

Queries given in Kurose and Ross textbook wireshark assignment on Wi-Fi

1. The SSIDs of the two access points that are issuing most of the beacon frames in this trace are **30 Munroe St** and **linksys_SES_24086**.

Wireshark_802_11.pcap

No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	70.226700	Pierry_Li_f7:1d:51	Broadcast	802.11	102	Beacon frame SN=2002 CN=0 Elanc- DT=100 CCTN=20 Munroe St

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2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	70.226700	Pierry_Li_f7:1d:51	Broadcast	802.11	102	Beacon frame SN=2002 CN=0 Elanc- DT=100 CCTN=20 Munroe St

2. The intervals of time between the transmissions of the beacon frames the **linksys_se_24086** and the **30 Munroe St.** access points are **0.102400 Seconds** and **0.102400 Seconds** respectively.

Wireshark_802_11.pcap

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wlan.fc.type_subtype == 0x08

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2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463292	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=Linksys_SES_24086
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2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Frame 2291: 183 bytes on wire (1464 bits), 183 bytes captured (1464 bits)

Radiotap Header V0, Length 24

802.11 radio information

IEEE 802.11 Beacon frame, Flags:

IEEE 802.11 Wireless Management

- Fixed parameters (12 bytes)
 - Timestamp: 174388531586
 - Beacon Interval: 0.102400 [Seconds]
 - Capabilities Information: A0A011

Wireshark_802_11.pcap

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wlan.fc.type_subtype == 0x08

No.	Time	Source	Destination	Protocol	Length	Info
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2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
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2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463292	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=Linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=Linksys_SES_24086
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2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Frame 2290: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)

Radiotap Header V0, Length 24

802.11 radio information

IEEE 802.11 Beacon frame, Flags:

IEEE 802.11 Wireless Management

- Fixed parameters (12 bytes)
 - Timestamp: 6351909098206
 - Beacon Interval: 0.102400 [Seconds]
 - Capabilities Information: A0A011

3. The source MAC address on the beacon frame from 30 Munroe St is 00:16:b6:f7:1d:51

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
wlan.fc.type_subtype == 0x08						
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2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
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2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
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Frame 2291: 183 bytes on wire (1464 bits), 183 bytes captured (1464 bits) Radiotap Header v0, Length 24 802.11 radio information IEEE 802.11 Beacon frame, Flags: Type/Subtype: Beacon frame (0x0008) Frame Control Field: 0x8000 .000 0000 0000 0000 = Duration: 0 microseconds Receiver address: Broadcast (ff:ff:ff:ff:ff:ff) Destination address: Broadcast (ff:ff:ff:ff:ff:ff) Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) Source address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)						

4. The destination MAC address on the beacon frame from 30 Munroe St is **ff:ff:ff:ff:ff:ff(broadcast address)**

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2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
Frame 2291: 183 bytes on wire (1464 bits), 183 bytes captured (1464 bits) Radiotap Header v0, Length 24 802.11 radio information IEEE 802.11 Beacon frame, Flags: Type/Subtype: Beacon frame (0x0008) Frame Control Field: 0x8000 .000 0000 0000 0000 = Duration: 0 microseconds Receiver address: Broadcast (ff:ff:ff:ff:ff:ff) Destination address: Broadcast (ff:ff:ff:ff:ff:ff) Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) Source address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)						

5. The MAC BSS id on the beacon frame from 30 Munroe St is **00:16:b6:f7:1d:51**

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Type/Subtype: Beacon frame (0x0008)
Frame Control Field: 0x8000
.0000 0000 0000 = Duration: 0 microseconds
Receiver address: Broadcast (ffff:ffff:ffff:ffff)
Destination address: Broadcast (ffff:ffff:ffff:ffff)
Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)
Source address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)
BSS ID: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)
.... 0000 = Fragment number: 0
1110 1101 0010 = Sequence number: 3794
Frame check sequence: 0x048420b9 [unverified]
[FCS Status: Unverified]

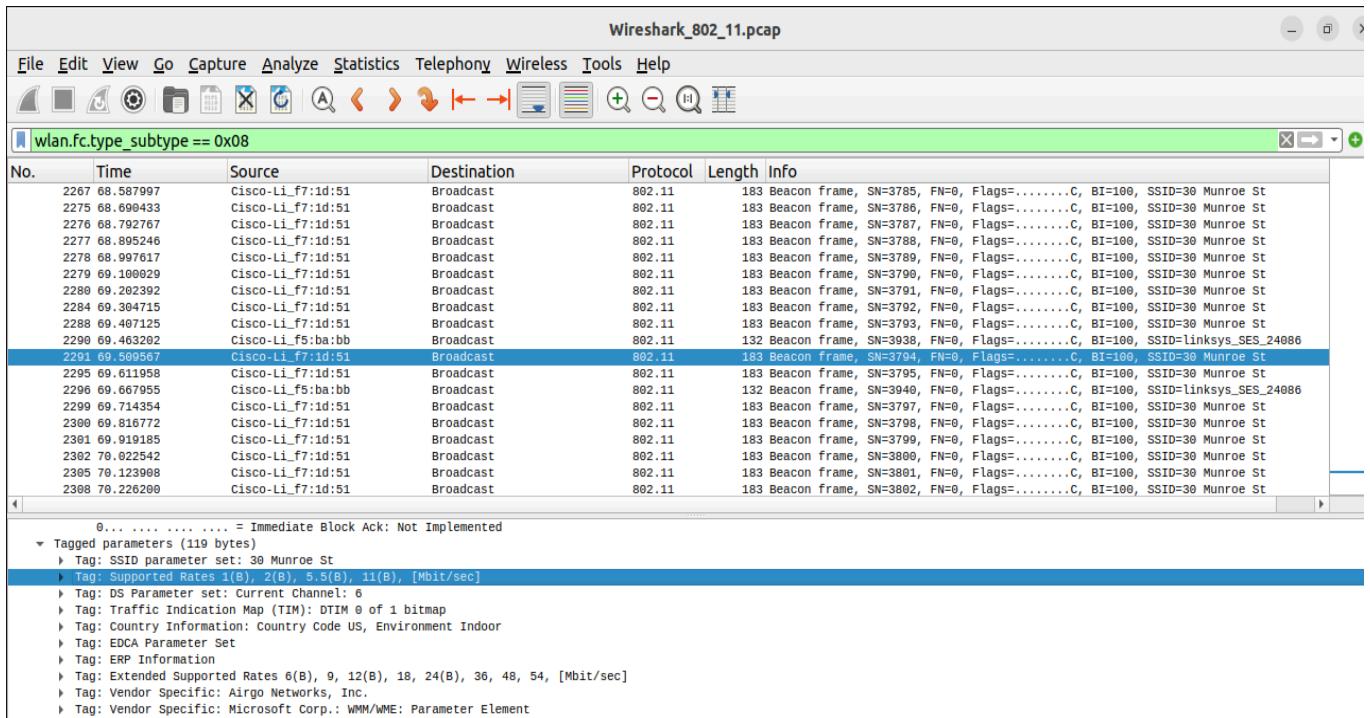
6. The beacon frames from the **30 Munroe St** access point advertise that the access point can support four data rates and eight additional rates are as follows:

four data rates : **1, 2, 5.5, 11 Mbit/sec**

eight additional rates are : **6, 9, 12, 18, 24, 36, 48, 54 Mbit/sec**

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

0... = Immediate Block Ack: Not Implemented
Tagged parameters (110 bytes)
Tag: SSID parameter set: 30 Munroe St
Tag: Supported Rates 1(B), 2(B), 5.5(B), 11(B), [Mbit/sec]
Tag: DS Parameter set: Current Channel: 6
Tag: Traffic Indication Map (TIM): DTIM 0 of 1 bitmap
Tag: Country Information: Country Code US, Environment Indoor
Tag: EDDA Parameter Set
Tag: ERP Information
Tag: Extended Supported Rates 6(B), 9, 12(B), 18, 24(B), 36, 48, 54, [Mbit/sec]
Tag: Vendor Specific: Argo Networks, Inc.
Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element



7. Three MAC address related to the TCP SYN sent at t = 24.811 seconds are as follows:

The MAC address of the host sending the TCP SYN is **00:13:02:d1:b6:4f**

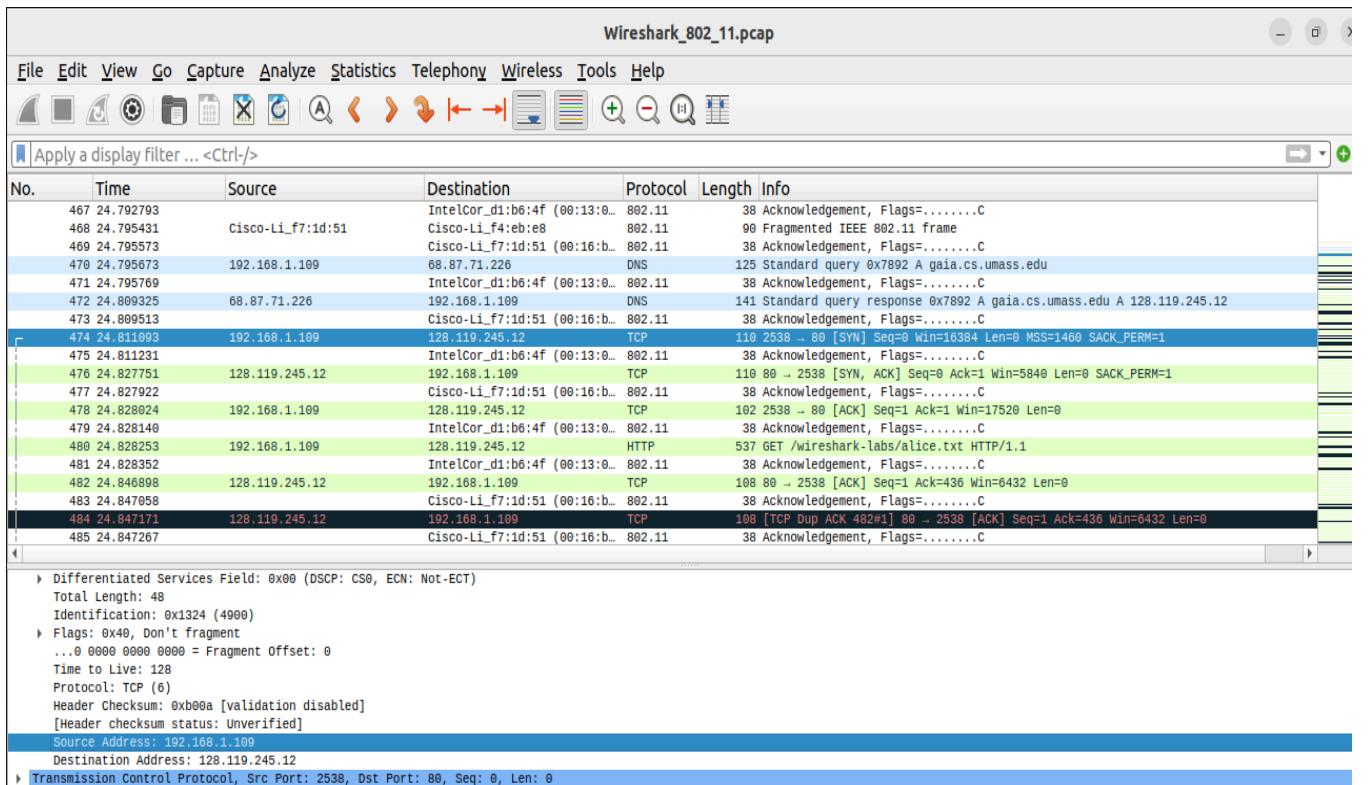
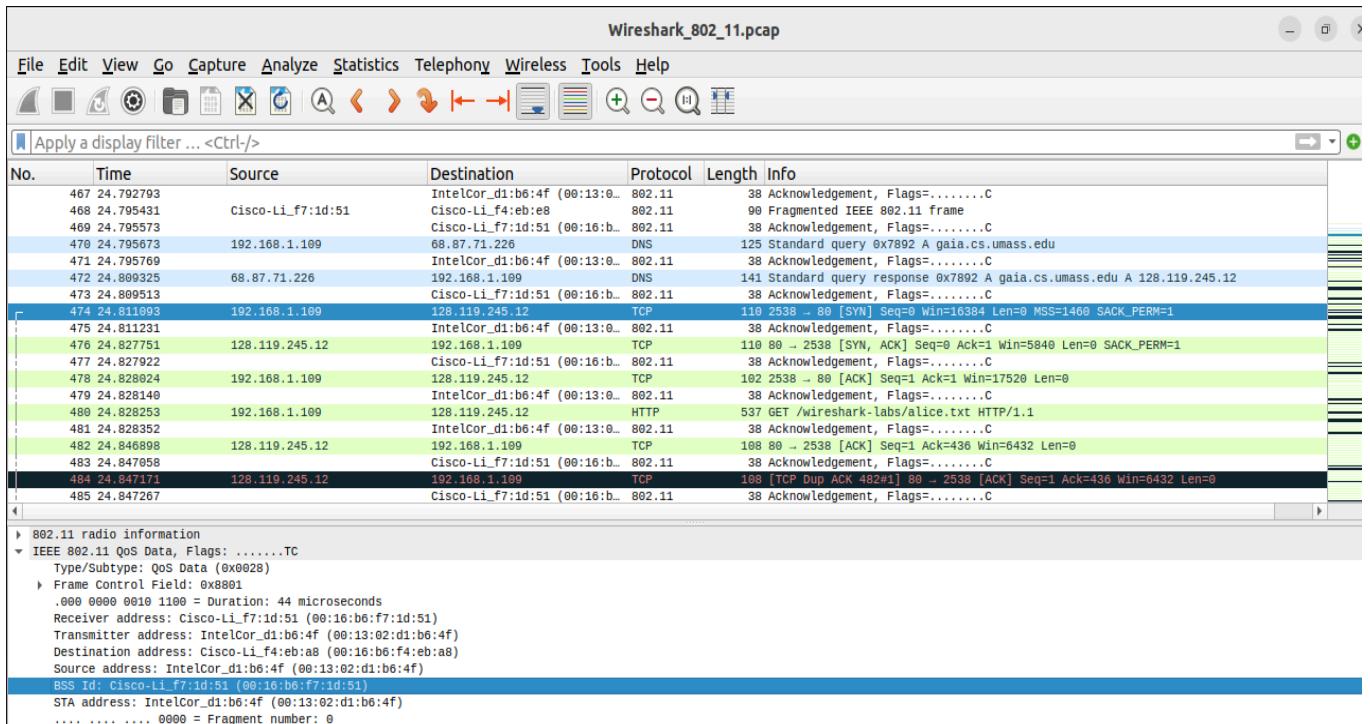
The MAC address for the destination(first hop router) is **00:16:b6:f4:eb:a8**

The MAC address for the BSS is **00:16:b6:f7:1d:51**

The IP address of the host sending the TCP SYN is **192.168.1.109**

The destination address is **128.199.245.12**

The IP address corresponds to host server(i.e., gaia.cs.umass.edu) because it is the target of the TCP connection.



8.

Three MAC address related to the TCP SYN sent at t = 24.827 seconds are as follows:

The MAC address of the host(first hop router) sending the TCP SYN ACK is **00:16:b6:f4:eb:a8**

The MAC address for the destination is **91:2a:b0:49:b6:4f**

The MAC address for the BSS is **00:16:b6:f7:1d:51**

The IP address of the host sending the TCP SYN ACK is **128.199.245.12**

The destination address is **192.168.1.109**

The MAC address of the device sending the TCP segment is not the same as the MAC address of the host used to send the TCP SYN. It seems like the host's wireless interface is acting as if it has two different addresses.

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
466	24.792693	IntelCor_d1:b6:4f	Broadcast	ARP	96	00 Who has 192.168.1.1? Tell 192.168.1.109
467	24.792793	IntelCor_d1:b6:4f (00:13:0...)	802.11		38	Acknowledgement, Flags=.....C
468	24.795431	Cisco_Li_f7:1d:51	Cisco_Li_f4:eb:68	802.11	90	Fragmented IEEE 802.11 frame
469	24.795573	Cisco_Li_f7:1d:51 (00:16:b...)	802.11		38	Acknowledgement, Flags=.....C
470	24.795673	192.168.1.109	68.87.71.226	DNS	125	Standard query 0x7892 A gaia.cs.umass.edu
471	24.795769	IntelCor_d1:b6:4f (00:13:0...)	802.11		38	Acknowledgement, Flags=.....C
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513		Cisco_Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231	IntelCor_d1:b6:4f (00:13:0...)	802.11		38	Acknowledgement, Flags=.....C
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922		Cisco_Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828140		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
482	24.846998	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847058		Cisco_Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0

Wireshark_802_11.pcap

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No.	Time	Source	Destination	Protocol	Length	Info
466	24.792693	IntelCor_d1:b6:4f	Broadcast	ARP	96	Who has 192.168.1.1? Tell 192.168.1.109
467	24.792793	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	ARP	802.11	38 Acknowledgement, Flags=.....C
468	24.795431	Cisco_Li_f4:e8:eb	Broadcast	802.11	98 Fragmented IEEE 802.11 frame	
469	24.795573	Cisco_Li_f7:1d:51	(00:16:0...)	802.11	38 Acknowledgement, Flags=.....C	
470	24.795673	192.168.1.109	68.87.71.226	DNS	125	Standard query 0x7892 A gaia.cs.umass.edu
471	24.795769	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38 Acknowledgement, Flags=.....C	
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513	Cisco_Li_f7:1d:51	(00:16:0...)	802.11	38 Acknowledgement, Flags=.....C	
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38 Acknowledgement, Flags=.....C	
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922	Cisco_Li_f7:1d:51	(00:16:0...)	802.11	38 Acknowledgement, Flags=.....C	
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828148	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38 Acknowledgement, Flags=.....C	
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38 Acknowledgement, Flags=.....C	
482	24.846898	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847088	Cisco_Li_f7:1d:51	(00:16:0...)	802.11	38 Acknowledgement, Flags=.....C	
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0

```

> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 48
Identification: 0x0000 (0)
> Flags: 0x40, Don't fragment
... 0 0000 0000 0000 = Fragment Offset: 0
Time to Live: 49
Protocol: TCP (6)
Header Checksum: 0x122f [validation disabled]
[Header checksum status: Unverified]
Source Address: 128.119.245.12
Destination Address: 192.168.1.109
> Transmission Control Protocol, Src Port: 80, Dst Port: 2538, Seq: 0, Ack: 1, Len: 0

```

9. The first action taken by the host in the trace just after t = 49.5836 seconds is DHCP release to the DHCP server. It is an IP-layer action.

Second, at t = 49.609617, the host sends a DEAUTHENTICATION frame and expects to see a DISASSOCIATION request. It is a 802.11-layer action.

Wireshark_802_11.pcap

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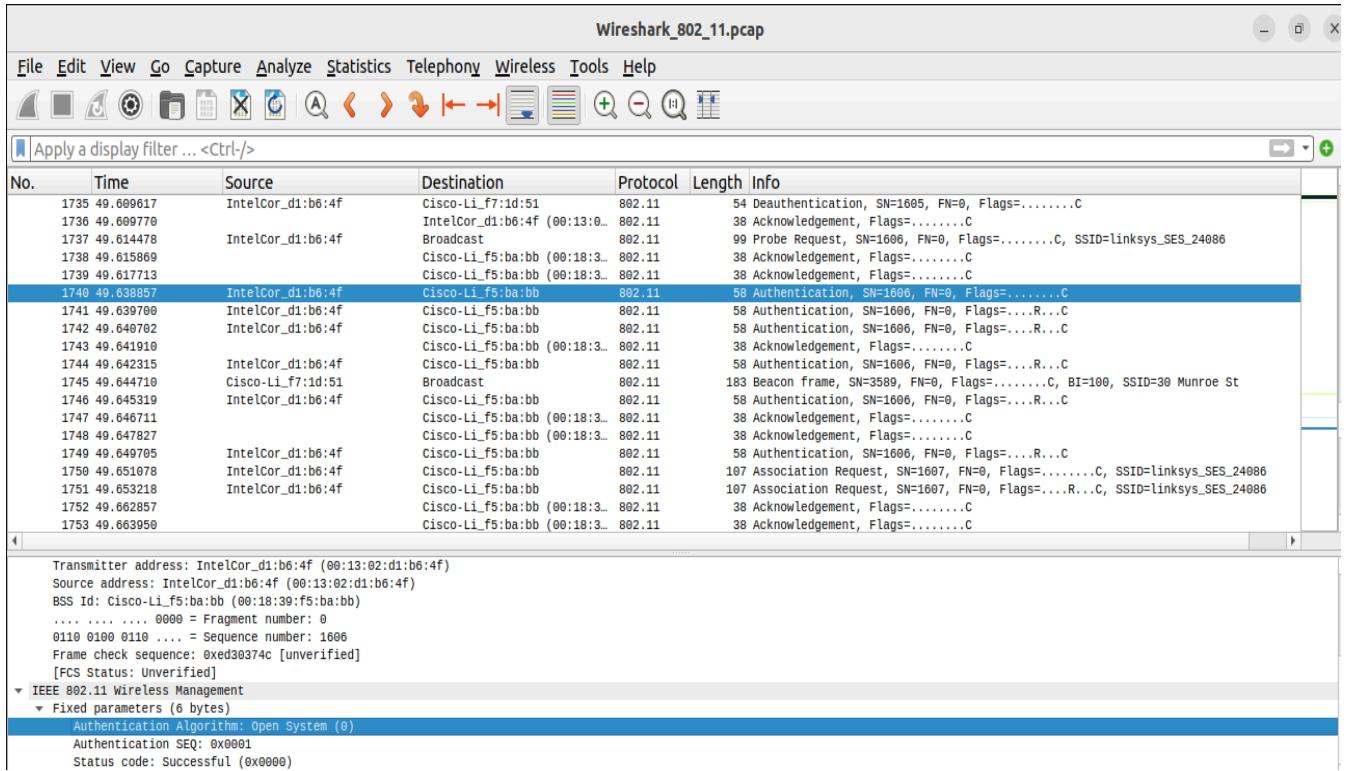
No.	Time	Source	Destination	Protocol	Length	Info
1724	49.235340	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1602, FN=0, Flags=...P...TC
1725	49.235439	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
1726	49.337573	Cisco_Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3586, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1727	49.429849	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1603, FN=0, Flags=.....C
1728	49.430007	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
1729	49.440041	Cisco_Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3587, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1730	49.440146	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1604, FN=0, Flags=...P...TC
1731	49.440243	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
1732	49.542481	Cisco_Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1733	49.583615	192.168.1.109	192.168.1.1	DHCP	399	DHCP Release - Transaction ID 0xea5a526
1734	49.583771	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
1735	49.609617	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770	IntelCor_d1:b6:4f	(00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869	Cisco_Li_f5:ba:bb	(00:18:0...)	802.11	38	Acknowledgement, Flags=.....C
1739	49.617713	Cisco_Li_f5:ba:bb	(00:18:0...)	802.11	38	Acknowledgement, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=...R...C
1742	49.640702	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=...R...C

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1724	49.235340	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1602, FN=0, Flags=...P...TC
1725	49.235439		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1726	49.337573	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3586, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1727	49.429849	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1603, FN=0, Flags=.....TC
1728	49.430007		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1729	49.440041	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3587, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1730	49.440146	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1604, FN=0, Flags=...P...TC
1731	49.440243		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1732	49.542481	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1733	49.593615	192.168.1.109	192.168.1.1	DHCP	390	DHCP Release - Transaction ID 0xeas5a526
1734	49.583771		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1739	49.617713	Cisco-Li_f5:ba:bb		802.11	38	Acknowledgment, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1742	49.640702	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1743	49.641910		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1744	49.642315	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1745	49.644710	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3589, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1746	49.645319	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1747	49.646711		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1748	49.647827	Cisco-Li_f5:ba:bb		802.11	38	Acknowledgment, Flags=.....C
1749	49.649705	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1750	49.651078	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=.....C, SSID=linksys_SES_24086
1751	49.653218	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=....R...C, SSID=linksys_SES_24086
1752	49.662857		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1753	49.663950	Cisco-Li_f5:ba:bb	(00:18:3:...	802.11	38	Acknowledgment, Flags=.....C

10. There are a total 6 AUTHENTICATION messages sent from the wireless host to the linksys_ses_24086 AP. The first AUTHENTICATION from the host to the AP is at t = 49.638

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgment, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1739	49.617713	Cisco-Li_f5:ba:bb		802.11	38	Acknowledgment, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1742	49.640702	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1743	49.641910		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1744	49.642315	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1745	49.644710	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3589, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1746	49.645319	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1747	49.646711		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1748	49.647827	Cisco-Li_f5:ba:bb		802.11	38	Acknowledgment, Flags=.....C
1749	49.649705	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1750	49.651078	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=.....C, SSID=linksys_SES_24086
1751	49.653218	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=....R...C, SSID=linksys_SES_24086
1752	49.662857		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgment, Flags=.....C
1753	49.663950	Cisco-Li_f5:ba:bb	(00:18:3:...	802.11	38	Acknowledgment, Flags=.....C

11. The host wants the authentication to be open(Authentication Algorithm: Open System).



12. From the given trace I cannot find the reply of the AUTHENTICATION request. It may be because the access point may be configured as a key required to authenticate and hence it ignores the open system authentication request.

13. At 63.168087 there is an AUTHENTICATION frame from the host(00:13:02:d1:b6:4f) to the 30 Munroe St. access point(00:16:b7:f7:1d:51).

There a reply AUTHENTICATION sent from that AP(00:16:b7:f7:1d:51) to the host (00:13:02:d1:b6:4f) at t = 63.169071

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=...R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=...R...C
2152	63.148186	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142868		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco_Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=1647, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168887	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169971	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=...R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	398	DHCP Discover - Transaction ID 0x101b218a

Receiver address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)
 Destination address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)
 Transmitter address: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 Source address: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 BSS Id: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 0000 = Fragment number: 0
 0110 1000 1110 = Sequence number: 3726
 Frame check sequence: 0x93eaeafc [unverified]
 [FCS Status: Unverified]

IEEE 802.11 Wireless Management
 Fixed parameters (6 bytes)
 Authentication Algorithm: Open System (0)

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=...R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco_Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=...R...C
2152	63.148186	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142868		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco_Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=1647, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168887	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169971	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=...R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco_Li_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco_Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco_Li_f7:1d:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	398	DHCP Discover - Transaction ID 0x101b218a

Receiver address: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 Destination address: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 Transmitter address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)
 Source address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)
 BSS Id: Cisco_Li_f7:1d:51 (00:16:b6:f7:1d:51)
 0000 = Fragment number: 0
 0110 0110 1111 = Sequence number: 1647
 Frame check sequence: 0x47e8cbe0 [unverified]
 [FCS Status: Unverified]

IEEE 802.11 Wireless Management
 Fixed parameters (6 bytes)
 Authentication Algorithm: Open System (0)

14. At 63.169910 there is an ASSOCIATE REQUEST from the host(00:13:02:d1:b6:4f) to the 30 Munroe St. access point(00:16:b7:f7:1d:51).

