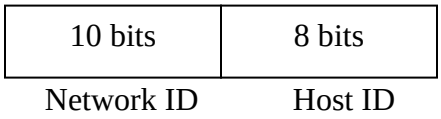
Quiz 1A Solution

a. Ethernet Packet is bigger, since an IP packet is encapsulated into an Ethernet header, which appends a header and a trailer.

b. A router deals with the network layer, data link layer, and physical layer. A router only needs to route the packets to the correct destination, and for this only needs to consult the three lower layers of the stack. The higher layers (Application, Transport) are dealt with end-to-end.

c. HTTP belongs to the application layer. It is built on top of TCP and allows an application such as web browsing to operate.

d. 1000 networks need a little less than 2^10 = 1024 addresses, so 10 bits are needed for the network ID.
200 computers need a little less than 2^8=256 addresses, so 8 bits are needed for the host ID.
The total number of bits needed in the address is therefore 18.



Quiz 1B Solution

a. Message = L bytes
TCP header = 20 bytes
IP header = 20 bytes
Ethernet header and trailer = 18 bytes
Therefore,
Total overhead = TCP overhead + IP overhead + Ethernet overhead = 20 + 20 + 18 = 58 bytes
Total transmitted bytes = (L + 58) bytes
Overhead = 58 bytes

Percentage of message information:
100 x L / (L + 58)

For L = 100 bytes, 63.3 %
For L = 1000 bytes, 94.5 %

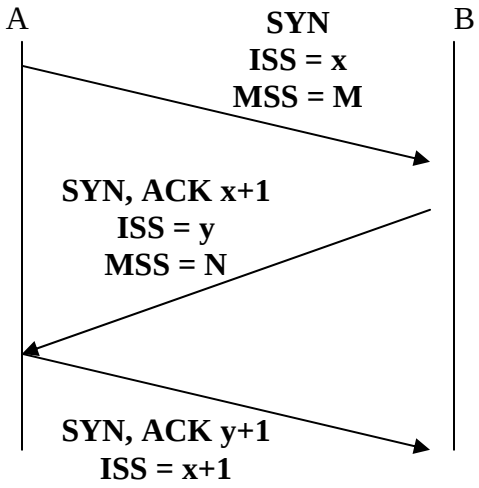
b. The packets should not be too small because the header overhead become high, and the bandwidth is not efficiently used because most of the bits sent are not the actual data that you want to send.

The packets should not be too large because error can occur, and retransmissions in case of long packets are expensive in terms of delay. (In small handheld devices, this operation also drains power, which is a limited resource). In addition, the packet might need to be fragmented as it traverses the network in case the size exceeds the Maximum Transmission Unit (MTU) at a particular link, which adds complexity.

Therefore, a tradeoff should be found between the short and long packet sizes for efficient operation.

Quiz 2A Solution

1.

