NNS Lab 1 – Appendix 1

Wireshark Tutorial

Introduction

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.

Figure 1 shows the structure of a packet sniffer. At the right of Figure 1 are the protocols (in this case, Internet protocols) and applications (such as a web browser or ftp client) that normally run on your computer. The packet sniffer, shown within the dashed rectangle in Figure 1 is an addition to the usual software in your computer, and consists of two parts. The **packet capture library** receives a copy of every link-layer frame that is sent from or received by your computer. Recall from the discussion from section 1.5 in the book that messages exchanged by higher layer protocols such as HTTP, FTP, TCP, UDP, DNS, or IP all are eventually encapsulated in link-layer frames that are transmitted over physical media such as an Ethernet cable. In Figure 1, the assumed physical media is an Ethernet, and so all upper-layer protocols are eventually encapsulated within an Ethernet frame. Capturing all link-layer frames thus gives you all messages sent/received from/by all protocols and applications executing in your computer.

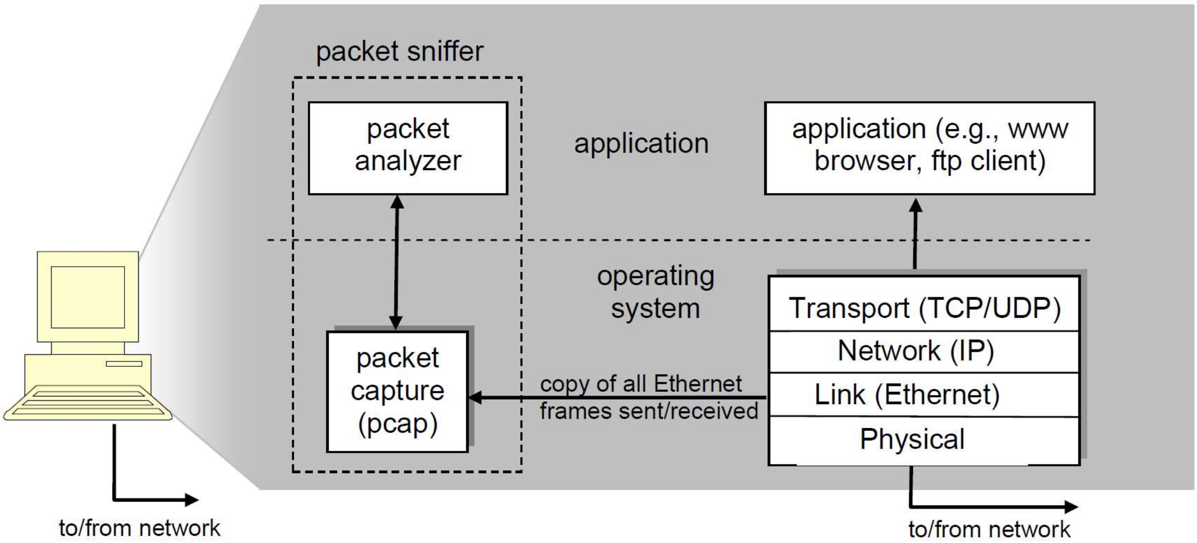


Figure 1 Packet sniffer structure

The second component of a packet sniffer is the **packet analyzer**, which displays the contents of all fields within a protocol message. In order to do so, the packet analyzer must "understand" the structure of all messages exchanged by protocols. For example, suppose we are interested in displaying the various fields in messages exchanged by the HTTP protocol in Figure 1. The packet analyzer understands the format of Ethernet frames, and so can identify the IP datagram within an Ethernet frame. It also understands the IP datagram format, so that it can extract the TCP segment within the IP datagram.

Finally, it understands the TCP segment structure, so it can extract the HTTP message contained in the TCP segment. Finally, it understands the HTTP protocol and so, for example, knows that the first bytes of an HTTP message will contain the string “GET,” “POST,” or “HEAD,” as shown in Figure 2.8 in the text.

