HO CHI MINH UNIVERSITY OF TECHNOLOGY
Faculty of Computer Science and Engineering

Computer Networks

Report for lab 8

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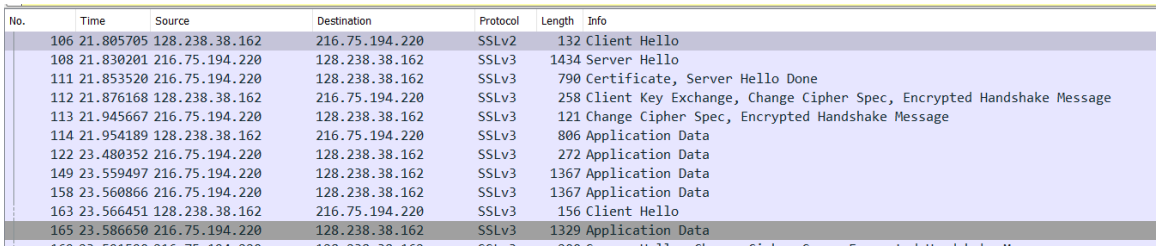
1/ For each of the first 8 Ethernet frames, specify the source of the frame (client or server), determine the number of SSL records that are included in the frame, and list the SSL record types that are included in the frame. Draw a timing diagram between client and server, with one arrow for each SSL record?

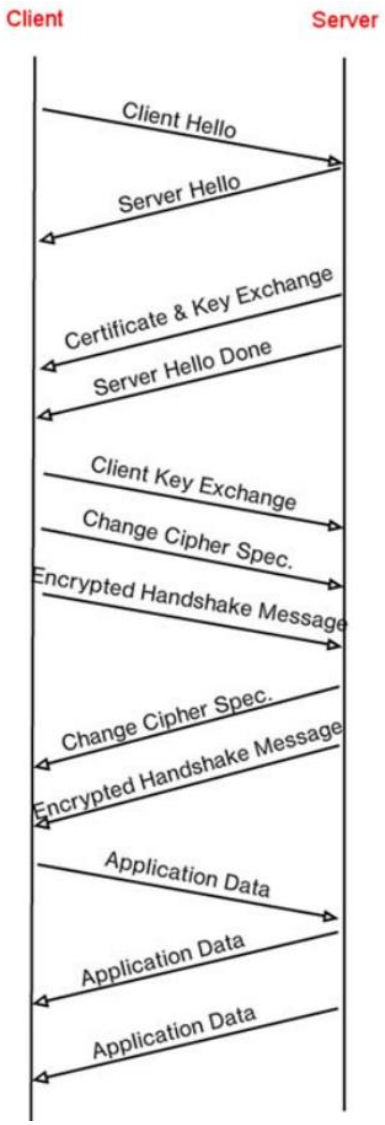
Answer:



No.	Time	Source	Destination	Protocol	Length	Info
106	21.805705	128.238.38.162	216.75.194.220	SSLv2	132	Client Hello
108	21.830201	216.75.194.220	128.238.38.162	SSLv3	1434	Server Hello
111	21.853520	216.75.194.220	128.238.38.162	SSLv3	790	Certificate, Server Hello Done
112	21.876168	128.238.38.162	216.75.194.220	SSLv3	258	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
113	21.945667	216.75.194.220	128.238.38.162	SSLv3	121	Change Cipher Spec, Encrypted Handshake Message
114	21.954189	128.238.38.162	216.75.194.220	SSLv3	806	Application Data
122	23.480352	216.75.194.220	128.238.38.162	SSLv3	272	Application Data
149	23.559497	216.75.194.220	128.238.38.162	SSLv3	1367	Application Data
158	23.560866	216.75.194.220	128.238.38.162	SSLv3	1367	Application Data
163	23.566451	128.238.38.162	216.75.194.220	SSLv3	156	Client Hello
165	23.586650	216.75.194.220	128.238.38.162	SSLv3	1329	Application Data

