Session 1: 1 March 2021

- Cover course information
- Cover protocol layering
- Live demo, MAC, IP, Ping, Traceroute
- Cover Why Mac and IP?

Tasks to be completed for Part 2 Intro

1. Watch video A01 (if you missed last Monday's session). Videos are available in LumiNUS Multimedia in the folder Webcast Videos.
2. Watch video A02 on protocol layering and read notes A02.pdf. Notes are available in LumiNUS Files in the folder Lecture Notes.
3. Watch video A03 on internetworking and read notes A03.pdf. Solve the problem on statistical multiplexing on slide 8 of pdf file A03.pdf
4. Complete Problem Set 1 (file H1 in LumiNUS Files in the Assessments folder). Due date for H1 is Wed 10 Mar 2021, 23:59. Please submit in the appropriate folder in LumiNUS Files. Look under the folder Student Submissions.
5. Explore the tools ping and traceroute. Try: ping www.stanford.edu. Try: traceroute www.yahoo.com. You can also check out https://ping.eu/
6. Install Wireshark and capture network packets.
7. Read my article on cross-layer design. The file is available in LumiNUS files in the folder Supplementary-Reading.
   https://luminus.nus.edu.sg/download/1c34b3ee-f3a0-4f68-b39e-a5fc346890dd?name=S1-CrossLayer-Srivastava-Motani.pdf

Session 2: 8 March 2021

- Finish MAC and IP
- Statistical multiplexing
- Cover Wireshark

Question: Why do we use both MAC and IP addresses on the Internet for routing?

1. Do we need both MAC and IP addresses to build a computer network?
    a. No, we don't both. We only need one addressing scheme and IP / MAC are unique addressing schemes by themselves.
    b. In a connected network, every host/computer/device must have at least ONE UNIQUE address.
    c. That means we can build a communication network with IP addresses only.
    d. That means we can build a communication network with MAC addresses only.
2. The next question is which one (MAC or IP) is better?
    a. IP is better in terms of complexity since IP is hierarchical and MAC address are flat.
    b. So why do have two addressing schemes in computer networks?
3. How are IP / MAC addresses used in the current Internet for routing?
    a. IP is used for routing – IP addresses are used to go long distance
    b. MAC addresses are used to address hosts on the local ethernet
    c. You get MAC from IP using ARP
4. Why are both used in the current Internet?
    a. Think about what a node has to do on an ethernet.
    b. Remember Ethernet is broadcast, every node on the LAN hears the packets for every other node.
    c. Nodes must accept packets destined for themselves but reject packets meant for others.
    d. Think of the scale of the problem. If you have 100 nodes on the LAN, each streaming youtube videos.
    e. If you can reject at Layer 2 using MAC addresses, then the rejecting can be done faster.
    f. So MAC addresses allow the node to reject at layer 2 and be more efficient.
    g. So the reason is efficiency!

The Power of Statistical Multiplexing

Given one router, link bandwidth of 1 Mbps
Users will use the router and each user requires 100 Kbps
Each user has an activity level of 10%, i.e., they are active only 10% of the time.
Let's generalize, say a user is active with probability p.
Question: How many users can be supported using Circuit Switching and with Packet Switching?

Circuit Switching:
Router == Pie = 1Mbps
Each piece of pie = 100 Kbps
How pieces of pie do we have? 1Mbps / 100Kbps = 10

** In Circuit Switching, we can support at most 10 users.

Packet Switching (Statistical Multiplexing)

Here, we have the problem that there are too many users who want a piece of pie (i.e, want to use the router).

How many is too many? More than TEN users.

Prob(failure) < 1 in some large number

Given that there are M users in the system, what is the probability of failure.

As M increases, prob(failure) increases
As M decreases, prob(failure) decreases

$$\Pr(\text{failure}) = \Pr(\#\text{ users} > 10) = 1 - \Pr(\#\text{ users} <= 10)$$

$$\Pr(\#\text{ users} <=10) = \Pr(0\text{ users}) + \Pr(1\text{ user}) + \Pr(2\text{ users}) + ... + \Pr(10\text{ users})$$

$$\Pr(k\text{ users}) = \binom{M}{k} p^k (1-p)^{(M-k)}$$

Notation: Pr(A) means Probability of the event A

Note: The first term is the nchoosek function which counts the number of way to choose k items from a total of n items

With M=35, prob(failure) < 5 in 10000 = 0.0005

Wireshark Demo

Run Wireshark, start capture, display filter: http

* Go to: http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file1.html

1. Is your browser running HTTP version 1.0 or 1.1? What version of HTTP is the server running?
2. What languages (if any) does your browser indicate that it can accept to the server?
3. What is the IP address of your computer? Of the gaia.cs.umass.edu server?
4. What is the status code returned from the server to your browser?
5. When was the HTML file that you are retrieving last modified at the server?
6. How many bytes of content are being returned to your browser?
7. By inspecting the raw data in the packet content window, do you see any headers within the data that are not displayed in the packet-listing window? If so, name one.

After reloading:

8. Inspect the contents of the first HTTP GET request from your browser to the server. Do you see an "IF-MODIFIED-SINCE" line in the HTTP GET?
9. Inspect the contents of the server response. Did the server explicitly return the contents of the file? How can you tell?
10. Now inspect the contents of the second HTTP GET request from your browser to the server. Do you see an "IF-MODIFIED-SINCE:" line in the HTTP GET? If so, what information follows the "IF-MODIFIED-SINCE:" header?
11. What is the HTTP status code and phrase returned from the server in response to this second HTTP GET? Did the server explicitly return the contents of the file? Explain.

* Go to: http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file3.html

12. How many HTTP GET request messages did your browser send? Which packet number in the trace contains the GET message for the Bill or Rights?
13. Which packet number in the trace contains the status code and phrase associated with the response to the HTTP GET request?
14. What is the status code and phrase in the response?
15. How many data-containing TCP segments were needed to carry the single HTTP response and the text of the Bill of Rights?