We will be using the Wireshark packet sniffer [http://www.wireshark.org/] for these labs, allowing us to display the contents of messages being sent/received from/by protocols at different levels of the protocol stack. (Technically speaking, Wireshark is a packet analyzer that uses a packet capture library in your computer). Wireshark is a free network protocol analyzer that runs on Windows, Linux/Unix, and Mac computers. It’s an ideal packet analyzer for our labs – it is stable, has a large user base and well documented support that includes a user-guide (http://www.wireshark.org/docs/wsug_html_chunked/), man pages (http://www.wireshark.org/docs/man-pages/), and a detailed FAQ (http://www.wireshark.org/faq.html), rich functionality that includes the capability to analyze hundreds of protocols, and a well-designed user interface. It operates in computers using Ethernet, serial (PPP and SLIP), 802.11 wireless LANs, and many other link-layer technologies (if the OS on which it's running allows Wireshark to do so).

Install Wireshark

The Wireshark is already installed on the lab machines. If you want to install it also on your computer, then follow these instructions. First you have to download and install wireshark. You can download and install the proper version for your operating system from http://www.wireshark.org/download.html. Have in mind that you have to have administrator right to the machine.

For more information about wireshark you can see the user-guide http://www.wireshark.org/docs/wsug_html_chunked/ and the FAQ http://www.wireshark.org/faq.html.

Running Wireshark

When you run the Wireshark program, you’ll get a startup screen, as shown below:

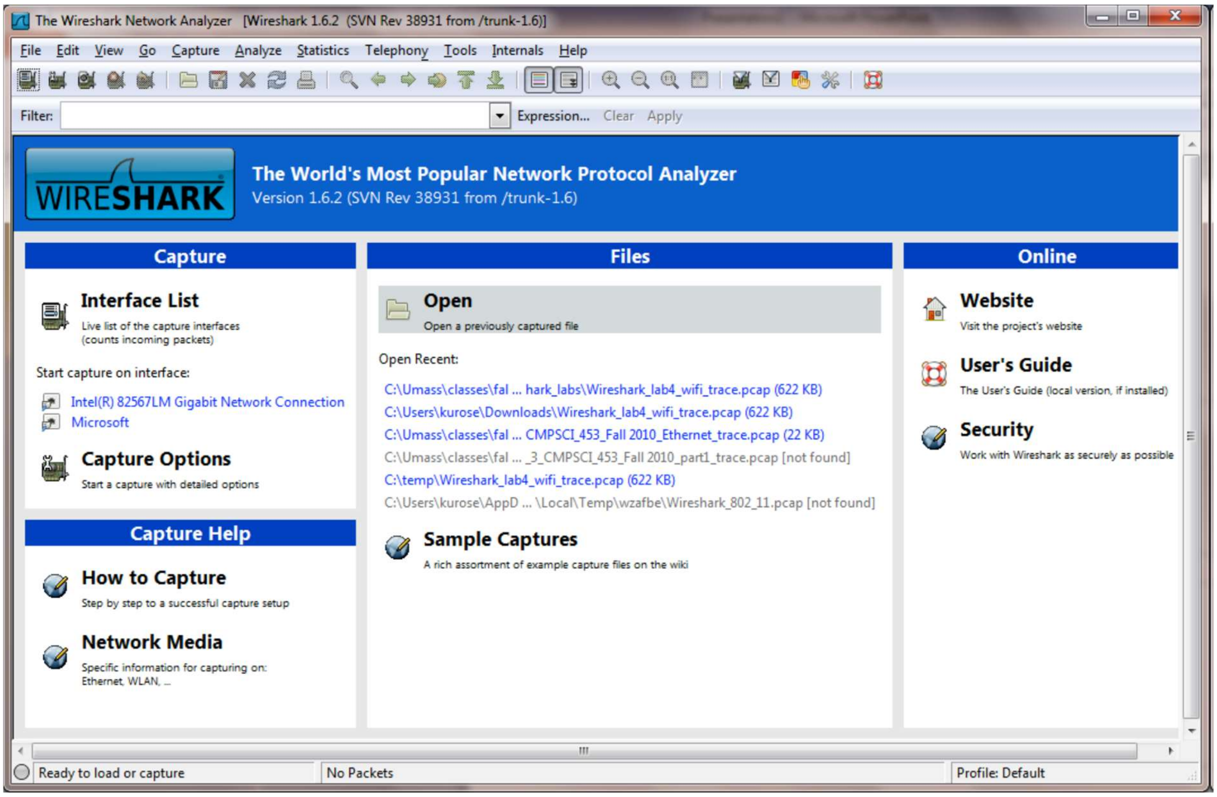
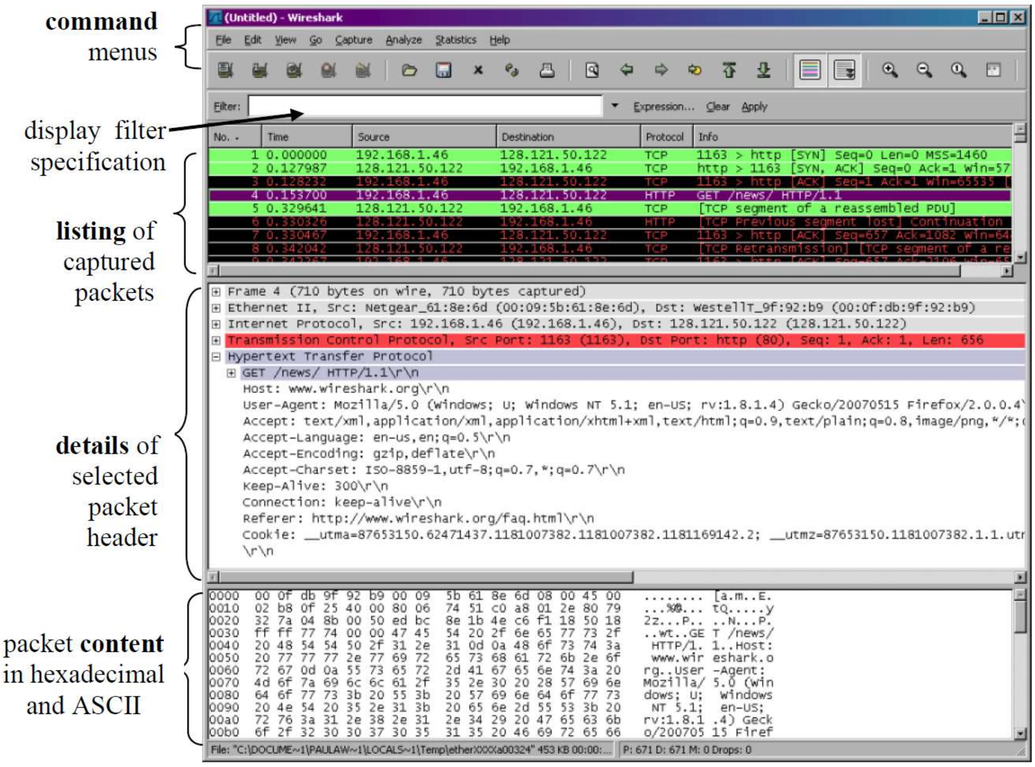

The Wireshark Network Analyzer [Wireshark 1.6.2 (SVN Rev 38931 from /trunk-1.6)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply
WIRESHARK
The World's Most Popular Network Protocol Analyzer
Version 1.6.2 (SVN Rev 38931 from /trunk-1.6)
Capture
Interface List
Live list of the capture interfaces (counts incoming packets)
Start capture on interface:
Intel(R) 82567LM Gigabit Network Connection
Microsoft
Capture Options
Start a capture with detailed options
Capture Help
How to Capture
Step by step to a successful capture setup
Network Media
Specific information for capturing on: Ethernet, WLAN, ...
Files
Open
Open a previously captured file
Open Recent:
C:\Umass\classes\fal ... hark_labs\Wireshark_lab4_wifi_trace.pcap (622 KB)
C:\Users\kurose\Downloads\Wireshark_lab4_wifi_trace.pcap (622 KB)
C:\Umass\classes\fal ... CMPSCI_453_Fall 2010_Ethernet_trace.pcap (22 KB)
C:\Umass\classes\fal ... _3_CMPSCI_453_Fall 2010_part1_trace.pcap [not found]
C:\temp\Wireshark_lab4_wifi_trace.pcap (622 KB)
C:\Users\kurose\AppD ... \Local\Temp\wzafbe\Wireshark_802_11.pcap [not found]
Sample Captures
A rich assortment of example capture files on the wiki
Online
Website
Visit the project's website
User's Guide
The User's Guide (local version, if installed)
Security
Work with Wireshark as securely as possible
Ready to load or capture
No Packets
Profile: Default

