Computer Networks

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Lab-1

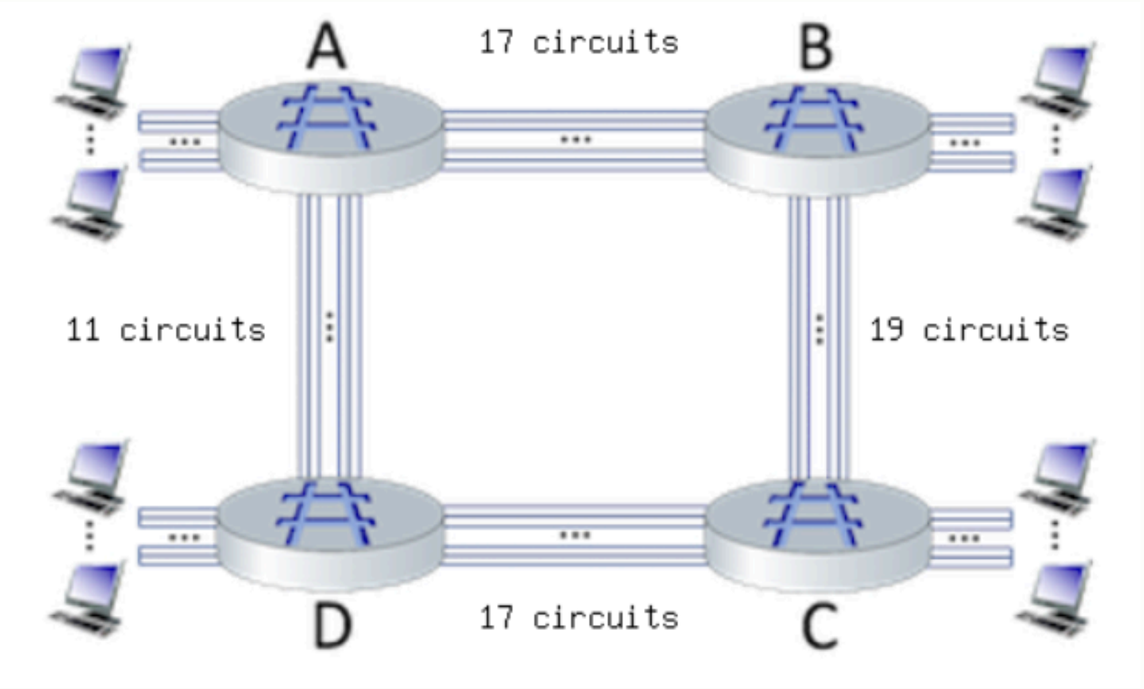
Forming Homework Groups

Let’s begin by organizing the homework groups.

- Groups should consist of 3 students each, with 2 students allowed in exceptional cases.

