## Jump Table

```
.quad .L4
    .quad .L6
    .quad .L6
    .quad .L7
    .quad .L3
    .quad .L8
    .quad .L7
2.
[1]31/0x1f
                              [2]6
[3]ja
                              [4].L5(,%rax,8)
[5]movb %dl, (%rax)
                              [6]6
[7]movw 0x201f, (%rax)
                              [8]7
3.
                  3
                                5
                                       6
0xf0 0x1f 0xf0 0xff 0x22 0x1f 0xf0 0x00
```

1. Jump table under label . L5 is hidden. Please fill in the hidden part according to the C code given above.

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
     int i;
     for (i = 0; i < BUF SIZE; i++) {
     switch (buf[i])
       case 0x1f:
       if (i > 0) {
          buf[i] += buf[i-1];
10.
11.
       case 0x20: case 0x21:
12.
         buf[i] = 0xf0;
13.
         break;
       case 0x22: case 0x25:
14.
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
       case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
         break;
20.
       default:
21.
          if (i < BUF SIZE - 1) {
22.
            *(short *\nablabuf[i] = 0x201f;
23.
24.
          break;
25.
26.
27. }
```

Base: 0x1f

Length: 7 (0x1f - 0x25)

```
20. .L4:
2. #define BUF SIZE 8
                                         21.
                                                   cmpl
                                                               $0, -4(%rbp)
3. void transfer(char *buf) {
    int i;
                                                   jle
                                         22.
                                                          .L6
    for (i = 0; i < BUF SIZE; i++) {
    switch (buf[i])
                                         23.
                                                               -4(%rbp), %eax
                                                   movl
     case 0x1f:
     if (i > 0) {
                                         24.
                                                   movslq
                                                              %eax, %rdx
       buf[i] += buf[i-1];
10.
                                         25.
                                                             -24(%rbp), %rax
11.
                                                   movq
     case UxZU: case UxZI:
12.
       buf[i] \mid = 0xf0;
                                         26.
13.
       break;
                                                   addq
                                                              %rdx, %rax
14.
     case 0x22: case 0x25:
     *((unsigned *)buf + i/4) = (unsigned)buf[i]; 27.
15.
                                                             -4(%rbp), %edx
                                                   movl
16.
       break;
17.
     case 0x24:
                                         28.
                                                   movslq
                                                              %edx, %rcx
18.
       buf[i] = (char)((*(long *)buf) >> 8);
19.
      break;
                                         29.
                                                             -24(%rbp), %rdx
                                                   movq
20.
     default:
21.
    if (i < BUF SIZE - 1) {
                                         30.
                                                             %rcx, %rdx
                                                   addq
22.
       *(short *\overline{)}buf[i] = 0x201f;
23.
                                                   movzbl (%rdx), %edx
                                         31.
24.
       break;
25.
                                         32.
                                                   movl
                                                              %edx, %esi
26.
27. }
                                         33.
                                                              -4(%rbp), %edx
                                                   movl
                                         34.
                   case 0x1f <-> .L4
                                                   movslq
                                                             %edx, %rdx
                                         35.
                                                              -1(%rdx), %rcx
                                                   leaq
                                         36.
                                                              -24(%rbp), %rdx
                                                   movq
                                         37.
                                                   addq
                                                              %rcx, %rdx
                                         38.
                                                   movzbl
                                                               (%rdx), %edx
                                         39.
                                                   addl
                                                              %esi, %edx
                                                             5]
                                         40.
```

```
2. #define BUF SIZE 8
  void transfer(char *buf) {
    int i;
    for (i = 0; i < BUF SIZE; i++) {
    switch (buf[i]) {
                                              41. .L6:
      case 0x1f:
      if (i > 0) {
                                              42.
                                                         movl
                                                                     -4(%rbp), %eax
       buf[i] += buf[i-1];
10.
                                              43.
                                                         movslq
                                                                     %eax, %rdx
11.
      case 0x20: case 0x21:
12.
       buf[i] = 0xf0;
                                              44.
                                                                     -24(%rbp), %rax
                                                         movq
13.
       break;
14.
      case 0x22: case 0x25:
                                                                     %rdx, %rax
15.
        *((unsigned *)buf + i/4) = (unsigned)buf[i];
                                              45.
                                                         addq
16.
       break;
17.
      case 0x24:
                                              46.
                                                                     -4(%rbp), %edx
                                                         movl
18.
       buf[i] = (char)((*(long *)buf) >> 8);
19.
       break;
                                              47.
                                                         movslq
                                                                     %edx, %rcx
20.
      default:
21.
       if (i < BUF SIZE - 1) {
                                              48.
                                                                     -24(%rbp), %rdx
                                                         movq
22.
         *(short *)buf[i] = 0x201f;
23.
                                              49.
                                                         addq
                                                                     %rcx, %rdx
24.
       break;
25.
26.
                                                         movzbl (%rdx), %edx
27. }
                                                                      $-16, %edx
                                                         orl
             case 0x20: case 0x21: <-> .L6
                                                         movb
                                                                     %dl, (%rax)
                                                         jmp
                                                                 .L9
```

