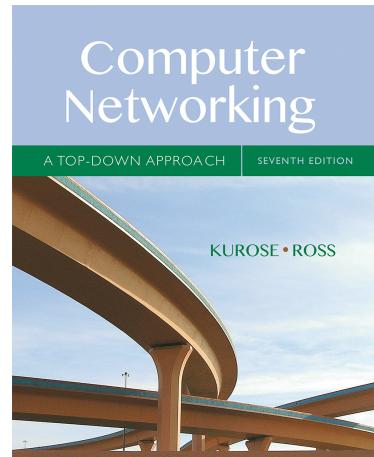


Wireshark Lab: NAT v7.0

Supplement to *Computer Networking: A Top-Down Approach*, 7th ed., J.F. Kurose and K.W. Ross

“Tell me and I forget. Show me and I remember. Involve me and I understand.” Chinese proverb

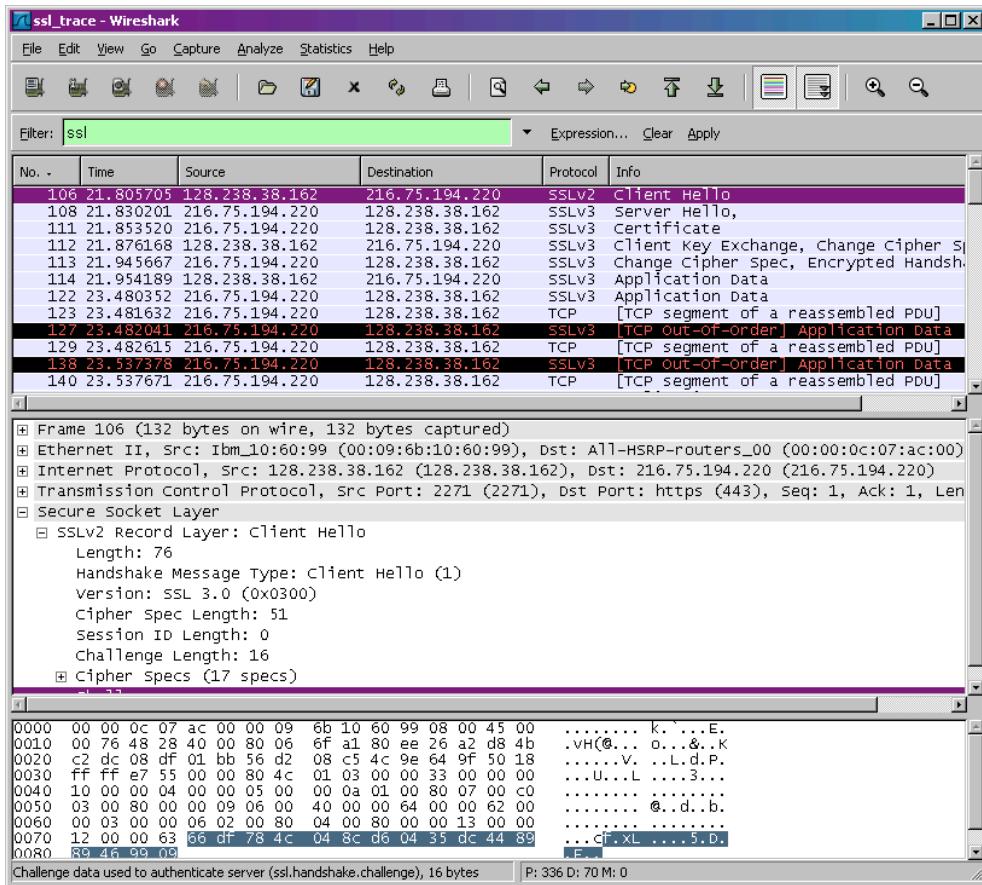


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In this lab, we'll investigate the Secure Sockets Layer (SSL) protocol, focusing on the SSL records sent over a TCP connection. We'll do so by analyzing a trace of the SSL records sent between your host and an e-commerce server. We'll investigate the various SSL record types as well as the fields in the SSL messages. You may want to review Section 8.6 in the text¹.

