



NATIONAL UNIVERSITY OF COMPUTER & EMERGING SCIENCE

Computer Network Lab (CL3001)

Lab Session 06 Wireshark Labs: HTTP/S - DNS - TCP - UDP

Objective:

Network traffic analysis of HTTP/S protocol headers, cookies using Wireshark

Having gotten our feet wet with the Wireshark packet sniffer in the introductory lab, we're now ready to use Wireshark to investigate protocols in operation. In this lab, we'll explore several aspects of the HTTP protocol: the basic GET/response interaction, HTTP message formats, retrieving large HTML files, retrieving HTML files with embedded objects, and HTTP authentication and security. Before beginning these labs, you might want to review Section 2.2 of the text.¹

1. The Basic HTTP GET/response interaction

Let's begin our exploration of HTTP by downloading a very simple HTML file - one that is very short, and contains no embedded objects. Do the following:

1. Start up your web browser.
2. Start up the Wireshark packet sniffer, as described in the Introductory lab (but don't yet begin packet capture). Enter "http" (just the letters, not the quotation marks) in the display-filter-specification window, so that only captured HTTP messages will be displayed later in the packet-listing window. (We're only interested in the HTTP protocol here, and don't want to see the clutter of all captured packets).
3. Wait a bit more than one minute (we'll see why shortly), and then begin Wireshark packet capture.
4. Enter the following to your browser
<http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file1.html>
Your browser should display the very simple, one-line HTML file.
5. Stop Wireshark packet capture.

¹ References to figures and sections are for the 8th edition of our text, *Computer Networks, A Top-down Approach*, 8th ed., J.F. Kurose and K.W. Ross, Addison-Wesley/Pearson, 2020.

Your Wireshark window should look similar to the window shown in Figure 1. If you are unable to run Wireshark on a live network connection, you can download a packet trace that was created when the steps above were followed.²

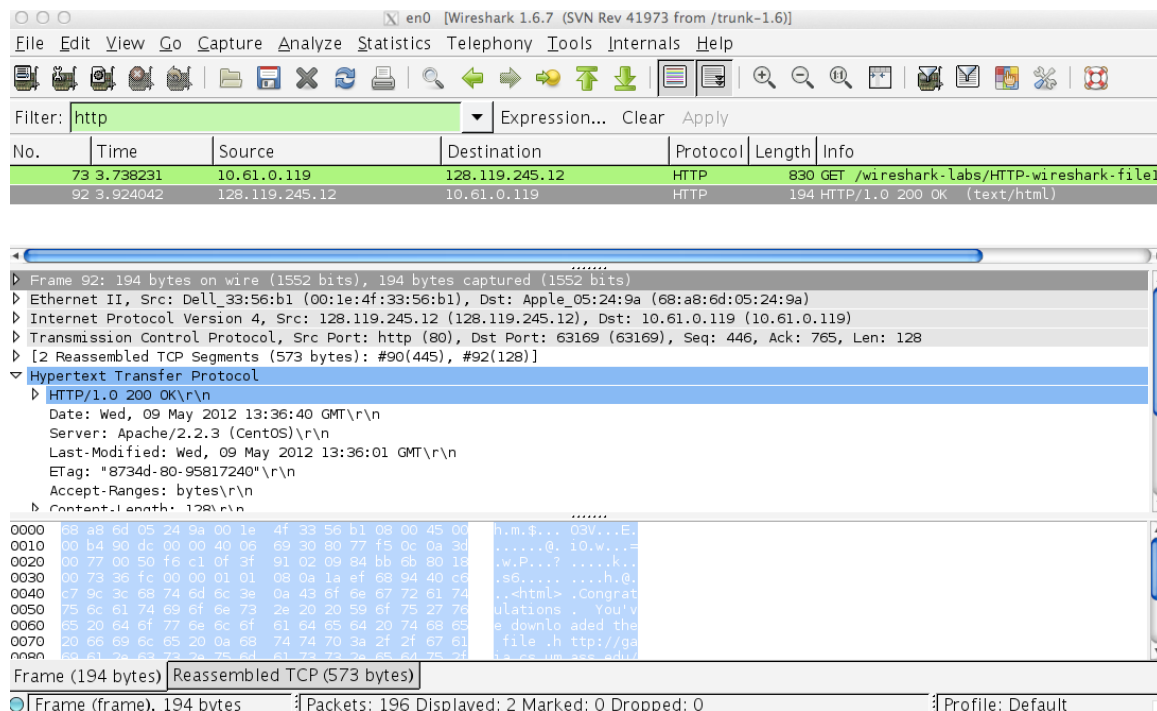


Figure 1: Wireshark Display after <http://gaia.cs.umass.edu/wireshark-labs/ HTTP-wireshark-file1.html> has been retrieved by your browser

The example in Figure 1 shows in the packet-listing window that two HTTP messages were captured: the GET message (from your browser to the gaia.cs.umass.edu web server) and the response message from the server to your browser. The packet-contents window shows details of the selected message (in this case the HTTP OK message, which is highlighted in the packet-listing window). Recall that since the HTTP message was carried inside a TCP segment, which was carried inside an IP datagram, which was carried within an Ethernet frame, Wireshark displays the Frame, Ethernet, IP, and TCP packet information as well. We want to minimize the amount of non-HTTP data displayed (we're interested in HTTP here, and will be investigating these other protocols in later labs), so make sure the boxes at the far left of the Frame, Ethernet, IP and TCP information have a plus sign or a right-pointing triangle (which means there is hidden, undisplayed information), and the HTTP line has a minus sign or a down-pointing triangle (which means that all information about the HTTP message is displayed).

