① A layer should be created where the abstraction is needed.

② Each layer must perform a well-defined function.

③ Each layer should be selected with internationalized standards for better performance.

④ The layer boundaries should minimize the information flow across interface.

⑤ The number of layer should be large enough to guarantee each layer has a distinct function.

⑥ The number of layer should be small enough to reduce the complexity of the architecture.

Copper wire:

Advantages: cheap, easy to tap

Disadvantage: easy to interference, limited distance, lower bandwidth

Error correction:

operation: Insert check bits into original bits by computing the result from some algorithms. philosophy: sender side computes check bits and inserts them into original bits, after receiver receives data bits, recompute check bits based on original bits and if error occurs, the check bits can tell which bit is needed to correct.

Error detection:

operation: some algorithms do not need to add check bits to the trailer, and the only thing the receiver does is detect whether there is an error. philosophy: compute check bits and send to receiver, so after the data bits are sent, receiver recompute check bits and compares with the received check bits to detect error.

Because appending to the end of the data bits could improve efficiency of the working. If we compute CRC value and put them into the header, it needs to scan the whole raw data bits and compute them. If we put them into the trailer, after scanning the whole data bits, we can simply append the result to the end, so this method is more effective and efficient.

If the LAN has a high traffic load, the contention between stations are fairly competitive, and contention protocol may not be appropriate under this scenario. Otherwise, the centrally controlled mechanism is needed to arrange the order of the sending message, so contention free protocol is used here.

connectionless service: Each packet is individually and independently injected to the subnet and routers look up their routing table to route each packet based on routing algorithm.

connection-oriented service: The virtual circuit is set up before transmitting and each packet travels the same path.

Subnetting allows to split a network into several pieces for internal use while acting like a single network for external use.

Videoconferencing is a two-way interactive data transmission, so it requires lower delay. If we buffer all incoming packet before delivering to the application to eliminate jitter, we will lose lower delay service.

Lower water mark: for safety margin and avoid a stall. When data in the buffer pool is lower than water mark, the media player requests media server for more data.

High water mark: to avoid data loss. If data in the buffer pool is larger than water mark, the media player sends a message to pause server to send more data.

1. Request Eb.

2. Send Eb.

3. Eb(A, Ra)

4. Request Ea

5. Send Ea

6. Ea(Ra, Rb, Ks)

7. Ks(Rb)

DNS can be both client and server. Client is responsible for send the query to server and return the result back to host. The server is for translating host name to IP address.

1. Given P, it is easy to compute MD(P).

2. Given MD(P), it is almost impossible to get P.

3. Given P, it is impossible to find P’ such that MD(P) = MD(P’).

4. A single bit change of P can have a significantly different message.

Create a empty set P to store each traversed node.

For each node in the network, assign a distance value **d** to them and initialize to zero.

Starting from the sink node, set the distance value to 0.

Repeat the following procedure until all nodes are in the set P:

For each node not in P, compare distance **d**.

Choose a node v with the minimal distance and add it to set P.

Update distance of all nodes that are adjacent to node v.