Circuit switching

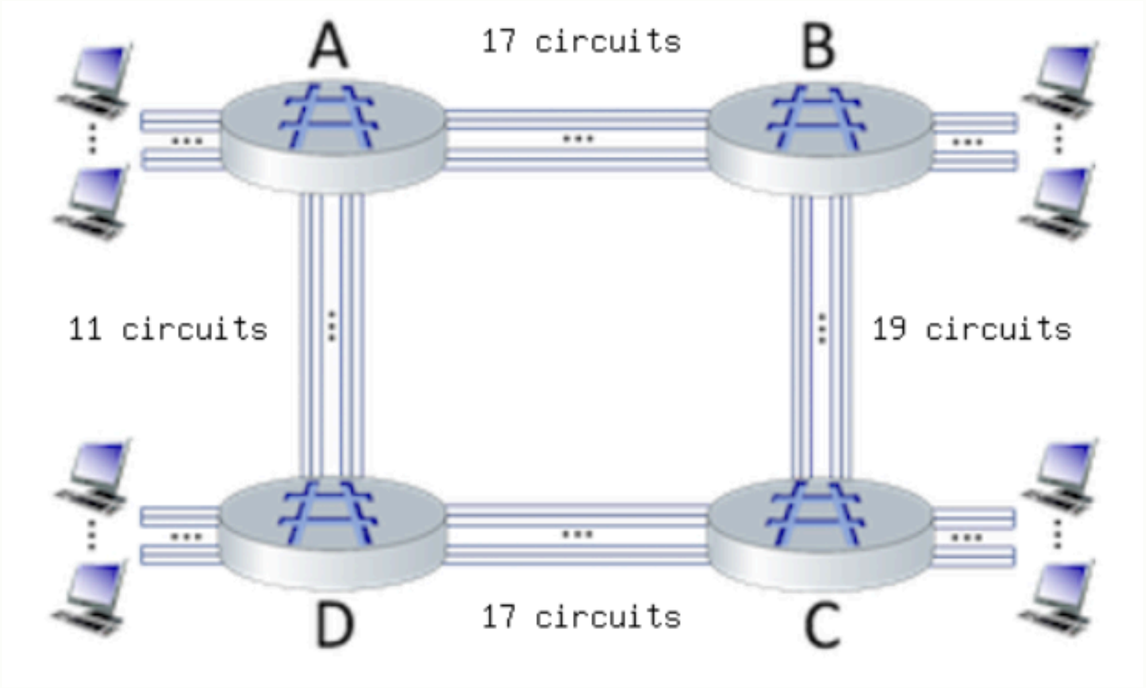
1. What is the maximum number of connections that can be ongoing in the network at any one time?
2. Suppose that every connection requires 2 consecutive hops, and calls are connected clockwise. For example, a connection can go from A to C, from B to D, from C to A, and from D to B. With these constraints, what is the is the maximum number of connections that can be ongoing in the network at any one time?
3. Suppose that 20 connections are needed from A to C, and 12 connections are needed from B to D. Can we route these calls through the four links to accommodate all 32 connections? Answer Yes or No.



Circuit switching

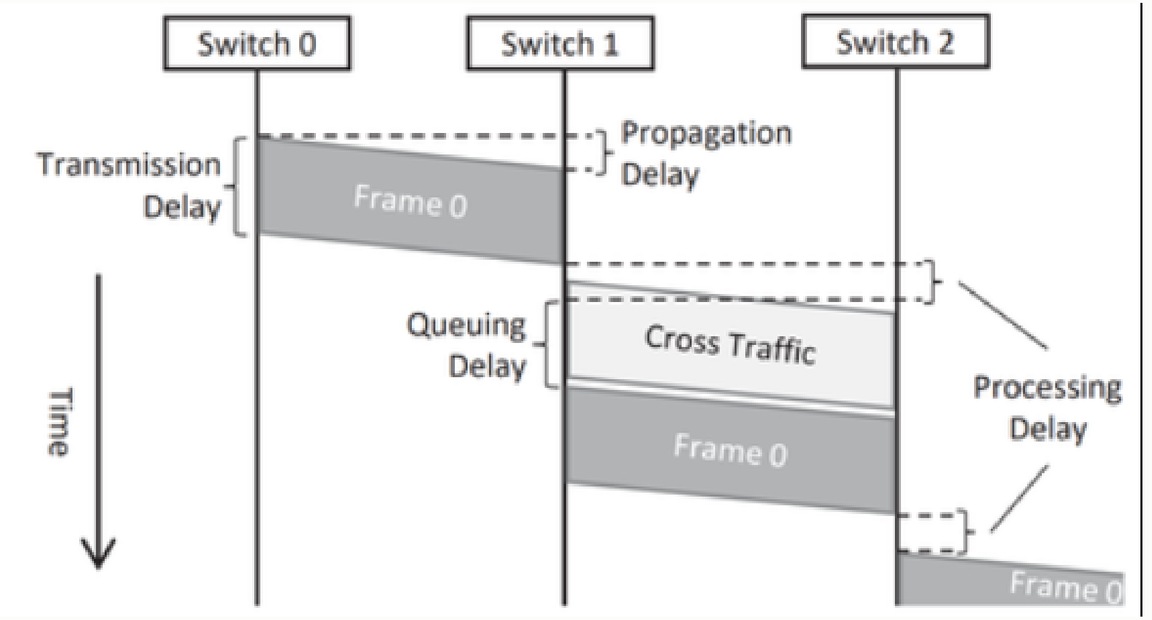
Answers:

