**Chapter 1**

Any teenager worth his or her salt is addicted to **instant messaging**. This facility, derived from the UNIX talk program in use since around 1970s, allows two people to type messages at each other in real time. A multiperson version of this idea is the **chat room**, in which a group of people can type messages for all to see.

Another type of person-to-person communication often goes by the name of **peer-to-peer** communication, to distinguish it from the client-server model.

Broadly speaking, there are two types of transmission of technology that are in widespread use. They are follows:

1. Broadcast links.
2. Point-to-point links.

A set of layers and protocols is called a **network architecture**. A list of protocols used by a certain system, one protocol per layer, is called a **protocol stack.**

**Error control** is an important issue because physical communication circuits are not perfect. An issue that occurs at every level is how to keep a fast sender from swamping a slow receiver with data. Various solutions have been proposed and will be discussed later. Some of them involve some kind of feedback from the receiver to the sender, either directly or indirectly, about the receiver’s current situation. Others limit the sender to an agreed-on transmission rate. This subject is called **flow control.**

Our first example of connection-oriented network is **X.25**, which was the first public data network. X.25 belongs to packet switching network.

P39 the OSI reference model

注意各个层的协议，以及对应的数据格式，frame或是Packet或是TPDU等。

P44 – A comparison of the OSI and TCP/IP Reference Models

**Chapter 2**

The Maximum Data Rate of a Channel

Nyquist proved that if an arbitrary signal has been run through a low-pass filter of bandwidth H, the filtered signal can be completely reconstructed by making only 2H samples per second. Nyquist’s theorem states:

Maximum data rate = 2Hlog2V bits/sec

If the signal consists of V discrete levels.

Shannon’s major result is that the maximum data rate of a noisy channel whose bandwidth is H Hz, and whose signal-to-noise ratio is S/N, is given by

Maximum number of bits/sec = H log2(1+S/N)

In summary, the telephone system consists of three major components:

1. Local loop (analog twisted pairs going into houses and business).
2. Trunks (digital fiber optics connecting the switching offices).
3. Switching offices (where calls are moved from one trunk to another).

Consequently, telephone companies have developed elaborate schemes for multiplexing many conversations over a single physical trunk. These multiplexing schemes can be divided into two basic categories: **FDM (Frequency Division Multiplexing) and TDM (Time Division Multiplexing)**. In FDM, the frequency spectrum is divided into frequency bands, with each user having exclusive possession of some band. In TDM, the uses take turns (in round-robin fashion), each one periodically getting the entire bandwidth for a little burst of time.

For fiber optic channels, a variation of frequency division multiplexing is used. It is called **WDM (Wavelength Division Multiplexing)**.

**PCM (Pulse Code Modulation)**

When you or your computer places a telephone call, the switching equipment within the telephone system seeks out a physical path all the way from your telephone to the receiver’s telephone. This technique is called **circuit switching**.

An alternative switching strategy is **message switching**. When this form of switching is used, no physical path is established in advance between sender and receiver. Instead, when the sender has a block of data to be sent, it is stored in the first switching office and then forwarded later, one hop at time. Each block is received in its entirety, inspected for errors, and then retransmitted. A network using this technique is called a **store-and-forward** network.

**Packet switching** networks place a tight upper limit on block size, allowing packets to be buffered in router main memory instead of on disk. By making sure that no user can monopolize any transmission line very long, packet-switching networks are well suited for handling interactive traffic.

**CDMA (Code Division Multiple Access)**

**Chapter 3**

Since it is too risky to count on timing to mark the start and end of each frame, other methods have been devised. We will look at four methods:

1. Character count.
2. Flag bytes with byte stuffing.
3. Starting and ending flags, with bit stuffing.
4. Physical layer coding violations.

Flow control:

Two approaches are commonly used. In the first one, **feedback-based flow control**, the receiver sends back information to the sender giving it permission to send more data or at least telling the sender how the receiver is doing. In the second one, **rate-based flow** control, the protocol has a built-in mechanism that limits the rate at which senders may transmit data, without using feedback from the receiver.

**The polynomial code, also known as a CRC (Cyclic Redundancy Check)**

Polynomial codes are based upon treating bit strings as representations of polynomials with coefficients of 0 and 1 only.

