**Vishwakarma Institute of Technology, Pune**

**Department of Information Technology & MCA**

**Academic Year: 2020-2021**

# DCAN COURSE PROJECT

Year: SY Batch: 3

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## Topic: Character Stuffing and Destuffing

Abstract:

The data link layer is the protocol layer in a program that handles the moving of data into and out of a physical link in a network. The data link layer is Layer 2 in the Open Systems Interconnection (OSI) architecture model for a set of telecommunication protocols. Data bits are encoded, decoded and organized in the data link layer, before they are transported as frames between two adjacent nodes on the same LAN or WAN.

The data link layer takes the packets it gets from the network layer and encapsulates them into frames for transmission. Each frame contains a frame header, a payload field for holding the packet, and a frame trailer, as illustrated in Fig. 1.

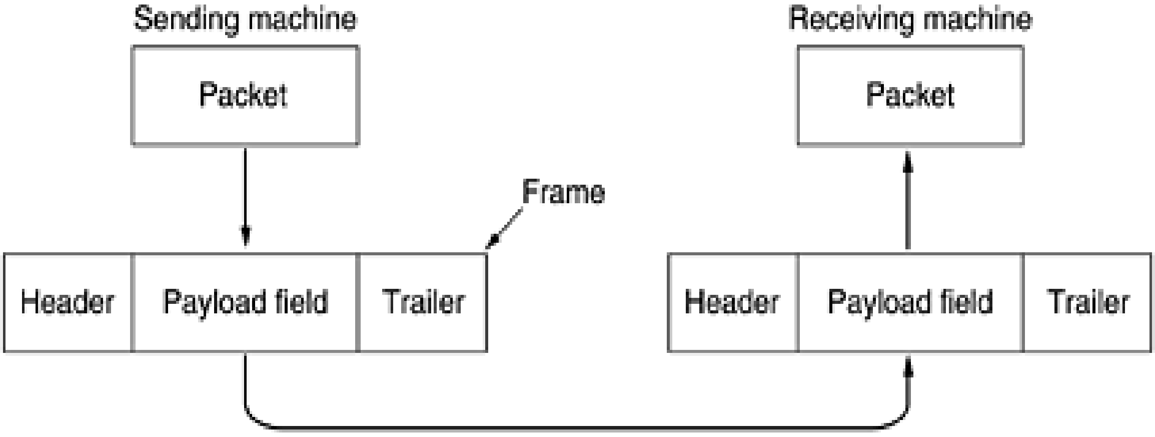


Fig. 1

Framing is a point-to-point connection between two computers or devices consists of a wire in which data is transmitted as a stream of bits. Frames have headers that contain information such as error-checking codes.

Character Stuffing and Destuffing framing method gets around the problem of resynchronization after an error by having each frame start and end with special bytes. In the past, the starting and ending bytes were different, but in recent years most protocols have used the same byte, called a flag byte, as both the starting and ending delimiter, as shown in Fig. 2 as FLAG. In this way, if the receiver ever loses synchronization, it can just search for the flag byte to find the end of the current frame. Two consecutive flag bytes indicate the end of one frame and start of the next one.

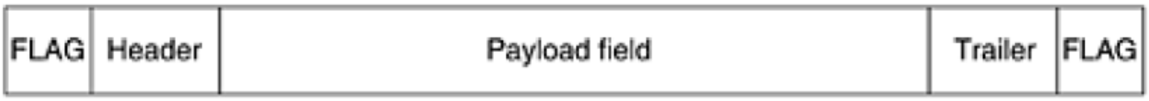


Fig. 2

The data link layer on the receiving end removes the escape byte before the data are given to the network layer. This technique is called byte stuffing or character stuffing. Thus, a framing flag byte can be distinguished from one in the data by the absence or presence of an escape byte before it.

