Tutor:

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Tutorial: 1 hour

- Discussion and solutions on tutorial problems.
- Q&A: your chance to ask technical questions.

Lab: 1 hour

- Group work:
- Form a group of 2 or 3 students each group.

Lab Assessment:

1 point each lab, 10 points in total (week 1-5, 7-11).

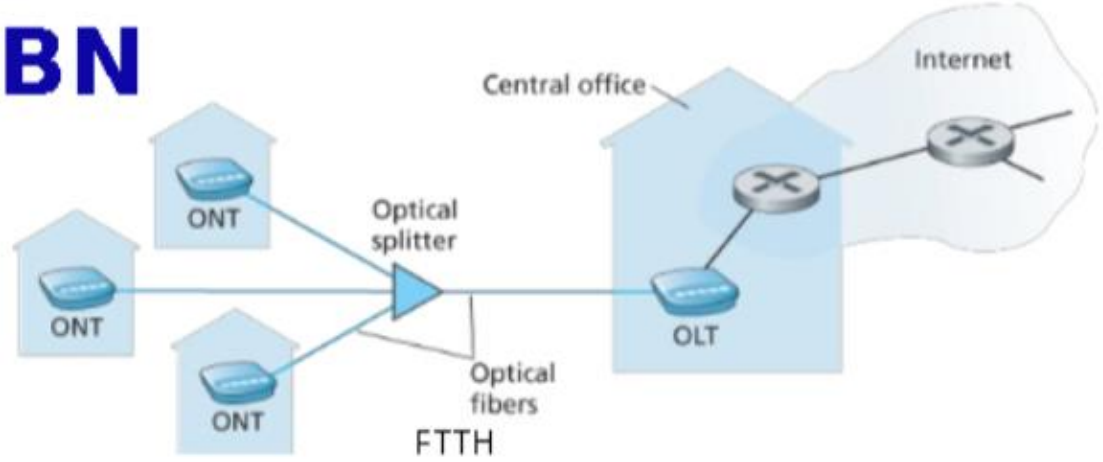
Individually assessed based on lab performance – **Not attendance!**

(Understand, Operations, and Results)

Week 1. Q&A

Speak to the students next you ☺ and get to know each other!

What is NBN



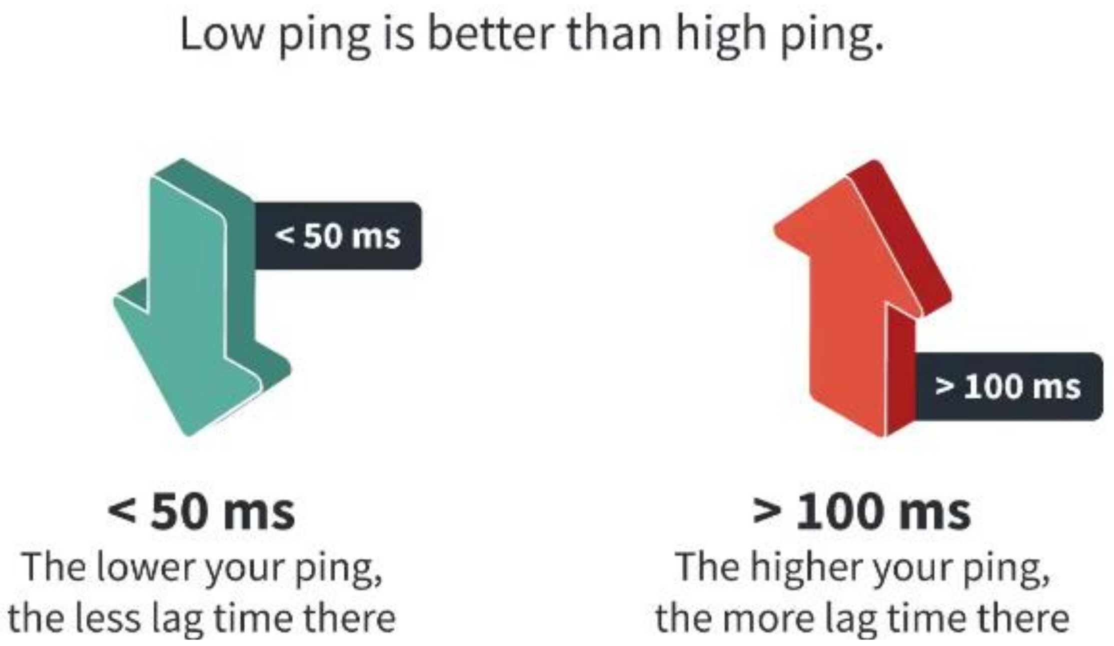
- What Access technologies are used in NBN?
- What is FTTH?
- What are the data rates for each technology?
- How much $ are they?
- Discuss Pros and Cons for each

Discuss in your Tutorial Class

Week 1. Tutorial problems and Solutions

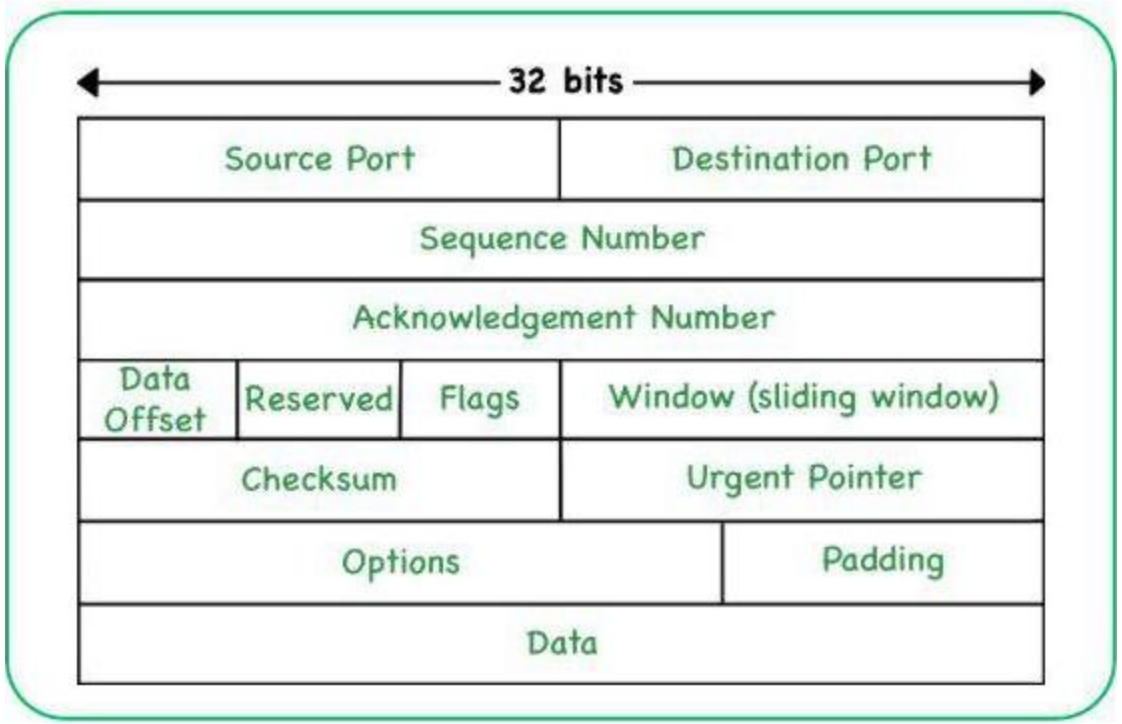
What's a **ping**?