² Download the zip file <http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip> and extract the file `http-ethereal-trace-1`. The traces in this zip file were collected by Wireshark running on one of the author's computers, while performing the steps indicated in the Wireshark lab. Once you have downloaded the trace, you can load it into Wireshark and view the trace using the *File* pull down menu, choosing *Open*, and then selecting the `http-ethereal-trace-1` trace file. The resulting display should look similar to Figure 1. (The Wireshark user interface displays just a bit differently on different operating systems, and in different versions of Wireshark).

(Note: You should ignore any HTTP GET and response for favicon.ico. If you see a reference to this file, it is your browser automatically asking the server if it (the server) has a small icon file that should be displayed next to the displayed URL in your browser. We'll ignore references to this pesky file in this lab.).

By looking at the information in the HTTP GET and response messages, answer the following questions. When answering the following questions, you should print out the GET and response messages (see the introductory Wireshark lab for an explanation of how to do this) and indicate where in the message you've found the information that answers the following questions. When you hand in your assignment, annotate the output so that it's clear where in the output you're getting the information for your answer (e.g., for our classes, we ask that students markup paper copies with a pen, or annotate electronic copies with text in a colored font).

1. Is your browser running HTTP version 1.0 or 1.1? What version of HTTP is the server running?
2. What languages (if any) does your browser indicate that it can accept to the server?
3. What is the IP address of your computer? Of the gaia.cs.umass.edu server?
4. What is the status code returned from the server to your browser?
5. When was the HTML file that you are retrieving last modified at the server?
6. How many bytes of content are being returned to your browser?
7. By inspecting the raw data in the packet content window, do you see any headers within the data that are not displayed in the packet-listing window? If so, name one.

In your answer to question 5 above, you might have been surprised to find that the document you just retrieved was last modified within a minute before you downloaded the document. That's because (for this particular file), the gaia.cs.umass.edu server is setting the file's last-modified time to be the current time, and is doing so once per minute. Thus, if you wait a minute between accesses, the file will appear to have been recently modified, and hence your browser will download a "new" copy of the document.

2. The HTTP CONDITIONAL GET/response interaction

Recall from Section 2.2.5 of the text, that most web browsers perform object caching and thus perform a conditional GET when retrieving an HTTP object. Before performing the steps below, make sure your browser's cache is empty. (To do this under Firefox, select *Tools->Clear Recent History* and check the Cache box, or for Internet Explorer, select *Tools->Internet Options->Delete File*; these actions will remove cached files from your browser's cache.) Now do the following:

- Start up your web browser, and make sure your browser's cache is cleared, as discussed above.
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser
<http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html>
Your browser should display a very simple five-line HTML file.

- Quickly enter the same URL into your browser again (or simply select the refresh button on your browser)
- Stop Wireshark packet capture, and enter “http” in the display-filter-specification window, so that only captured HTTP messages will be displayed later in the packet-listing window.
- (*Note:* If you are unable to run Wireshark on a live network connection, you can use the http-ethereal-trace-2 packet trace to answer the questions below; see footnote 1. This trace file was gathered while performing the steps above on one of the author’s computers.)

Answer the following questions:

8. Inspect the contents of the first HTTP GET request from your browser to the server. Do you see an “IF-MODIFIED-SINCE” line in the HTTP GET?
9. Inspect the contents of the server response. Did the server explicitly return the contents of the file? How can you tell?
10. Now inspect the contents of the second HTTP GET request from your browser to the server. Do you see an “IF-MODIFIED-SINCE:” line in the HTTP GET? If so, what information follows the “IF-MODIFIED-SINCE:” header?
11. What is the HTTP status code and phrase returned from the server in response to this second HTTP GET? Did the server explicitly return the contents of the file? Explain.

3. Retrieving Long Documents

In our examples thus far, the documents retrieved have been simple and short HTML files. Let’s next see what happens when we download a long HTML file. Do the following:

- Start up your web browser, and make sure your browser’s cache is cleared, as discussed above.
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser
<http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file3.html>
 Your browser should display the rather lengthy US Bill of Rights.
- Stop Wireshark packet capture, and enter “http” in the display-filter-specification window, so that only captured HTTP messages will be displayed.
- (*Note:* If you are unable to run Wireshark on a live network connection, you can use the http-ethereal-trace-3 packet trace to answer the questions below; see footnote 1. This trace file was gathered while performing the steps above on one of the author’s computers.)

In the packet-listing window, you should see your HTTP GET message, followed by a multiple-packet TCP response to your HTTP GET request. This multiple-packet response deserves a bit of explanation. Recall from Section 2.2 (see Figure 2.9 in the text) that the HTTP response message consists of a status line, followed by header lines, followed by a blank line, followed by the entity body. In the case of our HTTP GET, the

entity body in the response is the *entire* requested HTML file. In our case here, the HTML file is rather long, and at 4500 bytes is too large to fit in one TCP packet. The single HTTP response message is thus broken into several pieces by TCP, with each piece being contained within a separate TCP segment (see Figure 1.24 in the text). In recent versions of Wireshark, Wireshark indicates each TCP segment as a separate packet, and the fact that the single HTTP response was fragmented across multiple TCP packets is indicated by the “TCP segment of a reassembled PDU” in the Info column of the Wireshark display. Earlier versions of Wireshark used the “Continuation” phrase to indicate that the entire content of an HTTP message was broken across multiple TCP segments. We stress here that there is no “Continuation” message in HTTP!

