1. **chapter 1**
   1. **Homework**
2. No. 10--10

What are two reasons for using layered protocols? What is one possible disadvantage of using layered protocols?

1. 通过分层可以把设计问题划分成较小的易于处理的片段，以降低网络设计的复杂性。
2. 分层意味着某一层的协议的改变不会影响其它层的协议。
3. No. 11--17

What is the principal difference between connectionless communication and connection-oriented communication? Give one example of a protocol that uses (i) connectionless communication; (ii) connection-oriented communication.

面向连接通信有三个阶段，在使用网络服务之前必须建立一个连接，只有在成功建立连接后，才可以通信。通信完成后还要进入释放连接阶段。

无连接通信在发送报文前并不建立连接，它没有面向连接通信的三个阶段。

1. UDP协议

(ii) TCP协议

1. No. 19--

List two ways in which the OSI reference model and the TCP/IP reference model are the same. Now list two ways in which they differ.

相同点：a. 都是基于独立的协议栈概念。

b．两者都有功能相似的应用层、传输层、网络层。

不同点：a. 在OSI模型中，严格定义了服务、接口、协议；在TCP/IP模型中，并没有严格区分服务、接口、协议。

b. OSI模型中支持非连接和面向连接的网络层通信，但在传输层只支持面向连接的通信，但在传输层有支持非连接和面向连接的两种协议可供选择。

1. No. 37--35

The Internet is made up of a large number of networks. Their arrangement determines the topology of the Internet. A considerable amount of information about the Internet topology is available on line. Use a search engine to find out more about the Internet topology and write a short report summarizing your findings.

略。

* 1. **Discussion**

1. 分层体系结构的特点
2. 现有的网络拓扑结构

略。

1. **chapter 2**
   1. **Homework**
2. No. 7--8

It is desired to send a sequence of computer screen images over an optical fiber. The screen is 1920 x1200 pixels, each pixel being 24 bits. There are 50 screen images per second. How much bandwidth is needed?

1920×1200×24×60bps=

1. No. 30--30

What is the difference, if any, between the demodulator part of a modem and the coder part of a codec? (After all, both convert analog signals to digital ones.)

有。编码器接受任意的模拟信号，并从它产生数字信号。而解调器仅仅接受调制了的正弦（或 余弦）波，产生数字信号。

1. No. 35--37

Three packet-switching networks each contain n nodes. The first network has a star topology with a central switch, the second is a (bidirectional) ring, and the third is fully interconnected, with a wire from every node to every other node. What are the best-, average-, and worst-case transmission paths in hops?

星型：最好为2，最差为2，平均为2；

环形：最好为1，最差为n/2，平均为n/4

全连接：最好为1，最差为1，平均为1

1. No. 36--38

Compare the delay in sending an x-bit message over a k-hop path in a circuit-switched network and in a (lightly loaded) packet-switched network. The circuit setup time is s sec, the propagation delay is d sec per hop, the packet size is p bits, and the data rate is b bps. Under what conditions does the packet network have a lower delay? Also, explain the conditions under which a packet-switched network is preferable to a circuit-switched network.

1. 电路交换网络的延迟情况：
   1. t1=s 时电路建立；
   2. t2=s+x/b 时数据的最后一位被发送出去
   3. t3=s+x/b+kd 时数据开始到达目的地。

说明：这里忽略了信号在电路中传送的时间。

1. 分组交换网络的延迟情况：
   1. t4=x/b 时数据的最后一位被发送出去
   2. t5=x/b+(k-1)p/b+kd 时数据开始到达目的地。

说明：其中的(k-1)p/b，表示因为有 k 跳，所以每个分组会被路由器转发，总的转发次数为 k-1 次。故每次转发消耗的时间为：(k-1)p/b

若要分组网络延迟较短，则有 t3>t5

故有 s>(k-1)p/b

电路交换常与分组交换进行比较。其主要不同之处在于：分组交换的通信线路并不专用于源与目的地间的信息传输。在要求数据按先后顺序且以恒定速率快速传输的情况下，使用电路交换是较为理想的选择。因此，当传输实时数据时，诸如音频和视频；或当服务质量(QOS)要求较高时，通常使用电路交换网络。分组交换在数据传输方面具有更强的的效能，可以预防传输过程(如e-mail信息和Web页面)中的延迟和抖动现象。

