

ECE 458

Communication Networks

Laboratory Experiment #4 Report

## Introduction

Link-layer protocols, such as those for Ethernet and IEEE 802.11 networks, are investigated in this lab. The first half of this lab focuses on Ethernet frames, while the second portion looks at IEEE 802.11 frames. Data frames are sent out by Ethernet stations to communicate with one another. Each Ethernet station is given a 48-bit MAC address which can be used for the source or destination address of each data frame. Due to the ability of practically all generations of Ethernet to be quickly and inexpensively interconnected, Ethernet is a significant aspect of the network. The IEEE 802.11 standard's link-layer and management features are covered in the second half of the lab. The IEEE 802.11 standard is significant because it is widely used in wireless local area networks. Regarding IEEE 802.11, there are three types of frames that will be investigated in this lab:

- Management frame (Type 0)
- Control frame (Type 1)
- Data frame (Type 2)

Each of these frames also has subtypes which will be looked further into during this lab.

## Procedure

In the first part of the lab we observed the HTTP GET message and HTTP response message that was sent from the web browser to `gaia.cs.umass.edu` using the `ethernet-trace-1` file in Wireshark. With this packet the 48-bit destination MAC address, hexadecimal value corresponding to the two-bytes Frame type field, and source MAC address value can be determined. After, using the HTTP response message, we can determine the destination and device of the MAC address in the Ethernet frame.

In the second half of the lab we used the `wlan-trace-1` trace file and Wireshark to inspect the behavior of an IEEE 802.11 network. Within the trace file we determined which AP is the most active, the number of Data frames, and how the number of subtypes of Control and Management frames. In addition, we can calculate the ratio of the number of retransmissions, and determine the Type and Subtype values corresponding to the Association Request/Association Response frames.

The following tools and materials were used to complete this lab:

- ECE 458 Lab Manual Chapter 2
- `gaia.cs.umass.edu`
- Wireshark
- Trace files:
  - `ethernet-trace-11`
  - `Wlan-trace-1`

For a further detailed procedure, please see the lab manual [1].

## Procedures and Discussion, Ethernet

1. The 48-bit destination MAC address is **00:06:25:da:af:73**. This address is not the MAC address of *gaia.cs.umass.edu*. The MAC address is that of *router.asus.com*, which is an ASUS router.
2. The hexadecimal value of the two-byte Frame type field is **0x0800**.
3. The value of the source MAC address is **00:d0:59:a9:3d:68**.
4. The destination MAC address is **00:06:25:da:af:73**. The MAC address is that of the ASUS router connected to the computer [2].
5. The hexadecimal value of the two-byte Frame type field is **0x0800**.

## Discussion

6. The BSS ID of the most active AP is the **Cisco-Li\_e3:e9:8f**.
7. There are 1783 data frames in the trace. There are three subtypes in the trace: data frames (subtype 32), data+cf-poll (subtype 34) and null data (subtype 36). The most common subtype is 32 which corresponds to data frames.
8. There are 1391 control frames in the trace. There are three subtypes in the trace: PS-Poll (subtype 10), CTS (Subtype 12) and ACK (subtype 13). The most common subtype is 13 which corresponds to an ACK [3].
9. There are 557 management frames in the trace. There are six subtypes in the trace: association requests (subtype 0), association response (subtype 1), probe requests (subtype 4), probe responses (subtype 5), beacons (subtype 8) and authentications (subtype 11). The most common subtype is 8 which corresponds to a beacon.
10. The ratio of the number of retransmissions is  $3731 - 3368 = 363$ .
11. The type associated with an association is 0 (management frame) and the subtype for an association request/response is 0/1 respectively. The type associated with a probe is 0 (management frame) and the subtype for a probe request/response is 4/5 respectively.

## Conclusion

In this lab we investigated and learned about link-layer protocols including Ethernet and IEEE 802.11 networks.

In the first half of this lab we learned about how data frames are sent out by Ethernet stations to communicate with one another, and that each of these stations is given 48-bit MAC address which is used for the source or destination address of each data frame. With an HTTP GET message from the *ethernet-trace-1* in WireShark we learned how to find the 48-bit destination MAC address and value as well as the hexadecimal value corresponding to the two-byte Frame type field

In the second half of this lab we explored the link-layer and management functions of the IEEE 802.11 standard. We learned about the characteristics of three types of frames: Management (Type 0), Control (Type 1), and Data frame (Type 2). Using the *wlan-trace-1* file and WireShark we learned how to use various filters such as *wlan.gc.type==2* and *wlan.fc.retry==0* when inspecting the frames of different packets. We determined the number of Data frames and

Subtypes of Control and Management frames in the trace file using our acquired knowledge of IEEE 802.11. In addition, we determined the ratio of the number of retransmissions over the number of original transmissions to be 363. In the last part of lab we used the trace file to determine the Type and Subtype values corresponding to the Association Request/Response and Probe Request/Response frames.

## References

- [1] *ECE458*. [Online]. Available: <https://studentweb.uvic.ca/~wenjunyang/ECE458/notes.html>.
- [2] *Ethernet*. [Online]. Available: <https://wiki.wireshark.org/Ethernet>. [Accessed: 25-Mar-2022].
- [3] Published by Jeremy Sharp. “802.11 frame types and formats,” *FI*, 22-Oct-2020. [Online]. Available: <https://howiwifi.com/2020/07/13/802-11-frame-types-and-formats/>.

## Feedback

Little to no direction was given for certain procedure and discussion questions. Being given a starting prompt for certain questions would provide students with a more linear process for completing labs.