0 PING
200+ PING


Low ping is better than high ping.
< 50 ms
> 100 ms
< 50 ms
The lower your ping,
the less lag time there
> 100 ms
The higher your ping,
the more lag time there

What is a packet?

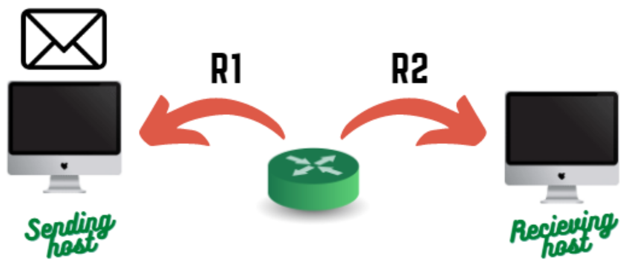
- Packets are used to break down larger pieces of data into manageable chunks that can traverse the network more efficiently.
- They are individually routed through the network based on the destination address information in the header.
- Once they reach their destination, the packets are reassembled into the original data.



OSI MODEL

7	Application Layer	Human-computer interaction layer, where applications can access the network services
6	Presentation Layer	Ensures that data is in a usable format and is where data encryption occurs
5	Session Layer	Maintains connections and is responsible for controlling ports and sessions
4	Transport Layer	Transmits data using transmission protocols including TCP and UDP
3	Network Layer	Decides which physical path the data will take
2	Data Link Layer	Defines the format of data on the network
1	Physical Layer	Transmits raw bit stream over the physical medium

Problem 1:

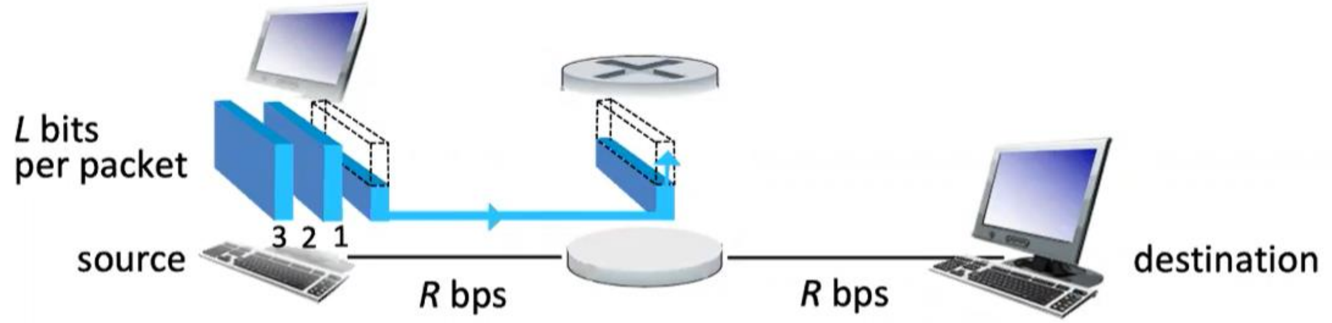


Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the **switch** and between the switch and the receiving host are R1 and R2, respectively. Assuming that the switch uses **store-and-forward** packet switching, what is the total end-to-end delay to send a packet of length L? (Ignore queuing, propagation delay, and processing delay.)

a. Now assume packet length L=1500 byte, R1=1Mbps, R2=2Mbps, calculate the **end-to-end Delay**.
b. Now assume packet length L=1200 byte, R1=3Mbps, R2=2Mbps, calculate the **end-to-end Delay**.

Brief Explanation:

Packet-switching: store-and-forward



- Transmission delay: takes L/R seconds to transmit (push out) L-bit packet into link at R bps
- *Store and forward: entire* packet must arrive at router before it can be transmitted on next link
- *End-end delay:* $2L/R$ (above), assuming zero propagation delay (more on delay shortly)

One-hop numerical example:

- L = 10 Kbits
- R = 100 Mbps
- one-hop transmission delay = 0.1 msec

Solution 1:

At time t_0 the sending host begins to transmit. At time $t_1 = L/R_1$, the sending host completes transmission, and the entire packet is received at the router (no propagation delay). Because the router has the entire packet at time t_1, it can begin to transmit the packet to the receiving host at time t_1. At time $t_2 = t_1 + L/R_2$, the router completes transmission, and the entire packet is received at the receiving host (again, no propagation delay). Thus, the end-to-end delay is $L/R_1 + L/R_2$.

a. Delay = 1500*8/1000000 + 1500*8/2000000 = 0.018s=18ms
b. Delay = 1200*8/3000000 + 1200*8/2000000 = 0.008s=8ms

Problem 2:

$$d_{\text{end-to-end}} = N\frac{L}{R} \qquad (1.1)$$

Gives a formula for the end-to-end delay of sending one packet of length L **by N links** of transmission rate R.

Generalize this formula for sending **P number packets back-to-back over the N links**.