Lab Exercise:

Answer the following questions:

1. How many HTTP GET request messages did your browser send? Which packet number in the trace contains the GET message for the Bill of Rights?
2. Which packet number in the trace contains the status code and phrase associated with the response to the HTTP GET request?
3. What is the status code and phrase in the response?
4. How many data-containing TCP segments were needed to carry the single HTTP response and the text of the Bill of Rights?

4. HTML Documents with Embedded Objects

Now that we’ve seen how Wireshark displays the captured packet traffic for large HTML files, we can look at what happens when your browser downloads a file with embedded objects, i.e., a file that includes other objects (in the example below, image files) that are stored on another server(s).

Do the following:

- Start up your web browser, and make sure your browser’s cache is cleared, as discussed above.
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser
<http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file4.html>

Your browser should display a short HTML file with two images. These two images are referenced in the base HTML file. That is, the images themselves are not contained in the HTML; instead the URLs for the images are contained in the downloaded HTML file. As discussed in the textbook, your browser will have to retrieve these logos from the indicated web sites. Our publisher’s logo is retrieved from the gaia.cs.umass.edu web site. The image of the cover for our 5th edition (one of our favorite covers) is stored at the caite.cs.umass.edu server. (These are two different web servers inside cs.umass.edu).

- Stop Wireshark packet capture, and enter “http” in the display-filter-specification window, so that only captured HTTP messages will be displayed.

- (Note: If you are unable to run Wireshark on a live network connection, you can use the http-ethereal-trace-4 packet trace to answer the questions below; see footnote 1. This trace file was gathered while performing the steps above on one of the author's computers.)

Lab Exercise:

Answer the following questions:

1. How many HTTP GET request messages did your browser send? To which Internet addresses were these GET requests sent?
2. Can you tell whether your browser downloaded the two images serially, or whether they were downloaded from the two web sites in parallel? Explain.

5 HTTP Authentication

Finally, let's try visiting a web site that is password-protected and examine the sequence of HTTP message exchanged for such a site. The URL http://gaia.cs.umass.edu/wireshark-labs/protected_pages/HTTP-wireshark-file5.html is password protected. The username is "wireshark-students" (without the quotes), and the password is "network" (again, without the quotes). So let's access this "secure" password-protected site. Do the following:

- Make sure your browser's cache is cleared, as discussed above, and close down your browser. Then, start up your browser
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser
http://gaia.cs.umass.edu/wireshark-labs/protected_pages/HTTP-wireshark-file5.html

Type the requested user name and password into the pop up box.

- Stop Wireshark packet capture, and enter "http" in the display-filter-specification window, so that only captured HTTP messages will be displayed later in the packet-listing window.
- (Note: If you are unable to run Wireshark on a live network connection, you can use the http-ethereal-trace-5 packet trace to answer the questions below; see footnote 2. This trace file was gathered while performing the steps above on one of the author's computers.)

Now let's examine the Wireshark output. You might want to first read up on HTTP authentication by reviewing the easy-to-read material on "HTTP Access Authentication Framework" at [http://frontier.userland.com/stories/storyReader\\$2159](http://frontier.userland.com/stories/storyReader$2159)

Lab Exercise:

Answer the following questions:

16. What is the server's response (status code and phrase) in response to the initial HTTP GET message from your browser?
17. When your browser's sends the HTTP GET message for the second time, what new field is included in the HTTP GET message?

Objective:

Network traffic analysis of DNS using Wireshark.

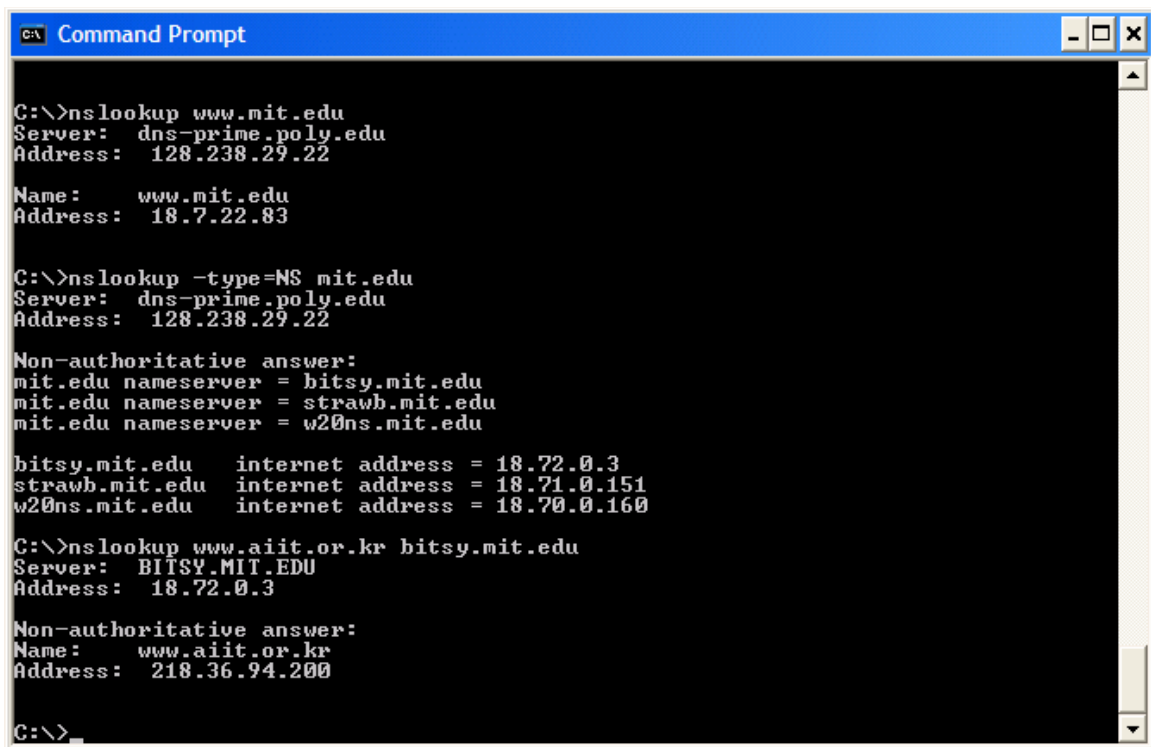
As described in Section 2.4 of the text¹, the Domain Name System (DNS) translates hostnames to IP addresses, fulfilling a critical role in the Internet infrastructure. In this lab, we'll take a closer look at the client side of DNS. Recall that the client's role in the DNS is relatively simple – a client sends a *query* to its local DNS server, and receives a *response* back. As shown in Figures 2.19 and 2.20 in the textbook, much can go on “under the covers,” invisible to the DNS clients, as the hierarchical DNS servers communicate with each other to either recursively or iteratively resolve the client's DNS query. From the DNS client's standpoint, however, the protocol is quite simple – a query is formulated to the local DNS server and a response is received from that server.