There a reply AUTHENTICATION sent from that AP(00:16:b7:f7:1d:51) to the host (00:13:02:d1:b6:4f) at t = 63.192101

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
Apply a display filter ... <Ctrl-/>						
2150	63.116231	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140106	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142860		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168087	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169071	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169919	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192181	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a
IEEE 802.11 Wireless Management						
Fixed parameters (6 bytes)						
Capabilities Information: 0x0601						
Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140106	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142860		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168087	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169071	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169919	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192181	Cisco-Li_f7:id:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco-Li_f7:id:51 (00:16:b..)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a
IEEE 802.11 Wireless Management						
Fixed parameters (4 bytes)						
Capabilities Information: 0xce01						

15. The ASSOCIATION REQUEST frame from the host to 30 Munroe St access point can support four data rates and eight additional rates are as follows:

four data rates : **1, 2, 5.5, 11 Mbit/sec**

eight additional rates are : **6, 9, 12, 18, 24, 36, 48, 54 Mbit/sec**

The ASSOCIATION RESPONSE frame from the **30 Munroe St** access point advertise that the access point can support four data rates and eight additional rates are as follows:

four data rates : **1, 2, 5.5, 11, 6, 9, 12, 18 Mbit/sec**

eight additional rates are : **24, 36, 48, 54 Mbit/sec**

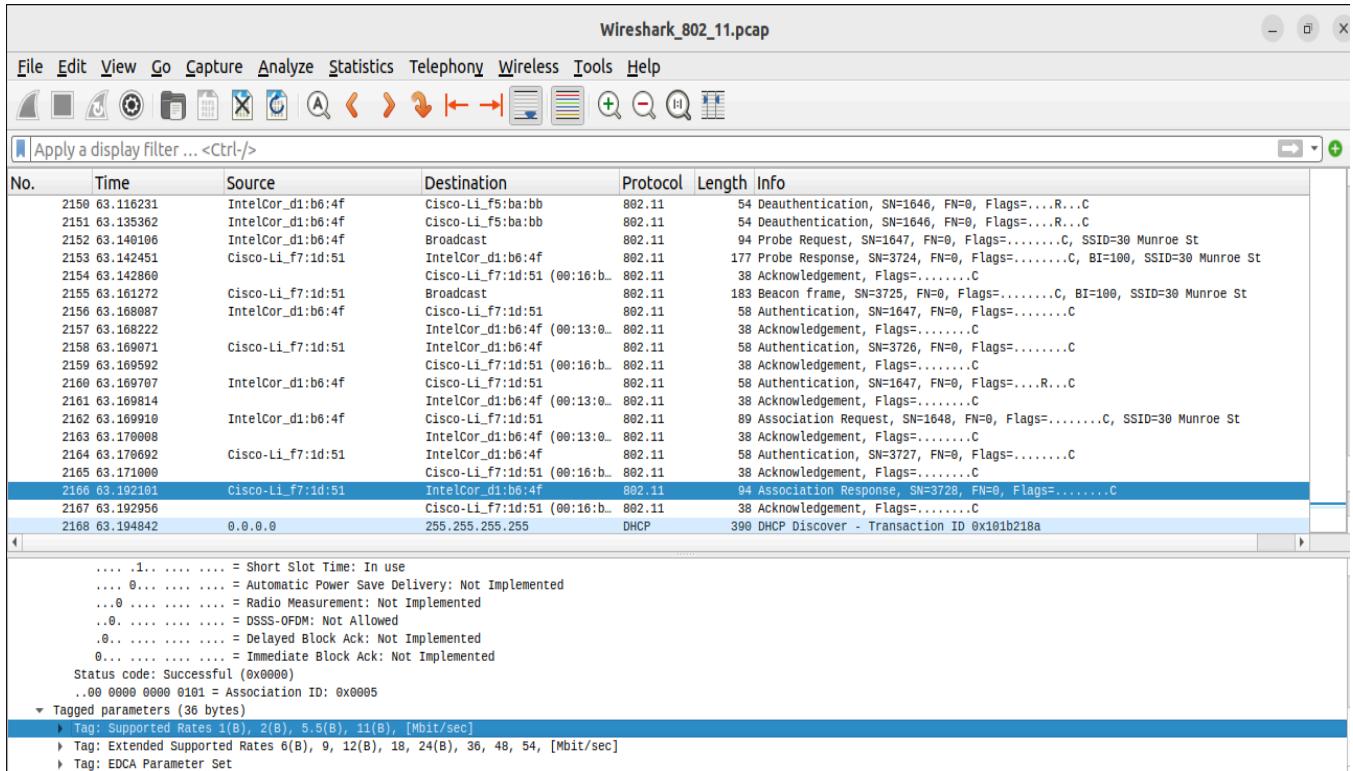
Wireshark_802_11.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

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

No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140166	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142868	Cisco-Li_f7:1d:51	Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168087	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222	IntelCor_d1:b6:4f (00:13:0...)	IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169071	Cisco-Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592	Cisco-Li_f7:1d:51 (00:16:b...)	IntelCor_d1:b6:4f	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814	IntelCor_d1:b6:4f (00:13:0...)	IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008	IntelCor_d1:b6:4f (00:13:0...)	IntelCor_d1:b6:4f	802.11	38	Acknowledgement, Flags=.....C
2164	63.170602	Cisco-Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171060	Cisco-Li_f7:1d:51 (00:16:b...)	Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco-Li_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956	Cisco-Li_f7:1d:51 (00:16:b...)	Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a

.... 1... = Short Slot Time: In use
.... 1... = Automatic Power Save Delivery: Implemented
...0 = Radio Measurement: Not Implemented
...0. = DSSS-OFDM: Not Allowed
..1.. = Delayed Block Ack: Implemented
1... = Immediate Block Ack: Implemented
Listen Interval: 0x000a
▼ Tagged parameters (33 bytes)
 ▶ Tag: SSID parameter set: 30 Munroe St
 ▶ Tag: Supported Rates 1(B), 2(B), 5.5(B), 11(B), 6(B), 9, 12(B), 18, [Mbit/sec]
 ▶ Tag: QoS Capability
 ▶ Tag: Extended Supported Rates 24(B), 36, 48, 54, [Mbit/sec]



16. At 2.297613 there is a PROBE REQUEST frame from source (00:12:f0:1f:57:13) to ff:ff:ff:ff:ff:ff(broadcast message) and BSSID of ff:ff:ff:ff:ff:ff

There a reply PROBE RESPONSE sent from that source(00:16:b6:f7:1d:51) to destination(00:12:f0:1f:57:13) and a BSSID of 00:16:b6:f7:1d:51 at t = 2.300697

A probe request is sent by a node searching an access point. This is one of the methods where instead for scanning beacon frames it sends probe requests to nearby access points. The probe request is sent by access point to the node in response to the probe request to provide necessary details for further process.

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
46	2.236634	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1486, FN=0, Flags=.....TC
47	2.236730		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
48	2.237689	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1487, FN=0, Flags=..P..TC
49	2.237786		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
50	2.297613	IntelCor_if:57:13	Broadcast	802.11	79	Probe Request, SN=576, FN=0, Flags=.....C, SSID=Home WIFI
51	2.308697	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
52	2.302191	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
53	2.304063	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
54	2.305562	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
55	2.308563	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
56	2.310072	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
57	2.338148	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2879, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
58	2.440572	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2880, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
59	2.453941	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2881, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
60	2.542945	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2882, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
61	2.645319	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2883, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
62	2.747697	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2884, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
63	2.850114	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2885, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
64	2.952572	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2886, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

► 802.11 radio information
 ▾ IEEE 802.11 Probe Response, Flags:C
 Type/Subtype: Probe Response (0x0005)
 ▶ Frame Control Field: 0x5000
 .000 0001 0011 1010 = Duration: 314 microseconds
 Receiver address: IntelCor_if:57:13 (00:12:f0:if:57:13)
 Destination address: IntelCor_if:57:13 (00:12:f0:if:57:13)
 Transmitter address: Cisco-Li_f7:1d:51 (00:16:be:f7:1d:51)
 Source address: Cisco-Li_f7:1d:51 (00:16:be:f7:1d:51)
 BSS Id: Cisco-Li_f7:1d:51 (00:16:be:f7:1d:51)
 0000 = Fragment number: 0
 1011 0011 1110 = Sequence number: 2878

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
46	2.236634	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1486, FN=0, Flags=.....TC
47	2.236730		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
48	2.237689	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1487, FN=0, Flags=..P..TC
49	2.237786		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
50	2.297613	IntelCor_if:57:13	Broadcast	802.11	79	Probe Request, SN=576, FN=0, Flags=.....C, SSID=Home WIFI
51	2.308697	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
52	2.302191	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
53	2.304063	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
54	2.305562	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
55	2.308563	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
56	2.310072	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2878, FN=0, Flags=....R...C, BI=100, SSID=30 Munroe St
57	2.338148	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2879, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
58	2.440572	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2880, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
59	2.453941	Cisco-Li_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2881, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
60	2.542945	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2882, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
61	2.645319	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2883, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
62	2.747697	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2884, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
63	2.850114	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2885, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
64	2.952572	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2886, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

► IEEE 802.11 Probe Request, Flags:C
 Type/Subtype: Probe Request (0x0004)
 ▶ Frame Control Field: 0x4000
 .000 0000 0000 0000 = Duration: 0 microseconds
 Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
 Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
 Transmitter address: IntelCor_if:57:13 (00:12:f0:if:57:13)
 Source address: IntelCor_if:57:13 (00:12:f0:if:57:13)
 BSS Id: Broadcast (ff:ff:ff:ff:ff:ff)
 0000 = Fragment number: 0
 0010 0010 0000 = Sequence number: 576
 Frame check sequence: 0xa373c5ff [unverified]

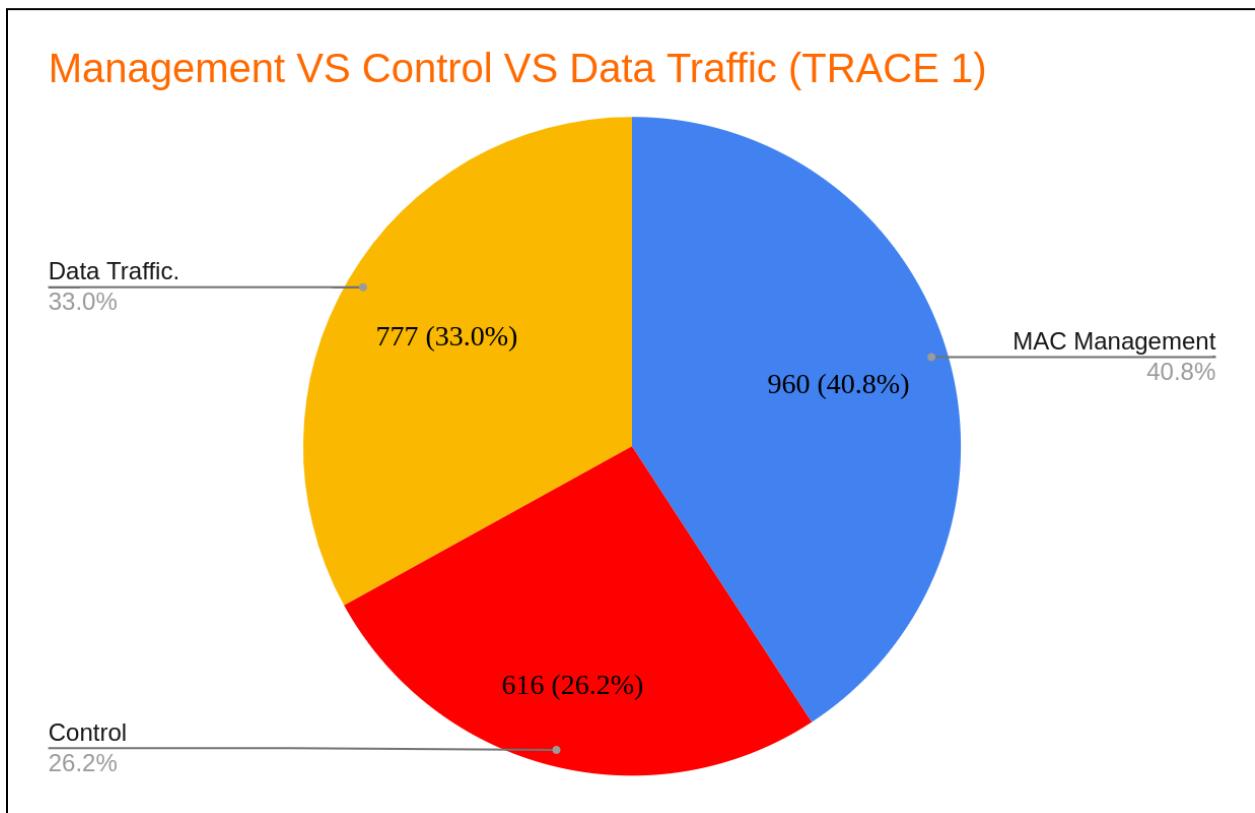
Q1

1. a) Pie chart of MAC Management, Control, Data Traffic. Further division in Management and control frames (i.e., probe reqs, association reqs, RTS/CTS, power-saving, etc).

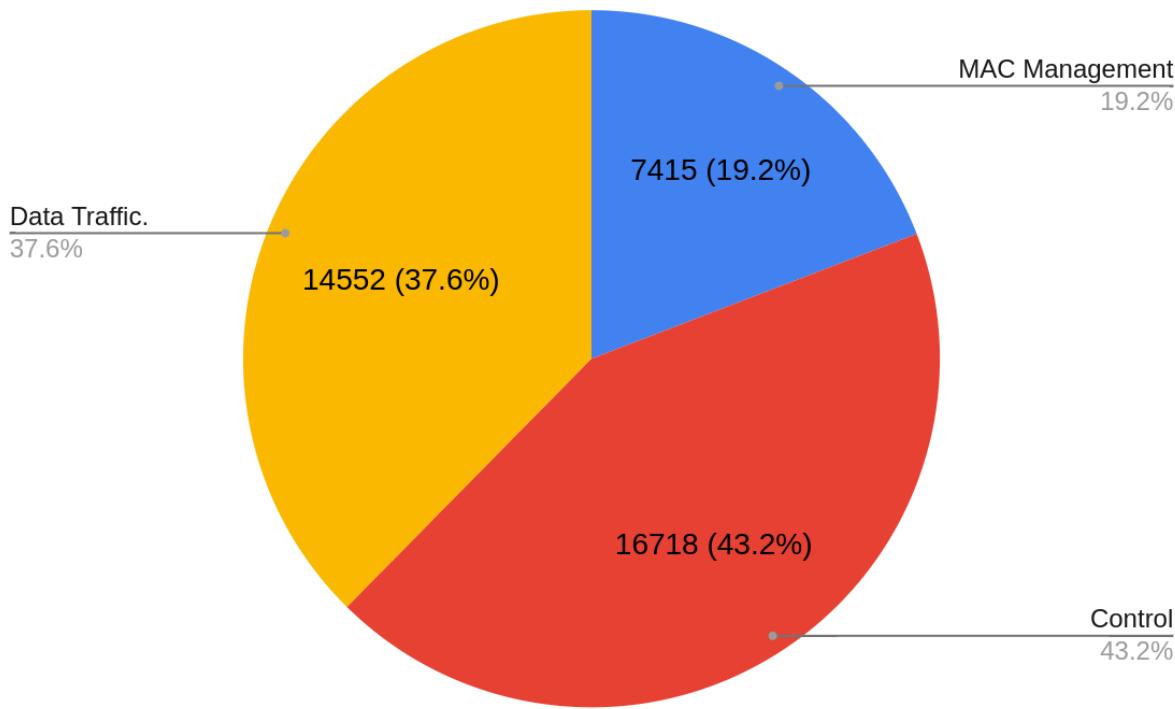
Data for creating pie charts are fetched from wireshark using appropriate filters for both TRACES.

Different data and corresponding pie charts for different kind of traffic captured using wireshark for both traces are given below:

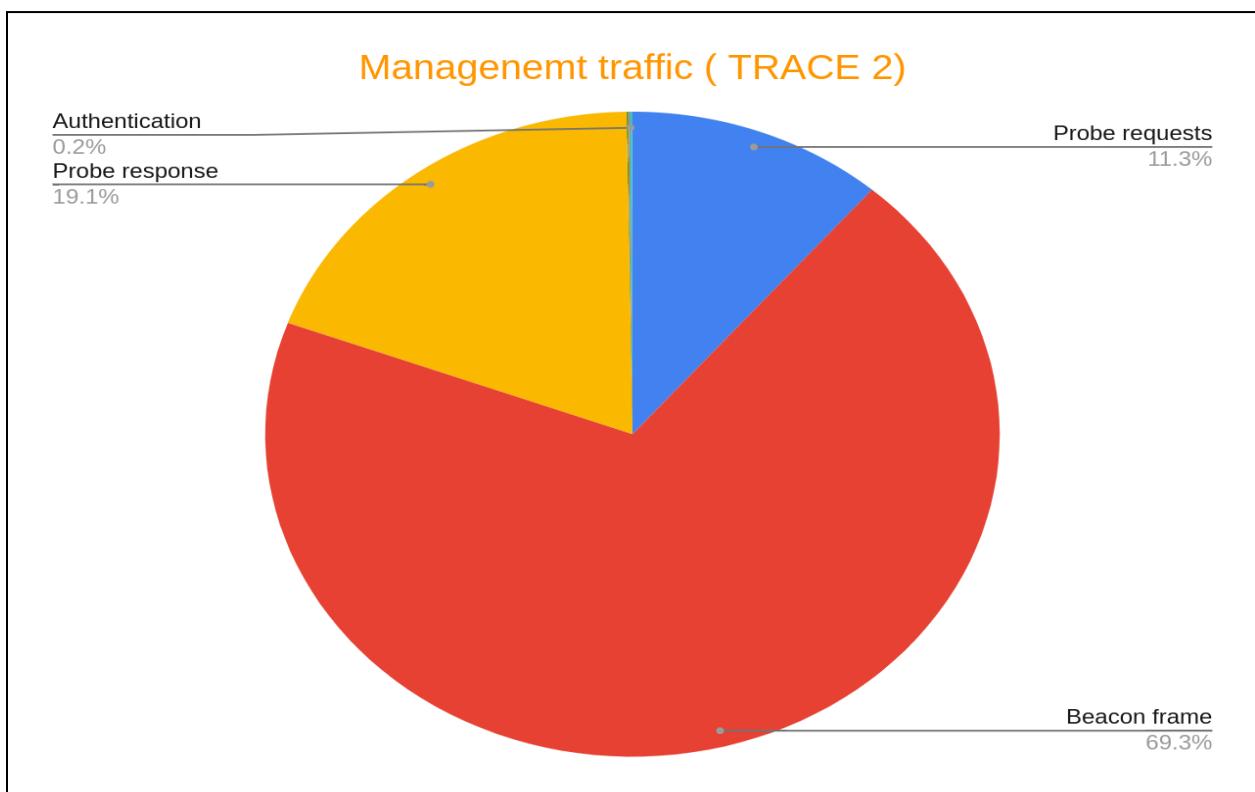
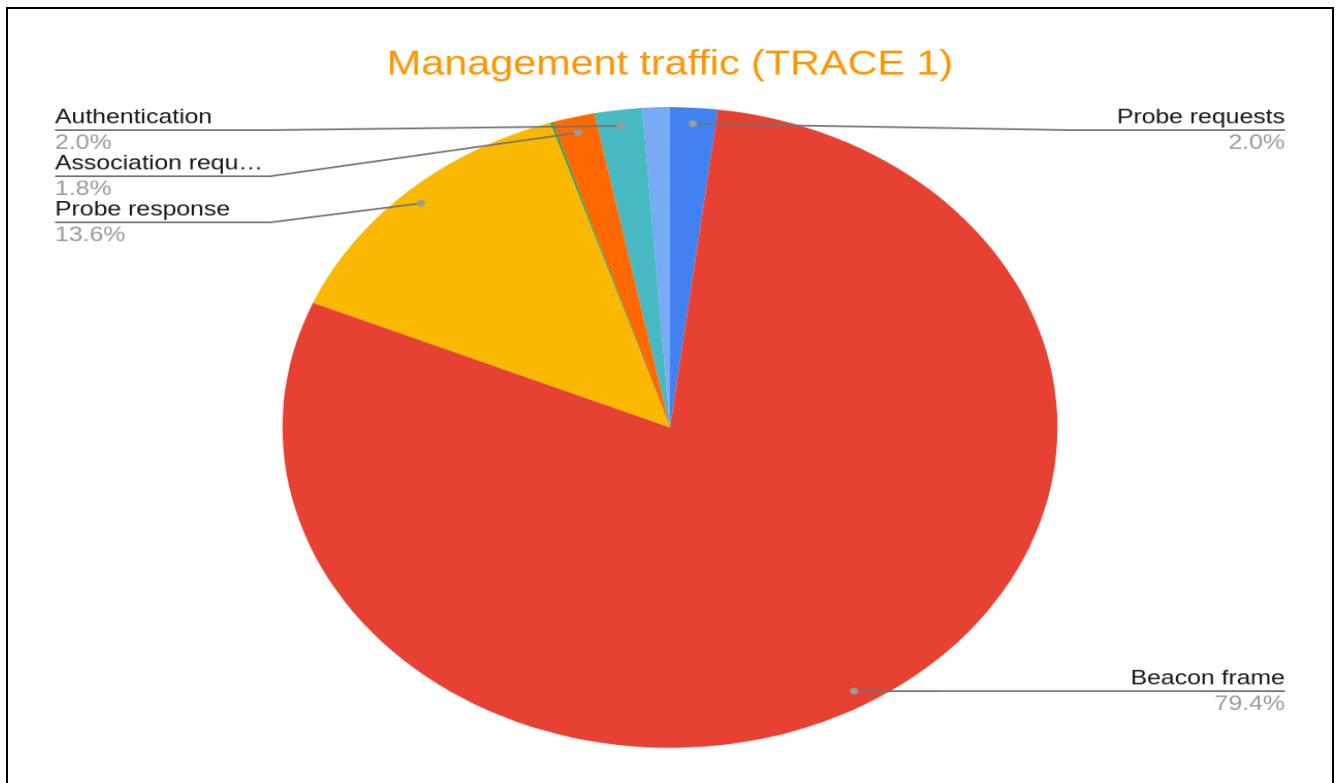
TRACE 1		TRACE 2	
MAC Management	960	MAC Management	7415
Control	616	Control	16718
Data Traffic.	777	Data Traffic.	14552



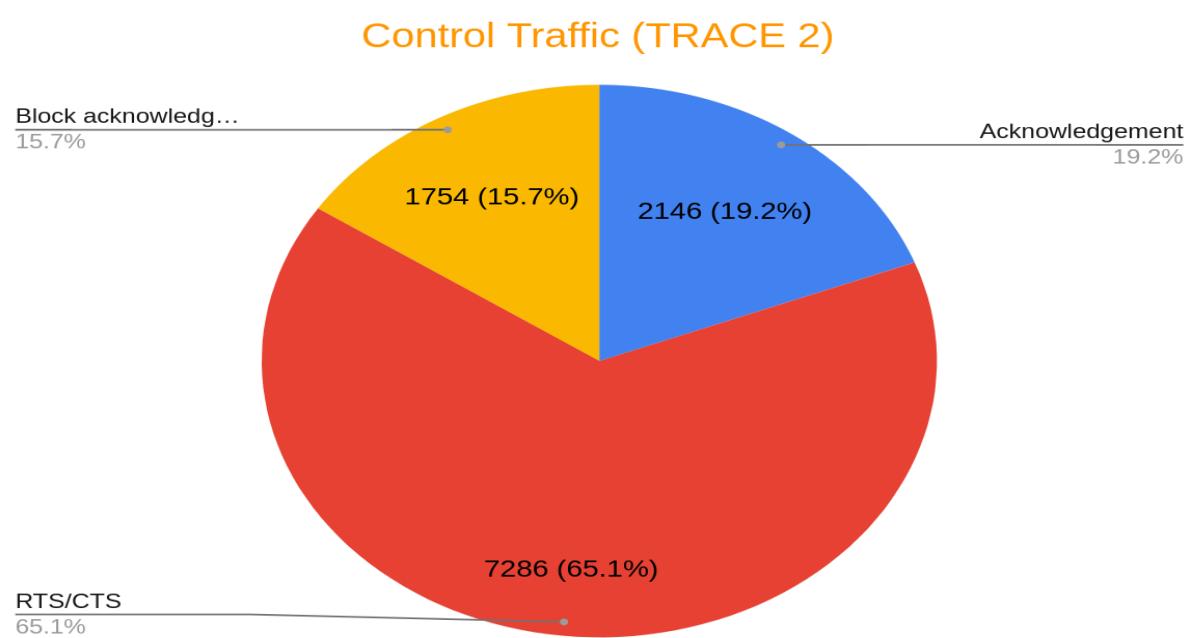
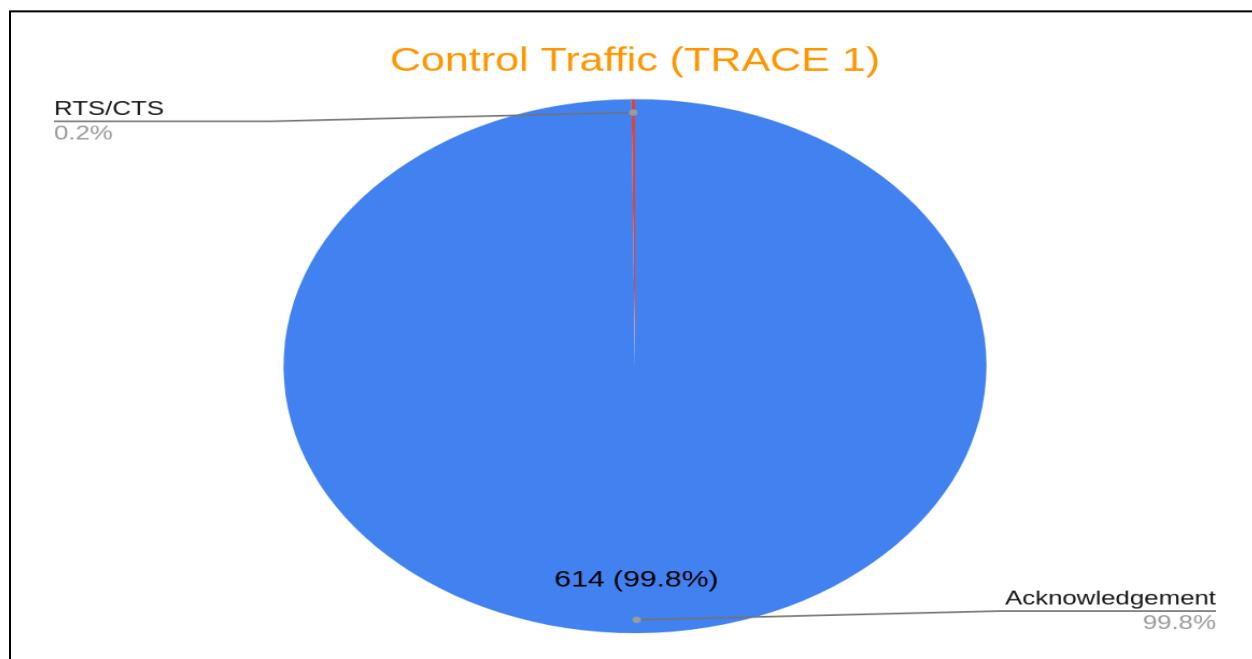
Management VS Control VS Data Traffic (TRACE 2)



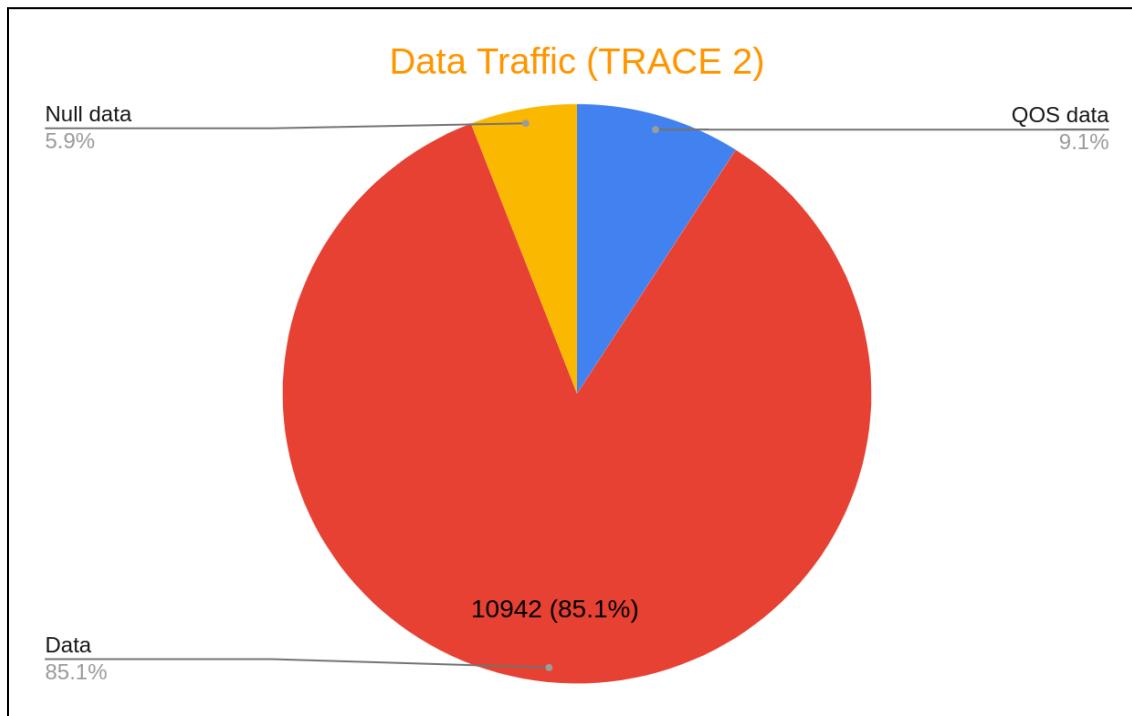
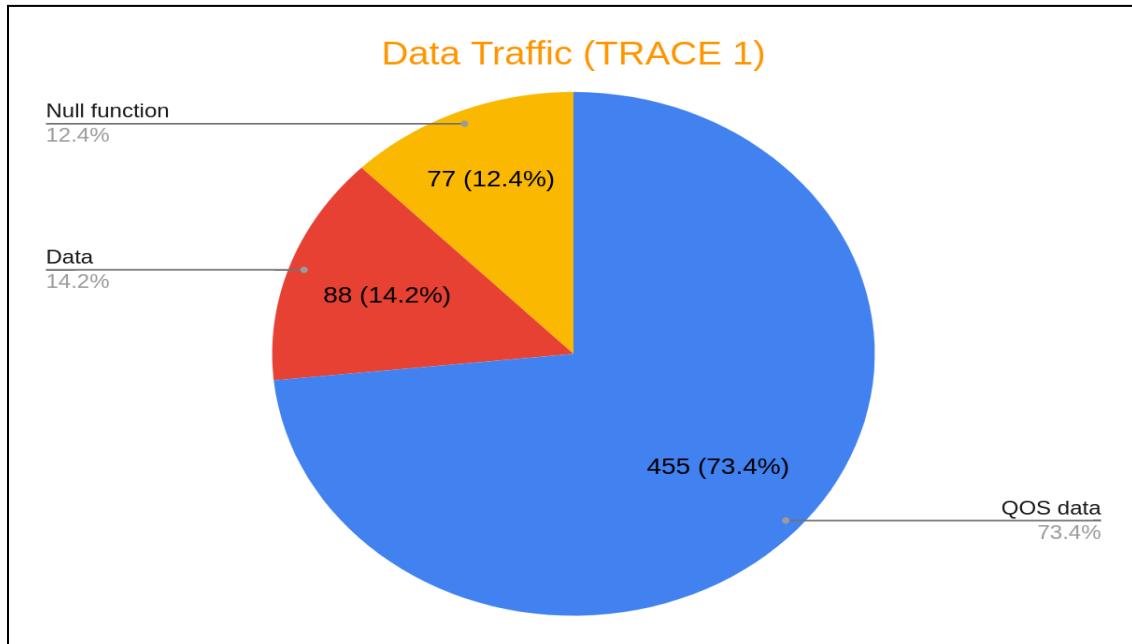
Management traffic			
TRACE 1		TRACE 2	
Probe requests	19	Probe requests	829
Beacon frame	762	Beacon frame	5079
Probe response	131	Probe response	1402
Association response	1	Association response	3
Association requests	17	Association requests	4
Authentication	19	Authentication	11
Deauthentication	11	Deauthentication	1



Control traffic			
TRACE 1		TRACE 2	
Acknowledgement	614	Acknowledgement	2146
RTS/CTS	1	RTS/CTS	7286
Block acknowledgement	0	Block acknowledgement	1754



Data Traffic			
TRACE 1		TRACE 2	
QOS data	455	QOS data	1165
Data	88	Data	10942
Null function	77	Null data	755



1. b.1) No. of different APs visible to device which collected the trace?