```
2. #define BUF SIZE 8
                                           54. .L7:
  void transfer(char *buf) {
                                           55.
                                                                  -4 (%rbp), %eax
    int i;
                                                     movl
    for (i = 0; i < BUF SIZE; i++) {
    switch (buf[i]) {
                                           56.
                                                                  3(%rax), %edx
                                                      leal
     case 0x1f:
     if (i > 0) {
                                           57.
                                                                  %eax, %eax
                                                      testl
       buf[i] += buf[i-1];
10.
                                           58.
                                                                  %edx, %eax
                                                      cmovs
11.
     case 0x20: case 0x21:
12.
       buf[i] = 0xf0;
                                           59.
                                                                  $2, %eax
13.
      break:
                                                      sarl
14.
     case 0x22: case 0x25:
15.
       *((unsigned *)buf + i/4) = (unsigned)buf[i];
                                           60.
                                                                  0(,%rax,4), %rdx
                                                      leaq
16.
      break:
17.
      case 0x24:
                                                                  -24(%rbp), %rax
                                            61.
                                                      mova
18.
       buf[i] = (char)((*(long *)buf) >> 8);
19.
       break;
                                            62.
                                                      addq
                                                                  %rax, %rdx
20.
     default:
       if (i < BUF SIZE - 1) {
21.
22.
         *(short *\nablabuf[i] = 0x201f;
                                            63.
                                                                  -4 (%rbp), %eax
                                                      movl
23.
24.
       break;
                                            64.
                                                                 %eax, %rcx
                                                      movslq
25.
26.
                                           65.
                                                                  -24(%rbp), %rax
                                                      movq
27. }
                                            66.
                                                                  %rcx, %rax
                                                      addq
             case 0x22: case 0x25: <-> .L7
                                            67.
                                                      movzbl (%rax), %eax
                                            68.
                                                      movsbl
                                                                  %al, %eax
                                            69.
                                                                  %eax, (%rdx)
                                                      movl
                                           70.
                                                      jmp .L9
```

```
2. #define BUF SIZE 8
                                                    71. .L8:
   void transfer(char *buf) {
    int i;
                                                                             -4(%rbp), %eax
    for (i = 0; i < BUF SIZE; i++) {
                                                    72.
                                                               movl
     switch (buf[i]) {
      case 0x1f:
                                                    73.
                                                                            %eax, %rdx
                                                               movslq
      if (i > 0) {
        buf[i] += buf[i-1];
                                                    74.
                                                                             -24(%rbp), %rax
                                                               movq
10.
11.
      case 0x20: case 0x21:
                                                                             %rax, %rdx
                                                    75.
                                                                addq
12.
        buf[i] \mid = 0xf0;
13.
        break;
14.
      case 0x22: case 0x25:
                                                    76.
                                                                             -24(%rbp), %rax
                                                               movq
        *((unsigned *)buf + i/4) = (unsigned)buf[i];
15.
16.
        break:
                                                    77.
                                                                              (%rax), %rax
                                                               movq
17.
      case 0x24:
        buf[i] = (char)((*(long *)buf) >> 8);
18.
                                                    78.
                                                                             $8, %rax
                                                                sarq
19.
        break;
20.
      derault:
                                                    79.
                                                                movb
                                                                             %al, (%rdx)
21.
        if (i < BUF SIZE - 1) {
22.
          *(short *\overline{}buf[i] = 0x201f;
                                                    80.
                                                                       .L9
23.
                                                                jmp
24.
        break;
25.
26.
27. }
```

case 0x24: <-> .L8

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
     int i;
    for (i = 0; i < BUF SIZE; i++) {
     switch (buf[i]) {
      case 0x1f:
                                                 81. .L3:
      if (i > 0) {
        buf[i] += buf[i-1];
                                                 82.
                                                             cmpl
                                                                              [6] , -4(%rbp)
10.
11.
       case 0x20: case 0x21:
                                                             jg
                                                                    .L9
                                                 83.
12.
        buf[i] \mid = 0xf0;
13.
        break;
14.
      case 0x22: case 0x25:
        *((unsigned *)buf + i/4) = (unsigned)buf[i]; 84. break:
                                                             movl
                                                                           -4(%rbp), %eax
15.
16.
        break;
                                                 85.
                                                             movslq %eax, %rdx
17.
       case 0x24:
        buf[i] = (char)((*(long *)buf) >> 8);
18.
                                                 86.
                                                                           -24(%rbp), %rax
                                                             movq
19.
20.
      default:
                                                 87.
                                                                           %rdx, %rax
                                                             addq
21.
        if (i < BUF SIZE - 1) {
22.
          *(short *\overline{}buf[i] = 0x201f;
23.
                                                 88.
24.
        break;
25.
```