结合综上：若传输的数据量很大，而且传送时间远大于呼叫时间，则采用电路交换较为合适；当端到端的通路有很多段链路组成时，采用分组交换较为合适。从提高整个网络的信道利用率上看，分组交换优于电路交换。

1. No. 44--46

A CDMA receiver gets the following chips: (−1 +1 −3 +1 −1 −3 +1 +1). Assuming the chip sequences defined in Fig. 2-28(a), which stations transmitted, and which bits did each one send?

只需计算四个标准化内积：

（-1+1-3+1-1-3+1+1）d（-1-1-1+1+1-1+1+1）/8 = (1-1+3+1-1+3+1+1)/8 = 8/8 = 1, 即：A发送了bit “1”

（-1+1-3+1-1-3+1+1）d（-1-1+1-1+1+1+1-1）/8 = (1-1-3-1-1-3+1-1)/8 = -8/8 = -1, 即：B发送了bit “0”

（-1+1-3+1-1-3+1+1）d（-1+1-1+1+1+1-1-1）/8 = (1+1+3+1-1-3-1-1)/8 = 0/8 = 0, 即：C没有发送信息”

（-1+1-3+1-1-3+1+1）d（-1+1-1-1-1-1+1-1）/8 = (1+1+3-1+1+3+1-1)/8 = 8/8 = 1, 即：D发送了bit “1”

* 1. **Discussion**

1. 比特率、波特率、信道容量和数据传输速率的关系
2. 编码和复用技术
3. 分组交换和电路交换

略。

1. **chapter 3**
   1. **Homework**
2. No. 1--1

An upper-layer packet is split into 10 frames,each of which has an 80% chance of arriving undamaged. If no error control is done by the data link protocol, how many times must the message be sent on average to get the entire thing through?

由于每一帧有0.8的概率正确到达，整个信息到达的概率为=0.107

为了使信息完整地到达接收方，发送一次成功地概率是p，二次成功的概率是, 三次成功的概率为，i次成功的概率为

因此平均发送次数等于：

1. No. 6--8

To provide more reliability than a single parity bit can give, an error-detecting coding scheme uses one parity bit for checking all the odd-numbered bits and a second parity bit for all the even-numbered bits. What is the Hamming distance of this code?

由于奇偶校验位的性质，奇数位的任何一个位错误都可以改变奇偶校验位，与偶数位相同，两个错误发生在奇数位或偶数位，不会改变奇偶校验位，也意味着汉明距离为2。

1. No. 17--19

In the discussion of ARQ protocol in Section 3.3.3, a scenario was outlined that resulted in the receiver accepting two copies of the same frame due to a loss of acknowledgement frame. Is it possible that receiver may accept multiple copies of the same frame when none of the frames (message or acknowledgement) are lost?

比特流是10011101生成多项式1001生成多项式阶位是3,所以后面补3个0得到10011101000用10011101000整除1001得到余数100,所以最后位串为10011101100如果第三位变反后,得出的数字不能整除1001.但如果出错后的位串仍能被1001整除,则错误无法被检测出来,最简单的就是所有位都为0

1. No. 18--20

A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50%?

设帧大小为F kb，则发送一帧的时间 信息往返延迟时间一共为

可列式子，解得

( 5 ) No. 30--34

Consider an error-free 64-kbps satellite channel used to send 512-byte data frames in one direction, with very short acknowledgements coming back the other way. What is the maximum throughput for window sizes of 1,7,15, and 127? The earth-satellite propagation time is 270 msec.

