Assignment 3: Implement p-persistent CSMA and CSMA/CD.

(Carrier-Sense Multiple Access with Collision Detection)

1) What is CSMA/CD?

CSMA/CD is a media access control method. It uses carrier-sensing to defer transmissions until no other stations are transmitting. This is used in combination with collision detection in which a transmitting station detects collisions by sensing transmissions from other stations while it is transmitting a frame. When this collision condition is detected, the station stops transmitting that frame, transmits a jam signal, and then waits for a random time interval which is a number between 0 to 2^k-1, before trying to resend the frame.

```c
#include <math.h>
#include <ncurses.h>

int channel[50]={0},n,tf=5,ttemp[10],a=0,k=2,w=0;
int ds[10]={1,1,1,1,1,1,1,1,1,1},is[10]={0},js[10]={0};
int status[10]={1,1,1,1,1,1,1,1,1,1};

typedef struct
{int data[5];
int dest;
int time;}station;

void send(int sno);
int stat_ini();
int send_data();
void collision();

int backoff()
{
  int kmax=15,r,s,tb;
  if(k>kmax)
  {
    printf("station exceeded its limit\n%d:",k);
    exit(0);
  }
  else
  {
    s=(pow(2,k)-1);
    r=rand()%s;
    tb=r*tf;
    printf(" 2^k-1: %d\n",s);
    printf("The random no generated %d ",r);
    k=k+1;
  }
  return (tb);
```

A channel array is taken and is initailised to 50.

A structure station is declared which has an array containing the data, and integer denoting the destination and the time.

The function backoff returns the time for which the station will back off once a collision has happened. It has a variable k and a random number is generated between 0 and 2^k-1 for which the station will back off.

```
station stat[10];
int main()
{
  int i,j,ch;
  //printf("*************************************************************
  //printf("\n\tCARRIER SENSE MULTIPLE ACCESS WITH COLLISION DETECTIO
  //printf("\t\t\t\tCSMA|CD\t\t\t\t\n");
  //printf("*************************************************************
  printf("Enter the number of stations :");
  scanf("%d",&n);
    for(i=1;i<=n;i++)
    {printf("\nEnter 1, If station%d want to transmit signal :",i);
     scanf("%d",&ch);
     stat[i].time=0;
       if(ch==1)
        {
         printf("\nEnter time of sending signal of station%d :",i);
         scanf("%d",&stat[i].time);
         a++;
         status[i]=0;
         l:printf("\nEnter destination of station%d :",i);
         scanf("%d",&stat[i].dest);
         if(stat[i].dest==i||stat[i].dest<1||stat[i].dest>n)
         {printf("Wrong destination,Try again\n");
          goto l;}
         printf("\nEnter the data(3-Bit data) :");
          for(j=1;j<=3;j++)
          {scanf("%d",&stat[i].data[j]);}
           }
    }
  for(i=1;i<=n;i++)
  {ttemp[i]=stat[i].time;}
  send_data();
  return 0;
}
```

A channel is taken which can have a maximum of 10 stations.

In the main function the input of the number of staions is taken and for each corresponding station the time, destionation and data is also taken. The send_data function is called for each stations that wants to send.

```
void collision(int sno)
{
  int i,tb;
  for(i=1;i<=n;i++)
  {
    if(status[i]!=1)
    {
      stat[i].time=ttemp[i];
      is[i]=0,js[i]=0,ds[i]=1;
    }
  }

  for(i=1;i<=(n*5);i++)
    channel[i]=0;
  printf("signal jam\n");
  tb=backoff();
  stat[sno].time=stat[sno].time+tb;
  printf("backoff by: %d",tb);
  send_data();
}
```

Function to determine if collision has occurred for a station number. If the collision has occurred signal jam will be printed and it will back off and will try to send the data again.

```
 99 int stat_ini() //to slect the least time
100 {
101   int x,i,min;
102   for(i=1;i<=n;i++)
103   {
104     if(stat[i].time!=0)
105     {
106       min=i;
107       break;
108     }
109   }
110   for(int i=0;i<n;i++)
111   {
112     printf("%d stat[i].time",stat[i].time);
113   }
114   printf("\n");
115   x=stat[min].time;
116   for(i=1;i<=n;i++)
117   {
118     if(x>stat[i].time&&stat[i].time!=0)
119       x=stat[i].time;}
120     printf("Time: %d\n",x);
121   return x;
122 }
```