default: <-> .L3

26. **27.** }

```
2. #define BUF SIZE 8
3. void transfer(char *buf) {
     int i;
    for (i = 0; i < BUF SIZE; i++) {
    switch (buf[i]) {
     case 0x1f:
    if (i > 0) { .L4
      buf[i] += buf[i-1];
10.
       case 0x20: case 0x21: .L6
       buf[i] \mid = 0xf0;
12.
13.
       break;
14.
    case 0x22: case 0x25:
      *((unsigned *)buf + i\sqrt{47} = (unsigned)buf[i];
15.
16.
       break;
17.
       case 0x24:
18.
      buf[i] = (char)((*(long o*)buf) >> 8);
19.
       break;
20.
       default:
    if (i < BUF SIZE - 1) {
21.
       *(short *)buf[i] = 0x201f;
22.
23.
24.
         break;
25.
26.
27. }
```

## .L5:

.quad .L4
.quad .L6
.quad .L6
.quad .L7
.quad .L3
.quad .L8
.quad .L7

```
movl -4(\$rbp), \$eax
8.
9.
      movslq %eax, %rdx
10. movq -24(%rbp), %rax
11. addq %rdx, %rax
                            .L5:
12. movzbl (%rax), %eax
13.
      movsbl %al, %eax
                            .quad .L4
14. subl Base: 0x1f[1], %eax
                              .quad .L6
                                .quad .L6
15. cmpl length-1: 62] , %eax
                                .quad .L7
16. ja [3] .L3
                                .quad .L3
17. movl %eax, %eax
                                .quad .L8
18. movq .L5(,\%rax,8)4] , %rax
                                .quad .L7
19.
      jmp *%rax
       #define BUF SIZE 8
       void transfer(char *buf) {
       int i;
     5. for (i = 0; i < BUF SIZE; i++) {
     6. switch (buf[i]) {
          case 0x1f:
```

```
movl -4 (%rbp), %eax
8.
9.
      movslq %eax, %rdx
10. movq -24(%rbp), %rax
11. addq %rdx, %rax
                              .L5:
12. movzbl (%rax), %eax
13. movsbl %al, %eax
                                 .quad .L4
14. subl Base: 0x1f[1] , %eax
                                 .quad .L6
                                 .quad .L6
15. cmpl length-1: 6[2] , %eax
                                 .quad .L7
16. ja [3] .L3
                                 .quad .L3
17. movl %eax, %eax
                                 .quad .L8
18. movq.L5(,\%rax,8)4], %rax
                                 .quad .L7
19. jmp *%rax
```

## Other answers?

- [2] 7, [3] jae
- [1] 0x1f + X, [2] 6 + X, [4] .L5(-X, %rax, 8)

```
20. .L4:
21. cmpl $0, -4(%rbp)
22. jle .L6
23. movl -4(%rbp), %eax
24. movslq %eax, %rdx
25. movq -24(\$rbp), \$rax
26. addq %rdx, %rax
27. movl -4 (%rbp), %edx
28. movslq %edx, %rcx
29. movq -24(%rbp), %rdx
30. addq %rcx, %rdx
31. movzbl (%rdx), %edx
32. movl %edx, %esi
33. movl -4 (%rbp), %edx
34. movslq %edx, %rdx
35.
     leaq -1(%rdx), %rcx
36.
     movq -24(%rbp), %rdx
37. addq %rcx, %rdx
38. movzbl (%rdx), %edx
39.
     addl %esi, %edx
           [5] movb %dl, (%rax)
40.
```

