand times)
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore

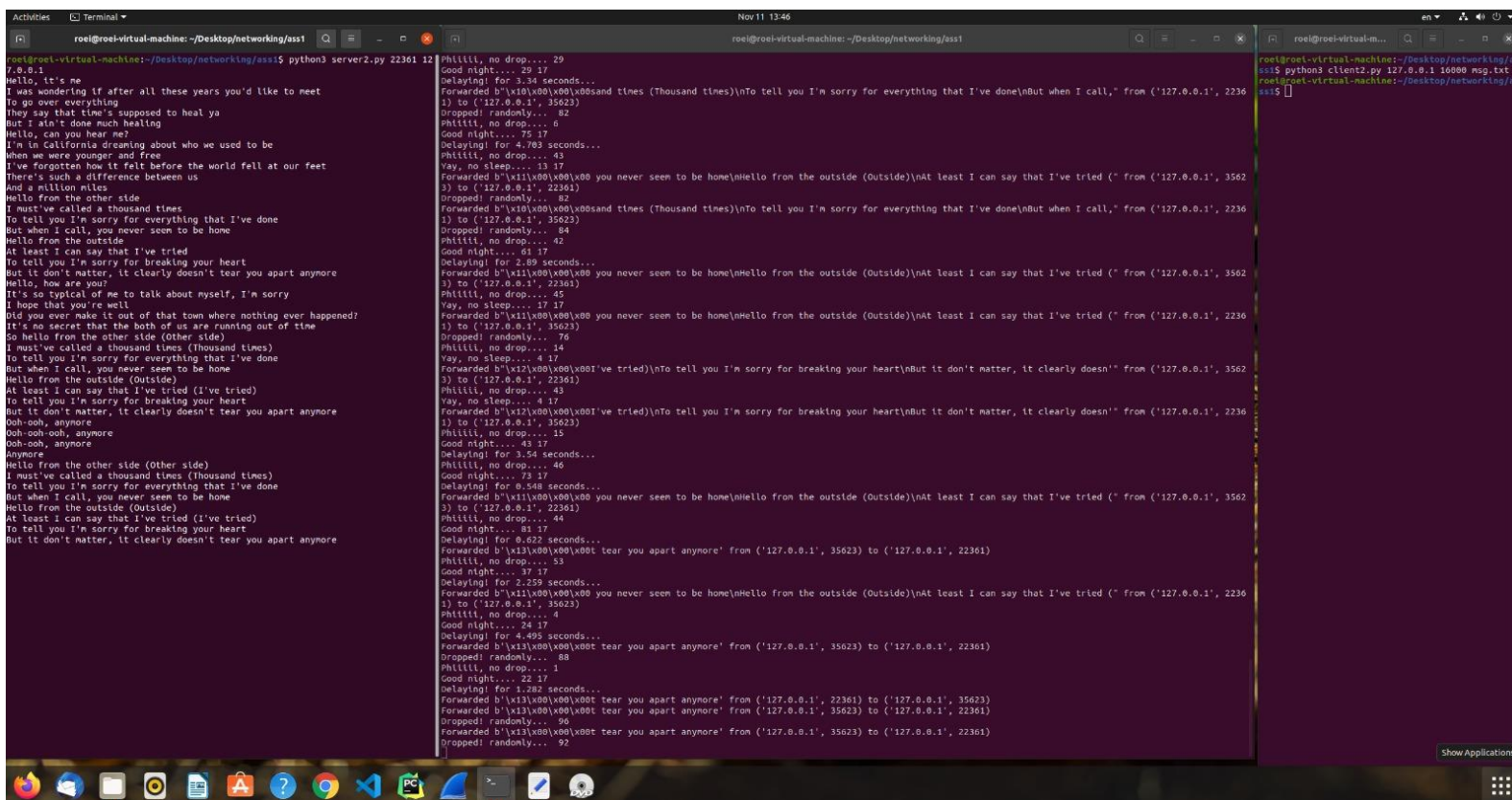
roei@roei-virtual-machine:~/Desktop/networking/ass1$ python3 foo.py 14589 127.0.0.1 32571 2
Dropping 32%
Dropped! randomly... 72
Phiiiiii, no drop... 56
Yay, no sleep... 0 100
Forwarded b"\x01\x00\x00\x00Hello, it's me\nI was wondering if after all these years you'd like to meet\nTo go over everything" from ('127.0.0.1', 5464)
Dropped! randomly... 72
Phiiiiii, no drop... 19
Yay, no sleep... 94 100
Forwarded b"\x01\x00\x00\x00Hello, it's me\nI was wondering if after all these years you'd like to meet\nTo go over everything" from ('127.0.0.1', 5464)
Phiiiiii, no drop... 39
Yay, no sleep... 91 100
Forwarded b"\x01\x00\x00\x00Hello, it's me\nI was wondering if after all these years you'd like to meet\nTo go over everything" from ('127.0.0.1', 3257)
Phiiiiii, no drop... 29
Yay, no sleep... 78 100
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 5464)
Dropped! randomly... 97
Phiiiiii, no drop... 44
Yay, no sleep... 83 100
Forwarded b"\x01\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 3257)
Dropped! randomly... 97
Phiiiiii, no drop... 62
Yay, no sleep... 23 100
Forwarded b"\x01\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 5464)
5) to ('127.0.0.1', 32571)
Phiiiiii, no drop... 42
Yay, no sleep... 12 100
Forwarded b"\x01\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 3257)
1) to ('127.0.0.1', 54645)
Dropped! randomly... 97
Phiiiiii, no drop... 36
Yay, no sleep... 74 100
Forwarded b"\x04\x00\x00\x00How it felt before the world fell at our feet\nThere's such a difference between us\nAnd a million" from ('127.0.0.1', 5464)
5) to ('127.0.0.1', 32571)
Phiiiiii, no drop... 39
Yay, no sleep... 59 100
Forwarded b"\x04\x00\x00\x00How it felt before the world fell at our feet\nThere's such a difference between us\nAnd a million" from ('127.0.0.1', 3257)