Before beginning this lab, you'll probably want to review DNS by reading Section 2.4 of the text. In particular, you may want to review the material on **local DNS servers**, **DNS caching**, **DNS records and messages**, and the **TYPE field** in the DNS record.

1. nslookup

In this lab, we'll make extensive use of the *nslookup* tool, which is available in most Linux/Unix and Microsoft platforms today. To run *nslookup* in Linux/Unix, you just type the *nslookup* command on the command line. To run it in Windows, open the Command Prompt and run *nslookup* on the command line.

In its most basic operation, *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 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.

A screenshot of a Windows Command Prompt window. The title bar is blue and says "C:\ Command Prompt". The background is black with white text. The text shows three separate `nslookup` commands and their outputs. The first command is `nslookup www.mit.edu`, which shows the default DNS server as `dns-prime.poly.edu` and the IP address of `www.mit.edu` as `18.7.22.83`. The second command is `nslookup -type=NS mit.edu`, which shows a non-authoritative answer with three nameservers: `bitsy.mit.edu`, `strawb.mit.edu`, and `w20ns.mit.edu`, each with its corresponding IP address. The third command is `nslookup www.aiit.or.kr bitsy.mit.edu`, which shows the IP address of `www.aiit.or.kr` as `218.36.94.200`. The prompt `C:\>` is visible at the bottom.

```
C:\>nslookup www.mit.edu
Server:  dns-prime.poly.edu
Address: 128.238.29.22

Name:    www.mit.edu
Address: 18.7.22.83

C:\>nslookup -type=NS mit.edu
Server:  dns-prime.poly.edu
Address: 128.238.29.22

Non-authoritative answer:
mit.edu nameserver = bitsy.mit.edu
mit.edu nameserver = strawb.mit.edu
mit.edu nameserver = w20ns.mit.edu

bitsy.mit.edu    internet address = 18.72.0.3
strawb.mit.edu   internet address = 18.71.0.151
w20ns.mit.edu    internet address = 18.70.0.160

C:\>nslookup www.aiit.or.kr bitsy.mit.edu
Server:  BITSY.MIT.EDU
Address: 18.72.0.3

Non-authoritative answer:
Name:    www.aiit.or.kr
Address: 218.36.94.200

C:\>
```

The above screenshot shows the results of three independent *nslookup* commands (displayed in the Windows Command Prompt). In this example, the client host is located on the campus of Polytechnic University in Brooklyn, where the default local DNS server is `dns-prime.poly.edu`. When running *nslookup*, if no DNS server is specified, then *nslookup* sends the query to the default DNS server, which in this case is `dns-prime.poly.edu`. Consider the first command:

```
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`. Although the response came from the local DNS server at Polytechnic University, it is quite possible that this local DNS server iteratively contacted several other DNS servers to get the answer, as described in Section 2.4 of the textbook.

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 answer, displayed in the above screenshot, first indicates the DNS server that is providing the answer (which is the default local DNS server) along with three MIT nameservers. Each of these servers is indeed an authoritative DNS server for the hosts on the MIT campus. However, *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. Finally, the answer also includes the IP addresses of the authoritative DNS servers at MIT. (Even though the type-NS query generated by *nslookup* did not explicitly ask for the IP addresses, the local DNS server returned these “for free” and *nslookup* displays the result.)

Now that we have provided an overview of *nslookup*, it is time for you to test drive it yourself. Do the following (and write down the results):

1. Run *nslookup* to obtain the IP address of a Web server in Asia. What is the IP address of that server?
2. Run *nslookup* to determine the authoritative DNS servers for a university in Europe.
3. Run *nslookup* so that one of the DNS servers obtained in Question 2 is queried for the mail servers for Yahoo! mail. What is its IP address?

2. ipconfig

ipconfig (for Windows) and *ifconfig* (for Linux/Unix) are among the most useful little utilities in your host, especially for debugging network issues. Here we’ll only describe *ipconfig*, although the Linux/Unix *ifconfig* is very similar. *ipconfig* can be used to show your Current TCP/IP information, including your address, DNS server addresses, adapter type and so on.

For example, if you all this information about your host simply by entering:

```
ipconfig \all
```

into the Command Prompt, as shown in the following screenshot.