**注意：计算CRC余数的时候除法以后不是用减法！是用异或运算！**

**The bits of the checksum is as the same as the degree of the generator polynomial.**

Protocols in which the sender sends one frame and then waits for an acknowledgement before proceeding are called **stop-and-wait**.

Protocols in which the sender waits for a positive acknowledgement before advancing to the next data item are often called **PAR (Positive Acknowledgement with Retransmission)** or **ARQ (Automatic Repeat reQuest)**.

The technique of temporarily delaying outgoing acknowledgments so that they can be hooked onto the next outgoing data frame is known as **piggybacking**.

**Sliding window protocols要清楚，如果序号是n，那么最大的的窗口尺寸应该是2^n-1。P212**

The essence of all sliding window protocols is that at any instant of time, the sender maintains a set of sequence numbers corresponding to frames it is permitted to send. These frames are said to fall within the **sending window**. Similarly, the receiver also maintains a **receiving window** corresponding to the set of frames it is permitted to accept.

A protocol using go back N

**Go back N**, is for the receiver simply to discard all subsequent frames, sending no acknowledgements for the discarded frames. The other general strategy for handling errors when frames are pipelined is called **selective repeat**. When it is used, a bad frame that is received is discarded, but good frames received after it are bufferd. When the sender times out, only the oldest unacknowledgement frame is transmitted.

**HDLC-High-Level Data Link Control**

Frames:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| bits | 8 | 8 | 8 | >=0 | 16 | 8 |
|  | 01111110 | Address | Control | Data | Checksum | 01111110 |

**这里要看看P236页的control fields，分别记住type 0 ~ type 3的含义。**

**PPP frame formats:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bytes | 1 | 1 | 1 | 1 or 2 | variable | 2 or 4 | 1 |
|  | Flag  01111110 | Address  11111111 | Control  00000011 | Protocol | payload | Checksum | Flag  01111110 |

PPP handles error detection, supports multiple protocols, allows IP addresses to be negotiated at connection time, permits authentication, and has many other features.

**Chapter 4**

**P271 Ethernet Cabling**

The notation 10Base5 means that it operates at 10 Mbps, uses baseband signaling, and can support segments of up to 500 meters.

同时注意100Base-T

**CSMA/CD (CSMA with Collision Detection)**

**CSMA/CA (CSMA with Collision Avoidance)**

**In 802.11, to solve the exposed station problem and the hidden station problem, we can Use CSMA/CA protocol. According this protocol, before the station sending a data, it must send RTS frame and wait a CTS frame back.P296**

**MACA (Multiple Access with Collision Avoidance)**

The basic idea behind it is for the sender to stimulate the receiver into outputting a short frame, so stations nearby can detect this transmission and avoid transmitting for the duration of the upcoming data frame. **RTS (Request To Send) CTS (Clear To Send)**

**Binary exponential backoff**, was chosen to dynamically adapt to the number of stations trying to send.

Bridge is used to interconnect network in the LLC layer.

Related to broadcasts is the problem that once in a while a network interface will break down and begin generating an endless stream of broadcast frames. The result of this broadcast storm is that (1) the entire LAN capacity is occupied by these frames, and (2) all the machines on all the interconnected LANs are crippled just processing and discarding all the frames being broadcast.

P328仔细读读VLAN的工作

P335 when a legacy PC sends a frame to a VLAN-aware switch, the switch builds a new tagged frame based on its knowledge of the sender’s VALN.

注意：IEEE 802.1Q is standard for frame tagging.

Manchester Coding, with Manchester Coding, each bit period is divided into two equal intervals. A binary 1 bit is sent by having the voltage set high during the first interval and low in the second one.

**Chapter 5**

**Datagram**

**VC (Virtual Circuit)**

**两者之间的区别**

**Routing Algorithms**

**Nonadaptive algorithm**

**Adaptive algorithm**

**Shortest Path Routing**

**Flooding**

**Distance Vector Routing**

**The Count-to-Infinity Problem**

**Link State Routing**

Distance vector routing was used in the ARPANET until 1979, when it was replaced by link state routing.