This function selects the station with the least time which wants to send data. The minimum time is returned.

```
125 int send_data() //to the state which sends data
126 {
127   int tmin=stat_ini(),t,i,tb;
128   for(t=tmin;;t++)
129   {
130     for(i=1;i<=n;i++)
131     {
132       if(t==stat[i].time)
133       {//printf("\nstation:%d",i);
134         if(ds[i]==1&&channel[i*5-4]!=0)
135         {
136           tb=backoff();
137           printf("channel not free backing off by:%dsec",tb);
138           stat[i].time=stat[i].time+tb;
139         }
140         else
141         {
142         send(i);
143         stat[i].time++;}
144
145       }
146     }
147     printf("\n");
148     for(i=1;i<=(n*5);i++)
149       printf("%d",channel[i]);
150     getch();
151   }
152 }
```

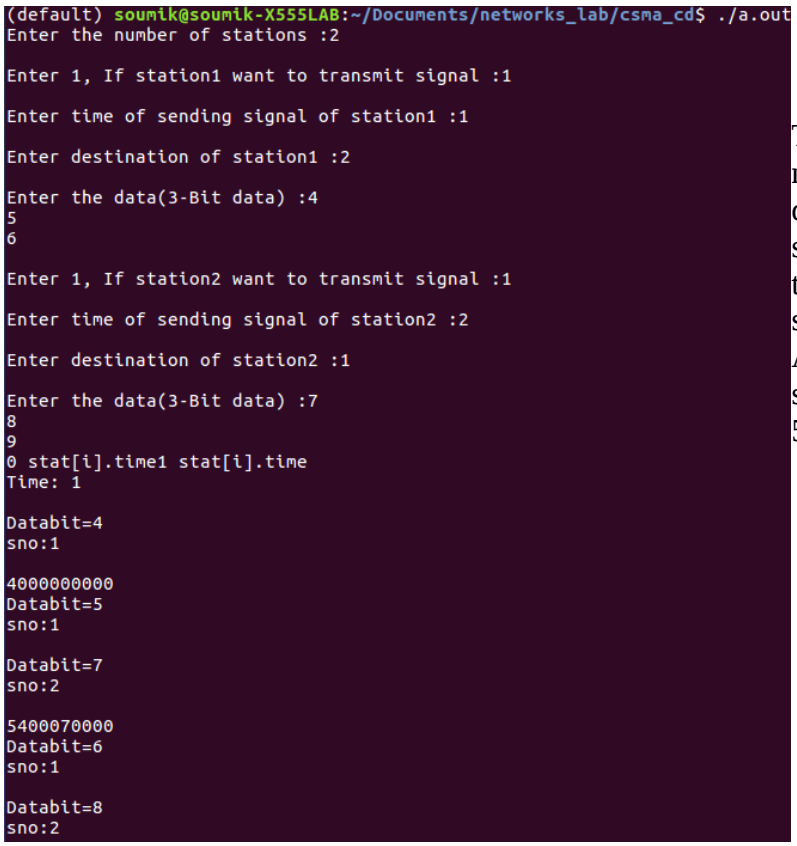
This function uses the minimum time to find out which station has to send the data. If the channel is not free it waits by the back off time and the send function is called again but with increasing value of the time.

```
154 void send(int sno)
155 {
156     int databit=0;
157     if(ds[sno]<=3)
158     databit=stat[sno].data[ds[sno]];
159     printf("\nDatabit=%d\nsno:%d\n",databit,sno);
160         if(is[sno]==0 && js[sno]==0)        //sending for first time
161          {is[sno]=js[sno]=sno*5-4;
162         channel[sno*5-4]=databit;}
163         else
164         {
165          if(channel[is[sno]+1]!=0 || channel[js[sno]-1]!=0)
166           {
167
168              printf("\nCollision!!\n");
169              getch();
170              collision(sno);
171             }
172              else
173              {if(ds[sno]<=3)
174                {
175                 int x;
176                if(sno!=n)
177                 { if(is[sno]<=(n*5)-1||stat[sno].dest!=n)
178                   {is[sno]++;}
179                   for(x=is[sno];x>sno*5-4;x--)
180                   channel[x]=channel[x-1];
181                  }
182                if(sno!=1)
183                  {if(js[sno]>=2||stat[sno].dest==1)
184                    {js[sno]--;}
185                    for(x=js[sno];x<sno*5-4;x++)
186                    channel[x]=channel[x+1];
187                  }
188                channel[sno*5-4]=databit;
189               }
190              else
191
192                 int x;
193                 if(sno!=n)
194                 {
195                      if(is[sno]<=(n*5)-1||stat[sno].dest!=n)
196                      is[sno]++;
197                      x=is[sno];
198                      int j;
199                      for(j=1;j<=3;x--)
200                      {channel[x]=channel[x-1];j++;}
201                      if(x!=(sno*5-4)||x==1)
202                      {channel[x]=0;}
203                  }
204                 if(sno!=1)
205                 {
206                       if(js[sno]>=2||stat[sno].dest==1)
207                       js[sno]--;
208                       x=js[sno];
209                       int j;
210                       for(j=1;j<=3;x++)
211                       {channel[x]=channel[x+1];
212                       j++;}
213                       channel[x]=0;
214                 }
215                 if(channel[stat[sno].dest*5-3]==stat[sno].data[3])
216                     {{printf("\n Data sending succesfull.\n");
217                       status[sno]=1;
218                       w++;
219                       getch();}
220                     if(a==w)
221                      {printf("All signals sent successfully\n");
222                       exit(0);}}
223                       channel[sno*5-4]=databit;}}
224           }
225     ds[sno]++;
226 }
```