1. The maximum number of connections that can be ongoing at any one time is the sum of all circuits, which happens when 17 connections go from A to B, 19 connections go from B to C, 17 connections go from C to D, and 11 connections go from D to A. This sum is 64.
2. There can be a maximum of 30 connections. Consider routes A->C and C->A, sum the bottleneck links, consider any leftover capacity that would allow for B->D and D->B connections, and compare that value to the equivalent of B->D and D->B.
3. Using our answer from question 2, the sum of our needed connections is 32, and we have 30 available connections, so it is NOT possible.



Delays in packet switching networks (ex: The Internet):

1. Processing Delay: Time taken by a router or switch to examine the packet's header and determine where to send it.
2. Queuing Delay: Time a packet spends waiting in a queue before being transmitted, usually due to congestion.
3. Transmission Delay: Time required to push all the packet's bits onto the link, calculated as packet size / transmission rate.
4. Propagation Delay: Time it takes for a signal to travel from the sender to the receiver across the physical medium.

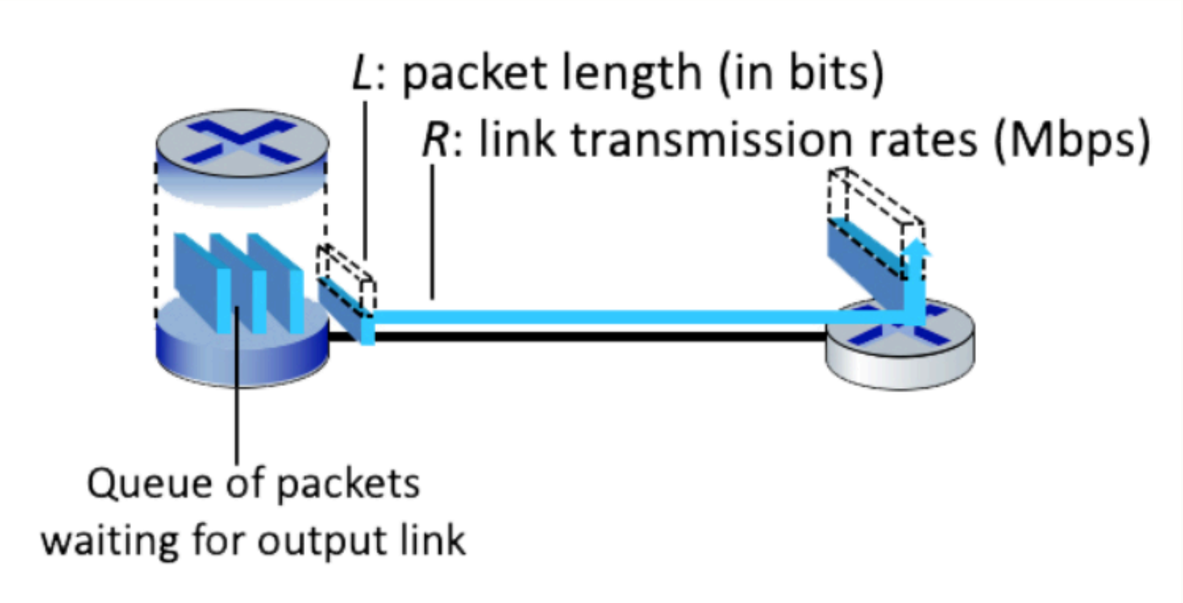


https://en.wikipedia.org/wiki/Network_delay

Transmision Delay

Consider the figure below, in which a single router is transmitting packets, each of length L bits, over a single link with transmission rate R Mbps to another router at the other end of the link.

1. Suppose that the packet length is L= 12000 bits, and that the link transmission rate along the link to router on the right is R = 1 Mbps. What is the transmission delay?
2. What is the maximum number of packets per second that can be transmitted by this link?