1) to ('127.0.0.1', 54645)
Phiiiiii, no drop... 10
Yay, no sleep... 4 100
Forwarded b"\x05\x00\x00\x00Miles\nHello from the other side\nI must've called a thousand times\nTo tell you I'm sorry for eve" from ('127.0.0.1', 5464)
45) to ('127.0.0.1', 32571)
Phiiiiii, no drop... 54
Yay, no sleep... 42 100
Forwarded b"\x05\x00\x00\x00Miles\nHello from the other side\nI must've called a thousand times\nTo tell you I'm sorry for eve" from ('127.0.0.1', 3257)
71) to ('127.0.0.1', 54645)
Phiiiiii, no drop... 64
Yay, no sleep... 80 100
Forwarded b"\x06\x00\x00\x00Anything that I've done\nBut when I call, you never seem to be home\nHello from the outside\nAt least I can say that I've tried" from ('127.0.0.1', 5464)
45) to ('127.0.0.1', 32571)
Phiiiiii, no drop... 64
Yay, no sleep... 67 100
Forwarded b"\x06\x00\x00\x00Anything that I've done\nBut when I call, you never seem to be home\nHello from the outside\nAt least I can say that I've tried" from ('127.0.0.1', 3257)
71) to ('127.0.0.1', 54645)
Dropped! randomly... 68
Dropped! randomly... 95
Phiiiiii, no drop... 38
Yay, no sleep... 4 100
Forwarded b"\x07\x00\x00\x00But I can say that I've tried\nTo tell you I'm sorry for breaking your heart\nBut it don't matter, I" from ('127.0.0.1', 5464)
5) to ('127.0.0.1', 32571)
Phiiiiii, no drop... 66
Yay, no sleep... 94 100
Forwarded b"\x07\x00\x00\x00But I can say that I've tried\nTo tell you I'm sorry for breaking your heart\nBut it don't matter, I" from ('127.0.0.1', 3257)
71) to ('127.0.0.1', 54645)
```

הרצת משימה 3 – עיכוב חבילות "playing grandpa"

```
Activities Terminal
roei@roei-virtual-machine: ~/Desktop/networking/ass1
roei@roei-virtual-machine:~/Desktop/networking/ass1$ python3 server2.py 22561 127.0.0.1
Hello, it's me
I was wondering if after all these years you'd like to meet
To go over everything
They say that time's supposed to heal ya
But I ain't done much healing
Hello, can you hear me?