**注：这几种算法一定要清楚，而且熟悉距离向量算法的缺陷。**

When too many packets are present in the subnet, performance degrades. This situation is called **congestion**.

The needs of each flow can be characterized by four primary parameters: reliability, delay, jitter, and bandwidth. Together these determine the **QoS (Quality of Service).**

**MPLS (MultiProtocol Label Switching)**

**On a router-to-router line using PPP as the framing protocol, the frame format, including the PPP, MPLS, IP, and TCP headers, P416 – 格式顺序记住！**

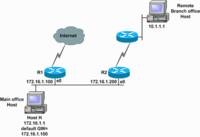
Handling the general case of making two different networks interwork is exceedingly difficult. However, there is a common special case that is manageable. This case is where the source and destination hosts are on the same type of network, but there is a different network in between. The solution to this problem is a technique called **tunneling**.

**IP Protocol不说了，肯定要看！**

**知道分配IP 和子网掩码是必须的，看P443的例子，已经很详尽了。**

　ICMP协议是一种面向连接的协议，用于传输出错报告控制信息。它是一个非常重要的协议，它对于[网络](http://baike.baidu.com/view/3487.htm)安全具有极其重要的意义。

　　它是[TCP/IP协议](http://baike.baidu.com/view/7649.htm)族的一个子协议,属于网络层协议,主要用于在主机与路由器之间传递控制信息,包括报告错误、交换受限控制和状态信息等。当遇到IP数据无法访问目标、IP路由器无法按当前的传输速率转发数据包等情况时，会自动发送ICMP消息。

[](http://baike.baidu.com/image/dbf554ed9529cbccb31cb1d0)

ICMP原理

ICMP提供一致易懂的出错报告信息。发送的出错报文返回到发送原数据的设备，因为只有发送设备才是出错报文的逻辑接受者。发送设备随后可根据ICMP报文确定发生错误的类型，并确定如何才能更好地重发失败的数据报。但是ICMP唯一的功能是报告问题而不是纠正错误，纠正错误的任务由发送方完成。

我们在网络中经常会使用到ICMP协议，比如我们经常使用的用于检查网络通不通的[Ping](http://baike.baidu.com/view/709.htm)命令（Linux和Windows中均有），这个“Ping”的过程实际上就是ICMP协议工作的过程。还有其他的网络命令如[跟踪路由](http://baike.baidu.com/view/493712.htm)的Tracert命令也是基于ICMP协议的。

以上是从网上找的。

**IPVv6的地址位有128。**

The problem of running out of IP address is not a theoretical problem that might occur at some point in the distant future. It is happening right here and right now. The long-term solution is for the whole Internet to migrate to IPv6. As a consequence, some people felt that a quick fix was needed for the short term. This quick fix came in the form of **NAT (Network Address Translation)**.

How do IP addresses get mapped onto data link layer address, such as Ethernet? The protocol used for asking this question and getting the reply is called **ARP (Address Resolution Protocol)**. **RARP (Reverse ARP)就是反过来，从数据链路层映射到IP地址。**

**OSPF (Open Shortest Path First)** is used for dynamic routing, which belongs to link state routing protocol.

**Chapter 6**

**P486 – A state diagram for a simple connection management scheme.**

**最好能够读懂 P543 – TCP connection management finite state machine.这幅图，理解P525 – 图也很有用**

**TPDU (Transport Protocol Data Unit)**

三次握手协议搞明白

还有两军问题

Berkeley Sockets P487 各个原语的意义需要了解

**UDP (User Datagram Protocol)**

**TCP (Transmission Control Protocol)**

Connections are established in TCP by means of the three-way handshake.

P529 RTP

Packet nesting: Ethernet header IP UDP RTP header

P547 – TCP Congestion Control 会考一道选择题的概率很大，看看。

Chapter 7

Pages are named using URLs (Uniform Resource Locators).

A URL has three parts: the name of the protocol (http), the DNS (Domain Naming System) name of the machine where the page is located, and the name of the file containing the page.

Naming in the Internet uses a hierarchical scheme called the **DNS (Domain Naming System).**

When a client requests a Web page, the server can supply additional information along with the requested page. This information may include a **cookie**, which is a small (at most 4 KB) file (or string).