Solution 2:

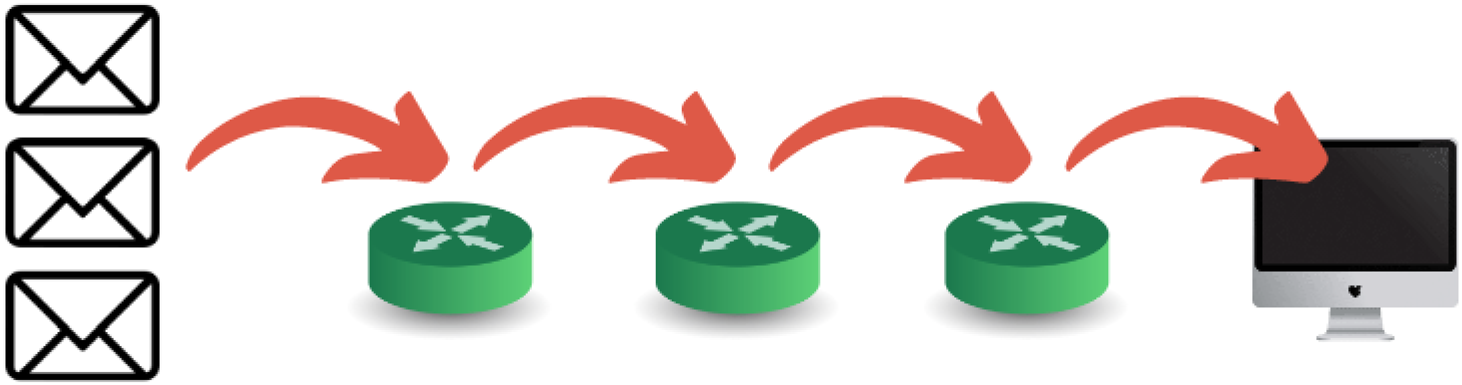
At time N*(L/R) the first packet has reached the destination, the second packet is stored in the last router, the third packet is stored in the next-to-last router, etc.

At time N*(L/R) + L/R, the second packet has reached the destination, the third packet is stored in the last router, etc.

Continuing with this logic, we see that at time N*(L/R) + (P-1)*(L/R) = (N+P-1)*(L/R) all packets have reached the destination.

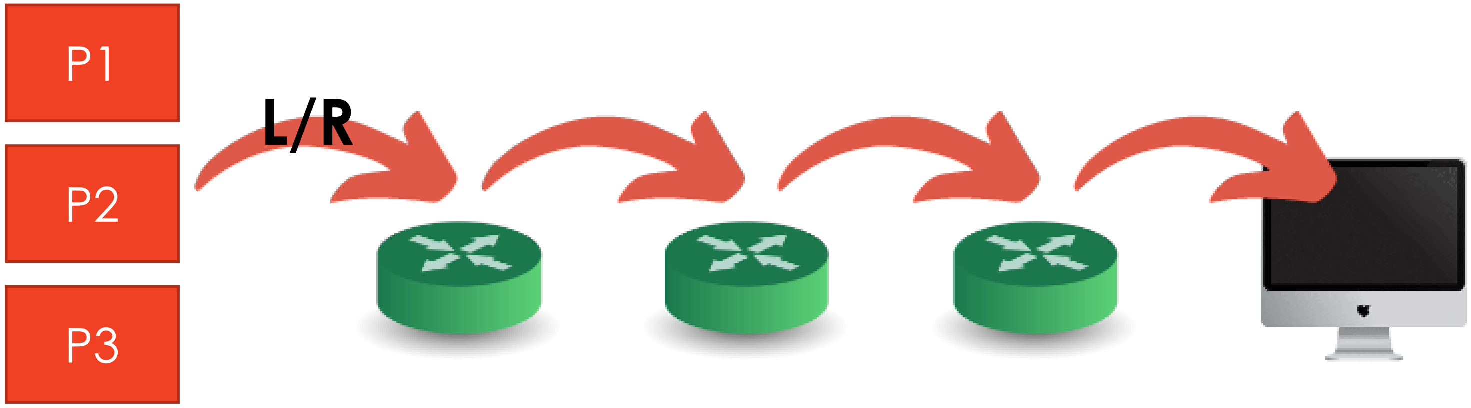
P2 Explanation:

What is N? in this example?



P2 Explanation:

What is N? in this example?



P2 Explanation:

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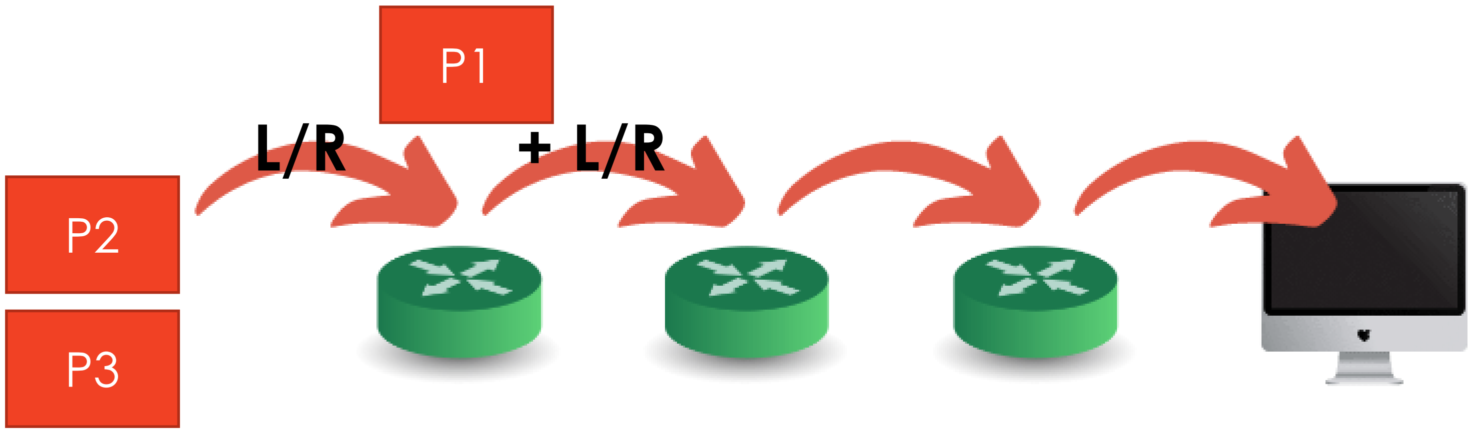

P2 Explanation:

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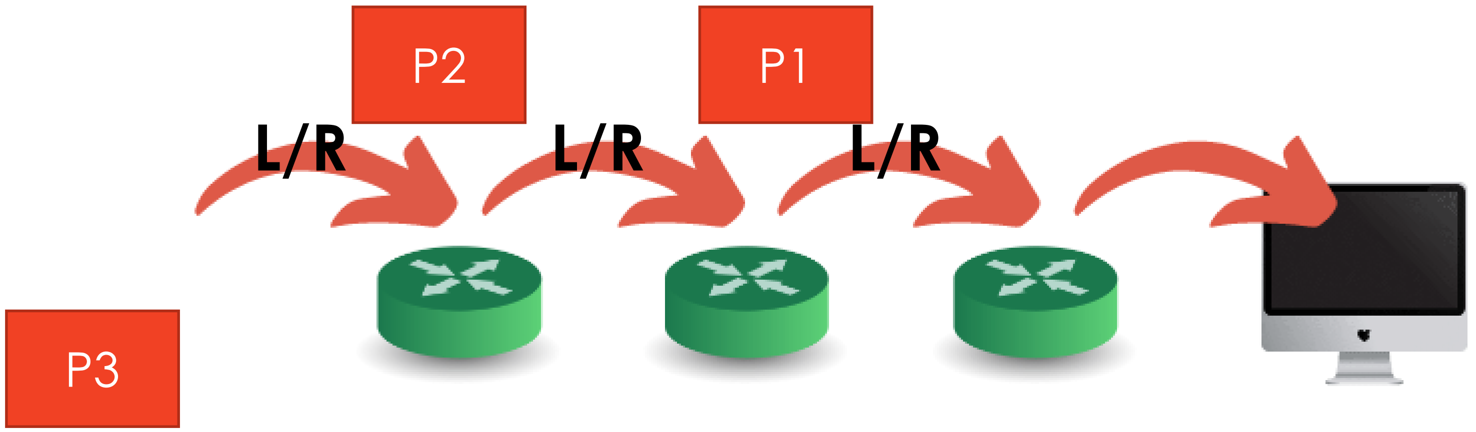
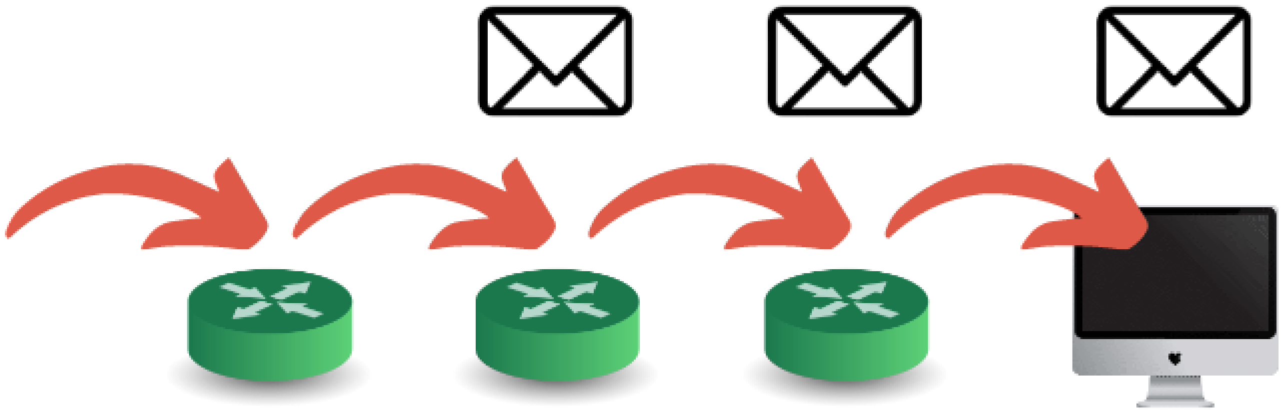


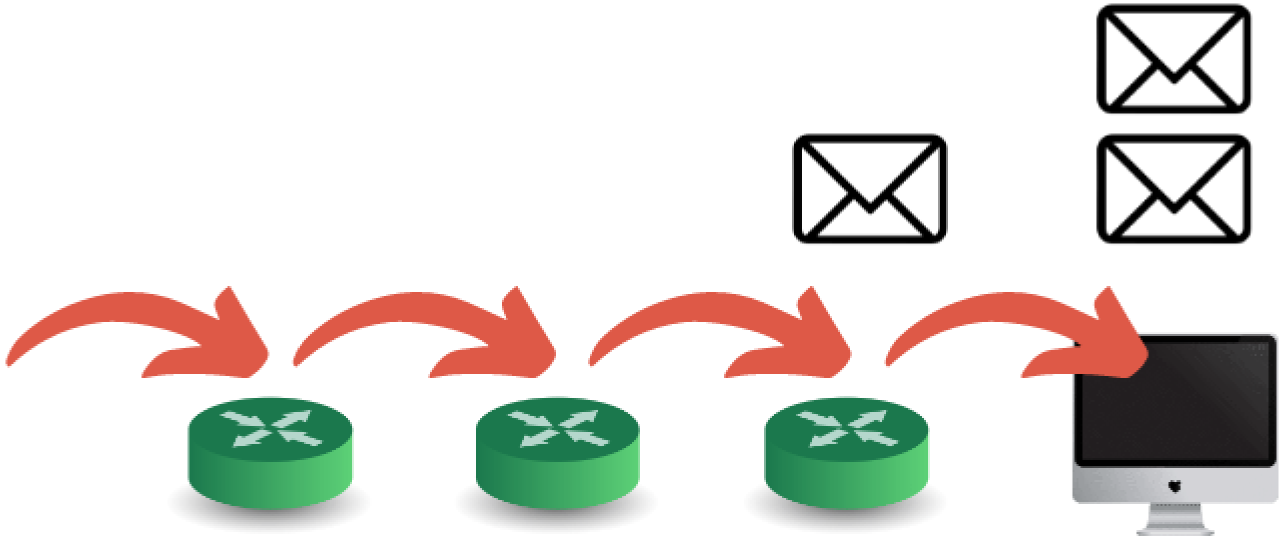
P2 Explanation:



For the first packet to arrive its destination we will need:

N * L/R

P2 Explanation:



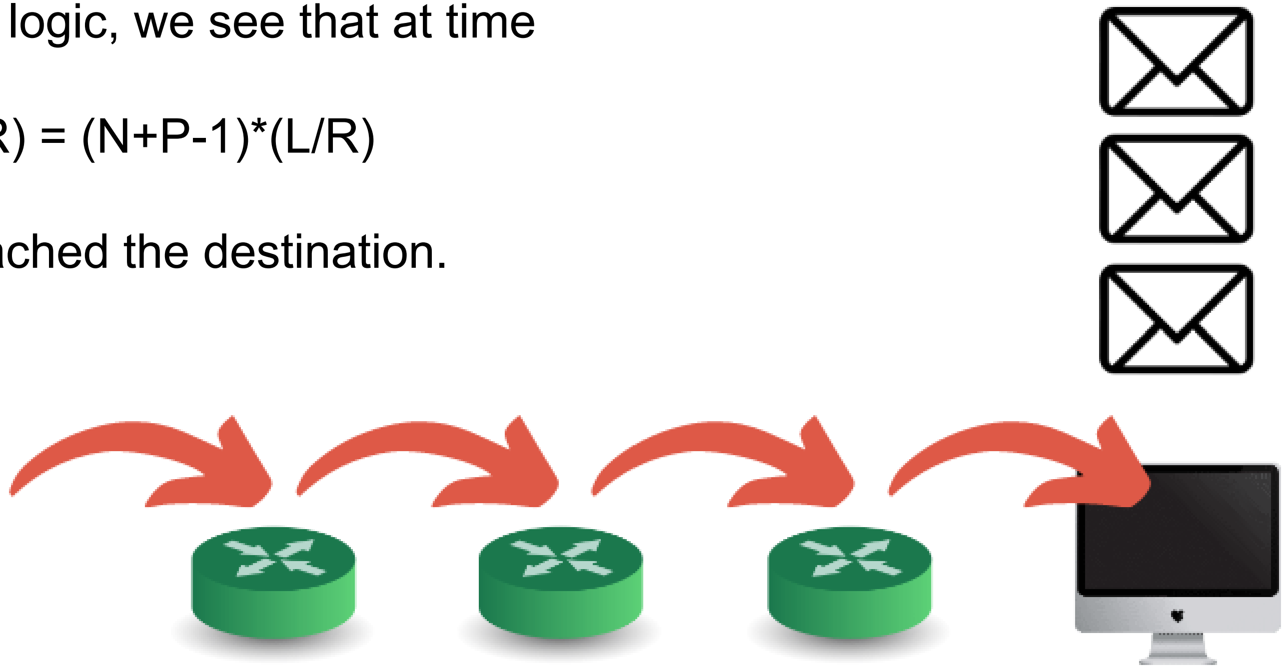
(4 * L/R) **+ L/R**

P2 Explanation:

Continuing with this logic, we see that at time

N*(L/R) + (P-1)*(L/R) = (N+P-1)*(L/R)

all packets have reached the destination.



(4 * L/R) + L/R **+ L/R**

The first part of the formula: **N * (L/R)** [calculates the delay of when the first packet arrives to the destination]
The second part of the formula: **(P-1) * (L/R)** [the delay of the remaining packets is calculated by this second part of the formula]

To double check, try and substitute the numbers of this topology into the formula:
P = 3
N = 4
4*(L/R) + (3 -1) * (L/R) = 6 * (L /R)

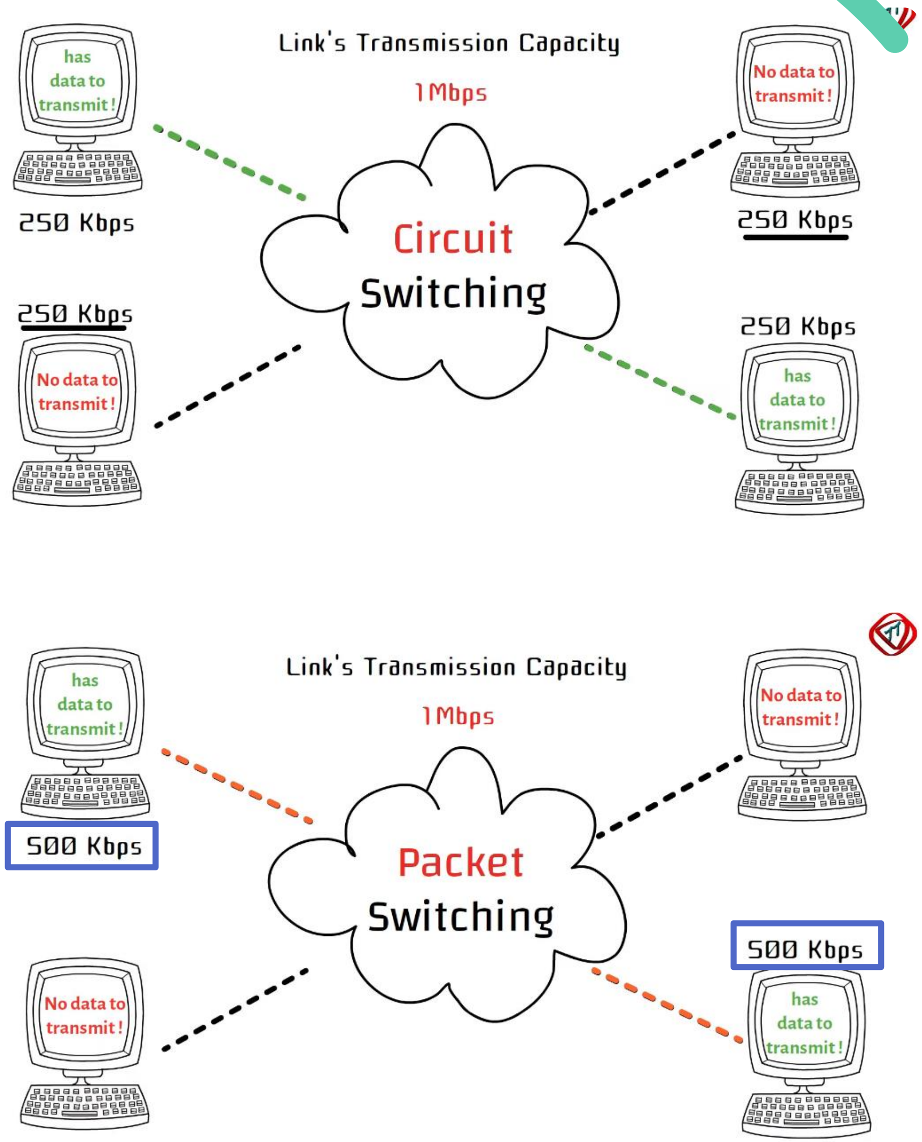
Problem 3:

Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively **long period of time**. Answer the following questions, briefly justifying your answer:

a. Would a **packet-switched network** or a **circuit-switched** network be more appropriate for this application? Why?

b. such applications as described above. Further-more, assume that the sum of the application data rates is **less than** the capacities of each and every link. Is some form of congestion control needed? Why?

