

CSCI 466: Networks

Fall 2024

Wireshark Lab 1: HTTP and DNS

Due: Friday September 13th @ 11:59 PM

The first few pages cover the basics of Wireshark. If you already feel ready and want to jump into the lab tasks, you can skip to page 4.

You are allowed to work with 1 or 2 partners.

Overview

The basic tool for observing the messages exchanged between executing protocol entities is called a **packet sniffer**. As the name suggests, a packet sniffer captures (“sniffs”) messages being sent/received from/by your computer; it will also typically store and/or display the contents of the various protocol fields in these captured messages. A packet sniffer itself is passive. It observes messages being sent and received by applications and protocols running on your computer, but never sends packets itself. Similarly, received packets are never explicitly addressed to the packet sniffer. Instead, a packet sniffer receives a copy of packets that are sent/received from/by application and protocols executing on your machine.

Getting Wireshark

In order to run **Wireshark**, the packet sniffing we will use in this class, you will need to have access to a computer that supports both Wireshark and the *libpcap* or *WinPcap* packet capture library. The *libpcap* software will be installed for you, if it is not installed within your operating system, when you install Wireshark. See <http://www.wireshark.org/download.html> for a list of supported operating systems and download sites

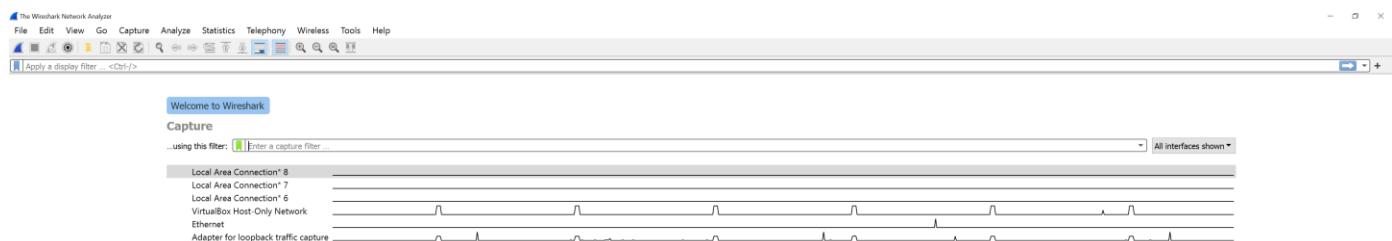
Download and install the Wireshark software:

- Go to <http://www.wireshark.org/download.html> and download and install the Wireshark binary for your computer.

The Wireshark FAQ has several helpful hints and interesting tidbits of information, particularly if you have trouble installing or running Wireshark