I'm in California dreaming about who we used to be
When we were younger and free
I've forgotten how it felt before the world fell at our feet
There's such a difference between us
And a million miles
Hello from the other side
I must've called a thousand times
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside
At least I can say that I've tried
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
Hello, how are you?
It's so typical of me to talk about myself, I'm sorry
I hope that you're well
Did you ever make it out of that town where nothing ever happened?
It's no secret that the both of us are running out of time
So hello from the other side (Other side)
I must've called a thousand times (Thousand times)
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore
ooh-ooh, anyone
ooh-ooh, anyone
ooh-ooh, anyone
Hello from the other side (Other side)
I must've called a thousand times (Thousand times)
To tell you I'm sorry for everything that I've done
But when I call, you never seem to be home
Hello from the outside (Outside)
At least I can say that I've tried (I've tried)
To tell you I'm sorry for breaking your heart
But it don't matter, it clearly doesn't tear you apart anymore

roei@roei-virtual-machine:~/Desktop/networking/ass1$ python3 foo.py 14000 127.0.0.1 22561 3
Delaying 63%
Phiiiiii, no drop... 4
Good night... 59 37
Delaying! for 0.021 seconds...
Forwarded b"\x01\x00\x00\x00Hello, it's me\nI was wondering if after all these years you'd like to meet\nTo go over everything" from ('127.0.0.1', 4730)
5) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 68
Yay, no sleep... 37
Forwarded b"\x01\x00\x00\x00Hello, it's me\nI was wondering if after all these years you'd like to meet\nTo go over everything" from ('127.0.0.1', 2256)
1) to ('127.0.0.1', 47305)
Phiiiiii, no drop... 70
Yay, no sleep... 76 37
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 47305)
305) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 17
Good night... 68 37
Delaying! for 2.122 seconds...
Phiiiiii, no drop... 62
Good night... 55 37
Delaying! for 3.517 seconds...
Phiiiiii, no drop... 48
Yay, no sleep... 22 37
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 47305)
305) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 35
Yay, no sleep... 13 37
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 2256)
Phiiiiii, no drop... 70
Yay, no sleep... 10 37
Forwarded b"\x01\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 4730)
5) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 99
Good night... 92 37
Delaying! for 1.791 seconds...
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 2256)
305) to ('127.0.0.1', 47305)
Phiiiiii, no drop... 15
Yay, no sleep... 16 37
Forwarded b"\x01\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 4730)
305) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 11
Good night... 99 37
Delaying! for 2.308 seconds...
Forwarded b"\x03\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 2256)
1) to ('127.0.0.1', 47305)
Phiiiiii, no drop... 50
Good night... 79 37
Delaying! for 4.341 seconds...
Forwarded b"\x02\x00\x00\x00\nThey say that time's supposed to heal ya\nBut I ain't done much healing\nHello, can you hear me?\n" from ('127.0.0.1', 47305)
305) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 10
Good night... 85 37
Delaying! for 1.539 seconds...
Phiiiiii, no drop... 38
Yay, no sleep... 25 37
Forwarded b"\x04\x00\x00\x00How it felt before the world fell at our feet\nThere's such a difference between us\nAnd a million" from ('127.0.0.1', 4730)
5) to ('127.0.0.1', 22561)
Phiiiiii, no drop... 40
Good night... 42 37
Delaying! for 3.932 seconds...
Forwarded b"\x03\x00\x00\x00I'm in California dreaming about who we used to be\nWhen we were younger and free\nI've forgotten " from ('127.0.0.1', 2256)
1) to ('127.0.0.1', 47305)
Phiiiiii, no drop... 10
Yay, no sleep... 34 37
```

הרצת משימה 4 – הכל ביחד



איך מימשנו

מימשנו עם `stop&wait`. כלומר, הלקוח שולח לשרת הודעה אחת בכל פעם ומחכה לתשובה. אם הוא לא מקבל את התשובה תוך הזמן שהגדרנו ל-`timeout`, הוא שולח שוב, ככה עד שהוא מקבל את התשובה.