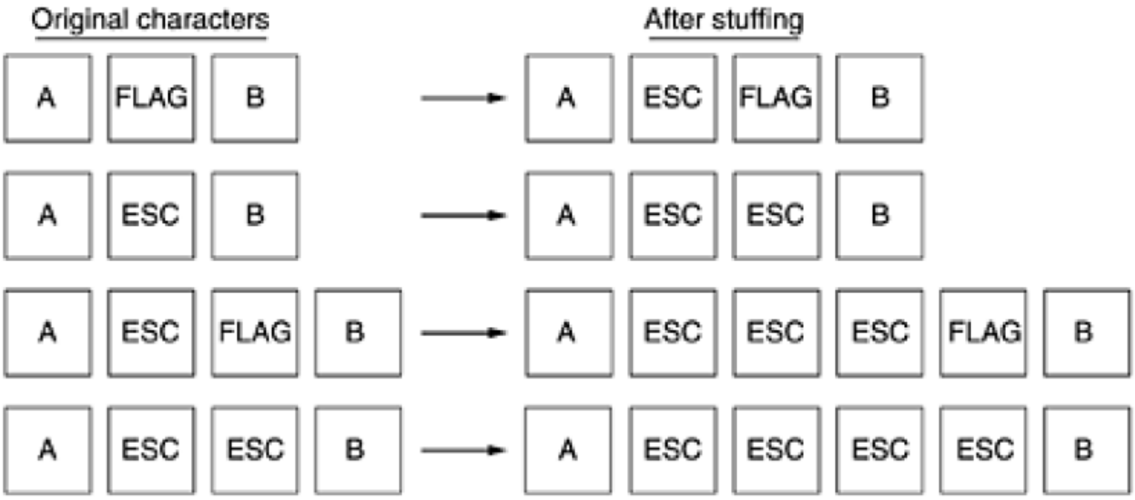


Fig. 3

**Code:**

SERVER:

```
    #include<stdio.h>

    #include<stdlib.h>

    #include<string.h>

    #include<sys/socket.h>

    #include<sys/types.h>

    #include<netinet/in.h>

    #include<arpa/inet.h>

    #include<ctype.h>
```

```
#define PORT 4455

int asciiValueToBinary(int asciiInput)
{
        int res = 0, i = 1, rem;

        while (asciiInput > 0)
        {
                rem = asciiInput % 2;
                res = res + (i * rem);
                asciiInput = asciiInput / 2;
                i = i * 10;
        }
        return(res);
}

int main()
{

    char d[50],s[50];
    int i=0,j=1;
    printf("\nEnter the codeword : ");
    scanf("%s",d);
    s[0]='$'; //Here $ is used as a flag .It must be at start and end of a frame.
    while(d[i]!='\0')
    {
        if((d[i]=='$')||(d[i]=='@'))
        {
            s[j]='@';
            j++;
        }
        s[j]=d[i];
        i++,j++;
    }
    s[j]='$',j++,s[j ]='\0';
    printf("\nStuffed frame(data sent) :  %s\n",s);

     printf("\n\n\t Character \t ASCII \t\t\t  Binary\n");


        int x=0;
          while (s[x]!='\0')
          {
                    printf("\t %c \t\t  %d \t\t\t %d \n", s[x], toascii(s[x]),
asciiValueToBinary(toascii(s[x])));
               x++;
          }
          printf("\n\nSent data in Binary format (Frame)");
          x=0;
          while (s[x]!='\0')
    {
        printf("%d", asciiValueToBinary(toascii(s[x])));
      x++;
    }
printf("\n");
int sockfd;
struct sockaddr_in serverAddr;

int newSocket;
struct sockaddr_in newAddr;

socklen_t addr_size;


sockfd = socket(AF_INET, SOCK_STREAM, 0);
memset(&serverAddr, '\0', sizeof(serverAddr));

serverAddr.sin_family = AF_INET; //
serverAddr.sin_port = htons(PORT);
serverAddr.sin_addr.s_addr = inet_addr("127.0.0.1");

bind(sockfd, (struct sockaddr*)&serverAddr, sizeof(serverAddr));

listen(sockfd, 5);
```

```
    addr_size = sizeof(newAddr);


    newSocket = accept(sockfd,( struct sockaddr*)&newAddr,
&addr_size);


    send(newSocket, s, strlen(s),0);

    printf("\nLength of sent data is %ld\n",strlen(s));




    return 0;

}
```

CLIENT (receiver):

```
#include<stdio.h>

#include<stdlib.h>

#include<string.h>

#include<sys/socket.h>

#include<sys/types.h>

#include<netinet/in.h>

#include<arpa/inet.h>

#include<ctype.h>


#define PORT 4455
```

```
int asciiValueToBinary(int asciiInput);

int main()
{
    int clientSocket;
    struct sockaddr_in serverAddr;
    char buffer[1024];

    clientSocket = socket(AF_INET, SOCK_STREAM,0);  //socket create
    memset(&serverAddr, '\0', sizeof(serverAddr));
    serverAddr.sin_family = AF_INET; //
    serverAddr.sin_port = htons(PORT);
    serverAddr.sin_addr.s_addr = inet_addr("127.0.0.1");

    connect(clientSocket, (struct
sockaddr*)&serverAddr,sizeof(serverAddr));

    int len,k;
    printf("\nEnter length of sent data: ");
    scanf("%d",&len);

    recv(clientSocket, buffer, len, 0);
   // printf("\nData Received: %s",buffer);

    char d[50],s[50];
    for (k=0;k<len;k++)

    {

        strcpy(d,buffer);

    }




    d[k]='\0';

    int i=1,j=0;

//    printf("\nEnter the code word from sender side :"); //Include the
flag($) in that code word.

  //  scanf("%s",d);

  printf("\nFrame received: ");

  int x=0;




  while (d[x]!='\0')

          {

                    printf("%d", asciiValueToBinary(toascii(d[x])));

                x++;

          }

           printf("\n");

  printf("\n\n\t Character \t ASCII \t\t\t  Binary\n");



    x=0;
```