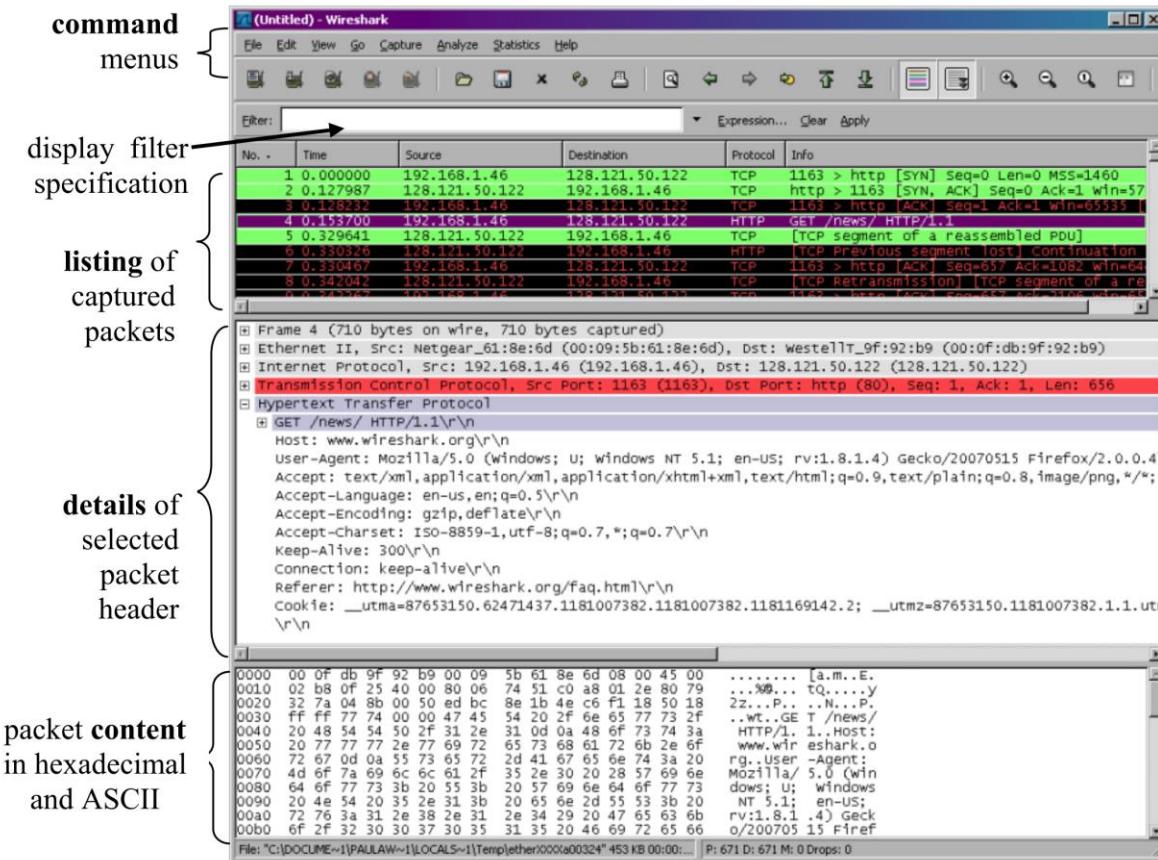
Running Wireshark

When you run the Wireshark program, you’ll get a startup screen that looks something like the screen below. Different versions of Wireshark will have different startup screens – so don’t panic if yours doesn’t look exactly like the screen below! The Wireshark documentation states “As Wireshark runs on many different platforms with many different window managers, different styles applied and there are different versions of the underlying GUI toolkit used, your screen might look different from the provided screenshots. But as there are no real differences in functionality these screenshots should still be well understandable.” Well said.



Under the “Capture” section, there is a list of so-called interfaces. On my desktop, I do not have a Wi-Fi interface, but you probably will. All packets to/from this computer will pass through one of the interfaces. You will likely select ethernet (if you have a wired internet connection), or Wi-Fi (if you have a wireless internet connection) for your network captures in these labs.

Let’s take Wireshark out for a spin! If you click on one of these interfaces to start packet capture (i.e., for Wireshark to begin capturing all packets being sent to/from that interface), a screen like the one below will be displayed, showing information about the packets being captured. Once you start packet capture, you can stop it by using the Capture pull down menu and selecting Stop.



The Wireshark interface has five major components:

- The **command menus** are standard pulldown menus located at the top of the window. Of interest to us now are the File and Capture menus. The File menu allows you to save captured packet data or open a file containing previously captured packet data and exit the Wireshark application. The Capture menu allows you to begin packet capture.
- The **packet-listing window** displays a one-line summary for each packet captured, including the packet number (assigned by Wireshark; this is not a packet number contained in any protocol’s header), the time at which the packet was captured, the packet’s source and destination addresses, the protocol type, and protocol-specific information contained in the packet. The packet listing can be sorted according to any of these categories by clicking on a column name. The protocol type field lists the highest-level protocol that sent or received this packet, i.e., the protocol that is the source or ultimate sink for this packet.
- The **packet-header details window** provides details about the packet selected (highlighted) in the packet-listing window. (To select a packet in the packetlisting window, place the cursor over the packet’s one-line

summary in the packet-listing window and click with the left mouse button.). These details include information about the Ethernet frame (assuming the packet was sent/received over an Ethernet interface) and IP datagram that contains this packet. The amount of Ethernet and IP-layer detail displayed can be expanded or minimized by clicking on the plus minus boxes to the left of the Ethernet frame or IP datagram line in the packet details window. If the packet has been carried over TCP or UDP, TCP or UDP details will also be displayed, which can similarly be expanded or minimized. Finally, details about the highest-level protocol that sent or received this packet are also provided.

- The **packet-contents window** displays the entire contents of the captured frame, in both ASCII and hexadecimal format.
- Towards the top of the Wireshark graphical user interface, is the **packet display filter field**, into which a protocol name or other information can be entered in order to filter the information displayed in the packet-listing window (and hence the packet-header and packet-contents windows). In the example below, we'll use the packet-display filter field to have Wireshark hide (not display) packets except those that correspond to HTTP messages.