בשביל שעיכובים של הודעות לא יגרמו לכך שהשרת לא ידפיס את אותה הודעה פעמיים, הגדרנו "פרוטוקול": הוספנו לתחילת כל הודעה תחילית עם המספר הסידורי של ההודעה (מתחיל ב-1). ככה השרת יכול להדפיס הודעה רק אם המספר הסידורי שלה גדול ממספר ההודעות שהודפסו עד עכשיו. בדומה, כשהלקוח מקבל תשובה מהשרת הוא יכול לבדוק אם המספר שלה מתאים למספר ההודעה שלתשובה אליה הוא מצפה.

נדגים בעזרת צילומי מסך מההסנפות של ווירשארק: (השרת האזין בפורט 23456 ו-foo האזין בפורט 56789. במקרה הזה יצא שהלקוח האזין בפורט 49532. לכן, כשנראה בוורשארק למשל סורס פורט 23456 ודסטינייטיון פורט 56789 נדע שמדובר בהודעה שנשלחה מהשרת ל-foo).

התעבורה בוורשארק: השרת האזין בפורט 23456 ו-foo האזין בפורט 56789. לכן השתמשנו בפילטר

```
udp && (udp.port == 12345 || udp.port == 45678)
```

כדי לסנן את כל התעבורה, ושמרנו בקובץ.

מקרה 1 – foo לא עושה בעיות.

בשורה 10 (המודגשת) הלקוח שולח ל-foo את הודעה מספר 3. foo זורק/מעכב את ההודעה (זה לא ממש משנה לצורך העניין), ולכן עוברת שנייה, זמן ה-timeout שהגדרנו, והלקוח עדיין לא קיבל תשובה. לכן, בשורה 11 שולח את ההודעה מספר 3 שוב. אותו דבר קורה ככה עד שורה 15.

Wireshark

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

No.	Time	Source	source port	Destination	dest port	Protocol	Length	Info
10	1.131647024	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
11	2.133361512	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
12	3.134881510	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
13	4.136049918	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
14	5.137761237	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
15	5.138020336	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
16	5.138322335	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
17	5.138606134	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	

[-] User Datagram Protocol, Src Port: 49532, Dst Port: 56789

Source Port: 49532

Destination Port: 56789

Length: 108

Checksum: 0xfe7f [unverified]

[Checksum Status: Unverified]

[Stream index: 0]

[Timestamps]

[-] ADwin configuration protocol

Command: Unknown (3)

Version: 544024393

0000	00 00 03 04 00 00 00 00 00 00 00 00 00 00 00 00@.....	
0010	45 09 00 80 b6 d4 40 00 40 11 85 96 7f 00 00 01	E.....@.....	
0020	7f 09 00 01 c1 7c dd d5 00 6c fe 7f 03 00 00 00 -1.....	
0030	49 27 6d 20 69 6e 20 43 61 6c 69 66 6f 72 6e 69	I'm in California	
0040	61 29 64 72 65 61 6d 69 6e 67 20 61 62 6f 75 74	a dreami ng about	
0050	20 77 68 6f 20 77 65 20 75 73 65 64 20 74 6f 20	who we used to	
0060	62 65 0a 57 68 65 6e 20 77 65 20 77 65 72 65 20	be·When we were	
0070	79 6f 75 6e 67 65 72 20 61 6e 64 20 66 72 65 65	younger and free	
0080	0a 49 27 76 65 20 66 6f 72 67 6f 74 74 65 6e 20	·I've fo rgotten	

בשורה 15 foo סוף-סוף מעביר לשרת, ובשורות שלאחר מכן ניתן לראות שהשרת עונה ל-foo ובשורה 17 foo מחזיר את התשובה ללקוח.

Wireshark

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	source port	Destination	dest port	Protocol	Length	Info
10	1.131647024	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
11	2.133361512	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
12	3.134881510	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
13	4.136049918	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
14	5.137761237	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
15	5.138020336	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
16	5.138322335	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
17	5.138606134	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	

[-] User Datagram Protocol, Src Port: 56789, Dst Port: 49532

Source Port: 56789

Destination Port: 49532

Length: 108

Checksum: 0xfe7f [unverified]

[Checksum Status: Unverified]

[Stream index: 0]

[+] [Timestamps]

[-] ADwin configuration protocol

Command: Unknown (3)

Version: 544024393

```

0000  00 00 03 04 00 06 00 00 00 00 00 00 00 08 00 00  .....@. ....
