CYCLE 2

Exp 2: Measurement of Throughput in LTE Network using NetSim Software

AIM: To measure and analyze the throughput performance of an LTE network using the NetSim software**.**

SOFTWARE REQUIRED: NetSim V12, PC

PROCEDURE:

Sample 1:

The following set of procedures were done to generate this sample:

NOTE: Before placement of any device grid length should be increased and it should be 10000 meters X 10000 meters. Click on Environment Settings present in the ribbon and set grid length as 10000.

Step 1: A network scenario is designed in NetSim GUI comprising of 1 User Equipment, 1 ENB, 1 MME, 1 Router, and 1 Wired Node in the "LTE/LTE-A" Network Library.

Step 2: TCP Protocol is disabled in Wired Node 1.

Step 3: The device positions are set as per the below table:

	ENB 4	UE 5
X/Lat	0	**50**
Y/Lon	**0**	**50**

Step 4: Go to ENB → Properties→ Interface LTE → Physical Layer → Set CA1 and CA2 Channel Bandwidth to 20 MHz for both the carriers.

Step 5: In the General Properties of UE "Velocity (m/s)" parameter is set to 0.

Step 6: The Wired Link Properties are set as follows:

Link Properties	Wired Link (R&WN)	Wired Link (ENB & MME)	Wired Link (MME&R)
Uplink Speed (Mbps)	100	100	100
Downlink Speed(Mbps)	100	100	100
Uplink BER	0	0	0
Downlink BER	0	0	0
Up Time	N/A	0	0
Down Time	N/A	0	0
Uplink PropagationDelay (microsec)	0	0	0
Downlink PropagationDelay (microsec)	0	0	0

Step 7: The Wireless Link Properties are set as follows:

Link Properties	Wireless Link 1
Channel characteristics	Path Loss Only
Path Loss Model	Log Distance
Path loss Exponent(n)	4

Step 8: Go to Application Flow → Properties→Select App type as CUSTOM.

A CUSTOM Application is generated from Wired Node 1 i.e. Source to UE 5 i.e. Destination with Packet Size set to 1460 Bytes and Inter Arrival Time set to 165 µs.

The Packet Size and Inter Arrival Time parameters are set such that the Generation Rate equals 70Mbps. Generation Rate can be calculated using the formula:

$$Generation\ Rate\ (Mbps) = Packet\ Size\ (Bytes) * 8/Interarrival\ time\ (\mu s)$$

Step 9: Run the Simulation for 10 Seconds. Under Packet Animation, Don't Play or Record Animation option is selected for the simulation to run faster.

NOTE: If users wish to view the packet animation, then select Record Animation option.

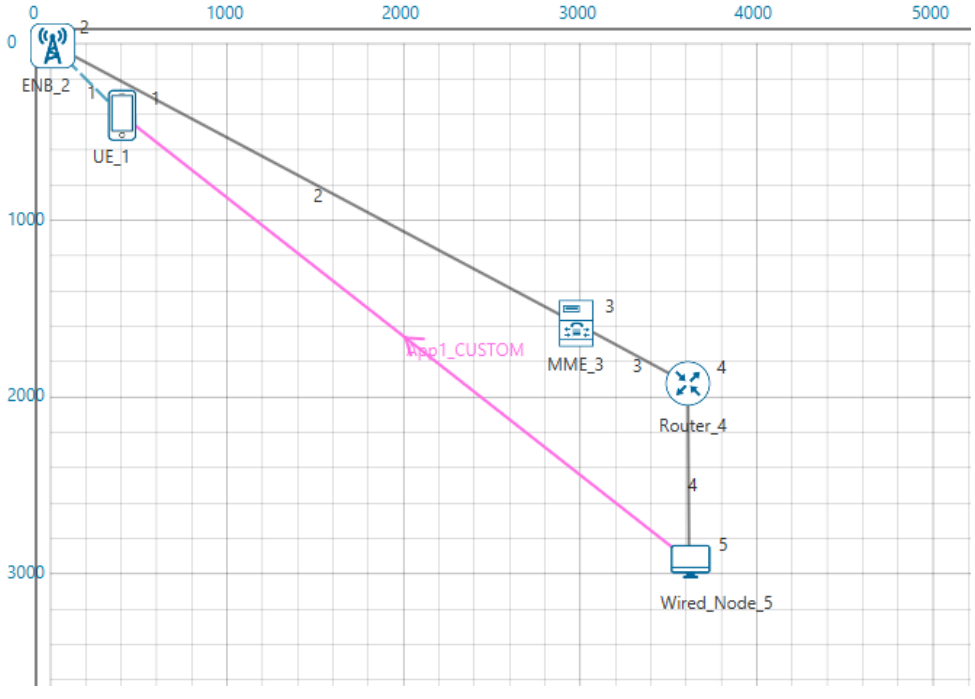
Sample 2:

The following changes in settings are done from the previous sample for the remaining samples:

Step 1: The device positions are changed as follows:

Change in UE Properties: (x, y)	
Sample 2	(100, 100)
Sample 3	(150,150)
Sample 4	(200,200)
Sample 5	(250,250)
Sample 6	(300,300)
Sample 7	(350,350)
Sample 8	(400,400)

Step 2: Repeat the above process for all the samples and measure the distance, throughput.