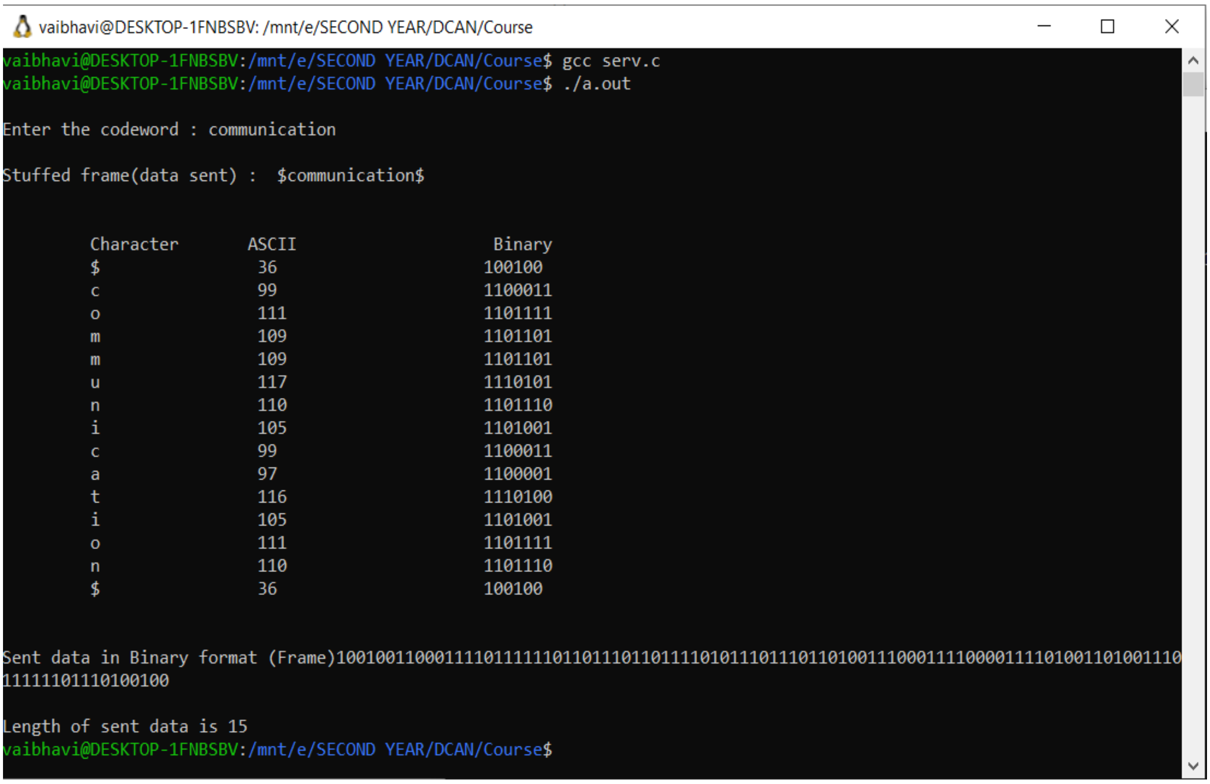
```
while (d[x]!='\0')
         {
                  printf("\t %c \t\t  %d \t\t\t %d \n", d[x], toascii(d[x]), 
asciiValueToBinary(toascii(d[x])));
              x++;
         }
  printf("\nData Received: %s",d);




   while(d[i+1]!='\0')
   {
      if(d[i]=='@'&&(d[i+1]=='@'||d[i+1]=='$'))
      {
          i++;
      }
      s[j]=d[i];
      i++;
      j++;
   }

   s[j]='\0';
   printf("\n\nOriginal code word is : %s\n",s);

   return 0;
```

```
}


int asciiValueToBinary(int asciiInput)
{
        int res = 0, i = 1, rem;

        while (asciiInput > 0)
        {
                rem = asciiInput % 2;
                res = res + (i * rem);
                asciiInput = asciiInput / 2;
                i = i * 10;
        }
        return(res);
}
```

# OUTPUT:

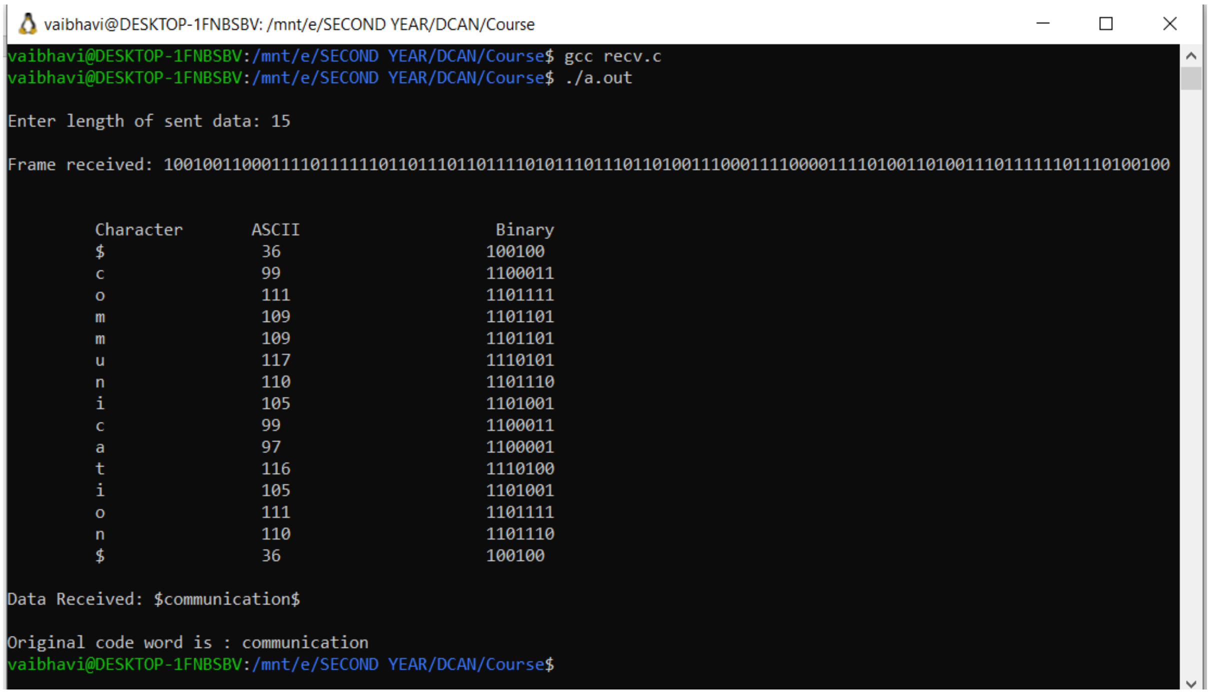
## CASE 1:

### Server:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc serv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter the codeword : communication

Stuffed frame(data sent) :  $communication$


         Character       ASCII                   Binary
         $                36                    100100
         c                99                    1100011
         o                111                   1101111
         m                109                   1101101
         m                109                   1101101
         u                117                   1110101
         n                110                   1101110
         i                105                   1101001
         c                99                    1100011
         a                97                    1100001
         t                116                   1110100
         i                105                   1101001
         o                111                   1101111
         n                110                   1101110
         $                36                    100100


Sent data in Binary format (Frame)10010011000111101111110110111011011110101110111011010011100011110000111101001101001110
1111101110100100