There are **3** different access points visible in TRACE 1.

SSID: Munroe st., linksys_SES_24086, linksys12

There are **7** different access points visible in TRACE 2.

SSID: IITH, Placement-2023, eduroam, IITH-Guest-PWD-IITH@2023, IITH-CE/HOD/OFFICE, OFFICE_TRIHUB 3244, Redmi A2,

No.	Time	Source	Destination	Protocol	Length	Info
5465	568.012325922	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3454, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5487	568.077568501	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1034, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5498	568.179103512	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1035, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5510	568.267220797	MojoNetw_81:be:20	Broadcast	802.11	404	Beacon frame, SN=3264, FN=0, Flags=.....C, BI=100, SSID=IITH-Guest-PWD-IITH@2023
5513	568.283327767	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1036, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5514	568.319468409	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3457, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5521	568.382388136	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1037, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5527	568.485814281	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1038, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5532	568.579697562	MojoNetw_81:be:22	Broadcast	802.11	355	Beacon frame, SN=3514, FN=0, Flags=.....C, BI=100, SSID=eduroam
5533	568.587188727	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1039, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5540	568.684813204	MojoNetw_81:be:23	Broadcast	802.11	362	Beacon frame, SN=3218, FN=0, Flags=.....C, BI=100, SSID=Placement-2023
5541	568.698042741	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1040, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5550	568.7164770931	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3803, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5557	568.729151655	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3462, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5569	568.793963113	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1041, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5571	568.809619289	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3804, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5575	568.831465597	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3463, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5588	568.911977133	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3805, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5592	568.933962870	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3464, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5599	569.014595210	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3806, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5604	569.036675304	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3465, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5605	569.086480625	MojoNetw_81:be:20	Broadcast	802.11	404	Beacon frame, SN=3272, FN=0, Flags=.....C, BI=100, SSID=IITH-Guest-PWD-IITH@2023
5666	569.094382550	MojoNetw_81:be:23	Broadcast	802.11	362	Beacon frame, SN=3222, FN=0, Flags=.....C, BI=100, SSID=Placement-2023

No.	Time	Source	Destination	Protocol	Length	Info
2313	70.6350978	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3806, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2314	70.738327	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3807, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2315	70.840739	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3808, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2319	70.943156	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3809, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2320	71.045542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3810, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2321	71.101576	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3954, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2322	71.147898	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3811, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2323	71.250339	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3812, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2327	71.352708	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3813, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2328	71.455665	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3814, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2331	71.557330	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3815, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2334	71.659897	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3816, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2336	71.762287	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3817, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2337	71.864626	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3818, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2338	71.967182	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3819, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2339	72.069393	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3820, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2340	72.172249	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3821, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2341	72.274307	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3822, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2342	72.282076	LinksysG_67:22:94	7f:26:ff:ff:ff:ff	802.11	90	Beacon frame, SN=3779, FN=0, Flags=.....C, BI=100, SSID=linksys12[Malformed Packet]
2345	72.376568	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3823, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2347	72.479021	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3824, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2348	72.581464	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3825, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2349	72.683846	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3826, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

1. b.2) Minimum size of MAC frame for which RTS/CTS exchanged?

TRACE 1 has **only 1 RTS/CTS** exchange and its frame size is **38 Bytes**.
 TRACE 2 has **7286 RTS/CTS** exchanges having minimum size **68 Bytes**.

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c						
No.	Time	Source	Destination	Protocol	Length	Info
1601	46.595317		LinksysG_67:22:94 (00:06:25:6.. 802.11		38	Clear-to-send, Flags=.....C

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c && frame.len < 68						
No.	Time	Source	Destination	Protocol	Length	Info

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c && frame.len <= 68						
No.	Time	Source	Destination	Protocol	Length	Info
17	1.005269559		d2:d0:26:91:02:8c (d2:d0:26:9.. 802.11		68	Clear-to-send, Flags=.....C
22	1.479338982	XiaomiCo_44:af:e9	(10:3f:44:4.. 802.11		68	Clear-to-send, Flags=.....C
25	2.700672240	XiaomiCo_44:af:e9	(10:3f:44:4.. 802.11		68	Clear-to-send, Flags=.....C
77	14.309586036	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
79	14.414651772	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
330	51.196302404	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
340	53.664134049	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
353	54.716640517	Broadcom_04:4e:f2	(e0:3e:44:0.. 802.11		68	Clear-to-send, Flags=.....C
358	54.820948984	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
400	55.741836955	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
419	56.423829105	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
463	57.526170482	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
465	57.557634230	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
543	60.065171367	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
544	60.140960414	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
545	60.145097673	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
562	60.307138492	Broadcom_08:2c:e3	(e0:3e:44:0.. 802.11		68	Clear-to-send, Flags=.....C
563	60.307823297	Broadcom_08:2c:e3	(e0:3e:44:0.. 802.11		68	Clear-to-send, Flags=.....C
591	60.475668379	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
592	60.495028677	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
624	60.851540876	Broadcom_08:2c:e3	(e0:3e:44:0.. 802.11		68	Clear-to-send, Flags=.....C
637	61.088497238	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C
711	63.177851349	MojoNetw_81:be:20	(30:b6:2d:8.. 802.11		68	Clear-to-send, Flags=.....C

1. b.3) What fraction of MAC frames are protected (encrypted)?

0.2% of MAC frames are protected in TRACE 1.
31.1% of MAC frames are protected in TRACE 2.

wlan.fc.protected == 1						
No.	Time	Source	Destination	Protocol	Length	Info
803	25.084183			802.11	38	Data + CF-Ack[Malformed Packet]
1227	33.079714	d1:b6:4f:00:16:b6	MS-NLB-PhysServer-32_08:00...	802.11	111	Association Request, SN=3775, FN=4, Flags=.pm...F.C
1519	43.097945	LinksysG_67:22:94	Broadcast	802.11	98	Beacon frame, SN=3492, FN=0, Flags=.pm..M..C
1545	44.310450	d3:95:ca:bb:f0:f5	3e:d3:27:e6:65:7f	802.11	1624	Beacon frame, SN=54, FN=11, Flags=.pmPRMFTC

▶ Frame 803: 38 bytes on wire (304 bits), 38 bytes captured (304 bits)
▶ Radiotap Header v0, Length 24
▶ 802.11 radio information
▶ IEEE 802.11 Data + CF-Ack
▶ [Malformed Packet: IEEE 802.11]

0000 00 00 18 00 ee 58 00 00 10 48 85 09 c0 00 d9 9c . . . X . . H
0010 40 00 00 3d 5e 66 c4 64 18 ef 1e b2 98 cc 37 63 0 . =^f . d 7c
0020 b7 4f 5e 66 c4 64 0^f d

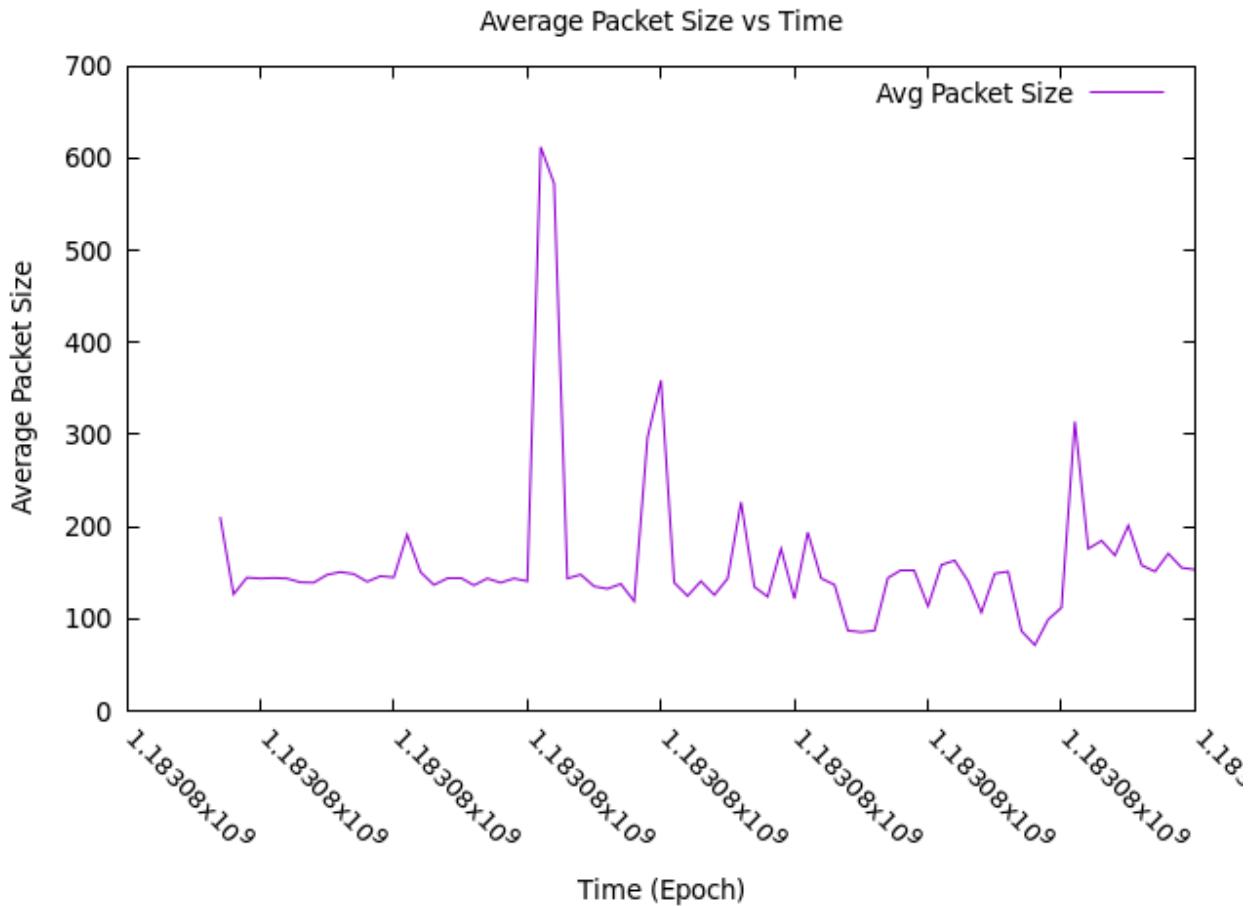
Wireshark 802.11.pcap						
Packets: 2364 · Displayed: 4 (0.2%)						
wlan.fc.protected == 1						
No.	Time	Source	Destination	Protocol	Length	Info
30920	641.111459404	aa:31:b5:95:3a:a6	IPv4mcast_fb	802.11	188	Data, SN=175, FN=0, Flags=.pm...F.C
30921	641.113496758	aa:31:b5:95:3a:a6	IPv6mcast_fb	802.11	208	Data, SN=176, FN=0, Flags=.pm...F.C
30922	641.114697665	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	169	Data, SN=177, FN=0, Flags=.pm...F.C
30923	641.115863509	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	167	Data, SN=178, FN=0, Flags=.pm...F.C
30924	641.117408098	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	189	Data, SN=179, FN=0, Flags=.pm...F.C
30925	641.118812000	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	187	Data, SN=180, FN=0, Flags=.pm...F.C
30926	641.121653270	Apple_64:fb:47	IPv4mcast_fb	802.11	381	Data, SN=181, FN=0, Flags=.pm...F.C
30941	641.205121663	bc:03:58:94:2c:c6	IPv4mcast_7f:ff:fa	802.11	313	Data, SN=2080, FN=0, Flags=.pm...F.C
30943	641.212631911	Apple_64:fb:47	IPv6mcast_fb	802.11	401	Data, SN=182, FN=0, Flags=.pm...F.C
30944	641.213642958	RealMeCh_40:bb:df	Broadcast	802.11	144	Data, SN=1246, FN=0, Flags=.pm...F.C
30947	641.216474422	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	170	Data, SN=183, FN=0, Flags=.pm...F.C
30948	641.217797429	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	190	Data, SN=184, FN=0, Flags=.pm...F.C
30949	641.219119741	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	188	Data, SN=185, FN=0, Flags=.pm...F.C
30950	641.220275323	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	168	Data, SN=186, FN=0, Flags=.pm...F.C
30951	641.221466031	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	167	Data, SN=187, FN=0, Flags=.pm...F.C

▶ Frame 30951: 167 bytes on wire (1336 bits), 167 bytes captured (1336 bits) on interface wlp6s0mon, id 0
▶ Radiotap Header v0, Length 54
▶ 802.11 radio information
▶ IEEE 802.11 Data, Flags: .p....F.C
▶ Data (77 bytes)

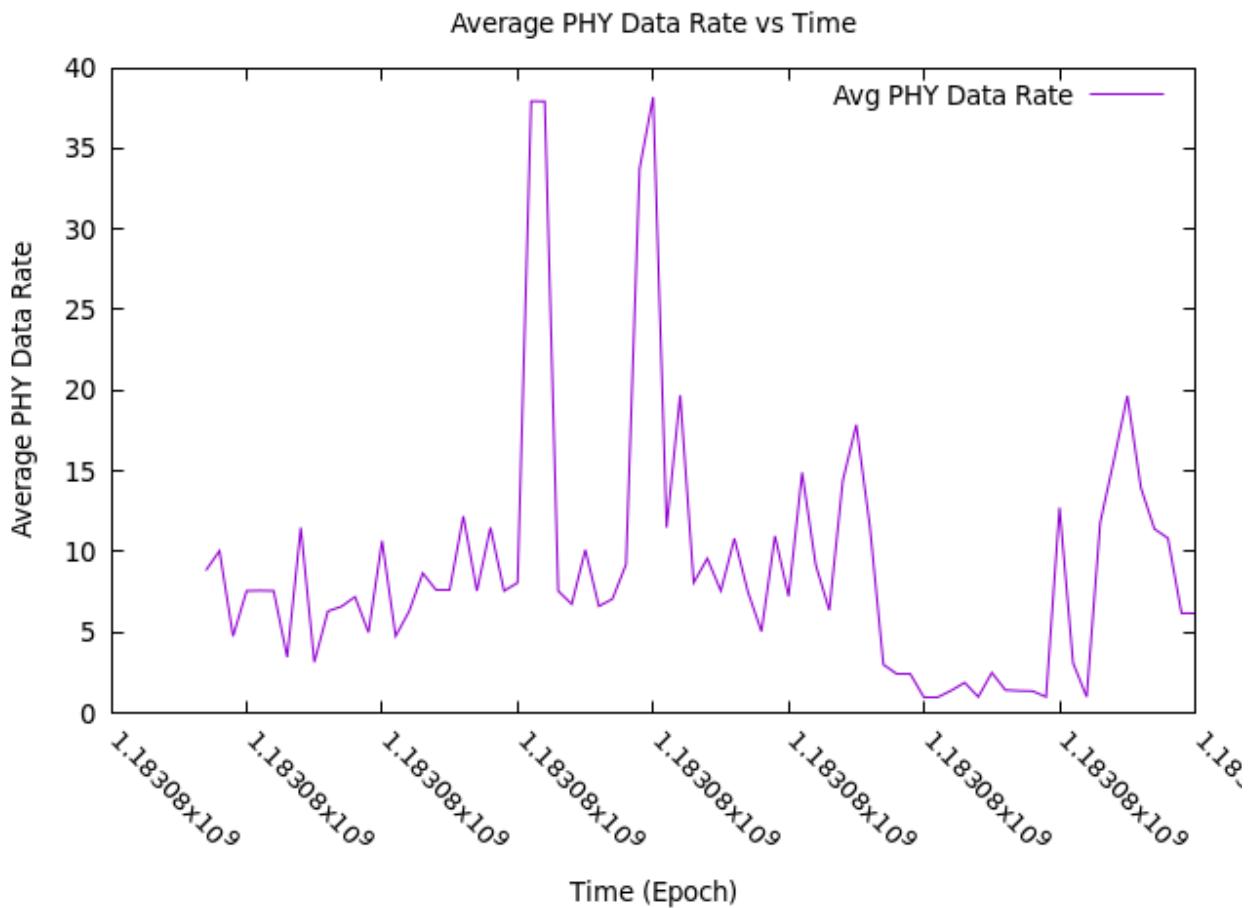
0000 00 00 36 00 2f 40 40 a0 20 08 00 00 00 00 00 00 . . . /@
0010 15 a2 77 2f c1 fd ff ff 10 02 99 09 a0 00 c7 00 . . w/
0020 00 00 00 00 00 00 00 00 00 ef 49 ee 04 00 00 00 00 I
0030 16 00 11 03 c7 00 08 42 00 00 01 00 5e 00 00 fb B . . . ^ . .
0040 30 b6 2d 81 be 21 30 f7 72 0b 19 cb 0b 0b 69 11 0 . . . ! 0 . r . . . i .
0050 00 60 7b 02 00 00 ff 7b b4 27 dd 58 22 8f 02 32 . . { . . . { . . ' x " . 2
0060 ad 63 36 64 8a 95 78 4a 43 82 f3 c7 42 e7 65 55 . . c6d . xJ C . . B . eU
0070 29 df 15 67 8a 8f 21 82 d1 ed ba 73 9a 03 0d c9) . . g . . ! . . s . . .
0080 05 5f ee b6 50 23 43 7f 45 52 e3 92 0b 3b 90 ab . . . P # C . ER . . ; . .
0090 46 08 b5 ac f3 6f 23 d1 11 e5 48 41 50 ac 20 e3 F . . o # . . H A P . . .
00a0 e8 f6 2b c5 15 62 b6 . . + . b . .

1. c) Plot avg packet size vs Time (1-minute resolution), Plot avg PHY data rate vs Time, Plot RSSI (received signal strength) vs Time and Plot Packet rate (pkts/sec) vs Time (1-minute resolution). You need to count total no. of packets received in each 1-min interval and divide that with 60 to get Packet rate. For other plots, you need to take avg of packets received in each 1-min interval. List out main observations in each plot.

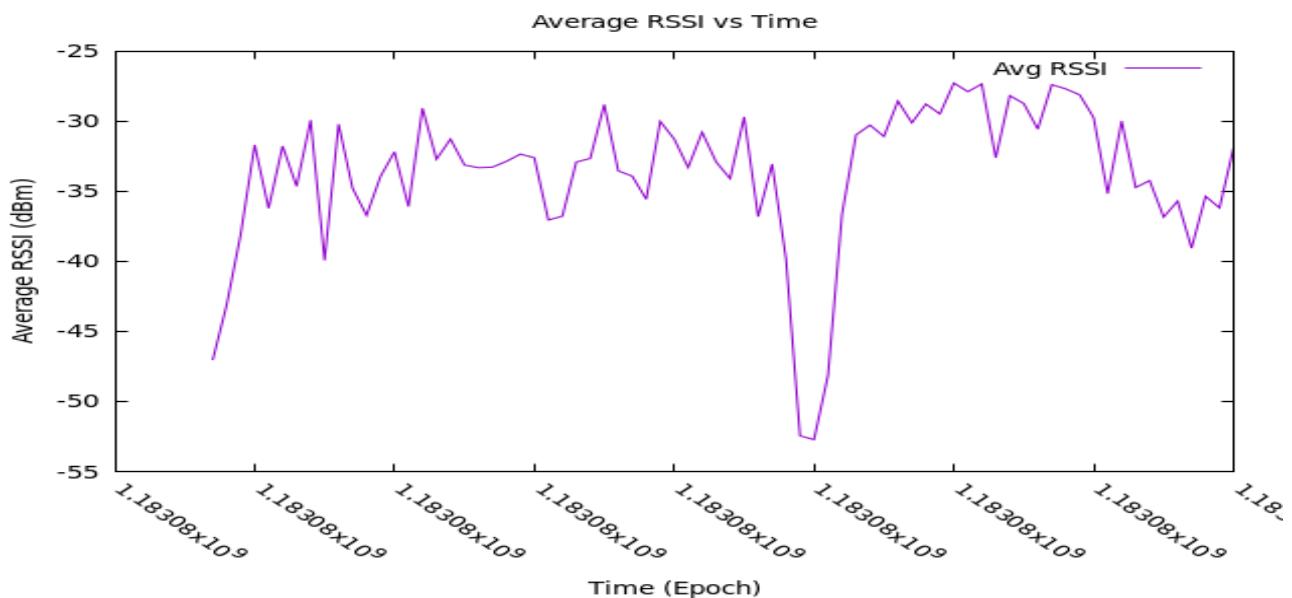
TRACE 1:



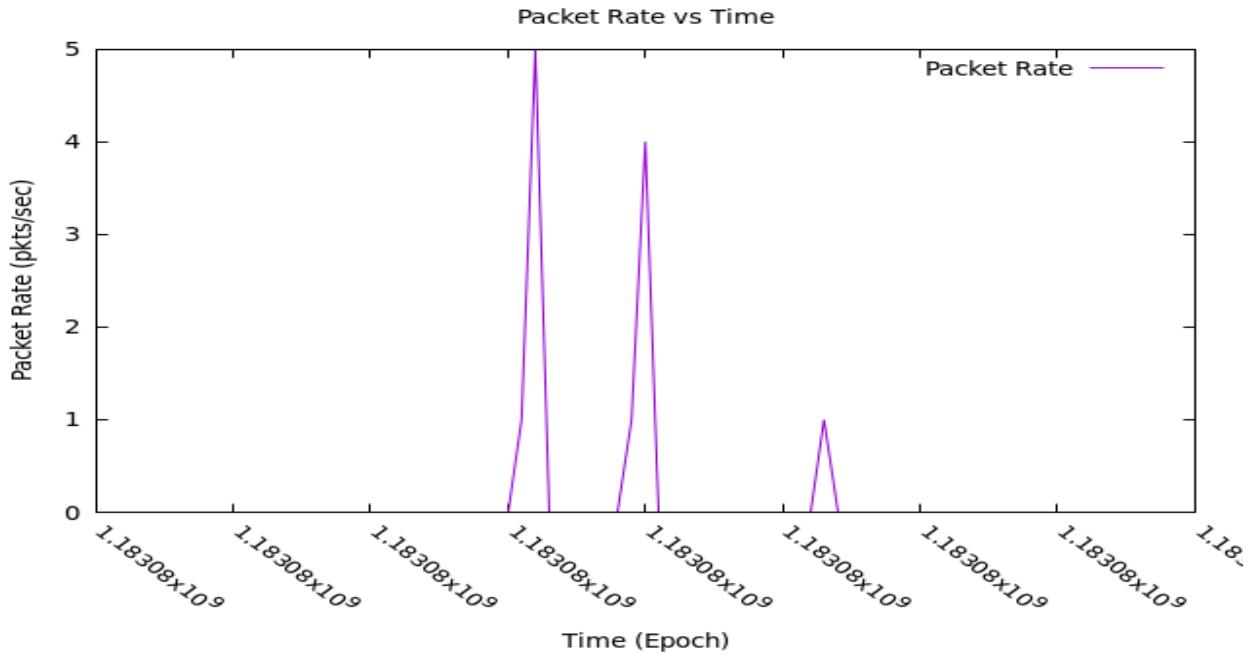
Observation: The average packet size received by the node is almost constant with very slight variations. From the above graph we can see that the average packet size is approximately equal to 70.



Observation: The average physical data rate received by the node is almost constant with slight variations. From the above graph we can see that the average packet size is approximately 7.5 with a deviation of 2.5. Sometimes that data rate goes quite high up to 38.