## buf[i] += buf[i-1]

- Type: char
- movb

```
81. .L3:
82.
                   6[6] , -4(%rbp)
         cmpl
                                            If (i < BUF_SIZE -1) {
83.
         jg
              .L9
84.
                   -4(%rbp), %eax
                                              *(short *)buf[i] = 0x201f;
         movl
85.
         movslq
                   %eax, %rdx
86.
                   -24(%rbp), %rax
         movq
87.
         addq
                   %rdx, %rax
                                              • Type: short
                   [7] movw $0x201f, (%rax)
88.
                                                 movw
```

```
2. #define BUF SIZE 8
3. void transfer(char *buf) {
4.
     int i;
5.
     for (i = 0; i < BUF SIZE; i++) {
6.
     switch (buf[i]) {
7.
       case 0x1f:
8.
     if (i > 0) {
9.
         buf[i] += buf[i-1];
10.
11.
      case 0x20: case 0x21:
12.
      buf[i] = 0xf0;
13.
         break;
14.
       case 0x22: case 0x25:
15.
         *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
         break;
17.
       case 0x24:
18.
         buf[i] = (char)((*(long *)buf) >> 8);
19.
         break;
20.
       default:
21.
         if (i < BUF SIZE - 1) {
22.
23.
24.
            *(short *\nablabuf[i] = 0x201f;
         break;
25.
26.
27. }
```

0	1	2	3	4	5	6	7
0x24	0xf0	0x22	0x1f	0x22	0x21	0x1f	0x21

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
4.
      int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                  i = 0
10.
11.
        case 0x20: case 0x21:
12.
          buf[i] \mid = 0xf0;
13.
          break;
14.
        case 0x22: case 0x25:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break:
17.
       case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
25.
        derault:
          if (i < BUF SIZE - 1) {
            *(short *\overline{}buf[i] = 0x201f;
          break;
26.
                                  2
                                              3
                                                                     5
                                                                                6
                                                                                            7
                       1
                                                         4
            0
27. }
            0x24
                       0xf0
                                   0x22
                                              0x1f
                                                         0x22
                                                                     0x21
                                                                                0x1f
                                                                                            0x21
            0xf0
                       0xf0
                                              0x1f
                                                                                0x1f
                                                                                            0x21
                                  0x22
                                                         0x22
                                                                     0x21
```

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
4.
     int i;
5.
     for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                 i = 1
10.
11.
        case 0x20: case 0x21:
12.
          buf[i] \mid = 0xf0;
13.
          break;
14.
        case 0x22: case 0x25:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
       default:
          if (i < BUF SIZE - 1) {
            *(short *\overline{}buf[i] = 0x201f;
          break;
26.
                                  2
                                             3
                                                                    5
                                                                                6
                                                                                           7
                       1
                                                         4
            0
27. }
            0x24
                       0xf0
                                  0x22
                                             0x1f
                                                         0x22
                                                                    0x21
                                                                               0x1f
                                                                                           0x21
            0xf0
                       0x1f
                                  0x20
                                             0x1f
                                                                    0x21
                                                                               0x1f
                                                                                           0x21
                                                         0x22
```

```
2. #define BUF_SIZE 8
   void transfer(char *buf) {
4.
      int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                   i = 2
10.
11.
12.
13.
        case 0x20: case 0x21:
          buf[i] \mid = 0xf0;
          break;
14.
        case 0x22: case 0x25:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
25.
        default:
          if (i < BUF SIZE - 1) {
             *(short *\overline{}buf[i] = 0x201f;
          break;
26.
                                   2
                                               3
                                                                      5
                                                                                  6
                                                                                             7
                        1
                                                          4
            0
27. }
            0x24
                        0x1f
                                   0x20
                                               0x1f
                                                          0x22
                                                                      0x21
                                                                                  0x1f
                                                                                             0x21
            0xf0
                                   0xf0
                        0x1f
                                               0x1f
                                                                                  0x1f
                                                                                             0x21
                                                          0x22
                                                                      0x21
```

```
2. #define BUF_SIZE 8
   void transfer(char *buf) {
4.
      int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i])
7.
8.
9.
10.
        case 0x1f:
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                   i = 3
                                 No break here!!
11.
12.
13.
        case 0x20: case 0x21:
          buf[i] \mid = 0xf0;
          break;
14.
        case uxzz: case uxzo:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
        default:
          if (i < BUF SIZE - 1) {
             *(short *\nablabuf[i] = 0x201f;
          break;
26.
                                   2
                                              3
                                                                      5
                                                                                 6
                                                                                             7
                        1
                                                          4
            0
27. }
            0x24
                        0x1f
                                   0xf0
                                               0x1f
                                                          0x22
                                                                      0x21
                                                                                 0x1f
                                                                                             0x21
            0xf0
                                               Oxff
                        0x1f
                                   0xf0
                                                                                 0x1f
                                                                                             0x21
                                                          0x22
                                                                      0x21
```