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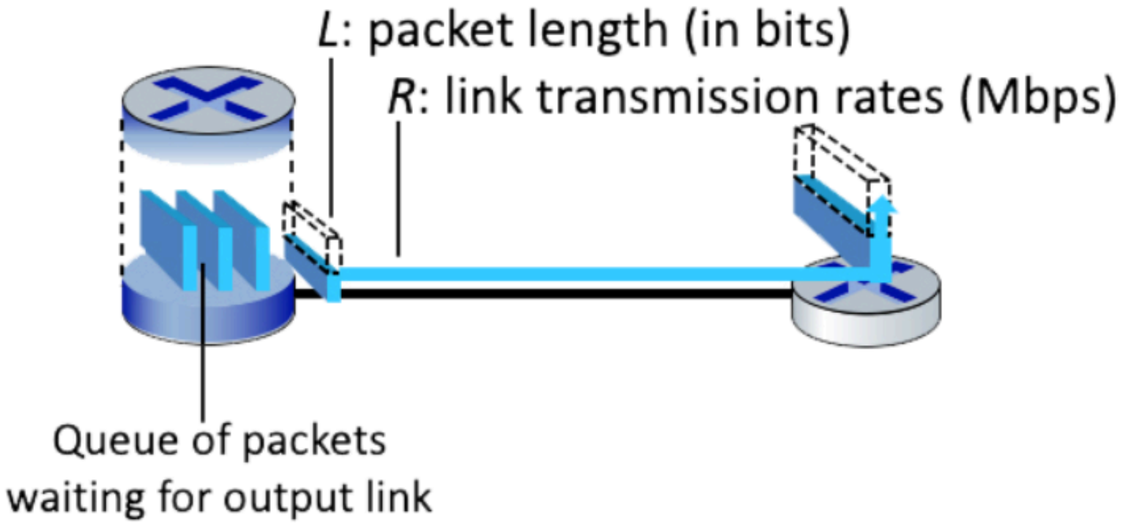
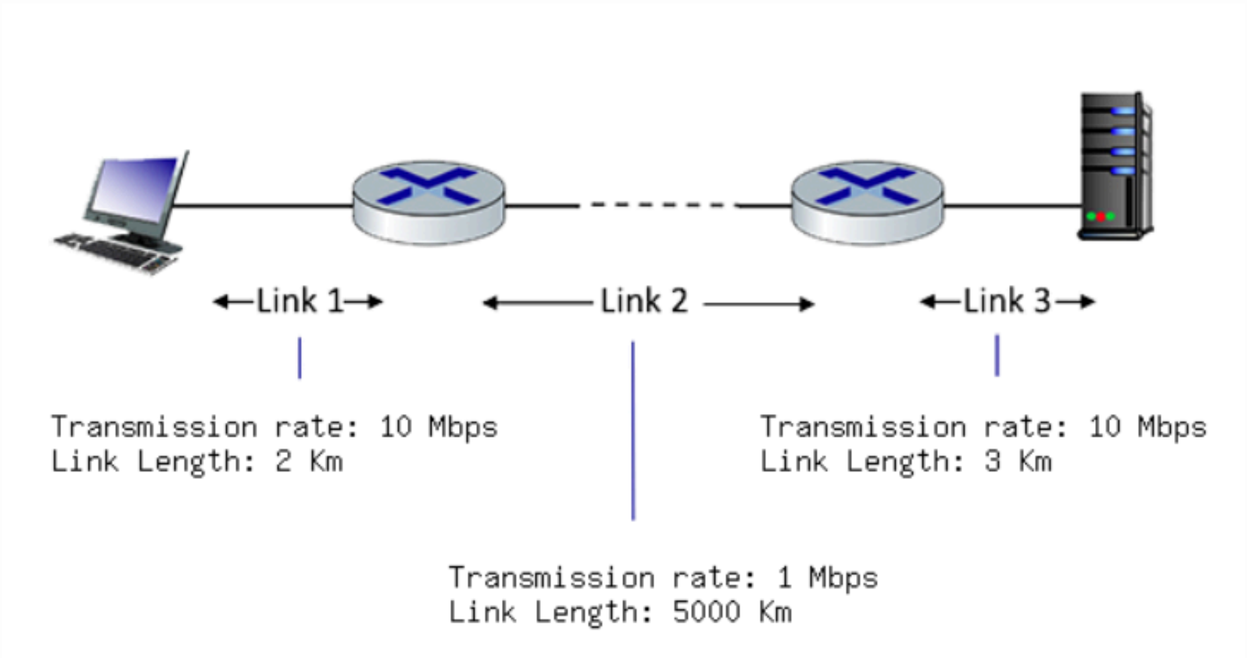
1. Suppose that the packet length is L= 12000 bits, and that the link transmission rate along the link to router on the right is R = 1 Mbps. What is the transmission delay?
    - The transmission delay = L/R = 12000 bits / 1000000 bps = 0.012 seconds.
2. What is the maximum number of packets per second that can be transmitted by this link?
    - The number of packets that can be transmitted in a second into the link = R / L = 1000000 bps / 12000 bits = 83 packets.