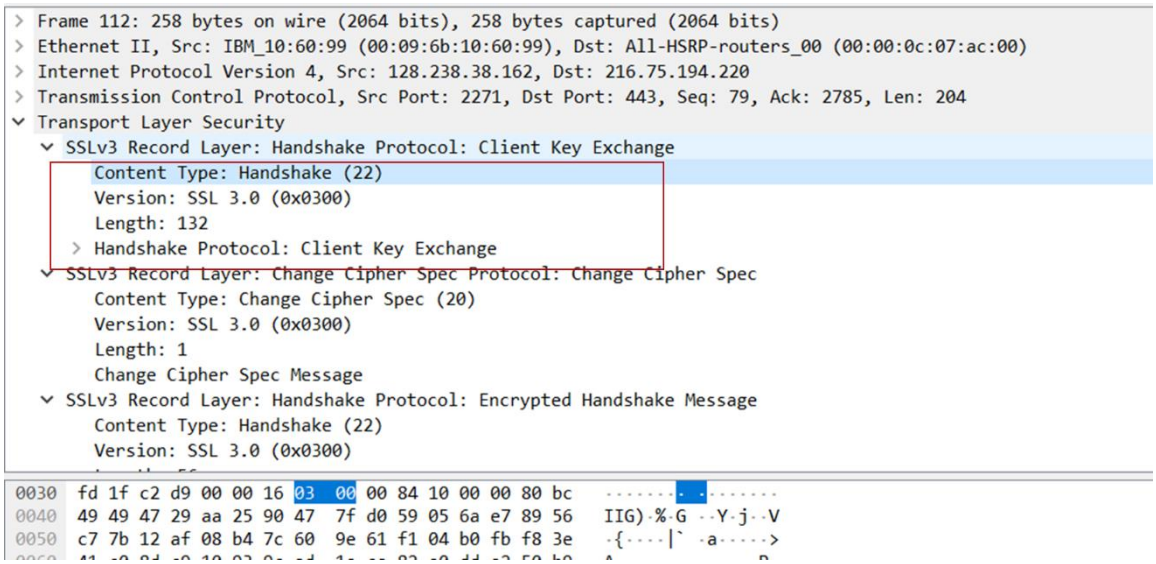
No	Frame	**Source**	**Destination**	**SSL count**	**SSL Type**
1	106	128.238.38.162	216.75.194.220	1	Client Hello
2	108	216.75.194.220	128.238.38.162	1	Server Hello
3	111	216.75.194.220	128.238.38.162	2	Server Hello Done
4	112	128.238.38.162	216.75.194.220	3	Client Key Exchange
5	113	216.75.194.220	128.238.38.162	2	Change Cipher Spec
6	114	128.238.38.162	216.75.194.220	1	Application Data
7	122	216.75.194.220	128.238.38.162	1	Application Data
8	149	216.75.194.220	128.238.38.162	1	Application Data

Timing diagram:



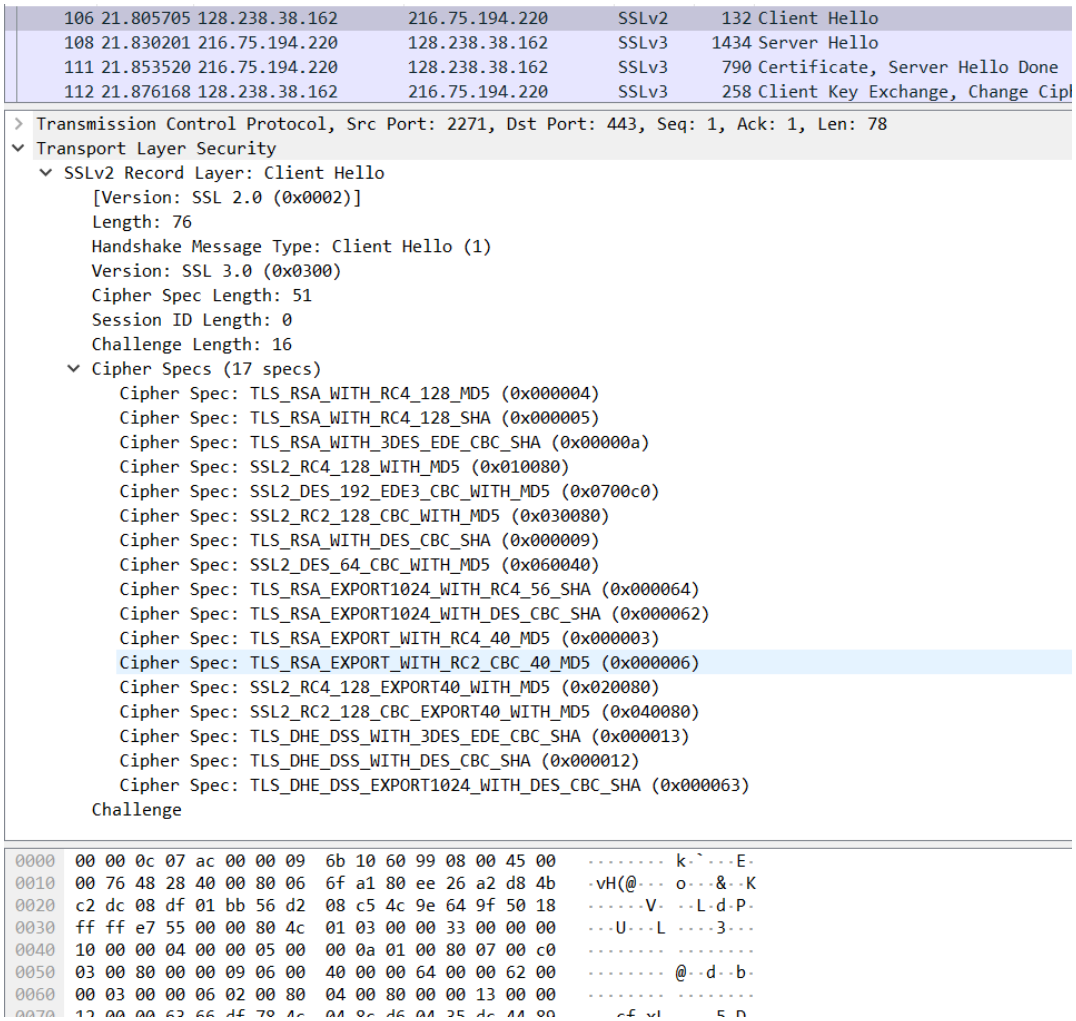
2/Each of the SSL records begins with the same three fields (with possibly different values). One of these fields is "content type" and has length of one byte. List all three fields and their lengths.

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



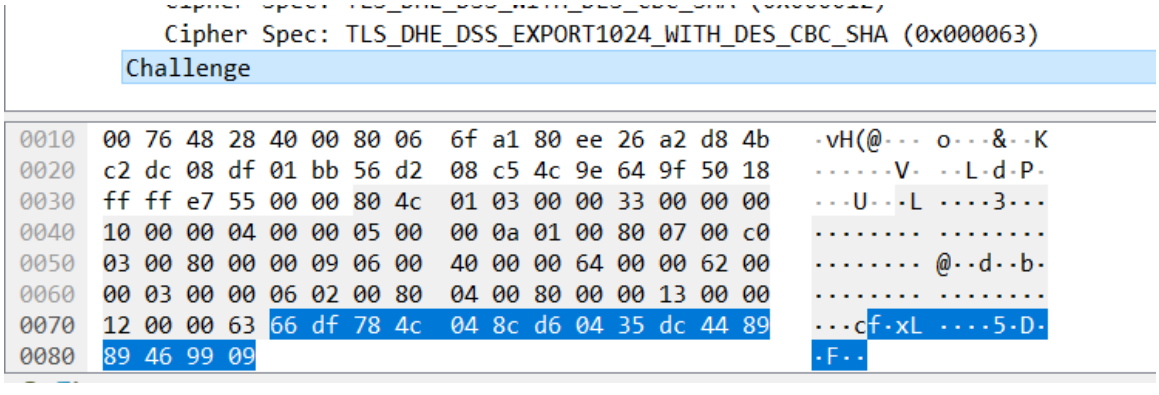
3/Expand the ClientHello record. (If your trace contains multiple ClientHello records, expand the frame that contains the first one.) What is the value of the content type?

Answer:
The content type is 22, for Handshake message type of 01, Client Hello.



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?

