Ch1 绪论

17.

a. ***Mesh topology***: If one connection fails, the other connections will still be working.

b. ***Star topology:*** The other devices will still be able to send data through the hub; there will be no access to the device which has the failed connection to the hub.

c. ***Bus Topology***: All transmission stops if the failure is in the bus. If the drop-line fails, only the corresponding device cannot operate.

d. ***Ring Topology***: The failed connection may disable the whole network unless it is a dual ring or there is a by-pass mechanism.

18.

是局域网，因为范围较小，且是由集线器连接起来的网络。

19.

Theoretically, in a ***ring topology***, unplugging one station, interrupts the ring. However, most ring networks use a mechanism that bypasses the station; the ring can continue its operation.

23.

a. E-mail is not an interactive application. Even if it is delivered immediately, it may stay in the mail-box of the receiver for a while. It is not sensitive to delay.

b. We normally do not expect a file to be copied immediately. It is not very sensitive to delay.

c. Surfing the Internet is the an application very sensitive to delay. We except to get access to the site we are searching.

24.

是点到点，若是局域网，则是多点。

Ch2 网络模型

16. 将下列各项与 OSI 模型的一层或者多层对应起来

    a.路由决策 ----- 网络层

    b.流量控制 ---- 数据链路层，传输层

    c.传输介质接口 ---- 物理层

    d. 为终端用户提供网络接口 ---- 应用层

17. 将下列各项与 OSI 模型的一层或者多层对应起来

    a. Reliable process-to-process delivery: ***transport layer***

    b. Route selection: ***network layer***

    c. Defining frames: ***data link layer***

    d. Providing user services: ***application layer***

    e. Transmission of bits across the medium: ***physical layer***

18. 将下列各项与 OSI 模型的一层或者多层对应起来

    a. 直接与用户的应用程序通信 ---- 应用层

    b. 纠错与重传 ---- 数据链路层，传输层

    c. 机械的、电器的和功能的接口 ---- 物理层

    d. 负责相邻两个节点之间帧的传输 ---- 数据链路层

19. 将下列各项与 OSI 模型的一层或者多层对应起来

    a. 格式和代码转换服务 ---- 表示层

    b. 建立、管理和终止会话 ---- 会话层

    c. 提供不同数据表示的独立型 ---- 表示层

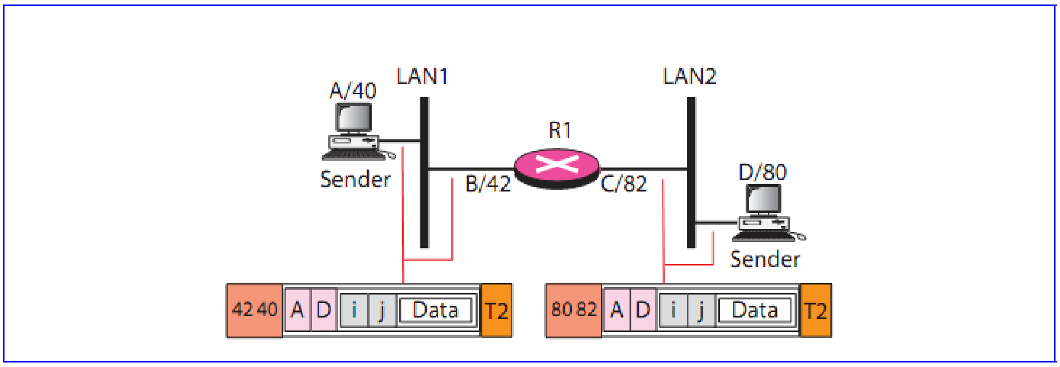
    d. 进入和退出系统 ---- 会话层

20.

(1) A/40 – B/42 – C/82 – D/80

(2) A/40 – D/80

21.



28.

表示层

Ch3 数据和信号

36.

$C = B\log_2(1 + SNR) = 4000K \times \log_2(1 + 1000) \approx 40M$ bps

41.

We have

$$\textbf{SNR} = (\text{signal power})/(\text{noise power}).$$

However, power is proportional to the square of voltage. This means we have

$$SNR = [(\text{signal voltage})^2] / [(\text{noise voltage})^2] = [(\text{signal voltage}) / (\text{noise voltage})]^2 = 20^2 = 400$$

We then have

$$SNR_{dB} = 10 \log_{10} SNR \approx 26.02$$

42.

a. $C = B\log_2(1 + SNR) = 20K \times \log_2(1 + 10000) \approx 266K$ bps

b. $C = B\log_2(1 + SNR) = 200K \times \log_2(1 + 10^{0.4}) \approx 362K$ bps

c. $C = B\log_2(1 + SNR) = 1M \times \log_2(1 + 100) \approx 6.67M$ bps

43.

a. The data rate is doubled ($C_2 = 2 \times C_1$).
b. When the SNR is doubled, the data rate increases slightly. We can say that, approximately, ($C_2 = C_1 + 1$).

46.

a. 2×10^8/1M b/s = 200m

b. 2×10^8/10M b/s = 20m

c. 2×10^8/100M b/s = 2m

47.

a. Number of bits = bandwidth × delay = 1 Mbps × 2 ms = **2000 bits**
b. Number of bits = bandwidth × delay = 10 Mbps × 2 ms = **20,000 bits**
c. Number of bits = bandwidth × delay = 100 Mbps × 2 ms = **200,000 bits**

Ch4 数字传输

13.

We use the formula $s = c \times N \times (1/r)$ for each case. We let $c = 1/2$.

a. $r = 1 \rightarrow s = (1/2) \times (1 \text{ Mbps}) \times 1/1 = 500$ kbaud

b. $r = 1/2 \rightarrow s = (1/2) \times (1 \text{ Mbps}) \times 1/(1/2) = 1$ Mbaud

c. $r = 2 \rightarrow s = (1/2) \times (1 \text{ Mbps}) \times 1/2 = 250$ Kbaud

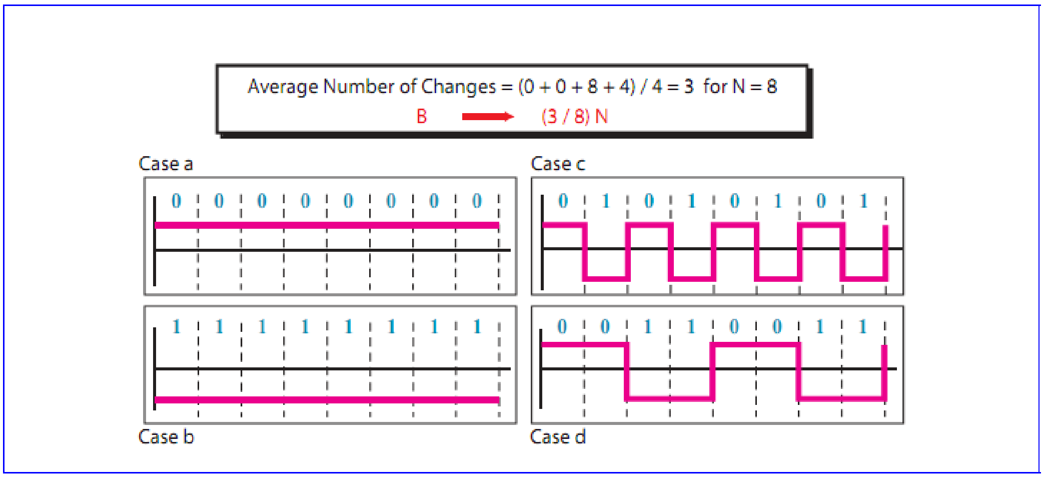
d. $r = 4/3 \rightarrow s = (1/2) \times (1 \text{ Mbps}) \times 1/(4/3) = 375$ Kbaud

14.

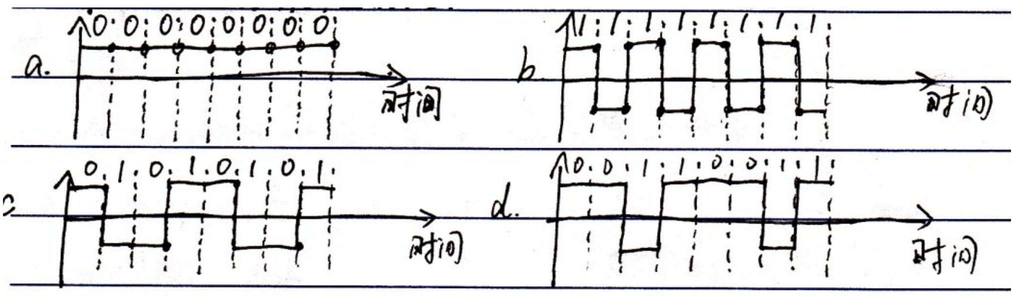
额外发送的数据位 = 1M – 1M×(1-0.2%) = 2000 bits

15.