Circuit-switched reserve a fixed bandwidth even if its not sending data.



Packet-switched does NOT reserve a fixed bandwidth when it does not need to use the route.

Solution 3: (a)

a) A circuit-switched network would be well suited to the application, because the application involves long sessions with **predictable** smooth bandwidth requirements. Since the transmission rate is known and not bursty, bandwidth can be **reserved** for each application session without **significant waste**. In addition, the overhead costs of setting up and tearing down connections are paid off over the lengthy duration of a typical application session.

Solution 3: (b)

b) In the worst case, all the applications simultaneously transmit over one or more network links. However, since each link has sufficient bandwidth to handle the sum of all of the applications' data rates, no congestion (very little queuing) will occur.

Given such generous link capacities, the network does not need congestion control mechanisms.

Problem 8:

Suppose users share a **10 Mbps link**. Also suppose each user requires 200 kbps when transmitting, **but each user transmits only 10 percent of the time.**

(See the discussion of packet switching versus circuit switching in Section 1.3.)

a. When **circuit switching** is used, how many users can be supported?
b. For the remainder of this problem, suppose **packet switching** is used. Find the **probability** that a given user is transmitting.
c. **Optional**: Suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (Hint: Use the binomial distribution.)

https://www.youtube.com/watch?v=oUN-s6aFMTk

Solution 8: (a, b, and c)

10Mbps = 10^8 bits per seconds.
200Kbps = 200000 bits per seconds.
Divide those two the rate and the user's requirement together.
Link capacity / user transmission requirement
10000000 / 200000 = 50 users!

a) 50 users can be supported.

10 / 100

b) $p = 0.1$.

c) $\binom{120}{n} p^n (1-p)^{120-n}$.

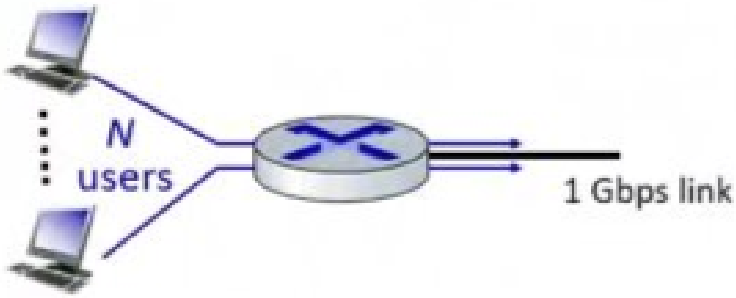
C) Suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (Hint: Use the binomial distribution.)

Packet switching versus circuit switching

packet switching allows more users to use network!

Example:

- 2 Mb/s link
- each user:
  - 1 Mb/s when "active"
  - active 20% of time, e.g. voice



- *circuit-switching:* 2 users
- *packet switching:* with 3 users, probability > 3 active at same time is less than .008 *

Q: how did we get value 0.008?

A: $C(3,3)p^3(1-p)^{3-3}=0.2^3=0.008$

Q: what happens if 4 users ?

ANSWER

c) $\binom{120}{n} p^n (1-p)^{120-n}$

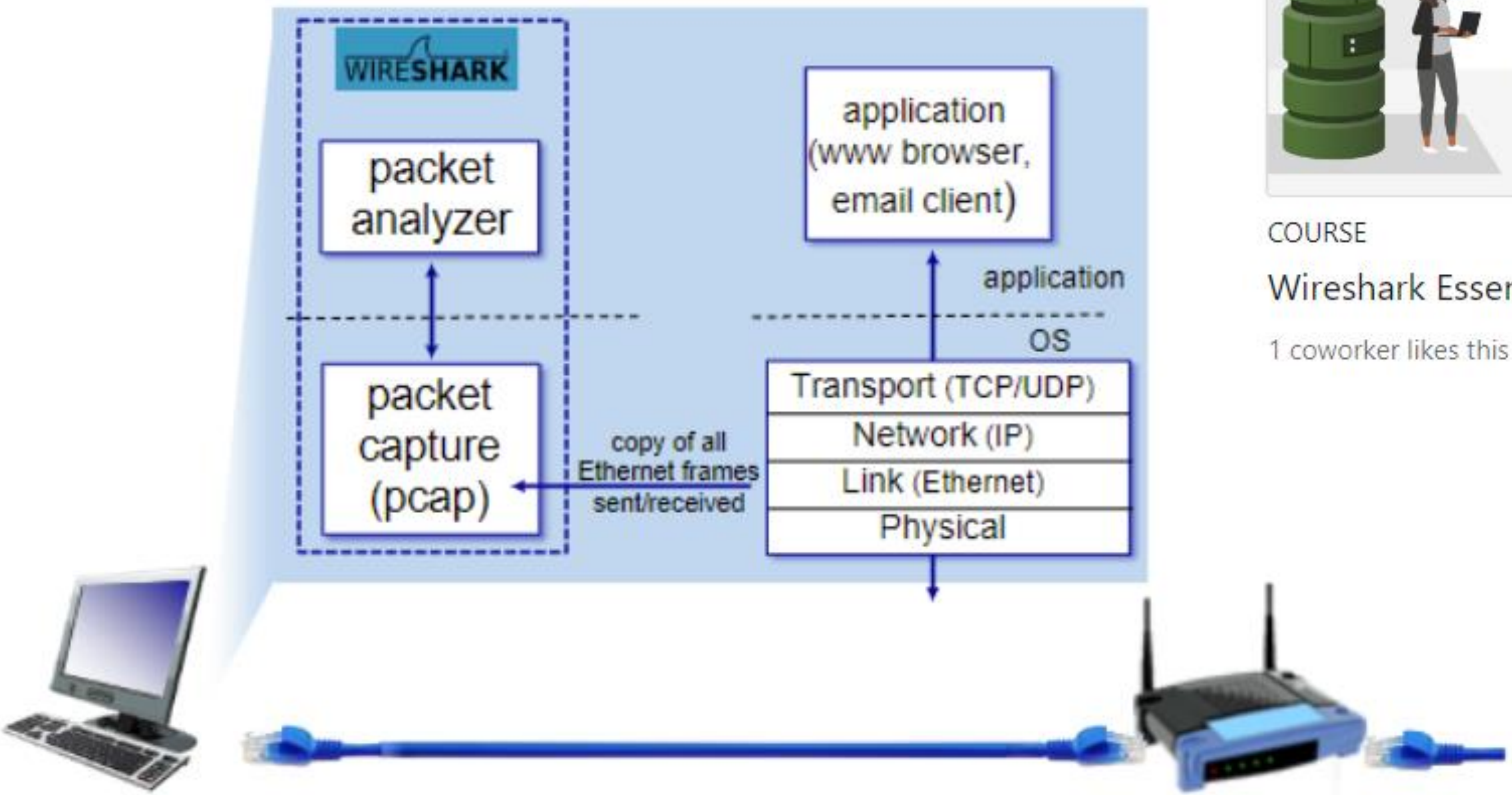
C) In the lecture we have been supplied a formula from which we can determine the probability. We can substitute the new values to complete the question.