Answer: 66 df 78 4c 04 8c d6 04 35 dc 44 89 89 46 99 09



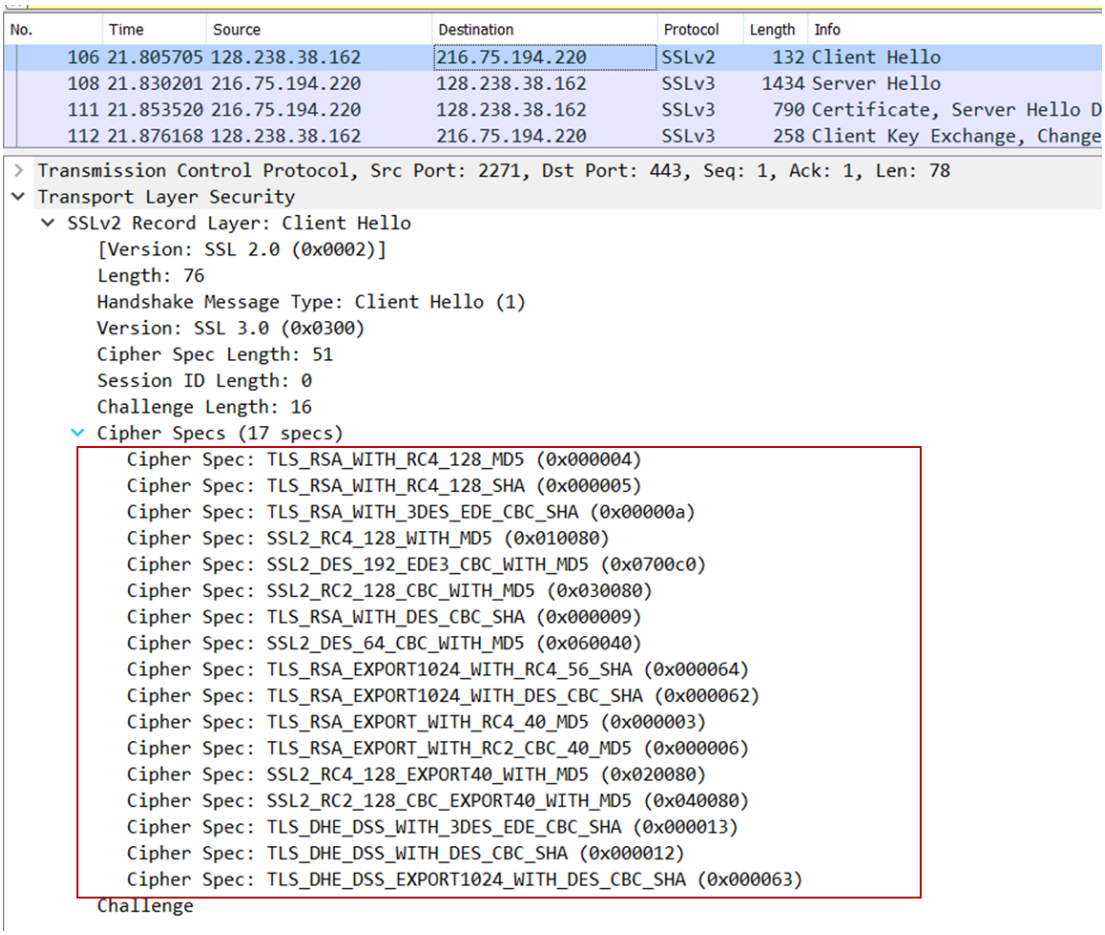
5/ Does the ClientHello record advertise the cyber suites it supports? If so, in the first listed suite, what are the public-key algorithm, the symmetric-key algorithm, and the hash algorithm?

