HỌ TÊN : NGUYỄN XUÂN TRỰC

MSSV : 1513804

LỚP : L07

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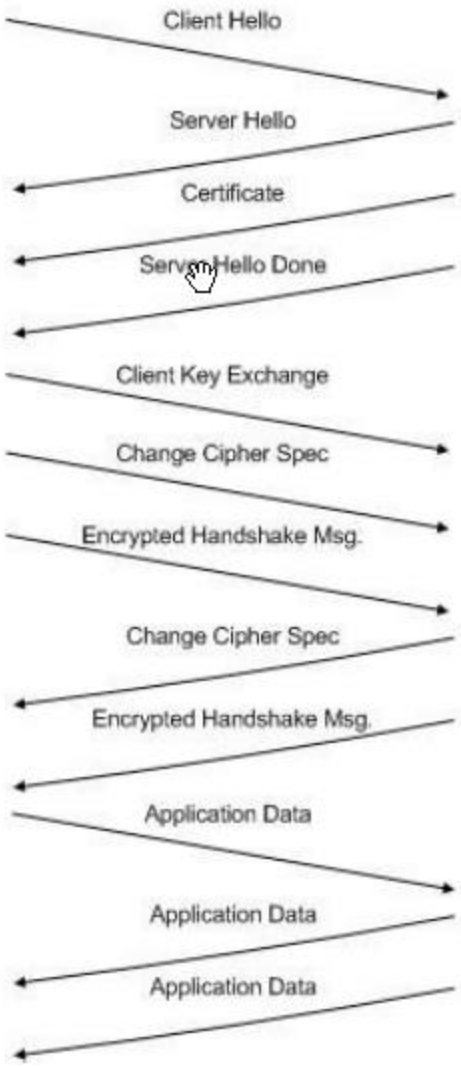
* Note – I am using the captured trace from the authors website

Question 01. 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.

ANSWER

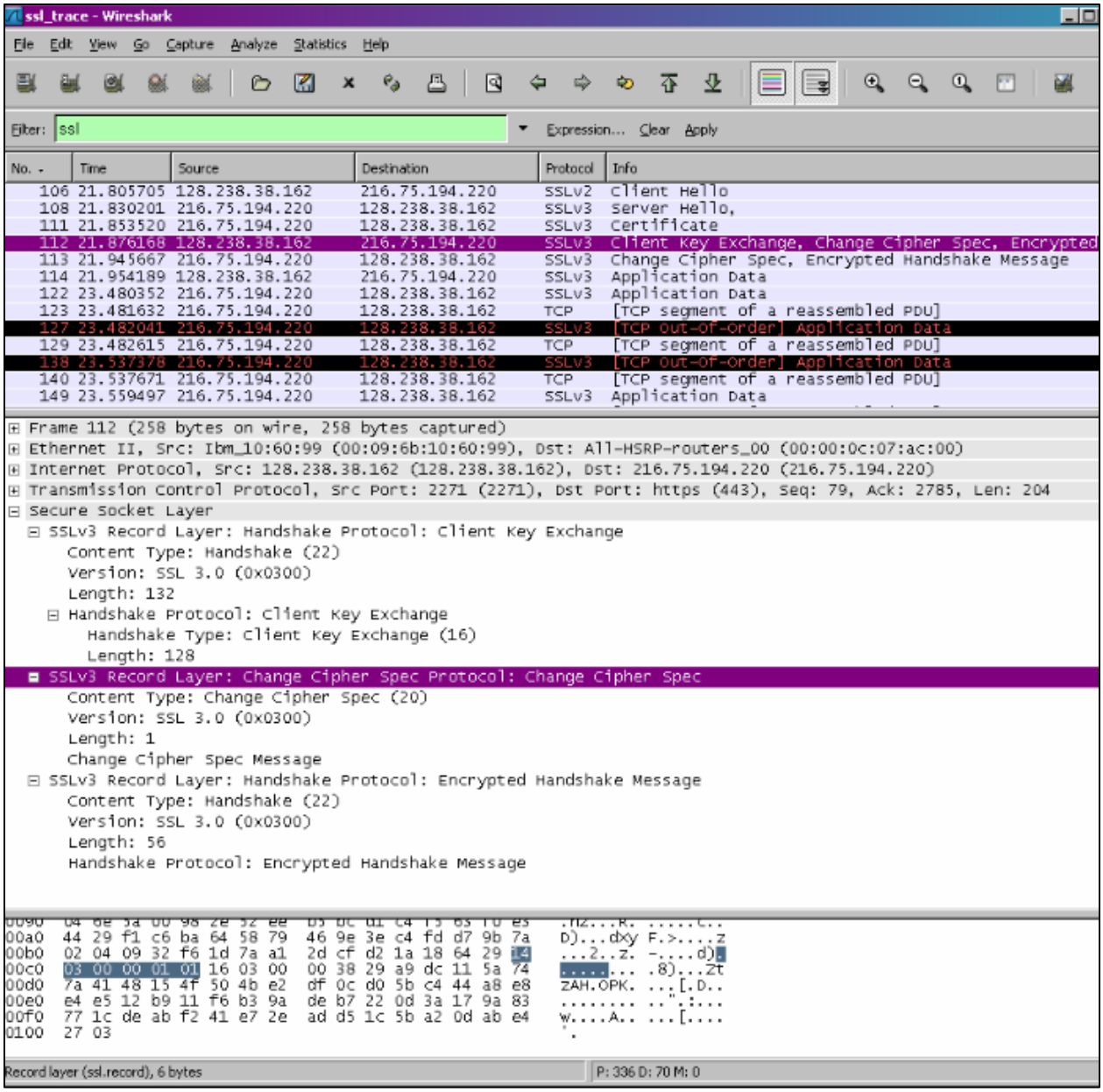
Frame	Source	SSL Count	SSL Type
106	Client	1	Client Hello
108	Server	1	Server Hello
111	Server	2	Certificate Server Hello Done
112	Client	3	Client Key Exchange Change Cipher Spec Encrypted Handshake Message
113	Server	2	Change Cipher Spec Encrypted Handshake Message
114	Client	1	Application Data
122	Server	1	Application Data
127	Server	1	Application Data