Bandwidth is proportional to (3/8)N which is within the range in Table 4.1 (B = 0 to N) for the NRZ-L scheme.

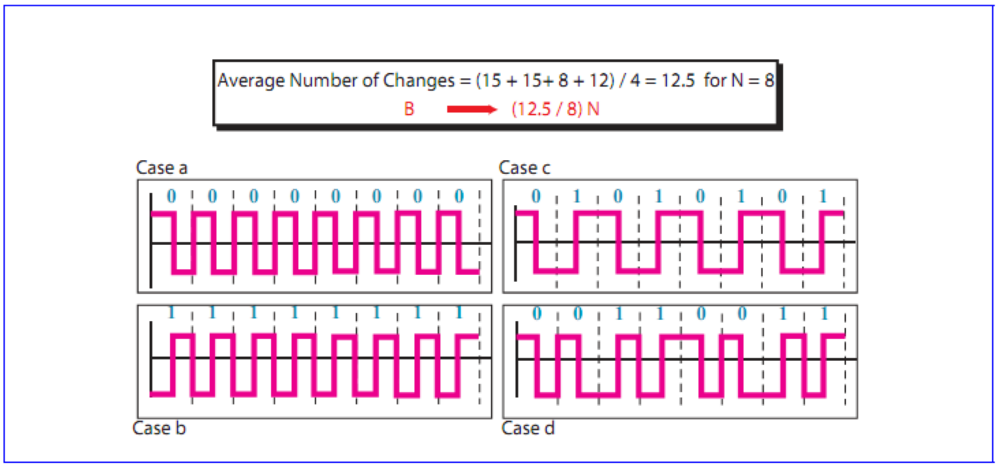


16.



17.

Bandwidth is proportional to (12.5 / 8) N which is within the range in Table 4.1 (B = N to B = 2N) for the Manchester scheme.



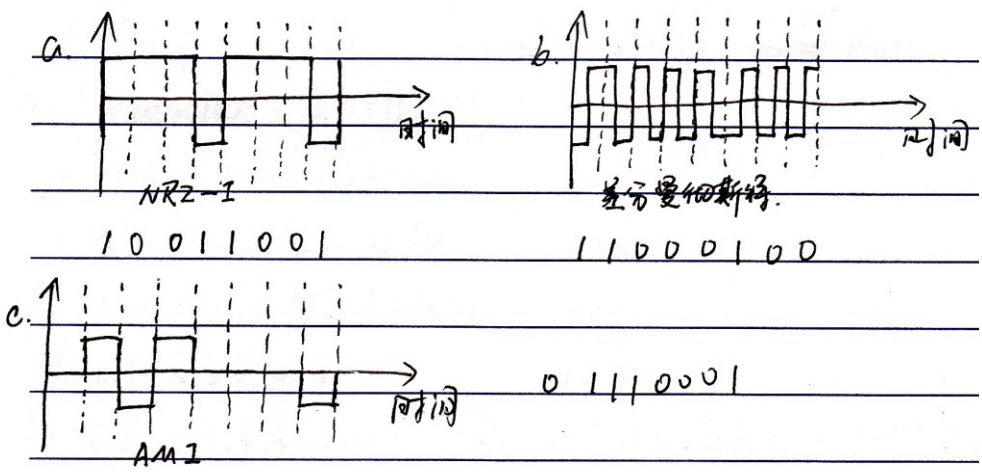
21.

The data stream can be found as

a. NRZ-I: **10011001**.

b. Differential Manchester: **11000100**.

c. AMI: **01110001**.



24.

a. 01010 11110 11110 11110 11110 01001

b. 21 (or 3 ?)

c.1 (or 4 ?)

27.

a. 400K bps

b. f_{max} = 100KHz + 200KHz = 300K Hz,

$f_s = 2 \times 300K = 600K$ bps

28. 对带宽 200KHz 的低通信号使用 1024 级采样

a.计算数字化信号的速率

b.计算这个信号的 SNR_{db}

c.计算这个信号 PCM 的带宽

d.

a. $N = 2 \times B = 2 \times 200K$ Hz = 400K

b. $SNR_{db} = 6.02n_b + 1.76 = 6.02 \times 10 + 1.76 = 61.96$

c. $B = n_b \times B_{anolog} = 10 \times 200K = 2M$ Hz

31. 带宽为 1MHz 的基带通道，按下列线路编码

a. NRZ-L

b.曼彻斯特编码

c.MLT-3

d.2B1Q

a. NRZ	→	$N = 2 \times B = 2 \times 1$ MHz = **2 Mbps**
b. Manchester	→	$N = 1 \times B = 1 \times 1$ MHz = **1 Mbps**
c. MLT-3	→	$N = 3 \times B = 3 \times 1$ MHz = **3 Mbps**
d. 2B1Q	→	$N = 4 \times B = 4 \times 1$ MHz = **4 Mbps**

Ch5 模拟传输

11. 已给定比特率和调制类型，试计算波特率

a.2000bps,FSK

b.4000bps,ASK

c.6000bps,QPSK

d.36000bps,64-QAM

We use the formula ***S* = (1/*r*)× *N***, but first we need to calculate the value of r for each case.

a. $r = \log_2 2$	$= 1$	$\rightarrow$	$S = (1/1) \times (2000\ \text{bps})$	= **2000 baud**
b. $r = \log_2 2$	$= 1$	$\rightarrow$	$S = (1/1) \times (4000\ \text{bps})$	= **4000 baud**
c. $r = \log_2 4$	$= 2$	$\rightarrow$	$S = (1/2) \times (6000\ \text{bps})$	= **3000 baud**
d. $r = \log_2 64$	$= 6$	$\rightarrow$	$S = (1/6) \times (36{,}000\ \text{bps})$	= **6000 baud**

13. 下列技术每波特有多少位?

a. 1000 波特，FSK

b. 1000 波特，ASK

c. 1000 波特，BPSK

d. 1000 波特，16-QAM

We use the formula ***r* = log₂L** to calculate the value of r for each case.

a. $\log_2 4$	$= 2$
b. $\log_2 8$	$= 3$
c. $\log_2 4$	$= 2$
d. $\log_2 128$	$= 7$

17. 如果发送速率为 4000 bps，试问下列情况要求的带宽是多少？设 d=1。

We use the formula ***B* = (1 + *d*)× (1/*r*)** × N, but first we need to calculate the value of r for each case.

a. $r = 1$ $\rightarrow$ $B = (1 + 1) \times (1/1) \times (4000\ \text{bps})$ = **8000** Hz

b. $r = 1 \quad \rightarrow \quad B = (1 + 1) \times (1/1) \times (4000\ bps) + 4\ KHz \quad = \mathbf{12000}\ Hz$

c. $r = 2 \quad \rightarrow \quad B = (1 + 1) \times (1/2) \times (4000\ bps) \quad = \mathbf{4000}\ Hz$

d. $r = 4 \quad \rightarrow \quad B = (1 + 1) \times (1/4) \times (4000\ bps) \quad = \mathbf{2000}\ Hz$

18. 电话线的带宽是 4KHz，用下列调制结束能发送的最大比特率是多少？设 d=0。

$B= (1 + d) \times s$, $s = N \times 1/r$

$\therefore B= (1 + d) \times (1/r) \times N$

$\therefore\ N = B/(1+d) \times r$

$\because\ d = 0$

$\because\ N = B \times r$

a.ASK，　$r = 1$，则 $N = B \times 1 = 4K$

b.QPSK，　$r = 2$，则 $N = B \times 2 = 8K$

c.16-QAM，　$r = 4$，则 $N = B \times 4 = 16K$

d.64-QAM，　$r = 6$，则 $N = B \times 6 = 24K$

21. 如果需要调制带宽为 5KHz 的语音信号，对下列形式，试求带宽。

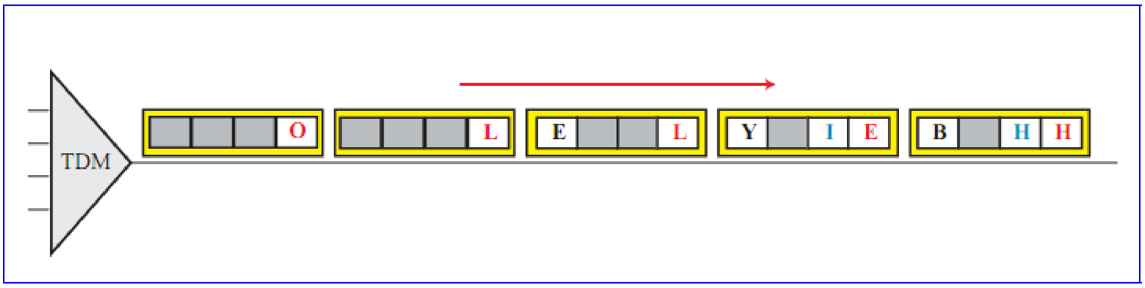
a. AM，　$BAM = 2 \times B = 2 \times 5 \quad = \mathbf{10\ KHz}$

b. FM（设 β=5），$BFM = 2 \times (1 + \beta) \times B = 2 \times (1 + 5) \times 5 \quad = \mathbf{60\ KHz}$

