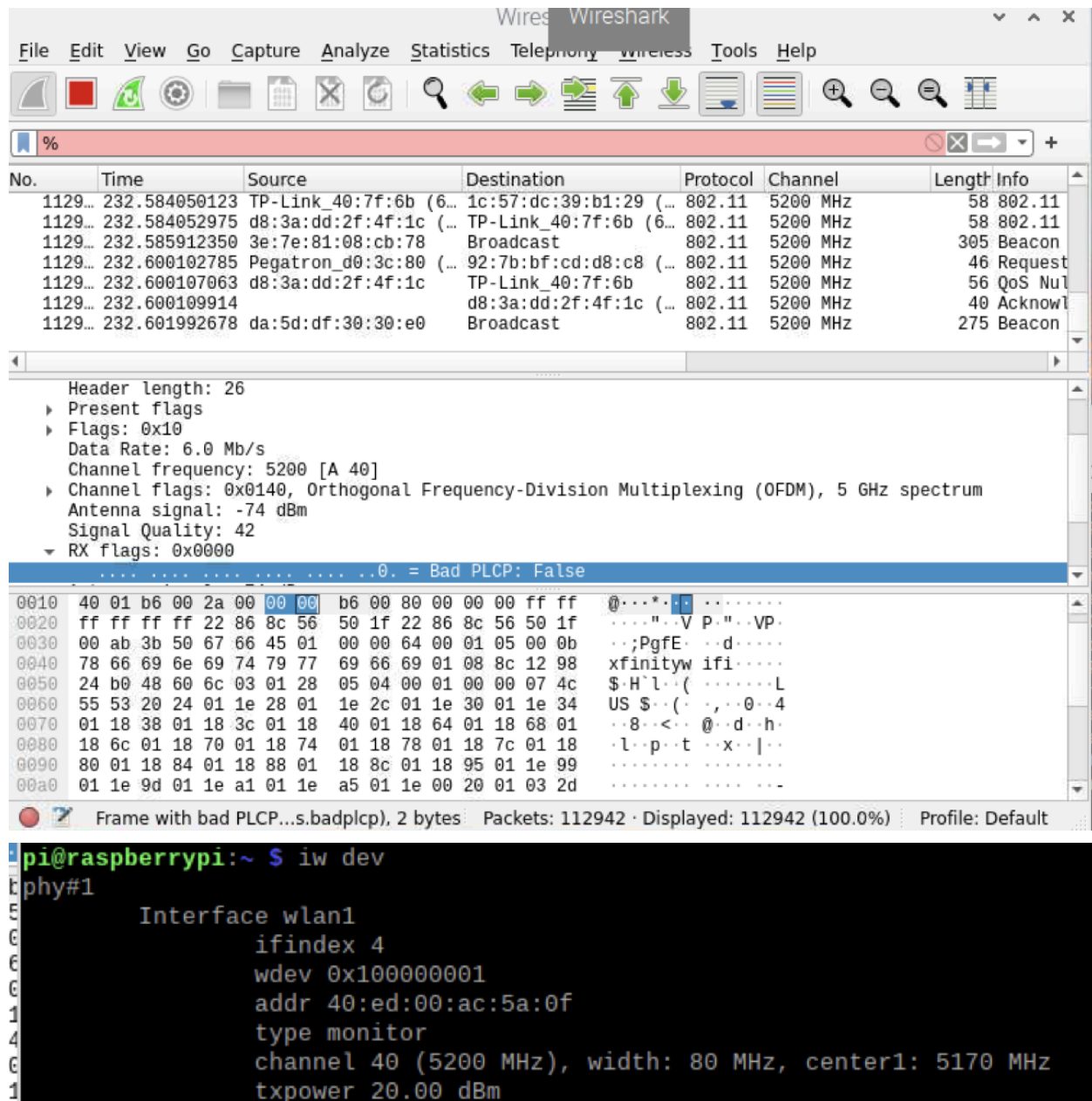


Prelab 1



The image displays a Wireshark packet capture of IEEE 802.11 Beacon frames and a terminal window showing the output of the `iw dev wlan1` command.