Length of sent data is 15
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

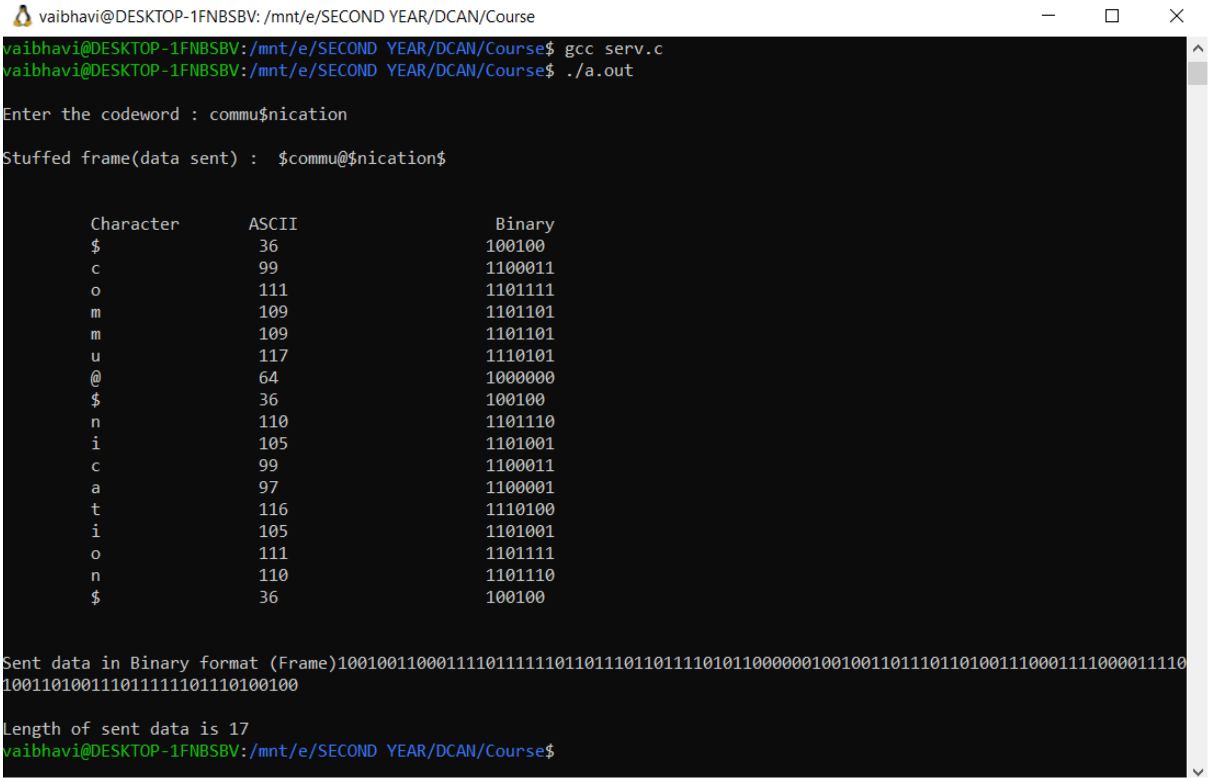
### Client:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc recv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter length of sent data: 15

Frame received: 100100110001111011111101101110110111101011101110110100111000111100001111010011010011101111101110100100


         Character       ASCII                   Binary
         $                36                    100100
         c                99                    1100011
         o                111                   1101111
         m                109                   1101101
         m                109                   1101101
         u                117                   1110101
         n                110                   1101110
         i                105                   1101001
         c                99                    1100011
         a                97                    1100001
         t                116                   1110100
         i                105                   1101001
         o                111                   1101111
         n                110                   1101110
         $                36                    100100

Data Received: $communication$

Original code word is : communication
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

CASE 2:

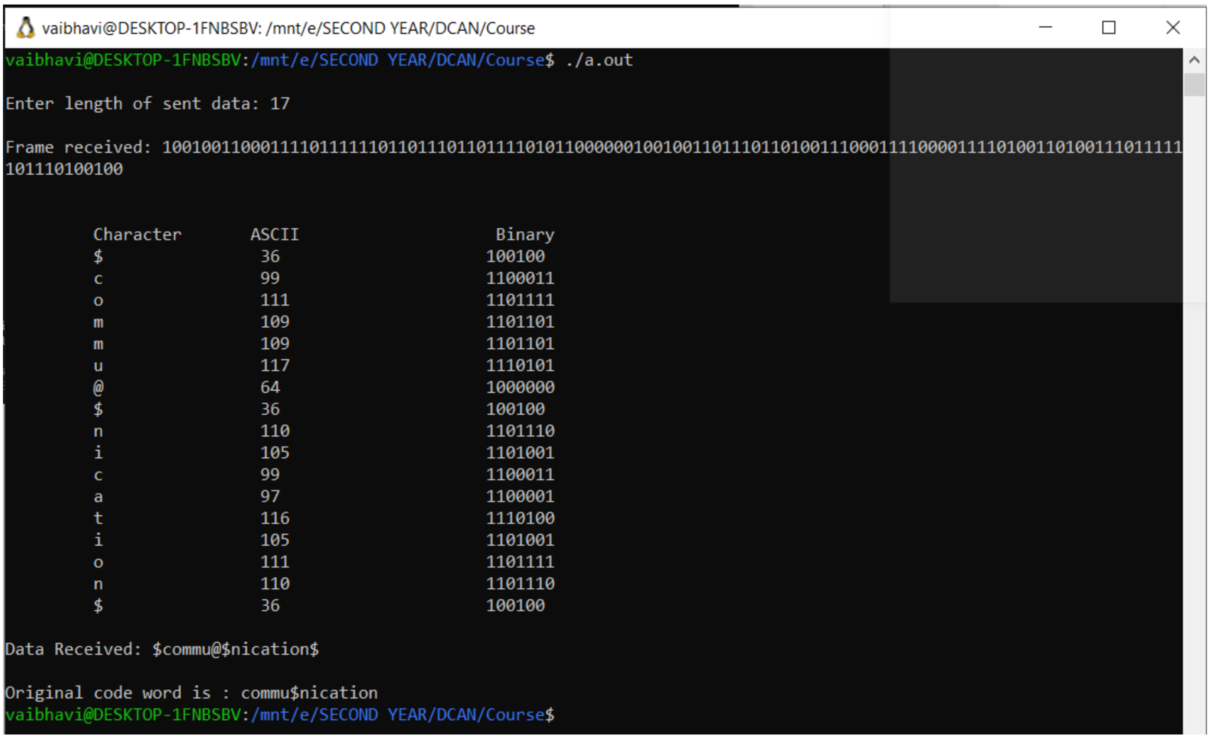
Server:



vaibhavi@DESKTOP-1FNBSBV: /mnt/e/SECOND YEAR/DCAN/Course

```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc serv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter the codeword : commu$nication

Stuffed frame(data sent) :  $commu@$nication$


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         @                64                     1000000
         $                36                     100100
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         a                97                     1100001
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100


Sent data in Binary format (Frame)10010011000111101111110110111011011110101100000010010011011101101001110001111000011110
1001101001110111111101110100100

Length of sent data is 17
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

Client:

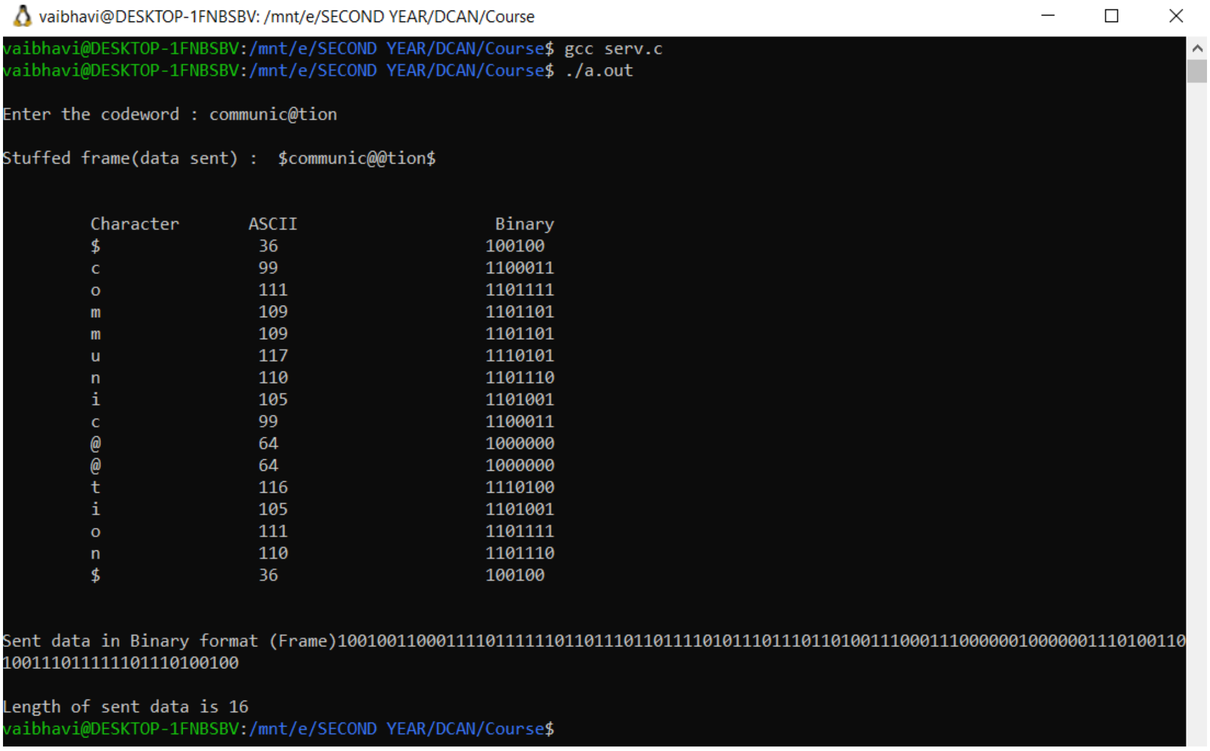


vaibhavi@DESKTOP-1FNBSBV: /mnt/e/SECOND YEAR/DCAN/Course

```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter length of sent data: 17

Frame received: 100100110001111011111101101110110111101011000000100100110111011010011100011110000111101001101001110111111
101110100100


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         @                64                     1000000
         $                36                     100100
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         a                97                     1100001
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100

Data Received: $commu@$nication$

Original code word is : commu$nication
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

