ELEC-H-417

COMMUNICATION NETWORKS: PROTOCOLS AND ARCHITECTURES

First and last names : _____

1. (20 points) Give short answers. Write them on this sheet.
   (a) In IPv6, there is no broadcasting. How do routers share routing messages over adjacent links ?

   (b) Are link-state routing protocols scalable ? Why ?

   (c) In UDP, what does uniquely identify the destination application to communicate to ?

   (d) What is the "challenge-response" authentication ? How does it work ?

   (e) What is the purpose of the DNS service ?

2. (15 points) **TCP**
   (a) What is the difference between flow control and congestion control ?
   (b) Establish the formula for the pipeline efficiency (i.e., the line utilisation as a function of the transmission time and the number of in-flight segments).
   (c) How does TCP detect congestion and how does it react ?
   (d) What is algorithm used by TCP to adjust the sending rate to the maximum possible value ? transmission) ?

3. (10 points) **Security** – Consider the public key infrastructure (PKI) model presented in Fig.3 .
   (a) Define the following terms: public key, private key, plain text, cipher text. Place them on a communication schema.
   (b) Alice wants to (securely) send a message to Bob in such a way that it is protected against evesdropping (i.e., ciphered). How does she proceed using the elements present in this PKI ?
   (c) How can we make sure that the public key of Bob can be trusted ?

4. (20 points) **Network Address Translation** – Fig. 2 depicts the general implementation of a residential internet access using a NAT box.

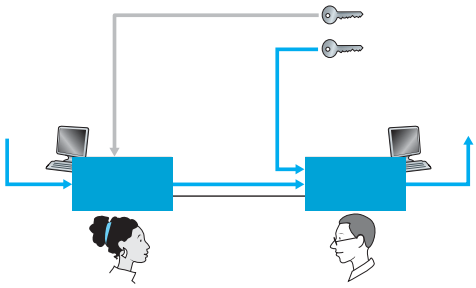

Figure 1: Public key crypto

(a) What is the purpose of NAT middleboxes ? Explain *in details* its functioning based on the scenario of Fig.1. For instance, consider that the computer at 10.0.1.1 connects to the webserver 164.15.59.200. Give, step by step, all transactions, the IP-layer headers of the packet, the content of the NAT table, etc.

(b) Is it possible to reach a host in the "inside" zone from the "outside" zone ? Why/How ?

(c) From a networking point-of-view, what is the maximum number of sessions that can be supported by a NAT box (consider that the RAM memory of the box is very large and not a limitation).

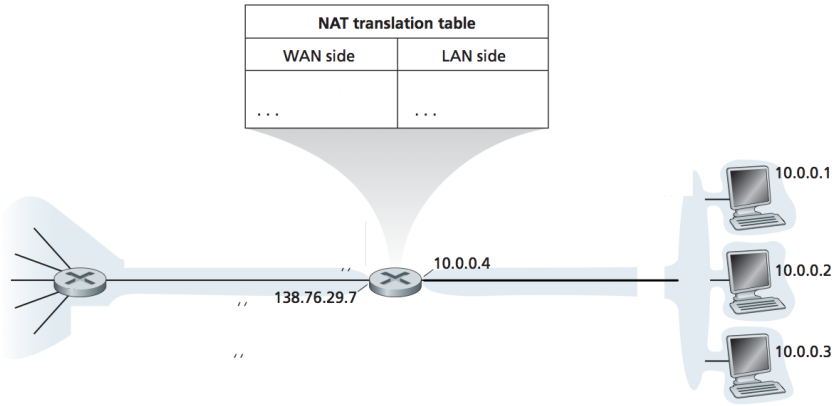

Figure 2: Network schema for a residential access using NAT box.

5. (10 points) **IP / Ethernet** – Consider the topology presented in Fig.2 . A packet is captured between routers R2 and R3. What are the contents of the packet at Layer2 (Ethernet) and Layer3 (IPv6) ?

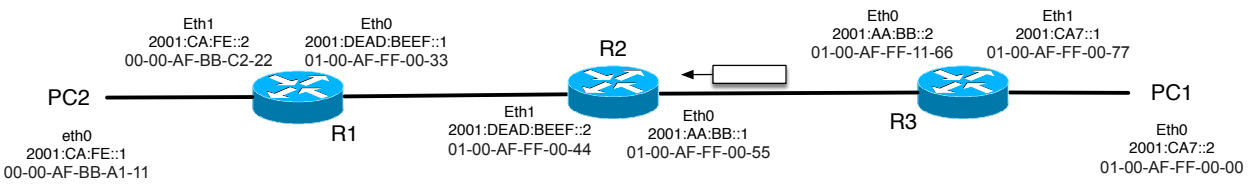

Figure 3: Packet Capture