Hw2 solution

1. A circuit-switched network can guarantee a certain amount of end-to-end bandwidth for the duration of a call. Most packet-switched networks today (including the Internet) cannot make any end-to-end guarantees for bandwidth. FDM requires sophisticated analog hardware to shift signal into appropriate frequency bands.

2.
   (a) 0.01 s
   (b) $\frac{d}{s}$
   (c) No
   (d) No

3.
   (a) 20 users can be supported
   (b) p = 0.1
   (c) $\binom{120}{\mathrm{n}}\mathrm{p}^{\mathrm{n}}(1-\mathrm{p})^{120-\mathrm{n}}$
   (d) $1-\sum_{\mathrm{n}=0}^{20}\binom{120}{\mathrm{n}}\mathrm{p}^{\mathrm{n}}(1-\mathrm{p})^{120-\mathrm{n}}$

4. The five layers in the Internet protocol stack are – from top to bottom – the application layer, the transport layer, the network layer, the link layer, and the physical layer. The principal responsibilities are outlined in Section 1.5.1.

5.
   (a) 160,000 bits
   (b) 160,000 bits
   (c) The bandwidth-delay product of a link is the maximum number of bits that can be in the link.
   (d) The width of a bit = length of link / bandwidth-delay product, so 1 bit is 125 meters long, which is longer than a football field
   (e) $\frac{s}{R}$

6.
   (a) Time to send message from source host to first packet switch $= \frac{8\times10^6}{2\times10^6}\mathrm{sec} = 4\mathrm{sec}$. With store-and-forward switching, the total time to move message from

source host to destination host $= 4\text{sec} \times 3\text{hops} = 12\text{sec}.$

(b) Time to send 1^{st} packet from source host to first packet switch $= \frac{1\times10^4}{2\times10^6}\text{sec} = 5\text{msec}$. Time at which 2^{nd} packet is received at the first switch = time at which 1^{st} packet is received at the second switch $= 2 \times 5\text{msec} = 10\text{msec}.$

(c) Time at which 1^{st} packet is received at the destination host$= 5\text{msec} \times 3\text{hops} = 15\text{msec}.$ After this, every 5msec one packet will be received; thus time at which last(800^{th}) packet is received $= 15\text{msec} + 799 \times 5\text{msec} = 4.01\text{sec}$. It can be seen that delay in using message segmentation is significantly less.