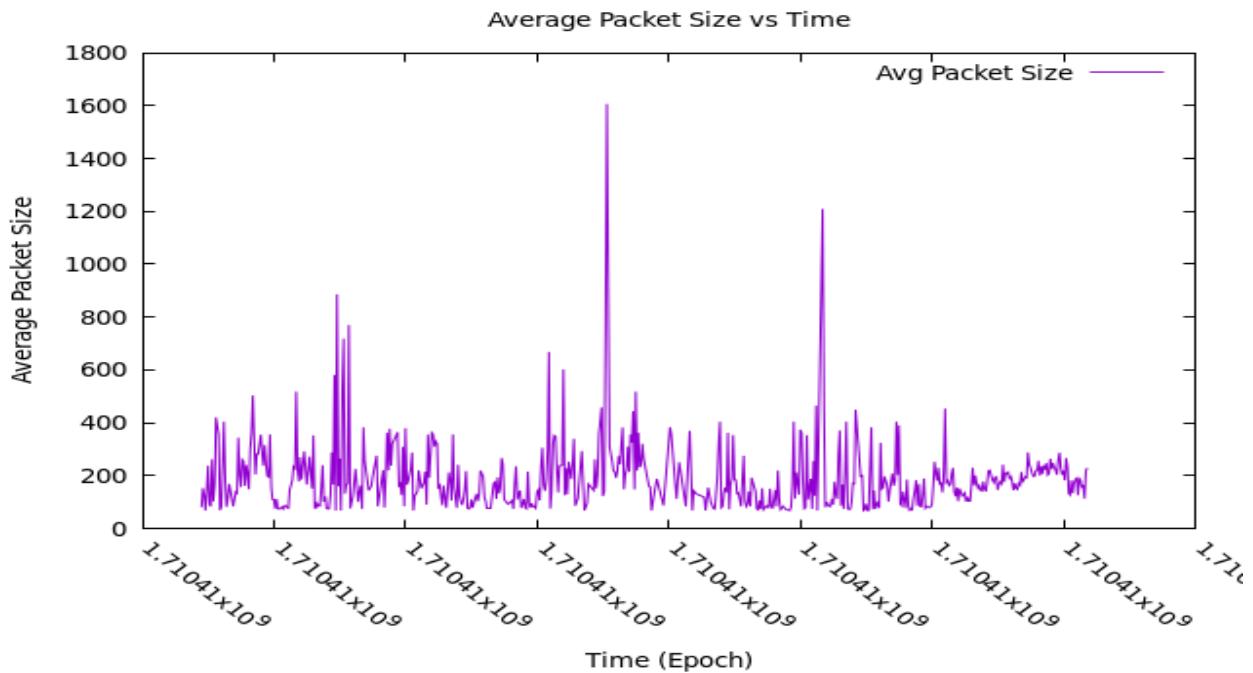


Observation: The signal strength received by the node keeps fluctuating over time. From the above graph we can see that the average RSSI fluctuates approximately between -40 to -28 dBm.

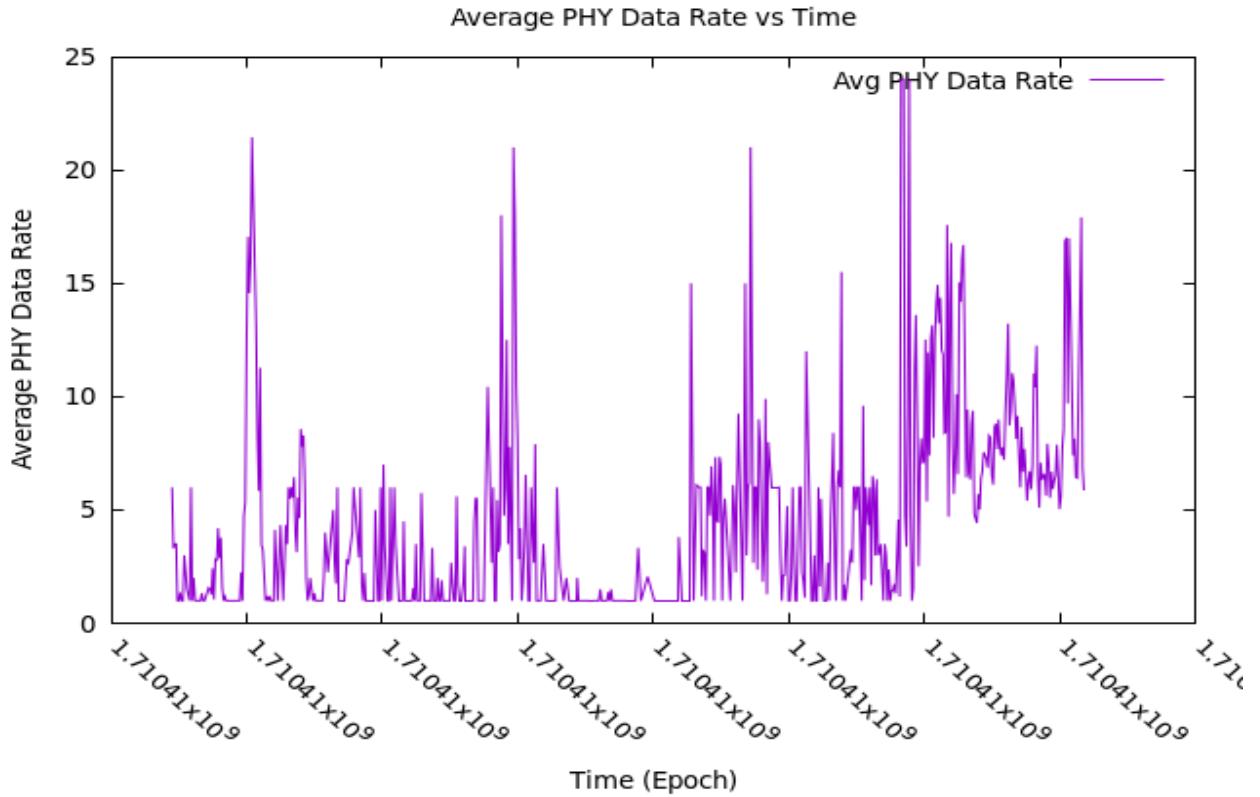


Observation: The packet rate received by the node is very less for all the time except few. From the above graph we can see that the packet rate is quite sparse.

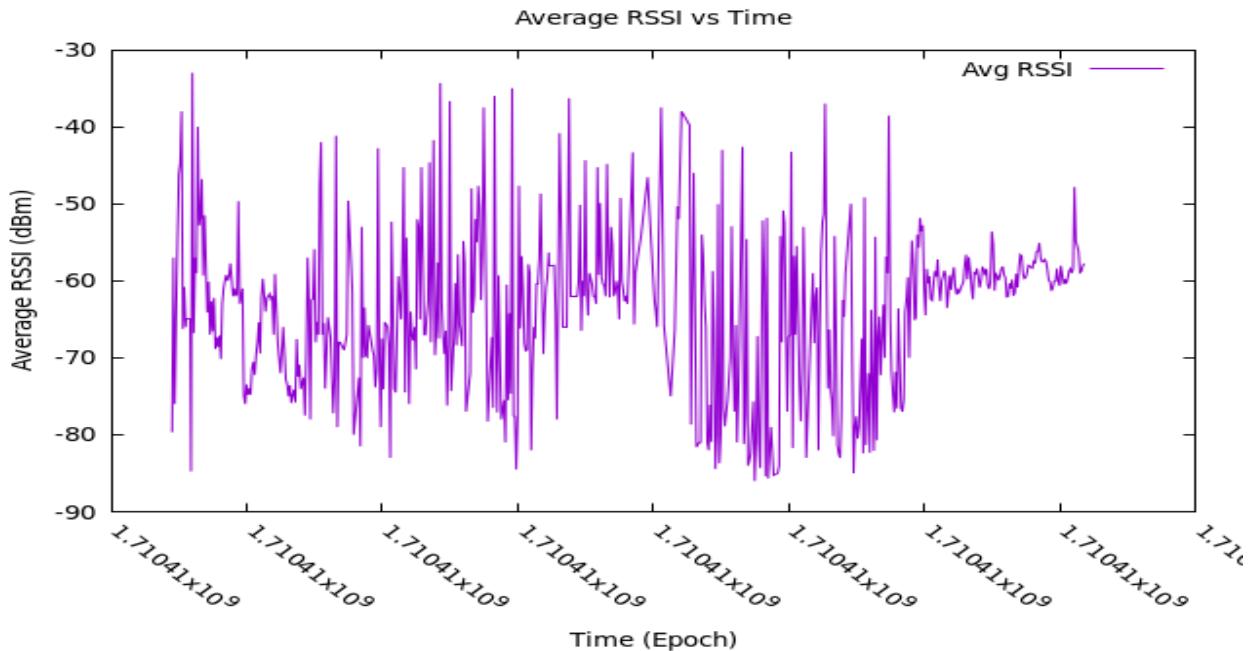
TRACE 2



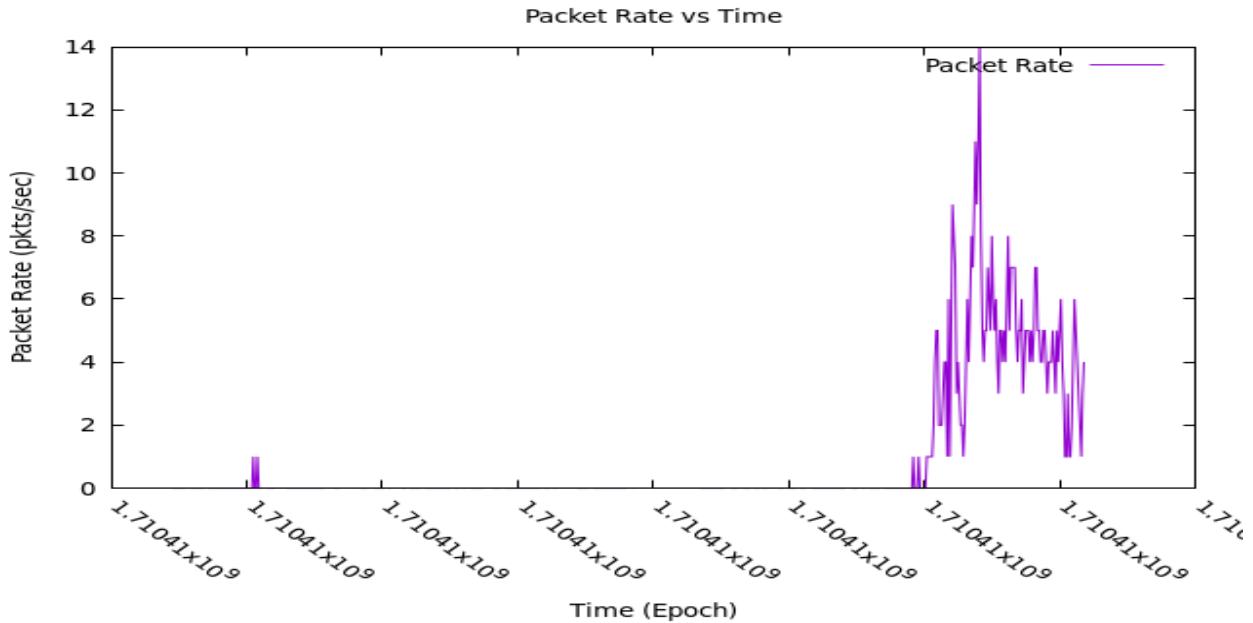
Observation: The average packet size received by the node is fluctuating. From the above graph we can see that the average packet size is approximately between 100 to 300.



Observation: The average physical data rate received by the node is fluctuating. From the above graph we can see that the average packet size is approximately between 1 and 6 for 75% of time and then between 6 to 10 for the rest of the time.



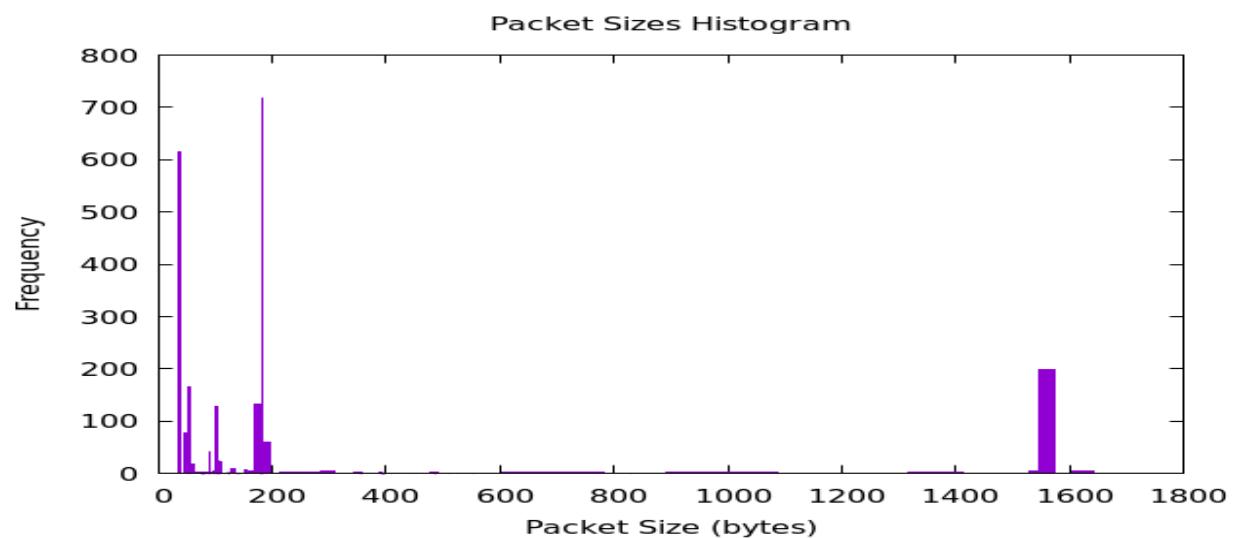
Observation: The signal strength received by the node keeps fluctuating over time. From the above graph we can see that the average RSSI fluctuates approximately between -80 to -40 dBm.



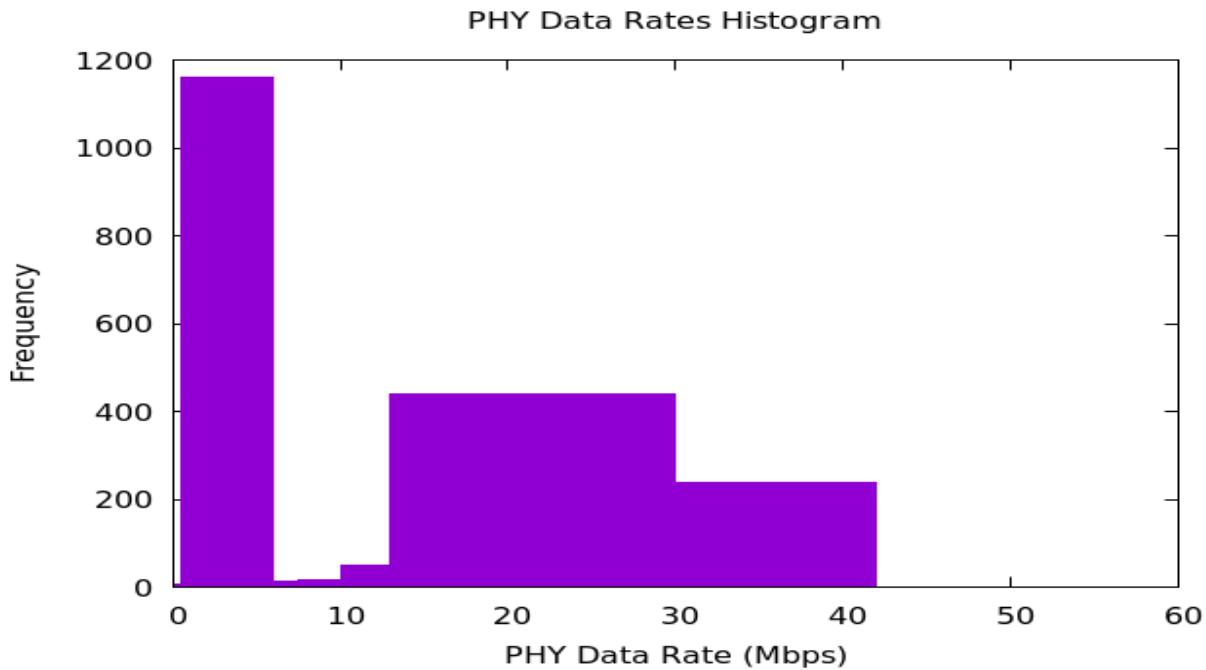
Observation: The packet rate received by the node is very less initially. From the above graph we can see that the packet rate is approximately 1 for 75% of the time and about 4 for the rest of the time.

1. d) Histograms of packet sizes and PHY data rates. List out main observations in each plot.

TRACE 1

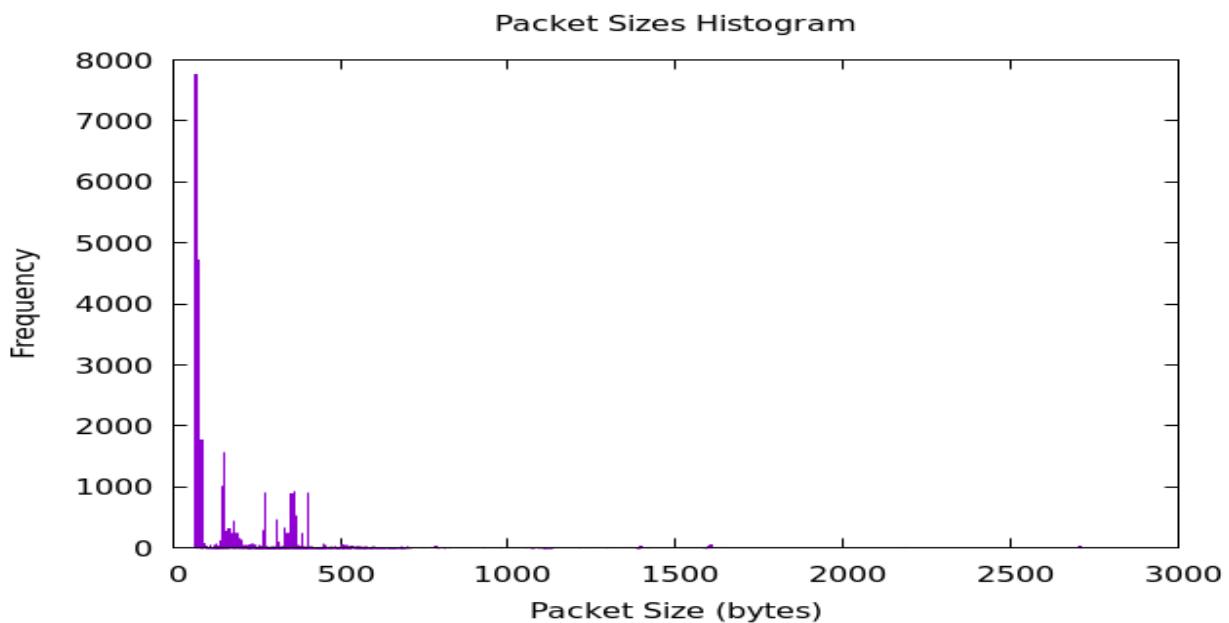


Observation: The packet size received by the node is mostly between 30 to 200 bytes. Some 200 packets are large in size of approx 1600 Bytes.

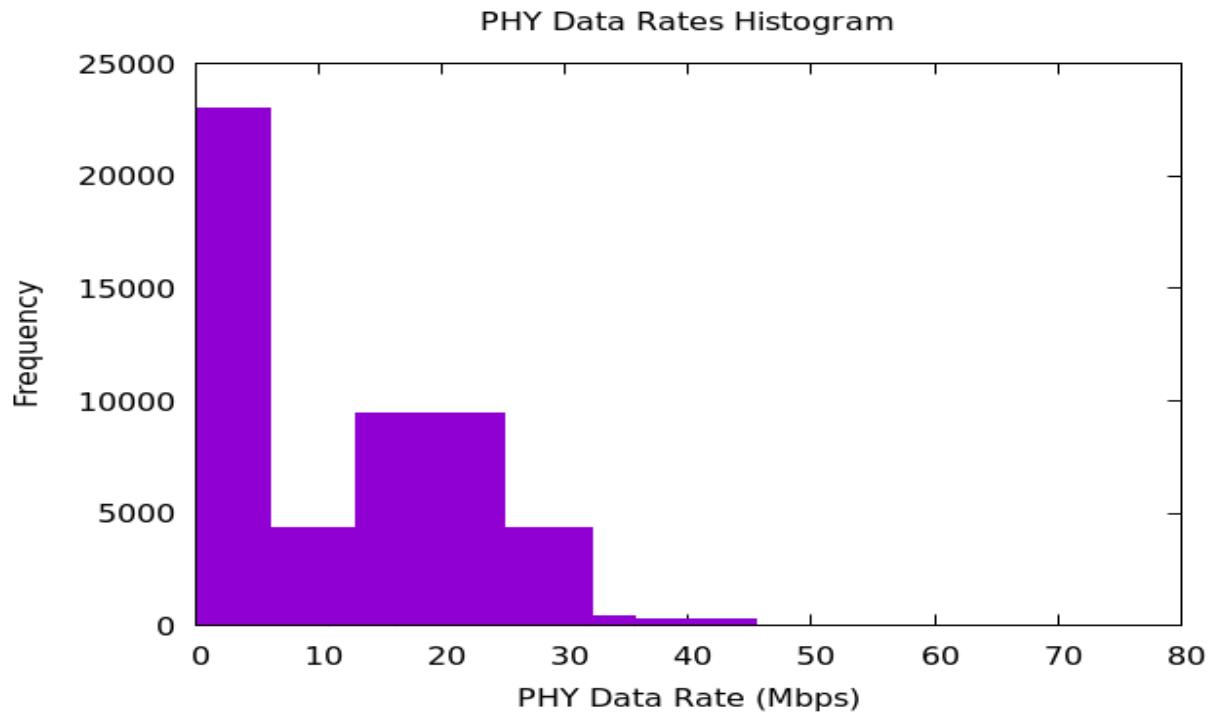


Observation: The physical data rate received by the node is mostly between 0 to 40 Mbps. Most data rates are low and its frequency decreases as the data rate increases.

TRACE 2



Observation: The packet size received by the node is mostly between 30 to 400 bytes. Almost 8000 packets are very small sized packets with size less than 100 bytes.



Observation: The physical data rate received by the node is mostly between 0 to 45 Mbps. Most data rates are low and its frequency decreases as the data rate increases.

Q2

a)

b)

Step 1: First check for whether the device supports for AP using the “iw list” command as shown below:

```
Supported Ciphers:
 * WEP40 (00-0f-ac:1)
 * WEP104 (00-0f-ac:5)
 * TKIP (00-0f-ac:2)
 * CCMP-128 (00-0f-ac:4)
 * CMAC (00-0f-ac:6)
Available Antennas: TX 0x1 RX 0x1
Configured Antennas: TX 0x1 RX 0x1
Supported interface modes:
 * IBSS
 * managed
 * AP
 * AP/VLAN
 * monitor
 * P2P-client
 * P2P-GO
 * P2P-device
Band 1:
    Capabilities: 0x116e
                  HT20/HT40
```

Step 2: create a wireless virtual interface in place on top of our interface using the given below command.

Queries given in Kurose and Ross textbook wireshark assignment on Wi-Fi

1. The SSIDs of the two access points that are issuing most of the beacon frames in this trace are **30 Munroe St** and **linsys_SES_24086**.

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2293	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2306	70.228900	Cisco-Li_f7:1d:51	Broadcast	802.11	100	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2293	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2306	70.228900	Cisco-Li_f7:1d:51	Broadcast	802.11	100	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

2. The intervals of time between the transmissions of the beacon frames the **linksys_ses_24086** and the **30 Munroe St.** access points are **0.102400 Seconds** and **0.102400 Seconds** respectively.

Wireshark_802_11.pcap

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wlan.fc.type_subtype == 0x08

No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.190629	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksy_SES_24086
2291	69.509567	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksy_SES_24086
2299	69.714354	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Frame 2291: 183 bytes on wire (1464 bits), 183 bytes captured (1464 bits)
 Radiotap Header v0, Length 24
 802.11 radio information
 IEEE 802.11 Beacon frame, Flags:C
 IEEE 802.11 Wireless Management
 Fixed parameters (12 bytes)
 Timestamp: 17438851586
 Beacon Interval: 0.102400 [Seconds]
 Capabilities Information: A0A0A1

Wireshark_802_11.pcap

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wlan.fc.type_subtype == 0x08

No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.190629	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksy_SES_24086
2291	69.509567	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksy_SES_24086
2299	69.714354	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

Frame 2290: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
 Radiotap Header v0, Length 24
 802.11 radio information
 IEEE 802.11 Beacon frame, Flags:C
 IEEE 802.11 Wireless Management
 Fixed parameters (12 bytes)
 Timestamp: 6351999898260
 Beacon Interval: 0.102400 [Seconds]
 Capabilities Information: A0A0A1

3. The source MAC address on the beacon frame from 30 Munroe St is 00:16:b6:f7:1d:51

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
<code>wlan.fc.type_subtype == 0x08</code>						
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100629	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
<ul style="list-style-type: none"> ▶ Frame 2291: 183 bytes on wire (1404 bits), 183 bytes captured (1404 bits) ▶ Radiotap Header v0, Length 24 ▶ 802.11 radio information ▼ IEEE 802.11 Beacon frame, Flags: Type/Subtype: Beacon frame (0x0008) ▶ Frame Control Field: 0x8000 <ul style="list-style-type: none"> .000 .0000 .0000 .0000 = Duration: 0 microseconds Receiver address: Broadcast (ff:ff:ff:ff:ff:ff) Destination address: Broadcast (ff:ff:ff:ff:ff:ff) Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) Source address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) 						

4. The destination MAC address on the beacon frame from 30 Munroe St is **ff:ff:ff:ff:ff:ff(broadcast address)**

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
<code>wlan.fc.type_subtype == 0x08</code>						
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100629	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463202	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2300	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
<ul style="list-style-type: none"> ▶ Frame 2291: 183 bytes on wire (1404 bits), 183 bytes captured (1404 bits) ▶ Radiotap Header v0, Length 24 ▶ 802.11 radio information ▼ IEEE 802.11 Beacon frame, Flags: Type/Subtype: Beacon frame (0x0008) ▶ Frame Control Field: 0x8000 <ul style="list-style-type: none"> .000 .0000 .0000 .0000 = Duration: 0 microseconds Receiver address: Broadcast (ff:ff:ff:ff:ff:ff) Destination address: Broadcast (ff:ff:ff:ff:ff:ff) Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) Source address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51) 						

5. The MAC BSS id on the beacon frame from 30 Munroe St is **00:16:b6:f7:1d:51**

Wireshark_802_11.pcap								
No.	Time	Source	Destination	Protocol	Length	Info		
wlan.fc.type_subtype == 0x08								
2267	68.587997	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2275	68.609433	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2276	68.792767	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2277	68.895246	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2278	68.997617	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2279	69.100629	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2280	69.202392	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2284	69.304715	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2288	69.407125	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2290	69.463202	Cisco-L1_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086		
2291	69.509567	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2294	69.611958	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2296	69.667955	Cisco-L1_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086		
2299	69.714354	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2300	69.816772	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2301	69.910185	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2302	69.922542	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2305	70.123908	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		
2308	70.226200	Cisco-L1_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St		

Type/Subtype: Beacon frame (0x0008)
 Frame Control Field: 0x8000
 .000 0000 0000 = Duration: 0 microseconds
 Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
 Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
 Transmitter address: Cisco-L1_f7:1d:51 (00:16:b6:f7:1d:51)
 Source address: Cisco-L1_f7:1d:51 (00:16:b6:f7:1d:51)
 BSS Id: Cisco-L1_f7:1d:51 (00:16:b6:f7:1d:51)
 0000 = Fragment number: 0
 1110 1101 0010 = Sequence number: 3794
 Frame check sequence: 0x648420b9 [unverified]
 [FCS Status: Unverified]

6. The beacon frames from the **30 Munroe St** access point advertise that the access point can support four data rates and eight additional rates are as follows:

four data rates : **1, 2, 5.5, 11 Mbit/sec**

eight additional rates are : **6, 9, 12, 18, 24, 36, 48, 54 Mbit/sec**

Wireshark_802_11.pcap

No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463282	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

0... = Immediate Block Ack: Not Implemented

- ↳ Tagged parameters (119 bytes)
- ↳ Tag: SSID parameter set: 30 Munroe St
- ↳ Tag: Supported Rates 1(B), 2(B), 5.5(B), 11(B), [Mbit/sec]
- ↳ Tag: DS Parameter set: Current Channel: 6
- ↳ Tag: Traffic Indication Map (TIM): DTIM 0 of 1 bitmap
- ↳ Tag: Country Information: Country Code US, Environment Indoor
- ↳ Tag: EDDA Parameter Set
- ↳ Tag: ERP Information
- ↳ Tag: Extended Supported Rates 6(B), 9, 12(B), 18, 24(B), 36, 48, 54, [Mbit/sec]
- ↳ Tag: Vendor Specific: Airgo Networks, Inc.
- ↳ Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element

Wireshark_802_11.pcap

No.	Time	Source	Destination	Protocol	Length	Info
2267	68.587997	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3785, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2275	68.690433	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3786, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2276	68.792767	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3787, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2277	68.895246	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3788, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2278	68.997617	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3789, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2279	69.100029	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3790, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2280	69.202392	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3791, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2284	69.304715	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3792, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2288	69.407125	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3793, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2290	69.463282	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3938, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2291	69.509567	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3794, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2295	69.611958	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3795, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2296	69.667955	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3940, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2299	69.714354	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3797, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	69.816772	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3798, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2301	69.919185	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3799, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2302	70.022542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3800, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2305	70.123908	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3801, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2308	70.226200	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3802, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

0... = Immediate Block Ack: Not Implemented

- ↳ Tagged parameters (119 bytes)
- ↳ Tag: SSID parameter set: 30 Munroe St
- ↳ Tag: Supported Rates 1(B), 2(B), 5.5(B), 11(B), [Mbit/sec]
- ↳ Tag: DS Parameter set: Current Channel: 6
- ↳ Tag: Traffic Indication Map (TIM): DTIM 0 of 1 bitmap
- ↳ Tag: Country Information: Country Code US, Environment Indoor
- ↳ Tag: EDDA Parameter Set
- ↳ Tag: ERP Information
- ↳ Tag: Extended Supported Rates 6(B), 9, 12(B), 18, 24(B), 36, 48, 54, [Mbit/sec]
- ↳ Tag: Vendor Specific: Airgo Networks, Inc.
- ↳ Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element

7. Three MAC address related to the TCP SYN sent at t = 24.811 seconds are as follows:

The MAC address of the host sending the TCP SYN is **00:13:02:d1:b6:4f**

The MAC address for the destination(first hop router) is **00:16:b6:f4:eb:a8**

The MAC address for the BSS is **00:16:b6:f7:1d:51**

The IP address of the host sending the TCP SYN is **192.168.1.109**

The destination address is **128.199.245.12**

The IP address corresponds to host server(i.e., gaia.cs.umass.edu) because it is the target of the TCP connection.

