جامعة الأهرام الكندية
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Network I Revision 2

1. Consider a point-to-point link $l = 100$ km in length. The propagation speed S_p of bits in this link is $2 \cdot 10^8 \frac{m}{s}$. At what bandwidth B will propagation delay D_p equal transmission delay D_t for a 100 byte packets?

Solution:

$$D_p = \frac{l}{S_p} = \frac{100 \text{ km}}{2 \cdot 10^8 \text{ ms}^{-1}} = \frac{10^5 \text{ m}}{2 \cdot 10^8 \text{ ms}^{-1}} = 5 \cdot 10^{-4} \text{ s} = \frac{1}{2} \text{ ms}$$

$$D_t = \frac{100 \text{ byte}}{B} = 5 \cdot 10^{-4} \text{ s} \Longrightarrow B = \frac{100 \text{ byte}}{5 \cdot 10^{-4} \text{ s}} = 2 \cdot 10^5 \frac{\text{byte}}{\text{s}} = 200 \text{ kbps}$$

2. Host A wants to send a 1 Mbyte packet to Host B. The propagation speed of bits is $2 \cdot 10^8$ m/s. Assume that A and B are connected via a router R. Link $\overline{AR}$ connects A to R, and link $\overline{RB}$ connects R to B. Link $\overline{AR}$ is 1 km long and link $\overline{RB}$ is 2 km long. Suppose the capacity of each of the two links is 10 Mbytes/s and the processing delay at the Router (R) is 10 ms. After how much time will host B receive the packet. Note that Router (R) must receive the whole packet before being able to forward it.

Solution:

In order to compute the total delay we will break it down into:

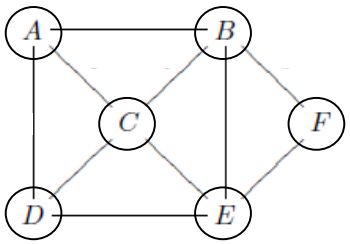
$$\begin{aligned} \text{Total delay} &= \text{Delay from host } A \text{ to router } R \\ &+ \text{Delay at the router} \\ &+ \text{Delay from router } R \text{ to host } B \end{aligned}$$

$$\begin{aligned} \text{Delay from host } A \text{ to router} &= \text{Transmission delay} + \text{Propagation delay} \\ &= \frac{1 \text{ Mb}}{10 \text{ Mb/s}} + \frac{10^3 \text{ m}}{2 \cdot 10^8 \text{ m/s}} \\ &= 0.1 \text{ s} + 0.5 \cdot 10^{-5} \text{ s} = 100.005 \text{ms} \end{aligned}$$

$$\begin{aligned} \text{Delay from Router to Host } B &= \text{transmission delay} + \text{propagation delay} \\ &= \frac{1 \text{ Mb}}{10 \text{ Mb/s}} + 2 \cdot \frac{10^3 \text{ m}}{2 \cdot 10^8 \text{ m/s}} \\ &= 100.01 \text{ ms} \end{aligned}$$

$$\text{Total delay} = 100.005 \text{ ms} + 10 \text{ ms} + 100.01 \text{ ms} = 210.015 \text{ ms}$$

3. Consider the following network of 6 hosts, where host A would like to send a packet to host F. Assume that the packet will only reach its destination in 4 steps or less it will be discarded on its 4^{th} "hop" unless it is at host F.



a) Find all possible paths from A to F, so that the same host is never visited more than once, and the above 4-step constraint is met.

Solution:

a) All possible path from A to F in 4 hops or less:

$A\ B\ C\ E\ F$
$A\ B\ E\ F$
$A\ B\ F$
$A\ C\ B\ E\ F$
$A\ C\ B\ F$
$A\ C\ D\ E\ F$
$A\ C\ E\ B\ F$
$A\ C\ E\ F$
$A\ D\ C\ B\ F$
$A\ D\ C\ E\ F$
$A\ D\ E\ B\ F$
$A\ D\ E\ F$