Answer:

Public key algorithm: RSA

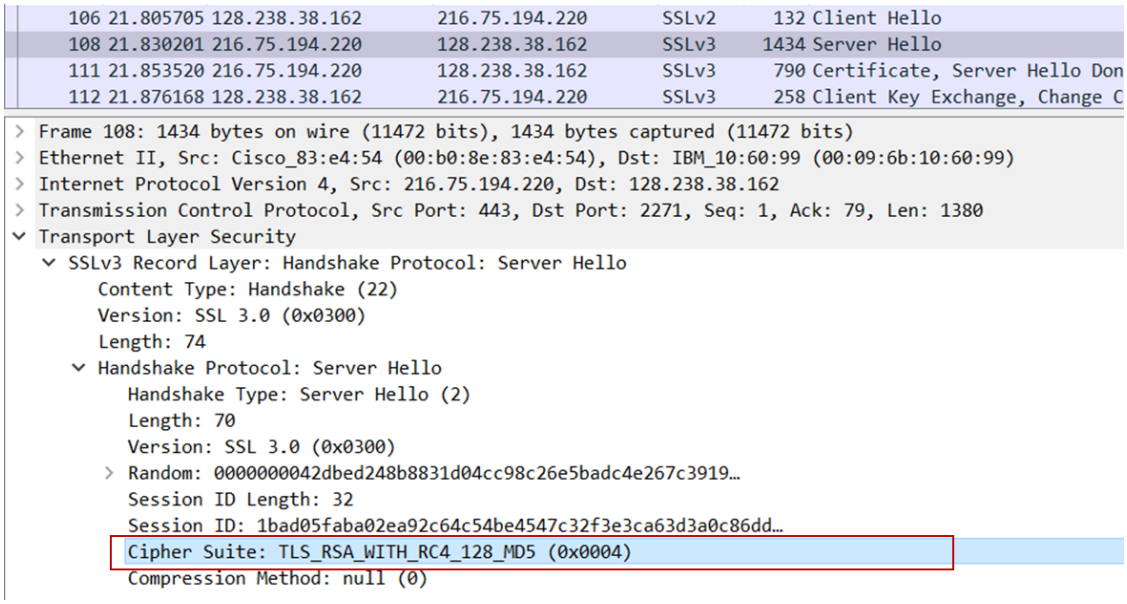
Symmetric-key algorithm: RC4

Hash algorithm: MD5



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

Answer:
Public key algorithm: RSA
Symmetric-key algorithm: RC4
Hash algorithm: MD5



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?

Answer: Yes, this package does include a nonce under Random field. It is 32 bits long (28bits data + 4 bits time), it is used for attack preventing.

```
Version: SSL 3.0 (0x0300)
Random: 0000000042dbed248b8831d04cc98c26e5badc4e267c3919…
    GMT Unix Time: Jan  1, 1970 07:00:00.000000000 SE Asia Standard Time
    Random Bytes: 42dbed248b8831d04cc98c26e5badc4e267c391944f0f070…
Session ID Length: 32
Session ID: 1bad05faba02ea92c64c54be4547c32f3e3ca63d3a0c86dd…
Cipher Suite: TLS_RSA_WITH_RC4_128_MD5 (0x0004)
Compression Method: null (0)
```

```
0040  00 00 00 00 00 42 db ed  24 8b 88 31 d0 4c c9 8c   ·····B·· $··1·L··
0050  26 e5 ba dc 4e 26 7c 39  19 44 f0 f0 70 ec e5 77   &···N&|9 ·D··p··w
0060  45 20 1b ad 05 fa ba 02  ea 92 c6 4c 54 be 45 47   E ····· ···LT·EG
0070  c3 2f 3e 3c a6 3d 3a 0c  86 dd ad 69 4b 45 68 2d   ·/><·=:· ···iKEh-
0080  a2 2f 00 04 00 16 03 00  0a 83 0b 00 0a 7f 00 0a   ·/····· ········
```

8/ Does this record include a session ID? What is the purpose of the session ID?

Answer: This record does include a session ID as described in the picture below. This session is for resume the same session later by using the server provided session ID when it sends the ClientHello.