Wireshark_802_11.pcap

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No.	Time	Source	Destination	Protocol	Length	Info
467	24.792793		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
468	24.795431	Cisco-Li_f7:1d:51	Cisco-Li_f4:eb:e8	802.11	90	Fragmented IEEE 802.11 frame
469	24.795573		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
470	24.795673	192.168.1.109	68.87.71.226	DNS	125	Standard query 0x7892 A gaia.cs.umass.edu
471	24.795769		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828140		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
482	24.846998	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847058		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
485	24.847267		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C

802.11 radio information

IEEE 802.11 QoS Data, Flags:TC

Type/Subtype: Qos Data (0x0028)

Frame Control Field: 0x8801

.000 0000 0010 1100 = Duration: 44 microseconds

Receiver address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)

Transmitter address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)

Destination address: Cisco-Li_f4:eb:a8 (00:16:b6:f4:eb:a8)

Source address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)

BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)

STA address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f)

..... 0000 = Fragment number: 0

Wireshark_802_11.pcap

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No.	Time	Source	Destination	Protocol	Length	Info
467	24.792793		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
468	24.795431	Cisco-Li_f7:1d:51	Cisco-Li_f4:eb:e8	802.11	90	Fragmented IEEE 802.11 frame
469	24.795573		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
470	24.795673	192.168.1.109	68.87.71.226	DNS	125	Standard query 0x7892 A gaia.cs.umass.edu
471	24.795769		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828140		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
482	24.846998	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847058		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
485	24.847267		Cisco-Li_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C

> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

Total Length: 48

Identification: 0x1324 (4000)

> Flags: 0x40, Don't fragment

... 0 0000 0000 0000 = Fragment Offset: 0

Time to Live: 128

Protocol: TCP (6)

Header Checksum: 0xb00a [validation disabled]

[Header checksum status: Unverified]

Source Address: 192.168.1.109

Destination Address: 128.119.245.12

> Transmission Control Protocol, Src Port: 2538, Dst Port: 80, Seq: 0, Len: 0

Three MAC address related to the TCP SYN sent at t = 24.827 seconds are as follows:

The MAC address of the host(first hop router) sending the TCP SYN ACK is **00:16:b6:f4:eb:a8**

The MAC address for the destination is **91:2a:b0:49:b6:4f**

The MAC address for the BSS is **00:16:b6:f7:1d:51**

The IP address of the host sending the TCP SYN ACK is **128.199.245.12**

The destination address is **192.168.1.109**

The MAC address of the device sending the TCP segment is not the same as the MAC address of the host used to send the TCP SYN. It seems like the host's wireless interface is acting as if it has two different addresses.

Wireshark_802_11.pcap

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No.	Time	Source	Destination	Protocol	Length	Info
466	24.792693	IntelCor_d1:b6:4f	Broadcast	ARP	90	Who has 192.168.1.1? Tell 192.168.1.109
467	24.792793		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
468	24.795431	Cisco-Li_f7:1d:51	Cisco-Li_f4:eb:08	802.11	99	Fragmented IEEE 802.11 frame
469	24.795573		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
470	24.795673	192.168.1.109		DNS	125	Standard query 0x7802 A gaia.cs.umass.edu
471	24.795769	IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C	
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828140		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
482	24.846898	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847658		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0

Type/Subtype: QoS Data (0x0028)
 ▶ Frame Control Field: 0x8832
 Duration/ID: 11560 (reserved)
 Receiver address: 01:2a:b0:49:b6:4f (01:2a:b0:49:b6:4f)
 Transmitter address: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)
 Destination address: 91:2a:b0:49:b6:4f (91:2a:b0:49:b6:4f)
 Source address: Cisco-Li_f4:eb:a8 (00:16:b6:f4:eb:a8)
 BSS Id: Cisco-Li_f7:1d:51 (00:16:b6:f7:1d:51)
 STA address: 91:2a:b0:49:b6:4f (91:2a:b0:49:b6:4f)
 0000 = Fragment number: 0
 1100 0011 0100 = Sequence number: 3124
 Frame check sequence: 0xecdc407d [unverified]

Wireshark_802_11.pcap

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No.	Time	Source	Destination	Protocol	Length	Info
466	24.792693	IntelCor_d1:b6:4f	Broadcast	ARP	90	Who has 192.168.1.1? Tell 192.168.1.109
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469	24.795573		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
470	24.795673	192.168.1.109		DNS	125	Standard query 0x7802 A gaia.cs.umass.edu
471	24.795769	IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C	
472	24.809325	68.87.71.226	192.168.1.109	DNS	141	Standard query response 0x7892 A gaia.cs.umass.edu A 128.119.245.12
473	24.809513		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
474	24.811093	192.168.1.109	128.119.245.12	TCP	110	2538 - 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
475	24.811231		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
476	24.827751	128.119.245.12	192.168.1.109	TCP	110	80 - 2538 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 SACK_PERM=1
477	24.827922		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
478	24.828024	192.168.1.109	128.119.245.12	TCP	102	2538 - 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
479	24.828140		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
480	24.828253	192.168.1.109	128.119.245.12	HTTP	537	GET /wireshark-labs/alice.txt HTTP/1.1
481	24.828352		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
482	24.846898	128.119.245.12	192.168.1.109	TCP	108	80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0
483	24.847658		Cisco-Li_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
484	24.847171	128.119.245.12	192.168.1.109	TCP	108	[TCP Dup ACK 482#1] 80 - 2538 [ACK] Seq=1 Ack=436 Win=6432 Len=0

> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 Total Length: 48
 Identification: 0x0000 (0)
 ▶ Flags: 0x40, Don't fragment
 ...0 0000 0000 0000 = Fragment Offset: 0
 Time to Live: 49
 Protocol: TCP (6)
 Header Checksum: 0x122f [validation disabled]
 [Header checksum status: Unverified]
 Source Address: 128.119.245.12
 Destination Address: 192.168.1.109
 Transmission Control Protocol, Src Port: 80, Dst Port: 2538, Seq: 0, Ack: 1, Len: 0

9. The first action taken by the host in the trace just after t = 49.5836 seconds is DHCP release to the DHCP server. It is an IP-layer action.

Second, at t = 49.609617, the host sends a DEAUTHENTICATION frame and expects to see a DISASSOCIATION request. It is a 802.11-layer action.

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1724	49.235340	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1602, FN=0, Flags=...P...TC
1725	49.235439		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1726	49.337573	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1727	49.429849	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1603, FN=0, Flags=...TC
1728	49.430087		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1729	49.440041	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3587, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1730	49.440146	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1604, FN=0, Flags=...P...TC
1731	49.440243		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1732	49.542481	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1733	49.583615	192.168.1.109	DHCP		396	DHCP Release - Transaction ID 0xeax5a526
1734	49.583771		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3..)	802.11	38	Acknowledgement, Flags=.....C
1739	49.617713		Cisco-Li_f5:ba:bb (00:18:3..)	802.11	38	Acknowledgement, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R..C
1742	49.640762	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R..C

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1724	49.235340	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1602, FN=0, Flags=...P...TC
1725	49.235439		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1726	49.337573	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1727	49.429849	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1603, FN=0, Flags=...TC
1728	49.430087		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1729	49.440041	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3587, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1730	49.440146	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	QoS Null function (No data), SN=1604, FN=0, Flags=...P...TC
1731	49.440243		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1732	49.542481	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3588, FN=0, Flags=.....C, BI=100, SSID=38 Munroe St
1733	49.583615	192.168.1.109	DHCP		396	DHCP Release - Transaction ID 0xeax5a526
1734	49.583771		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:1d:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0..)	802.11	38	Acknowledgement, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3..)	802.11	38	Acknowledgement, Flags=.....C
1739	49.617713		Cisco-Li_f5:ba:bb (00:18:3..)	802.11	38	Acknowledgement, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R..C
1742	49.640762	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R..C

10. There are a total 6 AUTHENTICATION messages sent from the wireless host to the linksys_ses_24086 AP. The first AUTHENTICATION from the host to the AP is at t = 49.638

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1739	49.617713		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....R...C
1742	49.640702	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1743	49.641910		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1744	49.642315	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1745	49.644710	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3589, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1746	49.645319	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1747	49.646711		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1748	49.647827		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1749	49.649705	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1750	49.651078	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=.....C, SSID=linksys_SES_24086
1751	49.653218	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=....R...C, SSID=linksys_SES_24086
1752	49.662857		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1753	49.663950		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C

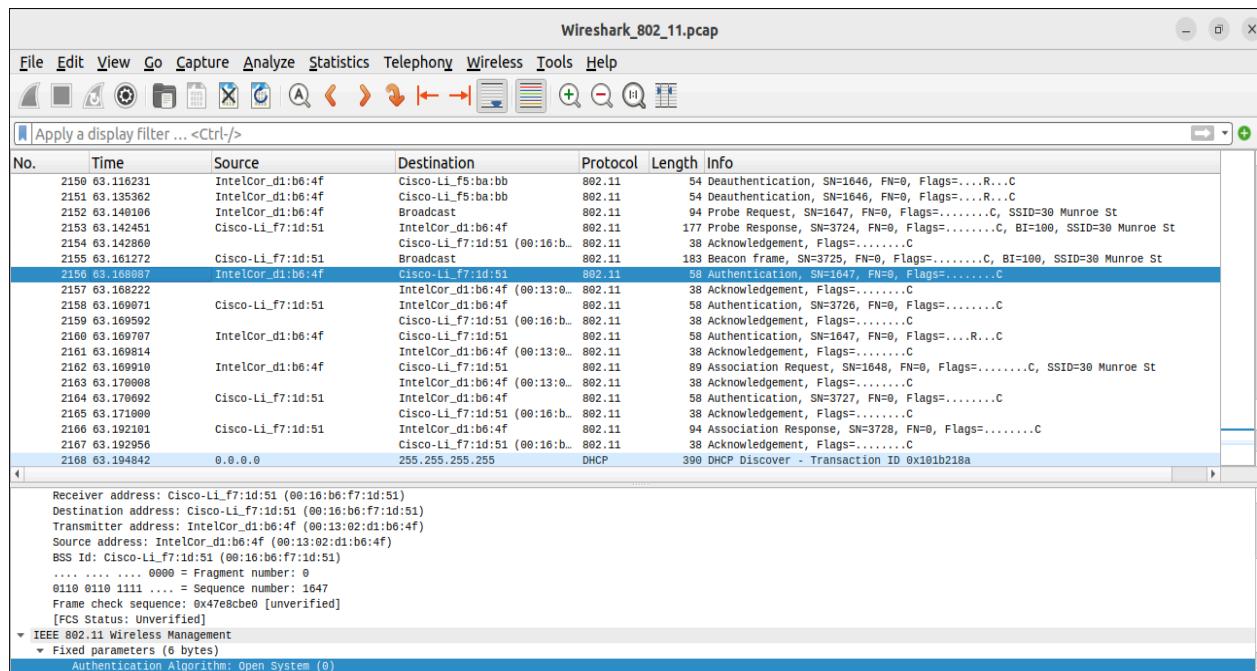
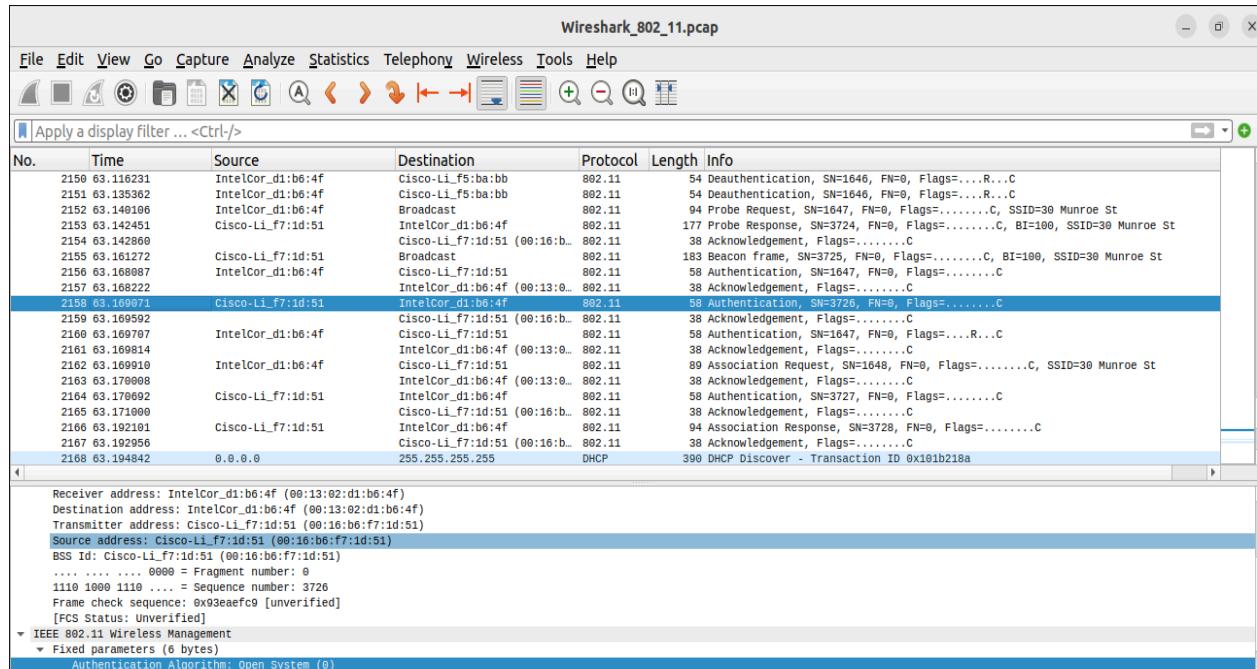
11. The host wants the authentication to be open(Authentication Algorithm: Open System).

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1735	49.609617	IntelCor_d1:b6:4f	Cisco-Li_f7:id:51	802.11	54	Deauthentication, SN=1605, FN=0, Flags=.....C
1736	49.609770		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
1737	49.614478	IntelCor_d1:b6:4f	Broadcast	802.11	99	Probe Request, SN=1606, FN=0, Flags=.....C, SSID=linksys_SES_24086
1738	49.615869		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1739	49.617713		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1740	49.638857	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1741	49.639700	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....R...C
1742	49.640702	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1743	49.641910		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1744	49.642315	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1745	49.644710	Cisco-Li_f7:id:51	Broadcast	802.11	183	Beacon frame, SN=3589, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
1746	49.645319	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=.....C
1747	49.646711		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1748	49.647827		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1749	49.649705	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	58	Authentication, SN=1606, FN=0, Flags=....R...C
1750	49.651078	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=.....C, SSID=linksys_SES_24086
1751	49.653218	IntelCor_d1:b6:4f	Cisco-Li_f5:ba:bb	802.11	107	Association Request, SN=1607, FN=0, Flags=....R...C, SSID=linksys_SES_24086
1752	49.662857		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C
1753	49.663950		Cisco-Li_f5:ba:bb (00:18:3...	802.11	38	Acknowledgement, Flags=.....C

12. From the given trace I cannot find the reply of the AUTHENTICATION request. It may be because the access point may be configured as a key required to authenticate and hence it ignores the open system authentication request.

13. At 63.168087 there is an AUTHENTICATION frame from the host(00:13:02:d1:b6:4f) to the 30 Munroe St. access point(00:16:b7:f7:1d:51).

There a reply AUTHENTICATION sent from that AP(00:16:b7:f7:1d:51) to the host (00:13:02:d1:b6:4f) at t = 63.169071



14. At 63.169910 there is an ASSOCIATE REQUEST from the host(00:13:02:d1:b6:4f) to the 30 Munroe St. access point(00:16:b7:f7:1d:51).

There a reply AUTHENTICATION sent from that AP(00:16:b7:f7:1d:51) to the host (00:13:02:d1:b6:4f) at t = 63.192101

Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140106	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142866		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168887	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2158	63.169971	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170088		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a
Receiver address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f) Destination address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f) Transmitter address: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) Source address: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) BSS Id: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) 0000 = Fragment number: 0 1110 1001 0000 = Sequence number: 3728 Frame check sequence: 0x37f2ab2b [unverified] [FCS Status: Unverified]						
IEEE 802.11 Wireless Management Fixed parameters (6 bytes) Capabilities Information: 0x0601						
Wireshark_802_11.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140106	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142866		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168887	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2158	63.169971	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170088		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171000		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco-LI_f7:1d:51 (00:16:b...	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a
Receiver address: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) Destination address: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) Transmitter address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f) Source address: IntelCor_d1:b6:4f (00:13:02:d1:b6:4f) BSS Id: Cisco-LI_f7:1d:51 (00:16:b6:f7:1d:51) 0000 = Fragment number: 0 0110 0111 0000 = Sequence number: 1648 Frame check sequence: 0xfe3badc6 [unverified] [FCS Status: Unverified]						
IEEE 802.11 Wireless Management Fixed parameters (4 bytes) Capabilities Information: 0xce01						

15. The ASSOCIATION REQUEST frame from the host to 30 Munroe St access point can support four data rates and eight additional rates are as follows:

four data rates : **1, 2, 5.5, 11 Mbit/sec**

eight additional rates are : **6, 9, 12, 18, 24, 36, 48, 54 Mbit/sec**

The ASSOCIATION RESPONSE frame from the **30 Munroe St** access point advertise that the access point can support four data rates and eight additional rates are as follows:

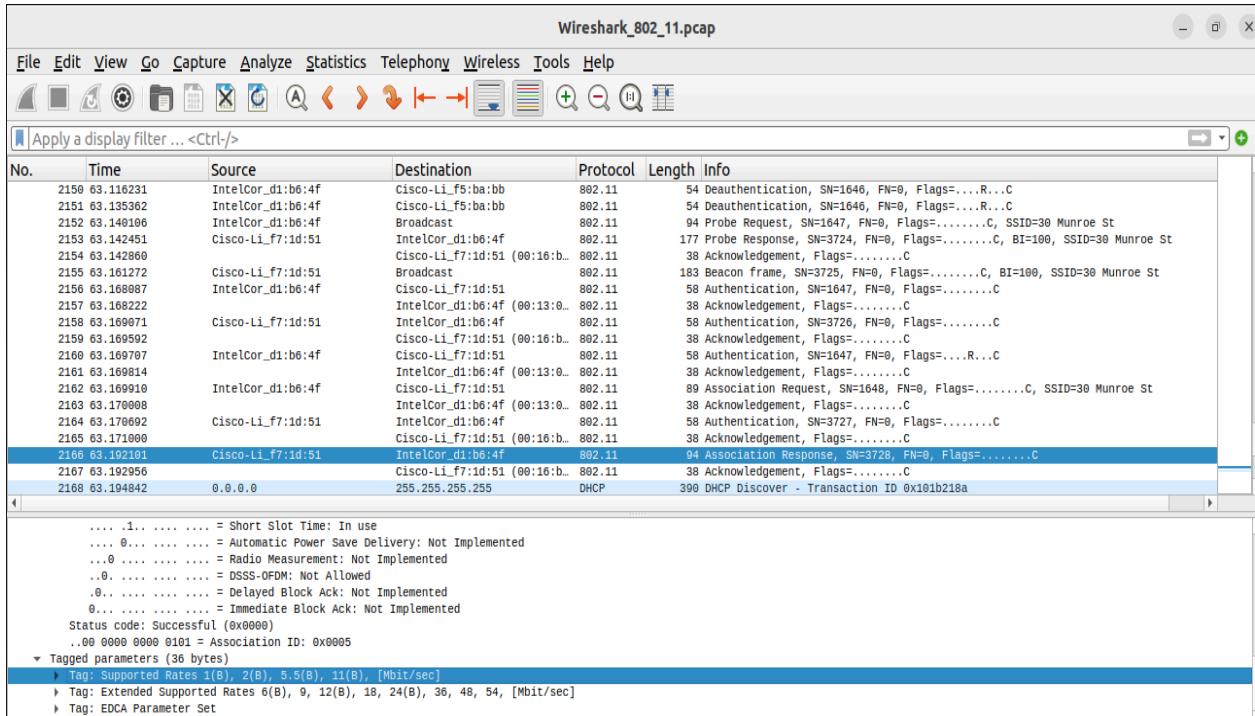
four data rates : **1, 2, 5.5, 11, 6, 9, 12, 18 Mbit/sec**

eight additional rates are : **24, 36, 48, 54 Mbit/sec**

No.	Time	Source	Destination	Protocol	Length	Info
2150	63.116231	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2151	63.135362	IntelCor_d1:b6:4f	Cisco-LI_f5:ba:bb	802.11	54	Deauthentication, SN=1646, FN=0, Flags=....R...C
2152	63.140106	IntelCor_d1:b6:4f	Broadcast	802.11	94	Probe Request, SN=1647, FN=0, Flags=.....C, SSID=30 Munroe St
2153	63.142451	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	177	Probe Response, SN=3724, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2154	63.142860		Cisco-LI_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2155	63.161272	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3725, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2156	63.168807	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=.....C
2157	63.168222		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
2158	63.169971	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3726, FN=0, Flags=.....C
2159	63.169592		Cisco-LI_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2160	63.169707	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	58	Authentication, SN=1647, FN=0, Flags=....R...C
2161	63.169814		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
2162	63.169910	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	89	Association Request, SN=1648, FN=0, Flags=.....C, SSID=30 Munroe St
2163	63.170008		IntelCor_d1:b6:4f (00:13:0...)	802.11	38	Acknowledgement, Flags=.....C
2164	63.170692	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	58	Authentication, SN=3727, FN=0, Flags=.....C
2165	63.171800		Cisco-LI_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2166	63.192101	Cisco-LI_f7:1d:51	IntelCor_d1:b6:4f	802.11	94	Association Response, SN=3728, FN=0, Flags=.....C
2167	63.192956		Cisco-LI_f7:1d:51 (00:16:b...)	802.11	38	Acknowledgement, Flags=.....C
2168	63.194842	0.0.0.0	255.255.255.255	DHCP	390	DHCP Discover - Transaction ID 0x101b218a

.... 1. = Short Slot Time: In use
.... 1. = Automatic Power Save Delivery: Implemented
.... 0 = Radio Measurement: Not Implemented
.... 0 = DSSS-OFDM: Not Allowed
.... 1. = Delayed Block Ack: Implemented
.... 1.... = Immediate Block Ack: Implemented
Listen Interval: 0x000a

- ▼ Tagged parameters (33 bytes)
 - ▶ Tag: SSID parameter set: 30 Munroe St
 - ▶ Tag: Supported Rates 1(B), 2(B), 5.5(B), 11(B), 6(B), 9, 12(B), 18, [Mbit/sec]
 - ▶ Tag: QoS Capability
 - ▶ Tag: Extended Supported Rates 24(B), 36, 48, 54, [Mbit/sec]



16. At 2.297613 there is a PROBE REQUEST frame from source (00:12:f0:1f:57:13) to ff:ff:ff:ff:ff:ff(broadcast message) and BSSID of ff:ff:ff:ff:ff:ff

There a reply PROBE RESPONSE sent from that source(00:16:b6:f7:1d:51) to destination(00:12:f0:1f:57:13) and a BSSID of 00:16:b6:f7:1d:51 at t = 2.300697

A probe request is sent by a node searching an access point. This is one of the methods where instead for scanning beacon frames it sends probe requests to nearby access points. The probe request is sent by access point to the node in response to the probe request to provide necessary details for further process.

