Communication Protocols and Internet Architectures
Harvard University, CSCI S-40, Summer 2018
Homework Assignment #5 due by 1:00 PM on August 2, 2018

Please submit your homework on the day it is due using the homework submission tool on the course website. You will need your HarvardKey to use this feature. Please do not email your homework to a TA or the instructor.

Your homework must use text format, PDF or MS Word. Do not use any fancy layout and do not use macros of any type. In other words, the simpler the format the better.

The file name for your homework must include your name and the specific hw# and the file name must not contain any spaces. In addition, you must always include your name and your email address as part of the document. We will not grade homework that does not follow these naming conventions.

There is a penalty for late homework and homework will not be accepted once the solutions are available. Graded homework will be posted on the course website or emailed back to you. Please note that the point assignment included next to each question might change as we refine the answer key for the assignment.

Your homework must be your own work, in your own words. The use of material from other sources, even when it is properly quoted and cited, should be limited. Please see, *Writing with Sources: A Guide for Harvard Students* if you have questions. We realize that some of the homework questions (or comparable questions) have been asked in previous terms but it is important that you learn the material covered by the question; it is never acceptable to copy an answer directly from another source. The teaching staff and the University take the issue of Academic Honestly very seriously.

Please note that the answer to a homework question is rarely longer than three or four paragraphs in length (plus any diagrams.) **If your answer is more than a page long, it means that you are probably not answering the question we asked, or your answer is not as concise as it should be. In either case, you will not receive full credit for your answer.** Finally, note that some of this homework requires that you do additional background reading and research.

HOMEWORK #5 QUESTIONS

Assume for the following questions that we are referring only to IPv4.

1.) (2 points) CAN-SPAM section 5.a.5 requires all bulk email senders to require an opt-out link on all emails, as well as certain other requirements. How might clicking on these opt-out links be counter-productive for the email recipient?

2.) (3 points) All routers today implement policies for packet filtering and forwarding and most of them use what are called Access Control Lists (ACLs) to configure these policies. Do some research on a commercially available router that uses ACLs (pick the router vendor of your choice) and describe in detail how ACLs are used and how the packet filtering is done. Include specific examples of the ACLs in your answer, but note that you do not need to describe how the hardware implements the packet filtering and forwarding.

Make sure to identify the router you are describing. Note that most of the routers meant for home networks do not allow users to configure or view the actual ACLs, rather, they use a simple GUI interface to set router policy; such a device **would not be a good example** for this question. Also, many of the commercial routers also provide a GUI interface to setting ACLs. For this question it is important that you describe the use of the ACL, not the GUI interface.

3.) (3 points) What is a X.509 certificate? What is a Certificate Authority? Given that anyone can create a public/private key pair on their own, describe why certificates and certificate authorities are necessary and how they are used?

4.) (3 points) Assume that you are submitting your homework via email. Describe in detail the methodology for using a digital signature using public-key cryptography to sign and submit your homework. (Note that an email that is digitally signed is not the same as encrypting it.)

5.) (3 points) Describe the functionality and operation of a SIP proxy server and also the other types of SIP servers that would be used in a network to support VoIP. Try to be clear and specific in your answer about the functionality of each server since current real-world product implementations combine a lot of the functionality into a single box.

6.) (3 points) Assume that you have recently implemented a Layer 2 switching environment in your network that uses OpenFlow. Assume that a packet enters the switch and a lookup is done in the flow tables in the switch, but no match is found. Describe the most common options for handling this packet. (Note: review the OpenFlow Switch Specification and the textbook for information on packet processing in OpenFlow switches.)

EXTRA CREDIT:
We will add 3 points to your total homework grade for the term if you answer this question.
7.) (3 points) In lecture, we will demonstrate a SIP softphone calling other SIP clients. Create an account for yourself on a SIP service provider (such as www.iptel.org) and using a SIP phone of your choice, call us at sip:cs40@iptel.org and leave us a voicemail message.

This question is worth 3 points and you should state in your homework that you have left us the voicemail, or tried to leave us a voicemail. The reason we are asking you to confirm this in your homework is that we are not sure how large a voicemail box we have. If your SIP registration did not work or if your call did not go through, then you should describe your configuration and the steps you used when you tried to debug the problem. You will get full credit, or partial credit, for explaining your configuration and your approach to debugging.

Important Note: The security and privacy policies of free SIP providers, might, or might not meet industry standard security practices and standards. Given this, we strongly recommend that the login and password that you use with these sites when you create your account should be ones that you don't care about, and should be limited to use at these sites only.

8.) Submit your homework via the course website. Please make sure that your name is on your homework assignment, and also confirm that your last name and the hw# are a part of the file name.