```
Command Prompt
C:\>ipconfig /all

Windows IP Configuration

    Host Name . . . . . : USG11631-ZMWQA6
    Primary Dns Suffix . . . . . :
    Node Type . . . . . : Hybrid
    IP Routing Enabled. . . . . : No
    WINS Proxy Enabled. . . . . : No

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . : poly.edu
    Description . . . . . : Intel(R) PRO/100 VE Network Connection
    Physical Address. . . . . : 00-09-6B-10-60-99
    Dhcp Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    IP Address. . . . . : 128.238.38.160
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 128.238.38.1
    DHCP Server . . . . . : 128.238.29.25
    DNS Servers . . . . . : 128.238.29.22
                           128.238.29.23
                           128.238.2.38
                           128.238.32.22
    Primary WINS Server . . . . . : 128.238.29.23
    Secondary WINS Server . . . . . : 128.238.29.22
    Lease Obtained. . . . . : Monday, August 30, 2004 1:30:50 PM
    Lease Expires . . . . . : Monday, August 30, 2004 7:30:50 PM

C:\>
```

ipconfig is also very useful for managing the DNS information stored in your host. In Section 2.5 we learned that a host can cache DNS records it recently obtained. To see these cached records, after the prompt C:\> provide the following command:

```
ipconfig /displaydns
```

Each entry shows the remaining Time to Live (TTL) in seconds. To clear the cache, enter

