

## TASK (2) :

### Bluetooth

#### Brief about the technology :

Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using UHF radio waves.

#### Why Bluetooth ?

- Bluetooth removes problem of radio interface by using speed frequency hopping technology.
- low power consumption for the chip almost 0.3 mW so more battery life.
- over comes constrains of line of sight.
- although new technologies nowadays but Bluetooth is a perfect solution for some applications like internet of things (IOT) and connecting some devices wire-less .



we have used in our experiment and all results are depending on a Bluetooth 4.2 version for both the transmitter and the receiver at outdoor .

## walking through the experiment :

a. Taking results for sending same file at different time .

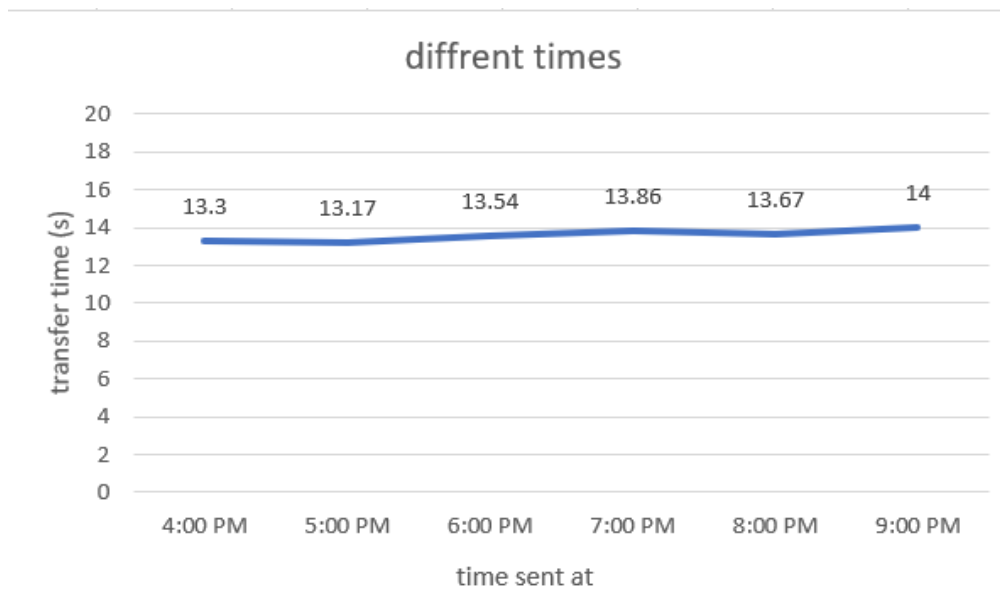
a file size 2.3 MB is used .

starting the experiment at 4 pm and repeating for every hour .

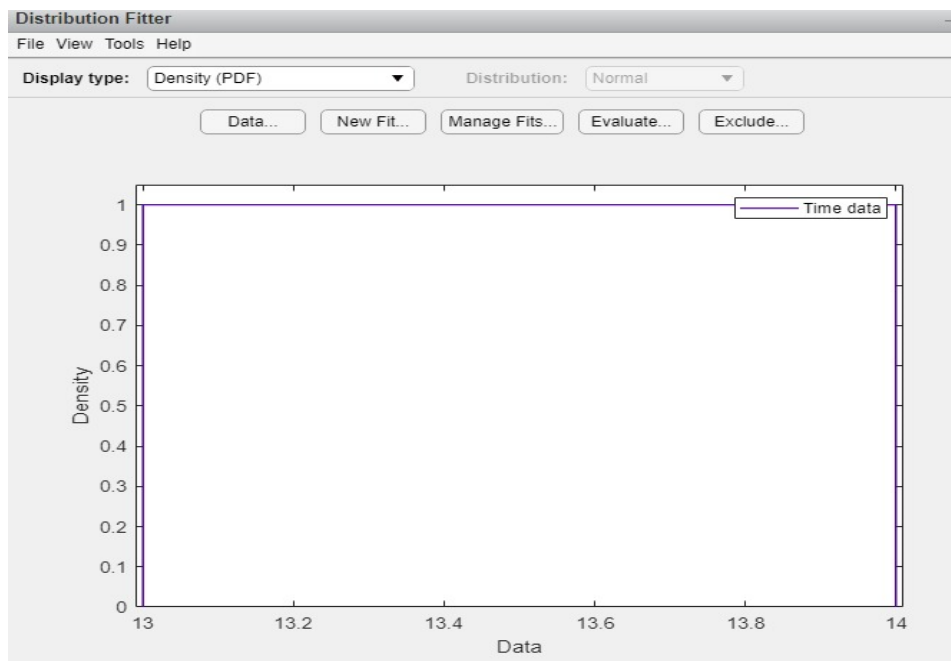
Time sent	Transfer time(S)
4:00 pm	13.3
5:00 pm	13.17
6:00 pm	13.54
7:00 pm	13.86
8:00 pm	13.67
9:00 pm	14