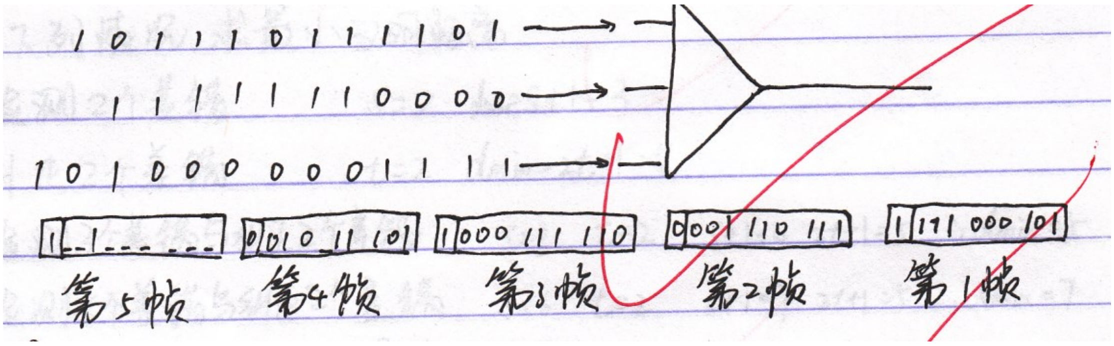
c.PM（设 β=1），　$BPM = 2 \times (1 + \beta) \times B = 2 \times (1 + 1) \times 5 \quad = \mathbf{20\ KHz}$

Ch6 带宽利用

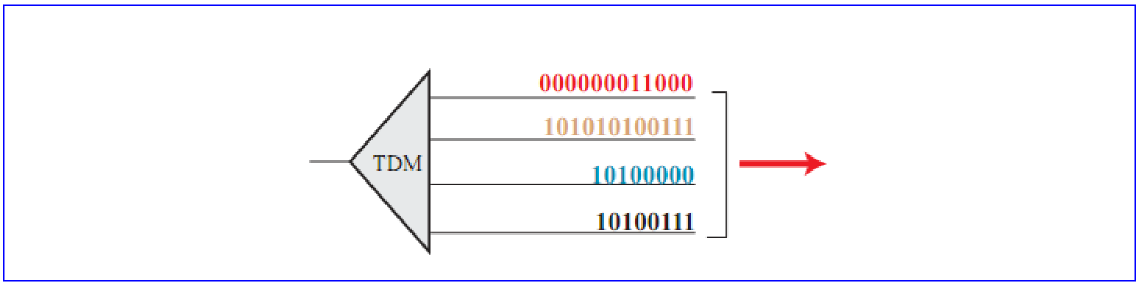
23.



24.



25.



Ch7 传输介质

Ch8 交换

Ch9 使用电话网和有线电视网进行数据传输

Ch10 检错与纠错

1. 单个位差错与突发性差错有什么不同。

In a single bit error only one bit of a data unit is corrupted; in a burst error more than one bit is corrupted (not necessarily contiguous).

4. 线性块编码的定义是什么？循环编码的定义是什么？

线性块编码是一种由任何两个有效数字的异或产生的另一个有效码字。

循环编码是特殊的线性块编码，如果码字是循环以为，则其结果是另一个码字。

7. 在 CRC 中年，表示下列实体之间的关系（长度是指位的个数）

a. 数据长度与码字的长度　　　　　　b. 除数长度与余数长度

c. 生成多项式的次数与除数的长度　　d. 生成多项式的次数与余数的长度。

a. The only relationship between the size of the codeword and dataword is the one based on the definition: **n = k + r.**, where n is the size of the codeword, k is the size of the dataword, and r is the size of the remainder.

b. The remainder is always one bit smaller than the divisor.

c. The degree of the generator polynomial is **one less than** the size of the divisor. For example, the CRC-32 generator (with the polynomial of degree 32) uses a 33-bit divisor.

d. The degree of the generator polynomial is **the same as** the size of the remainder (length of checkbits). For example, CRC-32 (with the polynomial of degree 32) creates a remainder of 32 bits.

8.

反码运算加法。

15.

a. d (10000, 00000) = **1**

b. d (10101, 10000) = **2**

c. d (1111, 1111) = **0**

d. d (000, 000) = **0**

Comment: Part c and d show that the distance between a codeword and itself is 0.

16.

参考答案：

(a) s =2 , d_{min} = s + 1 = 3

(b) $t = 2$, $d_{min} = 2t + 1 = 5$

(c) $s = 3$, $t = 2$, $s + 1 = 4$, $2t + 1 = 5$, $d_{min} = 5$

(d) $s = 6$, $t = 2$, $s + 1 = 7$, $2t + 1 = 5$, $d_{min} = 7$

17.

参考答案：

a. **01**
b. **error**
c. **00**
d. **error**

18.

Table 10.8 *Table for Exercise 18*

Dataword	*Codeword*
00	00000
01	01011
10	10111
11	11111

参考答案：

因为 $01011 \oplus 10111 = 11100$ 不是其中的有效码字

因此这不是有效的线性编码。

23. We need a dataword of at least 11 bits. Find the values of k and n in the Hamming code C(n, k) with $d_{min} = 3$.

参考答案：

We need to find $k = 2^m - 1 - m \geq 11$. We use *trial and error* to find the right answer:

a. Let $m = 1$ $k = 2^m - 1 - m = 2^1 - 1 - 1 = 0$ (not acceptable)
b. Let $m = 2$ $k = 2^m - 1 - m = 2^2 - 1 - 2 = 1$ (not acceptable)
c. Let $m = 3$ $k = 2^m - 1 - m = 2^3 - 1 - 3 = 4$ (not acceptable)
d. Let $m = 4$ $k = 2^m - 1 - m = 2^4 - 1 - 4 = 11$ (acceptable)

Comment: The code is **C(15, 11)** with $\mathbf{d_{min} = 3}$.

24.

(a) $(x^3+x^2+x+1) + (x^4 + x^2 + x + 1) = (x^4 + x^3)$

(b) $(x^3+x^2+x+1) - (x^4 + x^2 + x + 1) = (x^4 + x^3)$

(c) $(x^3+x^2) \times (x^4 + x^2 + x + 1) = (x^7 + x^5 + x^4 + x^3 + x^6 + x^4 + x^3 + x^2)$

$= (x^7 + x^6 + x^5 + x^2)$

(d) $(x^3+x^2+x+1) / (x^2 + 1) = (x + 1)$

26.

答案： a,d

27.

CRC-8 generator is $x^8 + x^2 + x + 1$.

a. It has more than one term and the coefficient of x^0 is 1. It can detect a single-bit error.

b. The polynomial is of degree 8, which means that the number of checkbits (remainder) r = 8. It will detect all burst errors of size 8 or less.

c. Burst errors of size 9 are detected most of the time, but they slip by with probability $(1/2)^{r-1}$ or $(1/2)^{8-1} \approx 0.008$. This means **8 out of 1000** burst errors of size 9 are left undetected.

d. Burst errors of size 15 are detected most of the time, but they slip by with probability $(1/2)^r$ or $(1/2)^8 \approx 0.004$. This means **4 out of 1000** burst errors of size 15 are left undetected.