```
ipconfig /flushdns
```

Flushing the DNS cache clears all entries and reloads the entries from the hosts file.

3. Tracing DNS with Wireshark

Now that we are familiar with *nslookup* and *ipconfig*, 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.

- Use *ipconfig* to empty the DNS cache in your host.
- Open your browser and empty your browser cache. (With Internet Explorer, go to Tools menu and select Internet Options; then in the General tab select Delete Files.)
- 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.
- Start packet capture in Wireshark.
- With your browser, visit the Web page: <http://www.ietf.org>
- Stop packet capture.

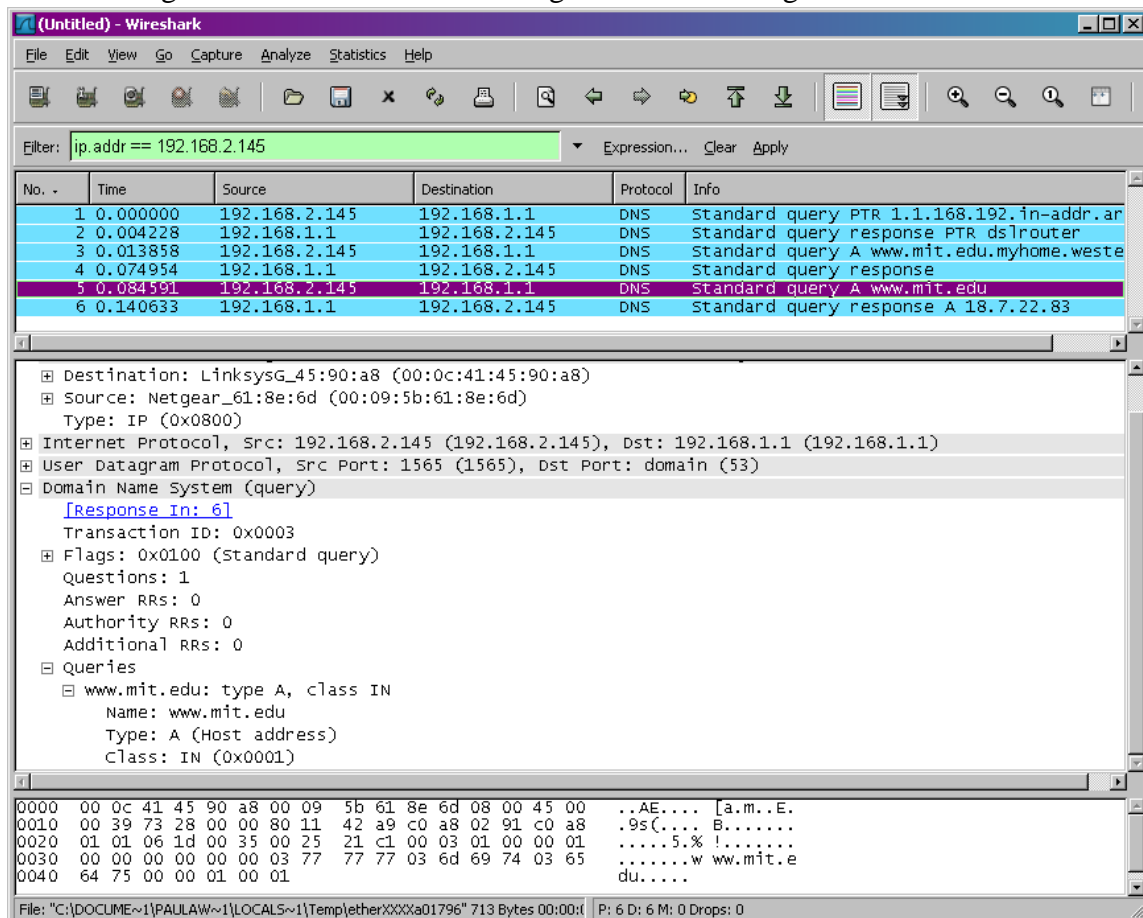
If you are unable to run Wireshark on a live network connection, you can download a packet trace file that was captured while following the steps above on one of the author's computers². Answer the following questions. Whenever possible, when answering a question below, you should hand in a printout of the packet(s) within the trace that you used to answer the question asked. Annotate the printout³ to explain your answer. To print a packet, use *File->Print*, choose *Selected packet only*, choose *Packet summary line*, and select the minimum amount of packet detail that you need to answer the question.

1. Locate the DNS query and response messages. Are then sent over UDP or TCP?
2. What is the destination port for the DNS query message? What is the source port of DNS response message?
3. To what IP address is the DNS query message sent? Use *ipconfig* to determine the IP address of your local DNS server. Are these two IP addresses the same?
4. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?
5. Examine the DNS response message. How many "answers" are provided? What do each of these answers contain?

Now let's play with *nslookup*.

- Start packet capture.
- Do an *nslookup* on *www.mit.edu*
- Stop packet capture.

You should get a trace that looks something like the following:



We see from the above screenshot that *nslookup* actually sent three DNS queries and received three DNS responses. For the purpose of this assignment, in answering the following questions, ignore the first two sets of queries/responses, as they are specific to *nslookup* and are not normally generated by standard Internet applications. You should instead focus on the last query and response messages.

⁴ If you are unable to run Wireshark and capture a trace file, use the trace file `dns-ethereal-trace-2` in the zip file <http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip>

Objective:

Network traffic analysis of TCP protocol using Wireshark

In this lab, we'll investigate the behavior of the celebrated TCP protocol in detail. We'll do so by analyzing a trace of the TCP segments sent and received in transferring a 150KB file (containing the text of Lewis Carroll's *Alice's Adventures in Wonderland*) from your computer to a remote server. We'll study TCP's use of sequence and acknowledgement numbers for providing reliable data transfer; we'll see TCP's congestion control algorithm – slow start and congestion avoidance – in action; and we'll look at TCP's receiver-advertised flow control mechanism. We'll also briefly consider TCP connection setup and we'll investigate the performance (throughput and round-trip time) of the TCP connection between your computer and the server.

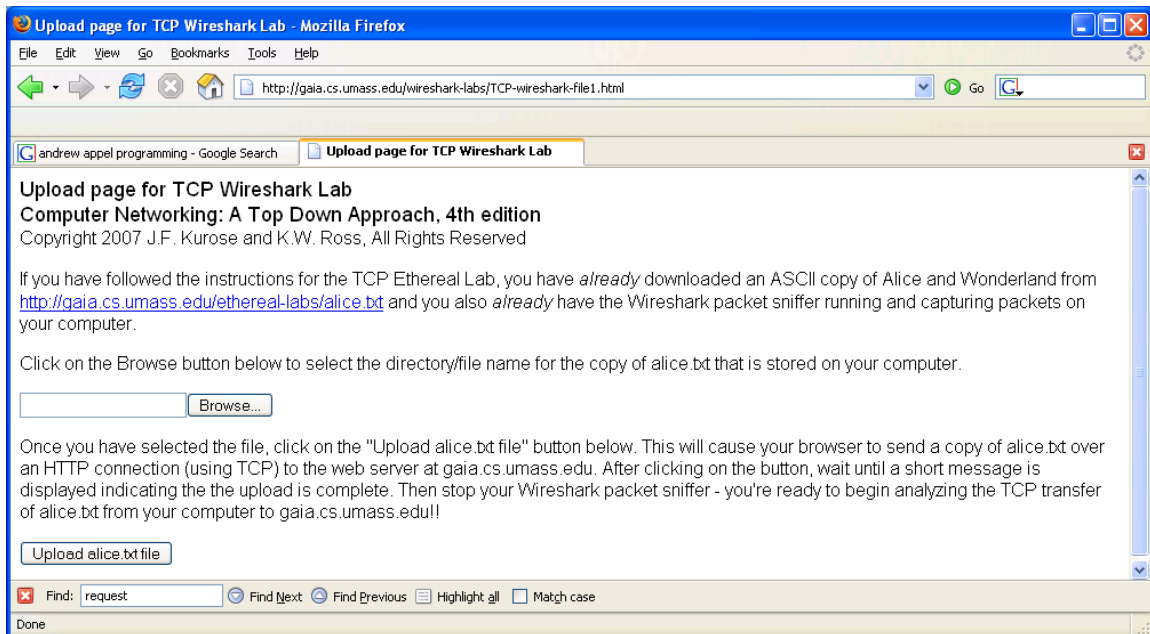
Before beginning this lab, you'll probably want to review sections 3.5 and 3.7 in the text¹.

1. Capturing a bulk TCP transfer from your computer to a remote server

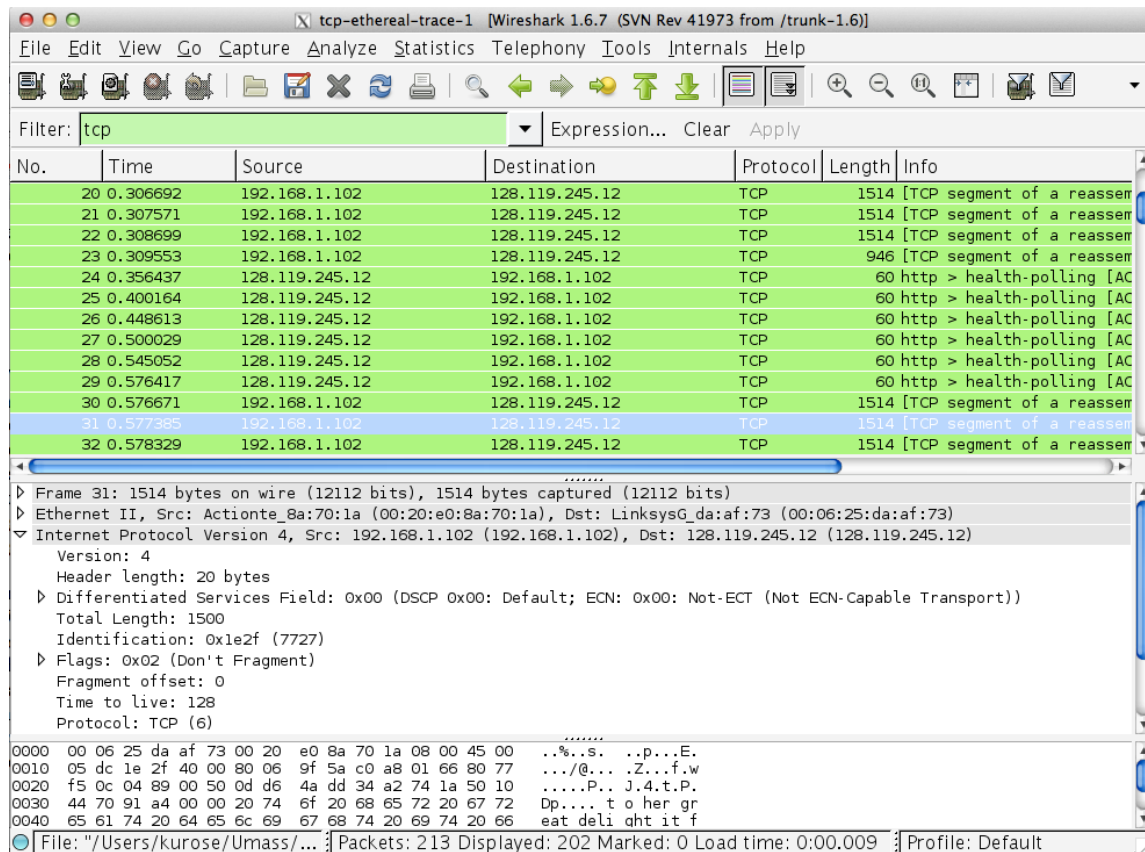
Before beginning our exploration of TCP, we'll need to use Wireshark to obtain a packet trace of the TCP transfer of a file from your computer to a remote server. You'll do so by accessing a Web page that will allow you to enter the name of a file stored on your computer (which contains the ASCII text of *Alice in Wonderland*), and then transfer the file to a Web server using the HTTP POST method (see section 2.2.3 in the text). We're using the POST method rather than the GET method as we'd like to transfer a large amount of data *from* your computer to another computer. Of course, we'll be running Wireshark during this time to obtain the trace of the TCP segments sent and received from your computer.

Do the following:

- Start up your web browser. Go the <http://gaia.cs.umass.edu/wireshark-labs/alice.txt> and retrieve an ASCII copy of *Alice in Wonderland*. Store this file somewhere on your computer.
- Next go to <http://gaia.cs.umass.edu/wireshark-labs/TCP-wireshark-file1.html>.
- You should see a screen that looks like:



- Use the *Browse* button in this form to enter the name of the file (full path name) on your computer containing *Alice in Wonderland* (or do so manually). Don't yet press the "*Upload alice.txt file*" button.
- Now start up Wireshark and begin packet capture (*Capture->Start*) and then press *OK* on the Wireshark Packet Capture Options screen (we'll not need to select any options here).
- Returning to your browser, press the "*Upload alice.txt file*" button to upload the file to the `gaia.cs.umass.edu` server. Once the file has been uploaded, a short congratulations message will be displayed in your browser window.
- Stop Wireshark packet capture. Your Wireshark window should look similar to the window shown below.