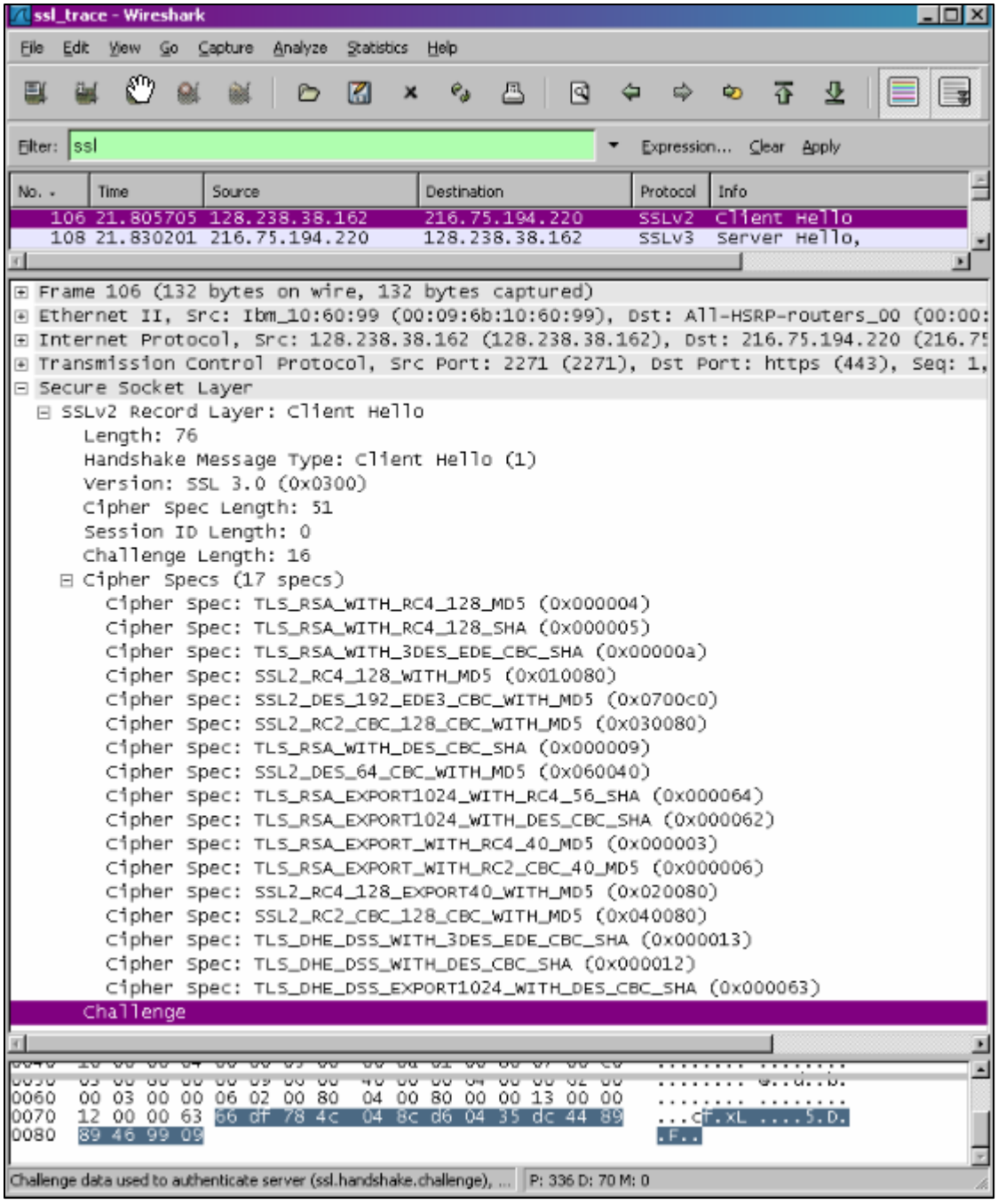


Question 02. Each of the SSL records begins with the same three fields (with possibly different values). One of these fields is "content type" and has length of one byte. List all three fields and their lengths.

ANSWER

Content Type:	1 byte
Version:	2 bytes
Length:	2 bytes


ssl_trace - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: ssl
Expression... Clear Apply
No. Time Source Destination Protocol Info
106 21.805705 128.238.38.162 216.75.194.220 SSLv2 Client Hello
108 21.830201 216.75.194.220 128.238.38.162 SSLv3 Server Hello,
111 21.853520 216.75.194.220 128.238.38.162 SSLv3 Certificate
112 21.876168 128.238.38.162 216.75.194.220 SSLv3 Client Key Exchange, Change Cipher Spec, Encrypted
113 21.945667 216.75.194.220 128.238.38.162 SSLv3 Change Cipher Spec, Encrypted Handshake Message
114 21.954189 128.238.38.162 216.75.194.220 SSLv3 Application Data
122 23.480352 216.75.194.220 128.238.38.162 SSLv3 Application Data
123 23.481632 216.75.194.220 128.238.38.162 TCP [TCP segment of a reassembled PDU]
127 23.482041 216.75.194.220 128.238.38.162 SSLv3 [TCP Out-Of-Order] Application Data
129 23.482615 216.75.194.220 128.238.38.162 TCP [TCP segment of a reassembled PDU]
138 23.537378 216.75.194.220 128.238.38.162 SSLv3 [TCP Out-Of-Order] Application Data
140 23.537671 216.75.194.220 128.238.38.162 TCP [TCP segment of a reassembled PDU]