Consider the figure below, with three links, each with the specified transmission rate and link length. Assume the length of a packet is 8000 bits. The speed of light propagation delay on each link is 3x10^8 m/sec.

1. What is the transmission delay of link 1? link 2? link 3?
2. What is the propogation delay of link 1? link 2? link 3 ?
3. What is the total delay of link 1? link 2? link 3?
4. What is the total delay?



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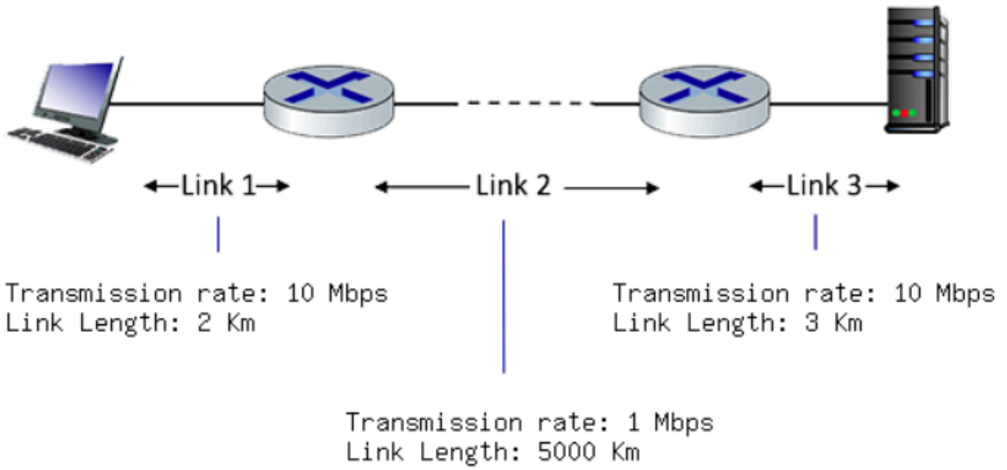
1. What is the transmission delay of link 1? link 2? link 3?
   - transmission delay = L/R :
   - Link 1: 8000 bits / 10 Mbps = 0.0008 seconds = 0.8 msec.
   - Link 2: 8000 bits / 1 Mbps = 0.008 seconds = 8 msec
   - 8000 bits / 10 Mbps = 0.0008 seconds. = 0.8 msec
2. What is the propogation delay of link 1? link 2? link 3 ?
   - propagation delay = d/s :
   - 2 Km * 1000 / 3*10^8 m/sec = 6.67E-6 seconds = 0.0067 msec
   - 5000 Km * 1000 / 3*10^8 m/sec = 0.017 seconds = 17 msec
   - 3 Km * 1000 / 3*10^8 m/sec = 1.00E-5 seconds = 0.01 msec
3. What is the total delay of link 1? link 2? link 3?
   - Total Delay = Dprop + Dtrans + Dproc + Dque
   - Total1 = 0.0067 + 0.8 + 0 + 0 = 0.8067 msec.
   - Total2 = 17 + 8 + 0 + 0 = 25 msec.
   - Total3 = 0.01 + 0.8 + 0 + 0 = 0.81 msec.
4. What is the total delay?
   - TotalD = Total1 + Total2 + Total3
   - = 0.81 msec + 25 msec + 0.81 msec ~= 26 msec



Next Laboratory in 2 Weeks...
Thanks.