Wireshark Packet Capture:

No.	Time	Source	Destination	Protocol	Channel	Length	Info
1129...	232.584050123	TP-Link_40:7f:6b (6...	1c:57:dc:39:b1:29 (...	802.11	5200 MHz	58	802.11
1129...	232.584052975	d8:3a:dd:2f:4f:1c (...	TP-Link_40:7f:6b (6...	802.11	5200 MHz	58	802.11
1129...	232.585912350	3e:7e:81:08:cb:78	Broadcast	802.11	5200 MHz	305	Beacon
1129...	232.600102785	Pegatron_d0:3c:80 (...	92:7b:bf:cd:d8:c8 (...	802.11	5200 MHz	46	Request
1129...	232.600107063	d8:3a:dd:2f:4f:1c (...	TP-Link_40:7f:6b	802.11	5200 MHz	56	QoS Nu
1129...	232.600109914		d8:3a:dd:2f:4f:1c (...	802.11	5200 MHz	40	Acknowl
1129...	232.601992678	da:5d:df:30:30:e0	Broadcast	802.11	5200 MHz	275	Beacon

Packet Details:

- Header length: 26
- Present flags
- Flags: 0x10
- Data Rate: 6.0 Mb/s
- Channel frequency: 5200 [A 40]
- Channel flags: 0x0140, Orthogonal Frequency-Division Multiplexing (OFDM), 5 GHz spectrum
- Antenna signal: -74 dBm
- Signal Quality: 42
- RX flags: 0x0000

Packet Bytes:

```

0010  40 01 b6 00 2a 00 00 00 b6 00 80 00 00 00 ff ff  @...*.V. ....
0020  ff ff ff ff 22 86 8c 56 50 1f 22 86 8c 56 50 1f  ....V P..."VP.
0030  00 ab 3b 50 67 66 45 01 00 00 64 00 01 05 00 0b  .;PgFE. .d....
0040  78 66 69 6e 69 74 79 77 69 66 69 01 08 8c 12 98  xfinityw ifi....
0050  24 b0 48 60 6c 03 01 28 05 04 00 01 00 00 07 4c  $H'l.( ....L
0060  55 53 20 24 01 1e 28 01 1e 2c 01 1e 30 01 1e 34  US $(. .,..0..4
0070  01 18 38 01 18 3c 01 18 40 01 18 64 01 18 68 01  .8.<.. @.d..h.
0080  18 6c 01 18 70 01 18 74 01 18 78 01 18 7c 01 18  .l.p..t..x..|..
0090  80 01 18 84 01 18 88 01 18 8c 01 18 95 01 1e 99  ....
00a0  01 1e 9d 01 1e a1 01 1e a5 01 1e 00 20 01 03 2d  ....
  
```

Terminal Output:

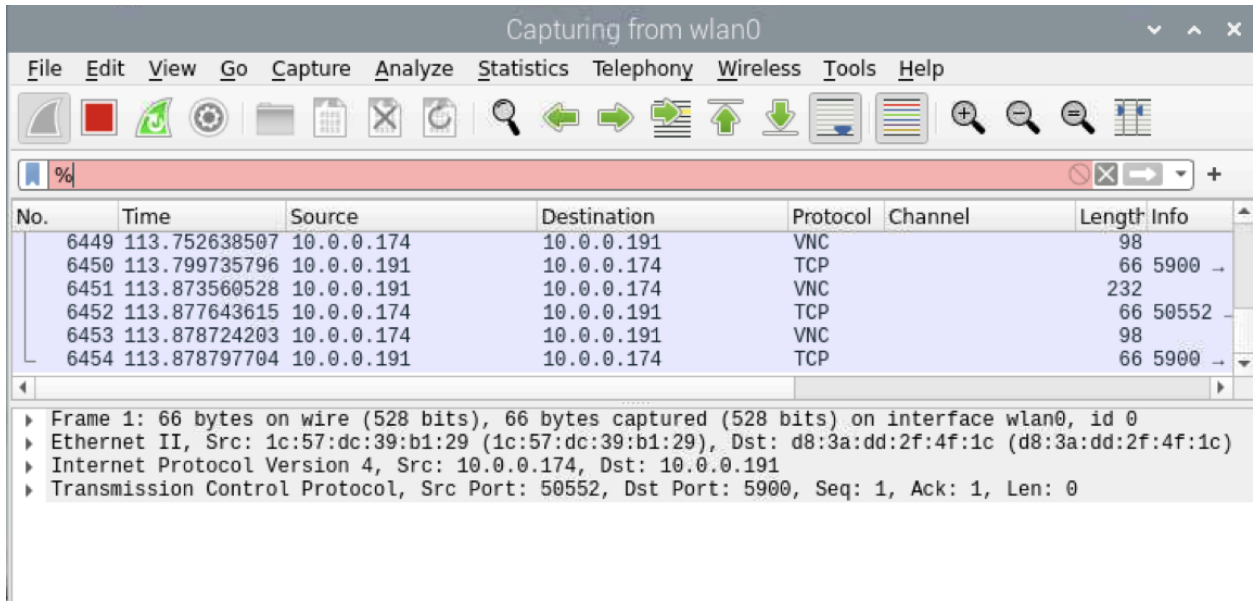
```

pi@raspberrypi:~ $ iw dev wlan1
phy#1
    Interface wlan1
        ifindex 4
        wdev 0x100000001
        addr 40:ed:00:ac:5a:0f
        type monitor
        channel 40 (5200 MHz), width: 80 MHz, center1: 5170 MHz
        txpower 20.00 dBm
  
