**Q. Estimate frequency reuse,user-capacity, co channel interface for cellular system**

**Implementation in C:**

#include<stdio.h>

#include<math.h>

int main(){

int i,j,k,N,cell,radius;

printf("\n\*\*\*\*\*=====GSM Architecture=====\*\*\*\*\*");

printf("\n[User Input] Enter total number of frequency allorted to the GSM network : "); scanf("%d",&k);

printf("\nReuse factor(N) may have the following values:-");

printf("\nI\tJ\tN=I^2+J^2");printf("\n--\t--\t--------");

for(i=0;i<4;i++){

for(j=0;j<4;j++) {

if(i==j) continue;else{N=((i\*i)+(j\*j)+(i\*j));printf("\n%d\t%d\t%d",i,j,N);

}

}

}

printf("\n[User Input] Enter your choosen reuse factor(cluster size) from the above suggested list :");

scanf("%d",&N);

printf("[User Input] Enter total number of cells present in the GSM network : "); scanf("%d",&cell);

printf("[User Input] Enter total radius of each cell in the GSM network(in KMs) : "); scanf("%d",&radius);

printf("\n[GSM] Specifications for the suggested GSM Architecture: -");

printf("\n[GSM] Total Area Coverage : %f KMs.",1.5\*radius\*radius\*sqrt(3)\*cell);

printf("\n[GSM] Number of frequencies/channels per cell : %d",(int)(k/N));

printf("\n[GSM] Frquency re-use ratio(D/R) : %f",sqrt(3\*N));

printf("\n[GSM] Total channel capacity/Maximum numer of concurrent calls possible : %d",(int)(k/N)\*cell);

printf("\n[GSM] Distance between to adjacent cells(d) : %f Kms",radius\*sqrt(3));

printf("\n[GSM] Minimum distance between centers of co-channels(cells using same frequecy band) D = : %f

Kms",radius\*sqrt(3\*N));

return 0;

}

**Test Run:**

nitish89@ADMINRG-R5IIR8M ~

$ gcc GSMModel.c -o gs

nitish89@ADMINRG-R5IIR8M ~

$ ./gs

\*\*\*\*\*=====GSM Architecture=====\*\*\*\*\*

[User Input] Enter total number of frequency allorted to the GSM network : 365

Reuse factor(N) may have the following values:-

I J N=I^2+J^2

-- -- --------

0 1 1

0 2 4

0 3 9

1 0 1

1 2 7

1 3 13

2 0 4

2 1 7

2 3 19

3 0 9

3 1 13

etc..........

[User Input] Enter your choosen reuse factor(cluster size) from the above suggested list : 7

[User Input] Enter total number of cells present in the GSM network : 32

[User Input] Enter total radius of each cell in the GSM network(in KMs) : 1.58

[GSM] Specifications for the suggested GSM Architecture: -

[GSM] Total Area Coverage : 83.138439 KMs.

[GSM] Number of frequencies/channels per cell : 52

[GSM] Frquency re-use ratio(D/R) : 4.582576

[GSM] Total channel capacity/Maximum numer of concurrent calls possible : 1664

[GSM] Distance between to adjacent cells(d) : 1.732051 Kms

[GSM] Minimum distance between centers of co-channels(cells using same frequecy band) D = : 4.582576 Kms

**Q. Implement a program in C/C++ to estimate free space loss for different scenarios.**

**C Code:**

#include<stdio.h>

#include<math.h>

int main()

{

int f,choice1,choice2;

float d,At,Ar,tag,rag,Ldb;

printf("\n\*\*\*\*\*=====Free Space Loss Calculations=====\*\*\*\*\*");

printf("\n[User Input] Enter frequency of transmitted signal(in GHz) : ");

scanf("%d",&f);

printf("\n[User Input] Amount of distance to be covered (in KMs) ? : ");

scanf("%f",&d);

printf("\n[User Choice] Choose from the below mentioned options to calculate the free space loss : ");

printf("\n1- Without considering transmitting and receiving antennas.\t2 - Considering antennas.");

printf("\n[User Choice] Choose : ");

scanf("%d",&choice1);

switch(choice1)

{

case 1:

Ldb = (20\*log10(f\*pow(10,9)))+(20\*log10(d\*pow(10,3)))-147.56;

printf("\n[User Output] The free space loss in the given parameters is : %f dbW",Ldb);

break;

case 2:

printf("\n[User Choice] Choose from the below mentioned options : ");

printf("\n1- Know antenna gains.\t2 - Know effective areas of antennas.");

printf("\n[User Choice] Choose : ");

scanf("%d",&choice2);

switch(choice2)

{

case 1:

printf("\n[User Input] Transmitting antenna's gain(in dbW) ? : ");

scanf("%f",&tag);

printf("\n[User Input] Receiving antenna's gain(in dbW) ? : ");

scanf("%f",&rag);

Ldb = ((20\*log10(f\*pow(10,9)))+(20\*log10(d\*pow(10,3)))-147.56)-tag-rag;

printf("\n[User Output] The free space loss in the given parameters is : %f dbW",Ldb);

break;

case 2:

printf("\n[User Input] Transmitting antenna's effective area(in meters) ? : ");

scanf("%f",&At);

printf("\n[User Input] Receiving antenna's effective area(in meters) ? : ");

scanf("%f",&Ar);

Ldb = -(20\*log10(f\*pow(10,9)))+(20\*log10(d\*pow(10,3)))-(10\*log10(At\*Ar))+169.54;

printf("\n[User Output] The free space loss in the given parameters is : %f dbW",Ldb);

break;

default:

printf("\n[Warning] Invalid Choice!!!");

break;

}

break;

default:

printf("\n[Warning] Invalid Choice!!!");

break;

}

return 0;

}

**Test Runs[1]:**

nitish89@ADMINRG-R5IIR8M ~

$ gcc FreeSpaceLoss.c -o flc

nitish89@ADMINRG-R5IIR8M ~

$ ./flc

\*\*\*\*\*=====Free Space Loss Calculations=====\*\*\*\*\*

[User Input] Enter frequency of transmitted signal(in GHz) : 4

[User Input] Amount of distance to be covered (in KMs) ? : 35863

[User Choice] Choose from the below mentioned options to calculate the free space loss:

1. Without considering transmitting and receiving antennas.
2. Considering antennas.

[User Choice] Choose : 1

[User Output] The free space loss in the given parameters is : 195.574127 dbW

**Test Runs[2]:**

nitish89@ADMINRG-R5IIR8M ~

$ gcc FreeSpaceLoss.c -o flc

nitish89@ADMINRG-R5IIR8M ~

$ ./flc

\*\*\*\*\*=====Free Space Loss Calculations=====\*\*\*\*\*

[User Input] Enter frequency of transmitted signal(in GHz) : 4

[User Input] Amount of distance to be covered (in KMs) ? : 35863

[User Choice] Choose from the below mentioned options to calculate the free space loss :

1- Without considering transmitting and receiving antennas. 2 - Considering antennas.

[User Choice] Choose : 2

[User Choice] Choose from the below mentioned options :

1- Know antenna gains. 2 - Know effective areas of antennas.

[User Choice] Choose : 1

[User Input] Transmitting antenna's gain(in dbW) ? : 44

[User Input] Receiving antenna's gain(in dbW) ? : 48

[User Output] The free space loss in the given parameters is : 103.574135 dbW

**Test Runs[3]:**

nitish89@ADMINRG-R5IIR8M ~

$ ./flc

\*\*\*\*\*=====Free Space Loss Calculations=====\*\*\*\*\*

[User Input] Enter frequency of transmitted signal(in GHz) : 4

[User Input] Amount of distance to be covered (in KMs) ? : 35863

[User Choice] Choose from the below mentioned options to calculate the free spac e loss :

1- Without considering transmitting and receiving antennas. 2 - Considering antennas.

[User Choice] Choose : 2

[User Choice] Choose from the below mentioned options :

1- Know antenna gains. 2 - Know effective areas of antennas.

[User Choice] Choose : 2

[User Input] Transmitting antenna's effective area(in meters) ? : 105

[User Input] Receiving antenna's effective area(in meters) ? : 106

[User Output] The free space loss in the given parameters is : 88.126778 dbW