Lab Tasks

For this lab, you can generate all the traffic yourself. If you are struggling with generating HTTP requests (some Mac users have this issue), then you can download and use a pcap file that has the traffic generated and captured for you. Download and extract the zip file found here: <http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip>, and then load `http-ethereal-trace-1.pcap` into Wireshark .

Task 1 HTTP Traffic.

Restart packet capture and while Wireshark is running, enter the URL

<http://gaia.cs.umass.edu/wireshark-labs/INTRO-wireshark-file1.html>

and have that page displayed in your web browser. In order to display this page, your browser will contact the HTTP server at gaia.cs.umass.edu and exchange HTTP messages with the server in order to download this page, as discussed in section 2.2 of the text. The Ethernet frames containing these HTTP messages (as well as all other frames passing through your Ethernet adapter) will be captured by Wireshark.

After your browser has displayed the INTRO-wireshark-file1.html page (it is a simple one line of congratulations), stop Wireshark packet capture by selecting stop in the Wireshark capture window. You now have live packet data that contains all protocol messages exchanged between your computer and other network entities! The HTTP message exchanges with the gaia.cs.umass.edu web server should appear somewhere in the listing of packets captured. But there will be many other types of packets displayed as well (see, e.g., the many different protocol types shown in the Protocol column in Figure 3). Even though the only action you took was to download a web page, there were evidently many other protocols running on your computer that are unseen by the user.

Type in “http” (without the quotes, and in lower case – all protocol names are in lower case in Wireshark) into the display filter specification window at the top of the main Wireshark window. Then select Apply (to the right of where you entered “http”). This will cause only HTTP message to be displayed in the packet-listing window.

- Take a screenshot of your Wireshark screen that shows all HTTP traffic from your capture
- If you are having issues seeing the HTTP request in Wireshark, your OS or browser may be forcing you to use HTTPS. Try to use the curl command to generate the HTTP request

Task 2 HTTP Get Request.

Locate the HTTP GET request that was sent from your computer to the gaia.cs.umass.edu HTTP server. Make sure you are **not** looking at the GET request for favicon.ico. Answer the following questions:

- 2.1. What is the IP address of gaia.cs.umass.edu?
- 2.2. What is the IP address of your machine?
- 2.3 What was the destination port for this packet?
- 2.4 What version of HTTP is being used for the HTPP request?
- 2.5 Take a screenshot of the header fields of the HTTP GET request.
- 2.6 Before an HTTP request can be sent, a TCP connection must be established with the server. There is a series of 3 TCP packets that are sent that establish this connection before the HTTP request is sent. Find these three packets and take a screenshot.

Task 3 HTTP Response.

Locate the HTTP response that was sent from the gaia.cs.umass.edu HTTP server to your computer. Answer the following questions:

- 3.1 What is the response code?
- 3.2 What type of content was returned from this response message?
- 3.3 How long did it take from when the HTTP GET message was sent until the HTTP OK reply was received?
- 3.4 What version of HTTP is being used for the HTTP response?
- 3.5 Take a screenshot of the header fields of the HTTP response.

(I highly recommend finishing Tasks 1,2 and 3 before proceeding)

Task 4 nslookup.

In its most basic operation, the *nslookup* tool allows the host running the tool to query any specified DNS server for a DNS record. The queried DNS server can be a root DNS server, a top-level-domain DNS server, an authoritative DNS server, or an intermediate DNS server (see the textbook or lecture slides for definitions of these terms). To accomplish this task, *nslookup* sends a DNS query to the specified DNS server, receives a DNS reply from that same DNS server, and displays the result.

```
C:\Users\reeese>nslookup www.mit.edu
Server: dns.google
Address: 8.8.8.8

Non-authoritative answer:
Name: e9566.dscb.akamaiedge.net
Addresses: 2600:1409:9800:18d::255e
           2600:1409:9800:1ac::255e
           23.6.97.213
Aliases: www.mit.edu
         www.mit.edu.edgekey.net

C:\Users\reeese>nslookup -type=NS mit.edu
Server: dns.google
Address: 8.8.8.8

Non-authoritative answer:
mit.edu nameserver = ns1-173.akam.net
mit.edu nameserver = use2.akam.net
mit.edu nameserver = ns1-37.akam.net
mit.edu nameserver = eur5.akam.net
mit.edu nameserver = asia2.akam.net
mit.edu nameserver = usw2.akam.net
mit.edu nameserver = asia1.akam.net
mit.edu nameserver = use5.akam.net
```