```

Channel value is consistent with the iw-dev output

Prelab2

The difference Joey and I observe between the sniffed packets of the two interfaces wlan0 and wlan1 is that the protocol shows that it is not 802.11 packets. Another difference is the channel frequency is not shown. The source addresses in wlan0 seem to vary while in wlan1 the source addresses are constant.

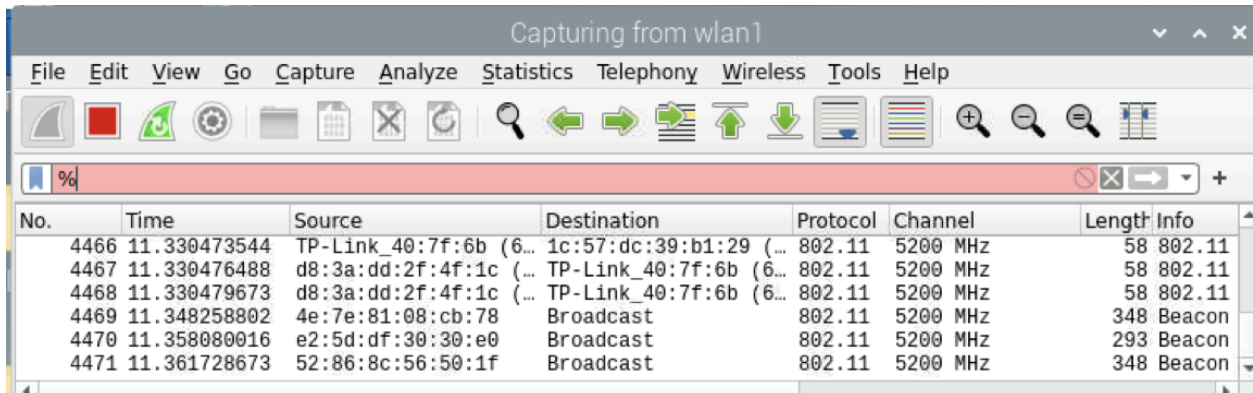


Wireshark interface showing a packet capture from wlan0. The packet list table is as follows:

No.	Time	Source	Destination	Protocol	Channel	Length	Info
6449	113.752638507	10.0.0.174	10.0.0.191	VNC		98	
6450	113.799735796	10.0.0.191	10.0.0.174	TCP		66	5900 →
6451	113.873560528	10.0.0.191	10.0.0.174	VNC		232	
6452	113.877643615	10.0.0.174	10.0.0.191	TCP		66	50552
6453	113.878724203	10.0.0.174	10.0.0.191	VNC		98	
6454	113.878797704	10.0.0.191	10.0.0.174	TCP		66	5900 →

Frame 1 details:

- Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface wlan0, id 0
- Ethernet II, Src: 1c:57:dc:39:b1:29 (1c:57:dc:39:b1:29), Dst: d8:3a:dd:2f:4f:1c (d8:3a:dd:2f:4f:1c)
- Internet Protocol Version 4, Src: 10.0.0.174, Dst: 10.0.0.191
- Transmission Control Protocol, Src Port: 50552, Dst Port: 5900, Seq: 1, Ack: 1, Len: 0



Wireshark interface showing a packet capture from wlan1. The packet list table is as follows:

No.	Time	Source	Destination	Protocol	Channel	Length	Info
4466	11.330473544	TP-Link_40:7f:6b (6...	1c:57:dc:39:b1:29 (...	802.11	5200 MHz	58	802.11
4467	11.330476488	d8:3a:dd:2f:4f:1c (...	TP-Link_40:7f:6b (6...	802.11	5200 MHz	58	802.11
4468	11.330479673	d8:3a:dd:2f:4f:1c (...	TP-Link_40:7f:6b (6...	802.11	5200 MHz	58	802.11
4469	11.348258802	4e:7e:81:08:cb:78	Broadcast	802.11	5200 MHz	348	Beacon
4470	11.358080016	e2:5d:df:30:30:e0	Broadcast	802.11	5200 MHz	293	Beacon
4471	11.361728673	52:86:8c:56:50:1f	Broadcast	802.11	5200 MHz	348	Beacon

Prelab 3

This is accurate because it detects the orientation of RPi, converts radians to degrees and in the video demonstrating each direction and velocity change, the yaw, pitch, roll matches accordingly.