149 23.559497 216.75.194.220 128.238.38.162 SSLv3 Application Data
Frame 112 (258 bytes on wire, 258 bytes captured)
Ethernet II, Src: Ibm_10:60:99 (00:09:6b:10:60:99), Dst: All-HSRP-routers_00 (00:00:0c:07:ac:00)
Internet Protocol, Src: 128.238.38.162 (128.238.38.162), Dst: 216.75.194.220 (216.75.194.220)
Transmission Control Protocol, Src Port: 2271 (2271), Dst Port: https (443), Seq: 79, Ack: 2785, Len: 204
Secure Socket Layer
SSLv3 Record Layer: Handshake Protocol: Client Key Exchange
Content Type: Handshake (22)
Version: SSL 3.0 (0x0300)
Length: 132
Handshake Protocol: Client Key Exchange
Handshake Type: Client Key Exchange (16)
Length: 128
SSLv3 Record Layer: Change Cipher Spec Protocol: Change Cipher Spec
Content Type: Change Cipher Spec (20)
Version: SSL 3.0 (0x0300)
Length: 1
Change Cipher Spec Message
SSLv3 Record Layer: Handshake Protocol: Encrypted Handshake Message
Content Type: Handshake (22)
Version: SSL 3.0 (0x0300)
Length: 56
Handshake Protocol: Encrypted Handshake Message
00a0 44 29 f1 c6 ba 64 58 79 46 9e 3e c4 fd d7 9b 7a
00b0 02 04 09 32 f6 1d 7a a1 2d cf d2 1a 18 64 29 14
00c0 03 00 00 01 01 16 03 00 00 38 29 a9 dc 11 5a 74
00d0 7a 41 48 15 4f 50 4b e2 df 0c d0 5b c4 44 a8 e8
00e0 e4 e5 12 b9 11 f6 b3 9a de b7 22 0d 3a 17 9a 83
00f0 77 1c de ab f2 41 e7 2e ad d5 1c 5b a2 0d ab e4
0100 27 03
Record layer (ssl.record), 6 bytes
P: 336 D: 70 M: 0