0010  45 00 00 80 b6 d7 40 00 40 11 85 93 7f 00 00 01  E....@. ....
0020  7f 00 00 01 dd d5 c1 7c 00 6c fe 7f 03 00 00 00  ....|..1.....
0030  49 27 6d 20 69 6e 20 43 61 6c 69 66 6f 72 6e 69  I'm in California
0040  61 20 64 72 65 61 6d 69 6e 67 20 61 62 6f 75 74  a dream ing about
0050  70 78 68 6f 20 77 65 20 75 73 65 64 20 74 6f 20  who we used to
0060  62 65 0a 57 68 65 6e 20 77 65 20 77 65 72 65 20  be when we were
0070  79 6f 75 6e 67 65 72 20 61 6e 64 20 66 72 65 65  younger and free
0080  0a 49 27 76 65 20 66 6f 72 67 6f 74 74 65 6e 20  -I've fo rgotten

```

בשורה 18 הלקוח כבר ישלח את הודעה מספר 4.

מקרה 3 – foo מעכב הודעה של הלקוח, וכתוצאה מכך היא מגיעה לשרת אחרי שהוא כבר הדפיס אותה. כלומר, השרת מקבל הודעה עם מספר שקטן ממספר ההודעה שאליו הוא מצפה. במקרה זה השרת לא ידפיס

אותה שוב, אלה רק ישלח אותה בחזרה ללקוח (כדי שאם הלקוח לא קיבל את התשובה בפעם הקודמת הוא יקבל עכשיו).

Wireshark

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	source port	Destination	dest port	Protocol	Length	Info
44	13.626473206	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	
45	13.626710505	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
46	13.626934304	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
47	13.627137404	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
48	14.489892176	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
49	14.490173475	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
50	14.627346521	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
51	14.627621521	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	

User Datagram Protocol, Src Port: 49532, Dst Port: 56789

Source Port: 49532

Destination Port: 56789

Length: 108

Checksum: 0xfe7f [unverified]

[Checksum Status: Unverified]

[Stream index: 0]

[Timestamps]

ADwin configuration protocol

Command: Unknown (7)

Version: 541663348

0000	00 00 03 04 00 06 00 00 00 00 00 00 00 00 00 00	E....@. @.?....
0010	45 00 00 80 bb 2b 40 00 40 11 81 3f 7f 00 00 011.....
0020	7f 00 00 01 c1 7c dd d5 00 6c fe 7f 07 00 00 00	
0030	74 20 49 20 63 61 6e 20 73 61 79 20 74 68 61 74	t I can say that
0040	20 49 27 76 65 20 74 72 69 65 64 0a 54 6f 20 74	I've tr ied.To t
0050	65 6c 6c 20 79 6f 75 20 49 27 6d 20 73 6f 72 72	ell you I'm sorr
0060	79 20 66 6f 72 20 62 72 65 61 6b 69 6e 67 20 79	y for br eaking y
0070	6f 75 72 20 68 65 61 72 74 0a 42 75 74 20 69 74	our hear t.But it
0080	20 64 6f 6e 27 74 20 6d 61 74 74 65 72 2c 20 69	don't m atter, 1

בשורה 45 (המודגשת) הלקוח שולח בפעם הראשונה את הודעה 7 ל-foo. בשורה 46 foo מעביר אותה לשרת. השרת מדפיס אותה, ובשורה 47 הוא שולח את התשובה אליה ל-foo.

Wireshark

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	source port	Destination	dest port	Protocol	Length	Info
44	13.626473206	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	
45	13.626710505	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
46	13.626934304	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
47	13.627137404	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
48	14.489892176	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
49	14.490173475	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
50	14.627346521	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
51	14.627621521	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	

User Datagram Protocol, Src Port: 56789, Dst Port: 23456

Source Port: 56789

Destination Port: 23456

Length: 108

Checksum: 0xfe7f [unverified]

[Checksum Status: Unverified]

[Stream index: 1]

[Timestamps]

ADwin configuration protocol

Command: Unknown (5)

Version: 1818848544

0000	00 00 03 04 00 06 00 00 00 00 00 00 00 00 00 00	
0010	45 00 00 80 bb c6 40 00 40 11 80 a4 7f 00 00 01	E....@. @.