Figure 2 Initial Wireshark Screen

Take a look at the upper left hand side of the screen – you'll see an "Interface list". This is the list of network interfaces on your computer. Once you choose an interface, Wireshark will capture all packets on that interface. In the example above, there is an Ethernet interface (Gigabit network Connection) and a wireless interface ("Microsoft").

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.


command menus
display filter specification
listing of captured packets
details of selected packet header
packet content in hexadecimal and ASCII
(Untitled) - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter:
Expression... Clear Apply

```
No. .  Time        Source           Destination      Protocol  Info
  1 0.000000    192.168.1.46     128.121.50.122   TCP       1163 > http [SYN] Seq=0 Len=0 MSS=1460
  2 0.127987    128.121.50.122   192.168.1.46     TCP       http > 1163 [SYN, ACK] Seq=0 Ack=1 Win=57
  3 0.128232    192.168.1.46     128.121.50.122   TCP       1163 > http [ACK] Seq=1 Ack=1 Win=65535 [
  4 0.153700    192.168.1.46     128.121.50.122   HTTP      GET /news/ HTTP/1.1
  5 0.329641    128.121.50.122   192.168.1.46     TCP       [TCP segment of a reassembled PDU]
  6 0.330326    128.121.50.122   192.168.1.46     HTTP      [TCP Previous segment lost] Continuation
  7 0.330467    192.168.1.46     128.121.50.122   TCP       1163 > http [ACK] Seq=657 Ack=1082 Win=64
  8 0.342042    128.121.50.122   192.168.1.46     TCP       [TCP Retransmission] [TCP segment of a re
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⊞ Frame 4 (710 bytes on wire, 710 bytes captured)
⊞ Ethernet II, Src: Netgear_61:8e:6d (00:09:5b:61:8e:6d), Dst: WestellT_9f:92:b9 (00:0f:db:9f:92:b9)
⊞ Internet Protocol, Src: 192.168.1.46 (192.168.1.46), Dst: 128.121.50.122 (128.121.50.122)
⊞ Transmission Control Protocol, Src Port: 1163 (1163), Dst Port: http (80), Seq: 1, Ack: 1, Len: 656
⊟ Hypertext Transfer Protocol
  ⊞ GET /news/ HTTP/1.1\r\n
    Host: www.wireshark.org\r\n
    User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.8.1.4) Gecko/20070515 Firefox/2.0.0.4
    Accept: text/xml,application/xml,application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;
    Accept-Language: en-us,en;q=0.5\r\n
    Accept-Encoding: gzip,deflate\r\n
    Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7\r\n
    Keep-Alive: 300\r\n
    Connection: keep-alive\r\n
    Referer: http://www.wireshark.org/faq.html\r\n
    Cookie: __utma=87653150.62471437.1181007382.1181007382.1181169142.2; __utmz=87653150.1181007382.1.1.utr
    \r\n
```

```
0000  00 0f db 9f 92 b9 00 09  5b 61 8e 6d 08 00 45 00   ........ [a.m..E.
0010  02 b8 0f 25 40 00 80 06  74 51 c0 a8 01 2e 80 79   ...%@... tQ.....y
0020  32 7a 04 8b 00 50 ed bc  8e 1b 4e c6 f1 18 50 18   2z...P.. ..N...P.
0030  ff ff 77 74 00 00 47 45  54 20 2f 6e 65 77 73 2f   ..wt..GE T /news/
0040  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1..Host:
0050  20 77 77 77 2e 77 69 72  65 73 68 61 72 6b 2e 6f    www.wir eshark.o
0060  72 67 0d 0a 55 73 65 72  2d 41 67 65 6e 74 3a 20   rg..User -Agent: 
0070  4d 6f 7a 69 6c 6c 61 2f  35 2e 30 20 28 57 69 6e   Mozilla/ 5.0 (Win
0080  64 6f 77 73 3b 20 55 3b  20 57 69 6e 64 6f 77 73   dows; U;  Windows
0090  20 4e 54 20 35 2e 31 3b  20 65 6e 2d 55 53 3b 20    NT 5.1;  en-US; 
00a0  72 76 3a 31 2e 38 2e 31  2e 34 29 20 47 65 63 6b   rv:1.8.1 .4) Geck
00b0  6f 2f 32 30 30 37 30 35  31 35 20 46 69 72 65 66   o/200705 15 Firef
```