28. r =32

a. 可以

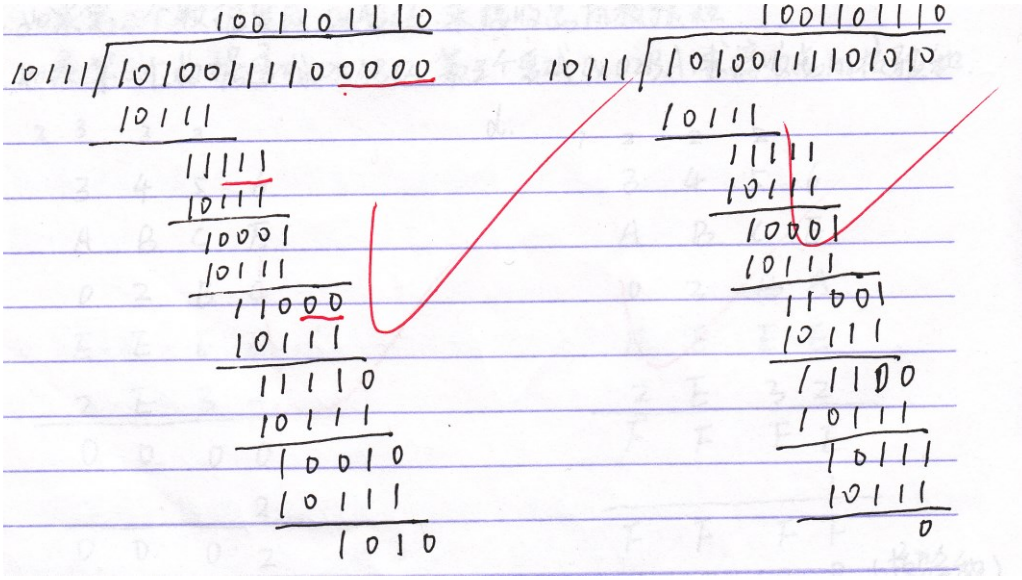
b. 可以

c. L = 33, $L = r + 1$， 检错率： $1-(\frac{1}{2})^{r-1} = 1-(\frac{1}{2})^{31}$

d. L = 55, $L > r + 1$， $1-(\frac{1}{2})^{r} = 1-(\frac{1}{2})^{32}$

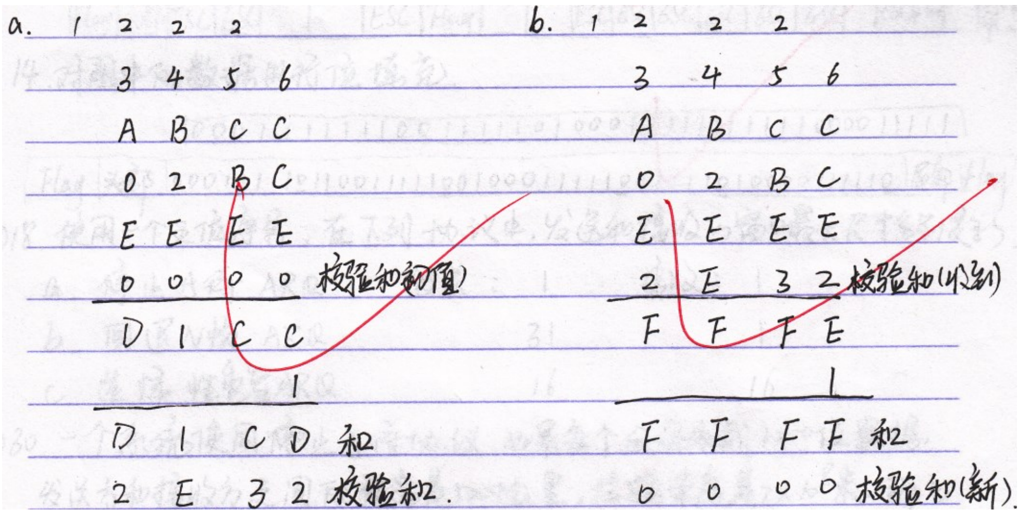
30.

参考答案：


1001101110
10111 / 10100111100000
10111
11111
10111
10001
10111
11000
10111
11110
10111
10010
10111
1010
1001101110
10111 / 10100111101010
10111
11111
10111
10001
10111
11001
10111
11100
10111
10111
10111
0

32.

参考答案：


a. 1 2 2 2
3 4 5 6
A B C C
0 2 B C
E E E E
0 0 0 0 校验和初值)
D 1 C C
1
D 1 C D 和
2 E 3 2 校验和.
b. 1 2 2 2
3 4 5 6
A B C C
0 2 B C
E E E E
2 E 3 2 校验和(收到)
F F F E
1
F F F F 和
0 0 0 0 校验和(新).

c.

```
  2 3   3   3
    3   4   5   6
    A   B   C   E
    0   2   B   C
    E   E   E   E
    2   E   3   2
  ----------------
    0   0   0   0
                2
  ----------------
    0   0   0   2
    F   F   F   D (校验和)
```

d.

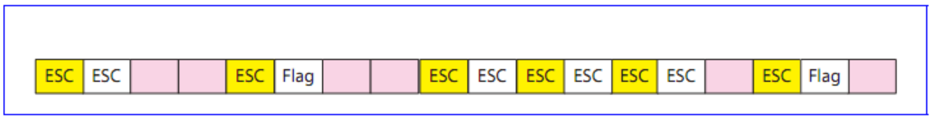
```
  1 2   2   2
    3   4   5   6
    A   B   C   E
    0   2   B   A
    E   E   E   E
    2   E   3   2
  ----------------
    F   F   F   E
                1
  ----------------
    F   F   F   F
    0   0   0   0 (校验和).
```

Ch11 数据链路控制

11. 对图 11.42 中的数据进行字节填充

参考答案：

按照字节填充的原理，对 ESC 和其他标志字符都需要填充。



14. 对图 11.43 的数据进行位填充。

100011111110011111101000111111111110000111111

参考答案：

1000 11111$\boxed{0}$ 110011111$\boxed{0}$ 01000 11111$\boxed{0}$ 111110 100001111$\boxed{0}$

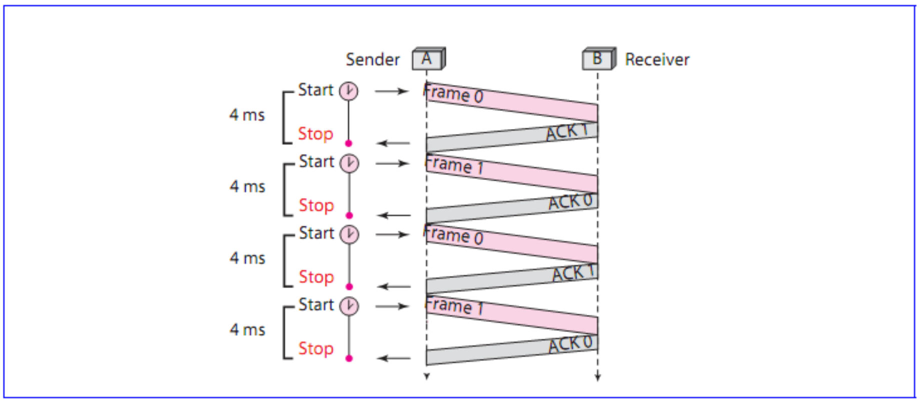
17. 一个发送方发送一系列分组到同一个目的地，使用一个 5 位长度的序列码。如果序号以 0 开始，发送 100 个分组后的序号是多少？

参考答案：

A five-bit sequence number can create sequence numbers from 0 to 31. The sequence number in the Nth packet is (N mod 32). This means that the 101th packet has the sequence number (101 mod 32) or **5**.

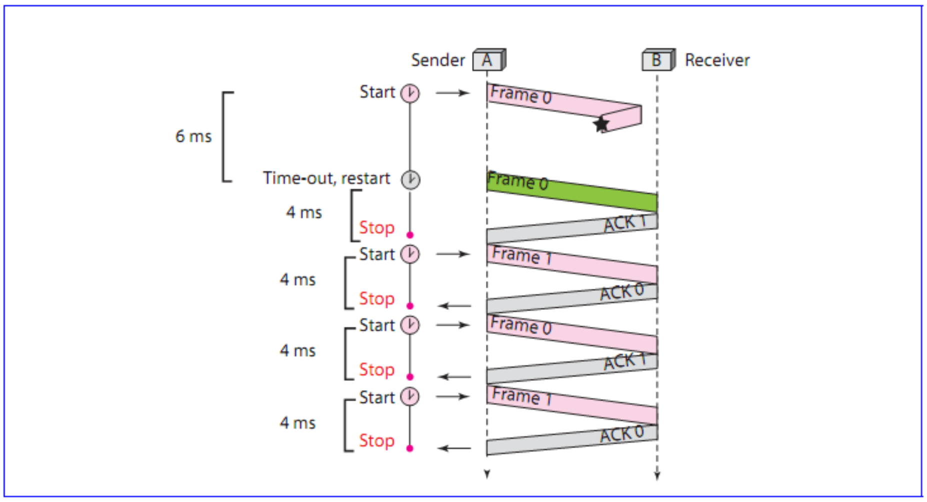
27. 使用停等 ARQ 的系统的一个定时器有 6 微妙超时。为 4 个帧画一张类似图 11.11 的流量图，假设往返延迟是 4 微秒，且没有数据帧或者控制帧被丢失或损坏。

参考答案：



29. 如果练习题 27 中第一个帧（帧 0）被丢失了，请画图。

参考答案：



30.