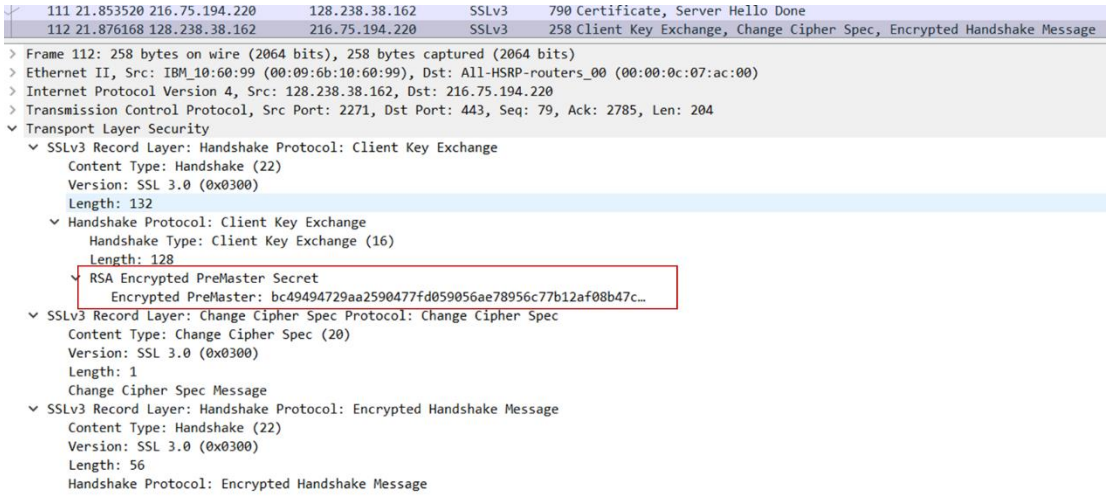
```
108 21.830201 216.75.194.220   128.238.38.162   SSLv3   1434 Server Hello
111 21.853520 216.75.194.220   128.238.38.162   SSLv3    790 Certificate, Server Hello Done
112 21.876168 128.238.38.162   216.75.194.220   SSLv3    258 Client Key Exchange, Change Cipher
Frame 108: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits)
Ethernet II, Src: Cisco_83:e4:54 (00:b0:8e:83:e4:54), Dst: IBM_10:60:99 (00:09:6b:10:60:99)
Internet Protocol Version 4, Src: 216.75.194.220, Dst: 128.238.38.162
Transmission Control Protocol, Src Port: 443, Dst Port: 2271, Seq: 1, Ack: 79, Len: 1380
Transport Layer Security
  SSLv3 Record Layer: Handshake Protocol: Server Hello
      Content Type: Handshake (22)
      Version: SSL 3.0 (0x0300)
      Length: 74
    Handshake Protocol: Server Hello
        Handshake Type: Server Hello (2)
        Length: 70
        Version: SSL 3.0 (0x0300)
      Random: 0000000042dbed248b8831d04cc98c26e5badc4e267c3919…
          GMT Unix Time: Jan  1, 1970 07:00:00.000000000 SE Asia Standard Time
          Random Bytes: 42dbed248b8831d04cc98c26e5badc4e267c391944f0f070…
        Session ID Length: 32
        Session ID: 1bad05faba02ea92c64c54be4547c32f3e3ca63d3a0c86dd…
        Cipher Suite: TLS_RSA_WITH_RC4_128_MD5 (0x0004)
        Compression Method: null (0)
```

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?

Answer: No, there is no certificate in this record. The certificate is in the separate record. The certificate does fit into a single Ethernet frame.