Question 03. 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?

ANSWER

The content type is 22, for Handshake Message, with a handshake type of 01, Client Hello

Question 04. Does the ClientHello record contain a nonce (also known as a "challenge")? If so, what is the value of the challenge in hexadecimal notation?

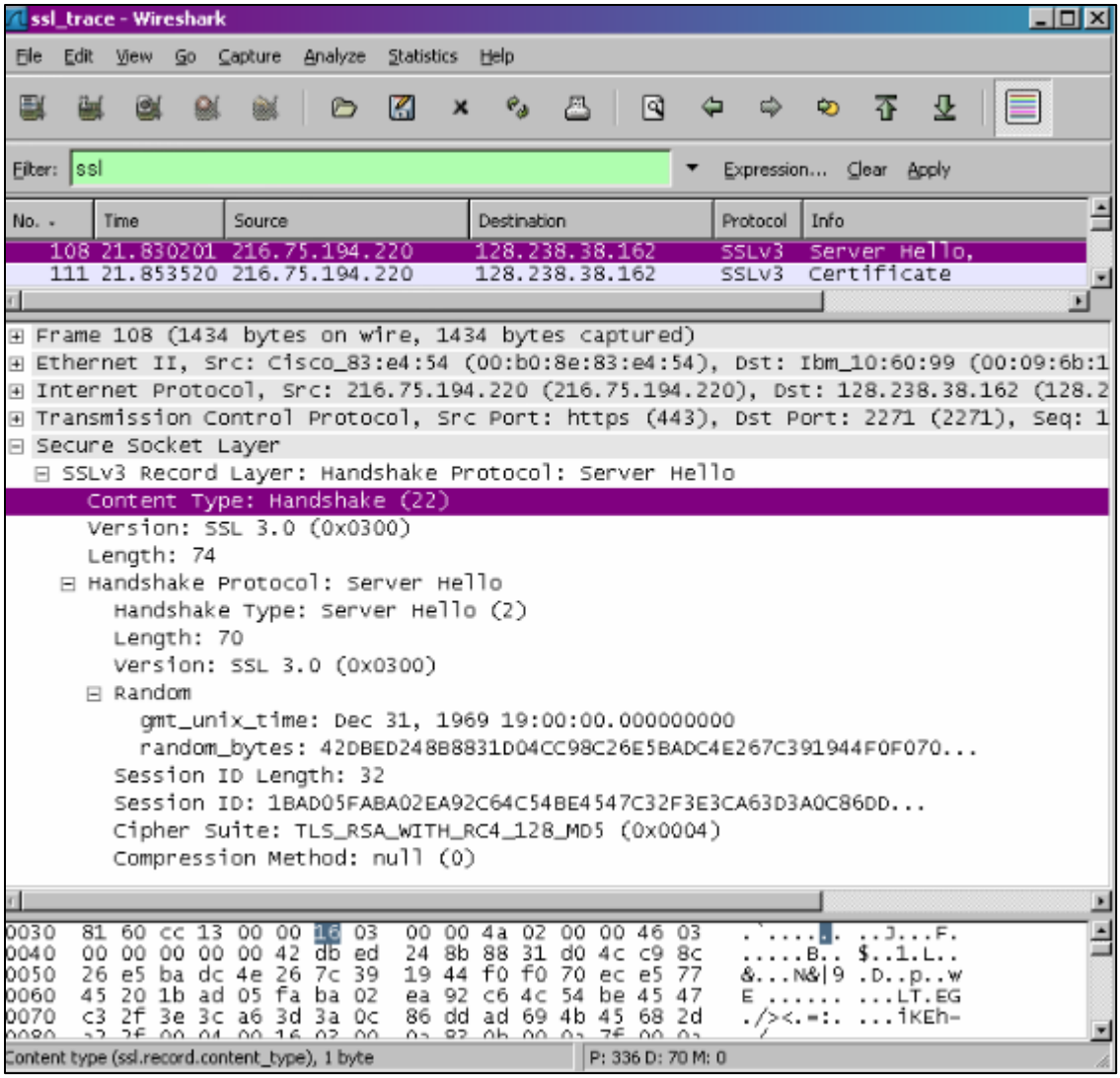
ANSWER

The client hello challenge is 66df 784c 048c d604 35dc 4489 8946 9909

Question 05. Does the ClientHello record advertise the cyber suites it supports? If so, in the first listed suite, what are the public-key algorithm, the symmetric-key algorithm, and the hash algorithm?

ANSWER

The first suite uses RSA for public key crypto, RC4 for the symmetric-key cipher and uses the MD5 hash algorithm.



Question 06. Locate the ServerHello SSL record. Does this record specify a chosen cipher suite? What are the algorithms in the chosen cipher suite?

ANSWER

The cipher suite uses RSA for public key crypto, RC4 for the symmetric-key cipher and uses the MD5 hash algorithm.

Question 07. Does this record include a nonce? If so, how long is it? What is the purpose of the client and server nonces in SSL?

ANSWER

Yes, this record does include a nonce listed under Random. The nonce is 32 bits long, 28 for data and 4 for the time. The purpose is to prevent a replay attack.

Question 08. Does this record include a session ID? What is the purpose of the session ID?

