EL5373 Internet Architecture and Protocols

Review Problems – Set One

Question 1

Compute the percentage overhead (defined as the number of bytes in headers and trailers divided by the total number of bytes sent) incurred by sending data payload in

a. fully loaded Ethernet frames (per RFC 894).
b. fully loaded PPP frames.

In both cases, assume the channel to be idle initially. Note that the period that a host must wait before it transmits is also ignored.

Solution

a. The Header and Trailer of an Ethernet frame count to 18 byte. A fully loaded Ethernet frame has 1500byte of payload. Thus the overhead is
$$\frac{18}{1500+18} = 1.186\%$$

b. Similarly, for a fully loaded PPP frame, the overhead is
$$\frac{8}{1500+8} = 0.531\%$$

Question 2

Assuming initially idle channel, consider sending 400 byte of data over an Ethernet and a PPP Link. What are the actual overhead percentages for the data transfers?

Solution

This is the same as the previous question, except that the payload sizes have changed. Thus, for an Ethernet frame, the overhead is
$$\frac{18}{400+18} = 4.306\%$$

and for the PPP frame, the overhead is
$$\frac{8}{400+8} = 1.961\%$$

Question 3

As you have learnt, a number of hosts using Ethernet, share a single channel and each collision decreases throughput. If hosts on a 6-host 10 Mbps 80 m Ethernet LAN send frames 64 byte long,

a. What is the scenario that maximizes throughput of the hosts?
b. For the scenario you chose, what is the maximum number of frames that can be sent in a 1 second time period?

Explain your assumptions and show all steps. Assume that the speed of light is 2×10^8 ms^{-1}.

Solution

a. The throughput will be maximized when only one of the 6 hosts transmits data at a time, while all others are silent (unrealistic, but maximizing throughput).

b. Two answers will be regarded as correct. Given the scenario mentioned above, we can assume no collisions for both answers.

   i. Since each frame is 64 byte long, its transmission takes

$$\left\lfloor\frac{64 \times 8\, bits}{10 \times 10^6\, bit \cdot s^{-1}}\right\rfloor = 51.2 \times 10^{-6}\ s = 51.2\ \mu s.$$

   Thus, maximum number of frames that can be sent in 1s is

$$\left\lfloor\frac{1\, s}{51.2 \times 10^{-6}\, s}\right\rfloor = 19531$$

   ii. In the above case, we assumed that a single host sends data continuously during the entire 1s period. This isn't actually allowed in Ethernet because it might result in a greedy host taking the shared bus forever. In Ethernet, when a host gets hold of the bus, it transmits a frame and waits for a period equal to twice the maximum propagation delay before starting to transmit the next frame. During this waiting period, the other hosts get a fair chance to compete for the channel.

   In this case, time required for transmission of one frame (which includes the waiting time) is

$$51.2 \times 10^{-6}\ s + 2 \times \frac{80\ m}{2 \times 10^8\ ms^{-1}} = 52 \times 10^{-6}\ s = 52\ \mu s$$

   Thus, maximum number of frames that can be sent in this case is

$$\left\lfloor\frac{1\, s}{52 \times 10^{-6}\, s} = 19{,}230\right\rfloor$$