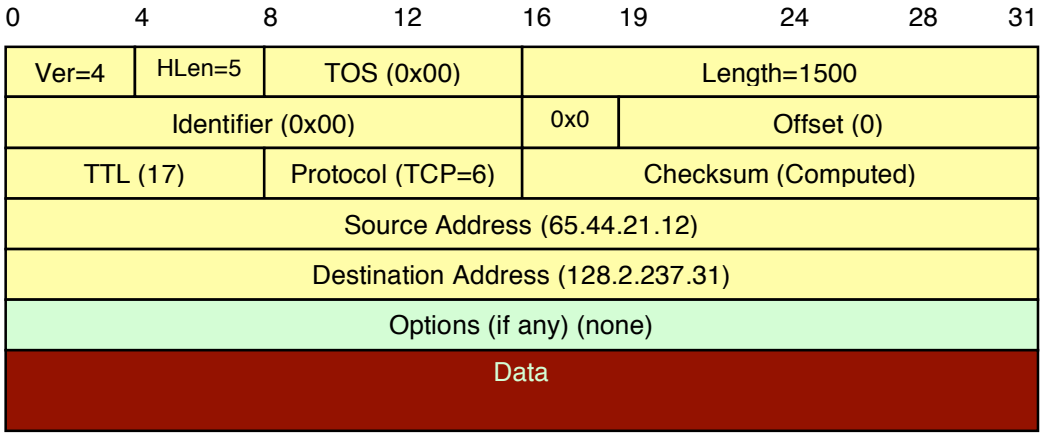
15-441 Computer Networks
Homework Two

Due Tuesday October 9th, 1:30pm, in class
Lead TA: Daniel Spangenberger

1. **Fragmentation and Layering**
   A TCP packet P containing a 1460 byte slice of the new Team Fortress 2 binary is in transit to you home computer (you are downloading it in your favorite web browser, Firefox). A router E on the route between the Steam servers and your computer has a maximum MTU of 576 bytes. Consider P:



   Note that IP headers are 20 bytes and TCP headers are 20 bytes as well.
   a. What packets are generated after the packet passes through router E? (write out the IP headers and the location of TCP headers, but not the contents of the TCP headers) – do not compute the checksum but note if it is the same as the original or different.
   b. What will your home computer receive at the IP level (i.e. as input to IP)? What guarantees on order or delivery are available?
   c. What will your home computer receive at the TCP level (i.e. as input to TCP)? What guarantees on order or delivery are available?
   d. What will you receive as input to Firefox? Will router E prevent the file from downloading?

2. **Ethernet**
   Assume that a current 100Mbps Ethernet network with links of up to 10 km exists. This system currently supports up to 20 machines on the wire. The system currently has a minimum packet size of 64bytes and a maximum packet size of 2000 bytes.

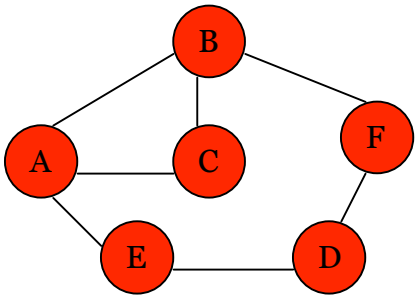
   We want to allow an Ethernet link of 1000 kilometers and support 100

hosts. Answer the following questions about how the network must change.

a. What do you need to change to accommodate the new settings? What are the new setting(s) for the parameter(s)?
b. Are these new settings reasonable for Internet use? If not, mention another carrier control method that would yield better performance under such constraints. If so, explain why they are reasonable.

3. **RIP and convergence**

Consider the following network topology running RIP as it's IGP (interior gateway protocol) for inter-domain routing:



a. Generate the initial routing table for nodes A and F.
b. Generate the final routing table for nodes A and F.
c. Now consider what happens if node C fails. What can happen in the worst case? (think of terms in convergence).
d. What is one way to fix this? Explain how it would work and its convergence properties.

4. **Internetworking with BGP**

Consider the following internet-work topology:

- Tier 1 ISP A services ISP's C and D
- Tier 1 ISP B services ISP's D and E
- Tier 2 ISP's C and D peer
- Tier 2 ISP's D and E peer
- Customer W is serviced by ISP D
- Customer X is serviced by ISP D
- Customer Y is serviced by ISP E
- Customer Z is serviced by ISP C

Draw a picture of this scenario and utilizing valley-free routing describe how traffic is routed for the following transmissions:

a. Customer X to Customer Y
b. Customer Z to Customer Y
c. Customer X to Customer W

5. **Class-less Addressing with CIDR**

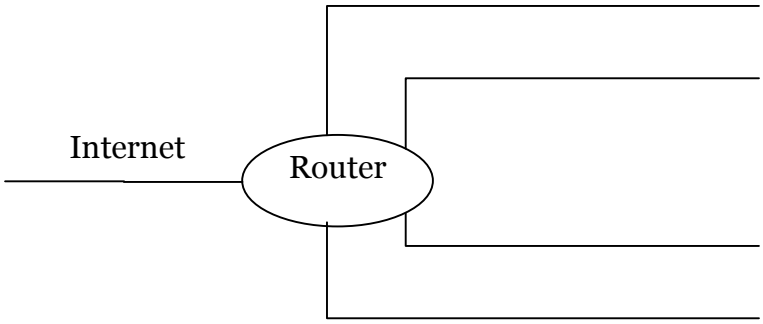
An organization has a class C network 200.1.1.0/24 and wants to form subnets for four departments, with hosts as follows:

a. 72 hosts
b. 35 hosts
c. 20 hosts

d. 18 hosts

There are a total of 145 hosts. Answer:

a. Give a possible arrangement of subnet masks to make this possible.
b. Generate a routing table for the organization's router (connected as below to the 4 subnets), assuming that the router's addresses for each subnet are the first IP address available in the subnet.



Suggest what the organization might do if department D grows to 34 hosts.

(Adapted from Peterson and Davie 4th Edition, problem 4.40)