参考答案：

题目中少了数据传输速率为 1M bps，

传播时延 $t_p = 5000 \times 10^3$ m/ 2×10^8 m/s = 25 ms

一帧的传输时延是 $t_f = 1000$ b/ 1×10^6 b/s = 1 ms

ACK 的传输时间 ＝0

因此传输 1 帧所需的时间是 25ms × 2 + 1 ms = 51 ms

1×10^6 b 所需要的帧数是：1×10^6 b / 1000 = 1000 帧

总共所需要的时间是：51 ms × 1000 = 51000 ms = 51s

31.

参考答案：

最坏的情况是：窗口大小是 7，一次把窗口中的 7 个帧全部发送出去，而没有得到 ACK。

这样需要总帧数是 1000 000 bits / 1000 bits = 1000 个

需要的窗口数是 1000 / 7 ≈ 143 个

传输每个窗口所需要的时间是：7000 bits / 1×10^6 b/s = 7 ms

传播时延 $t_p = 5000 \times 10^3$ m/ 2×10^8 m/s = 25 ms

ACK 的传输时间 = 0

传输 ACK 的传播延迟是 t_p = 25 ms

∵ 传输 1 个窗口所需要的时间是 7 + 25 + 25 = 57 ms

总的传播延迟是 143 × 57 ms = 8.151 s

Ch12 多路访问

11.

To achieve the maximum efficiency in pure ALOHA, G = 1/2. If we let $\boldsymbol{n}$ to be the number of stations and $\boldsymbol{f}$ to be the number of frames a station can send per second.

$\boldsymbol{G} = \boldsymbol{n} \times \boldsymbol{f} \times \boldsymbol{t}_{fr}$

$= 100 \times \boldsymbol{f} \times 1\ \mu s = 1/2 \quad \rightarrow \boldsymbol{f} = 5000$ frames/s

The reader may have noticed that the t_{fr} is very small in this problem. This means that either the data rate must be very high or the frames must be very small.

13.

We can first calculate $\boldsymbol{t_{fr}}$ and $\boldsymbol{G}$, and then the throughput.

$\boldsymbol{T_{fr}}$ = (1000 bits) / 1 Mbps = 1 ms

$\boldsymbol{G} = \boldsymbol{n} \times \boldsymbol{f} \times \boldsymbol{t_{fr}}$

$= 100 \times 10 \times 1$ ms $= 1$

For pure ALOHA → $\boldsymbol{S} = \boldsymbol{G} \times \boldsymbol{e}^{-2G}$ ≈ 13.53 percent

This means that each station can successfully send only 1.35 frames per second.

14.

∵ $\boldsymbol{G} = 1$

对时隙 ALOHA , $\boldsymbol{S} = \boldsymbol{G} \times \boldsymbol{e}^{-G}$ ≈ 36.8 percent

因此，效率达到最大，这意味着每个站可以每秒发送 3.68 帧。

（15,16,17 合成一题）

15.

Let us find the relationship between the minimum frame size and the data rate. We know that

t_{fr} = (frame size) / (data rate) = $2 \times t_p$ = 2×distance / (propagation speed)

or

(frame size) = [2 × (distance) / (propagation speed)] × (data rate)]

or

(frame size) = K × (data rate)

This means that minimum frame size is proportional to the data rate (K is a constant). When the data rate is increased, the frame size must be increased in a network with a fixed length to continue the proper operation of the CSMA/CD. In Example 12.5, we mentioned that the minimum frame size for a data rate of 10 Mbps is 512 bits. We calculate the minimum frame size based on the above proportionality relationship

Data rate = 10 Mbps → minimum frame size = 512 bits

Data rate = 100 Mbps → minimum frame size = 5120 bits

Data rate = 1 Gbps → minimum frame size = 51,200 bits

Data rate = 10 Gbps → minimum frame size = 512,000 bits

16.

$t_p = 25.6\ \mu s$

$t_p = d / 2 \times 10^8$ m/s

∴ $L_{min} = 2 \times t_p \times C = 512$bits

当最短帧长 L_{min} 不变的时候，距离将随着数据速率的提高而减少。

∴ $d = L_{min} /(2 \times C) \times 2 \times 10^8$ m/s

当数据速率是 10Mbps 的时候，d = 5120m

当数据速率是 100Mbps 的时候，d = 512m

当数据速率是 1Gbps 的时候，d = 51.2m

当数据速率是 10Gbps 的时候，d = 5.12m

17.

We have $t_1 = 0$ and $t_2 = 3\ \mu s$

a. $t_3 - t_1 = (2000\ m) / (2 \times 10^8\ m/s) = 10\ \mu s \rightarrow t_3 = 10\ \mu s + t_1 =$ **$10\ \mu s$**

b. $t_4 - t_2 = (2000\ m) / (2 \times 10^8\ m/s) = 10\ \mu s \rightarrow t_4 = 10\ \mu s + t_2 =$ **$13\ \mu s$**

c. $T_{fr(A)} = t_4 - t_1 = 13 - 0 = 13\ \mu s \rightarrow Bits_A = 10\ Mbps \times 13\ \mu s =$ **130 bits**

d. $T_{fr(C)} = t_3 - t_2 = 10 - 3 = 07 \mu s \rightarrow Bits_C = 10\ Mbps \times 07\ \mu s =$ **70 bits**

Ch13 有线局域网

13.

The bytes are sent from left to right. However, the bits in each byte are sent from the least significant (rightmost) to the most significant (leftmost). We have shown the bits with spaces between bytes for readability, but we should remember that that bits are sent without gaps. The arrow shows the direction of movement.

← **01011000 11010100 00111100 11010010 01111010 11110110**

15.

The first byte in binary is 0100001**1**. The least significant bit is 1. This means that the pattern defines a multicast address. ***A multicast address can be a destination address, but not a source address.*** Therefore, the receiver knows that there is an error, and discards the packet.

17.

The maximum data size in the Standard Ethernet is 1500 bytes. The data of 1510 bytes, therefore, must be split between two frames. The standard dictates that the first frame must carry the maximum possible number of bytes (1500); the second frame then needs to carry only 10 bytes of data (it requires padding). The following shows the breakdown:

Data size for the first frame: **1500 bytes**
Data size for the second frame: **46 bytes** (with padding)

19.

We can calculate the propagation time as t = (2500 m) / (200,000.000) = **12.5 μs**. To get the total delay, we need to add propagation delay in the equipment (10 μs). This results in **T = 22.5 μs.**

Ch14 无线局域网

11.

In *CSMA/CD*, the protocol allows collisions to happen. If there is a collision, it will be detected, destroyed, and the frame will be resent. *CSMA/CA* uses a technique that prevents collision.

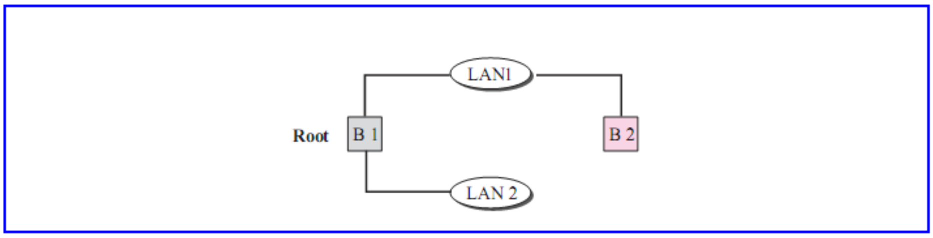
12. 使用表 14.5 比较 IEEE 802.3 和 802.11 中的字段

字段	IEEE 80.3	IEEE 802.11
目的地址	6	6
源地址	6	6
地址 1	/	6
地址 2	/	6
地址 3	/	6
地址 4	/	6
FC	/	2
D/ID	/	2
SC	/	2
PDU 长度	2	/
数据和填充	小于 46 字节时，有填充	/
帧主体	46-1500	0-2312
FCS（CRC）	4	4