1. 信道的延迟时间为 270ms
2. 传送一帧所需的时间为 512\*8/64=4096/64=64ms
3. 则每一次传输的周期为 270\*2+64=604ms （这里忽略了产生和发送 ACK 的时间）
4. 需要 604/64≈9 个帧保持通道不空。
5. 则对于窗口值1，每604ms发送4096位，吞吐率为 4096/0.604=6.78kb/s。
6. 对于窗口值7，每604ms发送4096\*7位，吞吐率为 4096\*7/0.604=47.5kb/s。
7. 而对于窗口值超过 9（包括 15、127），吞吐率达到最大值，即 64kb/s。
   1. **Discussion**
8. 停止等待协议
9. 滑动窗口
10. 海明码
11. 链路管理、流控、透明传输在BSC、HDLC和PPP协议中的实现方式

略。

1. **chapter 4**
   1. **Homework**
2. No. 6--6

What is the length of a contention slot in CSMA/CD for (a) a 2-km twin-lead cable (signal propagation speed is 82% of the signal propagation speed in vacuum)?, and (b) a 40-km multimode fiber optic cable (signal propagation speed is 65% of the signal propagation speed in vacuum)?

假设真空中的信号传播速度为V=3x108m/s

1. No. 7--7

How long does a station, s, have to wait in the worst case before it can start trans-mitting its frame over a LAN that uses the basic bit-map protocol?

在最坏的情况下，所有的站都要发送数据，而下一站是编号最低的站，等待时间为N bit的竞争时间+（N-1）×d bit的帧传输时间，即(N-1) d + N

1. No. 8--8

In the binary countdown protocol, explain how a lower-numbered station may bestarved from sending a packet.

因为低序位的站始终会让高序位的站先传输，所以若高序位的站一直传输，那么低序位的站将得不到发送数据包的机会。

1. No.15--15

A 1-km-long, 10-Mbps CSMA/CD LAN (not 802.3) has a propagation speed of 200 m / μ sec. Repeaters are not allowed in this system. Data frames are 256 bits long, including 32 bits of header, checksum, and other overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel in order to send a 32-bit acknowledgement frame. What is the effective data rate, excluding overhead, assuming that there are no collisions?

1. 发送方占用信道时间
2. 传播数据时间
3. 发送方到接收方传播时延
4. 接收方“抓住”信道
5. 接收方传输ACK时间：
6. 接收方到发送方传播时延
7. 有效数据率=
8. No.16--null

Consider building a CSMA/CD network running at 1Gbps over a 1-km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size?

对于1km电缆,单程传播时间为t=1/200000=5×10-6s,

来回路程传播时间为2t=10×10-6s

为了能够按照 CSMA/CD工作最小帧的发射时间不能小于10×10-6s。以1Gb/s速率工作, 10×10-6s可以发送的比特数等于

因此，最小帧是10000bit

1. No. 25--25

Suppose that an 11-Mbps 802.11b LAN is transmitting 64-byte frames back-to-back over a radio channel with a bit error rate of 10− 7. How many frames per second will be damaged on average?

一帧是 64bytes=512 bits，位出错率为 p=，所有 512位正确到达的概率为1- p)512= 0.9999488，所以帧被破坏的概率约为 5×10-5，每秒钟发送的帧数为 11×106/512 = 21484frames/sec，两数相乘，大约每秒钟有一帧被破坏。

* 1. **Discussion**

1. Multi Access Problem and Multi Access Protocols
2. CSMA/CD and CSMA/CA
3. Limited-Contention Protocol
4. WLAN
5. Ethernet
6. VLAN