Week 1 Lab.
PC Guide

Follow Lab PC Guide to configure Lab PC.

Enable the ‘FEIT’ adapter in the ‘network and internet sharing’ center for internet c

Week 1 Lab: Wireshark Intro



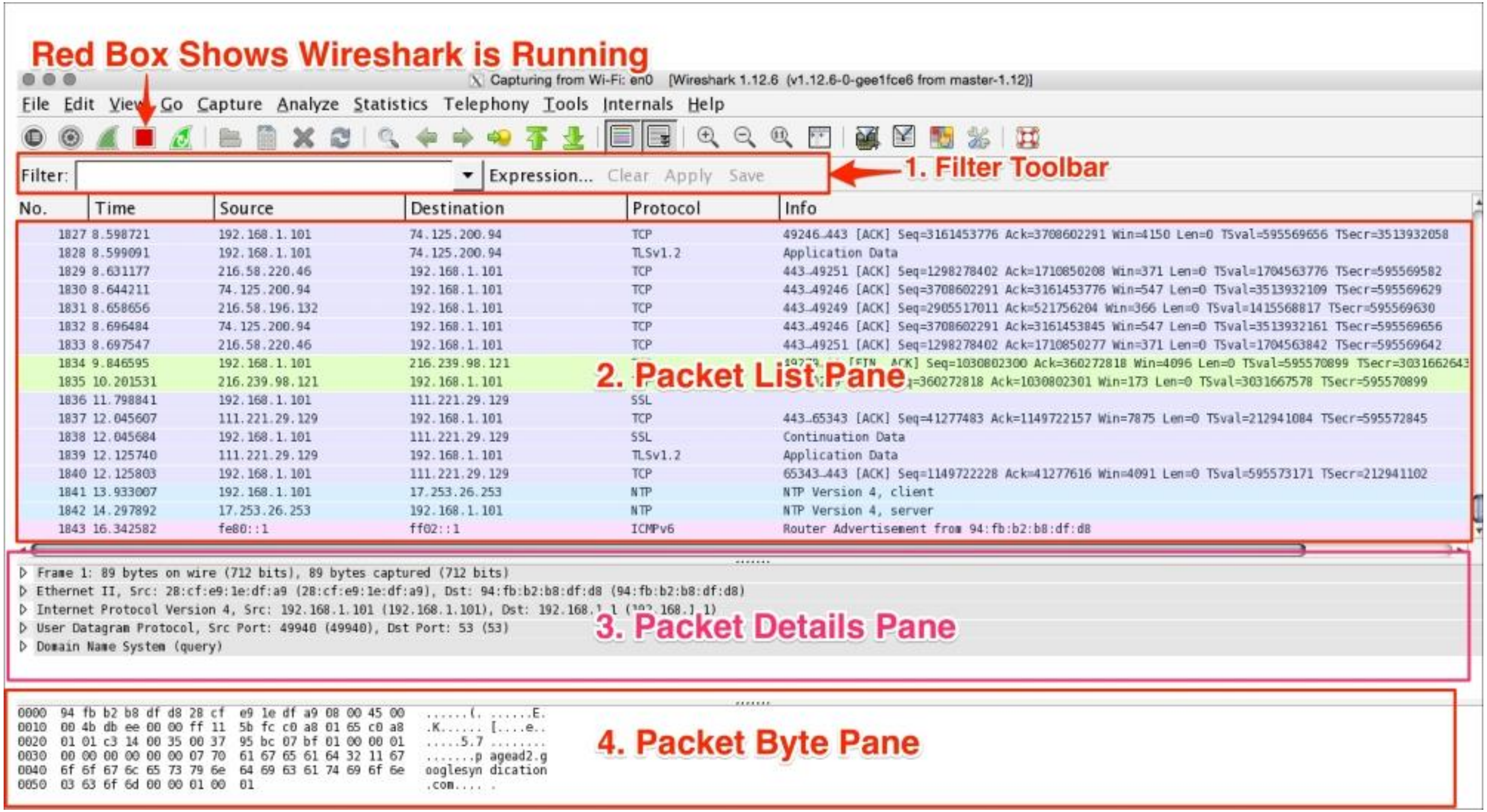
LinkedIn course

COURSE

Wireshark Essential Training

1 coworker likes this

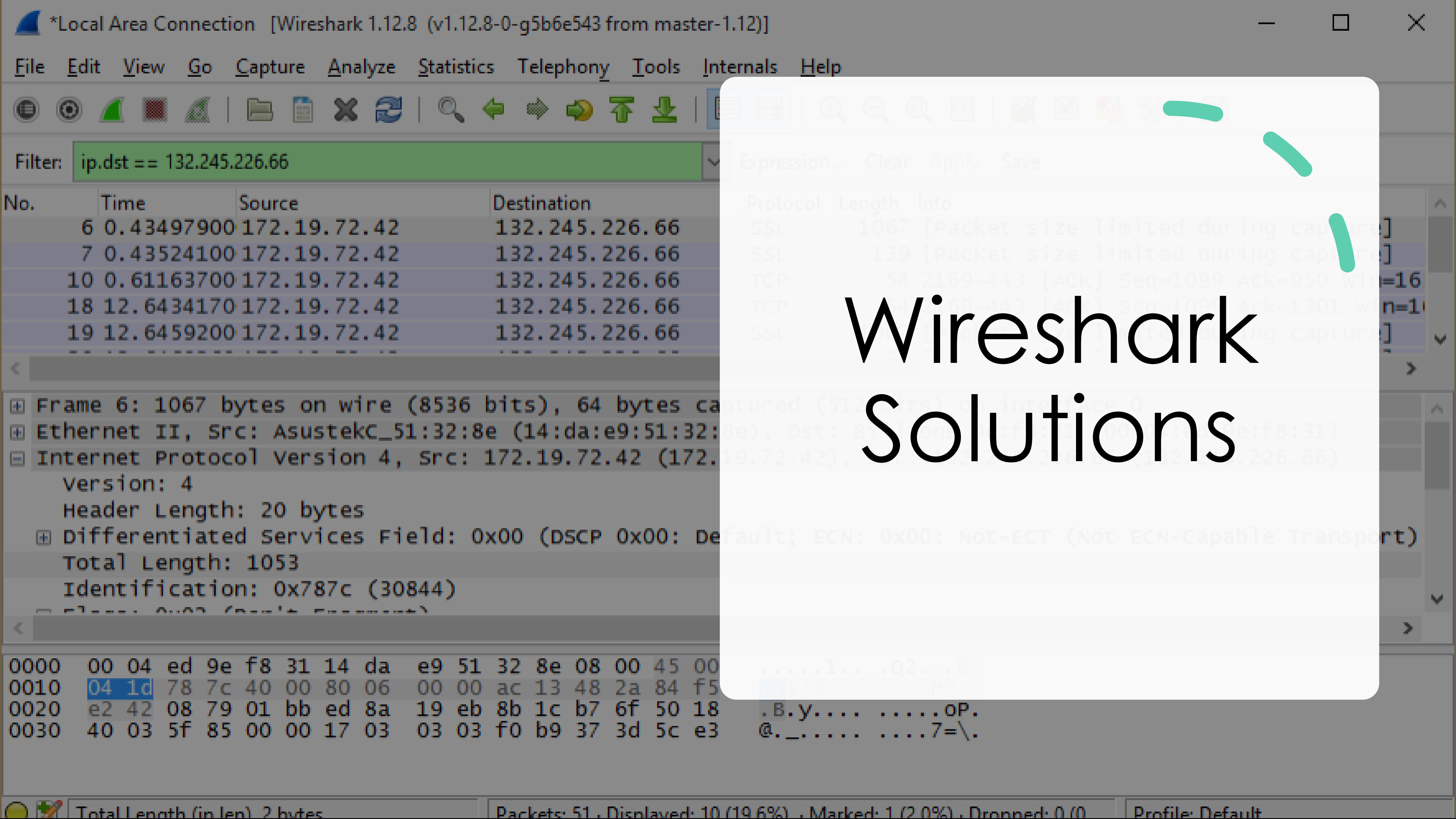
Wireshark Interface



What to hand in:

1. List 3 different protocols that appear in the protocol column in the unfiltered packet-listing window in step 7 above.
2. How long did it take from when the HTTP GET message was sent until the HTTP OK reply was received? (By default, the value of the Time column in the packet-listing window is the amount of time, in seconds, since Wireshark tracing began. To display the Time field in time-of-day format, select the Wireshark *View* pull down menu, then select Time *Display Format*, then select *Time-of-day*.)