From the previous results we can see clearly that transfer time for same file at different times is almost the same during whole experiment So , transfer time is independent of the time we send at .

The time we send at doesn't affect the results .



The probability that file is successively sent will also be constant as it doesn't depend on time we sent at .



- b. repeating the measurement for different distances between the wireless devices.

A 1.56 MB file is used through this part .

Taking in consider that Bluetooth 4.2 range out door is different from indoor

Our results based on outdoor readings .

Distance between devices (m)	Transfer time (s)
0	9.09
2.5	9.14
5	9.61
10	10.17
15	10.94
20	13.07
25	13.79
30	16
35	26.5
40	30.825
45	34.5
50	Connection failed

We have noted that time required to transfer the file depends on other factors rather the distance like the crowd in street so the readings is almost all in a little crowded street .

### Notes from results :

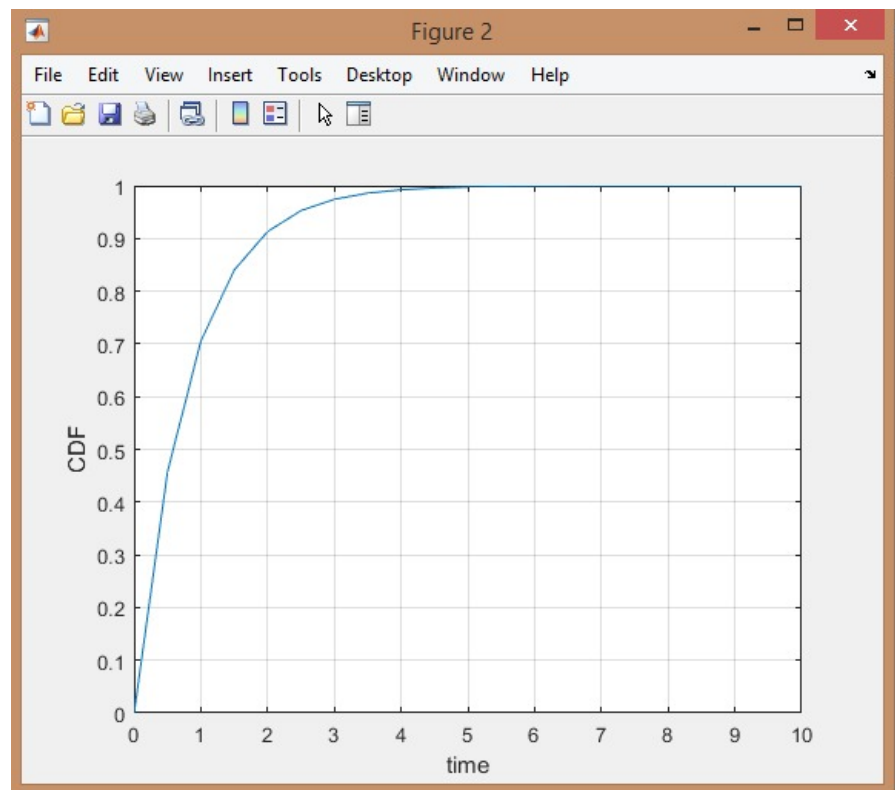
- As long as we increase the distance the time required to transfer the same file will increase .
- At 50m the connection between devices have failed So we can say that :
- Maximum range to transfer is  $< 50M$  , beyond this range connection failed .
- Our recommended range is  $< 25M$  ,connection was so good and take the shortest times to transfer at this range .

The time needed in a range less than 20m is better by almost 35% the maximum range .

-of course all ranges are for outdoor .