Wireshark_802_11.pcap

No.	Time	Source	Destination	Protocol	Length	Info
46	2.236634	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	54	QoS Null function (No data), SN=1486, FN=0, Flags=.....TC
47	2.236738		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
48	2.237689	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	54	QoS Null function (No data), SN=1487, FN=0, Flags=...P..TC
49	2.237786		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
50	2.237613	IntelCor_if:57:13	Broadcast	802.11	79	Probe Request, SN=576, FN=0, Flags=.....C, SSID=Home WiFi
51	2.389697	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
52	2.382191	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
53	2.394063	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
54	2.305562	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
55	2.306563	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
56	2.319072	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
57	2.338148	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2870, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
58	2.446572	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2880, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
59	2.453941	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2881, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
60	2.542945	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2882, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
61	2.645319	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2883, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
62	2.747697	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2884, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
63	2.859114	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2885, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
64	2.952572	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2886, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

802.11 radio information

IEEE 802.11 Probe Response, Flags:,C
Type/Subtype: Probe Response (0x0005)
Frame Control Field: 0x5000
.000 0001 1010 = Duration: 314 microseconds
Receiver address: IntelCor_if:57:13 (00:12:f0:1f:57:13)
Destination address: IntelCor_if:57:13 (00:12:f0:1f:57:13)
Transmitter address: Cisco-LI_f7:1d:51 (00:10:b6:f7:1d:51)
Source address: Cisco-LI_f7:1d:51 (00:10:b6:f7:1d:51)
BSS Id: Cisco-LI_f7:1d:51 (00:10:b6:f7:1d:51)
....0000 = Fragment number: 0
1011 0011 1110 = Sequence number: 2878

Wireshark_802_11.pcap

No.	Time	Source	Destination	Protocol	Length	Info
46	2.236634	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	54	QoS Null function (No data), SN=1486, FN=0, Flags=.....TC
47	2.236738		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
48	2.237689	IntelCor_d1:b6:4f	Cisco-LI_f7:1d:51	802.11	54	QoS Null function (No data), SN=1487, FN=0, Flags=...P..TC
49	2.237786		IntelCor_d1:b6:4f (00:13:0...	802.11	38	Acknowledgement, Flags=.....C
50	2.237613	IntelCor_if:57:13	Broadcast	802.11	79	Probe Request, SN=576, FN=0, Flags=.....C, SSID=Home WiFi
51	2.389697	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
52	2.382191	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
53	2.394063	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
54	2.305562	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
55	2.306563	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
56	2.319072	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2875, FN=0, Flags=.....R..C, BI=100, SSID=30 Munroe St
57	2.338148	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2870, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
58	2.446572	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2880, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
59	2.453941	Cisco-LI_f7:1d:51	IntelCor_if:57:13	802.11	177	Probe Response, SN=2881, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
60	2.542945	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2882, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
61	2.645319	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2883, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
62	2.747697	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2884, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
63	2.859114	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2885, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
64	2.952572	Cisco-LI_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=2886, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

IEEE 802.11 Probe Request, Flags:,C
Type/Subtype: Probe Request (0x0004)
Frame Control Field: 0x4000
.000 0000 0000 0000 = Duration: 0 microseconds
Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
Transmitter address: IntelCor_if:57:13 (00:12:f0:1f:57:13)
Source address: IntelCor_if:57:13 (00:12:f0:1f:57:13)
BSS Id: Broadcast (ff:ff:ff:ff:ff:ff)
....0000 = Fragment number: 0
0010 0000 0000 = Sequence number: 576
Frame check sequence: 0xa373c5ff [unverified]

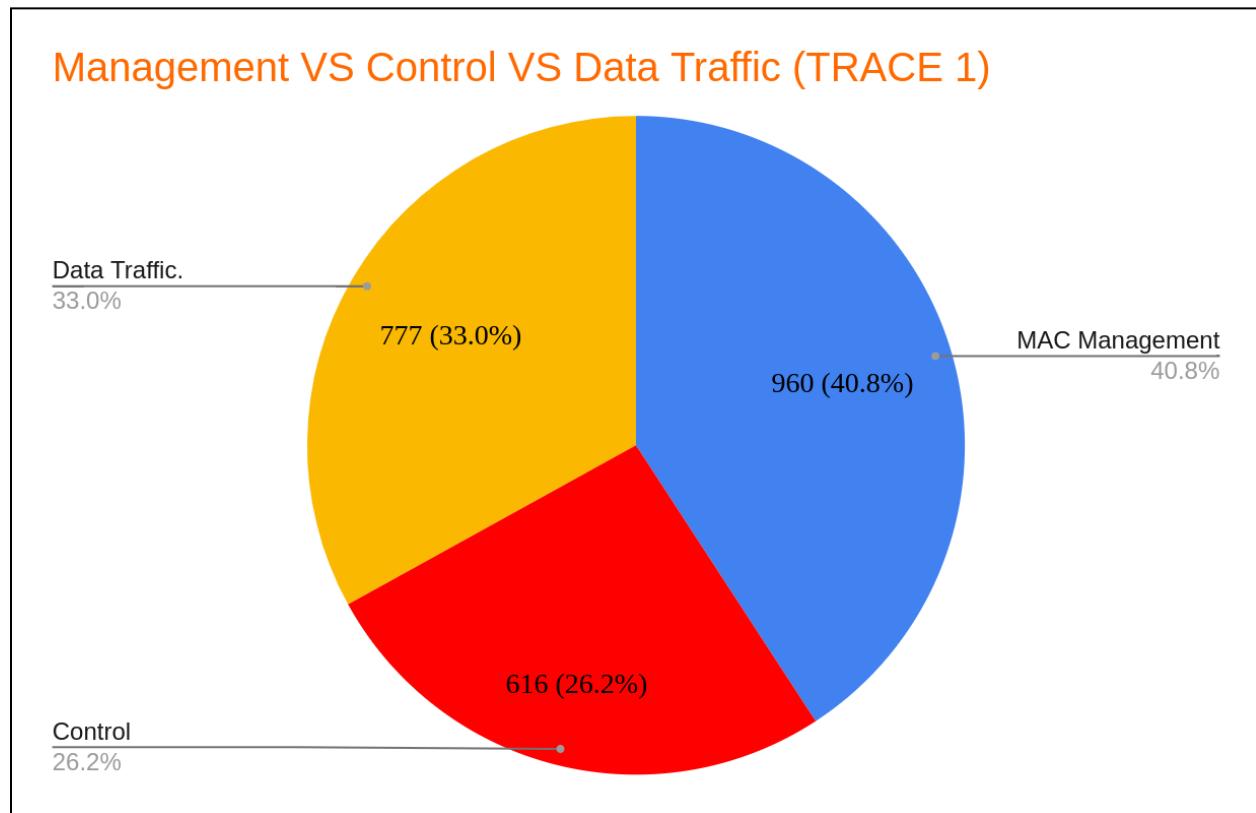
Q1

1. a) Pie chart of MAC Management, Control, Data Traffic. Further division in Management and control frames (i.e., probe reqs, association reqs, RTS/CTS, power-saving, etc).

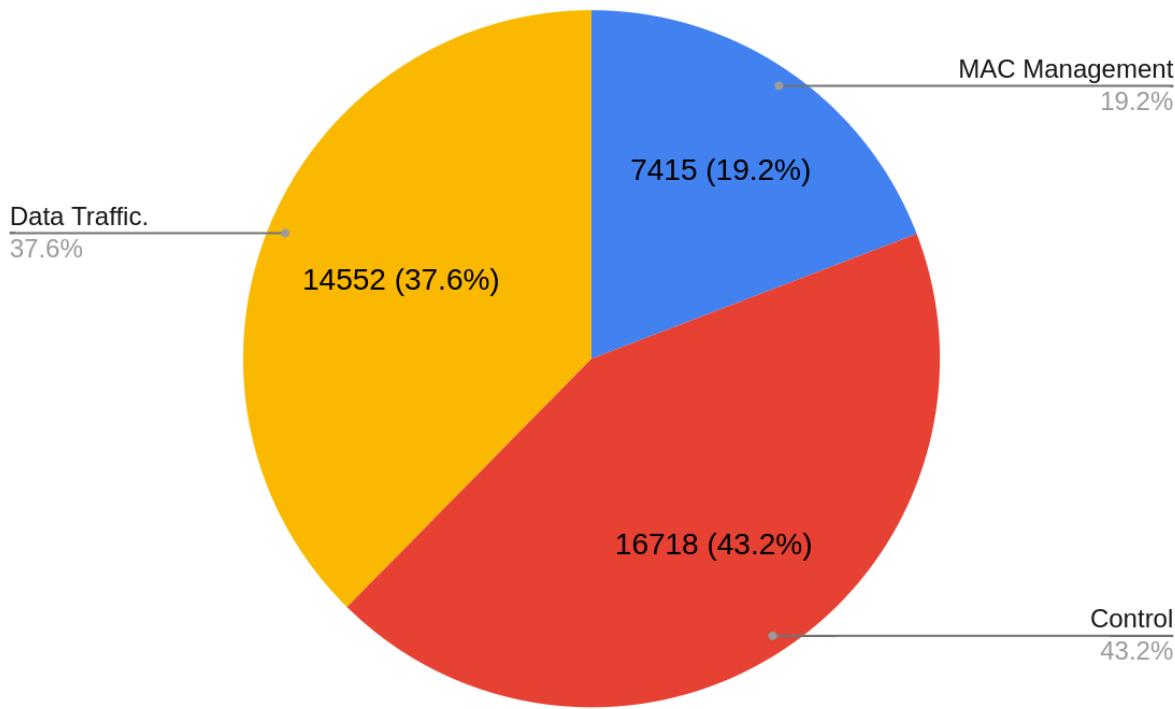
Data for creating pie charts are fetched from wireshark using appropriate filters for both TRACES.

Different data and corresponding pie charts for different kind of traffic captured using wireshark for both traces are given below:

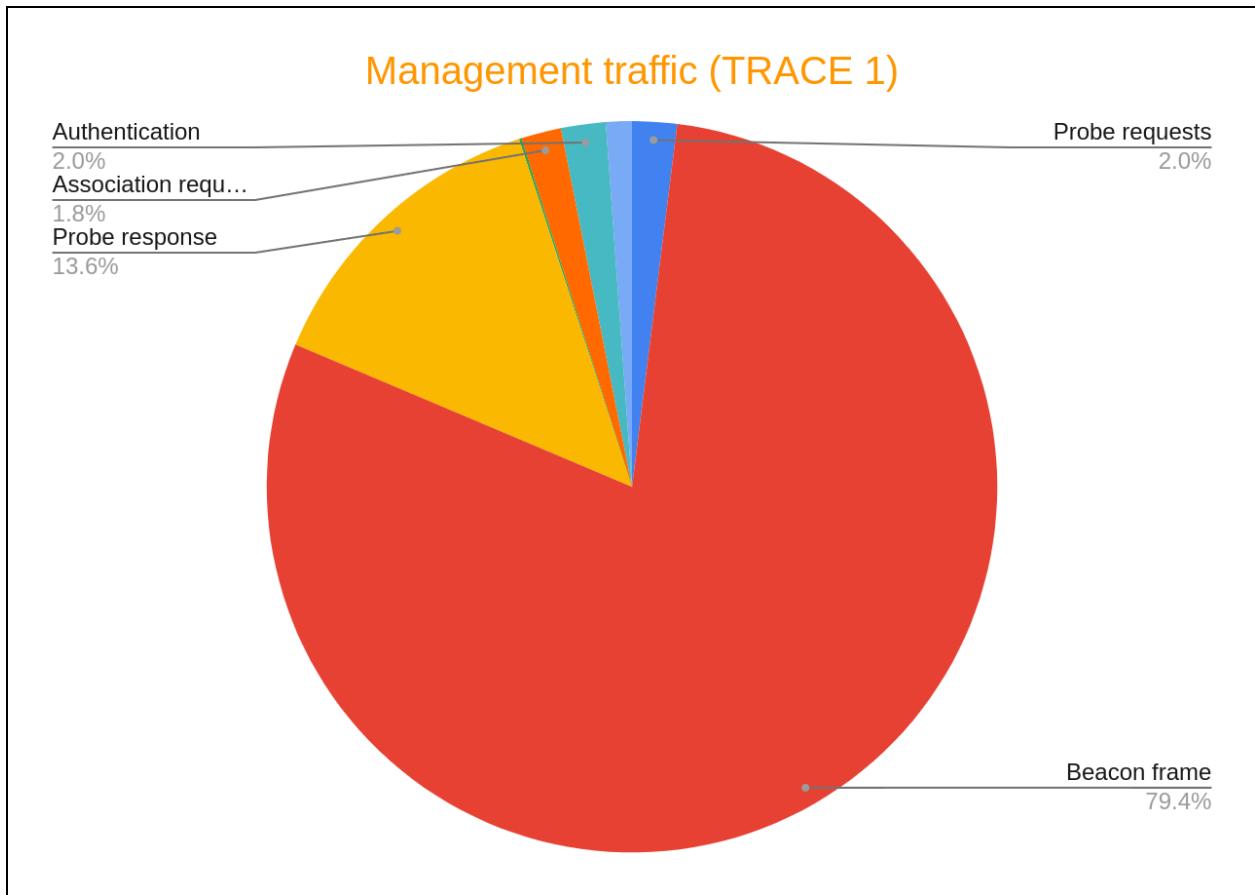
TRACE 1		TRACE 2	
MAC Management	960	MAC Management	7415
Control	616	Control	16718
Data Traffic.	777	Data Traffic.	14552

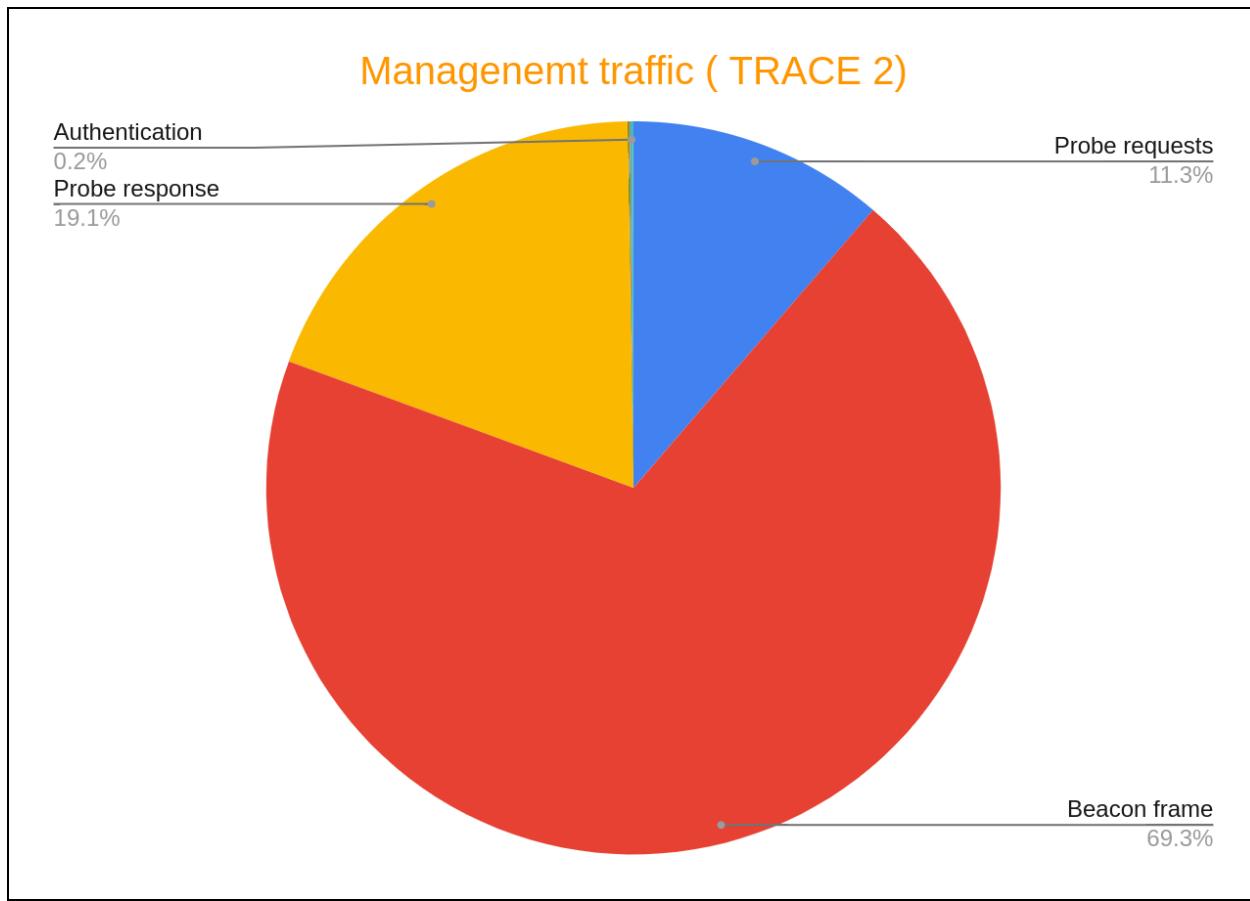


Management VS Control VS Data Traffic (TRACE 2)



Management traffic			
TRACE 1		TRACE 2	
Probe requests	19	Probe requests	829
Beacon frame	762	Beacon frame	5079
Probe response	131	Probe response	1402
Association response	1	Association response	3
Association requests	17	Association requests	4
Authentication	19	Authentication	11
Deauthentication	11	Deauthentication	1





Control traffic			
TRACE 1		TRACE 2	
Acknowledgement	614	Acknowledgement	2146
RTS/CTS	1	RTS/CTS	7286
Block acknowledgement	0	Block acknowledgement	1754

Control Traffic (TRACE 1)

RTS/CTS
0.2%

614 (99.8%)

Acknowledgement
99.8%

Control Traffic (TRACE 2)

Block acknowledg...
15.7%

7286 (65.1%)

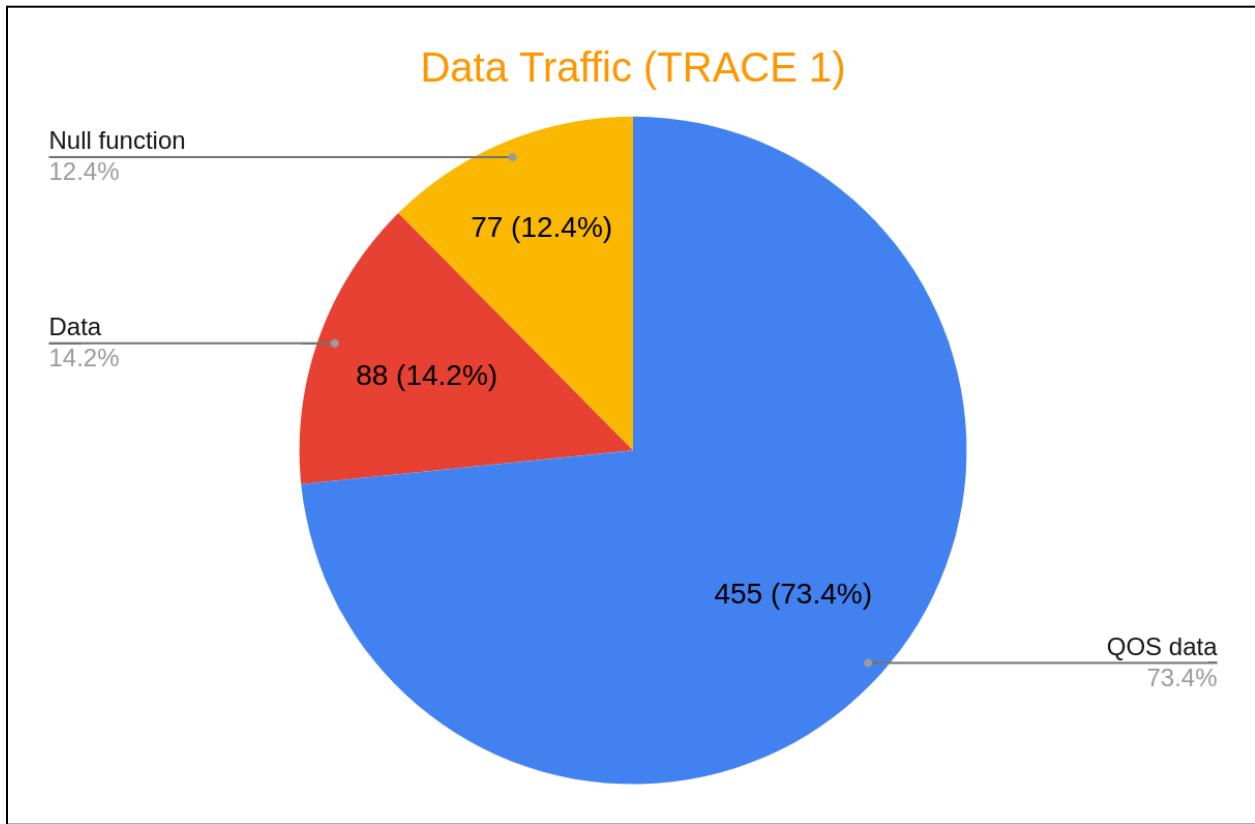
Acknowledgement
19.2%

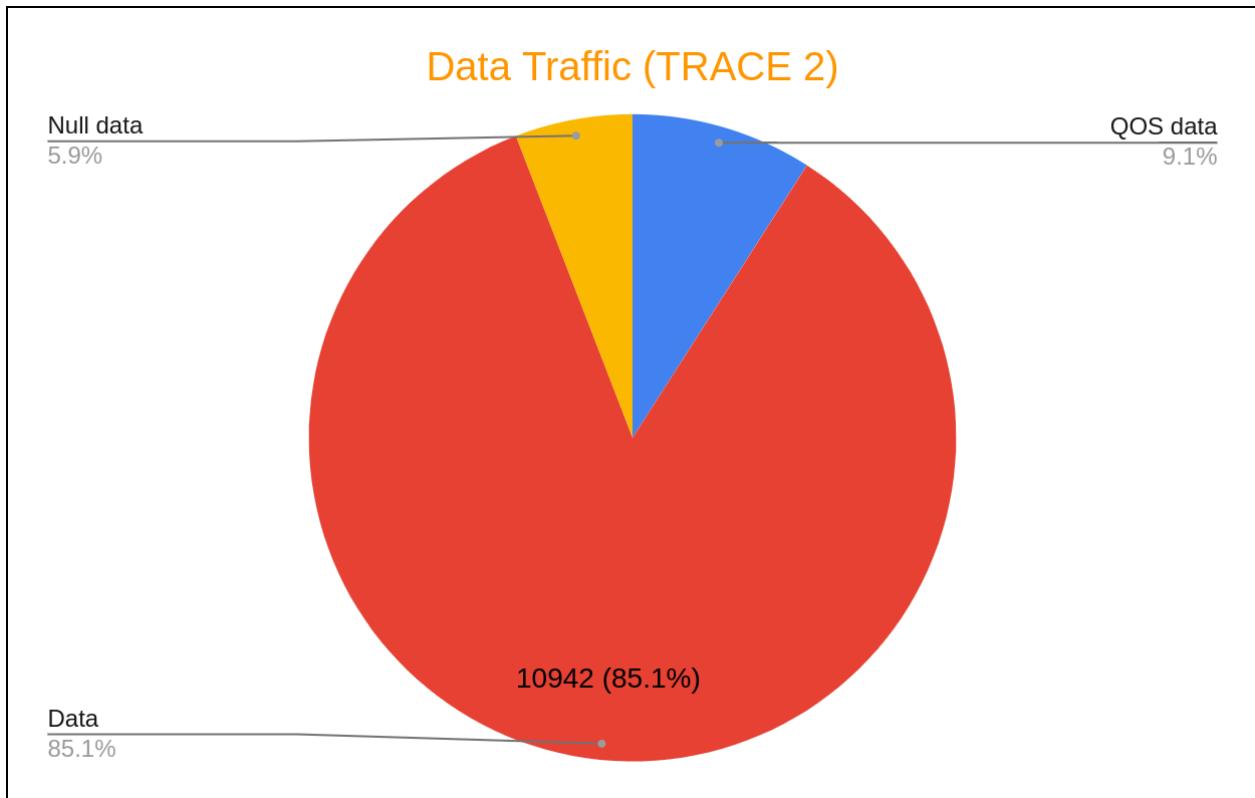
1754 (15.7%)

2146 (19.2%)

RTS/CTS
65.1%

Data Traffic			
TRACE 1		TRACE 2	
QOS data	455	QOS data	1165
Data	88	Data	10942
Null function	77	Null data	755





1. b.1) No. of different APs visible to device which collected the trace?

There are **3** different access points visible in TRACE 1.

SSID: Munroe st., linksys_SES_24086, linksys12

There are **7** different access points visible in TRACE 2.

SSID: IITH, Placement-2023, eduroam, IITH-Guest-PWD-IITH@2023, IITH-CE/HOD/OFFICE, OFFICE_TRIHUB 3244, Redmi A2,

wlan.fc.type_subtype == 8						
No.	Time	Source	Destination	Protocol	Length	Info
5465	568.012325922	fa:a6:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3454, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5487	568.077568501	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1034, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5498	568.179183512	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1035, FN=0, Flags=.....C, BI=100, SSID=IITH-Guest-PWD-IITH@2023
5519	568.267222079	MojonNetw_81:be:20	Broadcast	802.11	404	Beacon frame, SN=3264, FN=0, Flags=.....C, BI=100, SSID=IITH-Guest-PWD-IITH@2023
5513	568.283327767	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1034, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5518	568.319468409	fa:ab:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3457, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5521	568.382388136	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1037, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5527	568.485814281	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1038, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5532	568.579697562	MojonNetw_81:be:22	Broadcast	802.11	355	Beacon frame, SN=3514, FN=0, Flags=.....C, BI=100, SSID=eduroad
5533	568.587180727	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1039, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5540	568.684813204	MojonNetw_81:be:23	Broadcast	802.11	362	Beacon frame, SN=3218, FN=0, Flags=.....C, BI=100, SSID=Placement-2023
5541	568.690042741	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1040, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5550	568.716477031	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3803, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5557	568.729151655	fa:ab:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3462, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5569	568.793063113	TP-Link_dc:00:a8	Broadcast	802.11	335	Beacon frame, SN=1041, FN=0, Flags=.....C, BI=100, SSID=IITH-CE/HOD/OFFICE
5571	568.809610289	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3804, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5575	568.831465597	fa:ab:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3463, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5588	568.911977133	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3805, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5592	568.933982870	fa:ab:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3464, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5599	569.014595210	62:b3:3a:f4:82:d3	Broadcast	802.11	276	Beacon frame, SN=3806, FN=0, Flags=.....C, BI=100, SSID=Redmi A2
5600	569.036875304	fa:ab:54:90:18:1f	Broadcast	802.11	369	Beacon frame, SN=3465, FN=0, Flags=.....C, BI=100, SSID=OFFICE_TRIHUB 3244
5605	569.086480625	MojonNetw_81:be:20	Broadcast	802.11	404	Beacon frame, SN=3272, FN=0, Flags=.....C, BI=100, SSID=IITH-Guest-PWD-IITH@2023
5606	569.094382550	MojonNetw_81:be:23	Broadcast	802.11	362	Beacon frame, SN=3222, FN=0, Flags=.....C, BI=100, SSID=Placement-2023

wlan.fc.type_subtype == 0x0008						
No.	Time	Source	Destination	Protocol	Length	Info
2313	70.635970	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3806, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2314	70.738327	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3807, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2315	70.840739	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3808, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2319	70.943156	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3809, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2320	71.045542	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3810, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2321	71.101576	Cisco-Li_f5:ba:bb	Broadcast	802.11	132	Beacon frame, SN=3954, FN=0, Flags=.....C, BI=100, SSID=linksys_SES_24086
2322	71.147898	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3811, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2323	71.250339	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3812, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2327	71.352708	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3813, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2328	71.455065	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3814, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2331	71.557330	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3815, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2334	71.659897	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3816, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2336	71.762287	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3817, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2337	71.864626	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3818, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2338	71.967102	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3819, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2339	72.060939	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3820, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2340	72.172249	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3820, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2341	72.274307	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3822, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2342	72.282076	Linksys_6_07:22:94	7f:26:ff:ff:ff:ff	802.11	98	Beacon frame, SN=3779, FN=0, Flags=.....C, BI=100, SSID=linksys12 [Malformed Packet]
2345	72.376568	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3823, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2347	72.479021	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3824, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2348	72.581464	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3825, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St
2349	72.683846	Cisco-Li_f7:1d:51	Broadcast	802.11	183	Beacon frame, SN=3826, FN=0, Flags=.....C, BI=100, SSID=30 Munroe St

1. b.2) Minimum size of MAC frame for which RTS/CTS exchanged?

TRACE 1 has **only 1 RTS/CTS** exchange and its frame size is **38 Bytes**.

TRACE 2 has **7286 RTS/CTS** exchanges having minimum size **68 Bytes**.

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c						
No.	Time	Source	Destination	Protocol	Length	Info
1601	46.595317		Linksys6_67:22:94 (60:06:25:6... 802.11		38	Clear-to-send, Flags=.....C

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c && frame.len < 68						
No.	Time	Source	Destination	Protocol	Length	Info

wlan.fc.type_subtype == 0x001b wlan.fc.type_subtype == 0x001c && frame.len <= 68						
No.	Time	Source	Destination	Protocol	Length	Info
17	1.005269559		d2:d0:26:91:02:8c (d2:d0:26:9... 802.11		68	Clear-to-send, Flags=.....C
22	1.470338982	Xiaomico_44:af:e9	(10:3f:44:4... 802.11		68	Clear-to-send, Flags=.....C
25	2.700672240	Xiaomico_44:af:e9	(10:3f:44:4... 802.11		68	Clear-to-send, Flags=.....C
77	14.369586936	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
79	14.414651772	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
330	51.196392404	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
340	53.664134049	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
353	54.716648517	Broadcom_04:4e:f2	(e0:3e:44:0... 802.11		68	Clear-to-send, Flags=.....C
358	54.820948984	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
408	55.741836955	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
419	56.423829165	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
463	57.526170482	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
465	57.557634230	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
543	60.065171367	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
544	60.140966414	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
545	60.145097673	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
562	60.307138402	Broadcom_08:2:c:03	(e0:3e:44:0... 802.11		68	Clear-to-send, Flags=.....C
563	60.307823297	Broadcom_08:2:c:03	(e0:3e:44:0... 802.11		68	Clear-to-send, Flags=.....C
591	60.475668379	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
592	60.495028677	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
624	60.851540876	Broadcom_08:2:c:03	(e0:3e:44:0... 802.11		68	Clear-to-send, Flags=.....C
637	61.088497238	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C
711	63.177851349	Mojonetw_81:be:20	(30:b6:2d:8... 802.11		68	Clear-to-send, Flags=.....C

1. b.3) What fraction of MAC frames are protected (encrypted)?

0.2% of MAC frames are protected in TRACE 1.

