Computer Network

To achieve the three separate computers networks and must maintain the variable length files and data to exchange. We must consider aspects of the network. I tend to address this problem based on the OSI (Open System Interconnection Model)[1]. From down to up, first and foremost is the physical layer.

# Physical layer

As the fundamental layer, physical layer is closely associated with the physical connection between devices. Such as the network physical connection line material, devices, and topology.

## Physical connection line material

To achieve higher speed and do not be influenced by the increase of the distance among the PC. The best material is the Fiber optics [3] because compared with electrical cables they permit transmission over longer distances and at higher bandwidths. As the distance would be increased, thus should use the single-mode Fibers to address the long-distance communication. Furthermore, coaxial cable is used to reach the short-distance communication (hybrid Fiber coax).

## Devices

If consider the scalability, except the end system, the devices in the network also need the routers and packet switches (mainly link-layer switches). Because we need both types of switches forward packets toward their ultimate destinations (One is in access networks, other is in network core).

## Topology

According to the above, we use the Fiber cable from the CO to Fiber node. Using the Coaxial cable to connect the end devices which are closed with each other. Moreover, for a datagram to be transferred from source host to destination host, it must be moved over each of the individual links in the end-to-end path [2].

Also, for the better scalability, we tend to use layer 3 equipment including router and switch. And using the modem and CMTS (cable modem termination system) coverts the analog signal and digital signal (Figure 1-1).

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Figure ‑ Design of the topology

# Data Link Layer

## Error control

In data link layer, the main way to achieve error control is to use the error control code. Its main categories are hamming code, Parity Check and CRC (cyclic redundancy code). We tend to choose the CRC because it could detect most of the error.

## Flow control and congestion control

The protocol could address the flow control and congestion control, which include Single-Frame Stop-and-Wait protocol and Continuous Automatic Repeat request. Compared to Single-Frame Stop-and-Wait protocol, Continuous Automatic Repeat request is better because it has higher retransmission efficiency and addresses the longer the data frame, the higher the delay.

## Data link protocol selection

The data link protocol includes PPP, HDLC, SLIP, Frame Relay and ATM. We could not select the PPP protocol because no flow control function is provided. And then we would select the Frame Relay, because it is suitable for the environment of the WAN and is a packet-based protocol suitable for connecting networks in different geographical locations. It provides high bandwidth utilization efficiency.

# Network layer

## IP address

Ip (ipv4) address is classified into three parts, including class A, B and C. The class C is the most popular form of making the IP address. It has 28 network numbers and has 8 host numbers, which make the subnet cannot exceed 256.

To improve the usage rate of the IP address, we plan to take variable length subnet mask (Figure 3-1). Suppose it has two local area networks (one is 192.168.12.0/24, another is 192.168.13.0/24), each one has two subnets (netmask 255.255.255.128). It could be easily calculated that each subnet could contain 126 PCs. Undoubtedly, it can be divided into much more subnets if there are more than two subnets.

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Figure ‑ Variable Length Subnet Mask

## Routing protocol

Because the network is a small network, we may use the RIP (Routing Information Protocol) to automatically set the dynamic routing. RIP is based on V-D (vector-distance) routing algorithm. It mainly uses the (V,D) table to calculate the distance from the route to destination.

# Transport layer

## Transport protocol

The most popular transport protocol must be the TCP and UDP. For different situations, using the different protocol. For example, if we need higher reliability, TCP would be the better choice, because it not only addresses the flow control, congestion control, but addresses the automatic retransmission. Compared to TCP, UDP has higher speed while without the connection to build, which could be used in movies, music and so on.

## Encryption

TLS is the most widely used protocol for transport layer encryption. TLS (Transport Layer Security) are protocols for establishing authenticated and encrypted links between networked computers. It also usually be used in HTTP, SMTP and POP3.

# Session layer, Presentation layer and Application layer

## File transfer protocol

It has a lot of protocols which are related to file transfer, including DNS, FTP, HTTP and so on.

### FTP

This protocol uses the C/S mode, it based on TCP and through the internet translate the file to client (Figure 5-2). What’s more, it has two ways to establish a connection, which is PORT and PASV. The difference is PASV needs the client to send the PASV commend while PORT doesn’t need it. It is more suitable to use PASV when the network between the client and server has NAT, and it establishes a connection through TCP's 3-way handshake.

背景图案

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Figure ‑1 FTP protocol

### HTTP

HTTP (Hyper Text Transfer Protocol) also is based on the TCP/IP protocol. It works on the C/S architecture. The browser through the URL sends the application to the HTTP server, and according to this application, the HTTP server responds to it.

背景图案

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Figure ‑2 HTTP communication process

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