If you are unable to run Wireshark on a live network connection, you can download a packet trace file that was captured while following the steps above on one of the author's computers². You may well find it valuable to download this trace even if you've captured your own trace and use it, as well as your own trace, when you explore the questions below.

2. A first look at the captured trace

Before analyzing the behavior of the TCP connection in detail, let's take a high level view of the trace.

- First, filter the packets displayed in the Wireshark window by entering "tcp" (lowercase, no quotes, and don't forget to press return after entering!) into the display filter specification window towards the top of the Wireshark window.

What you should see is series of TCP and HTTP messages between your computer and gaia.cs.umass.edu. You should see the initial three-way handshake containing a SYN message. You should see an HTTP POST message. Depending on the version of

² Download the zip file <http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip> and extract the file tcp-ethereal-trace-1. The traces in this zip file were collected by Wireshark running on one of the author's computers, while performing the steps indicated in the Wireshark lab. Once you have downloaded the trace, you can load it into Wireshark and view the trace using the *File* pull down menu, choosing *Open*, and then selecting the tcp-ethereal-trace-1 trace file.

Wireshark you are using, you might see a series of “HTTP Continuation” messages being sent from your computer to `gaia.cs.umass.edu`. Recall from our discussion in the earlier HTTP Wireshark lab, that is no such thing as an HTTP Continuation message – this is Wireshark’s way of indicating that there are multiple TCP segments being used to carry a single HTTP message. In more recent versions of Wireshark, you’ll see “[TCP segment of a reassembled PDU]” in the Info column of the Wireshark display to indicate that this TCP segment contained data that belonged to an upper layer protocol message (in our case here, HTTP). You should also see TCP ACK segments being returned from `gaia.cs.umass.edu` to your computer.

Answer the following questions, by opening the Wireshark captured packet file *tcp-ethereal-trace-1* in <http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip> (that is download the trace and open that trace in Wireshark; see footnote 2). Whenever possible, when answering a question you should hand in a printout of the packet(s) within the trace that you used to answer the question asked. Annotate the printout³ to explain your answer. To print a packet, use *File->Print*, choose *Selected packet only*, choose *Packet summary line*, and select the minimum amount of packet detail that you need to answer the question.

1. What is the IP address and TCP port number used by the client computer (source) that is transferring the file to `gaia.cs.umass.edu`? To answer this question, it’s probably easiest to select an HTTP message and explore the details of the TCP packet used to carry this HTTP message, using the “details of the selected packet header window” (refer to Figure 2 in the “Getting Started with Wireshark” Lab if you’re uncertain about the Wireshark windows).
2. What is the IP address of `gaia.cs.umass.edu`? On what port number is it sending and receiving TCP segments for this connection?

If you have been able to create your own trace, answer the following question:

3. What is the IP address and TCP port number used by your client computer (source) to transfer the file to `gaia.cs.umass.edu`?

Since this lab is about TCP rather than HTTP, let’s change Wireshark’s “listing of captured packets” window so that it shows information about the TCP segments containing the HTTP messages, rather than about the HTTP messages. To have Wireshark do this, select *Analyze->Enabled Protocols*. Then uncheck the HTTP box and select *OK*. You should now see a Wireshark window that looks like:

tcp-ethereal-trace-1 [Wireshark 1.6.7 (SVN Rev 41973 from /trunk-1.6)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: tcp Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	health-polling > http [SYN]
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	http > health-polling [SYNACK]
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	health-polling > http [ACK]
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	health-polling > http [POST]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	health-polling > http [POST]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	http > health-polling [ACK]
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	health-polling > http [ACK]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	health-polling > http [ACK]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	http > health-polling [ACK]
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	health-polling > http [ACK]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	health-polling > http [ACK]
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	http > health-polling [ACK]
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	health-polling > http [POST]

Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)

Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)

Destination: LinksysG_da:af:73 (00:06:25:da:af:73)

Address: LinksysG_da:af:73 (00:06:25:da:af:73)

...0... = IG bit: Individual address (unicast)

...0... = LG bit: Globally unique address (factory default)

Source: Actionte_8a:70:1a (00:20:e0:8a:70:1a)

Address: Actionte_8a:70:1a (00:20:e0:8a:70:1a)

...0... = IG bit: Individual address (unicast)

...0... = LG bit: Globally unique address (factory default)