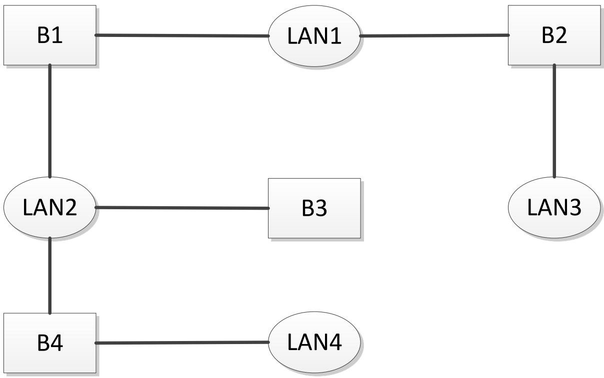
Ch15 连接局域网、主干网和虚拟网

13. Figure 15.1 shows one possible solution. We made bridge B1 the root.

Figure 15.1 *Solution to Exercise 13*

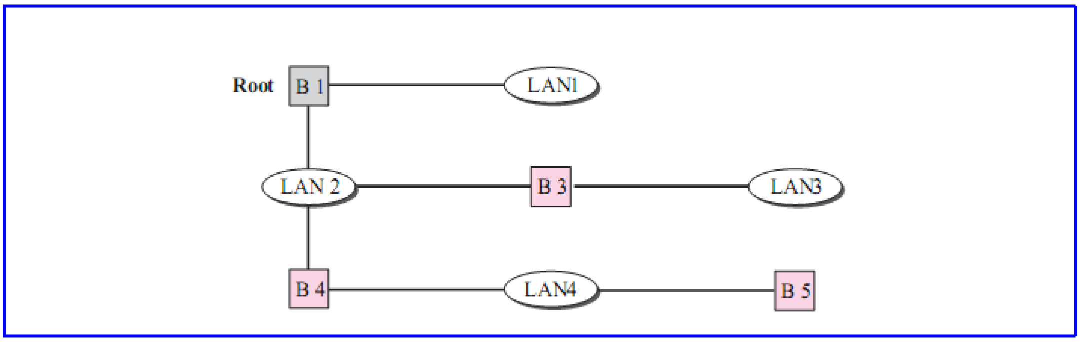


14.



15. Figure 15.2 shows one possible solution.

Figure 15.2 *Solution to Exercise 15*



17. Although any router is also a bridge, replacing bridges with routers has the

following consequences:

a. Routers are more expensive than bridges.

b. Routers operate at the first three-layers; bridges operates at the first two layers. Routers are not designed to provide direct filtering the way the bridges do. A router needs to search a routing table which is normally longer and more time consuming than a filtering table.

c. A router needs to decapsulate and encapsulate the frame and change physical addresses in the frame because the physical addresses in the arriving frame define the previous node and the current router; they must be changed to the physical addresses of the current router and the next hop. A bridge does not change the physical addresses. Changing addresses, and other fields, in the frame means much unnecessary overhead.

Ch16 无线 WAN：移动电话和卫星网络

11.

Ch17 广域网 SONET/SDH

11.

Ch18 虚拟电路：帧中继和 ATM

11.

Ch19 逻辑地址

25.

a.123.56.77.32/29 123.56.77.32 ~ 123.56.77.39

b.200.17.21.128/27 200.17.21.128~200.17.21.159

c.17.34.16.0/23 17.34.16.0 ~ 17.34.17.255

d.180.34.64.64/30 180.34.64.64~180.34.64.67

a. The number of address in this block is 2^{32-29} = **8**. We need to add 7 (one less) addresses (0.0.0.7 in base 256) to the first address to find the last address.

From:	**123**	.	**56**	.	**77**	.	**32**
	0	.	**0**	.	**0**	.	**7**
To:	**123**	.	**56**	.	**77**	.	**39**

b. The number of address in this block is 2^{32-27} = **32**. We need to add 31 (one less) addresses (0.0.0.31 in base 256) to the first address to find the last address.

From:	**200**	.	**17**	.	**21**	.	**128**
	0	.	**0**	.	**0**	.	**31**
To:	**200**	.	**17**	.	**21**	.	**159**

c. The number of address in this block is 2^{32-23} = 512. We need to add 511 (one less) addresses (0.0.1.255 in base 256) to the first address to find the last address.

From:	**17**	.	**34**	.	**16**	.	**0**
	0	.	**0**	.	**1**	.	**255**
To:	**17**	.	**34**	.	**17**	.	**255**

d. The number of address in this block is 2^{32-30} = 4. We need to add 3 (one less) addresses (0.0.0.3 in base 256) to the first address to find the last address.

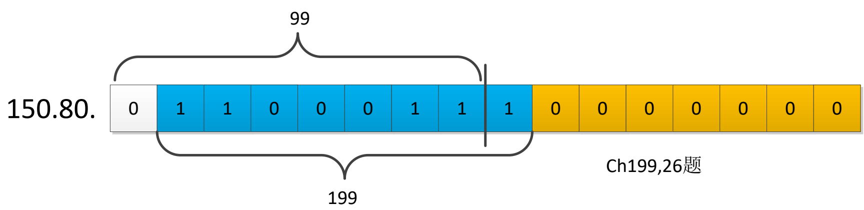
From:	180	.	34	.	64	.	64
	0	.	**0**	.	**0**	.	**3**
To:	180	.	34	.	64	.	67

26.

此题可以参考 Ch22 章的例 22.5（P432 页）

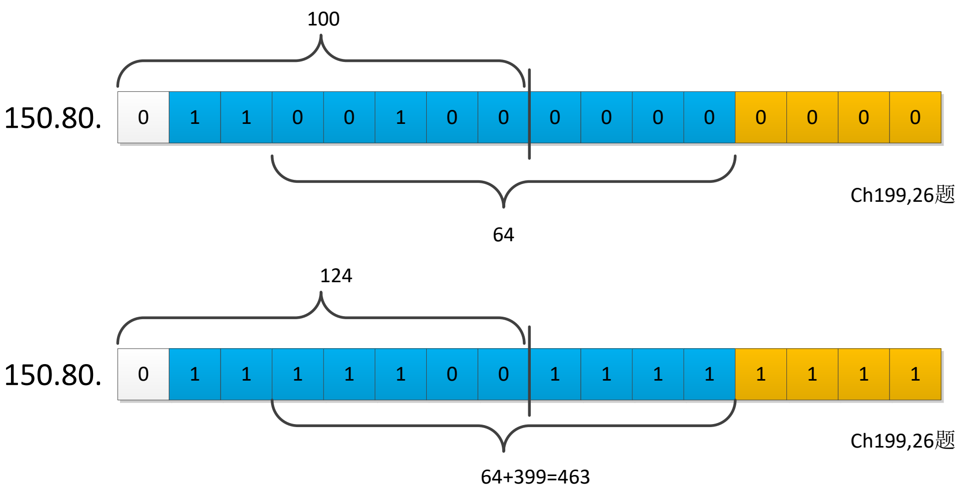
a. 要分配给 200 个中型企业，每个 128 个地址，总共需要 25600 个主机。也就是每个企业需要 7 位主机地址，200 个中型企业，需要 8 位地址来表示，总共需要 15 位来表示。因此掩码是/25，地址范围是：

200 的二进制是：11001000，



150.80.0.0/25 ~ 150.80.99.128/25

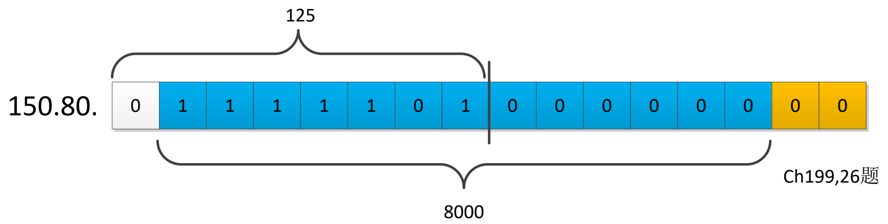
b.

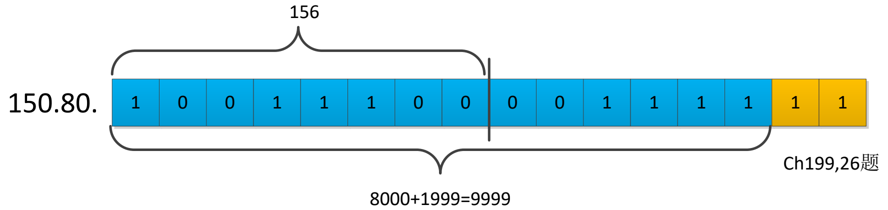


150.80.100.0/28 ~ 150.80.124.240/28

c.

