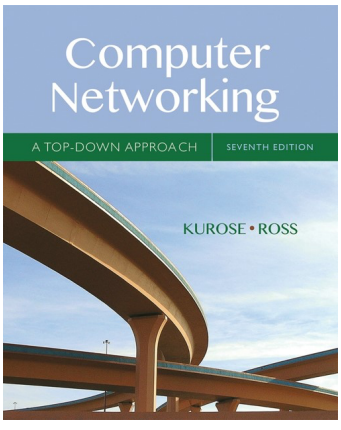
# CS 447: Network and Data Communication

## Wireshark Lab #03: NAT






**Note**:

- Make sure you produce your answers and any packet prints in PDF. Moodle will only accept PDF files.
- Provide a screenshot with each answer wherever applicable or possible as proof of your work.

In this lab, we'll investigate the behavior of the NAT protocol. This lab will be different from our other Wireshark labs, where we've captured a trace file at a single Wireshark measurement point. Because we're interested in capturing packets at both the input and output sides of the NAT device, we'll need to capture packets at two locations. Also, because many students don't have easy access to a NAT device or to two computers on which to take Wireshark measurements, this isn't a lab that is easily done "live" by a student. Therefore in this lab, you will use Wireshark trace files that we've captured for you. Before beginning this lab, you'll probably want to review the material on NAT section 4.3.4 in the text.[1]

## NAT Measurement Scenario

In this lab, we'll capture packets from a simple web request from a client PC in a home network to a www.google.com server. Within the home network, the home network router provides a NAT service, as discussed in Chapter 4.

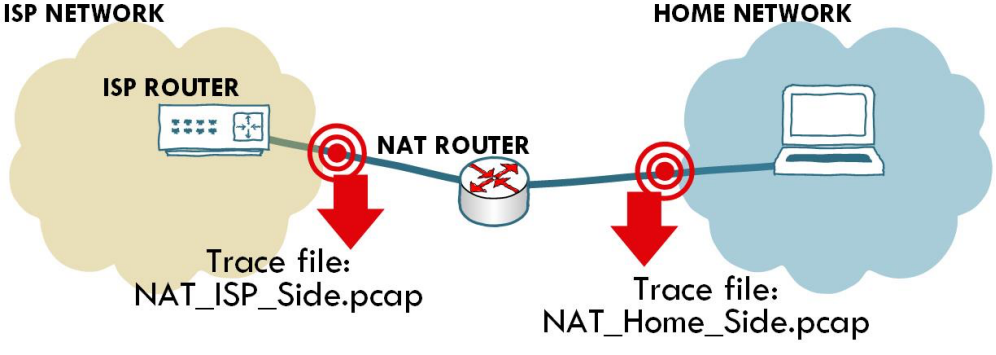



**Figure 1: NAT Trace Collection**

Figure 1 shows our Wireshark trace-collection scenario. As shown, you'll need two .pcap trace files – one for the home side and one for the ISP side – for either side of the NAT router. Please download the pre-captured trace files from https://www.cs.siue.edu/~tgamage/pcaps/nat-pcap.tar.gz

[1] References to figures and sections are for Computer Networking, A Top-down Approach, 7th ed., J.F. Kurose and K.W. Ross, Addison-Wesley/Pearson, 2017.

Open the NAT_Home_Side.pcap file from Wireshark and answer the following questions. You might find it useful to use a Wireshark filter so that only frames containing HTTP messages are displayed from the trace file. When answering a question below, whenever possible, you should hand in a printout of the packet(s) within the trace that you used to answer the question asked. Annotate the printout[2] 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 of the client?
2. The client actually communicates with several different Google servers in order to implement "safe browsing." (See extra credit section at the end of this lab). The main Google server that will serve up the main Google web page has IP address 64.233.169.104. In order to display only those frames containing HTTP messages that are sent to/from this Google, server, enter the expression "http && ip.addr == 64.233.169.104" (without quotes) into the Filter: field in Wireshark .
3. Consider now the HTTP GET sent from the client to the Google server (whose IP address is IP address 64.233.169.104) at time 7.109267. What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP GET?
4. At what time[3] is the corresponding 200 OK HTTP message received from the Google server? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP 200 OK message?
5. Recall that before a GET command can be sent to an HTTP server, TCP must first set up a connection using the three-way SYN/ACK handshake. At what time is the client-to-server TCP SYN segment sent that sets up the connection used by the GET sent at time 7.109267? What are the source and destination IP addresses and source and destination ports for the TCP SYN segment? What are the source and destination IP addresses and source and destination ports of the ACK sent in response to the SYN. At what time is this ACK received at the client? (Note: to find these segments you will need to clear the Filter expression you entered above in step 2. If you enter the filter "tcp", only TCP segments will be displayed by Wireshark).

In the following, we'll focus on the two HTTP messages (GET and 200 OK) and the TCP SYN and ACK segments identified above. Our goal below will be to locate these two HTTP messages and two TCP segments in the trace file (NAT_ISP_Side) captured on the link between the router and the ISP. Because these captured frames will have already been forwarded through the NAT router, some of the IP address and port numbers will have been changed as a result of NAT translation.

Open the NAT_ISP_Side.pcap. *Note that the timestamps in this file and in NAT_Home_Side.pcap are not synchronized since the packet captures at the two locations shown in* Figure 1 *were not started simultaneously.* (Indeed, you should discover that the timestamps of the packet captured at the ISP link is less than that of the timestamp of the packet captured at Home link.

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[2] What do we mean by "annotate"? If you hand in a paper copy, please highlight where in the printout you've found the answer and add some text (preferably with a colored pen) noting what you found in what you've highlight. If you hand in an electronic copy, it would be great if you could also highlight and annotate

[3] Specify time using the time since the beginning of the trace (rather than absolute, wall-clock time).

6. In the NAT_ISP_Side.pcap file, find the HTTP GET message was sent from the client to the Google server at time 7.109267 (where t=7.109267 is time at which this was sent as recorded in the NAT_home_side trace file). At what time does this message appear in the NAT_ISP_side trace file? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP GET (as recording in the NAT_ISP_side trace file)? Which of these fields are the same, and which are different, than in your answer to question 3 above?
7. Are any fields in the HTTP GET message changed? Which of the following fields in the IP datagram carrying the HTTP GET are changed: Version, Header Length, Flags, Checksum. If any of these fields have changed, give a reason (in one sentence) stating why this field needed to change.
8. In the NAT_ISP_Side trace file, at what time is the first 200 OK HTTP message received from the Google server? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP 200 OK message? Which of these fields are the same, and which are different than your answer to question 4 above?
9. In the NAT_ISP_Side trace file, at what time were the client-to-server TCP SYN segment and the server-to-client TCP ACK segment corresponding to the segments in question 5 above captured? What are the source and destination IP addresses and source and destination ports for these two segments? Which of these fields are the same, and which are different than your answer to question 5 above?

Figure 4.25 in the text shows the NAT translation table in the NAT router.

10. Using your answers to 1-8 above, fill in the NAT translation table entries for HTTP connection considered in questions 1-8 above.

# Extra Credit

The trace files investigated above have additional connections to Google servers above and beyond the HTTP GET, 200 OK request/response studied above. For example, in the NAT_Home_Side trace file, consider the client-to-server GET at time 1.572315, and the GET at time 7.573305. Research the use of these two HTTP messages and write a half page explanation of the purpose of each of these messages.