```

0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%.s.  ..p...E.
0010  00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77  .0..@...  ....f.w
0020  f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02  ....P...  .....p.
0030  40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02      @.....  .....

```

File: "/Users/kurose/Umass/... Packets: 213 Displayed: 202 Marked: 0 Load time: 0:00.011 Profile: Default

Lab Exercise:

Answer the following questions for the TCP segments:

- What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu? What is it in the segment that identifies the segment as a SYN segment?
- What is the sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment? How did gaia.cs.umass.edu determine that value? What is it in the segment that identifies the segment as a SYNACK segment?
- What is the sequence number of the TCP segment containing the HTTP POST command? Note that in order to find the POST command, you'll need to dig into the packet content field at the bottom of the Wireshark window, looking for a segment with a "POST" within its DATA field.

Objective:

Network traffic analysis of UDP protocol using Wireshark

In this lab, we'll take a quick look at the UDP transport protocol. As we saw in Chapter 3 of the text¹, UDP is a streamlined, no-frills protocol. You may want to re-read section 3.3 in the text before doing this lab. Because UDP is simple and sweet, we'll be able to cover it pretty quickly in this lab. So if you've another appointment to run off to in 30 minutes, no need to worry, as you should be able to finish this lab with ample time to spare.

At this stage, you should be a Wireshark expert. Thus, we are not going to spell out the steps as explicitly as in earlier labs. In particular, we are not going to provide example screenshots for all the steps.

The Assignment Lab Exercise:

Start capturing packets in Wireshark and then do something that will cause your host to send and receive several UDP packets. It's also likely that just by doing nothing (except capturing packets via Wireshark) that some UDP packets sent by others will appear in your trace. In particular, the Simple Network Management Protocol (SNMP – see section 5.7 in the text) sends SNMP messages inside of UDP, so it's likely that you'll find some SNMP messages (and therefore UDP packets) in your trace.

After stopping packet capture, set your packet filter so that Wireshark only displays the UDP packets sent and received at your host. Pick one of these UDP packets and expand the UDP fields in the details window. If you are unable to find UDP packets or are unable to run Wireshark on a live network connection, you can download a packet trace containing some UDP packets.²

¹

Lab Exercise:

1. Select *one* UDP packet from your trace. From this packet, determine how many fields there are in the UDP header. (You shouldn't look in the textbook! Answer these questions directly from what you observe in the packet trace.) Name these fields.
 2. By consulting the displayed information in Wireshark's packet content field for this packet, determine the length (in bytes) of each of the UDP header fields.
 3. The value in the Length field is the length of what? (You can consult the text for this answer). Verify your claim with your captured UDP packet.
 4. What is the maximum number of bytes that can be included in a UDP payload? (Hint: the answer to this question can be determined by your answer to 2. above)
 5. What is the largest possible source port number? (Hint: see the hint in 4.)
 6. What is the protocol number for UDP? Give your answer in both hexadecimal and decimal notation. To answer this question, you'll need to look into the Protocol field of the IP datagram containing this UDP segment (see Figure 4.13 in the text, and the discussion of IP header fields).
 7. Examine a pair of UDP packets in which your host sends the first UDP packet and the second UDP packet is a reply to this first UDP packet. (Hint: for a second packet to be sent in response to a first packet, the sender of the first packet should be the destination of the second packet). Describe the relationship between the port numbers in the two packets.
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