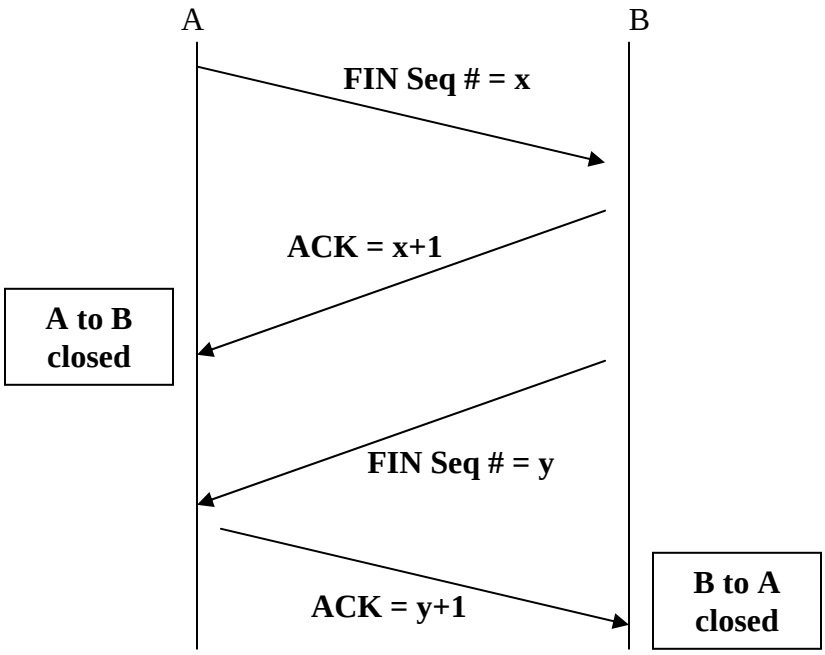


This sequence of segment exchanges is known as the three-way handshake to establish a TCP connection.

2.
See book for definitions

3.
The initial sequence number is randomized to avoid duplicate delivery of outstanding frames from a previous connection.

4.
Graceful is illustrated next.
Both sides close the connection independently.



Quiz 2B Solution

a)

$G = n * P = 20 * 0.04 = 0.8$

$S = Ge^{-G} = 0.8 * e^{-0.8} = 0.359$

Or:

$G = n * P = 20 * 0.04 = 0.8$

$S = GP[0\_transmission\_in\_X\_second] = G(1-P)^{20} = 0.8 * (1-0.04)^{20} = 0.3536$

b)

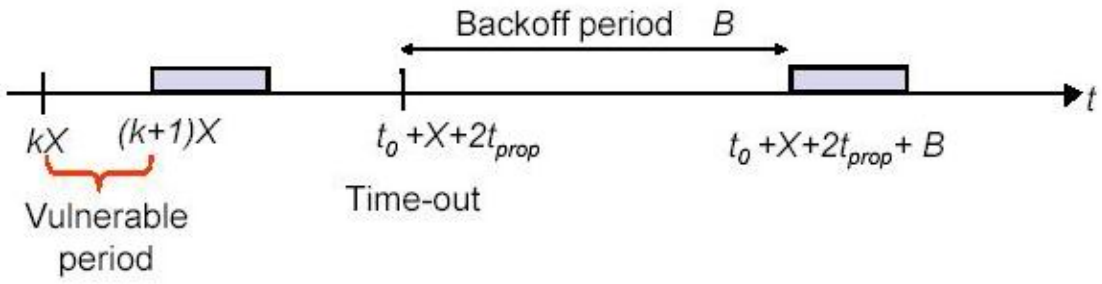


Figure 6.12 textbook page 381

The average number of transmission attempts/packet is $G/S = e^{G}$ *attempts / packet*

Therefore, the average number of unsuccessful attempts per packet is
$e^G - 1 attempts / packet$
The first transmission requires $X + t_{prop}$ seconds, and each subsequent retransmission requires $2t_{prop} + X + B$, where B is the average backoff time and t_{prop} is the one-way propagation delay. Thus the average packet transmission time is approximately given by:

$$E[T] = X + t_{prop} + (e^G - 1)(X + 2t_{prop} + B)$$

So: $\frac{E[T]}{X} = 1 + a + (e^G - 1)(1 + 2a + \frac{B}{X})$

Because t_{prop} =0, so a=0 and $\frac{B}{X} = 1$

$$\frac{E[T]}{X} = 1 + a + (e^G - 1)(1 + 2a + \frac{B}{X})$$

$$= 1 + (e^{0.8} - 1) * 2 = 3.44$$

c)
When G=1, S (max) =0.368
So: P=1/n=0.05

d)
Satellite channel have the large t_{prop}, so for the CSMA/CD, the maximum throughput is then $\rho_{\max} = \frac{1}{1 + 6.44a}$ will drop significantly.
For small a*:* CSMA/CD has best throughput
For larger a*:* Aloha & slotted Aloha have better throughput

e)
Reservation based protocol

Under light traffic CSMA/CD can provide low-delay frame transfer in broadcast networks. However, the randomness in the access can limit the maximum achievable throughput and can result in large variability in frame delays under heavier traffic loads.

(The more details can be found in textbook page 388)

BTW, Slotted Aloha is random access scheme rather than reservation based protocol.