略。

1. **chapter 5**
   1. **Homework**
2. No. 20--23

Suppose that host A is connected to a router R 1, R 1 is connected to another router, R 2, and R 2 is connected to hostB . Suppose that a TCP message that contains 900 bytes of data and 20 bytes of TCP header is passed to the IP code at host A for delivery to B . Show the Total length, Identification , DF, MF, and Fragment offset fields of the IP header in each packet transmitted over the three links. Assume that link A-R1 can support a maximum frame size of 1024 bytes including a 14-byte frame header, link R1-R2 can support a maximum frame size of 512 bytes, including an 8-byte frame header, and link R2-Bcan support a maximum frame size of 512 bytes including a 12-byte frame header.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Link | Total length | ID | DF | MF | offset |
| A-R1 | 940 | x | 0 | 0 | 0 |
| R1-R2 | 500 | x | 0 | 1 | 0 |
| 460 | 0 | 60 |
| R2-B | 500 | x | 0 | 1 | 0 |
| 460 | 0 | 60 |

1. No. 24--27

Convert the IP address whose hexadecimal representation is C22F1582 to dotted decimal notation.

194.47.21.130

1. No. 25--28

A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle?

255.255.240.0 -> 1111 1111.1111 1111.1111 0000.0000 0000

12 位

212-2=4094

1. No. 27--30

A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organizations, A , B , C , and D , request 4000, 2000, 4000, and 8000 addresses, respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z / s notation.

答案不唯一：

A 198.16.0.0 198.16.15.255 19816.0.0/20

B198.16.0.0 198.16.23.255 19816.16.0/21

C198.32.0.0 198.16.47.255 19816.32.0/20

D198.64.0.0 198.16.95.255 19816.64.0/19

1. No. 28--31

A router has just received the following new IP addresses: 57.6.96.0/21,57.6.104.0/21, 57.6.112.0/21, and 57.6.120.0/21. If all of them use the same outgoing line, can they be aggregated? If so, to what? If not, why not?

57.6. 0110 0000 .0/21

57.6. 0110 1000 .0/21

57.6. 0111 0000 .0/21

57.6. 0111 1000 .0/21

57.6.96.0/19

1. No.30--33

A router has the following (CIDR) entries in its routing table:

Address/mask Next hop

135.46.56.0/22 Interface 0 00111000

135.46.60.0/22 Interface 1 00111100

192.53.40.0/23 Router 1 00101000

Default Router 2

For each of the following IP addresses, what does the router do if a packet with that address arrives?

(a) Interface 1

(b) Interface 0

(c) Router 2

(d) Router 1

(e) Router 2

1. CIDR:假定计算机学院共90个办公室和实验室，每个办公室或实验室需要一个公网IP地址，分得一个C类IP地址，其net-id为202.202.5.0；但这样会造成IP地址的浪费。合理的解决方法有：（1）进行子网划分，请给出子网掩码；（2）CIDR，请给出CIDR地址块。
2. 划分3个子网，每个子网下有30台主机。 ，除去全0全1无法使用，5位刚好能划分30台主 机，由于是c类地址，最后8位的前3位高位来划分子网。所以子网掩码为255.255.255.224
3. CIDR 最后8位，前3位高位用来子网划分。所以3个CIDR块为：

202.202.5.32/27

202.202.5.64/27

202.202.5.128/27

1. RIP算法计算：假定网络中的路由器B的路由表有如下的项目（这3列分别表示“目的网络”，“距离”，“下一跳路由器”）

N1 7 A

N2 2 C

N6 8 F

N8 4 E

N9 4 F

现在B收到C发来的路由信息

（这2列分别表示“目的网络”，“距离”）

N2 4

N3 8

N6 4

N8 3

N9 5

试求出路由器B更新后的路由表（请给出计算步骤）。

更新后路由表如下:

N1 7 A 无更新

N2 5 C 相同的下一跳，更新

N3 9 C 新的路由信息，添加

N6 5 F 不同的下一跳，距离更短更新

N8 4 E 不同的下一跳，距离相同，不变

N9 4 F 不同的下一跳，距离更大，不变