31.1% of MAC frames are protected in TRACE 2.

wlan.fc.protected == 1						
No.	Time	Source	Destination	Protocol	Length	Info
803	25.084183	d1:b6:4f:00:16:b6	MS-NLB-PhysServer-32_08:00...	802.11	38	Data + CF-Ack[Malformed Packet]
1227	33.079714			802.11	111	Association Request, SN=3775, FN=4, Flags=.pm...F.C
1519	43.007945	LinksysG_67:22:94	Broadcast	802.11	99	Beacon frame, SN=3492, FN=0, Flags=.pm..M..C
1545	44.310450	d3:95:ca:bb:f0:f5	3e:d3:27:e6:65:7f	802.11	1624	Beacon frame, SN=54, FN=11, Flags=.pmPRMFTC

> Frame 803: 38 bytes on wire (304 bits), 38 bytes captured (304 bits)
> Radiotap Header v0, Length 24
> 802.11 radio information
> IEEE 802.11 Data + CF-Ack
> [Malformed Packet: IEEE 802.11]

0000 00 00 18 00 ee 58 00 00 18 48 85 09 c0 00 d9 9c . . . X . . H
0010 40 00 00 3d 5e 66 c4 64 18 ef 1e b2 98 cc 37 63 @ . =^f d 7c
0020 b7 4f 5e 66 c4 64 0^f d

Wireshark 802.11.pcap

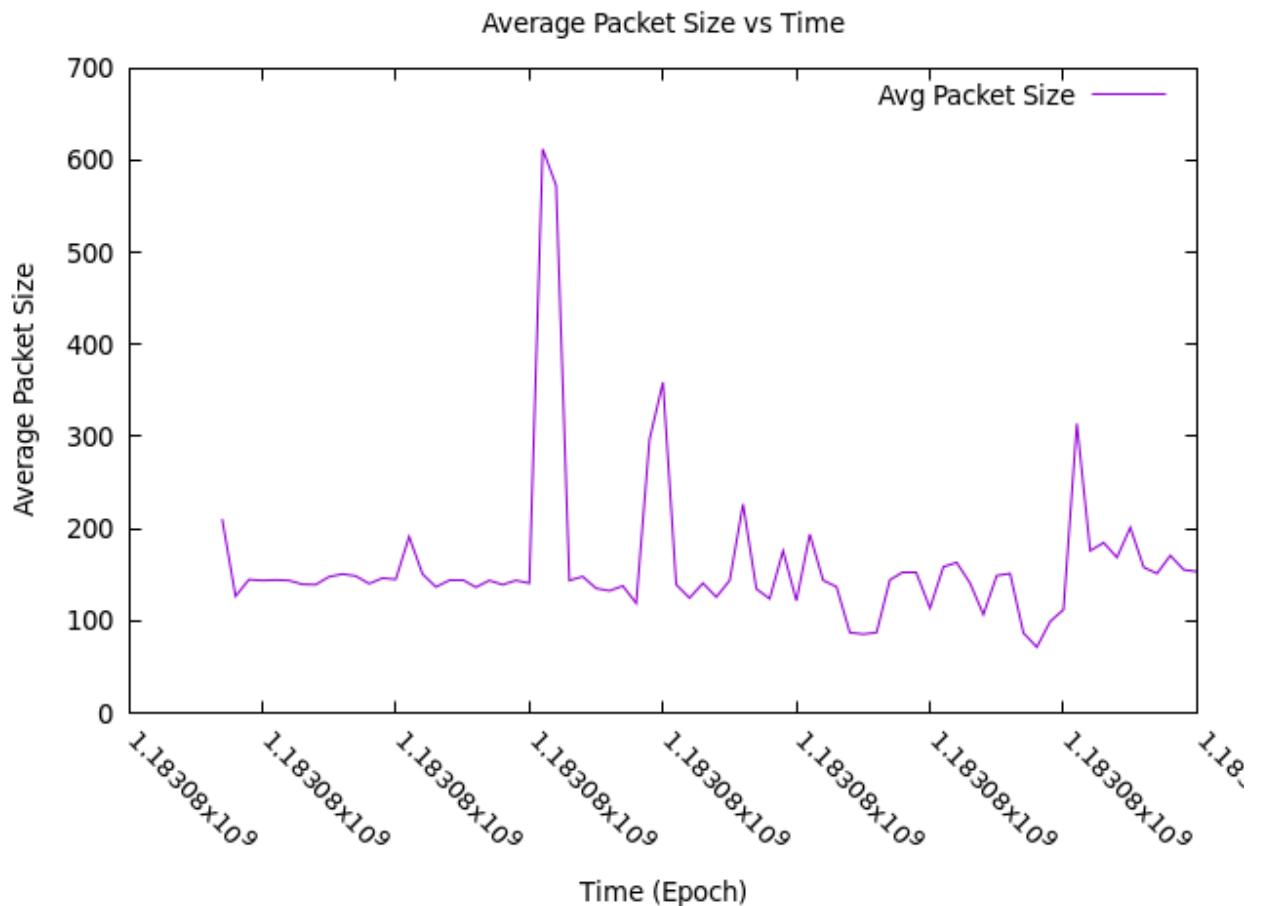
Packets: 2364 · Displayed: 4 (0.2%)

wlan.fc.protected == 1						
No.	Time	Source	Destination	Protocol	Length	Info
30920	641.111459404	aa:31:b5:95:3a:a6	IPv4mcast_fb	802.11	188	Data, SN=175, FN=0, Flags=.pm...F.C
30921	641.113496758	aa:31:b5:95:3a:a6	IPv6mcast_fb	802.11	208	Data, SN=176, FN=0, Flags=.pm...F.C
30922	641.114697665	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	169	Data, SN=177, FN=0, Flags=.pm...F.C
30923	641.115863509	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	167	Data, SN=178, FN=0, Flags=.pm...F.C
30924	641.117408098	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	189	Data, SN=179, FN=0, Flags=.pm...F.C
30925	641.118812000	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	187	Data, SN=180, FN=0, Flags=.pm...F.C
30926	641.121653270	Apple_64:fb:47	IPv4mcast_fb	802.11	381	Data, SN=181, FN=0, Flags=.pm...F.C
30941	641.205121663	bc:03:58:94:2c:c6	IPv4mcast_7f:ff:fa	802.11	313	Data, SN=2080, FN=0, Flags=.p....F.C
30943	641.212631911	Apple_64:fb:47	IPv6mcast_fb	802.11	401	Data, SN=182, FN=0, Flags=.pm...F.C
30944	641.213642959	RealmeCh_40:bb:df	Broadcast	802.11	144	Data, SN=1246, FN=0, Flags=.p....F.C
30947	641.216474422	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	170	Data, SN=183, FN=0, Flags=.pm...F.C
30948	641.217797429	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	190	Data, SN=184, FN=0, Flags=.pm...F.C
30949	641.219119741	HonHaiPr_0b:19:cb	IPv6mcast_fb	802.11	188	Data, SN=185, FN=0, Flags=.pm...F.C
30950	641.220275323	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	168	Data, SN=186, FN=0, Flags=.pm...F.C
30951	641.221466031	HonHaiPr_0b:19:cb	IPv4mcast_fb	802.11	167	Data, SN=187, FN=0, Flags=.p....F.C

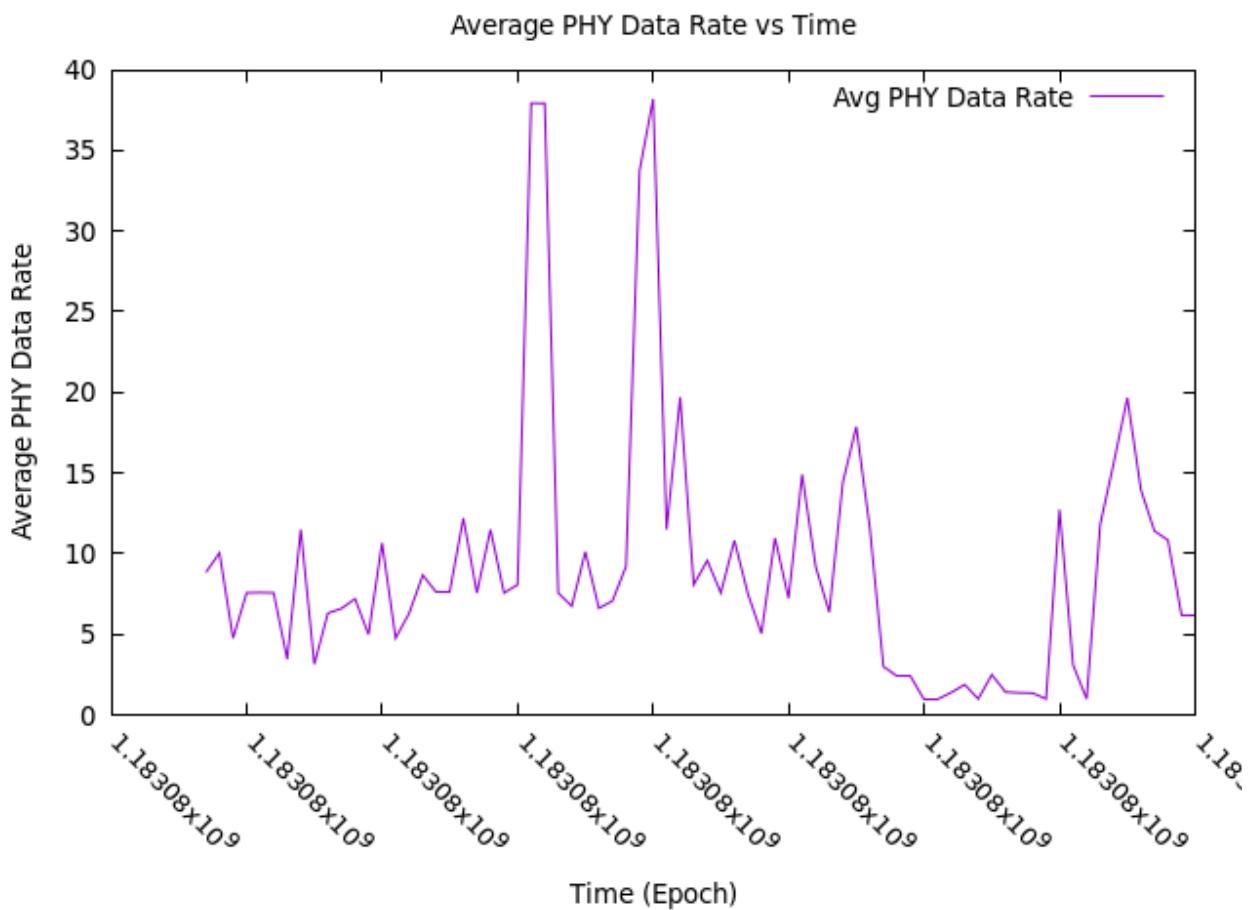
> Frame 30951: 167 bytes on wire (1336 bits), 167 bytes captured (1336 bits) on interface wlp6s0mon, id 0
> Radiotap Header v0, Length 54
> 802.11 radio information
> IEEE 802.11 Data, Flags: .p....F.C
> Data (77 bytes)

0000 00 00 36 00 2f 40 40 a0 20 08 00 00 00 00 00 00 . . 6 . /@
0010 15 a2 77 2f c1 fd ff ff 10 02 99 09 a0 00 c7 00 . . w
0020 00 00 00 00 00 00 00 00 ef 49 ee 04 00 00 00 00 I
0030 16 00 11 03 c7 00 08 42 00 00 01 00 5e 00 00 fb B . . . ^ . .
0040 30 b6 2d 81 be 21 3f f7 72 0b 19 cb b0 69 11 0 10 . r . . . 1 .
0050 00 60 7b 02 00 00 ff 7b b4 27 dd 58 22 ff 02 32 { . ' X " . . 2 .
0060 ad 63 36 64 8a 95 78 4a 43 82 f3 c7 42 e7 65 55 c6d . xJ C . . B . eU
0070 29 df 15 67 8a 8f 21 82 d1 ed ba 73 9a 03 0d c9) . g . ! . . . s . .
0080 05 5f ee b6 50 23 43 7f 45 52 e3 92 0b 3b 90 ab P/C . ER . . ; . .
0090 46 08 b5 ac f3 6f 23 d1 11 e5 48 41 50 ac 20 e3 F # . . HAP . .
00a0 e8 f6 2b c5 15 62 b6 + . . b . .

1. c) Plot avg packet size vs Time (1-minute resolution), Plot avg PHY data rate vs Time, Plot RSSI (received signal strength) vs Time and Plot Packet rate (pkts/sec) vs Time (1-minute resolution). You need to count total no. of packets received in each 1-min interval and divide that with 60 to get Packet rate. For other plots, you need to take avg of packets received in each 1-min interval. List out main observations in each plot.

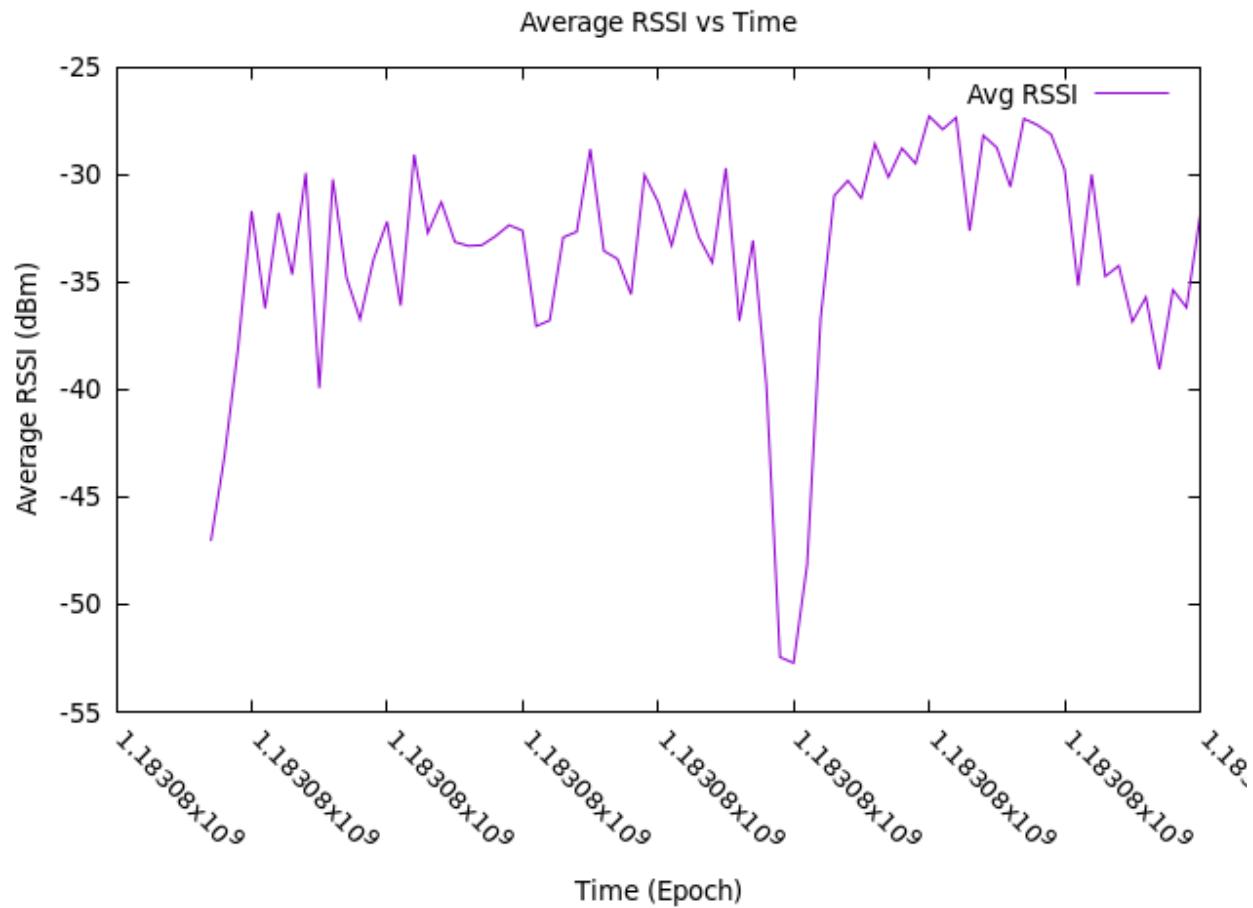
TRACE 1:

Observation: The average packet size received by the node is almost constant with very slight variations. From the above graph we can see that the average packet size is approximately equal to 70.

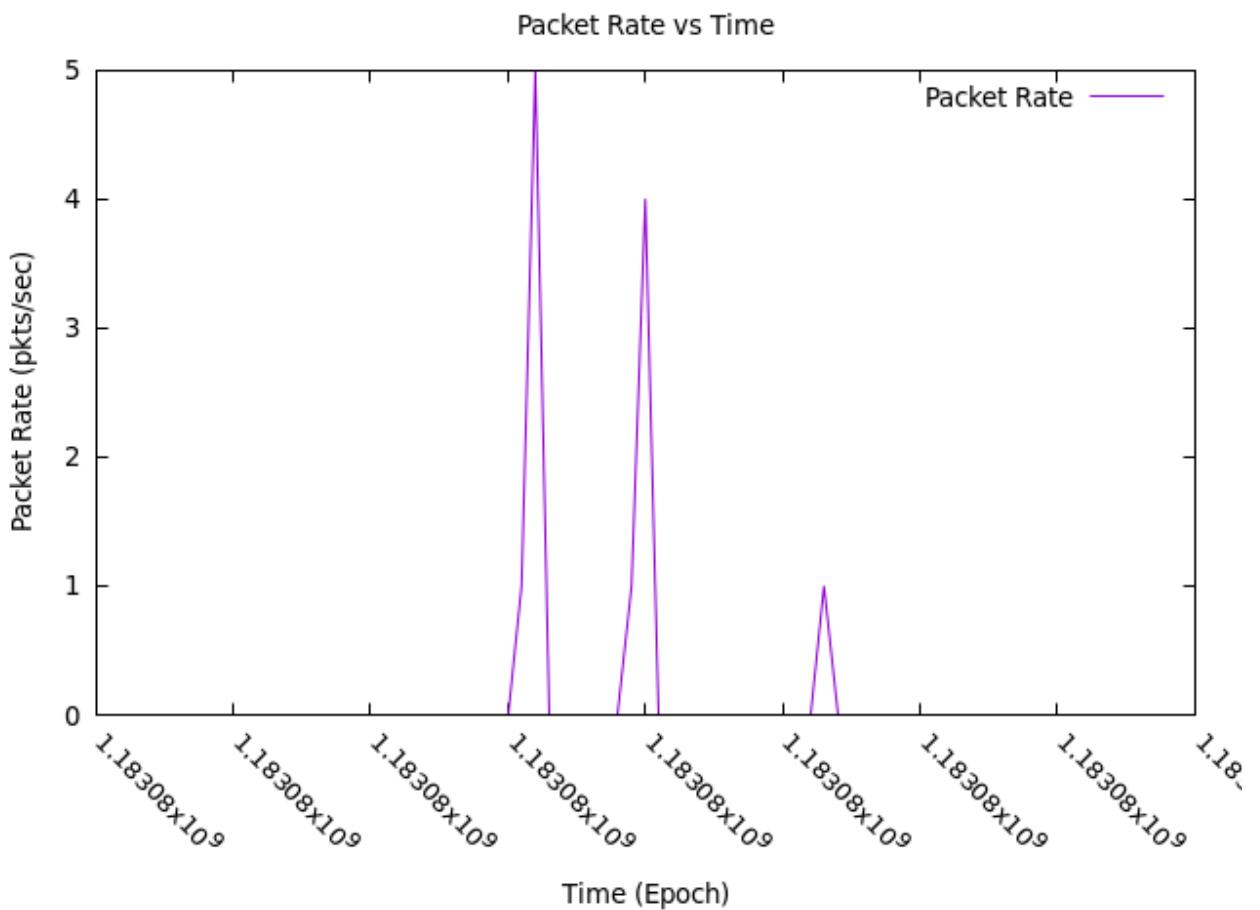


Observation: The average physical data rate received by the node is almost constant with slight variations. From the above graph we can see that the average packet size is

approximately 7.5 with a deviation of 2.5. Sometimes that data rates goes quite high up to 38.

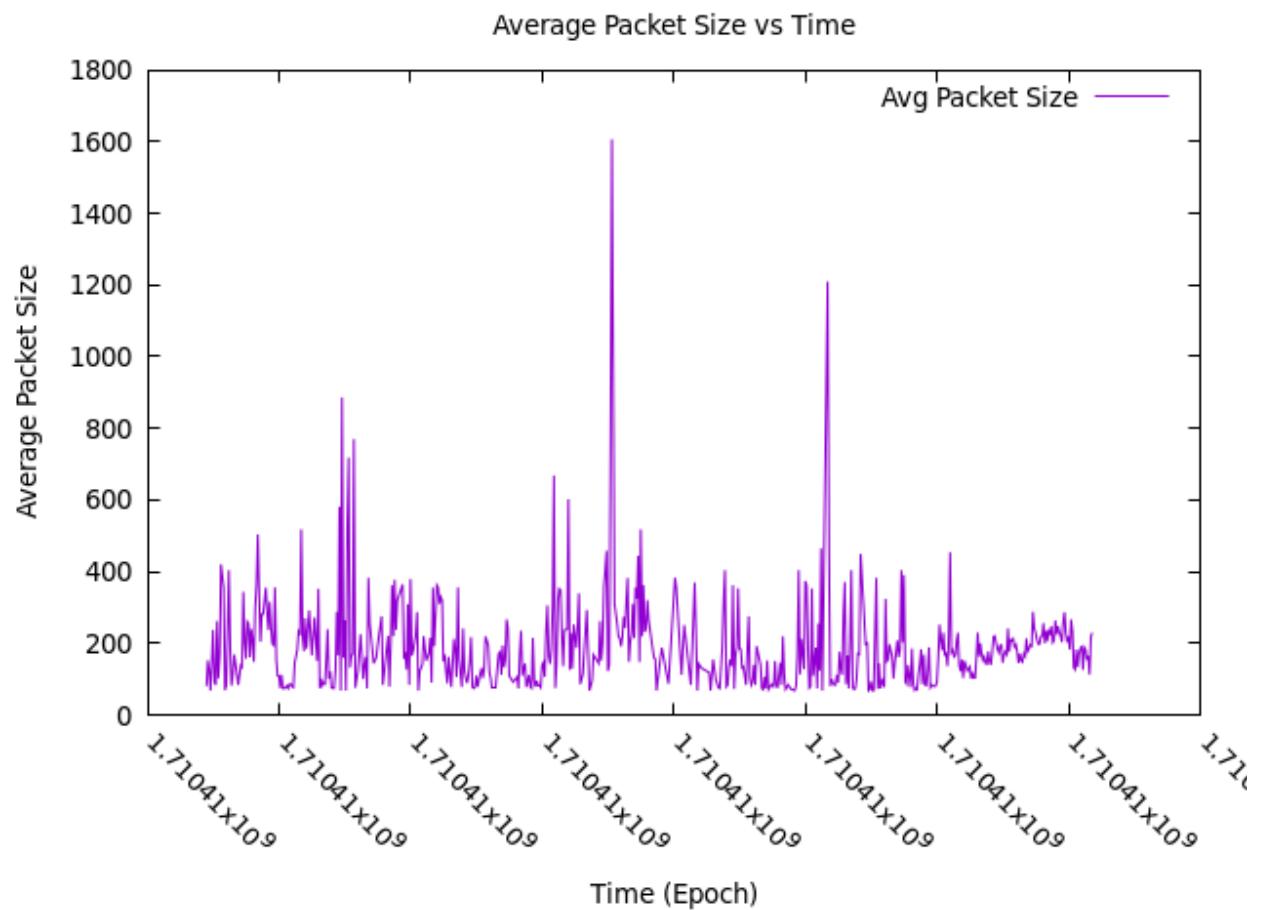


Observation: The signal strength received by the node keeps fluctuating over time. From the above graph we can see that the average RSSI fluctuates approximately between -40 to -28 dBm.

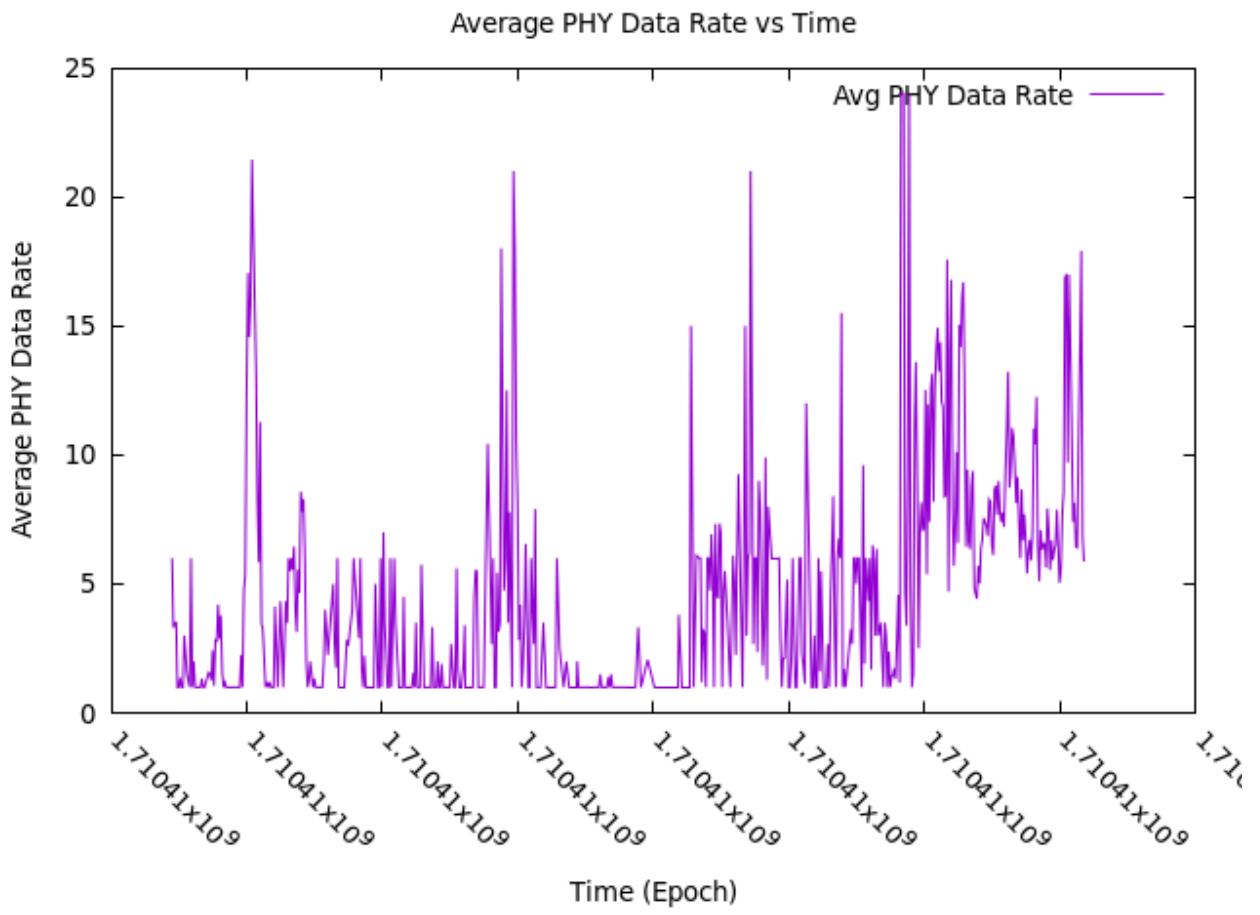


Observation: The packet rate received by the node is very less for all the time except few. From the above graph we can see that the packet rate is quite sparse.