- Probability same file to be sent decreases as long as we increase the distance we can say that it is almost exponential distributed .

The figure represent a C.D.F for previous results considering it follows an exponential distribution .



c. by repeating for different file sizes.

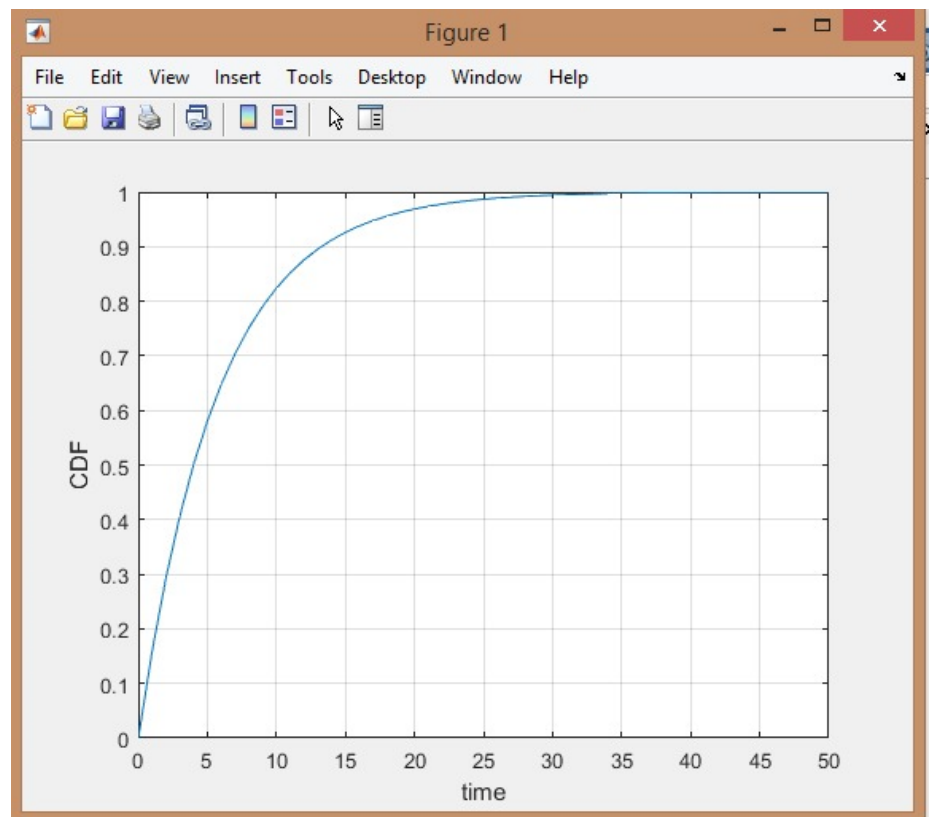
We have used a variety of file sizes up to 12.5 MB all the operation at a constant distance between the devices .

File size (MB)	Transfer time (s)	Rate (MB/S)
1.2	6.92	0.173
1.6	9.31	0.171
1.9	11.41	0.166
3	17.68	0.169
3.3	18.65	0.176
5.2	30	0.173
7.2	41.22	0.174
8.7	48.53	0.180
10.7	59.85	0.178
12.4	68.88	0.180

Notes from results :

- as long as the file size increase the time needed to transfer the file also increased .
- data rate is almost constant for variety of sizes .
- from our results we can say that bluetooth is a good choice for transferring small sizes of files but for large files it won't be the smartest choice .

the figure represent a C.D.F if  
it follows an exponential  
distribution .



Figures in this task is done by matlab with following code for the C.D.F's .

Note : the average used in the equations is the average of our results from previous tables .

Code :

```
%Plotting CDF of the file size
```

```
x1=[0:1:50];
```

```
e=2.7182818284590452353602874713527;
```

```
y1=1-(e.^(-.1739*x1));
```

```
figure(1);
```

```
plot(x1,y1), xlabel('time'), ylabel('CDF');
```

```
grid on;
```

```
%Plotting CDF of ditance
```

```
x2=[0:.5:10];
```

```
y2=1-(e.^(-1.223*x2));
```

```
figure(2);
```

```
plot(x2,y2),xlabel('time'), ylabel('CDF');
```

```
grid on;
```