Video:

<https://youtube.com/shorts/zyUVPRJjTRc?feature=share>

Code:

```
from sense_hat import SenseHat
import time
import math

sense = SenseHat()

while True:

    accel = sense.get_accelerometer_raw()
    mag = sense.get_compass_raw()

    pitch = math.atan2(accel['x'], math.sqrt(accel['y']**2 + accel['z']**2))
    roll = math.atan2(accel['y'], math.sqrt(accel['x']**2 + accel['z']**2))
    yaw = math.atan2(mag['y'], mag['x'])

    pitch = math.degrees(pitch)
    roll = math.degrees(roll)
    yaw = math.degrees(yaw)

    yaw += 90.0

    print(f"Pitch: {pitch:.2f} degrees")
    print(f"Roll: {roll:.2f} degrees")
    print(f"Yaw: {yaw:.2f} degrees")

    time.sleep(0.1)
```

Prelab 4

This is accurate because it detects the orientation of RPi, converts radians to degrees and in the video demonstrating each direction and velocity change, the yaw, pitch, roll matches accordingly. The yaw, pitch, roll changes according to the accelerator changes I made during the video.

Video:

<https://youtu.be/Z2D7n1Wil1I>

Code:

```
from sense_hat import SenseHat
import time
import math

sense = SenseHat()

while True:

    accel = sense.get_accelerometer_raw()
    mag = sense.get_compass_raw()

    pitch = math.atan2(accel['x'], math.sqrt(accel['y']**2 + accel['z']**2))
    roll = math.atan2(accel['y'], math.sqrt(accel['x']**2 + accel['z']**2))
    yaw = math.atan2(mag['y'], mag['x'])

    pitch = math.degrees(pitch)
    roll = math.degrees(roll)
    yaw = math.degrees(yaw)

    yaw += 90.0

    print(f"Pitch: {pitch:.2f} degrees")
```

```

print(f"Roll: {roll:.2f} degrees")
print(f"Yaw: {yaw:.2f} degrees")
print(accel['x'])
print(accel['y'])
print(accel['z'])

```

```
time.sleep(0.1)
```

Prelab 5

<https://github.com/prithbalaji/CS437-Prelab3/>

Plots and CSV files in Github:

	Timestamp	Raw X	Raw Y	Raw Z	Smoothed X	Smoothed Y	Smoothed Z
1							
2	1696341684.029021	0.036124441772699356	-0.47883340716362	0.6959982514381409	0.0036124441772699355	-0.04427089653909207	0.025328928604722023
3	1696341684.1406703	0.04315537214279175	-0.48365792632102966	0.8119979500770569	0.0296444658190012	-0.01872132681310177	0.06247846819460392
4	1696341684.2592058	0.04291292652487755	-0.4841403663158417	0.8112668395042419	0.06676976084709167	0.018355724215507508	0.09948240816593171
5	1696341684.3835812	0.04291292652487755	-0.4848640561103821	0.8132163882255554	0.10377370081841945	0.05167485103011131	0.18087983056902884
6	1696341684.5079892	0.043397821485996246	-0.4860701858997345	0.8154096603393555	0.11561978757381439	0.06269723176956177	0.19260399043560028
7	1696341684.6325328	0.04364026337862015	-0.48245176672935486	0.8173592686653137	0.1157682217657566	0.06323175244033337	0.1933817159384489
8	1696341684.7534165	0.043397821485996246	-0.48245176672935486	0.8190650939941406	0.11659481413662434	0.0640583448112011	0.19445125982165337
9	1696341684.86964	0.043397821485996246	-0.48317545652389526	0.8183339834213257	0.11746940314769745	0.0648120753467083	0.1952524922788143
10	1696341684.98127	0.04315537214279175	-0.48438161611557007	0.8210146427154541	0.11802706345915795	0.06522487550973892	0.19557151645421983

