Network Security I

Question 1  DNS Walkthrough
Your computer sends a DNS request for “www.google.com”

(a) Assume the DNS resolver receives back the following reply:

    com. NS a.gtld-servers.net
    a.gtld-servers.net A 192.5.6.30

Describe what this reply means and where the DNS resolver would look next.

(b) If an off-path adversary wants to poison the DNS cache, what values does the adversary need to guess?

(c) Why not use cryptography to make the DNS connection secure?
Question 2  
**Attack on TCP**

Suppose that a client connects to a server, and then performs the following TCP handshake and initial data transfer:

Client (port $P_C$)  
Server (port $P_S$)

1. Client sends initial SYN with sequence number $A$ (usually random).
2. Server sends SYN-ACK with sequence number $B$ (also usually random) and ACK $A + 1$.
5. Server sends DATA B of length $L_B$ with sequence number $B + 1$ and ACK $A + 1 + L_A$.
6. Client sends DATA C of length $L_C$ with sequence number $A + 1 + L_A$ and ACK $B + 1 + L_B$.
7. Data exchange continues until both sides are done sending data.

(a) Assume that the next transmission in this connection will be DATA D from the server to the client. What will this packet look like?

<table>
<thead>
<tr>
<th>Sequence number:</th>
<th>ACK:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source port:</td>
<td>$P_S$</td>
</tr>
<tr>
<td>Destination port:</td>
<td>$P_C$</td>
</tr>
<tr>
<td>Length:</td>
<td>$L_D$</td>
</tr>
<tr>
<td>Flags:</td>
<td>ACK</td>
</tr>
</tbody>
</table>

(b) You should be familiar with the concept and capabilities of a *man-in-the-middle* as an attacker who can observe and can modify traffic. There are two other types of relevant attackers in this scenario:

1. *On-path* attacker: can observe traffic but cannot modify it.
2. *Off-path* attacker: cannot observe traffic and cannot modify it.

Carol is an *on-path* attacker. Can Carol do anything malicious to the connection? If so, what can she do?
(c) David is an off-path attacker. Can David do anything malicious to the connection? If so, what can he do?

(d) The client starts getting responses from the server that don’t make any sense. Inferring that David is attempting to hijack the connection, the client then immediately sends the server a RST packet, which terminates the ongoing connection. David wants to impersonate the client by establishing a new connection. How would he go about doing this?
Question 3  *Introduction to Networking*

(a) **TCP and UDP** The transmission control protocol (TCP) and user datagram protocol (UDP) are two of the primary protocols of the Internet protocol suite.

   i. How do TCP and UDP relate to IP (Internet protocol)? Which of these protocols are encapsulated within (or layered atop) one another? Could all three be used simultaneously?

ii. What are the differences between TCP and UDP? Which is considered “best effort”? What does that mean?