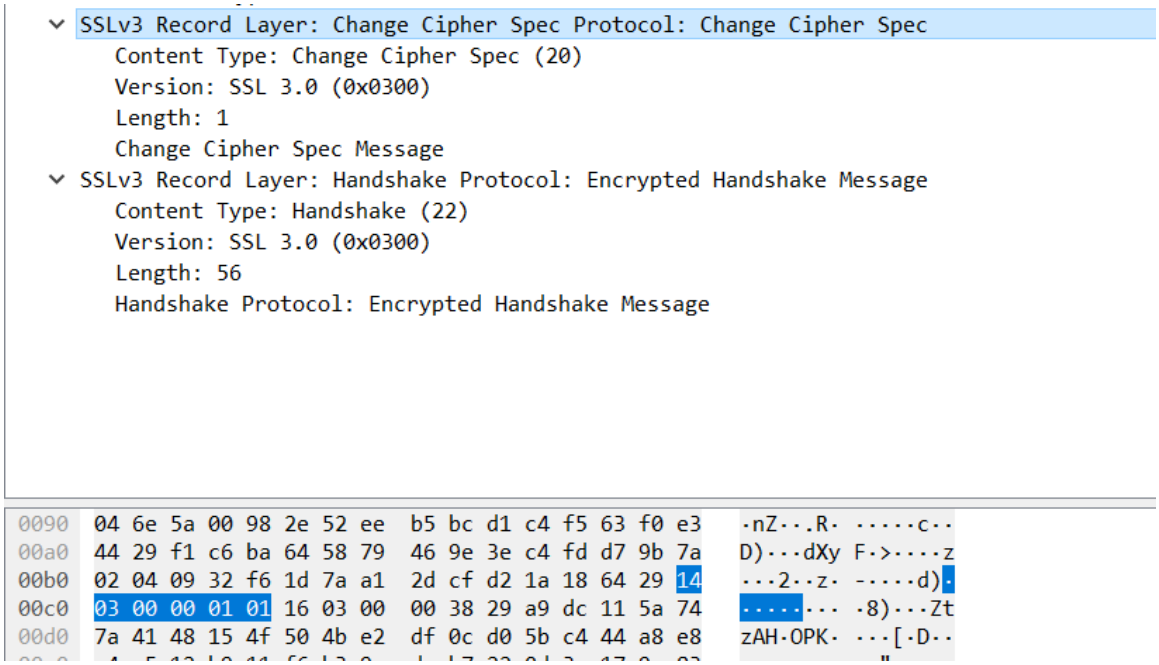
10/ Locate the client key exchange record. Does this record contain a pre-master secret? What is this secret used for? Is the secret encrypted? If so, how? How long is the encrypted secret?

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.



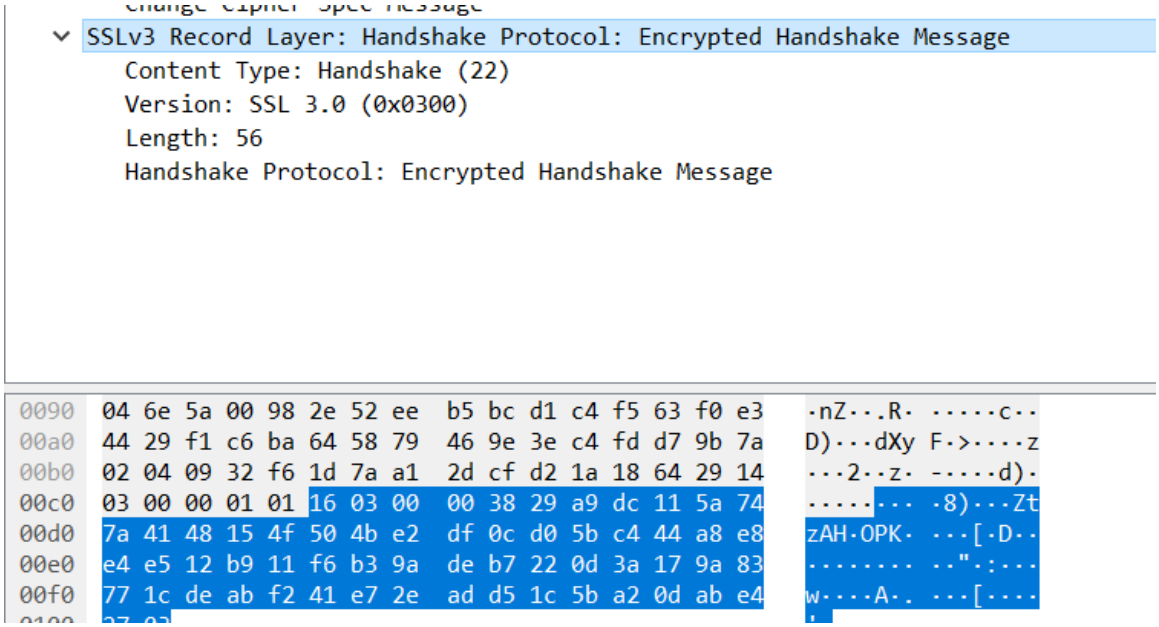
11/ What is the purpose of the Change Cipher Spec record? How many bytes is the record in your trace?