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
4.
      int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                   i = 4
10.
11.
12.
13.
        case 0x20: case 0x21:
          buf[i] \mid = 0xf0;
          break:
14.
15.
        case 0x22: case 0x25:
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case Ux24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
25.
        default:
          if (i < BUF SIZE - 1) {
             *(short *\nablabuf[i] = 0x201f;
          break;
26.
                                   2
                                               3
                                                                      5
                                                                                  6
                                                                                             7
                        1
                                                          4
            0
27. }
            0x24
                        0x1f
                                   0xf0
                                               Oxff
                                                           0x22
                                                                                  0x1f
                                                                                             0x21
                                                                      0x21
            0xf0
                        0x1f
                                   0xf0
                                               Oxff
                                                           0x22
                                                                      0x0
                                                                                  0x0
                                                                                             0x0
```

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
4.
     int i;
5.
     for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                  i = 5
10.
11.
        case 0x20: case 0x21:
12.
          buf[i] \mid = 0xf0;
13.
          break;
14.
        case 0x22: case 0x25:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
        default:
          if (i < BUF SIZE - 1) {
            *(short *\overline{}buf[i] = 0x201f;
          break;
26.
                                  2
                                              3
                                                                     5
                                                                                6
                                                                                           7
                       1
            0
                                                         4
27. }
            0x24
                       0x1f
                                  0xf0
                                              Oxff
                                                         0x22
                                                                                0x0
                                                                                           0x0
                                                                     0x0
            0xf0
                                  0xf0
                       0x1f
                                              Oxff
                                                         0x22
                                                                     0x1f
                                                                                           0x0
                                                                                0x20
```

```
2. #define BUF_SIZE 8
   void transfer(char *buf) {
4.
      int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                   i = 6
10.
11.
12.
13.
        case 0x20: case 0x21:
          buf[i] \mid = 0xf0;
          break;
14.
        case UxZZ: case UxZ5:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break;
20.
21.
22.
23.
24.
        default:
          if (i < BUF SIZE - 1) {
             *(short *\overline{}buf[i] = 0x201f;
          break;
26.
                                   2
                                               3
                                                                      5
                                                                                  6
                                                                                             7
                        1
                                                          4
            0
27. }
            0x24
                        0x1f
                                   0xf0
                                               Oxff
                                                          0x22
                                                                      0x1f
                                                                                  0x20
                                                                                             0x0
            0xf0
                                   0xf0
                                               Oxff
                       0x1f
                                                          0x22
                                                                      0x1f
                                                                                  0xf0
                                                                                             0x0
```

```
2. #define BUF SIZE 8
   void transfer(char *buf) {
4.
     int i;
5.
      for (i = 0; i < BUF SIZE; i++) {
6.
      switch (buf[i]) {
7.
        case 0x1f:
8.
9.
        if (i > 0) {
          buf[i] += buf[i-1];
                                                                  i = 7
10.
11.
        case 0x20: case 0x21:
12.
          buf[i] \mid = 0xf0;
13.
          break;
14.
        case 0x22: case 0x25:
15.
          *((unsigned *)buf + i/4) = (unsigned)buf[i];
16.
          break;
17.
        case 0x24:
18.
          buf[i] = (char)((*(long *)buf) >> 8);
19.
          break:
20.
21.
22.
23.
24.
25.
        default:
          if (i < BUF SIZE - 1) {
            *(short *\overline{}buf[i] = 0x201f;
          break;
26. }
                                   2
                                              3
                                                                     5
                                                                                 6
                                                                                            7
                       1
            0
                                                          4
27. }
            0x24
                       0x1f
                                   0xf0
                                              Oxff
                                                          0x22
                                                                     0x1f
                                                                                 0xf0
                                                                                            0x0
            0xf0
                       0x1f
                                   0xf0
                                              Oxff
                                                          0x22
                                                                     0x1f
                                                                                 0xf0
                                                                                            0x0
```