150.80.125.0/30~150.80.156.60/30

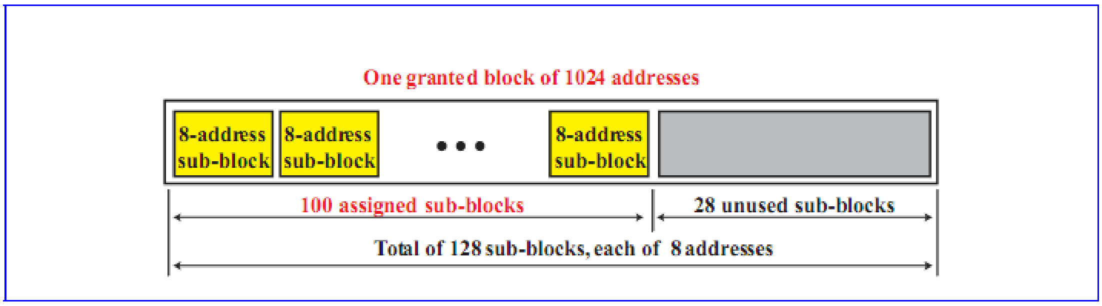




27.

The site has $2^{32-22} = 2^{10} =$ **1024** from **120.60.4.0/22** to **120.60.7.255/22** addresses. One solution would be to divide this block into **128** 8-address sub-blocks as shown in Figure 19.1. The ISP can assign the first 100 sub-blocks to the current customers and keep the remaining 28 sub-blocks. Of course, this does not mean the future customer have to use 8-address subblocks. The remaining addresses can later be divided into different-size sub-blocks (as long as the three restrictions mentioned in this chapter are followed). Each sub-block has 8 addresses. The mask for each sub-block is **/29** ($32 - \log_2 8$). Note that the mask has changed from /22 (for the whole block) to /29 for each subblock because we have 128 sub-blocks ($2^7 = 128$).

Figure 19.1 *Solution to Exercise 27*



Sub-blocks:

1st subnet:	**120.60.4.0/29**	to	**120.60.4.7/29**
2nd subnet:	**120.60.4.8/29**	to	**120.60.4.15/29**
...	**...**		**...**
32nd subnet:	**120.60.4.248/29**	to	**120.60.4.255/29**
33rd subnet:	**120.60.5.0/29**	to	**120.60.5.7/29**
...	**...**		**...**
64th subnet:	**120.60.5.248/29**	to	**120.60.5.255/29**
...	**...**		**...**
99th subnet:	**120.60.7.16/29**	to	**120.60.7.23/29**
100th subnet:	**120.60.7.24/29**	to	**120.60.7.31/29**

1024 – 800 = **224** addresses left (from **120.60.7.31** to 120.60.7.155)

29.

a. **2340:1ABC:119A:A000::0**

b. **0:AA::119A:A231**

c. **2340::119A:A001:0**

d. **0:0:0:2340::0**

30.

a. 0::0 0000:0000:0000:0000:0000:0000:0000:0000

b.0:AA::0 0000:00AA:0000:0000:0000:0000:0000:0000

c.0:1234::3 0000:1234:0000:0000:0000:0000:0000:0003

d.123::1:2 0000:0123:0000:0000:0000:0000:0001:0002

37.

The node identifier is **0000:0000:1211**. Assuming a 32-bit subnet identifier, the subnet address is **581E:1456:2314:ABCD:0000** where **ABCD:0000** is the subnet identifier.

Ch20 IP 协议

15.

The value of the header length field of an IP packet can never be less than 5 because every IP datagram must have at least a base header that has a fixed size of 20 bytes. The value of HLEN field, when multiplied by 4, gives the number of bytes contained in the header. Therefore the minimum value of this field is 5. This field has a value of exactly 5 when there are no options included in the header.

19.

Since there is no option information, the header length is 20, which means that the value of HLEN field is **5** or **0101** in binary. The value of total length is **1024 + 20** or **1044** (00000100 00010100 in binary).

21.

If the M (more) bit is zero, this means that the datagram is either the last fragment or the it is not fragmented at all. Since the offset is **0,** it cannot be the last fragment of a fragmented datagram. The datagram is not fragmented.

23.

Let us first find the value of header fields before answering the questions:

VER = 0x4 = **4**

HLEN =0x5 = 5 $\rightarrow$ 5 × 4 = **20**

Service =0x00 = **0**

Total Length = 0x0054 = **84**

Identification = 0x0003 = **3**

Flags and Fragmentation = 0x0000 $\rightarrow$ D = **0** M= **0** offset = **0**

Time to live = 0x20 = **32**

Protocol = 0x06 = **6**

Checksum = 0x5850
Source Address: 0x7C4E0302 = **124.78.3.2**
Destination Address: 0xB40E0F02 = **180.14.15.2**

We can then answer the questions:

a. If we calculate the checksum, we get 0x0000. ***The packet is not corrupted***.
b. Since the length of the header is 20 bytes, ***there are no options.***
c. Since $M = 0$ and *offset* = 0, ***the packet is not fragmented.***
d. The total length is 84. ***Data size is 64 bytes (84 −20)***.
e. Since the value of *time to live* = 32, ***the packet may visit up to 32 more routers***.
f. ***The identification number of the packet is 3***.
g. ***The type of service is normal***.

Ch21 ICMP

13.

See Figure 21.1. Note that all values are in hexadecimal. Note also that the hard-ware addresses does not fit in the 4-byte word boundaries. We have also shown the IP address in parentheses.

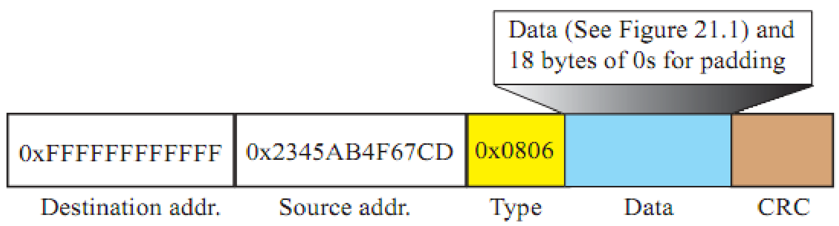
Figure 21.1 *Solution to Exercise 13*

<table>
<tr><td colspan="2">0x0001</td><td colspan="2">0x0800</td></tr>
<tr><td>0x06</td><td>0x04</td><td colspan="2">0x0001</td></tr>
<tr><td colspan="4">0x2345AB4F</td></tr>
<tr><td colspan="2">0x67CD</td><td colspan="2">0x7B2D (125.45)</td></tr>
<tr><td colspan="2">0x170C (23.12)</td><td colspan="2">0x0000</td></tr>
<tr><td colspan="4">0x00000000</td></tr>
<tr><td colspan="4">0x7B0D4E0A (125.11.78.10)</td></tr>
</table>

15.

See Figure 21.2. We have not shown the preamble and SFD fields, which are added in the physical layer.

Figure 21.2 *Solution to Exercise 15*

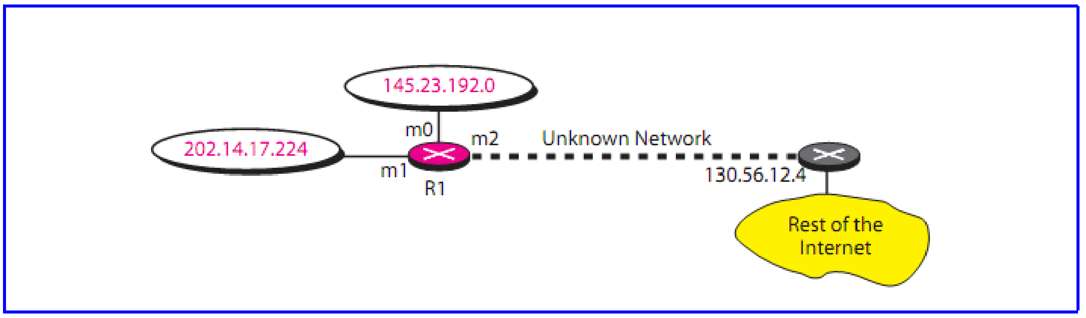


Or perhaps the datagram was dropped due to congestion and the error message generated by an intermediate router was lost.

Ch22 传递、转发和路由选择

15.

Figure 22.1 *Solution to Exercise 15*



19.

Table 22.1 *Solution to Exercise 19: Routing table for local ISP 1*

Mask	Network address	Next-hop address	Interface
/23	120.14.64.0	---	**m0**
/23	120.14.66.0	---	**m1**
/23	120.14.68.0	---	**m2**
/23	120.14.70.0	---	**m3**
/23	120.14.72.0	---	**m4**
/23	120.14.74.0	---	**m5**
/23	120.14.76.0	---	**m6**
/23	120.14.78.0	---	**m7**
/0	0.0.0.0	**default router**	**m8**

21.