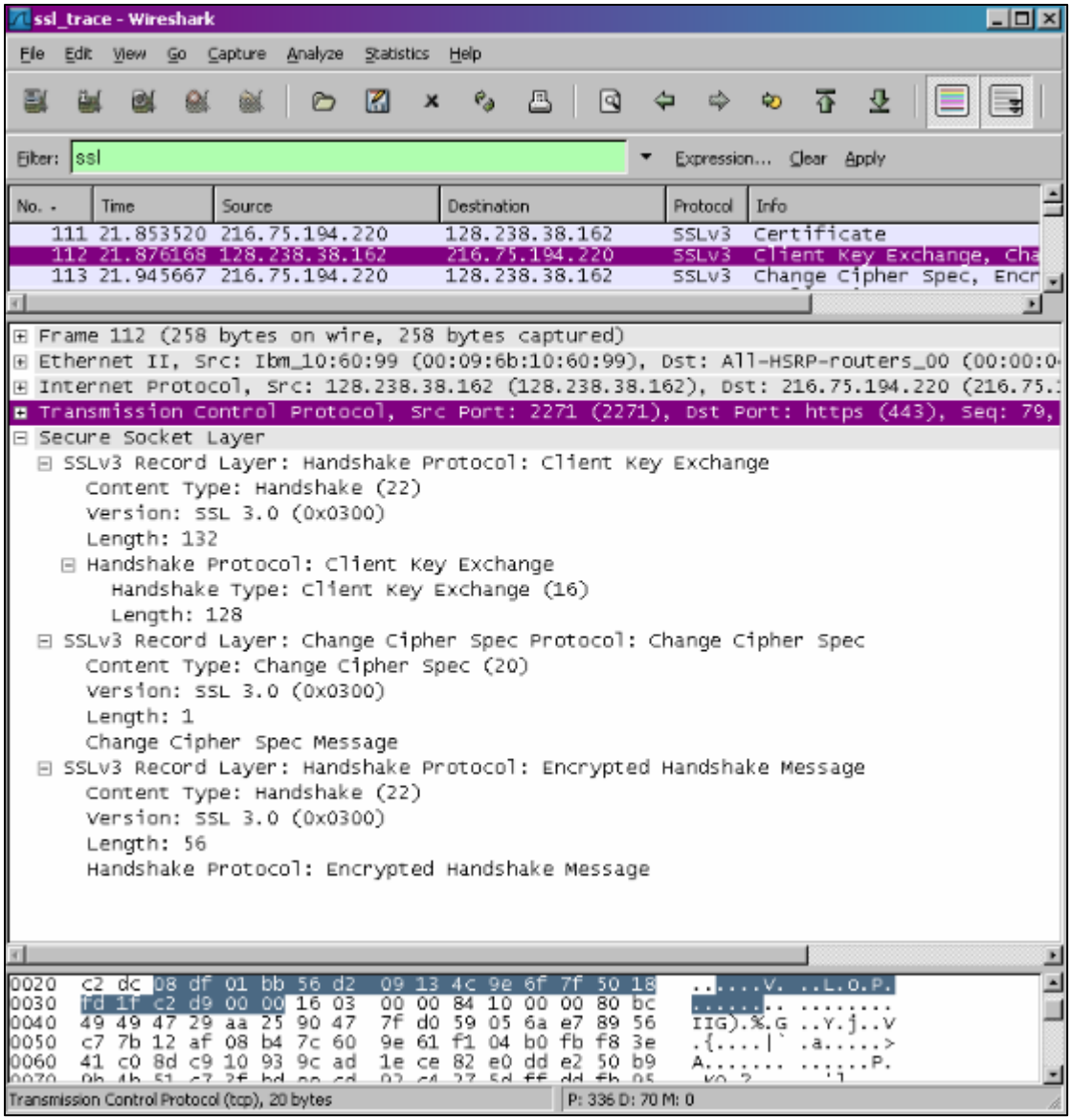
ANSWER

Yes it does. It provides a unique persistent identifier for the SSL session which is sent in the clear. The client may resume the same session later by using the server provided session ID when it sends the ClientHello.

Question 09. Does this record contain a certificate, or is the certificate included in a separate record. Does the certificate fit into a single Ethernet frame?

ANSWER

There is no certificate, it is in another record. It does fit into a single Ethernet frame.



Question 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?

ANSWER

Yes, it does contain a premaster secret. It is used by both the server and client to make a master secret, which is used to generate session keys for MAC and encryption. The secret gets encrypted using the server's public key, which the client extracted from the certificate sent by the server. The secret is 128 bytes long.

Question 11. What is the purpose of the Change Cipher Spec record? How many bytes is the record in your trace?

ANSWER

The purpose of the Change Cipher Spec record is to indicate that the contents of the following SSL records sent by the client (data, not header) will be encrypted. This record is 6 bytes long: 5 for the header and 1 for the message segment.

Question 12. In the encrypted handshake record, what is being encrypted? How?

ANSWER

In the encrypted handshake record, a MAC of the concatenation of all the previous handshake messages sent from this client is generated and sent to the server.

Question 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?

ANSWER

Yes the server will also send a Change Cipher Spec record and encrypted handshake to the client. The server's encrypted handshake record is different from that sent by the client because it contains the concatenation of all the handshake messages sent from the server rather than from the client. Otherwise the records would end up being the same.

Question 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?

ANSWER

Application data is encrypted using symmetric key encryption algorithm chosen in the handshake phase (RC4) using the keys generated using the pre-master key and nonces from both client and server. The client encryption key is used to encrypt the data being

sent from client to server and the server encryption key is used to encrypt the data being sent from the server to the client.

Question 15. Comment on and explain anything else that you found interesting in the trace.

ANSWER

The version of SSL used changes from SSLv2 in the initial ClientHello message to SSLv3 in all following message exchanges.

Also, during resumes the handshake process is slightly different from the initial one. The client does not need another cert so the server never sends it. It just has to send a new nonce followed by Change Cipher Spec and Encrypted Handshake records from the server to client. After a response from the client then application data can be sent.