File: "C:\DOCUME~1\PAULAW~1\LOCALS~1\Temp\etherXXXXa00324" 453 KB 00:00:... P: 671 D: 671 M: 0 Drops: 0

Figure 3 Wireshark Graphical User Interface, during packet capture and analysis

The Wireshark interface has five major components:

- The **command menus** are standard pulldown menus located at the top of the windows. 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 packet- listing 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.

Capturing packets with Wireshark

If you have installed Wireshark on your machine(s) you can try the following out to capture some Internet packets.

Also here, you can find some instruction on how to make packet filtering.

Before to start be sure that your computer is connected to the Internet via a wired Ethernet interface (you can also use a wireless connection, but we recommend you to use wired for the first time). Do the following:

1. Start up your favorite web browser, which will display your selected homepage.

2. Start up the Wireshark software. You will initially see a window similar to that shown in Figure 2 in appendix 1. Wireshark has not yet begun capturing packets.

3. To begin packet capture, select the Capture pull down menu and select Interfaces. This will cause the “Wireshark: Capture Interfaces” window to be displayed.

4. You'll see a list of the interfaces on your computer as well as a count of the packets that have been observed on that interface so far. Click on Start for the interface on which you want to begin packet capture. Packet capture will now begin - Wireshark is now capturing all packets being sent/received from/by your computer!

5. Once you begin packet capture, a window similar to that shown in Figure 3 in appendix 1 will appear. This window shows the packets being captured. To capture some interesting packets, we'll need to generate some network traffic. Let's do so using a web browser, which will use the HTTP protocol to download content from a website.

6. Before to continue you have to clear the cache of your browser. To do that in Firefox select *Tools->Clear Recent History*, expand the details and choose *Cache*, next press *clear now*. For Chrome go to *History->Show Full History* and next press *Clear all browsing data…*, select *Empty the cache* and press *Clear browsing data*.

7. While Wireshark is running, enter the URL of your favorable website and have that page displayed in your browser. In order to display this page, your browser will contact the HTTP server of the website and exchange HTTP messages with the server in order to download this page. The Ethernet frames containing these HTTP messages (as well as all other frames passing through your Ethernet adapter) will be captured by Wireshark.

8. After your browser has displayed the webpage, stop Wireshark packet capture by selecting stop in the Wireshark capture window. The main Wireshark window should now

look similar to Figure 3. 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 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 in appendix 1).

9. 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 dissplayed in the packet-listing window.

10. Find the HTTP GET message that was sent from your computer to the HTTP web server. Look for an HTTP GET message in the “listing of captured packets” portion of the Wireshark window (see Figure 3) that shows “GET” followed by the name of the file that you requested. If it still hard to find it, then type in the filter window ¨http.request¨ and press enter. This will show only the HTTP request packets that were sent from your computer. Furthermore you can filter more the displayed packets by defining the IP address where a HTTP message was sent or received. To do that you type in the filter window ¨http && ip.addr==X.Y.Z.N¨, where X.Y.Z.N the IP address. Notice that, you can filter using conjunction (&&) of expressions or disjunction (||) of expressions. You can always press the Expression button at the right of the packet display filter field to see all the available expressions.

References

- Computer Networking: A Top-Down Approach, 6 edition. http://wps.pearsoned.co.uk/ema_ie_kurose_compnetw_6
- http://wireshark.org/