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.



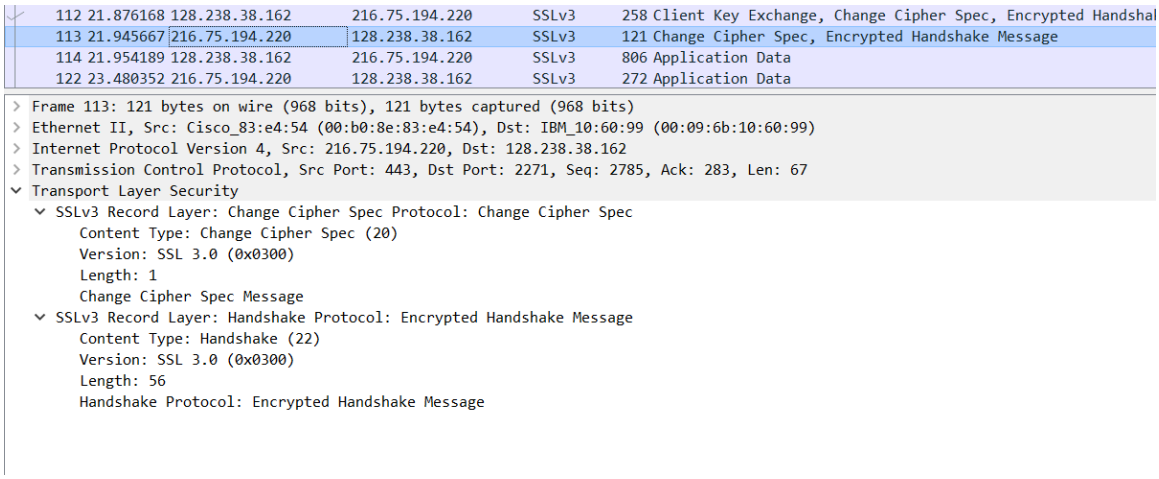
12/ In the encrypted handshake record, what is being encrypted? How?

Answer: In the encrypted handshake record, handshake messages and MAC addresses are concatenated and encrypted. They are sent to the server.



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?

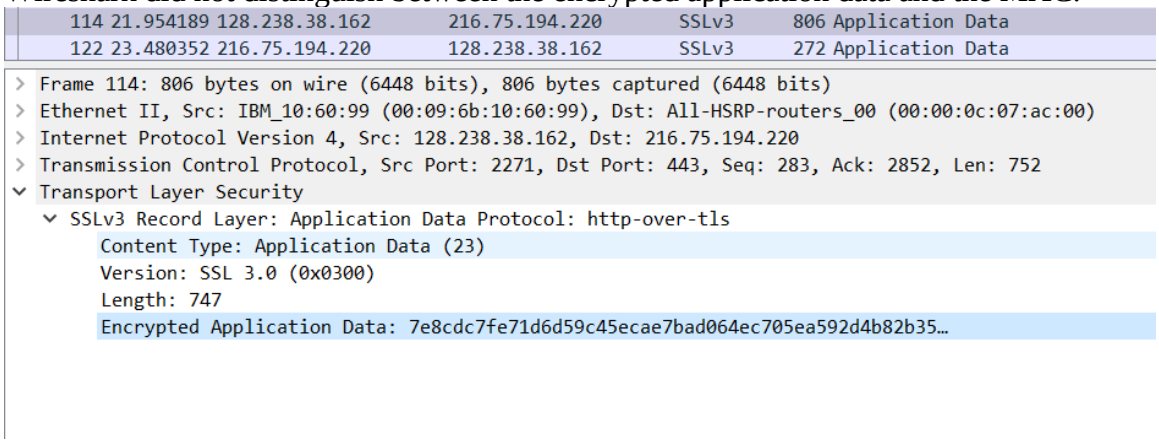
Answer: Yes, the server's encrypted handshake contains all the handshake messages sent from the server. Other contains messages sent from client.



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: The symmetric encryption algorithm is used to encrypt the application data. Yes, the records containing application data include a MAC.

Wireshark did not distinguish between the encrypted application data and the MAC.



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.