OUTPUT:

Step 1: Distance calculation:

Calculate the Distance between ENB (x_1, y_1) and UE (x_2, y_2) as follows:

$\sqrt{(x_2-x_1)^2+ (y_2-y_1)^2}$

For example, for Sample 1:

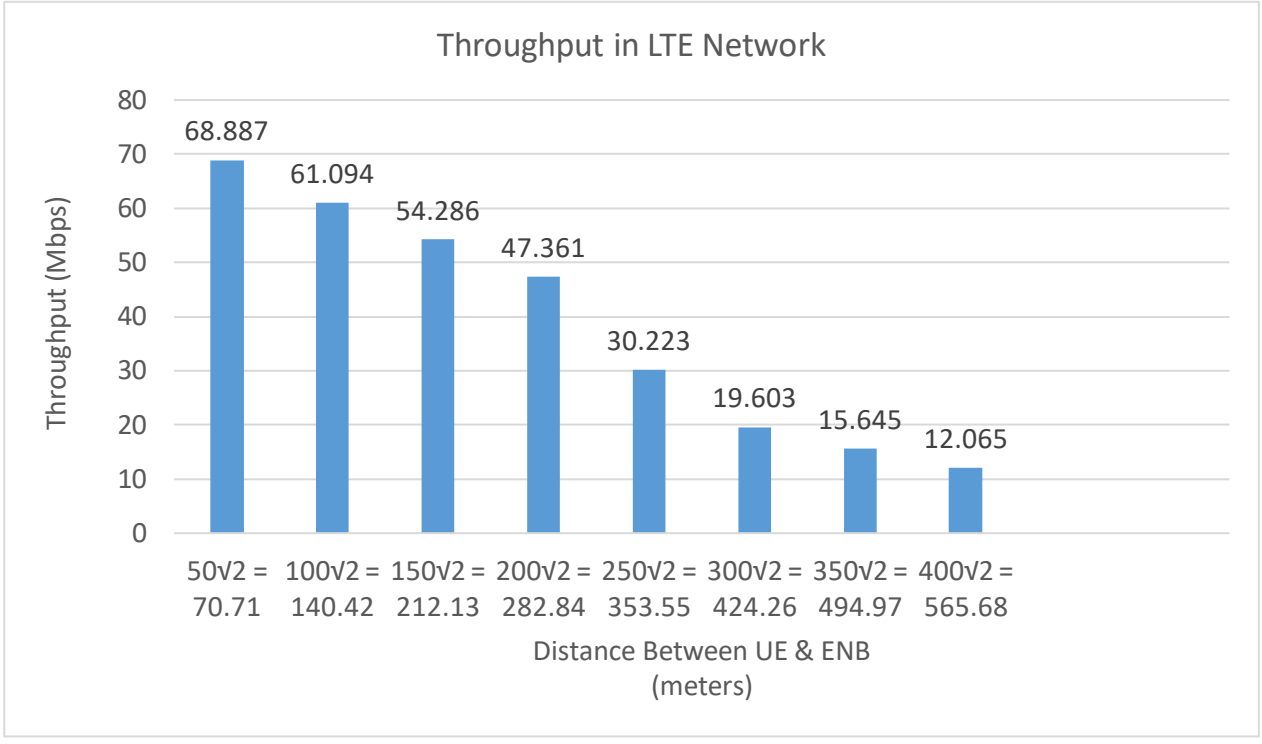
ENB (x_1, y_1) = (0, 0); UE (x_2, y_2) = (50, 50);

Distance = $\sqrt{(50-0)^2+ (50-0)^2} = \sqrt{2} \times 50 = 50\sqrt{2}$ meters.

Step 2: Open any Excel File and note down the distance between the UE and ENB and the throughput values as shown below:

Sample No.	Distance between UE & ENB (meters)	Throughput (Mbps)
1	**$50\sqrt{2} = 70.71$**	**68.887**
2	**$100\sqrt{2} = 140.42$**	**61.094**
3	**$150\sqrt{2} = 212.13$**	**54.286**
4	**$200\sqrt{2} = 282.84$**	**47.361**
5	**$250\sqrt{2} = 353.55$**	**30.223**
6	**$300\sqrt{2} = 424.26$**	**19.603**
7	**$350\sqrt{2} = 494.97$**	**15.645**
8	**$400\sqrt{2} = 565.68$**	**12.065**

Comparison Chart:



RESULT:

In this experiment, we verified how the throughput of LTE network varies as the distance between the ENB and UE (User Equipment) is increased.

INFERENCE:

As the distance increases between ENB and UE, throughput decreases. The reason is that as the distance increases between the devices, the received signal power decreases, and the LTE Phy Rate drops as the signal power reduces.