TRACE 2

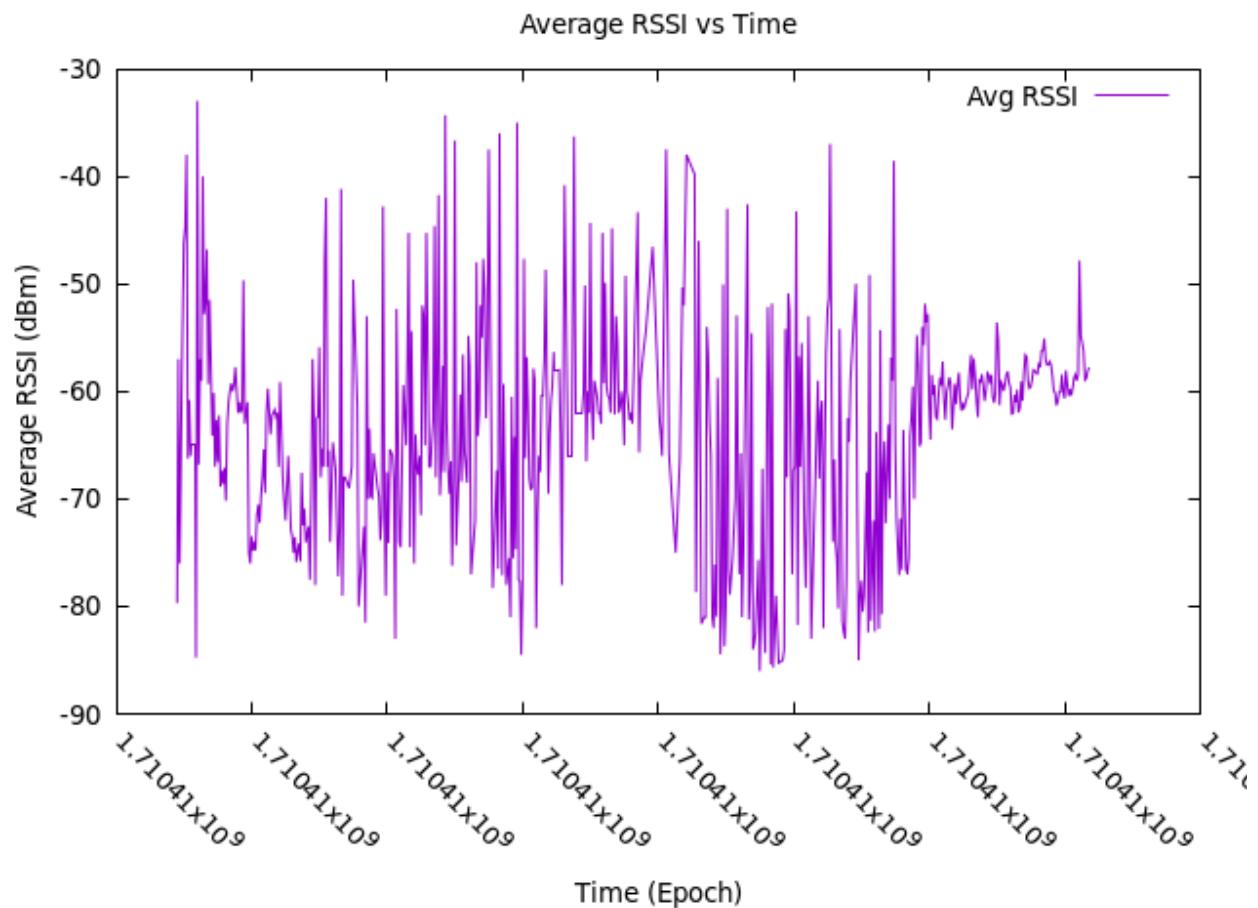


Observation: The average packet size received by the node is fluctuating. From the above graph we can see that the average packet size is approximately between 100 to 300.

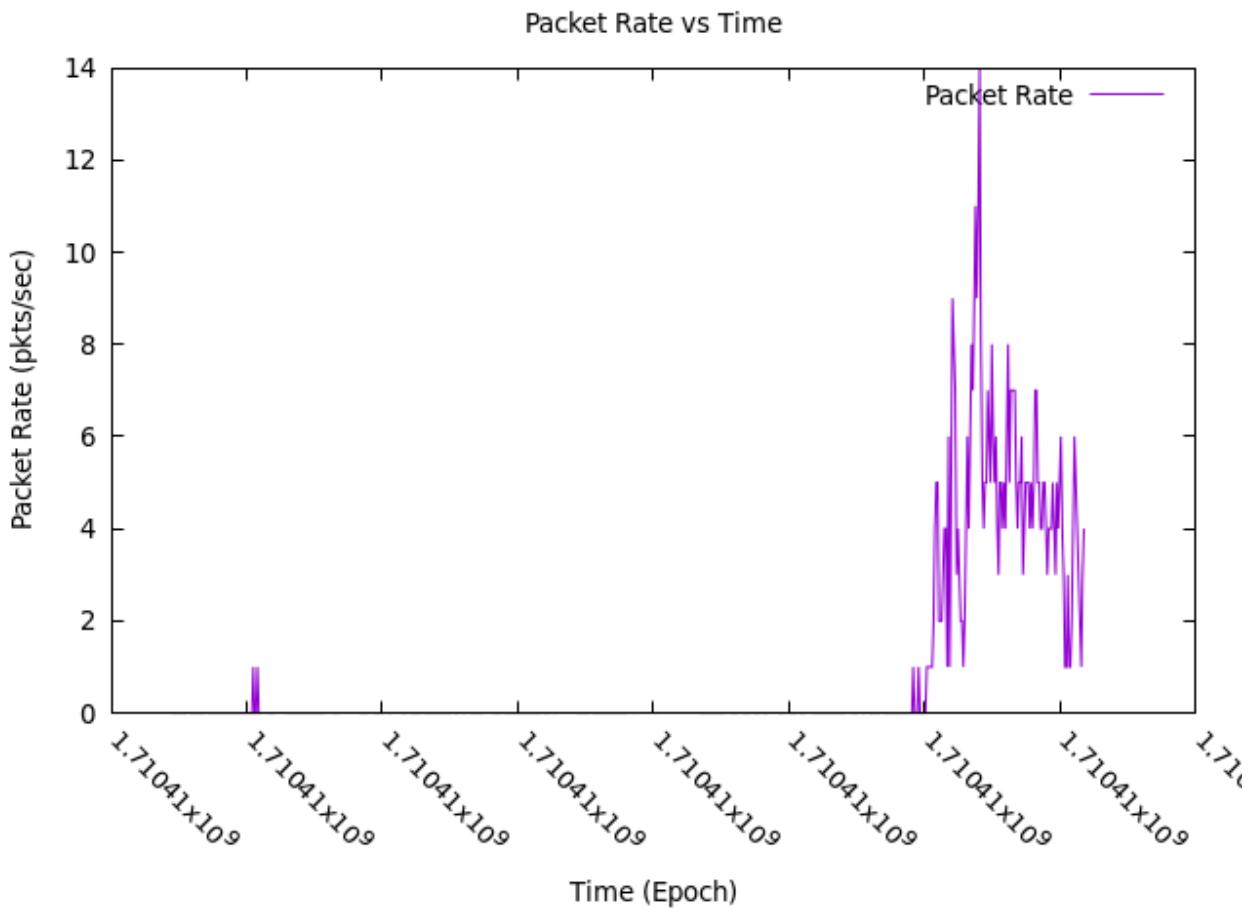


Observation: The average physical data rate received by the node is fluctuating. From the above graph we can see that the average packet size is approximately between 1 and 6 for

75% of time and then between 6 to 10 for the rest of the time.



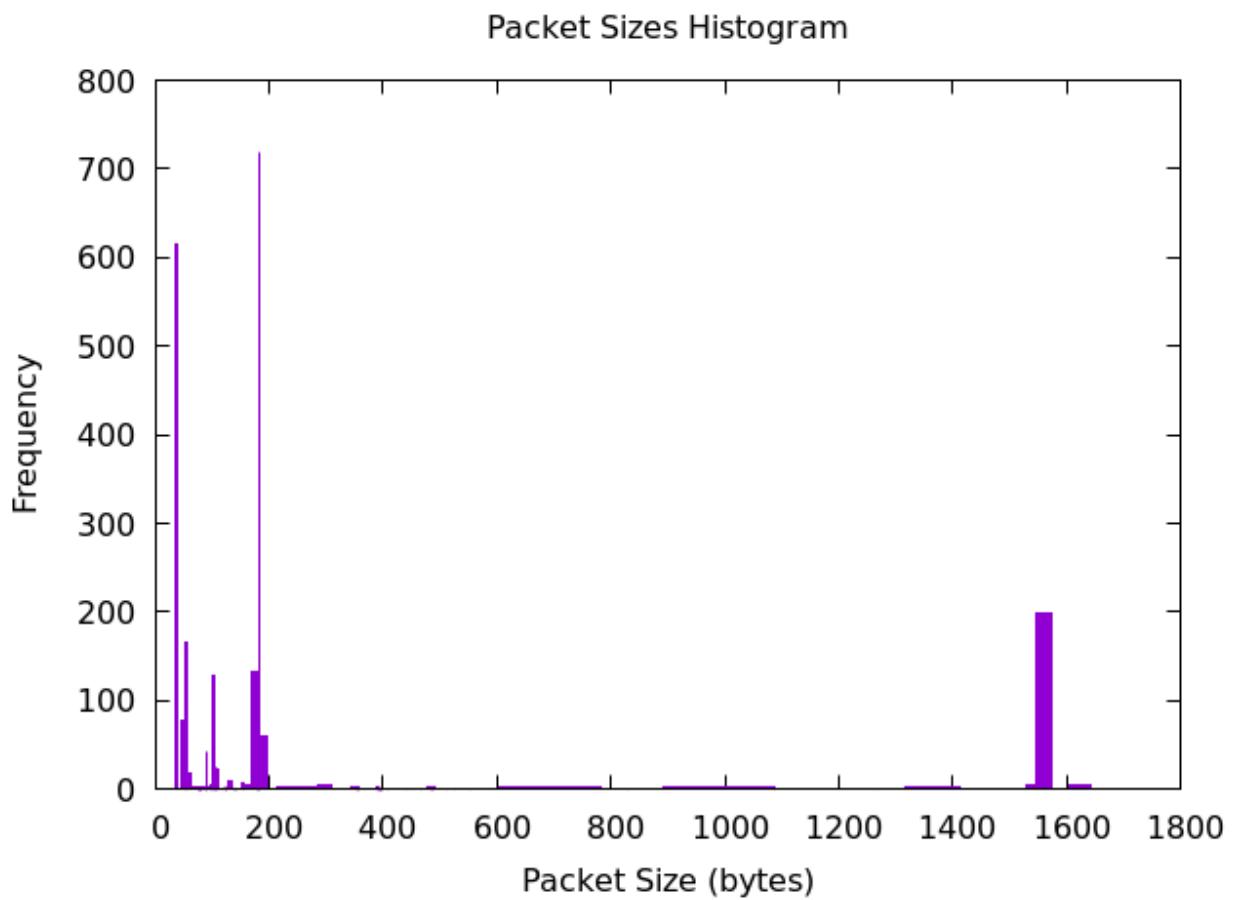
Observation: The signal strength received by the node keeps fluctuating over time. From the above graph we can see that the average RSSI fluctuates approximately between -80 to -40 dBm.



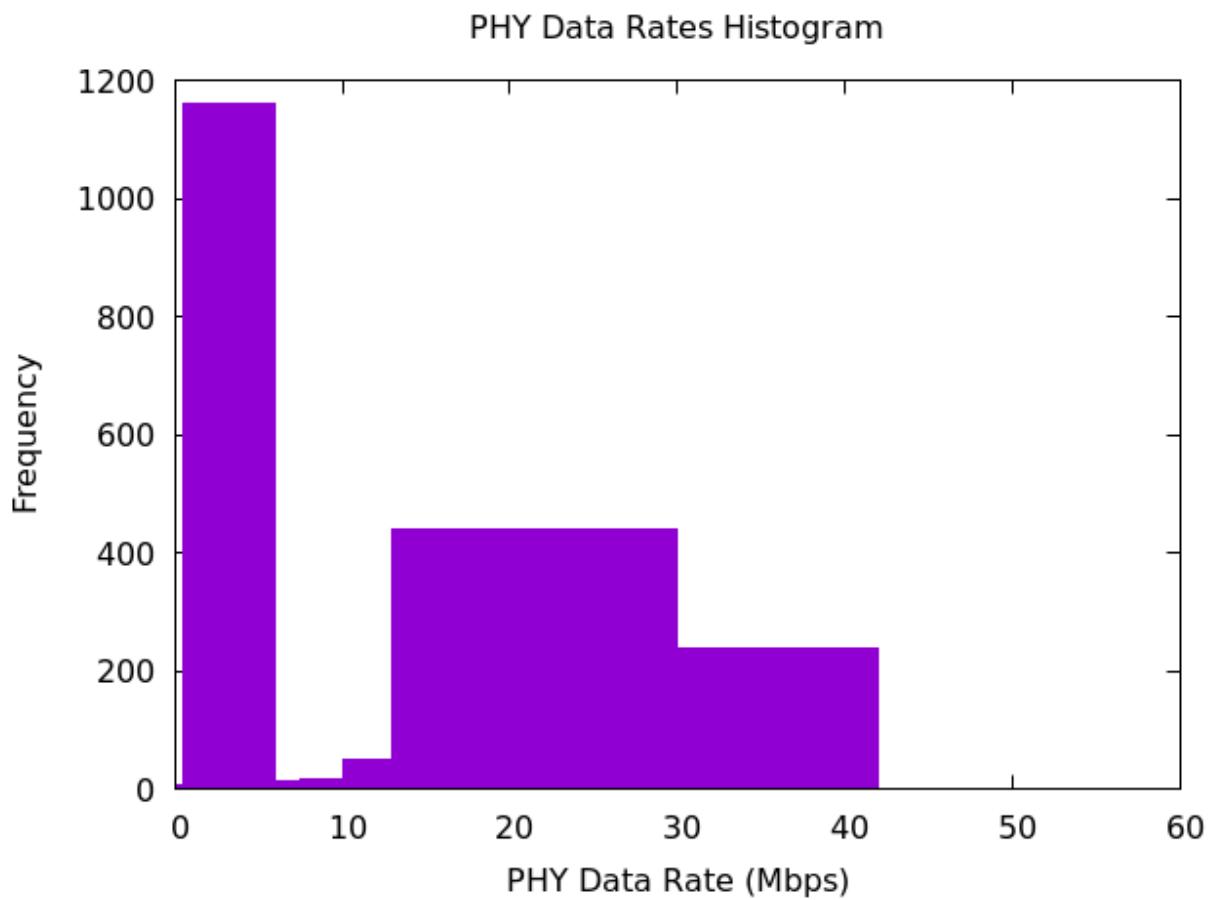
Observation: The packet rate received by the node is very less initially. From the above graph we can see that the packet rate is approximately 1 for 75% of the time and about 4 for the rest of the time.

1. d) Histograms of packet sizes and PHY data rates. List out main observations in each plot.

TRACE 1

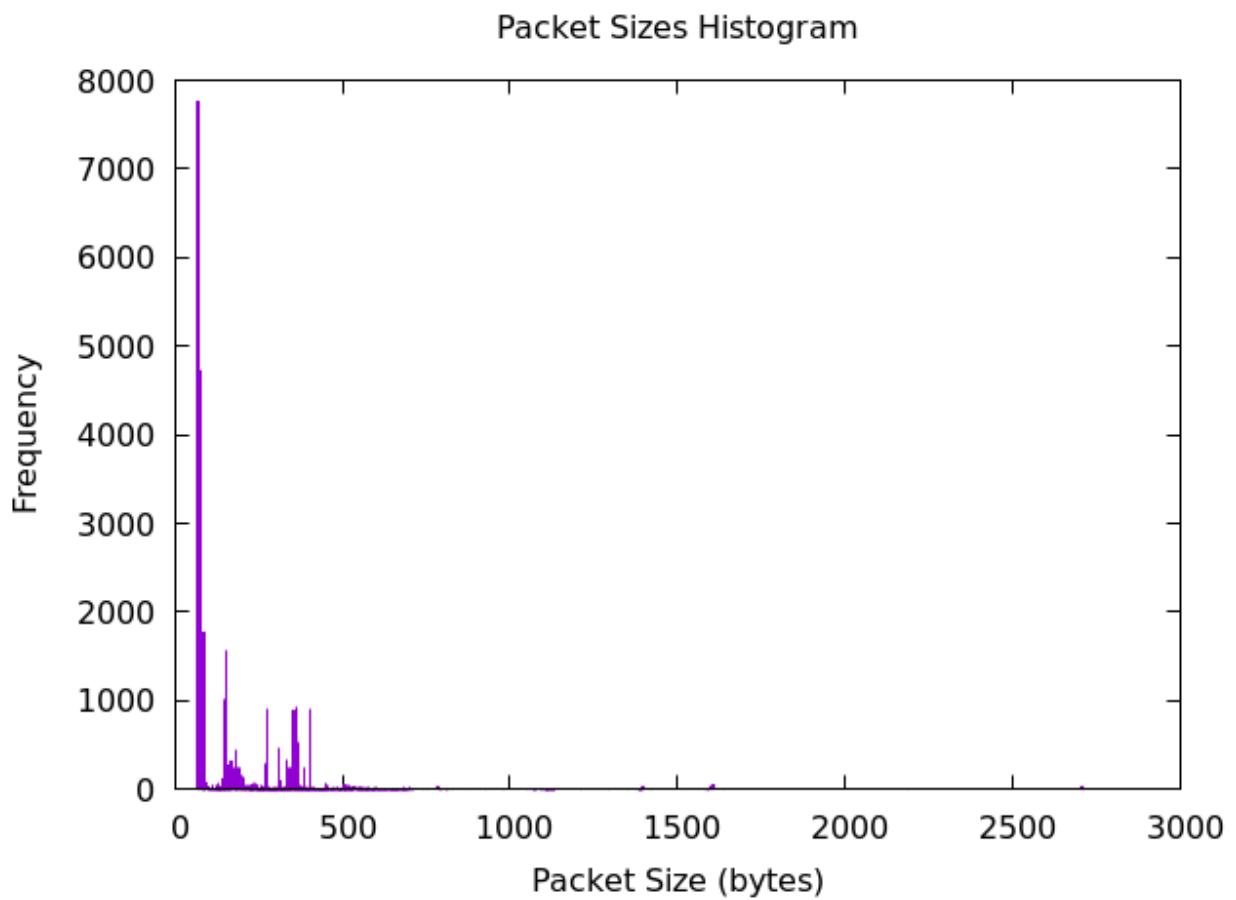


Observation: The packet size received by the node is mostly between 30 to 200 bytes. Some 200 packets are large in size of approx 1600 Bytes.

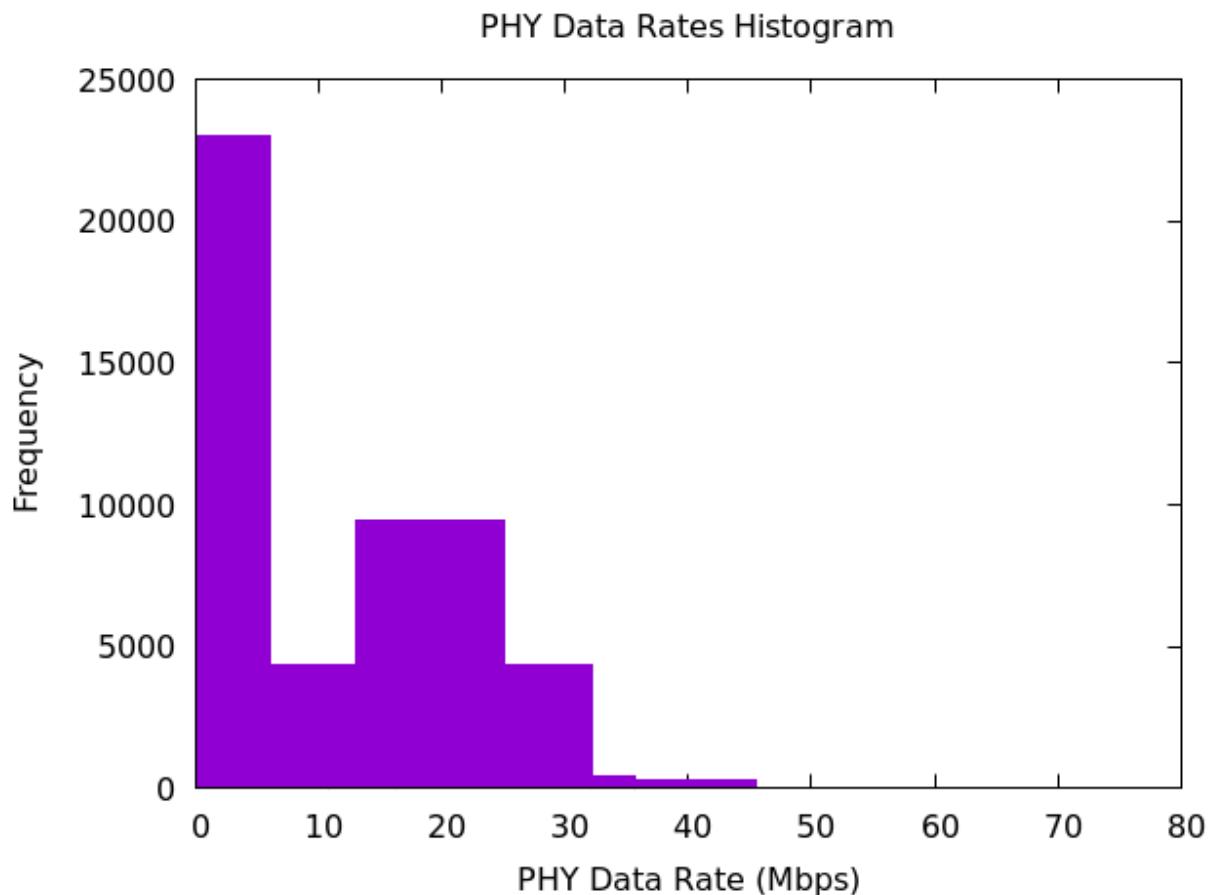


Observation: The physical data rate received by the node is mostly between 0 to 40 Mbps. Most data rates are low and its frequency decreases as the data rate increases.

TRACE 2



Observation: The packet size received by the node is mostly between 30 to 400 bytes. Almost 8000 packets are very small sized packets with size less than 100 bytes.



Observation: The physical data rate received by the node is mostly between 0 to 45 Mbps. Most data rates are low and its frequency decreases as the data rate increases.

Q2

a)

b)

Step 1: First check for whether the device supports for AP using the “iw list” command as shown below:

```
Supported Ciphers:
 * WEP40 (00-0f-ac:1)
 * WEP104 (00-0f-ac:5)
 * TKIP (00-0f-ac:2)
 * CCMP-128 (00-0f-ac:4)
 * CMAC (00-0f-ac:6)
Available Antennas: TX 0x1 RX 0x1
Configured Antennas: TX 0x1 RX 0x1
Supported interface modes:
 * IBSS
 * managed
 * AP
 * AP/VLAN
 * monitor
 * P2P-client
 * P2P-GO
 * P2P-device
Band 1:
    Capabilities: 0x116e
                  HT20/HT40
```

Step 2: Create a virtual wireless interface using the given below command:

“sudo iw phy phy0 interface add new2 type __ap”

```
akshay@Akshay:~$ sudo iw phy phy0 interface add new2 type __ap
akshay@Akshay:~$ ifconfig -a
enp7s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 10.5.82.155 netmask 255.255.254.0 broadcast 10.5.83.255
        inet6 fe80::a396:6a21:853:667d prefixlen 64 scopeid 0x20<link>
          ether 14:18:77:b8:52:09 txqueuelen 1000 (Ethernet)
            RX packets 169546 bytes 188108971 (188.1 MB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 42483 bytes 10921858 (10.9 MB)
            TX errors 2 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
        inet 127.0.0.1 netmask 255.0.0.0
        inet6 ::1 prefixlen 128 scopeid 0x10<host>
          loop txqueuelen 1000 (Local Loopback)
            RX packets 24538 bytes 2693179 (2.6 MB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 24538 bytes 2693179 (2.6 MB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lxcbr0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
        inet 10.0.3.1 netmask 255.255.255.0 broadcast 10.0.3.255
          ether 00:16:3e:00:00:00 txqueuelen 1000 (Ethernet)
            RX packets 0 bytes 0 (0.0 B)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 0 bytes 0 (0.0 B)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

new1: flags=4098<BROADCAST,MULTICAST> mtu 1500
      ether a0:d3:7a:87:0f:89 txqueuelen 1000 (Ethernet)
        RX packets 0 bytes 0 (0.0 B)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 0 bytes 0 (0.0 B)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

new2: flags=4098<BROADCAST,MULTICAST> mtu 1500
      ether a0:d3:7a:87:0f:8a txqueuelen 1000 (Ethernet)
        RX packets 0 bytes 0 (0.0 B)
        RX errors 0 dropped 0 overruns 0 frame 0
```

Step 3: Configure the hotspot and assign ip address using the given below command:

“sudo ifconfig hotspot 192.168.35.1 up”

```
akshay@Akshay:~$ sudo ifconfig new2 192.168.35.1 up
SIOCSIFFLAGS: Device or resource busy
SIOCSIFFLAGS: Device or resource busy
akshay@Akshay:~$ sudo rfkill list
1: phy0: Wireless LAN
    Soft blocked: no
    Hard blocked: no
5: hci0: Bluetooth
    Soft blocked: no
    Hard blocked: no
akshay@Akshay:~$ 
akshay@Akshay:~$ 
akshay@Akshay:~$ sudo rfkill list
1: phy0: Wireless LAN
    Soft blocked: yes
    Hard blocked: no
5: hci0: Bluetooth
    Soft blocked: no
    Hard blocked: no
akshay@Akshay:~$ sudo rfkill unblock wifi
akshay@Akshay:~$ sudo ifconfig new2 192.168.35.1 up
akshay@Akshay:~$ 
```

Step 4: Create a file named **hostapd.conf** with below details of interface, ssid and password.

```
interface=new2
driver=nl80211
ssid=aksinha
channel=7
hw_mode=g
wme_enabled=1
macaddr_acl=0
auth_algs=1
ignore_broadcast_ssid=0
wpa=2
wpa_passphrase=123456789
wpa_key_mgmt=WPA-PSK
wpa_pairwise=TKIP
rsn_pairwise=CCMP
```

Run the following command : “**sudo hostapd hostapd.conf**”

```
Processing triggers for man-db (2.10.2-1) ...
akshay@Akshay:~$ sudo hostapd hostapd.conf
new2: interface state UNINITIALIZED->ENABLED
new2: AP-ENABLED
new2: STA 02:dd:37:b2:b9:cd IEEE 802.11: authenticated
new2: STA 02:dd:37:b2:b9:cd IEEE 802.11: associated (aid 1)
new2: AP-STA-CONNECTED 02:dd:37:b2:b9:cd
new2: STA 02:dd:37:b2:b9:cd RADIUS: starting accounting session 460CA6C2E675914F
new2: STA 02:dd:37:b2:b9:cd WPA: pairwise key handshake completed (RSN)
new2: EAPOL-4WAY-HS-COMPLETED 02:dd:37:b2:b9:cd
```

Step 5: Configure the DHCP server. Open the file named “/etc/udhcpd.conf” and edit the details. Then the following command “**sudo udhcpcd -f**”

```
RX packets 722108 bytes 250442057 (250.4 MB)
RX errors 0 dropped 3 overruns 0 frame 0
TX packets 169413 bytes 58376142 (58.3 MB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

akshay@Akshay:~$ sudo udhcpcd -f
[sudo] password for akshay:
udhcpcd: started, v1.30.1
udhcpcd: can't open '/var/lib/misc/udhcpc.leases': No such file or directory
udhcpcd: sending OFFER of 192.168.35.106
udhcpcd: sending OFFER of 192.168.35.106
udhcpcd: sending ACK to 192.168.35.106
```

Step 6: run to command to use the hotspot “**sudo su**”

```
akshay@Akshay:~$ sudo su
[sudo] password for akshay:
root@Akshay:/home/akshay# echo "1" > /proc/sys/net/ipv4/ip_forward
root@Akshay:/home/akshay# iptables --table nat --append POSTROUTING --out-interface enp7s0
root@Akshay:/home/akshay# iptables --append FORWARD --in-interface new2 -j ACCEPT
root@Akshay:/home/akshay#
```

c)

c)

PLAGIARISM STATEMENT:

I certify that this assignment/report is my own work, based on my personal study and/or research and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I also certify that this assignment/report has not previously been submitted for assessment in any other course, except where specific permission has been granted from all course instructors involved, or at any other time in this course, and that I have not copied in part or whole or otherwise plagiarized the work of other students and/or persons. I pledge to uphold the principles of honesty and responsibility at CSE@IITH. In addition, I understand my responsibility to report honor violations by other students if I become aware of it.

Name: AKSHAY KUMAR

Date: 14/03/2024

Signature: AKSHAY KUMAR