3. What is the Internet address of the gaia.cs.umass.edu (also known as www-net.cs.umass.edu)? What is the Internet address of your computer?
4. Print the two HTTP messages (GET and OK) referred to in question 2 above. To do so, select *Print* from the Wireshark *File* command menu, and select the "*Selected Packet Only*" and "*Print as displayed*" radial buttons, and then click OK.

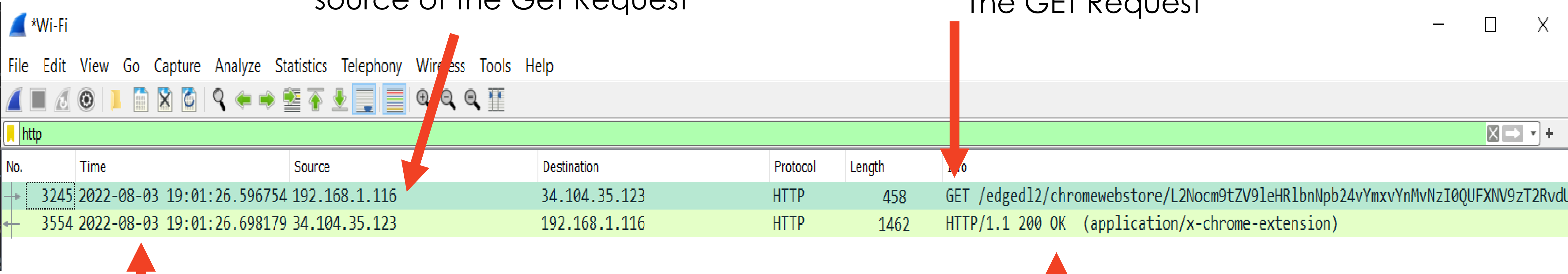
Wireshark Solutions



HTTP

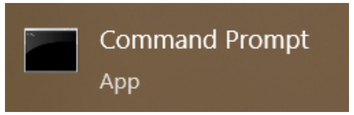
Our laptop address, is the source of the Get Request

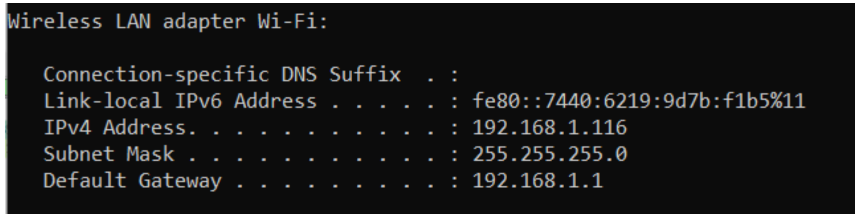
The GET Request



Time

The OK Response





Bonus trick: open the command prompt in your PC. And type **ipconfig** you will get to see your IP address