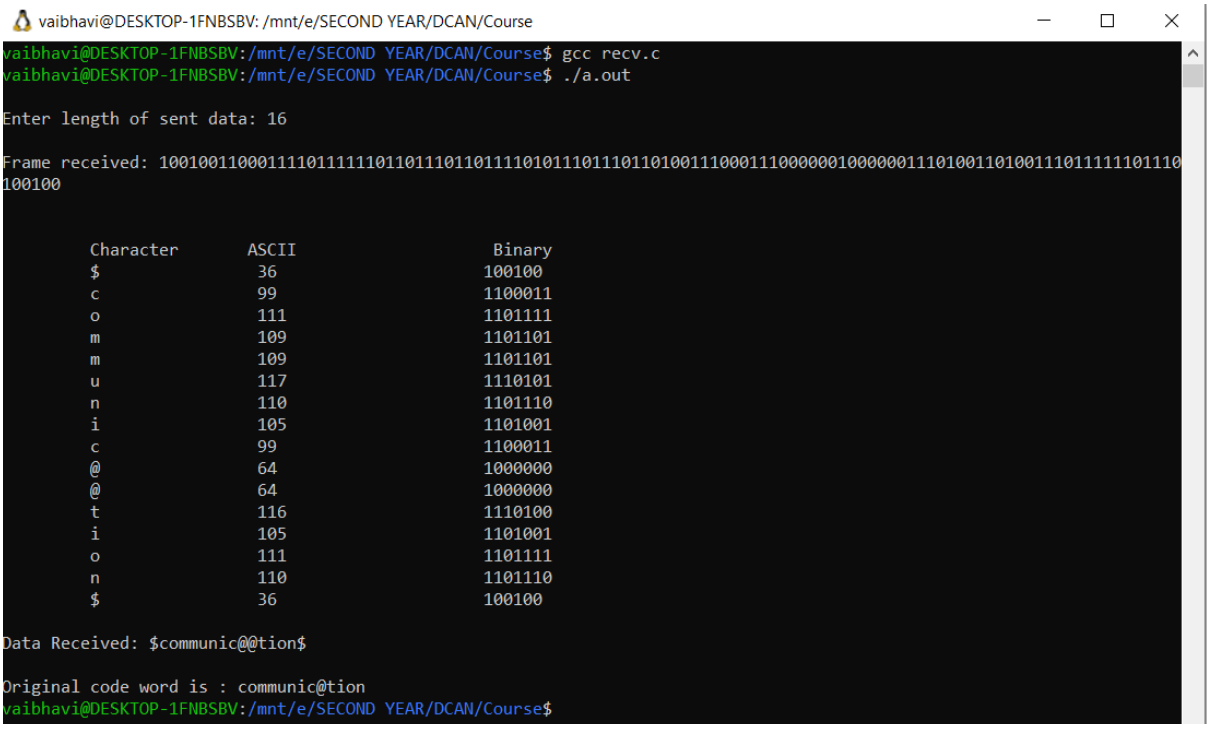
## CASE 3:

## Server:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc serv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter the codeword : communic@tion

Stuffed frame(data sent) :  $communic@@tion$


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100


Sent data in Binary format (Frame)10010011000111101111110110111011011110101110111011010011100011100000010000001110100110
100111011111101110100100

Length of sent data is 16
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

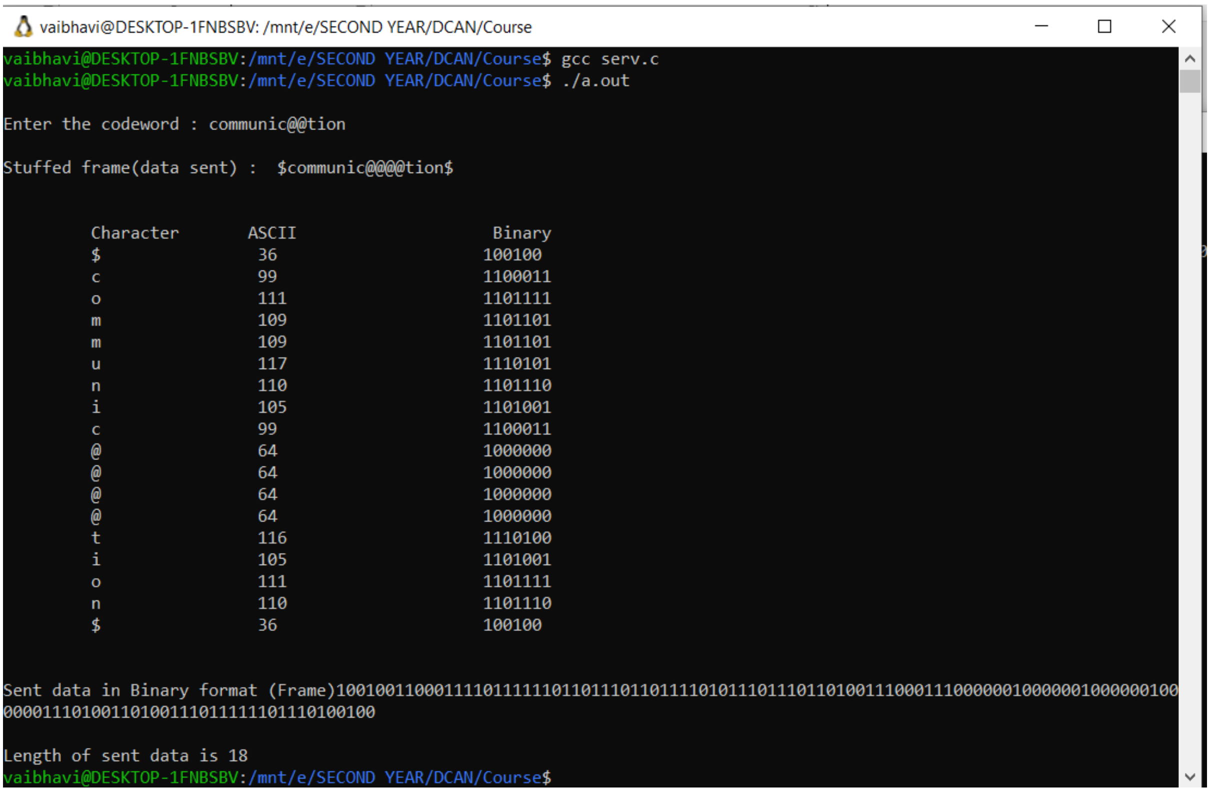
## Client:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc recv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter length of sent data: 16

Frame received: 10010011000111101111110110111011011110101110111011010011100011100000010000001110100110100111011111101110
100100