The above screenshot shows the results of two independent *nslookup* commands (displayed in the Windows Command Prompt). In this example, the client host is located on some home network, where the default local DNS server is 8.8.8.8 (Google's DNS server). I manually set my local DNS server to 8.8.8.8, but yours probably be a different address (you might even get "Unknown Server"). When running *nslookup*, if no DNS server is specified, then *nslookup* sends the query to the default DNS server, which is configured somewhere in your OS network settings.

nslookup www.mit.edu

In words, this command is saying "please send me the IP address for the host www.mit.edu". As shown in the screenshot, the response from this command provides two pieces of information: (1) the name and IP address of the DNS server that provides the answer; and (2) the answer itself, which is the host name and IP address of www.mit.edu. However in this screenshot, *nslookup* also indicates that the answer is "non-authoritative," meaning that this answer came from the cache of some server rather than from an authoritative MIT DNS server. It is quite possible that this local DNS server iteratively contacted several other DNS servers to get the answer, as discussed in lecture.

Now consider the second command:

nslookup -type=NS mit.edu

In this example, we have provided the option "-type=NS" and the domain "mit.edu". This causes *nslookup* to send a query for a type-NS record to the default local DNS server. In words, the query is saying, "please send me the host names of the authoritative DNS for mit.edu". (When the -type option is not used, *nslookup* uses the default, which is to query for type A records.)

The query results in several different nameservers, which are all authoritative DNS servers for MIT. Note that all these nameservers have **akam** in their domain. This is short for Akami Technologies, which is one of the most popular DNS hosting providers. To find the IP addresses for these nameservers, you could issue another *nslookup* for any of those domains.

Now answer the following questions (wireshark is not needed for this task,)

- 4.1 Run nslookup on montana.edu. What is the IP address of that server? Take a screenshot of this response.
- 4.2 Run that IP through <https://who.is/> and provide a screenshot of the registration information for that IP address. **Note:** If who.is is giving you no response, try another online whois service website.
- 4.3 Run nslookup -type=NS montana.edu and look at the results. What are the nameservers for montana.edu ? Take a screenshot of this response.
- 4.4 Run nslookup -type=MX followed by a URL of your choice. What does the -type=MX flag mean? What was the answer for the DNS query you requested?

Task 5: DNS Traffic

ipconfig is a helpful tool for identifying your IP address. In a command prompt/terminal, run ipconfig and identify your IPv4 address (on Linux, you can use ifconfig). Now that we are familiar with nslookup, we're ready to get down to some serious business. Let's first capture the DNS packets that are generated by ordinary Web-surfing activity. If you having issues getting your IP on Mac, try `ipconfig getifaddr en0`

1. Run the command `ipconfig /flushdns`. This will remove any DNS answers you have stored in your local cache (*you might need to google the correct command for macs*)
2. Open Wireshark and enter “`ip.addr == your_IP_address`” into the filter, where you obtain `your_IP_address` with ipconfig. This filter removes all packets that neither originate nor are destined to your host.
3. Start packet capture in Wireshark
4. With your browser, visit the Web page: <http://www.ietf.org>
5. Stop packet capture

Now answer the following questions:

- 5.1. Locate the DNS query and response messages for www.ietf.org. and take a screenshot of your screen
- 5.2. Are the DNS query and response messages sent over UDP or TCP?
- 5.3. What is the destination port for the DNS query?
- 5.4. To what IP address is the DNS query message sent?
- 5.5. Examine the DNS response message. How many “answers” are provided?
- 5.6. Based on your DNS response message, what is an IP address for <http://www.ietf.org>?

Task 6: Additional Analysis

- 6.1 Remove any filters on your Wireshark trace and answer the following question: What are all the unique IP addresses that are communicated with in your trace? Hint: You can find this in the “Statistics” tab in Wireshark and take a screenshot 😊

Submission

You will submit a lab report to D2L. This lab report will contain your answers for all the tasks, and any screenshots that were needed. Save it as a PDF and submit it to D2L. If you worked with a partner(s), make sure you indicate all group members at the top of your lab report. Both team members should submit to d2l.