Note: Modified original assignment a bit.

¹ References to figures and sections are for the 7th edition of our text, *Computer Networks, A Top-down Approach*, 7th ed., J.F. Kurose and K.W. Ross, Addison-Wesley/Pearson, 2016.



1. Capturing packets in an SSL session

The first step is to capture the packets in an SSL session. To do this, you should go to your favorite e-commerce site and begin the process of purchasing an item (but terminating before making the actual purpose!) or browsing any webserver that used HTTPS. After capturing all the packets with Wireshark/TCPDUMP, you should set the filter so that it displays only the Ethernet frames that contain SSL records sent from and received by your host. (An SSL record is the same thing as an SSL message.) You should obtain something like screenshot on the previous page.

2. A look at the captured trace

Your Wireshark GUI should be displaying only the Ethernet frames that have SSL records. It is important to keep in mind that an Ethernet frame may contain one or more SSL records. (This is very different from HTTP, for which each frame contains either one complete HTTP message or a portion of a HTTP message.) Also, an SSL record may not

completely fit into an Ethernet frame, in which case multiple frames will be needed to carry the record.

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 printout² 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. For each of the first 8 Ethernet frames, specify the source of the frame (client or server), determine the number of SSL records that are included in the frame, and list the SSL record types that are included in the frame. Draw a timing diagram between client and server, with one arrow for each SSL record.
2. Each of the SSL records begins with the same three fields (with possibly different values). One of these fields is “content type” and has length of one byte. List all three fields and their lengths.

[ClientHello Record:](#)

3. Expand the ClientHello record. (If your trace contains multiple ClientHello records, expand the frame that contains the first one.) What is the value of the content type?
4. Does the ClientHello record contain a nonce (also known as a “challenge”)? If so, what is the value of the challenge in hexadecimal notation?
5. Does the ClientHello record advertise the cipher suites it supports? If so, in the different listed suites, what are the public-key algorithm, the symmetric-key algorithm, and the hash algorithm?

[ServerHello Record:](#)

6. Locate the ServerHello SSL record. Does this record specify a chosen cipher suite? What are the algorithms in the chosen cipher suite?
7. Does this record include a nonce? If so, how long is it? What is the purpose of the client and server nonces in SSL?
8. Does this record include a session ID? What is the purpose of the session ID?
9. Does this record contain a certificate, or is the certificate included in a separate record. Does the certificate fit into a single Ethernet frame?
10. What is X.509 parser output of Digital certificate, provide various details asked in the other query posted over Google Classroom.

[Client Key Exchange Record:](#)

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 highlighted. If you hand in an electronic copy, it would be great if you could also highlight and annotate.

10. Locate the client key exchange record. Does this record contain a pre-master secret? What is this secret used for? Is the secret encrypted? If so, how? How long is the encrypted secret?

Change Cipher Spec Record (sent by client) and Encrypted Handshake Record:

11. What is the purpose of the Change Cipher Spec record? How many bytes is the record in your trace?
12. In the encrypted handshake record, what is being encrypted? How?
13. Does the server also send a change cipher record and an encrypted handshake record to the client? How are those records different from those sent by the client?

Application Data

14. How is the application data being encrypted? Do the records containing application data include a MAC? Does Wireshark distinguish between the encrypted application data and the MAC?
 15. Comment on and explain anything else that you found interesting in the trace.
 16. What is the duration of HTTPS session, how many number of IP packets exchanged in the SSL session (starting from the first TCP SYN packet till TCP FIN packet)?
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17. How do you compute master_secret (various session keys) from nonces and pre_master_secret? Explain. Which entity in your system does this job on-the-fly?

Note: Add screenshots of relevant in your report in order to prove that the capture trace used for analysis is indeed of your own!!