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100

Data Received: $communic@@tion$

Original code word is : communic@tion
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

CASE 4:

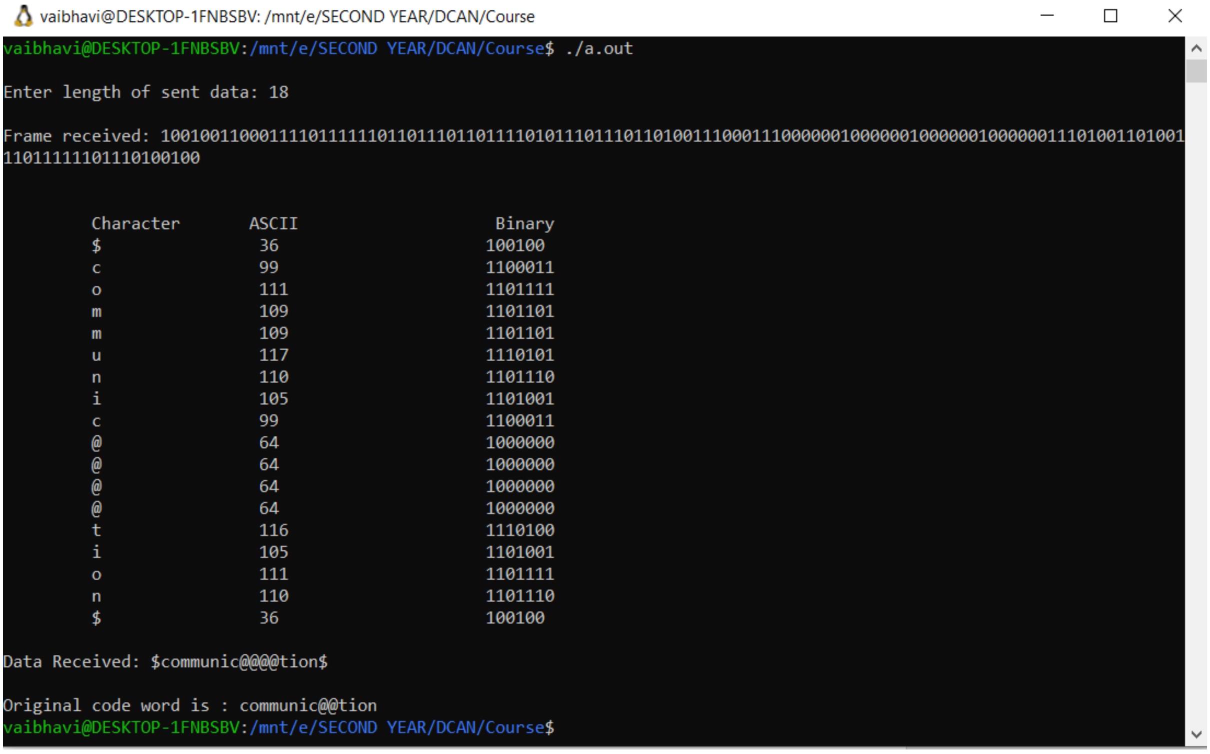
Server:



vaibhavi@DESKTOP-1FNBSBV: /mnt/e/SECOND YEAR/DCAN/Course

```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc serv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter the codeword : communic@@tion

Stuffed frame(data sent) :  $communic@@@@tion$


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         @                64                     1000000
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100


Sent data in Binary format (Frame)10010011000111101111110110111011011110101110111011010011100011100000010000001000000100
00001110100110100111011111101110100100

Length of sent data is 18
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

Client:

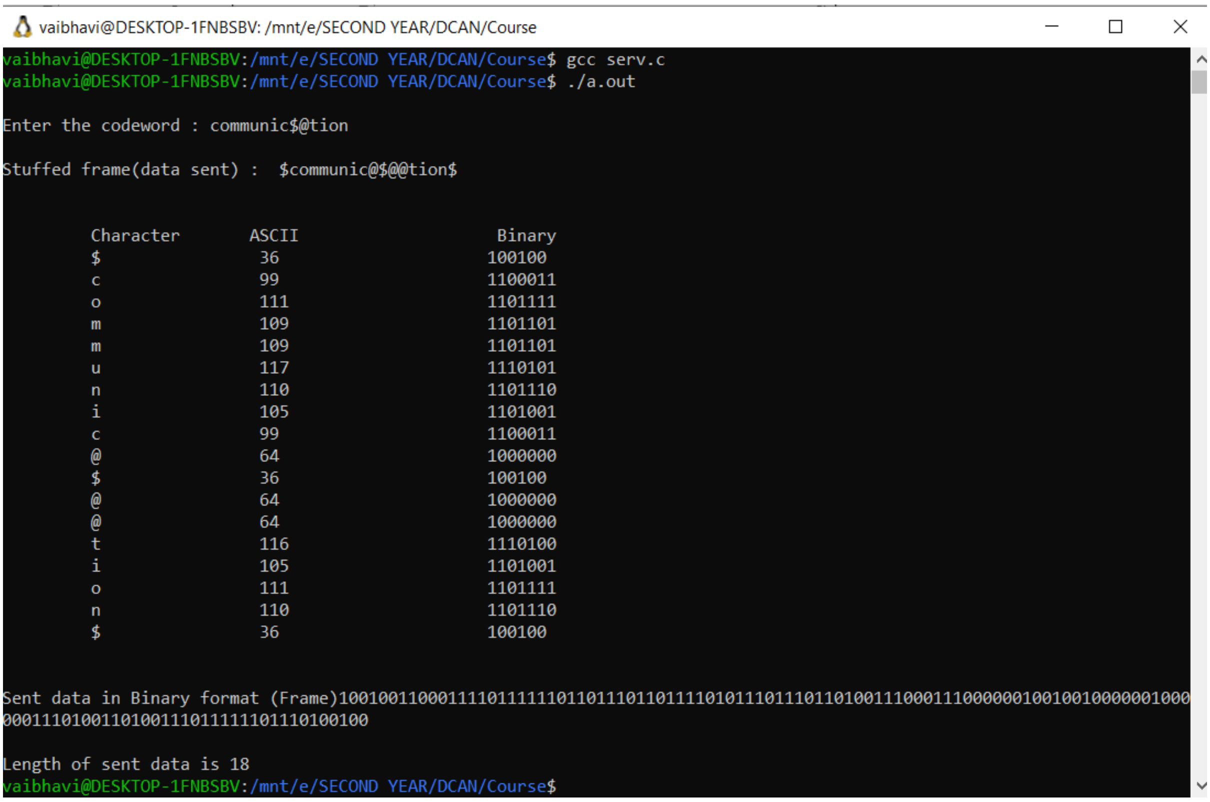


vaibhavi@DESKTOP-1FNBSBV: /mnt/e/SECOND YEAR/DCAN/Course