JavaScript is not the only way to make Web pages highly interactive. Another popular method is through the use of **applets**. These are small Java programs that have been compiled into machine instructions for a virtual computer called JVM (java Virtual Machine).

**HTTP1.1** supports persistent connections.

The correct way to encode binary messages is to use **base64 encoding**, sometimes called ASCII armor. In this scheme, groups of 24 bits are broken up into four 6-bits units, with each unit being sent as a legal ASCII character.

For messages that are almost entirely ASCII but with a few non-ASCII characters, base64 encoding is somewhat inefficient. Instead, an encoding known as **quoted-printable encoding** is used. This is just 7-bit ASCII, with all the characters above 127 encoded as an equal sign followed by the character’s value as two hexadecimal digits. Control characters and trailing spaces are also so encoded.

P602-609 **SMTP**、**POP3和IMAP**的概念，SMTP是在线的，通过建立一个TCP连接来发送消息。为了解决线下消息传递，使用了POP3，邮件保存在ISA中。

**HTML – The HyperText Markup Language** P629 最好了解结构，注意超链接的写法。

HTML, with or without forms, does not provide any structure to Web pages.

The W3C has developed an enhancement to HTML to allow Web pages to be structured for automated processing. Two new languages have been developed for this purpose. First, **XML (eXtensible Markup Language)** describes Web content in a structured way and second, **XSL (eXtensible style Language)** describes the formatting independently of the content.

P633 – HTML tags,

P635 – FORM tags,

P637 – form example,

P642 – XML example,

P 643 – XSL example,

P645 – embedded PHP

P648 – JavaScript

注意各种格式，可能会有填空需要。

**Dynamic Web Documents P643**

**Server-Side Dynamic Web Page Generation**

The traditional way to handle forms and other interactive Web pages is a system called **CGI (Common Gateway Interface)**

CGI scripts are not the only way to generate dynamic content on the server side. Another common way is to embed little scripts inside HTML pages and have them be executed by the server itself to generate the page. A popular language for writing these scripts is **PHP (PHP: Hypertext Preprocessor)**.

There is also a third technique, called **JSP (JavaServer Pages)**, which is similar to PHP, except that the dynamic part is written in the java programming language instead of in PHP.

**Client-Side Dynamic Web Page Generation**

The most popular scripting language for the client side is **JavaScript.**

JavaScript is not the only way to make Web pages highly interactive. Another popular method is through the use of **applets.**

P 772 – IPsec

Chapter 8

Encryption methods have historically been divided into two categories: **substitution ciphers** and **transposition ciphers**.

The main public-key algorithm is **RSA** which derives its strength from the fact that it is very difficult to factor larger numbers.

Digital Signatures:

1. **Symmetric-Key Signature**
2. **Public-Key Signature**

An organization that certifies public keys is now called **CA (Certification Authority)**.

Each **packet filter** is a standard router equipped with some extra functionality. The extra functionality allows every incoming or outgoing packet to be inspected.

**VPNs (Virtual Private Networks)** are overlay networks on top of public networks but with most of the properties of private networks.

**Authentication** is the technique by which a process verifies a process verifies that its communication partner is who it is supposed to be and not an imposer.

这一章注意下几个基本概念，还有P788的reflection attack，最好能够通读，理解这一部分。

以下是我没找到书上的，问了别人，应该是对的：

Switch can split an Ethernet into several collision domains.

Router can split an Ethernet into several broadcast domains.

The function of the OSI reference model’s transport layer: It sends data by using flow control.

The most efficient subnet mask to use on point-to-point WAN links is 255.255.255.252

这题是CCNA的测试题，我只知道答案是这个，原因不详。

What technology is a used by most switches to resolve topology loops and ensure that data flows properly through a single network path?

答案是STP，这也是CCNA上的，解释：Spanning Tree Protocol (STP) will make sure that no network loops occur at layer 2.

If your LAN network is currently congested and you are using only hubs in your network, what would be the BEST solution to decrease congestion on your network?

Solution: Replace your hubs with switches. Layer-2 switches break up collision domains and will decrease congestion on your network.

课后练习课间后有布置，答案也有，自己再看看吧，祝大家考试取得好成绩！