Table 22.2 *Solution to Exercise 21: Routing table for local ISP 3*

Mask	Network address	Next-hop address	Interface
/24	120.14.112.0	---	**m0**
/24	120.14.113.0	---	**m1**

Mask	Network address	Next-hop address	Interface
/24	120.14.114.0	---	**m2**
/24	120.14.115.0	---	**m3**
/24	120.14.116.0	---	**m4**
/24	120.14.117.0	---	**m5**
/24	120.14.118.0	---	**m6**
/24	120.14.119.0	---	**m7**
/24	120.14.120.0	---	**m8**
/24	120.14.121.0	---	**m9**
/24	120.14.122.0	---	**m10**
/24	120.14.123.0	---	**m11**
/24	120.14.124.0	---	**m12**
/24	120.14.125.0	---	**m13**
/24	120.14.126.0	---	**m14**
/24	120.14.127.0	---	**m15**
/0	0.0.0.0	**default router**	**m16**

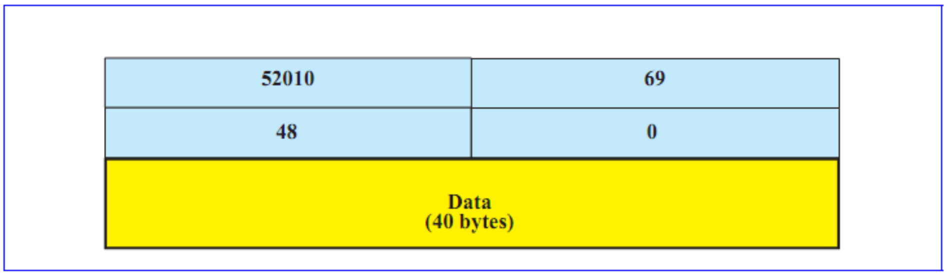
22.

和 21 题一样，原英文教材是表示 ISP1 的路由表，这有和 19 题一样了。

Ch23 UDP、TCP 和 SCTP

13．

Figure 23.1 *Solution to Exercise 13*



20．

a. 0x0632

b.0x000D

c.28 字节

d.20 字节

e.客户到服务器

f. 客户机进程是: daytime

21.

It looks as if both the destination IP address and the destination port number are corrupted. TCP calculates the checksum and drops the segment.

24.

a. 源端口是： 0x0532

b. 目的端口是： 0x0017

c. 序列号是： 0x00000001

d. 确认号是： 0x00000000

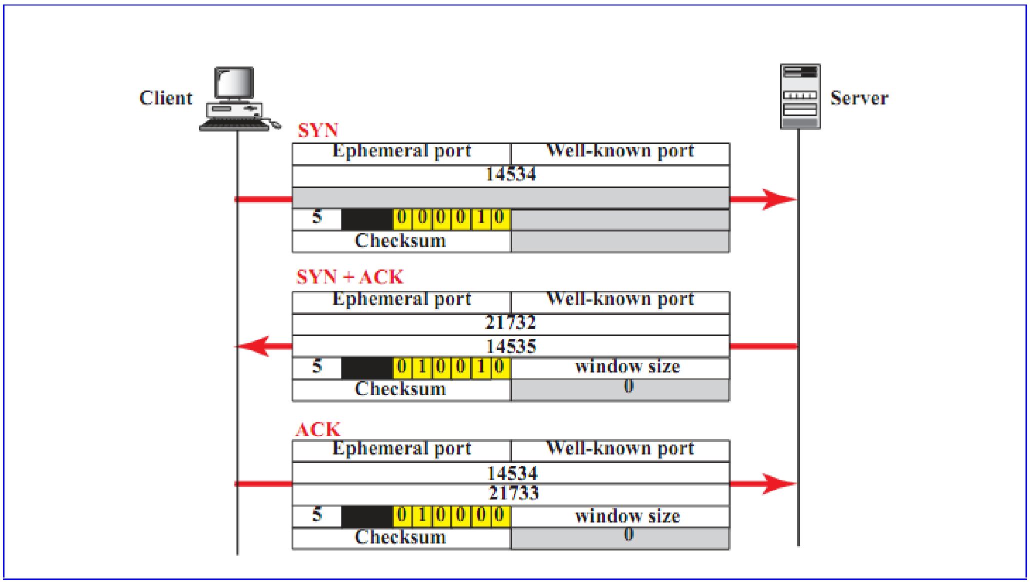
e. 5*4 = 20 字节

f. 段的类型是：终端网络

g. 窗口大小是：0x07ff

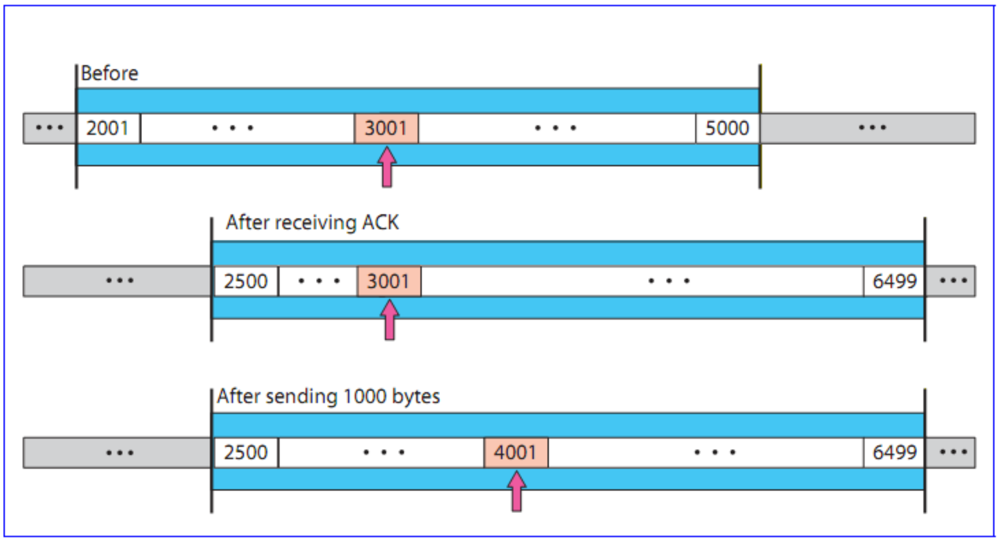
27.

Figure 23.3 *Solution to Exercise 27*



31.

Figure 23.4 *Solution to Exercise 31*



Ch24 拥塞控制和服务质量

补充作业：

2009 第 39 题。

39．一个 TCP 连接总是以 1KB 的最大段发送 TCP 段，发送方有足够多的数据要发送。当拥塞窗口为 16KB 时发生了超时，如果接下来的 4 个 RTT（往返时间）时间内的 TCP 段的传输都是成功的，那么当第 4 个 RTT 时间内发送的所有 TCP 段都得到肯定应答时，拥塞窗口大小是

A．7KB B. 8KB C. 9KB D. 16KB

2010 第 39 题。

39、主机甲和主机乙之间已建立一个 TCP 连接，TCP 最大段长度为 1000 字节，若主机甲的当前拥塞窗口为 4000 字节，在主机甲向主机乙连接发送 2 个最大段后，成功收到主机乙发送的第一段的确认段，确认段中通告的接收窗口大小为 2000 字节，则此时主机甲还可以向主机乙发送的最大字节数是（ ）

A：1000　　B：2000　　C：3000　　D：4000

39．主机甲向主机乙发送一个(SYN＝1，seq＝11220)的TCP段，期望与主机乙建立TCP连接，若主机乙接受该连接请求，则主机乙向主机甲发送的正确的TCP段可能是

A．(SYN＝0，ACK＝0，seq＝11221，ack＝11221)

B．(SYN＝1，ACK＝1，seq＝11220，ack＝11220)

C．(SYN＝1，ACK＝1，seq＝11221，ack＝11221)

D．(SYN＝0，ACK＝0，seq＝11220，ack＝11220)

40．主机甲与主机乙之间已建立一个TCP连接，主机甲向主机乙发送了3个连续的TCP段，分别包含300字节、400字节和500字节的有效载荷，第3个段的序号为900。若主机乙仅正确接收到第1和第3个段，则主机乙发送给主机甲的确认序号是

A．300　　B．500　　C．1200　　D．1400

Ch25 域名系统

19.

21.

Ch26 远程登录、电子邮件与文件传输

11.

Ch27 万维网与超文本传输协议

11.