The send function is actually responsible for sending the data of the station which is given as an argument. The channel was initialised to 0. If for a particular bit the channel is not 0 that means it already in use by some other station then collision has occurred. This is the part where collision is detected

If the collision has not occurred the data bit in the channel will be set to the data. If the status of the stations are same then data sending is successful. When all the stations have sent their data all signals sent successfully will be printed.

Output:



The main takes the input of number of stations, time,data and destination of each station. Since 2 stations are there, 10 is the size of the channel. At time t=1 only the station 1 sends data. So its just 4. At time=2 both station 1 and 2 send data. So output of channel is 540007000.

```
6540780000
Databit=0
sno:1

Databit=9
sno:2

Collision!!
signal jam
 2^k-1: 3
The random no generated 1 backoff by: 50 stat[i].time1 stat[i].time
Time: 1

Databit=4
sno:1

4000000000
Databit=5
sno:1

5400000000
Databit=6
sno:1

6540000000
Databit=0
sno:1

0654000000
Databit=0
sno:1

0065400000
Databit=0
sno:1

0006540000
Databit=0
sno:1
 2^k-1: 7
The random no generated 4 channel not free backing off by:20sec
0000654000
Databit=0
```

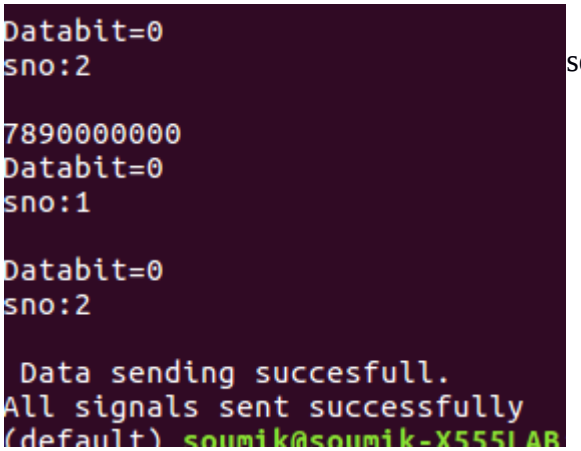
At time =4, both the stations want to change the 4th bit data from 0. So there is a collision. Therefore the backoff function will be called and a random number for which it will wait is generated. The data is sent again.

The data from the station 1 is sent first. When all the bits are sent data sending successful is printed. Next the station 2waits for the time as specified by the backoff function.

```
0000065400
Databit=0
sno:1

 Data sending succesfull.

0000006540
Databit=0
sno:1

0000000654
Databit=0
sno:1

0000000065
Databit=0
sno:1

0000000006
Databit=0
sno:1

0000000000
Databit=0
sno:1

0000000000
Databit=0
sno:1

0000000000
Databit=0
sno:1

0000000000
Databit=0
sno:1

0000000000
Databit=0
sno:1

0000000000
```

```
0000000000
Databit=0
sno:1

0000000000
Databit=0
sno:1

Databit=7
sno:2

0000070000
Databit=0
sno:1

Databit=8
sno:2

0000780000
Databit=0
sno:1

Databit=9
sno:2

0007890000
Databit=0
sno:1

Databit=0
sno:2

0078900000
Databit=0
sno:1

Databit=0
sno:2

0789000000
Databit=0
sno:1
```

time ne the data of station 2 will be sent again. This ision as the station 1 has already sent the data.



After all the data of the station 2 is sent All signals sent will be printed.