```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter length of sent data: 18

Frame received: 10010011000111101111110110111011011110101110111011010011100011100000010000001000000100000011101001101001
11011111101110100100


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         @                64                     1000000
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100

Data Received: $communic@@@@tion$

Original code word is : communic@@tion
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

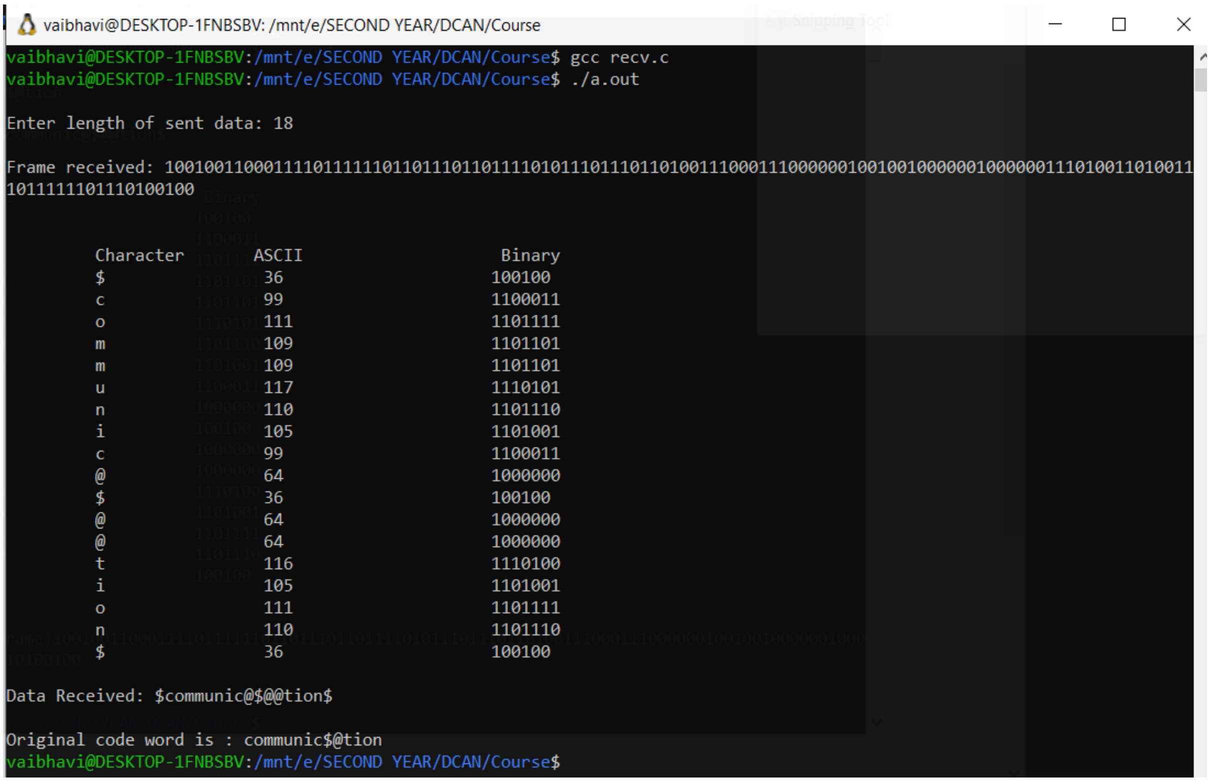
CASE 5:

Server:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc serv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter the codeword : communic$@tion

Stuffed frame(data sent) :  $communic@$@@tion$


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         $                36                     100100
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100


Sent data in Binary format (Frame)1001001100011110111111101101110110111101011101110110100111000111000000010010010000001000
0001110100110100111011111101110100100

Length of sent data is 18
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```

Client:



```
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ gcc recv.c
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$ ./a.out

Enter length of sent data: 18

Frame received: 10010011000111101111111011011101101111010111011101101001110001110000000100100100000001000000111010011010011
1011111101110100100


         Character       ASCII                    Binary
         $                36                     100100
         c                99                     1100011
         o                111                    1101111
         m                109                    1101101
         m                109                    1101101
         u                117                    1110101
         n                110                    1101110
         i                105                    1101001
         c                99                     1100011
         @                64                     1000000
         $                36                     100100
         @                64                     1000000
         @                64                     1000000
         t                116                    1110100
         i                105                    1101001
         o                111                    1101111
         n                110                    1101110
         $                36                     100100

Data Received: $communic@$@@tion$

Original code word is : communic$@tion
vaibhavi@DESKTOP-1FNBSBV:/mnt/e/SECOND YEAR/DCAN/Course$
```