0020	7f 00 00 01 dd d5 5b a0 00 6c fe 7f 05 00 00 001.....
0030	20 6d 69 6e 65 73 0a 48 65 6c 6c 6f 20 66 72 6f	miles.H ello fro
0040	6d 20 74 68 65 20 6f 74 68 65 72 20 73 69 64 65	m the ot her side
0050	0a 49 20 6d 75 73 74 27 76 65 20 63 61 6c 6c 65	.I must' ve calle
0060	64 20 61 20 74 68 6f 75 73 61 6e 64 20 74 69 6d	d a thou sand tim
0070	65 73 0a 54 6f 20 74 65 6c 6c 20 79 6f 75 20 49	es.To te ll you I
0080	27 6d 20 73 6f 72 72 79 20 66 6f 72 20 65 76 65	'm sorry for eve

כפי שניתן לראות, בשורה 48 השרת פתאום מקבל מ-foo את הודעה 5. השרת לא ידפיס אותה, אלה רק ישלח בחזרה תשובה עליה (שורה 49).

Wireshark								
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help								
Apply a display filter ... <Ctrl-/>								
No.	Time	Source	source port	Destination	dest port	Protocol	Length	Info
50	14.627346521	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
51	14.627621521	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
52	14.627841520	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
53	15.619132770	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	
54	15.619497469	127.0.0.1	49532	127.0.0.1	56789	ADwin Config	144	
55	15.619730469	127.0.0.1	56789	127.0.0.1	23456	ADwin Config	144	
56	15.620212567	127.0.0.1	23456	127.0.0.1	56789	ADwin Config	144	
57	15.620484767	127.0.0.1	56789	127.0.0.1	49532	ADwin Config	144	
[-] User Datagram Protocol, Src Port: 49532, Dst Port: 56789								
Source Port: 49532								
Destination Port: 56789								
Length: 108								
Checksum: 0xfe7f [unverified]								
[Checksum Status: Unverified]								
[Stream index: 0]								
[Timestamps]								
[-] ADwin configuration protocol								
Command: Unknown (7)								
Version: 541663348								
0000	80 00 03 04 80 05 00 00 00 80 00 00 00 80 08 00							
0010	45 00 00 80 bb d1 40 00 40 11 80 99 7f 00 00 01				E....@. @.....			
0020	7f 00 00 01 c1 7c dd d5 00 6c fe 7f 07 00 00 00			l.....			
0030	74 20 49 26 63 61 6e 20 73 61 79 20 74 68 61 74				[I can say that			
0040	20 49 27 76 65 20 74 72 69 65 64 0a 54 6f 20 74				I've tr ied.To t			
0050	65 6c 6c 20 79 6f 75 20 49 27 6d 20 73 6f 72 72				ell you I'm sorr			
0060	79 20 66 6f 72 20 62 72 65 61 6b 69 6e 67 20 79				y for br eaking y			
0070	6f 75 72 20 68 65 61 72 74 0a 42 75 74 20 69 74				our hear t.But it			
0080	20 64 6f 6e 27 74 20 6d 61 74 74 65 72 2c 20 69				don't m atter, i			

ניתן לראות ש-foo זרק/עיכב את התשובה שהשרת שלח על הודעה 7, ולכן (בשורה 50) הלקוח שולח אותה שוב. בשורה 53 הלקוח כבר מקבל את התשובה עליה.

באופן דומה, אם foo מעכב תשובה של השרת, וכתוצאה מכך היא מגיעה ללקוח כשהוא כבר מצפה לתשובה על הודעה אחרת - כלומר הלקוח מקבל תשובה עם מספר שקטן מהמספר שאליו הוא מצפה, אז הלקוח יתעלם מהתשובה הזאת. הוא ימשיך לחכות לתשובה המתאימה.