

ASSIGNMENT #1
BASIC NETWORKING
1/3/'16

Report Due: 10/03/'16
Date of Exam: 11/03/'16

Assignment Target:

This assignment is designed so that the students become familiar with devices of the 2 lower layers of the OSI stack and IPv4 addressing.

Goals:

1. Become accustomed to the fundamental software tools of the lab (most of which are contained in the livecd), these include but are not limited to:
ifconfig, netstat, arp, ping, iperf, wireshark, etc...
 2. Use hubs switches, understand their difference and the transmission settings on an ethernet interface
 3. Comprehend IPv4 addressing, CIDR & subnetting
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Tasks:

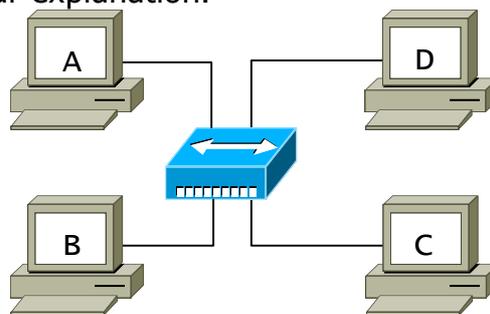
0. Examine the lab PCs & boot up using the live cd provided
 - a. Identify their ethernet interfaces. Report the MAC Addresses of at least 4 PCs.
 - b. Unhook them from the ethernet switch of the lab.
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CAUTION:

You are not the only users of this laboratory: other students need these PCs connected to the Internet after you leave. Take note which cable you unplug from where and once you are finished working restore the connectivity back to what you found it to be when you came in the lab. Verify the PC's are connected to the university network before you leave.

1. Use the 10Mbps hub provided to connect 4 lab PCs. (we will call them PCs A, B, C, D as in fig. 1)
 - a. Assuming you need not provide an address space for more devices set the IPv4 addresses on the 4 interfaces you have inter-connected.
 - b. Verify the connectivity using ping & report the delays.
 - c. Examine & report the arp table on each PC.
 - d. Report what changes you should make in the IP settings if you were told to provide addresses in your subnet exactly for
 - i. 1 more interface
 - ii. 10 more interfaces
2. Perform the following experiments:
 - a. Generate TCP traffic for 60 seconds using iperf, with A as server and B as client. Report the average throughput.

- b. Using multiple instances of iperf where you must, generate 2 TCP traffic flows for 60 seconds, with A as server and B, C as clients. Report the average throughput of both flows.
 - c. Again generate 2 TCP traffic flows for 60 seconds using iperf, with PCs A and B as servers and C as client. Report the average throughput of both flows.
 - d. Generate 2 TCP traffic flows for 60 seconds using iperf, with PCs A and B as servers and C, D as the respective client. Report the average throughput of both flows.
 - e. Generate same flows as in (2.d), only now flow 1 (from C to A) runs for 120 sec, flow 2 (D to B) starts at 60 seconds later and runs for 40 seconds. Plot the throughput at each second of the experiment for both flows.
 - f. Set up an ftp server on B and use a sufficiently large file for transfer to A. At the end of the transfer the client reports the time the file took to transport. Divide file size over time and compare the result with the result of (2.a).¹ Is there a discrepancy, why?
 - g. Using the setup of (2.d) set up the wireshark network analyzer on C. Verify that you can sniff the traffic from all four interfaces. Report one sniffed data packet in detail: mark/show all headers, addresses, sizes, sequence numbers etc
3. Replace the hub with the provided 1000Mbps switch. Verify using iperf that the link speed goes near the nominal value. If not examine whether the interface is not set to auto-detect the link speed. Conduct the same measurements as in (2) except (2.f) after you have set the PCs' Ethernet interfaces to 10Mbps so that results can be compared. Compare the two sets of results for each one of the experiments, providing adequate explanations. How would the network analyzer be enabled to capture all packets in this connectivity setup (without the use of the port replication function)?
 - Replay (2.a) on the switch using full-duplex 100Mbps and if supported by the interfaces use 1000Mbps also. Calculate the percentage of the capacity that the average throughput reaches. How can you explain the differences between 10, 100 and 1000Mbps?
 4. What would happen if you set the interfaces to Half-Duplex transmission mode? Verify performing the simplest experiment of your choice that demonstrates your explanation.



¹ if you are using a USB stick to store the transfer file make sure that the USB interface is running as a USB2 port, otherwise you might have bottleneck from the storage.

- Investigate the parameters and the operation of the official wireless networks in our department. Use all the available tools to discover topologies, servers and routers, and their performance. Can you spot any problem? Are there any improvements that you would suggest? Discuss in detail with facts, measurements, and complete proposal for any improvement.

Figure 1: The basic connectivity for this assignment

Report Guidelines:

You are required to deliver a report with clear results for each task. Do not provide any graph/figure without:

- clearly marking the axes and the plotted curves. "Clearly" means that:
 - the axes should have either equally spaced measurements on the independent variable, or following an exponential, or geometrical increment rule. (Linear x-axis or logarithmic respectively). For example figure 2 is how the graphs of Task 2.e might look like
 - The axes must have units
 - If more than one curves are plotted on a figure there must be a legend indicating which is which
- Providing a short reasoning why things appear as plotted.

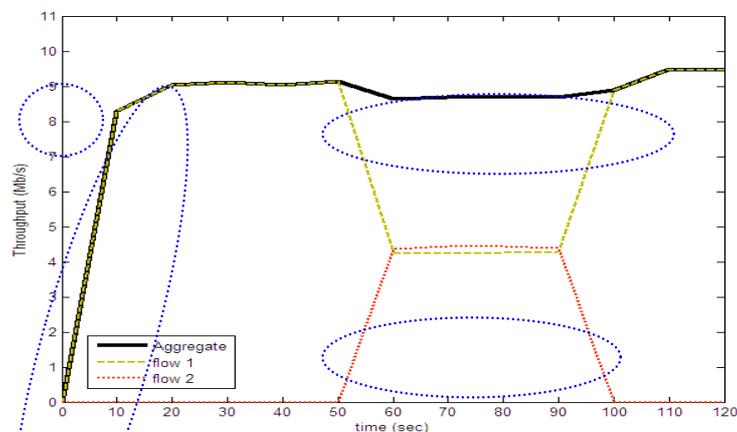


Figure 2: Example of a mock graph for Task 2.e. Noted with blue ellipses on the graph are areas/points of interest that are expected to be commented in the report and that you should be prepared to discuss about them in an oral exam.

Tip: If any additional curves (such as trendlines or aggregates) would make a point in your reasoning clearer then don't hesitate to plot them, just follow the rule above: any curve must be properly introduced to the reader.

Tip: tabulate results for better/faster viewing & reference, e.g.:

Table 1: Task 2 average throughput mock results

sub-task:	a	b		c		d		e	
throughput (in Mb/s)	9.43	flow1	flow2	flow1	flow2	flow1	flow2	flow1	flow2
		4.63	4.32	4.63	4.32	4.63	4.32	4.63	4.32